Title

Insect Biodiversity and Assessment of Herbivory in Native and Non-Native Plants in Mo'orea, French Polynesia

Author

Prado, Erin M.

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INSECT BIODIVERSITY AND ASSESSMENT OF HERBIVORY IN NATIVE AND NON-NATIVE PLANTS IN MO'OREA, FRENCH POLYNESIA

ERIN M. PRADO

Integrative Biology, University of California, Berkeley, California 94720 USA

Abstract. The objective of this study was to determine if the distribution of insect species and presence of herbivory differed between native and non-native plants in the coastal region of Mo'orea, French Polynesia. Therefore, four native plant species (*Barringtonia asiatica, Hibiscus tiliaceus, Terminalia catappa, Thespesia populnea)* and four non-native plant species *(Carica papaya, Mangifera spp., Morinda citrifolia, Musa spp.)* were sampled. Each collected insect was tested for herbivory, and placed in a cup with a 2X1in. piece of undamaged leaf from the tree it was found and frequently checked for damage. Significantly greater insect species abundance was found on native plants compared to non-native plants (p=0.0431). No significant difference was found in richness (p=0.6409) or diversity (p=0.8451) between native and non-native plants. Significantly more herbivory damage was observed on the whole tree in native plants (p=0.0001). The herbivory trials found more cases of herbivory damage in non-native plants compared to native plants, 14 cases and 10 cases respectively, but more total area damaged in native plants compared to non-native plants, with 5.015% and 4.18% damage respectively. No significant differences were found between abundance and height of sampling, richness and height of sampling, or diversity and height of sampling (p=0.1108, 0.0933, and 0.07695). No significant differences were found between abundance and tree height, richness and tree height, or diversity and tree height (p=0.5305, 0.6156, 0.7805). The results show that there is more insect abundance and more herbivory damage in native plants, suggesting that generalist herbivores are feeding on non-native plants while specialist and generalist herbivores are feeding on native plants.

Key words: insects; community structure, herbivory, French Polynesia, Barringtonia asiatica, Carica papaya, Hibiscus tiliaceus, Mangifera spp., Morinda citrifolia, Musa spp., Terminalia catappa, Thespesia populnea.

INTRODUCTION

Whether or not intended, increased trade and transportation has resulted in more plants being introduced to foreign areas of the world. Many non-native plant species have been found to exhibit greater abundance in new environments, causing serious environmental and economic concern (Bossdorf 2005; Pimentel 2005). Most notably, non-native species are considered the second most common cause for loss of native biodiversity (Wilcove et al. Al. 1998). The success of non-native plants may be explained by the Enemy Release Hypothesis.

The Enemy Release Hypothesis predicts that in the absence of coevolved specialist herbivores and pathogens, plants will achieve greater growth, reproduction, and size than in their native range. Introduced plants are able to do better because the native plants that they are competing with are not free of their respective coevolved herbivores (Keane and Crawley 2002). Several studies have found support for the Enemy Release Hypothesis. For example, in a comparison of leaf herbivory between native and invasive woody plants on the tropical island of Mahe ́, the percentage of leaves affected by herbivores was significantly higher on native species than on invasive species due to specialist herbivores feeding on native plant species, with 50% and 27% leaf damage respectively (Hansjorn 2004). However, there are cases that contradict these results, with more herbivory damage observed in non-native plant species, making this controversial hypothesis worth testing (Agrawal 2003).

The differences in biodiversity and herbivore damage between native and non-native plant species have not yet been studied in the rich coastal region of Mo'orea, French Polynesia. Previous investigations in insect distribution have looked at pest populations on specific species of plants or assessed the total distribution of specific insect species (Lehr 2004; Tang 1999). One study looked at the distribution of invasive insect species across different habitats and found the Glassy-winged sharpshooter, *Homalodisca vitripennis,* to be the most abundant insect on all plant species, native and introduced alike (Weiss 2004). Since this study, a biocontrol protocol has been introduced and the Glassy-winged sharpshooter population has fallen by 90% as of August 2006 (Petit 10/02/06). Results from my study will update the information on insect species distribution in this region.

The purpose of this study is to evaluate the insect species composition, herbivory damage, and major herbivore species across native and introduced plant species in the coastal region of Mo'orea. I will observe the differences between four native plant species: *Thespesia populnea (*Miro*), Barringtonia asiatica (*Hutu*), Terminalia catappa (*Autaraa Maohi*), and Hibiscus tiliaceus (*Purau*),* and on four non-native plant species that co-exist in the same coastal habitat, including *Mangifera spp (*Vi Popaa: Mango*), Carica papaya (*Iita: Papaya*), Musa spp. (*Meia: Banana*),* and *Morinda citrifolia* (Nono*).* I hypothesize that there will be a difference in species composition of insect communities and presence of herbivory between native and non-native plants, with more insect biodiversity and herbivory on native plant species. The results of this study will reveal the insect species distribution in this region, and provide a case study to support or reject the Enemy Release Hypothesis.

