National Park Service
Inventory & Monitoring Program
Southwest Alaska Network

Guide to Intertidal Bivalves In Southwest Alaska National Parks

Katmai National Park and Preserve
Kenai Fjords National Park
Lake Clark National Park and Preserve

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Keywords

Infauna; bivalve; inventory; intertidal; soft-sediment; Southwest Alaska Network, Katmai National Park and Preserve; Kenai Fjords National Park; Lake Clark National Park and Preserve.

Abbreviations

KATM—Katmai National Park and Preserve
KEFJ—Kenai Fjords National Park
LACL—Lake Clark National Park and Preserve
MLLW—Mean Lower Low Water
NPS—National Park Service
SWAN—Southwest Alaska Network of the National Park Service

Cover Photograph: *(Top left)* Brown bear feeding on softshell clams in an intertidal mud flat in front of Katmai Wilderness Lodge, Kukak Bay, Katmai National Park and Preserve. Depth and size relationships among Baltic macomas, oval macomas, softshell and truncate softshell clams in the sediment cross-section are approximately representative from top to bottom.

(Bottom left) Brown bear prospecting for razor clams on broad sand flat in front of Silver Salmon Creek Lodge, Lake Clark National Park and Preserve. Depth and size relationships among Alaska great-tellin, Arctic surf clam, and Pacific razor clams in the sediment cross-section are approximately representative from top to bottom.

(Right) Researchers sampling on a beach of mixed-soft sediments in McCarty Lagoon, McCarty Fjord, Kenai Fjords NP. Depth and size relationships among northern horsemussel, littleneck clams, bentnose macomas, and butter clams in the sediment cross-section are approximately representative from top to bottom.

Forward

The National Park Service's primary mission is to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations. Preservation of healthy parks depends on acquiring accurate and timely information about the condition of natural resources, monitoring the change of conditions over time, and acting on that information with confidence. The National Parks Omnibus Management Act of 1998 created a program to collect baseline information and to monitor long-term trends in the condition of natural resources in national parks. In 2000, this Inventory and Monitoring Program was initiated at Alagnak Wild River, Aniakchak National Monument, Katmai National Park and Preserve, Kenai Fjords National Park, and Lake Clark National Park and Preserve. These park units, collectively known as the Southwest Alaska Network (SWAN), contain over 1,000 miles of marine coastline in the Northern Gulf of Alaska.

In 2004-2006, the SWAN Inventory and Monitoring Program contracted with Dennis Lees, Littoral Ecological & Environmental Services, to assess the species composition and distribution of marine bivalve invertebrates on soft sediment intertidal beaches. Bivalve invertebrates provide an important prey resource for shorebirds, ducks, fish, bears, sea otters, humans, and other marine and terrestrial predators. Because they are sedentary and long-lived, they are sensitive indicators of environmental stress or change in the nearshore marine environment. Information from this inventory has expanded our knowledge of bivalve invertebrate occurrence in the SWAN, assisted in the design of a long-term monitoring program for the parks, and through this Guide will facilitate the identification and appreciation of intertidal animals.

Alan Bennett, Coordinator
SWAN Inventory and Monitoring Program

Acknowledgments

Several members of the staff for the NPS Southwest Alaska Network contributed substantially to the successful execution of the study underlying this guide. Mr. Alan Bennett's considerable contributions to program design and logistical and field support were invaluable. Other NPS personnel that accompanied the LEES field team included Laurel Bennett, Shelley Hall, Chief of Resource Management for KEFJ, Mr. Ian Martin, KEFJ Ecologist, and Dr. Amy Miller, Ecologist for SWAN. Furthermore, the assistance of Mr. William Driskell and Mr. Howard Teas were critical to the success of the bivalve studies. The enthusiasm, interest, knowledge, sharp eyes, and good humor of these individuals were key to the success of this field survey.

Finally, the author wishes to extend thanks to Ms. Nora Foster and Dr. Eugene Coan for their permission to use drawings from their publications in this guide. These excellent figures, illustrating crucial diagnostic characteristics, have been important in differentiating among similar species.

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Introduction

The purpose of this guide is to provide assistance to visitors to the Southwest Alaska Network (SWAN) national parks and National Park Service staff in identifying, understanding, and enjoying bivalves found in intertidal sediments in the SWAN parks. We have provided brief sections on the ecology of these clams, including comments on their habitats and feeding types, and a descriptive guide to the clams. The descriptive guide includes drawings and photographs to depict the appearance of the clams both in the hand and, where possible, the appearance of distinguishing indicators of their presence in the field. For each species, we have included a brief description of the clam, its typical habitat, and its distribution among the parks and in the North Pacific.

Bivalves are a critical source of nutrition for major predators such as bears, sea otters, sea (diving) ducks, shorebirds and other invertebrates at some time during the year. For example, bears along the KATM coast achieve higher rates of energy from razor and softshell clams than those foraging on vegetation (Smith 2004).

In addition to supporting the bears, sea otters, diving ducks, and shorebirds for millions of years, clams have been a major source of food for native Alaskans since their arrival in Alaska 15,000 to 20,000 years ago. They have been important in the success of native cultures in coastal environments. Evidence of the dependence of the native Alaskans on several species of clams for food has been well documented in archaeological excavations of shell middens in the vicinity of old coastal villages.

Bivalves provide insight into a very ancient and very successful inhabitant of our beaches. Early clams appear in the fossil record about 620 million years ago during the Cambrian period. They became one of the dominant life forms in the oceans over 200 million years ago and remain so today (Yonge 1960). On soft beaches, clams are a dominant sedentary life form in a variety of habitats, have a wide range of physiological tolerances, and are among the longest living animals, some species living at least 20

Introduction (continued)

years. With such longevity and lack of mobility, they are good indicators of long-term conditions (Bennett 2006). It can be assumed that beaches supporting reasonable numbers of long-lived clams are stable and "healthy."

Map of Southwest Alaska National Parks covered in this Guide: Lake Clark National Park and Preserve; Katmai National Park and Preserve, and; Kenai Fjords National Park.

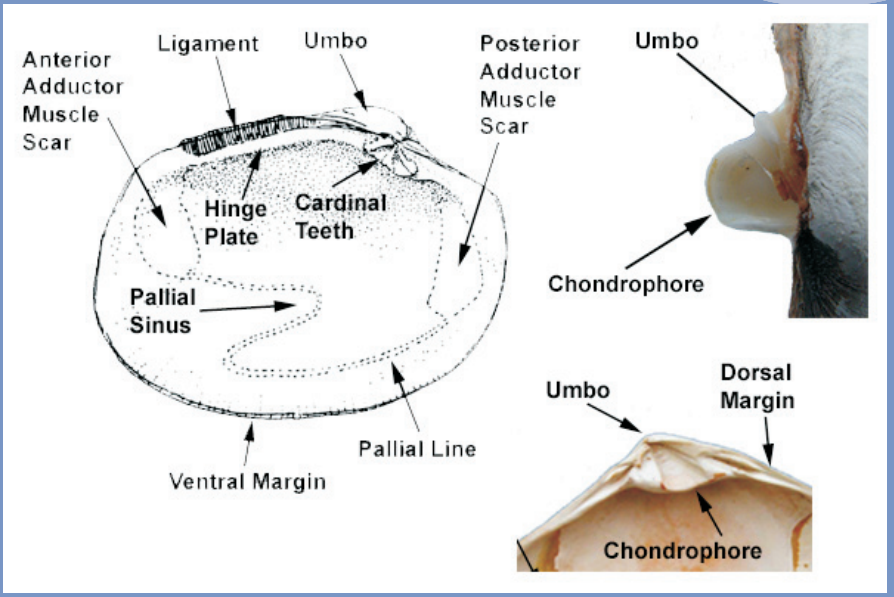
Introduction (continued)

This guide includes descriptions of twenty-nine species in thirteen families that were found in surveys of beaches in three SWAN national parks during the summers of 2004 and 2005 (Lees and Driskell 2004, 2006a, and 2006b). The parks surveyed were Katmai National Park and Preserve (KATM), Kenai Fjord National Park (KEFJ), and Lake Clark National Park and Preserve (LACL). Species composition of the clams varied considerably by park. Approximately the same number of clam species was observed in KATM and KEFJ, but LACL supports far fewer species. Only Baltic macomas and softshell clams were found in all parks. In contrast, half the species were found only in KATM (7) or in KEFJ (7).

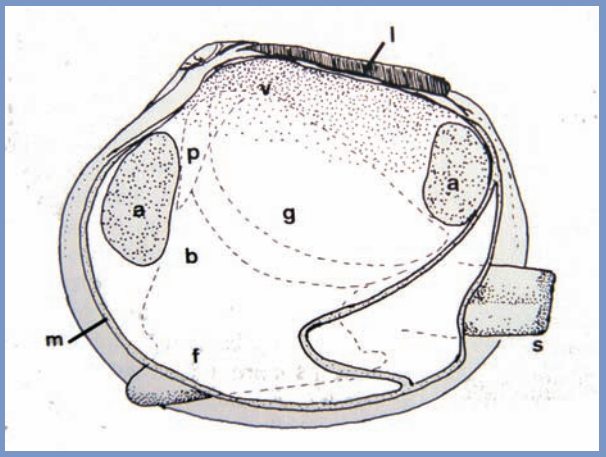
The two figures on the next page show a number of the shell and soft tissue characters that are used to describe the clams in the guide. Definitions of these and many other features are provided in the Glossary. Many other characters, especially external features, are demonstrated in the figures used to illustrate important characteristics for particular species.

