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Guide for Identifying Select Bivalve Species Common to Southeast Alaska

K. Keller, K. Brown, S. Atkinson, and R. Stone

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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Alaska Fisheries Science Center

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Guide for Identifying Select Bivalve Species Common to Southeast Alaska

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U.S. DEPARTMENT OF COMMERCE

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**All photos taken by Kierstin Keller. Figures 1.3 and 1.4 drawn and compiled by Kierstin Keller.*

Cover Photo: *A pea crab (*Pinnixia faba*) peaks out from behind the foot of a dissected fat gaper (*Tresus capax*).*

Right: *Lineup of freshly collected Nuttall cockles (*Clinocardium nuttallii*) from Sunshine Cove in Juneau, Alaska.*



GLOSSARY:

ADDUCTOR MUSCLES	Muscles that connect the two valves of a bivalve shell, drawing the shells together.	LOW INTERTIDAL ZONE	The area of the intertidal zone that is mostly submerged underwater and is only exposed to air during low tide.
ANTERIOR	Toward the front or head end; opposite of posterior.	MANTLE	The tissue that covers the bivalve body and secretes the valves, the outer proteinaceous layer, and is sometimes extended into the siphons.
BIVALVE	In the phylum Mollusca, a soft-bodied aquatic invertebrate such as clams, mussels, oysters, and scallops, enclosed by two valves hinged together.	MID INTERTIDAL ZONE	The area between the high (upper) and low intertidal zones; this area spends an equal amount of time exposed and submerged between high and low tides.
BYSSUS or BYSSAL THREADS	A bundle of tough threads of tanned protein that are secreted by the foot in some bivalve species and serve as a means of attachment to substrate or other bivalves.	PERIOSTRACUM	A leathery or parchment layer that covers the outer surface of bivalve shells.
CILIA	Short, fine, hair-like projections used in bivalve respiration.	POSTERIOR	Toward the back or rear end; opposite of anterior.
DORSAL	Toward the upper side of a bivalve shell; opposite of the ventral side.	SHEATH	A covering that surrounds the siphon.
EXCURRENT or EXHALANT SIPHON	An opening that moves water out of the body of a bivalve.	SIPHON	An extension that allows water to enter or exit the body of a bivalve.
FOOT	The muscular organ on the underside of the visceral mass, used for movement, burrowing, and/or anchoring.	SUBTIDAL ZONE	The area of the seashore that is below the lowest low tide line.
HIGH or UPPER INTERTIDAL ZONE	The area of the intertidal zone that is typically exposed to air and is only submerged underwater during the high tide.	UMBO	An elevation or knob; in molluscs, a projection above the hinge (plural: umbos or umbones).
HINGE	The top or dorsal part of the bivalve that holds or connects the two valves together.	VALVE	One of two halves of a bivalve shell.
INCURRENT or INHALANT SIPHON	An opening that brings water into the body of the bivalve.	VENTRAL	Toward the underside of a bivalve shell; opposite of the dorsal side.
INTERTIDAL ZONE	The area of a seashore that is covered by seawater during high tide and uncovered during low tide; between the high and low tide lines.	VISCERAL MASS or VISCERA	The region of a bivalve's body containing the gonads, digestive organs, heart, and excretory organs. The visceral mass does not include the mantle, siphons, nor most of the foot.

INTRODUCTION & USING THE GUIDE:

This guide presents a comparison of the major anatomical structures amongst select bivalve species common in Southeast Alaska. The guide was compiled for use in identifying the prey contents found inside sea otter (*Enhydra lutris*) stomachs (Brown *et al.*, 2017, in review), and is not inclusive of all bivalve species throughout Alaska. The guide was designed in response to a lack of photographical information with which to compare bivalve siphons. Clams comprise up to 75% of the sea otter diet (Garshelis *et al.*, 1986; Kvittek and Oliver, 1992; Kvittek *et al.*, 1993; Wolt *et al.*, 2012). However, sea otters rarely consume bivalve shells, leaving the soft parts – most notably the siphon and foot – as the most reliable features for identifying bivalve species inside sea otter stomachs. Since most guides include little or no information regarding the soft parts of bivalves, the authors set out in search of a way to compare bivalve siphons and feet. As part of that work, this guide was constructed with the intent that it would be useful to others doing similar work. It may also be useful for the identification of walrus (*Odobenus rosmarus*) and bearded seal (*Erignathus barbatus*) stomach contents (Nora Foster, University of Alaska Museum, personal communication) or for the identification of bivalve siphons from diving or submersible surveys of seafloor habitats (*sensu* Stone *et al.*, 2005).