METHODS

Study site

Data assessing species composition of insect communities and presence of herbivory was collected from eight plant species in the coastal region of Moorea, French Polynesia (Fig. 1) located at approximately 17°29'18" S and 149°43'38" W between the dates of October 10^{th} and November 17^{th}, 2006. Data was compared between four native plant species and four introduced plant species (see introduction) that have been cultivated in the same coastal region. Two sites were used in this study, including a stretch of coastal strand south of the UCB Gump Research Station located in the northwest corner of Cook's Bay (Fig. 2), and a plot of land belonging to Marimari Kellum located in the southeast corner of Opunohu Bay (Fig. 3). The habitat of the two sites varied slightly with Site 2 having more canopy cover than Site 1, however both are characteristic of Moorea's coastal region with rich soil and a varied composition of native and introduced plant species.

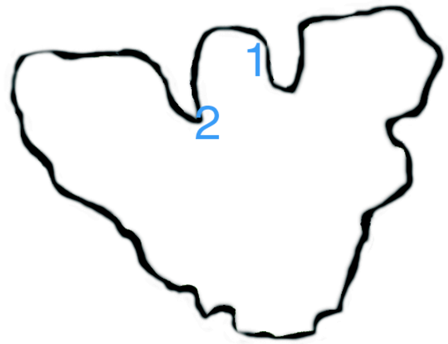

FIG.1. Sites sampled in this study. Site 1: Northwest corner of Cook's Bay, Site 2: Southeast corner of Opunohu Bay.

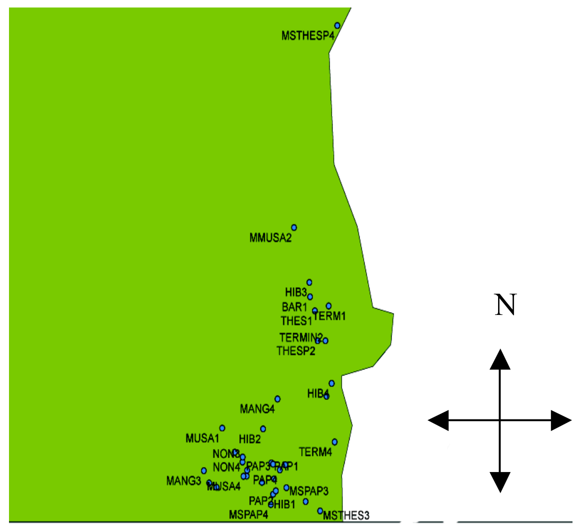

FIG. 2. Site 1: NW corner of Cook's Bay, property of Richard B. Gump Research Station.

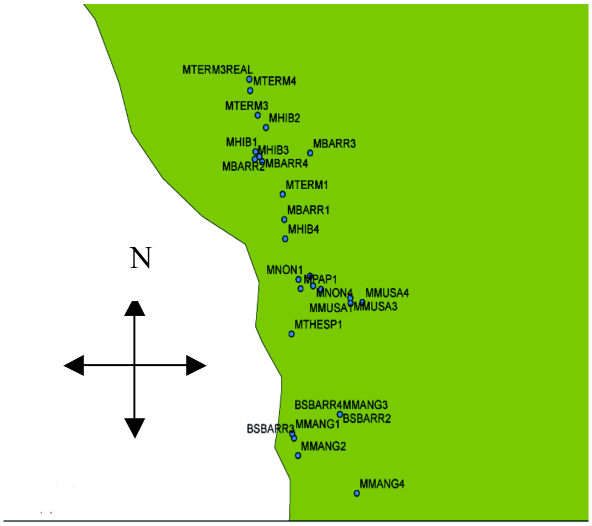

FIG.3. Site 2: SW corner of Opunohu Bay, property of Marimari Kellum.

Experimental design

A preliminary survey was conducted along the coast of Mo'orea to observe locations with multiple native and introduced plant species coexisting in the same habitat. Eight plant species were chosen due to their abundance along the coastal strand and similarity in height and leaf size. Two sites were selected based on the presence of at least four individuals of each plant species of interest to this study. Individuals were chosen to sample in order to have the shortest distance between the two vegetation types, native and introduced.