The frequency with which the species occurred in the parks provides some indication of the likelihood that the clams or their shells will be encountered while examining park beaches. Many species were observed only rarely in one or more parks. For species indicated by an asterisk (*), the individual clams are quite small and unlikely to be observed without the aid of a magnifying glass or a microscope. Clearly, Baltic macomas and foolish mussels were encountered far more frequently than any other species. The second tier for frequency of occurrence includes littleneck, butter, and softshell clams, oval macomas, and Arctic hiatellas.

The families are presented in order of evolutionary development (phylogeny), starting with the earliest, most primitive forms. The scientific and common names and phylogeny used in this document are based largely on the taxonomic treatment of Coan, Valentich Scott, and Bernard (2000). Drawings reproduced in the text are based on Foster (1991) and Coan (1971), as cited.



Important internal shell features used in descriptions of the clams in this guide (drawing after Foster 1991).



a. adductor muscles
b. body
f. foot
g. gills
l. ligament
m. mantle edge
p. labial palp
s. siphon
v. viscera (i.e., gonad, digestive organs, heart, excretory organs)

Important soft parts used in descriptions of clams in this guide (after Foster 1991).

Number of times clam species were observed in samples and their distribution among the parks.

SPECIES/PARK	KATM	KEFJ	LACL	Total
Western bittersweet		1		1
Foolish mussel	16	88		104
Northern horsemussel		9		9
Rough diplodon		2		2
Silky axinopsid*		8		8
Suborbicular kellyclam*		1		1
Compressed montacutid*		1		1
Robust mysella*	3	16		19
Low-rib cockle	1			1
Basket cockle	11	8		19
Lord dwarf-venus*	1	5		6
Littleneck clam	5	35		40
Butter clam	11	23		34
Minute turton*	7	1		8
Alaska great-tellin	1			1
Salmon telllin	7			7
Baltic macoma	39	69	26	134
Expanded macoma	3	1		4
Oval macoma	19	24		43
Pointed macoma	3	9		12
Bent-nose macoma	1			1
Alaska razor clam	7			7
Pacific razor clam	1		6	7
Arctic surf clam	8			8
Pacific gaper	2			2
Softshell clam	24	4	8	36
False softshell clam	6	5		11
Truncate clam	1	7		8
Arctic hiatella		33		33
Number of Samples in Which Encountered	177	350	40	567
Number of Species Encountered	22	21	3	29

* Individuals of species too small to be observed without a magnifying glass or microscope.

Notes on Habitat, Ecology, Structure and Evolution

Three important functional attributes in our consideration of clam species are the type of habitat they inhabit, how they occupy the habitat, and how they feed and live. These factors have structural ramifications that have been realized through evolution. These attributes are discussed in the sections below.

Habitats

The three major types of sediments found on beaches supporting clams in the parks are low-energy, protected muddy habitats (mud flats), high-energy sandy beaches, and sediments comprising varying amounts of silt, sand, gravel, cobbles, and boulders (referred to below as mixed-soft sediments) in low to moderately high-energy situations. All habitats support one or more species utilized as prey by "charismatic" predators such as brown bears, sea otters, diving sea ducks, or shorebirds, or support subsistence or commercial fishing by man.

The proportion of these habitats varies considerably among the three parks considered herein. Because clam species typically prefer a single generalized habitat type (but may occur in more than one), dominance patterns by the clams vary markedly among the parks. This is demonstrated clearly in the table above.

Typical intertidal mud flat that supports softshell clams and Baltic macomas. (Head of James Lagoon, at the north (upper) end of McCarty Fjord, KEFJ, at approximately +2.0 ft (0.6 m) above MLLW.

Mud flats are productive across a wider range of vertical elevation than the other habitat. Because the sediments are fine, they hold greater volumes of water during the immersion that occurs during low tides. The retained water buffers the animals living in the sediments from desiccation and temperature extremes that can occur during immersion. Consequently, the bivalve fauna on mud flats is similar from lower tide levels (below Mean Lower Low Water (MLLW) to at least 10 feet above MLLW where salinity remains high enough to support clams during high tide.

Typical sand beach that supports razor clams and surf clams. (Near Silver Salmon Creek Lodge in LACL about 3.5 ft (1.1 m) below MLLW.)

Sand beaches typically only support clams up to about 3 feet above MLLW. Above that elevation, desiccation and temperature extremes experienced during low tides exceed the clams' tolerance, especially juveniles living in upper layers of sediment.

Mixed-soft sediment with considerable shell debris from littleneck and butter clams. (The sediments in these mixed-soft photographs are located along the north shore of McCarty Lagoon in McCarty Fjord, KEFJ, about 2.3 feet (0.7 m) below MLLW.)

Seawater also drains rapidly out of mixed-soft sediments when water levels fall during low tides. Consequently, the animals living in these sediments are similarly exposed to desiccation and temperature extremes and so significant populations of clams are limited to a few feet above MLLW.

Because the pebbles, cobbles, and small boulders in the mixed-soft habitats tend to become "cemented" over time as they are jostled and reorganized by wave action and current flow, and fine sediment fills into the interstices among the larger particles, these particles provide an "armor" at the surface that protects the sediment and young specimens of many recruiting species from disturbance by wave action. Consequently, many more species can become successfully established in mixed-soft habitats than are observed in mud or sand habitats and these habitats are far richer than the finer substrates. This trend is apparent in many other types of organism as well as bivalves (e.g., burrowing shrimp, worms, and sea cucumbers).

The three major habitat types are not distributed equally within or among the parks. KATM has large areas of mud flats north of Kukak Bay, and especially in Kamishak Bay near Douglas River. This same area also has long stretches of sandy beach and sand flats. However, the sandy areas appear to be too exposed to support significant intertidal clam populations. The beaches from Kukak Bay south are generally smaller and more varied than in the northern region because the coastline is dissected by numerous bays that create a wide variety of exposures and sediment types. Multiple examples of all three major habitat types occur in the southern region of KATM.

Typical mixed-soft beach that supports littleneck and butter clams.

KEFJ is characterized mainly by mixed-soft habitats and mud flats. It has more mixed-soft beaches than the other parks. Exposed sandy beaches are uncommon, resulting in the virtual absence of razor and surf clams.

LACL is characterized mainly by mud flats and exposed or semi-exposed sand beaches. Many of the sand beaches support healthy populations of razor clams. The mud flats that are not overly influenced by freshwater runoff generally support healthy populations of softshell clams and Baltic macomas. However, due to the near absence of mixed-soft habitats, species adapted to such habitats (e.g., littleneck and butter clams) have not been observed in this park.

Clam species living in predominantly low-energy, protected muddy habitats include:

- Softshell clam *(Mya arenaria)*
- Truncate softshell clam *(Mya truncata)*
- Baltic macoma *(Macoma balthica)*
- Oval macoma *(Macoma golikovi)*
- False softshell clam *(Mya pseudoarenaria)*
- Pointed macoma *(Macoma inquinata)*
- Silky axinopsid *(Axinopsida serricata)*

Clam species living in predominantly high-energy sandy habitats include:

- Pacific razor clam *(Spisula patula)*
- Alaska great-tellin *(Tellina lutea)*
- Arctic surf clam *(Mactromeris polynyma)*
- Alaska razor clam *(Siliqua alta)*
- Salmon tellin *(Tellina nuculoides)*

Clam species living in low- to moderate-energy, mixed-soft habitats include:

- Littleneck clam *(Protothaca staminea)*
- Foolish mussel *(Mytilus trossulus)*
- Rough diplodon *(Diplodonta impolita)*
- Gaper clams *(Tresus spp.)*
- Butter clam *(Saxidomus gigantea)*
- Pointed macoma *(Macoma inquinata)*
- Northern horsemussel *(Modiolus modiolus)*

Feeding Types

The species discussed in this guide have two predominant feeding modes. All but the macomas and tellinids are obligatory suspension feeders. They pump large volumes of water from the water column over the gills and filter from that water the suspended plankton and/or particulate detrital matter that is then passed into the digestive tract for nutrition. In contrast, the macomas and tellinids are facultative suspension/deposit feeders. Depending on the velocity of the currents sweeping their habitat, they can either function as a suspension feeder or, under calmer conditions, they use their long, flexible incurrent siphons like a vacuum-cleaner hose to suck up a concentrated layer of organic matter from the surface of the sediments around their siphon holes.

Modes of Life

The bivalves observed during this study typically dwell in one of at least three different modes. Some, such as foolish mussels, have a mostly surficial lifestyle, i.e., they live on top of the sediments. Some species are nestlers, i.e., they nestle at the surface among the larger particles or in burrows created by burrowing organisms. These include the Arctic hiatella and robust mysella. But the most common forms are burrowing clams, i.e., those that live burrowed at varying depths in the sediments. These include such species as littleneck, butter, razor, and softshell clams. Specimens of the northern horsemussel can be found utilizing all three modes described above.

All burrowing species observed during this study connect to the overlying surface water through incurrent and excurrent siphons of varying length. These species extend their siphons through temporary openings in the sediment or semi-permanent burrows to connect to the surface of the sediment and achieve access to the water column. This is necessary because the water contains food and oxygenated water. This connection also allows the clams to discharge wastes and reproductive products. The length of the siphon varies from a few millimeters, in the case of horsemussels and cockles, to half a meter in the case of gaper clams.