The glossary section of this guide was assembled with the help of Carter *et al.* (2012). Basic bivalve anatomy is illustrated for user reference (Figure 1.3). Species profiles presented in this guide were summarized from Abbott (1974), Kessler (1985), Foster (1991), O’Clair and O’Clair (1998), and Coan *et al.* (2000). Each species profile includes characteristics of shell length and coloration, as well as habitat and distribution throughout Alaska. Shell length was used as the size measurement for the bivalve species presented in this guide. Shell coloration refers only to the pigmentation of the valves. Characteristics of the periostracum are noted separately. The bivalve species presented in this guide can be found anywhere within the intertidal and subtidal zones (Figure 1.4). They vary greatly in their distributions both in and outside of Alaska; however, as this guide is specific to Southeast Alaska, notes on distribution were limited to Alaska only. Photos of each species depict external and internal anatomy, with a focus on the siphons and foot. When large enough, siphons were dissected to compare inside anatomy. Bivalve siphons

and feet (lengths and girths) were not measured because the specimens collected were not necessarily representative of the average size of the species’ populations. “Quick Guides” comparing the siphons and feet of the bivalve species presented in this guide are included herein.

METHODS:

Select Southeast Alaska bivalve species were collected during the low tides of five sampling days in 2016. Nine species were collected at four Juneau, Alaska locations: Sunshine Cove, Eagle Beach, Auke Village Recreational Area (Auke Rec.), and the Mendenhall Wetlands (see Table 1 for a complete summary of bivalve species collected). A tenth species (northern horse mussel) was collected using scuba at Amalga Harbor since the species is found only in the subtidal zone (> 8 m depth) locally. Collected bivalves were maintained in aquaria of running seawater before being transferred to containers of fresh water where they remained until the animals stressed enough for the valves to open. At least two specimens of each species were dissected and photographed, if available. The remaining specimens were placed in labeled zip-lock bags and frozen for future reference. (The exception to this was the Arctic surf clam; only one specimen was collected, so the single specimen was both dissected and frozen.)

During the dissections, a Canon EOS 70D Digital SLR camera was used in conjunction with a light diffuser box to photograph the specimens. The goal was to include the following for each species: (1) exterior view of a valve, (2) exterior view of the umbo and hinge, (3) interior view of the whole specimen, (4) exterior view of the siphon neck, (5) interior view of the siphon neck, and (6) exterior view of the foot. Variation in the photographs was due to unique features of some of the species (e.g. mussel byssal threads). A photograph of the umbo and hinge were not collected for the two mussel species. Photographs were edited and compiled using Adobe Photoshop. Images of bivalves are not shown to scale; however, a 1 cm scale bar is given with the exterior view of each species.



Figure 1.1. Lab setup with light diffuser box, dissection trays, and bins with bivalve specimens.

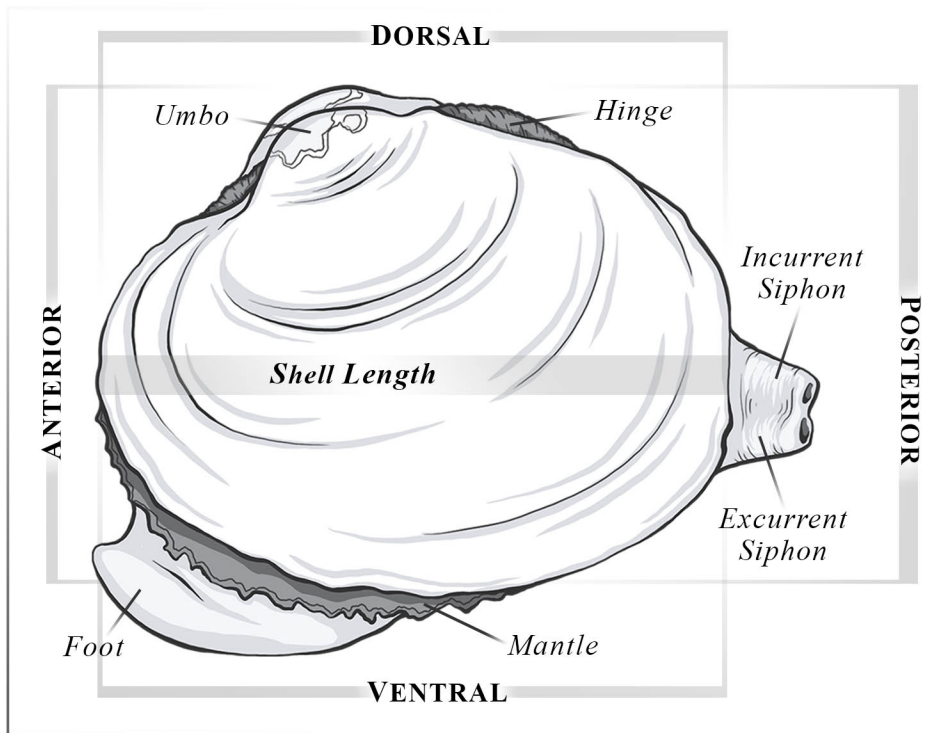
Table 1. Collection data for the ten bivalve species featured in this guide. Data include scientific and common names, location and date of collection, and tide stage in meters (MLLW).

