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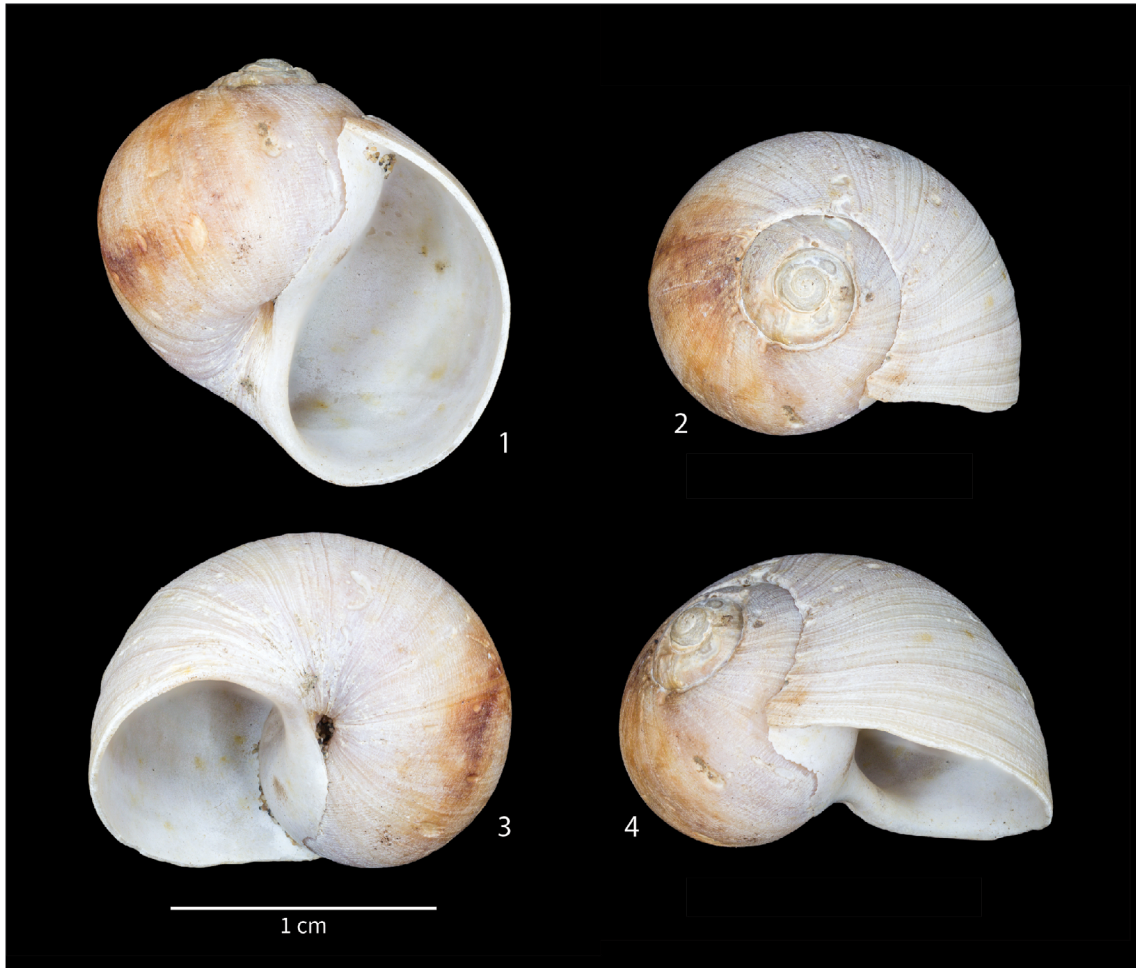
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# *PaleoBios*

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**Charles L. POWELL and Ashley A. DINEEN (2023).  
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**Cover:** *Euspira? louiemarincovichi* n. sp.. See Figures 1-4 for details.

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# A new fossil *Euspira?* (Mollusca: Gastropoda: Naticidae) from the Gubik Formation on the North Slope of Arctic Alaska

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A new naticid gastropod, *Euspira? louiemarincovichi* n. sp., is described from the Gubik Formation on the North Slope of Alaska between Skull Cliff in the west and the Kogru River/Teshkepuk Lake area in the east. It is easily distinguished from all other Atlantic, Pacific, and Arctic Ocean naticids by its fine radial and somewhat stronger spiral ribs. This new species lived during a time when water temperatures were warmer in the Arctic than today based on the occurrence of the gastropod genus *Littorina* with which this new species co-occurs. As such, *Euspira? louiemarincovichi* likely lived in the upper intertidal zone on hard substrate and were not present where sea-ice impinges on the shoreline. Based on co-occurrences of extinct species and the temperature regime indicated by *Littorina*, of significantly warmer temperatures, and some associated species, this new species probably lived during the Bigbendian and (or) Fishcreekian marine transgressions, or between about 2.5 and 2.1 Ma, which is the Gelasian Stage of the early Pleistocene.

**Keywords:** Mollusca, Naticidae, *Euspira*, Gubik Formation, Alaska, Gelasian Stage, early Pleistocene

## INTRODUCTION

A new species of Naticidae Guilding (1834) was first recognized in the 1970s by Louie Marincovich, Jr. (USGS retired) from fossil collections from the Gubik Formation on the North Slope of Alaska. Its spiral and subdued radial sculpture set it apart from all other Arctic Naticidae, although spiral sculpture does occur in some western Atlantic and Antarctic naticids. This new species is questionably referred to the genus *Euspira* and is here named *Euspira? louiemarincovichi* n. sp.

## Geology of the Gubik Formation

Pliocene and Pleistocene age marine deposits discontinuously mantle the northern part of Alaska from near Nome, south of the Bering Strait, north and east to the Canadian border, and beyond. These transgressive sediments record as much as 3 million years of episodic sea-level regressions and transgressions (Brouwers 1994) related to rise and fall of sea levels from the waxing and waning of polar ice sheets and continental glaciers (Dutton et al. 2015). The Gubik Formation was named by Schrader (1904) for unconsolidated surficial terrace

deposits of the coastal plain of north Alaska of Pleistocene age. Gubik is an Inuit name for the Colville River along which the Gubik Formation is exposed (Schrader 1904). In 1951, George Gryc et al. designated a type locality for the Gubik Formation in the bluff along the west bank of the Colville River from the mouth of the Anaktuvuk River to Ocean Point. In general, the Gubik Formation is composed largely of marine sediments, that is, loosely consolidated, cross-bedded, brown or buff, gravel, sand, silt and clay from < 1 m (a few feet) to over 45 m thick, but generally 3 to 10 m thick.

Fossil mollusks from the Gubik Formation were reviewed by Dall (1920), Meek (1923), MacNeil (1957), and Marincovich and Powell (1991). Dall (1920) discussed fossils from around Nome on the Sewart Peninsula and from the Arctic Coast between Skull Cliff along the Chukchi Sea north and east to Carter Creek south of the Beaufort Sea. MacNeil (1957) characterized the Gubik Formation as containing several faunules that could each be distinguished by containing different species of *Neptunea* Röding (1798) (Mollusca: Gastropoda). The *Neptunea leffingwelli* (Dall, 1920) faunule of MacNeil (1957) correlates, at least in part, with the outcrops discussed

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here. Marincovich and Powell (1991) give an overview of mollusks from the then eight marine transgressions from northern Alaska. Many other publications deal with various aspects of the geology and paleontology of the Gubik Formation but reviewing those publications is beyond the scope of this paper (Meek 1923, Faas 1962, Swain 1963, Black 1964, Hopkins et al. 1974, Repenning 1983, Repenning et al. 1987, Kaufman et al. 1990, Brigham–Grette and Carter 1992, Brouwers 1994, Nelson and Carter 2017).

#### MATERIALS AND METHODS

Specimens of *Euspira? louiemarincovich* were collected by various U.S. Geological Survey field geologists working on Neogene and Quaternary deposits in northern Alaska in the 1970s until the late 1990s. These collections are now housed at the University of California Museum of Paleontology (UCMP), Berkeley, California.

Terms used in the description of this new species are those of Marincovich (1977, fig. 10). Higher level systematics follow the scheme of Bouchet et al. (2017).

**Institutional abbreviations**—**LACM M**, Natural History Museum of Los Angeles County, Malacology Department; **UCMP**, University of California Museum of Paleontology, Berkeley, California; **USGS**, U.S. Geological Survey Cenozoic Collection, Menlo Park, California (now housed at UCMP).

#### SYSTEMATIC PALEONTOLOGY

PHYLUM MOLLUSCA LINNAEUS, 1758

CLASS GASTROPODA CUVIER, 1795

SUBCLASS CAENOGASTROPODA COX, 1960

COHORT SORBEOCONCHA PONDER AND LINDBERG,  
1997

SUBCOHORT HYPISOGASTROPODA PONDER AND  
LINDBERG, 1997

ORDER LITTORINIMORPHA BANDEL, 2002

SUPERFAMILY NATICOIDEA GUILDING, 1834

FAMILY NATICIDAE GUILDING, 1834

SUBFAMILY POLINICINAE GRAY, 1847A

GENUS *EUSPIRA* AGASSIZ, 1837 (?)

**Type species** — *Natica glaucinoides* J. Sowerby, 1812 accepted as *Euspira glaucinoides* (J. Sowerby, 1812) by subsequent designation of Bucquoy, Dautzenberg, and Dolfuss (1833:143). Eocene, Europe (see Kabat, 1991: Bull MCZ 152:429 for more details).

**Differential Diagnosis** — This new species is questionably referred to the genus *Euspira*, which is characterized by a globose shell, spire moderately elevated,

and an open umbilicus partially blocked by a weakly developed umbilical callus. While these features are found in *Euspira? louiemarincovich* it differs in having a higher spire than all but eastern Pacific and Arctic *Euspira* except *E. pallida* (Broderip and Sowerby, 1829) and in having sculpture.

**Geological Range** — Late Jurassic (Das et al. 2019) to Holocene.

*EUSPIRA? LOUIEMARINCOVICH*

POWELL AND DINEEN, N. SP.

FIGURES 1–4

**Zoobank ID**— urn:lsid:zoobank.org:act:2969452C-D99E-45B3-8851-D726958FB5C9

**Diagnosis**—The fine, closely spaced, narrow radial, and spiral sculpture forming a faint checkerboard pattern set this species apart from all northeastern Pacific and Arctic Naticidae.