These different modes of life have structural implications for the clams. Those that live at the surface or nestle in burrows of other organisms do not have a need for long siphons and digging capabilities. Short siphons appear to represent the more primitive condition in clams. It appears that primitive bivalves rested on the surface of the substrate and had no need for elongate siphons. Living on the surface, they were more exposed to predators and environmental stresses. One strong evolutionary trend appeared to provide features that would allow the clams to move deeper into the sediments, reducing susceptibility to these factors. But such an adaptation required that burrowing clams develop elongated siphons to retain access with the overlying water, which has structural implications.

Thus, a clam's mode of life is indicated by various shell structures. Those living at the surface do not need elongated siphons. However, clams with elongated siphons need to be able to retract them to some degree to escape predators wishing to feed on them. Retraction of siphons imposes a requirement for retractor muscles and these must be accommodated within the shell cavity. This cavity is lined with a layer of tissue, the mantle, which envelops the body of the clam and produces the shell. The interior of the shell exhibits a scar, the pallial line, marking where the margin of the mantle attaches to the shell. As the retractor muscles increased in size, the space required to accommodate them is reflected on the interior of the shell in an invagination of the pallial line as the mantle retracts to make space. This invagination of the pallial line is called a pallial sinus. As clams evolved to burrow deeper into the sediment, they needed longer siphons and larger retractor muscles, so the pallial sinuses became correspondingly larger. In most deep-burrowing clams, the siphon is often so large that it can't be retracted completely into the shell. Consequently, the posterior ends of the shell have a gap between them to accommodate the siphon. This is most conspicuous in very deep-burrowing clams like gapers and geoducks.

Two other features characterizing bivalves appear to have accompanied the evolution of the burrowing mode of life. Clams living on the sediments are generally relatively small and short-lived (1-5 years). In contrast, it appears that as the clams gained protection by burrowing into the sediment, they were able to live longer and grow bigger. Again, this is very apparent in geoducks, which attain weights of up to 5.5 kg (12 lb) and are estimated to live up to 130 years.

Obtaining and Handling Clam Specimens

Generally, the identity of clams inhabiting beaches can be determined by examining empty shells found on the surface of the sediments. An advantage of these loose, empty shells is that they can be carried back to camp for close examination with this guide or other references. However, while visiting beaches, visitors may be tempted to do some digging to obtain live specimens and get a better sense how these animals live. A clam digger should only dig directly where they see what appear to be clam “shows”. Random, undirected digging needlessly disturbs sediments and the resident fauna and, in mixed-soft sediments, the armoring established by the pebble/cobble matrix that protects young clams from winter storm activity and took many years to become established.

Before a visitor embarks on digging and examining live clams, he or she should first become familiar with a few basics of clam anatomy, particularly how to recognize the anterior and posterior end of the clam. This will be important in replanting the clam after examination is complete.

The safest, most environmentally sensitive way to dig a clam, at least for the clam, is to dig by hand, starting at the siphon hole, and excavate down to the level of the clam using the burrow as a guide. When the digger gets down to the level of the clam, he or she may encounter the siphon. Digging should proceed past that point down far enough that the fingers can grasp the shell beyond its fattest portion and cup it between the fingers. The clam can then be extracted vertically from the sediment.

Far fewer clams will be broken if they are dug by hand. This is important because survival of broken clams is low. One must take considerable care when excavating razor clams by hand to avoid cracking the fragile shell and, in addition, to protect one's self from the sharp edges of a fractured shell, which act on the fingers much like the name of the clam if the digger is careless.

Obtaining and Handling Clam Specimens (continued)

When replacing clams in the sediments, most must be placed vertically in the sediment so that the foot (the anterior end) faces downward and the siphons (the posterior end) face upward. They should be placed in a hole that is approximately as deep as they were located before extraction. The hole should then be gently filled partially with mainly fine sediments to hide the clam from predators but allow it to re-establish its siphon hole slowly as the sediments refill the hole.

Risks from Paralytic Shellfish Poisoning (PSP)

Visitors boating or camping in the parks may be tempted to harvest and eat mussels or other clams during their visit. This practice is not advisable unless there is clear local evidence that the local stocks are not contaminated with the toxin responsible for paralytic shellfish poisoning (PSP). PSP, caused by blooms of a particular species of phytoplankton, occurs mainly during warmer months, when most people visit the parks. Phytoplankton blooms are often localized, especially in embayments. Consequently, the fact that razor clams tested for commercial operations at Polly Creek, in Lake Clark National Park, does not assure that clams harvested elsewhere in that or another park are safe for human consumption. Moreover, some clams retain the toxin for as much as two years after a PSP episode. Finally, sea otters consuming clams can recognize and discard the PSP-contaminated tissues so it is not acceptable to use clam-feeding observations as a justification for consuming clams.

Descriptive Guide and Comments

Descriptions are summarized from Foster (1991) and Coan, Valentich Scott, and Bernard (2000). Natural history notes are based on personal observations or Morris et al. (1980).

Western Bittersweet

(Glycymeris septentrionalis)

Western bittersweet, right valve exterior (after Foster 1991).

Description

Shell ovate to trigonal, discoidal, compressed to moderately inflated, moderate to thin in thickness; anterior end generally longer, slightly produced; posterior margin rounded. Beaks orthogyrate. Radial sculpture evident in unworn specimens, where the outer surface is marked with very low, flat radial ribs and concentric growth checks. Hinge plate arched, with taxodont dentition; inner shell margin crenulate. Periostracum thick, dark, dehiscent, shaggy, finely hirsute; where worn, the shell is chalky, ash-white, with brown or purplish flammules. Interior color markings match pattern on the shell's exterior. Length to 45 mm (1.8 inches).

Western bittersweet, right valve exterior (after Foster 1991).

Habitat

Mixed-soft, fine-gravel, or sand habitats from low intertidal zone to 150 m (492 ft).

Significant Predators

Unknown.

Range in Park and Pacific

During the 2004-2005 surveys, this species was found only in KEFJ at a single site. Reported from Chirikof Island, Alaska to southern California.

Western bittersweet, left valve interior (after Foster 1991).

Mytilidae

Foolish Mussel,

Pacific Blue Mussel, Northern Bay Mussel, or Edible Mussel

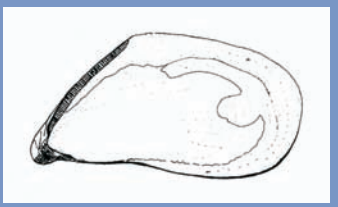
(Mytilus trossulus)

Individual foolish mussel on rocky substrate.

Description

Shell blue-black or brownish, trigonal, flared, outline variable, frequently expanded dorsally. Ventral surface relatively wide laterally; anterior end pointed, often curved. Hinge plate dark to light in color, curved. Anterior adductor muscle scar relatively small; posterior byssal retractor muscle scar relatively long, narrow. Interior with blue muscle scars and pale blue margins. Length to 100 mm (3.9 in).

Foolish mussel, left valve exterior (after Foster 1991).



Foolish mussel, right valve interior (after Foster 1991).

Habitat

Form dense extensive beds in mixed-soft habitats or in sparse beds in mud flats in mid and lower intertidal zones in rocky and mixed-soft habitats.

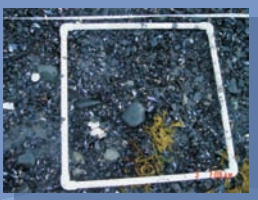
Large mussel bed in entrance channel to McCarty Lagoon.

Significant Predators

Sea otters, sea ducks, and black oystercatchers; possibly black bears; crabs, starfish.

Range in Park and Pacific

During the 2004-2005 surveys, mussels were found quite commonly in large beds in KEFJ, less commonly in KATM, generally not in beds, and were absent in LACL. Reported from Canadian Arctic through Bering Sea, south to central California.



Close-up of mussel bed in tidal channel.

Northern Horsemussel
(Modiolus modiolus)

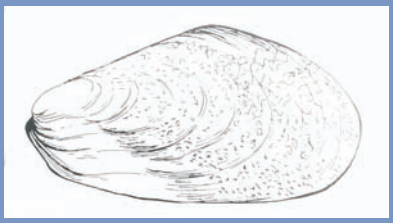
Description
Shell smooth, rhomboidal, moderately inflated; antero-ventral margin projecting slightly in front of umbones. Periostracum dehiscent, anterior and ventral surfaces glossy chestnut brown; posterior dorsal surface hairy, with sparse, short, non-serrate setae, broad on both sides at base; often encrusted with sand or other particles. Shell beneath periostracum violet; interior iridescent and whitish. Hairy periostracum and position of beaks distinguish this species. Length to 180 mm (7.1 in).

Habitat
Mixed-soft and cobble/boulder habitats from lower low intertidal zone to 200 m (656 ft). Forms nestling or infaunal beds in muddy, sandy gravel and cobble beds with posterior end of shell at sediment surface, using byssal threads to bind rocks and particles together.

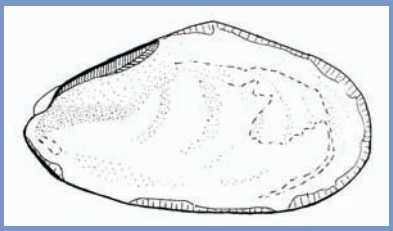
Significant Predators
Sea otters, starfish.

Range in Park and Pacific
Found at several mixed-soft sites only in KEFJ. Circumboreal; reported from Bering Sea south to central California; Greenland, northern Atlantic Ocean.