Sampling method

Each individual tree (n=64) was sampled once for ten minutes with a sweep net. Insects were collected from low and high vegetation in the tree and separated into these categories. Five minutes were allotted for sampling the low vegetation (0-6ft) with ten seconds spent sampling each branch. Five minutes were spent sampling the high vegetation (6ft-+) with ten seconds spent sampling each branch. If a tree had no low vegetation, that is, it's lowest branches were above 6ft, ten minutes were designated for sampling the vegetation and the insects collected were placed into the high category only. Insects were separated into different compartments in a Petri dish and observed under a light microscope for identification. Johnson's sixth edition (1989) was used to identify insects to family, while Renaud (2003) was used to identify insects to species. The diameter at breast height (DBH) and height of each tree was measured. DBH was measured in centimeters with measuring tape. The height of each tree was measured in centimeters by taking a picture with a scale of a known height next to the tree, and using Digimizer (MedCalc 2005) to measure the tree relative to the scale.

Data on the presence of herbivory were collected from each sampled tree. Total visible herbivore damage (ie. holes) was quantified and placed into one of four categories: 1:0-25%, 2:26-50%, 3:51-75%, and 4:76-100% herbivory damage. Herbivory trials were conducted as well, with each live insect collected from an individual tree being placed into a clear cup with a perforated lid. A 2X1 inch portion of a fresh, undamaged leaf from the tree the insect was collected was placed in the cup with the insect, and the leaf was continuously checked for herbivory damage and other forms of damage, such as tearing. The damaged area on the leaf, if any, was measured as a percentage of total area using Adobe Photoshop. Using the wand tool, the color of the leaf was separated from the white backdrop. The leaf without the damaged area was highlighted and a histogram was produced, showing the number of pixels the leaf was after damage. Then the holes were filled in, and another histogram was made, showing the number of pixels the leaf was before damage. The number of pixels after damage was divided by the number of pixels before damage to yield a percentage of total area damaged.

Data analysis

The Shannon-Weiner index of biodiversity was used to quantify the insect diversity of each tree, testing both insect richness and evenness (Shannon, C; Weiner 1953). Differences in insect species abundance, richness, and diversity between native and introduced plants were tested for significance. The data failed a test for normality and equal variance, so a nonparametric test was used to assess significance in difference. A Wilcoxon rank sum test was run to test for differences in insect diversity, richness, and abundance between native and non-native trees. A Kruskal-Wallace test was performed to test for differences between tree species. A Tukey HSD multiple comparison test was used to identify significantly different groups. A linear regression test was used to test correlations between insect abundance, richness, and diversity and herbivory damage category. All statistical analyses were performed using JMP 5.1 (SAS Institute 2003). A p-value of less than 0.05 showed a significant difference between vegetation types. A p-value of less than 0.00178, determined by Bonferroni's correction was needed to show a significance difference between tree species.

RESULTS

Insect Biodiversity

Abundance- A greater insect abundance was found on native vegetation compared to non-native vegetation with 243 individuals found on non-native vegetation and 619 individuals found on native vegetation. Insect abundance was significantly different between vegetation types (p=0.0431). Insect abundance was significantly different between tree species (p= 0.0351; Appendix B). *C. papaya* had the lowest insect abundance with 37 individuals, while *H. tiliaceus* had the highest insect abundance, with 238 individuals (Fig. 4).

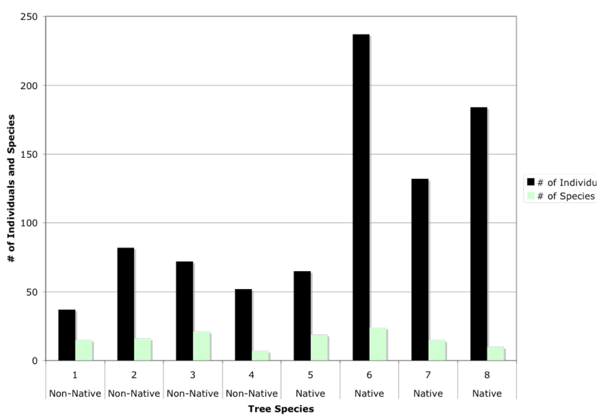

FIG. 4. Insect abundance and richness: the number of individuals and number of species in each tree species. 1: *Carica papaya,* 2: *Mangifera spp.,* 3:*Morinda citrifolia,* 4: *Musa spp.,* 5: *Barringtonia asiatica,* 6: *Hibiscus tiliaceus,* 7: *Terminalia catappa,* 8: *Thespesia populnea.*

Richness- A greater number of insect species was found on native plants, 44 of the total 60, while 37 of the total 60 insect species were found on non-native plants. 16 insect species were only found on native plants, 17 insect species were only found on non-native plants, and 27 insect species were shared between the two vegetation types (Fig. 4). Using the Wilcoxon rank sum test, the difference between vegetation types was deemed insignificant (p=0.6409). Richness between tree species was also insignificant (p=0.1951). *H. tiliaceus* had the highest insect species richness with 24 insect species, *M. citrifolia* had 21 insect species, and *B. asiatica* had 19 insect species. *Musa spp.* had the lowest insect species richness, with a total of 7 insect species (Appendix C).

