UC Berkeley
UC Berkeley Electronic Theses and Dissertations

Title

Plant carnivory in the Caryophyllales: phylogenetic relationships, morphological adaptations, and molecular evolution of digestive enzymes among carnivorous genera

Permalink

https://escholarship.org/uc/item/5gt6x4mm

Author

Renner, Tanya

Publication Date

2011

Peer reviewed|Thesis/dissertation

eScholarship.org Powered by the California Digital Library
University of California

Plant carnivory in the Caryophyllales: phylogenetic relationships, morphological adaptations, and molecular evolution of digestive enzymes among carnivorous genera

by

Tanya Renner

A dissertation submitted in partial satisfaction of the
requirements for the degree of
Doctor of Philosophy
in

Plant Biology

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Chelsea D. Specht, Chair
Professor Tom Bruns
Professor Rasmus Nielsen

Fall 2011

Plant carnivory in the Caryophyllales: phylogenetic relationships, morphological adaptations, and molecular evolution of digestive enzymes among carnivorous genera

© 2011

by

Tanya Renner

Abstract

Plant carnivory in the Caryophyllales: phylogenetic relationships, morphological adaptations, and molecular evolution of digestive enzymes among carnivorous genera

by

Tanya Renner

Doctor of Philosophy in Plant Biology

University of California, Berkeley

Professor Chelsea D. Specht, Chair

Phylogenetic relationships among carnivorous plants of the angiosperm order Caryophyllales are explored using Bayesian statistics and maximum-likelihood based searches of phylogeny. Nuclear ribosomal (ITS) and chloroplast intergenic spacer (PY-IGS) regions, along with previously-sequenced DNA are utilized for phylogenetic reconstructions. Taxonomic relationships across genera are refined and three strongly supported clades are identified: monophyletic Droseraceae, Nepenthaceae, and a third clade containing Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae. In combination with phylogenetic reconstruction, stochastic character mapping is utilized to assess evolutionary changes in the morphology of glands found on the lamina and involved in the digestion of prey. Adaptive changes resulting in the evolution of the carnivorous gland are discussed, which may have occurred either by emargination of the leaf blade or homologous transformation of pinnae.

A variety of enzymes are excreted from the carnivorous gland that aid in prey digestion. Within the carnivorous plants of the Caryophyllales, two subclasses of class I chitinases have been identified to play a role in the digestion of prey. Proteins produced by the large and diverse chitinase gene family are involved in the hydrolyzation of glycosidic bonds in chitin, a polymer of *N*-acetylglucosamines. Members of these subclasses, depending on the presence or absence of a C-terminal extension, can be secreted from specialized digestive glands found within morphologically diverse traps that develop from plant leaves. Homology among carnivorous plant class I chitinases and the method by which these enzymes have been adapted for the carnivorous habit are investigated. Novel class I chitinase homologs are recovered from *Ancistrocladus*, *Dionaea*, *Drosera*, *Nepenthes*, and *Triphyophyllum*, in addition to class I chitinases available from sequenced angiosperm genomes. Substitutions specific to carnivorous plant class I chitinases are revealed by detecting sites under positive selection, which may confer functional differences as indicated by protein structure homology-modeling.

To study gene function in non-model organisms, a virus induced gene silencing (VIGS) method was developed. VIGS has been shown to be effective for transient knockdown of gene expression in plants to analyze the effects of specific genes in development and stress related responses. It is demonstrated that the barley stripe mosaic virus (BSMV) is able to infect two species within the Zingiberaceae, and that BSMV-VIGS can be applied to specifically downregulate phytoene desaturase in the culinary ginger *Zingiber officinale*. BSMV–VIGS is likely to be effective in other angiosperms susceptible to BSMV infection. This should enable targeted studies for identifying gene function to be carried out in ecologically and evolutionarily important groups.

Contents

Section *Page*
Abstract 1
List of Figures iii
List of Tables iv
Acknowledgements v
Introduction vii

Chapter 1 A sticky situation: assessing adaptations for plant carnivory in the Caryophyllales utilizing stochastic character mapping

1.1 Introduction 1
Phylogenetic relationships among the carnivorous genera of the Caryophyllales 1
Glands involved in plant carnivory in the Caryophyllales 2
1.2 Material and Methods 4
Taxon sampling and tissue collection 4
Molecular marker sampling 4
PCR and DNA sequencing 4
Alignment and phylogenetic analyses 5
Character state reconstructions 6
1.3 Results 6
Phylogenetic reconstruction 6
Ancestral reconstruction 7
1.4 Discussion 8
Assessing phylogenetic relationships among the carnivorous Caryophyllales 8
Ancestral reconstruction of carnivorous glands of the Caryophyllales 9
On the origin of carnivorous glands in the Caryophyllales 10

Chapter 2 Molecular and functional evolution of class I chitinases for plant carnivory in the Caryophyllales

2.1 Introduction 18
2.2 Material and Methods 20
Tissue collection and DNA extraction 20
PCR and cloning of class I chitinase genes 21
Identification of class I chitinase homologs 21
Class I chitinase nomenclature 22
Phylogenetic analyses 23

Contents continued

Section *Page*

Detecting selection 24
Template identification, modeling homology, and functional analysis 24
2.3 Results 25
Class I chitinase homologs expanded in land plant genomes 25
Class I chitinase subclasses are identified in carnivorous plants and related genera of the Caryophyllales 26
Evolution of class I chitinases in 15 angiosperm genera 28
Certain class I chitinase lineages and sites carry different signatures of selection 29
Substitutions in the active site of class I chitinases may affect interactions with chitin substrate 29
2.4 Discussion 30
Molecular evolution of class I chitinases in angiosperms 30
Selection acting on subclasses of Caryophyllales class I chitinases 32
2.5 Conclusion 33

Chapter 3 Virus-induced gene silencing in the culinary ginger (*Zingiber officinale*): an effective mechanism for downregulating gene expression in tropical monocots

3.1 Introduction 41
3.2 Materials and Methods 42
Testing infection with wildtype BSMV 42
PDS amplification 43
Creating a ZoPDS VIGS construct 43
Quantifying PDS downregulation 44
3.3 Results 44
BSMV is able to infect members of the Zingiberales 44
BSMV can elicit VIGS of ZoPDS in ginger 45
ZoPDS transcripts are specifically downregulated in photobleached ginger 45
3.4 Discussion 46
BSMV infection of Zingiberales 46
BSMV-VIGS is effective in *Zingiber officinale* 47
BSMV-VIGS as a tool for studying gene function in the Zingiberales 48

References 55

Appendices 67

List of Figures

Figure		*Page*
1.1	Combined nDNA, nrDNA, and cpDNA molecular marker phylogenetic reconstruction for the carnivorous Caryophyllales	12
1.2	ITS and PY-IGS phylogenetic reconstruction for the carnivorous Caryophyllales	13
1.3	Stochastic character mapping of gland states associated with plant carnivory	14
1.4	Pinnation and emargination pathways for the evolution of the carnivorous gland in the Caryophyllales	17
2.1	Angiosperm-wide phylogenetic reconstruction for the class I chitinases	34
2.2	HMM-derived phylogenetic reconstruction for the carnivorous Caryophyllales	35
2.3	Distribution of positive selected sites along translated CDS of the class I chitinase genes	36
2.4	Homology-modeling of *Nepenthes khasiana* subclass Ia and Ib chitinases	37
3.1	Photographs of *Costus spicatus* and *Zingiber officinale* used in this study	50
3.2	Images of *Zingiber officinale* and *Costus spicatus* demonstrating phenotypes associated with viral infection and gene silencing	51
3.3	Western blot showing antibody hybridization to BSMV coat protein and RT-PCR showing presence of viral constructs in plants post-inoculation with either wt BSMV or BSMV RNA with the PDS insert	52
3.4	Agarose gel with RT-PCR demonstrating downregulation of phytoene desaturase (PDS) in *Zingiber officinale* plants infected with a BSMV construct containing a *Z. officinale* endogenous PDS gene fragment	53
3.5	Sequence comparison of PDS loci from *Zingiber officinale, Triticum aestivum, Hordeum vulgare, Oryza sativa, Zea mays, Crocus sativus, Lilium longiflorum, Hydrilla verticillata*	54
A.1	Voucher information for collected specimens utilized in chapter 1	67
A.2	Multiple sequence alignment of combined nDNA, nrDNA, and cpDNA molecular marker phylogenetic reconstruction for the carnivorous Caryophyllales	69
A.3	Multiple sequence alignment of ITS and PY-IGS phylogenetic reconstruction for the carnivorous Caryophyllales	91
A.4	Voucher information for collected specimens utilized in chapter 2	129
A.5	Multiple sequence alignment of translated CDS for angiosperm class I chitinases	130

List of Tables

Table *Page*

2.1 Caryophyllales class I chitinases 38
2.2 Class I chitinases identified by homology-based searches of eudicot and monocot genomes 39
2.3 Sites identified as under positive selection by the two-rate FEL model 40

Acknowledgements

This dissertation would not have been possible without the mentorship of Chelsea D. Specht. I can in no way understate my gratitude for Chelsea's continual dedication to me as an advisor. From the very beginning of my graduate studies, Chelsea has supplied support and mentorship from all angles.

While as a rotation student in Chelsea's lab, she encouraged me to develop a project involving viral induced gene silencing (VIGS) in non-model plants known as tropical gingers. During the time of my rotation, the VIGS method was not being used to study gene expression in the Specht lab, but collaboration with Dr. Andrew Jackson's laboratory and with guidance from Chelsea, I was able to establish VIGS as a protocol for *Zingiber*. I will not forget the massive amount of time spent together analyzing tropical ginger leaf color variation in the greenhouse and setting up a space for plant experiments with the correct lighting and humidity conditions, nor the number of constructive comments I received on the VIGS project from Chelsea.

In continuing with VIGS research, I began to plan other components of my dissertation project and proposed my topic to my advisor: the study of phylogenetic relationships among the carnivorous plants of the Caryophyllales and the molecular evolution of their digestive enzymes, specifically chitinase. Although independent from the lab's research on ginger floral morphology, Chelsea supported the individual nature of my research and allowed me to plow my own way through molecular biology. I applied for multiple grants to secure my stipend and research funding, all of which Chelsea provided a tremendous amount of feedback for. The research forming the basis of my dissertation was partially funded by UC Berkeley Committee on Research and the College of Natural Resources, a National Science Foundation Graduate Research Fellowship, a Chang-Lin Tien Graduate Fellowship in the Environmental Sciences, and a National Science Foundation Doctoral Dissertation Improvement Grant awarded to Chelsea Specht and myself (DEB 1011021). The skills I have learned from Chelsea to analyze and edit my scientific writings has been invaluable. Demonstratively, this skill set has already been applied to the chapters of my dissertation, the majority of which have already been accepted for publication. Throughout the development of these manuscripts, Chelsea consistently met with me to discuss methods and results, provide suggestions, and to mentor me through the rigors of journal article submission.

Chelsea has undoubtedly provided me with a basis for which to model my own mentoring and outreach. She continually strives to provide underrepresented groups with research experience in the laboratory. During my graduate career, Chelsea gave me the opportunity to mentor five undergraduate students and two graduate students through projects directly related to my dissertation research. In addition, she has was supportive of my own outreach to educationally underrepresented segments of society through public seminars and guest lectures specifically designed to increase interest in plant evolutionary biology.

Dissertation committee members Tom Bruns and Rasmus Nielsen have provided meaningful suggestions during the course of my graduate studies. Their expertise has guided me when I have needed to make decisions on where to go next with my research, for which I am ever grateful. Qualifying exam committee members Patrick O'Grady, Michael Freeling, Kimmen Sjölander, and Frank Harmon gave extreme value to my exam experience, from which I walked away with confidence and further ideas on how to approach my experiments. Patrick was undoubtedly accommodating and accessible following my exam and I am appreciative to have had him to bounce ideas off of – in the process I received some really great advice.

The graduate students, postdoctoral students, staff, and undergraduates of the Specht lab have contributed to this journey. Ana Almeida, Madelaine Bartlett, Heather Driscoll, Carolina Gomez, Mary Guisinger, Kali Lader, Eduardo Ruiz Sanchez, Chodon Sass, Stephen Yee and Roxana Yockteng provided thoughtful discussion, advice, comments, and invaluable help along the way. As rotation students in the Specht lab, Juliana Cho and Candace Cherk jumped in on the *Zingiber* VIGS project, offering fresh perspectives, ideas, advice, and physical labor. While undergraduates at UC Berkeley, Irene Liao, Ivet Ramiriz-Oritz, Shayla Salzman, Sarah Starkey, and Josephine Wong aided me when conducting experiments. I thank them for all their compassion and friendship – they made the laboratory a wonderful place to be.

Andrew Jackson and Jennifer Bragg taught me the techniques needed for VIGS and supplyed a number of the regents for the *Zingiber* project. Their expertise with the BSMV system enabled me to accomplish VIGS in *Zingiber*. I would also like to thank Holly Forbes and Christy Matasick (University of California Botanical Garden), Peter D'Amato (California Carnivores, Sebastopol) Gerhard Bringmann and Andreas Irmer (Universität Würzburg), Gretchen Walters (Missouri Botanical Garden), Barry Rice (University of California, Davis), and Richard Sivertsen for providing and/or helping to collect Caryophyllales tissue for my studies. I am indebted to my fellow graduate students Kevin Hockett, Kali Lader and Nhu Nguyen who lent their time and energy to assist in the collection of plant material for DNA extractions and vouchers. These collections brought me to the University and Jepson Herbaria, where Kim Kersh taught me how to construct herbarium sheets to serve as my vouchers.

I thank Elizabeth R. Waters, my undergraduate mentor at San Diego State University, for opening my eyes to the world of evolutionary biology. She was the first person to place a pipette in my hand and let me work independently at the laboratory bench. She instilled a sense of wonder in me for the study of adaptive evolution from a molecular standpoint; something I excitedly took with me to Berkeley and continue to be amazed by.

Without the love and support of my family and friends, none of this would have been possible. My parents Voley and Linda Renner have given me thoughtful guidance the entire step of the way, encouraging me to find and do what I love. I thank them for taking me on all those trips to the ocean, mountains, and desert, for bringing me zoos and museums, and for keeping Darwin's *The Voyage of the Beagle* on the bookshelf – they were essentially the first to introduce me to natural history. My best friend and partner Kevin Hockett has given an incredible amount of love, patience, understanding, support, and encouragement during my graduate studies; we have grown so much together and have learned so much from each other. Connie Woods and the late Dr. Malcolm Raff have been like surrogate parents to me while I have been at Cal. Our shared interest in avian dinosaurs and molecular biology might have been what brought us together, but it was our unexpected friendship that kept us close. Last, but not least, I thank a small Plum-headed Parakeet, a large African Grey Parrot, four rambunctious Cherry-headed Conures from the San Francisco Telegraph Hill flock, two amazing Cockatoos, one fabulous Crimson Rosella, a lovely Brewer's Blackbird, and a >65 year old tortoise for providing laughs, flaps, and unconditional love. Hot-dawg!

Introduction

The Carnivorous Caryophyllales

The following dissertation research is focused on understanding the evolution of carnivory and chitinase genes in one of the major groups of plants that has evolved the carnivorous habit: the Caryophyllales. The greatest number of carnivorous plant families can be found in the Caryophyllales (Droseraceae, Drosophyllaceae, Nepenthaceae and Dioncophyllaceae) and within these families are the most numerous of carnivorous plants. Families are comprised of the carnivorous genera *Drosera* (sundews), *Dionaea* (Venus flytrap), *Aldrovanda* (aquatic flytrap), *Drosophyllum* (Portuguese sundew), *Nepenthes* (tropical pitcher plants), part-time carnivore *Triphyophyllum*, along with non-carnivorous genera *Ancistrocladus*, *Habropetalum*, and *Dioncophyllum*. Shared among the carnivorous plant lineage of the Caryophyllales is the presence of multicellar glands that have evolved to function in the secretion of digestive enzymes as well as to absorb amino acids and other organic nutrients.

Families sister to the carnivorous non-core Caryophyllales (Tamaricaceae, Frankeniaceae, Polygonaceae and Plumbaginaceae) have a variety of sessile, stalked, and pitted glands (Wilson 1890). Although rarely vascularized themselves, these glands occur near vascular tissue, are known to exude salt or mucilage and are described as use for protection in halophytic conditions, seed dispersal, and to deter herbivory (Fahn and Werker 1972; Faraday and Thomson 1986; Lüttge 1971; Sakai 1974; Wilson 1890).

In the genus *Drosera,* two basic types of carnivorous glands are present: (1) vascularized, stalked multicellular glands and (2) non-vascularized, sessile glands. The upper leaf surface of *Drosera* is saturated with both types of gland, while only type 2 is found on the abaxial side of the leaf as well as petioles and inflorescence scapes (Juniper et al. 1989). Although the glands co-exist on the leaf surface, each gland type has different cellular origins. Cells of type 1 are either epidermal or parenchymatous in origin with tracheids and xylem embedded within, which extend into the veins of the leaves (Gilchrist and Juniper 1974). Conversely, type 2 are exclusively epidermal in origin and lack vasculature at maturity (Juniper et al. 1989).

In the monotypic genus *Dionaea* (*D. muscipula*) multiple types of sessile glands are present, all of which are non-vascularized. Sessile glands differ in their morphology depending whether the glands are located externally (abaxially) or internally (adaxially) on the plant trap. Glands found on the abaxial side of the leaf are stellate, whereas glands on the adaxial side (those involved in digestion) are made up of a variety of cell types which include a single basal cell, a stalk cell, and 8 or more digestive gland cells (Scala et al. 1968). In addition to the sessile glands on the digestive surface of the trap, trigger hairs are located at the very edge of the trap where the adaxial and abaxial sides meet. These structures are vascularized and are homologous in their position to the marginally located vascularized, stalked multicellular glands in *Drosera.*

Aldrovanda (*A. vesiculosa*) is an aquatic relative of *D. muscipula* and the only extant member of its genus. Each vegetative node contains eight leaves arranged in a whorl evenly distributed around the stem, with the carnivorous trap (the leaf blade) attached by a petiole to the leaf base. Similar to *Dionaea*, multiple types of non-vascularized, sessile glands can be found on the surface of the trap. Ashida divided the trap of *A. vesiculosa* into 2 morphological zones: marginal and central (Ashida 1935). The marginal zone consists of the rim, quadrified, and hairless regions of the trap. The rim, as in *Dionaea*, has teeth where the adaxial and abaxial sides of the leaf meet. These are hypothesized to be reduced stalked glands and may retain vestiges of vasculature. The quadrified region has two types of glands: quadrifid (4-lobed) glands on the adaxial surface and 2-lobed glands on the abaxial surface. The hairless region, which is not entirely hairless or glandless, has only 2-armed glands on the adaxial side of the leaf. The glands of the marginal zone may all be modified forms of sessile glands not involved in digestion of prey.

The central zone consists of the digestive, midrib, and detention regions, all of which have sessile glands that function in digestion of prey. The digestive region contains numerous small sessile glands on the adaxial surface, 2-armed glands on the abaxial surface, and >15 trigger hairs on each lobe. The midrib region also has trigger hairs (>10) as well as sessile glands on the adaxial surface. The detention region has sessile glands on the adaxial surface, but are not as numerous as those found in the digestive region of the adaxial midrib region.

Drosophyllum contains the single species *Drosophyllum lusitanicum*, a carnivorous plant with a shrub-like habit that lives among dry, alkaline soils (Harshberger 1925). The leaves of *D. lusitanicum* are linear with a major groove on the adaxial side of the blade. Unlike in *Drosera*, *D. lusitanicum* leaves show reverse circinate vernation; a character that is shared with *Triphyophyllum peltatum*. Attached to these leaves are both stalked and sessile glands that are accompanied by a network of vascular bundles. The stalked and sessile glands are organized by having a layer of cuticle, two layers of stalk cells and finally, a central vessel of xylem and phloem (Juniper et al. 1989).

Only a single member of Dioncophyllaceae, *Triphyophyllum peltatum*, is considered carnivorous, albeit only a part-time carnivore. *T. peltatum* exhibits seasonal heterophylly and is able to produce three types of leaves throughout its growth: conventional photosynthetic, carnivorous, and tendriled (Juniper et al. 1989; Shaw 1951; Sprague 1916). Carnivorous leaves last only a few weeks and are found on young growth. They are hypothesized to enable the plant to trap and digest insects to provide supplemental nourishment before the plant bolts into a wild liana (Bringmann et al. 2002). Field observations have noted that carnivorous leaves also arise when the plant has been injured (Metcalfe 1951) or on offshoots (McPherson 2008). While not in its carnivorous stage, *T. peltatum* produces tendriled and conventional photosynthetic leaves similar that of *Dioncophyllum tholloni* and *Habropetalum dawei*: this includes leaves on long shoots that bifurcate at the laminal apex into tendril hooks for climbing, and leaves on short shoots without tendril hooks (Sprague 1916).

The carnivorous leaves of *T. peltatum* have stalked and sessile multicellular glands that are vascularized with xylem and phloem (Metcalfe 1951) and share morphological characteristics at the cellular level. Both stalked and sessile glands are composed of two to four layers of outer secretory cells over domed endodermal cells. Within the endodermal layer, groups of branched vascular tracheids can be found ensheathed in parenchyma with numerous amyloplasts (Juniper et al. 1989). The glands are connected to the central vascular system of the midrib, with vascular traces leading from the stalked glands being wider in diameter than those that vascularize the sessile glands (Metcalfe 1951).

The glands of *T. peltatum* carnivorous leaves show a high degree of affinity to Drosophyllaceae. The stalked glands are similar in structure to those of *D. lusitanicum* (Green et al. 1979), containing vascular tissue that includes both xylem and phloem (unlike Droseraceae). The stalked glands of *T. peltatum* are immobile and are arranged on filiform leaves that show reverse circinate vernation, similar to those of *D. lusitanicum* (Green et al. 1979). This differs from *Drosera*, in which stalked glands can be highly mobile and are arranged on leaves that have circinate vernation but are not always filiform. In *D. tholloni* and *H. dawei*, multicellular stalked and sessile glands are absent from the leaves. However, it should be noted that numerous glandular hairs with flattened multicellular heads can be found on the stems of *H. dawei* (Metcalfe 1951).

Ancistrocladus is a genus of non-carnivorous wild lianas that contains ~20 species and can be found in Africa and Asia (Cheek 2000; Foster and Sork 1997; Gereau 1997; Taylor et al. 2005). Similar to *D. tholloni* and *H. dawei*, *Ancistrocladus* is a wild liana and hooks are formed from modified stem apices for climbing. On the abaxial side of the leaf, glandular pits partially covered by the epidermis can be found. These glands are thought to function in wax secretion and are similar in their morphological structure to the pitted glands of Nepenthaceae (Metcalfe 1951; Taylor et al. 2005). Given our current phylogeny, these wax-secreting glands may be an ancestral character that was lost in Droseraceae.

The genus *Nepenthes* comprises ~120 species found primarily in South East Asia with its center of diversity in the islands of Indonesia (Meimberg and Heubl 2006). Inside the pitcher, a variety of zones involved in trapping insects are found. Near the entrance to the pitcher and along the peristome, extrafloral nectaries are present. These nectaries are sunken, partially covered by epidermis, and surrounded at their periphery with bundles of phloem (Owen et al. 1999). The upper one-third of the pitcher is a waxy zone that, while not considered essential for trapping prey (Gaume 2009), can aid in trapping by providing a slick surface that is difficult for insect prey to climb (Knoll 1914). At the base of the pitcher are glands that are involved in digestion. Similar in morphology to the extrafloral nectaries, these glands are also partially covered by epidermis (Parkes 1980). Closer to the waxy zone of the pitcher, the epidermal overhang or epidermal ridge of these glands covers the majority of the glandular pit. Yet toward the base of the pitcher, these overhangs are almost completely absent. Gland structure is defined by one or more layers of secretory and endodermal cells overlaid with columnar cells and a cuticle (Owen and Lennon 1999). Often tracheids are found near these endodermal cells, although the glands themselves do not contain xylem and phloem (Lloyd et al. 1942; Rottloff et al. 2009).

The study detailed in chapter 1 investigates the morphological evolution of glands involved in the digestion of prey. Currently unresolved phylogenetic relationships are refined across carnivorous genera of the non-core Caryophyllales and the phylogeny is used to investigate the morphological evolution of glands involved in the digestion of prey, via stochastic character mapping (Renner and Specht 2011). Ancestral gland types are identified and it is tested whether certain types of glands are consistent indicators of plant carnivory. The phylogenetic results also detail gain and loss of plant carnivory in the Caryophyllales.

Chitinolytic Enzymes of the Carnivorous Caryophyllales

The isolation and characterization of carnivorous plant digestive enzymes secreted from glands began in the nineteenth century, when Sir Joseph D. Hooker discovered the first protease in *Nepenthes* sp. trap fluid cir. 1874 (Lönnig and Becker 2004). One year later, Charles R. Darwin published his accounts on *Drosera rotundifolia* and the ability of *Drosera* to digest nitrogenous and phosphate-containing compounds (Darwin 1875). However, it was not until the 1970s that the basic enzyme composition in carnivorous plant mucilage was characterized on a global scale. Among the various enzymes identified to be important in plant carnivory, chitinases have been one of the most thoroughly studied (Amagase et al. 1972; Robins and Juniper 1995; Matusíková et al. 2005; Eilenberg et al. 2006; Hatano and Hamada 2008).

Plant chitinases (EC 3.2.1.14) commonly act as pathogenesis-related (PR) proteins, which are either induced in response to insect herbivory and fungal elicitors, or constitutively expressed in tissues vulnerable to attack (Brogue et al. 1988; Samac et al. 1990). Chitinases belong to either glycoside hydrolase (GH) families 18 or 19 and function in the hydrolysis of β-1,4-glycosidic bonds between *N*-acetylglucosamine (NAG) oligomers residues in chitin polymers (Legrand et al. 1987). GH families 18 and 19 chitinases have been identified in all plants analyzed to date, many of which have been shown to inhibit fungal growth in vitro and enhance resistance to fungal pathogens in transgenic plants (Schlumbaum et al. 1986; Brogue et al. 1988; Leah et al. 1991; Jach et al. 1995; Eilenberg et al. 2006). GH families 18 and 19 do not share sequence similarity or three-dimensional structure eventhough these enzymes perform similar functions, which may suggest that chitinases arose independently from one another (Hamel et al. 1997).

Plant chitinases are encoded by large gene families, which have been previously organized into five classes according to sequence, structure and phylogenetic relationship. Class I, II, and IV chitinases belong to glycoside hydrolase (GH) family 19, and share a homologous catalytic domain as well a signal peptide at the amino terminus (Collinge et al. 1993; Araki and Torikata 1995; Neuhaus et al. 1996; Hamel et al. 1997). Class I is divided into two subclasses, each with a highly conserved cysteine-rich region involved in chitin-binding (Beintema 1994; Araki and Torikata 1995). Subclass Ia has a carboxyl terminal extension (CTE) that codes for transmission to the vacuole, while subclass Ib is extracellular due to the absence of a CTE (Neuhaus et al. 1995). Class IV comprises extracellular chitinases with similar domain architecture to class I, but which are significantly smaller due to deletions within the chitin-binding and catalytic domains (Passarinho and de Vries 2002). Class II chitinases lack the cysteine-rich region and CTE, but the catalytic domain may be very similar in sequence to class I chitinases (Araki and Torikata 1995). Class III and V chitinase are placed in GH family 18, are more similar to fungal and bacterial chitinases than to other plant chitinases, and have been found to exhibit additional lysozyme activities (Majeau et al. 1990; Graham and Sticklen 1994; Heitz et al. 1994).

Active production of chitinolytic enzymes were first demonstrated in *Drosera* and *Nepenthes* by Amagase et al. (1979), demonstrating digestion of colloidal chitin to increase over time in the presence of concentrated trap secretions. Several years later, Robins and Juniper (1995) found *Dionaea muscipula* traps to exhibit chitinase activity similar to that in *Drosera* and *Nepenthes*. However, none of these studies could rule out the possibility that a symbiotic microorganism could have created this chitinolytic activity. It was not until 2006 that these chitinases were shown to be endogenous to the plant itself. A study using sterile *Nepenthes khasiana* pitchers revealed two subclasses of class I chitinases (Ia and Ib) to be present in the secretory region of the trap (Eilenberg et al. 2006). Interestingly, each subclass had differential expression; subclass Ia being constitutively expressed and subclass Ib found to be upregulated in response to colloidal chitin. During the same year, Matusíková et al. (2005) demonstrated the localized expression of class I chitinase within the tentacles of *Drosera rotundifolia* via *in situ* hybridization after induction with chitin. For subclass Ib, the absence of a CTE is hypothesized to allow excretion from the secretory cells and thus make them available in the trap for use in plant carnivory (Eilenberg et al. 2006).

Interestingly, in non-carnivorous plants studied, class I chitinases have been identified to be under strong positive selection. Bishop et al. (2000) found that adaptive replacements occur disproportionately in the active site cleft in *Arabis* spp. subclass Ia chitinases. Further studies of subclass Ia chitinases in Poaceae (Tiffen 2004) have found similar replacements within the same sites. These observations are proposed to be due to an evolutionary arms race between the chitinolytic enzymes and competitive inhibitors produced by fungal pathogens. Could having a method (an absence of a CTE) by which to escape the digestive gland allowed for subfunctionalization of subclass Ia chitinases for pathogen response and subclass Ib chitinases for plant carnivory? In addition, if carnivorous plant subclass Ib chitinases are used primarily for the prey digestion and not for pathogenic response against fungi, have subclass Ib enzymes been released from positive selection to conserve amino acid structure at the active cleft? The first molecular evolutionary studies of class I chitinases in the carnivorous plants of the Caryophyllales attempt to address these questions in chapter 2.

A method for studying gene function in non-model organisms

Virus-induced gene silencing (VIGS) is a technique that utilizes the RNA interference (RNAi) pathway to downregulate endogenous gene expression (Dinesh-Kumar et al. 2003; Burch-Smith et al. 2004; Godge et al. 2008). The experimental procedure is in most instances rapid, making it more desirable as an application comparibly to *de novo* production of knockout mutants or analyses of transformed RNAi plants.

Susceptibility to viral infection is a critical component of VIGS. A variety of viruses have been utilized to down-regulate gene expression in model plants: tobacco mosaic virus (TMV) in *Nicotiana tabacum* L. (Kumagai et al. 1995), potato virus X (PVX–VIGS) in wild-type *Nicotiana benthamiana* Domin (Ruiz et al. 1998), tobacco rattle virus (TRV) in members of the Solanaceae and Brassicaceae (Ratcliff et al. 2001; Burch-Smith et al. 2004; Chen et al. 2004; Fu et al. 2005; Burch-Smith et al. 2006; Dong et al. 2007; Godge et al. 2008), and pea early browning virus (PEBV) in legumes (Constantin et al. 2004, 2008). Among the cereal crops, barley stripe mosaic virus (BSMV–VIGS) has been utilized to induce VIGS in barley (*Hordeum vulgare* L.) (Holzberg et al. 2002; Bruun-Rasmussen et al. 2007) and wheat (*Triticum aestivum* L.) (Scofield et al. 2005), but prior to the work detailed in chapter 3, application of VIGS to monocots other than cereal grasses had not been described.

After establishing that BSMV caused systemic infections in the Zingiberales, BSMV-VIGS was applied to *Zingiber officinale* using a combination of three BSMV transcripts consisting of RNAα, RNAβ derivative (B7) that is deficient in expression of the coat protein (CP), and RNAγ modified to block the expression of the γb VIGS suppressor and to enable the insertion of *Z. officinale* phytoene desaturase (PDS) cDNA (Petty et al. 1990; Bragg and Jackson 2004). PDS is an excellent gene to assay VIGS as it encodes for an enzymes involved in the biosynthesis of carotenoids. Once silenced, PDS is unable to protect chlorophyll from photo-oxidation, resulting photobleaching due to decreased carotene content (Benedito et al. 2004). In addition to the observed phenotypes resulting from PDS downregulation, decreased levels of phytoene desaturase RNA were evident following semi-quantitative PCR. These results indicate that BSMV can efficiently downregulate expression of specific target genes in *Z. officinale*.

The particular VIGS technique described in chapter 3 was developed out of interest in studying gene function in non-model plants. Importantly, demonstrated is the use of a non-native virus to induce VIGS in a phylogenetically distant taxon (Renner et al. 2009). These results suggest that the VIGS technique can be used among a variety of species, dependent on viral susceptibility. If a suitable virus can be identified, there is a great potential for the technique to be extended to future characterizations of digestive enzyme function in the carnivorous plants of the Caryophyllales.

Chapter One

A sticky situation: assessing adaptations for plant carnivory in the Caryophyllales utilizing stochastic character mapping

Published previously as:
Renner T, Specht CD. 2011. A sticky situation: assessing adaptations for plant carnivory in the Caryophyllales utilizing stochastic character mapping. International Journal of Plant Sciences. 172(7):889-901.

Abstract

Phylogenetic relationships among carnivorous plants of the angiosperm order Caryophyllales have been explored, although a robust phylogeny encompassing all carnivorous genera is absent. We sample nuclear ribosomal (ITS) and chloroplast intergenic spacer (PY-IGS), along with previously-sequenced DNA from members of the non-core Caryophyllales for use in Bayesian statistics and maximum-likelihood based searches of phylogeny. Taxonomic relationships across genera are refined and three strongly supported clades are identified: monophyletic Droseraceae, Nepenthaceae, and a third clade containing Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae. In combination with phylogenetic reconstruction, stochastic character mapping is utilized to assess evolutionary changes in the morphology of glands found on the lamina and involved in the digestion of prey. The presence of sessile glands is identified as the likely ancestral character state and stalked and pitted glands are suggested to have been acquired independently by ingroup and outgroup taxa. Additionally, in some genera we found a lack of association between gland vasculature and plant carnivory, demonstrating that internal architecture of glands is not indicative of whether the plant is a functional carnivore. Finally, we discuss how adaptive changes resulting in the evolution of the carnivorous gland may have occurred either by emargination of the leaf blade or homologous transformation of pinnae.

1.1 Introduction

Phylogenetic relationships among the carnivorous genera of the Caryophyllales

Léon Croizat once proposed that all carnivorous plants comprised a single lineage based upon similarities in trap type, and that carnivory represented an early condition of the Angiosperms (Croizat 1960). More recently, however, carnivory has been shown to be a derived condition and is hypothesized to have arisen independently at least five times within angiosperms, in angiosperm orders Ericales, Lamiales, Oxalidales, Poales, and Caryophyllales (APGII 2003), suggesting convergent evolution of the carnivorous habit across angiosperms. The greatest number of carnivorous plant species are found in the non-core Caryophyllales (Cuénoud et al. 2002) in families Droseraceae (*Aldrovanda, Dionaea, Drosera*), Drosophyllaceae (*Drosophyllum*), Nepenthaceae

(*Nepenthes*) and Dioncophyllaceae (*Triphyophyllum*) (Rice 2006). The carnivorous plant lineage of the Caryophyllales is also unique in that it appears as though plant carnivory arose once and was subsequently lost by closely-related members of Ancistrocladaceae (*Ancistrocladus*) and Dioncophyllaceae (*Dioncophyllum* and *Habropetalum*) (Heubl et al. 2006).

Previous phylogenetic analysis of the carnivorous Caryophyllales have focused sampling on species within Droseraceae (Rivadavia et al. 2003), Nepenthaceae and Ancistrocladaceae (Heubl et al. 2006; Meimberg et al. 2000, Meimberg and Heubl 2006, Meimberg et al. 2006) independently or have limited sampling designed to test the placement of *Dionaea* and *Aldrovanda* (Cameron et al. 2002). Gene regions used in these analyses tend to be either slowly evolving markers (*rbc*L, *mat*K, *atp*B) selected to investigate backbone relationships, or more rapidly evolving markers (18S, *trn*K, PTR1) selected to investigate species-level relationships within a given family or genus. In the current study, we add the chloroplast intergenic spacer between *psaA* and *ycf3* genes (PY-IGS) and nuclear ribosomal DNA (ITS) to molecular data previously published for analyses of phylogenetic relationships among the carnivorous plants of the Caryophyllales (*atp*B, *mat*K, *pet*B, PTR1, *rbc*L, *trn*K). We sample all carnivorous genera, including multiple representatives of each genus where possible in order to test phylogenetic relationships among genera.

Glands involved in plant carnivory in the Caryophyllales

The non-core Caryophyllales share a number of synapomorphies, including the possession of pitted, sessile, and stalked glands (Judd et al. 2002). In Plumbaginaceae and Polygonaceae, families sister to the carnivorous plants of the Caryophyllales, glands are rarely vascularized and function in the secretion of salt in halophytic conditions, in the secretion of mucilage to deter herbivory, or for dispersal (i.e. epizoochory) (Fahn and Werker 1972; Faraday and Thomson, 1986; Lüttge 1971; Sakai 1974). In carnivorous genera, homologous glands have apparently evolved to function in the secretion of digestive enzymes and to absorb amino acids and other organic nutrients (Amagase 1972; Eilenberg et al. 2006; Hatano and Hamada 2008; Juniper et al. 1989; Morrissey 1964; Owen et al. 1999). Of the three gland types that function in plant carnivory, sessile and stalked glands have diversified extensively to include vascularized forms.

Members of Droseraceae include the sundews (genus *Drosera*), in addition to the monotypic Venus Flytrap (*Dionaea muscipula*) and its aquatic sister species *Aldrovanda vesiculosa* (Cameron et al. 2002; Rivadavia et al. 2003). Species of Droseraceae can either have sessile glands or a combination of sessile and stalked glands. In *Drosera,* two basic types of carnivorous glands are present: (1) vascularized, stalked glands and (2) non-vascularized, sessile glands. The upper leaf surface of *Drosera* is densely covered with both types of gland, while only type 2 is found on the abaxial side of the leaf, petioles, and inflorescence scapes (Juniper et al. 1989). Cells of type 1 are either epidermal or parenchymatous in origin with tracheids and xylem embedded within, which extend into the veins of the leaves (Gilchrist and Juniper 1974). Conversely, the cells of type 2 are exclusively epidermal in origin and lack vasculature at maturity (Juniper et al. 1989). In *D. muscipula,* non-vascularized, sessile glands are located abaxially or adaxially on the plant trap. Glands found on the abaxial side of the leaf are stellate, whereas glands on the adaxial side (those involved in digestion) are made up of a variety of cell types, which include a single basal cell, a stalk cell, and 8 or more digestive gland cells (Scala et al. 1968). In addition to the sessile glands on the digestive surface of the trap, trigger hairs can be found adaxially and centrally on each lobe of the lamina (Juniper et al. 1989). Interlocking vascularized 'teeth' are present at the leaf margin and are homologous in their position to the marginally located stalked glands in *Drosera* (Juniper et al. 1989). In the sister species *A. vesiculosa*, non-vascularized, sessile glands are present in each trap and may be either 4-lobed when placed adaxially or 2-lobed abaxially (Ashida 1935). Similarly to *D. muscipula*, *A. vesiculosa* traps have teeth at the margin of the leaf.

The genus *Drosophyllum* contains the single species *D. lusitanicum*, a carnivorous plant with a shrub-like habit that lives among dry, alkaline soils (Harshberger 1925). Attached to the leaves of *D. lusitanicum*, are both stalked and sessile glands accompanied by a network of vascular bundles (Juniper et al. 1989). *Drosophyllum* is currently placed in its own family, Drosophyllaceae, with reported affinities to the Dioncophyllaceae (see discussion). *Triphyophyllum peltatum* (Dioncophyllaceae), a plant considered to be carnivorous during some periods of its development, has sessile and stalked glands similar in architecture to those of *D. lusitanicum* – being filled with a central vessel of xylem and phloem (Green et al. 1979). Interestingly, *Dioncophyllum tholloni*, a close sister taxon to *T. peltatum* (fig. 1.1), is not considered carnivorous and does not display glands on its lamina.

Closely related to Dioncophyllaceae is the genus Ancistrocladaceae, a family of non-carnivorous lianas from Africa and Asia (Cheek 2000; Foster and Sork 1997; Gereau 1997; Taylor et al. 2005). In members of Ancistrocladaceae, glandular pits that function in wax secretion can be found on the abaxial side of the lamina (Taylor et al. 2005). Although not vascularized, Ancistrocladaceae glands are approached by vasculature that terminates abruptly bellow the pitted glands (Metcalfe 1951).

In *Nepenthes* (Nepenthaceae), a genus of ~130 species native to tropical Asia (McPherson 2010), pitted glands partially covered by the epidermis are located at the base of a modified lamina (the pitcher), which acts as the carnivorous trap. Gland structure is defined by one or more layers of secretory and endodermal cells overlaid with columnar cells and a cuticle (Owen et al. 1999). Often tracheids are found near these endodermal cells, although the glands themselves do not contain xylem and phloem (Lloyd 1942; Rottloff et al. 2009).

Although the glands present in the carnivorous Caryophyllales have been described previously in great detail, assessments of gland homology have not resulted in a unanimous conclusion as to their developmental origin. In more recent papers and reviews, digestive glands have been considered homologous with trichomes (Heubl et al. 2006), hairs (Chase et al. 2009), or epidermal cells (Owen and Lennon 1999). Defining the carnivorous gland may be confounded by differences in gland morphology between genera. In order to investigate the evolution of gland morphology, we explore the morphology of glands among carnivorous genera utilizing stochastic character mapping to further understand how carnivorous glands may have evolved in the Caryophyllales.

The aims of the present study are to (1) evaluate past phylogenetic analyses which included carnivorous taxa of the Caryophyllales, (2) determine the utility of PY-IGS and ITS molecular markers for phylogenetic reconstruction at the level of genus and species in the Caryophyllales, and (3) investigate gland morphology among carnivorous taxa and closely related non-carnivorous taxa under a phylogenetic framework in order to identify characteristics that are key in determining whether glands found on the lamina of the leaf are indicative of plant carnivory.

1.2 Material and Methods

Taxon sampling and tissue collection

A total of 51 taxa from families Ancistrocladaceae, Dioncophyllaceae, Droseraceae, Drosophyllaceae, Plumbaginaceae, Nepenthaceae, and Polygonaceae were included in our analyses (appendix). Taxa were selected to represent biogeographic diversity across the carnivorous Caryophyllales. Samples collected originated mainly from living collections at the University of California Botanical Garden, Missouri Botanical Garden, Universität Würzburg and California Carnivores in Sebastopol, California. Freshly collected leaf tissue was preserved in silica gel, frozen at -80°C, and vouchers were deposited at the University of California Herbarium. *Dioncophyllum tholloni*, a species not easily obtained from living collections, was collected in the wild by Gretchen Walters (MO), vouchered, and tissue was sampled from the herbarium sheet. We were unable to obtain tissue for *Habropetalum dawei* (Dioncophyllaceae).

Molecular marker sampling

The nuclear ribosomal DNA including internal transcribed spacer (ITS) and the chloroplast intergenic spacer between *psaA* and *ycf3* genes (PY-IGS) were chosen for phylogenetic reconstruction based on previous studies demonstrating the utility of these markers for resolution at both genus and species levels within the eudicots and Nepenthaceae (Alejandro et al. 2008; Downie et al. 1996; Meimberg 2002; Miranda et al. 2010; Sang et al. 1997; Shi et al. 2001; Tan et al. 2002; Tate et al. 2003). A previous study attempted to utilize ITS in Droseraceae, yet with unsatisfactory results (Miranda et al. 2010). Total genomic DNA was extracted from leaf base (*Aldrovanda* and *Dionaea*), leaf lamina (*Ancistrocladus*, *Dioncophyllum*, *Drosera* and *Drosophyllum)* and the lamina-like region of the leaf-base (*Nepenthes* and *Triphyophyllum*) using a cetyltrimethyl ammonium bromide (CTAB) (Doyle and Doyle 1987) or modified sodium dodecyl sulfate (SDS) and sodium chloride protocol (Edwards et al. 1991). Extracted genomic DNA was quantified using a NanoDrop 1000 (Thermo Fisher Scientific Inc., Wilmington, DE, USA).

Previously published sequences for *atp*B, *mat*K, *pet*B, PTR1, *rbc*L, *trn*K were obtained from GenBank (http://www.ncbi.nlm.nih.gov/) for phylogenetic analyses (appendix). Of these molecular markers, only *matK* was available for *H. dawei* (GenBank: AF204845). In order to minimize missing data, outgroup genera *Limonium* (Plumbaginaceae) and *Polygonum* (Polygonaceae) are formed from composite sampling of *atp*B, ITS, *mat*K, *pet*B, PTR1, PY-IGS, *rbc*L, *trn*K sequences from multiple species where necessary. Taxa utilized in our analyses are summarized in A.1, along with voucher information and the GenBank accession number for each DNA sequence.

PCR and DNA sequencing

Previously published primer pairs ITS5a (Downie et al. 1996) and ITS4 (White, 1990) were used to amplify ITS in 10 µl aliquots with 10-100 ng of genomic DNA and the following reagents: 0.02 U iProof™ Polymerase (Bio-Rad, Hercules, CA, USA), 1x HF iProof buffer (Bio-Rad), 2.0 mM $MgCl_2$, 0.2 mM each of dNTP, 0.5 µM of each primer, 0.025 mg/mL BSA and 100% DMSO. PCR reactions were run on a MyCycler (Bio-Rad) thermal cycler under the following conditions: an initial denaturation for 3 min at 98°C, followed by 30 cycles of 98°C for 10 s, 54°C for 25 s, 72°C for 30 s (increasing 0.03 degrees with each cycle), and ending with a final extension at 72ºC for 7 minutes. For PY-IGS, PG1f and PG2r (Tan et al. 2002) were used to amplify PY-IGS from the majority of species using the same PCR chemistry as described for ITS, but with the following thermal cycler conditions: 5 min at 98ºC, followed by 40 cycles of 98ºC for 10 s, 60ºC for 30 s, 72ºC for 30 s, and ending with a final extension at 72ºC for 7 minutes. For *D. lusitanicum* and *D. tholloni,* PY-IGS was amplified from using newly designed primers PFF592 (5'-CAG-TCA-AGT-AAT-TAG-TGA-ACC-3') and PFF593 (5'-AGT-TAT-TCA-CTC-GAA-CAA-TTA-3') using the Phire® Plant Direct PCR Kit and the suggested 3-step PCR protocol with annealing temperature set at 50ºC (Finnzymes Inc., Woburn, MA, USA).

Prior to sequencing, PCR products were purified using exonuclease I and shrimp alkaline phosphatase to remove single-stranded primers and remaining dNTPs (Fermentas International Inc., Burlington, Ontario, Canada). PCR products were cycle sequenced using PCR primers and the ABI Prism BigDye Terminator Cycle Sequence Ready Reaction Kit v3.1 (Perkin-Elmer/Applied Biosystems, Foster City, CA, USA). Products of cycle sequencing were resolved on an ABI Prism 3100 automated sequencer (Applied Biosystems, Foster City, CA, USA).

Alignment and phylogenetic analyses

Forward and reverse sequences for ITS and PY-IGS were assembled and edited with Sequencher v.4.7 (Gene Codes Corp.). A multiple sequence alignment for 19 taxa (appendix) was constructed from ITS, PY-IGS, *atp*B, *mat*K, *pet*B, PTR1, *rbc*L, and *trn*K with ClustalX under default settings (Thompson et al. 1994) with subsequent manual adjustment in Mesquite v2.72 (Maddison and Maddison 2010). We excluded regions from ITS, PY-IGS, *atp*B, *mat*K, *pet*B, PTR1, *rbc*L, *trn*K alignments that were poorly aligned across the entire dataset, and combined all sequences into a single concatenated dataset (hereafter known as the combined dataset) with a final length of 9988 bp (A.2).

Bayesian inference (BI) of phylogeny was conducted in MrBayes v3.1.2 (Ronquist and Huelsenbeck 2003) utilizing the combined dataset and partitioned for each molecular marker under the best-fit model of evolution as determined by the Akaike information criterion (AIC) in jModelTest v0.1.1 (Posada 2008): GTR (PTR1), GTR+G (*atp*B, *mat*K, *pet*B, *trn*K) or GTR+G+I (ITS, PY-IGS, *rbc*L). Two Bayesian analyses were performed simultaneously with posterior probabilities of the generated trees approximated using the Metropolis-coupled Markov chain Monte Carlo algorithm with four incrementally heated chains for 22000 generations while sampling trees every 100 generations until both analyses converged on similar log likelihood scores (average standard deviation of split frequencies <0.01). The first 110 trees were discarded as burn-in and a 50% majority rule tree was assembled from the remaining trees. Our Bayesian analyses including *mat*K from *H. dawei* were unable to converge; most likely an artifact of increased missing data. Therefore, molecular data for *H. dawei* was removed from our phylogenetic analyses.

Maximum likelihood (ML) searches were performed using the interactive GARLI OSX GUI interface (Zwickl 2006) with an unpartitioned version of the combined dataset for 1000 bootstrap replicates. A consensus of bootstrap trees was constructed with SumTrees v3.0.0 using the DendroPy Phylogenetic Computing Library v3.7.1 (Sukumaran and Holder 2010). Trees were edited in Mesquite v2.72 (Maddison and Maddison 2010) and Adobe® Illustrator®.

Two Bayesian analyses of a dataset containing ITS and PY-IGS for 51 taxa (A.3) were performed in order to compare tree topology with the combined dataset of eight nDNA, nrDNA, and cpDNA molecular markers. These analyses were made simultaneously in MrBayes v3.1.2 (Ronquist and Huelsenbeck 2003) with GTR+G+I as determined by AIC in jModelTest v0.1.1 (Posada 2008). Posterior probabilities of the generated trees were approximated using the MCMC algorithm with methods similar to the combined eight molecular marker dataset. The first 2500 trees were discarded as burn-in and a 50% majority rule tree was assembled from the remaining trees as unrooted.

Character state reconstructions

Ancestral character reconstructions were conducted using maximum parsimony (MP) in MacClade v4.08 OSX (Maddison and Maddison 2005), ML in Mesquite v2.72 (Maddison and Maddison 2010), and Bayesian stochastic character mapping (Huelsenbeck et al. 2003) in SIMMAP v1.5 (Bollback 2006). Character reconstruction results were consistent among these different methods, therefore we only describe the Bayesian approach here.

We utilized the 50% majority rule tree generated in our BI analyses for the combined dataset to create stochastic mappings of gland types found on the lamina of the leaf and vasculature tissues associated with glands in SIMMAP. To assess evolutionary changes in gland morphology specifically related to plant carnivory, we scored character states as unordered for 3 gland types, taking in account the types of vasculature that can be found in each: (1) sessile glands; 0 = absence, 1 = presence, 2 = xylem and phloem (2) stalked glands; 0 = absence, 1 = presence, 2 = xylem, 3 = xylem and phloem (3) pitted glands; 0 = absence, 1 = presence. Descriptions of genera and illustrations of micrographs were used to determine character states and a summary of basic gland types and their morphologies (appendix). We chose to set bias and rate parameters with priors determined by a MCMC configuration calculated in SIMMAP for each gland type. For sessile glands, the bias parameter was set to equal (1/k) and we used a gamma rate prior with shape parameters $\alpha = 1.062$ and $\beta = 0.049$. For stalked glands, the bias parameter was similarly set to equal (1/k) and a gamma rate prior with shape parameters $\alpha = 0.671$ and $\beta = 0.011$ was used. Lastly, for pitted glands, $\alpha = 5.946$ was set as the beta distribution prior for the bias parameter and we used a gamma rate prior with shape parameters $\alpha = 0.972$ and $\beta = 0.019$. Default values for the number of categories (κ) for both beta and gamma distributions were used. Ancestral states at each node were calculated as the marginal posterior probability of each possible character state, which is dependent on the branch lengths and topology of the phylogenetic tree given (fig. 1.3A-C).

1.3 Results

Phylogenetic reconstruction

ML and BI methods of phylogenetic reconstruction gave congruent topologies that support monophyly of the carnivorous plant families of the Caryophyllales. Three strongly supported clades were identified corresponding with (a) a monophyletic Droseraceae, (b) a monophyletic Nepenthaceae, and (c) a third clade containing members of Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae (fig. 1.1, 1.2).

In ML and BI reconstructions of phylogeny for the combined dataset (fig. 1.1), Nepenthaceae (100 bs/1.00 pp) is placed as sister to the clade containing members of Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae with relatively strong support (89 bootstrap support (bs) value/1.00 posterior probability (pp) value). The monotypic *Drosophyllum* is supported (100 bs/1.00 pp) as sister to a clade containing Dioncophyllaceae and Ancistrocladaceae. Within the Dioncophyllaceae, *Dioncophyllum* and *Triphyophyllum* are sister (1.00 bs/1.00 pp) and together are sister to a clade containing all included members of the genus *Ancistrocladus* (Ancistrocladaceae; 100 bs/1.00 pp), with high support (100 bs/1.00 pp). Droseraceae is recovered as monophyletic (97 bs/1.00 pp), with *Dionaea* and *Aldrovanda* sister to members of *Drosera*. Lastly, *Dionaea* and *Aldrovanda* are sister to one another with high support (100 bs/1.00 pp).

To determine if tree topology for the carnivorous Caryophyllales is conserved among datasets, we compared ML and BI reconstructions for the combined dataset (fig. 1.1) to a BI reconstruction for a dataset including ITS and PY-IGS for a greater number of taxa (fig. 1.2). Topology was relatively consistent at the genus level between reconstructions, with the exception of the position of *Drosophyllum*, which forms a polytomy with *Dioncophyllum* and *Triphyophyllum* with relatively high support (0.94 pp). It is also evident that the ITS and PY-IGS reconstruction does not fully resolve evolutionary relationships between taxa. This is especially true in Nepenthaceae, where ITS and PY-IGS are not phylogenetically informative enough to resolve relationships at the species level.

Ancestral reconstruction

Stochastic character mapping reveals the presence of non-vascularized, sessile glands alone (stalked and pitted glands absent) as the ancestral state for the carnivorous Caryophyllales (fig. 1.3A). Sessile glands were then lost in the lineage leading to Nepenthaceae and the clade containing Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae (0.94 pp). Within this group, vascularized, sessile glands containing both xylem and phloem arose secondarily and independently in *Drosophyllum* and *Triphyophyllum*. Within the taxa studied here, there are no known sessile glands associated only with xylem.

Stochastic character mapping also infers three independent origins of stalked glands within the ingroup (fig. 1.3B). Independently, the presence of stalked glands is an ancestral character state for outgroups (0.55 pp) and for Droseraceae (0.98 pp). The stalked glands of Droseraceae are vascularized with xylem, and according to our analyses these glands are secondarily lost in the flytrap lineages *Dionaea* and *Aldrovanda* (absence of stalked glands: 0.60 pp *Dionaea – Aldrovanda*, whereas 0.01 pp *Drosera*). In *Drosophyllum* and *Triphyophyllum*, stalked glands vascularized with xylem and phloem are gained independently.

According to our reconstruction results, pitted glands are gained independently by ingroup and outgroup taxa (fig. 1.3C). Pitted glands are found in *Limonium* and *Polygonum* and are reconstructed as the ancestral condition of the outgroup. Pitted glands are also found in Nepenthaceae and Ancistrocladaceae, and their presence is reconstructed as an ancestral character state (0.58 pp) for the clade containing Nepenthaceae and members of Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae. However, in this case, pitted glands are secondarily lost in Drosophyllaceae (currently absent in *Drosophyllum*) and the Dioncophyllaceae (0.90 pp). Pitted glands are non-vascularized in all taxa sampled in our analyses.

1.4 Discussion

Assessing phylogenetic relationships among the carnivorous Caryophyllales

Bayesian and maximum likelihood inference of phylogeny of the Caryophyllales and closely-related taxa based on the combined dataset revealed a tree topology similar to previous molecular studies, which includes a single gene analysis of *mat*K (Meimberg et al. 2000) and combined analyses of 18S, *rbc*L, *atp*B, and *mat*K (Cameron et al. 2002).

The relationship presented here of a monophyletic *Drosera* with *D. regia* as the closest living ancestor to the remainder of sampled *Drosera* species is incongruent with previous *mat*K and *rbc*L single gene phylogenies, yet is consistent with 18S, *rbc*L, *atp*B, and *mat*K topologies presented in the same study (Cameron et al. 2002). Our analyses are also inconsistent with a *rbc*L study of primarily *Drosera* (Rivadavia et al. 2003), where *Drosera* was found to be polyphyletic due to *D. regia* and *Aldrovanda* forming a clade sister to the remaining *Drosera* species, with *Dionaea* sister to all remaining Droseraceae. A multiple gene study (Cameron et al. 2002) is the most similar to our topology with regards to Droseraceae relationships, however our eight molecular marker analysis provides higher support for the monophyly of *Drosera* (88 bs/1.00 pp), as well as the sister relationship between *Dionaea* and *Aldrovanda* (100 bs/1.00 pp). Our analyses are also inconsistent with a *rbc*L study of primarily *Drosera* (Rivadavia et al. 2003), where *Drosera* was found to be polyphyletic due to *D. regia* and *Aldrovanda* forming a sister relationship just outside the entirety of sampled *Drosera*, and *Dionaea* was the closest living relative to all remaining Droseraceae.

Single gene analyses of *rbc*L (Fay et al. 1997; Lledó et al. 1998) both included sufficient taxa to test generic relationships across the carnivorous Caryophyllales. In Fay et al. (1997), Nepenthaceae was reconstructed as sister to a clade containing Droseraceae and members of the families Plumbaginaceae and Polygonaceae. The remaining families (Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae), were recovered as sister to this clade. In Lledó et al. (1998), Nepenthaceae was recovered as sister to Droseraceae and Droseraceae sister to a clade containing Drosophyllaceae, Dioncophyllaceae, and Ancistrocladaceae. Both analyses are inconsistent with the tree topology of our eight molecular marker analyses (fig. 1.1).

There has been uncertainty in the phylogenetic placement of Nepenthaceae in almost all past analyses of the Caryophyllales (Cameron et al. 2002; Cuénoud et al. 2002; Fay et al. 1997; Nandi et al.1998; Soltis et al. 2000). The exception is a single gene analysis of *mat*K (Meimberg et al. 2000), in which Nepenthaceae and a clade containing Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae is sister to Droseraceae with moderate support. In our eight molecular marker analyses, Nepenthaceae as sister to the clade containing Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae is highly supported (89 bs/1.00 pp). In addition, analyses in the past show little support for the reconstruction of Nepenthaceae and Droseraceae as sister clades (Cuénoud et al. 2002; Fay et al. 1997; Hilu et al. 2003; Lledó et al. 1998; Nandi et al. 1998; Soltis et al. 2000). In contrast, combined and ITS and PY-IGS analyses show strong support for Droseraceae as sister to the clade containing Nepenthaceae, Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae (100 bs/1.00 pp).

Drosophyllum was previously thought to be allied with the Droseraceae (Cronquist 1988), an idea supported by an early *rbc*L analysis (Williams et al. 1994) that placed *Drosera* sister to *Drosophyllum.* A later analysis of *rbc*L (Lledó et al. 1998) also suggested a relationship between *Drosophyllum* and Droseraceae; one of their three equally most parsimonious trees depicted Droseraceae as sister to a clade that included *Drosophyllum, Ancistrocladus* and *Triphyophyllum*.

Since this time, *Drosophyllum* has been separated from Droseraceae and moved into the monotypic Drosophyllaceae based upon several multiple-locus phylogenies that suggest a sister relationship between *Drosophyllum* and the Nepenthaceae (APGII 2003). Our analyses clearly separate *Drosophyllum* from both Droseraceae and Nepenthaceae, placing it in a moderately well-supported clade with *Ancistrocladus, Dioncophyllum,* and *Triphyophyllum* (fig. 1.1). In our ITS and PY-IGS BI phylogenetic reconstruction (fig. 1.2), *Drosophyllum* forms a polytomy with *Dioncophyllum* and *Triphyophyllum*. The placement in the ITS and PY-IGS analysis is likely an artefact of the smaller dataset not providing sufficient phylogenetically informative characters to resolve the relationship between *Dioncophyllum*, *Drosophyllum* and *Triphyophyllum*.

The relationship of *Ancistrocladus* as sister to *Dioncophyllum* and *Triphyophyllum* has very high support (100 bs/1.00 pp), similar to previous analyses that recover this relationship (Cameron et al. 2002; Cuénoud et al. 2002; Fay et al. 1997; Heubl et al. 2006; Hilu et al. 2003; Meimberg et al. 2000; Soltis et al. 2000). Meimberg et al. (2000) and Heubl et al. (2006) also recover *Dioncophyllum* as sister to *Triphyophyllum*, comparable to our results (100 bs/1.00 pp).

Topological incongruence observed among ours and previous phylogenetic reconstructions may be due to a sampling limitation of species per genus in previous studies and/or the amount of missing data in many of the combined molecular marker analyses (Wiens 2003). We tested for familial relationships through larger sampling of species within each genus, limiting the amount of missing molecular data, and using Bayesian and likelihood-based methods for phylogenetic reconstruction to decrease the potential for long-branch attraction (Bergsten 2005) especially considering the seemingly long evolutionary distances in some of the monotypic lineages (*Drosophyllum*, *Dionaea*, *Aldrovanda*) (figs. 1.1 and 1.2). As both our BI and ML analyses (ML branch lengths not shown in fig. 1.1) agree with the long branch associated with *A. vesiculosa*, it is unlikely that BI's sometimes inaccurate branch-length estimates are the cause (Brown et al. 2010). It is more likely that the long branch is an relic of extinction (Magallón 2010), as *A. vesiculosa* represents a larger lineage with a rich fossil record dating back to the early Tertiary (Degreef 1997).

Ancestral reconstruction of carnivorous glands of the Caryophyllales

The results of our phylogenetic reconstructions provide a backbone to investigate the evolution of the carnivorous habit at the level of the gland – a morphological feature of the carnivorous plant trap that allow for the secretion of enzymes and absorption of digested products (Amagase 1972, Amagase et al. 1972; Dexheimer 1978; Henry and Steer 1985; Stoltzfus et al. 2002). The presence of glands is a synapomorphy for the non-core Caryophyllales (Judd et al. 2002). Glands can either be sessile, stalked, or pitted, and while sometimes vascularized with xylem and phloem, the presence of vasculature within a gland is not an indicator of its functionality in carnivory.

Stochastic mapping of gland morphology resulted in sessile gland type as most likely ancestral when considering gland type alone, whether absent, sessile, stalked, or pitted (fig. 1.3A). Sessile glands containing xylem and phloem evolved independently in *Drosophyllum* and *Triphyophyllum*, a feature absent from all other sessile glands found in Droseraceae, Plumbaginaceae, and Polygonaceae (fig. 1.3A). Stalked and pitted glands are gained independently by ingroup and outgroup taxa, with lower posterior probability values for the occurrence of these glands as ancestral character states for *Limonium* and *Polygonum*. These results could be due to the lack of knowledge and inclusion of characters related to gland functionality in our analyses.

Results from stochastic character mapping imply that the evolution of stalked glands with xylem-containing vasculature (Droseraceae) and those that contain both xylem and phloem (*Drosophyllum* and *Triphyophyllum*) occurred as separate events (fig. 1.3B). In addition, according to these results it is also highly unlikely (0.12 pp) that the evolution of glands containing both xylem and phloem occurred in the common ancestor to the clade comprising Ancistrocladaceae, Dioncophyllaceae, and Drosophyllaceae. Instead, the evolution of glands with both xylem and phloem was likely to have occurred twice, once in the lineage leading to the extant full-time carnivore *Drosophyllum* and a second time in the lineage leading to part-time carnivore *Triphyophyllum* after the divergence of the *Dioncophyllum* lineage. Additional studies investigating the development and secretion chemistry of stalked glands in *Drosophyllum* and *Triphyophyllum* would help shed light on this apparent homoplasy.

Stochastic character mapping also demonstrates the loss of stalked glands by the common ancestor of the flytraps *Dionaea* and *Aldrovanda* (fig. 1.3B). These taxa are considered carnivorous and retain sessile glands without associated vasculature. It has been proposed that vascularized, stalked multicellular glands may have been reduced to teeth and trigger hairs during the evolution of the lamina—a hypothesis with supporting evidence derived by S.E. Williams (1976) and revisited by T.C. Gibson and D.M. Waller (2009). This hypothesis is consistent with our reconstruction of ancestral gland character states, where stalked glands have been lost in *Dionaea,* while teeth and trigger hairs have been gained as a morphological character (data not coded). Like in *Dionaea*, the teeth and trigger hairs of the *Aldrovanda* trap may be derived from vascularized, stalked glands resulting in the apparent loss of these glands. If so, this conversion of vascularized, stalked glands to trigger hairs and teeth could have occurred in the common ancestor of *Dionaea* and *Aldrovanda*.

It is evident that the evolution of the vascularized gland is a novel feature of the carnivorous Caryophyllales, as only *Drosera*, *Drosophyllum*, and *Triphyophyllum* have vascularized glands involved in carnivory. In some genera of the Caryophyllales we found a lack of association between gland vasculature and carnivory (i.e. *Dionaea*, *Nepenthes*), as not all carnivorous plants have vascularized glands. It is also apparent that sessile and stalked glands are not required for carnivory in *Nepenthes*. Our investigations of gland morphology among carnivorous taxa and closely related non-carnivorous taxa therefore demonstrate that the internal architecture of glands on the lamina is not indicative of plant carnivory.

On the origin of carnivorous glands in the Caryophyllales

It is clear that plant carnivory is independent of the presence of vascularized glands in *Dionaea*, *Aldrovanda*, and *Nepenthes* (fig. 1.3A-C), as the absorption of nutrients by non-vascularized glands has been exemplified within *Dionaea*, *Aldrovanda*, and *Nepenthes* (An et al. 2002; Fabian-Galan and Salageanu 1968; Robins and Juniper 1980). This prompts two questions: how and why did vascularized glands arise in *Drosera*, *Drosophyllum*, and *Triphyophyllum*?

Vascularized, stalked multicellular glands that excrete enzymes and absorb nutrients for plant carnivory could have evolved by a number of methods, two of which could have been either by pinnation or emargination of the leaf blade (fig. 1.4). If by pinnation, marginal glands were formed by homologous transformation of pinnae into vascularized, stalked glands. Alternatively, emargination of the leaf blade could have occurred, whereby marginal glands evolved through gland definition. After the formation and evolution of vascularized, stalked multicellular glands, the ancestors of extant carnivorous Caryophyllales diversified and radiated through modification or reduction of stalked glands (Gibson and Waller 2009; Juniper et al. 1989). During three separate events, stalked glands with vasculature were acquired by ancestors of Droseraceae, Drosophyllaceae, and Dioncophyllaceae, leading to extant carnivorous taxa in the genera *Drosera*, *Drosophyllum*, and *Triphyophyllum*. Reduction of vascularized, stalked glands is hypothesized to have occurred in ancestors of extant *Aldrovanda* and *Dionaea*, whereby vascularized, stalked glands were reduced to vascularized teeth at the margin of the trap, as well as trigger hairs on the abaxial side of the leaf surface (Gibson and Waller 2009; Williams 1976). Stochastic character mapping for pitted, sessile, and stalked glands supports the loss of stalked glands at the ancestral node to *Dionaea* and *Aldrovanda* (fig. 1.3B).

Evidence to support pinnation, or the homologous transformation of pinnae to marginal glands, comes from studies of *Drosera* leaf development. In *D. capensis* seedlings, marginal glands that resemble pinnae can be found on cotyledons (Diels 1906). Interestingly, some closely related living members to the carnivorous Caryophyllales exhibit pinnately lobed leaves (e.g. Plumbaginaceae, *Limonium imbricatum*). If this type of leaf morphology is present in the Caryophyllales, it is possible that an ancestor to the carnivorous plants could have evolved pinnately compound leaves and secondarily evolved marginal glands through rearrangement of leaf architecture. Alternatively, emarginate leaves are a found in some Polygonaceae (*Rheum*), a sister family to Plumbaginaceae, and the study of this leaf type may provide clues as to another way by which marginal glands evolved.

A greater understanding of the evolutionary origin of carnivorous glands and structures involved in plant carnivory could stem from developmental genetic studies. For example, assessing which genes are expressed within the gland during its development may help to elucidate vascularized, stalked gland homology. Homologies in leaf form inferred from gene expression have been demonstrated in both angiosperms and gymnosperms (Bharathan et al. 2002; Eckardt 2007; Floyd and Bowman 2009). Similarly, expression profiling of carnivorous glands from the non-core Caryophyllales could allow us to escape misinterpretations of homologies within leaf morphology.

Acknowledgements

The authors would like to thank H. Forbes and C. Matasick (University of California Botanical Garden), P. D'Amato (California Carnivores), G. Bringmann and A. Irmer (Universität Würzburg), G. Walters (Missouri Botanical Garden), B. Rice (University of California, Davis), and R. Sivertsen for help in obtaining tissue for this study and K. Hockett, K. Lader and N. Nguyen for assisting in the collection of material for vouchers and DNA extractions. We would also like to thank S. Starkey for her assistance in amplifying ITS particularly in Ancistrocladaceae, and the Specht Lab (especially A. Almeida, M. Bartlett, H. Driscoll, C. Gomez, M. Guisinger, K. Lader, C. Sass, and R. Yockteng) for advice and suggestions. Funding for this research was provided by a NSF Graduate Research Fellowship to T.R. and NSF Doctoral Dissertation Improvement Grant (DEB 1011021) to C.D.S. and T.R. The authors thank 2 anonymous reviewers and the editor for their thoughtful comments on an earlier version of this manuscript.

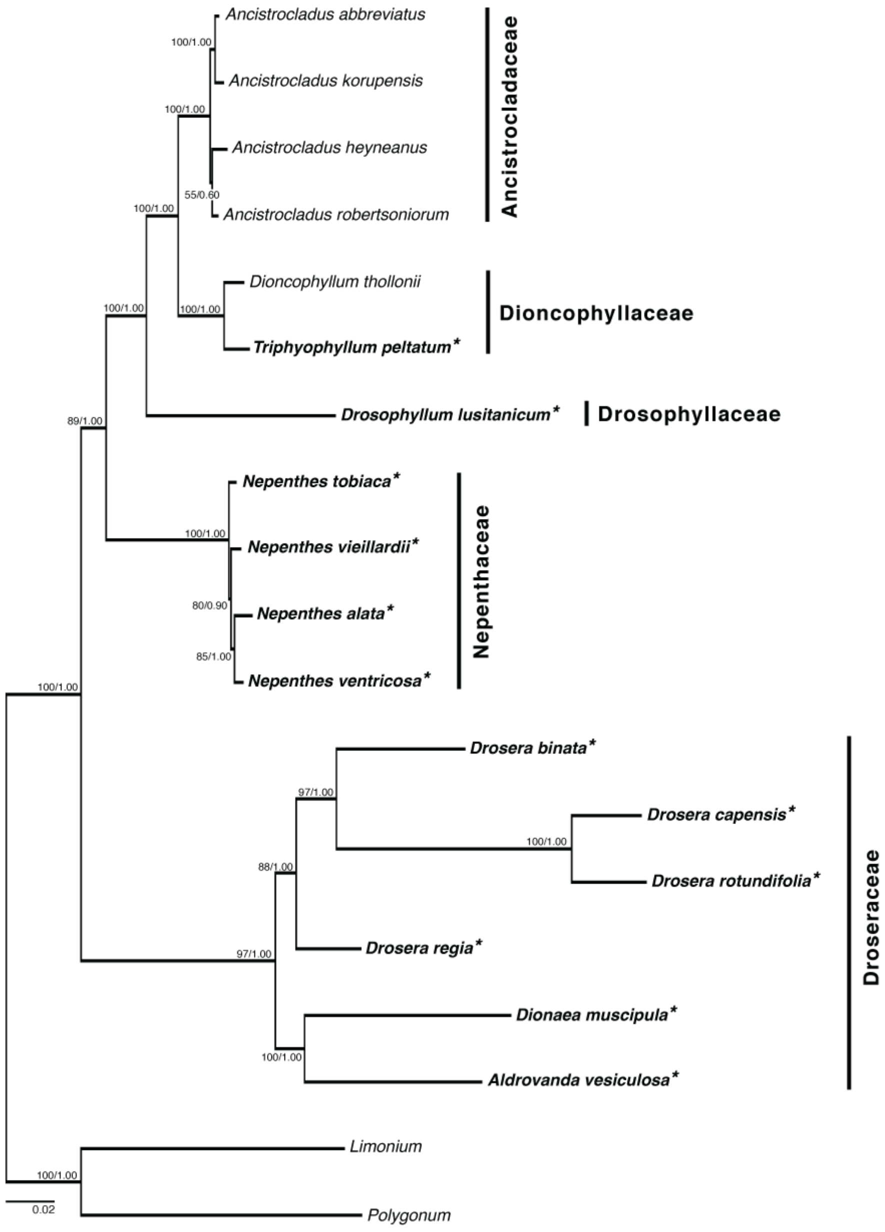


Fig. 1.1 Combined nDNA, nrDNA, and cpDNA molecular marker phylogenetic reconstruction for the carnivorous Caryophyllales. Results from ML and BI analyses of a concatenated ITS, PY-IGS, *atp*B, *pet*B, *mat*K, PTR1, *rbc*L, *trn*K dataset for 19 taxa. Posterior probabilities and bootstrap support from complete analysis are indicated (BS/PP) at nodes on the Bayesian 50% majority rule tree. Carnivorous taxa are indicated by an asterisk and are in bold typeface.

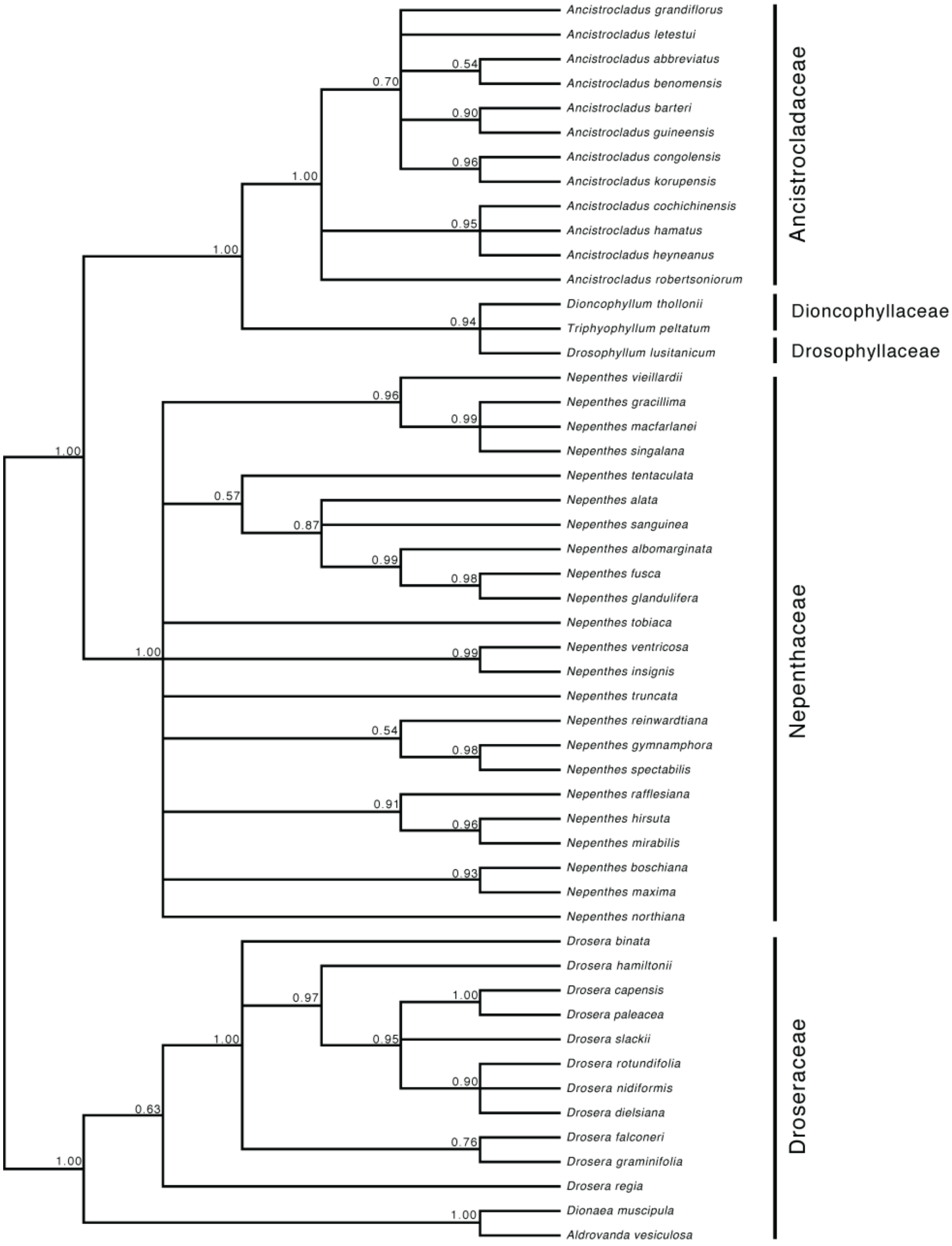


Fig. 1.2 ITS and PY-IGS phylogenetic reconstruction for the carnivorous Caryophyllales. Results from BI analyses of ITS and PY-IGS for 51 taxa. Posterior probabilities from complete analysis are indicated at nodes on the Bayesian 50% majority rule tree.

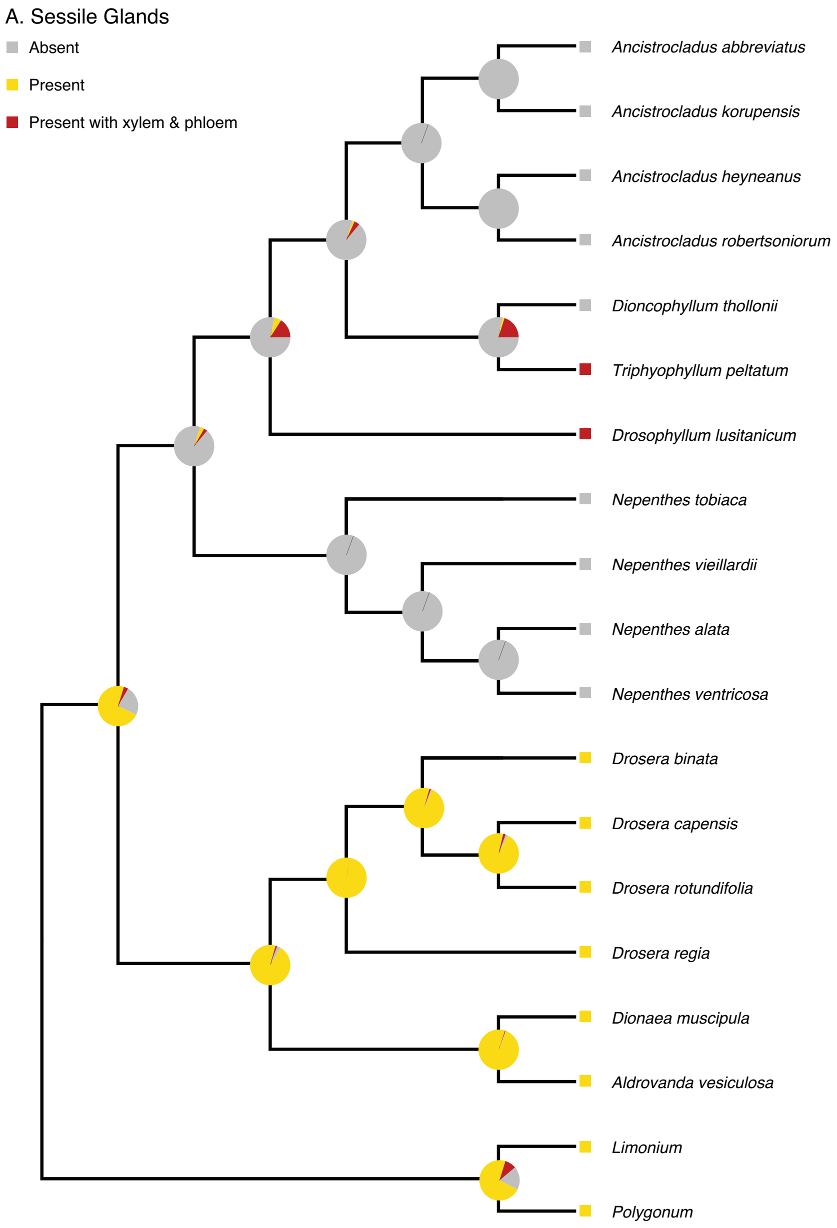


Fig. 1.3 A-C Stochastic character mapping of gland states associated with plant carnivory. Stochastic character mapping of gland types and associated vasculature in SIMMAP utilizing the 50% majority rule tree assembled from BI phylogenetic reconstruction of the concatenated ITS, PY-IGS, *atp*B, *mat*K, *pet*B, PTR1, *rbc*L, *trn*K dataset for 19 taxa. Pie charts at nodes represent ancestral states at each node that were calculated as the marginal posterior probability of each possible character state. Three basic gland types and associated vasculature found in carnivorous Caryophyllales and closely related non-carnivorous taxa were mapped: (*A*) sessile glands, (*B*) stalked glands, (*C*) pitted glands.

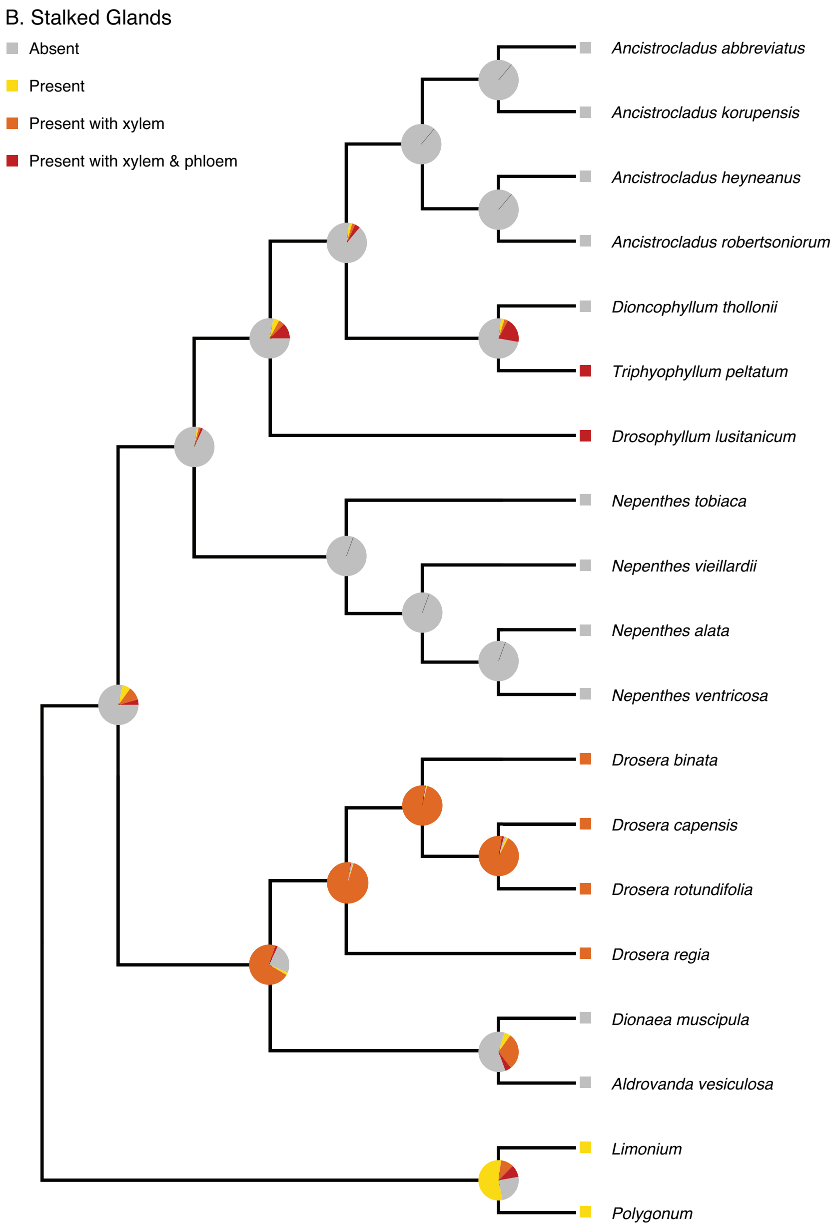


Fig. 1.3 continued.

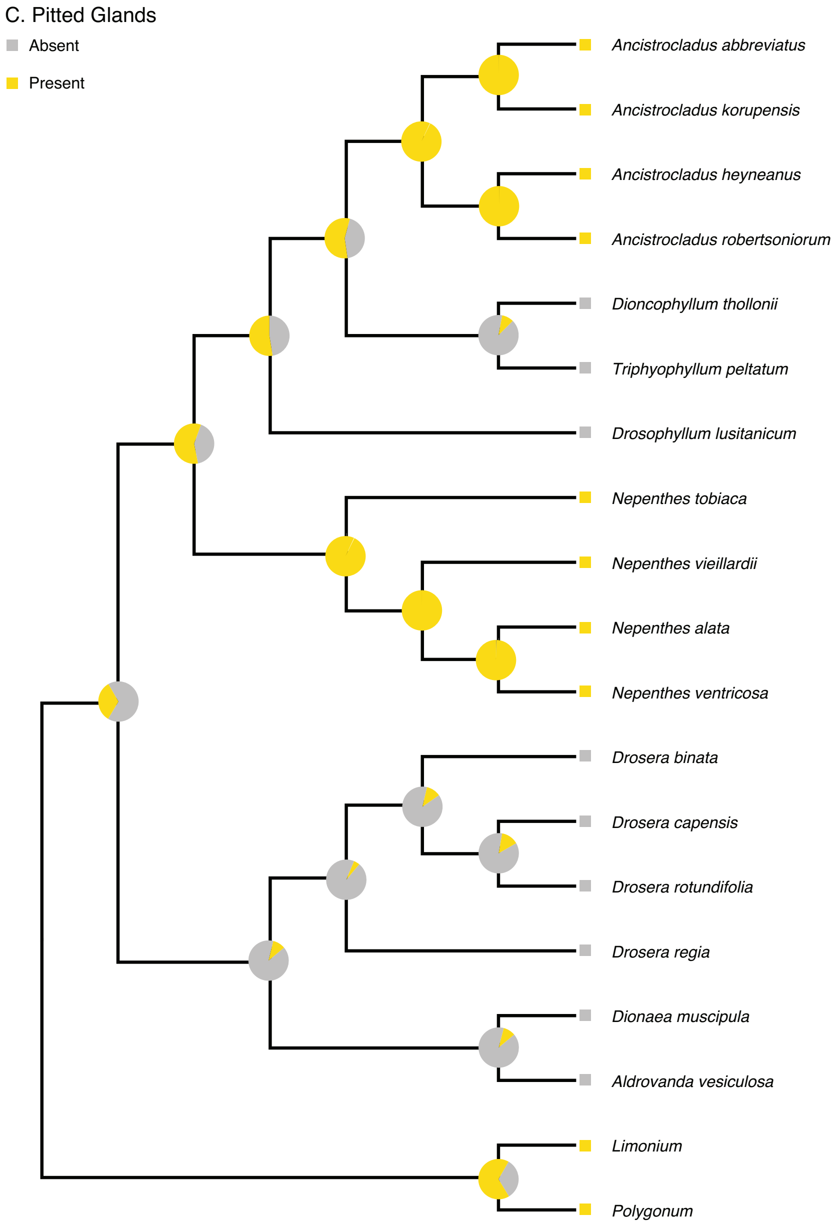


Fig. 1.3 continued.