Adult northern horsemussel showing rough periostracum and byssal threads.



Northern horsemussel, left valve exterior (after Foster 1991).



Northern horsemussel, right valve interior (after Foster 1991).

Rough Diplodon
(Diplodonta impolita)

Description
Shell very inflated, nearly orbicular to spherical, equilateral; postero-dorsal margin short, relatively straight; beaks high and prominent; shell surface with irregular, low commarginal growth lines. Periostracum very thin, generally dark in color, usually eroded and showing a grayish shell. Hinge teeth thick, not deeply bifid; posterior adductor muscle scar decidedly longer than anterior scar in adult specimens. Length to 36 mm (14 in).

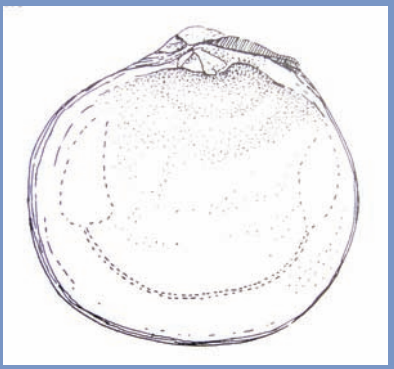
Habitat
Mixed-soft habitats from low intertidal zone to 100 m (328 ft).

Significant Predators
Unknown.

Range in Park and Pacific
Found at only a few sites in KEFJ. Kodiak Island to Oregon.

Two specimens of rough diplodon showing the globular nature of its shape.

Rough diplodon, left valve exterior (after Foster 1991).



Rough diplodon, right valve interior (after Foster 1991).

Silky Axinopsid
(Axinopsida Serricata)

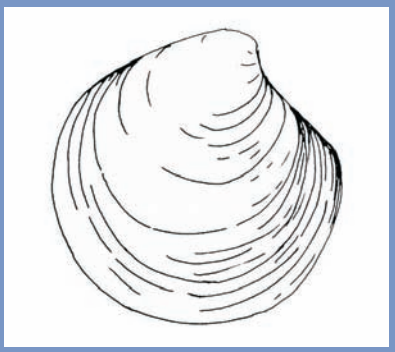
Description
Shell white, small, thin, smooth, ovate, inflated; umbones prominent, overhang slightly concave antero-dorsal margin; postero-dorsal margin nearly straight; lunule concave, obscure. Hinge plate weak, both valves with strong central tooth; right valve with obscure, elongate lateral. Periostracum transparent, yellow, or light green. Length to 8 mm (0.3 in).

Habitat
Muddy to sandy mud habitats from low intertidal zone to 275 m (902 ft).

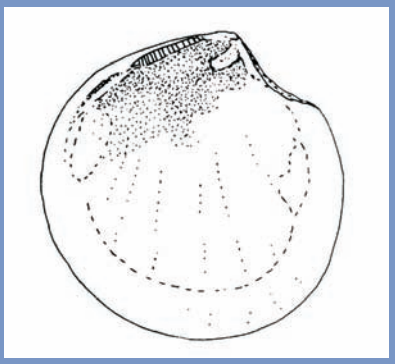
Significant Predators
Unknown.

Range in Park and Pacific
Found at several locations in KEFJ, sometimes abundant. Circumboreal and panarctic; Point Barrow, Alaska, Bering Sea and Gulf of Alaska south to Baja California and Gulf of California. Western Pacific Ocean south to northern Japan.

Group of adult silky axinopsids showing scale.



Silky axinopsid, right valve exterior (after Foster 1991).



Silky axinopsid, left valve interior (after Foster 1991).

Suborbicular Kellyclam
(Kellia suborbicularis)

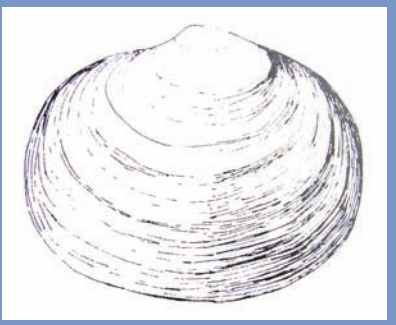
Description
Shell evenly ovate to globular, rather thin to translucent, inflated; sculpture lacking. Umbones prominent; hinge plate feeble; hinge with cardinal and posterior lateral tooth in right valve; two cardinal teeth and a posterior lateral tooth in left valve; resilium lies between cardinal and lateral teeth. Periostracum shiny light olive green or yellowish, thin, adherent over white shell. Length to 31 mm (1.2 in).

Habitat
Mixed-soft habitats, often nestling in holes or crevices from low intertidal zone to 20 m (66 ft).

Significant Predators
Unknown.

Range in Park and Pacific
Rare in parks, found at only one location in KEFJ. Appears to be a range extension. Circumboreal; Prince William Sound to Peru. Western Pacific south to Honshu Island, Japan.

Right exterior and left interior valve of adult suborbicular kellyclam.



Suborbicular kellyclam, left valve exterior (after Foster 1991).

Suborbicular kellyclam, right valve interior (after Foster 1991).

Compressed Montacutid

(Neaeromya ?compressa)

Description

Shell ovate-quadrate to subquadrate, thin, compressed; anterior and posterior ends broadly rounded; dorsal margin of right valve overlaps left valve slightly; sculpture of irregular commarginal ribs and striations. Umbones small, not prominent. Right valve with very small, peg-like cardinal tooth and deep resilifer, left valve with matching socket and oblique resilifer. Periostracum thin, silky to dull, transparent to light brown. Length to 20 mm (0.8 in).

Habitat

Sandy and muddy habitats from mid intertidal zone to 700 m (2,297 ft). Probably commensal, nestling in burrows of large burrowing organisms such as fat innkeepers (Echiurus) and mud shrimp (Upogebia).

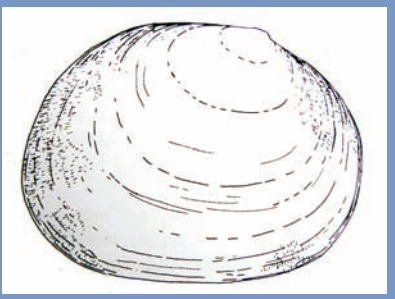
Significant Predators

Unknown.

Range in Park and Pacific

Found at only one location in KEFJ during this project. Point Barrow, Alaska to San Diego, California.

Right valve exterior of adult compressed montacutid.



Compressed montacutid, right valve exterior (after Foster 1991).

Compressed montacutid, left valve interior (after Foster 1991).

Robust Mysella
(Rochefortia tumida)

Description
Shell small, thick, chalky, subtrigonal to subquadrate, moderately inflated; inequilateral, anterior end much longer; sculpture of fine commarginal striations. Umbones prominent, often eroded; left valve is edentulous; right valve with two strong, diverging, subequal cardinal teeth below beaks. Periostracum thick, silky, light brown. Length to 5 mm (0.3 in).

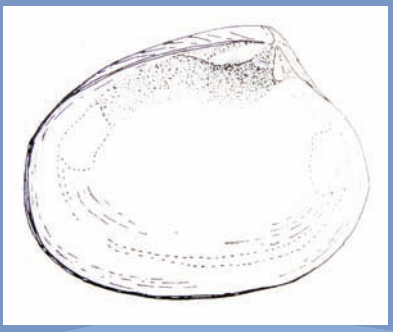
Habitat
Protected sandy, silty-sand, or mixed-soft habitats from lower intertidal zone to 973 m (3,192 ft). Nestling at surface or commensal in burrows of burrowing organisms.

Significant Predators
Unknown.

Range in Park and Pacific
One site in KATM and several sites in KEFJ. Beaufort Sea, Alaska, to San Diego, California, and Gulf of California.

Group of adult robust mysellas showing small size.

Robust mysella, left valve exterior (after Foster 1991).



Robust mysella, right valve interior (after Foster 1991).

Low-Rib Cockle
(Clinocardium blandum)

Left and right valves of low-rib cockle.

Description
Shell medium-sized, oval, somewhat longer posteriorly, inflated; sculpture of about 45 low ribs sometimes overlain by feeble commarginal riblets; interspaces generally narrow. Folds on posterior slope weak compared to C. nuttallii. External color yellow to brown. Inner shell margins shallowly crenulate. Length to 50 mm (2 in).

Habitat
Mud flats or muddy habitats from intertidal zone to 80 m (262 ft). Burrows with posterior end of shells just below the surface of the sediment.

Significant Predators
Probably sea otters, gulls, and starfish.

Range in Park and Pacific
Found at only one site in KATM. Pribilof Islands, Gulf of Alaska, Prince William Sound, south to Sonoma County, California.

Rough diplodon, left valve exterior (after Foster 1991).

Low-rib cockle, left valve exterior (after Foster 1991).

Cardiidae

Basket Cockle

or Nuttall Cockle

(Clinocardium nuttallii)

Largest of the North Pacific cockles. Lives up to 16 years.

Left and right valves of adult basket cockle.

Right valves of subadult basket cockle.

Posterior view of valves subadult of basket cockle showing distinguishing characters.

Description

Shell large, thick, inflated; mature specimens decidedly longer posteriorly, with beaks nearer posterior end; younger specimens more equilateral; with about 30-35 strong rounded, radial ribs, each topped with crescent-shaped nodes crossed by commarginal riblets; ribs weak at posterior end. Hinge plate narrow; teeth prominent; inner margin deeply crenulate. Periostracum thin. Shell color yellowish grey to brown; interior white, often with yellowish blush. Length to 146 mm (5.7 in).