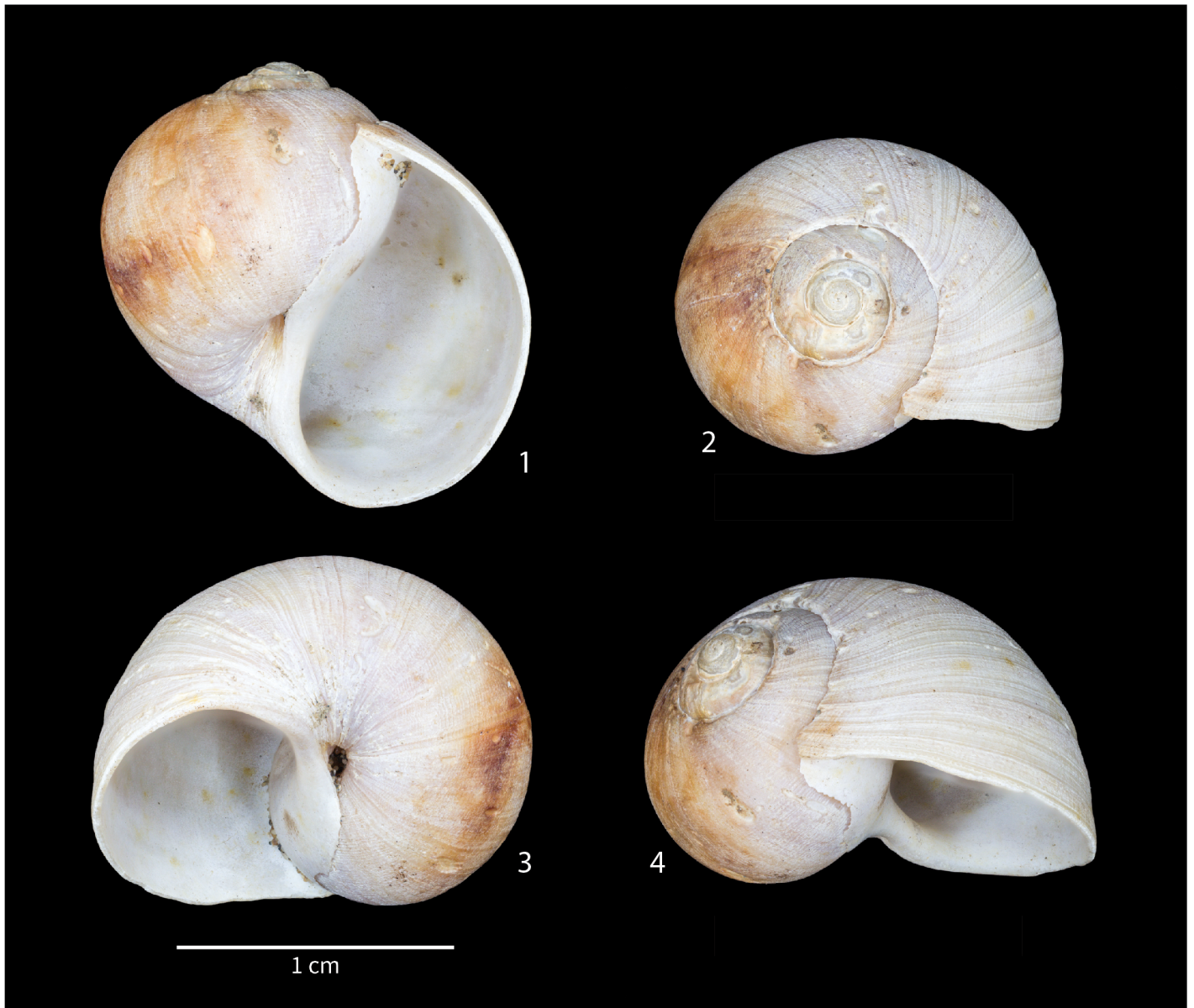
**Holotype**—UCMP 123663 from UCMP locality IP23235.

**Paratypes**—UCMP 123666 from UCMP locality IP23232 and UCMP 123677 from UCMP locality IP23248.

**Referred Collections**—The number of specimens and partial specimens in each collection are documented as follows: complete or nearly complete specimens followed in square brackets by partial specimens or larger identifiable fragments – i.e., 5[4] = 5 complete or nearly complete specimens (4 significantly broken or fragmented specimens). UCMP localities IP22958 (3[3]), IP23232 (5[1]), IP23233 (0[1]), IP23235 (3[0]), IP23238 (3[0]), IP23239 (3[0]), IP23248 (1[2]), IP23264 (4[0]), IP23266 (1[0]), IP23272 (2[0]), IP23279 (1[0]), IP23280 (7[0]), IP23316 (1[0]), IP23511 (3[3]), IP23555 (1[0]), IP23559 (12[3]), IP23561 (1[1]), IP23574 (7[0]), IP23576 (4[0]), IP23577 (8[0]), IP23588 (1[2]), IP23589 (6[2]), IP23590 (16[5]), IP23593 (9[1]), IP23596 (4[1]), IP23597 (1[0]), IP23602 (1[0]), IP23607 (1[0]), IP23721 (2[0]), IP23722 (5[0]), IP23724 (6[1]), IP23812 (1[0]), IP23856 (4[3]), IP23857 (3[0]), IP23868 (1[2]), IP23870 (6[1]), IP23879 (1[0]), IP23884 (5[0]), IP24104 (7[0]).

Additional collections observed: USGS localities M8151 and M8997. These collections could not be located at UCMP, but were identified for internal USGS E&R's (Evaluation and Report documents). The information is added here for completeness as either Louie Marincovich or the senior author (CPII) identified the specimens.

Locality information for all collections can be found in Appendix 1.



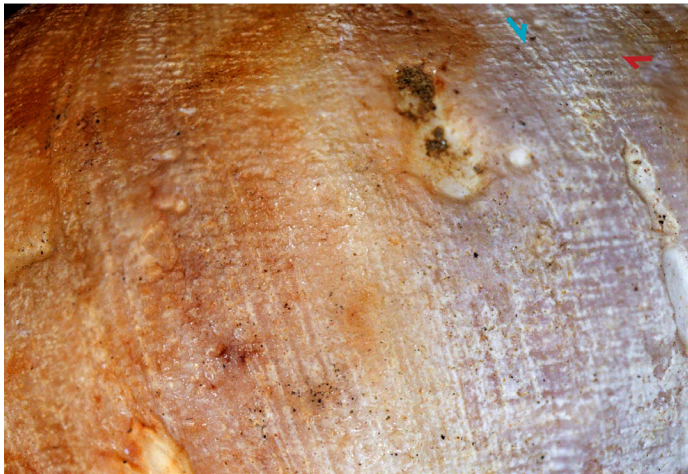
**Figures 1–4.** *Euspira? louiemarinovichii* n. sp. UCMP holotype 123663, UCMP locality IP23235 (USGS M7346). Bar = 1 cm. 1. Aperical view, 2. Apical view, 3. Umbilical view, 4. Inclined side view. Photographs by Dave Strauss, UCMP.

**Occurrence** — Known only from the Gubik Formation along the northwestern part of the Arctic Coastal Plain (North Slope) of Alaska from Skull Cliff south of Barrow in the west to along the Colville River and Kogru River/Teshekpuk Lake areas in the east, North Slope Borough, Alaska (Figure 6 and Appendix 1). Early Pleistocene in age (see discussion for details).

**Etymology** — This new species is named for Louie Marinovich, Jr. who first introduced this species to the senior author and for his work on unraveling many mysteries of Paleogene–Neogene Arctic geology and paleontology.

**Description** — This new species has a naticiform shell about as high as wide and with a moderate thick,

substantial shell. The spire is very short and consists of about four whorls and is less than a tenth the height of the entire shell. The protoconch is worn on all specimens and not available for description. With a generally smooth shell profile the whorls show a slight indentation or suture and a very fine, channel at the top of its whorls. The exterior of the shell shows very fine, closely spaced, irregular, spiral threads crossed by very fine, closely spaced, mostly continuous, radial threads forming a microscopic crosshatch pattern covering the exterior of the shell (Figure 5). The aperture is large, near-tear-drop shape and is about three-quarters of the shell's height with a parental callus that mirrors the inner margin of the aperture a few millimeters wide. The posterior apertural



**Figure 5.** Close-up of spiral and radial sculpture on the body whorl of the holotype specimen. Field of view approximately 0.5 cm. Blue arrow indicates radial sculpture, red arrow indicates spiral sculpture.

angle of the aperture is acute and points towards the apex. A deep, partially open umbilicus is present, but is obscured in part by the umbilical callus making it teardrop shaped.

#### DISCUSSION

Originally placed in the genus *Polinices* Montfort (1810) by Louie Marincovich, Jr. (USGS retired) work by Kabat (1991) and Huelsken et al. (2012) indicate that the genus *Euspira* is a better fit for this new species. It is possible that it represents a new genus; however, in all but its sculpture it is most similar to *Euspira* and therefore is its placement in that genus is questioned.

In the eastern Pacific, *Euspira?* *louiemarincovichi* is similar in shape to some specimens of *Bulbus fragilis* (Leach, 1819), *E. canonica* (Dall 1919), *E. draconis*, and *E. pallida* (Broderip and Sowerby, 1829), but is easily distinguished from all but *E. pallida* by its fine sculpture. In addition, it can be distinguished from *B. fragilis* which has a thinner shells and higher spires. Whereas *Euspira canonica* is significantly smaller with a thinner shell and also lacks sculpture, while *E. draconis* can be much larger and also has a thinner shells and a much more open umbilicus. Some forms of *E. pallida* resemble *E.?* *louiemarincovichi* and may have spiral sculpture of fine striae and axial sculpture of fine growth lines and the umbilicus can be open to totally closed (Hasegawa 2009, figs 100-108). It is usually distinguished by its higher spire and narrower apical angle than *E.?* *louiemarincovichi* and the spiral sculpture is consistently stronger in our new species. The East Coast *E. heros* (Say, 1822) can also be similar but has a more open umbilicus and lacks an umbilical callus.

Elsewhere in the world other naticid genera have spiral sculpturing and can be distinguished from our new species as follows: *Maxwellinatica* is known only from the Miocene of New Zealand and is easily distinguished by from *E.?* *louiemarincovichi* by its large callus and slit-like umbilicus. The Antarctic Holocene genus *Sinuber* is distinguished by the shape of its shell which is higher than wide. In the northern hemisphere, the Miocene genus *Poliniciella* is similar in shape, but has a small, tongue-shaped callus, that completely closes the umbilicus easily distinguishing it from *E.?* *louiemarincovichi*. *Sigatica*, of Paleocene to Holocene age, appears to be poorly defined genus with an open to nearly closed umbilicus, with spiral grooves near the top of the body whorl (*S. semisulcata* Gray, 1839), across the entire shell [*S. carolinensis* (Dall, 1889) and *S. caractica* (Dall, 1900)], or only near the umbilicus (e.g., *S. cubiana* Ortea Rato, 2007). *Sigatica* differs from *E.?* *louiemarincovichi* in being higher than wide, with a wide-open umbilicus. Also occurring in the northern hemisphere is the genus *Stigmaulax*, which is similar to *Poliniciella* in having spiral sculpture, but differs in having a wide, open, umbilicus and broadly rounded radial ribs of varying strengths and differs from our new species in a similar manner. Lastly, the genus *Sigaretotrema* Sacco (1890) has spiral lines similar to *E.?* *louiemarincovichi* but it has a much different shape and is associated with the subfamily Sininae (Woodring, 1928).

#### Age and Environmental Interpretation

**Age**—At least eight marine transgressions, spanning over 3 million years (Repenning 1983, Brigham-Grette and Carter 1992, Brouwers 1994), have been proposed for the Gubik Formation by Hopkins et al. (1972), Hopkins (1974) and later by Brouwers et al. (1984) and Kauffman et al. (1989) and are illustrated in Table 1. Six of these are named (from oldest to youngest): Colvillian (=Beringian I of Kaufman et al. [1989], =Beringian of Brouwers et al. [1984], =Killi Creek beds of Brigham [1985]), Bigbendian (=Beringian II Kaufman et al. [1989], =Tuapaktushak beds of Brigham-Grette and Carter [1992]), Fishcreekian (=Beringian 3 of Kaufman et al. [1989]), Wainwrightian (=Anvilian of Kaufman et al. [1989], Péwé [1975], =Kotzebuan of Brouwers et al. [1984], =Karmuk beds of Brigham [1985]), Pelukian (=Walakpa beds of Brigham [1985]) and Krusensternian (=Flandrian of Bouwers et al. [1984]). In addition, two unnamed Late Pleistocene transgressions are recognized by Marincovich and Powell (1991).