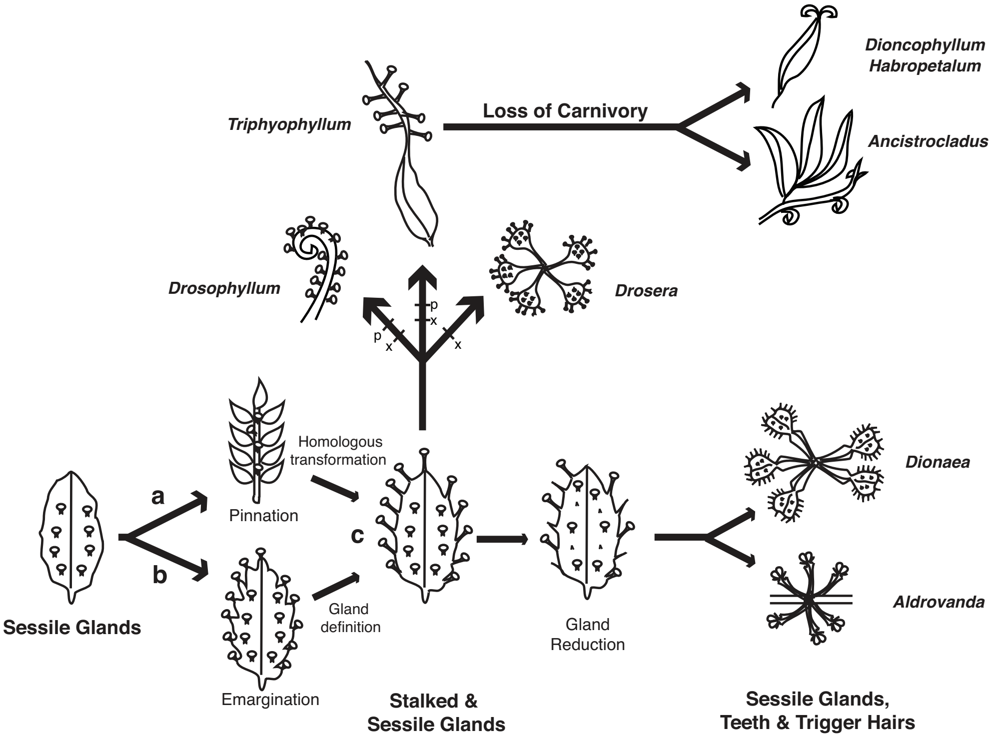


Fig. 1.4 Pinnation and emargination pathways for the evolution of the carnivorous gland in the Caryophyllales. Shown are two alternative pathways for the evolution of the carnivorous gland: following pinnation, marginal glands were formed by homologous transformation of pinna into vascularized stalked glands (*a*); as an alternative, emargination of the leaf blade occurred, and marginal glands evolved at the leaf margins (*b*). After the formation and evolution of stalked glands, the Caryophyllales diversified and radiated into the carnivorous taxa known today through retainment or reduction of glands (*c*). Extant taxa have sessile, stalked, or pitted glands. Teeth and trigger hairs, two unique morphological features of *Dionaea* and *Aldrovanda*, respectively, may be homologous to stalked glands. The three separate vascularization events in ancestors of *Drosera*, *Drosophyllum*, and *Triphyophyllum* are indicated, and the presence of xylem and/or phloem is represented by *x* (xylem) and *p* (phloem).

Chapter Two

Molecular and functional evolution of class I chitinases for plant carnivory in the Caryophyllales

Intended for future submission as a research article:
Renner T, Specht CD. Molecular and functional evolution of class I chitinases for plant carnivory in the Caryophyllales.

Abstract

Proteins produced by the large and diverse chitinase gene family are involved in the hydrolyzation of glycosidic bonds in chitin, a polymer of *N*-acetylglucosamines. In flowering plants, class I chitinases are important pathogenesis-related (PR) proteins, functioning in the determent of herbivory and pathogen attack by acting on insect exoskeletons and fungal cell walls. Within carnivorous plants, two subclasses of class I chitinases have been identified to play a role in the digestion of prey. Members of these two subclasses, depending on the presence or absence of a C-terminal extension, can be secreted from specialized digestive glands found within the morphologically diverse traps that develop from carnivorous plant leaves. The degree of homology among carnivorous plant class I chitinases and the method by which these enzymes have been adapted for the carnivorous habit has yet to be elucidated. This study focuses on understanding the evolution of carnivory and chitinase genes in one of the major groups of plants that has evolved the carnivorous habit: the Caryophyllales. We recover novel class I chitinase homologs from species of genera *Ancistrocladus*, *Dionaea*, *Drosera*, *Nepenthes*, and *Triphyophyllum*, while also confirming the presence of two subclasses of class I chitinases based upon sequence homology and phylogenetic affinity to class I chitinases available from sequenced angiosperm genomes. We further detect residues under positive selection and reveal substitutions specific to carnivorous plant class I chitinases. These substitutions may confer functional differences as indicated by protein structure homology-modeling.

2.1 Introduction

Plants have evolved a wide array of methods to protect themselves against pathogens, including the production of pathogenesis-related (PR) proteins. Chitinases, which comprise four of the PR families (PR-3, PR-4, PR-8, and PR-11) are either induced in direct response to insect herbivory and fungal elicitors or are constitutively expressed in tissues vulnerable to attack (Brogue et al. 1988; Samac et al. 1990). The chitinase catalytic mechanism involves the hydrolysis of β-1,4-glycosidic linkages between *N*-acetylglucosamine (NAG) oligomers in chitin polymers, the major constituents of fungal walls and arthropod exoskeletons. Chitinases are further divided into families 18 and 19 of glycoside hydrolases (GH) based on amino acid sequence similarity (Li and Greene 2010). Members of the two chitinase families have been identified in all plants analyzed to date, many of which have been shown to inhibit fungal growth *in vitro* (Schlumbaum et al. 1986; Leah 1991) and enhance resistance to fungal pathogens in transgenic plants (Brogue et al. 1988; Jach 1995; Eilenberg et al. 2006).

Although functionally related, members of these two chitinase families do not share sequence similarity or three-dimensional structure and the two families are hypothesized to have arisen independently (Hamel et al. 1997). GH families 18 and 19 are encoded by large gene families and have been organized into five classes according to sequence, structure, and phylogenetic relationship (Shinshi et al. 1990; Collinge et al. 1993; Beintema 1994; Melchers et al. 1994; Araki and Torikata 1995; Neuhaus 1996; Hamel et al. 1997; Passarinho and de Vries 2002): classes I, II, and IV comprise family 19, and classes III and V together form GH family 18.

GH family 19 chitinases, which are able to bind to and catalyze the hydrolysis of chitin polymers, are responsible for the majority of chitinolytic activity within plant material (Legrand et al. 1987). These include the class I chitinases, characterized by four consecutive domains: (1) a hydrophobic but variable N-terminal signal peptide, (2) a cysteine-rich domain, (3) a highly variable proline-rich hinge, and (4) a catalytic domain (Iseli et al. 1993; Melchers et al. 1993; Graham and Sticklen 1994). Processing of class I chitinase preproteins occurs at the endoplasmic reticulum, where the N-terminal signal peptide is removed from the mature form. The cysteine-rich domain is involved in chitin-binding and certain positions within the chitin recognition or binding domain signature PS00026 (C-x(4,5)-C-C-S-x(2)-G-x-c-g-x(4)-[FYW]-C) are highly conserved. Separating the cysteine-rich domain from the catalytic domain is the highly variable proline-rich hinge, a region that not only varies in sequence but length, and may be absent altogether. Within the catalytic domain, positions are conserved between class I chitinases within the chitinase 19_1 signature PS00773 (C-x(4,5)-F-Y-[ST]-x(3)-[FY]-[LIVMF]-x-A-x(3)-[YF]-x(2)-F-[GSA]) and chitinase 19_2 signature PS00774 ([LIVM]-[GSA]-F-x-[STAG](2)-[LIVMFY]-W-[FY]-W-[LIVM]). In addition to these domains, a C-terminal extension (CTE) may also be present, a sequence that has been shown to be necessary and sufficient for transmission of the protein to the vacuole (Neuhaus et al. 1991; Chrispeels and Raikhel 1992). When the CTE is absent or is altered via mutagenesis, class I chitinases are translocated extracellularly (Esaka et al. 1990; Dore et al. 1991; Melchers et al. 1993; Neuhaus et al. 1994). The presence or absence of a CTE thus divides class I chitinases into two subclasses: subclass Ia (CTE present) and subclass Ib (CTE absent).

Class I chitinases play a major role in pathogenic response in plants (Wu et al. 1994; Gijzen et al. 2001; Zhao et al. 2011) and evidence for the rapid adaptive evolution of these genes exists for both eudicot and monocot class I chitinases (Bishop et al. 2000; Tiffen 2004). In *Arabis*, adaptive amino acid replacements occur disproportionately in the active site cleft (Bishop et al. 2000), while positively selected amino acids have been identified within a homologous active site cleft in *Zea* class I chitinases (Tiffen 2004). The presence of positively selected sites has been attributed to an evolutionary arms race between class I chitinases and competitive inhibitors produced by fungal pathogens. Differences in the number of positively selected sites for certain flowering plant lineages may reflect lineage-specific adaptive responses.

In addition to serving as a pathogenic response in plants, class I chitinases have been show to be important players in plant carnivory. Chitinase enzyme activity in the presence of chitin was demonstrated in the Caryophyllales within the specialized carnivorous traps of sundews (*Drosera*) and tropical pitcher plants (*Nepenthes*). To validate that chitinolytic activity was endogenous, plant cDNA, genomic, and protein sequences were obtained and expression was localized to the digestive glands (Matusíková et al. 2005; Eilenberg et al. 2006). In *Nepenthes khasiana*, subclass Ia and Ib chitinases were shown to be differentially expressed in the secretory region of the trap. Subclass Ia is constitutively expressed in the secretory cells, whereas subclass Ib expression was upregulated in response to chitin (Eilenberg et al. 2006). Sequence dissimilarity between these subclasses is attributed to the presence of a variable proline-rich hinge and loss of a vacuole targeting signal at the carboxyl terminal in subclass Ib, the later hypothesized to allow excretion from the secretory cells for prey digestion (Eilenberg et al. 2006). In *Drosera rotundifolia*, class I chitinases were localized to the sessile and stalked glandular tentacles utilized in prey trapping and digestion and, similar to subclass Ib chitinases in *Nepenthes*, were shown to be upregulated in response to chitin substrate. Class I chitinases thus seem to play a double role in carnivorous plants, both for pathogenic response and prey digestion.

While the evolution of class I chitinases has been studied in non-carnivorous plants in relation to pathogenic-response (Bishop et al. 2000; Tiffen 2004), this study is the first to analyze the relationship between the evolution of the chitinase gene family and plant carnivory. We identify homologs of subclass Ia and Ib chitinases in the Caryophyllales from *Drosera*, *Dionaea*, a closely related part-time carnivorous plant (*Triphyophyllum*) and related plants that have lost the carnivorous habit (*Ancistrocladus*) (Renner and Specht 2011). In addition, we test whether subclasses of class I chitinases in the carnivorous Caryophyllales have a similar proportion of residue replacements in the active site cleft as class I chitinases primary utilized as PR proteins by non-carnivorous monocots and eudicots. If a certain subclass of chitinase is primarily used for prey digestion rather than for pathogenic response, selection may act differently on these proteins. Our research is driven by two hypotheses: (1) during the evolution of carnivory within the Caryophyalles, chitinase genes that were primarily utilized for pathogenesis response by ancestral non-carnivorous plants diverged, allowing for subfunctionalization of subclass Ia (for pathogenesis) and Ib chitinases (for carnivory), and (2) selection pressure acting on subclass Ib chitinases shifted as functional pathogenesis response gave way to a role specific to carnivory.

2.2 Materials and Methods

Tissue collection and DNA extraction

Class I chitinases were amplified from species within the families Ancistrocladaceae, Dioncophyllaceae, Droseraceae, and Nepenthaceae (appendix). Collected tissue samples originated mainly from living collections at California Carnivores in Sebastopol, California, Missouri Botanical Garden, University of California Botanical Garden, and Universität Würzburg. Freshly collected leaf tissue was preserved in silica gel and frozen at -80°C. Total genomic DNA was extracted from the leaf base (*Dionaea*), leaf lamina (*Ancistrocladus* and *Drosera*) and the lamina-like region of the leaf-base (*Nepenthes* and *Triphyophyllum*) using cetyltrimethyl ammonium bromide (CTAB) (Doyle and Doyle 1987) or a modified sodium dodecyl sulfate (SDS) and sodium chloride protocol (Edwards et al. 1991). Extracted genomic DNA was quantified with a NanoDrop 1000 (Thermo Fisher Scientific Inc., Wilmington, DE, USA). Genomic DNA was chosen over cDNA for the ability to use intergenic regions to distinguish multiple gene copies from allelic variability, the capability to isolate pseudogenes, and the potential that certain subclasses were not be expressed in all tissue obtained for cDNA synthesis. Taxa utilized in our analyses are summarized in A.4.

PCR and cloning of class I chitinase genes

Four sets of primer pairs were designed from full-length *Nepenthes khasiana* gDNA sequences (AY618881, AY618883, AY618885, AY618887), and partial subclass Ib mRNA sequences from Droseraceae (AY643484, AY622818, AY643483) available in GenBank. Subclass Ia chitinase genes were amplified using primer pairs PFF 509 (5'-CCA-AAC-TTC-CCA-TGA-AAC-TAC-3')/PFF 511 (5'- CCC-CAC-CGT-TGA-TGA-TGT-T-3') and PFF 757 (5'-GCC-AGA-GCC-AGT-GCA-GC-3')/PFF 758 (5'- CCC-ACC-GTT-GAT-GAT-GTT-3'). Subclass Ib chitinase genes were amplified with primer pairs PFF 755 (5'- TGC-CAG-AGC-CAG-TGT-GG-3')/PFF 756 (5'- CTG-GMT-GTA-GCA-GTC-CAA-GTT-3'). PCRs were performed in 10 µl aliquots with 10-100 ng of genomic DNA, 0.02 U iProof™ Polymerase (Bio-Rad, Hercules, CA, USA), 1X HF iProof buffer, 2.0 mM $MgCl_2$, 0.2 mM each of dNTP, 0.5 µM of each primer and 100% DMSO. When the iProof ™ Polymerase system failed to amplify PCR products using the designed primer pairs, the Phire® Plant Direct PCR Kit (Finnzymes Inc., Woburn, MA, USA) was used. All PCR reactions were run on a MyCycler (Bio-Rad) thermal cycler under a three-step PCR protocol as suggested by the manufacturer.

Amplified products were either directly cloned or gel-purified with a QIAquick gel extraction kit (QIAGEN, Germantown, MD, USA) and subsequently cloned into the pJet1.2 vector (Fermentas International Inc., Burlington, Ontario, Canada). At least 8 colonies per ligation reaction were chosen to screen with colony PCR. Sequences from the resulting colonies were amplified with vector-specific primers and the Phire® Polymerase (Finnzymes Inc., Woburn, MA, USA). PCR products were purified using exonuclease I and shrimp alkaline phosphatase to remove single-stranded primers and remaining dNTPs (Fermentas International Inc., Burlington, Ontario, Canada) and cycle sequenced using described PCR primers (2 µM) and the ABI Prism BigDye Terminator Cycle Sequence Ready Reaction Kit v3.1 (Perkin-Elmer/Applied Biosystems, Foster City, CA, USA). Products of cycle sequencing were resolved on an ABI Prism 3100 or 3730 automated sequencer (Applied Biosystems, Foster City, CA, USA). Caryophyllales subclass Ia and Ib chitinase gDNA sequences (table 2.1) are available via GenBank (Benson et al. 2005), with the exception of sequences >200bp, which are available in A.5.

The percentage of identical sites between translated *N. khasiana* complete subclass Ia and Ib chitinases (AY618881, AY618883, AY618885, AY618887) and partial class I chitinases amplified from Nepenthaceae, Droseraceae, Ancistrocladaceae, and Dioncophyllaceae, was calculated in Geneious Pro 5.3.6 (Drummond et al. 2010; available at http://www.geneious.com/). Perfect and imperfect tandem repeats were located in Caryophyllales subclass Ia and Ib chitinase sequences using Phobos 3.3.12 (Mayer 2006-2010).

Identification of class I chitinase homologs

Two bioinformatic approaches were used in combination to identify homologs of carnivorous plant class I chitinases from online databases. First, *Nepenthes khasiana* subclass Ia and Ib chitinases (Genbank AY618881, AY618883, AY618885, AY618887) were used as query sequences for CoGeBlast (Lyons and M. 2008; Lyons et al. 2008) tblastx searches against the following genomes: *Arabidopsis thaliana* (TAIR: v9, masked repeats 50x), *Brachypodium distachyon* line Bd21 (JGI: v1, masked repeats 50x), *Glycine max* (JGI: v1, masked repeats 50x), *Lotus japonicus* (v1, unmasked), *Medicago truncatula* (Medicago.org: v3.5.1, unmasked), *Oryza sativa* ssp. *japonica* (MSU Rice

Genome Annotation: v6.1 masked repeats 50x), *Physcomitrella patens* (JGI: v1.1, unmasked), *Populus trichocarpa* (JGI: v2 masked by JGI v1.4), *Selaginella moellendorffii* (JGI: v1, unmasked), *Sorghum bicolor* (JGI: v1.4, masked repeats 50x), *Vitis vinifera* (French National Sequence Center: v2 masked by genoscope), *Zea mays* ssp. *mays* (MaizeSequence.org: refgen_v2 assembly, filtered gene set annotations: 5b, v2 super masked repeats 50x). Only hits with an E-value cut-off of less than 0.001 and the most complete gene model for each chromosomal location were retained. An alignment of class I chitinases identified by CoGeBlast was constructed with ClustalX under default settings (Thompson et al. 1994), adjusted manually, and subsequently translated in Mesquite v2.72 (Maddison and Maddison 2010).

HMMER v3.0 (http://hmmer.janelia.org/) was then used to create the HMM profile 'krEiAAFLaQTSHETTgGWatAPdGpYaWGYCf' to surround the H-E-T-T motif, a signature highly conserved among class I chitinases (Passarinho and de Vries 2002) to search against annotated *A. thaliana*, *O. sativa* ssp. *japonica*, *S. bicolor*, and *V. vinifera* genomes. Corresponding gene hits obtained with HMMER from the specified plant genomes were downloaded from Phytozome v7.0 (http://www.phytozome.net/). Any class I chitinases found in addition to those retrieved from CoGe searches were included in our analyses.

As class IV chitinases can be remarkably similar in their sequence and domain structure to class I chitinases, a set of criteria were developed to ensure only class I chitinases were saved from CoGeBlast and HMMER searches. Sequences from genome searches were retained only if the following signatures were present: (1) chitinase-binding domain (Prosite PS00026), (2) Chitinase 19_1 signature (Prosite PS00773), (3) Chitinase 19_2 signature (Prosite PS00774), and (4) H-E-T-T motif.

Five class IV chitinases from eudicots and monocots (AtChitIV, AT2G43590; NaChitIV, GenBank AB289807; OsChitIV, LOC_Os02g39330; SbChitIV, Sb06g021220; VvChitIV, GSVIVG01038117001) serve as the outgroup for analyses of the HMM-derived dataset. Class IV chitinases have a similar domain architecture to class I, but are significantly shorter due to deletions within the chitin-binding and catalytic domains (see supplementary S1 and S2, Supplementary Material online). In addition, for each class IV sequence, the proline-rich hinge is absent and amino acid substitutions occur in the H-E-T-T motif of the first active site of the catalytic domain resulting in H-E-T-G/I. All identified class IV chitinases are missing a CTE and are therefore presumed to be extracellular.

Class I chitinase nomenclature

To easily refer to the proteins discovered via the methods described, we have designated the following naming system: for those class I chitinases from *Ancistrocladus grandiflorus*, AgChitI-x; *Ancistrocladus robertsoniorum*, ArChitI-x; *Arabidopsis thaliana*, AtChitI-x; *Brachypodium distachyon*, BdChitI-x; *Dionaea muscipula*, DmChitI-x; *Drosera binata*, DbChitI-x; *Drosera capensis*, DcChitI-x; *Drosera rotundifolia*, DrChitI-x; *Drosera spathulata*, DsChitI-x; *Glycine max*, GmChitI-x; *Lotus japonicus*, LjChitI-x; *Medicago truncatula*, MtChitI-x; *Nepenthes khasiana*, NkChitI-x; *Nepenthes maxima*, NmaxChitI-x; *Nepenthes mirabilis*, NmirChitI-x; *Oryza sativa* ssp. *japonica*, OsChitI-x; *Populus trichocarpa*, PtChitI-x; *Sorghum bicolor*, SbChitI-x; *Triphyophyllum peltatum*, TpChitI-x; *Vitis vinifera*, VvChitI-x; *Zea mays* ssp. *mays*, ZmChitI-x. The letter *x* denotes the number associated with the genomic DNA (gDNA) sequence (table 2.2).

Phylogenetic analysis

Forward and reverse sequences for newly amplified class I chitinase genes from the Caryophyllales were assembled and edited with Sequencher v4.7 (Gene Codes Corp.). A multiple sequence alignment for 49 chitinase sequences was constructed with ClustalX under default settings (Thompson et al. 1994) with manual adjustment in Mesquite v2.72 (Maddison and Maddison 2010). Regions that were poorly aligned across the entire dataset were removed from the CDS translation for phylogenetic analyses. These include intergenic regions, the proline-rich hinge between chitin-binding and catalytic domains, and N- and C- termini. For subsequent analyses, we used two datasets to assess class I chitinase evolution: (1) a protein alignment including all class I chitinase homologs identified in angiosperm genomes studied here and those retrieved from the Caryophyllales either via PCR or through GenBank ("angiosperm-wide"), and (2) a reduced dataset only including HMM-derived *A. thaliana*, *V. vinifera*, *O. sativa* ssp. *japonica*, and *S. bicolor* class I chitinase homologs and those obtained from the Caryophyllales ("HMM-derived"). Class I chitinase sites and corresponding residues described here are numbered according to positions within these multiple sequence alignments (A.5). The seven active sites (I-VII) of the catalytic domain are also indicated in A.5, which correspond to regions described by Garcia-Casado et al. (1998), Bishop et al. (2000), Passarinho and de Vries (2002), and Tiffen (2004).

Bayesian inference (BI) was used to build phylogeny for the angiosperm-wide dataset in MrBayes v3.1.2 (Ronquist and Huelsenbeck 2003) under the WAG+I+G model of evolution as determined by the Bayesian information criterion (BIC) in ProtTest v2.4.mac (Abascal et al. 2005). Two Bayesian analyses were performed simultaneously with posterior probabilities (pp) of the generated trees approximated using the Metropolis-coupled Markov chain Monte Carlo (MCMCMC) algorithm with four incrementally heated chains for 2,132,000 generations while sampling trees every 100 generations until both analyses converged on similar log likelihood scores (average standard deviation of split frequencies <0.01). Data was further analyzed to ensure convergence with Tracer v1.5 (Rambaut and Drummond 2003-2009). SumTrees v3.0.0 (Sukumaran and Holder 2010) was used to combine the trees from both runs using a burn-in of 2,132 trees per run and to assemble a 50% majority rule tree from the remaining trees.

Under the Blosum62+I+G+F model of evolution as determined by BIC in ProtTest, two Bayesian analyses were performed for the HMM-derived dataset simultaneously with posterior probabilities of the generated trees approximated using the MCMCMC algorithm with four incrementally heated chains for 1,782,000 generations, sampling trees every 100 generations. Similar to the phylogenetic analyses of angiosperm-wide dataset, analyses were run until log likelihood scores converged as determined by visual inspection of runs with Tracer. SumTrees was used to combine trees from both runs following removal of a burn-in of 1,782 trees per run and to assemble a 50% majority rule tree post burn-in. Angiosperm-wide and HMM-derived phylogenetic trees were edited in FigTree v1.3.1 and Adobe® Illustrator®.

Detecting selection

As an initial assessment of evolutionary forces acting on angiosperm class I chitinases, we used TestBranchdNdS method in HyPhy 2.0.mac (Pond et al. 2005) to test whether branches leading to the two major class I chitinase lineages evolved under different selection pressures than the remaining branches of the phylogeny (fig. 2.2). The analysis was performed using the with the MG94xGTR nucleotide substitution model, site-to-site rate variation model with dN (the number of non-synonymous substitutions per non-synonymous site) and dS (the number of synonymous substitutions per synonymous site) allowed to vary simultaneously, and the default amino acid class model. For lineage-specific tests, two evolutionary models were fit to the tree: (1) the rates of protein evolution are the same across the entire tree, and (2) the rates of protein evolution are different in the branch separating Class I-Clade 1 or Class I-Clade 2 from the rest of the class I and IV chitinases in the phylogeny (fig. 2.2). Because models 1 and 2 are nested, we used a likelihood ratio test (LRT) to determine statistical significance of improvement in likelihood with the addition of parameters in model 1.

To further test certain lineages for differential selection, we used the fixed effects likelihood (FEL) model in HyPhy 2.0.mac to estimate non-neutral evolution for specific branches of the BI 50% majority rule consensus tree for the HMM-derived dataset (fig. 2.2). For each lineage, a two-rate analysis was used to allow adjustment of dN and dS across sites, a GTR model crossed with MG94 was specified for the nucleotide model of evolution, and dN/dS was estimated from the data with branch corrections. As suggested by the HyPhy program default, *p*-values < 0.10 were considered to be significant.

Template identification, modeling homology, and functional analysis

Protein structure homology-modeling of full-length *N. khasiana* subclass Ia (NkChitI-1) and Ib (NkChitI-3) chitinases was performed using gapped blast and HHSearch database searches with the SWISS-MODEL server (Peitsch 1995; Arnold et al. 2006; Kiefer et al. 2009) against HMMPfam, HMMTigr, ProfileScan, SuperFamily libraries. A crystal structure of a family 19 chitinase from *Carica papaya* (PDB ID: 3cqlB) was identified as the closest homolog to NkChitI-1 and NkChitI-3 in complex with NAG (Bernstein et al. 1977). Comparative modeling of *N. khasiana* class I chitinase was accomplished by constructing a model of NkChitI-1 and NkChitI-2 from *C. papaya* 3cqlB utilizing the SWISS-MODEL alignment mode tool. The program MacPyMOL v1.3 (Schrödinger LLC) was then used to thread the three-dimensional models of NkChitI-1 and NkChitI-2 to 3cqlB associated with two NAG oligomers in the active site cleft and introduced water molecules (Huet et al. 2008). To detect substrate interacting regions, polar contacts ≤ 5 Å were visualized in MacPyMOL between *N. khasiana* subclass Ia/Ib chitinases and 3cqlB-complexed NAG and water molecules positioned in the active site cleft via threading. Sites identified as under positive selection by the two-rate FEL model that coincide with residues directly interacting with NAG or in water-mediated interactions were mapped to PDB coordinates in MacPyMOL.

2.3 Results

Class I chitinase homologs expanded in land plant genomes

Within the land plant genomes studied here, we were unable to identify genes that contained all required class I chitinase signatures from *P. patens* (a moss) and *S. moellendorffii* (a lycophyte) genomes. Instead, chitinases recovered from these taxa lacked a chitin-binding site characteristic of class I.

Subclass Ia and Ib chitinases distinguished by the presence or absence of a CTE and are represented generally within eudicot genomes, however when considering any individual genome, the presence of both subclasses is not guaranteed (fig. 2.1A-B, table 2.2). Similar to a previous analysis of the *A. thaliana* chitinase gene family (Passarinho and de Vries 2002), we found a single subclass Ia chitinase with a 7-residue-long CTE (AtChitI-1). On the contrary, one subclass Ib chitinase was recovered from the *V. vinifera* genome (VvChitI-1), which is missing a CTE indicative of extracellular activity, a portion of chitin-binding domain, and the majority of the proline-rich hinge.

Subclass Ib chitinases of *G. max* (GmChitI-1 and GmChitI-2) and *M. trunculata* (MtChitl-1) are missing a CTE like that of VvChitI-1, but have a complete proline-rich hinge. *L. japonicus* LjChitI-1 is missing a portion of the proline-rich hinge similar to GmChitI-1, GmChitI-2, and MtChitI-1, yet unlike these Fabaceae class I chitinases, it is subtended by a 9-residue-long CTE; an indicator that LjChitI-1 is a subclass Ia chitinase. Residues identified as important players in catalytic activity and substrate binding (Garcia-Casado et al. 1998) are conserved in GmChitI-1, GmChitI-2, MtChitI-1, and LjChitI-1 with the exception of Thr273 located in active site IV of the catalytic domain.

In *P. trichocarpa*, PtChitI-1, PtChitI-2, PtChitI-3, PtChitI-4, PtChitI-5 are all subclass Ia chitinases based on the presence of a CTE. The CTE is relatively conserved between PtChitI-1, PtChitI-2, PtChitI-3, PtChitI-4, beginning with Gly-Leu-Leu, however the C-terminal extension of PtChitI-5 is deviant, beginning with Thr-Leu-Gly and containing an extra residue (10 residues in PtChitI-5 versus 9 residues in PtChitI-1, PtChitI-2, PtChitI-3, and PtChitI-4). All are missing portions of the proline-rich hinge, and 6+ glycine repeats can be found in this domain for PtChitI-1, PtChitI-3, and PtChitI-5. Similar glycine repeats are present in PtChitI-2 and PtChitI-4 in the proline-rich hinge domain, but to less of a degree. A number of amino acid substitutions are present in the active sites of the catalytic domain, namely, in active site III where tyrosine (Tyr256) has been substituted for a tryptophan at a site identified to participate in substrate binding (Garcia-Casado et al. 1998).

Like eudicot genomes, monocot genomes contain both subclasses Ia and Ib chitinases (fig. 2.1A-B, table 2.2). Of the 4 class I chitinases identified in the *O. sativa* ssp. *japonica* genome, only one (OsChit1-2) is considered a subclass Ia chitinase based on the presence of a 9-residue-long CTE (beginning with Gly-Ser-Ser). OsChitI-3 is unique in that threonine (Thr273) is substituted for serine at a site demonstrated to bind directly to the substrate (Brameld and Goddard 1998; Fukamizo 2000; Huet et al. 2008), while OsChitI-1, OsChitI-2, and OsChitI-4 all have the conserved serine (Ser273). Also within active site IV of OsChitI-1 and OsChitI-2, phenylalanine (Phe276) has been substituted for tyrosine at a site identified as important for catalytic activity and substrate binding (Verburg and Huynh 1991; Verburg et al. 1992; Verburg et al. 1993; Huet et al. 2008).

We found two class I chitinases in the *Z. mays* ssp. *mays* genome (ZmChitI-1 and ZmChitI-2), both of which are identified as subclass Ia and vacuolar based on the presence of CTE extensions, 9 and 16 residues respectively. Each *Z. mays* ssp. *mays* class I chitinase has a proline-rich hinge with glycine repeats. Additionally, in ZmChitI-1 at Arg315, arginine is substituted for glutamine, a residue important in substrate binding (Garcia-Casado et al. 1998). The CTE of ZmChitI-1 and ZmChitI-2 are highly divergent from each other and do not begin with Gly-Leu-Leu as in AtChitI-1. Tiffen's (2004) molecular evolutionary study of chitinase gene family members in Poaceae included subclass Ib chitinase genes amplified from *Z. mays* ssp. *parviglumis* and *Z. diploperennis*, yet we were unable to recover class I chitinases without a C-terminal extension from the *Z. mays* ssp. *mays* genome.

The majority of the proline-rich hinge of *S. bicolor* class I chitinases is missing, with only two proline repeats in this domain for SbChitI-1. SbChitI-1 has a CTE (subclass Ia) while SbChit1-2 does not (subclass Ib). As in ZmChitI-1, an arginine is substituted for glutamine at Arg315 in SbChitI-1.

The *B. distachyon* genome contains subclass Ia and Ib chitinases, all of which have the proline-rich hinge domain: BdChitI-1, BdChitI-2, and BdChitI-3 are all missing a CTE (likely subclass Ib), whereas BdChitI-4 has an exceptionally long +41 residue CTE (subclass Ia). BdChitI-4 is also missing a region 5-prime to active site VII in the catalytic domain and has a single amino acid change from serine to threonine (Thr273) in active site IV a site observed to form a direct hydrogen bond with NAG (Brameld and Goddard 1998; Huet et al. 2008).

Class I chitinase subclasses are identified in carnivorous plants and related genera of the Caryophyllales

Comparative analyses of class I chitinases amplified from *Nepenthes*, *Drosera*, and *Dionaea, Ancistrocladus,* and *Triphyophyllum* show differences in the length and sequence of of non-coding regions (see GenBank for gDNA sequences, table 2.1), while coding regions are fairly conserved at the amino acid level within respective subclasses as determined via pairwise distance. Subclasses are reciprocally monophyletic, indicating origins prior to the evolution of the carnivorous Caryophyllales (fig. 2.1A).

Four *Nepenthes* sequences were recovered from GenBank (NkChitI-1, NkChitI-2, NkChitI-3, NkChitI-3) representing both subclass Ia and Ib chitinases (table 1). Subclass Ia chitinases (NkChitI-1 and NkChitI-2) possess a CTE beginning with Gly-Leu-Leu, comparable to the vacuolar eudicot class I chitinases, and are characterized as constitutively expressed housekeeping chitinases (Eilenberg et al. 2006). Similar to OsChitI-1 and OsChitI-2, both possess a phenylalanine at site 276 in active site IV of the catalytic domain. NkChitI-1 and NkChitI-2 are also missing the majority of the proline-rich hinge domain. Subclass Ib chitinases (NkChitI-3 and NkChitI-4) are both missing a CTE and are secreted into the pitcher fluid when induced in response to chitin (Eilenberg et al. 2006). NkChitI-3 and NkChitI-4 also have the proline-rich hinge, similar to the monocot class I chitinases. Unlike NkChitI-1 and NkChitI-2, NkChitI-3 and NkChitI-4 do not have the phenylalanine substitution in active site IV.

We sequenced subclass Ia and Ib chitinases from *N. mirabilis* and *N. maxima* (fig. 2.1A-B, table 2.1), categorizing them based on percent pairwise identity of translated CDS sequences to previously-sequenced *N. khasiana* class I chitinases. NmaxChitI-1, NmaxChitI-2 and NmirChitI-1 share high percent similarity with NkChitI-1 and NkChitI-2 (>99%), suggesting that these sequences are subclass Ia chitinases. NmirChitI-3 shows high percent similarity (>99%) with NkChitI-3 and NkChitI-4 and could be a subclass Ib chitinase. Two additional sequences were recovered from *N. mirabilis* and *N. maxima* with domains similar to *N. khasiana* subclass Ib chitinases. Although these sequences have the proline-rich hinge characteristic to NkChitI-3 and NkChitI-4, they also contain stop codons and/or a base pair change that results in disruption of the conserved H-E-T-T motif. We consider these possible pseudogenes, as premature stop codons would hinder translation into a full-length class I chitinases. Our phylogenetic analyses exclude *N. mirabilis* and *N. maxima* class I chitinase pseudogenes, but sequences were submitted to GenBank (JN867627 and JN867630).

Subclass Ia and Ib chitinases were retrieved for taxa within the genus *Drosera* either via GenBank queries or by PCR (fig. 2.1A-B, table 2.1). A single class I chitinase has been previously sequenced from *D. rotundifolia* (DrChitI-1). The CDS translation of DrChitI-1 has high percent identity to NkChitI-1 and NkChitI-2 (93.1%), which suggests that this may be a subclass Ia chitinase. We amplified two additional *D. rotundifolia* chitinase gene sequences (DrChitI-2 and DrChitI-3), one of which includes part of the proline-rich hinge domain, and both of which contain the 5-prime region of the catalytic domain with valine, as in the monocot class I chitinases described here. DrChitI-2 and DrChitI-3 share high percent identity with NkChitI-3 and NkChitI-4, and may be subclass Ib sequences. DsChitI-1 is a previously sequenced *D. spathulata* class I chitinase, which has high percent identity (91.2%) with NkChitI-3 and NkChitI-4 and therefore could be subclass Ib sequence. A notable deviation for DsChitI-1 is a substitution of tryptophan for a tyrosine (Tyr256) in active site III, a site identified as important in substrate binding (Garcia-Casado et al. 1998). We amplified a region corresponding to a region of the catalytic domain from two *D. binata* chitinases. Both share high percent identity with NkChitI-3 and NkChitI-4 and therefore may be subclass Ib sequences. A partial chitinase gene sequence corresponding to a region of the proline-rich hinge and the catalytic domain was amplified from *D. capensis* (DcChitI-1). As the CDS translation shares high percent identity (94.0%) with NkChitI-3 and NkChitI-4, this could be subclass Ib sequence. Like DrChitI-2, the 5-prime end of the catalytic region is preceded by a string of 3 glycines. Valine is also present in the 5-prime end of the catalytic region, similar to DrChitI-2 and DrChitI-3 and monocot class I chitinases described here. We were able to extend amplification to the H-E-T-T motif for DcChitI-1, another indicator of this gene sequence's homology with class I chitinases.

Two partial *D. muscipula* chitinase sequences were also included in our analyses (fig. 2.1A-B, table 2.1). These comprise DmChitI-1, a chitinase amplified by PCR and DmChitI-2, a class I chitinase mRNA sequence previously deposited into GenBank (AY643484). The CDS translation of DmChitI-1 begins just after the start of the catalytic domain, extends through the H-E-T-T motif, and terminates after active site VII. Similar to NkChitI-1 and NkChitI-2, tyrosine is substituted with phenylalanine in active site IV. DmChitI-1 shares moderately high percent identity (89.6%) with NkChitI-1 and NkChitI-2, and is possibly a subclass Ia chitinase. The translated CDS of DmChitI-2 begins within active site IV and extends through active site VI. Interestingly, and quite unlike all the other class I chitinases described here, active site IV has a cysteine at site 276 (Cys276). DmChitI-2 shares 94.0% identical sites with NkChitI-3 and NkChitI-4 and thus may be a subclass Ib chitinase.

We amplified five partial chitinase genes from two species of *Ancistrocladus*: *A. grandiflorus* and *A. robertsoniorum* (fig. 2.1A-B, table 2.1). Compared to class I chitinases amplified from *Nepenthes*, *Ancistrocladus* amplicons corresponding to the five chitinases described were unusually short (<500bp). The CDS translation of AgChitI-1 contains all seven active sites of the catalytic domain, the first active site having the conserved H-E-T-T motif. A portion of the proline-rich hinge is present in the AgChitI-2 sequence, as well as the 5-prime region of the catalytic domain up to the first active site of the catalytic domain. AgChitI-3 contains the same region as AgChitI-2, but differences are found in the proline-rich hinge. We were able to partially sequence ArChit-1 to include the 5-prime region of the catalytic domain through active site I, as well as amplify a portion of ArChitI-2 from the proline-rich hinge up to the first active site of the catalytic domain. Considerable nucleotide differences within the first and second intergenic regions can be found between ArChitI-1 and ArChitI-2. AgChitI-1 and ArChitI-1 share high sequence identity with NkChitI-1 and NkChitI-2, and may be subclass Ia chitinases. The sequence identity shared between AgChitI-2 and ArChitI-2 and full-length *N. khasiana* class I chitinases is almost identical, making it difficult to classify these sequences on site similarity alone. AgChitI-3 shares high sequence identity (92.4%) with NkChitI-1 and NkChitI-2, yet phylogenetic analyses place AgChitI-3 close to NkChitI-3 and NkChitI-4 (fig. 2.1A and 2.2).

Similar to the *Ancistrocladus* class I chitinases described above, certain amplified chitinase PCR products from *Triphyophyllum* were shorter in length than expected: the CDS for TpChitI-3 is ~200bp, whereas TpChitI-1 and TpChitI-2 range from ~500-800bp. TpChitI-1 and TpChitI-3 do not span the proline-rich hinge, but begin either at the 5-prime end of the catalytic domain (TpChitI-2) or at active site I (TpChitI-1). TpChitI-1 and TpChit-2 extend to the sixth active site, and TpChitI-2 continues to include active site VII.

Evolution of class I chitinases in 15 angiosperm genera

Phylogenetic analysis of class I chitinases indicates there are three major lineages of class I chitinases in the angiosperms (fig. 2.1A). The first lineage (A) includes vacuolar-located (subclass Ia) and extracellular (subclass Ib) class I chitinases of the eudicots. Within this lineage, there are three distinct clades. One well-supported (0.99 pp) clade (A1) is composed of Caryophyllales-exclusive (*Ancistrocladus*, *Nepenthes*, and *Triphyophyllum*) class I chitinases, two of which are known to have a CTE (*N. khasiana*, NkChitI-1 and NkChitI-2). The second clade (A2) includes *A. thaliana*, *L. japonicus*, and *P. trichocarpa* class I chitinases, all of which have a CTE. A single carnivorous plant class I chitinase (*D. rotundifolia*, ChitI-2) is positioned sister to this clade. Five additional eudicot class I chitinases comprise the third clade (A3), which includes a partial class I chitinase from *D. muscipula* and full-length *G. max*, *M. truncatula*, and *V. vinifera* sequences without a CTE.

A second major lineage sister to lineage A is yet another Caryophyllales-exclusive clade that is relatively well-supported (0.86 pp) (B). Two clades are present in this lineage. The first clade (B1) is exclusive to *Nepenthes* class I chitinases, two of which (*N. khasiana*, NkChitI-3 and NkChitI-4) are full-length sequences which are missing a CTE. The second clade (B2) is a polytomy of partially sequenced *Ancistrocladus*, *Dionaea*, *Drosera*, and *Triphyophyllum* class I chitinases.

The monocot class I chitinases form another lineage (C) with good support (0.76 pp). A few phylogenetic relationships can be inferred; *B. distachyon* class I chitinases with and without a CTE (BdChitI-4 and BdChitI-1 through 3, respectively) form a monophyletic group (C1, 0.98 pp), while *O. sativa* ssp. *japonica*, *S. bicolor*, and *Z. mays* class I chitinases are polyphyletic. Clade C2 (0.98 pp) contains members with (ZmChitI-2) and without (OsChitI-1, OsChitI-4, OsChitI-3, and SbChitI-2) a CTE, whereas clade C3 (1.00 pp) includes *O. sativa* ssp. *japonica*, *S. bicolor*, *Z. mays* ssp. *mays* class I chitinases all with a CTE (OsChitI-2, SbChitI-1, and ZmChitI-1).

In the phylogenetic analysis of HMM-derived class I chitinases from *A. thaliana*, *O. sativa* ssp. *japonica*, *S. bicolor*, and *V. vinifera* genomes, two major lineages are present (fig. 2.2). The first lineage (Class I-Clade 1) includes two subfamilies of Caryophyllales class I chitinases. The first clade (I-4) contains *Nepenthes* class I chitinases, two of which are known to have a CTE (*N. khasiana*, NkChitI-1 and NkChitI-2). Sister to this clade is a single *T. peltatum* class I chitinase (TpChitI-2). The second clade (I-6) is comprised of *Ancistrocladus* and *T. peltatum* class I chitinases. One *Drosera* class I chitinase (DrChitI-1) is sister to the two described clades of *Ancistrocladus*, *Nepenthes*, and *Triphyophyllum* chitinases (I-2). A single *V. vinifera* class I chitinase (VvChitI-1) without a CTE is placed at the base of Class I-Clade 1 (1-1).

The second major lineage of class I chitinases (fig. 2.2, Class I-Clade 2), includes eudicot and monocot class I chitinases. Three clades are present in Class I-Clade 2, the first (I-8, 0.93 pp) contains *O. sativa* ssp. *japonica* and *S. bicolor* class I chitinases without a CTE (OsChitI-1, OsChitI-3, OsChitI-4, and SbChitI-2). The second clade (1-10, 1.00 pp) contains only *Nepenthes* class I chitinases, two of which are full-length sequences (*N. khasiana*, NkChitI-3 and NkChitI-4) that are missing a CTE. Clade I-11 is a polytomy containing *Ancistrocladus*, *Dionaea*, *Drosera*, and *Triphyophyllum* class I chitinases (0.84 pp).

Certain class I chitinase lineages and sites carry different signatures of selection

The TestBranchdNdS test in HyPhy indicated that dN/dS is significantly different in Class I-Clade 1 ($p = 0$) as compared to the rest of the phylogeny (fig. 2.2). Conversely, dN/dS in Class I-Clade 2 is not significantly different ($p = 0.22539$) than dN/dS for the remainder of the tree.

To further estimate non-neutral evolution for specific branches of the HMM-derived class I chitinase phylogeny, we used the FEL method in HyPhy. Sites identified by the FEL method as being under positive selection are found in both major lineages of the class I chitinases (Class I-Clade I and Class I-Clade 2, fig. 2.3, and table 2.3). In Class I-Clade 1, clades I-2, I-4, and I-5 each contain at least one site under positive selection that falls within one of the seven active sites (see A.5). In clade I-5, which contains *Nepenthes* subclass Ia chitinases, site 276 falling within active site IV is identified as under positive selection. In Class I-Clade 2, the FEL method identified site 317 positioned within active site V as under positive selection in clade I-9. Amino acid site 156, a positively selected site detected by the FEL method, is shared between the two major lineages of class I chitinases in clades I-2 (Caryophyllales subclass Ia), and I-3 (Caryophyllales subclass Ia, excluding DrChitI-1), I-4 (Caryophyllales subclass Ia, including TpChitI-2 and *Nepenthes* sequences), I-7 (Class I-Clade 2 in its entirety), and I-8 (*O. sativa* ssp. *japonica* and *S. bicolor* subclass Ib).

Substitutions in the active site of class I chitinases may affect interactions with chitin substrate

Homology-modeling revealed polar interactions between *N. khasiana* subclass Ia and Ib chitinase residues and NAG oligomers, some of which involve water molecules (fig. 2.4). In subclass Ia (NkChitI-1) and Ib (NkChitI-3) chitinases, hydrogen bonding is observed between NAG and residues His214, Asn277, Ile352, Glu357, Arg365, and Arg370. Hydrogen bonding mediated by water molecules is also observed between NAG and NkChitI-1 residues Thr217, Asn350, Ile351, Asn353, Gly354, Gly355, Val356. In NkChitI-3, water bridges residues Thr217, Tyr276, Asn350, Ile351, Asn353, Gly354, Gly355, and Leu356 to NAG. A number of NkChitI-1 and NkChitI-3 residues directly interact with NAG, while also taking part in water-mediated hydrogen bonding. Residues that participate in this type of interaction are Glu215, Gln239, Gln271, Ser273, Tyr274, and Lys318 in NkChitI-1, and Glu215, Val239, Gln271, Ser 273, Tyr274, and Lys318 in NkChitI-3.

Three sites have the potential to influence hydrogen bonding and ultimately functionality due to residue discrepancies between NkChitI-1 and NkChitI-3 (fig. 2.4). At site 239, a glutamine is present in NkChitI-1 (Gln239), whereas a valine occupies the same site in NkChitI-3 (Val239). This site is positionally homologous to Arg90 in *C. papaya* GH family 19 chitinase, a residue involved in substrate binding that is also conserved across other plant GH family 19 chitinases (Huet et al. 2008). Site 276, identified as under positive selection in *Nepenthes* subclass Ia chitinases by the FEL method (clades I-4 and I-5, fig. 2.2, fig. 2.3, and table 2.3), is homologous in its position to a tyrosine residue in NkChitI-3 involved in water-mediated hydrogen bonding to NAG (fig. 2.4). In NkChitI-1, a phenylalanine occupies site 276, a substitution that prevents hydrogen bond formation due to the hydrophobic nature of the benzyl side chain. Lastly, NAG-interacting site 356 differs between NkChitI-1 and NkChitI-3 by the presence of either a valine or leucine, respectively. This site is homologous to *C. papaya* family 19 chitinase Leu202, a residue that forms a hydrogen bond with NAG by involving a water molecule (Huet et al. 2008).

2.4 Discussion

Molecular evolution of class I chitinases in angiosperms

While phylogenetic relationships among chitinase gene families have been explored in monocot and eudicot taxa (Davis et al., 1991; Hamel et al., 1997; Tiffen, 2004; Bishop et al., 2006; Shoresh et al., 2008; Xu et al., 2007; Prakash et al. 2010; Rottloff et al., 2011), this study is the first to conduct an in-depth analysis of angiosperm class I chitinases, while focusing on the functional evolution of class I chitinase subclasses in the carnivorous plants of the Caryophyllales.

Phylogenetic reconstructions of class I chitinase homologs reveal three major lineages in the angiosperms and two well-supported clades containing either Caryophyllales subclass Ia or Ib chitinases (fig. 2.1). Sequences amplified from carnivorous genera *Dionaea*, *Drosera*, and *Nepenthes*, part-time carnivore *Triphyophyllum,* and non-carnivorous *Ancistrocladus* fall within subclass Ia and Ib chitinase specific clades, with the exception of DmChitI-1, a *D. muscipula* class I chitinase sequence that is unresolved in the HMM-derived phylogeny (fig. 2.2). Clade specificity for subclass (Ia, Ib) is inconsistent among other angiosperms class I chitinases analyzed. For example, *B. distachyon*, *O. sativa* ssp. *japonica*, *S. bicolor*, and *Z. mays* class I chitinases do not show phylogenetic affinity based on the presence or absence of a CTE. Additionally, the eudicot subfamily containing *G. max*, *V. vinifera*, and *M. truncatula* chitinases without a CTE do not fall within the lineage containing Caryophyllales subclass Ib chitinases. Therefore, with the exception of subclasses retrieved from the Caryophyllales, a well-supported division is relatively absent between subclasses of eudicot and monocot class I chitinases based on phylogenetic history. This observation is consistent with earlier studies of evolutionary relationships among flowering plant chitinases (Hamel et al. 1997; Xu et al. 2007), where class I chitinases clustered in clades based on taxonomic affinity rather than subclass.

The separation of Caryophyllales subclass Ia and Ib chitinases into two distinct clades could be an indictor of a subfunctionalization, an explanation for the preservation of duplicate copies introduced by Force et al. (1999) in which complementary, degenerative mutations in duplicates leads to persistence of each copy. As evidenced by the presence of subclass Ia and Ib in monocots and other eudicots, a duplication event obviously occurred prior to the evolution of the Caryophyllales, but each copy may have become specialized to perform complementary functions in carnivorous plants. Differences in expression patterns within the carnivorous trap may have contributed to subclass specialization and initiation of processes that lead to functional diversification. This idea is consistent with expression studies in *Nepenthes*, where differential expression of subclass Ia and Ib within the trap has been demonstrated prior to and after mimicking prey capture (Eilenberg et al. 2006). Subclass Ia chitinases are considered housekeeping chitinases, as they are constitutively expressed in *Nepenthes* traps, whereas subclass Ib chitinases are synthesized in traps only after the traps have been exposed to chitin. A similar observation was made for *Drosera*, in which chitinase activity differed among tissue types, most strikingly in the secretory stalked and sessile glands of the lamina after chitin exposure (Matusíková et al. 2005; Libantová et al. 2009). It seems as though in the carnivorous plants of the Caryophyllales, subclass Ia clade is responsible for pathogenesis response and subclass Ib clade for carnivory, two functions essential for preservation of the carnivorous habit.

If subclass Ib genes have been co-opted for plant carnivory, their presence in species that have partially (*Triphyophyllum*) or completely lost (*Ancistrocladus*) the carnivorous habit is curious. Due to the unexpectedly short length of amplicons (see results), these genes may have been converted to pseudogenes after loss of functional domains. It is plausible that during the transition from a plant carnivore to a part-time or non-carnivorous plant, *Triphyophyllum* and *Ancistrocladus* lost certain enzymes required for plant carnivory. Loss of chitinase function in the Caryophyllales is supported by the occurrence of *Nepenthes* subclass Ib chitinase homologs with premature stop codons recovered via PCR (see results). Gene birth and death events are common occurrences during gene family evolution (Nei et al. 2000; Hua et al. 2011), and clearly *Nepenthes* is not immune to chitinase gene turnover. GH family 19 chitinases, which include class I, are thought to be under notorious levels of domain rearrangement and excision. A study of class I chitinases in flowering plants documented perfect direct nucleotide repeats in the chitin-binding domain and proline-rich hinge, indicating possible transposition events that could have resulted in domain excision and ultimately the formation of new classes of chitinases (Shinshi et al. 1990). Transposition events may also be detrimental for chitinase genes, as the removal can produce pseudogenes (Finnegan 1989). In *Ancistrocladus*, we found a trinucleotide perfect repeat (GTG-GTG-GTG) in AgChitI-2 and AgChitI-3, and a trinucleotide imperfect repeat (GTA-GTG-GTG) in ArChitI2 immediately following the proline-rich hinge. *Triphyophyllum* TpChitI-3 also has a trinucleotide imperfect repeat (CTG-GTG-GTG) immediately following the proline-rich hinge, terminating just prior to the first active site of the catalytic domain. The presence of these repeats could be attributed to transposition events as suggested by Shinshi (1990) and could also account for observable differences in sequence length, especially if an excision event resulted in domain hitchhiking and removal. As expression data for these specific sequences is currently unavailable, it is difficult to say whether these genes are likely to be pseudogenes because of transposition events.

Selection acting on subclasses of Caryophyllales class I chitinases

Bishop et al.'s (2000) analyses of *Arabis* class I chitinases suggest that adaptive replacements are localized disproportionately in the active site cleft of the chitinase enzyme. This pattern of replacements was taken as evidence for rapid coevolutionary interactions, most likely between plant chitinases and chitinolytic inhibitors produced by pathogenic fungi. Yet another molecular evolutionary study of class I chitinases in Poaceae (grasses) found positively selected sites to not be significantly overrepresented in the active cleft and that the majority of sites identified are not shared with *Arabis* (Tiffen 2004). These results imply that selective pressures acting on class I chitinases may be lineage specific. We expand class I chitinase homologs to investigate signatures of selection in the Caryophyllales carnivorous plant lineage.

Rate variation was observed among codons at branches nested within Class I-Clade 1 containing Caryophyllales subclass Ia homologs, and Class I-Clade 2 containing Caryophyllales Ib homologs. Replacements associated with rate variation were present throughout protein sequences analyzed, a number of which fall within one or more active sites coded for in the catalytic domain (A.5, table 2.3). In clades I-5 and I-9 (fig. 2.2), replacements occurred at amino acid sites previously demonstrated to participate in substrate-binding and/or catalytic activity (Verburg and Huynh 1991; Verburg et al. 1992; Verburg et al. 1993; Anderson et al. 1997; Brameld and Goddard 1998; Garcia-Casado et al. 1998; Tang et al. 2004). Site 276 is positively selected in *Nepenthes* subclass Ia chitinase homologs (clades I-4 and I-5, fig. 2.2) and positionally homologous to a tyrosine residue essential for substrate binding in the catalytic site, but not catalysis (Verburg et al. 1992; Verburg et al. 1993). Selective replacement of this tyrosine residue with an alternative residue such as phenylalanine proves to significantly reduce enzymatic activity for a variety of angiosperm class I chitinases, up to 100% loss of activity in *Zea* (Verburg et al. 1992; Verburg et al. 1993; Anderson et al. 1997; Tang et al. 2004). Fascinatingly, all *Nepenthes* subclass Ia chitinases analyzed here have phenylalanine at site 276, yet *in vivo* studies have confirmed their activity in the carnivorous trap of *N. khasiana* (Eilenberg et al. 2006). This is in contrast to the *Nepenthes* subclass Ib chitinase homologs we recovered, which all contain the conserved tyrosine at this site. Protein structure homology-modeling of *N. khasiana* class I chitinases also provides evidence for the significance of site 276 in forming polar interactions with NAG. In *N. khasiana* subclass Ib chitinase NkChitI-3, Tyr276 forms a hydrogen bond with NAG mediated by a water molecule, whereas a phenylalanine at site 276 prevents hydrogen bond formation (fig. 2.4). Based on this observation, the presence of certain residues in the active site cleft could thus be very important in determining how subclasses of class I chitinases interact with the substrate.

Five positively selected sites in Caryophyllales class I chitinases were previously identified as a target of selection in *Arabis* and *Zea* class I chitinases (Bishop et al. 2000; Tiffen 2004) (table 2.3). However, only one of these shared sites, 247, falls within the active cleft, and is a replacement exclusive to Caryophyllales subclass Ia chitinase homologs (clade I-2). That the majority of positively selected sites are not shared between these groups of taxa may infer that adaptive responses to selective pressures are lineage specific. Our results also suggest that adaptive responses could be subclass specific, as sites identified under positive selection are not shared between Ia and Ib subclasses of Caryophyllales class I chitinases. Tiffen (2004) proposed that selection favors functional divergence of duplicated genes involved in pathogenic response, as plants are afflicted by a wide variety of pathogens. The fact that chitinases are well known for their substrate specificity and different antifungal abilities is indicative that having a number of defense mechanisms confers some selective advantage (Brunner et al. 1998; Schultze et al. 1998). It is thus reasonable that carnivorous plant subclass Ib chitinases would have a signature of selection different from that of subclass Ia, as the absence of a CTE enables subclass Ib chitinases to escape from digestive glands into the carnivorous trap and access materials different from those found intracellularly (Adlassnig et al. 2011). Additionally, if positive selection has driven the evolution of Caryophyllales subclass Ia chitinases at sites important for functionality, then these enzymes may have evolved greater activity against fungal pathogens, whereas selection on Caryophyllales subclass Ib chitinases has been relaxed.

2.5 Conclusion

The utilization of digestive enzymes for the carnivorous habit can be extended to other members of the GH families. Class IV chitinases have been recently identified by proteome analysis to be present in non-exposed *N. alata* pitcher fluid (Hatano and Hamada 2008), while GH family 18 class III chitinases have been demonstrated to be up-regulated in the presence of prey in a few species of *Nepenthes* (Rottloff 2011). The occurrence of multiple classes of chitinase in the carnivorous trap may indicate synergistic roles in insect digestion, some of which could be influenced by differential expression patterns. Further molecular evolutionary studies of carnivorous plant digestive enzymes thus are warranted to explore functional divergence that can be promoted by shifts in selection.

Acknowledgements

This work was supported by a NSF GRFP and Chang-Lin Tien Graduate Fellowship in the Environmental Sciences awarded to T.R. and a NSF Doctoral Dissertation Improvement Grant awarded to C.D.S. and T.R. (DEB 1011021). The authors would like to thank H. Forbes and C. Matasick (University of California Botanical Garden), G. Walters (Missouri Botanical Garden), G. Bringmann and A. Irmer (Universität Würzburg) for providing and/or helping to collect plant tissue for this study and J. Wong for her assistance in amplifying subclass Ia chitinase sequences, particularly from *Nepenthes*. The authors would also like to thank the Specht lab (especially A. Almeida, M. Bartlett, H. Driscoll, M. Guisinger, K. Lader, E. Ruiz Sanchez, C. Sass, S. Yee, R. Yockteng) for thoughtful discussion, advice, and comments on the manuscript.

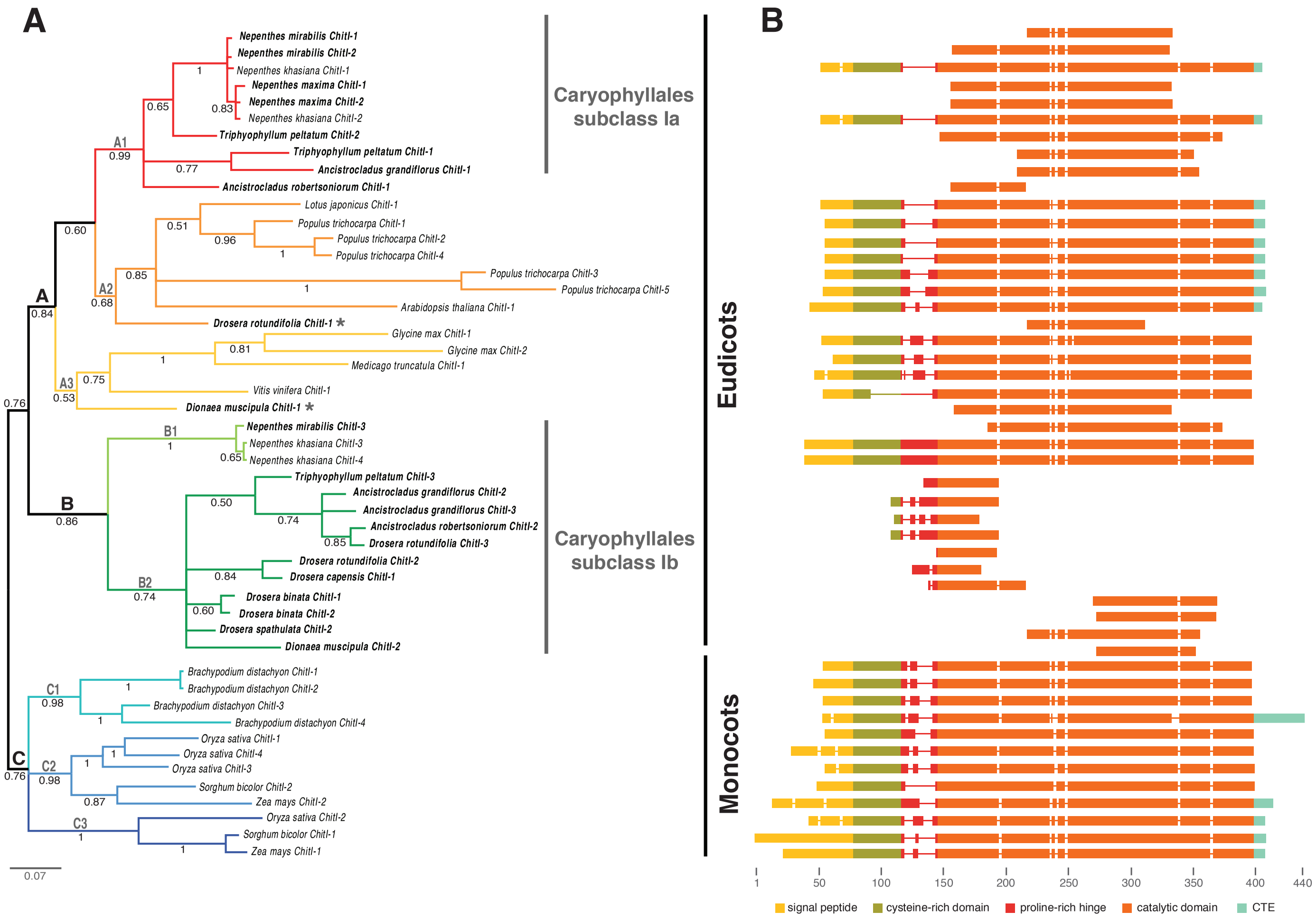


Fig. 2.1 Angiosperm-wide phylogenetic reconstruction for the class I chitinases. (A) Results from BI analysis of 49 class I chitinase homologs retrieved from angiosperms. Posterior probabilities (pp) from complete analysis are indicated at nodes on the Bayesian 50% majority rule tree. Chitinases in bold indicate partial sequences obtained from GenBank or amplified via PCR and asterisks mark *Dionaea* and *Drosera* sequences that do not fall within Caryophyllales subclass Ia or Ib specific clades. (B) Representation of class I chitinase homologs and their consecutive domains deduced from the multiple sequence alignment available in A.5.

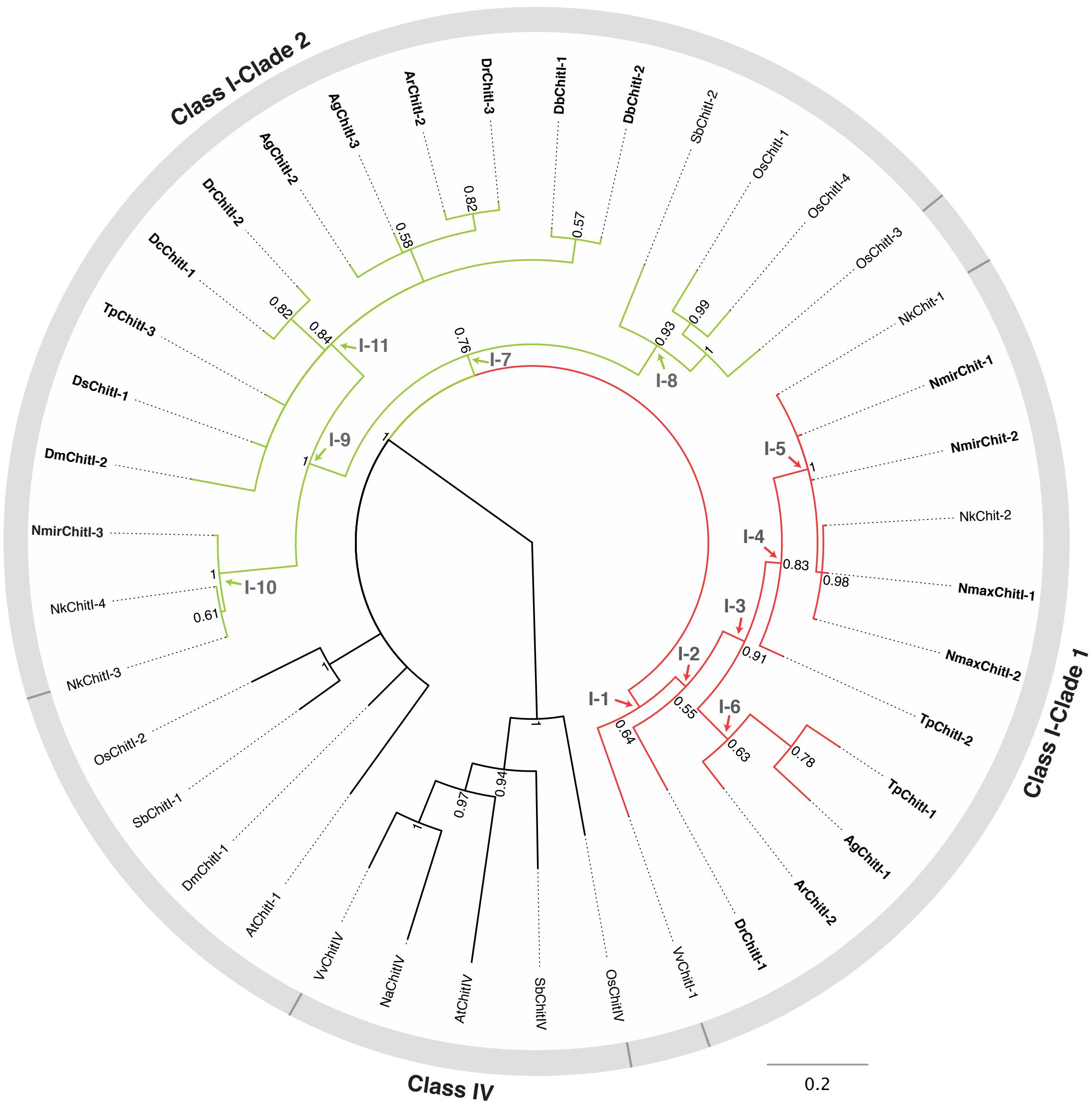


Fig. 2.2 HMM-derived phylogenetic reconstruction for the carnivorous Caryophyllales**.** Results from BI analyses of the HMM-derived dataset of class I chitinase homologs. Posterior probabilities (pp) are indicated at nodes on the Bayesian 50% majority rule tree. Chitinases in bold indicate partial sequences obtained from GenBank or amplified via PCR. Marked arrows indicate lineages tested for instances of differential selection by FEL. Chitinases in bold indicate partial sequences obtained from GenBank or amplified via PCR.

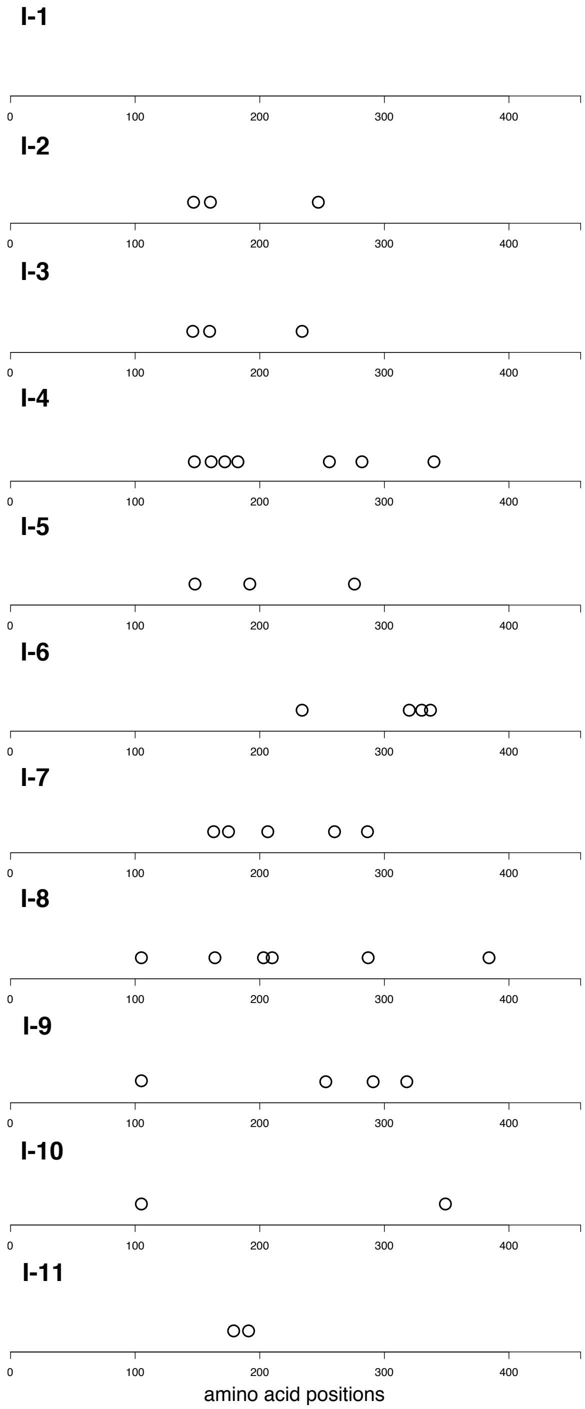


Fig. 2.3 Distribution of positive selected sites along translated CDS of the class I chitinase genes. Sites under positive selection identified by the two-rate FEL model in HyPhy (circles, $p < 0.1$) in clades I-1 through I-11 of fig. 2.2.

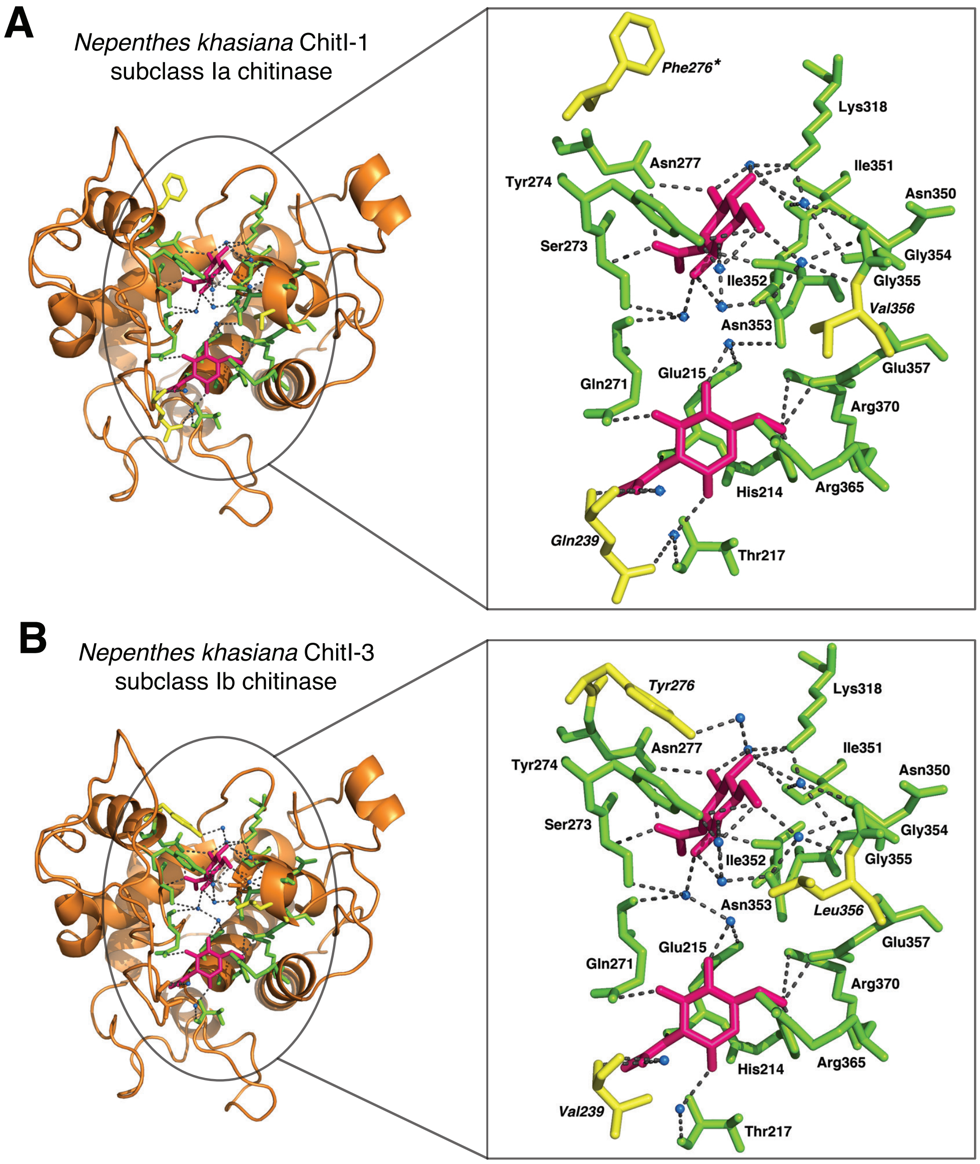


Fig. 2.4 Homology-modeling of *Nepenthes khasiana* subclass Ia and Ib chitinases. 3D models of (A) subclass Ia chitinase NkChitI-1 and (B) subclass Ib chitinase NkChitI-3 in association with NAG and water. Expansion of the active site cleft (right) depicts substrate-interacting residues (green and yellow) with polar contacts ≤ 5 Å to two NAG oligomers (pink) and introduced water molecules (blue). Sites that differ in the residue type interacting with the substrate are shown in yellow and are italicized. In (A), residue Phe276 (italicized and asterisk) disrupts the formation of a water-mediated hydrogen bond to NAG. Site 276 is positively selected in *Nepenthes* subclass Ia chitinase homologs (clade I-5, fig. 2.2) as identified by the two-rate FEL model in HyPhy.

Table 2.1 Caryophyllales class I chitinases

Class I Chitinase	**GenBank ID**
Ancistrocladus grandiflorus	
AgChitI-1	JN867619
AgChitI-2	JN867620
AgChitI-3	-
Ancistrocladus robertsoniorum	
ArChitI-1	JN867621
ArChitI-2	JN867622
Dionaea muscipula	
DmChitI-1	JN867626
DmChitI-2	AY643484
Drosera binata	
DbChitI-1	JN867623
DbChitI-2	JN867624
Drosera capensis	
DcChitI-1	JN867625
Drosera rotundifolia	
DrChitI-1	AY622818
DrChitI-2	-
DrChitI-3	-
Drosera spathulata	
DsChitI-1	AY643483
Nepenthes khasiana	
NkChit-1	AY618885
NkChit-2	AY618887
NkChitI-3	AY618881
NkChitI-4	AY618883
Nepenthes maxima	
NmaxChitI-1	JN867628
NmaxChitI-2	JN867629
Nepenthes mirabilis	
NmirChitI-1	JN867631
NmirChitI-2	JN867632
NmirChitI-3	JN867633
Drosera rotundifolia	
DrChitI-1	AY622818
DrChitI-2	-
DrChitI-3	-
Triphyophyllum peltatum	
TpChitI-1	JN867634
TpChitI-2	JN867635
TpChitI-3	-

Dashes represent class I chitinase sequences >200bp that are available in A.5.

Table 2.2 Class I chitinases identified by homology-based searches of angiosperm genomes

Genome location	Gene ID
Arabidopsis thaliana	
AtChitI-1 3: 3962382 - 3963984	AT3G12500
Brachypodium distachyon	
BdChitI-1 1: 25385703-25386665	Bradi1g29887.1
BdChitI-2 1: 25351801-25352859	Bradi1g29890.1
BdChitI-3 2: 47548066-47549245	Bradi2g47210.1
BdChitI-4 2: 47539862-47541277	Bradi2g47190.1
Glycine max	
GmChitI-1 2: 3943354-3946663	Glyma02g04820.2
GmChitI-2 16: 26279746-26281120	Glyma16g22680.1
Lotus japonicus	
LjChitI-1 AP004945: 3792-4848	AP004945_25
Medicago truncatula	
MtChitI-1 8: 19907150-19909682	Medtr8g074350.1
Oryza sativa ssp. *japonica*	
OsChitI-1 3: 17389600-17390681	LOC_Os03g30470
OsChitI-2 5: 19363900-19365359	LOC_Os05g33130
OsChitI-3 6: 30886217-30887473	LOC_Os06g51050
OsChitI-4 6: 30889813 - 30890862	LOC_Os06g51060
Populus trichocarpa	
PtChitI-1 scaffold_4: 18602513-18603761	POPTR_0004s18870.1
PtChitI-2 scaffold_9: 11302400-11303661	POPTR_0009s14420.1
PtChitI-3 scaffold_9: 11305831-11307159	POPTR_0009s14430.1
PtChitI-4 scaffold_9: 11275939-11277215	POPTR_0009s14380.1
PtChitI-5 scaffold_9: 11279620-11280968	POPTR_0009s14390.1
Sorghum bicolor	
SbChitI-1 9: 48498207-48499444	Sb09g019660
SbChitI-2 9: 1068140-1069105	Sb09g001210
Vitis vinifera	
VvChitI-1 chr4_random: 51200-52868	GSVIVT01007190001
Zea mays ssp. *mays*	
ZmChitI-1 8: 88706159-88706973	GRMZM2G062974 T01
ZmChitI-2 6: 82813531-82815309	GRMZM2G145518 T01

Class I chitinase; ID. Genome location refers to the chromosomal location.

Table 2.3 Sites identified as under positive selection by the two-rate FEL model

Clade	Amino Acid Site[a]	dN/dS	*p*-value
Class I-Clade 1			
I-1	-	-	-
I-2	151[f]	291.866	0.00821021
	156	214.846	0.0694136
	247[dfg]	21230.7	0.0668876
I-3	151[fg]	64.7185	0.00871179
	156	41.1455	0.0906384
	234	752463	0.000479813
I-4	151[f]	398.085	0.008519
	156	246.081	0.0679215
	169	63.6414	0.0268142
	179[g]	104.068	0.0806864
	254	1282.24	0.07899
	280[d]	53.7885	0.0292034
	337	4749.31	0.0693429
I-5	151[f]	19680.3	0.0752647
	192	510.634	0.00637564
	276[bcde]	345021	0.00413544
I-6	234	73.7649	0.0575944
	321	868728	6.36E-05
	330	375.33	0.0012951
	337	756.867	0.0808631
Class I-Clade 2			
I-7	156	361.33	0.103665
	163[f]	114.477	0.010233
	205	38.6138	0.0480599
	260[f]	30.1684	0.100461
	287	266.611	0.0369899
I-8	105	48.9854	0.0968827
	156	112.156	0.0232119
	203	69.4737	0.090665
	210	193.948	0.0478296
	287	113.908	0.028478
	384	25.4691	0.0884657
I-9	105	14820	0.0520161
	253[g]	15368.8	0.0141464
	291	232.766	0.0302471
	317[cd]	21.1525	0.0549449
I-10	105	4963.49	0.0440919
	348	46.1381	0.0667295
I-11	187	22.3358	0.0845388
	195	784.304	0.100128

[a] Relative position of amino acid sites in the class I chitinase multiple sequence alignment (A.5). [b] Important for catalytic activity (Garcia-Casado et al. 1998). [c] Residue that putatively binds the substrate (Garcia-Casado et al. 1998). [d] Positioned in one of the seven active sites previously described for class I chitinases (Garcia-Casado et al. 1998; Bishop et al. 2000; Passarinho and de Vries 2002; Tiffen 2004). [e] Residue essential for substrate binding in the catalytic site but not for catalysis. Residue substitution at this site alters or eliminates catalytic activity (Verburg et al. 1992; Verburg et al. 1993). [f] Positionally homologous to site previously identified as under positive selection in *Arabis* (Bishop et al. 2000). [g] Positionally homologous to site previously identified as under positive selection in *Zea* (Tiffen 2004).

Chapter Three

Virus-induced gene silencing in the culinary ginger (Zingiber officinale): an effective mechanism for downregulating gene expression in tropical monocots

Published previously as:
Renner T, Bragg J, Cho J, Driscoll HE, Jackson AO, Specht, CD. 2009. Virus-induced gene silencing in the culinary ginger (*Zingiber officinale*): an effective mechanism for downregulating gene expression in tropical monocots. Molecular Plant. 2:1084-1094.

Abstract

Virus induced gene silencing (VIGS) has been shown to be effective for transient knockdown of gene expression in plants to analyze the effects of specific genes in development and stress related responses. VIGS is well established for studies model systems or crops within the Solanaceae, Brassicaceae, Leguminaceae and Poaceae, but only recently has been applied to plants residing outside these families. Here we have demonstrated that barley stripe mosaic virus (BSMV) can infect two species within the Zingiberaceae, and that BSMV-VIGS can be applied to specifically downregulate phytoene desaturase in the culinary ginger *Zingiber officinale*. These results suggest that extension of BSMV-VIGS to monocots other than cereals has the potential for directed genetic analyses of many important temperate and tropical crop species.

3.1 Introduction

Virus-induced gene silencing (VIGS) is a technique that utilizes the RNA interference (RNAi) pathway to down-regulate endogenous gene expression (Dinesh-Kumar et al. 2003; Burch-Smith et al. 2004; Godge et al. 2008). This process begins by abrading leaves with modified viral transcripts that express a plant cDNA sequence of a gene to be targeted for degradation (Kumagai et al. 1995; Ruiz et al. 1998). Once the transcripts begin replicating in vivo, double-stranded RNAs (dsRNAs) are generated by a viral RNA-dependent RNA polymerase, and the dsRNA intermediates are recognized by the plant's defense system and targeted for degradation into small interfering RNAs (siRNAs) by DICER-like enzymes (Benedito et al. 2004; Robertson 2004). Highly specific silencing of gene expression subsequently occurs as the amplified siRNAs are incorporated into RNA-induced silencing complexes (RISC) that degrade complementary endogenous plant mRNAs (Baulcombe 2004).

VIGS is a relatively new approach to down-regulate gene expression in plants. The technique was first applied with tobacco mosaic virus (TMV) to interfere with chlorophyll synthesis in *Nicotiana tabacum* L. (Kumagai et al. 1995). Later potato virus X (PVX–VIGS) was used to silence phytoene desaturase (PDS) in wild-type *Nicotiana benthamiana* Domin and to express green fluorescence protein (GFP) in transgenic *N. benthamiana* (Ruiz et al. 1998). However, tobacco rattle virus (TRV) has become the most widely used VIGS vector for members of the Solanaceae and Brassicaceae (Ratcliff et al. 2001; Burch-Smith et al. 2004; Chen et al. 2004; Fu et al. 2005; Burch-Smith et al. 2006; Dong et al. 2007; Godge et al. 2008), and the related pea early browning virus (PEBV) has been applied for developmental analysis of legumes (Constantin et al. 2004, 2008). TRV–VIGS has also recently been used for genetic analyses of the non-model basal eudicots, *Papaver somniferum* L. (Hileman et al. 2005; Drea et al. 2007), *Aquilegia* (Gould and Kramer 2007), and *Eschscholzia californica* Cham. (Wege et al. 2007). Among the cereal crops, VIGS using barley stripe mosaic virus (BSMV–VIGS) has been applied for barley (*Hordeum vulgare* L.) (Holzberg et al. 2002; Bruun-Rasmussen et al. 2007) and wheat (*Triticum aestivum* L.) (Scofield et al. 2005), but application of VIGS for monocots other than cereal grass species has not been described.