Habitat

Muddy and sandy habitats from low intertidal zone to 180 m (591 ft). Lives with posterior end of shells just below the surface of the sediment. Colonies sometimes dense.

Significant Predators

Sea otters, gulls, and starfish.

Range in Park and Pacific

Observed in several locations in KATM and KEFJ. Large specimens common in earlier studies in LACL. Punuk Islands, near St. Lawrence Island; Dutch Harbor, Unalaska Island; through Gulf of Alaska south to San Diego, California. Western Pacific Ocean from Kamtschatka to Hokkaido Island, Japan.

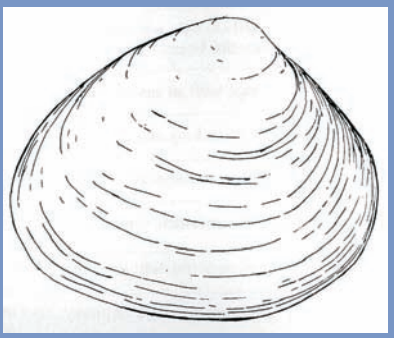
Basket cockle, left valve exterior (after Foster 1991).

Lord Dwarf-Venus

(Nutricola ?lordi)

Description

Shell small, white, thick, smooth, trigonal or subtrigonal, moderately inflated. Sculpture of commarginal striations but shell and periostracum brilliantly polished. Umbones prominent. Ligament slightly protruding. Hinge with three cardinal teeth on each valve, but no lateral teeth. Pallial sinus shallow, pointed. Length to 10 mm (0.4 in).



Lord dwarf-venus, right valve exterior (after Foster 1991).

Habitat

Mixed-soft habitats from intertidal zone to 20 m (66 ft).

Lord dwarf-venus, left valve interior (after Foster 1991).

Significant Predators

Unknown.

Range in Park and Pacific

Observed at only one location in KATM and few in KEFJ. Southeastern Bering Sea, Cook Inlet south to Punta Pequeña, Baja California.

Veneridae

Littleneck Clam

or Pacific Littleneck Clam

(Protothaca staminea)

Littleneck and butter clams are very important prey for sea otters and for human subsistence. They live at least 15 years. Littleneck and butter clams are the "redwoods" in mixed-soft sediments.

Description

Shell subovate to subquadrate, inflated, distinctive cancellate sculpture, with radial and commarginal ribs. Lunule obscure; escutcheon narrow, in left valve only. External color creamish to brown, sometimes with brownish maculations and zigzag markings. Inner shell margins finely crenulate. Hinges each with three cardinal teeth, no lateral teeth. Pallial sinus deep. Length to 80 mm (3.2 in), but usually to 40 mm (1.6 in).

Three medium-sized littleneck clams showing scale.

Habitat

Burrows up to 20 cm (8 in) deep in semi-protected mixed-soft, sand, sandy-mud habitats from lower intertidal zone to 10 m (33 ft).

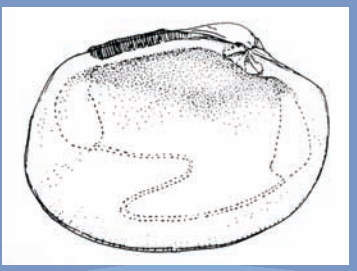
Littleneck clam, right valve exterior (after Foster 1991).

Significant Predators

Sea otters, starfish.

Range in Park and Pacific

Common at a few sites in KATM and at numerous sites in KEFJ. Attu Island in the Aleutians through Gulf of Alaska and Prince William Sound, south to Bahia Santa Maria, Baja California. Western Pacific from the Commander Islands south to Hokkaido, Japan.



Littleneck clam, left valve interior (after Foster 1991).

Butter clams, largest of the hardshell clams in Alaska, live up to 20 years.

Butter Clam

or Washington Butter Clam

(Saxidomus gigantea)

Description

Shell white, solid, thick, ovate-subquadrate, moderate gape at posterior end. Lunule and escutcheon absent. External sculpture consists mostly of heavy growth lines only, although fine, closely spaced, irregular commarginal ribs can sometimes be observed. Periostracum thin, light brown, frequently worn. Older specimens may be stained dark grey. Ligament conspicuously large, brown. Hinge has three cardinal teeth; one small or no anterior lateral tooth. Inner shell margin is smooth. Pallial sinus deep. Dark-tipped siphon can be retracted into the shell only with difficulty. Shell length to 136 mm (5.4 in).

Habitat

Burrows up to 35 cm (14 in) deep in semi-protected mixed-soft, sand, sandy-mud, or mud habitats from lower intertidal zone to 40 m (131 ft).

Significant Predators

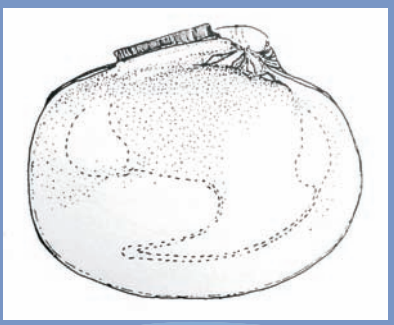
Sea otters, starfish.

Range in Park and Pacific

Observed to be common at several locations in KATM and numerous sites in KEFJ. Seward Peninsula, Alaska to Kodiak; Kachemak Bay, Cook Inlet; Prince William Sound south to Capitola, California.

Right valve exterior of butter clam showing typical dark tip of siphon extending from shell.

Butter clam, right valve exterior (after Foster 1991).



Butter clam, left valve interior (after Foster 1991).

Butter Clam (continued)
(Saxidomus gigantea)

Dorsal view of butter clam showing large external ligament typical of this clam.

Posterior view of butter clam showing gaping valves at posterior end and sand-covered siphon extending from shell.

Minute Turton

(Turtonia minuta)

Description

Shell thin, fragile, inflated, ovate. Central slope stained red to purple. Sculpture of faint commarginal growth lines mark outer surface. Periostracum thin. Hinge plate narrow; two teeth in right valve, three in left; weak posterior lateral teeth present in both valves. Interior of shell light brown. Pallial line weak but continuous, without pallial sinus. Length to 3 mm (0.1 in).

Habitat

Rocky and mixed-soft habitats in the intertidal zone. Attached to epibiota, especially algae, by byssal threads.

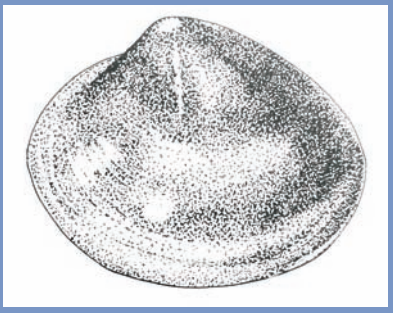
Significant Predators

Unknown.

Range in Park and Pacific

Observed at several locations in KATM but only one in KEFJ. Circumboreal; Nunivak Island, St. Paul Island, Pribilof Islands, south in the Aleutians to Amchitka Island; Prince William Sound south to Barkley Sound, Vancouver Island, British Columbia. Western Pacific from Kurile Islands to Honshu, Japan.

Group of adult minute turtons showing small size.



Minute turton, left valve exterior (after Foster 1991).

Minute turton, left valve interior (after Foster 1991).

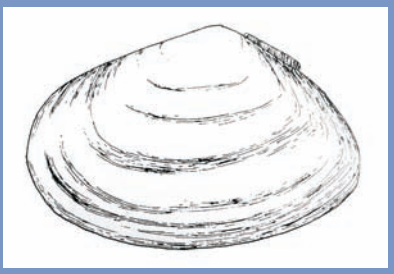
Alaska Great-Tellin

(Tellina lutea)

This is the largest tellin in Alaska.

Description

Shell large, heavy, white, slightly angular outline, narrowly subovate, longer posteriorly; exterior smooth but often eroded externally. Low, wide ridge on the shell's inner surface; anterior lateral hinge teeth short, very weak to obscure; pallial sinus moderate, extending two-thirds distance to anterior adductor muscle scar. Periostracum heavy, grey-green, olive to dark brown, usually eroded, or, in smaller specimens, yellow. Interior is pink or white with red or yellow patches. Length to 130 mm (5.1 in).



Alaska great-tellin, right valve exterior (after Foster 1991).

Alaska great-tellin, left valve interior (after Foster 1991).

Habitat

Shallow burrower (up to 15 cm [6 in] deep) in exposed sandy or silty-sand habitats from lower intertidal zone to 100 m (328 ft).

Significant Predators

Unknown.

Range in Park and Pacific

Observed at only a single site in KATM. Frequently observed on exposed sandy beaches in LACL during other studies. American Arctic coast, Chukchi and Bering Seas, to Cook Inlet, Alaska. Western Pacific from Kamchatka to northern Japan and Korea.

Alaska Great-Tellin (continued)
(Tellina lutea)

Exterior of the valves of the Alaska great-tellin.

Interior of the valves of the Alaska great-tellin.

Salmon Tellin
(Tellina nuculoides)

Description
Shell inflated, thick for size, subtrigonal. Sculpture absent, with occasional growth checks. Periostracum polished, glossy grey green and yellow. Lateral teeth prominent, only a hint of internal rib. Entire shell pink to white, with pink blotches, sometimes with external commarginal red banding; interior pink and orange. Length to 20 mm (0.8 in).