Marincovich and Powell (1991) give a general overview of the eight chronostratigraphic unit names attributed to

Age (Hopkins 1965, 1967, Carter et al. 1986)	Bering Sea (Kaufman et al. 1989, Hopkins, written com- mon., 1990 in Marin- covich and Powell 1991)	Western and northern Alaska (Brouwers et al. 1984)	Skull Cliff (north- west Alaskan coast) (Brigham 1985, these units are all informal)	Arctic Coastal Plain (Carter et al. 1986)
< 4 ka	Krusensternian	Flandrian	—	Flandrian
circa. 25 ka	—	—	—	Middle Wisconsin
90–105 ka	—	Flaxsman Fm.	—	Simpsonian
120–130 ka	Pelukian	Pelukian	Walakpa beds	Pelukian
circa. 500 ka	Anvilian	Kotzebuan	Karmuk beds	Wainwrightian
>1.5 Ma, <2.4 Ma	Beringian III	Fishcreekian	Tuapaktushak beds	Fishcreekian
>2.4 Ma	Beringian II	Anvilian	Killi Creek beds	Bigbendian
<3.5 Ma	Beringian I	Beringian	Nulavik beds	Colvillian

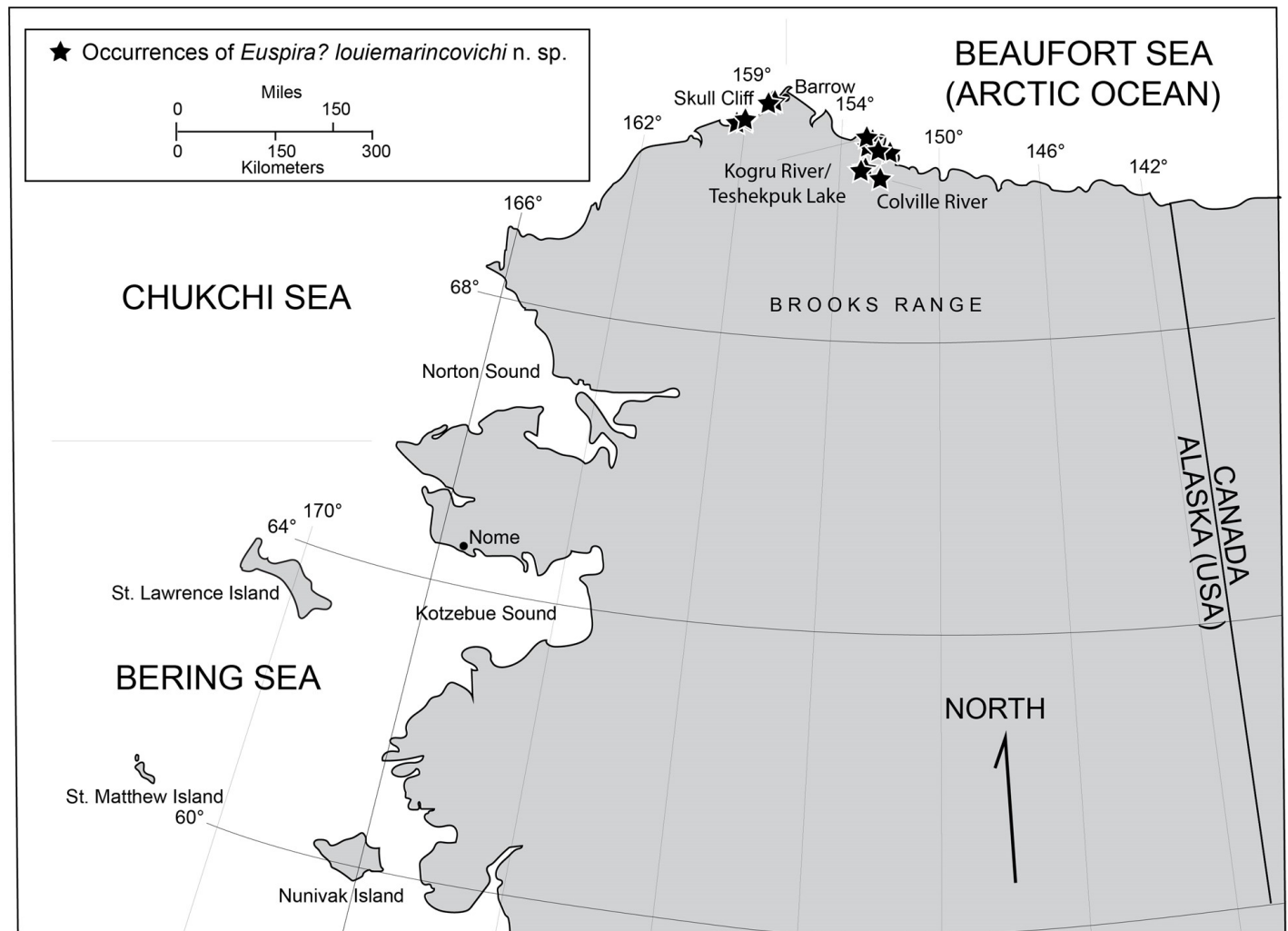
**Table 1.** Correction of Pliocene and Pleistocene marine transgressions of western and northern Alaska (after [Marincovich and Powell, 1991](#)).

the lithostratigraphic units of the Gubik Formation and give a general correlation of transgressive deposits from western and northern Alaska, their age, and some fossil taxa characterizing the various deposits. They report *Euspira? louiemarincovichi* (as *Polinices* n. sp.) from the Colvillian, Bigbendian, Fishcreekian, questionably from the Wainwrightian, and lastly from the Pelukian, as reported in Hopkins and Marincovich (1981). Most outcrops and collections of the Gubik Formation have not been integrated into this chronostratigraphic scheme and dating of deposits with *E.? louiemarincovichi* is attributed to either the Bigbendian and (or) Fishcreekian transgressions as a best guess from limited data.

**Environmental Interpretation**—A composite list of all taxa (n=135) occurring together with *Euspira? louiemarincovichi* from 41 sites consists of 52 bivalves and 83 gastropods (Appendix 1). Because all occurrences of the new species we believe to be restricted to a relatively

short time interval (Bigbendian and (or) Fishcreekian transgressions; early Pleistocene), the composite fauna is therefore used to get an idea of what water temperatures were like on the North Slope when *E.? louiemarincovichi* was alive. This is based on the overlap of latitude ranges of associated extant species. We plot the geographic ranges of extant species associated with *E.? louiemarincovichi* and where the vast majority of them overlap that area is considered to represent the latitude range (and associated water temperatures) that were present when it was alive. Using a similar method for water depths of extant species present a depth range is also generated using this method.

Overlapping geographic range and depth data from Coan et al. (2000) for the bivalves and various sources for the gastropods (Groves and Mertz 2023; WoRMS Editorial Board 2023) show overlapping distributions of fossil species associated with *Euspira? louiemarincovichi*

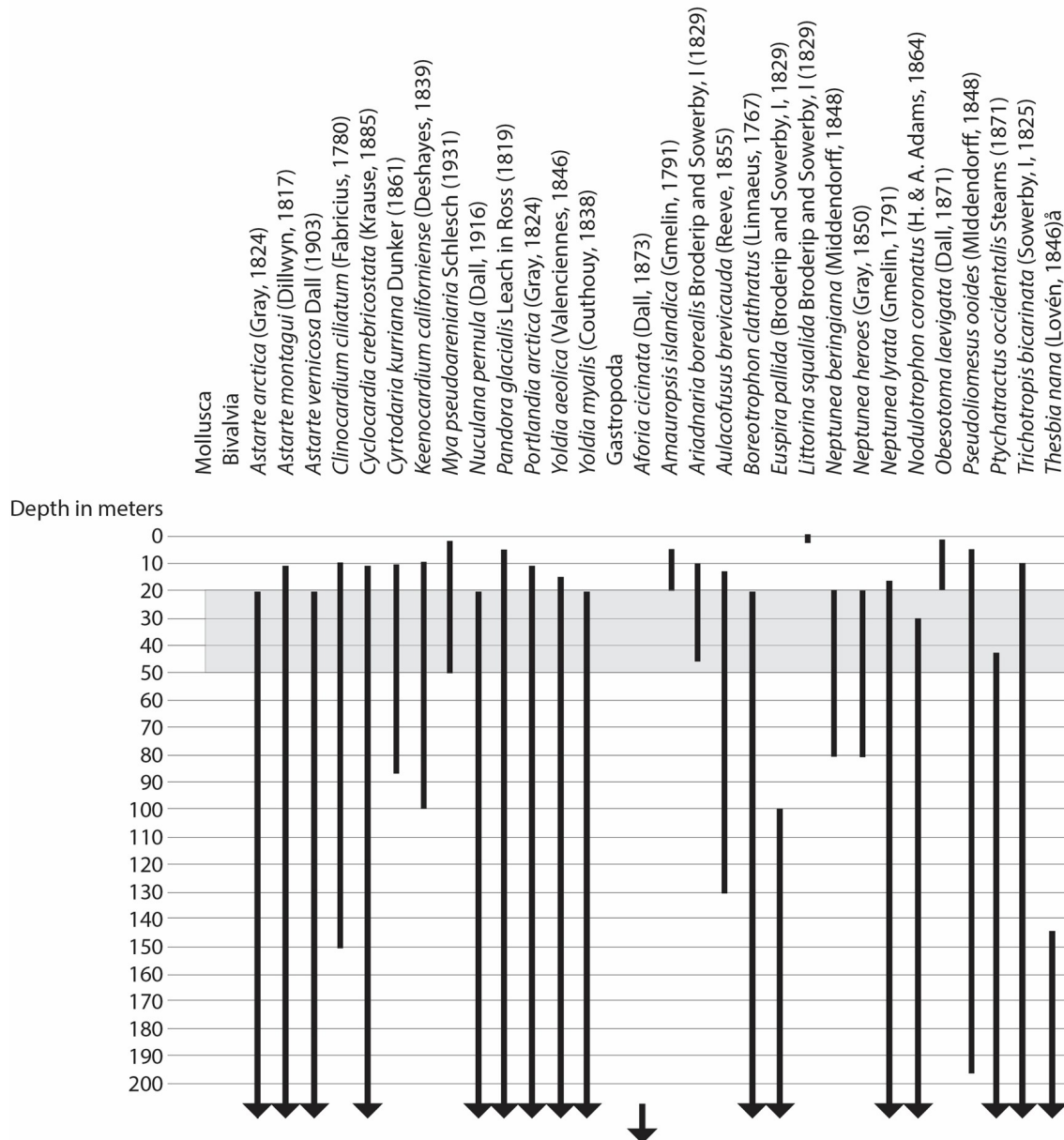


**Figure 6.** Map showing generalized occurrences of *Euspira? louiemarinovichi* along the northern coastal plain of Alaska. These occurrences are concentrated in three areas: adjacent to the Colville River (southern eastern occurrences), near and along the Kogru River/Teshekpuk Lake (northern eastern occurrences), and along Skull Cliff (occurrences southwest of Barrow to the west). Not all collections are represented in this figure, just enough to determine the general geographic areas where this new species occurs. Some additional geographic names are mentioned to help interpret the geographic ranges of some gastropods.

between Barrow (71°N) and Nome (64°N), Alaska (Figure 6). The following taxa have distributions that do not extend across this entire interval but occur mostly to the south and likely indicate slightly warmer water temperatures during at least part of the year across the Alaskan North Slope during the period when *E.? louiemarinovichi* lived. These include the bivalves *Keenocardium californiense* (Deshayes, 1839) (69°N–59.2°N), *Macoma lama* Bartsch (1929) (69°N–53°N), *M. lipara* Dall (1916) (64.6°N–33.8°N; cf. here), *Mactromeris polynyma* (Stimpson, 1860) (70.8°N–46°N) and the gastropods *Aforia circinata* (Dall, 1873a) (northeast Gulf of Alaska into Bering Sea; Ronai and Shimek 1984), *Ariadnaria insignis* (Middendorff, 1848) (Bering Sea and Gulf of Alaska; LACM M collections [74 lots]), *Buccinum plectrum*

Stimpson (1865) (cf. here; Chukchi Sea to northern California; LACM M collections [97 lots]), *Bulbus fragilis* (Bering Sea to Gulf of Alaska; LACM M collections [16 lots]), *Latisipho hallii* (Dall, 1873) (western Bering Sea, Russia, to Prince William Sound, Alaska; LACM M collections [18 lots]), *Littorina squalida* Broderip and Sowerby, I (1829) (Golovin Bay, Norton Sound, Alaska; Pribilof and Nunivak islands, Bering Sea, Alaska (USNM), *Neptunea beringiana* (Middendorff, 1849) (Chukchi Sea to Beaufort Sea; Kurile Islands, to Bering Sea; LACM M collection), and *N. lyrata* (Gmelin, 1791) (Kuril Islands, the western Bering Sea, the Gulf of Alaska, from South of the Alaska Peninsula to Juneau, Alaska; LACM M collections). Sea ice occurs in the recent past to the shore of the Arctic coast, however the gastropod genus *Littorina* Férussac





**Figure 7.** Depth data for selected species, showing the majority of recovered species co-occur between 20 and 50 m with a few taxa occurring shallower and some occurring deeper.