Because BSMV–VIGS has been very valuable for analysis of gene function in its natural host *Hordeum* (Hein et al. 2005; Oikawa et al. 2007; Shen et al. 2007) and in the closely related *Triticum* (Scofield et al. 2005; Cloutier et al. 2007; Fu et al. 2007; Zhou et al. 2007; Sindhu et al. 2008), we sought to determine whether the technology could be applied to tropical plants of the order Zingiberales. The Zingiberales (tropical gingers and bananas) exhibit a wide range of flower forms, making them an interesting system for investigating the role of specific gene families in the evolution of floral development (fig. 3.1). The order also exhibits substantial differences in growth habit; hence it is ideal for developmental studies on shoot, rhizome, and root systems. For this purpose, we designed a BSMV–VIGS vector to suppress PDS in the culinary ginger, *Zingiber officinale* Roscoe, using strategies similar to those successfully applied to barley (Holzberg et al. 2002) and wheat (Tai et al. 2005). Our results suggest wild-type (wt) BSMV is able to establish systemic infections of *Z. officinale* and *Costus spicatus* (Jacq.) Sw. We found that in *Z. officinale*, silencing of endogenous PDS (ZoPDS) results in white striations or fully photobleached leaves in systemically infected plants. We propose using *Z. officinale* as a model for studying gene function in non-grass monocots.

3.2 Materials and Methods

Testing infection with wildtype BSMV

Hordeum vulgare leaves infected for 5 to 6 days with the BSMV ND18 strain were ground in a mixture of 50 mL of 10 mM sodium phosphate buffer, pH 7.0 and 1% Celite Analytical Filter Aid (World Minerals). The extract was used to mechanically inoculate the leaves of young (~2 weeks after transplantation) vegetative shoots of *Z. officinale* (eight plants) and *C. spicatus* (four plants). Two leaves were inoculated per shoot and the plants were grown in ambient light under shading conditions in a whitewash-coated greenhouse maintained at 85% humidity. BSMV infection of the emerging leaves was indicated by visual observation (fig. 3.2B) and confirmed by RT-PCR of the RNAβ subunit (fig. 3.3). At 14 days post infection (DPI), total RNA was extracted from ~0.5 g of leaf tissue using Purelink Plant Reagent protocol described by the supplier (Invitrogen) and the RNA was used for cDNA synthesis. For this purpose, 1.5 μg of the total RNA extract primed with the BSMV3 primer 5’-TGG-TCT-TCC-CTT-GGG-GGA-CCG-AAG-CT-3’. RT-PCR was performed using the forward primer TGB3 EcoRI 5'-GCG-AAT-TCC-ATG-GCA-ATG-CCT-CAT-CCC-C-3' and BSMV3 as the reverse primer with polymerase iTaq (BioRad Laboratories) and 5% DMSO at 95°C for 3 min, 35 cycles at 95°C for 30 seconds, 60°C for 30 seconds and 72°C for 30 seconds and a single 7 min final extension cycle at 72°C.

PDS amplification

Total RNA was isolated from uninfected *Z. officinale* leaves with the Purelink Plant Reagent kit (Invitrogen) and subsequently used for cDNA synthesis using the iScript cDNA Synthesis Kit (BioRad Laboratories). To amplify PDS from the leaf RNA, the forward and reverse primers (5’-CTT-ATG-TTG-ARG-CYC-AAG-ATG-G-3’ and 5’-GTG-TTC-TTS-AGT-TTT-CKR-TCA-AAC-3’, respectively) were designed from a conserved region (fig. 3.4) in *Hydrilla verticillata*, *Lilium longiflorum*, *Crocus sativus*, *Zea mays*, *Oryza sativa*, *Hordeum vulgare* and *Triticum aestivum* (GenBank accession numbers AY639658, AY500378, AY183118, L39266, AF049356, AY062039 and DQ270236). A Polymerase Chain Reaction (PCR) was carried out utilizing the polymerase iProof kit (BioRad Laboratories) with 0.05 mg/mL BSA at 98°C for 4 min, 35 cycles at 98°C for 10 seconds, 62°C for 30°C seconds and 72°C for 30 seconds, and a single 7 min final extension cycle at 72°C.

Creating a ZoPDS VIGS construct

To apply BSMV-VIGS to *Z. officinale*, existing full-length cDNA plasmids derived from the ND18 strain (Petty et al. 1989) were used to generate RNAs for the infection mixture. These included the wild type RNAα plasmid and a modified BSMVβ plasmid (B7), containing a mutation in the coat protein start codon (Petty and Jackson 1990). The B7 plasmid RNA was included in the infection mixture because Holzberg et al. (2002) have indicated that disruption of coat protein synthesis enhances the persistence of VIGS. The infection mixture also contained transcripts from the BSMVγ-ZoPDS plasmid, which is similar to the BSMVγ-TaPDS described for wheat VIGS by Tai et al. (2005). Both plasmids were derived from BSMV RNAγ-γb*Bam*HI, which has an introduced *Bam*HI site that alters the start codon of the γb ORF and blocks expression of the γb protein (Petty 1990; Bragg and Jackson 2004). PDS cDNA amplified from *Z. officinale* was then digested with *Bam*HI and inserted non-directionally into the *Bam*HI site of BSMV RNAγ-γb*Bam*HI to produce the BSMVγ-ZoPDS plasmid. Orientation of ZoPDS in the BSMVγ-ZoPDS transcript used for the infection mixture was determined to be positive via sequencing.

The BSMV plasmids were prepared separately for *in vitro* transcription reactions by linerization with Mlu1 (α and γ plasmids) or Spe1 (β plasmid), and synthesized *in vitro* in reactions containing ~500 ng of plasmid DNA and bacteriophage T7 RNA polymerase (Petty et al. 1989). After synthesis, the RNAs were extracted with phenol/chloroform, ethanol precipitated and resuspended in 50 µl of 50 mM glycine, 30 mM sodium phosphate monobasic, 1% bentonite (Sigma) and 1% Celite (Petty et al. 1989). The RNAs were mixed, inoculated by rubbing transcripts directly onto two leaves of each plant, and the plants were grown as described above before leaf symptoms were evaluated at various times after inoculation. The BSMVγ-TaPDS construct containing the *T. aestivum* PDS gene was substituted for BSMVγ-ZoPDS in some experiments to evaluate its effectiveness for VIGS in *Z. officinale*. The *T. aestivum* and *Z. officinale* PDS sequences have 77.3% sequence identity as determined by the program Geneious v3.7 (Drummond et al. 2007; available at http://www.geneious.com/). The nucleotide sequence for the ZoPDS gene was submitted to GenBank (accession number EU854153).

Quantifying PDS downregulation

Total RNA was isolated from uninfected control Z. officinale leaves, and leaves infected with BSMVγ–TaPDS and BSMVγ–ZoPDS. Tissue (~0.5 g) was ground in the presence of the Purelink Plant Reagent (Invitrogen) and extracted using the recommended procedures, and the extracts were subjected to DNase treatment (RQ1 RNase-Free DNase, Promega). The DNase-treated RNAs were subsequently used for total cDNA synthesis (iScript cDNA Synthesis Kit, BioRad Laboratories) and RT–PCR. PDS RNAs were amplified using the same primers as those used to amplify ZoPDS from cDNA, and the resulting products were analyzed by agarose gel electrophoresis. Forward and reverse primers for Actin (5′-GAT-GGA-TCC-TCC-AAT-CCA-GAC-ACT-GTA-3' and 5′-GTA-TTG-TGT-TGG-ACT-CTG-GTG-ATG-GTG-T-3′, respectively) were used as controls during cDNA amplification with iProof polymerase (Biorad Laboratories) and 50 mg/ml of BSA.

3.3 Results

BSMV is able to infect members of the Zingiberales

BSMV has a very broad host range and infects several graminaceous hosts as well as some non-monocot species (Jackson and Lane 1981). Although there is a single report of *Commelina communis* L. (Commelinaceae; Commelinales) susceptibility (Jackson and Lane 1981), extensive studies have not been carried out on monocots belonging to families other than Poaceae, and, to the best of our knowledge, BSMV host range studies with the Zingiberales have not been conducted. Leaves of young *Z. officinale* shoots were inoculated with extracts of leaves from *H. vulgare* harboring the wt ND18 strain of BSMV. At 10 days after inoculation, newly emerging leaves developed a lightly striated mosaic phenotype (fig. 3.2B), and infection was confirmed with a Western blot for viral coat protein (CP) (fig. 3.3A) and by RT–PCR using primers targeting a 734-nt fragment within ORFs 3 and 4 of RNAβ (fig. 3.3B). In addition to *Z. officinale*, we tested the susceptibility of the closely related *C. spicatus* to BSMV. We were able to confirm the presence of the BSMV in all inoculated plants by Western blotting (fig. 3.3A) and RT-PCR (fig. 3.3B) in all *C. spicatus*-inoculated individuals.

Interestingly, new shoots that developed from growing apices of rhizomes of plants previously infected with BSMV also developed symptoms of the viral infection. These shoots typically emerged 14 – 20 days post infection and do not appear to be delayed compared with uninfected plants. This observation supports past seed transmission and VIGS studies showing BSMV is able to to infect meristematic tissue of grasses (Jackson and Lane 1981; Benedito et al. 2004). Our results also indicate that in Z. *officinale*, BSMV can move systemically from the primary inoculated leaves of a shoot into the rhizome system and into new shoots arising from the rhizome. Because of the growth habit of Z. *officinale*, in which many genetical identical shoots can be generated from the same rhizome, only one shoot may need to be infected to obtain a large number of genotypically-identical infected plants bearing terminal flowering shoots.

BSMV can elicit VIGS of ZoPDS in ginger

To determine whether *Z. officinale* endogenous plant mRNAs can be silenced via a BSMV–VIGS approach, a fragment of the coding region of ZoPDS (GenBank accession number AF049356) was amplified by RT–PCR from *Z. officinale* mRNA. Once amplified, ZoPDS was sequenced and inserted at the 5' terminus of the γb gene to create an infectious BSMV–VIGS vector unable to express the γb protein (Tai et al. 2005). The ZoPDS fragment is an excellent gene for VIGS assays because it encodes for an enzyme involved in the biosynthesis of carotenoids and, once silenced, PDS is unable to protect chlorophyll from photo-oxidation, resulting in photobleaching due to decreased carotene content (Kumagai et al., 1995; Benedito et al., 2004). Silencing of PDS in *H. vulgare* (Holzberg et al. 2002) and *T. aestivum* (Tai et al. 2005) has been shown to reduce levels of carotene content and to result in an obvious photobleached phenotype.

Endogenous gene silencing by BSMV–VIGS was accomplished by inoculating leaves of eight young *Z. officinale* shoots through leaf abrasion with a combination of BSMV RNA transcripts designated BSMVγ–ZoPDS. This combination consisted of RNAα, a modified BSMV RNAβ derivative (B7) that is deficient in expression of the coat protein (CP) (Petty and Jackson 1990), and BSMV RNAγ–ZoPDS transcripts. The RNAβ and RNAγ modifications were introduced previously to enhance VIGS expression in barley and wheat (Holzberg et al. 2002; Tai et al. 2005). The 'B7' RNAβ mutant was originally engineered to eliminate CP expression by mutagenesis of the AUG initiation codon of the CP ORF (Petty and Jackson 1990), and was used by Holzberg et al. (2002) to enhance BSMV–VIGS. Expression of the γb silencing supressor protein was also disrupted by creation of a *Bam*HI site to eliminate the γb AUG (Petty et al. 1990) and to provide a site for insertion of cloned DNA fragments (Bragg and Jackson 2004).

Thirty days post inoculation with BSMVγ–ZoPDS, a silenced PDS photobleached phenotype appeared in the systemic leaves of all eight inoculated plants. Photobleaching was easily visible as partially or fully bleached sectors following the parallel veination along the length of the leaf blades (fig. 3.2C-D). Infected *Z. officinale* shoots developed varying degrees of photobleaching in new leaves and experienced slowed growth of the infected shoots, with high levels of mortality following complete bleaching of terminal leaves. Of eight plants inoculated that had only a single vegetative shoot, all lost their vegetative shoot apparently due to the death of the shoot apical meristem. Rhizomes remained viable, but did not display any signs of VIGS. wtBSMV-infected plants continued to grow and produce leaves and new shoots with only slight mosaic yellowing. In contrast to the bleaching with BSMVγ–ZoPDS, *Z. officinale* failed to develop a visible bleached phenotype after infection with BSMVγ–TaPDS (RNAα, B7 RNAβ, and RNAγ–TaPDS) transcripts, which harbored *T. aestivum* PDS sequences.

ZoPDS transcripts are specifically downregulated in photobleached ginger

RT-PCR analyses revealed a dramatic reduction in the levels of PDS mRNA in the photobleached regions of the secondary leaves of plants inoculated with RNAγ-ZoPDS (fig. 3.4). As anticipated, RT-PCR analyses indicated that the secondary leaves of plants inoculated with BSMVγ-TaPDS had levels of endogenous PDS mRNAs comparable to those of plants infected with the wild type BSMV ND18 strain or uninoculated plants (fig. 3.4). Further comparisons of *Triticum aestivum* and *Z. officinale* PDS sequences show a sequence identity of 77.3%, and varying degrees of identity are illustreated in other genera (fig. 3.5). A recent VIGS study in *Hordeum vulgare* shows that cDNA sequences used in viral vectors must have a high percentage of sequence identity to endogenous mRNA for VIGS to be successful (Fu et al. 2007). Our results indicate that BSMV-VIGS is just as sensitive to sequence identity in ginger as in grasses or in non-monocot systems (Burch-Smith et al. 2004; Godge et al. 2008; Scofield and Nelson 2009).

3.4 Discussion

The monocot order Zingiberales (tropical gingers) contains approximately 2500 species that form specialized pollination relationships via alterations in floral form. Members of the order comprise a major component of both tropical and subtropical ecosystems and include crop plants (e.g. banana, plantain, ginger), sources of traditional medicines and spices (e.g. cardamom, turmeric, galanga), and horticulturally important ornamentals (e.g. Heliconia, Bird-of-Paradise, Canna). Detailed studies of two families, Costaceae and Zingiberaceae, indicate that specialized relationships with animal pollinators have led to increased rates of diversification (i.e. rapid radiations) in bird-pollinated and bee-pollinated lineages (Specht 2005, 2006). Species within these two families thus represent ideal evolutionary models for comparative morphology and developmental genetic studies.

Of the tropical gingers, *Zingiber officinale* is the most extensively described and widely cultivated for use of its aromatic rhizomes in cooking and home remedies. Extracts from *Z. officinale* have been shown to have pharmacological activities, and may be effective in inhibiting a variety of illnesses, including the promotion of tumors, inflammation, and emesis (Kawai et al. 1994; Katiyar et al. 1996; Penna et al. 2003). *Zingiber officinale* and related species are easily cultivated vegetatively from rhizome cuttings or vegetative bulbils. This characteristic obviates the need for seed production for successful reproduction and permits rapid generation of multiple genetically identical individuals. In addition, gingers are herbaceous perennials with fast growth rates and short times to maturity (6–7 months seed to seed), making them realistically amenable to gene silencing and subsequent phenotyping. In order to further understand and add to research of the Zingiberales, we demonstrate that virus-induced gene-silencing (VIGS) using a cereal virus, barley stripe mosaic virus (BSMV), can be used effectively to study gene function in *Z. officinale*.

BSMV infection of Zingiberales

While *Hordeum vulgare* (subfamily Pooideae: tribe Triticeae) is the natural host for BSMV, systemic viral infection with BSMV has been demonstrated for most subfamilies and many tribes of grasses (Jackson and Lane 1981). BSMV-VIGS has been successful demonstrated for barley and wheat (Pooideae: Triticeae) and is proving to be extremely valuable for analysis of genes affecting morphogenesis and disease resistance (Hein et al. 2005). Here, we demonstrate that BSMV systemic infections of distantly-related monocots, such as gingers, occurs after mechanical inoculation with both wild type and engineered ND18 strain transcripts. Moreover, infections can be maintained in *Zingiber officinale* (Zingiberaceae) and a closely related species in the family Costaceae (*Costus spicatus*) for at least 5 months during normal greenhouse growing conditions.

Plants infected with BSMV ND18 developed a mild yellow mosaic on the normally bright green leaves, but did not show obvious reductions in overall plant growth or in the timing of transition from vegetative to reproductive phase. In the absence of intentional leaf abrasion, BSMV does not appear to be easily transmitted to surrounding plants in the greenhouse. This is an important practical feature for gene silencing in the Zingiberales since many plants become too large for growth in chambers and require high levels of humidity that are difficult to maintain if plants are grown in isolation.

In each of the tested species, BSMV moved from the initial sites of infection to developing leaves above the site of infection. Additionally, in *Zingiber* we observed the movement of the virus downward through the infected shoot and into the rhizome (underground stem), where it ultimately infected new shoots developing from the rhizome tip (see fig. 3.1). The recently reported stability of BSMV VIGS (Bruun-Rasmussen et al. 2007) demonstrates the potential to control gene expression for a considerable period of time during plant development. In *Z. officinale* BSMV persists over several vegetative and flowering cycles, and presents the opportuntiy to create a large number of ginger shoots with down-regulated gene expression from inoculation of a single leaf. After a cluster is infected, we should be able grow individual shoots separately to test the effects of gene down-regulation under a variety of environmental conditions.

BSMV-VIGS is effective in *Zingiber officinale*

We have shown that BSMV-VIGS is an efficient method for inducing the down-regulation of the expression of specific target genes in *Z. officinale.* A modified BSMVγ RNA containing a partial sequence of the *Z. officinale* phytoene desaturase (PDS) gene was able to effect the down-regulation of endogenous PDS and cause visible photo bleaching of leaf and stem tissue. The extent of PDS silencing in *Z. officinale* after BSMV-VIGS inoculation is similar to that found in studies of PDS VIGS in other monocots (Holzberg et al. 2002; Tai et al. 2005). However, *Z. officinale* shoots with photobleached leaves showed high rates of mortality, and rhizomes were not able to produce new shoots or develop inflorescences for over 50 days after inoculation. The vegetative shoots showing PDS eventually died, and failed to regenerate photosynthetic tissue, suggesting complete gene silencing in the shoot apical meristem. It is therefore likely that gene silencing will be an effective means to illucidate the functions of genes involved in developmental and biochemical pathways. Future analyses with other marker genes that do not lead to photo-oxidation are planned to determine the duration of gene down-regulation as well as to test the physical movement of gene silencing throughout the plant.

VIGS has become a widley used technique, most commonly applied to eudicot plants using tobacco rattle virus (TRV) derived vectors and *Agrobacterium*-mediated transfer into host cells. Despite reports of a host range for TRV that includes monocots (see TEC Release October 2005: www.pbltechnology.com), we were unable to infect Zingiberales using *Agrobacterium*-mediated infiltration of TRV in several attempts using various published delivery methods. The use of a native monocot virus to affect VIGS in phylogenetically distant monocot taxa presents an effective means of transfering VIGS technology to a wide range of crop species, model organisms, and non-model species within the monocots. This transfer of technology provides a high-throughput means for assaying the function of a large number of genes recently identified and sequenced through EST databases and genome sequencing projects being developed for a number of diverse grasses (*Zea mays*, *Oryza sativa, Hordeum vulgare, Triticum* spp., *Sorghum* spp., *Panicum virgatum, Brachypodium* *distachyon, Saccharum officinarum*) and non-grass monocots (*Musa acuminata*, *Asparagus officinalis*, *Phalaenopsis* spp., *Ananas comosus, Allium cepa*). The simple topical application method for introduction of the virus increases the ease at which BSMV can be used to assess gene funtion across monocots. We are currently testing the efficacy of the virus in infecting species of Allium (Alliaceae; Asparagales), Hippeastrum (Amaryllidaceae; Asparagales), Iris (Iridaceae; Asparagales), Acorus (Acoraceae; Acorales), and Chamaedorea (Arecaceae; Arecales).

In addition to studying host gene function, VIGS has the potential to provide a useful method for assaying host factors involved in viral pathogenicity (Zhu and Dinesh-Kumar 2008). Biochemical assays have been used to identified various host translation initiation factors associated with viral replication proteins (Quadt et al. 1993). VIGS provides an additional means for testing the function of candidate host factors in viral pathogenicity, providing a high-throughput mechanism for screening potental new host factors and testing for the effects of candidate host factors on pathogenesis. The recent spread of the vector-borne banana virus, Banana bunchy top virus (BBTV), has resulted in the spread of banana bunchy top disease and the subsequent failure of banana crops in Hawaii (Conant 1992) and across the South Pacific and Southeast Asia (Dale 1987). BSMV-VIGS in banana (*Musa acuminata*: Musaceae; Zingiberales) could provide a reverse genetics approach to help elucidate host mechanisms involved in viral pathogenicity.

BSMV-VIGS as a tool for studying gene function in the Zingiberales

BSMV–VIGS is likely to be effective in other members of the Zingiberales that are susceptible to BSMV infection. This should enable targeted studies for identifying gene function to be carried out in this ecologically and evolutionarily important group of tropical crops and ornamentals. The ginger family, Zingiberaceae, includes species such as turmeric (*Curcuma longa* L.), galanga (*Kaempferia galanga* L.), cardamom (*Elettaria cardamomum* Maton), and ginger root (*Z. officinale*), all of which have uses as spices and medicinals. Most rhizomes of Zingiberaceae species accumulate high levels of pharmacologically active metabolites derived from the phenylpropanoid pathway. Several of these, gingerols in *Zingiber* and curcuminoids in *Curcuma*, have been isolated and characterized, but little is known about their biosynthesis. Recent biochemical studies have started to identify enzymes involved in the biosynthetic pathways (Ramirez-Ahumada et al. 2006; Kita et al. 2008); however, nothing is known about the genetic network involved in biosynthesis. Our developed BSMV–VIGS tool could be used to functionally analyze ESTs believed to be associated with the biosynthesis of these important compounds.

Our interest in developing BSMV–VIGS in Zingiberales extends to floral developmental evolution. We are interested in dissecting the genetic networks leading to development of the diverse floral forms found across the order, particularly floral forms involved in the attraction of distinct pollinators. Unlike grasses, Zingiberales are ‘petaloid monocots’, having floral organs comprising sepals, petals, stamens, and carpels. The formation of the staminodes and the labellum may be a question of organ identity, with these structures functionally homologous to petals yet sharing positional homology with stamens. A group of transcription factors, many of which belong to the MADS-box family, are involved in floral organ identity in several model plant systems (Saedler et al. 2001; Theissen 2001). VIGS has been successfully used to study MADS-box gene function in a variety of eudicots (Schwartz-Sommer et al. 1990; Liu et al. 2004; Hileman et al. 2005; Drea et al. 2007; Gould and Kramer 2007) and future studies using VIGS may allow us to determine how these organ identity genes influence floral form throughout the Zingiberales (e.g. Gao et al. 2006).

Funding
This research was partially funded by UC Berkeley Committee on Research and the College of Natural Resources.

Acknowledgements

We thank V.F. Irish, S.P. Dinesh-Kumar, E. Kramer, and A. Litt for early advice on VIGS in non-model plants and Doug Dahlbeck for his assistance and persistence in early attemps at infecting *Zingiber* with TRV. Tessa Burch-Smith provided additional insights for growing gingers once infected by the virus. The Specht Lab and especially Madelaine Bartlett, Chodon Sass, Ana Almeida, Kali Lader and Candice Cherk contributed ideas, advice, and physical labor to assist in developing virus-infected gingers. No conflict of interest declared.

Fig. 3.1 Photos of the two species used in this study, clockwise from upper left. (A). Inflorescence of *Costus spicatus,* showing current and past flowers. One flower opens per day from the conical inflorescence. (B). Close-up of *C. spicatus* flower (credit: Madelaine E. Bartlett). (C). *Zingiber officinale* inflorescence with flowers. (D,E). *Zingiber officinale* shoots and rhizomes showing facility for replication of greenhouse experiments. (D) Close-up of the three rhizome sections shown in E. The growing end of the rhizome is toward the bottom of the photograph, seen as a small protrusion of the rhizome tissue. This protrusion represents a single apical meristem and will grow out as a new vegetative shoot. Lateral thickening at the base will form the rhizome, and roots will develop from axillary meristems along the rhizome. (E). Three rhizome sections with corresponding shoot and root systems, demonstrating 4 months of growth. Each rhizome section can be separated from adjoining sections and planted as an individual, complete with shoot and root system. Flowering, leafless shoots (C) form directly off the rhizome.

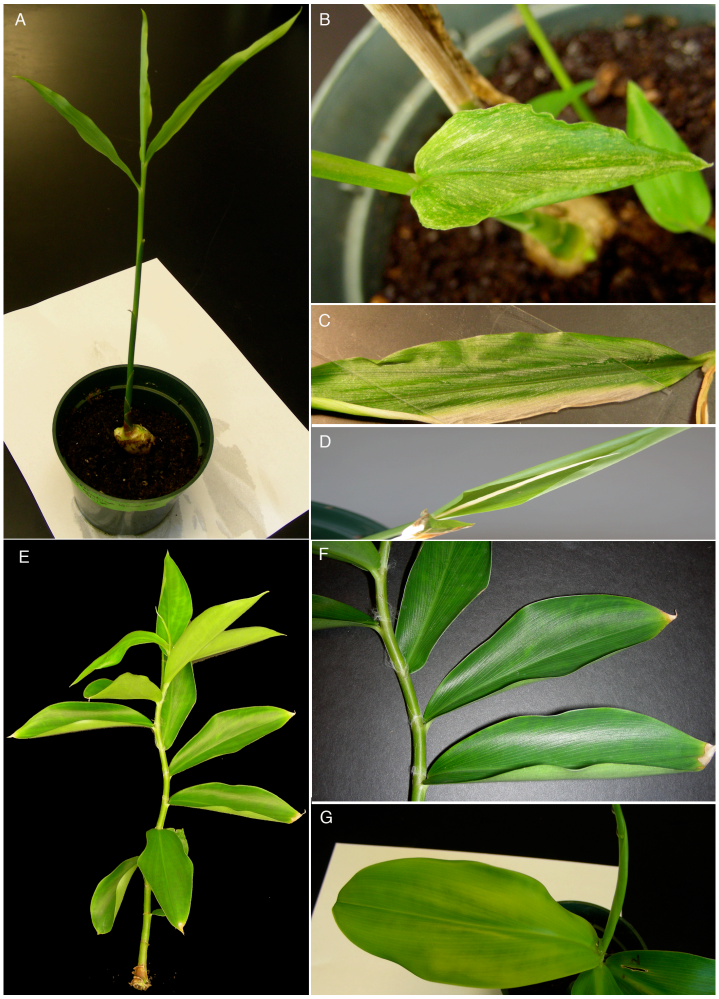


Fig. 3.2 Images of *Zingiber officinale* (A-D) and *Costus spicatus* (E-G) demonstrating phenotypes associated with viral infection and gene silencing. (A) Whole *Z. officinale* plant with rhizome. (B) Leaf from BSMV infected *Z. officinale* plant showing characteristic yellow stripes. (C) Leaf from a *Z. officinale* plant systemically infected with BSMV-ZoPDS. Photobleaching is evident in one sector of the single leaf located directly above the leaf of infection and can be seen in throughout the terminal leaves of plants 30 days post-infection. (C) Leaf from *Z. officinale* plant systemically infected with BSMV-ZoPDS. Photobleaching is evident in one sector of the single leaf located directly above the inoculated leaf and can be seen throughout the terminal leaves of plants 30 days post-innoculation. (D) Terminal leaf of *Z. officinale* plant with complete photobleaching characteristic of PDS silencing. (E) Whole C. spicatus stem produced from bulbil in the leaf axil of the parent flowering plant. The rhizome at the base of the shoot has rootlets that developed while this stem was still attached to the parent plant. (F) Close-up of uninfected *C. spicatus* leaves. (G) Close-up of *C. spicatus* leaf infected with BSMV, showing the infected phenotype of characteristic yellow stripes in a mosaic pattern.

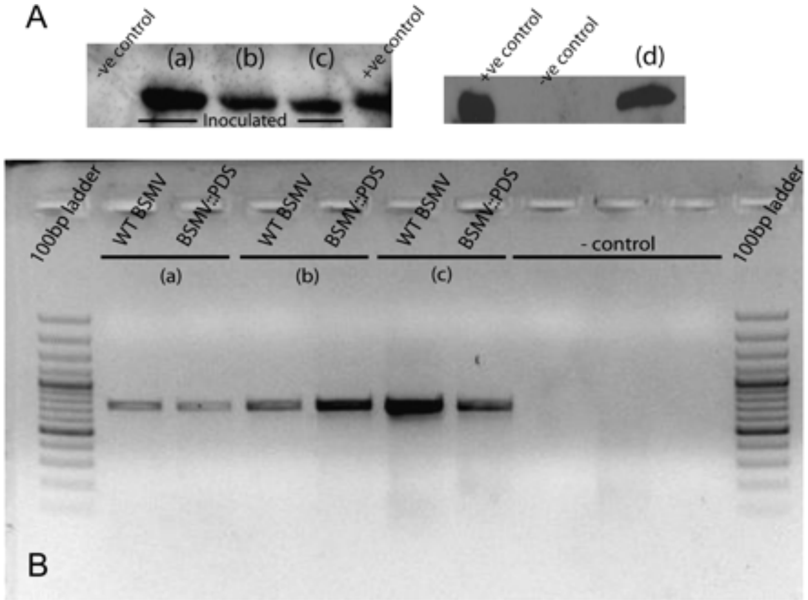


Fig. 3.3 (A) Western blots showing antibody hybridization to BSMV CP. Detected CP in inoculated lanes indicates viral replication >3 cm from site of abrasion in 3 different *Costus* plants (a-c) and in *Z. officinale* (d). Negative control lanes use leaf material harvested from uninfected *C. spicatus* (left blot) or *Z. officinale* (right blot). Positive control lanes on both blots use leaf material from barley (*Hordeum*) known to be systemically infected with BSMV. (B) RT-PCR showing presence of viral constructs in plants post-inoculation with either wt BSMV or BSMV RNA with the PDS insert. Primers were designed to amplify BSMVβ RNA. Control lanes contain RT-PCR from plants not infected with viral transcripts. (a) *C. spicatus*, (b) *Z. officinale*, (c) *H. vulgare.*

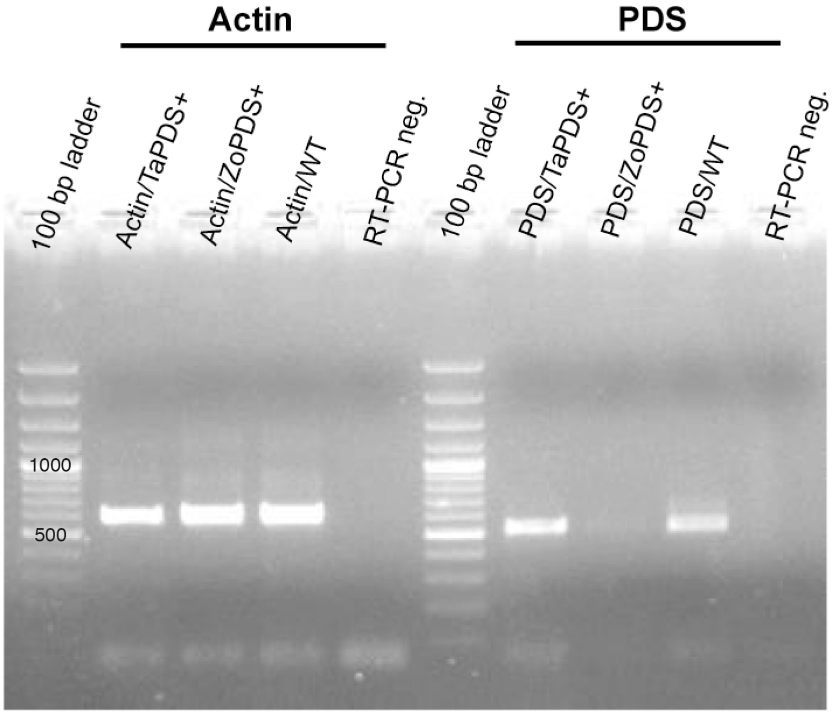


Fig. 3.4 Agarose gel with RT-PCR demonstrating down-regulation of PDS in *Z. officinale* plants infected with a BSMV construct containing a *Z. officinale* endogenous PDS gene fragment. Actin was used as a postive RT-PCR control for RNA extractions from *Z. officinale* plants infected with BSMV containing no construct (WT), a fragment of the PDS gene from wheat (Ta), or the endogenous *Z. officinale* PDS fragment (Zo). In all cases, actin is consistently transcribed. Significantly less PDS is transcribed from plants infected with the BSMV vector containing the endogenous PDS gene fragment, indicating successful downregulation of *PDS* (ZoPDS+). The negative control reaction lacks reverse transcriptase.

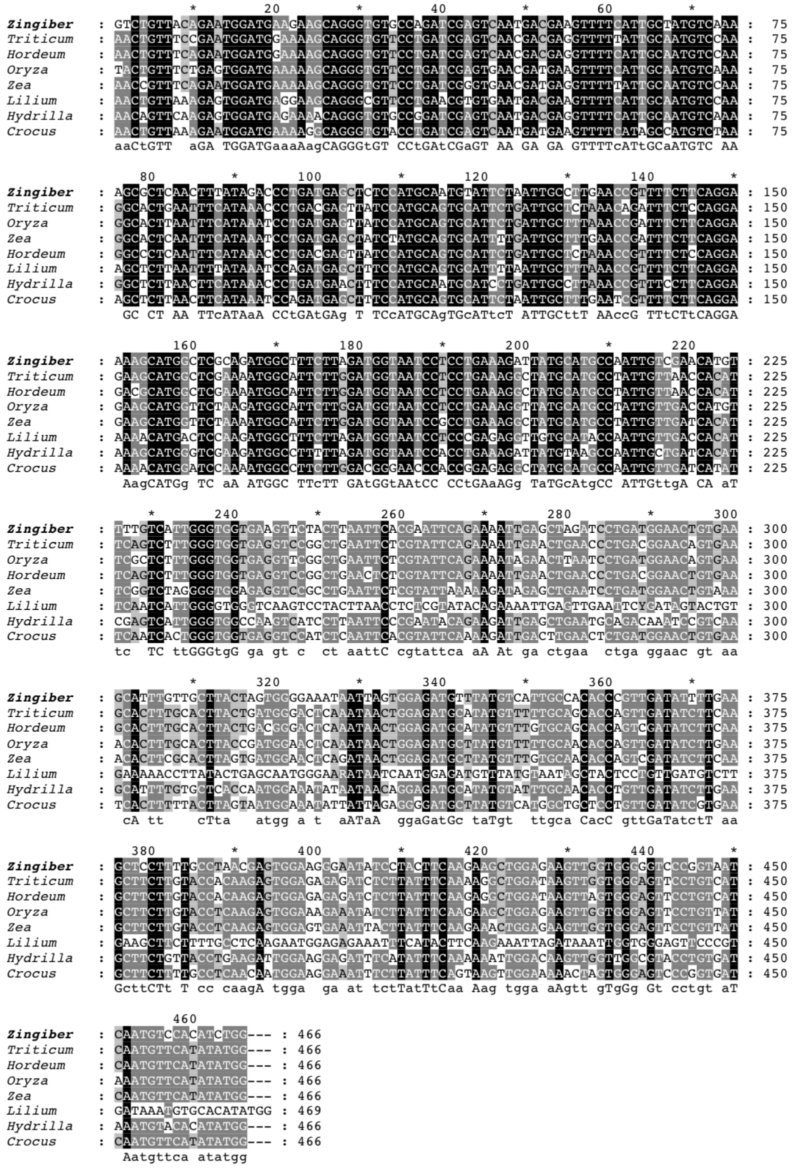


Fig. 3.5 Sequence comparison of PDS loci from *Zingiber officinale*, *Triticum aestivum, Hordeum vulgare, Oryza sativa, Zea mays, Crocus sativus, Lilium longiflorum, Hydrilla verticillata* (GenBank accession numbers EU854153, DQ270236, AF049356, AY062039, L39266, AY183118, AY500378, AY639658) utilizing the program GeneDoc version 2.06.02 (Nicholas et al. 1997). Nucleotides shaded by black boxes with white lettering (100% conserved), gray shading with white lettering (80% or greater conserved), gray shading with black lettering (60% or greater conserved), no shading with black lettering (less than 60% conserved).

References

Abascal F, Zardoya R, Posada D. 2005. ProtTest: selection of best-fit models of protein evolution. Bioinformatics 21:2104-2105.

Alejandro GJD, Madulid RS, Madulid DA. 2008. The utility of Internal Transcribed Spacer (nrDNA) sequence data for phylogenetic reconstruction in endemic Philippine *Nepenthes* L. (Nepenthaceae). The Philippine Scientist 45:99-110.

Amagase S. 1972. Digestive Enzymes in Insectivorous Plants III. Acid Proteases in the genus *Nepenthes* and *Drosera peltata*. The Journal of Biochemistry 72(1):73-81.

Amagase S, Mori, M, Nakayama S. 1972. Digestive enzymes in insectivorous plants IV. Enzymatic digestion of insects by *Nepenthes* secretion and *Drosera peltata* extract: proteolytic and chitinolytic activities. The Journal of Biochemistry 72(3):765–767.

An CI, Takekawa S, Okazawa A, Fukusaki E, Kobayashi A. 2002 Degradation of a peptide in pitcher fluid of the carnivorous plant *Nepenthes alata* Blanco. Planta 215:472-477.

Anderson MD, Jensen A, Robertus JD, Leah R, Skriver K. 1997. Heterologous expression and characterization of wild-type and mutant forms of a 26 kDa endochitinase from barley (*Hordeum vulgare* L). Biochemical Journal 322:815-822.

APGII. 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnean Society 14:399-436.

Araki T, Torikata T. 1995. Structural classification of plant chitinases: two subclasses in class I and class II chitinases. Bioscience, Biotechnology and Biochemistry 59:336-338.

Arnold K, Bordoli L, Kopp J, Schwede T. 2006. The SWISS-MODEL Workspace: A web-based environment for protein structure homology modelling. Bioinformatics 22:195-201.

Ashida J. 1935. Studies of the leaf movement of *Aldrovanda vesiculosa* L. II. Effects of mechanical, electrical, thermal, osmotic and chemical influences. Memoirs of the College of Science, Kyoto Imperial University 11:55-113.

Baulcombe D. 2004. RNA silencing in plants. Nature 431:356-363.

Beintema J. 1994. Structural features of plant chitinases and chitin-binding proteins. FEBS Letters 350:159-163.

Benedito VA, Visser PB, Angenent GC, Krens and FA. 2004. The potential of virus-induced gene silencing for speeding up functional characterization of plant genes. Genes and Molecular Research 3:323-341.

Benson DA, Karsch-Mizrachi I, Lipman DJ, Ostell J, Wheeler DL. 2005. GenBank. Nucleic Acids Research 33:D34–D38.

Bergsten J. 2005. A review of long-branch attraction. Cladistics 21:163-193.

Bernstein FC, Koetzle TF, Williams GJ, Meyer EE Jr, Brice MD, Ridgers JR, Kennard O, Shimanouchi T, Tasumi M. 1977. The Protein Data Bank: A computer-based archival file for macromolecular structures. Journal of Molecular Biology 112:535.

Bharathan G, Goliber TE, Moore C, Kessler S, Pham T, Sinha NR. 2002. Homologies in leaf form inferred from KNOXI gene expression during development. Science 296:1858-1860.

Bishop JG, Dean AM, Mitchell-Olds T. 2000. Rapid evolution in plant chitinase: molecular targets of selection in plant pathogen coevolution. Proceedings of the National Academy of Sciences, USA 97:5322-5327.

Bollback JP. 2006. Simmap: stochastic character mapping of discrete traits on phylogenies. BMC Bioinformatics 7:88.

Bragg, JN, O. Jackson AO. 2004. The C-terminal region of the barley stripe mosaic virus γb protein participates in homologous interactions and is required for suppression of RNA silencing. Molecular Plant Pathology 5:465-481.

Brameld KA, Goddard WAI. 1998. The role of enzyme distortion in the single displacement mechanism of family 19 chitinases. Proceedings of the National Academy of Sciences, USA 95:4276-4281.

Bringmann G, Risher H, Schlauer J, Wolf K, Kreiner A, Duschek M, Assi LA. 2002. The tropical liana *Triphyophyllum peltatum* (Dioncophyllaceae): formation of carnivorous organs is only a falcultative prerequisite for shoot elongation. Carnivorous Plant Newsletter:44-52.

Brogue K, Chet I, Holliday M, Cressman R, Biddle P, Knowlton S, Mauvais CJ, Broglie R. 1988. Transgenic plants with enhanced resistance to the fungal pathogen *Rhizoctonia solani*. Science 254:1194-1197.

Brown JM, Hedtke SM, Lemmon AR, Lemmon EM. 2010. When trees grow too long: investigating the causes of highly inaccurate Bayesian branch-length estimates. Systematic Biology 59:145-161.

Brunner F, Stintzi A, Fritig B, Legrand M. 1998. Substrate specificity of tobacco chitinases. The Plant Journal 14:225-234.

Bruun-Rasmussen M, Madsen CT, Jessing S, and Albrechtsen M. 2007. Stability of barley stripe mosaic virus–induced gene silencing in barley. Molecular Plant-Microbe Interactions 20:1323-1331.

Burch-Smith TM, Anderson JC, Martin GB, Dinesh-Kumar SP. 2004. Applications and advantages of virus-induced gene silencing for gene function studies in plants. The Plant Journal 39:734-746.

Burch-Smith, TM, Schiff M, Liu Y, Dinesh-Kumar SP. 2006. Efficient virus-induced gene silencing in *Arabidopsis*. Plant Physiology 142:21-27.

Cameron K, Wurdack K, Jobson R. 2002. Molecular evidence for the common origin of snap-traps among carnivorous plants. American Journal of Botany 89:1503-1509.

Chase MW, Christenhusz MJM, Sanders D, Fay MF. 2009. Murderous plants: Victorian gothic, Darwin and modern insights into vegetable carnivory. Botanical Journal of the Linnaean Society 161:329-356.

Cheek M. 2000. A Synoptic revision of *Ancistrocladus* (Ancistrocladaceae) in Africa, with new species from western Cameroon. Kew Bulletin 55:871-882.

Chen J-C, Jiang C-Z, Gookin TE, Hunter DA, Clark DG, Reid MS. 2004. Chalcone sythase as a reporter in virus-induced gene silencing studies of flower senescence. Plant Molecular Biology 55:521-530.

Chrispeels MJ, Raikhel NV. 1992. Short peptide domains target proteins to plant vacuoles. Cell 68:613-616.

Cloutier S, McCallum BD, Loutre C, Banks TW, Wicker T, Fueillet C, Keller B, Jordan MC. 2007. Leaf rust resistance gene Lr1, isolated from bread wheat (*Triticum aestivum* L.) is a member of the large psr567 gene family. Plant Molecular Biology 65:93-106.

Collinge DB, Kragh KM, Mikkelsen JD, Nielsen KK, Rasmussen U, Vad K. 1993. Plant chitinases. The Plant Journal 3:31-40.

Conant P. 1992. Banana bunchy top disease, a new threat to banana cultivation in Hawaii. Proceedings, Hawaiian Entomological Society 31:91-95.

Constantin GD, Karath BN, MacFarlane SA, Nicolaisen M, Johansen IE, Lund OS. 2004. Virus-induced gene silencing as a tool for functional genomics in a legume species. The Plant Journal 40:622-631.

Constantin GD, Gronlund M, Johansen IE, Stougaard J, Lund OS. 2008. Virus-induced gene silencing as a reverse genetic tool to study development of symbiotic root nodules. Plant-Microbe Interactions 21:720-727.

Croizat L. 1960. Principia Botanica. Published by the author, Caracas, Venezuela.

Cronquist A. 1988. The evolution and classification of flowering plants. 2nd Edition.The New York Botanical Garden, Bronx, NY.

Cuénoud P, Savolainen V, Chatrou LW, Powell M, Grayer RJ, Chase MW. 2002. Molecular phylogenetics of Caryophyllales based on nuclear 18S and plastid *rbc*L, *atp*B, *mat*K DNA sequences. American Journal of Botany 89:132-144.

Dale JL. 1987. Banana bunchy top: an economically important tropical plant virus disease. Advances in Virus Research 33:301-325.

Darwin CR. 1875. Insectivorous Plants. London: John Murray.

Degreef JD. 1997. Fossile *Aldrovanda*. Carnivorous Plant Newsletter 26:93-97.

Dexheimer J. 1978. Study of mucilage secretion by the cells of the digestive glands of *Drosera capensis* L. using staining of the plasmalemma and mucilage by phosphotungstic acid. Cytologia 43:45-52.

Diels L. 1906. Droseraceae. In: A. Engler ed. Das Pflanzenreich 4: 1-136. W. Engelmann, Weinheim, Germany.

Dinesh-Kumar SP, Anandalakshmi R, Marathe R, Schiff M, Liu Y. 2003. Virus-induced gene silencing. Plant Functional Genomics 236:287-293.

Dong Y, Burch-Smith TM, Liu Y, Mamillapalli P, Dinesh-Kumar SP. 2007. A ligation-independent cloning tobacco rattle virus vector for high-throughput virus-induced gene silencing identifies a role for NbMADS4-1 and -2 in floral development. The Plant Journal 145:1161-1170.

Dore I, Legrand M, Cornelissen BJC, Bol JF. 1991. Subcellular localization of acidic and basic PR proteins in tobacco mosaic virus-infected tobacco leaves. Archives of Virology 120:97-107.

Downie SR, Katz-Downie DS. 1996. A molecular phylogeny of Apiaceae subfamily Apioideae: evidence from nuclear ribosomal DNA internal transcribed spacer sequences. American Journal of Botany 83:234-251.

Doyle JJ, Doyle JL. 1987. A rapid DNA isolation procedure for small quantities of fresh leaf tissue. Phytochemistry Bulletin 19:11-15.

Drea S, Hileman LC, de Martino G, Irish V. 2007. Functional analyses of genetic pathways controlling petal specification in poppy. Development 134:4157-4166.

Drummond AJ, Ashton B, Buxton S, Cheung M, Cooper A, Duran C, Field M, Heled J, Kearse M, Markowitz S, Moir R, Stones-Havas S, Sturrock S, Thierer T, Wilson A. 2010. Geneious v5.3.6, Available from http://www.geneious.com/

Drummond AJ, Ashton B, Cheung M, Heled J, Kearse M, Moir R, Stones-Havas S, Thierer T, Wilson A. 2007. Geneious v3.7. Available from http://www.geneious.com/

Eckardt NA. 2007. Evolution of compound leaf development in legumes: evidence for overlapping Roles of KNOX1 and FLO/LFY genes. The Plant Cell 19:3315-3316.

Edwards K, Johnstone C, Thompson C. 1991. A simple and rapid method for the preparation of plant genomic DNA for PCR analysis. Nucleic Acids Research 19:1349.

Eilenberg H, Pnini-Cohen S, Schuster S, Movtchan A, Zilberstein A. 2006. Isolation and characterization of chitinase genes from pitchers of the carnivorous plant *Nepenthes khasiana*. Journal of Experimental Botany 57:2775-2784.

Esaka M, Enoki K, Kouchi B, Sasaki T. 1990. Purification and characterization of abundant secreted protein in suspensio-cultured pumpkin cells. Plant Physiology 93:1037-1041.

Fabian-Galan G, Salageanu N. 1968. Considerations on the nutrition of certain carnivorous plants (*Drosera capensis* and *Aldrovanda vesiculosa*). Revue Roumaine de Biologie-Botanique 13:275-280.

Fahn A, Werker E. 1972 Anatomical mechanisms of seed dispersal. In: Koslowsky TT, ed. Pages 152-221 in TT Koslowsky ed. Seed Biology. Academic Press, New York, NY.

Faraday CD, Thomson WW. 1986. Functional aspects of the salt glands of the Plumbaginaceae. Journal of Experimental Botany 37:1129-1135.

Fay MF, Cameron KM, Prance GT, Lledó MD, Chase MW. 1997. Familial relationships of Rhabdodendron (Rhabdodendraceae). Plastid *rbc*L sequences indicate a caryophyllid placement. Kew Bulletin 52:923-932.

Floyd SK, Bowman JL. 2009. Gene expression patterns in seed plant shoot meristems and leaves: homoplasy or homology? Journal of Plant Research 123:43-55.

Force A, Lynch M, Pickett FB, Amores A, Yan Y, Postlethwait J. 1999. Preservation of duplicate genes by complementary, degenerative mutations. Genetics 151:1531-1545.

Foster PF, Sork VL. 1997. Population and genetic structure of the west african rain forest liana *Ancistrocladus korupensis* (Ancistrocladaceae). American Journal of Botany 84:1078-1091.

Fu D-Q, Zhu B-Z, Zhu H-L, Jiang W-B, Luo Y-B. 2005. Virus-induced gene silencing in tomato fruit. The Plant Journal 43:299-308.

Fu D, Uauy C, Blechl A, Dubcovsky J. 2007. RNA interference for wheat functional gene analysis. Transgenic Research 16:689-701.

Fukamizo T. 2000. Chitinolytic enzymes: catalysis, substrate binding, and their application. Current Protein and Peptide Science 1:105-124.

Funk JL, Oyarzo JN, Frye JB, Chen G, Lantz RC, Jolad SD, Solyom AM, and Timmerman BN. 2006. Turmeric extracts containing curcuminoids prevent experimental rheumatoid arthritis. Journal of Natural Products Chemistry 69:351-355.

Geo X-M, Xia Y-M, Liet Q-J. 2006. Isolation of two putative homologues of PISTILLATA and AGAMOUS from *Alpinia oblongifolia* (Zingiberaceae) and characterization of their expression. Plant Science 170:674-684.

Garcia-Casado G, Collada C, Allona I, Casado R, Pacios LF, Aragoncillo C, Gomez L. 1998. Site-directed mutagenesis of active site residues in a class I endochitinase from chesnut seeds. Glycobiology 8:1021-1028.

Gaume L, Di Giusto B. 2009. Adaptive significance and ontogenetic variability of the waxy zone in *Nepenthes rafflesiana*. Annuals of Botany 104:1281-1291.

Gereau RE. 1997. Typification of names in *Ancistrocladus* Wallich (Ancistrocladaceae). Novon 7:242-245.

Gibson TC, Waller DM. 2009. Evolving Darwin's 'most wonderful' plant: ecological steps to a snap-trap. New Phytologist 183:575-587.

Gijzen M, Kuflu K, Qutob D, Chernys JT. 2001. A class I chitinase from soybean seed coat. Journal of Experimental Botany 52:2283-2289.

Gilchrist AJ, Juniper BE. 1974. An excitable membrane in the stalked glands of *Drosera capensis* L. Planta 119:143-147.

Godge MR, Purkayastha A, Dasgupta I, and Kumar PP. 2008. Virus-induced gene silencing for functional analysis of selected genes. Plant Cell Reports 27:209-219.

Gould B, Kramer E. 2007. Virus-induced gene silencing as a tool for functional analyses in the emerging model plant *Aquilegia* (columbine, Ranunculaceae). Plant Methods 3(6).

Graham L, Sticklen M. 1994. Plant chitinases. Canadian Journal of Botany 72:1057-1083.

Green S, Green TL, Heslop-Harrison Y. 1979. Seasonal heterophylly and leaf gland features in *Triphyophyllum* (Dioncophyllaceae) a new carnivorous plant genus. Botanical Journal of the Linnaean Society 78:99-116.

Hamel F, Boivin R, Tremblay C, Bellemar G. 1997. Structural and evolutionary relationships among chitinases of flowering plants. Journal of Molecular Evolution 44:614-624.

Harshberger JW. 1925. Notes on the Portuguese insectivorous plant, *Drosophyllum lustanicum*. Proceedings of the American Philosophical Society 64:51-54.

Hatano N, Hamada T. 2008. Proteome analysis of pitcher fluid of the carnivorous plant *Nepenthes alata*. Journal of Proteome Research 7:809-816.

Hein I, Barciszewska-Pacak M, Hrubikova K, Williamson S, Dinesen M, Soenderby IE, Sundar S, Jarmolowski A, Shirasu K, Lacomme C. 2005. Virus-induced gene silencing-based functional characterization of genes associated with powdery mildew resistance in barley. Plant Physiology 138:2155-2164.

Heitz T, Segond S, Kauffmann S, Geoffroy P, Prasad V, Brunner F, Fritig B, Legrand M. 1994. Molecular characterization of a novel tobacco pathogenesis-related (PR) protein: a new plant chitinase/lysozyme. Molecular Genetics & Genomics 245:246-254.

Henry Y, Steer MW. 1985. Acid phosphatase localization in the digestive glands of *Dionaea muscipula* Ellis flytraps. Journal of Histochemistry and Cytochemistry 33:339-344.

Heubl G, Bringmann G, Meimberg H. 2006. Molecular phylogeny and character evolution of carnivorous plant families in Caryophyllales-revisited. Plant Biology 8:821-830.

Hileman LC, Drea S, de Martino G, Litt A, Irish VF. 2005. Virus-induced gene silencing is an effective tool for assaying gene function in the basal eudicot species *Papaver sominiferum* (opium poppy). The Plant Journal 44:334-341.

Hilu KW, Borsch T, Müller K, Soltis PS, Savolainen V, Chase MW, Powell MP, Alice LA, Evans R, Sauquet H, Neinhuis C, Slotta TAB, Rohwer JG, Campbell CS, Chatrou LW. 2003. Angiosperm phylogeny based on *mat*K sequence information. American Journal of Botany 90:1758-1776.

Holzberg S, Brosio P, Gross C, Pogue GP. 2002. Barley stripe mosaic virus-induced gene silencing in a monocot plant. Plant Journal 30:315-327.

Hua Z, Zou C, Shiu SH, Vierstra RD. 2011. Phylogenetic comparison of F-Box (FBX) gene superfamily within the plant kingdom reveals divergent evolutionary histories indicative of genomic drift. PLoS ONE 6:e16219.

Huelsenbeck JP, Nielsen R, Bollback JP. 2003. Stochastic mapping of morphological characters. Systematic Biology 52:131-158.

Huet J, Rucktooa P, Clantin B, Azarkan M, Looze Y, Villeret V, Wintjens R. 2008. X-ray structure of papaya chitinase reveals the substrate binding mode of glycosyl hydrolase family 19 chitinases. Biochemistry 47:8283-8291.

Iseli B, Boller T, Neuhaus JM. 1993. The N-terminal cysteine-rich domain of tobacco class I chitinase is essential for chitin binding but not for catalytic or antifungal activity. Plant and Cell Physiology 103:221-226.

Jach C, Görnhardt B, Mundy J, Logemann J, Pinsdorf E, Leah R, Schell J, Maas C. 1995. Enhanced quantitative resistance against fungal disease by combinatorial expression of different barley antifungal proteins in transgenic tobacco. The Plant Journal 8:97-109.

Jackson AO, Lane LC. 1981. Hordeiviruses. Pp. 565-626. Ch. 520 in E. Kurstak, ed. Plant Virus Infections and Comparative Diagnosis. Elsevier/North Holland Biomedical Press.

Judd WS, Campbell CS, Kellogg EA, Stevens PF. 2002. Plant systematics: a phylogenetic approach. Sinauer Associates, Inc., Sunderland, MA.

Juniper BE, Robins RJ, Joel DM. 1989. The Carnivorous Plants. Academic Press, London, UK.

Katiyar SK, Agarwal R, Mukhtar H. 1996. Inhibition of tumor promotion in SENCAR mouse skin by ethanol extract in *Zingiber officinale* rhizome. Cancer Research 56:1023-1030.

Kawai T, Kinoshita K, Koyama K, Takahashi K. 1994. Anti-emetic principles of *Magnolia obovata* bark and *Zingiber officinale* rhizome. Planta Medicine 60:17-20.

Kiefer F, Arnold K, Künzli M, Bordoli L, Schwede T. 2009. The SWISS-MODEL Repository and associated resources. Nucleic Acids Research 37:D387-D392.

Kita T, Imai S, Sawada H, Kumagai H, Seto H. 2008. The biosynthetic pathway of curcuminoid in turmeric (*Curcuma longa*) as revealed by 13C-labeled precursors. Bioscience, Biotechnology, and Biochemistry 72(7):1789-1798.

Knoll F. 1914. Über die Ursache des Ausgleitens der Insectenbeine an wachsbedekten Pflanzentheilen. Jahrbuch für wissenschaftliche Botanik 54:448-497.

Kumagai MH, Donson J, Della-Cioppa G, Harvey D, Hanley K, Grill LK. 1995. Cytoplamic inhibition of carotenoid biosynthesis with virus derived RNA. Proceedings of the National Academy of Sciences, USA 92:1679-1683.

Leah R, Tommerup H, Svendsen I, Mundy J. 1991. Biochemical and molecular characterization of three barley seed proteins with antifungal properties. Journal of Biological Chemistry 266:1564-1573.

Legrand M, Kauffmann S, Geoffroy P, Fritig B. 1987. Biological function of pathogensis-related proteins: four tobacco pathogenisis-related proteins are chitinases. Proceedings of the National Academy of Sciences, USA 84:6750-6754.

Li H, Greene LH. 2010. Sequence and structural analysis of the chitinase insertion domain reveals two conserved motifs involved in chitin-binding. PLoS ONE 5:e8654. 10.1371/journal.pone.0008654.

Libantová J, Kämäräinen T, Moravcíková J, Matusíková I, Salaj J. 2009. Detection of chitinolytic enzymes with different substrate specificity in tissues of intact sundew (*Drosera rotundifolia* L.): chitinases in sundew tissues. Molecular Biology Reports 36:851-856.

Liu Y, Nakayama N, Schiff M, Litt A, Irish VF, Dinesh-Kumar SP. 2004. Virus induced gene silencing of a DEFICIENS ortholog in *Nicotiana benthamiana*. Plant Molecular Biology 54:701-711.

Lledó MD, Crespo MB, Cameron KM, Fay MF, Chase MW. 1998. Systematics of the Plumbaginaceae based upon cladistic analysis of *rbc*L sequence data. Systematic Botany 23:21-29.

Lloyd FE. 1942. The carnivorous plants. Chronica Botanica Company, Waltham, MA.

Lönnig WE, Becker HA. 2004. Carnivorous Plants. Nature Encyclopedia of Life Sciences doi: 10.1038/npg.els.0003818.

Lüttge U. 1971. Structure and function of plant glands. Annual Review of Plant Physiology 22:23-44.

Lyons E, Freeling M. 2008. How to usefully compare homologous plant genes and chromosomes as DNA sequences. The Plant Journal 53:661-673.

Lyons E, Pederson B, Kane J, Alam M, Ming R, Tang H, Wang X, Bowers J, Paterson A, Lisch D. 2008. Finding and comparing syntenic regions among Arabidopsis and the outgroups papaya, poplar and grape: CoGe with rosids. Plant Physiology 148:1772-1781.

Maddison WP, Maddison DR 2005. MacClade 4. Sinauer Associates, Inc., Sunderland, MA.

Maddison WP, Maddison DR 2010. Mesquite: a modular system for evolutionary analysis. Mesquite v2.74. Available from http://mesquiteproject.org/

Magallón S. 2010. Using fossils to break long branches in molecular dating: a comparison of relaxed clocks applied to the origin of angiosperms. Systematic Biology 59:384-399.

Majeau N, Trudel J, Asselin A. 1990. Diversity of cucumber chitinase isoforms and characterization of one seed basic chitinase with lysozyme activity. Plant Science 68:9-16.

Martin C, Glover BJ. 2007. Functional aspects of cell patterning in aerial epidermis. Current Opinion in Plant Biology 10:70-20.

Matusíková I, Salaj J, Moravcíková J, Mlynárová L, Nap JP, Libantová J. 2005. Tentacles of in vitro-grown round-leaf sundew (*Drosera rotundifolia* L.) show induction of chitinase activity upon mimicking the presence of prey. Planta 222:1020–1027.

Mayer C. 2006-2010. Phobos v3.3.11. Available from http://www.ruhr-uni-bochum.de/ecoevo/cm/cm_phobos.htm

McPherson SR. 2008. Glistening Carnivores: The Sticky-leaved Insect-eating Plants. Poole, Dorset, England: Redfern Natural History Productions Ltd.

McPherson SR. 2010. Carnivorous plants and their habitats. Redfern Natural History Productions, Poole, UK.

Meimberg H. 2002. Molekular-systematische untersuchungen an den familien Nepenthaceae und Ancistrocladaceae sowie verwandter taxa aus der unterklasse Caryophyllidae s. I. PhD diss. Ludwig-Maximilians-Universität München, München, Germany.

Meimberg H, Heubl G. 2006. Introduction of a nuclear marker for phylogenetic analysis of Nepenthaceae. Plant Biology 8:831-840.

Meimberg H, Dittrich P, Bringmann G, Schlaure J, Heubl G. 2000. Molecular phylogeny of Caryophyllidae s. l. based on *mat*K Sequences with special emphasis on carnivorous taxa. Plant Biology 2:218-228.

Meimberg H, Thalhammer S, Brachmann A, Heubl G. 2006. Comparative analysis of a translocated copy of the *trn*K intron in carnivorous family Nepenthaceae. Molecular Phylogenetics and Evolution 39:478-490.

Melchers LS, Apotheker-de Groot M, van der Knaap JA, Ponstein AS, Sela-Buurlage MB, Bol JF, Cornelissan BJ, van den Elzen PJ, Linthorst HJ. 1994. A new class of tobacco chitinase homologous to bacterial exo-chitinases displays antifungal activity. The Plant Journal 5:469-480.

Melchers LS, Sela-Buurlage MB, Vloemans SA, Woloshuk CP, Van Roekel JS, Pen J, van den Elzen PJ, Cornelissen BJ. 1993. Extracellular targeting of the vacuolar tobacco proteins AP24, chitinase and beta-1,3-glucanase in transgenic plants. Plant Molecular Biology 24:583-593.

Metcalfe CR. 1951. The anatomical structure of the Dioncophyllaceae in relation to the taxonomic affinities of the family. Kew Bulletin 6(3):351-368.

Miranda VFO, Martins VG, Furlan A, Bacci M Jr. 2010 Plant or fungal sequences? An alternative optimized PCR protocol to avoid ITS (nrDNA) misamplification. Brazilian Archives of Biology and Technology 53:141-152.

Morrissey SM. 1964. Carbonic anhydrase and acid secretion in a tropical insectivorous plant (*Nepenthes*). International Union of Biochemistry. 32:660.

Nandi O, Chase MW, Endress PK. 1998. A combined cladistic analysis of angiosperms using *rbc*L and non-molecular data sets. Annuals of the Missouri Botanical Garden 79:249-265.

Nei M, Rogozin IB, Piontkivska H. 2000. Purifying selection and birth-and-death evolution in the ubiquitin gene family. Proceedings of the National Academy of Sciences, USA 97:10866-10871.

Neuhaus JM, Fritig B, Linthorst JM, Mikkelsen, JD, Ryals J. 1996. A revised nomenclature for chitinase genes. Plant Molecular Biology Reporter 14(2):102-104.

Neuhaus JM, Pietrzak M, Boiler T. 1994. Mutation analysis of the C-terminal vacuolar targeting peptide of tobacco chitinase: low specificity of the sorting system, and gradual transition between intracellular retention and secretion into the extracellular space. The Plant Journal 5:45-54.

Neuhaus JM, Sticher L, Meins F, Boller T. 1991. A short C-terminal sequence is necessary and sufficient for the targeting of chitinases to the plant vacuole. Proceedings of the National Academy of Sciences, USA 88:10362-10366.

Nicholas KB, Nicholas HB Jr, Deerfield DW II. 1997. GeneDoc: analysis and visualization of genetic variation. *EMBNEW News* 4:14.

Oikawa A, Rahman A, Yamashita T, Taira H, Kidou S-I. 2007. Virus-induced gene silencing of P23k in barley leaf reveals morphological changes involved in secondary wall formation. Journal of Experimental Botany 58:2617-2625.

Owen TP Jr, Lennon KA, Santo MJ, Anderson AN. 1999. Pathways for nutrient transport in the pitcher of the carnivorous plant *Nepenthes alata*. Annals of Botany 84:459-466.

Owen TP Jr, Lennon KA. 1999. Structure and development of the pitchers from the carnivorous plant *Nepenthes alata* (Nepenthaceae). American Journal of Botany 86:1382-1390.

Parkes DM. 1980. Adaptive mechanisms of surfaces and glands in some carnivorous plants. Clayton, Victoria, Australia: Monash University.

Passarinho P, de Vries SC. 2002. *Arabidopsis* chitinases: a genomic survey. The Arabidopsis Book. DOI: 10.1199/tab.0023.

Peitsch MC. 1995. Protein modeling by e-mail. Biotechnology 13:658-660.

Penna SC, Medeiros MV, Aimbire FSC, Faria-Neto HCC, Sertié JAA, Lopes-Martins RAB. 2003. Anti-inflammatory effect of the hydralcoholic extract of *Zingiber officinale* rhizomes on rat paw and skin edema. Phytomedicine 10:381-385.

Petty, ITD, Jackson AO. 1990. Mutational analysis of barley stripe mosaic virus RNA β. Virology 179:712-718.

Petty ITD, Hunter BG, Wei N, Jackson AO. 1989. Infectious barley stripe mosaic virus RNA transcribed in vitro from full-length genomic cDNA clones. Virology 171:342-349.

Petty, ITD, French R, Jones RW, Jackson AO. 1990. Identification of barley stripe mosaic virus genes involved in viral RNA replication and systemic movement. EMBO Journal 9:3453-3457.

Pond SLK, Frost SDW, Muse SV. 2005. HyPhy: hypothesis testing using phylogenies. Bioinformatics 21:676-679.

Posada D. 2008. jModelTest: Phylogenetic Model Averaging. Molecular Biology and Evolution 25:1253-1256.

Quadt R, Kao CC, Browning KS, Hershberger RP, Ahlquist P. 1993. Characterization of a host protein associated with brome mosaic virus RNA-dependent RNA polymerase. Proceedings of the National Academy of Sciences, USA 90:1498-1502.

Rambaut A, Drummond AJ. 2003-2009. Tracer: MCMC trace analysis tool.

Ramirez-Ahumada MC, Timmerman BN, Gang DR. 2006. Biosynthesis of curcuminoids and gingerols in turmeric (*Curcuma longa*) and ginger (*Zingiber officinale*): identification of curcuminoid synthase and hydroxycinnamoyl-CoA thioesterases. Phytochemistry 67:2017-2029.

Ratcliff F, Martin-Hernandez AM, Baulcombe D. 2001. Tobacco rattle virus as a vector or analysis of gene function by silencing. The Plant Journal 25:237-245.

Renner T, Bragg J, Driscoll HE, Cho J, Jackson AO, Specht CD. 2009. Virus-induced gene silencing in the culinary ginger (Zingiber officinale): an effective mechanism for down-regulating gene expression in tropical monocots. Molecular Plant 2(5):1084-1094.

Renner T, Specht CD. 2011. A sticky situation: assessing adaptations for plant carnivory in the Caryophyllales by means of stochastic character mapping. International Journal of Plant Sciences 172:889-901.

Rice B. 2006. Growing Carnivorous Plants. Timber Press, Portland, OR.

Rivadavia F, Kondo K, Kato M, Hasebe M. 2003. Phylogeny of the sundews, *Drosera* (Droseraceae), based on chloroplast *rbc*L and nuclear 18S ribosomal DNA sequences. American Journal of Botany 90:123-130.

Robertson D. 2004. VIGS vectors for gene silencing: Many targets, many tools. Annual Review of Plant Biology 55:495-519.

Robins R, Juniper B. 1980. The secretory cycle of *Dionaea muscipula* Ellis. II. Storage and synthesis of the secretory proteins. New Phytologist 86:297-311.

Ronquist F, Huelsenbeck JP. 2003, MRBAYES 3: Bayesian phylogenetic inference under mixed models. Bioinformatics 19:1572-1574.

Rottloff S, Stieber R, Maischak H, Turini FG, Heubl G, Mithöfer A. 2011. Functional characterization of a class III acid endochitinase from the traps of the carnivorous pitcher plant genus, *Nepenthes*. Journal of Experimental Botany 62:4639-4647.

Rottloff S, Müller U, Kilper R, Mithöfer A. 2009. Micropreparation of single secretory glands from the carnivorous plant Nepenthes. Analytical Biochemistry 349:135-137.

Ruiz MT, Voinnet O, Baulcombe DC. 1998. Initiation and maintenance of virus-induced gene silencing. Plant Cell Physiology 10:937-946.

Saedler H, Becker A, Winter K-U, Kirchner C, Theissen G. 2001. MADS-box genes are involved in floral development and evolution. Acta Biochimica Polonica 48:351-358.

Sakai WS. 1974. Scanning eletron microscopy and energy dispersive x-ray analysis of chalk secreting leaf glands of *Plumbago capensis*. American Journal of Botany 61:94-99.

Samac D, Hironaka C, Yallaly P, Shah D. 1990. Isolation and characterization of the genes encoding basic and acidic chitinase in *Arabidopsis thaliana*. Plant Physiology 93:907-914.

Sang T, Crawford DJ, Stuessy TF. 1997. Chloroplany DNA phylogeny, reticulate evolution, and biogeography of *Paeonia* (Paeoniaceae). American Journal of Botany 84:1120–1136.

Scala J, Schwab D, Simmons E. 1968. The fine structure of the digestive gland of Venus's-flytrap. American Journal of Botany 55:649-657.

Schlauer J. 1997a. Fossil *Aldrovanda*-additions. Carnivorous Plant Newsletter 26:98.

Schlauer J. 1997b. "New" data relating to the evolution and phylogeny of some carnivorous plant families. Carnivorous Plant Newsletter 26:34-38.

Schlumbaum A, Mauch F, Vögeli U, Boller T. 1986. Plant chitinases are potent inhibitors of fungal growth. Nature 324:365-367.

Schultze M, Staehelin C, Brunner F, Genetet I, Legrand M, Fritig B, Kondorosi E, Kondorosi A. 1998. Plant chitinase/lysozyme isoforms show distinct substrate specificity and cleavage site preference towards lipochitooligosaccharide Nod signals. The Plant Journal 16:571-580.

Schwartz-Sommer Z, Huijser P, Nacken W, Saelder H, Sommer H. 1990. Genetic control of flower development by homeotic genes in *Antirrhinum majus*. Science 250:931-935.

Scofield SR, Huang L, Brandt AS, Gill BS. 2005. Development of a virus-induced gene-silencing system for hexaploid wheat and its use in function analysis of the Lr21-mediated leaf rust resistance pathway. Plant Physiology 138:2165-2173.

Scofield SR, Nelson RS. 2009. Resources for virus induced silencing in the grasses. Plant Physiology 149:152-157.

Shaw HKA. 1951. On the Dionophyllaceae, a remarkable new family of flowering plants. Kew Bulletin 6:327-347.

Shen Q-H, Saijo Y, Mauch S, Biskup C, Bieri S, Keller B, Seki H, Ulker B, Somssich IE, Schulze-Lefert P. 2007. Nuclear activity of MLA immune receptors links isolate-specific and basal disease-resistance responses. Science 315:1098-1103.

Shi S, Huang Y, Zhong Y, Du Y, Zhang Q, Chang HT, Boufford DE. 2001. Phylogeny of the Altingiaceae based on cpDNA *mat*k, PY-IGS and nrDNA ITS sequences. Plant Systematics and Evolution 230:13-24.

Shinshi H, Neuhaus JM, Ryals J, Meins F. 1990. Structure of a tobacco endochitinase gene: evidence that different chitinase genes can arise by transposition of sequences encoding a cysteine-rich domain. Plant Molecular Biology 14:357-368.

Sindhu A, Chintamanani S, Brandt AS, Zanis M, Scofield SR, Gohal GS. 2008. A guardian of grasses: Specific origin and conservation of a unique disease-resistance gene in the grass lineage. Proceedings of the National Academy of Sciences, USA 105:1762-1767.

Soltis DE, Soltis PS, Chase MW, Mort ME, Albach DC, Zanis M, Savolainen V, Hahn WH, Hoot SB, Fay MF, Axtell M, Swensen SM, Prince LM, Kress WJ, Nixon KC, Farris JS. 2000. Angiosperm phylogeny inferred from a combined data set of 18S rDNA, *rbc*L and *atp*B sequences. Botanical Journal of the Linnaean Society 133:381-461.

Specht CD. 2005. Phylogenetics, floral evolution and rapid radiation in the tropical monocot family Costaceae (Zingiberales). Scientific Publications, Inc., Calcutta.

Specht CD. 2006. Key Innovations and diversification rates across all Zingiberales: a supertree approach. Botany 2006, Botany 2006, Chico, CA: abstract.

Sprague TA. 1916. *Dioncophyllum*. Kew Bulletin of Miscellaneous Information 1916(4):89-92.

Stoltzfus A, Suda J, Kettering R, Wolfe A, Williams S. 2002. Secretion of digestive enzymes in *Plumbago*. The 4th International Carnivorous Plant Conference. Tokyo, Japan.

Sukumaran J, Holder MT. 2010. DendroPy: A Python library for phylogenetic computing. Bioinformatics 26:1569-1571.

Tai YS, Bragg J, Edwards MC. 2005. Virus vector for gene silencing in wheat. BioTechniques 39:310-314.

Tan F, Shi S, Zhong Y, Gong X, Wang Y. 2002. Phylogenetic relationships of Combretoideae (Combretaceae) inferred from plastid, nuclear gene and spacer sequences. Journal of Plant Research 115:475-481.

Tang CM, Chye M, Ramalingam S, Ouyang S, Zhao K, Ubhayasekera W, Mowbray SL. 2004. Functional analyses of the chitin-binding domains and the catalytic domain of *Brassica juncea* chitinase BjCHI1. Plant Molecular Biology 56:285-298.

Tate JA, Simpson BB. 2003. Paraphyly of Tarasa (Malvaceae) and diverse origins of the polyploid species. Systematic Botany 28:723-737.

Taylor CM, Gereau RE, Walters GM. 2005. Revision of *Ancistrocladus* Wall. (Ancistrocladaceae). Annals of the Missouri Botanical Garden 92:360-399.

Theissen G. 2001. Development of floral organ identity: stories from the MADS house. Current Opinion in Plant Biology 4:75-85.

Thompson JD, Higgins DG, Gibson TJ. 1994. CLUSTAL W: improving the sensitivity of progressive multiple sequence alignments through sequence weighting, position specific gap penalties and weight matrix choice. Nucleic Acids Research 22:4673-4680.

Tiffen P. 2004. Comparative evolutionary histories of chitinase genes in the genus Zea and family Poaceae. Genetics 167:1331-1340.

Verburg JG, Huynh QK. 1991. Purification and characterization of an antifungal chitinase from *Arabidopsis thaliana*. Plant Physiology 95:450-455.

Verburg JG, Rangwala SH, Samac DA, Luckow VA, Huynh QK. 1993. Examination of the role of tyrosine-174 in the catalytic mechanism of the *Arabidopsis thaliana* chitinase: comparison of variant chitinases generated by site-directed mutagenesis and expressed in insect cells using baculovirus vectors. Archives of Biochemistry and Biophysics 300:223-230.

Verburg JG, Smith CE, Lisek CA, Huynk QK. 1992. Identification of an essential tyrosine residue in the catalytic site of chitinase isolated from *Zea mays* that is selectively modified during inactivation with 1-ethyl-3-(3-dimethylaminopropyl)-carbodiimide. The Journal of Biological Chemistry 267:3886-3893.

Wege S, Scholz A, Gleissberg S, Becker A. 2007. Highly efficient virus-induced gene silencing (VIGS) in California poppy (*Eschscholzia californica*): An evaluation of VIGS as a strategy to obtain functional data from non-model plants. Annals of Botany 100:641-649.

White TJ, Bruns TS, Taylor LJ. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. Pp. 315-322 in Innis M, Sninsky J, White T, eds. PCR protocols: a guide to methods and applications. Academic Press, San Diego, CA.

Wiens JJ. 2003. Missing data, incomplete taxa, and phylogenetic accuracy. Systematic Biology 52:528-538.

Williams SE. 1976. Comparative sensory physiology of the Droseraceae-the evolution of a plant sensory system. Proceedings of the American Philosophical Society 120:187-204.

Williams SE, Albert VA, Chase MW. 1994. Relationships of Droseraceae: A cladistic analysis of *rbc*L sequence and morphological data. American Journal of Botany 81:1027-1037.

Wilson J. 1890. The mucilage- and other glands of the Plumbagineae. Annuals of Botany 4:231-258.

Wu S, Kriz AL, Widholm JM. 1994. Molecular analysis of two cDNA clones encoding acidic class I chitinase in maize. Plant Physiology 105:1097-1105.

Xu F, Fan C, He Y. 2007. Chitinases in *Oryza sativa* ssp. japonica and *Arabidopsis thaliana*. Journal of Genetics and Genomics 34:138-150.

Yang Z. 2007. PAML 4: phylogenetic analysis by maximum likelihood. Molecular Biology and Evolution 24:1586-1591.

Zhang JZ, Nielsen R, Yang ZH. 2005. Evaluation of an improved branch-site likelihood method for detecting positive selection at the molecular level. Molecular Biology and Evolution 22:2472-2479.

Zhao M, Ma Y, Pan Y-H, Zhang C-H, Yuan W-X. 2011. A hevein-like protein and a class I chitinase with antifungal activity from leaves of the paper mulberry. Biomedical Chromatography 25:908-912.

Zhou H, Li S, Deng Z, Wang X, Chen T, Zhang J, Chen S, Ling L, Zhang A, Wang D, Zhang X. 2007. Molecular analysis of three new receptor-like kinase genes from hexaploid wheat and evidence for their participation in the wheat hypersensitive response to stripe rust fungus infection. The Plant Journal 52:420-434.

Zhu X, Dinesh-Kumar SP. 2008. Chapter 43: Virus-induced gene silencing as a tool to identify host genes affecting viral pathogenicity. Pp. 641-648 in Foster GD, Johansen IE, Hong Y, Nagy PD, eds. Methods in Molecular Biology. Humana Press, Totowa, NJ.

Zwickl DJ. 2006. Genetic algorithm approaches for the phylogenetic analysis of large biological sequence datasets under the maximum likelihood criterion: The University of Texas at Austin.

Appendices

A.1

Voucher information for collected specimens utilized in chapter 1

The voucher information includes the names of taxa used in this study, details of the tissue collection, herbaria where the vouchers are deposited, and GenBank accession numbers for the sequences of ITS, PY-IGS, *atp*B, *mat*K, *pet*B, PTR1, *rbc*L, and *mat*K. Greenhouse-grown specimens cultivated at the Botanical Gardens of the University of California, Berkeley, California Carnivores, Missouri Botanical Garden or elsewhere are noted after the voucher information. California Carnivores, Sebastopol, CA (Peter D'Amato) = CC, Indonesian Institute of Sciences/Center for Plant Conservation-Bogor Botanical Gardens = LIPI/CPCBG, Missouri Botanical Garden = MO, Botanical Garden of the University of California, Berkeley = UCBG, Botanischer Garten der Universität Würzberg = BGW. Voucher specimens are deposited in the following herbaria: Missouri Botanical Garden = MO, The University and Jepson Herbaria of the University of California, Berkeley = UC, Universität Würzberg = UW. Dashes indicate missing data.

Taxon; ITS, PY-IGS, *atp*B, *mat*K, *pet*B, PTR1, *rbc*L, *mat*K; Voucher specimen or living collection number; DNA collection number; Collection locale; Herbarium.

Aldrovanda vesiculosa; HM204865, HM204823, AY096108, AY096120, –, –, AY096106, –; –; TR174; USA, New Jersey, cultivated (R. Sivertsen); UC.

Ancistrocladus abbreviatus; HM204866, –, –, AF204840, FN598602, –, –, AF315939; 97-12-B-10; TR114; BGW, cultivated; UW. *Ancistrocladus barteri*; HM204867, HM204824, –, –, –, –, –, –; 05-87-B-10; TR118; BGW, cultivated; UW. *Ancistrocladus benomensis*; HM204868, HM204825, –, –, –, –, –, –; 00-54-B-20; TR117; BGW, cultivated; UW. *Ancistrocladus cochinchinensis*; HM204869, HM204826, –, –, –, –, –, –; 04-96-B-20; TR120; BGW, cultivated; UW. *Ancistrocladus congolensis*; HM204870, –, –, –, –, –, –, –; 00-29-B-10; TR119; BGW, cultivated; UW. *Ancistrocladus grandiflorus*; HM204871, HM204827, –, –, –, –, –, –; R.E. Gereau 5557; TR122; MO, cultivated; MO. *Ancistrocladus guineensis*; HM204872, HM204828, –, –, –, –, –, –; R.E. Gereau 5546; TR125; MO, cultivated; MO. *Ancistrocladus hamatus*; HM204873, HM204829, –, –, –, –, –, –; TR113; LIPI/CPCBG, cultivated; –. *Ancistrocladus heyneanus*; HM204874, HM204830, –, AF204841, –, –, –, GQ470529; 95-49-B-10; TR115, BGW, cultivated; UW. *Ancistrocladus korupensis;* HM204875, HM204831, AF209526, AF204839, –, –, Z97636, GQ470536; 99-3-B-10; TR116; BGW, cultivated; UW. *Ancistrocladus letestui*; –, HM204832, –, –, –, –, –, –; R.E. Gereau 5566; TR123; MO, cultivated; MO. *Ancistrocladus robertsoniorum*; HM204876, HM204833 –, –, –, –, –, –; K.M. Meyer 277; TR124; MO, cultivated; MO.

Dionaea muscipula; HM204877, HM204834, AY096112, –, FN598597, –, DONCPRBCL, –; 2009.0254; TR186; UCBG, cultivated; UC.

Dioncophyllum tholloni; HM204878, HM204835, –, AF204844, –, –, –, –; G. Walters 1948; TR187; Gabon, Haut-Ogooué, Batéké Plateaux; MO.

Drosera binata; HM204879, HM204836, –, –, –, –, DRSCPRBCL, –; 2001.0104; TR03; UCBG, cultivated; UC. *Drosera capensis*; HM204880, –, –, AY096122, –, –, DRSCPRBCB, –; 69.0172; TR05; UCBG, cultivated; UC. *Drosera dielsiana*; HM204881, –, –, –, –, –, –, –; TR0004;

TR41; CC, cultivated; UC. *Drosera falconeri*; HM204882, –, –, –, –, –, –, –; TR0073; TR112; CC, cultivated; UC. *Drosera graminifolia*; HM204883, –, –, –, –, –, –, –; TR0015; TR53; CC, cultivated; UC. *Drosera hamiltonii*; HM204884, –, –, –, –, –, –, –; TR0009; TR47; CC, cultivated; UC. *Drosera nidiformis*; HM204885, –, –, –, –, –, –, –; TR0003; TR40; CC, cultivated; UC. *Drosera paleacea*; HM204886, –, –, –, –, –, –, –; TR0011; TR49; CC, cultivated; UC. *Drosera regia*; HM204887, HM204837, AY096111, AF204848, FN598596, –, DRSCPRBCG, –; TR0002; TR39; CC, cultivated; UC. *Drosera rotundifolia*; HM204888; HM204838, –, –, AB298084, –, AB072538, –; TR0024; TR62; CC, cultivated; UC. *Drosera slackii*; HM204889, –, –, –, –, –, –, –; TR0001; TR38; CC, cultivated; UC.

Drosophyllum lusitanicum; HM204890; HM204839, AY096113, AF204846, FN598600, –, DRHCPRBCLA, AY514860; TR0023; TR61; CC, cultivated; –.

Limonium; EU410356, –, AF209620, AY042610, FN598585, –, AF206789, AY514861; –; –; –; –.

Nepenthes alata; HM204891, HM204840, AF093388, AF204834, –, AF080545, NETCPRBCL, AF315891; 87.0830; TR09; UCBG, cultivated; UC. *Nepenthes albomarginata*; HM204892, HM204841, –, –, –, –, –, –; 95.1376; TR10; UCBG, cultivated; UC. *Nepenthes boschiana*; HM204893, HM204842, –, –, –, –, –, –; 2004.0625; TR11; UCBG, cultivated; UC. *Nepenthes glandulifera*; HM204895, HM204844, –, –, –, –, –, –; 2005.1319; TR14; UCBG, cultivated; UC. *Nepenthes gracillima*; HM204896, HM204845, –, –, –, –, –, –; 95.1453; TR15; UCBG, cultivated; UC. *Nepenthes gymnamphora*; HM204897, HM204846, –, –, –, –, –, –; 95.1499; TR16; UCBG, cultivated; UC. *Nepenthes hirsuta*; –, HM204847, –, –, –, –, –, –; 93.0479; TR17; UCBG, cultivated; –. *Nepenthes insignis*; HM204898, HM204848, –, –, –, –, –, –; 95.1399; TR19; UCBG, cultivated; UC. *Nepenthes macfarlanei*; HM204900, HM204850, –, –, –, –, –, –; 95.1300; TR21; UCBG, cultivated; –. *Nepenthes maxima*; HM204901, HM204851, –, –, –, –, –, –; 76.1342; TR22; UCBG, cultivated; UC. *Nepenthes mirabilis*; HM204902, HM204852, –, –, –, –, –, –; 95.1378; TR23; UCBG, cultivated; UC. *Nepenthes northiana*; HM204903, HM204853, –, –, –, –, –, –; 95.1124; TR24; UCBG, cultivated; UC. *Nepenthes rafflesiana*; HM204904, HM204854, –, –, –, –, –, –; 69.0037; TR25; UCBG, cultivated; UC. *Nepenthes reinwardtiana*; HM204905, HM204855, –, –, –, –, –, –; 87.0822; TR26; UCBG, cultivated; –. *Nepenthes sanguinea*; HM204906, HM204856, –, –, –, –, –, –; 95.1297; TR27; UCBG, cultivated; UC. *Nepenthes singalana*; HM204907, HM204857, –, –, –, –, –, –; 95.1292; TR29; UCBG, cultivated; UC. *Nepenthes spectabilis*; HM204908, HM204858, –, –, –, –, –, –; 95.1516; TR31; UCBG, cultivated; UC. *Nepenthes tentaculata*; HM204909, HM204859, –, –, –, –, –, –; 93.0483; TR32; UCBG, cultivated; UC. *Nepenthes tobiaca*; –, HM204860, –, AF204829, –, DQ840233, –, AF315899; 95.1501; TR33; UCBG, cultivated; UC. *Nepenthes truncata*; HM204910, HM204861, –, –, –, –, –, –; 87.0829; TR34; UCBG, cultivated; UC. *Nepenthes ventricosa*; HM204911, HM204862, –, AF204833, –, –, FJ860397, AF315892; 91.1046; TR35; UCBG, cultivated; UC. *Nepenthes vieillardii*; HM204912, HM204863, –, –, –, AB232943, AB103319, AF315897; 95.1349; TR37; UCBG, cultivated; UC.