SCIENTIFIC NAME	COMMON NAME	#	LOCATION	DATE	TIDE
<i>Clinocardium nuttallii</i>	Nuttall Cockle	5	Sunshine Cove	01/11/2016	-0.88 m
<i>Macoma inquinata</i>	Pointed Macoma	6	Sunshine Cove	08/03/2016	-0.88 m
<i>Mactromeris polynyma</i>	Arctic Surfclam	1	Mendenhall Wetlands	01/11/2016	-0.88 m
<i>Mya arenaria</i>	Softshell Clam	4	Eagle Beach	01/09/2016	-0.67 m
<i>Mya truncata</i>	Truncate Softshell Clam	4	Auke Rec.	01/10/2016	-0.82 m
<i>Protothaca staminea</i>	Pacific Littleneck	4	Sunshine Cove	08/03/2016	-0.88 m
<i>Saxidomus gigantea</i>	Washington Butterclam	2	Auke Rec.	01/11/2016	-0.88 m
		2	Mendenhall Wetlands	01/09/2016	-0.67 m
<i>Tresus capax</i>	Fat Gaper	4	Mendenhall Wetlands	01/09/2016	-0.67 m
<i>Modiolus modiolus</i>	Northern Horsemussel	3	Amalga Harbor	01/30/2016	n/a
<i>Mytilus trossulus</i>	Foolish Mussel	3	Auke Rec.	01/11/2016	-0.88 m



Figure 1.2. Specimens were placed in a container of fresh water to fatigue the adductor muscles. This process facilitated cleansing, dissecting, and photographing.

(a) Left Side View:



(b) Dorsal View:

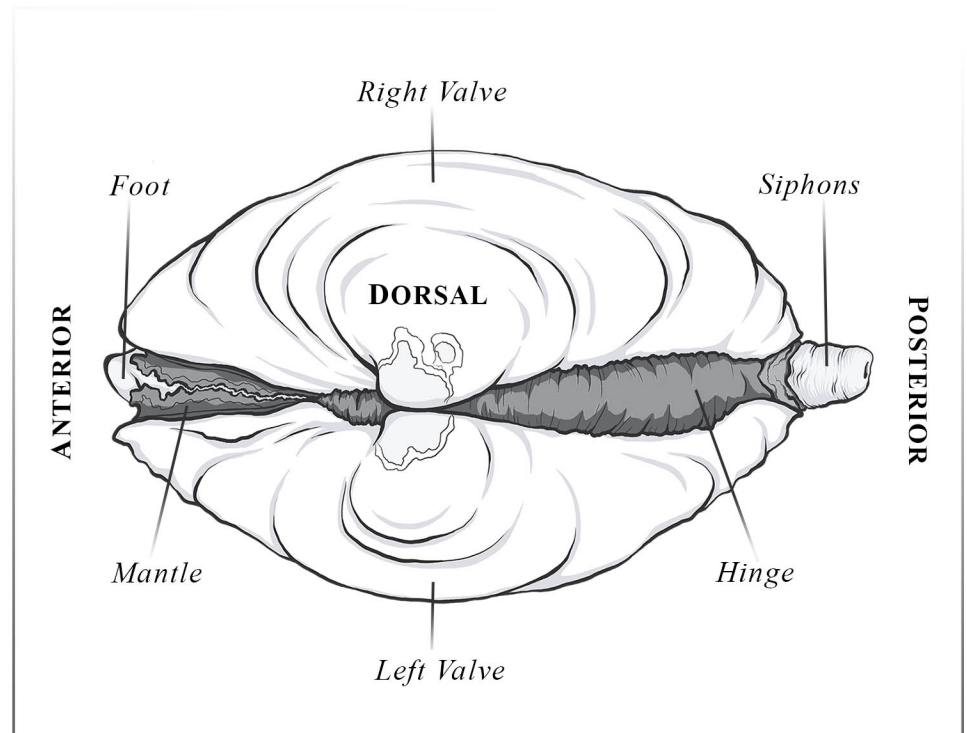


Figure 1.3. Basic bivalve anatomy viewed from (a) the left side and (b) the dorsal side.