(1822), which occurs today in the intertidal zone on hard surfaces (Rolán-Alvarez, et al. 2015), indicates that sea-ice did not contact the shore during this time period as the ice would easily crush anything living in the intertidal zone. The yearly temperature of waters at Nome in Norton Sound range from about 4.8° to 17.3°C, whereas at Nome they range from -1.7° to 10.8° C (Clayson et al. 2016). Today the Beaufort Sea has seasonal surface water temperatures between -1.8° and -1.4° C (Clayson et al. 2016). Given these data we envision surface water temperatures >0°C (no ice) to possibly as high as about

17°C (the maximum recorded at Nome) when *Euspira? louiemarinovichi* lived.

Water depth data indicate water depths associated of the fauna associated with *Euspira? louiemarinovichi* are shelfal and likely between 20 and 50 m as those are the depths where the the majority of the taxa overlap (Figure 7). Depth ranges data is bimodal with the *Littorina* only occurring in the intertidal zone and a number of other species occurring only deeper than 20 m (Bivalves: *Astarte arctica* [Gray, 1824], *A. vernicosa* Dall [1903], *Nuculana pernula* [Müller, 1779], *Yoldia myalis*

[Couthouy, 1838]; Gastropods: *Aforia circinata*, *Beringius behringi* [Middendorff, 1848], *Boreotrophon clathratus* [Linnaeus, 1767], *Euspira pallida* [Broderip and Sowerby, I, 1829], *Neptunea beringiana*, *N. heros* [Gray, 1850], *Nodulotrophon coranatus* [Adams and Adams, 1864], *Ptychotrachus occidentalis* Stearns [1871], *Thesbia nana* [Lovén, 1846]). This and the lack of shoreline features at the fossil sites indicate that deposits was likely at the deeper part of the range (20–50 m) and shallow water taxa were transported in.

### Biogeography

While the genus *Euspira* is widespread in the northern hemisphere, other species associated with this new species show strong Arctic and Atlantic affinities in the parts of the Gubik Formation where *Euspira? louiemarinovichi* n. sp. is found. These Arctic and Atlantic ranging species including the bivalves *Astarte borealis* (Schumacher, 1817), *A. montagui* (Dillwyn, 1817), *A. vernicosa*, *Clino-cardium ciliatum* (Fabricius, 1780), *Cyrtodaria kurriana* Dunker (1861), *Ennucula tenuis* (Montagu, 1808), *Hiatella arctica* (Linnaeus, 1767), *Limeocola balthica* (Linnaeus, 1758), *Liocyma fluctuosa* (Gould, 1841), *Macoma calcarea* (Gmelin, 1791) (cf. here), *Mya pseudoarenaria* Schlesch (1931), *M. truncata* Linnaeus (1758), *Nuculana pernula*, *Pandora glacialis* Leach in Ross (1819), *Portlandia arctica* (Gray, 1824), *Serripes groenlandicus* (Mohr, 1786), *Yoldia myalis*, and the gastropods *Admete viridula* (Fabricius, 1780), *Ariadnaria borealis* (Broderip and Sowerby, I, 1829), *Aulacofusus brevicauda* (Deshayes, 1832), *Boreotrophon truncatus* (Strøm, 1768), *Buccinum ciliatum* (Fabricius, 1780) (cf. here), *Bu. glaciale* Linnaeus (1761) (cf. here), *Bu. polare* Gray (1839), *Cryptonatica affinis* (Gmelin, 1791), *Obesotoma laevigata* (Dall, 1871), *Oenopota elegans* (Möller, 1842) (cf. here), *Oe. pyramidalis* (Strøm, 1788) (cf. here), *Plicifusus kroyeri* (Möller, 1842), *Propebela arctica* (Adams, 1855) (cf. here), *Solariella obscura* (Couthouy, 1838), *Tachyrhynchus erosus* (Couthouy, 1838) and *Trichotropis bicarinata* (Sowerby, 1825). In addition to the mollusks, a number of marine vertebrates including porpoise (Lambert 2010, Colpaert et al. 2015), otters (Boessenecker 2016), and walrus (Boessenecker et al. 2018) from the Gubik Formation appear to have migrated along the Arctic coast from the Atlantic Ocean at around the same time. Elsewhere in the “Gubik” Formation collections from the North Slope from undated deposits specimens of the pelican-foot snail *Arhoges occidentalis* (Beck, 1836) (Mollusca: Gastropoda: Aporrhaidae) (UCMP locality IP23243) has been found. This species today lives in the northeast Atlantic and

northwestern Atlantic including the Mediterranean and Greenland (Johnson 1926, 1930). These data indicate an Arctic and Atlantic contribution to the Gubik fauna associated with *E.? louiemarinovichi* although it was after the opening of the Bering Strait to the Pacific Ocean (5.5 to 4.8 Ma; Marincovich and Gladenkov, 1999) indicating the currents were likely from east to west as they are today during the early Pleistocene.

### CONCLUSIONS AND FUTURE WORK

The new naticid species, *Euspira? louiemarinovichi*, is described from the early Pleistocene Gubik Formation of the North Slope of Alaska. This species is easily distinguished by spiral sculpture, and likely lived in the upper intertidal zone on hard substrate during the Bigbendian and (or) Fishcreekian marine transgressions.

More work is needed to document the history of marine deposits in northern Alaska towards development of a more complete profile of the faunas and timing of the various marine transgressions. Numerous collections from the North Slope of Alaska are already present in American museums. Integrating these collections with a knowledge of northern Alaska geology, world-wide sea-level fluctuations, and literature already published on marine transgressions of northern Alaska will result in a more precise biostratigraphy/chronostratigraphy that will aid field geologists in dating the numerous widespread fossil sites over the coastal plain of northern Alaska.

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## APPENDICES

**Appendix 1 – Locality information and associated faunas**

These collections were identified by Louie Marinovitch and the lead author in the late 1970s to early 1990s. The lists are taken from USGS E&R's (Evaluations and Reports) of various dates and the taxonomy has been updated here. These E&R's are available from the Museum of Paleontology, University of California, Berkeley (CA) and the U.S. Geological Survey (Reston, VA).

IP22958 (M6918a). Section 14, T17N, R24W, Meade River D-4 quadrangle, North Slope, Alaska. Latitude 70°49'27"N, longitude 158°06'36"W.

Mollusca

Bivalvia Linnaeus (1758)

*Astarte montagui* (Dillwyn)

*Astarte* J. Sowerby (1816) sp.

*Axinopsida serricata* (Carpenter, 1864) [as *A. orbiculata* (Sars, 1878) and *A. viridis* Dall (1901)]

*Clinocardium ciliatum* (Fabricius)

*Clinocardium* Keen (1936) sp.

*Hiatella arctica* (Linnaeus)

*Keenocardium californiense* (Deshayes)

*Limeocola balthica* (Linnaeus)

*Macoma* cf. *M. brota* Dall (1916)

*Macoma golikovi* Scarlato and Kafanov (1988) [as *M. obliqua* J. Sowerby (1817)]

*Macoma lama* (Bartsch, 1929)

*Macoma* cf. *M. lama* (Bartsch)

*Macoma* Leach (1819) sp.

*Mya pseudoarenaria* Schlesch

*Mya* Linnaeus (1758) sp.

*Serripes groenlandicus* (Mohr)

*Thracia* Blainville (1824) sp.

Gastropoda

*Admete* cf. *A. viridula* (Fabricius) [as *A. cf. A. couthouyi* (Jay, 1839)]

*Amauropsis islandica* (Gmelin, 1791)

*Boreotrophon* cf. *B. pacificus* Dall (1902)

*Buccinum* cf. *B. ciliatum* (Fabricius)

*Buccinum* cf. *B. glaciale* Linnaeus

*Bulbus fragilis* (Leach)

*Colus* (Röding, 1798) sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* (Broderip and G.B. Sowerby, I, 1829)]

*Cryptonatica janthostoma* (Deshayes, 1839)

*Euspira?* *louiemarinovichi* n. sp.

*Euspira pallida* (Broderip and G.B. Sowerby, I)

*Neptunea* cf. *N. lyrata* (Gmelin, 1791)

*Neptunea* cf. *N. heroes* (Gray, 1850)

*Obesotoma laevigata* (Dall)

*Obesotoma* Bartsch (1941) sp.

*Plicifusus* Dall (1902) sp.

IP23232 (M7343). Coastal cliff in section 7, T14N, R2W, Harrison Bay C-5 quadrangle, North Slope, Alaska. Latitude 70°34.88'N, longitude 152°30.9'W.

Mollusca

Bivalvia

*Clinocardium ciliatum* (Fabricius)

*Hiatella arctica* (Linnaeus)

*Limeocola balthica* (Linnaeus)

*Liocyma fluctuosa* (Gould)

*Mya* sp.

*Serripes groenlandicus* (Mohr)

Gastropoda

*Admete* Krøyer in Möller (1842) sp.

*Amauropsis islandica* (Gmelin)

*Cryptonatica affinis* (Gmelin) [as *C. clausa* (Broderip and G.B. Sowerby, I)]

*Euspira?* *louiemarinovichi* n. sp.

*Margarites* cf. *M. groenlandicus* (Gmelin, 1791)

*Obesotoma laevigata* (Dall)

*Tachyrhynchus* Mörch (1868) sp.

IP23233 (M7344). Coastal cliff in section 7, T14N, R2W, Harrison Bay C-5 quadrangle, North Slope, Alaska. Latitude 70°34.88'N, longitude 152°30.9'W.

Mollusca

Bivalvia

*Astarte borealis* (Schumacher)

*Limeocola balthica* (Linnaeus)

*Serripes groenlandicus* (Mohr)

Gastropoda

*Buccinum* Linnaeus (1758) sp.

*Euspira?* *louiemarinovichi* n. sp.

*Obesotoma* cf. *O. laevigata* (Dall)

IP23235 (M7346). Coastal cliff in section 7, T14N, R2W, Harrison Bay C-5 quadrangle, North Slope, Alaska. Latitude 70°34.88'N, longitude 152°30.9'W.

Mollusca

Bivalvia

*Astarte borealis* (Schumacher)

*Clinocardium* sp.

*Limeocola balthica* (Linnaeus)

*Liocyma fluctuosa* (Gould)

*Mya truncata* Linnaeus

*Serripes groenlandicus* (Mohr)

Gastropoda

*Acteocina* Gray (1847a) sp.

*Amauropsis islandica* (Gmelin)

*Buccinum* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* (Broderip and Sowerby, I)]

*Euspira?* *louiemarincovich* n. sp.

*Euspira pallida* (Broderip and G.B. Sowerby, I)

*Margarites* cf. *M. groenlandicus* (Gmelin)

*Neptunea* Röding (1798) sp.

*Obesotoma* cf. *O. laevigata* (Dall)

IP23238 (M7349). River bluff on Fish Creek, section 36, T11N, R1W, Harrison Bay B-4 quadrangle, North Slope, Alaska. Latitude 70°15.84'N, longitude 152°00.85'W.

Mollusca

Bivalvia

*Astarte borealis* Schumacher

*Astarte* sp.

*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]

*Clinocardium ciliatum* (Fabricius)

*Cyclocardia crebricostata* (Krause, 1885)

*Cyrtodaria kurriana* Dunker

*Hiatella arctica* (Linnaeus)

*Liocyma fluctuosa* (Gould)

*Macoma* cf. *M. calcarea* (Gmelin, 1791)

*Mya* sp.

*Nuculana* cf. *N. minuta* (Müller, 1776)

*Serripes groenlandicus* (Mohr)

Gastropoda

*Admete* sp.

*Amauropsis islandica* (Gmelin)

*Ariadnaria borealis* (Broderip and G.B. Sowerby, I)

*Boreotrophon* (Fischer, 1884) sp.