Polygonum; GQ206260, EU840331, AJ235569, EF438020, FN598591, –, AF297127, EF653710; –; –; –; –.

Triphyophyllum peltatum; HM204913, HM204864, –, AF204843, FN598601, –, –, AF315940; UW plant culture; TR121; BGW, cultivated; –.

A.2

Multiple sequence alignment of combined nDNA, nrDNA, and cpDNA molecular marker phylogenetic reconstruction for the carnivorous Caryophyllales

The following 21 pages consist of a multiple sequence alignment of combined nDNA, nrDNA, and cpDNA molecular marker phylogenetic reconstruction for the carnivorous Caryophyllales. ITS = 1 - 1705; PYIGS = 1706 - 3075; *atp*B = 3076 - 4583; *pet*B = 4584 - 5721; *mat*K = 5722 - 7185; PTR1 = 7186 - 8975; *rbc*L = 8976 - 11142; *trn*K = 11143 - 13773. GAP = - and MISSING = ? The following sites were excluded for analyses: 1 - 32, 55 - 79, 91 - 608, 629 - 909, 1082 - 1191, 1217 - 1258, 1290 - 1353, 1376 - 1639, 1671 - 1705, 1925 - 1960, 2035 - 2199, 2355 - 2889, 3076 - 3134, 4530 - 4583, 4584 - 4601, 5706 - 5721, 5722 - 6035, 7181 - 7185, 7186 - 7306, 8892 - 8975, 8976 - 9774, 11081 - 11142, 11143 - 11150, 11779 - 11835, 12196 - 12217, 13487 - 13518, 13535 - 13553, 13766 - 13773.

```
                              1        10        20        30        40        50        60        70        80        90        100       110       120       130       140       150       160
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATT-GTCGAAACCT-GCATAGCAGAAC--GACCC-GCGAACATGTT-------------------------------------------------------------------------------
Ancistrocladus_korupensis     AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATT-GTCGAAACCT-GCATAGCAGAAT--GACCC-GCGAACATGTT-------------------------------------------------------------------------------
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????CCCCTGATCTTCG
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                GAGTCGTAACAAGGTT--CCGTAGGTGAAC--TGCGGAAGGATCATT-GTCGAAGCCC--------TGGTATGACTC-GCGAACTTGTAAACTAAAATGAAAGG-GGGGAAG-----------------CCTTCTCCCCCCTTGC---TGCGGGGCTGTACCC------
Drosera_capensis              ?????????????????????????????CC-TGCGGAAGGATCATT-GTCGAAACCCCGACCGAAACGAGCTGACTT-GCGCACGTGTCAACC-AAATAGAGGG-GATGGGCGTGTCGTGCG-AGGGGTCCCTCCTCGTCGCC---TCCCCGCCCCCCCCTCGAATG
Drosera_regia                 ?????????????????????????????????????????????????????????????????????????ACTT-GTGAACATGTTAACTAAAATATGGGTGGGGGGTG-----------------TCTTTT------TGGCACCTGC----CTG--CCCTG----
Drosera_rotundifolia          ??????????????????????????????????????????????????AAACCCTCGATCGAAACGAGCCGACCC-GCGCACGTGTCAACC-AATCGGAGGG-GACGG-AGCGCGTCGCGCGAGAGACCCCTCCGCGTCGCC---TCCCCCCCC-----TCGAATG
Drosophyllum_lusitanicum      ????????????GGTTT-C-GTAGGTGA-CC-TGCGGAAGGATCATTGTCG-AA-ACCT-GTCCATGAGAA---A--CCGCGAACACGTG-------------------------------------------------------------------------------
Limonium                      ??????????????????CCGTAGGTGAACC-TGCGGAAGGATCATTGTCG-AA-ACTT-ACACAACAAGACC-ATTT-GTGAACTTGTT-------------------------------------------------------------------------------
Nepenthes_alata               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ??????????????????????????????????????????CCATT-GTCGAA-AATT-GCCAAGCAGAGCG-ACCC-GCGGACATGTT-------------------------------------------------------------------------------
Nepenthes_vieillardii         ???????????????????????????????????????????????????????????????????????????CCC-GCGGACATGTT-------------------------------------------------------------------------------
Polygonum                     ??????????????????????????????????????????????????G-AA-ACCT-GCGAAAGCAGAAAGACCC-GCGAACATGTTG------------------------------------------------------------------------------
Triphyophyllum_peltatum       AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATTGTCG-AA-ACCT-GCACAGCAGAAC--ATCCCGCGAACTCGTT-------------------------------------------------------------------------------
                              170       180       190       200       210       220       230       240       250       260       270       280       290       300       310       320       330
Aldrovanda_vesiculosa         ??????????????????????TCTTCCGCGGCAC-------CGTCC--GGTAG-AGCGGAAA-G-GTGTGCGCCTGGCGCGGCGACTTAACAA-CAATC---------------------------------------------------------------------
Ancistrocladus_abbreviatus    ???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????CCCC---CAC-CTTGGAGGCCCC-GCTTCCTGCTGTTTGGGG
Ancistrocladus_heyneanus      ----------------------------------------------------------------------------------------------------ACATAAAATG--CACAGGTGCGG--AGCCC---CAC-CTTGGAGGCCCC-GCTTCCTGCTGTTTGGGG
Ancistrocladus_korupensis     ----------------------------------------------------------------------------------------------------ACTTAAAATG--CACAGGTGCGG--AGCCC---CAC-CTTGGAGGCCCC-GTTTCCTGCTGTTTGGGG
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             TGCTTGCA-CCCTCTACT-CCCTCGGCGATGCCCC----CTTGCTGGGTGATCGTTCCGTCGA-G-TGGGGTGTCTTGTGCAGAGCCTTAACAA-CACCC---------------------------------------------------------------------
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????CG-----TGT---C-C-CGT-GACGCAGC-----------GT------
Drosera_binata                -GTTGTCG-GCTCGG-----------CAT-CTCC------ATATGCG-GGATG-TCCGCCGT-ATGACGGTTTCATGCCCCGCTAAACAACCA-AACCC---------------------------------------------------------------------
Drosera_capensis              TCGTCCTG-GCGTGGTCGCGAGGCGG-CTCCTTCG---CTTTATGCG-GGATG-CTTGTCGA-GCGGCGACGATAGGT-CGGCAGCACAACAA-AACCC---------------------------------------------------------------------
Drosera_regia                 -GATGCCGGGCTGGG-----------C---CCCCT-----GTGAGCG-GGGGG---GCCAC-GCG-CGG------------CGCCA--CAAC-GTAACCC---------------------------------------------------------------------
Drosera_rotundifolia          TCGTCCTG-GCGTTGTCGCGAGGCGGGCACCTTCG---CTCCGTGTG-GGGTG-CTTGTCGA-GCGGCGACGATAGGTGCGGCAGCACAACCA-AACCC---------------------------------------------------------------------
Drosophyllum_lusitanicum      ----------------------------------------------------------------------------------------------------ACACAACAAAAT-CGGG---GAAGGA-TCT---C-CTTATCA-AG--GGGTCTTT-----G-------
Limonium                      ----------------------------------------------------------------------------------------------------TTAT------------------------CTT---T-C-C----CATAGC-T----------G-------
Nepenthes_alata               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_vieillardii         -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Polygonum                     ----------------------------------------------------------------------------------------------------TTAAA------------------------CT-AAAAGC-C----CG-GGC-TC--------A-------
Triphyophyllum_peltatum       ----------------------------------------------------------------------------------------------------GCATAACAAA--TGCGGGTGCGAG---CCT---C-C-CATGA-CGTAGCGTC--------G-------
                               340       350       360       370       380       390       400       410       420       430       440       450       460       470       480       490       500
Aldrovanda_vesiculosa         -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Ancistrocladus_abbreviatus    ACGAGTCTCTCGTGATGCAA--CGTTGTGCTACTTGGGC-CAACGATGTGC---A-TG-AT------------------GGCT------TG-------------G-CCCTAACC--CAA---TAATA-AACAT------------------------------------
Ancistrocladus_heyneanus      ACGAGTCTGTCGTGATGCAA--TGTTGTGCTACTTGGGC-CAACGATGTGC---A-CG-GT------------------GGCT------TG-------------C-CCCTAACC--CAA---TAATA-AACAT------------------------------------
Ancistrocladus_korupensis     ACGAGTCTC--GTGATGCAA--CGTTGTGCTACTTGGGC-CAATGATGTGC---A-TG-AT------------------GGCT------TG-------------C-CCCTGACC--CAA---TAATA-AACAT------------------------------------
Ancistrocladus_robertsoniorum ?????T-TC--GTGATGCAA--CGTTGTGCTACTTGAGC-CAACGATGTGC---A-TG-AT------------------GGCT-----TGC-------------C-CCCTGACC--CAA---TAATA-AACAT------------------------------------
Dionaea_muscipula             -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Dioncophyllum_thollonii       -CG--CCCCTC----------------------------------------------------------------------------------------------------------------------------------------C------GGGGT----C---GG
Drosera_binata                -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Drosera_capensis              -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Drosera_regia                 -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Drosera_rotundifolia          -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Drosophyllum_lusitanicum      ----------------CCTCT-GATAT----C---GG-G-----ACGTGCCTCAT-GA-TGCGATGCAGCCATTTTTGAGCTATCCT-TGCACACGTAGGCATGTCCTT-GACCC-AAACAGAA-AA---CCC------------------------------------
Limonium                      ---------------------------------------------------------------------------------------------------------------------------------------------------C------GGGGT---TT--GG
Nepenthes_alata               ???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????TCGTCGGGGC--ACGGCGTCGAACGT
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ---------------------------------------------------------------------------------------------------------------------------------------GAAATAAATCGTCGGGGC--ACGGCGTCGAACGT
Nepenthes_vieillardii         ---------------------------------------------------------------------------------------------------------------------------------------GAAACAAATCGTCGGGGC--ACGGCGTCTAACGC
Polygonum                     ---------------------------------------------------------------------------------------------------------------------------------------------------C------AAGGC----TC--GG
Triphyophyllum_peltatum       ---------------------------------------------------------------------------------------------------------------------------------------------------CCCCTCCGAGGT----C---GG
                                510       520       530       540       550       560       570       580       590       600       610       620       630       640       650       660       670
Aldrovanda_vesiculosa         ----------------------------------------------------------------------------------------------------AGGCGCGGATGCGCCAAGGACAATGG---A---TGCTTTGACATGC--CTTTGCCCCT----TCTGT
Ancistrocladus_abbreviatus    ----------------------------------------------------------------------------------------------------CGGCGCGGATTGCGCCAAGG-------------------------------------------------
Ancistrocladus_heyneanus      ----------------------------------------------------------------------------------------------------CGGCGCGGATTGCGCCAAGG-------------------------------------------------
Ancistrocladus_korupensis     ----------------------------------------------------------------------------------------------------CGGCGCGGATTGCGCCAAGG-------------------------------------------------
Ancistrocladus_robertsoniorum ----------------------------------------------------------------------------------------------------CGGCGCGGATTGCGCCAAGG-------------------------------------------------
Dionaea_muscipula             ----------------------------------------------------------------------------------------------------CGGCGCGAGTCGCGCCAAGGACGATTG---A--TAT---GATGAGCA--CGATCCCCC----GTTAT
Dioncophyllum_thollonii       C-A----ACGCGC---G-----CG-GC----------------------------------------------TGCTCGCCCTCGAGCTAATAACGAACCCGGCGCGGACCGCGCCAAGGAACA-TG------A-----------------------------------
Drosera_binata                ----------------------------------------------------------------------------------------------------GGGCGCAGGCTGCGCCAAGGAAAA-CG---G---AAG-CAATAGGCT-TGCCCTCTCCC----CACAC
Drosera_capensis              ----------------------------------------------------------------------------------------------------CGGCGCAAGTCGCGCCAAGGAAAA-TG---G---ATA--TACAACC--TGCGCGCTCCC----CGT--
Drosera_regia                 ----------------------------------------------------------------------------------------------------CGGCGCCGGACGCGCCAAGGAAGA-TGGATATG-AAG-----AG---TGCGCTCCCCCATTGCTGGC
Drosera_rotundifolia          ----------------------------------------------------------------------------------------------------CGGCGCAAGTCGCGCCAAGGAAAA-TG---G---ATA--TACAACC--TCCGCGCTCCC----CGC--
Drosophyllum_lusitanicum      -----------------------------------------------------------------------------------------------------GGCGTGAACAACGCCAAGGAACA-TG------A----AT-CGT-----AG-----------------
Limonium                      -------ACGTGT---ATCCCTTG--T---------------------------------------GGTTCCTTTCCTTCCTCCGCGGTTGAACATTGTGCGACGCGGAATGCGTCAAGGAACA-TG------AACG----CAACTTTC--------------------
Nepenthes_alata               GGCAC-GGCACCCTCGACTGCCGGC-GGACCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGATGCGGGGCAAGGCTTGGCACAAGAACGAACCCGGGCGCGGATCGCGCCAAGG-------------------------------------------------
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          GGCAC-GGCGCCCTCGACTGCCGGCCGAGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGATGCGGGGCAAGGCTTGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAG--------------------------------------------------
Nepenthes_vieillardii         GGCAC-GGTGCCCTCGACCGCCGGCCGAGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGTGCGGGGCAAGGCTTGGCACAAGAATGAACCCCGGCGCGGATCGCGCCAAGG-------------------------------------------------
Polygonum                     C------AC---------C-----------------------------------------------------------------------AACAAAACCCCGGCGCGGATTGCGCCAAGGACCA-TG------AACA----TGAG---C--------------------
Triphyophyllum_peltatum       CG-----ACGCGC---AT-----GA-T----------------------------------------------GGCTCGCCCTTCAACTAATAACAACCCCCGGCGCAGACTGCGCCAAGGAACA-TG------AGCAAA--CAA-----AG-----------------
```

```
                                  680       690       700       710       720       730       740       750       760       770       780       790       800       810       820       830       840
Aldrovanda_vesiculosa          C-TGGTTCTTGGACCAGGGGATAGGGGACGGCAAT-GCGCTGTACGCGCGA-GATTGACAC------------------------------------------------------------------------------------------------------------
Ancistrocladus_abbreviatus     -------------------------------------------------------------AATATGAGCA-AAAAGCGTGCTTCCTCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAGCGTTTCA-CATTATAAACAAAC---------------------------
Ancistrocladus_heyneanus       -------------------------------------------------------------AATATGAGCA-AAAAGCGTGCTTCCCCGCTTCCGGTTTCTCGGCATGCGGTGGTAGCAGCGTTTCA-CATTATAAACAAAC---------------------------
Ancistrocladus_korupensis      -------------------------------------------------------------AATATGAGCA-AAAGGCGTGCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAACGTTTCA-CATTATAAACAAAC---------------------------
Ancistrocladus_robertsoniorum  -------------------------------------------------------------AATATGAGCA-AAAAGCGTGCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAACGTTTCA-CATTATAAACAAAC---------------------------
Dionaea_muscipula              C--GGTTATTGATCCGATAAGAA-GGGGTGTGTATCGTGCTCTTTTAG-TT-GACCAAAAT------------------------------------------------------------------------------------------------------------
Dioncophyllum_thollonii        ----------------------------------------------------------------------------------------------------------------------------------------------ACAAAGAGCGCGCC-C---C-CCGTGT
Drosera_binata                 GTTTGTTTCGGCAGCGGGG------GGGATGGTGA--TGCCGTCATCGGCAT--AA-AGAT------------------------------------------------------------------------------------------------------------
Drosera_capensis               --CGGCTTAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATAATAGAT------------------------------------------------------------------------------------------------------------
Drosera_regia                  TTTTGCTCCGGCAATCGG-------GGGACAGCGTTGTGTCGTCATCGGCACT-----GAT------------------------------------------------------------------------------------------------------------
Drosera_rotundifolia           --CGGCTCAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATAAGAGAT------------------------------------------------------------------------------------------------------------
Drosophyllum_lusitanicum       ----------------------------------------------------------------------------------------------------------------------------------------------C------------GTGC-CCACCT---
Limonium                       ----------------------------------------------------------------------------------------------------------------------------------------------AC-----------CTTCGTGCACCTGT
Nepenthes_alata                ----------------------------------------------------------------------------------------------------------------------------------------------AACGGTAACATAGC-G---T-GCGTTG
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           ----------------------------------------------------------------------------------------------------------------------------------------------------AACATAGC-G---T-GCGTTG
Nepenthes_vieillardii          ----------------------------------------------------------------------------------------------------------------------------------------------AACGGTAACATAGC-G---T-GCGCTG
Polygonum                      -----------------------------------------------------------------------------------------------------------------------------------------------------------GCGCCCCGCCCCGC
Triphyophyllum_peltatum        ----------------------------------------------------------------------------------------------------------------------------------------------A------------GTGCGCCGCCTTGT

                                   850       860       870       880       890       900       910       920       930       940       950       960       970       980       990       1,000     1,010
Aldrovanda_vesiculosa          ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGGACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Ancistrocladus_abbreviatus     ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Ancistrocladus_heyneanus       ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Ancistrocladus_korupensis      ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Ancistrocladus_robertsoniorum  ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Dionaea_muscipula              ----------------------------------------------------------------GACTCTCGGCAACGGATATCTAGGCTCTCGCATCGATGAAGGACGTAGCAAAGTGCGATAAATGGTGTGAATTGCAGAATCCC-GTGAA-CCATCAAGTCTTTGA
Dioncophyllum_thollonii        --CCGGCC--CACCGGCA-CAC--GGCGGCTGCGGCGTC--CGACATTAT-GA---GA--GAACGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosera_binata                 ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosera_capensis               ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosera_regia                  ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosera_rotundifolia           ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosophyllum_lusitanicum       CCG--GTG--CGCCGGTGTGTG--GGTAGGTGA--CGCC--TTACA-CGA-AA--AAT--GAACGACTCTCGACAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Limonium                       TTGTTGCT--T---GGA-------GGTG-TTGC-TTCGTTGAAATA--CCAAATACAA--AAATGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Nepenthes_alata                --CCTTGC--CGCCGGATGCCT--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGGATATCTCGGCTATCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCCCGTGAA-CCATCGAGTCTTTGA
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           --CCTTGC--CGCCGGATGCCT--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---TT--GAACGACTCTCGGCAACGGATATCTCGGCTATCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Nepenthes_vieillardii          --CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Polygonum                      CGG--GCCTCCGGCGGACGC--GGCGGCGTCGT-GTCGTT--TCTA--CCA--TAAAACAGAACGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Triphyophyllum_peltatum        CCG--GCC--CACCGGAACGC---GGCGGCTGCGACGTC--TAATATTCTAAG----A--GAACGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA

                                    1,020     1,030     1,040     1,050     1,060     1,070     1,080     1,090     1,100     1,110     1,120     1,130     1,140     1,150     1,160     1,170     1,180
Aldrovanda_vesiculosa          ACGCAAGTTGCACCCGAGGC-C-ACCAAGGCTAAGGGCACGTCTGCCTGGGTGTCACCTAGACCCTCACCAAAC-CCGGG---TTCACTT--CAGCGGAAGT-------------------------------------------------------------------
Ancistrocladus_abbreviatus     ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------------------------------GCCCCTACACCCTACGCTTTGCATGGGGTGA------------------------------------
Ancistrocladus_heyneanus       ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCAAGGGCACGTCTGCCTGGGCGTCACGCATAGCATC-----------------------------------GCCCCTACACCCTACGCGTAGCGTGGGGTGA------------------------------------
Ancistrocladus_korupensis      ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------------------------------GCCCCCACACCCTACGCGTAGCATGGGGTGA------------------------------------
Ancistrocladus_robertsoniorum  ACGCAAGTTGCGCCCGAAGC-C-ATTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------------------------------GCCCCTACACCCTACGCGTAGCATGGGGTGA------------------------------------
Dionaea_muscipula              ACGCAAGTTGCACCCGAGGC-C-ACCTAGGCCAAGGGCACGTCTGCCTGGGCGTCTCATAGAGCGTCACTGAAC-CCCAT---TCCTATCCCCATCATGAGG-------------------------------------------------------------------
Dioncophyllum_thollonii        ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCACAGCGTC-------------------------------------------------------------------GCCTCCC----ACCCCGTC-GCAT-CGTGCGGGGC
Drosera_binata                 ACGCAAGTTGCGCCCGAGGC-C-ACTAAGGTCGAGGGCACGTCTGTCTGGGCGTCGCACACAGCGTCACCT----GCCAA---CGGTC----CTCCTCGAGA-------------------------------------------------------------------
Drosera_capensis               ACGCAAGTTGCGCCCGAGGC-C-ACTACGGCCGAGGGCACGTCTGTCTGGGCGTCGAAAGCAGAGGAACCTCAC-ACCTC---GCCCC----CGCGTGGAGG-------------------------------------------------------------------
Drosera_regia                  ACGCAAGTTGCGCCCGAGGC-C-ACTAAGGCCGAGGGCACGTCTGCCTGGGCGTCGCACAGAGCGTCACCCGACACCACAC--TAGTT----CTCAGTGAGG-------------------------------------------------------------------
Drosera_rotundifolia           ACGCAAGTTGCGCCCGAGGC-C-ACCACGGCCGAGGGCACGTCTGTCTGGGCGTCGCGTGCAGCGTCACCTAAC-ACCTCCTCGCCCCCC---GCGCGGAGG-------------------------------------------------------------------
Drosophyllum_lusitanicum       ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCTAAGGGCACGTCTGCCTGGGCGTCACGCACAACGTC------------------------------------------------------------------ACTCC-CAACCTACATACTCTGCCT-CGTGCGAGGG
Limonium                       ACGCAAGTTGCGCCCAAAGC-C-ATTT-GGCCGAGGGCACGTCTGCCTGGGTGTCACGCACTATGTT------------------------------------------------------------------GCCCCGCC----GCCCACTT-GTAG-TTTGGGCGGG
Nepenthes_alata                ACGCAAGTTGCGCCCGAAGC-CCTCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-------------------------------------------------------------------GCCCCCG----ACCTAGCC-GCCGGCGTCTCTGCA
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           ACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGGGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-------------------------------------------------------------------GCCCCCG----ACCTAGCC-GCCG-CGTCTCTGCA
Nepenthes_vieillardii          ACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-------------------------------------------------------------------GCCCGCG----ACCAAGCC-ACCG-CGTCTCTGCA
Polygonum                      ACGCAAGTTGCGCCCGAAGCC-CT?GT-GGCC-AGGGCACGTCTGTCTGGGCGTCACGCACCGCGTC------------------------------------------------------------------GCCCC--C----?CCCCCCT--CCG------GGGGG
Triphyophyllum_peltatum        ACGCAAGTTGCACCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCATGCACAGCGTC------------------------------------------------------------------GCCCC-CC----ACCC-CTTTGCAT-CTTGCCGGG-

                                     1,190     1,200     1,210     1,220     1,230     1,240     1,250     1,260     1,270     1,280     1,290     1,300     1,310     1,320     1,330     1,340     1,350
Aldrovanda_vesiculosa          --------GGCGGGGGGT-GGTGGACGATGGCCTCCCGTGCTCC--TCG--------------------------TGCGGTTG-G-CGGAATCTGGAGC-TGGAG--CCGTTGAGCGCA-GCGGCG-TA----------------------------------------
Ancistrocladus_abbreviatus     --------TTGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AGTGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTTGCGACGATT--------------------
Ancistrocladus_heyneanus       --------TCGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AGTGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTCACGACGATT--------------------
Ancistrocladus_korupensis      --------TCGGGGCGGA-GATTGACTTCCCAT-----------------TGGATTCCTTC--------------AGTGGTTG-GTCTAAAACTAGAGC-TCGAGG-----------------------TGAGCTGTGTCGCGACGATT--------------------
Ancistrocladus_robertsoniorum  --------TCGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AGTGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCTGTGTTGCGACGTTT--------------------
Dionaea_muscipula              --------AGGGGGTGGT-GG--GG---TGG------GTG--------G????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        GA--A-GG--G-GGCGGA-GATTGACCTCCCGT------------------------------CGGCTGCA-GCCTGCGGTTG-GTCCAAAACGGGAGC-TCGGGG-------------------------------------------CGAGCCGCG-CCGCGACGGC
Drosera_binata                 --------GGCAGGTGGA-TTATGGCCTCCCGTGCC-TCGGTG--CAAGG-------------------------CGCGGTTG-GCCCAAATGGGAAGC-T-GGGG-CGATGGA-TGCC-GTGGCAGTG----------------------------------------
Drosera_capensis               --------TGTCGGTGGA-GTATGGCCTCCCGTGTCGTACGTCGTCTCGA-------------------------TGCGGTTG-GCTCAAATGGGAAGC-TCGGGG-AAACGGA-TGCC-GTGGCAATG----------------------------------------
Drosera_regia                  --------TGCGGGTGGA-GAATGGCCTCCCGTGC-TCGGCTG----AAG-------------------------TGCGGTTT-GCCAAAATTTGAAGC-TCGGGG-CAGCGAA-TGCC-GTGACAATT----------------------------------------
Drosera_rotundifolia           --------TGTCGGTGGA-GTATGGCCTCCCGTGTCGTAGGTC-TC--GA-------------------------CGCGGTTG-GCCCAAATGGGAAGC-TCGGGG-CAACGGA-TGCC-GTGACAATG----------------------------------------
Drosophyllum_lusitanicum       AGGTG-ATGGG-GGCGGAT-AGTGGCCTCCCGT----------------------------C-CGTCGACA--TGGGCGGTTG-GCCTAAAAAAGGAGA-TCG-----CGG-------------------------------------TGAAATCTCAT-CACGATGGT
Limonium                       ----A-GG--G-GACAGACTAT-GGCTTCCCAC----------------------------TTGTCTTGA--ACTAATGGATG-GCCTAAATAGGGAGC-TCGCAGTTG-----------------------------------------TGAGCGCCG----TGATGAT
Nepenthes_alata                TGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------GGCGCC----GTTGTGCGGCTG-GCCTAAAATCGGAGC-TTGGCG----------------------------------------------AACGCG-CCACGACGTC
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           TGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGAC----GTTGTGCGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CCACGACGTC
Nepenthes_vieillardii          TGCTA-GGTTGGGGCGGA-GAGTGGCCTTCCTT----------------------------G-CGCC----GTTGTGCGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACGGCA-CCACGACTTC
Polygonum                      T---A-CG--G-GGCGGAG-ATTGGCCCCCCGT------------------------------GTGCCTCGTGGCGCGCGGCCGGCCCAAACATAGACC-CCGCGACCGC---------------------------------------TGGACGGCG----CGACGAT
Triphyophyllum_peltatum        TG--AAGG--G-GGCGGAG-ATTGACCTCCCGT------------------------------CGGTTGCA-GCCTGCGGTTG-GTCTAAAATGGGAGC-TCG-----GGG--------------------------------------TGAGCCGTG-CTGCGACGGT
```

```
                                  680       690       700       710       720       730       740       750       760       770       780       790       800       810       820       830       840
Aldrovanda_vesiculosa          C-TGGTTCTTGGACCAGGGGATAGGGGACGGCAAT-GCGCTGTACGCGCGA-GATTGACAC------------------------------------------------------------------------------------------------------------
Ancistrocladus_abbreviatus     -------------------------------------------------------------AATATGAGCA-AAAAGCGTGCTTCCTCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAGCGTTTCA-CATTATAAACAAAC---------------------------
Ancistrocladus_heyneanus       -------------------------------------------------------------AATATGAGCA-AAAAGCGTGCTTCCCCGCTTCCGGTTTCTCGGCATGCGGTGGTAGCAGCGTTTCA-CATTATAAACAAAC---------------------------
Ancistrocladus_korupensis      -------------------------------------------------------------AATATGAGCA-AAAGGCGTGCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAACGTTTCA-CATTATAAACAAAC---------------------------
Ancistrocladus_robertsoniorum  -------------------------------------------------------------AATATGAGCA-AAAAGCGTGCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAACGTTTCA-CATTATAAACAAAC---------------------------
Dionaea_muscipula              C--GGTTATTGATCCGATAAGAA-GGGGTGTGTATCGTGCTCTTTTAG-TT-GACCAAAAT------------------------------------------------------------------------------------------------------------
Dioncophyllum_thollonii        ----------------------------------------------------------------------------------------------------------------------------------------------ACAAAGAGCGCGCC-C---C-CCGTGT
Drosera_binata                 GTTTGTTTCGGCAGCGGGG------GGGATGGTGA--TGCCGTCATCGGCAT--AA-AGAT------------------------------------------------------------------------------------------------------------
Drosera_capensis               --CGGCTTAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATAATAGAT------------------------------------------------------------------------------------------------------------
Drosera_regia                  TTTTGCTCCGGCAATCGG-------GGGACAGCGTTGTGTCGTCATCGGCACT-----GAT------------------------------------------------------------------------------------------------------------
Drosera_rotundifolia           --CGGCTCAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATAAGAGAT------------------------------------------------------------------------------------------------------------
Drosophyllum_lusitanicum       ----------------------------------------------------------------------------------------------------------------------------------------------C------------GTGC-CCACCT---
Limonium                       ----------------------------------------------------------------------------------------------------------------------------------------------AC-----------CTTCGTGCACCTGT
Nepenthes_alata                ----------------------------------------------------------------------------------------------------------------------------------------------AACGGTAACATAGC-G---T-GCGTTG
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           ----------------------------------------------------------------------------------------------------------------------------------------------------AACATAGC-G---T-GCGTTG
Nepenthes_vieillardii          ----------------------------------------------------------------------------------------------------------------------------------------------AACGGTAACATAGC-G---T-GCGCTG
Polygonum                      -----------------------------------------------------------------------------------------------------------------------------------------------------------GCGCCCCGCCCCGC
Triphyophyllum_peltatum        ----------------------------------------------------------------------------------------------------------------------------------------------A------------GTGCGCCGCCTTGT

                                   850       860       870       880       890       900       910       920       930       940       950       960       970       980       990     1,000     1,010
Aldrovanda_vesiculosa          ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGGACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Ancistrocladus_abbreviatus     ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Ancistrocladus_heyneanus       ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Ancistrocladus_korupensis      ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Ancistrocladus_robertsoniorum  ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Dionaea_muscipula              ----------------------------------------------------------------GACTCTCGGCAACGGATATCTAGGCTCTCGCATCGATGAAGGACGTAGCAAAGTGCGATAAATGGTGTGAATTGCAGAATCCC-GTGAA-CCATCAAGTCTTTGA
Dioncophyllum_thollonii        --CCGGCC--CACCGGCA-CAC--GGCGGCTGCGGCGTC--CGACATTAT-GA---GA--GAACGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosera_binata                 ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosera_capensis               ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosera_regia                  ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosera_rotundifolia           ----------------------------------------------------------------GACTCTCGGCAACGGATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Drosophyllum_lusitanicum       CCG--GTG--CGCCGGTGTGTG--GGTAGGTGA--CGCC--TTACA-CGA-AA--AAT--GAACGACTCTCGACAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Limonium                       TTGTTGCT--T---GGA-------GGTG-TTGC-TTCGTTGAAATA--CCAAATACAA--AAATGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Nepenthes_alata                --CCTTGC--CGCCGGATGCCT--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGGATATCTCGGCTATCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCCCGTGAA-CCATCGAGTCTTTGA
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           --CCTTGC--CGCCGGATGCCT--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---TT--GAACGACTCTCGGCAACGGATATCTCGGCTATCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Nepenthes_vieillardii          --CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Polygonum                      CGG--GCCTCCGGCGGACGC--GGCGGCGTCGT-GTCGTT--TCTA--CCA--TAAAACAGAACGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA
Triphyophyllum_peltatum        CCG--GCC--CACCGGAACGC---GGCGGCTGCGACGTC--TAATATTCTAAG----A--GAACGACTCTCGGCAACGGATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGTCTTTGA

                                    1,020     1,030     1,040     1,050     1,060     1,070     1,080     1,090     1,100     1,110     1,120     1,130     1,140     1,150     1,160     1,170     1,180
Aldrovanda_vesiculosa          ACGCAAGTTGCACCCGAGGC-C-ACCAAGGCTAAGGGCACGTCTGCCTGGGTGTCACCTAGACCCTCACCAAAC-CCGGG---TTCACTT--CAGCGGAAGT-------------------------------------------------------------------
Ancistrocladus_abbreviatus     ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------------------------------GCCCCTACACCCTACGCTTTGCATGGGGTGA------------------------------------
Ancistrocladus_heyneanus       ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCAAGGGCACGTCTGCCTGGGCGTCACGCATAGCATC-----------------------------------GCCCCTACACCCTACGCGTAGCGTGGGGTGA------------------------------------
Ancistrocladus_korupensis      ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------------------------------GCCCCCACACCCTACGCGTAGCATGGGGTGA------------------------------------
Ancistrocladus_robertsoniorum  ACGCAAGTTGCGCCCGAAGC-C-ATTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------------------------------GCCCCTACACCCTACGCGTAGCATGGGGTGA------------------------------------
Dionaea_muscipula              ACGCAAGTTGCACCCGAGGC-C-ACCTAGGCCAAGGGCACGTCTGCCTGGGCGTCTCATAGAGCGTCACTGAAC-CCCAT---TCCTATCCCCATCATGAGG-------------------------------------------------------------------
Dioncophyllum_thollonii        ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCACAGCGTC-------------------------------------------------------------------GCCTCCC----ACCCCGTC-GCAT-CGTGCGGGGC
Drosera_binata                 ACGCAAGTTGCGCCCGAGGC-C-ACTAAGGTCGAGGGCACGTCTGTCTGGGCGTCGCACACAGCGTCACCT----GCCAA---CGGTC----CTCCTCGAGA-------------------------------------------------------------------
Drosera_capensis               ACGCAAGTTGCGCCCGAGGC-C-ACTACGGCCGAGGGCACGTCTGTCTGGGCGTCGAAAGCAGAGGAACCTCAC-ACCTC---GCCCC----CGCGTGGAGG-------------------------------------------------------------------
Drosera_regia                  ACGCAAGTTGCGCCCGAGGC-C-ACTAAGGCCGAGGGCACGTCTGCCTGGGCGTCGCACAGAGCGTCACCCGACACCACAC--TAGTT----CTCAGTGAGG-------------------------------------------------------------------
Drosera_rotundifolia           ACGCAAGTTGCGCCCGAGGC-C-ACCACGGCCGAGGGCACGTCTGTCTGGGCGTCGCGTGCAGCGTCACCTAAC-ACCTCCTCGCCCCCC---GCGCGGAGG-------------------------------------------------------------------
Drosophyllum_lusitanicum       ACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCTAAGGGCACGTCTGCCTGGGCGTCACGCACAACGTC------------------------------------------------------------------ACTCC-CAACCTACATACTCTGCCT-CGTGCGAGGG
Limonium                       ACGCAAGTTGCGCCCAAAGC-C-ATTT-GGCCGAGGGCACGTCTGCCTGGGTGTCACGCACTATGTT------------------------------------------------------------------GCCCCGCC----GCCCACTT-GTAG-TTTGGGCGGG
Nepenthes_alata                ACGCAAGTTGCGCCCGAAGC-CCTCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-------------------------------------------------------------------GCCCCCG----ACCTAGCC-GCCGGCGTCTCTGCA
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           ACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGGGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-------------------------------------------------------------------GCCCCCG----ACCTAGCC-GCCG-CGTCTCTGCA
Nepenthes_vieillardii          ACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-------------------------------------------------------------------GCCCGCG----ACCAAGCC-ACCG-CGTCTCTGCA
Polygonum                      ACGCAAGTTGCGCCCGAAGCC-CT?GT-GGCC-AGGGCACGTCTGTCTGGGCGTCACGCACCGCGTC------------------------------------------------------------------GCCCC--C----?CCCCCCT--CCG------GGGGG
Triphyophyllum_peltatum        ACGCAAGTTGCACCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCATGCACAGCGTC------------------------------------------------------------------GCCCC-CC----ACCC-CTTTGCAT-CTTGCCGGG-

                                     1,190     1,200     1,210     1,220     1,230     1,240     1,250     1,260     1,270     1,280     1,290     1,300     1,310     1,320     1,330     1,340     1,350
Aldrovanda_vesiculosa          --------GGCGGGGGT-GGTGGACGATGGCCTCCCGTGCTCC--TCG---------------------------TGCGGTTG-G-CGGAATCTGGAGC-TGGAG--CCGTTGAGCGCA-GCGGCG-TA----------------------------------------
Ancistrocladus_abbreviatus     --------TTGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AGTGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTTGCGACGATT--------------------
Ancistrocladus_heyneanus       --------TCGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AGTGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTCACGACGATT--------------------
Ancistrocladus_korupensis      --------TCGGGGCGGA-GATTGACTTCCCAT-----------------TGGATTCCTTC--------------AGTGGTTG-GTCTAAAACTAGAGC-TCGAGG-----------------------TGAGCTGTGTCGCGACGATT--------------------
Ancistrocladus_robertsoniorum  --------TCGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AGTGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCTGTGTTGCGACGTTT--------------------
Dionaea_muscipula              --------AGGGGGTGGT-GG--GG---TGG-----GTG--------G?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        GA--A-GG--G-GGCGGA-GATTGACCTCCCGT------------------------------CGGCTGCA-GCCTGCGGTTG-GTCCAAAACGGGAGC-TCGGGG-------------------------------------------CGAGCCGCG-CCGCGACGGC
Drosera_binata                 --------GGCAGGTGGA-TTATGGCCTCCCGTGCC-TCGGTG--CAAGG-------------------------CGCGGTTG-GCCCAAATGGGAAGC-T-GGGG-CGATGGA-TGCC-GTGGCAGTG----------------------------------------
Drosera_capensis               --------TGTCGGTGGA-GTATGGCCTCCCGTGTCGTACGTCGTCTCGA-------------------------TGCGGTTG-GCTCAAATGGGAAGC-TCGGGG-AAACGGA-TGCC-GTGGCAATG----------------------------------------
Drosera_regia                  --------TGCGGGTGGA-GAATGGCCTCCCGTGC-TCGGCTG----AAG-------------------------TGCGGTTT-GCCAAAATTTGAAGC-TCGGGG-CAGCGGA-TGCC-GTGACAATT----------------------------------------
Drosera_rotundifolia           --------TGTCGGTGGA-GTATGGCCTCCCGTGTCGTAGGTC-TC--GA-------------------------CGCGGTTG-GCCCAAATGGGAAGC-TCGGGG-CAACGGA-TGCC-GTGACAATG----------------------------------------
Drosophyllum_lusitanicum       AGGTG-ATGGG-GGCGGAT-AGTGGCCTCCCGT----------------------------C-CGTCGACA--TGGGCGGTTG-GCCTAAAAAAGGAGA-TCG-----CGG-------------------------------------TGAAATCTCAT-CACGATGGT
Limonium                       ----A-GG--G-GACAGACTAT-GGCTTCCCAC----------------------------TTGTCTTGA--ACTAATGGATG-GCCTAAATAGGGAGC-TCGCAGTTG----------------------------------------TGAGCGCCG----TGATGAT
Nepenthes_alata                TGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------GGCGCC----GTTGTGCGGCTG-GCCTAAAATCGGAGC-TTGGCG----------------------------------------------AACGCG-CCACGACGTC
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           TGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGAC----GTTGTGCGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CCACGACGTC
Nepenthes_vieillardii          TGCTA-GGTTGGGGCGGA-GAGTGGCCTTCCTT----------------------------G-CGCC----GTTGTGCGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACGGCA-CCACGACTTC
Polygonum                      T---A-CG--G-GGCGGAG-ATTGGCCCCCCGT------------------------------GTGCCTCGTGGCGCGCGGCCGGCCCAAACATAGACC-CCGCGACCGC---------------------------------------TGGACGGCG----CGACGAT
Triphyophyllum_peltatum        TG--AAGG--G-GGCGGAG-ATTGACCTCCCGT------------------------------CGGTTGCA-GCCTGCGGTTG-GTCTAAAATGGGAGC-TCG-----GGG--------------------------------------TGAGCCGTG-CTGCGACGGT
```