Diversity- Using the Shannon-Wiener index for diversity in a test for richness and evenness of insect species, no difference was found between native and non-native vegetation (p= 0.8451) or between tree species (p= 0.1068) (Fig. 5). *M. citrifolia* had the highest average diversity (H'= 0.5910), followed by *Mangifera spp*. (H'= 0.5488), and *B. asiatica* (H= 0.5314). *Musa spp.* had the lowest average diversity (H= 0.3802).

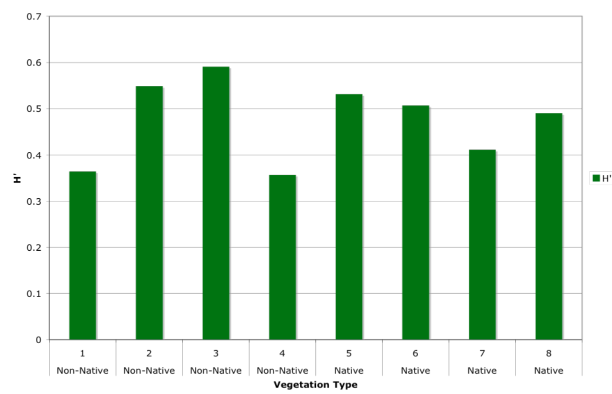

FIG. 5. Shannon-Weiner diversity index averages for each tree species. 1: *Carica papaya,* 2: *Mangifera spp.,* 3: *Morinda citrifolia,* 4: *Musa spp.,* 5: *Barringtonia asiatica,* 6: *Hibiscus tiliaceus,* 7: *Terminalia catappa,* 8: *Thespesia populnea.*

Insect Communities- 20 herbivore species, 10 predator species, 3 parasitoid species, 4 sap sucker species, 1 detritivore species, 1 granivore species, and 16 spider morphospecies were collected from native vegetation (Fig. 6). Non-native vegetation had 16 herbivore species, 7 predator species, 3 parasitoid species, 4 sap sucker species, 2 detritivore species, 1 granivore species, and 6 spider morphospecies (Fig 6). Native vegetation had 267 herbivores, 39 predators, 3 parasitoids, 290 sap suckers, 5 granivores, 1 detritivore, and 40 spiders (Fig. 7). Non-native vegetation had 82 herbivores, 69 predators, 12 parasitoids, 66 sap suckers, 9 granivores, 2 detritivores, and 11 spiders (Fig. 7, Appendix C).

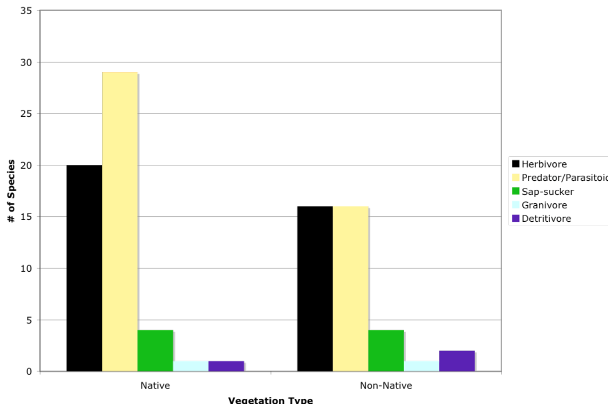

FIG.6. The number of herbivore, predator and parasitoid, sap sucker, granivore, and detritivore species by vegetation type.

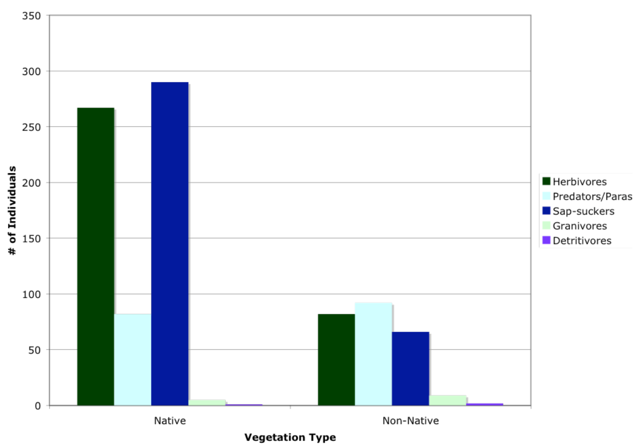

FIG.7. The number of herbivore, predator and parasitoid, granivore, and detritivore individuals by vegetation type.

High vs. Low

No differences were found between abundance and height of sampling (p=0.1108), richness and height of sampling (p=0.0933), or diversity and height of sampling (p=0.07695).

Tree height

No differences were found between abundance and tree height (p=0.5303), richness and tree height (p=0.6156), or diversity and tree height (0.7805).