*Buccinum* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Euspira?* *louiemarincovich* n. sp.

*Littorina* cf. *L. sitkana* Philippi (1946) [as *L. sitchana* (Philippi, 1847)]

*Neptunes heros* (Gray)

*Neptunea beringiana* (Middendorff)

*Neptunea* sp.

*Obesotoma* sp.

*Plicifusus kroyeri* (Möller, 1842)

*Plicifusus?* sp.

*Retusa umbilicata* (Montagu, 1803)

IP23239 (M7350). River bluff on Fish Creek, section 36,

T11N, R1W, Harrison Bay B-4 quadrangle, North Slope, Alaska. Latitude 70°15.84'N, longitude 152°00.85'W.

Mollusca

Bivalvia

*Astarte* sp.

*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]

*Clinocardium ciliatum* (Fabricius)

*Cyclocardia* cf. *C. crebricostata* (Krause)

*Cyrtodaria kurriana* Dunker

*Limeocola balthica* (Linnaeus)

*Limocyma fluctuosa* (Gould)

*Macoma* cf. *M. calcarea* (Gmelin)

*Serripes groenlandicus* (Mohr))

Gastropoda

*Admete* sp.

*Amauropsis islandica* (Gmelin)

*Aulacofusus brevicauda* (Deshayes, 1832) [as *Colus spitzbergensis* (Reeve, 1855)]

*Boreotrophon* sp.

*Buccinum* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* (Broderip and G.B. Sowerby, I)]

*Euspira?* *louiemarincovich* n. sp.

*Littorina* cf. *L. sitkana* Philippi [as *L. cf. L. sitchana* (Philippi)]

*Margarites* Gray (1847b) sp.

*Netpunea* cf. *N. heros* (Gray)

*Neptunea* cf. *N. leffingwelli* (Dall)

*Neptunea* cf. *N. beringiana* (Middendorff)

*Obesotoma* cf. *O. laevigata* (Dall)

*Oenopota* Mörch (1852) sp.

*Plicifusus kroyeri* (Möller)

*Plicifusus* sp.

*Retusa umbilicata* (Montagu)

IP23248 (M7359). Colville River bluff, sec. 9, T7N, R2E, Umiat D-3 quadrangle, North Slope, Alaska. Latitude 69°43.85'N, longitude 151°38.58'W.

Mollusca

Bivalvia

*Astarte* sp.

*Hiatella arctica* (Linnaeus)

*Limeocola balthica* (Linnaeus)

*Liocyma fluctuosa* (Gould)

*Mytilus trossulus* Gould (1850) [as *Mytilus edulis* Linnaeus (1758)]

*Serripes groenlandicus* (Mohr)

*Siliqua* Megerle von Mühlfeld (1811) sp.

Gastropoda

*Amauropsis islandica* (Gmelin)

*Aulacofusus brevicauda* (Deshayes) [as *Colus spitabergensis* (Reeve)]

*Cryptonatica affinis* (Gmelin) [as *C. clausa* (Broderip and G.B. Sowerby, I)]

*Euspira? louiemarinovichi* n. sp.

*Margarites* sp.

*Neptunea lyrata* (Gmelin) s.l.

*Obesotoma* sp.

*Oenopota* sp.

*Retusa* Brown (1827) sp.

IP23264 (M7405). North shore of Kogru River, Harrison Bay (C-4) quadrangle, North Slope, Alaska. Latitude 70°34'25.5"N, longitude 152°15'48"W.

Mollusca

Bivalvia

*Astarte borealis* (Schumacher)

*Limeocola balthica* (Linnaeus)

*Liocyma fluctuosa* (Gould)

*Serripes groenlandicus* (Mohr)

Gastropoda

*Amauropsis islandica* (Gmelin)

*Aulacofusus brevicauda* (Deshayes) [as *Colus spitabergensis* (Reeve)]

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and Sowerby, I]

*Euspira? louiemarinovichi* n. sp.

Naticidae, indeterminate

*Oenopota* sp.

*Retusa* sp.

IP23266 (M7407). North shore of Kogru River, Harrison Bay (C-4) quadrangle, North Slope, Alaska. Latitude 70°34'26"N, longitude 152°18'21"W.

Mollusca

Bivalvia

*Astarte borealis* (Schumacher)

*Limeocola balthica* (Linnaeus)

*Liocyma fluctuosa* (Gould)

*Mactromeris polynyma* (Stimpson) [as *Spisula voyi* (Gabb, 1866)]

*Macoma lama* (Bartsch)

*Serripes* Gould (1841) sp.

*Siliqua* sp.

Gastropoda

*Euspira? louiemarinovichi* n. sp.

*Oenopota* sp.

IP23272 (M7413). North bluff, Saktuina Island, Harrison Bay (C-4) quadrangle, North Slope, Alaska. Latitude

70°33'48"N, longitude 152°05'48"W.

Mollusca

Bivalvia

*Astarte borealis* (Schumacher)

*Astarte* sp.

*Limeocola balthica* (Linnaeus)

*Macoma* cf. *M. brota* Dall

*Mytilus trossulus* Gould [as *Mytilus edulis* Linnaeus]

Gastropoda

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Neptunea* sp.

*Euspira? louiemarinovichi* n. sp.

IP23279 (M7420). Second terrace, north end of Skull Cliff, Mead River D-3 quadrangle, North Slope, Alaska. Latitude 70°59'58"N, longitude 157°21'42"W.

Mollusca

Bivalvia

*Astarte borealis* (Schumacher)

*Astarte* sp.

*Cyclocardia crebricostata* (Krause)

*Macoma lama* (Bartsch)

*Macoma obliqua* (Sowerby)

*Mactromeris polynyma* (Stimpson) [as *Spisula voyi* (Gabb)]

*Serripes groenlandicus* (Mohr)

*Serripes laperousii* (Deshayes, 1839)

Gastropoda

*Astyris* H. and A. Adams (1853) sp.

*Boreoscala groenlandicum* (Perry, 1811)

*Buccinum* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Euspira? louiemarinovichi* n. sp.

*Neptunea heroes* (Gray)

*Neptunea* sp.

IP23280 (M7421). Second terrace, north end of Skull Cliff, Barrow A-6 quadrangle. Latitude 71°00'10"N, longitude 157°21'12"W.

Mollusca

Bivalvia

*Astarte borealis* (Schumacher)

*Axinopsida* Keen and Chavan, in Chavan (1951) sp.

*Clinocardium ciliatum* (Fabricius)

*Cyclocardia crebricostata* (Krause)

*Mactromeris polynyma* (Stimpson) [as *Spisula voyi* (Gabb)]

*Macoma* cf. *M. brota* Dall

*Macoma* sp.

*Mya* sp.

*Serripes laperousii* (Deshayes)

*Yoldia* Möller (1842) sp.

Gastropoda

*Admete* sp.

*Boreotrophon?* sp.

*Buccinum* sp.

*Bulbus fragilis* (Leach)?

*Colus?* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and Sowerby, I]

*Cryptonatica janthostoma* (Deshayes)

*Euspira?* *louiemarinovichi* n. sp.

*Euspira pallida* (Broderip and Sowerby, I)?

*Margarites* sp.

Naticidae, indeterminate

*Neptunea* cf. *N. lyrata* (Gmelin)

*Obesotoma* sp.

*Oenopota* sp.

*Retusa* sp.

*Trichotropis* Sowerby, I (1829) sp.

IP23316 (M7458). Bluffs near the south end of Skull Cliff, Meade River D-4 quadrangle, North Slope, Alaska. Latitude 70°49'30"N, approximate longitude 158°06'36"W.

Mollusca

Bivalvia

*Hiatella arctica* (Linnaeus)

*Serripes laperousii* (Deshayes)

Gastropoda

*Boreoscala groenlandicum* (Perry)

*Buccinum?* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Euspira?* *louiemarinovichi* n. Sp.

*Neptunea* sp.

*Volutopsius?* Mörch (1857) sp.

IP23511 (M7841). Pleistocene locality in Mt. Michelson (D-2) quadrangle, North Slope, Alaska. Latitude 79°57'30"N, 144°43'W. Same locality as M7840 and faunas is combined.

Mollusca

Bivalvia

*Astarte borealis* (Schumacher)

*Cyrtodaria kurriana* Dunker

*Limeocola balthica* (Linnaeus)

*Mya truncata* (Linnaeus)

*Mya* sp.

Gastropoda

*Admete* sp.

*Amauropsis islandica* (Gmelin)

*Euspira?* *louiemarinovichi* n. sp.

IP23555 (M7907). About 0.5 mi northeast of Tuapaktushak Creek and about 36.2 mi southwest of Barrow along Skull Cliff, SW1/4, NE1/4, sec. 15, T18N, R22W, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska.

Mollusca

Bivalvia

*Clinocardium ciliatum* (Fabricius)

*Cyclocardia crebricostata* (Krause)

*Liocyra fluctuosa* (Gould)

*Macoma* cf. *M. brota* Dall

*Nuculana* cf. *N. pernula* (Dall)

*Serripes laperousii* (Deshayes)

Gastropoda

*Admete viridula* (Fabricius) [as *A. couthouyi* (Jay)]

*Buccinum* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Euspira?* *louiemarinovichi* n. sp.

*Euspira pallida* (Broderip and G.B. Sowerby, I)

*Oenopota* sp.

*Plicifusus kroyeri* (Mörch)

IP23559 (M7912). About 0.5 mi northeast of mouth of Tuapaktushak Creek and about 36.2 mi southwest of Barrow along Skull Cliff, SW1/4, NE1/4, sec. 15, T18N, R22W, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska.

Mollusca

Bivalvia

*Astarte arctica* (Gray, 1824) [as *A. broweri* Meek, 1923]

*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]

*Cyclocardia crebricostata* (Krause)

*Keenocardium californiense* (Deshayes)

*Macoma* sp.

*Mya* sp.

*Serripes laperousii* (Deshayes)

*Siliqua* cf. *S. alta* (Broderip and G.B. Sowerby, I, 1829)

*Yoldia* sp.

*Zirfaea pilsbryi* Lowe (1931)

Gastropoda

*Admete* cf. *A. viridula* (Aurivillius, 1885) [as *A. cf. A. regina* Dall (1902)]

*Amauropsis islandica* (Gmelin)

*Boreoscala groenlandicum* (Perry)

*Buccinum* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]  
*Euspira? louiemarincovichi* n. sp.  
*Euspira pallida* (Broderip and Sowerby, I)  
*Lacuna Turton* (1827) sp.  
*Margarites* cf. *M. helycinus* (Phillipps, 1774)  
*Neptunea* sp.  
*Oenopota* sp.  
*Propebela* cf. *P. arctica* (A. Adams)  
*Trichotropis* cf. *T. borealis* Broderip and G.B. Sowerby, I  
*Trichotropis* Broderip and G.B. Sowerby, I sp.

IP23574 (M7934). 4.1 mi. Northeast of Teshaktushak Creek and about 36 miles southwest of Barrow along Skull Cliff NW1/4, sec. 16, T18N, R22W, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska.

Mollusca  
 Bivalvia  
*Astarte* cf. *A. arctica* (Gray) [as *A. cf. A. broweri* Meek]  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
*Cyclocardia crebricostata* (Krause)  
*Liocyma fluctuosa* (Gould)  
*Macoma* cf. *M. lipara* Dall  
*Macoma?* sp.  
*Mya* sp.  
*Serripes* sp.  
*Siliqua* cf. *S. alta* (Broderip and G.B. Sowerby, I)  
*Yoldia* sp.  
 Gastropoda  
*Admete* cf. *A. viridula* (Fabricius) [as *A. cf. A. couthouyi* Jay]  
*Buccinum* cf. *B. plectrum* Stimpson  
*Buccinum* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* (Broderip and G.B. Sowerby, I)]  
*Cylichnoides alba* (Brown, 1827)  
*Epitonium* Röding (1798) sp.  
*Euspira? louiemarincovichi* n. sp.  
*Littorina* cf. *L. sitkana* Philippi [as *L. cf. L. sitkana* (Philippi)]  
*Neptunea* sp.  
*Oenopota* cf. *O. elegans* (Möller)  
*Oenopota* cf. *O. harpa* (Dall, 1885)  
*Oenopota* cf. *O. pyramidalis* (Strøm)  
*Oenopota* sp.  
*Plicifusus?* sp.  
*Tachyrhynchus* sp.