72

```
                               2,030     2,040     2,050     2,060     2,070     2,080     2,090     2,100     2,110     2,120     2,130     2,140     2,150     2,160     2,170     2,180     2,190
Aldrovanda_vesiculosa          --ACTTATCCTAACCTAATTA-CCTAATTTGAAATT--ATTCAAATTTCATTTT--------------------------------------------------------GAAACAC-AAAAGA?????????????????????????????????????????????
Ancistrocladus_abbreviatus     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus       TCAATT-------------------------------------------------------------------------------------------------------------------------------------------------------------------
Ancistrocladus_korupensis      TCAATT-------------------------------------------------------------------------------------------------------------------------------------------------------------------
Ancistrocladus_robertsoniorum  TCAATT-------------------------------------------------------------------------------------------------------------------------------------------------------------------
Dionaea_muscipula              --AATTATCCGAACAAAAGAATAGAAT-----AATCG-ATAGGTATTTCT-------------------AAGGT--ATTCT-------------------------------------AAAAG-----AATAGAATAATCGAT---------------------AGGTA
Dioncophyllum_thollonii        TCAATT-------------------------------------------------------------------------------------------------------------------------------------------------------------------
Drosera_binata                 --AATA--------AAATGAATAGAATTTATTAATGTATAGATATTAATTAGTAATTGAGTTAGTAATTGAGGTATTTT----------------------------------------------TATAT----TCTTTTTTT--------------------AAGGTA
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  --AATT--------AA-CTAATTCAATTAATCAAATTTATATCTATTTTATCTATATTCTATTT-AATTTATCTATATTCTATTTAAATATAAATAAATTAATATAATTC--------AAATTAATATATATATTCTATTTAAATCGATTAAAATAGATTTAAATAATA
Drosera_rotundifolia           --AATG--------AAATTCATATAATTTCTTAATGTATAGATATTAATTAGTAATT---------------------------------------------------------CATT--AAGGCATTATTCGATCTTTTTT---------------------------
Drosophyllum_lusitanicum       -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Limonium                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                TCAATT-------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_tobiaca              -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_ventricosa           TCAATT-------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_vieillardii          TCAATT-------------------------------------------------------------------------------------------------------------------------------------------------------------------
Polygonum                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        TCAATT-------------------------------------------------------------------------------------------------------------------------------------------------------------------

                                 2,200     2,210     2,220     2,230     2,240     2,250     2,260     2,270     2,280     2,290     2,300     2,310     2,320     2,330     2,340     2,350     2,360
Aldrovanda_vesiculosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus       --AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAACAGTTTCATTACTAT-TACTCTATTTACTTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCATTC------------
Ancistrocladus_korupensis      --AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAACAGTTTCATTACTAT-TACTCTATTTACTTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCATTC------------
Ancistrocladus_robertsoniorum  --AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAACAGTTTCATTACTAT-TACTCTATTTACTTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCATTC------------
Dionaea_muscipula              TTTCTAAGGTATTAGATGGA-----TTCATTTTTTACATTCCAATTTTTC-TTACTAT-TACTTTACTTGACTCGA---TTCGAAATCGCGCGAACAGCCATTA-------CTAAGAAAGATCTCGGTATCTCTTTTTCTATTTCATTTCGAAATTCGAAATGAAAT--
Dioncophyllum_thollonii        --AGAAA-GTCTTAGACAGAGCTACTAAATGTTTTACATAAAAC------ATTACTAT-TACTCTATTTACTTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CTAT---ATTTAGTCATTC------------
Drosera_binata                 TTAGAAAGGTATTAGACGGA-----TTCATGTTTTACACAAAAA-TTTTCATTCCTAT-TACTCTATT-------------CTAAATCGCGCGAGCAGCTATTA-------CTAAGAAAGATCTCCCTGTCTCTTTT-CTATTTCATTTAATCATTT------------
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  TT--AA-GGTATTAGACGGA-----TTCATGTTTTACAT--------------------------------------------ATATCGCGCGAGCAGCCATTA-------CTAAGAAA---CTCGGTATCTTTTTT-CTATTTCATTTAATCATTC------------
Drosera_rotundifolia           --AGAA-GGTATTAAACAGA-----TTCATGTTTTACATAAAGA-TTGTCATTCCTAT-TCCTCTATT------CAAAATTCTCAATCGTACCAGCAGCCATTA---ATAAGCAAGATCTCCCTTGGTATTCTTTTG---ATTGG-TTTAATAGGTA------------
Drosophyllum_lusitanicum       -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Limonium                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                --AGAA-GGTCTCAAACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT-------CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCATTT------------
Nepenthes_tobiaca              -------------------------------------------------------------------------------------ATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCATTT------------
Nepenthes_ventricosa           --AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT-------CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCATTT------------
Nepenthes_vieillardii          --AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT-------CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCATTT------------
Polygonum                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        --AGAA-GGTCTTAGACGGAGCTACTAAATGTTTTACAT-------------TACTAT-TACTCTATTTACTTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CTAT---ATTTAGTCATTC------------

                                  2,370     2,380     2,390     2,400     2,410     2,420     2,430     2,440     2,450     2,460     2,470     2,480     2,490     2,500     2,510     2,520     2,530
Aldrovanda_vesiculosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus       -------------------------------------------------------------------------------------------------TATCTATATTT------ATTTTTTTATTTAATATTTAATTTATTTAATTGATAATTGAAATTTGATTTAAGA
Ancistrocladus_korupensis      -------------------------------------------------------------------------------------------------TATCTATATTTCTATATATTTTATTATTTAACAGTTAATTTATTTAATTGATAATTGAAATTTGATTTAAGA
Ancistrocladus_robertsoniorum  -------------------------------------------------------------------------------------------------TATCTATATTTATATTTATTTTTTGATTTAATATTTAATTTATTTAATTGATAATTGAAATTTGATT-AAGA
Dionaea_muscipula              -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Dioncophyllum_thollonii        -------------------------------------------------------------------------------------------------TATCTATATTT------ATTTATCTATATTTT----------------------------------------
Drosera_binata                 -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Drosera_rotundifolia           -------------------------------------------------------------TTTTCTTTTATGGTTCATATTCCGGATTAGGTTCATCCCTGTAGGAATCAGATGAATGGAGTCATAGATCTGAAAGCGTAAGAACTCAACTTCCCTTCCCCCTGAATT
Drosophyllum_lusitanicum       -----------------------------------------------------------------------------------------------------------------------------------------------------------------------GA
Limonium                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_tobiaca              -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_ventricosa           -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_vieillardii          -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Polygonum                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        -------------------------------------------------------------------------------------------------TATCTATATTT------ATTTATCTATATTTT----------------------------------------

                                   2,540     2,550     2,560     2,570     2,580     2,590     2,600     2,610     2,620     2,630     2,640     2,650     2,660     2,670     2,680     2,690     2,700
Aldrovanda_vesiculosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus       ATTTCATTTTCATTTAATAGAAAAT------------------AAATAAAATTTAATTA--ATTTAATAAATTCT-ATTTTCATTTTCTATTCTATTTCTATT-----------CTATTTC----------TATAC-TA-----T---TTTCTAAATAGTATAGAAATA
Ancistrocladus_korupensis      ATTTCATTTTCATTTAATCGAAAAT------------------AAATCAAATTTCATTA--ATTTAATAAATTCT-ATTTTCATTTTCTATTCTATTTCTATTCTATTTCTATACTATTTAGAAAATAGTATAGAAATAGAAATTCGATTTCTAAATAGTATAGAAATA
Ancistrocladus_robertsoniorum  ATTTCATTTTCATTTAATAGAAAATTTTCATTTAATAGAAAATAAATCAAATTTCATTA--ATTTAATAAATTCT-ATTTTCATTTTCTATTCTATTTCTATTCTATTTCTATACTATTTTCTAAATAGTATAGAAATAG-----------------------------
Dionaea_muscipula              -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Dioncophyllum_thollonii        --------------------------------------------------ATTTAATTA--ATTTAATAGATTCT-ATTTTCATTTTCTATTCT-----------ATTTCTATACTATTTAGAAAATAGTATAGAAATAG-----------------------------
Drosera_binata                 -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Drosera_rotundifolia           TGACAAAGAAAGAAGGGGGAGGTCCCCTCCCCGTTCAATTCCTTTTTGTTATCTTGTCTGATCCTGTTTTGAAAGTTTTGTTGATTAAGAATATTCTTCCTCGATAAATCCCTTATTTTCAATTTGAAGAAAAAAGAAGGAATTGCTTGATGTTATGAAAGACACAATA
Drosophyllum_lusitanicum       CCTTTTTTCTTATTTAATTGAAA--TTTC------------------AGAATTTCATTGTCATTTAATCGATTTTGATTTTCGTTTTCTATTCTATA-CTATTTTGTTT------TATTTTGAAAATAGTATAGAA-TAGAAAACGAAAATGAGAGATTTTTTGAATTA
Limonium                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_tobiaca              -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_ventricosa           -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_vieillardii          -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Polygonum                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        --------------------------------------------------ATTTAATTA--ATTTAATAGATTCT-ATTTTCATTTTCTATTCG-----------ATTTCTATACTATTTTCTAAATAGTATAGAAATCG-----------------------------
```

```
                                 2,710     2,720     2,730     2,740     2,750     2,760     2,770     2,780     2,790     2,800     2,810     2,820     2,830     2,840     2,850     2,860     2,870
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      G--AAATTAGAGATTTATTAAATAGTAATT------TATTAAT------------------------------------------------------------------------------------------------------------------------------
Ancistrocladus_korupensis     G--AAATTAGAGATTTATTAAATAGTAATTCCGTAATAGTAAT------------------------------------------------------------------------------------------------------------------------------
Ancistrocladus_robertsoniorum ---AAATTAGAGATTTATTAA-TAGTAATT------TCTTAAT------------------------------------------------------------------------------------------------------------------------------
Dionaea_muscipula             -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Dioncophyllum_thollonii       ---AAATTAGAGATTTATTAAATAGTAATT------TATTAAT------------------------------------------------------------------------------------------------------------------------------
Drosera_binata                -------------------------------------------------------------GAAGG--TCTTTTTTT--------------------------------------------------------AAT-AGAATTTTTTTTTTATA--A-TTTAGAAAA--
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 -------------------------------------------------------------GAAGG--TCTTTTTTT-----------------------------TTTTATTAAATAGATAAATTAGAT--AAAT-AGATTTTCTTTCATATTTTATTTCATATAAAA
Drosera_rotundifolia          TAGAGAGGGATCTTTTTGATCTTCATCGTCCCCCATTTCTACGATTGC?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      TCTAAATT--CGATTTATGAAATTGAAATA--------GTAATTTATGAAATTAAATAGTC------------------------------------------------------------------------------------------------------------
Limonium                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata               -------------------------------------------------------------AAAGGTATCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATC-TA---TTTATAAA--T
Nepenthes_tobiaca             -------------------------------------------------------------AAAGGTATCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA-TA---TTTAGAAA--T
Nepenthes_ventricosa          -------------------------------------------------------------AAAGGTATCTTTTTTAAAATATACATTACATATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGCGAATTCTATTT-----------T-TAAA--T
Nepenthes_vieillardii         -------------------------------------------------------------AAAGGTATCTTTTTTAAAATATACAT-----ATAGATAATCTATTTAATAAAAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA-TA---TTTATAAA--T
Polygonum                     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum       ---AAATTAGAGATTTATTAAATAGTAATC------TATTAAT------------------------------------------------------------------------------------------------------------------------------

                                  2,880     2,890     2,900     2,910     2,920     2,930     2,940     2,950     2,960     2,970     2,980     2,990     3,000     3,010     3,020     3,030     3,040
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ----------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATAAATTC--TGTACT-GTATCTATGTATTCTTTATCCCTACAAAATATCAGACAAAA-TAGAACGATCTGAGAAGGGATATAATGAAAT????????????????????????????
Ancistrocladus_korupensis     ----------------AGTAATTAGCTAATAGCATAGCATAAAAGAAAGAAATCAATTC--TGTACT-GTATCTATGTATTATTTATCCCTACAAAATATCAGACAAAA-TAGAACGATCTGAGAAGGGATATAATGAAATTCTTTGATTGGTTCTTCCCAGAGCAATG
Ancistrocladus_robertsoniorum ----------------AGTAATTAGCTAATAGCATAGC???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ----------------AGAAATTAGCTAAT--------AGAAAAGAAAT----CGCTTCGGTACCGAACTCCCTAT---TT-TTTATGCCTACCAAATATCGGACAAAA-TAGAACGATCTGAGAGGGGATATAATGAAATTCTTTGATTGGTTCTTTTCAGAGCAATC
Dioncophyllum_thollonii       ----------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATCGATTC--TGTACT-CTATCTATGTATTCTTTATCCCTACAAAATATCAGACAAAA-TAGAACGATCTGAGAAGGGATATAATGAAATTCTTTGATTGGTTCTCC???????????
Drosera_binata                TC--TAAAAAAA-------AATTAGCTAA-----T---AGAAAAGGAAT----CGCTTCC-TAGAGT-CTC-CTAT---TT-TTTTTGCCTACGAAATATCGGACAAAA-TAGAA-----TGAG--GGGATATAATGAAATTCTTTGATTGGTTCTTTTCAGAGCAATG
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 TTTTGATTTAGACTTTCTAAATTCGAAAAGAA--T---AGAAAAGAAAT----CGCTTCT-----GTACTG--GAT---TT---TATGCCTACGAAATATCGGACAGAA--CGATTTGG--GAG--GGGATATAATGAAATTCTTTGATTGGTTCTTTTCAGAGCAATG
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      ----------------A--AATTAGCTAATAGCATAGCAGAAAAGAAATAAATTGATTT---GT--T-GTATCTATGTATTCTGTATCCCTACAAAATATTCGACAAAA-TAGAA-GATTTGAGAAGGGATATAATGAAATTCTTTAATTGGTTCTTCCCTCTTCCC??
Limonium                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata               TC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT-CTATCTATGTATTCTTTATACCTACGAAATACCAGAAAAAA-TAGAACGATATGAGAAGGGATATAATGAAATTCTTTGATTGGTTCTTCCCAGAGCAATG
Nepenthes_tobiaca             TC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT-CTATCTATGTATTCTTTATACCTACGAAATACCAGAAAAAA-TAGAACGATATGAGAAGGGATATAATGAAATTCTTTGATTGGTTCTTCCCAGAGCAATG
Nepenthes_ventricosa          TC--TTAAATAGTCT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT-CTATCTATGTATTCTTTATACCTACGAAATACCAGAAAAAA-TAAAACGATATGAGAAGGGATATAATGAAATTCTTTGATTGGTTCTTCCCAGAGCAATG
Nepenthes_vieillardii         TC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT-CTATCTATGTATTCTTTATACCTACGAAATACCCGAAAAAA-TAGAACGATATGAGAAGGGATATAATGAAATTCTTTGATTGGTTCTTCCCAGAGCAATG
Polygonum                     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum       ----------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATAGATTC--TGTACT-CTATCTATGTATTCTTTATCCCTACAAAATATTAGACAAAA-TAGAACGATCTGAGAAGGGATATAATGAAATCCTTTGATTGGTTCTTCCCAGAGCAATG

                                   3,050     3,060     3,070     3,080     3,090     3,100     3,110     3,120     3,130     3,140     3,150     3,160     3,170     3,180     3,190     3,200     3,210
Aldrovanda_vesiculosa         ???????????????????????????????????TCCATCCTACTACTTCTGGTACTGAAGTTTCGACACGTGAAAAAAAAAACCTGGGA-CGTATCATTCAAATCATTGGTCCGGTACTGGATGTAGCTTTTTCACCAGGCAAGATGCCTTATATTTACAACGCTCT
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ATACCATTTTATTT-G-----ATTAATGGGACC?????????????????CTGTTCCTGAGGTTTC--CAC-------AAAAAACCTAGGA-CGTATTGCTCAAATCATTGGTCCGGTACTGGATGTAGCTTTTCCACCAGGCAAGATGCCTAATATTTACAACGCTCT
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ATCGCATTTTTTTT-GCTTTTCCAGATGGGACC?????????????????????TCCTGAAGTTTCGACACGTGAAAAAAAAAAACCTGGGGCGTATCATTCAAATCATTGGGCCGGTACTGGATGTAGCTTTTCCACCAAGCAAGATGCCTTATATTTACAACGCTCT
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ATCACATTTTATTT-GCTTTGCCTGATGGGACC????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ???????????????????????????????????????????????????????????????????????????AAAAAAAGAC-TGGGG-CGTATCAGTCAAATTATTGGTCCGGTACTGGATGTCACTTTTCCGCCAGGCAAGATGCCTTATATTTACAACGCTCT
Drosera_regia                 ATCAC----TATTT-GCTTTGCCTGATGGGACCACCAATCCCTACTACTTCTGGTCCTGAAGTTTTGACACGTGAAAAAAAAAACCTGGGG-CGTATCATTCAAATAATTGGTCCGGTACTGGATATAGCTTTTCCACCAGGCAAGATGCCTTATATTTACAACGCTCT
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      ????????????????????????????????????????????????????????CTGGGGTTTCCACACTTGAAAAAAAAAACCTAGGA-CGTATTGCTCAAATCATTGGTCCGGTACTGGATGTAGCTTTTCCACCAGGCAAGATGCCTAATATCTACAACGCTCT
Limonium                      ?????????????????????????????????????????????????????????????GCC----CACTTGAAAAACAAAGCCTGGGG-CGTGTCTCTCAAATCATTGGTCCGGTACTGGATGTAGTTTTTAAATCAGGCAAGATGCCTAATATTTACAATGCTCT
Nepenthes_alata               ATCCCATTTTATTT-G-----ACTGATGGAACC???????????CTACTTCTGGTTCTGGGGTTTCCACACTTGAAAAAAAAAACCTGGGG-CGGATCGATCAAATCATTGGTCCGGTACTAGATGTAGCTTTTCCACCAGGCAAGATGCCTAATATTTACAACGCTTT
Nepenthes_tobiaca             ATCCCATTTTATTT-G-----ACTGATGGAACC????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ATCCCATTTTATTT-G-----ACTGATGGAACC????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         ATCCCATTTTATTT-G-----ACTGATGGAACC????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                     ??????????????????????????????????????????????????????TT?TGGGGTT?CCACACTTGA?A?AAAGAACYYGGGG-CGTGTCG?CC?A?TCATTGGTCCAGTGCT?GATGTAACTTTTCCACCAGGCAAGATGCCTAATATTTACAACGCTCT
Triphyophyllum_peltatum       ATACCATTTTATTT-G-----ATTGATGGGACC????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                    3,220     3,230     3,240     3,250     3,260     3,270     3,280     3,290     3,300     3,310     3,320     3,330     3,340     3,350     3,360     3,370     3,380
Aldrovanda_vesiculosa         AGTAGTTAAAGGTCGAGATACTCTTGGTGAACCAATTAATGTGACTTGTGAGGTACAACAATTATTAGGAAATAATCGAGTTAGAGCTGTAGCTATGAGTGCTACAGATGGTCTAATGAGAGGGATGGAAGTAGTTGATACAGGAGCTGCTTTAAGCGTTCCAGTAGGC
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     GGTAGTTAAGGGTCGAGATACTCTTGGTCAACCAATTAATGTAACTTGTGAGGTACAACAATTATTAGGAAATAATCGAGTTAGGGCTGTAGCTATGAGTGCTACAGATGGTCTAATGCGAGGAATGGAAGTAATTGATACAGGGGCTCCTTTAAGTGTTCCAGTCGGC
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             AGTAGTTAAAGGTCGAGATACTCTTGGTCAACCAATTAATGTTACTTGTGAGGTACAACAATTATTAGGAAATAATCGAGTTAGAGCTGTAGCTATGAGTGCTACAGATGGTCTAATGAGAGGGATGGAAGTAGTTGATACAGGAGCTGCTTTAAGCGTTCCGGTGGGC
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              AGTAGTTAGAGGTCGAGATACTCTTGGCCAACCAATTAATGTGACTTGTGAGGTACAACAATTATTAGGAAATAATCGAGTTAGAACTGTAGCTATGAGTGCTACAAATGGTCTAATGCGAGGGATGGAAGTAGTTGATACAGGAGCTGCTTTAAGTGTTCCAGTGGGC
Drosera_regia                 AGTAGTTAAAGGTCGAGATACTCTTGGTCAACCAATTAATGTGACTTGTGAGGTACAACAATTATTAGGAAATAATCGAGTTAGAGCTGTAGCTATGAGTGCTACAGATGGTCTAACGCGAGGGATGGACGTAGTTGATACAGGAACTGCTTTAAGCGTTCCAGTGGGC
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      AGTAGTTAAGGGTCGAGATACTGTTGGTCAACCAATTAATGTGACTTGTGAGGTCCAACAATTATTAGGAAATAATCGAGTTAGGACTGTAGCTATGAGTGCTACAGATGGTCTAATGCGAGGAATGGAAGTGATTGATACAGGGGTTCCTTTAAGTGTTCCAGTCGGC
Limonium                      GGTTGTTAAGGGCCGAGATACTTCTGGTCAACCAATTAATGTAACTTGTGAGGTACAACAATTATTAGGAAATAATCGAGTTAGGACTGTAGCTATCAGTGCTACAGATGGTCTAACGCGAGGAATGGAAGTGATTGATACAGGGGCCCCTTTAAGTGTTCCAGTCGGC
Nepenthes_alata               GGTAGTTGAAGGTCGAGATACTGCTGGTCAACCAATTAATGTGACTTGTGAGGTACAACAATTATTAGGAAATAATCGAGTTAGGGCTGTAGCTATGAGTGCTACAGATGGTCTAATGCGAGGAATGGAAGTGGTTGATACAGGATCTCCTTTAAGTGTTCCAGTCGGC
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                     GGTCGTTAAGGGCCGAGATACTGCTGGTCAACCGATTAATGTAACCTGTGAGGTACAACAATTATTAGGAAATAATCGCGTTAGGGCTGTAGCTATGAGTGCTACAGACGGTCTAACGCGAGGAATGGAAGTGGTTGATACAGGGGCTCCTTTAAGTGTTCCAGTAGGC
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                            3,390     3,400     3,410     3,420     3,430     3,440     3,450     3,460     3,470     3,480     3,490     3,500     3,510     3,520     3,530     3,540
Aldrovanda_vesiculosa       AGCACAACTCTCGGACGAATTTTTAACGTACTTGGGGAGCCTATTGATAATTTAGGTCCTGTAGATACTCGCACAACATCTCCTATTCATAGATCTGCGCCCGCCTTTATACAGTTAGAGACAAAATTGTCGATTTTTGAAACAGGAATTAAAGTAGTAGATCTTTTAG
Ancistrocladus_abbreviatus  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis   GGAGCAACTCTCGGACGAATTTTTAACGTACTTGGAGAGCCTGTTGATAATTTAGGTCCTGTAGATACTCGTACAACATCTCCTATTCATAGATCCGCGCCCGCCTTTATACAGTTAGATACAAAATTATCTATTTTTGAAACAGGAATTAAAGTGGTAGATCTTTTAG
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula           AGCGCAACTCTCGGACGAATTTTTAACGTCCTTGGGGAGCCTATTGATAATTTAGGTCCTGTAGATACTCGCACAACATCTCCTATTCATAGATCTGCACCCGCCTTTATACAGTTAGAGACAAAATTGTCGATTTTTGAAACAGGAATTAAAGTCGTAGATCTTTTAG
Dioncophyllum_thollonii     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis            AGCCTAACTCTCGGACGAATTTTTAACGTACTGGGACAGCCTATTGATAATTTAGGTCCTGTAGCTACTGACACAACATCTCCTATTCATAGATCTCCGCCTGCCTTTATACAATTAGAAACAAAATTGTCGATTTTTGAAACAGGAATTAAAGTAGTAGATCTTTTAG
Drosera_regia               AGCGCAACTCTCGGACGAATTTTTAACGTACTTGGGGAGCCTATTGATAATTTAGGTCCTGTAGATACTCGCACAACATCTCCTATTCATAGATCTGCACCCGCCTTTATACAGTTAGAGACAAAATTGTCGATTTTTGAAACAGGAATTAAAGTCGTAGATCTTTTAG
Drosera_rotundifolia        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum    GGAGCAACTCTTGGACGAATTTTTAACGTACTTGGAGAGCCTATTGATAATTTAGGTCCTGTAGACACTAGCACAACATCGCCTATTCATAGATCTGCACCCGCCTTTATACAGTTAGATACAAAATTATCGATTTTTGAAACAGGAATTAAAGTGGTAGATCTTTTAG
Limonium                    GGAGCGACTCTCGGACGAATTTTTAACGTACTTGGGGAACCTGTTGATAATTTAGGTCCTGTAGATACTAGCACAACATCTCCTATTCATAAATCGGCACCCGACTTTATACAGTTAGATACAAAATTATCGATTTTTGAAACAGGAATTAAAGTGGTAGACCTTTTAG
Nepenthes_alata             GGAGCAACGCTCGGACGAATTTTTAACGTACTTGGAGAGCCTGTTGATAATTTAGGTCCTGTCGATACTCGCACAACATCTCCTATTCATAGATCTGCGCCCGCCTTTATACAGTTAGATACAAAATTATCTATTTTTGAAACAGGAATTAAAGTGGTCGATCTTTTAG
Nepenthes_tobiaca           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                   GGAGCAACTCTCGGACGAATTTTTAATGTACTTGGGGAGCCCGTTGATAATTTAGGTCCTGTAGATACTCGAACAACATCTCCTATTCATAGATCCGCACCCGCCTTTATACAGTTAGACACAAAATTATCCATTTTTGAAACAGGAATTAAAGTGGTAGACCTTTTAG
Triphyophyllum_peltatum     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                            3,550     3,560     3,570     3,580     3,590     3,600     3,610     3,620     3,630     3,640     3,650     3,660     3,670     3,680     3,690     3,700     3,710
Aldrovanda_vesiculosa       CCCCTTATCGTCGTGGAGGAAAAATCGGACTATTTGGGGGAGCTGGAGTGGCAAAACAGTACTCATTATGGAATTGATCAACAACATTGCAAAAGCTCATGGAGGTGTATCTGTATTTGCCGGAGTAGGTGAACGTACTCGTGAAGGAAATGATCTTTACAAGGAAAT
Ancistrocladus_abbreviatus  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis   CCCCTTATCGCCGTGGAGGAAAAATCGGACTATTCGGGGGAGCTGGAGTGGGTAAAACAGTACTCATTATGGAATTGATCAATAACATTGCAAAAGCTCATGGCGGTGTATCTGTATTTGGCGGAGTAGGTGAACGTACTCGTGAAGGAAATGATCTTTACATGGAAAT
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula           CCCCTTATCGTCGTGGAGGAAAAATTGGACTATTTGGGGGAGCTGGAGTGGCAAAACAGTACTCATTATGGAATTGATCAACAACATCGCAAAAGCTCATGGGGGTGTATCCGTATTTGCCGGAGTAGGTGAGCGTACTCGTGAAGGAAATGATCTTTACAAGGAAAT
Dioncophyllum_thollonii     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis            CCCCCTATCGTCGTGGGGGAAAAACAGGACTCTTTGGGGGAGCTGGAGTGGCAAAACAGTACTCATTATGGAATTGATCAACAACATTGCAAAGGCTCATCGAGGTGTATCCGTCTTTGCCGGAGTAGGTGAACGTACTCGTGAAGGAAATGATCTTTACAAGGAGAT
Drosera_regia               CCCCTTATCGTCGGGGAGGAAAAATCGGACTATTTGGGGGAGCTGGAGTGGCAAAACAGTACTCATTATGGAATTGATCAACAACATTGCAAAAGCTCATGGAGGTGTATCCGTATTTGCCGGAGTAGGTGAACGTACTCGTGAAGGAAATGATCTTTACAAGGAGAT
Drosera_rotundifolia        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum    CCCCTTATCGCCGTGGAGGAAAAATAGGACTATTCGGGGGGGCTGGAGTAGGTAAAACAGTACTCATTATGGAATTGATCAATAACATTGCAAAAGCTCATGGGGGTGTATCCGTATTTGGCGGAGTAGGGGAACGTACTCGTGAAGGAAATGATCTTTACATGGAAAT
Limonium                    CCCCCTATCGACGTGGAGGAAAAATAGGCCTATTCGGGGGAGCTGGAGTAGGTAAAACCGTACTCATTATGGAATTGATCAATAATATTGCAAAAGCTCATGGGGGTGTATCTGTATTTGGCGGCGTAGGCGAGCGTACTCGTGAAGGAAATGATCTTTACAAGGAAAT
Nepenthes_alata             CCCCTTATCGCCGTGGAGGAAAAATCGGACTATTCGGGGGAGCTGGAGTGGGTAAAACAGTACTCATTATGGAATTGATCAACAACATTGCAAAAGCTCATGGAGGTGTATCCGTATTTGGCGGAGTAGGTGAACGTACTCGTGAAGGAAATGATCTTTACATGGAAAT
Nepenthes_tobiaca           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                   CCCCCTATCGCCGTGGAGGGAAAATAGGACTGTTTGGGGGGGCTGGAGTGGGTAAAACCGTACTCATTATGGAATTAATCAACAATATTGCAAAAGCTCATGGAGGTGTATCTGTATTTGGCGGCGTAGGTGAACGTACTCGTGAAGGAAATGATCTTTACATGGAAAT
Triphyophyllum_peltatum     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                            3,720     3,730     3,740     3,750     3,760     3,770     3,780     3,790     3,800     3,810     3,820     3,830     3,840     3,850     3,860     3,870     3,880
Aldrovanda_vesiculosa       GAAAGAATCTGGCGTTATTAATGAACAAAATATTGCAGAATCAAAAGTGGCTCTAGTATACGGTCAAATGAATGAACCACCAGGAGCTCGTATGAGAGTTGGTTTGACTGCCCTAACTATGGCGGAATATTTTCGAGATGTTAATAAACAAGACGTACTTCTATTTATC
Ancistrocladus_abbreviatus  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis   GAAAGAATCTGGAGTTATTAATGAACAAAATATTGCAGAATCAAAAGTGGCTCTAGTCTATGGTCAAATGAATGAGCCGCCGGGAGCTCGTATGAGAGTTGGTTTGACTGCCCTAACTATGGCGGAATATTTCCGAGATGTTAATGAACAAGACGTGCTTCTATTTATC
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula           GAAAGAATCTGGAGTTATTAATGAACAAAATATTGGAGAATCAAAAGTGGCTCTAGTATACGGCCAAATGAATGAACCGCCGGGAGCTCGTATGAGAGTGGGTTTGACTGCCCTAACGATGGCGGAATTTTTTCGAGATGTTAATAAACAAGACGTACTTCTATTTATC
Dioncophyllum_thollonii     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis            GAAAGAATCGGAGTTATTAATGAACAAAATATTTCAGAATCAAAAGTGGCTCTAGTATACGGTCAAATGAATGAACCACCAGGAGCTCGTATGAGGGTTGGTTTGACTGCCCTAACTATGGCGGAATATTTCCGAGATGTTAATAAACAAGACGTACTTCTATTTATC
Drosera_regia               GAAAGAATCTGGAGTTATTAATGAACAAAATATTCCAGAATCAAAAGTGGCTCTAGTATACGGTCAAATGAATGAACCACCAGGAGCTCGTATGAGAGTTGGTTTGACTGCCCTAACTATGGCGGAATATTTCCGAGATGTTAATAAACAAGACGTACTTCTATTTATC
Drosera_rotundifolia        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum    GAAAGAATCTGGAGTTATTAATGAACAAAATATTGCAGAATCAAAAGTGGCTCTAGTCTATGGTCAAATGAATGAGCCGCCGGGAGCTCGTATGAGAGTTGGTTTGACTGCCCTAACTATGGCGGAATATTTTCGAGATGTTAATGAACAAGACGTGCTTCTATTTATC
Limonium                    GAAAGAATCCGGAGTTATTAATGAAAAAAATATTCCAGAATCAAAAGTAGCTCTAGTCTACGGGCAAATGAATGAACCGCCTGGAGCCCGTATGAGAGTTGGTTTGACCGCCCTAACTATGGCGGAATATTTCCGAGATGTTAATAAACAAGATGTACTTCTATTTATT
Nepenthes_alata             GAAAGAATCCGGAGTTATTAATGAACAAAATATTGCAGAATCAAAAGTGGCTCTAGTCTACGGTCAAATGAATGAACCGCCGGGAGCTCGTATGAGAGTTGGTTTGACTGCCCTAACTATGGCGGAATATTTCCGAGATGTTAATGAACAAGACGTACTTCTATTTATC
Nepenthes_tobiaca           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                   GAAAGAATCCGGAGTTATTAATGAACAAAATATTCCAGAATCCAAAGTGGCTCTAGTCTACGGGCAAATGAATGAACCGCCCGGAGCTCGTATGAGAGTTGGTTTGACTGCCCTAACTATGGCGGAATATTTCCGAGATGTTAATAAACAAGACGTACTTCTATTTATT
Triphyophyllum_peltatum     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                            3,890     3,900     3,910     3,920     3,930     3,940     3,950     3,960     3,970     3,980     3,990     4,000     4,010     4,020     4,030     4,040     4,050
Aldrovanda_vesiculosa       GACAATATCTTCCGTTTCGTCCAAGCAGGATCTGAAGTATCTGCCTTGTTGGGTCGAATGCCTTCGGCTGTCGGTTATCAACCTACTCTTAGTACCGAAATGGGCTCTTTACAAGAAAGAATTACTTCTACCAAAGAAGGGTCCATAACTTCGATTCAAGCAGTTTATG
Ancistrocladus_abbreviatus  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis   GACAATATCTTCCGCTTCGTCCAAGCAGGATCTGAAGTATCTGCCTTATTGGGTAGAATGCCTTCCGCTGTGGGTTATCAACCTACCCTTAGTACCGAAATGGGCTCTTTACAAGAAAGAATTACTTCGACCAAAGAAGGGTCCATAACTTCGATTCAAGCAGTTTATG
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula           GACAATATTTTCCGTTTCGTCCAAGCAGGATCTGAAGTATCTGCCTTATTGGGTCGAATGCCTTCTGCTGTCGGTTATCAACCTACTCTTAGTACCGAAATGGGTTCTTTACAAGAAAGAATTACTTCTACCAAAGAAGGTTCCATAACTTCGATTCAAGCAGTTTATG
Dioncophyllum_thollonii     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis            GACAATATCTTCCGTTTCGTCCAAGCAGGATCTGAAGTATCTGCTTTATTGGGTAGAATTCCTTCCGCTGTCGGCTATCAACCTACTCTTAGTACCGAAATGGGCTCTTTACAAGAAAGAATTACTTCGACCAAAGAAGGATCCATAACTTCAATTCAAGCAGTTTATG
Drosera_regia               GACAATATCTTCCGTTTCGTCCAAGCAGGATCGGAAGTATCTGCTTTATTGGGTCGAATGCCTTCTGCTGTCGGCTATCAACCTACTCTTAGTACCGAAATGGGCTCTTTACAAGAAAGAATTACTTCTACAAAAGAAGGGTCCATAACTTCGATTCAAGCAGTTTATG
Drosera_rotundifolia        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum    GACAATATCTTCCGATTCGTCCAAGCAGGATCTGAAGTATCTGCCTTATTGGGTAGAATGCCTTCTGCTGTGGGTTATCAACCTACCCTTAGTACCGAAATGGGCTCTTTACAAGAAAGAATTACTTCGACCAAAGAAGGGTCCATAACTTCCATTCAAGCAGTTTATG
Limonium                    GACAATATCTTCCGTTTCGTTCAAGCAGGATCCGAAGTATCTGCGTTATTGGGTAGAATGCCTTCTGCTGTAGGTTATCAACCCACTCTTAGTACTGAAATGGGCTCCTTACAAGAAAGAATTACTTCTACCAAACAAGGATCCATAACTTCGATTCAAGCAGTTTATG
Nepenthes_alata             GACAATATCTTCCGTTTCGTCCAAGCAGGATCTGAAGTATCTGCCTTATTGGGTAGAATGCCTTCCGCTGTAGGTTATCAACCTACCCTTAGTACCGAAATGGGCTCTTTACAAGAAAGAATTACTTCTACCAAAGAAGGGTCCATAACTTCGATTCAAGCAGTTTATG
Nepenthes_tobiaca           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                   GACAATATCTTCCGTTTCGTCCAAGCGGGATCTGAAGTATCTGCCTTATTGGGCAGAATGCCTTCAGCTGTGGGTTATCAACCTACTCTTAGTACCGAAATGGGCTCTTTACAAGAAAGAATTACTTCTACCAAACAAGGGTCCATAACTTCGATTCAAGCAGTTTATG
Triphyophyllum_peltatum     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                              4,060     4,070     4,080     4,090     4,100     4,110     4,120     4,130     4,140     4,150     4,160     4,170     4,180     4,190     4,200     4,210     4,220
Aldrovanda_vesiculosa          TAC-CTGCAGATGATTTGACCGACCCTGCTCCTGCCACGACATTTGCACATTTAGATGCAACTACTGTCCTATCAAGAGGATTAGCCGCCAAAGGTATCTATCCAGCAGTAGATCCTTTAGATTCAACGTCAACTATGCTCCAACCTAACATCGTTGGTGACGAACACT
Ancistrocladus_abbreviatus     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis      TAC-CTGCAGATGATTTGACCGACCCCGCTCCTGCCACGACCTTTGCACATTTAGATGCAACTACCGTACTATCAAGAGGATTAGCCGCCAAAGGTATCTATCCAGCAGTAGATCCTTTAGATTCAACGTCAACTATGCTCCAACCTCGAATCGTTGGTGAGGAACATT
Ancistrocladus_robertsoniorum  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula              TAC-CTGCAGATGATTTGACCGACCCCGCTCCTGCCACGACATTTGCACATTTAGATGCAACTACCGTCCTATCAAGAGGATTAGCCGCCAAAGGTATCTATCCCGCAGTAGATCCTTTAGATTCAACGTCAACTATGCTCCAACCTAAGATCGTTGGTGACAAACATT
Dioncophyllum_thollonii        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               TAC-CTGCGGATGATTTGACGGACCCCGCCCCGGCCACGACATTTGCACATTTAGATGCAACTACCGTCCTATCCAGAGGCTTAGCCGCCAAAGGTATCTATCCAGCAGTAGACCCTTTAGATTCAACGTCAACTATGCTCCAACCTAATATCGTTGGTGACGAACATT
Drosera_regia                  TAC-CTGCGGATGATTTGACCGACCCCGCTCCTGCCACGACATTTGCACATTTAGATGCAACTACCGTCCTATCAAGAGGATTAGCCGCCAAAGGTATCTATCCAGCAGTAGATCCTTTAGATTCAACGTCAACTATGCTCCAACCTAAGATCGTTGGTGACGAACATT
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       TAC-CTGCAGATGATTTGACCGACCCTGCTCCTGCCACGACATTTGCACATTTAGATGCTACTACCGTACTCTCAAGGGGATTAGCCGCCAAAGGTATCTATCCAGCAGTAGATCCTTTAGATTCAACATCAACTATGCTCCAACCTCGAATCGTTGGTGAGGAACATT
Limonium                       TAC-CTGCAGACGATTTGACCGATCCCGCTCCTGCCACGACATTTGCACATTTAGATGCAACTACTGTACTATCAAGAGGATTAGCCGCCAAAGGTATCTACCCTGCAGTAGATCCTTTAGATTCAACGTCAACTATGCTCCAACCTCGAATCGTTGGCGATAAACATT
Nepenthes_alata                TAC-CTGCAGATGATTTGACCGACCCCGCTCCTGCCACGACATTTGCACATTTAGATGCAACTACCGTACTCTCAAGAGGATTAGCCGCCAAAGGTATCTATCCAGCAGTAGATCCTTTAGATTCAACGTCAACTATGCTCCAACCTCGAATCGTTGGTGAAGAACATT
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                      TAC-CTGCAGACGATTTAACTGACCCCGCTCCTGCCACGACATTTGCACATTTAGATGCAACTACTGTACTATCAAGAGCATTAGCCGCCAAAGGTATCTATCCAGCAGTAGATCCTTTAGATTCAACGTCAACTATGCTCCAACCTCGAATCGTTGGCGAGGAACATT
Triphyophyllum_peltatum        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                 4,230     4,240     4,250     4,260     4,270     4,280     4,290     4,300     4,310     4,320     4,330     4,340     4,350     4,360     4,370     4,380     4,390
Aldrovanda_vesiculosa          ATGAAATTGCACAACGAGTTAAACAAACTTTACAACGTTACAAAGAACTTCAGGACATTATAGCCATCCTTGGATTGGACGAATTATCCGAAGAAGATCGTTTAACTGTAGCAAGAGCACGAAAAATTGAGCGTTTCTTATCACAACCCTTTGTCG-TAGCAGAAGTAT
Ancistrocladus_abbreviatus     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis      ATGAAACTGCGCAAAGAGTTAAGCAAACTTTACAACGTTACAAAGAACTTCAGGACATTATAGCTATCCTTGGGTTGGATGAATTATCCGAAGAAGATCGTTTAACCGTAGCAAGAGCACGAAAAATTGAGCGTTTCTTATCACAACCCTTTTTCG-TAGCAGAAGTAT
Ancistrocladus_robertsoniorum  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula              ATGAAACTGCACAACGAGTAAAACAAACTTTACAACGTTACAAAGAAGTTCAAGACATTATAGCTATTCTTGGATTGGACGAATTATCCGAAGAAGATCGTTTAACTGTATCCAGAGCACGCAAAATTGAGCGTTTCTTATCACAACCCTTTGTCG-TAGCAGAAGTAT
Dioncophyllum_thollonii        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ATGAAACTGCACAACAAGTTAAACAAACTTTACAACGTTACAAAGAAGTTCAGGACATTATAGCTATCCTTGGATTGGACGAATTATCCGAAGAAGATCGTTTAACTGTAGCAAGAGCACGAAAAATTGAGCGTTTTTTATCGCAACCCTTTGTCG-TAGCAGAAGTTT
Drosera_regia                  ATGAAACTGCACAACAAGTTAAACAAACTTTACAACGTTACAAAGAACTTCAGGACATTATAGCTATCCTTGGATTGGACGAATTATCCGAAGAAGATCGTTTAACTGTAGCAAGAGCACGAAAAATTGAGCGTTTCTTATCACAACCCTTTGTCG-TAGCAGAAGTAT
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ATGAAACTGCGCAAAGAGTTAAGGAAACTTTACAACGCTACAAAGAACTTCAGGACATTATAGCTATCCTTGGGTTGGATGAATTATCCGAAGAAGATCGTTTAACCGTAGCAAGAGCACGAAAAATTGAGCGTTTCTTATCACAACCCTTTTTCG-TAGCAGAAGTAT
Limonium                       ATGAAACTGCACAAAGAGTTAAGGAAACTTTACAACGTTACAAAGAACTTCAAGATATTATAGCTATCCTTGGGTTAGACGAATTATCCGAAGAAGATCGTTTAACCGTAGCAAGAGCACGAAAAATTGAGCGTTTCTTATCACAACCCTTTTTCG-TAGCAGAAGTAT
Nepenthes_alata                ATGAAACTGCGCAAAGAGTTAAGCAAACTTTACAACGTTACAAAGAACTTCAGGACATTATAGCTATCCTTGGGTTGGACGAATTATCCGAAGAAGATCGTTTAACCGTAGCAAGAGCACGAAAAATTGAGCGTTTCTTATCACAACCCTTTTTCG-TAGCGGAAGTAT
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                      ATAAAATTGCGCAAAGAGTTAAGCAAACTTTACAACGTTACAAAGAACTTCAGGACATTATAGCTATCCTTGGGTTAGATGAATTATCCGAAGAAGATCGTTTAACCGTAGCAAGAGCACGAAAAATTGAGCGTTTCTTATCACAACCTTTTTTCG-TTGCCGAAGTAT
Triphyophyllum_peltatum        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                    4,400     4,410     4,420     4,430     4,440     4,450     4,460     4,470     4,480     4,490     4,500     4,510     4,520     4,530     4,540     4,550     4,560
Aldrovanda_vesiculosa          TTACCGGTTCCCCAGGAAAATATGTTGGTCTAGCAGAAACAATTAGAGGGTTTCAATTGATCCTTTCCGGAGAATTAGACAGTCTTCCCGAACAGGCCTTCTATTTAGTGGGTAATATCGATGAAGCTACAGAGAAAGC--TAT-GAACTTAGAAA-GGAGAACAAATT
Ancistrocladus_abbreviatus     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis      TTACAGGTTCTCCAGGAAAATATGTTGGTCTAGCAGAAACAATTAGAGGGTTTCAATTGATCCTTTCCGGAGAATTAGACGGTCTTCCTGAGCAGGCCTTTTATTTGGTAGGTAACATCGATGAAGCTAGCGCGAAAGC--TAT-GAACTTAGAAATGGAGAGC?????
Ancistrocladus_robertsoniorum  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula              TTACCGGTTCCCCAGGAAAATTCGTCGGTCTCGCAGAAACAATTAGAGGGTTTCAATTGATCCTTTCCGGAGAATTAGATGGTCTTCCTGAACAGGCCTTTTATTTGGTGGGTAACATCGATGAAGCTACCGAGAMAGC--TAT-TAACTTAGAAA-GGAG????????
Dioncophyllum_thollonii        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               TTACTGGTTCCATAGGAAAATATGTTAGTCTAGCAGAAACAATTAGAGGGTTTAAATTGATCCTTTCCGGAGAATTAGACGATCTTCCTGAACAGGCCTTTTATTTGGTGGGTAACATCGATGAAGCTACCGAGAAAGCGCTATTGAACTTAA????????????????
Drosera_regia                  TTACCGGTTCCCCAGGAAAATATGTTGGTCTAGCAGAAACAATTAGAGGGTTTCAATTGATCCTTTCCGGAGAATTAGACGGTCTTCCTGAACAGGCCTTTTATTTGGTGGGTAACATCGATGAAGCTACCGAGAAAGC--TAT-GAACTTAGAAATGGAGAACAAATT
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       TTACCGGTTCTCCAGGAAAATATGTTGGTTTAGCAGAAACAATTAGAGGGTTTCAATTGATCCTTTCCGGAGAATTAGACGGTCTTCCTGAGCAGGCCTTTTATTTGGTAGGTAACATCGATGAAGCTACCGCGAAA????????????????????????????????
Limonium                       TTACAGGTTCGCCAGGAAAATATGTTGGTCTAGCAGAAACAATTAGAGGCTTTCAATTAATTCTATCCGGAGAATTAGACGGTCTTCCGGAACAGGCCTTTTATTTGGTAGGTAACATCGATGAAGCTACCGCGCA?????????????????????????????????
Nepenthes_alata                TTACCGGTTCTCCAGGAAAATATGTTGGTCTAACCGAAACAATTAGAGGGTTTCAATTGATCCTTTCCGGAGAATTAGACGGTCTTCCTGAGCAGGCCTTTTATTTGGTGGGTAACATCGATGAAGCTACCGCGAAAGC--TAT-GAATTTAGAAATGGAGAACAAATT
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                      TTACAGGTTCGCCAGGAAAATATGTTGGTCTAGCAGAAACAATTAGAGGGTTTCAATTGATCCTTTCCGGAGAATTCGACGGGCTTCCCGAGCAGGCCTTTTATTTRGTAGGT?ACATCGACG??GC?ACCG?GAA?GC--TAT-GAA???AG??ATGGAGA?CAA?TT
Triphyophyllum_peltatum        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                     4,570     4,580     4,590     4,600     4,610     4,620     4,630     4,640     4,650     4,660     4,670     4,680     4,690     4,700     4,710     4,720     4,730
Aldrovanda_vesiculosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ?????????????????????????????????????CATAGA-------GATGATAGAT---------CATAGATATTTGTAATCAATTATTTATTATTTTGGGAAGGAACAATAGTATTTCATTGCTACAAGTATGGATTATTGAAAAGAATAAGACAT-GTATTTG
Ancistrocladus_heyneanus       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula              ??????????????????????GTATTTTCGGTCCTCTATAGA-------GAGG-TA------------C-TAAATAGTTGGAATTAATTATTTCTCATTCGGGGAAG-AAAAA-A--A-TTCATTGCTACAAGTATGGATTATTGAAAAGAATAAGACAT-GTATTTG
Dioncophyllum_thollonii        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  GA??????????????????AGGTATTTCTGGTCCCTTATAGATTATAGAGAGGGTAGATCATAACTAGC-TAAATAGTTGGAATTAATTATTTATCATTTGGGGAAG-AAAAATAGTATTTCATTGCTACAAGTATGGATTATTGAAAAGAATAAGACAT-GTATTTG
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ???????????????????????????TCTGGTCCCTTATAGA-------GATGAGAAAT---------CATAGATATTTGTAATTAATTATTTCTTATTTTGGGAAG-AACAATAGTATTTCATTGCTACAAGTATGGATTATTGAAAAGAATAAGACAT-GTATTTG
Limonium                       ???????????????????????TATATCTGGTCCCCTATAGA-------AAAGATAGAT---------CATAGATCTATCTAATCAATCATTTATCACTTGGGGAAGGAACAATAGTATTTCATTGCTATAGGTATGGATTATTAAATTGAATAAACCAT-GTGTTTG
Nepenthes_alata                GAAGAAATGA???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                      GA?GA??????????????????????TCCGGGCCCT-ATAGAGCTATG-AGAGATAGAT---------CATAGATCTTGGTAATAAACCATTTA-CACTTGGGGAAGGAACAATAGTATTTCATTGCTACAA-TGT-GTCTAT--------ATAAGACAT-GTTTTTG
Triphyophyllum_peltatum        ????????????????????AGGTATTTCTGGTCCCTTATAGA-------GATGATAGAT---------CATAGATATTTGTAATAAATTATTTATCATTTGGGGAAGGAACAATAGTATTTCATTGCTACAAGTATGGATTATTGAAAAGAATAAGACAT-GTATTTG
```

```
                              4,740     4,750     4,760     4,770     4,780     4,790     4,800     4,810     4,820     4,830     4,840     4,850     4,860     4,870     4,880     4,890     4,900
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    GA---CATTTT------CCTTCAACTCCACAAT--------ATTGTATTTAGATATTTAACGTAACACGACTAGTTGAAGCGAATTCTCTGAAAAGAAAA-TGGATTATGGGAGTGTGTGACTTGAAATATTGATTAGGCCGTGCAGATATATACCTTTTTCTGCCACA
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             GA---CATTTT------CCTGCAACTCCACAATACAATATAAAAATATTC-GATTTGTAACATAAGAAGGCCGGTTGCAGGGAATTCTCCGAAAAGAAAA-TGGATTATGGGAGTGTGTGACTTGAAGTATTGATTAGGCCGTGCAGATATATGCACTTTTCTGCCACA
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 GA---CATTTT------CCTTCAACTCCACAAT---ACAATATAGTATTTAGATCTGTAACATAACACGACTAGTTGCAGGGAATTCTCCGAAAAAAAAAATGGATTATGGGAGTGTGTGACTTGAAGTATTGATTAGGCCGTGCAGATATATGCGTTTTTCTGCCACA
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      GA---TATTTT------CCTTCAATTACACAAT--------ATTGTATTTAGATATTTCACATAACACGACTAGTTGAAGGCAATTCTCCGAAAAGAAAA-TGGATGATGGGAGTGTGTGACTTGAAGTATTGATTAAGCCGTGCAGATATATACCCTTTTCTGCCACA
Limonium                      GA---TATTTTATTTTTCCTTCAACTCCAC--T------AAATTGTATTTAGTTGTTTAACATAACACAAATAGTTGAAAGGAATTCTCCGAAACGACAAATGGATTATGGGAGTGTGTGACTTGAACTATTGATTAGGCCGTGTAGATATATGTCCTTTTCTGCCACA
Nepenthes_alata               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                     GACAGTCTCTTT-----CCTTCAACCCCACAATATTGTAATTAGGTA-TTATGTATTTAACATAACACGACGAGTTGAAGGGAATTCTCCGAAAGGAAAA-TGGATTATGGGAGTGTGTGACTGAAACTATTGAGTAGGCCGTGCAGATATATGCCCCTTTCTGCCACA
Triphyophyllum_peltatum       GA---CATTTT------CCTTCAACTCCACAAT--------ATTGTATTTAGATATTTAACGTAACACGACTAGTTGAAGGGAATTCTCCGAAAAGAAAA-TGGATTATGGGAGTGTGTGACTTGAAGTATTGATTAGGCCGTGCAGATATATACCTTTTTTTGCCACA

                                4,910     4,920     4,930     4,940     4,950     4,960     4,970     4,980     4,990     5,000     5,010     5,020     5,030     5,040     5,050     5,060     5,070
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    TTGAAACTCACAAACCAAT-----GTGTCTTTGTTCCAACCACC--GTATA----AGCTCTATACAG-----AGGA-TAGGCCGG-----TTTGCTTGAAGAGGATTTTTTCTATGATCAGCCCCGAATCATGTCATACATGAACAGGCTCCGTAAGATCCAGTCGAAT
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             TTCAAATTAACAAGCCAATCCAATGTGTCTTTGTTCAAACTACC--CTAT------GCCCTATACAATACGTAGGAATAGGAAAG-----TTCGTTTGAATAGAATTTTGTCTATGATCACCCCCCAAGCATGTCTTGCATGAAGAGGCTCCGTAAGATCCAGTCGAAT
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 TTAAAATTCACAAGCCAATCCAATGTGTCTTTGTTCCAACCACC--ATATA----AGCCCTATACAT-----AGGAATAGGAAAGGCTGGTTCGCTGGAAAAAAATTTGGTCTATGATCAACCCCAAAGCATGTCCTACATGAACAGGCTCCGTAAGATCCAGTCAAAT
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      TTGAAATTCCCAACTCAAT-----GTGTCTTTGTTCCAACTACC--GTATA----AGCCCTATACAG-----AGGA-TAGGCCGG-----TTTTCTTGAAGATAATTTTGTCTATGATCAGCCCCGAATCATGTTATACATGAATAGGCTCCGTAAGATCCAGTCGAAT
Limonium                      TTGCAATTCACAAACCAAT-----GTGTCTTTGTTCCAACCATCTTATATATCTAATTCCTATACAG-----AGGA-TAGGCTGG-----TTCGCTTGAATAGAATTCTTTCTATGATCAGTTCCGAATCATGTTATGCATGAAAAGGCTCCGTAAGATCCAGTCGAAT
Nepenthes_alata               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                     TGGAAATCCACAAACCAGT-----GTGTCTTGGTCCCAACCACC--GTATA----RGCTATATACAG-----ACGA-TAGGCTGG-----TTTGCTTGAATAGAATTCTTTCTATGATTAGCCCCGAATCATGTCATGCATGAACAGGCTCCGTAAGATCCAGTCGAAT
Triphyophyllum_peltatum       TTGAAATTCTCAAACCAAT-----GTGTCTTTGTTCCAACCACC--GTATA----AGCTCTATACAG-----AGGA-TAGGCCGG-----TTTGCTTGAAGAGGATTTTTTCTATGATCAACCCCGAATTATGTCATACATGAACAGGCTCCGTAAGATCCAGTCGAAT

                                       5,080     5,090     5,100     5,110     5,120     5,130     5,140     5,150     5,160     5,170     5,180     5,190     5,200     5,210     5,220     5,230
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    CAGTTATTTTGCAGAATCCAGATTCTGTGTTTCTCTATTTCACTTAT-AAAATTAAAT--AATAATTTATTTATAGTTTT---------------AATAGTATGGAAATGCATTCATTTCCTCTGCATCGACCCGATCTATGATACTATCGGAGTGAAAGAAGGGA
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             CGGTGGTTTGGCAGAATTCATAGTCTGC--TTTATCTAATTAATAAGTTAA---------TTAGCAATCGATTTCTCATTTTT----------------ATAGTATGGAAATGCATTCATTTCCTCTGCATCGACTTGATCTATGAGACTATCGGAGTAAAAGAAGGGA
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 CAGTGGTTTGGCAGAATTCAGATTCTGC---TTAATCTATTTCACTTATTAATTAGAAAAATTAGAAATCTTTTTTCATTTTATTTAATTTT-ATTTAATAGTATGGAAATGCATTCATTTCCTCTGCATCGACTTGATCTATGATACTATCGGAGTAAAAGAAGGGA
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      CAGTGATTTTTCAGAATCCAGATTCTGTCTTTCTCTATTTCACTTATTAAAAATTTCAAATAATCGTTTTCTTTATCGTTTTATTATTTATAGTTTTAATAGTATGGAAATGCATTCATTTCCTCTGCATCGAACCGATCTACGATACTATCGGAGTGAAAGAAGGGA
Limonium                      CAGTGATTTGTTAGAATCCAGATTCCGT--TTCTTGTATTT---------AAATT-------AA-TGTTTTATTTC-----------------------ATAGTATGGAAATGCACTCATTTCCTCTGCATTGACCCAATCTATGATACTATCGGAGTGAAACAAGGGA
Nepenthes_alata               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                     CAATGATTTGGCAGAATCCAGAT-CCAT--TTCTTATTCGTTCGTACGTATTAATCAATAAGTTTTGTTTT----------------------------ATAGTATGGAAATGCATTCATTTCCTCTGCATCGACGCGACCTATGATACTATCGGAGTGAAACAGGGCA
Triphyophyllum_peltatum       CGGTTATTTTGGAGAATCCAGATGCTGTGTTTCTCTATTTCACTTATT-AAATTG--AAATAATAGTTTATTTATAGTTTTAATAGT-ATGGA--AAATAGTATGGAAATGCATYCATTTCCTCTGCATCGACCCGATCTATGATACTATTGGAGTGAAAGAAGGGA

                              5,240     5,250     5,260     5,270     5,280     5,290     5,300     5,310     5,320     5,330     5,340     5,350     5,360     5,370     5,380     5,390     5,400
Aldrovanda_vesiculosa         ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    TCTAAAGAAGAATAGAGGC-TAGAGTCTATTAGTAACAAGTAAAC-TTTTGTAT--------------GTAAAAGTTTCCAAAT--T-----TTTATTTTTGTAGAAAA--ATACCAATCATAAGGTCTGAGACCACCCAGA-AAGCCTTTGATCATAATCTACTTT-
Ancistrocladus_heyneanus      ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             TCTAAAGAAGAATAGAGGC-TCGAATCTATTAGTAACAAGTAAACCTTTTGCATATAAAA------ATCAGAAAGTTTCCAAAT--T-----T---TTT--GGAGATGG--ATACTAATCGCAAGGTCTGAGACGTCCCAGG-AAGCTCTTGATCATAATCCACTTTT
Dioncophyllum_thollonii       ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 TCTAAAGAAGAATAGAGGC-TAGAGTCTATTAGTAACAAGTAAACCTTTTGTATGTAAAAATTT-TATGTAAAAGTTTCCTAAT-ATAAAAAT---TTT--GGAGATGA--ATACCAATCGCAAGGTCTGAGACGCCCCAGG-AAGCATTTGATCATAATCCACTTTT
Drosera_rotundifolia          ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      TCTAAAGAAGAATAGAGGC-TACAGTCTATTAGTAACAAGTAAAC-TTTTGTAT--------------GGAAAAGTCTCCAAATCAT-----TTT-TTTTTGGAGAAAAAAATACTAATCATAAGGTCTGAGACTGCCCAGA-AAGCTTTTGATCATAATCTACTTT-
Limonium                      TCTAAAGAAGAATATAGGC-TAGAGAATGTTAGTAACAAGTAAACGCTTTGC---------TTTGTATGTCAAAAGTCTCACA-T-------TTT-TTT--GGAGATAA--ACAACAAACGCAAGGTCTGAGACAACCCAAA-AAGCATTTGATCATGATCAACTTT-
Nepenthes_alata               ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                     TCTAAAGAAGACTAGAGGCTATATGTTAGTTAGTAACAAGTATACCCTTTGC---------TTTGTATGTAAAAGTCTCACAAT--------TTT-TT----GAGA-GAA-ACACCAATCGCAAAGTCTAAGACGGCCCAGA-AAGCATTTGAACATGATCAACTTT-
Triphyophyllum_peltatum       TCTAAAGAAGAATAGAG--------TCTATTAGTAACAAGTAAAC-TTTTGTAT--------------GTAAAAGTCTCCAAAT--TCCAA-TTT-TT---GGAGAAAA--ATACCAATCATAAGTTCTGAGACCACCCAGAAAGCCTTTGGATCATAATCTACTTT-
```

```
                                5,410 5,420 5,430 5,440 5,450 5,460 5,470 5,480 5,490 5,500 5,510 5,520 5,530 5,540 5,550 5,560 5,570
Aldrovanda_vesiculosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ---GTACGCCTACTTGGGTATTGAGCATTTACCTGTAAGAACCGAATTCCTTGCAATGGATAGTTGCAATTC-CGGAAAAGAGAATCGGAGAAA-------TTTTTTC--TTACAGAG----------AACCATTGTGGATAT-----GGATAACATAT-ATATTAGAT
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               TTTGTAAGCCGACTTGGGTATTGAGCATTTACCTGTAAGAACAAGATTCTTTGCAATGGATA-GTTGAACTC-CGGAA-TGGGAATCAAAGCCA-------TTTTTTC--TTAGAGAG----------AGCTGTTGTGGAGAT-----GCATAAAATATAGATATTAGA
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   TTTGTAAGCCTACTTGGGTATTGAGCATTTACCTGTAAGAACAAGATTCTTTGCAATCTATA-GTTGAACTCTCGGAA-TGGGAATCTAAGAAA-------TTTTTTC--TTACAGAG----------AACTGTTGTGGAGAT-----GCATAAAATATAGATTTTAGA
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ---GTAAGCCTACTTGGGTATTGAGCATTTACCTGTAAGAATCGAATTCCTTCCAA-C-----TTGTAATTT-CGGAAAAGGGAATCTAATCAA-------TTTTTTC--TTACAGAA----------AACCYTTGTGGATAT-----GGATAACATAT-------AAT
Limonium                        ---GTAAGCCTACTTGGGGTTTGAGCATTTATCTGTAAGAACGGAATTCCTTGGAATGGGTAGTTGCAACTCT-GGAAAAGGGAGTCTAGTTTC-------ATTTTTT--ATACAGAGAACC--------CCTATGTGGAGATAGACAACATATTATAGGGTTAAGATA
Nepenthes_alata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ---GTAAGCCTACTTGGGGATTGAGCATTTATCTGGAAGAACGGAATTCCTTGTAATAGGTAGTTGCAACTTT-GGAAAGGGGAATCTAGTCTAAACTTTTCGTACTTCCATACAGAGAACCCAATCATATATGTATGGATATCGACAACATAAC-TAT--ATATCTTA
Triphyophyllum_peltatum         ---GTAAGCCTACTTGGGTATTGAGCATTTACCTATAAGAACCGAATTCCTTGCAATGGATAGTTACAATTC-CGGGAAAGGGAATCGAAGAAA-------TTATTTC--TTACAGAG----------AACCATTGTGAATAT-----GGATAACATAT-AGATTCTAT

                                5,580 5,590 5,600 5,610 5,620 5,630 5,640 5,650 5,660 5,670 5,680 5,690 5,700 5,710 5,720 5,730 5,740
Aldrovanda_vesiculosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      AAGATATATATTTTCTATTT-CT-ATAGATCTAT---TTGGTTTTTTT-ATTCTTGCTCGAGCCGGATGCTGAAAAATTATCATGTCCGGTTCCTTGGGGGGATGAATCT-GTAAGAATTCACCTATCCTAATAA??????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               AAGATCTCTTTTT---ATTTTCTTATTGATAGAAA------TTTTTT-----TTTGCTCGAGCCGGATGATGAAAAATTATCATGTCCGGTTCTTTCGGGGGATAAATTC-ATAAGAATTCACCTATCCTAATAACAATAAAAC?????????????????????????
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   AAGATCTCTTTTT-C---------------------------TTTTT-----TTTGCTCGAGCCGGATGATGCAAAATTATCATGTCCGGTTCTTTCGGGGGATGAATTC-ATAAGAATTCACCTATCCT???????????????????????????????????????
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        AAGATATATATGTTAT--------AGAGATCTATTATTTGGTTTTTTTGATTCTTGCTCGAGCCGGATGATGAAAAATTATCATGTCCGGTTCTTTTGGGGGACGAATCG-ATAAGAATTTACCTATC?????????????????????????????????????????
Limonium                        TAAATTCT----------------AGATCTAGTTAGTTCTTTATATT-----ATTGCTCGAGCCGGATGATGAAAAATTCTCATGTCCGGTTCCTTCGGGGGATGAGTCT-ATAAGAATTCACCTATCCTAATAACAAAA?????????????????????????????
Nepenthes_alata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       AC--ATATATATGTTGGTCCTT----------------CTTTACATT-----CTTGCTCGAGCCGGATGATGAAAAATTCTCATGTCCGGTTCCTTCGGGGGATGAGTCTCATAAGCATTCACCTATCCTCATAACAAAAACA?CAGGAGTATATTTATGCACTTGTAC
Triphyophyllum_peltatum         AAGATATAGATTTTCTATTTAT--ATAAATC---TATTTGGTTTTTTT-ATTCTTGCTCGAGCCGGATGCTGAAAAATTATCATGTCCGGTTCCTTGGGGGGATGAATCT-GTAAGAATTCACCTATCCTAA?????????????????????????????????????

                                5,750 5,760 5,770 5,780 5,790 5,800 5,810 5,820 5,830 5,840 5,850 5,860 5,870 5,880 5,890 5,900 5,910
Aldrovanda_vesiculosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ACGATTCGGGTTTTGTTTTAAACGGGCCCATTTTGTTGTCCAATCGAAATAAAGGTTATGACACAAACTACAGTTTCCTAGTTGTAAAACGTTTAGTTATTCGAATGTATCAACAGAATTTTTTGATTCCTTCTGTTAATGATTCTAACAAAAACGACTTTCTTGGGCA
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                5,920 5,930 5,940 5,950 5,960 5,970 5,980 5,990 6,000 6,010 6,020 6,030 6,040 6,050 6,060 6,070 6,080
Aldrovanda_vesiculosa           ??????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????GACAAATTTTCTC--
Ancistrocladus_abbreviatus      ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCAC--
Ancistrocladus_heyneanus        ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCAC--
Ancistrocladus_korupensis       ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCAC--
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCAC--
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????TTTCGAGGACAAATTGTCTC--
Drosera_regia                   ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTCGAGGACAAATTTTCTC--
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTAGAGGATCAATTCTCAC--
Limonium                        ???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????AC
Nepenthes_alata                 ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCAC--
Nepenthes_tobiaca               ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCAC--
Nepenthes_ventricosa            ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCAC--
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       CAAGAAAAATTTTTATTCTCAACAGATCTCAGAGGGGTTTGCAGCTATTGCGGAAATTCCATTTTCTATGCGATTAATATCTTCCCTAGAAGGAAAAGAACTCAAAAAATCGCAAAATTTACGACCAATTCATTCAACGTTTCCTTTTTTAGAGGACAAATTTTTACG-
Triphyophyllum_peltatum         ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ACGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCAC--
```

```
                               6,090     6,100     6,110     6,120     6,130     6,140     6,150     6,160     6,170     6,180     6,190     6,200     6,210     6,220     6,230     6,240     6,250
Aldrovanda_vesiculosa          -TTTAAATTATATATTAAAAATACTGATCCCCTACCCCATCCATCTGGAAATATCGGTCCAAACTCTTCGGTATTGGATGAAAGATGTCTCTTCGTTACATTTATTACGATTCCTTCTTTATAAGTATCGTAATTGTAATAGAAAGAGTTTTATTTTTCGCAAGGAATC
Ancistrocladus_abbreviatus     ATTTAAATTATGTGTTAGATATACGAATACCCCATCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTGAAAGATACCTCTTCTTTGCATTTATTACGATTCTTTCTTTATGAGTATTGTAATTGGAATAG------TCTTTTTTCTCTAAAGAAAAA
Ancistrocladus_heyneanus       ATTTAAATTATGTGTTAGATATACGAATACCCCATCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTGAAAGATGCCTCTTCTTTGCATTTATTACGATTCTTTCTTTATGAGTATTGTAATTTGAATAG------TCTTTTTTCTTTAAAGAAAAA
Ancistrocladus_korupensis      ATTTTAATTATGTGTTAGATATACGAATACCCCATCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTGAAAGATGCCTCTTCTTTGCATTTATTACGATTCTTTCTTTATGAGTATTGTAATTGGAATAG------TCTTTTTTCTCTAAAGAAAAA
Ancistrocladus_robertsoniorum  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ATTTAAATTCTGTGTTAGATATACGAATACCCCACCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTGAAAGATGCCTCTTCTTTTCATTTATTACGATTCTTTCTTTATGAGTATCGTAATTGGAATAG------TCTTTTTTCTCTAAAGAAAAA
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ATTTAAATTATATGTTAAATATACTGATAGCTTACCCGGTCCATTTGGAAATATTGGTTCAAAATCTTCGATATTGGGTGAAAGATGCCCCTTCTTTGCATTTTTTACGATTCCTTATTTACGAATATCGTAATTGGAATAGAAAGAGTATTCTTTTTTCAGAGCAATT
Drosera_regia                  ATTTAAATTATATATTAAATATACTGATAGCCTACCCTGTCCATCTGGAAATATTGGTTCAAACTCTTCGGTATTGGGTGAAAGATGCCTCTTCTTTGCATTTATTACGATTCCTTCTTTATGAGTATCGTAATTGGAATAGAAAGAGTCTTCTTTTTCGAAAGCAATC
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ATTTAAATTATGTCTTAGATATAAGAATACCTCACCCTGTCCATCTAGAAATCCTGGTTCAAACTCTTCGCTACTGGGTGAAAGATGCGCCTTCCTTGCATTTATTACGATTTTTTCTTTATGAGTCTCATAATTGGAATAG------TTTTTTTTCTTTAAAGAAAAA
Limonium                       ATTTAAATTATGTGTTAGATATATTGATACCTTACCCCGTTCATCTGGAAATCTTGGTTGAAAGTATTCGCTACTGGGTAAAAGATGCCTCTTGCTTGCATTTATTGCGAGTCTTTCTTTATGAGTATCGTAACTTTAATAG------TCTTATTATTCAAAGAAATC
Nepenthes_alata                ATTTAAATTATGTGTTAGATATACTGATACCCCATCCTGTCCATCTGGAAATCCTAGTTCAAACTATTCGCTACTGGACGAAAGATGCTTCTTCTTTGCATTTATTACGATTCTTTCTTTATGAGTATCGTAATTGGAATAG------TCGTATTTCTATAAAGCAATA
Nepenthes_tobiaca              ATTTAAATTATGTGTTAGATATACTGATACCCCATCCTGTCCATCTGGAAATCCTAGTTCAAACTATTCGCTACTGGACGAAAGATGCTTCTTCTTTGCATTTATTACGATTCTTTCTTTATGAGTATCGTAATTGGAATAG------TCGTATTTCTATAAAGCAATA
Nepenthes_ventricosa           ATTTAAATTATGTGTTAGATATACTGATACCCCATCCTGTCCATCTGGAAATCCTAGTTCAAACTATTCGCTACTGGACGAAAGATGCTTCTTCTTTGCATTTATTACGATTCTTTCTTTATGAGTATCGTAATTGGAATAG------TCGTATTTCTATAAAGCAATA
Nepenthes_vieillardii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                      -TTTAAGTTTTGTGTTAGATATATTGATACCTCACCCTGTCCATCTGGAAATCTTGGTTCAAACTATTCGGTACTGGGTAAAAGATACCTCCTGTTTGCATTTATTACGATTCTTTCTTTATGAGTATTGTAAT------AG------TGTTATTACTCTAAAGAGATC
Triphyophyllum_peltatum        ATTTAAATTATGTGTTAGATATACGAATACCCCACCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTGAAAGATGCCTCTTCTTTTCATTTATTACGATTCTTTCTTTATGAGTATCGTAATTGGAATAG------TCTTTTTTTTCTAAAGAAAAA

                               6,260     6,270     6,280     6,290     6,300     6,310     6,320     6,330     6,340     6,350     6,360     6,370     6,380     6,390     6,400     6,410     6,420
Aldrovanda_vesiculosa          CATTT-CGCTTTTTTCAA--A-AAGGAATCAAAGATTATTTTTGTTTCTATATAATTCCTATGTATGTGAATACGAATCCGTTATTATTTTTCTTCACAACCAATCCTCTCATTTACGATCAACCTTTTATGGAGCCCTTCTTGAGCGAATTTATTTCTATGGAAAGAT
Ancistrocladus_abbreviatus     CATTT-CTATTTTTTCAA--A-AAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTATCCGCAATCAATCCTCTCATTTACGATCAACATTTTCGGGAGCCTTTCTTGAACGAATCTCTTTCTATGCAAAGAT
Ancistrocladus_heyneanus       CATTT-CTATTTTTTTAA--A-AAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTATCCGCAATCAATCCTATCATTTACGATCAACATTTTCGGGAGCCTTTCTTGAACGAATCTCTTTCTATACAAAGAT
Ancistrocladus_korupensis      CATTT-CTATTTTTTCAA--A-AAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCTATCTTCATTTTTATCCGCAATCAATCCTCTCATTTACGATCAACATTTTCGGGAGCCTTTCTTGAACGAATCTCTTTCTATGCAAAGAT
Ancistrocladus_robertsoniorum  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        CATTT-CTATTCTTTCAA--A-AAGGAATCAAAGATTCTTTTTGTTCCTATATAATTCCTATGTGTGTGAATACGAATCCATCTTCATTTTTATCCGCAATCAATCCTCTCATTTACGATCAACGTTTTTGGGAGCCCTTCTTGAACGAATCTCTTTCTATGCAAAGAT
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               CATTT-ATAGTTTTTCAA--A-AAGGAATCAAAGATTCTTTTTATTTCTATATAATTCCTATCTATGTGAATATGAATCCATCCTTCTTTTTCTTCCCAACCAATGCTATCACTTACGATCAACCTTTTATGGAGCCCTTATTGAGAGAATATTTTTCTATCGAAAGAT
Drosera_regia                  CATTT-CTATTTTTTCAA--A-AAGGAATCAAAGATTATTTTTGTTTCTATATAATTCCTATGTGTGTGAATACGAATCCATCGTTATCTTTCTACGCAACCAATCCTCTCATTTACGATCAACCTTTTATGGAGCCCTTCTTGAGCGAATCTCTTTCTATGGAAAGAT
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       CATTT-C-CTTTTTGAAAA-A-AAGGAATCAAAGATTCTTCTTGTTCCTATATAATTCTCATGTGTGTGAATACGAATCTATCTTCTTTTTTATCTGCAATCAATCCTCTCATTTACAATCAACATTTTATGGATCCCTTATTGAACGAATCCATTTCTATGGAAAGGT
Limonium                       TGTTTACAAATTTTTTAA--A--ACAAGTAAAAGATTCTTCTTGTTACTATATAATTCCCATGTGTGTGAATATCAATCCATCTTCGTTTTTCTCCGCAACCAATCCTCTCATTTACGATCAACATCTTACGGAGCCTTTCTTGCACGAATATATTTCTACGGAAAGAT
Nepenthes_alata                CATTT-CTTTTTTTTCAA--A-CAGGAATCAAAGATTATTCTTGTTCCT?TATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTCTCCGCAACCAACCCTTCCATTTACGATCAACTTTTTCTGGAGCCTTTCTTGAACGAATCCTTTTCTATGAAAAGAT
Nepenthes_tobiaca              CATTT-CTTTTTTTTCAA--A-CAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTCTCCGCAACCAACCCTCCCATTTACGATCAACTTTTTCTGGAGCCTTTCTTGAACGAATCCATTTCTATGAAAAGAT
Nepenthes_ventricosa           CATTT-CTTTTTTTTCAA--A-CAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTCTCCGCAACCAACCCTCCCATTTACGATCAACTTTTTCTGGAGCCTTTCTTGAACGAATCCATTTCTATGAAAAGAT
Nepenthes_vieillardii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                      TGTTT-CTCATTTTTCAAAAAAAAAAAATCACAGATTTTTATTGTTCTTATATAATTCCTATGTGTGTGAATGCGAATCCATCTTCGTTTTTCTCCGCAACCAATCTTCTCATTTAGGATCAACATCTTACAGAGCCTTTCTTGCGCGAGTTTATTTCTACCTAAAGTT
Triphyophyllum_peltatum        CATTT-CTATTCTTTCAA--A-AAGGAATCAAAGATTCTTTTTGTTCCTATATAATTCCTATGTGTGTGAATACGAATCCATCTTCATTTTTATCCGCAATCAATCCTCTCATTTACGATCAACGTTTTTGGGAGCCCTTCTTGAACGAATCTCTTTCTATGCAAAGAT

                               6,430     6,440     6,450     6,460     6,470     6,480     6,490     6,500     6,510     6,520     6,530     6,540     6,550     6,560     6,570     6,580     6,590
Aldrovanda_vesiculosa          GGAGCATCTTGTAAAGGTTTTCCGAAGAAATTTCATACTATGCTATGGTTCTTCCAGGATCCTTTGATGCATTATGTTAGGTATCAAGATAAATCCATTATGGCTTCAAAAGGGACATCTCTTCTGATGAATAAATGGAGATATTACCTTATCAATTTGTGGCAATTT
Ancistrocladus_abbreviatus     AGAACATCTTGTAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGGACATCTCTTCTGATGAATAAATGGAAATATTACCTTGTAAATTTCTGGCAATGT
Ancistrocladus_heyneanus       AGAACATCTTGTAAAGTCTTTACTAAGAATTTTCAGGTTATCATATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGGACATCTCTTCTGATGAATAAATGGAAATATTACCTTGTAAATTTCTGGCAATGT
Ancistrocladus_korupensis      AGAACATCTTGTAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGGACATCTCTTCTGATGAATAAATGGAAATATTACCTTGTAAATTTCTGGCAATGT
Ancistrocladus_robertsoniorum  ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula              ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        AGAACACCTTGTAAAGTCTTTACTAAGACTTTTCAGGTTATCCTATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGGACATCTCTTCTGATGAATAAATGGAAATATTACCTTGTCAATTTCTGGCAATGT
Drosera_binata                 ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               GGAAGATCTTGTAAAGGCTTTCGTAAGAATTTTCAGATAATCCGATGGTTTTTCCAGGATCCTTTCATGCATTATGTTAGGTATCAAGGAAGATCCATTATTGCTTCAAAAGGGACATCTCTTTTGATAAATAAATGGAGAAATTATCTTGTTAATTTGTGGCAATTT
Drosera_regia                  GGAACATCTTGTAAAGGCTTTCCGAAGAATTTTCAGATTATCCTATGGTTCTTCCAGGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATCCATTATGGCTTCAAAAGGGACATCTCTTCTGATAAATAAATGGAGATATTACCTTATCAATTTGTGGCAATTT
Drosera_rotundifolia           ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       AGAACATCTTGTAAAGTCTTTACTAAGAATTTTCAGGTTATCTTATGGTTCTTCCAAGATCCTTTGATGCATTATGTTAGGTATCAAGGAAAATCCATTCTAGCTTCAAAAGCAACATCTCTTCTGATCAATAAATGGAAATATTATCTTGTCAATTTCTGGCAATGT
Limonium                       AGAATATCTTGGAAAGGCTTTACTAAGCCTTTGAAAGGGATCCTATGGTTCTTTAAGGACCCTTTTATGCATTATGTTAGGTATCAAGGAAAATGGATTCTGGCTTCAAAAGGTACATCTCTTCTGGTGAATAAATGGAAATATTACCTTGTCCGTTTCTGGCAATGT
Nepenthes_alata                GGAACATCTTGTAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTTTTCAAAGATACTTTCATACATTATGTTAGGTATCAAGGAAAATCTTTTGTGGCTTCAAAAGGGACATCTCTTCTGATGATTAAATGGAAATATTACCTTGTCAATTTTTGGCAATGT
Nepenthes_tobiaca              GGAACATCTTGTAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTTTTCAAAGATACTTTCATGCATTATGTTAGGTATCAAGGAAAATCTTTTGTGGCTTCAAAAGGGACATCTCTTCTGATGATTAAATGGAA?ATTACCTTGTCAATTTTTGGCAATGT
Nepenthes_ventricosa           GGAACATCTTGTAAAGTCTTTACTAATAATTTTCAGGTTATCCTATGGTTTTTCAAAGATACTTTCATGCATTAT?TTAGGTATCAAGGAAAATCTTTTGTGGCTTCAAAAGGGACATCTCTTCTGATGATTAAATGGAAATATTACCTTGTCAATTTTTGGCAATGT
Nepenthes_vieillardii          ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                      AGAACATTTTGTAAAGTATTTACTAAGAA----C-------CCTGGGGT---------ATCCTTT???????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        AGAACACCTTGTAAAGTCTTTACTAAGACTTTTCAGGTTATCCTATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGGACATCTCTTCTGATGAATAAATGGAAATATTACCTTGTCAATTTCTGGCAATGT

                               6,600     6,610     6,620     6,630     6,640     6,650     6,660     6,670     6,680     6,690     6,700     6,710     6,720     6,730     6,740     6,750     6,760
Aldrovanda_vesiculosa          TATTTTTCTGTGTGGTCACAACCAAGAAGAATCTATATTGATCAACTATCAAATT-TTCC-TTCAACTTTATGGGTTTTCTTTCAAGTCTACGATTAAATCCTTCAATGGTCCGAAGTCAAATGTTAGAAAATTCATTTTTAATAGATAATCCGAGACAAAA------T
Ancistrocladus_abbreviatus     TATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAATCATTCC-CTGGACCTTATGGGTTTTCTTTTAAGTGTGCGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATTCATTTCTAATAGATAATGCTATTAAGAA------G
Ancistrocladus_heyneanus       TATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAATCATTCC-CTGGACCTTATGGGTTTTCTTTTAAGTGTGCGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATTCATTTCTAATAGATAATGCTATTAAGAA------G
Ancistrocladus_korupensis      TATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAATCATTCC-CTGGACCTTATGGGTTTTCTTTTAAGTGTGCGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATTCATTTCTAATAGATAATGCTATTAAGAA------G
Ancistrocladus_robertsoniorum  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        TATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTTTCAAATCATTCC-CTGGACTTTATGGGTTCTCTTTTAAGTGTGTGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATTCATTTCTAATAGATAATGCTATTAAGAA------G
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               TATTTTTCTGTCTGGTCGCAACCAAAAAGAATCTATATCACTCAACTATTAATATCTTCC-TTCTACTTTATGGGTTTTTTTTCAAGTCTAGGGCGAAATCCTTCGATGATACGTAGTCAAATGTTAAAAAATTCATTTTTAATAGAAAATGCTATTAAAAATAAAAAG
Drosera_regia                  TATTTTTCTGTGTGGTCTCAACCAAGAAGAATCTATATCAATCAACTATTAAAATTTTCC-TTCCACTTTATGGGTTTTCTTTCAAGTCTACGACTAAATCCTTCGATGGTACGTAGTCAAATGTTAGAAAATTCATTTTTAATAGATAATGCTATTAAAAA------G
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       TATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAAAAATTCC-CTGGACTTTACGGGTTTTCTTTCAAGTGTGTGCCTAAATACTTCCGTGGTACGGAGTCAAATGTTAGAAAATTCATTTATAATGGATAATGCTATTAATAA------G
Limonium                       CATTTTTCCATATGGTCTCAACCAAGAAGAATCCATATGAATGTATTATCAAACT-GTCCTATTGACTTTATGGGTTTTGTTTTCAGTGTGCGACTCAAGCCTTCTGTGGTACGGAGTCAAATGTTAGAAAATTCATTCGTAATAGAGAATGGGATTAAGGA------G
Nepenthes_alata                TATTTTTCCGTGTGGTCTCAACCAAGAAGAATCTATATCAATCAATTATCAAATCATTCC-CTGGACTTTATG?GTTTTCTTTCAAGTGTGCGACTAAATCCTTCCGTGGTACGGATTCAAATGTTCGAAAAATCTTTTATCATAGATAATGCTATTAATAC------G
Nepenthes_tobiaca              TATTTTTCCGTGTGGTCTCAACCAAGAAGAATCTATATCAATCAATTATCAAATCATTCC-CTGGACTTTATG?GTTTTCTTTTAAGTGTGCGAC?AAATCCTTCCGTGGTACGGATTCAAATGTTCGAAAAATCTTTTATCCTAGATAATGCTATTAATAC------G
Nepenthes_ventricosa           TCTTTTTCCGTGTGGTCTCAACCAAGAAGAATCTATATCAATCAATTATCAAATCATTCC-CTGGACTTTATGGGTTTTCTTTCAAGTGTGCGACTAAATCCTTCCGTGGTACGGATTCAAATGTTCGAAAAATCTTTTATCATGGATAATGCTATTAATAC------G
Nepenthes_vieillardii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        TATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAATCATTCC-CTGGACTTTATGGGTTTTCTTTTAAGTGTGTGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATTCATTTCTAATAGATAATGCTATTAAGAA------G
```

```
                                 6,770     6,780     6,790     6,800     6,810     6,820     6,830     6,840     6,850     6,860     6,870     6,880     6,890     6,900     6,910     6,920
Aldrovanda_vesiculosa           TTTGCTACCCTAGTTCCGACTATTTCTCTGATTGGATCATTGACGAAATCGAAATTTTGTAACGGTTTAAGACATCCCATTAGTAAGTCGGCCTGGGCTGATTTATCAGATTCTGATATTATTGACCGATTTGGTCGTATATGCAGAAGTCTTTCTCATTATTACAGCG
Ancistrocladus_abbreviatus      TTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCGAAATTTTGTAACGTATTAGGACATCCCATTAGTAAGTCGGTTTGGGCCGATTTCTCAGATTCAGAGATTATTGAACGATTTGGGCGTATATGCAGAAGTCTTTATCATTATTACAGCG
Ancistrocladus_heyneanus        TTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCGAAATTTTGTAACGTATTAGGACATCCCATTAGTAAGTCGGTTTGGGCCGATTTCTCAGATTCTGAGATTATTGAACGATTTGGGCGTATATGCAGAAGTCTTTATCATTATTACAGCG
Ancistrocladus_korupensis       TTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCGAAATTTTGTAACGTATTAGGACATCCCATTAGTAAGTCGGTTTGGGCCGATTTCTCAGATTCAGAGATTATTGAACGATTTGGGCGTATATGCAGAAGTCTTTATCATTATTACAGCG
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         TTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCACAATTTTGTAACGTATTAGGACATCCCA?TAGTAAGCCGGTTTGGGTTGATTTCTCAGATTCTGAGATTATTGACCGATTTGGGCGTATATGCAGAAGTCTTTATCATTATTACAGCG
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                TTCGATACCCTAGTTCCAAGTAGTCCTTTGATGGGATCATTAACAAAAACGAGATTATGTAACAGCTTAGGACATCCCATTAGTAAGTCGGCTTGGGCCCATTTTTCAGATTCTGAGATTATTAACCGATTTAGTCGTATATGCAAAAGTATTTCTCATTATTACATGG
Drosera_regia                   TTCGATACCCTAGTTCCAAGTATTCCCCTGATTGGATCATTGACGAAAGCGAAATTTTGTAACGGCTTAGGACATCCCATTAGTAAACCGGCCTGGGCTGATTTATCAGATTCTGATATTATTGACCGATTTGGTCGTATATGCAGAAGTCTTTCTCATTATTACAGCG
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        TTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCGAAAGCGAAATTTTGTAACGTATTAGGGCATCCCATTAGTAAGCCTGTTTGGACTGATTTATCAGATTCGGAGATCATTGACCGATTTGGG?GTATATGCCGAAGTATTTCTCATTATTATAGCG
Limonium                        TTTGATACCATAGTTCCAATTATGCCTCTCATTGGATCTTTGGCTAAAGCAAAATTTTGTAATGGATTAGGACATCCCATTAGTAAGCCGGTCTGGGCTGATTTAGCCGATTCAGATATTATTGACCGATTTGGCCGTATATGCAGAAATCTTTCCCATTATTACAGCG
Nepenthes_alata                 TTCGATACCCTAGTTCCAAATATTCATATGAGTGGATCATTTGCGAAAGAAAAATTTTGTAACATATTTGGACATCCCATTAGTAAACCGGTATGGGCCGATTTATCAGATTCTGATATTATTGATCGATTTGGTCGTATATGCAGAAGTCTTTCTCATTATTACAGCG
Nepenthes_tobiaca               TTC?ATACCCTAGTTCCAAATATTCCTATGATTGGATCATTTGCGAAAGAAAAATTTTGTAACATATTTGGACATCCCATTAGTAAGCCGGTATGGGCCGATTTATCAGATTCTGATATTATTGACCGATTTGGGCGTATATGCAGAAGTCTTTCTCATTATTACAGCG
Nepenthes_ventricosa            TTCGATACCCTAGTTCCAAATATTCCTATGGTTGGATCATTTGCGAAAGAAAAATTTTGTAACATATTTGGACATCCCATTAGTAAACCGGTATGGGCCGATTTATCAGATTCTGATATTATTGACCGATTTGGTCGTATATGCAGAAGTCTTTCTCATTATTACAGCG
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum         TTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCGCAATTTTGTAACGTATTAGGACATCCCATTAGTAAGCCGGTTTGGGTCGATTTCTCAGATTCTGAGATTATTGACCGATTTGGGCGTATATGCAGAAGTCTTTATCATTATTACAGCG

                                6,930     6,940     6,950     6,960     6,970     6,980     6,990     7,000     7,010     7,020     7,030     7,040     7,050     7,060     7,070     7,080     7,090
Aldrovanda_vesiculosa           GATCTTCAAGAAGAAGCAGTTTGTATTCAATACAGTATATACTTCGACTT???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      GATCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTT???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        GATCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTT???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       GATCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTT???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         GATCTTCAAGAAAAAAGGGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCGAGAACTTTGTCTCGTAAACACAAAAGCACTGTACGTGCTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTTATGGAGGAAGAAAAAGTTCTTTCTTTGAT
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                GATCTTCAAGAAAAAGTAGGTTGTATCGAATACAATATATACCTCGACTT???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   GATCTTCAAGAAAAAGGAGTTTGTATCGAATACAGTATATACTTCGACTTTCTTGTGCTAAAACTTTGTCGCGTAAACACAAAAGTACTGTACATGCTTTTTTGAAACGATTAGGTTCAGATTTTTTGGAAGAATTCTTTACAGAGGAAGAAAAAGTTCTTTCTTTCAT
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        GATCTTCAAAA????????????????????????????????????????CTTGTGCTAGAACTTTGGCTCGTAAACACAAAA??A????AC???CTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTTACAGAGGAAGAAAAAGTTCTTTCTTTTCT
Limonium                        GTTCTTCACGAAAGAGGA???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                 GGTCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGGCTCGGAAACACAAAAGTACTGTACGTACTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTTATGGAGGAAGAAAAAGTTCTTTCTTTGAT
Nepenthes_tobiaca               GGTCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGAATTTCTTGTGCTAGAACTTTGGCTCGGAAACACAAAAGTACTGTACGTACTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTTATGGAGGAAGAAAAAGTTCTTTCTTTGAT
Nepenthes_ventricosa            GGTCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGGCTCGGAAACACAAAAGTACTGTACGTACTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTTATGGAGGAAGAAAAAGTTCTTTCTTTGAT
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum         GATCTTCAAGAAAAAAGGGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGTCTCGTAAACACAAAAGCACTGTACGTGCTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTTATGGAGGAAGAAAAAGTTCTTTCTTTGAT

                                 7,100     7,110     7,120     7,130     7,140     7,150     7,160     7,170     7,180     7,190     7,200     7,210     7,220     7,230     7,240     7,250     7,260
Aldrovanda_vesiculosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         CTTACCAAGAGATTCTTCTATTTCACAGAGGTTATATAGAGGACCCATTTGGTATTTGGATATTTTTTGCATCCATGATTTT???????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   TGTACCAAGAGATTCTTATATTTCACAGAAGTTATATAGAGTACGTATTTGGTATTTGGATATTTTTTGTATCCATGATTTGTCCAA??????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        T???CCAAGAGATTATTCTATTTCACAGAGGTTATATAGAGGGCGTATTTGGTATTTGGATATTTTTTGTATTCATGATTTTGCCAA??????????????????????????????????????????????????????????????????????????????????
Limonium                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                 CTTACCAAGGGATTCTTATACTTCACAGAGGTTCTATAGAGGACGTATTTGGTATTTGGATATTTTCTGTATTCATGATTTGGCCAAGATCAGTTTGACGATACCGATCCTAGAGAGAAGATAAAGAAGGGATCCTTTTTCAATTGGTTTTACTTCTCCGTCAACATTG
Nepenthes_tobiaca               CTTACCAAGGGATTCTTATACTTCACAGAGGTTCTATAGAGGACGTATTTGGTATTTGGATATTTTCTGTATTCATGATTTGGCCAA??????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa            CTTACCAAGGGATTCTTATACTTCACAGAGGTTCTATAGAGGACGTATTTGGTATTTGGATATTTTCTGTATTCATGATTTGGCCAA??????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum         CTTACCAAGAGATTCTTCTATTTCACAGAGGTTATATAGAGGACCCATTTGGTATTTGGATATTTTTTGTATCCATGATTTTGCCAA??????????????????????????????????????????????????????????????????????????????????

                                  7,270     7,280     7,290     7,300     7,310     7,320     7,330     7,340     7,350     7,360     7,370     7,380     7,390     7,400     7,410     7,420     7,430
Aldrovanda_vesiculosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                 GCGCTCTCATATCAAGTAGTCTTATTGTCTGGGTTCAAGAAAATCTTGGATGGGCCTTGGGTTTTGGAATTCCTGCAATATCCATGGGAATTGCTATTGCAAGTTTCTTTTCTGGTACGGCTCTATATAGGTTGCAGAAACCCGGAGGAAGCCCACTTACCCGAATGTG
Nepenthes_tobiaca               ?????????????????????T?AG?G?G?GGGTTCAAGAAAATCTTGGATGGGCCTTGGG?TTTGGAA?TCCTGCA???TCCATGGGAATTGCTAT?G?A?GTTTCTTTTCTGGTAC?GCTCTATATACGT?GCA?AAACC?GGAGGAAGCCCACTTAC?CGAATGTG
Nepenthes_ventricosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                                 7,440     7,450     7,460     7,470     7,480     7,490     7,500     7,510     7,520     7,530     7,540     7,550     7,560     7,570     7,580     7,590     7,600
Aldrovanda_vesiculosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                 CCAGGTTTGGTAGCATCATTCCGTAAGTCAAAATTGGCTCTTCCAGAAGACAGTAATCTCCTCTATGAAACATCAGACGAAAATTCCGTGATTGAAGGAGGTCGAAAACTTGAGCACACCAATGACTTGAA-------------------------------------
Nepenthes_tobiaca               CCAGGTTTGG??GCATCATTCCG?AA?TCAAAATTGGCTCTGCCA?AA?ACAGGA??C??CT?TATGAAAC?TCCGAC?GAAA?TCCGTGATTGAAGGAAGTC?AAAACTTGAGCACACCAATGAATTGAAGTAATGTTCTCAATTATTACCTTGATCTTTGAATGGC
Nepenthes_ventricosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
                                    7,610     7,620     7,630     7,640     7,650     7,660     7,670     7,680     7,690     7,700     7,710     7,720     7,730     7,740     7,750     7,760     7,770
Aldrovanda_vesiculosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                 -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_tobiaca               TATGTATAGCTTGTCATTTCATTGAGTACTTTTAAGTTTTGGGTTACGGCTGTTTGTTTTACTA?AACAGGTGGATCTTCAACTTCTGCATATTCA?AGTGATT??GATGATTCCTGTGATT?TCATGACTTCATAATTATCACATTCAAAGATAAAACACGTACAAAT
Nepenthes_ventricosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
                                    7,780     7,790     7,800     7,810     7,820     7,830     7,840     7,850     7,860     7,870     7,880     7,890     7,900     7,910     7,920     7,930     7,940
Aldrovanda_vesiculosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                 -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_tobiaca               GCATGTATTCATATA?AAA?ATCTACATCTTGATTTCTTGTAT?TTGGCCTTTATTGGTGATGGGTATAAATATCCTTTGAATATACAGGCTCTGTGAGGCTTTTCCCTTGTGGGTACTCTTTTATTAGT?CAAGTCACTCTTTTTGTTTAATTTTTCATGGATCCTGC
Nepenthes_ventricosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
                                    7,950     7,960     7,970     7,980     7,990     8,000     8,010     8,020     8,030     8,040     8,050     8,060     8,070     8,080     8,090     8,100     8,110
Aldrovanda_vesiculosa           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                 -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_tobiaca               TTTTGGTTTTTTATATAGTAGTCCACTAAGACAAATTTGACATTAGTTTGATTACTTGTGTAGGTTGCCGTGGTTATTTACATGGTATGACAGGCAAAATATAATTGCAAACTAACGTGATGACTTAAAGGCCTACC-TTTTTTTCTTAGAATTGAGGATAATTTAGC
Nepenthes_ventricosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                                         8,120     8,130     8,140     8,150     8,160     8,170     8,180     8,190     8,200     8,210     8,220     8,230     8,240     8,250     8,260     8,270     8,280
Aldrovanda_vesiculosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                  -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_tobiaca                TGTTTTAACTCTACTTCTGTCTCTTTGTCAGCATTTGTCATTTTAACCCACTCTGCAAGAACCTATATCATTCTCTTGAAATTCATCCTCGTCATAATAAATGATCCTCTTTCAAACGACATGCACCATCATTTTGTATCATTATAATTCATCTTTTTT-CATCCCCCA
Nepenthes_ventricosa             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                                          8,290     8,300     8,310     8,320     8,330     8,340     8,350     8,360     8,370     8,380     8,390     8,400     8,410     8,420     8,430     8,440     8,450
Aldrovanda_vesiculosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                  -------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Nepenthes_tobiaca                AAAAATCATTTTCATTTAGACGTGTATTATAACGAACAACTATGGATTCAGACATCTTTACAACATTGTGAAATTGTTTAAATGAAGAACTTTTATCTCATGCTCAGAGATTGTCCTACTACCTTCTATCCATTGGGAAGAATGAATAGACAAAAAATTTGATACTACT
Nepenthes_ventricosa             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                                           8,460     8,470     8,480     8,490     8,500     8,510     8,520     8,530     8,540     8,550     8,560     8,570     8,580     8,590     8,600     8,610
Aldrovanda_vesiculosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                  -----------------ATGCCTGGATAAAGCGGCTGTGGTCTCGGACAAAGAAATCAAATGTGAGGACTTCTCGAATCCGTGGAGGTTATGCACTGTGACACAGATCGAGGAACTGAAGATCTTGATTCGCATGTTTCCCATCTGGGCTACGGGAATCGTCTTCTCTG
Nepenthes_tobiaca                TACACTTTCTGCCGCAGATGCCTGGATAAAGCGGCTGTGGTCTCGGACAAAGAAATCAAATGTGAGGACTTCTCGAATCCGTGGAGGTTATGCACTGTGACACAGATCGAGGAACTGAAGATCTTGATTCGCATGTTTCCCAT?TGGG?TACGGGAATCGTCTTCTCTG
Nepenthes_ventricosa             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                                 8,620     8,630     8,640     8,650     8,660     8,670     8,680     8,690     8,700     8,710     8,720     8,730     8,740     8,750     8,760     8,770     8,780
Aldrovanda_vesiculosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata                  CCATATATGCCCAGATGTCAACTATGTTTGTTGAGCAAGGCGAAGTCATGGACAGAACCATTGGGTCTTTCACCATACCAGCCGCTTCCCTGTCGATGTTTGACACCATCAGCGTCATATTCTGGGTCCCCGTCTATGACAAGATCCTTGTCCCGCTTGCCAGAAAGTC
Nepenthes_tobiaca                CCATATATGCCCAGATGTCAACTATGTTTGTTGAGCAAGGCGAAGTCATGGACAGAACCATTGGGTCTTTCACCATACCAGCCGGTTCCCTGTCGATGTTTGACACCATCAGCGTCATATTCTGGGTCCCCGT?TATGACAAGATCC?TGTCCCGCTTGCC?GAAAGTT
Nepenthes_ventricosa             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

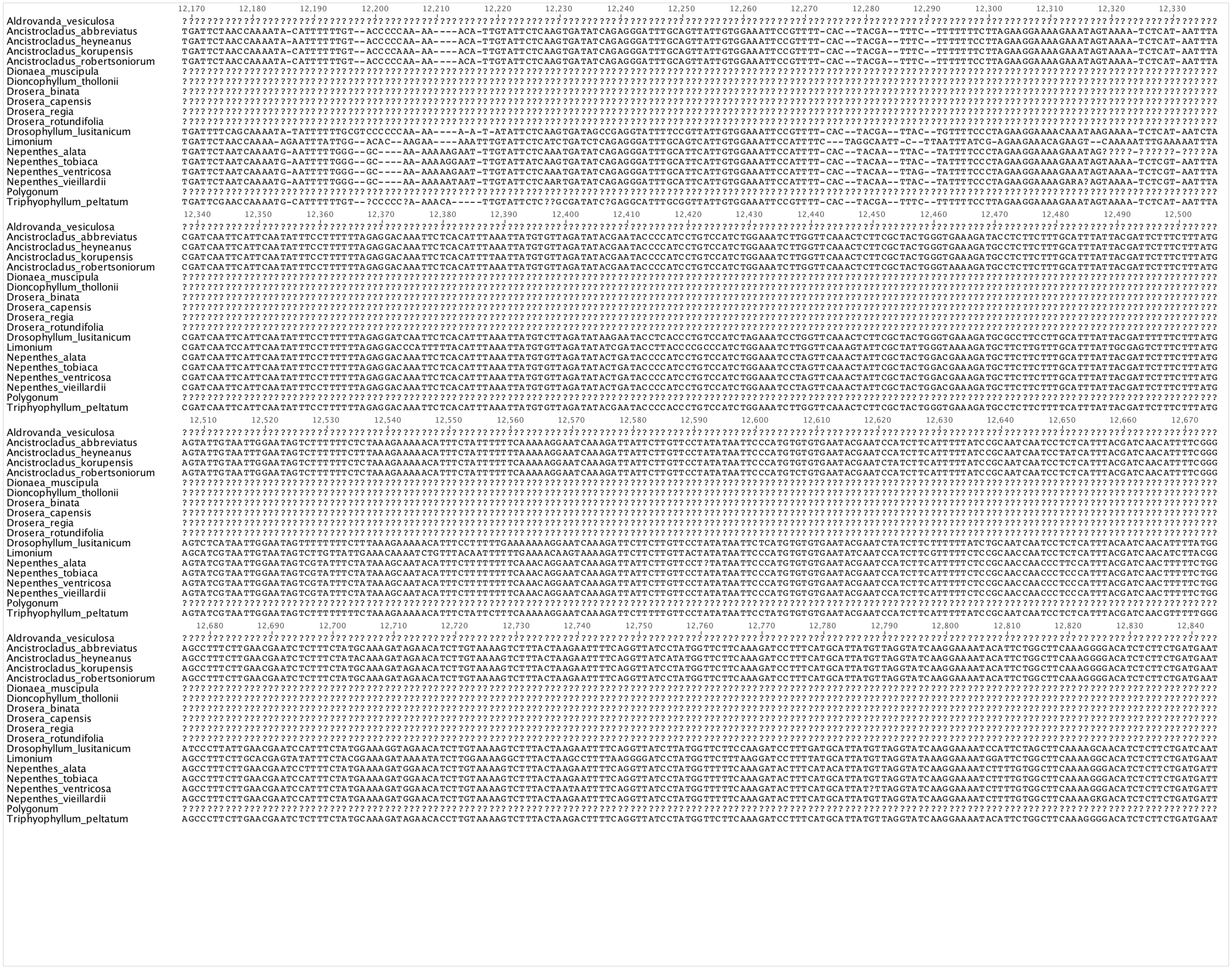
```
                              8,790     8,800     8,810     8,820     8,830     8,840     8,850     8,860     8,870     8,880     8,890     8,900     8,910     8,920     8,930     8,940     8,950
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata               CACCGGCAAGCAAAGGGGCTTCTCAGAGCTTCAACGCATGGGAATAGGCCTCTTCATCTCAATCCTTTCCATGGCAGCCGCTGCCTTGGTGGAAATGAAGCGGCTGCAGCTCGCAAAAGAGCTCGGGTTGGTTGACGAAGATGTCGCTGTGCCCCTCAGCATCTTCTGG
Nepenthes_tobiaca             C?CCGGC?AGCAAAGGGGCTT?TCAGAGCTTCAACGCATGGGAATAGGCCT??TCATC?CAATCCTTTCC??G?CAGCCGCTGCCTTGGTGGAAATG?A?CGG??????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                8,960     8,970     8,980     8,990     9,000     9,010     9,020     9,030     9,040     9,050     9,060     9,070     9,080     9,090     9,100     9,110     9,120
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata               CAAATTCCCCCATACTTC???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         ??????????????????AAATAAAAATTTTCGAATCAAAAAAAGAAATGTCCGATAGCAAGTTGGTCGGTTAATTCAATAAGATAAGAATGGGAGTTAGCATTCGATTTCGTTGGTACCATCCAACCGAATTCAATTGTTTACTTATTCTATTTCAGTAAGTGAATTT
Polygonum                     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                 9,130     9,140     9,150     9,160     9,170     9,180     9,190     9,200     9,210     9,220     9,230     9,240     9,250     9,260     9,270     9,280     9,290
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         TCAAGTTCAACCAACCTATTTTCAAAATATTAAGTGAATGAACAAAAATCTTGAGAAAGTCTTTTATTTGTCTATCATTATAGACACTCTCATCTATCTTATCTATGGAATTCGAACTTGAACTCTACACTTATTGAATTTATGATTCATTTTTTTTCTATATTTCTAT
Polygonum                     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                  9,300     9,310     9,320     9,330     9,340     9,350     9,360     9,370     9,380     9,390     9,400     9,410     9,420     9,430     9,440     9,450     9,460
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         CGCATTGGCCCTTATTTCTTTCTTATTTAGCATATTGATTTACCTGTAATTTCTTTTTTTTTTTATATATATATCTTTCATGGATGAATTCCGCATATTTTCCCATCTAGGATTTACATATACAACATATATCGCTGTCAAGAGTGAATTTCTTTTTTTTTTTTTA
Polygonum                     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                              9,470     9,480     9,490     9,500     9,510     9,520     9,530     9,540     9,550     9,560     9,570     9,580     9,590     9,600     9,610     9,620     9,630
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Limonium                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_alata               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_vieillardii         TTTCGATTCAAAGTAAGGGATTAGAAACTTGAAAAACAAGGGTTGCGCCATATATATGAAAGAGTATACAATAATGATGTATTTGGCGAATCCCTGGTCTAAAAACTTTTTTGATTAGTTGATAATTTTCGTTGAGAATTATATAAAAGATTCCTGTAAAGTAAAAGCT
Polygonum                     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                    9,640     9,650     9,660     9,670     9,680     9,690     9,700     9,710     9,720     9,730     9,740     9,750     9,760     9,770     9,780     9,790     9,800
Aldrovanda_vesiculosa         ????????????????????????????????????????????????????????????????????????????????????????????????????AAGCAAGTATTGGATTCAAAGCGGGTGTTAAAGAGTACAAATTGACTTATTATACTCCTGACTATGAAA
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ??????????????????????????????????????????????????????????????????????????????????????????????????????????GTGTTGGATTCAAAGCTGGTGTTAAAGATTACAAATTAACTTATTATACTCCTGATTATAAAA
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ?????????????????????????????????????????????????????????????????????????????????????????????????????????GGTGTTGGATTCAAAGCGGGTGTTAAAGAGTACAAATTGACTTATTATACTCCTGACTATGAAA
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????AGTGTTGGATTCAAAGCGGGTGTTAAAGAGTACAAATTAACTTATTATACTCCTGACTATGAAA
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????GGTGTTGGATTCAAAGCGGGTGTTAAAGATTACAAATTAACTTATTATACTCCTGAATATCAAA
Drosera_regia                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????AATGTTGGATTCAAAGCGGGTGTTAAAGAGTACAAATTGACTTATTATACTCCTGACTATGAAA
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????TTAACTTATTATACTCCTGACTATCAAA
Drosophyllum_lusitanicum      ?????????????????????????????????????????????????????????????????????????????????????????????????????????GGTGTTGGATTCAAAGCTGGTGTTAAAGATTACAAATTGACTTATTATACTCCTGATTATCAAA
Limonium                      ???????????????????????????????????????????????????????????????????????????????????????????????????????????????????????AGCTGGTGGTAAAGATCACAAATTGACTTATTATACTCCTGAATATGAAA
Nepenthes_alata               ????????????????????????????????????????????????????????????????????????????????????????????????????????????GTTGGATTCAAAGCTGGTGTTAAAGATTACAAATTGACTTATTATACTCCTGACTATGAAA
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ?????????????????????????????????????????????????????????????????????????????????????CACAGA-----ACTAAAGCAAGTGTTGGATTCAAAGCTGGTGTTAAAGATTACAAATTGACTTATTATACTCCTGACTATGAAA
Nepenthes_vieillardii         TTCATTAACGCCTAATTCATGTCGAGTAGACCTTGTTGTTGTGAGAATTTTAAATTCATGAGTTGTAGGGAGGACTTATGTCACCACAAACAGAGACTAAAGCAAGTGTTGGATTCAAAGCTGGTGTTAAAGATTACAAATTGACTTATTATACTCCTGACTATGAAA
Polygonum                     ??????????????????????????????????????????????????????????????????????????????????????????????????????????????TGGATTCAAAGCTGGTGTTAAAGAATACAAATTGACTTATTATACTCCTGACTATGAA-
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                     9,810     9,820     9,830     9,840     9,850     9,860     9,870     9,880     9,890     9,900     9,910     9,920     9,930     9,940     9,950     9,960     9,970
Aldrovanda_vesiculosa         CCCTA-GATACTGATATCTTGGCAGCATTCCGAGTAACTCCGCAACCTGGAGTTCCACCAGAAGAAGCAGGA-GCGGCGGTAGCTGCCGAATCTTCTACCGGTACCTGGACAACTGTGTGGACCGATGGACTTACCAGCCTTGATCGTTACAAAGGGCGATGCTACCAC
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     CCAAA-GATACTGATATCTTGGCAGCATTCCGGGTAACTCCTCAACCTGGAGTTCCACCAGAAGAAGCAGGG-GCCGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACCGATGGACTTACCAGCCTTGATCGTTACAAAGGACGATGCTACCAC
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             CCCTA-GATACTGATATCTTGGCAGCATTCCGAGTAACTCCGCAACCTGGAGTTCCGCCAGAAGAGGCAGGA-GCAGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACCGATGGACTTACCAACCTTGATCGTTACAAAGGGCGATGCTACCAC
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                CCCAA-GATACTGATATCTTGGCAGCATTCCGAGTAACCCCGCAACCAGGAGTTCCACCAGAAGAAGCAGGA-GCAGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACCGATGGACTTACCAGCCTTGATCGTTACAAAGGGCGATGCTACCAC
Drosera_capensis              CCCTA-GATACTGATATCTTGGCAGCATTCCGAGTCACCCCGCAACCTGGAGTTCCACCAGAAGAAGCAGGA-ACAGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACTGATGGACTTACCAGCCTTGATCGTTACAAAGGGCGATGCTACCAC
Drosera_regia                 CCCTA-GATACTGATATCTTGGCAGCATTCCGAGTAACTCCGCAACCTGGAGTTCCACCAGAAGAAGCAGGA-GCAGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACCGATGGACTTACCAACCTTGATCGTTACAAAGGTCGATGCTACCAC
Drosera_rotundifolia          CCCTA-GATACTGATATCTTGGCAGCATTCCGAGTCACCCCGCAACCTGGAGTTCCACCAGAAGAAGCAGGA-GCAGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACTGATGGACTTACCAGCCTTGATCGTTACAAAGGGCGATGCTACCAC
Drosophyllum_lusitanicum      CCCAA-GATACTGATATCTTGGCAGCATTCCGAGTAACTCCTCAACCTGGAGTTCCACCAGAAGAAGCAGGA-GCCGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACAGATGGACTTACCAGCCTTGATCGTTACAAAGGACGATGCTACCAC
Limonium                      CCCTA-GATACTGATATCTTGGCAGCATTTCGAGTAACTCCTCAACCTGGAGTTCCACCAGAGGAAGCAGGG-GCTGCAGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACCGATGGACTTACCAACCTTGATCGTTACAAAGGACGATGCTACCAC
Nepenthes_alata               CCCTA-GATACTGATATCTTGGCAGCATTCCGAGTCACTCCTCAACCTGGAGTTCCGCCGGAAGAAGCAGGG-GCCGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACCGATGGACTTACCAGCCTTGATCGTTACAAAGGACGATGCTACCAC
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          CCAAA-GATACTGATATCTTGGCAGCATTCCGAGTCACTCCTCAACCTGGAGTTCCGCCGGAAGAAGCAGGG-GCCGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACTGTGTGGACCGATGGACTTACCAGCCTTGATCGTTACAAAGGACGATGCTACCAC
Nepenthes_vieillardii         CCAAA-GATACTGATATCTTGGCAGCATTCCGAGTCACTCCTCAACCTGGAGTTCCACCGGAAGAAGCAGGGAGCCGCGGTAG??????????????????????????????????????????????????????????????????????????????????????
Polygonum                     CCGCATGATCATGATATCTTGGCAGCATTTCGAGTAACTCCTCAACCTGGAGTTCCGCCAGAAGAAGCAGGG-GCCGCGGTAGCTGCCGAATCTTCTACTGGTACATGGACAACCGTGTGGACCGATGGACTTACCAGCCTTGATCGTTACAAAGGACGATGCTACGAC
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                      9,980     9,990    10,000    10,010    10,020    10,030    10,040    10,050    10,060    10,070    10,080    10,090    10,100    10,110    10,120    10,130    10,140
Aldrovanda_vesiculosa         ATCGAGCCTGTTGCTGGAGAAGAAAATCAATTTATTGCTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCCGTTACTAACATGTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCTCTGCGTGCTCTACGTTTGGAGGATTTGCGAATCCCTGCTG
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     ATCGAGCCTGTTGCTGGAGAAGAAAATCAATATATTGCTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACATGTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCCCTGCGTGCTCTACGTTTGGAGGATTTGCGAATCCCTCCTG
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ATCGAGCCTGTTGCTGGAGAAGAAAATCAATATATTGCTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACCTCTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCTCTGCGTGCTCTACGTTTGGAGGATTTGCGAATCCCCCCGG
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ATCGAGCCTGTTGCTGGAGAAGACAATCAATATATTGTTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACATGTTTACTTCCATTGTGGGGAATGTATTTGGGTTCAAAGCTCTGCGTGCTCTACGTTTGGAGGATTTGCGAGTCCCCCCCG
Drosera_capensis              ATCGAGCCTGTTTCTGGCGAAGAGAATCAATTTATTGTTTATGTAGCTTATCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACATGTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCTCTGCGTGCTCTACGTTTAGAGGATTTGCGAATCCCTCCTG
Drosera_regia                 ATCGAGCCTGTTGCTGGAGAAGAAAATCAATATATTGTTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACATGTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCTCTGCGTGCTCTACGTTTGGAGGATTTACGAATCCCTCCTG
Drosera_rotundifolia          ATCGAGCCTGTTTCTGGAGAAGAGAATCAATTTATTGCTTATGTAGCTTATCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACATGTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCTCTGCGTGCTCTACGTTTGGAGGATTTGCGAATCCCTCCTT
Drosophyllum_lusitanicum      ATCGAGCCTGTTGCTGGAGAAGAAAATCAATTTATTGCTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACATGTTTACTTCCATTGTGGGTAATGTATTTGGATTCAAAGCCCTGCGTGCTCTACGTTTGGAAGATTTGCGAATCCCCCCTG
Limonium                      ATCGAGCCTGTTCCTGGAGAAGAAAGTCAATTTATTGCTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCTGTGACTAATATGTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCTCTGCGTGCTCTACGTTTGGAAGATTTGAGAATCCCTCCTG
Nepenthes_alata               ATCGAGCCTGTTGCTGGAGAAGAAAATCAATATATTGCTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACATGTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCCCTGCGTGCTCTACGCTTGGAGGATTTGCGAATCCCTCCTG
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          ATCGAGCCTGTTGCTGGAGAAGAAAATCAATATATTGCTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACATGTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCCCTGCGTGCTCTACGCTTGGAGGATTTGCGAATCCCTCCTG
Nepenthes_vieillardii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                     ATCGAGCCTGTTCCTGGCGAAGAAAGTCAATTTATTGCTTATGTAGCTTACCCATTAGACCTTTTTGAAGAAGGTTCTGTTACTAACATGTTTACTTCCATTGTGGGTAATGTATTTGGGTTCAAAGCCTTGCGTGCTCTTCGTTTGGAGGATTTGCGAATCCCTCCTG
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                                 10,150    10,160    10,170    10,180    10,190    10,200    10,210    10,220    10,230    10,240    10,250    10,260    10,270    10,280    10,290    10,300
Aldrovanda_vesiculosa           CTTATGCAAAAACTTTCCAAGGCCCACCTCACGGTATCCAAGTTGAGAGAGATAAATTGAACAAATATGGTCGTCCCCTATTGGGATGTACTATTAAACCAAAATTAGGGTTATCCGCTAAGAACTATGGTCGAGCAGTTTATGAATGTCTTCGCGGTGGACTTGATTT
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       CTTATTCGAAAACTTTCCAAGGCCCGCCTCACGGTATCCAAGTTGAGAGAGATAAATTGAACAAATATGGTCGTCCCCTATTGGGATGTACTATTAAACCTAAATTGGGGTTATCCGCTAAGAACTACGGTCGAACATGTTATGAATGTCTTCGCGGTGGACTTGATTT
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               CTTATTCAAAAACTTTCCAAGGCCCACCTCACGGTATCCAAGTTGAGAGAGATAAATTGAACAAATACGGTCGTCCCCTATTGGGATGTACTATTAAACCTAAATTGGGTTTATCCGCTAAGAACTACGGCCGAGCAGTTTATGAATGTCTTCGCGGTGGACTTGATTT
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  CTTATTCAAAAACTTTCCAAGGCCCCCCTCACGGTATCCAAGTTGAGAGAGATAAATTGAACAAATATGGTCGTCCCCTATTGGGATGTACTATTAAACCGAAATTGGGGTTATCCGCTAAGAACTATGGACGAGCAGTTTATGAATGTCTTCGCGGTGGACTTGATTT
Drosera_capensis                CTTATTCAAAAACTTTCCAAGGCCCCCCTCACGGTATCCAAGTTGAGAGAGATAAATTGAACAAATATGGTCGTCCCCTATTGGGATGTACTATTAAACCTAAATTAGGGTTATCTGCGAAGAACTATGGCCGAGCAGTTTATGAATGTCTTCGCGGTGGACTTGATTT
Drosera_regia                   CTTATGTAAAGACTTTCCAAGGCCCACCTCACGGTATCCAAGTTGAGAGAGATAAATTGAACAAATATGGTCGTCCCCTATTGGGATGTACTATTAAACCAAAATTGGGGTTATCCGCTAAGAACTATGGCCGAGCAGTTTATGAATGTCTTCGCGGTGGACTTGATTT
Drosera_rotundifolia            CTTATACAAAAACTTTCCAAGGCCCACCTCACGGTATCCAAGTTGAGAGAGATAAATTGAACAAATATGGTCGTCCCCTATTGGGATGTACTATTAAACCTAAATTAGGGTTATCTGCGAAGAACTATGGCCGAGCAGTTTATGAATGTCTTCGCGGTGGACTTGATTT
Drosophyllum_lusitanicum        CTTATACAAAAACTTTCCAGGGACCGCCTCACGGTATCCAAGTTGAGAGAGATAAATTGAACAAATATGGTCGTCCGCTATTGGGATGTACTATTAAACCGAAATTGGGGTTATCCGCTAAGAACTACGGCCGAGCAGTTTATGAATGTCTTCGCGGTGGACTTGATTT
Limonium                        CTTATTCAAAAACTTTCCAAGGCCCGCCTCACGGTATCCAAGTTGAAAGAGATAAATTGAACAAATATGGTCGTCCCCTATTGGGATGTACTATTAAACCTAAATTGGGGTTGTCCGCTAAGAACTACGGTCGAGCTGTTTATGAATGTCTTCGCGGTGGACTTGATTT
Nepenthes_alata                 CTTATTCGAAAACTTTCCAAGGACCGCCTCATGGTATCCAAGTTGAGAGAGATAAATTGAACAAATATGGTCGTCCACTATTGGGATGTACTATTAAACCGAAATTGGGGTTATCCGCTAAGAACTACGGTCGAGCAGTTTATGAATGTCTTCGCGGTGGACTGGATTT
Nepenthes_tobiaca               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa            CTTATTCGAAAACTTTCCAAGGACCGCCTCACGGTATCCAAGTTGAGAGAGATAAATTGAACAAATATGGTCGTCCACTATTGGGATGTACTATTAAACCGAAATTGGGGTTATCCGCTAAGAACTACGGTCGAGCAGTTTATGAATGTCTTCGGGGTGGACTGGATTT
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       CTTATACGAAAACTTTCCAAGGCCCGCCTCATGGTATCCAAGTTGAAAGAGATAAATTGAACAAATATGGACGTCCCCTATTGGGATGTACTATTAAACCGAAATTGGGATTGTCCGCTAAGAACTACGGTCGGGCAGTTTATGAATGCTTCCGTGGCGGACTTGATTT
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                10,310    10,320    10,330    10,340    10,350    10,360    10,370    10,380    10,390    10,400    10,410    10,420    10,430    10,440    10,450    10,460    10,470
Aldrovanda_vesiculosa           TACCAAAGATGATGAAAACGTTAACTCCCAACCATTTATGCGTTGGAGAGATCGTTTCTTATTTTGTGCCGAAGCAATTTATAAAGCCCAGGCAGAAACTGGTGAAATCAAAGGGCATTACTTGAATGCGACTGCTGGTACATGCGAAGAGATGATAAAAAGGGCTGTA
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       TACCAAAGATGATGAAAACGTGAACTCCCAGCCATTTATGCGTTGGAGAGACCGTTTCTTATTTTGTGCCGAAGCAATTTATAAAGCACAGGCTGAAACAGGTGAAATCAAAGGGCATTACTTGAATGCTACTGCAGGTACATGTGAAGAAATGATAAAAAGGGCTGTA
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               TACCAAAGATGATGAAAACGTAAACTCCCAACCATTTATGCGTTGGAGAGACCGTTTCTTATTTTGTGTCGAAGCCATTTATAAAGCCCAGTCAGAAACCGGTGAAATTAAGGGGCATTACTTGAATGCTACTGCCGGTACATGTGAAGAGATGATAAAAAGGGCTGCA
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  TACCAAAGATGATGAAAACGTTAACTCCCAACCATTTATGCGTTGGAGAGACCGTTTCTTATTTTGTGCCGAAGCAATTTATAAAGCCCAGGCGGAAACTGGTGAAATCAAAGGGCATTACTTGAATGCTACTGCCGGTACATGTGAAGAGATGACAAAAAGGGCTGAC
Drosera_capensis                TACCAAAGATGATGAAAACGTTAACTCCCAACCATTTATGCGTTGGAGAGACCGTTTCTTATTCTGTGCAGAAGCACTTTATAAAGCCCAGGCGGAAACTGGTGAAATTAAAGGGCATTACTTGAATGCTACTGCCGGGACATGCGAAGAGATGATAAAAAGGGCTGTA
Drosera_regia                   TACCAAAGATGATGAAAACGTTAACTCCCAACCATTTATGCGTTGGAGAGACCGTTTCGTATTTTGTGCTGAAGCAATTTATAAAGCCCAGGCTGAAACTGGTGAAATCAAAGGGCATTACTTGAATGCTACTGCCGGTACATCCGAAGAGATGATAAAAAGGGCTGTA
Drosera_rotundifolia            TACCAAAGATGATGAAAACGTTAACTCCCAACCATTTATGCGTTGGAGAGACCGTTTCTTATTTTGTGCAGAAGCACTTTATAAAGCCCAGGCAGAAACTGGTGAAATCAAAGGGCATTACTTGAATGCTACTGCCGGGACATGCGAAGAGATGATAAAAAGGGCTGTA
Drosophyllum_lusitanicum        TACCAAAGATGATGAAAACGTGAACTCCCAGCCATTTATGCGTTGGAGAGACCGTTTCTTATTTTGTGCCGAAGCCATTTATAAAGCACAGGCTGAAACCGGTGAAATCAAAGGGCATTATTTGAATGCTACTGCAGGTACATGCGAAGAAATGATAAAAAGGGCTGTA
Limonium                        TACCAAAGATGATGAAAACGTGAACTCCCAACCATTTATGCGTTGGAGAGACCGTTTCTTATTTTGTACCGAAGCTCTTTATAAAGCACAGGCTGAAACAGGTGAAGTCAAAGGACATTACTTGAATGCTACTGCAGGTACATCCGAAGAAATGATAAAAAGAGCTGCG
Nepenthes_alata                 TACCAAAGATGATGAAAACGTGAACTCCCAACCATTTATGCGTTGGAGAGACCGTTTCGTATTTTTTGCCGAAGCACTTTATAAAGCACAGGCTGAAACAGGTGAAATCAAAGGGCATTACTTGAATGCTACTGCAGGTACATGCGAAGAAATGATAAAAAGGGCAGTA
Nepenthes_tobiaca               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa            TACCAAAGATGATGAAAACGTGAACTCCCAACCATTTATGCGTTGGAGAGACCGTTTCGTATTTTGTGCCGAAGCAATTTATAAAGCACAGGCTGAAACAGGTGAAATCAAAGGGCATTACTTGAATGCTACTGCAGGTACATGCGAAGAAATGATAAAAAGGGCAGTA
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       TACCAAAGATGATGAAAACGTGAACTCCCAACCATTTATGCGTTGGAGAGACCGGTTCTTATTCTGTGCCGAGGCTATTTTTAAATCACAGTCCGAAACAGGTGAAATCAAAGGACATTACTTGAATGCTACTGCAGGTACATGCGAAGAAATGATAAAAAGGGCTGTA
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                 10,480    10,490    10,500    10,510    10,520    10,530    10,540    10,550    10,560    10,570    10,580    10,590    10,600    10,610    10,620    10,630    10,640
Aldrovanda_vesiculosa           TTTGCCAGAGAATTGGGAGTTCCTATCATCATGCATGACTACTTAACAGGAGGATTCACTGCAAATACTACCTTGTCTTATTATTGCCGAGATAATGGTCTACTTCTTCACATCCACCGTGCAATGCATGCGGTTATTGATCGACAGAAGAATCATGGTATACATTTCC
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       TTTGCCAGAGAATTGGGAGTGCCTATCGTAATGCATGACTACTTAACAGGCGGATTCACTGCAAATACTAGCTTGGCTCATTATTGCCGAGATAATGGCCTACTTCTTCACATTCACCGTGCAATGCATGCAGTTATTGATAGACAGAAGAATCATGGTATGCATTTCC
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               TTTGCCAGAGAATTGGGAGCTCCTATCATCATGCATGACTACTTAACAGGAGGATTCACTGCAAATACTAGCTTGGCTCATTATTGCCGAAATCATGGCCTACTTCTTCACATCCACCGTGCAATGCATGCGGTTATTGATAGACAGAAGAATCATGGTATGCATTTCC
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  TTTGCTTACGAATTGGGCGTTCCTATCATAATGCATGACTACTTAACAGGAGGATTCACCGCAAATACTAGCTTAGCTCTTTATTGCCGAAATCATGGCCTACTTCTTCACATCCACCGTGCAATGCATGCGGTTATTGATAGACAGAAGAATCATGGTATACATTTTC
Drosera_capensis                TTTGCCAGAGAACTGGGAGTTCCTATCGTAATGCATGACTACTTAACAGGAGGATTCACCGCAAATACTAGCTTGGCTCATTATTGCCGAGATAATGGACTACTTCTTCACATCCACCGTGCAATGCATGCTGTTATTGATAGACAGAAGAATCATGGTATAGATTTCC
Drosera_regia                   TTTGCCAGAGAATTGGGAGTTCCTATCGTAATGCATGACTACTTAACAGGAGGATTCACTGCAAATACTAGCTTGTCTCATTATTGCCGAGATAATGGCCTACTTCTTCACATCCACCGTGCAATGCATGCGGTTATTGATAGACAGAAGAATCATGGTATACATTTCC
Drosera_rotundifolia            TTTGCCAGAGAACTGGGAGTTCCTATCGTAATGCATGACTACTTAACAGGAGGATTCACCGCAAATACTAGCTTGGCTCAGTATTGTCGAGATAATGGACTACTTCTTCACATCCACCGTGCAATGCATGCCGTTCTTGATAGACAGAAGAATCATGGTATACATTTCC
Drosophyllum_lusitanicum        TTTGCCAGAGAATTGGGAGTTCCTATCGTAATGCATGACTACTTAACCGGGGGATTCACTGCAAATACTAGCTTGGCTCATTATTGCCGAGATAATGGACTACTTCTTCACATCCACCGTGCAATGCATGCTGTTATTGATAGACAGAAGAATCATGGTATACATTTCC
Limonium                        TGTGCTAGAGAATTGGGAGTTCCTATCGTAATGCATGACTACTTAACAGGGGGATTCACTTCAAATACTAGTTTAGCTCATTATTGCCGCGATAATGGGCTACTTCTTCACATCCACCGTGCAATGCACGCAGTTATTGATTGACAGAAAAATCACGGGATACACTTCC
Nepenthes_alata                 TTTGCCAGAGAATTGGGAGTTCCTATCGTAATGCATGACTACCTAACAGGGGGATTCACAGCAAATACTAGCTTGGCTCATTATTGCCGAGATAATGGCCTACTTCTTCACATCCACCGTGCAATGCATGCAGTTATTGATAGACAGAAAAATCATGGTATACATTTCC
Nepenthes_tobiaca               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa            TTTGCCAGAGAATTGGGAGTTCCTATCGTAATGCATGACTACCTAACAGGGGGATTCACTGCAAATACTAGCTTGGCTCATTATTGCCGAGATAATGGCCTACTTCTTCACATCCACCGTGCAATGCATGCAGTTATTGATAGACAGAAAAATCATGGTATACATTTCC
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       TTTGCCAGAGAATTGGGAGTTCCTATCGTAATGCACGACTACTTAACAGGGGGATTCACAGCAAATACTAGTTTAGCTCATTATTGCAGAGATAATGGCCTACTTCTTCACATTCACCGCGCAATGCATGCAGTTATTGACAGACAGAAAAATCACGGTATGCACTTCC
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                  10,650    10,660    10,670    10,680    10,690    10,700    10,710    10,720    10,730    10,740    10,750    10,760    10,770    10,780    10,790    10,800    10,810
Aldrovanda_vesiculosa           GTGTACTAGCTAAAGCCTTACGTCTGTCTGGTGGTGATCATATTCATTCTGGTACCGTAGTAGGTAAACTTGAAGGGGAACGAGAAATCACCTTAGGCTTTGTTGATTTATTACGTGATGATTATATTGAAAAAGACCGAAGTCGCGGTATTTATTTCACGCAACCTTG
Ancistrocladus_abbreviatus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis       GTGTACTCGCTAAAGCGTTACGTCTGTCTGGTGGAGATCATATTCATGCTGGTACCGTAGTAGGTAAACTTGAAGGGGAAAGAGACATTACTTTAGGCTTTGTTGATTTATTACGTGATGATTATATTGAAAAAGACCGAAGTCGCGGTATTTATTTCACTCAATTTTG
Ancistrocladus_robertsoniorum   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               GAGTACTAGCTAAAGCCTTACGTCTGTCTGGTGGCGATCATATTCATTCTGGTACCGTAGTCGGTAAACTTGAAGGGGAACGAGACATCACCTTAGGCTTTGTTGATTTATTACGTGATGATTTTATTGAAAAAGACCGAGCTCGCGGTATCTATTTCACGCAATTTTG
Dioncophyllum_thollonii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  GTGTACTAGCTAAAGCCTTACGTCTGTCTGGTGGCGATCATATTCATGCTGGTACTGTAGTAGGTAAACTTGAAGGGGAGCGAGACATCACCTTAGGCTTTGTTGTTTTATTACGTGATGATTACCTTGAAAAAGACAGAAGTCGCGGTATTTATTTCACTCAATTTTG
Drosera_capensis                GGGTATTAGCTAAAGCCTTACGTATGTCTGGTGGCGATCATATTCATTCTGGAACCGTAGTAGGTAAGCTGGAAGGGGAACGAGACATCACCTTAGGCTTCGTTGTTTTATTACGTGATGATTTTATTGAAAAAGACAGAAGTCGCGGTATTTATTTCACCCAACCTTG
Drosera_regia                   GTGTACTAGCTAAAGCCTTACGTATGTCTGGAGGCGATCATATTCATTCTGGTACCGTAGTAGGTAAACTTGAAGGGGAACGAGACATCACCTTAGGCTTTGTTGTTTTATTACGTGATGATTATATTGAAAAAGACCGAAGTCGTGGTATTTATTTCACGCAACCTTG
Drosera_rotundifolia            GTGTACTAGCTAAAGCCTTACGTCTGTCTGGTGGCGATCATATTCATTCTGGAACCGTAGTAGGTAAACTGGAAGGGGAACGAGACATCACCTTAGGCTTCGTTGATTTATTACGTGATGATTTTATTGAAAAAGACAGAACTCGCGGTATTTATTTCACCCAACCTTG
Drosophyllum_lusitanicum        GTGTACTAGCTAAAGCGTTACGTCTGTCTGGTGGAGATCATATTCATTCTGGTACCGTAGTAGGTAAACTTGAAGGGGAAAGAGAAATTACTTTAGGCTTTGTTGATTTATTACGTGATGATAATACTGAAAAAGACCGAAGTCGCGGTATTTATTTCACTCAATCTTG
Limonium                        GTGTACTAGCTAAAGCCTTACGTATGTCTGGTGGAGATCATATTCATTCTGGTACTGTAGTAGGTAAACTTGAAGGAGAAAGAGATATCACTTTAGGGTTTGTTGATTTACTACGTGATGATTATATTGAAAAAGACCGATCTCGCGGTATTTATTTCACTCAAGATTG
Nepenthes_alata                 GTGTACTAGCTAAAGCGTTACGTCTGTCTGGTGGAGATCATATTCATGCTGGTACTGTAGTAGGTAAACTTGAAGGGGAAAGAGACATTACTTTAGGTTTTGTTGATTTATTACGTGATGATTATGTTGAAAAAGACCGAAGTCGCGGTATTTATTTCACTCAATTTTG
Nepenthes_tobiaca               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa            GTGTACTAGCTAAAGCGTTACGTCTGTCTGGTGGAGATCATATTCATGCTGGTACTGTAGTAGGTAAACTTGAAGGGGAAAGAGACATTACTTTAGGTTTTGTTGATTTATTACGTGATGATTATATTGAAAAAGACCGAAGTCGCGGTATTTATTTCACTCAATTTTG
Nepenthes_vieillardii           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                       GTGTACTAGCTAAAGCCTTACGTATGTCTGGTGGAGATCATATCCATTCCGGTACTGTAGTAGGTAAACTTGAAGGGGAAAGGGAAATTACTTTAGGGTTTGTTGATTTACTACGTGATGACTTTGTTGAAAAAGACCGAAGTCGCGGTATTTATTTCACTCAACCTTG
Triphyophyllum_peltatum         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
```

```
                               10,820    10,830    10,840    10,850    10,860    10,870    10,880    10,890    10,900    10,910    10,920    10,930    10,940    10,950    10,960    10,970    10,980
Aldrovanda_vesiculosa         GGTATCCATACCGGGTGTTCTGCCTGTAGCTTCAGGGGGCATTCACGTTTGGCATATGCCCGCTCTAACCGAGATCTTTGGGGATGATTCC-GTATTACAATTCGGTGGAGGAACTTTAGGACACCCTTGGGGAAATGCGCCGGGTGCTGTAGCGAATCGAGTCGCTCT
Ancistrocladus_abbreviatus    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_korupensis     GGTTTCCCTACCAGGTGTTATACCCGTGGCTTCGGGGGGTATTCACGTTTGGCATATGCCCGCTCTAACCGAGATCTTTGGGGATGATTCC-GTATTACAGTTCGGTGGAGGAACTTTAGGACACCCTTGGGGAAATGCGCCGGGTGCTGTAGCGAATCGAGTGGCTCT
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             GGTTTCCATACCGGGTGTTCTGCCTGTAGCTTCGGGGGGTATTCACGTTTGGCATATGCCCGCTCTAACCGAGATCTTTGGCGATGATTCC-GTACTACAGTTCGGTGGAGGAACTTTAGGACACCCTTGGGGAAATGCGCCAGGTGCTGTAGCGAATCGAGTAGCTCT
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                GGTTTCCCTACCTGGTGTTCTGCCCGTAGCTTCAGGGGGCATTCACGTTTGGCATATGCCCGCTCTAACTGAGATCTTTGGGGATGATTCC-GTATTACAGTTCGGTGGAGGAACTTTAGGACACCCTTGGGGAAATGCGCCGGGTGCTGTAGCGAATCGAGTAGCTCT
Drosera_capensis              GGTTTCCCTACCAGGTGTTCTGCCCGTAGCTTCAGGGGGCATTCACGTTTGGCATATGCCCGCTCTAACCGAGATCTTTGGGGATGATTCC-GTATTACAATTCGGTGGAGGAACTTTAGGGCACCCTTGGGGAAATCCGCCGGGTGCTGCAGCGAATCGAGTAGCTCT
Drosera_regia                 GGTTTCCTTACCGGGTGTTCTGCCCGTAGCTTCAGGGGGCATTCACGTTTGGCATATGCCCGCTCTAACCGAGATCTTTGGGGATGATTCC-GTATTACAGTTCGGTGGAGGAACTTTAGGACACCCTTGGGGAAATGCACCGGGTGCTGTAGCGAATCGAGTAGCTCT
Drosera_rotundifolia          GGTTTCCCTACCAGGTGTTCTGCCCGTAGCTTCAGGGGGCATTCACGTTTGGCATATGCCCGCTCTAACCGAGATCTTTGGGGATGATTCC-GTATTACAATTCGGTGGAGGAACTTTAGGGCACCCTTGGGGAAATGCACCGGGTGCTGCAGCGAATCGAGTAGCTCT
Drosophyllum_lusitanicum      GGTTTCCCTGCCGGGTGTTCTGCCCGTGGCTTCGGGGGGCATTCACGTTTGGCATATGCCCGCTCTAACCGAGATCTTTGGGGATGATTCC-GTATTACAGTTCGGCGGAGGAACTTTAGGACACCCTTGGGGAAATCCGCCGGGTGCTGTAGCGAATCGAGTGGCACT
Limonium                      GGTTTCCATGCCGGGTGTTATACCTGTTGCTTCGGGCGGTATTCACGTTTGGCATATGCCCGCTCTAACCGAGATCTTTGGAGATGATTCC-GTACTGCAATTCGGTGGTGGAACTTTAGGCCACCCTTGGGGAAATGCACCAGGTGCTGTAGCGAATCGAGTAGCTCT
Nepenthes_alata               GGTTTCCATACCTGGTGTTCTGCCCGTGGCTTCGGGGGGTATTCACGTTTGGCATATGCCCGCTCTAACCGAAATCTTTGGGGATGATTCC-GTATTACAGTTCGGTGGAGGAACTTTAGGACATCCTTGGGGAAATGCGCCGGGTGCTGTAGCGAATCGAGTAGCTCT
Nepenthes_tobiaca             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Nepenthes_ventricosa          GGTTTCCATACCTGGTGTTCTGCCCGTGGCTTCGGGGGGTATTCACGTTTGGCATATGCCCGCTCTAACCGAAATCTTTGGGGATGATTCCAGTAT-ACAGTTCGGTGGAGGAACTTTAGGACACCCTTGGGGAAATGCGCCGGGTGCTGTAGCGAATCGAGTAGCTCT
Nepenthes_vieillardii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Polygonum                     GGTTTCCATGCCTGGTGTTATTCCTGTGGCTTCCGGGGGTATTCACGTTTGGCATATGCCCGCTTTAACCGAGATCTTTGGGGATGACTCT-GTATTACAGTTTGGTGGCGGAACTTTAGGCCACCCATGGGGAAATGCACCGGGTGCTGTAGCGAATCGAGTAGCTCT
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????