Herbivory

Tree damage- More herbivory damage was observed on native plants with an average damage category of 1.76 for non-natives, and 2.56 for natives (Fig. 9). Using the Wilcoxon rank sum test, this difference was determined to be significant (p=0.001). *H. tiliaceus* had the highest average damage category of 3.25, while *C. papaya* had the lowest average damage category of 1.5. Herbivory damage between tree species was significant (p=0.0001). Using linear regression, a positive correlation between abundance of insects and tree damage was observed (p-value 0.0001; Fig.8). A similar positive correlation was found between number of insect species and tree damage (p-value 0.0054).

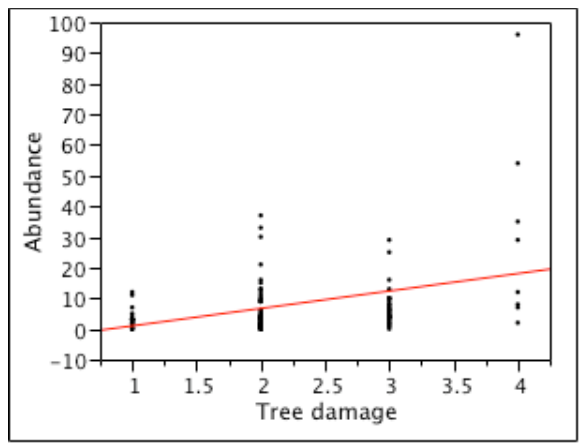

FIG.8. A positive correlation between tree damage and abundance of insects.

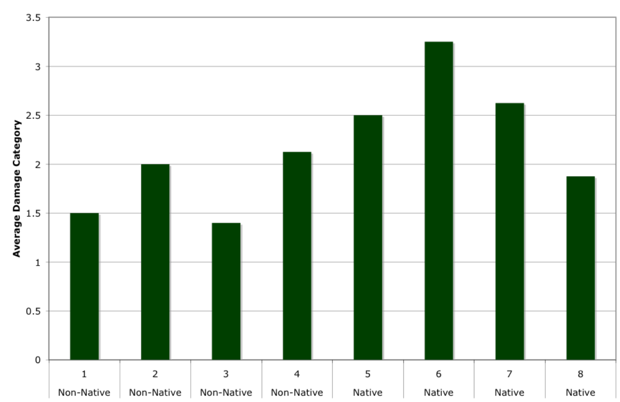

FIG.9. The average damage category for each tree species. Damage categories (Y-axis): 1=0-25% damage, 2=25-50% damage, 3=50-75% damage, 4=75-100% damage. Tree species (X-axis): 1: *Carica papaya*, 2: *Mangifera spp.*, 3: *Morinda citrifolia*, 4: *Musa spp.*, 5:

Barringtonia asiatica, 6: *Hibiscus tiliaceus*, 7: *Terminalia catappa*, 8: *Thespesia populnea.*

Herbivory trials- Contrary to the observed herbivory damage on native plant species, more damage cases were observed in non-native plant species. However, 6 of these cases were by non-herbivores. Herbivory trials resulted in more non-native plants being damaged, with 10 herbivory cases and 14 non-native cases respectively (Fig.10). The total percentage of leaf damage was greater in native plant species, with an average 15.13% leaf damage in native plant species and 12.48% leaf damage in non-native plant species. The standardized percentage of leaf damage (standardized by the number of days until damage was observed) was also greater in native plant species with an average 5.02% damage on natives, and 4.20% damage on non-natives (Appendix A).

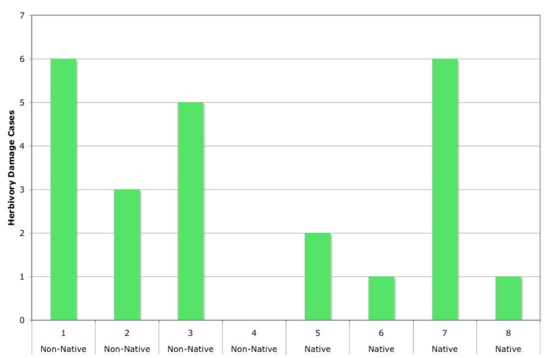

FIG.10. The number of herbivory damage cases by trees species. 1: *Carica papaya*, 2: *Mangifera spp.*, 3: *Morinda citrifolia*, 4: *Musa spp.*, 5: *Barringtonia asiatica*, 6: *Hibiscus tiliaceus*, 7: *Terminalia catappa*, 8: *Thespesia populnea.*