IP23576 (M7936). Float specimens from sea cliff about 4

mi northeast of mouth of Tuapaktushak Creek, Skull Cliff, NW1/4, sec. 6, T18N, R21W, Mead River D-3 quadrangle, Northern Coastal Plain, Alaska

Mollusca  
 Bivalvia  
*Astarte borealis* (Schumacher)  
*Astarte montagui* (Dillwyn)  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
*Clinocardium ciliatum* (Fabricius)  
*Clinocardium* sp.  
*Cyclocardia crebricostata* (Krause)  
*Hiatella arctica* (Linnaeus)  
*Liocyma fluctuosa* (Gould)  
*Limeocola balthica* (Linnaeus)  
*Macoma* cf. *M. brota* Dall  
*Macoma lama* (Bartsch)  
*Macoma* cf. *M. obliqua* (J. Sowerby)  
*Mactromeris polynyma* (Stimpson) [as *Spisula voyi* (Gabb)]  
*Mya* sp.  
*Serripes laperousii* (Deshayes)  
*Siliqua* sp.  
 Gastropoda  
*Boreotrophon clathratus* (Linnaeus)  
*Boreotrophon truncatus* (Strøm)  
*Cingula?* Fleming (1828) sp.  
*Colus* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and Sowerby, I]  
*Cryptonatica janthostoma* (Deshayes)  
*Euspira? louiemarincovichi* n. sp.  
*Euspira pallida* (Broderip and G.B. Sowerby, I)  
*Neptunea* cf. *N. borealis* (Philippi, 1850)  
*Neptunea heroes* (Gray)  
*Neptunea* sp.  
*Oenopota* aff. *O. declivis* (Lovén, 1846)  
*Propebela* cf. *P. arctica* (A. Adams, 1855)  
*Retusa umbilicata* (Montagu, 1803)  
*Solariella obscura* (Couthouy)  
*Volutosius* sp.

IP23577 (M7937). Float collected from base of sea cliff about 4 mi northeast of Tuapaktushak Creek, NW1/4, sec. 6, T18N, R21W, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska.

Mollusca  
 Bivalvia  
*Astarte montagui* (Dillwyn)  
*Axinopsida serricata* (Carpenter) (as *A. orbiculata* Sars)  
*Cyclocardia crebricostata* (Krause)

*Liocyma fluctuosa* (Gould)  
*Macoma* cf. *M. brota* Dall  
*Mactromeris polynyma* (Stimpson)  
*Mya* sp.  
*Nuculana?* Link (1807) sp.  
 Gastropoda  
*Admete viridula* (Fabricius) [as *A. couthouyi* (Jay)]  
*Amauropsis islandica* (Gmelin)  
*Buccinum scalariforme* Möller (1842) [as *B.* cf. *B. normalis* (Middendorff, 1848)]  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* (Broderip and G.B. Sowerby, I)]  
*Euspira?* *louiemarinovichi* n. sp.  
*Euspira pallida* (Broderip and Sowerby, I)  
*Neptunea* sp.  
*Oenopota* aff. *O. declivis* (Lovén)  
*Propebela* cf. *P. arctica* (A. Adams)  
*Retusa umbilicata* (Montagu)

IP23588 (M7959). Float from beach from north side of Kogru River, SE1/4, sec. 12, T14N, R3W, Harrison Bay C-5 quadrangle, Northern Coastal Plain, Alaska.

Mollusca  
 Bivalvia  
*Astarte borealis* (Schumacher)  
*Clinocardium ciliatum* (Fabricius)  
*Hiatella arctica* (Linnaeus)  
*Limeocola balthica* (Linnaeus)  
*Liocyma fluctuosa* (Gould)  
*Mya* cf. *M. pseudoarenaria* Schlesch  
*Serripes groenlandicus* (Mohr)  
*Siliqua* sp.  
 Gastropoda  
*Buccinum* cf. *B. tenellum* Dall in Kobelt (1883)  
*Buccinum* sp.  
*Euspira?* *louiemarinovichi* n. sp.

IP23589 (M7960). Foat and in situ fossils from bluff on north side of Kogru River, SE1/4, sec. 12, T14N, R3W, Harrison Bay C-5 quadrangle, North Slope, Alaska.

Mollusca  
 Bivalvia  
*Astarte vernicosa* Dall [as *A. bennetti* Dall (1903)]  
*Astarte borealis* (Schumacher)  
*Astarte montagui* (Dillwyn)  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars, also as *A. viridis* Dall?]  
*Clinocardium ciliatum* (Fabricius)  
*Cyrtodaria kurriana* Dunker  
*Liocyma fluctuosa* (Gould)

*Lyonsia?* Turton (1822) sp.  
*Limeocola balthica* (Linnaeus)  
*Macoma* cf. *M. obliqua* (J. Sowerby)  
*Macoma* sp.  
*Mya truncata* Linnaeus  
*Nuculana?* sp.  
*Pandora glacialis* Leach in Ross  
*Serripes groenlandicus* (Mohr)  
*Siliqua* cf. *S. alta* (Broderip and G.B. Sowerby, I)  
 Gastropoda  
*Admete solida* (Aurivillius) [as *A. regina* Dall]  
*Admete viridula* (Fabricius) [as *A. couthouyi* (Jay)]  
*Alvania?* (Risso, 1826) sp.  
*Amauropsis islandica* (Gmelin)  
*Aulacofusus brevicauda* (Reeve) [as *Colus spitzbergensis* (Reeve)]  
*Beringius behringi* (Middendorff)  
*Boreotrophon* cf. *B. truncatus* (Strøm)  
*Buccinum polare* Gray  
*Buccinum* cf. *B. tenellum* Dall in Kobelt  
*Buccinum* sp.  
*Bulbus fragilis* (Leach)  
*Cryptonatica affinis* (Gmelin) [as *Natica clausa* Broderip and G.B. Sowerby, I]  
*Euspira?* *louiemarinovichi* n. sp.  
*Euspira pallida* (Broderip and G.B. Sowerby, I)  
*Limneria undata* (Brown in Smith, 1839) [as *Velutina undata* Brown, 1839]  
*Neptunea heroes* (Gray)  
*Oenopota* cf. *O. declivis* (Lovén)  
*Oenopota* sp.  
*Propebela* cf. *P. arctica* (A. Adams)  
*Retusa umbilicata* (Montagu)  
*Thesbia nana* (Lovén)?

IP23590 (M7961). North side of Kogru River, SE1/4, sec. 12, T14N, R3W, Harrison Bay C-5 quadrangle, North Slope, Alaska.

Mollusca  
 Bivalvia  
*Astarte borealis* (Schumacher)  
*Clinocardium ciliatum* (Fabricius)  
*Cyrtodaria kurriana* Dunker  
*Hiatella arctica* (Linnaeus)  
*Limeocola balthica* (Linnaeus)  
*Liocyma fluctuosa* (Gould)  
*Macoma* sp.  
*Mya* sp.  
*Portlandia?* sp.  
*Serripes groenlandicus* (Mohr)



*Siliqua* sp.  
*Zirfaea?* Gray (1842) sp.  
 Gastropoda  
*Admete* cf. *A. solida* (Aurivillius) [as *A. cf. A. regina* Dall]  
*Amauropsis islandica* (Gmelin)  
*Aulacofusus brevicauda* (Reeve) [as *Colus spitzbergensis* (Reeve)]  
*Buccinum* cf. *B. plectrum* Stimpson  
*Buccinum* cf. *B. tenellum* Dall in Kobalt  
*Bulbus fragilis* (Leach)  
*Euspira?* *louiemarinovichii* n. sp.  
*Euspira pallida* (Broderip and G.B. Sowerby, I)  
*Habevolutopsius* cf. *H. attenatus* (Dall, 1874)  
*Limneria undata* (Brown in Smith) [as *Velutina undata* Brown]  
*Margarites* cf. *M. helycinus* (Phipps)  
*Neptunea heroes* (Gray)  
*Neptunea* cf. *N. beringiana* (Middendorff)  
*Neptunea* sp.  
*Oenopota* aff. *O. declivis* (Lovén)  
*Propebela* cf. *P. arctica* (A. Adams)  
*Retusa umbilicata* (Montagu)

IP23593 (M7966). Float from sea cliff just north of broad valley 3.5 mi northeast of Tuapaktushak Creek, center E1/2, sec. 1, T18N, R22W, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska.

Mollusca  
 Bivalvia  
*Clinocardium ciliatum* (Fabricius)  
*Crassocardia crassidens* (Broderip and G.B. Sowerby, I, 1829)  
*Cyclocardia crebricostata* (Krause)  
*Hiatella arctica* (Linnaeus)  
*Limeocola* cf. *L. balthica* (Linnaeus)  
*Liocyma fluctuosa* (Gould)  
*Macoma* sp.  
*Mya* sp.  
*Serripes laperousii* (Deshayes)  
 Gastropoda  
*Admete* cf. *A. solida* (Aurivillius) [as *A. cf. A. regina* Dall]  
*Buccinum* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]  
*Cryptonatica janthostoma* (Deshayes)  
*Euspira?* *louiemarinovichii* n. sp.  
*Euspira pallida* (Broderip and G.B. Sowerby, I)  
*Neptunea* sp.  
*Oenopota* sp.  
*Propebela* cf. *P. arctica* (A. Adams)

IP23596 (M7969). Float collected in E1/2, sec. 36, 1400' east, 2400' north of SE corner section 36, T11N, R1W, Harrison Bay B-4 quadrangle, Northern Coastal Plain, Alaska.

Mollusca  
 Bivalvia  
*Astarte borealis* (Schumacher)  
*Astarte* cf. *A. esquimalti* (Baird, 1863)  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
*Crassocardia crassidens* (Broderip and G.B. Sowerby, I)  
*Cyclocardia crebricostata* (Krause)  
*Cyrtodaria kurriana* Dunker  
*Hiatella arctica* (Linnaeus)  
*Keenocardium californiense* (Deshayes)  
*Macoma* cf. *M. brota* Dall  
*Mya truncata* (Linnaeus)  
*Mya* sp.  
*Nuculana pernula* (Dall) [? as *Nuculana radiata* Krause]  
*Pandora* Bruguière (1797) sp.  
*Portlandia* Mörch (1857) sp.  
*Serripes groenlandicus* (Mohr)  
*Yoldia myalis* (Couthouy)  
 Gastropoda  
*Admete* cf. *A. solida* (Aurivillius) [as *A. cf. A. regina* Dall]  
*Admete viridula* (Fabricius) [as *A. couthouyi* (Jay)]  
*Aforia circinata* (Dall)  
*Alvinia* (Risso, 1826) sp.  
*Amauropsis islandica* (Gmelin)  
*Antiplanes* Dall (1902) sp.  
*Ariadnaria borealis* Broderip and G.B. Sowerby, I  
*Ariadnaria* cf. *A. borealis* Broderip and G.B. Sowerby, I  
*Aulacofusus brevicauda* (Reeve) [as *Colus spitzbergensis* (Reeve)]  
*Boreoscala groenlandicum* (Perry)  
*Boreotrophon clathratus* (Linnaeus)  
*Boreotrophon pacificus* (Dall)  
*Boreotrophon truncatus* (Strøm)  
*Buccinum* cf. *B. plectrum* Stimpson  
*Buccinum polare* (Gray)  
*Colus pubescens* (Verrill, 1882)  
*Colus* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]  
*Euspira?* *louiemarinovichii* n. sp.  
*Euspira pallida* (Broderip and G.B. Sowerby, I)  
*Littorina* cf. *L. sitkana* Philippi [as *L. cf. L. sitchana* (Philippi)]  
*Margarites* sp.  
*Neptunea heros* (Gray)  
*Neptunea* cf. *N. leffingwelli* (Dall)

*Neptunea* cf. *N. beringiana* (Middendorff)  
*Neptunea* sp.  
*Plicifusus kroyeri* (Möller)  
*Propebela* cf. *P. arctica* (A. Adams)  
*Pseudoliomensus ooides* (Middendorff, 1848)  
*Retusa umbilicata* (Montagu)  
*Tachyrhynchus erosus* (Couthouy)  
*Trichotropis bicarinata* (G.B. Sowerby, I)  
*Volutopsius* sp.