                                10,990    11,000    11,010    11,020    11,030    11,040    11,050    11,060    11,070    11,080    11,090    11,100    11,110    11,120    11,130    11,140    11,150
Aldrovanda_vesiculosa         TGAAGCATGTGTACAAGCTCGTAATGAAGGACGTGATCTTGCTCGCGAGGGTAACGAAATTATCCGCAAGGCTGCCAAATGGAGTCTTGAACTAACTGCTGC???????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ??????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????GA?CTTTATAC
Ancistrocladus_heyneanus      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????TTTTATAC
Ancistrocladus_korupensis     AGAAGCATGTGTACAAGCTCGTAACGAGGGACGTGATCTTGCTCGCGAGGGTAACGAAATTATCCGTGAGGCTAGCAAATGGAGTCCTGAACTAGCTGCTGCTTGTGAAG???????????????????????????????????????????????????TTTTATAC
Ancistrocladus_robertsoniorum ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????TTTTATAC
Dionaea_muscipula             AGAAGCATGTGTACAAGCTCGTAATGAAGGACGCGATCTTGCTCGCGAGGGGAACGAAATTATTCGCAAGGCTGGCAAATGGAGTCCTGAACTAGCTGCTGCTTGTGAGGTATGGAAGGAAATCAAATTTGAATTCGCAGCAGTGGATACTTTGTAA????????????
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                AGAAGCATGTGTACAAGCTCGTAATGAAGGACGCGATCTTGCTCGCGAGGGTAACGAAATTATCCGCAAGGCTAGCAAATGGAGTCCTGAACTATCTGCTGCTTGTGAGGTATGGAAAGAAATCAAATTATATTTCGAAGCAGTGGATACTTTGTAA????????????
Drosera_capensis              AGAAGCATGTGTACAAGCTCGTAATCACGGACAAGATCTTGCTCGTGAGGGTAACGACGTTATACGCAGGGCTAGCAAATGGAGTCCTGAACTATCTTCTGCTTGTGAGGTATGGAAGGAAATAAAATTATATTTCGAAGCAATGGATACTTTGTAA????????????
Drosera_regia                 AGAAGCATGTGTACAAGCTCGTAATGAAGGACGCGATCTTGCTCGCGAGGGTAACGAAATTATCCGCAAGGCTAGCAAATGGAGTCCTGAACTAGCTGCTGCTTGTGAAGTATGGAAGGAAATCAAATTTGAATTCCAAGCAATGGATACTTTGTAA????????????
Drosera_rotundifolia          AGAAGCATGTGTACAAGCT??????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      AGAAGCATGTGTCCAAGCGCGTAATGAGGGACGTGATCTTGCTCGCGAGGGTAACGAAATTATCCGTGAGGCTAGCAAATGGAGTCCGGAACTAGCTGCTGCTTGTGAGGTATGGAAGGAAATCAAATTTGAATTCCCAGCAATGGATACTTTGTAA??TCTTTTATAC
Limonium                      AGAAGCCTGTGTACAAGCTCGTAATGAGGGACGTGATCTTGCTCGTGAGGGTAACGAAATTATCCGCAAGGCTGCTACATGGAGTCCTGAACTAG?????????????????????????????????????????????????????????????????TCTTTACAC
Nepenthes_alata               AGAAGCATGTGTACAAGCTCGTAATGAGGGACGTGATCTTGCTCGCGAGGGTAACGAAATTATCCGTGAGGCTAGCAAATGGAGTACTGAACTAGCTGCTGCTTGTGAGATATGGAAGGAAATAAAATTTGTATTCGAAGCAATGGATACTTTGTAAGATCTTTTACAC
Nepenthes_tobiaca             ??????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????ATCTTTTACAC
Nepenthes_ventricosa          AGAAGCATGTGTACAAGCTCGTAATGAGGGACGTGATCTTGCTCGCGAGGGTAACGAAATTATCCGTGAGGCTAGCAAATGGAGTACTGAACTAGCTGCTGCTTGTGAGATATGGAAGGTA????????????????????????????????????GATCTTTTACAC
Nepenthes_vieillardii         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????GATCTTTTACAC
Polygonum                     AGAAGCCTGTGTACAAGCTCGTAATGAGGGCGTGATCTTGCTCGCGAGGGTAACGATATTATTCGCAAAGCTGCTAAATGGAGTCCTGAACTAGCTGCCGCTTGTGAAGTATGGAAGGAAATCAAATTTGAATTCCAAGCAATGGATACTTTGTAA????????????
Triphyophyllum_peltatum       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????GATCTTTTATAC

                                 11,160    11,170    11,180    11,190    11,200    11,210    11,220    11,230    11,240    11,250    11,260    11,270    11,280    11,290    11,300    11,310    11,320
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ATTTGGATGAAGCGAGGGATTCGTCCATGCTATCGGTAGAGTTTGTAAGACCACGACTGATCCTGAAAGGAA-TGAGTGGAAAAAAGAGCATGTCGTATCAATGGAGAATTATGAGACTATTTCATTCTTACCAGATTGGTAAAAAACTT--TGTTTGAATTCATTT--
Ancistrocladus_heyneanus      ATTTGGATGAAGCGAGGGATTCGTCCATGCTATCGGTAGAGTTTGTAAGACCACGACTGATCCTGAAAGGAA-TGAGTGGAAAAAAGAGCATGTCGTATCAATGGAGAATTATGAGACTATTTCATTCTTACCAGATTGGTAAAAAACTT--TGTTTGAATTCATTT--
Ancistrocladus_korupensis     ATTTGGATGAAGCGAGGGATTCGTCCATGCTATCGGTAGAGTTTGTAAGACCACGACTGATCCTGAAAGGAA-TGAGTGGAAAAAAGAGCATGTCGTATCAATGGGGAATTATGAGACTATTTCATTCTTACCAGATTGGTAAAAAACTT--TGTTTGAATTCATTT--
Ancistrocladus_robertsoniorum ATTTGGATGAAGCGAGGGATTCGTCCATGCTATCGGTAGAGTTTGTAAGACCACGACTGATCCTGAAAGGAA-TGAGTGGAAAAAAGAGCATGTCGTATCAATGGAGAATTATGAGACTATTTTATTCTTACCAGATTGGTAAAAAACTT--TGTTTGAATTCATTT--
Dionaea_muscipula             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      ATTTTGATGAAGCAAGGGATTCGTCCATACTTTCGGTAGAGTTTGTAAGACCACGACTGATCCTGAAAGGAAATGAATGGAAAAAAGAGCATGTCGTATCAATGGAGAATTCGAAGAGTATTTCATTCTTACCAGATTGGTAAAAAACTA--TGTTTGAATTCATTT--
Limonium                      ATTTGGATGAAGCAAGGAATTCGTCCACATCATCGGTAGAGTTTGTGAGACCACGACTGATCCTGAAAGTAA-TGAATGGAAAAAAGAGCATGTCGTATCAATGAATAATTATGAGATTGTTTCGTTCTTA--------G-AAA---CTCCCTGTTTGGATTC--TTGG
Nepenthes_alata               ATTTGGATGAAGCAAAGTATTCGTCCACACCATCAGCAGAGTTTGTAAGACCACGACTGATCCTGAAATGAA-TGACTGGAAAAAAAAGCATGTCGCATCAATGGAGAATTATGAGACTATTTCAGTCTTACCAGATT---------CTT--TGTTTGAATTTATTG--
Nepenthes_tobiaca             ATTTGGATGAAGCAAAGGATTCGTCCACACCATCAGCAGAGTTTGTAAGACCACGACTGATCCTGAAAGGAA-TGAATGGAAAAAAAAGCATGTCGCATCAATGGAGAATTATGAGACTATTTCAGTCTTACCAGATT---------CTT--TGTTTGAATTTATTG--
Nepenthes_ventricosa          ATTTGGATGAAGCAAAGGATTCGTCCACACCATCAGCAGAGTTTGTAAGACCACGACTGATCCTGAAAGGAA-TGAATGGAAAAAAAAGCATGTCGCATCAATGGAGAATTATGAGACTATTTCAGTCTTACCAGATT---------CTT--TGTTTGAATTTATTG--
Nepenthes_vieillardii         ATTTGGATGAAGCAAAGGATTCGTCCACACCATCAGCAGAGTTTGTAAGACCACGACTGATCCTGAAAGGAA-TGAATGGAAAAAAAAGCATGTCGCATCAATGGAGAATTATGAGACTATTTCAGTCTTACCAGATT---------CTT--TGTTTGAATTTATTG--
Polygonum                     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum       ATTTGGATGAAGCGAGGGATTCGTCCATGCCATCGGTAGAGTTTGTGAGACCACGACTGATCCTGAAAGGAA-TGAGTGGAAAAAAGAGCATGTCGTATCAATGGAGAATTATGAGAATATTTCATTCTTACCAGATTGGTAAAAAACTT--TGTTTGAATTCATTT--

                                  11,330    11,340    11,350    11,360    11,370    11,380    11,390    11,400    11,410    11,420    11,430    11,440    11,450    11,460    11,470    11,480    11,490
Aldrovanda_vesiculosa         ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    --CGTT-CGAAGAA-TTCA-----AAGTTGGGTCAATTGAATAAATGGATCGAGTCCTATGGCTCTAATTGTAGAGAAAGAAAAAGCAACGAGCTTATGTTC---TA---AATTTGAAT-----GATTATCCGCCCTAATTAAATGTTAAAAATAGATTAGTGACTGAT
Ancistrocladus_heyneanus      --CGTT-CGAAGAA-TTCA-----AAGTTGGGTCAATTGAATAAATGGATCGAGTCCTATGGCTCTAATTGTAGAGAAAGAAAAAGCAACGAGCTTATGTTC---TA---AATTTGAAT-----GATTATCCGCCCTAATTAAATGTTAAAAATAGATTAGTGACTGAT
Ancistrocladus_korupensis     --CGTT-CGAAGAA-TTCA-----AAGTTGGGTCAATTGAATAAATGGATCGAGTCCTATGGCTCTAATTGTAGAGAAAGAAAAAGCAACGAGCTTATGTTC---TA---AATTTGAAT-----GATTATCCGCCCTAATTAAATGTTAAAAATAGATTAGTGACTGAT
Ancistrocladus_robertsoniorum --CGTT-CGAAGAA-TTCA-----AAGTTGGGTCAATTGAATAAATGGATCGAGTCCTATGGCTCTAATTGTAGAGAAAGAAAAAGCAACGAGCTTATGTTC---TA---AATTTGAAT-----GATTATCCGCCCTAATTAAATGTTAAAAATAGATTAGTGACTGAT
Dionaea_muscipula             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii       ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      --CGTT-CGAAAAA-TTCAA-----AGTTGGGTCAATTGAATAAATGGATCGAGGCCTATGGCTCTAATTGGAGGGAAAGAAAAAGCAACGAGCTTATGTTC---TT---AATTTGAATTCAAGGATTATCCGCCCTAATTAAATGTTAAAAATTGATTAGTGACTGAT
Limonium                      AACGATACGAAGAAATACA-----AAGTTAGGTTGATTGAATACATGGATCGAGCCTTATGGCTCTAATTGGAG-GAAAAAAAAAGCAACGAGCTTGTGTTC---TT---AATTGGAAT-----GATTACCCGCCCTATATAAATGTTAAAAATATATTGGTGACTGAT
Nepenthes_alata               --CGTT-CGAAGAA-TTCAATTCAAAGTTGGGTCAATTGAATAAATGGATCGAGTCCGATGGCTCGAATTGTAGGGAAAGAAAAAGCAACGAGCTTATGTTC---TT---TATTTGAAT-----GATTATCCGCCCTAATTACATGTTAAAAATAGATTAGTGACTGAT
Nepenthes_tobiaca             --CGTT-CGAAGAA-TTCAA-----AGTTGGGTCAATTGAATAAATGGATCGAGTCCTATGACTCGAATTGTAGGGAAAGAAAAAGCAACGAGCTTATGTTC---TT---TATTTGAAT-----GATTATCCGCCCTAATTACATGTTAAAAATAGATTAGTGACTGAT
Nepenthes_ventricosa          --CGTT-CGAAGAA-TTCAA-----AGTTGGGTCAATTGAATAAATGGATCGAGTCTTATGGCTCGAATTCTAGGGAAAGAAAAAGCAACGAGCTTATGTTC---TT---TATTTGAAT-----GATTATCCGCCCTAATTACATGTTAAAAATAGATTAGTGACTGAT
Nepenthes_vieillardii         --CGTT-CGAAGAA-TTCAA-----AGTTGGGTCAATTGAATAAATGGATCGAGTCCTATGGCTCGAATTGTAGGGAAAGAAAAAGCAACGAGCTTATGTTC---TT---TATTTGAAT-----GATTATCCGCCCTAATTACATGTTAAAAATAGATTAGTGACTGAT
Polygonum                     ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum       --CGTT-CGAAGAA-TTCAA-----AGTTGGGTCAATTGAATAAATGGATCGAGTCCTATGGCTCTAATTGTAGGGAAAGAAAAAG?AA?GAGCTTATGTTCTAAATTTGAATTTGAAT-----GATTATCCGCCCTAATTAAATGTTAAAAATAGATTAGTGACTGAT
```

```
                                 11,500    11,510    11,520    11,530    11,540    11,550    11,560    11,570    11,580    11,590    11,600    11,610    11,620    11,630    11,640    11,650    11,660
Aldrovanda_vesiculosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus       GCGGGAAAGGTTTTTCCCATAAATGGATTATCTGTT----TTT--TA-GTGAATCCTAATTATTAGTCATTCTCTATT--AGGAAATGGAGATGAATGTGTAGAAGAAACAGTATATTGGTAAGG-ATACTTTTT-CCAAAATCAAAAGAGCGATTGGGTCGAAAAAAA
Ancistrocladus_heyneanus         GCGGGAAAGGTTTTTCCCATAAATGGATTATCTGTT----TTT--TA-GTGAATCCTAATTATTAGTCATTCTCTATT--AGGAAATGGAGATGAATGTGTAGAAGAAACAGTATATTGGTAAGG-ATACTTTTT-CCAAAATCAAAAGAGCGATTGGGTCGAAAAAA-
Ancistrocladus_korupensis        GCGGGAAAGGTTTTTCCCATAAATGGATTATCTGTT----TTT--TA-GTGAATCCTAATTATTAGTCATTCTCTATT--AGGAAATGGAGATGAATGTGTAGAAGAAACAGTATATTGGTAAGG-ATACTTTTT-CCAAAATCAAAAGAGCGATTGGGTCGAAAAAA-
Ancistrocladus_robertsoniorum    GCGGGAAAGGTTTTTCCCATAAATGGATTATCTGTT----TTT--TA-GTGAATCCTAATTATTAGTCATTCTCTATT--AGGAAATGGAGATGAATGTGTAGAAGAAACAGTATATTGGTAAGG-ATACTTTTT-CCAAAATCAAAAGAGCGATTGGGTCGAAAAAA-
Dionaea_muscipula                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum         GCGGTAAAGGTTTT-CCCATGAATGGATTATCTATT----TTT--TAAGTAAATCCTAATTATTAGTCATTCTCCATT--ATAAAATGGGGATGAATGTGTAGAAGAA?CAGTATATTGGTAAGGGAAACTTTTTTCCAAAATCAAAAGAGCGATTGGGT-GGAAAAAA
Limonium                         GCGGGAA-GCTTTTTCTTGGAAGTCTATTATCCATT----TTT--TC-GTGAATCCTAACTATTAGTCATTCCCCATTTTAGGGTAT--AGATAAATGTGTA?AAGAAACAGTATATTGATAAGG-ATACTTTT--CCAAAATCAAAAGAGCGATTGGGTTGAAAAAA-
Nepenthes_alata                  GCGGGAAAGGCTTCTCCCATGAATGGATTATCCATTTTGCTTTGTTA-GTGAATCCTAATTATTAGTCATTCTCCTTT--AGGAAATGGAGATGAATGTGTAGAAGAAAGAGTATATTGGTAAGG-ATACTTTTT-CCAAAATCAAAAGAGCGATTGGATTGAAAAAA-
Nepenthes_tobiaca                CCGGGAAAGGCTTCTCCCATGAATGGATTATCCATTTTGCTTTGTTA-GTGAATCCTAATTATTAGTCATTCTCCTTT--AGGAAATGGAGATGAATGTGTAGAAGAAAGAGTATATTGGTAAGG-ATACTTTTT-CCAAAATCAAAAGAGCGATTGGATTGAAAAAA-
Nepenthes_ventricosa             GCGGGAAAGGCTTCTCCCATGAATGGATTATCCATTTTGCTTTGTTA-GTGAATCCTAATTATTAGTCATTCTCCTTT--AGGAAATGGAGATGAATGTGTAGAAGAAAGAGTATATTGGTAAGG-ATACTTTTT-CCAAAATCAAAAGAGCGATTGGATTGAAAAAA-
Nepenthes_vieillardii            GCGGGAAAGGCTTCTCSCATGAATGGATTATCCATTTTGCTTTGTTA-GTGAATCCTAATTATTAGTCATTCTCCTTT--AGGAAATGGAGATGAATGTGTAGAAGAAAGAGTATATTGGTAAGG-ATACTTTTT-CCAAAATCAAAAGAGCGATTGGATTGAAAAAA-
Polygonum                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum          GCGGTGCGGGAAAGGCTTTTCCCATAAATGGATTATCCG-TTTTTTA-GTGAATCCTAATTATTAGTCATTTTCTATT--AGAAAATGGAGATGAATGTGTAGAAGAAAGAGTATATTGGTAAGG-ATACTTTTT-CAAAAATCAAAAGAGCGATTGGGTTGAAAAAA-

                                   11,670    11,680    11,690    11,700    11,710    11,720    11,730    11,740    11,750    11,760    11,770    11,780    11,790    11,800    11,810    11,820    11,830
Aldrovanda_vesiculosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus       TAAAGGATTTCTAACCATCTTCTTATCCGAT--------GAAGAAATAAACCAATTAGATGG-AAAAAAGATAG-AA---GTCT-ATT-GATG-CATTTACCTGTCTCCGAGATATCGATTTATTA-TAATGTTCTT---TTTATT--ATTATAATGTTATAA------
Ancistrocladus_heyneanus         TAAAGGATTTCTAACCATCTTCTTATCCGAT--------GAAGAAATAAACCAATTAGATGG-AAAAAAGATAG-AA--AGTCT-ATT-GATG-CATTTACCTGTCTCCGAGATATCGATTTATTA-TAATGTTCTT---TTTATT--ATTATAATGTTATAA------
Ancistrocladus_korupensis        TAAAGGATTTCTAACCATCTTCTTATCCGAT--------GAAGAAATAAACCAATTAGATGG-AAAAAAGATAG-AA--AGTCT-ATT-GATG-CATTTACCTGTCTCCGAGATATCGATTTATTA-TAATGTTCTT---TTTATT--ATTATAATGTTATAA------
Ancistrocladus_robertsoniorum    TAAAGGATTTCTAACCATCTTCTTATCCGAT--------GAAGAAATAAACCAATTAGATGG-AAAAAAGATAG-AA--AGTCT-ATT-GATG-CATTTACCTGTCTCCGAGATATCGATTTATTA-TAATGTTCTT---TTTATT--ATTATAATGTTATAA------
Dionaea_muscipula                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum         TAAAGGATTTCTAACCATCTTCT------------------AG--------------GATGGGAAAAAAGATAG-GAAAGGTCGGGTT-GATG-CATTTACTTGTTTCCGAGATATC----TATTATTGATTATTCG---AATATAAAATTATTA-GAAATTAGAATAG
Limonium                         TAAAGGATTTCTAACCATCTTCTTTTCCTAT--------AAAGAAA--GACCGATTAGATGG-AAAAAAGATAGCGA---GTCC-GTTGATAAGTAT--ATTTGTCTCCGAGGTATC----TATTA-----GTTCTCATCTCTATT------AGTTCTTACAA------
Nepenthes_alata                  TAAAAGATTTCTAACCATCTTCTTATCCTAT--------AAAGAAATAAACCAATTAGATGG-AAAAA-GATAG-AGA--GTCT-GTT-GATG-CATTTAGATGTCTCCAAGATATC----TATTA--------------TTTATA--ATTATTA--------------
Nepenthes_tobiaca                TAAAAGATTTCTAACCATCTTCTTATCCTATTATCCTATAAAGAAATAAACCAATTAGATGG-AAAAA-GATAG-AGA--GTCT-GTT-GATG-CATTTAGATGTCTCCAAGATATC----TATTA--------------TTTATT--ATTATTA--------------
Nepenthes_ventricosa             TAAAAGATTTCTAACCATCTTCTTATCCTAT--------AAAGAAATAAAC-AATTAGATGG-AAAAA-GATAG-AGA--GTCT-GTT-GATG-CATTTAGATGTCTCCAAGATATC----TATTAT-------------TTTAT---ATTATTAGAATA---------
Nepenthes_vieillardii            TAAAAGATTTCTAACCATCTTCTTATCCTAT--------AAAGAAATAAACCAATTAGATGG-AAAAA-GATAG-AGA--GTCT-GTT-GATG-CATTTAGATGTCTCCAAGATATC----TATTAT--------------TTATT--ATTATTA--------------
Polygonum                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum          TAAAGGATTTCTAACCATCTTCTTATCCAAT--------AAAGAAATAAACCAATTCGATGG-AAAAAAGATAG-AAA--GTCT-GTT-GATG-CATTTACCTGTCTCCGAGATATC----TATTTATTAGAATGGTATAATTTAT-TATTATAATGGTGTAA------

                                    11,840    11,850    11,860    11,870    11,880    11,890    11,900    11,910    11,920    11,930    11,940    11,950    11,960    11,970    11,980    11,990
Aldrovanda_vesiculosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus       -----TAATACCTTGTTTTGACTATATCGCACTATGTATCATTTAATAACCCAAGAAACTTT--CTACTTTTACTTGAGTTTC----TGGTCTAATTTCAAATGAAAATGGAAGAATTCCAAGGATATTTAGAATTAGATAGATCTTGGCAACATGACCTTTTATATCC
Ancistrocladus_heyneanus         -----TAATACCTTGTTTTGACTATATCGCACTATGTATCATTTAATAACCCAAGAAACTTT--CTACTTTTACTTGAGTTTC----TGGTCTAATTTCAAATGAAAATGGAAGAATTCCAAGGATATTTAGAATTAGATAGATCTTGGCAACATGACCTTTTATATCC
Ancistrocladus_korupensis        -----TAATACCTTGTTTTGACTATATCGCACTATGTATCATTTAATAACCCAAGAAACTTT--CTACTTTTACTTGAGTTTC----TGGTCTAATTTCAAATGAAAATGGAAGAATTCCAAGGATATTTAGAATTAGATAGATCTTGGCAACATGACCTTTTATATCC
Ancistrocladus_robertsoniorum    -----TAATACCTTGTTTTGACTATATCGCA?TATGTATCATTTAATAACCCAAGAAACTTT--CTACTTTTACTTGAGTTTC----TGGTCTAATTTCAAATGAAAATGGAAGAATTCCAAGGATATTTAGAATTCGATAGATCTTGGCAACATGACTTTTTATATCC
Dionaea_muscipula                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum         AATAAAAATACCTTGTTTTGACTGTATCGCACTATGTATTATTTAATAACCCAAGAAACCTTTGTTTATTTTCCTTGAGTTTCTTTTTGGTATAATTAAAAATGAAAATCGACGAATTCCAAGGATATTTAGAACTAGATAGATCTTGGCAAGATTCTTTTTTATATCC
Limonium                         -----GGATACCTTGTTTTGACTGTATCGCACTATGTATCATTTGATAACCTAAGAAACCCC--CTACTTTTACTTTTGTTTC----GGATCTTATTT----T--AAATGGAGCAATTCCAAGGATATTTAGATTTGTTTAGATCTTGGCAAGACGATTTCTTATATCC
Nepenthes_alata                  -----TAATACCTTGCTTTGACTGTATCGCACTATGTATCATTTGATAACCCCCAAAACCCT--CTATTTTTACTTGAGTTTC----TGGTCCAATTT------AAAATGGAAGAATTACGAGGATACTTAGAACTAGATAGATCTTGGCAACGTGACTTTTTATATAC
Nepenthes_tobiaca                -----TAATACCTTGCTTTGACTGTATCGCACTATGTATCATTTGATAACCCCAAAAACCCT--CTACTTTTACTTGAGTTTC----TGGTCCAATTG------AAAATGGAAGAATTACGAGGATACTTAGAACTAGATAGATCTTGGCAACGTGACTTTTTATATAC
Nepenthes_ventricosa             -----TAATACCTTGCTTTGACTGTATCGCACTATGTATCATTTGATAACCCCAAAAACCCT--CTACTTTTACTTGAGTTTC----TGGTCCAATTT------AAAATGGAAGAATTACGAGGATACTTAGAACTAGATAGATCTTGGCAACGTGACTTTTTATATAC
Nepenthes_vieillardii            -----TAATACCTTGCTTTGACTGTATCGCACTATGTATCATTTGATAATCCCARAAACCCT--CTACTTTTACTTGAGTTTC----TGGTCCAATKT------AAAATGGAAGAATTACGAGGATACTKAGAACTAGATAGATCTTGGCAACGTGACTTTTTATATAC
Polygonum                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum          -----TAATACCTTGTTTTGACTCTATCACACTATGTATCATTTAATAACCCAAGAAACTTT--CTACTTTTACTTGAGTTTC----TGATCGAATTTAAAATGAAAATGGAAAAATTCCAAGGATATTTCGAATTAGATAGATCTTGGCAACATGACTTTTTATATCC

                                 12,000    12,010    12,020    12,030    12,040    12,050    12,060    12,070    12,080    12,090    12,100    12,110    12,120    12,130    12,140    12,150    12,160
Aldrovanda_vesiculosa            ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus       ACTTATCTTTCAGGAATATATTTATGCATTGGCACATGATCAT-GGTT-TA----AATAGAACTGTTTTGTTG-GAAAATGAGGGTTATGAGAAAAAATACAGTTTACTAATTGTAAAACGTTTAATTACTCGAATGTATCGACAGAATCATTTGATTCTTTCTGCTAA
Ancistrocladus_heyneanus         ACTTATCTTTCAGGAATATATTTATGCATTGGCACATGATCAT-GGTT-TA----AATAGAACTGTTTTGTTG-GAAAATGAGGGTTATGAGAAAAAATACAGTTTACTAATTGTAAAACGTTTAATTACTCGAATGTATCGACAGAATCATTTGATTCTTTCTGCTAA
Ancistrocladus_korupensis        ACTTATCTTTCAGGAATATATTTATGCATTGGCACATGATCAT-GGTT-TA----AATAGAACTGTTTTGTTG-GAAAATGAGGGTTATGAGAAAAAATACAGTTTACTAATTGTAAAACGTTTAATTACTCGAATGTATCGACAGAATCATTTGATTCTTTCTGCTAA
Ancistrocladus_robertsoniorum    ACTTATCTTTCAGGAATATATTTATGCATTGGCACATGATCAT-GGTT-TA----AATAGAACTGTTTTGTTG-GAAAATGAGGGTTATGAGAAAAAATACAGTTTACTAATTGTAAAACGTTTAATTACTCGAATGTATCGACAGAATCATTTGATTCTTTCTGCTAA
Dionaea_muscipula                ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                   ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                    ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia             ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum         ACTTAGCTTTCAGGAATATATTTATGCATTGGCACATGATCAT-GGTT-TA----AATAGAACTATTTTGTTG-GAAAATGCGGGTTATGAAAATAAATACAATTTTTTAATTGTAAAACGTTTAATTATTCGAATGTATCGACAGAATCAGTTTATTCTTTCTACTAA
Limonium                         ACTTATTTTTCAGGAATATATTTATGCATTTGTACATGATCATGATTTCGATTTTGATAGGTCTATTTTGTTG-GAAAATAGAGGTTATGACACAAAATACAGTTTACTAACTGTGAAACGTTTAGTTACTCAAATGTATCAACAGAATCATTTGAGTC---CTGTTAA
Nepenthes_alata                  ACTTATCCTTCAGGAATATATTTATTCATTGGCACATGATCAT-GGTT-TC----AATAGAACTATTTTTTTG-GAAAATGCCGGTTATGAGAAAAAATACAGTTTCCTAATTGTAAAACGTTTAATTACTCGAATGTACCAACAGAATCATTTGATTCTTTCTGCTAA
Nepenthes_tobiaca                ACTTATCCTTCAGGAATATATTTATTCATTGGCACATGATCAT-GGTT-TC----AATCGAACTATTTTTTTG-GAAAATGCCGGTTATGAGACGAAATACAGTTTCCTAATTGTAAAACGTTTAATTACTCGAATGTACCAACAGAATCATTTGATTCTTTCTGCTAA
Nepenthes_ventricosa             ACTTATCCTTCAGGAATATATTTATTCATTGGCACATGATCAT-GGTT-TC----AATAGAACTATTTTTTTG-GAAAATGCCGGTTATGAGAAAAAATACAGTTTCCTAATTGTAAAACGTTTAATTACTCGAATGTACCAACAGAATCATTTGATTCTTTCTGCTAA
Nepenthes_vieillardii            ACTTATCCTTCAGGAATATADTTATTCATTGGCACATGATCAT-GGTT-TC----RRTAGAACTATTTTTTTT-GAAAATGCCGGTTATGAGAAGAAATACAGTTTCCTAATTGTAAAACGTTTAATTACTCGAATGTACCAACAGAATCATTTGATTCTTTCTGCTAA
Polygonum                        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum          ACTTATCTTTCAGGAATATATTTATGCATTGGCACATGATCAT-GGTT-TA----AATAGAACTGTTTTGTTGGAAAAATGAGGGTTATGAAAAGAAATATAGTTTACTA?TTGTAAAACGTTTAATTACTCGAATGTATCGACAGAATCATTTAATTCTTTCTGCTAA
```



```
                                12,170    12,180    12,190    12,200    12,210    12,220    12,230    12,240    12,250    12,260    12,270    12,280    12,290    12,300    12,310    12,320    12,330
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     TGATTCTAACCAAAATA-CATTTTTTGT--ACCCCCAA-AA----ACA-TTGTATTCTCAAGTGATATCAGAGGGATTTGCAGTTATTGTGGAAATTCCGTTTT-CAC--TACGA--TTTC--TTTTTTTCTTAGAAGGAAAGAAATAGTAAAA-TCTCAT-AATTTA
Ancistrocladus_heyneanus       TGATTCTAACCAAAATA-AATTTTTTGT--ACCCCCAA-AA----ACA-TTGTATTCTCAAGTGATATCAGAGGGATTTGCAGTTATTGTGGAAATTCCGTTTT-CAC--TACGA--TTTC--TTTTTTCCTTAGAAGGAAAGAAATAGTAAAA-TCTCAT-AATTTA
Ancistrocladus_korupensis      TGATTCTAACCAAAATA-CATTTTTTGT--ACCCCAAA-AA----ACA-TTGTATTCTCAAGTGATATCAGAGGGATTTGCAGTTATTGTGGAAATTCCGTTTT-CAC--TACGA--TTTC--TTTTTTTCTTAGAAGGAAAGAAATAGTAAAA-TCTCAT-AATTTA
Ancistrocladus_robertsoniorum  TGATTCTAACCAAAATA-CATTTTTTGT--ACCCCCAA-AA----ACA-TTGTATTCTCAAGTGATATCAGAGGGATTTGCAGTTATTGTGGAAATTCCGTTTT-CAC--TACGA--TTTC--TTTTTTCCTTAGAAGGAAAGAAATAGTAAAA-TCTCAT-AATTTA
Dionaea_muscipula              ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       TGATTTTCAGCAAAATA-TATTTTTTGCGTCCCCCAA-AA----A-A-T-ATATTCTCAAGTGATAGCCGAGGTATTTTCCGTTATTGTGGAAATTCCGTTTT-CAC--TACGA--TTAC--TGTTTTCCCTAGAAGGAAAACAAATAAGAAAA-TCTCAT-AATCTA
Limonium                       TGATTCTAACCAAAA-AGAATTTATTGG--ACAC--AAGAA----AAATTTGTATTCTCATCTGATCTCAGAGGGATTTGCAGTCATTGTGGAAATTCCATTTTC---TAGGCAATT-C--TTAATTTATCG-AGAAGAAACAGAAGT--CAAAAATTTGAAAAATTTA
Nepenthes_alata                TGATTCTAATCAAAATG-AATTTTTGGG--GC----AA-AAAAAGAAT-TTGTATTCTCAAATGATATCAGAGGGATTTGCATTCATTGTGGAAATTCCATTTT-CAC--TACAA--TTAC--TATTTTCCCTAGAAGGAAAGAAATAG????-??????-?????A
Nepenthes_tobiaca              TGATTCTAATCAAAATG-AATTTTTGGG--GC----AA-AAAAGGAAT-TTGTATTATCAAGTGATATCAGAGGGATTTGCATTCATTGTGGAAATTCCATTTT-CAC--TACAA--TTAC--TATTTTCCCTAGAAGGAAAGAAATAGTAAAA-TCTCGT-AATTTA
Nepenthes_ventricosa           TGATTCTAATCAAAATG-AATTTTTGGG--GC----AA-AAAAAGAAT-TTGTATTCTCAAATGATATCAGAGGGATTTGCATTCATTGTGGAAATTCCATTTT-CAC--TACAA--TTAG--TATTTTCCCTAGAAGGAAAGAAATAGTAAAA-TCTCGT-AATTTA
Nepenthes_vieillardii          TGATTCTAATCAAAATG-AATTTTTGGG--GC----AA-AAAAATAAT-TTGTATTCTCAARTGATATCAGAGGGATTTGCATTCATTGTGGAAATTCCATTTT-CAC--TACAA--TTAC--TATTTTCCCTAGAAGGAAAGARA?AGTAAAA-TCTCGT-AATTTA
Polygonum                      ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        TGATTCGAACCAAAATG-CATTTTTTGT--?CCCCC?A-AAACA----TTGTATTCTC??GCGATATC?GAGGCATTTGCGGTTATTGTGGAAATTCCGTTTT-CAC--TACGA--TTTC--TTTTTTCCTTAGAAGGAAAGAAATAGTAAAA-TCTCAT-AATTTA
                                12,340    12,350    12,360    12,370    12,380    12,390    12,400    12,410    12,420    12,430    12,440    12,450    12,460    12,470    12,480    12,490    12,500
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     CGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCACATTTAAATTATGTGTTAGATATACGAATACCCCATCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTGAAAGATACCTCTTCTTTGCATTTATTACGATTCTTTCTTTATG
Ancistrocladus_heyneanus       CGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCACATTTAAATTATGTGTTAGATATACGAATACCCCATCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTGAAAGATGCCTCTTCTTTGCATTTATTACGATTCTTTCTTTATG
Ancistrocladus_korupensis      CGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCACATTTTAATTATGTGTTAGATATACGAATACCCCATCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTGAAAGATGCCTCTTCTTTGCATTTATTACGATTCTTTCTTTATG
Ancistrocladus_robertsoniorum  CGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCACATTTAAATTATGTGTTAGATATACGAATACCCCATCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTAAAAGATGCCTCTTCTTTGCATTTATTACGATTCTTTCTTTATG
Dionaea_muscipula              ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       CGATCAATTCATTCAATATTTCCTTTTTTAGAGGATCAATTCTCACATTTAAATTATGTCTTAGATATAAGAATACCTCACCCTGTCCATCTAGAAATCCTGGTTCAAACTCTTCGCTACTGGGTGAAAGATGCGCCTTCCTTGCATTTATTACGATTTTTCTTTATG
Limonium                       CGATCAATCCATTCAATATTTCCTTTTTTAGAGGACCCATTTTTACATTTAAATTATGTGTTAGATATATCGATACCTTACCCCGCCCATCTGGAAATCTTGGTTCAAAGTATTCGCTATTGGGTAAAAGATGCTTCTTGTTTGCATTTATTGCGAGTCTTTCTTTATG
Nepenthes_alata                CGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCACATTTAAATTATGTGTTAGATATACTGATACCCCATCCTGTCCATCTGGAAATCCTAGTTCAAACTATTCGCTACTGGACGAAAGATGCTTCTTCTTTGCATTTATTACGATTCTTTCTTTATG
Nepenthes_tobiaca              CGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCACATTTAAATTATGTGTTAGATATACTGATACCCCATCCTGTCCATCTGGAAATCCTAGTTCAAACTATTCGCTACTGGACGAAAGATGCTTCTTCTTTGCATTTATTACGATTCTTTCTTTATG
Nepenthes_ventricosa           CGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCACATTTAAATTATGTGTTAGATATACTGATACCCCATCCTGTCCATCTGGAAATCCTAGTTCAAACTATTCGCTACTGGACGAAAGATGCTTCTTCTTTGCATTTATTACGATTCTTTCTTTATG
Nepenthes_vieillardii          CGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCACATTTAAATTATGTGTTAGATATACTGATACCCCATCCTGTCCATCTGGAAATCCTAGTTCAAACTATTCGCTACTGGACGAAAGATGCTTCTTCTTTGCATTTATTACGATTCTTTCTTTATG
Polygonum                      ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        CGATCAATTCATTCAATATTTCCTTTTTTAGAGGACAAATTCTCACATTTAAATTATGTGTTAGATATACGAATACCCCACCCTGTCCATCTGGAAATCTTGGTTCAAACTCTTCGCTACTGGGTGAAAGATGCCTCTTCTTTTCATTTATTACGATTCTTTCTTTATG
                                12,510    12,520    12,530    12,540    12,550    12,560    12,570    12,580    12,590    12,600    12,610    12,620    12,630    12,640    12,650    12,660    12,670
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     AGTATTGTAATTGGAATAGTCTTTTTTCTCTAAAGAAAAACATTTCTATTTTTCAAAAAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTATCCGCAATCAATCCTCTCATTTACGATCAACATTTTCGGG
Ancistrocladus_heyneanus       AGTATTGTAATTTGAATAGTCTTTTTTCTTTAAAGAAAAACATTTCTATTTTTTAAAAAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTATCCGCAATCAATCCTATCATTTACGATCAACATTTTCGGG
Ancistrocladus_korupensis      AGTATTGTAATTGGAATAGTCTTTTTTCTCTAAAGAAAAACATTTCTATTTTTCAAAAAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCTATCTTCATTTTTATCCGCAATCAATCCTCTCATTTACGATCAACATTTTCGGG
Ancistrocladus_robertsoniorum  AGTATTGTAATTGGAATAGTCTTTTTTCTCTAAAGAAAAACATTTCTATTTTTCAAAAAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTCTGTGAATACGAATCCATCTTCATTTTTATCCGCAATCAATCCTCTCATTTACGATCAACATTTTCGGG
Dionaea_muscipula              ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       AGTCTCATAATTGGAATAGTTTTTTTTCTTTAAAGAAAAACATTTCCTTTTTGAAAAAAGGAATCAAAGATTCTTCTTGTTCCTATATAATTCTCATGTGTGTGAATACGAATCTATCTTCTTTTTTATCTGCAATCAATCCTCTCATTTACAATCAACATTTTATGG
Limonium                       AGCATCGTAATTGTAATAGTCTTGTTATTGAAACAAAATCTGTTTACAATTTTTGAAAACAAGTAAAAGATTCTTCTTGTTACTATATAATTCCCATGTGTGTGAATATCAATCCATCTTCGTTTTTCTCCGCAACCAATCCTCTCATTTACGATCAACATCTTACGG
Nepenthes_alata                AGTATCGTAATTGGAATAGTCGTATTTCTATAAAGCAATACATTTCTTTTTTTCAAACAGGAATCAAAGATTATTCTTGTTCCT?TATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTCTCCGCAACCAACCCTTCCATTTACGATCAACTTTTTCTGG
Nepenthes_tobiaca              AGTATCGTAATTGGAATAGTCGTATTTCTATAAAGCAATACATTTCTTTTTTTCAAACAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTCTCCGCAACCAACCCTCCCATTTACGATCAACTTTTTCTGG
Nepenthes_ventricosa           AGTATCGTAATTGGAATAGTCGTATTTCTATAAAGCAATACATTTCTTTTTTTCAAACAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTCTCCGCAACCAACCCTCCCATTTACGATCAACTTTTTCTGG
Nepenthes_vieillardii          AGTATCGTAATTGGAATAGTCGTATTTCTATAAAGCAATACATTTCTTTTTTTCAAACAGGAATCAAAGATTATTCTTGTTCCTATATAATTCCCATGTGTGTGAATACGAATCCATCTTCATTTTTCTCCGCAACCAACCCTCCCATTTACGATCAACTTTTTCTGG
Polygonum                      ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        AGTATCGTAATTGGAATAGTCTTTTTTTCTAAAGAAAAACATTTCTATTCTTTCAAAAAGGAATCAAAGATTCTTTTTGTTCCTATATAATTCCTATGTGTGTGAATACGAATCCATCTTCATTTTTATCCGCAATCAATCCTCTCATTTACGATCAACGTTTTTGGG
                                12,680    12,690    12,700    12,710    12,720    12,730    12,740    12,750    12,760    12,770    12,780    12,790    12,800    12,810    12,820    12,830    12,840
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     AGCCTTTCTTGAACGAATCTCTTTCTATGCAAAGATAGAACATCTTGTAAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGACATCTCTTCTGATGAAT
Ancistrocladus_heyneanus       AGCCTTTCTTGAACGAATCTCTTTCTATACAAAGATAGAACATCTTGTAAAAGTCTTTACTAAGAATTTTCAGGTTATCATATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGACATCTCTTCTGATGAAT
Ancistrocladus_korupensis      AGCCTTTCTTGAACGAATCTCTTTCTATGCAAAGATAGAACATCTTGTAAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGACATCTCTTCTGATGAAT
Ancistrocladus_robertsoniorum  AGCCTTTCTTGAACGAATCTCTTTCTATGCAAAGATAGAACATCTTGTAAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGACATCTCTTCTGATGAAT
Dionaea_muscipula              ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ATCCCTTATTGAACGAATCCATTTCTATGGAAAGGTAGAACATCTTGTAAAAGTCTTTACTAAGAATTTTCAGGTTATCTTATGGTTCTTCCAAGATCCTTTGATGCATTATGTTAGGTATCAAGGAAAATCCATTCTAGCTTCAAAAGCAACATCTCTTCTGATCAAT
Limonium                       AGCCTTTCTTGCACGAGTATATTTCTACGGAAAGATAAAATATCTTGGAAAAGGCTTTACTAAGCCTTTTAAGGGGATCCTATGGTTCTTTAAGGATCCTTTTATGCATTATGTTAGGTATAAAGGAAAATGGATTCTGGCTTCAAAAGGCACATCTCTTCTGATGAAT
Nepenthes_alata                AGCCTTTCTTGAACGAATCCTTTTCTATGAAAAGATGGAACATCTTGTAAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTTTTCAAAGATACTTTCATACATTATGTTAGGTATCAAGGAAAATCTTTTGTGGCTTCAAAAGGGACATCTCTTCTGATGATT
Nepenthes_tobiaca              AGCCTTTCTTGAACGAATCCATTTCTATGAAAAGATGGAACATCTTGTAAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTTTTCAAAGATACTTTCATGCATTATGTTAGGTATCAAGGAAAATCTTTTGTGGCTTCAAAAGGGACATCTCTTCTGATGATT
Nepenthes_ventricosa           AGCCTTTCTTGAACGAATCCATTTCTATGAAAAGATGGAACATCTTGTAAAAGTCTTTACTAATAATTTTCAGGTTATCCTATGGTTTTTCAAAGATACTTTCATGCATTAT?TTAGGTATCAAGGAAAATCTTTTGTGGCTTCAAAAGGGACATCTCTTCTGATGATT
Nepenthes_vieillardii          AGCCTTTCTTGAACGAATCCATTTCTATGAAAAGATGGAACATCTTGTAAAAGTCTTTACTAAGAATTTTCAGGTTATCCTATGGTTTTTCAAAGATACTTTCATGCATTATGTTAGGTATCAAGGAAAATCTTTTGTGGCTTCAAAAGKGACATCTCTTCTGATGATT
Polygonum                      ????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        AGCCCTTCTTGAACGAATCTCTTTCTATGCAAAGATAGAACACCTTGTAAAAGTCTTTACTAAGACTTTTCAGGTTATCCTATGGTTCTTCAAAGATCCTTTCATGCATTATGTTAGGTATCAAGGAAAATACATTCTGGCTTCAAAGGGACATCTCTTCTGATGAAT
```

```
                                12,850    12,860    12,870    12,880    12,890    12,900    12,910    12,920    12,930    12,940    12,950    12,960    12,970    12,980    12,990    13,000    13,010
Aldrovanda_vesiculosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     AAATGGAAATATTACCTTGTAAATTTCTGGCAATGTTATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAATCATTCCCTGGACCTTATGGGTTTTCTTTTAAGTGTGCGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATT
Ancistrocladus_heyneanus       AAATGGAAATATTACCTTGTAAATTTCTGGCAATGTTATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAATCATTCCCTGGACCTTATGGGTTTTCTTTTAAGTGTGCGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATT
Ancistrocladus_korupensis      AAATGGAAATATTACCTTGTAAATTTCTGGCAATGTTATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAATCATTCCCTGGACCTTATGGGTTTTCTTTTAAGTGTGCGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATT
Ancistrocladus_robertsoniorum  AAATGGAAATATTACCTTGTAAATTTCTGGCAATGTTATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAATCATTCCCTGGACCTTATGGGTTTTCTTTTAAGTGTGCGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATT
Dionaea_muscipula              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       AAATGGAAATATTATCTTGTCAATTTCTGGCAATGTTATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAAAAATTCCCTGGACTTTACGGGTTTTCTTTCAAGTGTGTGCCTAAATACTTCCGTGGTACGGAGTCAAATGTTAGAAAATT
Limonium                       AAATGGAAATATTACCTTGTCCGTTTCTGGCAATGTCATTTTTCCGTATGGTCTCAACCAAGAAGAATCCATATTAATGTATTATCAAACTGTTCTATTGACTTTATGGGTTTTGTTTTCAGTGTGCGACTCAAGCCTTCTGTGGTACGGAGTCAAATGTTAGAAAATT
Nepenthes_alata                AAATGGAAATATTACCTTGTCAATTTTTGGCAATGTTATTTTTCCGTGTGGTCTCAACCAAGAAGAATCTATATCAATCAATTATCAAATCATTCCCTGGACTTTATGKGTTTTCTTTCAAGTGTGCGACTAAATCCTTCCGTGGTACGGATTCAAATGTTCGAAAAAT
Nepenthes_tobiaca              AAATGGAAAYATTACCTTGTCAATTTTTGGCAATGTTATTTTTCCGTGTGGTCTCAACCAAGAAGAATCTATATCAATCAATTATCAAATCATTCCCTGGACTTTATGKGTTTTCTTTTAAGTGTGCGACYAAATCCTTCCGTGGTACGGATTCAAATGTTCGAAAAAT
Nepenthes_ventricosa           AAATGGAAATATTACCTTGTCAATTTTTGGCAATGTTCTTTTTCCGTGTGGTCTCAACCAAGAAGAATCTATATCAATCAATTATCAAATCATTCCCTGGACTTTATGGGTTTTCTTTCAAGTGTGCGACTAAATCCTTCCGTGGTACGGATTCAAATGTTCGAAAAAT
Nepenthes_vieillardii          AAATGGAAAYATTACCTTGTCAATTTTTGGCAATGTTCTTTTTCCGTGTGGTCTCAACCAAGAAGAATCTATATCAATCAATTATCAAATCATTCCCTGGACTTTATGKGTTTTCTTTCAAGTGTGCGAYYAAATCCTTTCGTGGTAYGGATTCAAATGTTCGAAAAAT
Polygonum                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Triphyophyllum_peltatum        AAATGGAAATATTACCTTGTCAATTTCTGGCAATGTTATTTTTCTGTGTGGTCTCAACCAAAAAGAATCTATATCAATCAATTATCAAATCATTCCCTGGACTTTATGGGTTTTCTTTTAAGTGTGTGCCTAAATCCTTCCGTGGTACGGAGTCAAATGTTAGAAAATT

                                  13,020    13,030    13,040    13,050    13,060    13,070    13,080    13,090    13,100    13,110    13,120    13,130    13,140    13,150    13,160    13,170    13,180
Aldrovanda_vesiculosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     CATTTCTAATAGATAATGCTATTAAGAAGTTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCGAAATTTTGTAACGTATTAGGACATCCCATTAGTAAGTCGGTTTGGGCCGATTTCTCAGATTCAGAGATTATTGAACGATTTGGGCGTAT
Ancistrocladus_heyneanus       CATTTCTAATAGATAATGCTATTAAGAAGTTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCGAAATTTTGTAACGTATTAGGACATCCCATTAGTAAGTCGGTTTGGGCCGATTTCTCAGATTCTGAGATTATTGAACGATTTGGGCGTAT
Ancistrocladus_korupensis      CATTTCTAATAGATAATGCTATTAAGAAGTTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCGAAATTTTGTAACGTATTAGGACATCCCATTAGTAAGTCGGTTTGGGCCGATTTCTCAGATTCAGAGATTATTGAACGATTTGGGCGTAT
Ancistrocladus_robertsoniorum  TATTTCTAATAGATAATGCTATTAAGAAGTTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCGAAATTTTGTAACGTATTAGGACATCCCATTAGTAAGTCGGTTTGGGCCGATTTCTCAGATTCTGAGATTATTGAACGATTTGGGCGTAT
Dionaea_muscipula              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       CATTTATAATGGATAATGCTATTAATAAGTTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCGAAAGCGAAATTTTGTAACGTATTAGGGCATCCCATTAGTAAGCCTGTTTGGACTGATTTATCAGATTCGGAGATCATTGACCGATTTGGG?GTAT
Limonium                       CATTCGTAATACAGAATGGGATTAAGGAGTTTGATACCACAGTTCCAATTATGCCTCTGATTGGATCTTTGGCTAAGGCAAAATTTTGTAATGGATTAGGACATCCCATTAGTAAGCCGGTCTGGGCTGATTTAGCCGATTCGGATATTATTGACCGATTTGGCCGTAT
Nepenthes_alata                CTTTTATCATAGATAATGCTATTAATACGTTCGATACCCTAGTTCCAAATATTCATATGAGTGGATCATTTGCGAAAGAAAAATTTTGTAACATATTTGGACATCCCATTAGTAAACCGGTATGGGCCGATTTATCAGATTCTGATATTATTGATCGATTTGGTCGTAT
Nepenthes_tobiaca              CTTTTATCCTAGATAATGCTATTAATACGTTCSATACCCTAGTTCCAAATATTCCTATGATTGGATCATTTGCGAAAGAAAAATTTTGTAACATATTTGGACATCCCATTAGTAAGCCGGTATGGGCCGATTTATCAGATTCTGATATTATTGACCGATTTGGGCGTAT
Nepenthes_ventricosa           CTTTTATCATGGATAATGCTATTAATACGTTCGATACCCTAGTTCCAAATATTCCTATGGTTGGATCATTTGCGAAAGAAAAATTTTGTAACATATTTGGACATCCCATTAGTAAACCGGTATGGGCCGATTTATCAGATTCTGATATTATTGACCGATTTGGTCGTAT
Nepenthes_vieillardii          CTTTTATCATAGATAATGCTATTAATATGTTCSATACCCTAGTTCCAAATATTCCTATGATTGGATCATTTGCGAAAGAAAAATTTTGTAACATATTTGGACATCCCATTAGTAAGCCAGTATGGGCCGATTTATCAGATTCTGATATTATTGACCGATTTGGTCGTAT
Polygonum                      ?????????????????????????????????????????????????????????????????????????????????????????????????????????CCATTAGTAAGCCGGCCTGGGCTGATTTATCTGATTCTGATATTATACGTCGATTTGGGCGTAT
Triphyophyllum_peltatum        CATTTCTAATAGATAATGCTATTAAGAAGTTCGATACCATAGTTCCAAGTATTCCTCTGATTGGATCATTGTCAAAAGCGCAATTTTGTAACGTATTAGGACATCCCATTAGTAAGCCGGTTTGGGTCGATTTCTCAGATTCTGAGATTATTGACCGATTTGGGCGTAT

                                   13,190    13,200    13,210    13,220    13,230    13,240    13,250    13,260    13,270    13,280    13,290    13,300    13,310    13,320    13,330    13,340    13,350
Aldrovanda_vesiculosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ATGCAGAAGTCTTTATCATTATTACAGCGGATCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTT?GGCTCGTAAACACAAAAGCACTGTACGTGCTTTTGTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTT
Ancistrocladus_heyneanus       ATGCAGAAGTCTTTATCATTATTACAGCGGATCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGGCTCGTAAACACAAAAGCACTGTACGTGCTTTTGTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTTTTT
Ancistrocladus_korupensis      ATGCAGAAGTCTTTATCATTATTACAGCGGATCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGGCTCGTAAACACAAAAGCACTGTACGTGCTTTTGTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTT
Ancistrocladus_robertsoniorum  ATGCAGAAGTCTTTATCATTATTACAGCGGATCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGGCTCGTAAACACAAAAGCACTGTACGTGCTTTTGTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTT
Dionaea_muscipula              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ATGCCGAAGTATTTCTCATTATTATAGCGGATCTTCAAAAAAAACAAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGGCTCGTAAACACAAAAGTACTGT?CGTTCTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTT
Limonium                       ATGCAGAAATCTTTCTCATTATTACAGCGGTTCTTCACGAAAGAGGAGTTTTTATCGAATAAAGTACATCCTTCGACTTTCTTGTGCTAGAACTTTGGCTCGTAAGCATAAAAGCAGTGTACGTGCTTTTTTGAAAAGATTAGGTTCGGCTTTTTTGGAAGAGTTTTTT
Nepenthes_alata                ATGCAGAAGTCTTTCTCATTATTACAGCGGGTCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGGCTCGGAAACACAAAAGTACTGTACGTACTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTT
Nepenthes_tobiaca              ATGCAGAAGTCTTTCTCATTATTACAGCGGGTCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGAATTTCTTGTGCTAGAACTTTGGCTCGGAAACACAAAAGTACTGTACGTACTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTT
Nepenthes_ventricosa           ATGCAGAAGTCTTTCTCATTATTACAGCGGGTCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGGCTCGGAAACACAAAAGTACTGTACGTACTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTT
Nepenthes_vieillardii          ATGCAGAAGTCTTTCTCATTATTACAGCGGGTCTTCAAGAAAAAAGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGGCTCGGAAACACAAAAGTACTGTACGTACTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTT
Polygonum                      ATGTAGAAATCTTTCTCATTATTATAGCGGATCTTCAAAAAGGGGGAGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACATTGGCTCGTAAACATAAAAGCACTGTACGTGCTTTTTTGAAAAAATTAGGTTCAGAATTTTTGGAAGAATTTTTT
Triphyophyllum_peltatum        ATGCAGAAGTCTTTATCATTATTACAGCGGATCTTCAAGAAAAAAGGGTTTGTATCGAATAAAGTATATACTTCGACTTTCTTGTGCTAGAACTTTGTCTCGTAAACACAAAAGCACTGTACGTGCTTTTTTGAAAAGATTAGGTTCAGAATTTTTGGAAGAATTCTTT

                                    13,360    13,370    13,380    13,390    13,400    13,410    13,420    13,430    13,440    13,450    13,460    13,470    13,480    13,490    13,500    13,510    13,520
Aldrovanda_vesiculosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ATGGAGGAAGAAAAAGTTCTTTCTTTGATCTTACCAAGAGATTCTTCTATTTCAAAGAGGTTATATAGAGGACCTATTTGGTATTTGGATATTTTTTGTATCCATGATTTCGCCAATCATGAATGGTTGGTTATG--------------------------------AG
Ancistrocladus_heyneanus       ATGGAGGAAGAAAAAGTTCTTTCTTTGATCTTACCAAGAGATTCTTCTATTTCAAAGAGGTTATATAGAGGACCTATTTGGTATTTGGATATTTTTTGTATCCATGATTTCGCCAATCATGAATGGTTGGTTATG--------------------------------AG
Ancistrocladus_korupensis      ATGGAGGAAGAAAAAGTTCTTTCTTTGATCTTACCAAGAGATTCTTCTATTTCAAAGAGGTTATATAGAGGACCTATTTGGTATTTGGATATTTTTTGTATCCATGATTTCGCCAATCATGAATGGTTGTTTATG--------------------------------AG
Ancistrocladus_robertsoniorum  ATGGAGGAAGAAAAAGTTCTTTCTTTGATCTTACCAAGAGATTCTTCTATTTCAAAGAGGTTATATAGAGGACCTATTTGGTATTTGGATATTTTTTGTATCCATGATTTCGCCAATCATGAATGGTTGGTTATG--------------------------------AG
Dionaea_muscipula              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ACAGAGGAAGAAAAAGTTCTTTCTTTTCTTTTACCAAGAGATTATTCTATTTCACAGAGGTTATATAGAGGGCGTATTTGGTATTTGGATATTTTTTGTATTCATGATTTTGCCAATCATGAATGGTTGGTTATG--------------------------------AG
Limonium                       ACAGAAGAAAGTAAAGTTCTTTCTTTGATCTTACCAAAGGATTCTTTTACTTCATACAAATTATATCAAGGGCGAATTTGGTATTTGGATATTATTTGTATTCATGATTTGGTCAATCA-TTCTAATAATTGATATTGATTAGAAGACTTCTTAACTAA--------CG
Nepenthes_alata                ATGGAGGAAGAAAAAGTTCTTTCTTTGATCTTACCAAGGGATTCTTATACTTCACAGAGGTTCTATAGAGGACGTATTTGGTATTTGGATATTTTCTGTATTCATGATTTGGCCAATCATGAATGATTGATTATG--------------------------------AG
Nepenthes_tobiaca              ATGGAGGAAGAAAAAGTTCTTTCTTTGATCTTACCAAGGGATTCTTATACTTCACAGAGGTTCTATAGAGGACGTATTTGGTATTTGGATATTTTCTGTATTCATGATTTGGCCAATCATGAATGATTGATTATGTGAATGATTGATTATG----------------AG
Nepenthes_ventricosa           ATGGAGGAAGAAAAAGTTCTTTCTTTGATCTTACCAAGGGATTCTTATACTTCACAGAGGTTCTATAGAGGACGTATTTGGTATTTGGATATTTTCTGTATTCATGATTTGGCCAATCATGAATGATTGATTATGTGAATGATTGATTATG----------------AG
Nepenthes_vieillardii          ATGGAGGAAGAAAAAGTTCTTTCTTTGATCTTACCAAGGGATTCTTATACTTCACAGAGGTTCTATAGAGGACGTATTTGGTATTTGGATATTTTCTGTATTCATGATTTGGCCAATCATGAATGATTGATTATGTGAATGATTGATTATG----------------AG
Polygonum                      ATCAAAGAAGAAAAAGTGCTTTCTTTGATCTTATCAAGAGATTCTTCTATTTCACGAAGGTTATATAGAGTACGCATTTGGTATTTGGATATTTTTTGTATTCATGATTTGGCCAGTCA-TAA---TGATTGATATTGATTATG-----------------------AA
Triphyophyllum_peltatum        ATGGAGGAAGAAAAAGTTCTTTCTTTGATCTTACCAAGAGATTCTTCTATTTCACAGAGGTTATATAGAGGACCCATTTGGTATTTGGATATTTTTTGTATCCATGATTTTGCCAATCATGAATGGTTGGTTATG--------------------------------AA
```

```
                                     13,530    13,540    13,550    13,560    13,570    13,580    13,590    13,600    13,610    13,620    13,630    13,640    13,650    13,660    13,670    13,680
Aldrovanda_vesiculosa          ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ACTATCTAAATGAA-----------TTCA--A-AATTATACTTAA--ATTAATAAAAAGATAAGA-AAAAATTGAATTCATTTCTATTCTGAAATGCTGATGCAGTAAGGGTTGAATCAACTGAGTATTCAATTTTCTTAGAGTTCTGTCTAGT-----GAAGGAATTC
Ancistrocladus_heyneanus       ACCATCTAAATGAA-----------TTCA--A-AATTATACTTAA--ATTAATAAAAAGATAAGA-AAAAATTGAATTCATTTCTATTCTGAAATGCTGATGCAGTAAGGGTTGAATCAACTGAGTATTCAATTTTCTTAGAGTTCTGTCTAGT-----GAAGGAATTA
Ancistrocladus_korupensis      ACTATCTAAATGAA-----------TTCA--A-AATTATACTTAA--ATTAATAAAAAGATAAGA-AAAAATTGAATTCATTTCTATTCTGAAATGCTGATGCAGTAAGGGTTGAATCAACTGAGTATTCAATTTTCTTAGAGTTCTGTCTAGT-----GAAGGAATTC
Ancistrocladus_robertsoniorum  ACCATCTAAATGAA-----------TTCA--A-AATTATACTTAA--ATTAATAAAAAGATAAGA-AAAAATTGAATTCATTTCTATTCTGAAATGCTGATGCAGTAAGGGTTGAATCAACTGAGTATTCAATTTTCTTAGAGTTCTGTCTAGT-----GAAGGAATTA
Dionaea_muscipula              ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ?????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ACTATCTAAATAAATGATAAATCAATTCA--A-AATTTTACTTAA--ATAAA-ATAAAGATAAGA-AAAAATTCA-TTCATTTCTATTCTGAAATGCTGATGTAGTAAGGGTTGAATCAATTGAGTATTCAACTTTCTTAGAGTTCTGGCTAGG-----GAAGGAATTC
Limonium                       GAAAACTAAATGAAA----------T-GAAAATTCTAGTACT-AATGAATGATAAA-----AATTACAAAATT---TTCATTTCTATTCTGAAATGTTCATGTGGTAGGGTTTGAATCAACTGAGTATTCAA-T---------TTCCGTCGAGG-----AAAGGAACT-
Nepenthes_alata                CCCATAGAAATGAAA----------T--G--G-AATTCTACTGAA--ATGAATGAAGAGATAAGAAAATAATTTA-TTCATT---A--CTGAAATGCTGATGCAGTAAGGCTTGAATCAACTGAGTATTCAACTTTCTTAGAGTTCCGTCTACC-----GAAGGAATTG
Nepenthes_tobiaca              CCCATCGAAATGAAA----------T--G--G-AATTCTACTTAA--ATGAATGAAGAGATAAGAAAAAAATTCA-TTCATT---A--CTGAAATGCTGATGCAGTAAGGCTTGAATCAACTGAGTATTCAACTTTCTTCGAGTTCCGTCTACC-----GAAGGAATTG
Nepenthes_ventricosa           CCCATCGAAATGAAA----------T--G--G-AATTCTACTTAA--ATGAATGAAGAGATAAGAAAAAAATTTA-TTCATT---A--CTGAAATGCTGATGCAGTAAGGCTTGAATCAACTGAGTATTCAACTTTCTTAGAGTTCCATCTACC-----GAAGGAATTG
Nepenthes_vieillardii          CCCATCGAAATGAAA----------T--G--G-AATTCTACTTAA--ATGAATGAAGAGATAAGAAAAAAATTCA-TTCATT---A--CTGAAATGCTGATGCAGTAAGGCTTGAATCAAATGAGTATTCAACTTTCTTAGAGTTCCGTCTACC-----GAAGGAATTG
Polygonum                      ACTGACTAAGTAACTGAATTG----T-AGCAATTCTAGTAAAAAA--AATGATAA------ATAAAAAAAATTCA-TCCAGTTCCATTCTGAAATGTTCATGCAGTAGGGTTTGAATCAACTGAGTATTCAACT---------TTCCGTCTAGG-----AAAGTAACGG
Triphyophyllum_peltatum        ACCATCTAAATGAAT----------TC-A--A-AATTCTACTAAA--ATTAATAAAAAGATAAGAAA-CAATTTAATTGATTTCTATTCTGAAATGCTGATGCAGTAAGGGTTGAATCAACTGAGTATTCAACTTTTTTAGAGTTCTGTCTAGC-----GAAGGAATTA

                               13,690 13,700    13,710    13,720    13,730    13,740    13,750    13,760       13,773
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     AGTTT-----TA------GATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTTGGGGAG??????????
Ancistrocladus_heyneanus       AGTTT-----TA------GATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTTGGGGAAAA????????
Ancistrocladus_korupensis      AGTTT-----TA------GATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTT????????????????
Ancistrocladus_robertsoniorum  AGTTT-----TA------GATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTTGGGGAAAA????????
Dionaea_muscipula              ????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        ????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                 ????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       CGTTT-----TA------GATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTTGGGGAGAGGGTTTTCT
Limonium                       -GTTC-------------AATGTGTACATAGGGAAAGCTGTGTGCAAT-AAAAATGCAAGCCCGGC??????????????????
Nepenthes_alata                AGTTTTATTTTA------TATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTTGGGGAGGG????????
Nepenthes_tobiaca              AGTTTTATTTTA------TATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTTGGGGAGGG????????
Nepenthes_ventricosa           AGTTTTATTTTA------TATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTTGGGGAGGG????????
Nepenthes_vieillardii          AGTTTTTTTTTA------TATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTTGGGGAGGG????????
Polygonum                      AGTTT-----TA------GATGTGTACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCT?????????????????
Triphyophyllum_peltatum        CGTTTTAG-----------ATGTATACATAGGGAAAGCTGTGTGCAATGAAAAATGCAAGCACGGCTTGGGGAGGG????????
```

A.3

Multiple sequence alignment of ITS and PY-IGS phylogenetic reconstruction for the carnivorous Caryophyllales

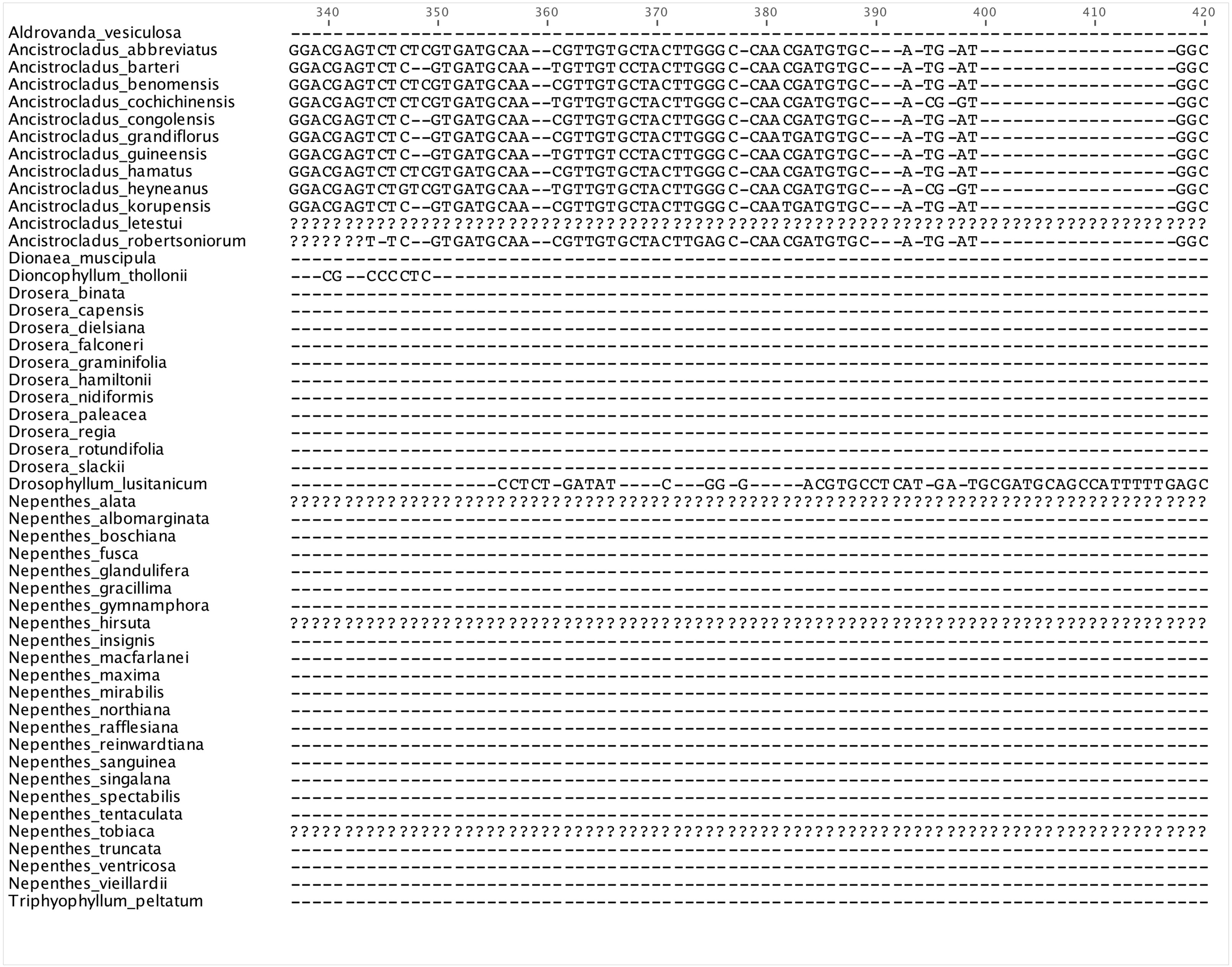
The following 37 pages consist of a multiple sequence alignment of ITS and PY-IGS phylogenetic reconstruction for the carnivorous Caryophyllales. ITS = 1 – 1705 and PYIGS = 1706 – 3075. GAP = - and MISSING = ? The following sites were excluded for analyses: 1 – 32, 55 – 79, 91 – 608, 629 – 909, 1082 – 1191, 1217 – 1258, 1290 – 1353, 1376 – 1639, 1671 – 1705, 1925 – 1960, 2035 – 2199, 2355 – 2889.