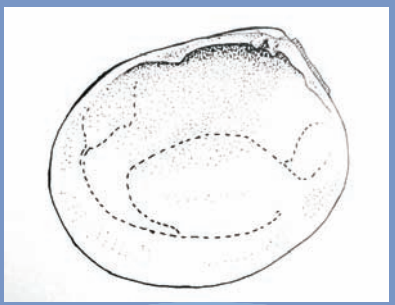
Habitat
Shallow burrower in exposed medium to coarse sand habitats from lower intertidal zone to 75 m

Significant Predators
Unknown.

Range in Park and Pacific
Observed only at a few sites in KATM. Southeastern Bering Sea out to Attu Island in the Aleutians; Cook Inlet south to Coronados Islands, northern Baja California.

Group of valves showing pink color on interior and exterior and external growth checks for salmon tellin.

Salmon tellin, right valve exterior (after Foster 1991).



Salmon tellin, left valve interior (after Foster 1991).

Tellinidae

Baltic Macoma
(Macoma balthica)

The Baltic macoma was, by far, the most abundant macroinfaunal clam species observed in the SWAN parks.

Description
Shell pink, red, yellow, or white, ovate to subovate to subtrigonal, subequilateral, moderately inflated; posterior end rounded to pointed, anterior end rounded. Periostracum often abraded. Pallial sinuses in both valves equal in size, deep; pallial line and sinus are confluent. Length to 45 mm (1.8 in), usually less than 30 mm (1.2 in).

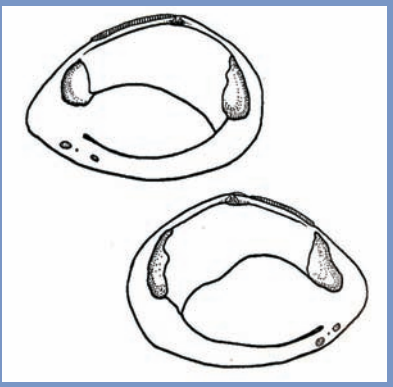
Individual pink colored Baltic macoma.

Group of Baltic macomas showing pink, yellow, and white color variants.

Habitat
Moderately shallow burrower (up to 20 cm [8 in] deep) in sandy mud to silty mud in somewhat protected to moderately exposed habitats with reduced salinity from mid intertidal zone to 40 m (131 ft). A conspicuous, abundant resident of mud flats due to feeding tracks.

Significant Predators
Shorebirds, diving sea ducks, flatfish.

Range in Park and Pacific
Commonly observed and widespread in muddy habitats in KATM, KEFJ, and LACL. Panarctic and circumboreal. Beaufort Sea to San Francisco, California. Western Pacific from Arctic south to Japan.



Baltic macoma, left and right interior (after Coan 1971).

Baltic Macoma (continued)
(Macoma balthica)

Characteristic stellate feeding tracks from Baltic

Straight movement tracks formed by parasitized Baltic macomas.

Expanded Macoma
(Macoma expaansa)

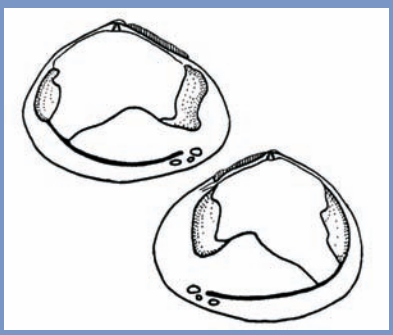
Description
Shell thin, subovate, subequilateral to slightly longer posteriorly, slightly inflated; anterior end rounded, posterior end rounded to slightly produced, without dorsal flange. Periostracum shiny, adherent. Pallial sinuses moderate, about the same size in both valves; pallial line confluent with pallial sinus for about half its length. Length to 51 mm (2 in).

Exterior of right and left valves of expanded macoma.

Habitat
Protected or exposed sand and sandy mud flats from mid intertidal zone to 30 m (98).

Significant Predators
Unknown.

Range in Park and Pacific
Observed at three sites in KATM and only one site in KEFJ. Nunivak Island, Bering Sea, south to Attu Island in the Aleutians, and to Oceano, California.



Expanded macoma, left and right interior (after Coan 1971).

Oval Macoma
(Macoma golikovi)

Description
Shell ovate to round, heavy, inflated, anterior end longer; posterior end acute, rounded to slightly truncate. Periostracum dark, usually worn. Pallial sinus deep in left valve, moderate in right; pallial line in right valve detached from pallial sinus for about half its length; in left valve, pallial line and sinus are slightly detached or confluent. Length to 50 mm (2 in).

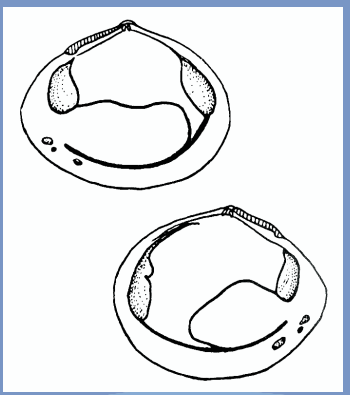
Habitat
Protected mixed-soft and silty sand habitats; gravel and sand from lower intertidal zone to 200 m (656 ft).

Significant Predators
Unknown.

Range in Park and Pacific
Commonly observed in both KATM and KEFJ. Point Barrow, Alaska south to Puget Sound, Washington. Western Pacific from Sakhalin Island to Sea of Japan.

Posterior end of oval macoma showing characteristic flexure of valves.

Exterior of left valve of oval macoma.



Oval macoma, left and right interior (after Coan 1971).

Pointed Macoma

(Macoma inquinata)

Description

Shell elongate-ovate to subovate, moderately inflated; inequilateral, posterior end longer, produced; slight indentation in ventral margin is distinctive. Pallial sinuses in both valves very deep, about equal in length, confluent. Length to 66 mm (2.6 in).

Habitat

Protected mixed-soft habitats or sandy mud flats from lower intertidal zone to 50 m (164 ft).

Significant Predators

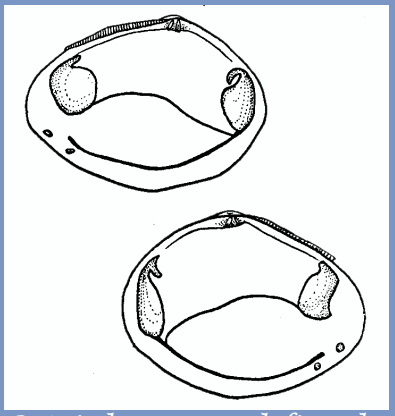
Unknown.

Range in Park and Pacific

Observed at few sites in KATM and several sites in KEFJ. Pribilof Island, Bering Sea, south to Atka Island in the Aleutians; south to Santa Barbara and Mugu Lagoon, California.

Right valve exterior of pointed macoma.

Interior and exterior appearance of pointed macoma.



Pointed macoma, left and right interior (after Coan 1971).

Bent-Nose Macoma

(Macoma nasuta)

Description

Shell narrowly subovate, subequilateral; posterior end produced, longer than anterior, distinctly bent to the right. Pallial sinus in left valve extremely deep, merging with anterior adductor muscle scar; deep in right valve; pallial sinus and pallial line are confluent for their entire lengths. Length to 110 mm (4.3 in), usually less than 75 mm (3 in).

Bent-nose macoma, ventral exterior.

Bent-nose macoma, dorsal exterior (after Coan 1971).

Habitat

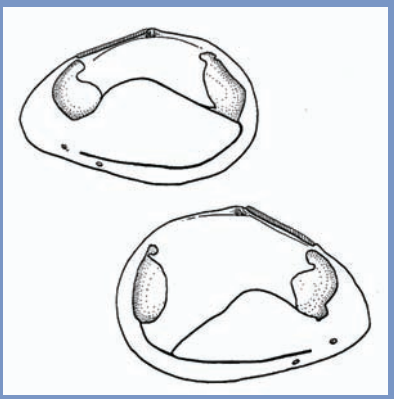
Burrows up to 20 cm (8 in) deep in protected or exposed sandy or silty mud flats or mixed-soft sediments from lower intertidal zone to 50 m (164 ft).

Significant Predators

Moon snails.

Range in Park and Pacific

Uncommon, observed on only one location in KATM. Cook Inlet and Prince William Sound, Alaska, south to Punta Rompiente, Baja California.



Bent-nosed macoma, left and right interior (after Coan 1971).

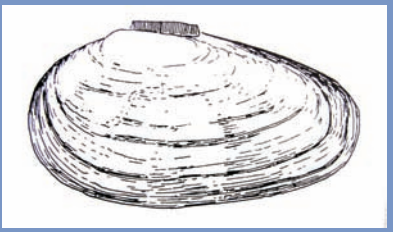
Pharidae

Alaska Razor Clam

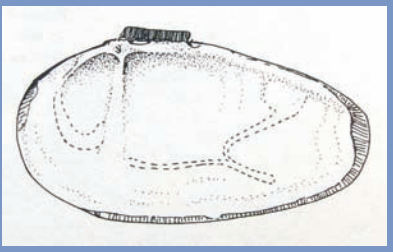
(Siliqua alta)

Description

Shell heavy, thin when small; anterior end short, rounded; posterior end rounded. Periostracum glossy, thick, light olive to dark brown. External shell color white, with a central radial brown band, and commarginal brown bands when small; internal color white to purple or purplish brown. Internal rib relatively narrow, nearly vertical. Vertical interior rib and rounded posterior end distinguish this species from Siliqua patula.