IP23597 (M7970). Fish Creek, 1400' E, 2400' N of SE corner sec. 36, T11N, R1W, Harrison Bay B-4 quadrangle, North Slope, Alaska.

Mollusca  
 Bivalvia  
*Astarte* sp.  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
*Clinocardium* sp.  
*Cyrtodaria kurriana* Dunker  
*Licyma fluctuosa* (Gould)  
*Macoma* sp.  
*Mya* sp.  
*Pandora?* sp.  
*Portlandia* sp.  
*Serripes* cf. *S. groenlandicus* (Mohr)  
 Gastropoda  
*Admete solida* (Aurivillius) [as *A. regina* Dall]  
*Admete* cf. *A. viridula* (Fabricius) [as *A. cf. A. couthouyi* (Jay)]  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]  
*Euspira?* *louiemarinovichi* n. sp.  
*Hydrobia* Hartmann (1821) sp.  
*Littorina* cf. *L. sitkana* Philippi [as *L. cf. L. sitchana* (Philippi)]  
*Margarites* sp.  
*Propebela* cf. *P. arctica* (A. Adams)  
*Retusa umbilicata* (Montagu)

IP23602 (M7976). Locality in bluff about 6 mi SE along Beaufort Sea coast from south end of McKay Inlet, Barrow A-1 quadrangle, North Slope, Alaska. Latitude 71°08'N, longitude 154°38'W. Same locality as M7975 and faunas combined.

Mollusca  
 Bivalvia  
*Astarte borealis* (Schumacher)  
*Clinocardium* sp.  
*Crenella decussata* (Montagu, 1808)  
*Cyclocardia crebricostata* (Krause)

*Cyrtodaria kurriana* Dunker?  
*Limeocola balthica?* (Linnaeus)  
*Mactromeris polynyma* (Stimpson) [as *Spisula voyi* (Gabb)]  
*Mya* sp.  
*Portlandia* sp.  
*Serripes* cf. *S. laperousii* (Deshayes)  
*Serripes* sp.  
 Gastropoda  
*Acteocina* sp.  
*Admete?* sp.  
*Boreotrophon* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]  
*Euspira?* *louiemarinovichi* n. sp.  
*Liomesus* (H. & A. Adams, 1853) sp.  
 Naticidae, indeterminate  
*Neptunea* sp.  
*Oenopota* sp.  
*Trichotropis bicarinata* (Sowerby)  
 Echinodermata Klein (1778)  
 Echinoidea Leske (1778)  
 Sand dollar fragments

IP23607 (M7981). Locality about 1 mi. inland (south) from Camden Bay, on Carter Creek, Mt. Michelson D-2 quadrangle, North Slope, Alaska. Latitude 69°57'30"N, longitude 69°57'30"N.

Mollusca  
 Bivalvia  
*Astarte* cf. *A. borealis* (Schumacher)  
*Limeocola balthica* (Linnaeus)  
*Mya truncata* Linnaeus  
*Mya* sp.  
 Gastropoda  
*Acteocina* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]  
*Euspira?* *louiemarinovichi* n. sp.  
*Littorina* cf. *L. sitkana* Philippi [as *L. cf. L. sitchana* (Philippi)]

IP23721 (M8149). Float, about 5 mi. NE of Tuapaktushak Creek along Skull Cliff, Meade River D-3 quadrangle, North Slope, Alaska. Latitude 70°57'N, longitude 157°28'W.

Mollusca  
 Bivalvia  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
*Clinocardium* cf. *C. ciliatum* (Fabricius)  
*Cyclocardia crebricostata* (Krause)

*Hiatella arctica* (Linnaeus)  
*Liocyma fluctuosa* (Gould)  
*Macoma* sp.  
*Mya* sp.  
*Nucula* sp.  
*Nuculana* sp.  
*Serripes groenlandicus* (Mohr)  
*Siliqua* cf. *S. alta* (Broderip and G.B. Sowerby, I)  
*Yoldia* sp.  
 Gastropoda  
*Admete viridula* (Fabricius) [as *A. couthouyi* (Jay)]  
*Buccinum* cf. *B. tenellum* Dall in Kobalt  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and Sowerby, I]  
*Cylichnoides occulta* (Mighels and C.B. Adams, 1842)  
*Euspira? louiemarinovichii* n. sp.  
*Margarites costalis* (Gould, 1841)  
*Margarites* sp.  
*Neptunea* sp.  
*Oenopota* sp.  
*Trichotropis* sp.

IP23722 (M8150). Site about 5 mi northeast of Tuapak-tushak Creek along Skull Cliff, Meade River D-3 quadrangle, North Slope, Alaska. Latitude 70°57'N, longitude 157°28'W.

Mollusca  
 Bivalvia  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
*Cyclocardia crebricostata* (Krause)  
*Liocyma fluctuosa* (Gould)  
*Mactromeris polynyma* (Stimpson) [as *Spisula voyi* (Gabb)]  
*Musculus* Röding (1798) sp.  
*Nucula* Lamarck (1799) sp.  
*Nuculana pernula* (Müller)  
*Serripes groenlandicus* (Mohr)  
*Yoldia?* sp.  
 Gastropoda  
*Admete* sp.  
*Amauropsis islandica* (Gmelin)  
*Beringius?* Dall (1887) sp.  
*Buccinum* sp.  
*Colus* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]  
*Euspira? louiemarinovichii* n. sp.  
*Euspira pallida* (Broderip and G.B. Sowerby, I)  
*Margarites* sp.  
 Naticidae, indeterminate

*Neptunea heroes* (Gray)  
*Neptunea* cf. *N. leffingwelli* (Dall)  
*Neptunea* sp.  
*Odostoma* sp.  
*Piliscus commodus* (Middendorff, 1851)  
*Trichotropis* sp.

M8151. Northern coastal plain, sec. 32, T19N, R22W, Meade River D-3 quadrangle, Alaska. Latitude 70°57', longitude 157°28'W.

Mollusca  
 Bivalvia  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
 Cardiidae Lamarck (1809), indeterminate  
*Clinocardium* sp.  
*Cyclocardia crebricostata* (Krause)  
*Ennucula tenuis* (Montagu) [as *Nucula bellotii* A. Adams, 1856]  
*Liocyma fluctuosa* (Gould)  
*Mactromeris polynyma* (Stimpson) [as *Spisula voyi* (Gabb)]  
*Macoma* cf. *M. calcarea* (Gmelin)  
*Macoma* cf. *M. lipara* Dall  
*Mya truncata* Linnaeus  
*Mysella* cf. *M. tumida* (Carpenter, 1864)  
*Serripes* cf. *S. laperousii* (Deshayes)  
*Siliqua* cf. *S. alta* (Broderip and G.B. Sowerby, I)  
*Yoldia myalis* (Couthouy)  
 Gastropoda  
*Admete viridula* (Fabricius) [as *A. couthouyi* (Jay)]  
*Boreotrophon* cf. *B. clathratus* (Linnaeus)  
*Buccinum* sp.  
*Colus?* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]  
*Cylichnoides alba* (Brown)  
*Cylichnoides occulta* (Mighels and C.B. Adams)  
*Euspira? louiemarinovichii* n. sp.  
*Euspira pallida* (Broderip and G.B. Sowerby, I)  
*Margarites* sp.  
*Neptunea* cf. *N. leffingwelli* (Dall)  
*Neptunea* sp.  
*Nodotoma* cf. *N. impressa* (Beck in Mörch, 1869)  
*Nodotoma* Bartsch (1941) sp.  
*Oenopota* cf. *O. pyramidalis* (Strøm)  
*Oenopota* sp.  
*Plicifusus* sp.  
*Retusa* sp.  
*Trichotropis bicarinata* (G.B. Sowerby, I)

IP23724 (M8153). Skull Cliff, sec. 31, T19M, R22W, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska. Latitude 70°56'N, longitude 157°29'W.

Mollusca

Bivalvia

*Axinopsis serricata* (Carpenter) [as *A. orbiculata* Sars]

*Clinocardium?* sp.

*Cyclocardia crebricostata* (Krause)

*Liocyma fluctuosa* (Gould)

*Macoma* sp.

*Mya truncata* Linnaeus

*Mya* sp.

*Serripes groenlandicus* (Mohr)

*Yoldia myalis* (Couthouy)

*Yoldia* sp.

Gastropoda

*Admete* cf. *A. solida* (Aurivillius) [as *A. cf. A. regina* Dall]

*Boreoscala groenlandicum* (Perry)

*Buccinum* cf. *B. plectrum* Stimpson

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Cylichnoides alba* (Brown)

*Euspira pallida* (Broderip and G.B. Sowerby, I)

*Euspira? louiemarinovich* n. sp.

*Oenopota* sp.

*Trophonopsis* sp.

IP23812 (M8360). "Fossil Gully," at Ocean Point along the Colville River, North Slope, Alaska. Latitude 70°05.4', longitude 151,24.7'W.

Mollusca

Bivalvia

*Cyclocardia crebricostata* (Krause)

*Hiatella arctica* (Linnaeus)

Gastropoda

*Buccinum* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Euspira? louiemarinovich* n. sp.

*Neptunea leffingwelli* (Dall)

*Plicifusus kroyeri* (Mörch)

IP23856 (M8407). Near the outlet of Taupaktusak Creek, southwest of Barrow along Skull Cliff, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska. Latitude 70°49.5'N, longitude 158°06.1'W.

Mollusca

Bivalvia

*Astarte* sp.

*Axinopsis serricata* (Carpenter) [as *A. orbiculata* Sars]

*Clinocardium?* sp.

*Cyclocardia crebricostata* (Krause)

*Hiatella arctica* (Linnaeus)

*Keenocardium californiense* (Deshayes)

*Limeocola balthica* (Linnaeus)

*Liocyma fluctuosa* (Gould)

*Macoma* cf. *M. calcarea* (Gmelin)

*Macoma* sp.

*Musculus* sp.

*Mya* sp.

*Mytilus* sp.

*Pandora* sp.

*Siliqua* cf. *S. alta* (Broderip and Sowerby, I)

*Yoldia (Cnesterium)* sp.

*Zirfaea pilsbryi* Lowe

Gastropoda

*Admete viridula* (Fabricius) [as *A. couthouyi* (Jay)]

*Amauropsis islandica* (Gmelin)

*Boreotrophon* sp.

*Buccinum?* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Cylichnoides occulta* (Mighels and C.B. Adams)

*Euspira? louiemarinovich* n. sp.

*Euspira pallida* (Broderip and G.B. Sowerby, I)

*Margarites* sp.

Naticidae, indeterminate

*Neptunea* sp.

*Oenopota* sp.

*Trichotropis borealis* Broderip and G.B. Sowerby, I

IP23857 (M8408). Northeast of Taupaktushak Creek southwest of Barrow along Skull Cliff, Meade River D-3 quadrangle, Northern coastal Plain, Alaska.

Mollusca

Bivalvia

*Axinopsis orbiculata*

*Cyclocardia* Conrad (1867) sp.

*Hiatella arctica* (Linnaeus)

*Limeocola* cf. *L. balthica* (Linnaeus)

*Liocyma fluctuosa* (Gould)

*Macoma* sp.

*Mya* sp.

*Siliqua* cf. *S. alta* (Broderip and Sowerby, I)

Gastropoda

*Amauropsis islandica* (Gmelin)

*Buccinum* sp.

*Buccinum?* sp.

*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Euspira? louiemarincovichi* n. sp.  
*Mohnia?* (Friele, 1897) sp.  
 Naticidae, indeterminate  
*Oenopota* cf. *O. nazanensis* Dall (1919)  
*Oenopota* sp.