```
                             1        10        20        30        40        50        60        70        80
                             |        |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus   ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri       AAGTCGTAACAAAGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATT-GTCGAAACCT-GCATAGCAGAAC--GACCC-GCGAA
Ancistrocladus_benomensis    ?????????????????????????????????????????????TT-GTCGAAACCT-GCACAGCAGAAC--GACCC-GCGAA
Ancistrocladus_cochichinensis AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATT-GTCGAAACCT-GCATAGCAGAAC--GACCC-GCGAA
Ancistrocladus_congolensis   AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATT-GTCGAAACCT-GCATAGCAGAAC--GACCC-GCGAA
Ancistrocladus_grandiflorus  ????????????????????????????????????????GATCATT-GTCGAAACCT-GCATAGCAGAAC--GACCC-GCGAA
Ancistrocladus_guineensis    ???????????????????????????????????????????????????????CCT-GCATAGCAGTACC-GACCC-GCGAA
Ancistrocladus_hamatus       ????????????????????????????????????????????????????????CT-GCATAGCAGAAC--GACCC-GTGAA
Ancistrocladus_heyneanus     AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATT-GTCGAAACCT-GCATAGCAGAAC--GACCC-GCGAA
Ancistrocladus_korupensis    AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATT-GTCGAAACCT-GCATAGCAGAAT--GACCC-GCGAA
Ancistrocladus_letestui      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula            ????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii      ????????????????????????????????????????????????????????????????????????????????????
Drosera_binata               GAGTCGTAACAAGGTT--CCGTAGGTGAAC--TGCGGAAGGATCATT-GTCGAAGCCCC--------TGGTATGACTC-GCGAA
Drosera_capensis             ?????????????????????????????CC-TGCGGAAGGATCATT-GTCGAAACCCCGACCGAAACGAGCTGACTT-GCGCA
Drosera_dielsiana            ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri            ?????????????????????????????????????????????TT-GTCGAAATCCC-----AAA-GGAAAGACAC-GCGAA
Drosera_graminifolia         ????????????????????????????????????????????????????????????????????????TC-AA---GGGG
Drosera_hamiltonii           GAGTCGTA-CAAGGTTT-CCGTAGGTGAAC--TGCGGAAGGATCATT-GTCGAAAC-------GAAACGAATG-ACTC-GCGAA
Drosera_nidiformis           ??????????????????????????????????????????????????????????????????????????ACCT-GCGCA
Drosera_paleacea             GAGTCGT-ACAAGGTTT-CCGTAAGTGAACC-TGCGGAAGGATCATT-GTCGAAACCCCGACCGAAACGAGCTGACTT-GCGCA
Drosera_regia                ??????????????????????????????????????????????????????????????????????????ACTT-GTGAA
Drosera_rotundifolia         ????????????????????????????????????????????????????AAACCTCGATCGAAACGAGCCGACCC-GCGCA
Drosera_slackii              ???????????????????????????????????????????????????????????????????CGAGCTGACTT-GCGCA
Drosophyllum_lusitanicum     ????????????GGTTT-C-GTAGGTGA-CC-TGCGGAAGGATCATTGTCG-AA-ACCT-GTCCATGAGAA---A--CCGCGAA
Nepenthes_alata              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_albomarginata      AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAG-ATCATT-GTCGAA-AATT-GCCAAGCAGGGCG-ACCC-GCGGA
Nepenthes_boschiana          AAGTCGTAACAAGGTTT-CCGTAGGTGAAC--TGCGGAAG-ATCATT-GTCGAA-AATT-GCCAAGCAGGGCG-ACCC-GCGGA
Nepenthes_fusca              AAGTCGTAACAAGGTTT-CCGTAGGTGAAC--TGCGGAAGGATCATT-GTCGAA-AATT-GCCAAGCAGGGCG-ACCC-GCGGA
Nepenthes_glandulifera       AAGTCGTAACAAGGTTT-CCGTAGGTGAAC--TGCGGAAGGATCATT-GTCGAA-AATT-GCCAAGCAGGGCG-ACCC-GCGGA
Nepenthes_gracillima         AAGTCGTAACAAGGTTTCCCGTAGGTGAACCTTGCGGAAGGATCATT-GTCGAA-AATTTGCCAAGCAGAGCGAACCC-GCGGA
Nepenthes_gymnamphora        AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATTTGTCGAA-AATT-GCCAAGCAGAGCG-ACCC-GCG-A
Nepenthes_hirsuta            ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis           ????????????????????GTAGGTGAACC-TGCGGAAGGATCATT-GTCAAA-AATT-GCCAAGCAGAGCG-ACCC-GCGGA
Nepenthes_macfarlanei        ????????????????????????????????????????????ATT-GTCGAA-AATT-GCCAAGCAGAGCG-ACCC-GCGGA
Nepenthes_maxima             GAGTCGTAACAAGGTTT-CCGTAGGTGCAC--TGCGGAAGGATCATT-GTCGAA-AATT-GCCAAGCAGGGCG-ACCC-GCGGA
Nepenthes_mirabilis          ????????????GGTTT-CCGTAGGTGAAC--TGCGGAAGGATCATT-GTCGAA-AATT-GCTGAGCAGGGCG-ACCC-GCGGA
Nepenthes_northiana          AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATT-GTCGAA-AATT-GCTAAGAAGAGCG-ACCC-GCGGA
Nepenthes_rafflesiana        ??GTCGTAACAAGGTTTCCCGTAGGTGAACC-TGCGGAAGGATCATT-GTCGAA-AATT-GCTGAGCAGAGCG-ACCC-GCGGA
Nepenthes_reinwardtiana      ???????????AGGTTT-C-GTAGGTGAAC--TGCGGAAGGATCATT-GTCGAA-AATT-GCCAGGCAGAGCG-ACCC-GCGGA
Nepenthes_sanguinea          ????????????GGTTT-CCGTAGGTGAAC--TGCGGAAGGATCATT-GTCGAA-AATT-GCTAGGGAGAGCG-ACCC-GCGTA
Nepenthes_singalana          ??????????????????C-GTAGGTGA-CC-TGCGGAAGGATCATT-GTCGAA-AATT-GCCAAGCAGAGGG-ACCC-GCGGA
Nepenthes_spectabilis        ????????????????????????????????????????GATCATT-GTCGAA-AATT-GCCAAGCAGAGCG-ACCC-GCGGA
Nepenthes_tentaculata        ???????????AGGTTT-CCGTAGGTGA-CC-TGCGGAAGGATCATT-GTCGAA-AATT-GCCAATTAGAGCG-ACCC-GCGGA
Nepenthes_tobiaca            ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata           ??????????????????????????????????????????????T-GTCGAA-AATT-GCCAATTAGAGCGACCCC-GCGGA
Nepenthes_ventricosa         ??????????????????????????????????????????CCATT-GTCGAA-AATT-GCCAAGCAGAGCG-ACCC-GCGGA
Nepenthes_vieillardii        ???????????????????????????????????????????????????????????????????????????CCC-GCGGA
Triphyophyllum_peltatum      AAGTCGTAACAAGGTTT-CCGTAGGTGAACC-TGCGGAAGGATCATTGTCG-AA-ACCT-GCACAGCAGAAC--ATCCCGCGAA
```

```
                                  90        100       110       120       130       140       150       160
                                   |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa         ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri        CATGTT------------------------------------------------------------------------------
Ancistrocladus_benomensis     CATGTT------------------------------------------------------------------------------
Ancistrocladus_cochichinensis CATGTT------------------------------------------------------------------------------
Ancistrocladus_congolensis    CATGTT------------------------------------------------------------------------------
Ancistrocladus_grandiflorus   CATGTT------------------------------------------------------------------------------
Ancistrocladus_guineensis     CATGTT------------------------------------------------------------------------------
Ancistrocladus_hamatus        CATGTT------------------------------------------------------------------------------
Ancistrocladus_heyneanus      CATGTT------------------------------------------------------------------------------
Ancistrocladus_korupensis     CATGTT------------------------------------------------------------------------------
Ancistrocladus_letestui       ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ????????????????????????????????????????????????????????????????????????CCCCTGATCTTC
Dioncophyllum_thollonii       ????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                CTTGTAAACTAAAATGAAAGG-GGGGAAG----------------CCTTCTCCCCCCTTGC---TGCGGGGCTGTACCC-----
Drosera_capensis              CGTGTCAACC-AAATAGAGGG-GATGGGGCGTGTCGTGCG-AGGGGTCCCTCCTCGTCGCC---TCCCCGCCCCCCCCTCGAAT
Drosera_dielsiana             ?????????????????????????CGGGGCGCGTCGTGCGAGGGACCCCTCCGCGTCGCC--CTCCCCCCGCCCCCCTCGAAT
Drosera_falconeri             CGAGTTAAAG-TAACTAACGG-GGGC--GGTATGATGTGTG----TCCTCTCGACACCCTT---CACCCTTCC------AACTT
Drosera_graminifolia          GGAGGGAGCG-TGGCTCGCGA-AG----------CCTTGCG----TTCCCT-------------CACCCCTCG--------ATC
Drosera_hamiltonii            CGTGTCAACC-AAACAGAGGG-GA-CCGAGCGCGGCGTGCGAG--ACCCCTCCGCATCGCC---TCGCCCC-------TCGAAT
Drosera_nidiformis            CGTGTCAACC-AAACAGAGGG-GACGG-GGCGCGTCGTGCGAGGGACCCCTCCGCGTCGCC---TCCCCCCGCCCCCCTCGAAT
Drosera_paleacea              CGTGTCAACC-AAATAGAGGG-GATGG-GGTGTGTCGTGCGAGGGGTCCCTCCTCGTCGCC---TCCCCGCCCCCCC-TCGAAT
Drosera_regia                 CATGTTAACTAAAATATGGGGTGGGGGGTG---------------TCTTTT------TGGCACCTGC----CTG--CCCTG---
Drosera_rotundifolia          CGTGTCAACC-AATCGGAGGG-GACGG-AGCGCGTCGCGCGAGAGACCCCTCCGCGTCGCC---TCCCCCCCC-----TCGAAT
Drosera_slackii               CGTGTCAACC-AAATGGAGGG-GATGG-GGCGTGTCGTGCGAGGGACCCCTCCGCTTCGCC---TCCCCCCACCCCCCTCGAAT
Drosophyllum_lusitanicum      CACGTG------------------------------------------------------------------------------
Nepenthes_alata               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_albomarginata       CATGTT------------------------------------------------------------------------------
Nepenthes_boschiana           CATGTT------------------------------------------------------------------------------
Nepenthes_fusca               CATGTT------------------------------------------------------------------------------
Nepenthes_glandulifera        CATGTT------------------------------------------------------------------------------
Nepenthes_gracillima          CATGTT------------------------------------------------------------------------------
Nepenthes_gymnamphora         CATGTT------------------------------------------------------------------------------
Nepenthes_hirsuta             ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis            CATGTT------------------------------------------------------------------------------
Nepenthes_macfarlanei         CATGTT------------------------------------------------------------------------------
Nepenthes_maxima              CATGTT------------------------------------------------------------------------------
Nepenthes_mirabilis           CATGTT------------------------------------------------------------------------------
Nepenthes_northiana           CATGTT------------------------------------------------------------------------------
Nepenthes_rafflesiana         CATGTT------------------------------------------------------------------------------
Nepenthes_reinwardtiana       CATGTT------------------------------------------------------------------------------
Nepenthes_sanguinea           CATGTT------------------------------------------------------------------------------
Nepenthes_singalana           CATGTT------------------------------------------------------------------------------
Nepenthes_spectabilis         CATGTT------------------------------------------------------------------------------
Nepenthes_tentaculata         CATGTT------------------------------------------------------------------------------
Nepenthes_tobiaca             ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata            CATGTT------------------------------------------------------------------------------
Nepenthes_ventricosa          CATGTT------------------------------------------------------------------------------
Nepenthes_vieillardii         CATGTT------------------------------------------------------------------------------
Triphyophyllum_peltatum       CTCGTT------------------------------------------------------------------------------
```

```
                                170       180       190       200       210       220       230       240       250
                                 |         |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa           ???????????????????????TCTTCCGCGGCAC-------CGTCC--GGTAG-AGCGGAAA-G-GTGTGCGCCTGGCGCGG
Ancistrocladus_abbreviatus      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri          ------------------------------------------------------------------------------------
Ancistrocladus_benomensis       ------------------------------------------------------------------------------------
Ancistrocladus_cochichinensis   ------------------------------------------------------------------------------------
Ancistrocladus_congolensis      ------------------------------------------------------------------------------------
Ancistrocladus_grandiflorus     ------------------------------------------------------------------------------------
Ancistrocladus_guineensis       ------------------------------------------------------------------------------------
Ancistrocladus_hamatus          ------------------------------------------------------------------------------------
Ancistrocladus_heyneanus        ------------------------------------------------------------------------------------
Ancistrocladus_korupensis       ------------------------------------------------------------------------------------
Ancistrocladus_letestui         ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula               GTGCTTGCA-CCCTCTACT-CCCTCGGCGATGCCCC----CTTGCTGGGTGATCGTTCCGTCGA-G-TGGGGTGTCTTGTGCAG
Dioncophyllum_thollonii         ????????????????????????????????????????????????????????????????????????????????????
Drosera_binata                  --GTTGTCG-GCTCGG------------CAT-CTCC------ATATGCG-GGATG-TCCGCCGT-ATGACGGTTTCATGCCCCG
Drosera_capensis                GTCGTCCTG-GCGTGGTCGCGAGGCGG-CTCCTTCG----CTTTATGCG-GGATG-CTTGTCGA-GCGGCGACGATAGGT-CGG
Drosera_dielsiana               GTCGTCCTG-GCGTGGTCGCGAGGCGG-CGCCCTCG----CTTCGTGCG-GGGTG-CTTGTCGA-GCGACGACGGTAGGTGCGG
Drosera_falconeri               GCAGGGCTG-GTGCCGTTGTGAGGCGG-CATGCGCG----GCTGGAATG-GCTCG-TCTGTCGA-CCGCAGGTGCCATGCCATG
Drosera_graminifolia            GTCGGGCTA-GCGGCTCCGCGAGGCGG-CTCCTTC-ATATCTCCATATATGGATGTCCCGCCGAAGCGGCGACGATATGTTCGG
Drosera_hamiltonii              GTCGTGCCG-ACGCCGTGGTGAGGCGG-CTTCCTCG----TGTCACGTG-GGATG-CTCGTCGA-GCGATGACGGTGGGTGCGA
Drosera_nidiformis              GTCGTCCTG-GCGTGGTCGCGAGGCGG-CGCCCTCG----CTTCGTGCG-GGGTG-CTTGTCGA-GCGACGACGGTAGGTGCGG
Drosera_paleacea                GTCGTCCTG-GCGTGGTCGCGAGGCGG-CTCCTTCG----CTTTATGCG-GGATG-CTTGTCGA-GCGGCGACGATAGGT-CGG
Drosera_regia                   --GATGCCGGGCTGGG------------C---CCCCT-----GTGAGCG-GGGGG----GCCAC-GCG-CGG----------CG
Drosera_rotundifolia            GTCGTCCTG-GCGTTGTCGCGAGGCGGGCACCTTCG----CTCCGTGTG-GGGTG-CTTGTCGA-GCGGCGACGATAGGTGCGG
Drosera_slackii                 GTCGTCCTG-GCGTGGTCGCGAGGCGG-CTCCTTCG----CTTTATGCG-GGATG-CTTGTCGC-GCGGCGACGATAGGTGCGG
Drosophyllum_lusitanicum        ------------------------------------------------------------------------------------
Nepenthes_alata                 ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_albomarginata         ------------------------------------------------------------------------------------
Nepenthes_boschiana             ------------------------------------------------------------------------------------
Nepenthes_fusca                 ------------------------------------------------------------------------------------
Nepenthes_glandulifera          ------------------------------------------------------------------------------------
Nepenthes_gracillima            ------------------------------------------------------------------------------------
Nepenthes_gymnamphora           ------------------------------------------------------------------------------------
Nepenthes_hirsuta               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis              ------------------------------------------------------------------------------------
Nepenthes_macfarlanei           ------------------------------------------------------------------------------------
Nepenthes_maxima                ------------------------------------------------------------------------------------
Nepenthes_mirabilis             ------------------------------------------------------------------------------------
Nepenthes_northiana             ------------------------------------------------------------------------------------
Nepenthes_rafflesiana           ------------------------------------------------------------------------------------
Nepenthes_reinwardtiana         ------------------------------------------------------------------------------------
Nepenthes_sanguinea             ------------------------------------------------------------------------------------
Nepenthes_singalana             ------------------------------------------------------------------------------------
Nepenthes_spectabilis           ------------------------------------------------------------------------------------
Nepenthes_tentaculata           ------------------------------------------------------------------------------------
Nepenthes_tobiaca               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata              ------------------------------------------------------------------------------------
Nepenthes_ventricosa            ------------------------------------------------------------------------------------
Nepenthes_vieillardii           ------------------------------------------------------------------------------------
Triphyophyllum_peltatum         ------------------------------------------------------------------------------------
```

```
                                     260       270       280       290       300       310       320       330
Aldrovanda_vesiculosa          CGACTTAACAA-CAATC-------------------------------------------------------------------
Ancistrocladus_abbreviatus     ????????????????????????????????????????????CCCC---CAC-CTTGGAGGCCCC-GCTTCCTGCTGTTTGG
Ancistrocladus_barteri         -----------------ACTTAAAATG--CACAGGGTGCGG--AGCCC---CAC-CTTGGAGGCCTC-GTTTCTTGCTGTTTGG
Ancistrocladus_benomensis      -----------------ACATAAAATG--CACAGGGTGCGG--AGCCC---CAC-CTTGGAGGCCCC-GCTTCCTGCTGTTTGG
Ancistrocladus_cochichinensis  -----------------ACATAAAATG--CACAGGGTGCGG--AGCCC---CAC-CTTGGAGGCCCC-GCTTCCTGCTGTTTGG
Ancistrocladus_congolensis     -----------------ACTTAAAATG--CACAGGGTGCGG--AGCCC---CAC-CTTGGAGGCCCC-GTTTCCTGCTGTTTGG
Ancistrocladus_grandiflorus    -----------------ACTTAAAATG--CACAGGGTGCGG--AGCCC---CAC-CTTGGAGGCCCC-GTTTCCTGCTGTTTGG
Ancistrocladus_guineensis      -----------------ACTTAAAATG--CACAGGGTGCGG--AGCCC---CAC-CTTGGAGGCCTC-GTTTCCTGTTGTTTGG
Ancistrocladus_hamatus         -----------------ACATAAAATG--CACAGGGTGCGG--AGTCC---CCC-CTTGGAGGCCCC-GCTTCCTGCTGTTTGG
Ancistrocladus_heyneanus       -----------------ACATAAAATG--CACAGGGTGCGG--AGCCC---CAC-CTTGGAGGCCCC-GCTTCCTGCTGTTTGG
Ancistrocladus_korupensis      -----------------ACTTAAAATG--CACAGGGTGCGG--AGCCC---CAC-CTTGGAGGCCCC-GTTTCCTGCTGTTTGG
Ancistrocladus_letestui        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  ????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula              AGCCTTAACAA-CACCC-------------------------------------------------------------------
Dioncophyllum_thollonii        ??????????????????????????????????????CG-----TGT---C-C-CGT-GACGCAGC-----------GT----
Drosera_binata                 CTAAACAACCA-AACCC-------------------------------------------------------------------
Drosera_capensis               CAGCACAACAA-AACCC-------------------------------------------------------------------
Drosera_dielsiana              CAGCACAACCA-AACCC-------------------------------------------------------------------
Drosera_falconeri              CAATCTCTTCACAATCT-------------------------------------------------------------------
Drosera_graminifolia           CAACACAACCA-AACCC-------------------------------------------------------------------
Drosera_hamiltonii             CATCTAACCCA-AACCC-------------------------------------------------------------------
Drosera_nidiformis             CAGCACAACCA-AACCC-------------------------------------------------------------------
Drosera_paleacea               CAGCACAACAA-AACCC-------------------------------------------------------------------
Drosera_regia                  CCA--CAAC-GTAACCC-------------------------------------------------------------------
Drosera_rotundifolia           CAGCACAACCA-AACCC-------------------------------------------------------------------
Drosera_slackii                CAGCACAACCA-AACCC-------------------------------------------------------------------
Drosophyllum_lusitanicum       -----------------ACACAACAAAAAT-CGGG---GAAGGA-TCT---C-CTTATCA-AG--GGGTCTTT-----G-----
Nepenthes_alata                ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_albomarginata        ------------------------------------------------------------------------------------
Nepenthes_boschiana            ------------------------------------------------------------------------------------
Nepenthes_fusca                ------------------------------------------------------------------------------------
Nepenthes_glandulifera         ------------------------------------------------------------------------------------
Nepenthes_gracillima           ------------------------------------------------------------------------------------
Nepenthes_gymnamphora          ------------------------------------------------------------------------------------
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             ------------------------------------------------------------------------------------
Nepenthes_macfarlanei          ------------------------------------------------------------------------------------
Nepenthes_maxima               ------------------------------------------------------------------------------------
Nepenthes_mirabilis            ------------------------------------------------------------------------------------
Nepenthes_northiana            ------------------------------------------------------------------------------------
Nepenthes_rafflesiana          ------------------------------------------------------------------------------------
Nepenthes_reinwardtiana        ------------------------------------------------------------------------------------
Nepenthes_sanguinea            ------------------------------------------------------------------------------------
Nepenthes_singalana            ------------------------------------------------------------------------------------
Nepenthes_spectabilis          ------------------------------------------------------------------------------------
Nepenthes_tentaculata          ------------------------------------------------------------------------------------
Nepenthes_tobiaca              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata             ------------------------------------------------------------------------------------
Nepenthes_ventricosa           ------------------------------------------------------------------------------------
Nepenthes_vieillardii          ------------------------------------------------------------------------------------
Triphyophyllum_peltatum        -----------------GCATAACAAA--TGCGGGTGCGAG----CCT---C-C-CATGA-CGTAGCGTC--------G-----
```



```
                                 340       350       360       370       380       390       400       410       420
Aldrovanda_vesiculosa            ------------------------------------------------------------------------------------
Ancistrocladus_abbreviatus       GGACGAGTCTCTCGTGATGCAA--CGTTGTGCTACTTGGGC-CAACGATGTGC---A-TG-AT------------------GGC
Ancistrocladus_barteri           GGACGAGTCTC--GTGATGCAA--TGTTGTCCTACTTGGGC-CAACGATGTGC---A-TG-AT------------------GGC
Ancistrocladus_benomensis        GGACGAGTCTCTCGTGATGCAA--CGTTGTGCTACTTGGGC-CAACGATGTGC---A-TG-AT------------------GGC
Ancistrocladus_cochichinensis    GGACGAGTCTCTCGTGATGCAA--TGTTGTGCTACTTGGGC-CAACGATGTGC---A-CG-GT------------------GGC
Ancistrocladus_congolensis       GGACGAGTCTC--GTGATGCAA--CGTTGTGCTACTTGGGC-CAACGATGTGC---A-TG-AT------------------GGC
Ancistrocladus_grandiflorus      GGACGAGTCTC--GTGATGCAA--CGTTGTGCTACTTGGGC-CAATGATGTGC---A-TG-AT------------------GGC
Ancistrocladus_guineensis        GGACGAGTCTC--GTGATGCAA--TGTTGTCCTACTTGGGC-CAACGATGTGC---A-TG-AT------------------GGC
Ancistrocladus_hamatus           GGACGAGTCTCTCGTGATGCAA--CGTTGTGCTACTTGGGC-CAACGATGTGC---A-TG-AT------------------GGC
Ancistrocladus_heyneanus         GGACGAGTCTGTCGTGATGCAA--TGTTGTGCTACTTGGGC-CAACGATGTGC---A-CG-GT------------------GGC
Ancistrocladus_korupensis        GGACGAGTCTC--GTGATGCAA--CGTTGTGCTACTTGGGC-CAATGATGTGC---A-TG-AT------------------GGC
Ancistrocladus_letestui          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum    ???????T-TC--GTGATGCAA--CGTTGTGCTACTTGAGC-CAACGATGTGC---A-TG-AT------------------GGC
Dionaea_muscipula                ------------------------------------------------------------------------------------
Dioncophyllum_thollonii          ---CG--CCCCTC-----------------------------------------------------------------------
Drosera_binata                   ------------------------------------------------------------------------------------
Drosera_capensis                 ------------------------------------------------------------------------------------
Drosera_dielsiana                ------------------------------------------------------------------------------------
Drosera_falconeri                ------------------------------------------------------------------------------------
Drosera_graminifolia             ------------------------------------------------------------------------------------
Drosera_hamiltonii               ------------------------------------------------------------------------------------
Drosera_nidiformis               ------------------------------------------------------------------------------------
Drosera_paleacea                 ------------------------------------------------------------------------------------
Drosera_regia                    ------------------------------------------------------------------------------------
Drosera_rotundifolia             ------------------------------------------------------------------------------------
Drosera_slackii                  ------------------------------------------------------------------------------------
Drosophyllum_lusitanicum         -------------------CCTCT-GATAT----C---GG-G-----ACGTGCCTCAT-GA-TGCGATGCAGCCATTTTTGAGC
Nepenthes_alata                  ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_albomarginata          ------------------------------------------------------------------------------------
Nepenthes_boschiana              ------------------------------------------------------------------------------------
Nepenthes_fusca                  ------------------------------------------------------------------------------------
Nepenthes_glandulifera           ------------------------------------------------------------------------------------
Nepenthes_gracillima             ------------------------------------------------------------------------------------
Nepenthes_gymnamphora            ------------------------------------------------------------------------------------
Nepenthes_hirsuta                ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis               ------------------------------------------------------------------------------------
Nepenthes_macfarlanei            ------------------------------------------------------------------------------------
Nepenthes_maxima                 ------------------------------------------------------------------------------------
Nepenthes_mirabilis              ------------------------------------------------------------------------------------
Nepenthes_northiana              ------------------------------------------------------------------------------------
Nepenthes_rafflesiana            ------------------------------------------------------------------------------------
Nepenthes_reinwardtiana          ------------------------------------------------------------------------------------
Nepenthes_sanguinea              ------------------------------------------------------------------------------------
Nepenthes_singalana              ------------------------------------------------------------------------------------
Nepenthes_spectabilis            ------------------------------------------------------------------------------------
Nepenthes_tentaculata            ------------------------------------------------------------------------------------
Nepenthes_tobiaca                ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata               ------------------------------------------------------------------------------------
Nepenthes_ventricosa             ------------------------------------------------------------------------------------
Nepenthes_vieillardii            ------------------------------------------------------------------------------------
Triphyophyllum_peltatum          ------------------------------------------------------------------------------------
```

```
                                       430       440       450       460       470       480       490       500
Aldrovanda_vesiculosa          ------------------------------------------------------------------------------------
Ancistrocladus_abbreviatus     T------TG-------------G-CCCTAACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_barteri         T------TG-------------C-CCCTGACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_benomensis      T------TG-------------G-CCCTAACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_cochichinensis  T------TG-------------C-CCCTAACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_congolensis     T------TG-------------C-CCCTGACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_grandiflorus    T------TG-------------C-CCCTGACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_guineensis      T------TG-------------C-CCCTGACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_hamatus         T------TG-------------C-CCCCAACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_heyneanus       T------TG-------------C-CCCTAACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_korupensis      T------TG-------------C-CCCTGACC--CAA---TAATA-AACAT---------------------------------
Ancistrocladus_letestui        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  T-----TGC-------------C-CCCTGACC--CAA---TAATA-AACAT---------------------------------
Dionaea_muscipula              ------------------------------------------------------------------------------------
Dioncophyllum_thollonii        -----------------------------------------------------------------C------GGGGT----C--
Drosera_binata                 ------------------------------------------------------------------------------------
Drosera_capensis               ------------------------------------------------------------------------------------
Drosera_dielsiana              ------------------------------------------------------------------------------------
Drosera_falconeri              ------------------------------------------------------------------------------------
Drosera_graminifolia           ------------------------------------------------------------------------------------
Drosera_hamiltonii             ------------------------------------------------------------------------------------
Drosera_nidiformis             ------------------------------------------------------------------------------------
Drosera_paleacea               ------------------------------------------------------------------------------------
Drosera_regia                  ------------------------------------------------------------------------------------
Drosera_rotundifolia           ------------------------------------------------------------------------------------
Drosera_slackii                ------------------------------------------------------------------------------------
Drosophyllum_lusitanicum       TATCCT-TGCACACGTAGGCATGTCCTT-GACCC-AAACAGAA-AA---CCC--------------------------------
Nepenthes_alata                ????????????????????????????????????????????????????????????TCGTCGGGGGC--ACGGCGTCGAA
Nepenthes_albomarginata        ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGTCTAA
Nepenthes_boschiana            ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGTCTAA
Nepenthes_fusca                ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGTCTAA
Nepenthes_glandulifera         ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGTCTAA
Nepenthes_gracillima           ----------------------------------------------------GAAACAAATCGTCGGGGGC--ACGGCGTCTAA
Nepenthes_gymnamphora          ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGTCTAA
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGTCGAA
Nepenthes_macfarlanei          ----------------------------------------------------GAAACAAATCGTCGGGGGC--ACGGCGTCTAA
Nepenthes_maxima               ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGTCTAA
Nepenthes_mirabilis            ----------------------------------------------------GAAATAAATCGTCGGGGGC-------------
Nepenthes_northiana            ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGTC-AA
Nepenthes_rafflesiana          ----------------------------------------------------GAAATATATCGTCGGGGGC-------------
Nepenthes_reinwardtiana        ----------------------------------------------------GAAATAAATCGTCGGGGGCGCACGGCGTCAAA
Nepenthes_sanguinea            ----------------------------------------------------GAAACAAATTGTCGGGGGC--ACGGCGTCCAA
Nepenthes_singalana            ----------------------------------------------------GAAAGAAATCGTCGGGGGC--ACGGCGTCTAA
Nepenthes_spectabilis          ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGCCTAA
Nepenthes_tentaculata          ----------------------------------------------------GAAATAAATCGTCGGGGGC-------------
Nepenthes_tobiaca              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata             ----------------------------------------------------GAAATAAATCGTCGGGGGC-------------
Nepenthes_ventricosa           ----------------------------------------------------GAAATAAATCGTCGGGGGC--ACGGCGTCGAA
Nepenthes_vieillardii          ----------------------------------------------------GAAACAAATCGTCGGGGGC--ACGGCGTCTAA
Triphyophyllum_peltatum        -----------------------------------------------------------------CCCCTCCGAGGT----C--
```

```
                                   510       520       530       540       550       560       570       580
                                    |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa          ------------------------------------------------------------------------------------
Ancistrocladus_abbreviatus     ------------------------------------------------------------------------------------
Ancistrocladus_barteri         ------------------------------------------------------------------------------------
Ancistrocladus_benomensis      ------------------------------------------------------------------------------------
Ancistrocladus_cochichinensis  ------------------------------------------------------------------------------------
Ancistrocladus_congolensis     ------------------------------------------------------------------------------------
Ancistrocladus_grandiflorus    ------------------------------------------------------------------------------------
Ancistrocladus_guineensis      ------------------------------------------------------------------------------------
Ancistrocladus_hamatus         ------------------------------------------------------------------------------------
Ancistrocladus_heyneanus       ------------------------------------------------------------------------------------
Ancistrocladus_korupensis      ------------------------------------------------------------------------------------
Ancistrocladus_letestui        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  ------------------------------------------------------------------------------------
Dionaea_muscipula              ------------------------------------------------------------------------------------
Dioncophyllum_thollonii        -GGC-A----ACGCGC---G-----CG-GC----------------------------------------------TGCTCGCC
Drosera_binata                 ------------------------------------------------------------------------------------
Drosera_capensis               ------------------------------------------------------------------------------------
Drosera_dielsiana              ------------------------------------------------------------------------------------
Drosera_falconeri              ------------------------------------------------------------------------------------
Drosera_graminifolia           ------------------------------------------------------------------------------------
Drosera_hamiltonii             ------------------------------------------------------------------------------------
Drosera_nidiformis             ------------------------------------------------------------------------------------
Drosera_paleacea               ------------------------------------------------------------------------------------
Drosera_regia                  ------------------------------------------------------------------------------------
Drosera_rotundifolia           ------------------------------------------------------------------------------------
Drosera_slackii                ------------------------------------------------------------------------------------
Drosophyllum_lusitanicum       ------------------------------------------------------------------------------------
Nepenthes_alata                CGTGGCAC-GGCACCCTCGACTGCCGGC-GGACCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGATGCGGGGCAAGG
Nepenthes_albomarginata        CGTGGCAC-GGCGCCCTCGACTGCCGGCCGGGCCCGCACCTTGCGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_boschiana            CGTGGCAC-GGCGCCCTCGACTGCCGGCCGGGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_fusca                CGTGGCAC-GGCGCCCTCGACAGCCGGCCGGGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_glandulifera         CGTGGCAC-GGCGCCCTCGACTGCCGGCCGGGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGACAAGG
Nepenthes_gracillima           CGCGGCACCGGTGCCCTCGACCGCCGGCCGAGCCCGCACCTTACGGCCCGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_gymnamphora          CGTGGCAC-GGCGCCCTCGACTGCCGGCCGAGCCCGCACCTAACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             CGTGGCAC-GGCGCCCTCGACTGCCGGCCGAGCCCGGGCCTTACGGCCTTCTCCAGGAGCGGCA-ACGGGGATGCGGGGCAAGG
Nepenthes_macfarlanei          CGCGGCAC-GGTGCCCTCGACCGCCGGCCGAGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_maxima               GGTGGCAC-GGCGCCCTCGACTGCCGGCCGGGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTTCGGGGCAAGG
Nepenthes_mirabilis            ------AC-GGCGCCCTCGACTGCCGGCCGAGCCCGCACCTTACAGCCTGCTCCAGGAGCGGCGGTGGGGGGTGCCGGGCCAGG
Nepenthes_northiana            GGCGGCAC-GGCGCCCTCGACTGCCGGCCGAGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCCGGGCAAGG
Nepenthes_rafflesiana          ------AC-GGCGCCCTCGACTGCCGGCCGAGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCG-GTGGGGGTGCCGGGCCAGG
Nepenthes_reinwardtiana        CGTGGCAC-GGTGCCCTCGACCGCCGGC---------ACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_sanguinea            CGTGGCAC-GGCGCCCTCGACTGCCGATCAGGCCCGCACCTTACGGCCTGCTCCAGGAGCAGCA-ACGGGGGTGCCGGGCCAGG
Nepenthes_singalana            CGCGGCAC-GGTGCCCTCGACCGCCGGCCGAGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_spectabilis          CGTGGCAC-GGCGCCCTCGACTGCCGGCCGAGCCCGCACCTTAGGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_tentaculata          ------AC-GGCGCCCTCGGCTGCCGGCCGAGCCGGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGTGGCAAGG
Nepenthes_tobiaca              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata             ------AC-GGCGCCCTCGGCTGCCGGCCGAGCCGGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Nepenthes_ventricosa           CGTGGCAC-GGCGCCCTCGACTGCCGGCCGAGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGATGCGGGGCAAGG
Nepenthes_vieillardii          CGCGGCAC-GGTGCCCTCGACCGCCGGCCGAGCCCGCACCTTACGGCCTGCTCCAGGAGCGGCA-ACGGGGGTGCGGGGCAAGG
Triphyophyllum_peltatum        -GGCG-----ACGCGC---AT-----GA-T----------------------------------------------GGCTCGCC
```

```
                               590       600       610       620       630       640       650       660       670
Aldrovanda_vesiculosa          --------------------AGGCGCGGGATGCGCCAAGGACAATGG---A---TGCTTTGACATGC--CTTTGCCCCT----T
Ancistrocladus_abbreviatus     --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_barteri         --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_benomensis      --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_cochichinensis  --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_congolensis     --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_grandiflorus    --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_guineensis      --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_hamatus         --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_heyneanus       --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_korupensis      --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Ancistrocladus_letestui        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  --------------------CGGCGCGGATTGCGCCAAGG--------------------------------------------
Dionaea_muscipula              --------------------CGGCGCGAGTCGCGCCAAGGACGATTG---A---TAT---GATGAGCA--CGATCCCCC----G
Dioncophyllum_thollonii        CTCGAGCTAATAACGAACCCCGGCGCGGACCGCGCCAAGGAACA-TG------A------------------------------
Drosera_binata                 --------------------GGGCGCAGGCTGCGCCAAGGAAAA-CG---G---AAG-CAATAGGCT-TGCCCTCTCCC----C
Drosera_capensis               --------------------CGGCGCAAGTCGCGCCAAGGAAAA-TG---G---ATA--TACAACC--TGCGCGCTCCC----C
Drosera_dielsiana              --------------------CGGCGCAAGTCGCGCCAAGGAAAA-TG---G---ATA--TACAACC--CGCGTGCTCCC----C
Drosera_falconeri              --------------------GGGCGTGGTATGCGCCAAGGAGAA-TG---G---ACA-GATTAGTC--CTTGCCATCCC----T
Drosera_graminifolia           --------------------GGGCGCAATACGCGCCAAGGAAAAATG---G---ATG--TACAATC--CTTGCCCTCCC----T
Drosera_hamiltonii             --------------------GGGCGCAAGTCGCGCCAAGGAAGA-TG---G---ATA--TACAACC--TCCGACCTCCC----C
Drosera_nidiformis             --------------------CGGCGCAAGTCGCGCCAAGGAAAA-TG---G---ATA--TACAACC--CGCGTGCTCCC----C
Drosera_paleacea               --------------------CGGCGCAAGTCGCGCCAAGGAAAA-TG---G---ATA--TACAACC--TGCGCGCTCCC----C
Drosera_regia                  --------------------CGGCGCCGGACGCGCCAAGGAAGA-TGGATATG-AAG-----AG----TGCGCTCCCCCATTGC
Drosera_rotundifolia           --------------------CGGCGCAAGTCGCGCCAAGGAAAA-TG---G---ATA--TACAACC--TCCGCGCTCCC----C
Drosera_slackii                --------------------CGGCGCAAGTCGCGCCAAGGAAAA-TG---G---ATA--TACAACC--TGCGCGCTCCC----C
Drosophyllum_lusitanicum       ---------------------GGCGTGAACAACGCCAAGGAACA-TG------A----AT-CGT-----AG-------------
Nepenthes_alata                CTTGGCACAAGAACGAACCCGGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_albomarginata        CTTGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_boschiana            CTTGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_fusca                CTTGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_glandulifera         CTTGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_gracillima           CTTGGCACAAGAATGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_gymnamphora          CTTGGCACAAGAACGAACCCCGGCGGGGATCGCGCCAAGG--------------------------------------------
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             CTTGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_macfarlanei          CTTGGCACAAGAATGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_maxima               CTTGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_mirabilis            CTTGGCACGAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_northiana            CTTGGCACAAGAACGAACCCCGGCGTGGATCGCGCCAAGG--------------------------------------------
Nepenthes_rafflesiana          CTTGGCACGAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_reinwardtiana        CTTGGCACAAGCATGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_sanguinea            CTTGGCACAAGAAGGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_singalana            CTTGGCACAAGAATGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_spectabilis          CTTGGCACAAGAACGAACCCCGGCGGGGATCGCGCCAAGG--------------------------------------------
Nepenthes_tentaculata          CTCGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_tobiaca              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata             CTCGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Nepenthes_ventricosa           CTTGGCACAAGAACGAACCCCGGCGCGGATCGCGCCAAG---------------------------------------------
Nepenthes_vieillardii          CTTGGCACAAGAATGAACCCCGGCGCGGATCGCGCCAAGG--------------------------------------------
Triphyophyllum_peltatum        CTTCAACTAATAACAACCCCCGGCGCAGACTGCGCCAAGGAACA-TG------AGCAAA--CAA-----AG-------------
```

```
                                      680       690       700       710       720       730       740       750
                                       |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa           CTGTC-TGGTTCTTGGACCAGGGGATAGGGGACGGCAAT-GCGCTGTACGCGCGA-GATTGACAC-------------------
Ancistrocladus_abbreviatus      -----------------------------------------------------------------AATATGAGCA-AAAAGCGT
Ancistrocladus_barteri          -----------------------------------------------------------------AATATGAGCA-AAAGGCGT
Ancistrocladus_benomensis       -----------------------------------------------------------------AATATGAGCA-AAAAGCGT
Ancistrocladus_cochichinensis   -----------------------------------------------------------------AATATGAGCA-AAAAGCGT
Ancistrocladus_congolensis      -----------------------------------------------------------------AATATGAGCA-AAAGGCGT
Ancistrocladus_grandiflorus     -----------------------------------------------------------------AATATGAGCA-AAAGGCGT
Ancistrocladus_guineensis       -----------------------------------------------------------------AATATGAGCAAAAGTGCGT
Ancistrocladus_hamatus          -----------------------------------------------------------------AATATGAGCA-AAAAGCGT
Ancistrocladus_heyneanus        -----------------------------------------------------------------AATATGAGCA-AAAAGCGT
Ancistrocladus_korupensis       -----------------------------------------------------------------AATATGAGCA-AAAGGCGT
Ancistrocladus_letestui         ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   -----------------------------------------------------------------AATATGAGCA-AAAAGCGT
Dionaea_muscipula               TTATC--GGTTATTGATCCGATAAGAA-GGGGTGTGTATCGTGCTCTTTTAG-TT-GACCAAAAT-------------------
Dioncophyllum_thollonii         ------------------------------------------------------------------------------------
Drosera_binata                  ACACGTTTGTTTCGGCAGCGGGG------GGGATGGTGA--TGCCGTCATCGGCAT--AA-AGAT-------------------
Drosera_capensis                GT----CGGCTTAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATAATAGAT-------------------
Drosera_dielsiana               GT----CGGCTTAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATGAGAGAT-------------------
Drosera_falconeri               AGG-AAGTTGTTGCATAAGCAGCTGT---GGGATGGTGACATGCCGTCATTGGCA----A-AGAT-------------------
Drosera_graminifolia            CTA---TTCCTTCGGGAATGG--------GGGTCGGCGATGTGTCGTTTTCGACA-AAAAGAGAT-------------------
Drosera_hamiltonii              TG-----GGCTTAGGCCACGG--------GGGCTGGCTTCGTGTGGTAAAATGCA--TAAGAGAT-------------------
Drosera_nidiformis              GT----CGGCTTAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATAAGAGAT-------------------
Drosera_paleacea                GT----CGGCTTAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATAATAGAT-------------------
Drosera_regia                   TGGCTTTTGCTCCGGCAATCGG-------GGGACAGCGTTGTGTCGTCATCGGCACT-----GAT-------------------
Drosera_rotundifolia            GC----CGGCTCAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATAAGAGAT-------------------
Drosera_slackii                 GT----CGGCTTAGGCGACGG--------GGGCCGGCGTTGTGTCGTTTAATGCATATAAGAGAT-------------------
Drosophyllum_lusitanicum        ------------------------------------------------------------------------------------
Nepenthes_alata                 ------------------------------------------------------------------------------------
Nepenthes_albomarginata         ------------------------------------------------------------------------------------
Nepenthes_boschiana             ------------------------------------------------------------------------------------
Nepenthes_fusca                 ------------------------------------------------------------------------------------
Nepenthes_glandulifera          ------------------------------------------------------------------------------------
Nepenthes_gracillima            ------------------------------------------------------------------------------------
Nepenthes_gymnamphora           ------------------------------------------------------------------------------------
Nepenthes_hirsuta               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis              ------------------------------------------------------------------------------------
Nepenthes_macfarlanei           ------------------------------------------------------------------------------------
Nepenthes_maxima                ------------------------------------------------------------------------------------
Nepenthes_mirabilis             ------------------------------------------------------------------------------------
Nepenthes_northiana             ------------------------------------------------------------------------------------
Nepenthes_rafflesiana           ------------------------------------------------------------------------------------
Nepenthes_reinwardtiana         ------------------------------------------------------------------------------------
Nepenthes_sanguinea             ------------------------------------------------------------------------------------
Nepenthes_singalana             ------------------------------------------------------------------------------------
Nepenthes_spectabilis           ------------------------------------------------------------------------------------
Nepenthes_tentaculata           ------------------------------------------------------------------------------------
Nepenthes_tobiaca               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata              ------------------------------------------------------------------------------------
Nepenthes_ventricosa            ------------------------------------------------------------------------------------
Nepenthes_vieillardii           ------------------------------------------------------------------------------------
Triphyophyllum_peltatum         ------------------------------------------------------------------------------------
```

```
                                  760       770       780       790       800       810       820       830       840
Aldrovanda_vesiculosa           ------------------------------------------------------------------------------------
Ancistrocladus_abbreviatus      GCTTCCTCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAGCGTTTCA-CATTATAAACAAAC----------------------
Ancistrocladus_barteri          GCTTCCCTGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAACGTTTCA-CATTATAAACAAAC----------------------
Ancistrocladus_benomensis       GCTTCCTCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAGCGTTTCA-CATTATAAACAAAC----------------------
Ancistrocladus_cochichinensis   GCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAGCGTTTCA-CATTATAAACAAAC----------------------
Ancistrocladus_congolensis      GCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAACGTTTCA-CATTATAAACAAAC----------------------
Ancistrocladus_grandiflorus     GCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGTAACGTTTCA-CATTATAAACAAAT----------------------
Ancistrocladus_guineensis       GCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAACGTTTCAACATTATAAACAAAC----------------------
Ancistrocladus_hamatus          GCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAATGTTTCA-CATTATAAACAAAC----------------------
Ancistrocladus_heyneanus        GCTTCCCCGCTTCCGGTTTCTCGGCATGCGGTGGTAGCAGCGTTTCA-CATTATAAACAAAC----------------------
Ancistrocladus_korupensis       GCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAACGTTTCA-CATTATAAACAAAC----------------------
Ancistrocladus_letestui         ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   GCTTCCCCGCTTCCGGTTTCTCGGCATGCGGCGGTAGCAACGTTTCA-CATTATAAACAAAC----------------------
Dionaea_muscipula               ------------------------------------------------------------------------------------
Dioncophyllum_thollonii         --------------------------------------------------------------ACAAAGAGCGCGCC-C---C-C
Drosera_binata                  ------------------------------------------------------------------------------------
Drosera_capensis                ------------------------------------------------------------------------------------
Drosera_dielsiana               ------------------------------------------------------------------------------------
Drosera_falconeri               ------------------------------------------------------------------------------------
Drosera_graminifolia            ------------------------------------------------------------------------------------
Drosera_hamiltonii              ------------------------------------------------------------------------------------
Drosera_nidiformis              ------------------------------------------------------------------------------------
Drosera_paleacea                ------------------------------------------------------------------------------------
Drosera_regia                   ------------------------------------------------------------------------------------
Drosera_rotundifolia            ------------------------------------------------------------------------------------
Drosera_slackii                 ------------------------------------------------------------------------------------
Drosophyllum_lusitanicum        --------------------------------------------------------------C------------GTGC-CCAC
Nepenthes_alata                 --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_albomarginata         --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_boschiana             --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_fusca                 --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_glandulifera          --------------------------------------------------------------AACGGTAACGTAGC-G---T-G
Nepenthes_gracillima            --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_gymnamphora           --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_hirsuta               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis              --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_macfarlanei           --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_maxima                --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_mirabilis             --------------------------------------------------------------AAGAGTAACATAGC-G---C-G
Nepenthes_northiana             --------------------------------------------------------------AACAGTAACATAGC-G---T-G
Nepenthes_rafflesiana           --------------------------------------------------------------AAGAGTAACATAGC-G---C-G
Nepenthes_reinwardtiana         --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_sanguinea             --------------------------------------------------------------AACAGTATCATAGC-G---T-G
Nepenthes_singalana             --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_spectabilis           --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Nepenthes_tentaculata           --------------------------------------------------------------AACGGTAACATAGG-G---T-G
Nepenthes_tobiaca               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata              --------------------------------------------------------------AACGGTAACATAGG-G---T-G
Nepenthes_ventricosa            --------------------------------------------------------------------AACATAGC-G---T-G
Nepenthes_vieillardii           --------------------------------------------------------------AACGGTAACATAGC-G---T-G
Triphyophyllum_peltatum         --------------------------------------------------------------A------------GTGCGCCGC
```

```
                                        850       860       870       880       890       900       910       920
                                         |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa           ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_abbreviatus      ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_barteri          ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_benomensis       ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_cochichinensis   ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_congolensis      ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_grandiflorus     ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_guineensis       ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_hamatus          ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_heyneanus        ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_korupensis       ---------------------------------------------------------------------GACTCTCGGCAACGG
Ancistrocladus_letestui         ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum   ---------------------------------------------------------------------GACTCTCGGCAACGG
Dionaea_muscipula               ---------------------------------------------------------------------GACTCTCGGCAACGG
Dioncophyllum_thollonii         CGTGT--CCGGCC--CACCGGCA-CAC--GGCGGCTGCGGCGTC--CGACATTAT-GA---GA--GAACGACTCTCGGCAACGG
Drosera_binata                  ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosera_capensis                ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosera_dielsiana               ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosera_falconeri               ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosera_graminifolia            ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosera_hamiltonii              ---------------------------------------------------------------------GACTCCCGACAACGG
Drosera_nidiformis              ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosera_paleacea                ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosera_regia                   ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosera_rotundifolia            ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosera_slackii                 ---------------------------------------------------------------------GACTCTCGGCAACGG
Drosophyllum_lusitanicum        CT---CCG--GTG--CGCCGGTGTGTG--GGTAGGTGA--CGCC--TTACA-CGA-AA--AAT--GAACGACTCTCGACAACGG
Nepenthes_alata                 CGTTG--CCTTGC--CGCCGGATGCCT--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_albomarginata         CGTTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GACCGGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_boschiana             CGTTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGAC-GACCGGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_fusca                 CGTTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGAC-GACCGGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_glandulifera          CGTTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GGCCGGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_gracillima            CGCTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_gymnamphora           CGCTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_hirsuta               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis              CGTTG--CCTTGC--CGTCGGATGCCT--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_macfarlanei           CGCTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_maxima                CGTTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGAC-GACCGGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_mirabilis             CGTTG--CCTTGC--CGCCGGATGCCC--GGCGGGCGAGGTGGC-GACCCGTCGT-GT---CT--GAACGACTCTCGGCAACGG
Nepenthes_northiana             CGTTG--CCTTGC--CGTCGGATGCCC--GGCGAGGGAGGTGGC-GACCTGTCGT-AT---CG--GAACGACTCTCGGCAACGG
Nepenthes_rafflesiana           CGTTG--CCTTGC--CGCCGGATGCCC--GGCGGGCGAGGTGGC-GACCCGTCGT-GT---CT--GAACGACTCTCGGCAACGG
Nepenthes_reinwardtiana         CGCTG--CCCTGC--CGCCGGATGCCC--GGCGAGCGAGGGGGC-GACCTGTCGT-AT---CT--GGACGACTCTCGGCAACGG
Nepenthes_sanguinea             CGTTG--CCTTGC--CGTCGGATCCCC--GGCGAGCGAGGTGGC-GACCTGTCGC-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_singalana             CGCTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_spectabilis           CGCTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_tentaculata           CGTTG--CCTCGC--CGCCGGATGCCC--GGCGAGGGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_tobiaca               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata              CGTTG--CCTCGC--CGCCGGATGCCC--GGCGAGGGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Nepenthes_ventricosa            CGTTG--CCTTGC--CGCCGGATGCCT--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---TT--GAACGACTCTCGGCAACGG
Nepenthes_vieillardii           CGCTG--CCTTGC--CGCCGGATGCCC--GGCGAGCGAGGTGGC-GACCTGTCGT-AT---CT--GAACGACTCTCGGCAACGG
Triphyophyllum_peltatum         CTTGTCCG--GCC--CACCGGAACGC---GGCGGCTGCGACGTC--TAATATTCTAAG----A--GAACGACTCTCGGCAACGG
```

```
                                 930       940       950       960       970       980       990       1,000
Aldrovanda_vesiculosa            ATATCTCGGCTCTCGCATCGATGAAGGACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_abbreviatus       ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_barteri           ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_benomensis        ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_cochichinensis    ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_congolensis       ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_grandiflorus      ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_guineensis        ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_hamatus           ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_heyneanus         ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_korupensis        ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Ancistrocladus_letestui          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum    ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Dionaea_muscipula                ATATCTAGGCTCTCGCATCGATGAAGGACGTAGCAAAGTGCGATAAATGGTGTGAATTGCAGAATCCC-GTGAA-CCATCAAGT
Dioncophyllum_thollonii          ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_binata                   ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_capensis                 ATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_dielsiana                ATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_falconeri                ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_graminifolia             ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAAACCATCGAGT
Drosera_hamiltonii               ATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_nidiformis               ATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_paleacea                 ATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_regia                    ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_rotundifolia             ATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosera_slackii                  ATATCTCGGCTCTTGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Drosophyllum_lusitanicum         ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_alata                  ATATCTCGGCTATCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCCCGTGAA-CCATCGAGT
Nepenthes_albomarginata          ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_boschiana              ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_fusca                  ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_glandulifera           ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_gracillima             ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_gymnamphora            ATATCTCGGCTCTCGCGTCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_hirsuta                ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis               ATATCTCGGCTATCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_macfarlanei            ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_maxima                 ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_mirabilis              ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GCGAA-CCATCGAGT
Nepenthes_northiana              ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATGCTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_rafflesiana            ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GCGAA-CCATCGAGT
Nepenthes_reinwardtiana          ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_sanguinea              ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_singalana              ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_spectabilis            ATATCTCGGCTCTCGCGTCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_tentaculata            ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_tobiaca                ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata               ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_ventricosa             ATATCTCGGCTATCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Nepenthes_vieillardii            ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
Triphyophyllum_peltatum          ATATCTCGGCTCTCGCATCGATGAAGAACGTAGCGAAATGCGATACTTGGTGTGAATTGCAGAATCCC-GTGAA-CCATCGAGT
```

```
                               1,010     1,020     1,030     1,040     1,050     1,060     1,070     1,080     1,090
                                |         |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa          CTTTGAACGCAAGTTGCACCCGAGGC-C-ACCAAGGCTAAGGGCACGTCTGCCTGGGTGTCACCTAGACCCTCACCAAAC-CCG
Ancistrocladus_abbreviatus     CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Ancistrocladus_barteri         CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCTGAGGGCACGTCTGCCTGGGTGTCACGCATAGCGTC-----------
Ancistrocladus_benomensis      CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Ancistrocladus_cochichinensis  CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Ancistrocladus_congolensis     CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Ancistrocladus_grandiflorus    CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCATC-----------
Ancistrocladus_guineensis      CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCTGAGGGCACGTCTGCCTGGGTGTCACACATAGCGTC-----------
Ancistrocladus_hamatus         CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Ancistrocladus_heyneanus       CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCAAGGGCACGTCTGCCTGGGCGTCACGCATAGCATC-----------
Ancistrocladus_korupensis      CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Ancistrocladus_letestui        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  CTTTGAACGCAAGTTGCGCCCGAAGC-C-ATTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Dionaea_muscipula              CTTTGAACGCAAGTTGCACCCGAGGC-C-ACCTAGGCCAAGGGCACGTCTGCCTGGGCGTCTCATAGAGCGTCACTGAAC-CCC
Dioncophyllum_thollonii        CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCACGCACAGCGTC-----------
Drosera_binata                 CTTTGAACGCAAGTTGCGCCCGAGGC-C-ACTAAGGTCGAGGGCACGTCTGTCTGGGCGTCGCACACAGCGTCACCT----GCC
Drosera_capensis               CTTTGAACGCAAGTTGCGCCCGAGGC-C-ACTACGGCCGAGGGCACGTCTGTCTGGGCGTCGAAAGCAGAGGAACCTCAC-ACC
Drosera_dielsiana              CTTTGAACGCAAGTTGCGCCCGAGGC-C-ACTACGGCCGAGGGCACGTCTGTCTGGGCGTCGCGTGCAGCGTCACCTTAC-GCC
Drosera_falconeri              CTTTGAACGCAAGTTGCGCCCGAGGC-C-ATTACGGTCGAGGGCACGTCTGTCTGGGCGTCGCACGTTGCGTCACCTGCC-GCC
Drosera_graminifolia           CTTTGAACGCAAGTTGCGCCCGAGGC-C-ACTACGGCTGAGG-CACGTCTGTCTGGGCGTCGC?????????????????????
Drosera_hamiltonii             CTTTGAACGCAAGTTGCGCCCGAGGC-C-ACTACGGTTGAGGGCACGTCTGTCTGGGCGTCGCATGCAGCGTCACCCGAC-ACC
Drosera_nidiformis             CTTTGAACGCAAGTTGCGCCCGAGGC-C-ACTACGGCCGAGGGCACGTCTGTCTGGGCGTCGCGTGCAGCGTCACCTTAC-GCC
Drosera_paleacea               CTTTGAACGCAAGTTGCGCCCGAGGC-C-ACTACGGCCGAGGGCACGTCTGTCTGGGCGTCGCATGCAGCGTCACCTCAC-ACC
Drosera_regia                  CTTTGAACGCAAGTTGCGCCCGAGGC-C-ACTAAGGCCGAGGGCACGTCTGCCTGGGCGTCGCACAGAGCGTCACCCGACACCA
Drosera_rotundifolia           CTTTGAACGCAAGTTGCGCCCGAGGC-C-ACCACGGCCGAGGGCACGTCTGTCTGGGCGTCGCGTGCAGCGTCACCTAAC-ACC
Drosera_slackii                CTTTGAACGCAAGTTGCGCCCGGCGC-C-ACTACGGCCGAGGGCACGTCTGTCTGGGCGTCGCATGCAGCGTCACCTTAC-ACC
Drosophyllum_lusitanicum       CTTTGAACGCAAGTTGCGCCCGAAGC-C-ACTA-GGCTAAGGGCACGTCTGCCTGGGCGTCACGCACAACGTC-----------
Nepenthes_alata                CTTTGAACGCAAGTTGCGCCCGAAGC-CCTCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_albomarginata        CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_boschiana            CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_fusca                CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_glandulifera         CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_gracillima           CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_gymnamphora          CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             CTTTGAACGCGAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_macfarlanei          CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_maxima               CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_mirabilis            CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCCGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_northiana            CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_rafflesiana          CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_reinwardtiana        CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_sanguinea            CTTTGAACGCAAGTTGCGCCCGAAGC-C-TTTA-GGCTGAGGGCACGTCTGCCTGGGCGCCACGCATAGCGTC-----------
Nepenthes_singalana            CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_spectabilis          CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_tentaculata          CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_tobiaca              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata             CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_ventricosa           CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGGGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Nepenthes_vieillardii          CTTTGAACGCAAGTTGCGCCCGAAGC-C-TCTA-GGCTGAGGGCACGTCTGCCTGGGCGTCACGCATAGCGTC-----------
Triphyophyllum_peltatum        CTTTGAACGCAAGTTGCACCCGAAGC-C-ACTA-GGCCGAGGGCACGTCTGCCTGGGCGTCATGCACAGCGTC-----------
```

```
                                    1,100     1,110     1,120     1,130     1,140     1,150     1,160     1,170
Aldrovanda_vesiculosa          GG---TTCACTT--CAGCGGAAGT------------------------------------------------------------
Ancistrocladus_abbreviatus     ------------------------GCCCCTACACCCTACGCTTTGCATGGGGTGA-----------------------------
Ancistrocladus_barteri         ------------------------GCCCCTACACCCTATGCGTAGAATGGGGTGA-----------------------------
Ancistrocladus_benomensis      ------------------------GCCCCTACACCCTACGCTTTGCATGGGGTGA-----------------------------
Ancistrocladus_cochichinensis  ------------------------GCCCCTACACCCTACACGTAGCATGGGGTGA-----------------------------
Ancistrocladus_congolensis     ------------------------GCCCCTACACCCTACGCGTAGCATAGGGTGA-----------------------------
Ancistrocladus_grandiflorus    ------------------------GCCCCTACACCCTACGCGTAGCATGGGGTGA-----------------------------
Ancistrocladus_guineensis      ------------------------GCCCCTACACCCTACGCGTAGAATGGGGTGA-----------------------------
Ancistrocladus_hamatus         ------------------------GCCCCTACACCCTACGCGTAGCATGGGGTGA-----------------------------
Ancistrocladus_heyneanus       ------------------------GCCCCTACACCCTACGCGTAGCGTGGGGTGA-----------------------------
Ancistrocladus_korupensis      ------------------------GCCCCCACACCCTACGCGTAGCATGGGGTGA-----------------------------
Ancistrocladus_letestui        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  ------------------------GCCCCTACACCCTACGCGTAGCATGGGGTGA-----------------------------
Dionaea_muscipula              AT---TCCTATCCCCATCATGAGG------------------------------------------------------------
Dioncophyllum_thollonii        --------------------------------------------------------GCCTCCC----ACCCCGTC-GCAT-CGT
Drosera_binata                 AA---CGGTC----CTCCTCGAGA------------------------------------------------------------
Drosera_capensis               TC---GCCCC----CGCGTGGAGG------------------------------------------------------------
Drosera_dielsiana              TC---GCCCC----TGCGGGGAGG------------------------------------------------------------
Drosera_falconeri              AT---CGTCC----TTGGTCGAGG------------------------------------------------------------
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             TT---CTCCC----TT-GTTTAGG------------------------------------------------------------
Drosera_nidiformis             TC---GCCCC----TGCGGGGAGG------------------------------------------------------------
Drosera_paleacea               TC---GCCCC----CGCGTGGAGG------------------------------------------------------------
Drosera_regia                  CAC--TAGTT----CTCAGTGAGG------------------------------------------------------------
Drosera_rotundifolia           TCCTCGCCCCCC---GCGCGGAGG------------------------------------------------------------
Drosera_slackii                TC---GCCCC----TGCGTGGAGG------------------------------------------------------------
Drosophyllum_lusitanicum       -------------------------------------------------------ACTCC-CAACCTACATACTCTGCCT-CGT
Nepenthes_alata                --------------------------------------------------------GCCCCCG----ACCTAGCC-GCCGGCGT
Nepenthes_albomarginata        --------------------------------------------------------GCCCCCG----ACCAAGCC-ACCG-CGT
Nepenthes_boschiana            --------------------------------------------------------GCCCCCG----ACCAAGCC-ACCG-CGT
Nepenthes_fusca                --------------------------------------------------------GCCACCG----ACCAAGCC-ACCG-CGT
Nepenthes_glandulifera         --------------------------------------------------------GCCCCCG----ACCAAGCC-ATCG-CGT
Nepenthes_gracillima           --------------------------------------------------------GCCCGCG----ACCAAGCC-ACCG-CGT
Nepenthes_gymnamphora          --------------------------------------------------------GCCCCCG----ACCAAGCC-ACGG-CGT
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             --------------------------------------------------------GCCCCCG----ACCTAGCC-GCCC-CGT
Nepenthes_macfarlanei          --------------------------------------------------------GCCCGCG----ACCAAGCC-ACCG-CGT
Nepenthes_maxima               --------------------------------------------------------GCCCCCG----ACCAAGCC-ACCG-CAT
Nepenthes_mirabilis            --------------------------------------------------------GCCCCCG----GCCGAGCC-ACCG----
Nepenthes_northiana            --------------------------------------------------------GCCCCCG----ACCAAGCC-ACCG-CGT
Nepenthes_rafflesiana          --------------------------------------------------------GCCCCCG----GCCAAGCC-ACCG----
Nepenthes_reinwardtiana        --------------------------------------------------------GCCCGCG----ACCAAGCC-ACCG-CGT
Nepenthes_sanguinea            --------------------------------------------------------GCCCCCG----ACCAAGCC-ACCG-CGT
Nepenthes_singalana            --------------------------------------------------------GCCCGCG----ACCAAGCC-ACCG-CGT
Nepenthes_spectabilis          --------------------------------------------------------GCCCCCG----ACCAAGCC-ACGG-CGT
Nepenthes_tentaculata          --------------------------------------------------------GCCCCCG----ACAAAGCC-ACCG-CGT
Nepenthes_tobiaca              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata             --------------------------------------------------------GCCCCCG----ACAAAGCC-ACCG-CGT
Nepenthes_ventricosa           --------------------------------------------------------GCCCCCG----ACCTAGCC-GCCG-CGT
Nepenthes_vieillardii          --------------------------------------------------------GCCCGCG----ACCAAGCC-ACCG-CGT
Triphyophyllum_peltatum        -------------------------------------------------------GCCCC-CC----ACCC-CTTTGCAT-CTT
```

```
                                 1,180     1,190     1,200     1,210     1,220     1,230     1,240     1,250     1,260
Aldrovanda_vesiculosa          ---------------GGCGGGGGGT-GGTGGACGATGGCCTCCCGTGCTCC--TCG--------------------------TG
Ancistrocladus_abbreviatus     ---------------TTGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AG
Ancistrocladus_barteri         ---------------TTGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AG
Ancistrocladus_benomensis      ---------------TTGGGG???????????????????????????????????????????????????????????????
Ancistrocladus_cochichinensis  ---------------TCGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AG
Ancistrocladus_congolensis     ---------------TCGGGGCGGA-GATTGACTTCCCAT-----------------TGGATTCATTC--------------AG
Ancistrocladus_grandiflorus    ---------------TCGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AG
Ancistrocladus_guineensis      ---------------TTGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AG
Ancistrocladus_hamatus         ---------------TCGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCATTC--------------AG
Ancistrocladus_heyneanus       ---------------TCGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AG
Ancistrocladus_korupensis      ---------------TCGGGGCGGA-GATTGACTTCCCAT-----------------TGGATTCCTTC--------------AG
Ancistrocladus_letestui        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  ---------------TCGGGGCGGA-GATTGACTTCCCGT-----------------TGGATTCCTTC--------------AG
Dionaea_muscipula              ---------------AGGGGGTGGT-GG--GG---TGG------GTG--------G????????????????????????????
Dioncophyllum_thollonii        GCGGGGCGA--A-GG--G-GGCGGA-GATTGACCTCCCGT------------------------------CGGCTGCA-GCCTG
Drosera_binata                 ---------------GGCAGGTGGA-TTATGGCCTCCCGTGCC-TCGGTG--CAAGG-------------------------CG
Drosera_capensis               ---------------TGTCGGTGGA-GTATGGCCTCCCGTGTCGTACGTCGTCTCGA-------------------------TG
Drosera_dielsiana              ---------------TGTCGGTGGA-GTATGGCCTCCCGTGTCCAAGGTC-TC--GA-------------------------TG
Drosera_falconeri              ---------------CGCAGGTGGA-TTATGGCCTCCCGTGCC-TCGTTT-T-GGTT-------------------------CG
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ---------------TGTCGGTGGA-GTATGGCCTCCCGTGTCGTAGGTT---ATGA-------------------------CG
Drosera_nidiformis             ---------------TGTCGGTGGA-GTATGGCCTCCCGTGTCCAAGGTC-TC--GA-------------------------TG
Drosera_paleacea               ---------------TGTCGGTGGA-GTATGGCCTCCCGTGTCGTACGTCGTCTCGA-------------------------TG
Drosera_regia                  ---------------TGCGGGTGGA-GAATGGCCTCCCGTGC-TCGGCTG----AAG-------------------------TG
Drosera_rotundifolia           ---------------TGTCGGTGGA-GTATGGCCTCCCGTGTCGTAGGTC-TC--GA-------------------------CG
Drosera_slackii                ---------------TGTCGGTGGA-GTATGGCCTCCCGTGTCGTAGGTC-TC--GA-------------------------TG
Drosophyllum_lusitanicum       GCGAGGGAGGTG-ATGGG-GGCGGAT-AGTGGCCTCCCGT----------------------------C-CGTCGACA--TGGG
Nepenthes_alata                CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------GGCGCC----GTTGTG
Nepenthes_albomarginata        CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_boschiana            CTCTGCATGCTT-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_fusca                CTCTGCATGCTT-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_glandulifera         CTCTGCATGCTT-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_gracillima           CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTTCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_gymnamphora          CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_macfarlanei          CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTTCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_maxima               CTCTGCATGCTT-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_mirabilis            -----CGTGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCT----GTCGTG
Nepenthes_northiana            CTCGGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGCG
Nepenthes_rafflesiana          -----CGTGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCT----GTCGTG
Nepenthes_reinwardtiana        CTGTGCATGCTA-GGTCTGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_sanguinea            CTCTGCATGGTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_singalana            CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTTCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_spectabilis          CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTCGTG
Nepenthes_tentaculata          CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_tobiaca              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata             CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGCC----GTTGTG
Nepenthes_ventricosa           CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTCCCGT----------------------------G-CGAC----GTTGTG
Nepenthes_vieillardii          CTCTGCATGCTA-GGTTGGGGCGGA-GAGTGGCCTTCCTT----------------------------G-CGCC----GTTGTG
Triphyophyllum_peltatum        GCCGGG-TG--AAGG--G-GGCGGAG-ATTGACCTCCCGT------------------------------CGGTTGCA-GCCTG
```

```
                                       1,270     1,280     1,290     1,300     1,310     1,320     1,330     1,340
                                           |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa             CGGTTG-G-CGGAATCTGGAGC-TGGAG--CCGTTGAGCGCA-GCGGCG-TA--------------------------------
Ancistrocladus_abbreviatus        TGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTTGCGACGATT------------
Ancistrocladus_barteri            TGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTCGCGATTATT------------
Ancistrocladus_benomensis         ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_cochichinensis     TGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTCGCGACGATT------------
Ancistrocladus_congolensis        TGGTTG-GTCTAAAACTAGAGC-TCGAGG-----------------------TGAGCCGTGTCGCGATGATT------------
Ancistrocladus_grandiflorus       TGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTCGCGATGATT------------
Ancistrocladus_guineensis         TGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTCGCGATTATT------------
Ancistrocladus_hamatus            TGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTCGCGACGATT------------
Ancistrocladus_heyneanus          TGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCCGTGTCACGACGATT------------
Ancistrocladus_korupensis         TGGTTG-GTCTAAAACTAGAGC-TCGAGG-----------------------TGAGCTGTGTCGCGACGATT------------
Ancistrocladus_letestui           ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum     TGGTTG-GTCTAAAACTAGAGC-TCGGGG-----------------------TGAGCTGTGTTGCGACGTTT------------
Dionaea_muscipula                 ????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii           CGGTTG-GTCCAAAACGGGAGC-TCGGGG-------------------------------------------CGAGCCGCG-CC
Drosera_binata                    CGGTTG-GCCCAAATGGGAAGC-T-GGGG-CGATGGA-TGCC-GTGGCAGTG--------------------------------
Drosera_capensis                  CGGTTG-GCTCAAATGGGAAGC-TCGGGG-AAACGGA-TGCC-GTGGCAATG--------------------------------
Drosera_dielsiana                 CGGTTG-GCCCAAATGGGAAGC-TCGGGG-CAACGGA-TGCCCGTGACAATG--------------------------------
Drosera_falconeri                 CGGTTG-GCCAAAAATGTGAAAGTTGGGG-CGACGGA-AGCC-GTGACAACG--------------------------------
Drosera_graminifolia              ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii                CGGTTG-GTCCAAATGGGAAGC-TCGGGG-CAACGAA-AGCC-GTGACAATG--------------------------------
Drosera_nidiformis                CGGTTG-GCCCAAATGGGAAGC-TCGGGG-CAACGGA-TGCCCGTGACAATG--------------------------------
Drosera_paleacea                  CGGTTG-GCTCAAATGGGAAGC-TCGGGG-AAACGGA-TGCC-GTGGCAATG--------------------------------
Drosera_regia                     CGGTTT-GCCAAAATTTGAAGC-TCGGGG-CAGCGAA-TGCC-GTGACAATT--------------------------------
Drosera_rotundifolia              CGGTTG-GCCCAAATGGGAAGC-TCGGGG-CAACGGA-TGCC-GTGACAATG--------------------------------
Drosera_slackii                   CGGTGG-GCCCAAATGGGAAAGCTCGGGG-CAACGGA-TGCC-GTGACAATG--------------------------------
Drosophyllum_lusitanicum          CGGTTG-GCCTAAAAAAGGAGA-TCG-----CGG-------------------------------------TGAAATCTCAT-C
Nepenthes_alata                   CGGCTG-GCCTAAAATCGGAGC-TTGGCG----------------------------------------------AACGCG-CC
Nepenthes_albomarginata           CGGTTG-GCCTAAAATTGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_boschiana               CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_fusca                   CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_glandulifera            CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_gracillima              CGGCTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_gymnamphora             CGGCTG-GCCTAAAATTGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_hirsuta                 ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis                CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_macfarlanei             CGGCTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_maxima                  CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_mirabilis               CGGTTG-GCCTAAAACCGGAGC-TCGGCG----------------------------------------------GCTGCG-CC
Nepenthes_northiana               CGGTTT-GCCTAAAAGCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_rafflesiana             CGGTTG-GCCTAAAACCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_reinwardtiana           CGGCTG-GCCTAAAGTTGGAGC-TCGGCG----------------------------------------------GCTGTG-AC
Nepenthes_sanguinea               CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACAGTG-CC
Nepenthes_singalana               CGGCTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_spectabilis             CGGCTG-GCCTAAAATTGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_tentaculata             CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_tobiaca                 ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata                CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_ventricosa              CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACTGCG-CC
Nepenthes_vieillardii             CGGTTG-GCCTAAAATCGGAGC-TCGGCG----------------------------------------------ACGGCA-CC
Triphyophyllum_peltatum           CGGTTG-GTCTAAAATGGGAGC-TCG-----GGG--------------------------------------TGAGCCGTG-CT
```

```
                                     1,350     1,360     1,370     1,380     1,390     1,400     1,410     1,420
                                       |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa          -----------TGG--TG-G-TTGGG--C--GAGGA-GAA-A---GT---CC-------TCGA-TTCGT???????????????
Ancistrocladus_abbreviatus     ---------GGTGG--AC-G-ACGAG--GCC-----------------------------------------------------
Ancistrocladus_barteri         ---------GGTGG--AC-G-ACGAG--GCC-----------------------------------------------------
Ancistrocladus_benomensis      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_cochichinensis  ---------GGTGG--AC-G-ACGAG--GCC-----------------------------------------------------
Ancistrocladus_congolensis     ---------GGTGG--AC-G-ACAAG--GCC-----------------------------------------------------
Ancistrocladus_grandiflorus    ---------GGTGG--AC-G-ACGAG--GCC-----------------------------------------------------
Ancistrocladus_guineensis      ---------GGTGG--AC-G-ACGAG--GCC-----------------------------------------------------
Ancistrocladus_hamatus         ---------GGTGG--AC-G-ATGAG--GCG-----------------------------------------------------
Ancistrocladus_heyneanus       ---------GGTGG--AC-G-ACGAG--GCC-----------------------------------------------------
Ancistrocladus_korupensis      ---------GGTGG--AC-G-ACAAG--GCC-----------------------------------------------------
Ancistrocladus_letestui        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  ---------GGTGG--AC-G-ACGAG--GCC-----------------------------------------------------
Dionaea_muscipula              ????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        GCGACGGCTGGTGG--TC-G-ACGAG--GCC-----------------------------------------------------
Drosera_binata                 ---------GGTGG--TT-A-GCGAG--TCCTGAACGGCA-AGCGGTT-ACGACGACTTGTCACGGTCCC-GTTGCCAACCTTG
Drosera_capensis               ---------GGTGG--TC-A-GCGAGTTGTCGGAAAGGCA---CCGTC-----GGTCATGTCACGTCTT-GGTTTC--CTCGAG
Drosera_dielsiana              ---------GGTGG--TC-A-GCGAG--GCCG-AAAGGCA---CGGTC-ACGACGTCTTGTCATCGGGACGGTTT---CCC???
Drosera_falconeri              ---------GGTGG--TT-A-GCGAGCCTCC--AAGGGCA-CGCCGCT-ACGTCGACTTGTCGCGTTTCTTCTGTCG-TACTTG
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ---------GGTGG--TC-A-GCGAG--GCCG-AAAGGCA---AGGTT-GCGACGTCTTGTCATTGCATCGTTTGC--CGGTTG
Drosera_nidiformis             ---------GGTGG--TC-A-GCGAG--GCCG-AAAGGCA---CGGTC-ACGACGTCT-GTCATCGGGA-CG????????????
Drosera_paleacea               ---------GGTGG--TC-A-GCGAGTTGTCGGAAAGGCA---CCGTC-----GGTCATGTCACGTCTT-GGTTTC--CTCGAG
Drosera_regia                  ---------GGTGG--TA-AAGCATG--TCC-GACCGGCGAGCGG--AAACGACAACTTGTGGCGGTGTT-GCTGTCATCCGTG
Drosera_rotundifolia           ---------GGTGG--TC-C-GCGAG--GCCG-AAAGGCA---CGGTC-ACGACGTCTTGTCATTGCAT-GGTTTC--CCGCTG
Drosera_slackii                ---------GGTGG--TC-A-GCGAG--GCCG-AA?????????????????????????????????????????????????
Drosophyllum_lusitanicum       ACGATGGTTGGTGG--TTGACACAAG--GCTA----------------------------------------------------
Nepenthes_alata                ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_albomarginata        ACGACGTCCGGTGG--TG-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_boschiana            GCGACGTCCGGTGG--TG-G-ACAGG--GCG-----------------------------------------------------
Nepenthes_fusca                ACGACGTCCGGTGG--TG-G-ACAGG--GCG-----------------------------------------------------
Nepenthes_glandulifera         ACGACGTCCGGTGG--GG-G-ACAGG--GCG-----------------------------------------------------
Nepenthes_gracillima           ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_gymnamphora          ACGGCGTCCGGTGG--TC-G-GCAAG--GCG-----------------------------------------------------
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_macfarlanei          ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_maxima               ACGACGTCCGGTGG--TG-G-ACAGG--GCG-----------------------------------------------------
Nepenthes_mirabilis            GCGACGTTCGGTGG--TC-G-GCAAG--GCG-----------------------------------------------------
Nepenthes_northiana            ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_rafflesiana          GCGACGTCCGGTGG--TC-G-GCAAG--GCG-----------------------------------------------------
Nepenthes_reinwardtiana        ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_sanguinea            ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_singalana            ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_spectabilis          ACGGCGTCCGGTGG--TC-G-GCAAG--GCG-----------------------------------------------------
Nepenthes_tentaculata          ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_tobiaca              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata             ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_ventricosa           ACGACGTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Nepenthes_vieillardii          ACGACTTCCGGTGG--TC-G-ACAAG--GCG-----------------------------------------------------
Triphyophyllum_peltatum        GCGACGGTTGGTGG--TCGA--CGAG--GC--C---------------------------------------------------
```

```
                               1,430     1,440     1,450     1,460     1,470     1,480     1,490     1,500     1,510
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     -------------------------------------TATGCCAAGGTTGCATCGCGTCGTGCA--TGTGCTGCCCTCAATGCT
Ancistrocladus_barteri         -------------------------------------TATGCCAAGGTTGCATCGTGTCGTGCA--TGTGCTGCCCTCAACGCT
Ancistrocladus_benomensis      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_cochichinensis  -------------------------------------TATGCCAAGGTTGCATCGCGTCGTGCA--TGTGCTGCCCTCAATGCT
Ancistrocladus_congolensis     -------------------------------------TATGCCAAGGTTGCATCGCGTCGTGCA--TGTGCTGCCCTCAACGCT
Ancistrocladus_grandiflorus    -------------------------------------TATGCCAAGGTTGCATCGCGTCGTGCA--TGTGCTGCCCTCAACGCT
Ancistrocladus_guineensis      -------------------------------------TATGCCAAGGTTGCATCGTGTCGTGCA--TGTGCTGCCCTCAACGCT
Ancistrocladus_hamatus         -------------------------------------TATGCCAAGGTTGCATCGCGTCGTGCA--TGTGCTGCCCTCAATGCT
Ancistrocladus_heyneanus       -------------------------------------CATGCCAAGGTTGCATCGCGTTGTGCA--TGTGCTGCCCTCAACGCT
Ancistrocladus_korupensis      -------------------------------------TATGCCAAGGTTGCATCGCGTCGTGCA--TGTGCTGCCCTCAACGCT
Ancistrocladus_letestui        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  -------------------------------------TATGCCAAGGTTGCATCGCGTCGTGCA--TGTGCTGCCCTCAAAGCT
Dionaea_muscipula              ????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii        -------------------------------------CAGGCCAAGGTTGCATCGCGTCGCG----------------------
Drosera_binata                 CTTGGTTTGA-CCCTGACATGCCGTGCACAGCGGC?????????????????????????????????????????????????
Drosera_capensis               CTTGGTTCGATCCCGTT???????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              CTTGCTTCCTTAGCCATA??????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             CTTGTTTCGATCCCGAAC-TGCCACCATGGCAGGAAT-----------------------------------------------
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               CTTGGTTCGATCC-GTTC-TACGGGTTAAA------------------------------------------------------
Drosera_regia                  CTCGTGTTGA-CC???????????????????????????????????????????????????????????????????????
Drosera_rotundifolia           CTTGTTTAGATCCCCTTCCGCCA-CCGTGGC?????????????????????????????????????????????????????
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       --------------------------------------CGGCCAAGTTTACATCGCATCGC-----------------------
Nepenthes_alata                -------------------------------------ATGGCCAAGGTTGCTTGGCGTGTCG----------------------
Nepenthes_albomarginata        -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_boschiana            -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_fusca                -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_glandulifera         -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_gracillima           -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG??????????????????????
Nepenthes_gymnamphora          -------------------------------------AAGGCAAAGGTTGCATCGCGTCGTG----------------------
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             -------------------------------------ATGGCCAGGGTTGCATGGCGTGGCG----------------------
Nepenthes_macfarlanei          -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_maxima               -------------------------------------AAGGCCAAGGTTGCATCGCGTCGTG----------------------
Nepenthes_mirabilis            -------------------------------------AAGGCCAAGGTTGCATCGCGCCGCG----------------------
Nepenthes_northiana            -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_rafflesiana          -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_reinwardtiana        -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_sanguinea            -------------------------------------GATGCCCGGGTTGCATCGCGTCGCG----------------------
Nepenthes_singalana            -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_spectabilis          -------------------------------------AAGGCAAAGGTTGCATCGCGTCGTC??????????????????????
Nepenthes_tentaculata          -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_tobiaca              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata             -------------------------------------AAGGCCAAGGTTGCATCGCGTCGCG----------------------
Nepenthes_ventricosa           -------------------------------------ATGGCCAAGGTTGCATGGCGTGGCG----------------------
Nepenthes_vieillardii          -------------------------------------AAGGCCAAGGTTGCATCGGGTCGCG----------------------
Triphyophyllum_peltatum        -------------------------------------CAAGCCAAGGTTGCATCACGTCGCGCAAGCG-TT-------------
```

```
                                      1,520     1,530     1,540     1,550     1,560     1,570     1,580     1,590
                                        |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa            ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus       ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri           CATATGACCCTATTGAGCCTCATAAAAG????????????????????????????????????????????????????????
Ancistrocladus_benomensis        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_cochichinensis    CATACGACCCTATTGAGCCGCATAAAAGCAAAGGCTCCAACTCT----------------------------------------
Ancistrocladus_congolensis       CATATGACCCTATTGAGCTGCATAAAAGCAAAGGCTCCAACTCT----------------------------------------
Ancistrocladus_grandiflorus      CATACGACCCTATTGAGCCGCATAAAAGCAAA????????????????????????????????????????????????????
Ancistrocladus_guineensis        C???????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_hamatus           CATACGACCCTATTGAGCCGCATAAAAGCAAAGGCTCCAACTCT----------------------------------------
Ancistrocladus_heyneanus         CATACGACCCTATTGAGCTGCATAAAAGCAAAGGCTCCAACTCT----------------------------------------
Ancistrocladus_korupensis        CATATGACCCTATTGAGCCGCATAAAAGTAAAGGCTCCAACTTT----------------------------------------
Ancistrocladus_letestui          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum    CATACGACCCTATTGAGCCGCATAAAAGCAAA????????????????????????????????????????????????????
Dionaea_muscipula                ????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii          --------------------------------------------CAAGC-GT----GCCGCCCTC-GACGCTCGCAGGACCTGT
Drosera_binata                   ????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis                 ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana                ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri                ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia             ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii               ------------------------------------------------------------------------------------
Drosera_nidiformis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea                 ------------------------------------------------------------------------------------
Drosera_regia                    ????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia             ????????????????????????????????????????????????????????????????????????????????????
Drosera_slackii                  ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum         --------------------------------------------ATCGT-GC----TCATGAGTC-ACTCG-GATG-CTTGAAC
Nepenthes_alata                  --------------------------------------------CTCGG-CA----TGTCGCCCG-TGAAG-CTCG-CACGAA-
Nepenthes_albomarginata          --------------------------------------------CTCGG-CC----CGTCGCCGG-TGAAG-CTCG-CACGA-C
Nepenthes_boschiana              --------------------------------------------CTCGG-CC----CGTCGCCGG-TGAAG-CTCG-CACGA-C
Nepenthes_fusca                  --------------------------------------------CTCGG-CC----CGTCGCCGG-TGAAG-CTCG-CACGAA?
Nepenthes_glandulifera           --------------------------------------------CTCGG-CC----CGTCGTCGG-TGAAG-CTCG-CACGA-C
Nepenthes_gracillima             ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_gymnamphora            --------------------------------------------CTCGG-CA----CGTCGCCCG-TGAAG-CTCG-CACG???
Nepenthes_hirsuta                ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis               --------------------------------------------CTTGGGCA----TGTCGCCCG???????????????????
Nepenthes_macfarlanei            --------------------------------------------CTCGG-CA----CGTCGCCCG-TGAAG-CTCG-CACGA-C
Nepenthes_maxima                 --------------------------------------------CTCGG-CC----CGTCGCCGG-T?????????????????
Nepenthes_mirabilis              --------------------------------------------GCCGG-CA----CGTCGCCCG-TGAAG-CTCG-CACGA-C
Nepenthes_northiana              --------------------------------------------CTCGG-CA----CGTCGCCCG-TGAAG-CTCG-CACGA-C
Nepenthes_rafflesiana            --------------------------------------------CCCGG-CA----CGTCGCCCG-TGAAG-CTCG-CACGA-C
Nepenthes_reinwardtiana          --------------------------------------------CTCGG-CA----CGTCGCCCG-TGAAG-CTCG-CAC????
Nepenthes_sanguinea              --------------------------------------------CTCGG-CA----CGTCGCCCG-TGAAG-CTCG-CATGA-C
Nepenthes_singalana              --------------------------------------------CTCGG-CA----CGTCGCCCG-C?????????????????
Nepenthes_spectabilis            ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tentaculata            --------------------------------------------CTCGG-CC----CGTCGCCCG-TGATG-CTCG-CACGA-C
Nepenthes_tobiaca                ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata               --------------------------------------------CTCGG-CA----CGTCGCCCG-TGATG-CTCG-CACGA-C
Nepenthes_ventricosa             --------------------------------------------CTCGG-CA----TGTCGCCCG-TGAAG-CTCG-CACGA-A
Nepenthes_vieillardii            --------------------------------------------TTCGG-CA----CGTCGCCGG-TGAAG-TTAG-CACGA-C
Triphyophyllum_peltatum          --------------------------------------------------CAACCCTCG----ACG-CTCA-TTGG-ACCCT-G
```

```
                                 1,600     1,610     1,620     1,630     1,640     1,650     1,660     1,670     1,680
Aldrovanda_vesiculosa         ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus    ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri        ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_benomensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_cochichinensis -------------------------------------------GCGACCCCAGG-TCAGGCGGGGCTACCCGCT??????????
Ancistrocladus_congolensis    -------------------------------------------GCGACCCCAGG-TCAGGCGGGGCTACCCGCT??????????
Ancistrocladus_grandiflorus   ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_guineensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_hamatus        -------------------------------------------GCGAACCCAGGGTCAGGCGGGGCTACCCGCT??????????
Ancistrocladus_heyneanus      -------------------------------------------GCGACCCCAGG-TCAGGCGGGGCTACCCGCT??????????
Ancistrocladus_korupensis     -------------------------------------------GCGACCCCAGG-TCAGGCGGGGCTACCCGCT??????????
Ancistrocladus_letestui       ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_robertsoniorum ????????????????????????????????????????????????????????????????????????????????????
Dionaea_muscipula             ????????????????????????????????????????????????????????????????????????????????????
Dioncophyllum_thollonii       CTAGCCGCGCG--CG-A-----------GCAAGCTCA-ACGTCGCGACCC-AGG-TCAGGCGGGGCTACCCGCT??????????
Drosera_binata                ????????????????????????????????????????????????????????????????????????????????????
Drosera_capensis              ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana             ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri             ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia          ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii            ------------------------------------A-CATG-GCGACCC-AGA-TCAGGCGGGGCTACCCGCT??????????
Drosera_nidiformis            ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea              -------------------------------------------GCGACCC-AGA-TCAGGCGGGGTTACCCGCT??????????
Drosera_regia                 ????????????????????????????????????????????????????????????????????????????????????
Drosera_rotundifolia          ????????????????????????????????????????????????????????????????????????????????????
Drosera_slackii               ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      GACCCTATTGAACC-----TTTAAAGAAAAGGGATCATACGCAGCGACCCCAGG-TCAGGCGGGGCTACCCGCT??????????
Nepenthes_alata               CCT--G-CC----GC-G--CCGTCCCGCACGGCACCA-ACGC??????????????????????????????????????????
Nepenthes_albomarginata       CCC--G-CC----GC-G--CCGTCCTTTC-GGCACCA-ACGCAGCGACCCCAGG-TCA??????????????????????????
Nepenthes_boschiana           CCC--G-CC----GC-G--CCGTCCTTTTCGGCAGCA-ACG???????????????????????????????????????????
Nepenthes_fusca               ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_glandulifera        CCC--G-TC----GC-G--CCGTC????????????????????????????????????????????????????????????
Nepenthes_gracillima          ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_gymnamphora         ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_hirsuta             ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis            ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_macfarlanei         CCC--G-CC----GC-G--CCGTCCTTTC-GGCACCA-ACGCAGCGACCCCAGG-TCAGGCGGGGCTACCCGCT??????????
Nepenthes_maxima              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_mirabilis           CCC--G-CC----GC-G--CG-GTCCGTACGGCACCA-ACGCAGCGACCCCAGG-TCGGGCGGGGCTACCCGCT??????????
Nepenthes_northiana           CCC--G-CC----GC-G--CC-GTACGTACGGCACCA-ACGCAGCGACCCCAGG-TCAGGCGGGGCTACCCGCT??????????
Nepenthes_rafflesiana         CCC--G-CC----GC-G--CG-GTCCGTACGGGACCA-ACGCAGCGACCCCAGG-TCGGGCGGGGCTACCCGCT??????????
Nepenthes_reinwardtiana       ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_sanguinea           CCA--G-CC----GC-C--GCCGTCTGTACGGCACCA-ACGCAGCGA?????????????????????????????????????
Nepenthes_singalana           ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_spectabilis         ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_tentaculata         CCC--G-GC----GC-G--CC-GTCCGTACGGCACCA-ACGCAG????????????????????????????????????????
Nepenthes_tobiaca             ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_truncata            CCC--G-GC----GC-G--CC-GTCCGTACGGCACCA-ACGCAGCGACCCCA????????????????????????????????
Nepenthes_ventricosa          CCC--G-CC----GT-G--CC-GTCCGCACGG????????????????????????????????????????????????????
Nepenthes_vieillardii         CCC--G-CC----TC-G--TCTTCTTTTC-GGCACCA-AGGCACCGAC????????????????????????????????????
Triphyophyllum_peltatum       TTG--AGCCGCGCAC-GAG--------CAAGGCTCCA-ACGTCGCGACCCTAGG-TCAGGCGGGGCTACCCGCT??????????
```