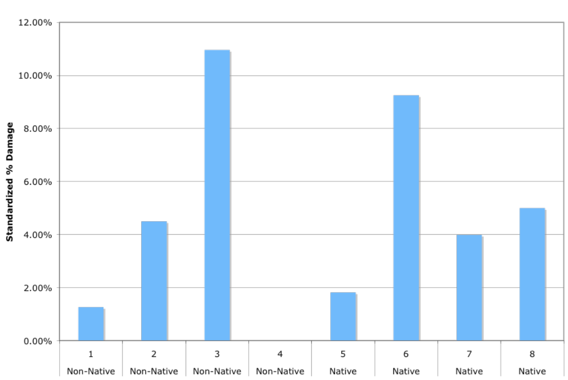

FIG.11. Standardized herbivory damage (total % damage/# of days for insect to eat leaf). 1: *Carica papaya*, 2: *Mangifera spp.*, 3: *Morinda citrifolia*, 4: *Musa spp.*, 5: *Barringtonia asiatica*, 6: *Hibiscus tiliaceus*, 7: *Terminalia catappa*, 8: *Thespesia populnea.*

DISCUSSION

Insect Biodiversity

Abundance- Consistent with previous findings (Hansjorg 2004, Wolfe 2002), the results of this study indicate a significant difference in insect abundance between native and non-native vegetation, with native plants supporting a greater number of individuals. This difference was predicted by my hypothesis, which was based on a previous study in Mo'orea that found native vegetation in high elevations to support both native specialist insects and non-native generalist insects (Weiss 2004). The Enemy Release Hypothesis supports this phenomenon by explaining that non-native plants do better in terms of growth and reproduction compared to native plants because they lose contact with their co-evolved specialist herbivores. Specialist herbivores are those that feed on one or a few closely related plant species, and generalist herbivores are those which feed on several non-related plant species (Joshi 2005). With significantly more insects residing on native plants compared to non-native plants, 619 to 243, it is likely that co-evolved specialist insects as well as introduced generalist insects make up this large population.

Richness- A higher number of insect species on native plants was expected based on the Enemy Release Hypothesis which expects native plants to support both co-evolved specialist herbivores as well as generalist invasive herbivores while non-native plants only support generalist herbivores. However, no significant differences in richness were found. No significant difference in diversity was found either, as determined by the Shannon-Weiner test for diversity. This result is not surprising since richness is used to calculate diversity, and diversity failed the test for significance as well. A possible explanation for these results is that the introduced plants have evolved a decreased defense against specialist herbivores, which are scarce in the introduced range, and a higher protection against generalist herbivores. It is possible that the native co-evolved specialists have started to move over to the native plant species, which are not well defended against them. This sequence of events led to the invasive success of *Senecio jacobaea* in Australia, New Zealand, and North America (Joshi 2005). However, richness alone may not be a good indicator of differences between native and non-native plants or very relevant to the Enemy Release Hypothesis if there is only one individual for each insect species on the non-native vegetation and five individuals for every insect species on the native vegetation. In determining if the Enemy Release Hypothesis supports what is seen in the coastal region of Mo'orea, it is more important to look at insect communities grouped by diet.

Insect communities- An equal number of predator/parasitoid species and herbivore species were found on non-native vegetation, while more predator/ parasitoid species and more herbivore species were found on native vegetation. Significantly more individual herbivores were found on native vegetation compared to predator/ parasitoids, while an equal number of predator/parasitoids and herbivores were found on non-native vegetation. Perhaps more herbivory occurred on native trees not because more specialist herbivores were found on native trees but because there were as many predators and parasitoids there to kill the herbivores on the non-native trees. A similar case was observed in central Germany, where herbivory levels were correlated negatively with spider abundances (Unsicker 2006). However, other data support the correlation between number of herbivore species and herbivory damage, such as the positive correlation found between species richness and overall tree damage.

High vs. Low

I expected there to be a difference in insect abundance and richness between high and low vegetation due to differences in abiotic factors such as canopy cover and moisture. A case study from the Ozarks in Missouri supports this hypothesis, finding that insect density and richness increased in the shady areas, and drastically decreased in the sunnier areas of the tree (Jeffries 2006). However, no differences were found between sampling levels in this study. Similarly, I expected there to be a difference in abundance and richness of insects between taller and shorter trees due to differences in abiotic factors. A study from Brazil on *Anadenanthera macrocarpa* (Mimosaceae) found a significant increase in both abundance and species richness of ants and herbivorous insects as tree height increased. This correlation was attributed to the microclimate gradient between the understory and canopy not being very steep (Campos 2006). However, no significant differences were found.

Herbivory

I expected more herbivory damage on native trees based on the prediction of the Enemy Release Hypothesis. My findings from quantifying the damage of each tree support my hypothesis, with more herbivory damage on native trees as a whole. Positive correlations between average damage category for each tree species and abundance, as well as average damage category and richness lead me to believe that native trees exhibit more herbivory due to more herbivore species and individuals. However, in the herbivory trials, more insects fed on non-native plants. Similar results of more insect herbivory exhibited on exotic plants compared to native plants have been found in a few studies. This phenomenon has been explained by the theory that native plants are better adapted to the local herbivore fauna compared to non-natives (Agrawal 2003). Another explanation is offered by the Evolution of Increased Ability Hypothesis, which suggests that non-native plants are more palatable, that is, they taste better because they have reallocated their resources from defense to growth (Genton 2004).