IP23868 (M8419). Coastal bluff about 23,300' northwest of mouth of Tuapaktushak Creek along Skuff Cliff, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska.

Mollusca  
 Bivalvia  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
*Hiatella arctica* (Linnaeus)  
*Macoma* cf. *M. calcarea* (Gmelin)  
*Serripes* sp.  
*Siliqua* cf. *S. alta* (Broderip and G.B. Sowerby, I)  
 Gastropoda  
*Buccinum* cf. *B. plectrum* Stimpson  
*Buccinum?* sp.  
*Euspira? louiemarincovichi* n. sp.  
 Naticidae, indeterminate  
*Nodotoma* sp.

IP23870 (M8421). Coastal bluff about 4.8 mi northeast of the mouth of Tupaktushak Creek along Skull Cliff, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska. Latitude 70°57.4'N, longitude 157°28.6'W.

Mollusca  
 Bivalvia  
*Axinopsida serricata* (Carpenter,) [as *A. orbiculata* Sars]  
*Clinocardium?* sp.  
*Cyclocardia crebricostata* (Krause)  
*Liocyma fluctuosa* (Gould)  
*Macoma* cf. *M. calcarea* (Gmelin)  
*Macoma* cf. *M. lipara* Dall  
*Mactromeris* sp.  
*Mya* sp.  
*Nuculana* sp.  
*Serripes groenlandicus* (Mohr)  
*Siliqua* cf. *S. alta* (Broderip and G.B. Sowerby, I)  
*Yoldia (Cnesterium)* sp.  
*Yoldia (Yoldia)* sp.  
 Gastropoda  
*Admete solida* (Aurivillius) [as *A. regina* Dall]  
*Amauropsis?* sp.  
*Bringius beringi* (Middendorff)  
*Buccinum* cf. *B. plectrum* Stimpson  
*Buccinum* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]

*Cylichnoides* cf. *C. alba* (Brown)  
*Euspira? louiemarincovichi* n. sp.  
*Euspira* cf. *E. pallida* (Broderip and G.B. Sowerby, I)  
*Littorina squalida* Broderip and G.B. Sowerby, I  
*Margarites* sp.  
 Naticidae, indeterminate  
*Neptunea heros* (Gray)  
*Neptunea leffingwelli* (Dall)  
*Nodotoma* sp.  
*Oenopota* cf. *O. pyramidalis* (Strøm)

IP23879 (M8430). Outcrop along Kikiakrorak River near its junction with the Colville River, near SW1/4, SW1/4, sec. 7, T7N, R2E, Umiat D-3 quadrangle, North Slope, Alaska.

Mollusca  
 Bivalvia  
*Astarte* cf. *A. vernicosa* Dall [as *A. bennettii* Dall]  
*Astarte* cf. *A. borealis* (Schumacher)  
*Hiatella arctica* (Linnaeus)  
*Macoma* cf. *M. calcarea* (Gmelin)  
*Mya* sp.  
 Gastropoda  
*Euspira? louiemarincovichi* n. sp.

IP23884 (M8435). Float from sea cliff about 1.5 mi northeast of mouth of Papigak Creek along Skull Cliff, NE1/4, SE1/4, sec. 14, T17N, R24W, Meade River D-3 quadrangle, Northern Coastal Plain, Alaska.

Mollusca  
 Bivalvia  
*Astarte* cf. *A. vernicosa* Dall [as *A. bennettii* Dall]  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
*Clinocardium* sp.  
*Cyclocardia crebricostata* (Krause)  
*Hiatella arctica* (Linnaeus)  
*Limeocola balthica* (Linnaeus)  
*Liocyma fluctuosa* (Gould)  
*Macoma* cf. *M. calcarea* (Gmelin)  
*Macoma* sp.  
*Mya* sp.  
*Mytilus* sp.  
*Serripes laperousii* (Deshayes)  
*Siliqua* cf. *S. alta* (Broderip and Sowerby, I)  
*Yoldia aeolica* (Valenciennes, 1846) [as *Yoldia scissurata* Dall, 1897]  
*Zirfaea pilsbryi* Lowe  
 Gastropoda  
*Admete viridula* (Fabricius) [as *A. couthouyi* (Jay)]  
*Amauropsis islandica* (Gmelin)

*Boreotrophon* sp.  
*Buccinum* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip and G.B. Sowerby, I]  
*Euspira? louiemarinovichi* n. sp.  
 Naticidae, indeterminate  
*Neptunea* sp.  
*Nodulotrophon coronatus* (Adams and Adams, 1864) [as *Boreotrophon dalli* (Kobelt, 1878)]  
*Oenopota* sp.  
*Retifusus* cf. *R. jessoensis* (Schrenck, 1863) [as *Plicifusus* cf. *P. brunneus* (Dall, 1877)]  
*Retusa* sp.  
*Retusa?* sp.  
*Trichotropis borealis* Broderip and G.B. Sowerby, I

IP24104 (M8768). 1400' E and 2400' N of SE corner of sec. 36, T11N, R1W, Harrison Bay B-4 quadrangle, North Slope Alaska.

Mollusca  
 Bivalvia  
*Astarte borealis* (Schumacher)  
*Astarte montagui* (Dillwyn)  
*Astarte* sp.  
*Axinopsida serricata* (Carpenter) [as *A. orbiculata* Sars]  
*Cyclocardia crebricostata* (Krause)  
*Cyclocardia* sp.  
*Cyrtodaria kurriana* Dunker  
*Hiatella arctica* (Linnaeus)  
*Keenocardium californiense* (Deshayes)  
*Liocyma fluctuosa* (Gould)  
*Macoma* cf. *M. brota* Dall  
*Musculus* sp.  
*Mya* sp.  
*Pandora* sp.  
*Portlandia arctica* (Gray, 1824)  
*Serripes* cf. *S. groenlandicus* (Mohr)  
*Yoldia myalis* (Couthouy)  
 Gastropoda  
*Admete solida* (Aurivillius) [as *A. regina* Dall]  
*Admete viridula* (Fabricius) [as *A. couthouyi* (Jay)]  
*Aforia circinata* (Dall)  
*Amauropsis islandica* (Gmelin)  
*Aulacofusus brevicauda* (Deshayes) [as *Colus spitabergensis* (Reeve)]  
*Beringius?* sp.  
*Boreoscala groenlandicum* (Perry)  
*Boreotrophon pacificus* (Dall)  
*Buccinum?* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* (Broderip

and G.B. Sowerby, I)  
*Cylichnoides occulta* (Mighels and C.B. Adams)  
*Euspira? louiemarinovichi* n. sp.  
*Euspira pallida* (Broderip and G.B. Sowerby, I)  
*Latisipho* cf. *L. hallii* (Dall)  
*Littorina squalida* Broderip and G.B. Sowerby, I  
 Naticidae, indet.  
*Neptunea heros* (Gray)  
*Neptunea leffingwelli* (Dall)  
*Neptunea* cf. *N. leffingwelli* (Dall)  
*Neptunea* cf. *beringiana* (Middendorff)  
*Neptunea* sp.  
*Nodotoma impressa* (Beck in Mörch)  
*Oenopota* sp.  
*Plicifusus kroyeri* (Möller)  
*Retusa* sp.  
*Volutopsius?* sp.

M8997. 1.5 mi northeast of the mouth of Papigak Creek along Skull Cliff, NE1/4, SE1/4, sec. 14, T17N, R24W, Meade River D-4 quadrangle, Northern Coastal Plain, Alaska.

Mollusca  
 Bivalvia  
*Astarte* cf. *A. vernicosa* Dall [as *A. bennettii* Dall]  
*Axinopsida serricata* (Carpenter) (as *A. orbiculata* Sars)  
*Clinocardium* sp.  
*Cyclocardia crebricostata* (Krause)  
*Hiatella arctica* (Linnaeus)  
*Limeocola balthica* (Linnaeus)  
*Liocyma fluctuosa* (Gould)  
*Macoma* cf. *M. calcarea* (Gmelin)  
*Macoma* cf. *M. obliqua* (Sowerby)  
*Musculus* sp.  
*Mya truncata* Linnaeus  
*Pandora* sp.  
*Serripes* sp.  
*Siliqua* cf. *S. alta* (Broderip and G.B. Sowerby, I)  
*Yoldia* (*Yoldia*) sp.  
*Zirfaea pilsbryi* Lowe  
 Gastropoda  
*Admete* aff. *A. viridula* (Fabricius) [as *A. aff. A. couthouyi* (Jay)]  
*Admete* cf. *A. solida* (Aurivillius) [as *A. cf. A. regina* Dall]  
*Amauropsis islandica* (Gmelin)  
*Ariadnaria* cf. *A. insignis* (Middendorff)  
*Boreotrophon?* sp.  
*Buccinum* cf. *B. plectrum* Stimpson  
*Buccinum?* sp.  
*Cryptonatica affinis* (Gmelin) [as *C. clausa* Broderip

and G.B. Sowerby, I]

*Euspira? louiemarinovichi* n. sp.

*Euspira pallida* (Broderip and G.B. Sowerby, I)

*Neptunea* cf. *N. heros* (Gray)

*Plicifusus* sp.

*Ptychatractus occidentalis* Stearns

*Volutopsius?* sp.

## Appendix 2 – Taxonomic notes for selected species

### MOLLUSCA

#### BIVALVIA

*Axinopsida serricata* — Reported as *A. orbiculata* in USGS E&R's. However, *A. serricata* is a European Arctic and Atlantic species not present in the eastern Pacific or this part of the Arctic today.

*Hiatella arctica* — Recent work by Flyachinskaya and Lezin (2014), Laakkonen et al. (2015) show that this taxon is a species group that has not been differentiated. It is doubtful when these species are sorted out biologically that shell features alone will be adequate for distinguishing between the various species.

#### GASTROPODA

*Buccinum tenellum* — The author(s) of this species has been confused since the name was first used and is usually attributed to W.H. Dall (1883) or 'Dall ms' Kobelt (1883). Dall's papers in 1883 do not deal with this species. Kobelt (1883) translated from the German approximately writes "I know of this species, which is not yet published anywhere, only the figure sent to me by the author, copied on our plate, according to which diagnosis and description I do not dare to give..." (Bd. 3, Abt. 1C - Systematisches Conchylien-Cabinet - Biodiversity Heritage Library, p. 88). The only definition Kobelt gives is "...smooth or nearly so, dark brown," which apparently came from Dall, is not enough to distinguish it from other buccinums, nor is his illustration in our opinion, although he did make the name available. Kobelt attributes the species to Dall, however Dall did not describe or illustrate this species till 1902 (v.24=no.1241-1274 (1902) - Proceedings of the United States National Museum - Biodiversity Heritage Library, p. 519) and says "the figure in the Conchylien Cabinet "Was not accompanied by a diagnosis [description], which I now provide." It wasn't until the second International Zoological Congress (Paris 1889, Moscow 1892) that zoologists saw the need to establish commonly accepted international rules to replace conventions and unwritten rules that varied from discipline to discipline, country to country, and language to language. So the question for us is, is Kobelt's discussion

and illustration good enough to define a species distinct from other *Buccinum* and if so who is the author(s). We consider the answer - no, it is not enough. However, since Kobelt was using Dall's illustration and list no specimens it seems problematic that he had specimens available to him even though he states he is familiar with the species. Dall (1902) describes, illustrates and designates USNM 108975 as type tying the name to a specimen and stabilizing the name. In regards to authorship and considering the International Commission of Zoological Nomenclature (<https://www.iczn.org/the-code/the-code-online/>), article 50 and to be consistent with these authors and for taxonomic stability we attribute *B. tenellum* to Dall in Kobelt (1883), while not completely correct by today's standards this seems the best solution to this problem.

*Neptunea leffingwelli* — An extinct species, reported by MacNeil (1957) only from sites along the Colville River, North Slope, Alaska and restricted to his *Neptunea leffingwelli* faunule, his basal faunule in the Gubik Formation..