```
                                   1,690      1,700      1,710      1,720      1,730      1,740      1,750      1,760
Aldrovanda_vesiculosa              ?????????? ?????????? ?????TCCTC CTCTTTCCGG ACAAGACATA CAAAGAGACC TGCCAACAG- CAAGTCATTA GTAA
Ancistrocladus_abbreviatus         ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Ancistrocladus_barteri             ?????????? ?????????? ?????TCCTC CTCTTTCCAG ACAAAACATA CAAAGAGACC TGCCAACAGT CAAGTAATTA GTGA
Ancistrocladus_benomensis          ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Ancistrocladus_cochichinensis      ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Ancistrocladus_congolensis         ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Ancistrocladus_grandiflorus        ?????????? ?????????? ?????TGCTC CTCTTTCCAG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTA GTGA
Ancistrocladus_guineensis          ?????????? ?????????? ?????????? ?????????? ?????????? ????GAGACC TGCCAACAGT CAAGTAATTA GTGA
Ancistrocladus_hamatus             ?????????? ?????????? ?????TCCTC CTCTTTCCAG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTA GTGA
Ancistrocladus_heyneanus           ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Ancistrocladus_korupensis          ?????????? ?????????? ?????TCCTC CTCTTTCCAG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTA GTGA
Ancistrocladus_letestui            ?????????? ?????????? ?????TCCTC CTCTTTCCAG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTA GTGA
Ancistrocladus_robertsoniorum      ?????????? ?????????? ?????TCCTC CTCTTTCCAG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTA GTGA
Dionaea_muscipula                  ?????????? ?????????? ?????TCCTC CTCCTTCCGG ACAAGACATA CAAAGAGACC TGCCGACAGT CAAGTCATTA GTGA
Dioncophyllum_thollonii            ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosera_binata                     ?????????? ?????????? ?????TCCTC CTCTTTCCGG ACAAGACATA CAAAGAGACT TGCCAACAGT CAAGTCATTC GTGA
Drosera_capensis                   ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosera_dielsiana                  ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosera_falconeri                  ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosera_graminifolia               ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosera_hamiltonii                 ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosera_nidiformis                 ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosera_paleacea                   ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosera_regia                      ?????????? ?????????? ?????????? ?????????? ????????TA CAAAGAGACC TGCCAACAGT CAAGTCATTA GTGA
Drosera_rotundifolia               ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosera_slackii                    ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Drosophyllum_lusitanicum           ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ??????ATT- -T--
Nepenthes_alata                    ?????????? ?????????? ?????????? ?????????? ?????????? ????GAGACC TGCCAACAGT CAAGTAATTG GTGA
Nepenthes_albomarginata            ?????????? ?????????? ?????TCCTC CTCTTTCCGG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTG GTGA
Nepenthes_boschiana                ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Nepenthes_fusca                    ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????ACAGT CAAGTAATTG GTGA
Nepenthes_glandulifera             ?????????? ?????????? ?????TCC-C CTCTT-CCGG -CCAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTG GTGA
Nepenthes_gracillima               ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????G GTG-
Nepenthes_gymnamphora              ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ???????TTG GTGA
Nepenthes_hirsuta                  ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Nepenthes_insignis                 ?????????? ?????????? ?????TCCTC CTCTT-CCGG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTG GTGA
Nepenthes_macfarlanei              ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?GCCAACAGT CAAGTAATTG GTGA
Nepenthes_maxima                   ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????????GT CAAGTAATTG GTGA
Nepenthes_mirabilis                ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Nepenthes_northiana                ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????AATTG GTGA
Nepenthes_rafflesiana              ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Nepenthes_reinwardtiana            ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Nepenthes_sanguinea                ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? TGCCA-CAGT CAAGTAATTG GTG-
Nepenthes_singalana                ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ????
Nepenthes_spectabilis              ?????????? ?????????? ?????????? ?????????? ?????????? CAAAGAGACC TGCCAACAGT CAAGTAATTG GTGA
Nepenthes_tentaculata              ?????????? ?????????? ?????????? ?????????? ?????????A CAAAGAGACC TGCCAACAGT CAAGTAATTG GTGA
Nepenthes_tobiaca                  ?????????? ?????????? ?????????? ?????TC-GG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTG GTGA
Nepenthes_truncata                 ?????????? ?????????? ?????TCCTC CTCTTTCCGG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTG GTGA
Nepenthes_ventricosa               ?????????? ?????????? ?????TCCTC CTCTTTCCGG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTG GTGA
Nepenthes_vieillardii              ?????????? ?????????? ?????TCCTC CTCTT-CCGG AC-AGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTG GTGA
Triphyophyllum_peltatum            ?????????? ?????????? ?????TCCTC CTCTTTCCGG ACAAGACATA CAAAGAGACC TGCCAACAGT CAAGTAATTA GTGA
```

```
                                  1,770     1,780     1,790     1,800     1,810     1,820     1,830     1,840
                                    |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa          ACCTTTGAGAGATCTATATTAATGAATTTCCT-CTATTC--TCT-CC-ATCTCTCTTTTTTCTTT--AGCTATTCACTCGAACA
Ancistrocladus_abbreviatus     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri         ACCTCTGAGAGATATTTAT-AATTAGTTTCTTTTTCTTCTATCTCCC-ATCTTTCTATTTTCTTT--AGTTATTCACTCGAACA
Ancistrocladus_benomensis      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_cochichinensis  ???????????????????????????????TTTTCTTCTATCTCCC-ATCTTTCTATTTTCTTT--AGTTATTCACTCGAACA
Ancistrocladus_congolensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus    ACCTCTGAGAGATATTTAT-AATTAGTTTCTTTTTCTTCTATCTCCC-ATCTTTCTATTTTCTTT--AGTTATTCACTCGAACA
Ancistrocladus_guineensis      ACCTCTGAGAGATATTTAT-AATTAGTTTCTTTTTCTTCTATCTCCC-ATCTTTCTATTTTCTTT--AGTTATTCACTCGAACA
Ancistrocladus_hamatus         ACCTCTAAGAGATATTTAT-AATTAGTTTCTTTTTCTTCTATCTCCC-ATCTTTCTATTTTCTTT--AGTTATTCACTCGAACA
Ancistrocladus_heyneanus       ??????TAGAGATATT-AT-AAATAGGTTCTTTTTCTTCTATCTCCCCATCTTTCTATTTTCTTT--AGTTATTCACTCGAACA
Ancistrocladus_korupensis      ACCTCTGAGAGATATTTAT-AATTAGTTTCTTTTTCTTCTATCTCCC-ATCTTTCTATTTTCTTT--AGTTATTCACTCGAACA
Ancistrocladus_letestui        ACCTCTGAGAGATATTTAT-AATTAGTTTCTTTTTCTTCTATCTCCC-ATCTTTCTATTTTCTTT--AGTTATTCACTCGAACA
Ancistrocladus_robertsoniorum  ACCTCTGAGAGATATTTAT-AATTAGTTTCTTTTTCTTCTATCTCCC-ATCTTTCTATTTTCTTT--AGTTATTCACTCGAACA
Dionaea_muscipula              ACCTTTGAGAGATCGATAG-AATGAATTTTTTTCTATTCTATCTTCC-ATCTCTCTATTTTCTTT--AGCTATTCACTCGAAGA
Dioncophyllum_thollonii        ?????TGAGAGATATTTAG-AATTAATTTGTTTTTCTTCTATCTCCC-ATCTCTCTATTTTCTTT--AGTTATTCACTTGAACA
Drosera_binata                 ACCTTTGAGAGATCTATAT-AATGAATTTCTTTCTATTCTATCTTCC-ATCTATCTATTTTCGTT--CGTTATTCACTCGAAGA
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ACCTTTGAGAGATCTATAT-AATGAATTTATTTCTATTCAATCTTCT-ATCTCTCTATTTTCTTT--AGTTATTCACTCGAACA
Drosera_rotundifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       --CTCT------AATT-AG---TTTCTTTCTTTTTCGTCTATCTCCCC-TCTCTCTATGTTCTTT--AGTCATTCACTAGAACA
Nepenthes_alata                ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_albomarginata        ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_boschiana            ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_fusca                ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_glandulifera         ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_gracillima           ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_gymnamphora          ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_hirsuta              ?????????????????CG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_insignis             ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_macfarlanei          ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_maxima               ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_mirabilis            ???????????????TTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_northiana            ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_rafflesiana          ???????????????????????????????TTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_reinwardtiana        ?????????????????????????GTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTTTTAGTTATTCACTCGAACA
Nepenthes_sanguinea            ACCTAGGAGAGATA-TTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_singalana            ?CCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_spectabilis          ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_tentaculata          ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTGTT--AGTTATTCACTCGAACA
Nepenthes_tobiaca              ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_truncata             ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_ventricosa           ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Nepenthes_vieillardii          ACCTAGGAGAGATATTTCG-AATTAGTTTCTTTCTCTTCTATCTCCT-ATCTCTCGATTTTTTTT--AGTTATTCACTCGAACA
Triphyophyllum_peltatum        ACCTCTGAGAGATATTTCG-AATGAGTTTGTTTTTATTCTATCTCCC-ATCTCTCTATTTTCTTT--AGTTATTCACTTGAACA
```

```
                                1,850     1,860     1,870     1,880     1,890     1,900     1,910     1,920     1,930
Aldrovanda_vesiculosa           ATTATGATTTGGAAGTCGATCCAGGGCAAGTGTTCGAATCTAT-TATGACAT-AGCTGTCAGGCGCGCCAGGGACACGAT-TGT
Ancistrocladus_abbreviatus      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri          ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TT-TTT
Ancistrocladus_benomensis       ??????????GG-AGTCCATCTAGGGCAA-TGTT-GGATCTA--TATGACAT-AGCCATGAGGTGCTCTACGG-CC--TT-TTT
Ancistrocladus_cochichinensis   ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TT-TTT
Ancistrocladus_congolensis      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus     ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TT-TTT
Ancistrocladus_guineensis       ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TT-TTT
Ancistrocladus_hamatus          ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TT-TTT
Ancistrocladus_heyneanus        ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TT-TTT
Ancistrocladus_korupensis       ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TA-TTT
Ancistrocladus_letestui         ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TT-TTT
Ancistrocladus_robertsoniorum   ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TT-TTA
Dionaea_muscipula               ATTATGATCTGGAAGTCGATCCAGGGCAAGTGTTCGAATCTAT-TATGACAT-AGCTGCGAGGCGCGCAAGGGACCCGAT-TTT
Dioncophyllum_thollonii         ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACCC-TT-TTT
Drosera_binata                  ATGATGATCTGGAAGTCGATCCAGGGCAAGTGTTCGAATCTAT-TATGACAT-AGCTATGAGGCGCGCAAGGGACCCCTT-TTT
Drosera_capensis                ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana               ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri               ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia            ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii              ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis              ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea                ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   ATTATGATCTGGAAGTCGATCCAGGGCAAGTGTTCGAATCTAT-TATGACAT-AGCTGTTAGGCGCGCAAGGGACCTAATAAAT
Drosera_rotundifolia            ????????????????????????????????GTCGATTCTATATATTACATTAGGTATTAAGTGCTCAAAGGACTCCTT-CTT
Drosera_slackii                 ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ATTATGATTCGGAATTAGACCGAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGGCATAAGGCGCTCAATG------------
Nepenthes_alata                 ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCTAGAGGCGCTCAACGGACC--TT-TTT
Nepenthes_albomarginata         ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCTAGAGGCGCTCAACGGACC--TT-TTT
Nepenthes_boschiana             ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_fusca                 ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCTAGAGGCGCTCAACGGACC--TT-TTT
Nepenthes_glandulifera          ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCTAGAGGCGCTCAACGGACC--TT-TTT
Nepenthes_gracillima            ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCAGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_gymnamphora           ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_hirsuta               ATTATGATCTGGAAGTCT-TCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_insignis              ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGAC---TT-TTT
Nepenthes_macfarlanei           ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCAGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_maxima                ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_mirabilis             ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_northiana             ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_rafflesiana           ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_reinwardtiana         ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_sanguinea             ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCTAGAGGCGCTCAACGGACC--TT-TTT
Nepenthes_singalana             ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCAGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_spectabilis           ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCTAGAGGCGCTCAACGGACC--TT-TTT
Nepenthes_tentaculata           ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACC--TT-TT-
Nepenthes_tobiaca               ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TTT
Nepenthes_truncata              ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Nepenthes_ventricosa            ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACC--TT-TTT
Nepenthes_vieillardii           ATTATGATCTGGAAGTCTATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCCGGAGGCGCTCAACGGACCC-TT-TT-
Triphyophyllum_peltatum         ATTATGATCTGGAATTCGATCCAGGGCAAGTGTTCGGATCTAT-TATGACAT-AGCCATGAGGCGCTCAACGGACC--TT-TTT
```

```
                                    1,940     1,950     1,960     1,970     1,980     1,990     2,000     2,010
Aldrovanda_vesiculosa          TTT-ATTAT-------------------AATAAAGCCTTTT--------------GATGGAAAAGCCTTCTTTGTGGAACTTAG
Ancistrocladus_abbreviatus     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri         ----AT-AGTATAATAAAT---------AAGAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Ancistrocladus_benomensis      ----AT-AGTATAATAA-T---------AAGAAAACCTTTTTTGGACTTTGGGT-GACGTAAAAGACTTTTTTGTGCAACCTAG
Ancistrocladus_cochichinensis  ----AT-AGTATAATAAAT---------AAAAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTT-GTGCAACCTAG
Ancistrocladus_congolensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus    ----AT-AGTATAATAAAAA--------AAAAAAACCT---CTGGGCTTTGGA-TGACGTAAAA-ACTTT-TTG-GCAACCTA-
Ancistrocladus_guineensis      ----AT-AGTATAATAAAT---------AAGAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Ancistrocladus_hamatus         ----AT-AGTATAATAAAT---------AAAAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTT-GTGCAACCTAG
Ancistrocladus_heyneanus       ----AT-AGTATAATAAAT---------AAAAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTT-GTGCAACCTAG
Ancistrocladus_korupensis      ----AT-AGTATAATAAAT---------AAGAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Ancistrocladus_letestui        ----AT-AGTATAATAAAT---------AAGAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Ancistrocladus_robertsoniorum  ----AT-AGTCTAATAAAT---------AAGAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Dionaea_muscipula              TCT--T-AT-------------------AAAAAAATCTTTG--------------GATGTAAA-----TCTTTGTGAAACTCAG
Dioncophyllum_thollonii        TT-AATAAATATAATAAAT---------AAGAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Drosera_binata                 ----ATTAG-------------------AATAAAATCTTTT--------------GATGTAAAGGTCTTCGTTGTGAAACTTAG
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  TTG-ATTCT-------------------AATAAAATCTTTT--------------GATGTAAAAGCCTTCTTTGTGAAACTTAG
Drosera_rotundifolia           TC--ATTCT-------------------AATAAAATCTTTT--------------TATGTCAAGGCCTTC------AAAATTAG
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ------------------------------------------------------------------------------------
Nepenthes_alata                TT--------------------ACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_albomarginata        TT--------------------ACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_boschiana            ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_fusca                TT--------------------ACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_glandulifera         TT--------------------ACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_gracillima           ---------------------AACTA-GAAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_gymnamphora          ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_hirsuta              ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_insignis             T--------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_macfarlanei          ---------------------AACTA-GAAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_maxima               ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_mirabilis            ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_northiana            ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_rafflesiana          ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_reinwardtiana        ---------------------AACTAT-AAAAAAAGATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_sanguinea            TT--------------------ACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_singalana            ---------------------AACTA-GAAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_spectabilis          TT--------------------ACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_tentaculata          --------------------AAACTATGAAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_tobiaca              ----------------------ACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_truncata             ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGAAACCTAG
Nepenthes_ventricosa           ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Nepenthes_vieillardii          ---------------------AACTAT-AAAAAAATATTTTCTGGGCTT-GGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
Triphyophyllum_peltatum        TTT-A--AGTATAATAAAT---------AAGAAAACCTTTTCTGGGCTTTGGATTGACGTAAAAGACTTTTTTGTGCAACCTAG
```

```
                               2,020     2,030     2,040     2,050     2,060     2,070     2,080     2,090     2,100
                                 |         |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa         ----TTCCT-----ACTTATCCTAACCTAATTA-CCTAATTTGAAATT--ATTCAAATTTCATTTT------------------
Ancistrocladus_abbreviatus    ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri        CCTATTTCTATCTCAATT------------------------------------------------------------------
Ancistrocladus_benomensis     CCCATTTTTATCTCAATT------------------------------------------------------------------
Ancistrocladus_cochichinensis CCTATTCCTATCTCAATT------------------------------------------------------------------
Ancistrocladus_congolensis    ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus   -CTATTTCTATCTCAA--------------------------------------------------------------------
Ancistrocladus_guineensis     CCTATTTCTATCTCAATT------------------------------------------------------------------
Ancistrocladus_hamatus        CCTATTCCTATCTCAATT------------------------------------------------------------------
Ancistrocladus_heyneanus      CCTATTCCTATCTCAATT------------------------------------------------------------------
Ancistrocladus_korupensis     CCTATTTCTATCTCAATT------------------------------------------------------------------
Ancistrocladus_letestui       CCTATTTCTATCTCAATT------------------------------------------------------------------
Ancistrocladus_robertsoniorum CCTATTCCTATCTCAATT------------------------------------------------------------------
Dionaea_muscipula             ----TTCCT-----AATTATCCGAACAAAAGAATAGAAT-----AATCG-ATAGGTATTTCT-------------------AAG
Dioncophyllum_thollonii       CCTATTCCTATCTCAATT------------------------------------------------------------------
Drosera_binata                ----TTTCT-----AATA--------AAATGAATAGAATTTATTAATGTATAGATATTAATTAGTAATTGAGTTAGTAATTGAG
Drosera_capensis              ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana             ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri             ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia          ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii            ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis            ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea              ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                 ----TTCCT-----AATT--------AA-CTAATTCAATTAATCAAATTTATATCTATTTTATCTATATTCTATTT-AATTTAT
Drosera_rotundifolia          ----TTCCT-----AATG--------AAATTCATATAATTTCTTAATGTATAGATATTAATTAGTAATT---------------
Drosera_slackii               ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum      ------------------------------------------------------------------------------------
Nepenthes_alata               CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_albomarginata       CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_boschiana           CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_fusca               CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_glandulifera        CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_gracillima          TGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_gymnamphora         CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_hirsuta             CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_insignis            CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_macfarlanei         TGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_maxima              TGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_mirabilis           CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_northiana           CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_rafflesiana         CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_reinwardtiana       CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_sanguinea           CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_singalana           TGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_spectabilis         CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_tentaculata         CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_tobiaca             CGTATTCCTA--------------------------------------------------------------------------
Nepenthes_truncata            CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_ventricosa          CGTATTCCTATCTCAATT------------------------------------------------------------------
Nepenthes_vieillardii         TGTATTCCTATCTCAATT------------------------------------------------------------------
Triphyophyllum_peltatum       CCTATTCCTATCTCAATT------------------------------------------------------------------
```

```
                                      2,110     2,120     2,130     2,140     2,150     2,160     2,170     2,180
                                        |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa          --------------------------------------GAAACAC-AAAAGA????????????????????????????????
Ancistrocladus_abbreviatus     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri         ------------------------------------------------------------------------------------
Ancistrocladus_benomensis      ------------------------------------------------------------------------------------
Ancistrocladus_cochichinensis  ------------------------------------------------------------------------------------
Ancistrocladus_congolensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus    ------------------------------------------------------------------------------------
Ancistrocladus_guineensis      ------------------------------------------------------------------------------------
Ancistrocladus_hamatus         ------------------------------------------------------------------------------------
Ancistrocladus_heyneanus       ------------------------------------------------------------------------------------
Ancistrocladus_korupensis      ------------------------------------------------------------------------------------
Ancistrocladus_letestui        ------------------------------------------------------------------------------------
Ancistrocladus_robertsoniorum  ------------------------------------------------------------------------------------
Dionaea_muscipula              GT--ATTCT-------------------------------------AAAAG-----AATAGAATAATCGAT-------------
Dioncophyllum_thollonii        ------------------------------------------------------------------------------------
Drosera_binata                 GTATTTT----------------------------------------------TATAT----TCTTTTTTT-------------
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  CTATATTCTATTTAAATATAAATAAATTAATATAATTC--------AAATTAATATATATATTCTATTTAAATCGATTAAAATA
Drosera_rotundifolia           ------------------------------------------CATT--AAGGCATTATTCGATCTTTTTT--------------
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ------------------------------------------------------------------------------------
Nepenthes_alata                ------------------------------------------------------------------------------------
Nepenthes_albomarginata        ------------------------------------------------------------------------------------
Nepenthes_boschiana            ------------------------------------------------------------------------------------
Nepenthes_fusca                ------------------------------------------------------------------------------------
Nepenthes_glandulifera         ------------------------------------------------------------------------------------
Nepenthes_gracillima           ------------------------------------------------------------------------------------
Nepenthes_gymnamphora          ------------------------------------------------------------------------------------
Nepenthes_hirsuta              ------------------------------------------------------------------------------------
Nepenthes_insignis             ------------------------------------------------------------------------------------
Nepenthes_macfarlanei          ------------------------------------------------------------------------------------
Nepenthes_maxima               ------------------------------------------------------------------------------------
Nepenthes_mirabilis            ------------------------------------------------------------------------------------
Nepenthes_northiana            ------------------------------------------------------------------------------------
Nepenthes_rafflesiana          ------------------------------------------------------------------------------------
Nepenthes_reinwardtiana        ------------------------------------------------------------------------------------
Nepenthes_sanguinea            ------------------------------------------------------------------------------------
Nepenthes_singalana            ------------------------------------------------------------------------------------
Nepenthes_spectabilis          ------------------------------------------------------------------------------------
Nepenthes_tentaculata          ------------------------------------------------------------------------------------
Nepenthes_tobiaca              ------------------------------------------------------------------------------------
Nepenthes_truncata             ------------------------------------------------------------------------------------
Nepenthes_ventricosa           ------------------------------------------------------------------------------------
Nepenthes_vieillardii          ------------------------------------------------------------------------------------
Triphyophyllum_peltatum        ------------------------------------------------------------------------------------
```

```
                                  2,190     2,200     2,210     2,220     2,230     2,240     2,250     2,260
                                    |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri         ---------------AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAAAAGTTTCATTACTAT-TACTCTATTTAC
Ancistrocladus_benomensis      ---------------AGAA-GGTCTTAGATGGAGCTACT-AATTTTTCACATA-AGCAGTTTCATTACTAT-TACT-TATTTAT
Ancistrocladus_cochichinensis  ---------------AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAACAGTTTCATTACTAT-TACTCTATTTAC
Ancistrocladus_congolensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus    ----------------GAA-GGTCT--GACGG---TACTTAATTTTTTACATAAAAAAGTTTCATTACTAT-TACTCTATTTAC
Ancistrocladus_guineensis      ---------------AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAAAAGTTTCATTACTAT-TACTCTATTTAC
Ancistrocladus_hamatus         ---------------AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAACAGTTTCATTACTAT-TACTCTATTTAC
Ancistrocladus_heyneanus       ---------------AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAACAGTTTCATTACTAT-TACTCTATTTAC
Ancistrocladus_korupensis      ---------------AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAACAGTTTCATTACTAT-TACTCTATTTAC
Ancistrocladus_letestui        ---------------AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAAAAGTTTCATTACTAT-TACTCTATTTAC
Ancistrocladus_robertsoniorum  ---------------AGAA-GGTCTTAGACGGAGCTACTTAATTTTTTACATAAAACAGTTTCATTACTAT-TACTCTATTTAC
Dionaea_muscipula              --------AGGTATTTCTAAGGTATTAGATGGA-----TTCATTTTTTACATTCCAATTTTTC-TTACTAT-TACTTTACTTGA
Dioncophyllum_thollonii        ---------------AGAAA-GTCTTAGACAGAGCTACTAAATGTTTTACATAAAAC------ATTACTAT-TACTCTATTTAC
Drosera_binata                 -------AAGGTATTAGAAAGGTATTAGACGGA-----TTCATGTTTTACACAAAAA-TTTTCATTCCTAT-TACTCTATT---
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  GATTTAAATAATATT--AA-GGTATTAGACGGA-----TTCATGTTTTACAT--------------------------------
Drosera_rotundifolia           ---------------AGAA-GGTATTAAACAGA-----TTCATGTTTTACATAAAGA-TTGTCATTCCTAT-TCCTCTATT---
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ------------------------------------------------------------------------------------
Nepenthes_alata                ---------------AGAA-GGTCTCAAACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_albomarginata        ---------------AGAA-GGTTTCAAACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_boschiana            ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_fusca                ---------------AGAA-GGTTTCAAACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_glandulifera         ---------------AGAA-GGTTTCAAACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_gracillima           ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_gymnamphora          ---------------AGAC-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_hirsuta              ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_insignis             ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_macfarlanei          ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_maxima               ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_mirabilis            ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_northiana            ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_rafflesiana          ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_reinwardtiana        ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_sanguinea            ---------------AGAA-GGTCTCAAACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_singalana            ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_spectabilis          ---------------AGAA-GGTCTCAAACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_tentaculata          ---------------AGAA-GGTCTCAAACAGAGCTACTTAATGTTTTATATCAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_tobiaca              ------------------------------------------------------------------------------------
Nepenthes_truncata             ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_ventricosa           ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Nepenthes_vieillardii          ---------------AGAA-GGTCTCAGACGGAGCTACTTAATGTTTTACATAAAAAATTTTCATTACTATCTACTCTATT---
Triphyophyllum_peltatum        ---------------AGAA-GGTCTTAGACGGAGCTACTAAATGTTTTACAT-------------TACTAT-TACTCTATTTAC
```

```
                               2,270     2,280     2,290     2,300     2,310     2,320     2,330     2,340     2,350
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri         TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCAT
Ancistrocladus_benomensis      TTT-------CCAAATCGACTGAGTAGTCATTA-------CTAA-AAAGATTTTGGTAT--------CCAT----TTTAGTC-T
Ancistrocladus_cochichinensis  TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCAT
Ancistrocladus_congolensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus    TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCAT
Ancistrocladus_guineensis      TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTAGGTAT--------CCAT---ATTTAGTCAT
Ancistrocladus_hamatus         TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCAT
Ancistrocladus_heyneanus       TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCAT
Ancistrocladus_korupensis      TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCAT
Ancistrocladus_letestui        TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCAT
Ancistrocladus_robertsoniorum  TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CCAT---ATTTAGTCAT
Dionaea_muscipula              CTCGA---TTCGAAATCGCGCGAACAGCCATTA-------CTAAGAAAGATCTCGGTATCTCTTTTTCTATTTCATTTCGAAAT
Dioncophyllum_thollonii        TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CTAT---ATTTAGTCAT
Drosera_binata                 ----------CTAAATCGCGCGAGCAGCTATTA-------CTAAGAAAGATCTCCCTGTCTCTTTT-CTATTTCATTTAATCAT
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ------------ATATCGCGCGAGCAGCCATTA-------CTAAGAAA---CTCGGTATCTTTTTT-CTATTTCATTTAATCAT
Drosera_rotundifolia           ---CAAAATTCTCAATCGTACCAGCAGCCATTA---ATAAGCAAGATCTCCCTTGGTATTCTTTTG---ATTGG-TTTAATAGG
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ------------------------------------------------------------------------------------
Nepenthes_alata                ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_albomarginata        ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_boschiana            ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_fusca                ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_glandulifera         ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_gracillima           ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_gymnamphora          ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAAAATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_hirsuta              ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCTTTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_insignis             ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_macfarlanei          ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_maxima               ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_mirabilis            ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCTTTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_northiana            ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_rafflesiana          ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_reinwardtiana        ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---AGTTAGTCAT
Nepenthes_sanguinea            ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_singalana            ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_spectabilis          ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_tentaculata          ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---AT--------
Nepenthes_tobiaca              --------------ATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_truncata             ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAG---ATTTAGTCAT
Nepenthes_ventricosa           ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Nepenthes_vieillardii          ----CCAAATCCAAATCGAGCGAGCAGTCATTAGTCATTACTAAGAAACATCCTGTTAT--------CTAT---ATTTAGTCAT
Triphyophyllum_peltatum        TTT-------CCAAATCGCGTGAGCAGTCATTA-------CTAAGAAAGATCTCGGTAT--------CTAT---ATTTAGTCAT
```

```
                                    2,360     2,370     2,380     2,390     2,400     2,410     2,420     2,430
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri         TC----------------------------------------------------------------------------------
Ancistrocladus_benomensis      TC----------------------------------------------------------------------------------
Ancistrocladus_cochichinensis  TC----------------------------------------------------------------------------------
Ancistrocladus_congolensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus    TC----------------------------------------------------------------------------------
Ancistrocladus_guineensis      TC----------------------------------------------------------------------------------
Ancistrocladus_hamatus         TC----------------------------------------------------------------------------------
Ancistrocladus_heyneanus       TC----------------------------------------------------------------------------------
Ancistrocladus_korupensis      TC----------------------------------------------------------------------------------
Ancistrocladus_letestui        TC----------------------------------------------------------------------------------
Ancistrocladus_robertsoniorum  TC----------------------------------------------------------------------------------
Dionaea_muscipula              TCGAAATGAAAT------------------------------------------------------------------------
Dioncophyllum_thollonii        TC----------------------------------------------------------------------------------
Drosera_binata                 TT----------------------------------------------------------------------------------
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  TC----------------------------------------------------------------------------------
Drosera_rotundifolia           TA-------------------------------------------------------------------------TTTTCTTTT
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ------------------------------------------------------------------------------------
Nepenthes_alata                TT----------------------------------------------------------------------------------
Nepenthes_albomarginata        TT----------------------------------------------------------------------------------
Nepenthes_boschiana            TT----------------------------------------------------------------------------------
Nepenthes_fusca                TT----------------------------------------------------------------------------------
Nepenthes_glandulifera         TT----------------------------------------------------------------------------------
Nepenthes_gracillima           TT----------------------------------------------------------------------------------
Nepenthes_gymnamphora          TT----------------------------------------------------------------------------------
Nepenthes_hirsuta              TT----------------------------------------------------------------------------------
Nepenthes_insignis             TT----------------------------------------------------------------------------------
Nepenthes_macfarlanei          TT----------------------------------------------------------------------------------
Nepenthes_maxima               TT----------------------------------------------------------------------------------
Nepenthes_mirabilis            TT----------------------------------------------------------------------------------
Nepenthes_northiana            TT----------------------------------------------------------------------------------
Nepenthes_rafflesiana          TT----------------------------------------------------------------------------------
Nepenthes_reinwardtiana        TT----------------------------------------------------------------------------------
Nepenthes_sanguinea            TT----------------------------------------------------------------------------------
Nepenthes_singalana            TT----------------------------------------------------------------------------------
Nepenthes_spectabilis          TT----------------------------------------------------------------------------------
Nepenthes_tentaculata          ------------------------------------------------------------------------------------
Nepenthes_tobiaca              TT----------------------------------------------------------------------------------
Nepenthes_truncata             TT----------------------------------------------------------------------------------
Nepenthes_ventricosa           TT----------------------------------------------------------------------------------
Nepenthes_vieillardii          TT----------------------------------------------------------------------------------
Triphyophyllum_peltatum        TC----------------------------------------------------------------------------------
```

```
                                 2,440     2,450     2,460     2,470     2,480     2,490     2,500     2,510     2,520
Aldrovanda_vesiculosa           ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri          ---------------------------TATCTATATTT------ATTTTATTATTTAATAGTTAATTTATTTAATTGATAATTG
Ancistrocladus_benomensis       ---------------------------TATCTATATTT------ATTTTATTATTTAATAATTAATTT-TTCAATTGATAATTG
Ancistrocladus_cochichinensis   ---------------------------TATCTATATTT------ATTTTTTTATTTAATATTTAATTTATTTAATTGATAATTG
Ancistrocladus_congolensis      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus     ---------------------------TATCTATATTT------ATTTTATTATTTAAKAGTTAATTTATTTAATTGAYAATTG
Ancistrocladus_guineensis       ---------------------------TATCTATATTT------ATTTTATTATTTAATAGTTAATTTATTTAATTGATAATTG
Ancistrocladus_hamatus          ---------------------------TATCTATATTT------ATTTTTTTATTGAATATTTAATTTATTTAATTGATAATTG
Ancistrocladus_heyneanus        ---------------------------TATCTATATTT------ATTTTTTTATTTAATATTTAATTTATTTAATTGATAATTG
Ancistrocladus_korupensis       ---------------------------TATCTATATTTCTATATATTTTATTATTTAACAGTTAATTTATTTAATTGATAATTG
Ancistrocladus_letestui         ---------------------------TATCTATATTT------ATTTTATTATTTAATAGTTAATTTATTTAATTGATAATTG
Ancistrocladus_robertsoniorum   ---------------------------TATCTATATTTATATTTATTTTTTGATTTAATATTTAATTTATTTAATTGATAATTG
Dionaea_muscipula               ------------------------------------------------------------------------------------
Dioncophyllum_thollonii         ---------------------------TATCTATATTT------ATTTATCTATATTTT-------------------------
Drosera_binata                  ------------------------------------------------------------------------------------
Drosera_capensis                ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana               ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri               ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia            ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii              ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis              ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea                ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   ------------------------------------------------------------------------------------
Drosera_rotundifolia            ATGGTTCATATTCCGGATTAGGTTCATCCCTGTAGGAATCAGATGAATGGAGTCATAGATCTGAAAGCGTAAGAACTCAACTTC
Drosera_slackii                 ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ------------------------------------------------------------------------------------
Nepenthes_alata                 ------------------------------------------------------------------------------------
Nepenthes_albomarginata         ------------------------------------------------------------------------------------
Nepenthes_boschiana             ------------------------------------------------------------------------------------
Nepenthes_fusca                 ------------------------------------------------------------------------------------
Nepenthes_glandulifera          ------------------------------------------------------------------------------------
Nepenthes_gracillima            ------------------------------------------------------------------------------------
Nepenthes_gymnamphora           ------------------------------------------------------------------------------------
Nepenthes_hirsuta               ------------------------------------------------------------------------------------
Nepenthes_insignis              ------------------------------------------------------------------------------------
Nepenthes_macfarlanei           ------------------------------------------------------------------------------------
Nepenthes_maxima                ------------------------------------------------------------------------------------
Nepenthes_mirabilis             ------------------------------------------------------------------------------------
Nepenthes_northiana             ------------------------------------------------------------------------------------
Nepenthes_rafflesiana           ------------------------------------------------------------------------------------
Nepenthes_reinwardtiana         ------------------------------------------------------------------------------------
Nepenthes_sanguinea             ------------------------------------------------------------------------------------
Nepenthes_singalana             ------------------------------------------------------------------------------------
Nepenthes_spectabilis           ------------------------------------------------------------------------------------
Nepenthes_tentaculata           ------------------------------------------------------------------------------------
Nepenthes_tobiaca               ------------------------------------------------------------------------------------
Nepenthes_truncata              ------------------------------------------------------------------------------------
Nepenthes_ventricosa            ------------------------------------------------------------------------------------
Nepenthes_vieillardii           ------------------------------------------------------------------------------------
Triphyophyllum_peltatum         ---------------------------TATCTATATTT------ATTTATCTATATTTT-------------------------
```

```
                                      2,530     2,540     2,550     2,560     2,570     2,580     2,590     2,600
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri         AAATTTGATTTAAGAATTTCATTTTCATTTAATCGAAAAT------------------AAATAAAATTTTATTA--ATTTAATA
Ancistrocladus_benomensis      AAATTTGATTTAAGAATT-CATTT-C--TTCCTCGA---GAAGTTTTTACGGGATC----ATAAAAT---A-------T--ATA
Ancistrocladus_cochichinensis  AAATTTGATTTAAGAATTTCATTTTCATTTAATAGAAAAT------------------AAATAAAATGAAATTA--ATTTAATA
Ancistrocladus_congolensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus    AAATTTGATTTAAGAATTTCATTTTCATTTAATCGAAAAT------------------AAATAAAATTTTATCA--ATTTAATA
Ancistrocladus_guineensis      AAATTTGATTTAAGAATTTCATTTTCATTTAATCGAAAAT------------------AAATAAAATTTTATTA--ATTTAATA
Ancistrocladus_hamatus         AAATTTGATTTAAGAATTTCATTTTCATTTAATAGAAAAT------------------AAATAAAATTGAATTA--ATTTAATA
Ancistrocladus_heyneanus       AAATTTGATTTAAGAATTTCATTTTCATTTAATAGAAAAT------------------AAATAAAATTTAATTA--ATTTAATA
Ancistrocladus_korupensis      AAATTTGATTTAAGAATTTCATTTTCATTTAATCGAAAAT------------------AAATCAAATTTCATTA--ATTTAATA
Ancistrocladus_letestui        AAATTTGATTTAAGAATTTCATTTTCATTTAATCGAAAAT------------------AAATAAAATTTTATTA--ATTTAATA
Ancistrocladus_robertsoniorum  AAATTTGATT-AAGAATTTCATTTTCATTTAATAGAAAATTTTCATTTAATAGAAAATAAATCAAATTTCATTA--ATTTAATA
Dionaea_muscipula              ------------------------------------------------------------------------------------
Dioncophyllum_thollonii        -----------------------------------------------------------------ATTTAATTA--ATTTAATA
Drosera_binata                 ------------------------------------------------------------------------------------
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  ------------------------------------------------------------------------------------
Drosera_rotundifolia           CCTTCCCCCTGAATTTGACAAAGAAAGAAGGGGGAGGTCCCCTCCCCGTTCAATTCCTTTTTGTTATCTTGTCTGATCCTGTTT
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       -------------GACCTTTTTTCTTATTTAATTGAAA--TTTC------------------AGAATTTCATTGTCATTTAATC
Nepenthes_alata                ------------------------------------------------------------------------------------
Nepenthes_albomarginata        ------------------------------------------------------------------------------------
Nepenthes_boschiana            ------------------------------------------------------------------------------------
Nepenthes_fusca                ------------------------------------------------------------------------------------
Nepenthes_glandulifera         ------------------------------------------------------------------------------------
Nepenthes_gracillima           ------------------------------------------------------------------------------------
Nepenthes_gymnamphora          ------------------------------------------------------------------------------------
Nepenthes_hirsuta              ------------------------------------------------------------------------------------
Nepenthes_insignis             ------------------------------------------------------------------------------------
Nepenthes_macfarlanei          ------------------------------------------------------------------------------------
Nepenthes_maxima               ------------------------------------------------------------------------------------
Nepenthes_mirabilis            ------------------------------------------------------------------------------------
Nepenthes_northiana            ------------------------------------------------------------------------------------
Nepenthes_rafflesiana          ------------------------------------------------------------------------------------
Nepenthes_reinwardtiana        ------------------------------------------------------------------------------------
Nepenthes_sanguinea            ------------------------------------------------------------------------------------
Nepenthes_singalana            ------------------------------------------------------------------------------------
Nepenthes_spectabilis          ------------------------------------------------------------------------------------
Nepenthes_tentaculata          ------------------------------------------------------------------------------------
Nepenthes_tobiaca              ------------------------------------------------------------------------------------
Nepenthes_truncata             ------------------------------------------------------------------------------------
Nepenthes_ventricosa           ------------------------------------------------------------------------------------
Nepenthes_vieillardii          ------------------------------------------------------------------------------------
Triphyophyllum_peltatum        -----------------------------------------------------------------ATTTAATTA--ATTTAATA
```

```
                                   2,610     2,620     2,630     2,640     2,650     2,660     2,670     2,680
Aldrovanda_vesiculosa              ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus         ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri             AATTCT-ATTTTCATTTTCTATTCTATTTCTATTCTATTTCTATACTATTTTCTAAATAGTATAGAAATAG-------------
Ancistrocladus_benomensis          -ATTCT-CT-TTCA-TTT-T-----------ATTCTATTTCTATACTATTTTCTAAATAGT-TAGAAATAGAAA--------CT
Ancistrocladus_cochichinensis      AATTCG-ATTTTCATTTTCTATTCTATTTCTATTCTATTTCTATACTATTTAGGAAATAGTATAGAAATAG-------------
Ancistrocladus_congolensis         ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus        AATTCT-ATTTTCATTTTCTATTCTATTTCTATTCTATTTCTATACCATTTTCTAAATAGTATAGAAATAGAAATTCGATTTCT
Ancistrocladus_guineensis          AATTCT-ATTTTCATTTTCTATTCTATTTCTATTCTATTTCTATACTATTTTCTAAATAGTATAGAAATAGAAATTCGATTTCT
Ancistrocladus_hamatus             AATTCT-ATTTTCATTTTCTATTCTATTTCTATTCTATTTCTATACTATTTTCTAAATAG-ATAGAAATAG-------------
Ancistrocladus_heyneanus           AATTCT-ATTTTCATTTTCTATTCTATTTCTATT-----------CTATTTC----------TATAC-TA-----T---TTTCT
Ancistrocladus_korupensis          AATTCT-ATTTTCATTTTCTATTCTATTTCTATTCTATTTCTATACTATTTAGAAAATAGTATAGAAATAGAAATTCGATTTCT
Ancistrocladus_letestui            AATTCT-ATTTTCATTTTCTATTCTATTTCTATT-----TCTATACTATTTAGAAAATAGTATAGAAATAGAAATTCGATTTCT
Ancistrocladus_robertsoniorum      AATTCT-ATTTTCATTTTCTATTCTATTTCTATTCTATTTCTATACTATTTTCTAAATAGTATAGAAATAG-------------
Dionaea_muscipula                  ------------------------------------------------------------------------------------
Dioncophyllum_thollonii            GATTCT-ATTTTCATTTTCTATTCT-----------ATTTCTATACTATTTAGAAAATAGTATAGAAATAG-------------
Drosera_binata                     ------------------------------------------------------------------------------------
Drosera_capensis                   ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana                  ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri                  ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia               ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii                 ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis                 ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea                   ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                      ------------------------------------------------------------------------------------
Drosera_rotundifolia               TGAAAGTTTTTGTTGATTAAGAATATTCTTCCTCGATAATCCCTTATTTTCAATTTGAAGAAAAAAGAAGGAATTGCTTGATGT
Drosera_slackii                    ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum           GATTTTGATTTTCGTTTTCTATTCTATA-CTATTTTGTTT------TATTTTGAAAATAGTATAGAA-TAGAAAACGAAAATGA
Nepenthes_alata                    ------------------------------------------------------------------------------------
Nepenthes_albomarginata            ------------------------------------------------------------------------------------
Nepenthes_boschiana                ------------------------------------------------------------------------------------
Nepenthes_fusca                    ------------------------------------------------------------------------------------
Nepenthes_glandulifera             ------------------------------------------------------------------------------------
Nepenthes_gracillima               ------------------------------------------------------------------------------------
Nepenthes_gymnamphora              ------------------------------------------------------------------------------------
Nepenthes_hirsuta                  ------------------------------------------------------------------------------------
Nepenthes_insignis                 ------------------------------------------------------------------------------------
Nepenthes_macfarlanei              ------------------------------------------------------------------------------------
Nepenthes_maxima                   ------------------------------------------------------------------------------------
Nepenthes_mirabilis                ------------------------------------------------------------------------------------
Nepenthes_northiana                ------------------------------------------------------------------------------------
Nepenthes_rafflesiana              ------------------------------------------------------------------------------------
Nepenthes_reinwardtiana            ------------------------------------------------------------------------------------
Nepenthes_sanguinea                ------------------------------------------------------------------------------------
Nepenthes_singalana                ------------------------------------------------------------------------------------
Nepenthes_spectabilis              ------------------------------------------------------------------------------------
Nepenthes_tentaculata              ------------------------------------------------------------------------------------
Nepenthes_tobiaca                  ------------------------------------------------------------------------------------
Nepenthes_truncata                 ------------------------------------------------------------------------------------
Nepenthes_ventricosa               ------------------------------------------------------------------------------------
Nepenthes_vieillardii              ------------------------------------------------------------------------------------
Triphyophyllum_peltatum            GATTCT-ATTTTCATTTTCTATTCG-----------ATTTCTATACTATTTTCTAAATAGTATAGAAATCG-------------
```

```
                               2,690     2,700     2,710     2,720     2,730     2,740     2,750     2,760     2,770
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri         -------------------AAATTAGAGATTTATTAAATAGTAATT------TCGTAAT-------------------------
Ancistrocladus_benomensis      ------------------------A--GATTTATTAAATAGTAATT------TAGTAAT-------------------------
Ancistrocladus_cochichinensis  -------------------AAATTAGAGATTTATTAAATAGTAATT------TATTAAT-------------------------
Ancistrocladus_congolensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus    AAATAGTATAGAAATAG--AAATTAGAGATTTATTAAATAGTAATT------TCGTAAT-------------------------
Ancistrocladus_guineensis      AAATAGTATAGAAATAG--AAATTAGAGATTTATTAAATAGTAATT------TCGTAAT-------------------------
Ancistrocladus_hamatus         -------------------AAATTAGAGATTTATTAAATAGTAATT------TATTAAT-------------------------
Ancistrocladus_heyneanus       AAATAGTATAGAAATAG--AAATTAGAGATTTATTAAATAGTAATT------TATTAAT-------------------------
Ancistrocladus_korupensis      AAATAGTATAGAAATAG--AAATTAGAGATTTATTAAATAGTAATTCCGTAATAGTAAT-------------------------
Ancistrocladus_letestui        AAATAGTATAGAAATAG--AAATTAGAGATTTATTAAATAGTAATT------TCGTAAT-------------------------
Ancistrocladus_robertsoniorum  -------------------AAATTAGAGATTTATTAA-TAGTAATT------TCTTAAT-------------------------
Dionaea_muscipula              ------------------------------------------------------------------------------------
Dioncophyllum_thollonii        -------------------AAATTAGAGATTTATTAAATAGTAATT------TATTAAT-------------------------
Drosera_binata                 -----------------------------------------------------------------------------GAAGG--
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  -----------------------------------------------------------------------------GAAGG--
Drosera_rotundifolia           TATGAAAGACACAATATAGAGAGGGATCTTTTTGATCTTCATCGTCCCCCATTTCTACGATTGC????????????????????
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       GAGATTTTTTGAATTATCTAAATT--CGATTTATGAAATTGAAATA--------GTAATTTATGAAATTAAATAGTC-------
Nepenthes_alata                -----------------------------------------------------------------------------AAAGGTA
Nepenthes_albomarginata        -----------------------------------------------------------------------------AAAGGTA
Nepenthes_boschiana            -----------------------------------------------------------------------------AAAGGTA
Nepenthes_fusca                -----------------------------------------------------------------------------AAAGGTA
Nepenthes_glandulifera         -----------------------------------------------------------------------------AAAGGTA
Nepenthes_gracillima           -----------------------------------------------------------------------------AAAGGTA
Nepenthes_gymnamphora          -----------------------------------------------------------------------------AAAGGTA
Nepenthes_hirsuta              -----------------------------------------------------------------------------AAAGGTA
Nepenthes_insignis             -----------------------------------------------------------------------------AAAGGTA
Nepenthes_macfarlanei          -----------------------------------------------------------------------------AAAGGTA
Nepenthes_maxima               -----------------------------------------------------------------------------AAAGGTA
Nepenthes_mirabilis            -----------------------------------------------------------------------------AAAGGTA
Nepenthes_northiana            -----------------------------------------------------------------------------AAAGGTA
Nepenthes_rafflesiana          -----------------------------------------------------------------------------AAAGGTA
Nepenthes_reinwardtiana        -----------------------------------------------------------------------------AAAGGTA
Nepenthes_sanguinea            -----------------------------------------------------------------------------AAAGGTA
Nepenthes_singalana            -----------------------------------------------------------------------------AAAGGTA
Nepenthes_spectabilis          -----------------------------------------------------------------------------AAAGGTA
Nepenthes_tentaculata          --------------------------------------------------------------------------------G-TA
Nepenthes_tobiaca              -----------------------------------------------------------------------------AAAGGTA
Nepenthes_truncata             -----------------------------------------------------------------------------AAAGGTA
Nepenthes_ventricosa           -----------------------------------------------------------------------------AAAGGTA
Nepenthes_vieillardii          -----------------------------------------------------------------------------AAAGGTA
Triphyophyllum_peltatum        -------------------AAATTAGAGATTTATTAAATAGTAATC------TATTAAT-------------------------
```

```
                                      2,780     2,790     2,800     2,810     2,820     2,830     2,840     2,850
                                        |         |         |         |         |         |         |         |
Aldrovanda_vesiculosa           ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri          ------------------------------------------------------------------------------------
Ancistrocladus_benomensis       ------------------------------------------------------------------------------------
Ancistrocladus_cochichinensis   ------------------------------------------------------------------------------------
Ancistrocladus_congolensis      ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus     ------------------------------------------------------------------------------------
Ancistrocladus_guineensis       ------------------------------------------------------------------------------------
Ancistrocladus_hamatus          ------------------------------------------------------------------------------------
Ancistrocladus_heyneanus        ------------------------------------------------------------------------------------
Ancistrocladus_korupensis       ------------------------------------------------------------------------------------
Ancistrocladus_letestui         ------------------------------------------------------------------------------------
Ancistrocladus_robertsoniorum   ------------------------------------------------------------------------------------
Dionaea_muscipula               ------------------------------------------------------------------------------------
Dioncophyllum_thollonii         ------------------------------------------------------------------------------------
Drosera_binata                  TCTTTTTT---------------------------------------------------------AAT-AGAATTTTTTTTTTA
Drosera_capensis                ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana               ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri               ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia            ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii              ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis              ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea                ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                   TCTTTTTT------------------------------TTTTATTAAATAGATAAATTAGAT--AAAT-AGATTTTCTTTCATA
Drosera_rotundifolia            ????????????????????????????????????????????????????????????????????????????????????
Drosera_slackii                 ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum        ------------------------------------------------------------------------------------
Nepenthes_alata                 TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATC
Nepenthes_albomarginata         TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATC
Nepenthes_boschiana             TCTTTTTTAAAATATACAT-----ATAGATCATCTATTTAATAAAAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_fusca                 TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTAATAAAAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATC
Nepenthes_glandulifera          TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATC
Nepenthes_gracillima            TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_gymnamphora           TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_hirsuta               TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTAATAAAAA?????????????????????????????????????
Nepenthes_insignis              TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_macfarlanei           TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_maxima                TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTAATAAAAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_mirabilis             TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_northiana             TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTAATAAAAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_rafflesiana           TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_reinwardtiana         TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTAATAAAAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_sanguinea             TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATC
Nepenthes_singalana             TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_spectabilis           TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATC
Nepenthes_tentaculata           TATTTTTAAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_tobiaca               TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_truncata              TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTTTTAAAAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Nepenthes_ventricosa            TCTTTTTTAAAATATACATTACATATAGATAATCTATTTTTTATTAAATAGATTATCTATTTCTAAATGCGAATTCTATTT---
Nepenthes_vieillardii           TCTTTTTTAAAATATACAT-----ATAGATAATCTATTTAATAAAAAATAGATTATCTATTTCTAAATGAGAATTCTATTTATA
Triphyophyllum_peltatum         ------------------------------------------------------------------------------------
```

```
                                2,860     2,870     2,880     2,890     2,900     2,910     2,920     2,930     2,940
Aldrovanda_vesiculosa          ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_barteri         ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATCAATTC--TGTACT
Ancistrocladus_benomensis      ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATCAATTG--TGTACT
Ancistrocladus_cochichinensis  ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATAAATTC--TGTACT
Ancistrocladus_congolensis     ????????????????????????????????????????????????????????????????????????????????????
Ancistrocladus_grandiflorus    ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATCAATTC--TGTACT
Ancistrocladus_guineensis      ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATCAATTC--TGTACT
Ancistrocladus_hamatus         ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATAAATTC--TGTACT
Ancistrocladus_heyneanus       ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATAAATTC--TGTACT
Ancistrocladus_korupensis      ---------------------------------AGTAATTAGCTAATAGCATAGCATAAAAGAAAGAAATCAATTC--TGTACT
Ancistrocladus_letestui        ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAACCAATTC????????
Ancistrocladus_robertsoniorum  ---------------------------------AGTAATTAGCTAATAGCATAGC?????????????????????????????
Dionaea_muscipula              ---------------------------------AGAAATTAGCTAAT--------AGAAAAGAAAT----CGCTTCGGTACCGA
Dioncophyllum_thollonii        ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATCGATTC--TGTACT
Drosera_binata                 TA--A-TTTAGAAAA--TC--TAAAAAAA-------AATTAGCTAA-----T---AGAAAAGGAAT----CGCTTCC-TAGAGT
Drosera_capensis               ????????????????????????????????????????????????????????????????????????????????????
Drosera_dielsiana              ????????????????????????????????????????????????????????????????????????????????????
Drosera_falconeri              ????????????????????????????????????????????????????????????????????????????????????
Drosera_graminifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_hamiltonii             ????????????????????????????????????????????????????????????????????????????????????
Drosera_nidiformis             ????????????????????????????????????????????????????????????????????????????????????
Drosera_paleacea               ????????????????????????????????????????????????????????????????????????????????????
Drosera_regia                  TTTTATTTCATATAAAATTTTGATTTAGACTTTCTAAATTCGAAAAGAA--T---AGAAAAGAAAT----CGCTTCT-----GT
Drosera_rotundifolia           ????????????????????????????????????????????????????????????????????????????????????
Drosera_slackii                ????????????????????????????????????????????????????????????????????????????????????
Drosophyllum_lusitanicum       ---------------------------------A--AATTAGCTAATAGCATAGCAGAAAAGAAATAAATTGATTT---GT--T
Nepenthes_alata                -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_albomarginata        -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_boschiana            -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_fusca                -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_glandulifera         -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_gracillima           -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_gymnamphora          -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTT--TATACT
Nepenthes_hirsuta              ????????????????????????????????????????????????????????????????????????????????????
Nepenthes_insignis             -TA---TTTATAAA--TTC--TTAAATAGTCT-AGTATTTAGCTAA-----TAGCAGAAAAGAAAGAAATCGATTC--TATACT
Nepenthes_macfarlanei          -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_maxima               -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_mirabilis            -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_northiana            -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_rafflesiana          -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_reinwardtiana        -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_sanguinea            -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_singalana            -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_spectabilis          -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_tentaculata          -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_tobiaca              -TA---TTTAGAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_truncata             -TA---TTTATAAA--TTC--TTAAATAGTAG-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_ventricosa           --------T-TAAA--TTC--TTAAATAGTCT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Nepenthes_vieillardii          -TA---TTTATAAA--TTC--TTAAATAGTAT-AGTATTTAGCTAA-----TAGCAGAAAAGAAATAAATCGATTC--TATACT
Triphyophyllum_peltatum        ---------------------------------AGTAATTAGCTAATAGCATAGCAGAAAAGAAAGAAATAGATTC--TGTACT
```

```
                                    2,950      2,960      2,970      2,980      2,990      3,000      3,010      3,020
                                        |          |          |          |          |          |          |          |
Aldrovanda_vesiculosa           ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Ancistrocladus_abbreviatus      ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Ancistrocladus_barteri          -GTAT CTATG TATTC TTTAT CCCTA CAAAA TATCA GACAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAATT CTTTG ATTG
Ancistrocladus_benomensis       -AGAT CTATG TATTC TTTAT CCCTA CAAAA TA-CA GAGAA AA-TA CAATG AT-T- AGAAG GGATA TAATG AAATT CTTTG AGTG
Ancistrocladus_cochichinensis   -GTAT CTATG TATTC TTTAT CCCTA CAAAA TATCA GACAA AA-TA GAACG ATCTT AGAAG GGA?? ????? ????? ????? ????
Ancistrocladus_congolensis      ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Ancistrocladus_grandiflorus     -GTAT CTATG TATTC TTTAT CCCTA CAAAA TATCA GACAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAATT CTTTG ATTG
Ancistrocladus_guineensis       -GTAT CTATG TATTC TTTAT CCCTA CAAAA TATCA GACAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAATT CTTTG ATTG
Ancistrocladus_hamatus          -GTAT CTATG TATTC TTTAT CCCTA CAAAA TATCA GACAA AA-TA GAACG ATCTG AGAA? ????? ????? ????? ????? ????
Ancistrocladus_heyneanus        -GTAT CTATG TATTC TTTAT CCCTA CAAAA TATCA GACAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAAT? ????? ????
Ancistrocladus_korupensis       -GTAT CTATG TATTA TTTAT CCCTA CAAAA TATCA GACAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAATT CTTTG ATTG
Ancistrocladus_letestui         ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Ancistrocladus_robertsoniorum   ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Dionaea_muscipula               ACTCC CTAT- --TT- TTTAT GCCTA CCAAA TATCG GACAA AA-TA GAACG ATCTG AGAGG GGATA TAATG AAATT CTTTG ATTG
Dioncophyllum_thollonii         -CTAT CTATG TATTC TTTAT CCCTA CAAAA TATCA GACAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAATT CTTTG ATTG
Drosera_binata                  -CTC- CTAT- --TT- TTTTT GCCTA CGAAA TATCG GACAA AA-TA GAA-- ---TG AG--G GGATA TAATG AAATT CTTTG ATTG
Drosera_capensis                ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Drosera_dielsiana               ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Drosera_falconeri               ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Drosera_graminifolia            ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Drosera_hamiltonii              ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Drosera_nidiformis              ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Drosera_paleacea                ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Drosera_regia                   ACTG- -GAT- --TT- --TAT GCCTA CGAAA TATCG GACAG AA--C GATTT GG--G AG--G GGATA TAATG AAATT CTTTG ATTG
Drosera_rotundifolia            ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Drosera_slackii                 ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Drosophyllum_lusitanicum        -GTAT CTATG TATTC TGTAT CCCTA CAAAA TATTC GACAA AA-TA GAA-G ATTTG AGAAG GGATA TAATG AAATT CTTTA ATTG
Nepenthes_alata                 -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_albomarginata         -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_boschiana             -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_fusca                 -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_glandulifera          -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_gracillima            -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_gymnamphora           -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_hirsuta               ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????? ????
Nepenthes_insignis              -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA AAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_macfarlanei           -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_maxima                -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_mirabilis             -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_northiana             -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_rafflesiana           -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATTTG AGA-G GGATA TAATG AAATT CTTTG AT??
Nepenthes_reinwardtiana         -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_sanguinea             -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATTTG AGAAG GGATA TAATG GAATT CTTGG ATGG
Nepenthes_singalana             -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_spectabilis           -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_tentaculata           -CTAT CTATG TAGTC TTTAT ACCTA CGAAA TACCA GAAAA AAATA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_tobiaca               -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_truncata              -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_ventricosa            -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCA GAAAA AA-TA AAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Nepenthes_vieillardii           -CTAT CTATG TATTC TTTAT ACCTA CGAAA TACCC GAAAA AA-TA GAACG ATATG AGAAG GGATA TAATG AAATT CTTTG ATTG
Triphyophyllum_peltatum         -CTAT CTATG TATTC TTTAT CCCTA CAAAA TATTA GACAA AA-TA GAACG ATCTG AGAAG GGATA TAATG AAATC CTTTG ATTG
```

```
                                   3,030     3,040     3,050     3,060     3,070 3,075
                                       |         |         |         |         |    |
Aldrovanda_vesiculosa          ???????????????????????????????????????????????????
Ancistrocladus_abbreviatus     ???????????????????????????????????????????????????
Ancistrocladus_barteri         GTTCTTCCCAGAGCAATGATACCATTTTATTT-G-----ATTAATGGGACC
Ancistrocladus_benomensis      GATCTTTCCAGAGCAATGATACCATTTTACTTTG-----ATTAATGGGACC
Ancistrocladus_cochichinensis  ???????????????????????????????????????????????????
Ancistrocladus_congolensis     ???????????????????????????????????????????????????
Ancistrocladus_grandiflorus    GTTCTTCCCAGAGCAATGATACCATTTTATTT-G-----ATTAATGGGACC
Ancistrocladus_guineensis      GTTCTTCCCAGAGCAATGATACCATTTTATTT-G-----ATTAACGGGACC
Ancistrocladus_hamatus         ???????????????????????????????????????????????????
Ancistrocladus_heyneanus       ???????????????????????????????????????????????????
Ancistrocladus_korupensis      GTTCTTCCCAGAGCAATGATACCATTTTATTT-G-----ATTAATGGGACC
Ancistrocladus_letestui        ???????????????????????????????????????????????????
Ancistrocladus_robertsoniorum  ???????????????????????????????????????????????????
Dionaea_muscipula              GTTCTTTTCAGAGCAATCATCGCATTTTTTTT-GCTTTTCCAGATGGGACC
Dioncophyllum_thollonii        GTTCTCC????????????????????????????????????????????
Drosera_binata                 GTTCTTTTCAGAGCAATGATCACATTTTATTT-GCTTTGCCTGATGGGACC
Drosera_capensis               ???????????????????????????????????????????????????
Drosera_dielsiana              ???????????????????????????????????????????????????
Drosera_falconeri              ???????????????????????????????????????????????????
Drosera_graminifolia           ???????????????????????????????????????????????????
Drosera_hamiltonii             ???????????????????????????????????????????????????
Drosera_nidiformis             ???????????????????????????????????????????????????
Drosera_paleacea               ???????????????????????????????????????????????????
Drosera_regia                  GTTCTTTTCAGAGCAATGATCAC----TATTT-GCTTTGCCTGATGGGACC
Drosera_rotundifolia           ???????????????????????????????????????????????????
Drosera_slackii                ???????????????????????????????????????????????????
Drosophyllum_lusitanicum       GTTCTTCCCTCTTCCC???????????????????????????????????
Nepenthes_alata                GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_albomarginata        GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGACCC
Nepenthes_boschiana            GTTCTTCCC??????????????????????????????????????????
Nepenthes_fusca                GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_glandulifera         GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGA???????
Nepenthes_gracillima           GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_gymnamphora          GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_hirsuta              ???????????????????????????????????????????????????
Nepenthes_insignis             GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_macfarlanei          GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_maxima               GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_mirabilis            GTTCTTCCCAGAGCA-TGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_northiana            GTTCTTCCCAGAGCAATGATCCCA???????????????????????????
Nepenthes_rafflesiana          ???????????????????????????????????????????????????
Nepenthes_reinwardtiana        GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGACCC
Nepenthes_sanguinea            GTTCTTCCCAGAGCA-TGATCC-ATTTTATT--G-----ACTGATGGACCC
Nepenthes_singalana            GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGACC?
Nepenthes_spectabilis          GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_tentaculata          GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_tobiaca              GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_truncata             GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_ventricosa           GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Nepenthes_vieillardii          GTTCTTCCCAGAGCAATGATCCCATTTTATTT-G-----ACTGATGGAACC
Triphyophyllum_peltatum        GTTCTTCCCAGAGCAATGATACCATTTTATTT-G-----ATTGATGGGACC
```

A.4

Voucher information for collected specimens utilized in chapter 2

Voucher information includes the names of taxa from which class I chitinases were amplified for this study, details of the tissue collection, and herbaria where the vouchers have been deposited. Greenhouse-grown specimens cultivated at the Botanical Gardens of the University of California, Berkeley (UCBG), Missouri Botanical Garden (MO) or Botanischer Garten der Universität Würzberg (BGW). Voucher specimens are deposited in the following herbaria: Missouri Botanical Garden = MO, The University and Jepson Herbaria of the University of California, Berkeley = UC, Universität Würzberg = UW.

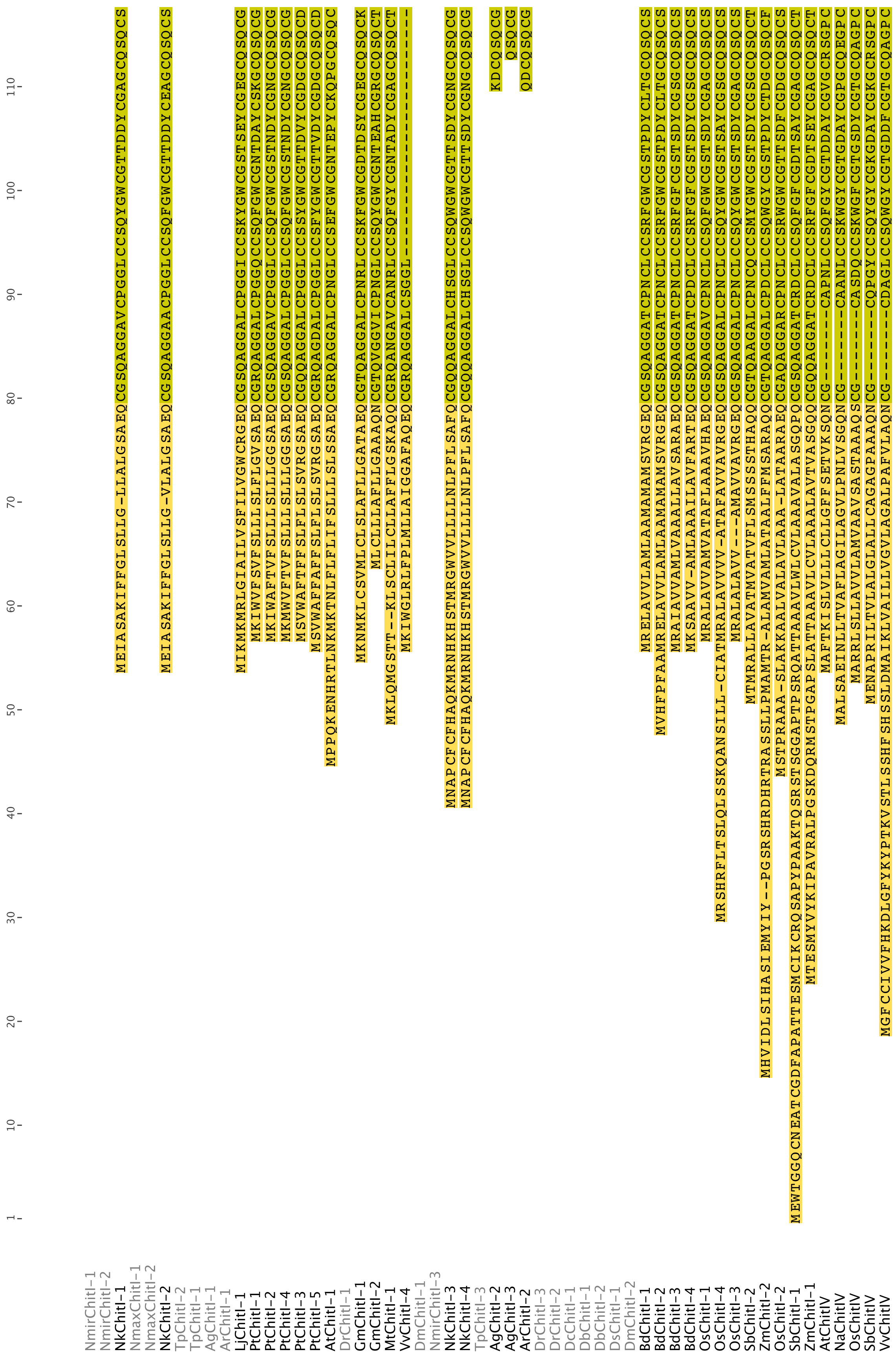
Taxon; Voucher specimen or living collection number; DNA collection number; Collection locale; Herbarium.

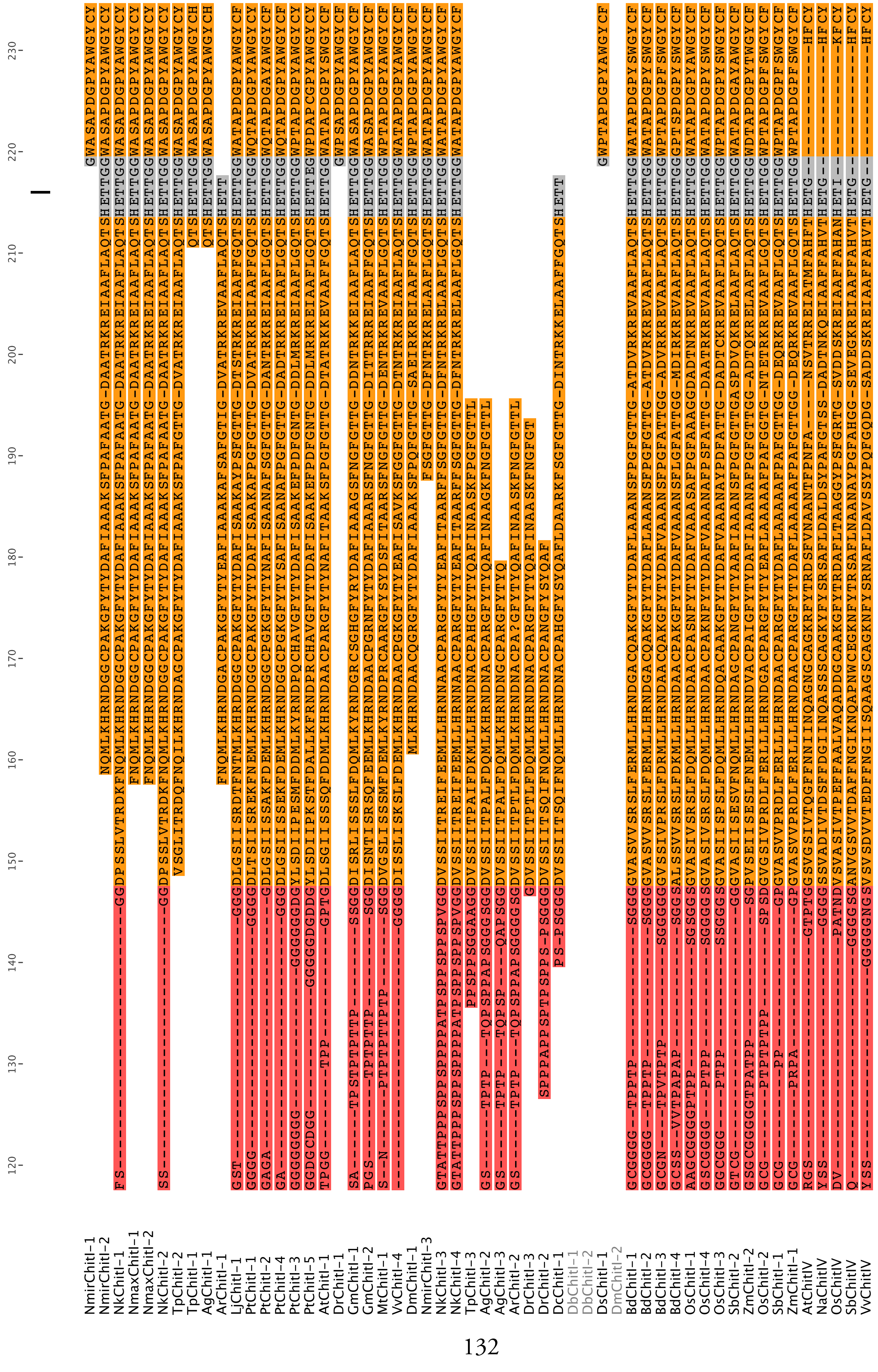
Ancistrocladus grandiflorus; R.E. Gereau 5557; TR122; MO cultivated; MO.
Ancistrocladus robertsoniorum; K.M. Meyer 277; TR124; MO cultivated; MO.
Dionaea muscipula; 2009.0254; TR186; UCBG cultivated; UC.
Drosera binata; 2001.0104; TR03; UCBG cultivated; UC.
Drosera capensis; 69.0172; TR05; UCBG cultivated; UC.
Nepenthes maxima; 76.1342; TR22; UCBG cultivated; UC.
Nepenthes mirabilis; 95.1378; TR23; UCBG cultivated; UC.
Triphyophyllum peltatum; UW plant culture; TR121; BGW cultivated.

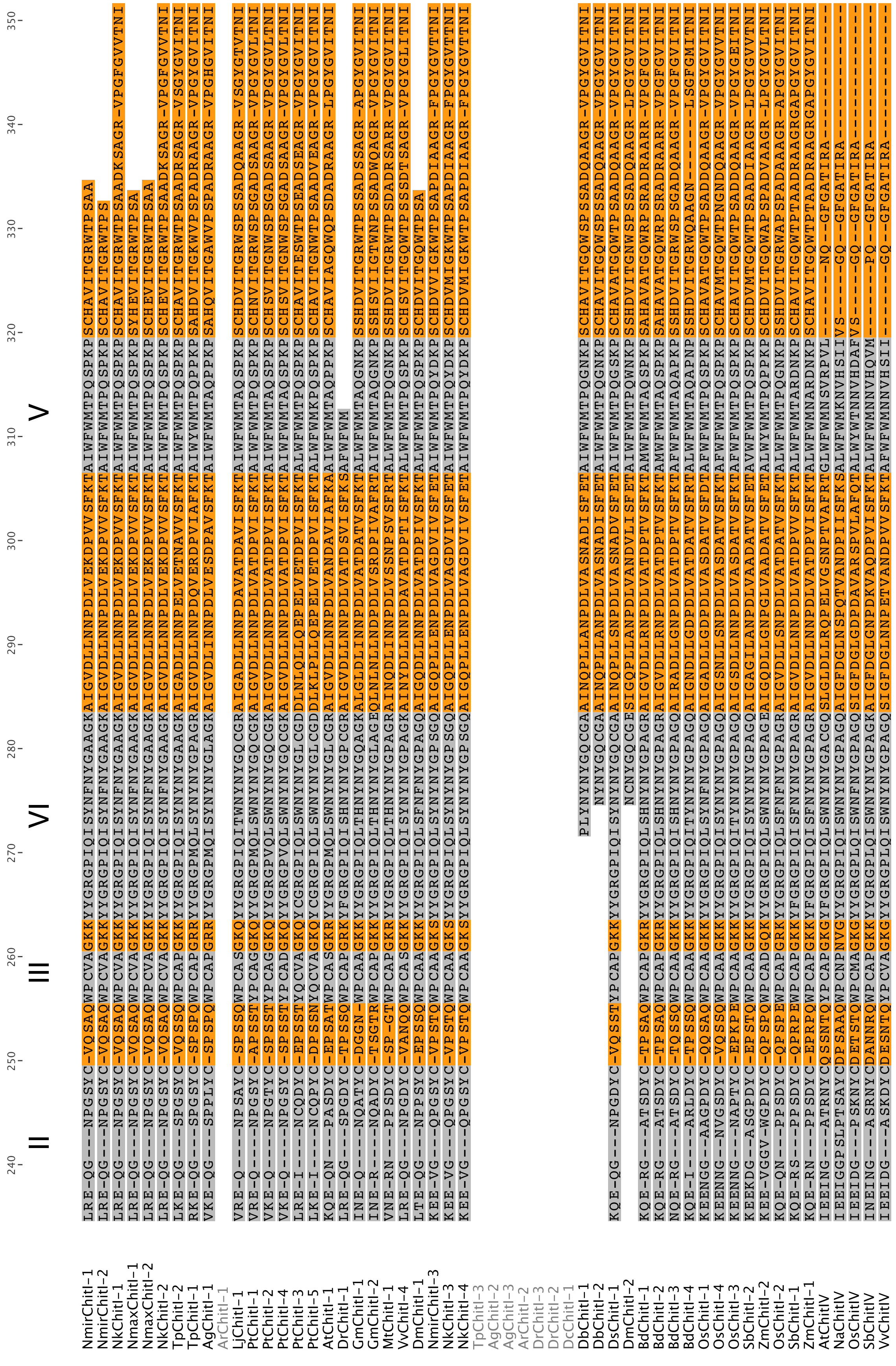
A.5

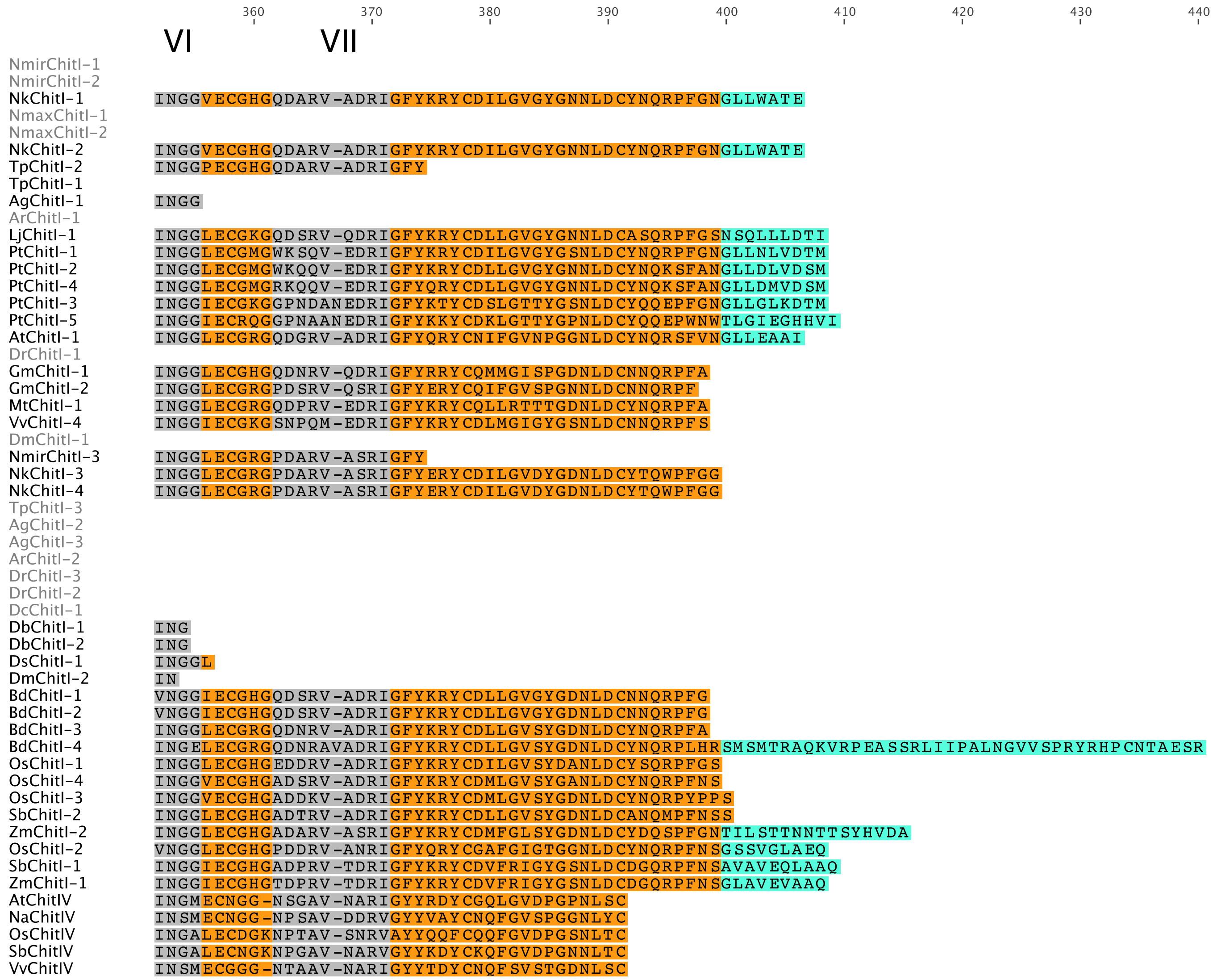
Multiple sequence alignment of translated CDS for angiosperm class I chitinases

The following four pages consist of a multiple sequence alignment of translated CDS for angiosperm class I and IV chitinase homologs identified. Chitinase sequences are grouped based on phylogenetic placement in figure 2.1. Colors highlight the following chitinase domains: yellow, signal peptide; green, cysteine-rich domain; red, proline-rich hinge; orange, catalytic domain; cyan, CTE. The seven active sites (I-VII) of the catalytic domain are indicated above the alignment, which correspond to regions described by Garcia-Casado et al. (1998), Bishop et al. (2000), and Tiffen (2004). Poorly aligned regions (1-93, 116-148, 390-440) including the proline-rich hinge, N- and C- termini were removed for phylogenetic analyses (figs. 2.1 and 2.2). GAP = - and MISSING = ?


1
10
20
30
40
50
60
70
80
90
100
110
NmirChitI-1
NmirChitI-2
NkChitI-1
NmaxChitI-1
NmaxChitI-2
NkChitI-2
TpChitI-2
TpChitI-1
AgChitI-1
ArChitI-1
LjChitI-1
PtChitI-1
PtChitI-2
PtChitI-4
PtChitI-3
PtChitI-5
AtChitI-1
DrChitI-1
GmChitI-1
GmChitI-2
MtChitI-1
VvChitI-4
DmChitI-1
NmirChitI-3
NkChitI-3
NkChitI-4
TpChitI-3
AgChitI-2
AgChitI-3
ArChitI-2
DrChitI-3
DrChitI-2
DcChitI-1
DbChitI-1
DbChitI-2
DsChitI-1
DmChitI-2
BdChitI-1
BdChitI-2
BdChitI-3
BdChitI-4
OsChitI-1
OsChitI-4
OsChitI-3
SbChitI-2
ZmChitI-2
OsChitI-2
SbChitI-1
ZmChitI-1
AtChitIV
NaChitIV
OsChitIV
SbChitIV
VvChitIV


120
130
140
150
160
170
180
190
200
210
220
230
NmirChitI-1
NmirChitI-2
NkChitI-1
NmaxChitI-1
NmaxChitI-2
NkChitI-2
TpChitI-2
TpChitI-1
AgChitI-1
ArChitI-1
LjChitI-1
PtChitI-1
PtChitI-2
PtChitI-4
PtChitI-3
PtChitI-5
AtChitI-1
DrChitI-1
GmChitI-1
GmChitI-2
MtChitI-1
VvChitI-4
DmChitI-1
NmirChitI-3
NkChitI-3
NkChitI-4
TpChitI-3
AgChitI-2
AgChitI-3
ArChitI-2
DrChitI-3
DrChitI-2
DcChitI-1
DbChitI-1
DbChitI-2
DsChitI-1
DmChitI-2
BdChitI-1
BdChitI-2
BdChitI-3
BdChitI-4
OsChitI-1
OsChitI-4
OsChitI-3
SbChitI-2
ZmChitI-2
OsChitI-2
SbChitI-1
ZmChitI-1
AtChitIV
NaChitIV
OsChitIV
SbChitIV
VvChitIV


240
250
260
270
280
290
300
310
320
330
340
350
II
III
VI
V
NmirChitI-1
NmirChitI-2
NkChitI-1
NmaxChitI-1
NmaxChitI-2
NkChitI-2
TpChitI-2
TpChitI-1
AgChitI-1
ArChitI-1
LjChitI-1
PtChitI-1
PtChitI-2
PtChitI-4
PtChitI-3
PtChitI-5
AtChitI-1
DrChitI-1
GmChitI-1
GmChitI-2
MtChitI-1
VvChitI-4
DmChitI-1
NmirChitI-3
NkChitI-3
NkChitI-4
TpChitI-3
AgChitI-2
AgChitI-3
ArChitI-2
DrChitI-3
DrChitI-2
DcChitI-1
DbChitI-1
DbChitI-2
DsChitI-1
DmChitI-2
BdChitI-1
BdChitI-2
BdChitI-3
BdChitI-4
OsChitI-1
OsChitI-4
OsChitI-3
SbChitI-2
ZmChitI-2
OsChitI-2
SbChitI-1
ZmChitI-1
AtChitV
NaChitV
OsChitV
SbChitV
VvChitV



```
NmirChitI-1
NmirChitI-2
NkChitI-1     INGGVECGHGQDARV-ADRIGFYKRYCDILGVGYGNNLDCYNQRPFGNGLLWATE
NmaxChitI-1
NmaxChitI-2
NkChitI-2     INGGVECGHGQDARV-ADRIGFYKRYCDILGVGYGNNLDCYNQRPFGNGLLWATE
TpChitI-2     INGGPECGHGQDARV-ADRIGFY
TpChitI-1
AgChitI-1     INGG
ArChitI-1
LjChitI-1     INGGLECGKGQDSRV-QDRIGFYKRYCDLLGVGYGNNLDCASQRPFGSNSQLLLDTI
PtChitI-1     INGGLECGMGWKSQV-EDRIGFYKRYCDILGVGYGSNLDCYNQRPFGNGLLNLVDTM
PtChitI-2     INGGLECGMGWKQQV-EDRIGFYKRYCDLLGVGYGNNLDCYNQKSFANGLLDLVDSM
PtChitI-4     INGGLECGMGRKQQV-EDRIGFYQRYCDLLGVGYGNNLDCYNQKSFANGLLDMVDSM
PtChitI-3     INGGIECGKGGPNDANEDRIGFYKTYCDSLGTTYGSNLDCYQQEPFGNGLLGLKDTM
PtChitI-5     INGGIECRQGGPNAANEDRIGFYKKYCDKLGTTYGPNLDCYQQEPWNWTLGIEGHHVI
AtChitI-1     INGGLECGRGQDGRV-ADRIGFYQRYCNIFGVNPGGNLDCYNQRSFVNGLLEAAI
DrChitI-1
GmChitI-1     INGGLECGHGQDNRV-QDRIGFYRRYCQMMGISPGDNLDCNNQRPFA
GmChitI-2     INGGLECGRGPDSRV-QSRIGFYERYCQIFGVSPGNNLDCNNQRPF
MtChitI-1     INGGLECGRGQDPRV-EDRIGFYKRYCQLLRTTTGDNLDCYNQRPFA
VvChitI-4     INGGIECGKGSNPQM-EDRIGFYKRYCDLMGIGYGSNLDCNNQRPFS
DmChitI-1
NmirChitI-3   INGGLECGRGPDARV-ASRIGFY
NkChitI-3     INGGLECGRGPDARV-ASRIGFYERYCDILGVDYGDNLDCYTQWPFGG
NkChitI-4     INGGLECGRGPDARV-ASRIGFYERYCDILGVDYGDNLDCYTQWPFGG
TpChitI-3
AgChitI-2
AgChitI-3
ArChitI-2
DrChitI-3
DrChitI-2
DcChitI-1
DbChitI-1     ING
DbChitI-2     ING
DsChitI-1     INGGL
DmChitI-2     IN
BdChitI-1     VNGGIECGHGQDSRV-ADRIGFYKRYCDLLGVGYGDNLDCNNQRPFG
BdChitI-2     VNGGIECGHGQDSRV-ADRIGFYKRYCDLLGVGYGDNLDCNNQRPFG
BdChitI-3     INGGLECGRGQDNRV-ADRIGFYKRYCDLLGVSYGDNLDCYNQRPFA
BdChitI-4     INGELECGRGQDNRAVADRIGFYKRYCDLLGVSYGDNLDCYNQRPLHRSMSMTRAQKVRPEASSRLIIPALNGVVSPRYRHPCNTAESR
OsChitI-1     INGGLECGHGEDDRV-ADRIGFYKRYCDILGVSYDANLDCYSQRPFGS
OsChitI-4     INGGVECGHGADSRV-ADRIGFYKRYCDMLGVSYGANLDCYNQRPFNS
OsChitI-3     INGGVECGHGADDKV-ADRIGFYKRYCDMLGVSYGDNLDCYNQRPYPPS
SbChitI-2     INGGLECGHGADTRV-ADRIGFYKRYCDLLGVSYGDNLDCANQMPFNSS
ZmChitI-2     INGGLECGHGADARV-ASRIGFYKRYCDMFGLSYGDNLDCYDQSPFGNTILSTTNNTTSYHVDA
OsChitI-2     VNGGLECGHGPDDRV-ANRIGFYQRYCGAFGIGTGGNLDCYNQRPFNSGSSVGLAEQ
SbChitI-1     INGGIECGHGADPRV-TDRIGFYKRYCDVFRIGYGSNLDCDGQRPFNSAVAVEQLAAQ
ZmChitI-1     INGGIECGHGTDPRV-TDRIGFYKRYCDVFRIGYGSNLDCDGQRPFNSGLAVEVAAQ
AtChitIV      INGMECNGG-NSGAV-NARIGYYRDYCGQLGVDPGPNLSC
NaChitIV      INSMECNGG-NPSAV-DDRVGYYVAYCNQFGVSPGGNLYC
OsChitIV      INGALECDGKNPTAV-SNRVAYYQQFCQQFGVDPGSNLTC
SbChitIV      INGALECNGKNPGAV-NARVGYYKDYCKQFGVDPGNNLTC
VvChitIV      INSMECGGG-NTAAV-NARIGYYTDYCNQFSVSTGDNLSC
```