Despite more herbivory damage cases in non-native plants, the resulting damaged area on native leaves, both real values and standardized values, were greater on native plants. This suggests that specialist herbivores are feeding on native plant species, while generalist herbivores are feeding on non-native plant species. These results are consistent with other findings that specialist herbivores cause more damage compared to generalist herbivores in total damage to the plant (Joshi 2005).

Cosmopterigidae 1 may be an example of a co-evolved specialist for *T. catappa.* Cosmopterigidae 1 proved to cause the most damage on *T. catappa* out of the two herbivores that attacked it. The insect ate *T. catappa's* leaves five out of seven times in the herbivory trials and caused an average of 4.2% damage, with as high as 31% total area damage on one 2X1 inch leaf. The individual Cosmopterigidae 1 in these trials came from category three and four damaged trees, suggesting that they are the cause for severely damaging these trees.

Cerambycidae 2 is another example of a possible co-evolved specialist herbivore, having caused significant damage on two native plant species that belong to the same plant family, Malvaceae: *Hibiscus tiliaceus* with and average of 9.25% standardized damage and *Thespesia populnea* with an average of 5% standardized damage. The differences in amount of herbivory between native and non-native vegetation were not found to be significant by the Wilcoxon rank sum test, however, based on biodiversity and field herbivory results, I find it to be representative of what is happening overall.

CONCLUSION

I conclude, based on more visible herbivore damage on the whole tree, more insect abundance, more herbivore species, more herbivore individuals, and fewer cases of damage, yet a higher average percent damage in native plant species, that the Enemy Release Hypothesis can explain the biodiversity and herbivory in the coastal region of Mo'orea, French Polynesia.

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APPENDIX A

Table 1. Summary of insect species, diet, percent damage of leaf (% damage), standardization of damage (% Damage / # of days to consume leaf), and species of tree damaged (Tree species).

Insect Species	Diet	% Damage	Standardized	Tree Species
Acicnemis variegatus	Herbivore	5%	1.25	*Carica p.*
Adoretus vestitus	Herbivore	24%	24%	*Morinda c.*
Anthribidae	Herbivore	4% 5% 8% 13%	1% 1.25% 0.80% 13%	*Carica p.* *Morinda c.*
Bruchidae	Granivore	1% 2	0.25% 0.50%	*Musa spp.* *Carica p.*
Cerambycidae 1	Herbivore	24% 18%	1.5% 9.25%	*Carica p.*
Cerambycidae 2	Herbivore	37% 5%	9.25% 5%	*Hibiscus t.* *Thespesia p.*
Ceresium unicolor	Herbivore	1%	0.14%	*Barringtonia a.*
Cixiidae	Sap sucker	2% 1%	0.40% 1%	*Musa sp.* *Morinda c.*
Coccinellidae	Insectivore	1%	0.20%	*Musa spp.*
Cosmopterigidae 1	Herbivore	31% 10% 7% 5% 10%	10.33% 3.33% 2.33% 1.66% 3.33%	*Terminalia p.*
Geometridae	Herbivore	3%	3%	*Terminalia p.*
Machilidae	Herbivore	14% 6% 49%	3.50% 1% 12.25%	*Barringtonia a.* *Mangifera spp.* *Mangifera spp.*
Mantidae	Predator	1%	1%	*Morinda c.*
Diplopida (Milipede)	Detritivore	1%	0.33%	*Musa spp.*
Sphingidae	Herbivore	48%	16%	*Morinda c.*
Tettigoniidae 1	Herbivore	3%	0.75%	*Carica p.*
Tettigoniidae 2	Herbivore	1% 1%	0.20% 1%	*Mangifera spp.* *Morinda c.*

APPENDIX B

Table 2. Summary of comparisons in abundance, richness, and diversity between native and non-native vegetation, high and low vegetation, height of trees, tree damage categories, and tree species.

Comparison	Variable	Result	p-value
Native vs. Introduced	Abundance	Greater Abundance in Native Vegetation	0.0431
	Richness	No difference	0.6409
	Diversity	No difference	0.8451
	Herbivory on tree	More herbivory on Native trees	0.001
	Variable	Result	Nominal value
	Real % Damage on leaf	More herbivory damage on Native	12.48% damage on native 15.13% damage on non-native
	Standardized % damage on leaf	More Herbivory damage on Native	5.02% damage on native 4.20% damage on non-native
	Number of Herbivory Incidents	More Herbivory Cases in Non-Native Insects	10 Native 14 Non-Native
			p-value
High vs. Low	Abundance	No difference	0.1108
	Richness	No difference	0.0935
	Diversity	No difference	0.7695
Height	Abundance	No difference	0.5303
	Richness	No difference	0.6156
	Diversity	No difference	0.7805
Tree damage	Abundance	More insects in highly damaged trees	0.0001
	Richness	More insect species in highly damaged trees	0.0054
	Diversity	No correlation between diversity and tree damage	0.6895
Tree Species	Abundance	Difference between tree species	0.0351
	Richness	No difference	0.1951
	Diversity	No difference	0.1068

APPENDIX C

Table 3. Insect species distribution by tree species in real numbers.