Alaska razor clam, left valve exterior (after Foster 1991).



Alaska razor clam, right valve interior (after Foster 1991).

Habitat

Exposed to semi-exposed sand or silty-sand habitats from mid intertidal zone to 85 m (279 ft).

Significant Predators

Brown bears, sea otters, and humans. Harvested for subsistence and once commercially in KATM.

Range in Park and Pacific

Observed on several sandy beaches only in KATM. Chukchi and Bering Seas south to Cold Bay, Alaska Peninsula; Cook Inlet, Alaska, south to Point Conception, California. Western Pacific from Kamchatka Peninsula south to northern Japan.

Alaska Razor Clam (continued)

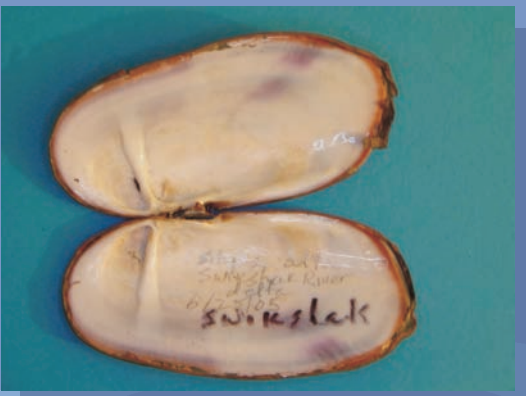
(Siliqua alta)

On the sand flats, the razor clams, active diggers requiring sediments that can easily be liquefied in order to dig or rebury, appear to represent the climax community. They are relatively long-lived (at least 19 years) and can be considered the "redwoods" of the sand flats.

Razor clam shows in intertidal beach sand.

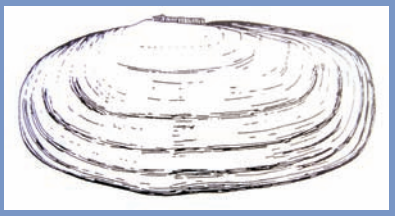
Exterior of valves of Alaska razor clam showing shiny periostracum.

Interior of valves of Alaska razor clam showing nearly perpendicular angle of internal rib.



Pacific Razor Clam
(Siliqua patula)

Description
Shell thin; anterior end rounded, proportionately longer than in other eastern Pacific species; posterior end slightly quadrate. Periostracum adherent, thick, glossy, highly polished, light to dark olive to dark brown or purple. External shell with radial purple pattern on beaks; internally white to purple. Internal radial rib anteriorly directed, becoming wider from umbones. Overall, this species is longer with respect to its height than Siliqua alta. Length to 190 mm (7.5 in).



Pacific razor clam, left valve exterior (after Foster 1991).

Pacific razor clam, right valve interior (after Foster 1991).

Habitat
Burrow deeply (at least 50 cm [20 in] into exposed or semi-exposed sandy or silty-sand habitats from lower intertidal zone to 85 m (279 ft).

Significant Predators
Brown bears, sea otters, and humans. Harvested commercially and for subsistence in LACL.

Range in Park and Pacific
Observed at only one site in KATM but commonly observed on exposed sand beaches in LACL. Cook Inlet, Alaska, south to Morro Bay, California.

Pacific Razor Clam (continued)

(Siliqua patula)

Exterior of valves for Pacific razor clam showing shiny periostracum.

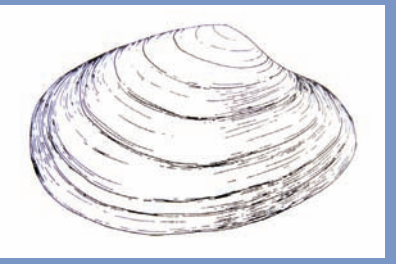
Interior of valves for Pacific razor clam showing anteriorly angled internal rib.

Arctic Surfclam

(Mactromeris polynyma)

Description

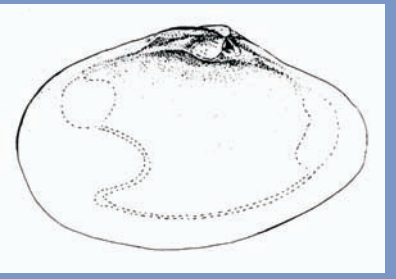
Shell smooth, broad oval or trigonal-elongate, moderately compressed; subequilateral; posterior slope rounded, not set off; gape at posterior end narrow. Periostracum olive, tan to dark brown, shiny, rugose. Hinge distinctive, with an internal ligament between chondrophores and inverted v-shaped teeth; pallial sinus short. Length to 155 mm (6.1 in).



Arctic surfclam, right valve exterior (after Foster 1991).

Habitat

Burrows at least 30 cm (12 in) into exposed or semi-exposed sandy or silty-sand habitats from lower intertidal zone to 110 m (361 ft).



Arctic surfclam, left valve interior (after Foster 1991).

Significant Predators

Sea otters.

Range in Park and Pacific

Peard Bay, Beaufort Sea; throughout Bering Sea; Cook Inlet and Gulf of Alaska south to Puget Sound, Washington. Western Pacific in Sea of Okhotsk and Kamchatka Peninsula.

Arctic Surfclam (continued)

(Mactromeris polynyma)

On the sand flats, Arctic surfclams have similar status to the razor clams. They are long-lived clams and also appear to represent the climax community of sand flats.

Surfclam shells indicating dense surf clam bed.

Surfclam shows on exposed sand bar.

Right valve exterior of older Arctic surfclam.

Right valve interior young of Arctic surfclam.

Right valve exterior of young Arctic surfclam.

Pacific Gaper
(Tresus nuttallii)

Description
Shell ovate-elongate, longer posteriorly and more evenly curved ventrally than T. capax, with only slightly produced ventral margins in some specimens; posterior end truncate, gape broad. Chondrophore medium in size, posteriorly directed. Siphons cannot be retracted into shell; with terminal periostracal plates, which are lacking in T. capax. Shell length to 225 mm (8.9 in).

Habitat
Burrows up to 1 m (39 in) deep into protected sandy or muddy habitats from mid intertidal zone to 80 m (262 ft).

Significant Predators
Sea otters and starfish.

Range in Park and Pacific
Observed at several locations in KATM. Kodiak Island, Alaska, south to Bahia Magdalena, Baja California.

Gapers are the largest clams living in this region. The fat gaper (Tresus capax) is probably more common in this region than the Pacific gaper but living specimens are difficult to collect and shells were not confirmed during the surveys in SWAN parks.

Young Pacific gaper clam, left valve exterior.

Young Pacific gaper clam, left valve interior.

Softshell Clam

(Mya arenaria)

Softshell clams are relatively long-lived and achieve large size, have a broad spectrum of habitat and food acceptability, tolerate a wide range of environmental conditions such as salinity and temperature, and are considered good colonizers.

Description

Shell thin, white, ovate-elliptical; posterior end produced, attenuate; anterior end narrow. Posterior end pointed, anterior end, rounded. Periostracum thin, dehiscent, light brown. Chondrophore without anterior buttress. Pallial line detached from pallial sinus; sinus of moderate depth, extending to or slightly beyond beaks. Length to 170 mm (6.7 in).

Habitat

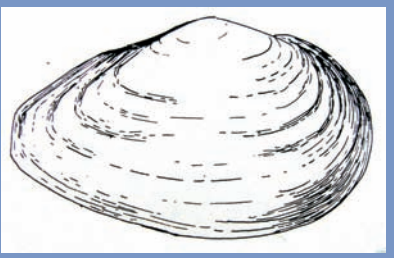
Burrows down at least 25 cm (10 in) into protected to semi-protected sandy to muddy mud flats in mid to lower intertidal zone. Generally abundant where observed.

Significant Predators

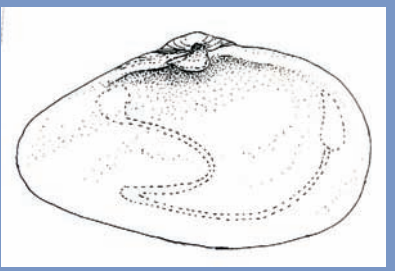
Brown bears, sea otters.

Range in Park and Pacific

Observed very commonly in KATM and LACL, but in only a few sites in KEFJ. Circumboreal. Icy Cape, Alaska, southern Bering Sea and Yukon Delta; Alaska Peninsula, Cook Inlet, and south to Elkhorn Slough, California. Western Pacific to Korea, Kurile Islands, and northern Japan.



Softshell clam, right valve exterior (after Foster 1991).



Softshell clam, left valve interior (after Foster 1991).

Softshell Clam (continued)

(Mya arenaria)

On mud flats, it is likely that long-lived softshell clams are indicators of the climax assemblage in stable substrate (the "redwoods" of the mud flats). In areas where they are absent, sediments are probably too disturbed.

Right exterior and left interior valves of softshell clam.

Softshell clam shows on mud flat.

Chondrophore on left valve of softshell clam.

Group of excavated softshell clams lying on boulder.

Right valve exterior of softshell clam.