	Carica papaya	*Mangifera spp.*	*Morinda citrifolia*	*Musa spp.*	*Barringtonia asiatica*	*Hibiscus tiliaceus*	*Terminalia catappa*	*Thespesia populnea*
Pheidole fervus	1	9	12	39	4	1	0	13
Machilidae 1	1	19	12	4	2	2	0	0
Coccinellidae 1	0	0	0	2	2	0	0	0
Cixiidae 1	6	30	20	3	31	83	29	143
Bruchidae 1	6	0	1	2	3	0	0	2
Muscidae 1	0	0	0	1	1	0	0	0
Tettigoniidae 1	1	0	0	0	0	0	0	0
Tettigoniidae 2	0	5	3	0	2	1	1	4
Blattellidae 1	1	0	0	0	0	0	0	0
Anthribidae 1	6	2	3	0	2	2	1	12
Acicnemis variegetus	1	2	0	0	0	0	0	0
Miridae 1	0	0	0	0	0	3	0	0
Miridae 2	0	0	1	0	1	5	3	0
Miridae 3	1	0	0	0	0	0	4	0
Miridae 4	0	0	0	0	0	1	0	0
Cerambycidae 1	2	1	0	0	0	0	0	0
Cerambycidae 2	1	1	0	0	0	1	0	1
Braconidae 1	7	0	3	0	0	0	0	0
Braconidae 2	0	0	0	0	1	0	0	0
Empicoris 1	1	0	0	0	0	0	0	0
Dermastidae 1	0	0	1	0	0	0	0	0
Dermaptera 1	0	0	0	0	0	1	0	0
Drosophilidae 1	0	0	1	0	0	0	0	0
Drosophilidae 2	0	1	0	0	0	1	1	0
Drosophilidae 3	0	0	0	0	0	0	0	1
Drosophilidae 4	0	0	1	0	0	3	0	0
Neriidae 1	0	0	1	0	0	0	0	0
Coagulata viyripennis	1	0	4	0	1	0	0	1
Adoretus vestitus	0	0	1	0	0	0	1	0
Blattidae 1	0	0	1	0	0	2	0	0
Chalcidoidea 1	0	1	0	0	0	1	0	0
Chalcidoidea 2	0	1	0	0	0	0	0	0
Chalcidoidea 3	0	0	0	0	0	1	0	0
Hemiptera 1	0	1	0	0	0	1	0	0
Pseudoscorpionida	0	1	0	0	3	0	0	0
Nueroptera 1	0	0	0	0	2	0	0	0
Ceresium unicolor	0	0	0	0	2	0	0	0
Cosmopterigidae 1	0	0	0	0	1	0	81	0
Tingidae 1	0	0	0	0	0	0	2	0
Mantidae 1	0	0	2	0	1	1	2	1
Reduviidae 1	0	0	0	0	0	0	1	0
Tineidae 1	0	1	0	0	0	0	0	0
Phyllocnistidae 1	0	0	0	0	0	0	1	0
Coleoptera 1	0	0	0	0	0	0	1	0
Geometridae 1	0	0	0	0	0	0	2	0
Crambinae 1	0	0	0	0	0	0	2	0
Chrysopidae 1	0	0	1	0	0	1	0	0
Psyllidae 1	1	6	0	0	4	1	0	0
Psyllidae 2	0	0	0	0	0	113	0	6
Anthrocoridae 1	0	0	0	0	0	7	0	0
Entomobryidae 1	0	0	0	0	0	1	0	0
Aphididae 1	0	0	0	0	0	3	0	0
Oedomeridae 1	0	0	0	1	0	0	0	0
Sphingidae 1	0	0	1	0	0	0	0	0
Nitidulidae 1	0	0	1	0	0	0	0	0
Dictyopharidae 1	0	0	1	0	0	0	0	0
Pseudococcidae 1	0	0	1	0	0	0	0	0

Formicidae 1	0	0	0	0	1	0	0	0
Formicidae 2	0	1	0	0	0	0	0	0
Neuroptera 1	0	0	0	0	1	0	0	0
Plataspidae 1	0	0	0	0	0	1	0	0
Blattidae 2	0	0	0	0	0	1	0	0