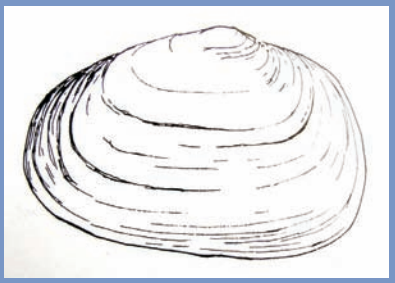
Myidae

False Softshell Clam

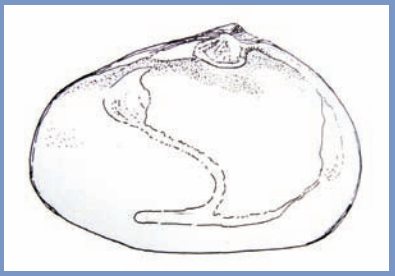
(Mya pseudoarenaria)

Description

Externally similar to M. arenaria. Pointed anterior end and sharply rounded to slightly attenuate posterior end. Chondrophore with anterior buttress. White shell has a light brown periostracum. Details of the hinge and pallial line and sinus separate this species from M. arenaria. Pallial sinus extending to or slightly past umbones, mostly confluent with pallial line. Length to 110 mm (4.3 in).



False softshell clam, right valve exterior (after Foster 1991).



False softshell clam, left valve interior (after Foster 1991).

Habitat

Protected mixed-soft, sandy, or muddy habitats from lower intertidal zone to 50 m (164 ft).

Significant Predators

Probably brown bears and sea otters.

Range in Park and Pacific

Observed at several locations in KATM and KEFJ. Point Barrow, Beaufort Sea, Alaska, throughout the Bering Sea; Cook Inlet. Western Pacific south to northern Japan.

Myidae

Truncate Softshell Clam

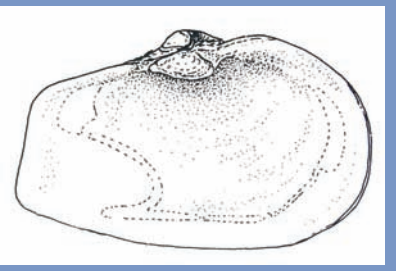
(Mya truncata)

Description

Shell subquadrate, inflated; posterior end abruptly truncate to broadly rounded. Squarish posterior is unique to this species. Sculpture consists of numerous commarginal undulations and growth lines. Chondrophore with anterior buttress. Shell is chalky white with papery brown, thick, dehiscent periostracum, which bridges ventral gape and forms a siphonal sheath. Siphon cannot be retracted into shell. Pallial sinus extending to beaks, broad, confluent with pallial line to partly detached. Shell length to 86 mm (3.4 in).

Right exterior valve and siphon of truncate softshell.

Truncate softshell clam, right valve exterior (after Foster 1991).



Truncate softshell clam, left valve interior (after Foster 1991).

Habitat

Burrows down at least 25 cm (10 in) into silty-sand to sandy- or silty-mud habitats. Lower intertidal zone to 100 m (328 ft).

Significant Predators

Probably brown bears and sea otters.

Range in Park and Pacific

Observed at only one site in KATM and several sites in KEFJ. Has been observed on mud flats in LACL in other surveys. Circumboreal, panarctic. Point Barrow, Beaufort Sea, through Chukchi and Bering Seas, Cook Inlet south to Puget Sound, Washington. Western Pacific south to northern Japan.

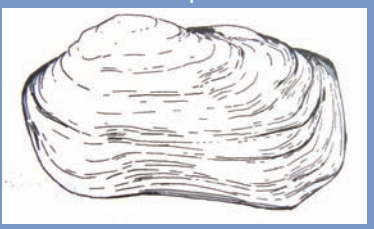
Arctic Hiatella
(Hiatella arctica)

Arctic hiatellas are widely recognized as a very successful colonizing species, among the first clam species to appear in disturbed sediments or new habitats. The specimens observed are generally highly variable and probably comprise more than one species.

Description
Shell white, oblong, often distorted, rough, irregular; sculpture of irregular commarginal growth lines. Umbones prominent, near anterior end. Small, distinct lunule present. Ligament attached to short nymph. Periostracum thin, dark, dehiscent; not covering siphon, which may be white- or red-tipped. Pallial line is patchy, discontinuous, with a shallow pallial sinus. Juveniles have two small hinge teeth in the left valve and one in the right; adults lack them. Shell length to 78 mm (3.1 in), but generally less than 50 mm (2 in).

Group of Arctic hiatellas showing right and left valves and dorsal and ventral sides of valves.

Habitat
Nestling in a variety of habitats including rock, especially mixed-soft habitats; burrowing in gravelly mud in mussel beds. Often attached to hard surfaces with byssal threads. Mid intertidal zone to 1,190 m (3,904 ft).



Arctic hiatella, left valve exterior (after Foster 1991).

Significant Predators
Unknown.

Range in Park and Pacific
Observed at numerous sites in KEFJ, absent in other parks. Cosmopolitan. Point Barrow, Beaufort Sea, throughout the Bering Sea, Gulf of Alaska, Prince William Sound, south to Chile.

Arctic hiatella, right valve interior (after Foster 1991).

Glossary

Adductor muscle: Muscles connecting the two valves together and used to close or draw them together. Typically, clams in this guide have an anterior and a posterior adductor muscle.

Anterior: The front end of a clam, where the mouth and foot are typically located.

Attenuate: Gradually tapering.

Beak: The pointed end of the shell above the hinge; the part of the shell formed first; earliest part of the umbo.

Bifid: Divided in two; forked.

Buttress: A structure providing support between the hinge and the chondrophore.

Byssus: Tough conchiolin fibers produced by the foot of some bivalves for attachment to rocks, other bivalves, or other surfaces upon which they live.

Cancellate: Sculpture on exterior of shell a network of both radial and concentric (commarginal) ribs.

Cardinal teeth: Primary teeth projecting laterally from the vicinity of the hinge directly below the beaks.

Circumboreal: Found throughout cold-water regions south of the Arctic, i.e., from Bering Strait to about Point Conception, California.

Chondrophore: A large, laterally projecting spoon-like tooth that supports an internal ligament. Typically matched with a pit on the opposing valve.

Commarginal: Concentric, parallel to the shell margins.

Commensal: Lives with a host organisms.

Compressed: Flattened, of reduced thickness.

Conchiolin: A proteinaceous substance forming byssal threads and the periostracum covering the exterior of shells

Confluent: Joined, flowing together.

Crenulate: Finely toothed or notched edge.

Dehiscent: Readily peeling off.

Dentition: Tooth structure on the hinge plate.

Dorsal: The shell margin nearest the hinge.

Edentulous: Lacking teeth.

Equilateral: Anterior and posterior ends of shell of about length.

Escutcheon: A lozenge-shaped indentation on the dorsal surface of the shell posterior to the beaks, often bordered by a ridge of shell.

Glossary

Flammule: Flame-shaped color pattern in shell.
Hinge: The point on the dorsal surface of the two valves of a clam at which they articulate. Generally includes supporting structures such as teeth or chondrophores of variable sizes.
Hinge plate: The infolded dorsal margin of a valve on which the teeth are found.
Hirsute: Hairy, with short hairs.
Inequilateral: With umbones displaced from the center of the shell toward either the posterior or anterior end of the valves so that one end is longer than the other.
Lateral teeth: Hinge teeth anterior to and posterior to the cardinal teeth.
Ligament: A horny elastic structure joining the valves together along the dorsal surface and causing the valve to gape open when the adductor muscles relax.
Lunule: A heart-shaped area on the dorsal margin anterior of the beaks.
Mantle: The fleshy outer layer of a molluscan body that secretes its shell and periostracum, and, in bivalves, forms the tubular folds that constitute the siphons.
Muscle scars: Impressions on the interior surface of the shells caused by the attachment of adductor and other muscles.
Non-serrate: Smooth; not notched or saw-toothed.
Orbicular: Orb-shaped or rounded in outline.
Orthogyrate: Beaks pointed toward each other.
Ovate: Egg-shaped or oval.
Pallial line: A light scar on the inner surface of the valves generally between the adductor muscle scars resulting from the attachment of the muscles at the edge of the mantle.
Pallial sinus: Indentation in the pallial line indicating where the mantle has retreated to accommodate the retractor muscles for the siphons.
Panarctic: Distributed throughout the Arctic Ocean.
Periostracum: The outermost leathery or parchment-like layer of a clam shell formed from the proteinaceous material, conchiolin.
Posterior: The back end of the clam; the end containing the siphons, pallial sinus, and ligament.

Glossary

Produced: Drawn out, elongated.
Quadrate: Rectangular or squarish.
Radiate: Radiating from the umbo or beak toward the ventral margin of the shell.
Resilifer: Structure supporting the resilium. Sometimes a tooth, sometimes a socket.
Resilium: The internal ligament connecting the hinges of the right and left (opposing) valves.
Sculpture: Patterns of raised or incised ribs on the external surface of the valves.
Siphon: Tube-like projection from the ventral end of the mantle through which water is drawn or expelled from the mantle cavity. Siphons are separate in some clams (e.g., macomas) and joined on others (butter clams, cockles, and gapers).
Striation: Fine scratch, groove, or line, sometimes representing a growth check.
Subequilateral: Nearly equilateral.
Subovate: Nearly ovate.
Subquadrate: Nearly quadrate.
Taxodont dentition: A row of fine teeth of similar size and shape along the hinge plate found in more primitive clams.
Trigonal: Somewhat triangular in outline.
Umbo (plural umbones): Viewed from the outer surface of a valve, the projecting, curved structure on the dorsal surface, including the beak and first-developing part of the shell.
Valve: Right or left shell of the two shells that are characteristic of a bivalve.
Ventral: The side of the shell opposite the hinge and dorsal surface; the bottom of the shell.

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