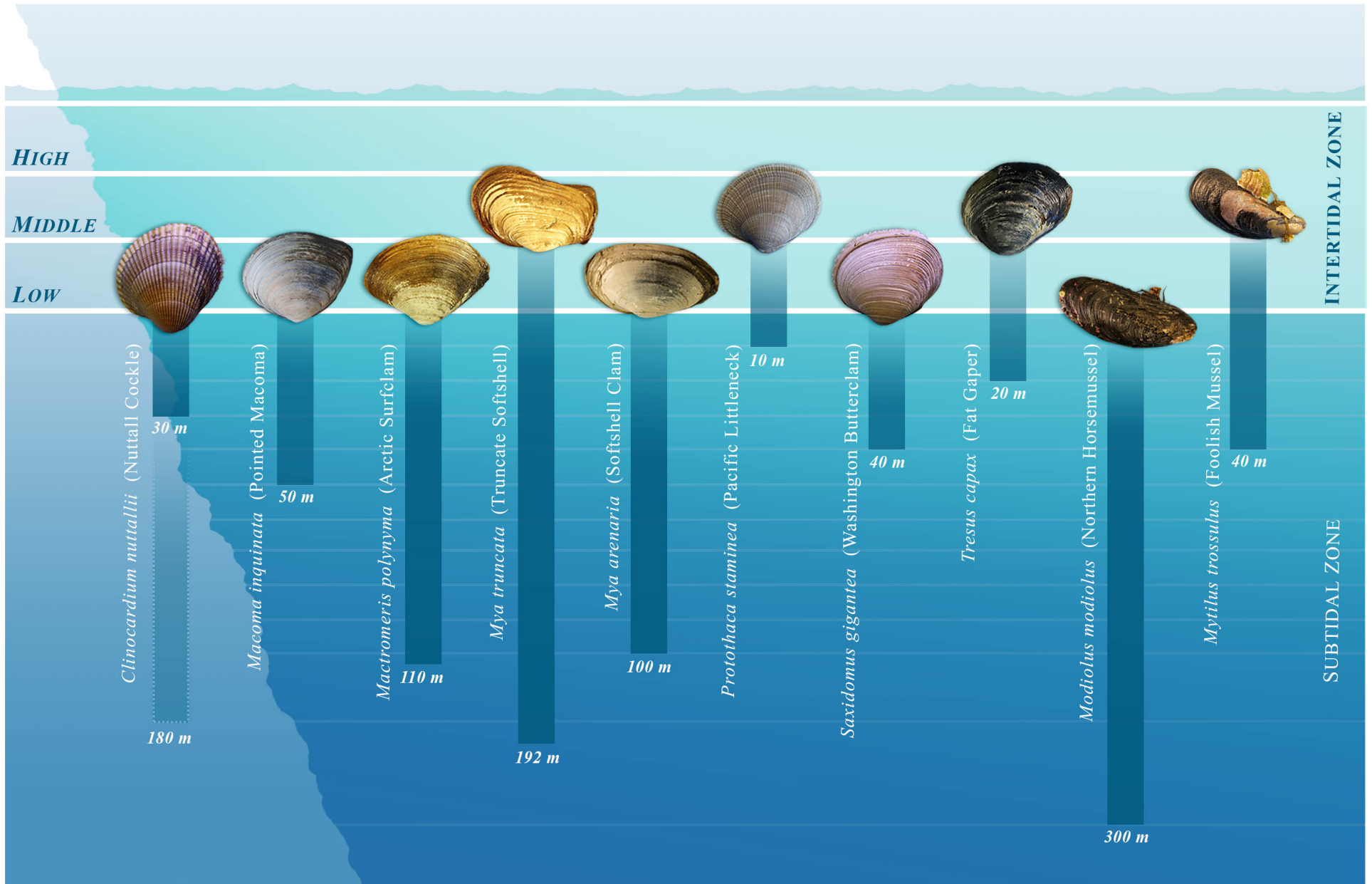


Figure 1.4. Tidal zones and depth ranges inhabited by select bivalve species. The majority of the species occupy the middle to low intertidal zone; *Modiolus modiolus* is the only species to nearly completely inhabit the subtidal zone. *Clinocardium nuttallii* is primarily found between the low intertidal zone and 30 m, but occasionally to depths of 180 m (indicated as a double bar above).

|| *Clinocardium nuttallii* ||

NUTTALL COCKLE

I. EXTERNAL ANATOMY:

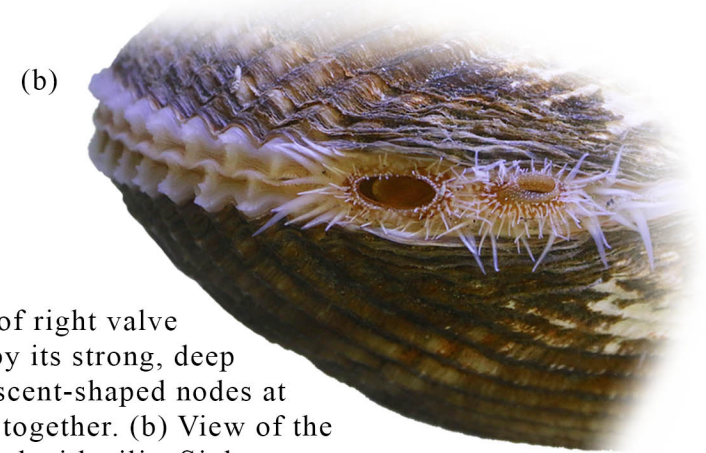
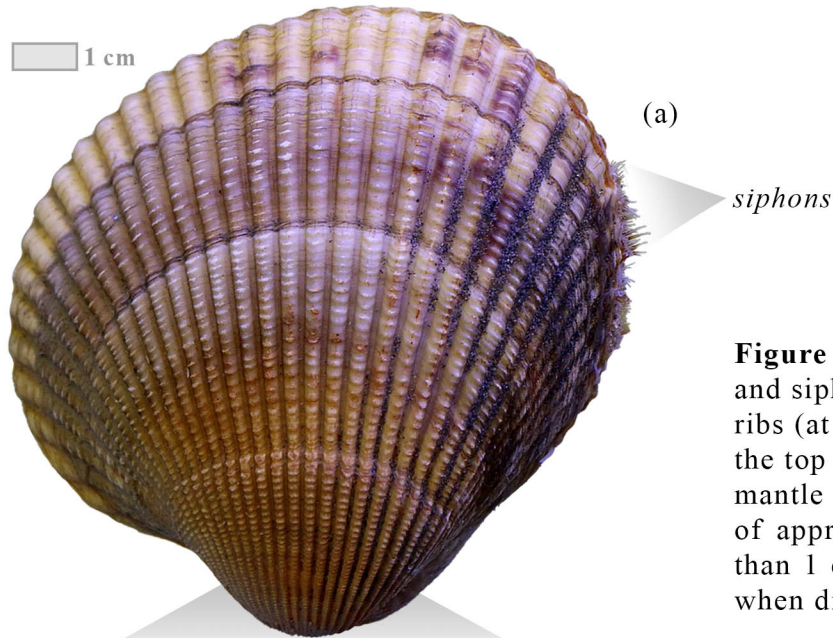


Figure 2.1. (a) External view of right valve and siphons. Distinguishable by its strong, deep ribs (at least 30) that have crescent-shaped nodes at the top where the valves draw together. (b) View of the mantle and open siphons fringed with cilia. Siphons are of approximate equal length and do not extend more than 1 cm past the bivalve shell. The siphons collapse when dissected and are indiscernible from the mantle.



Figure 2.2. Dorsal view showing the umbo and hinge.

Table 2. Species profile for the Nuttall cockle.

LENGTH	Up to 15 cm, the largest of the Northern Pacific cockles. The specimen shown is 9.5 cm.
SHELL COLORATION	Yellow-grey or tan to brown outer valves.
HABITAT	Low intertidal zone to 30 meters, occasionally to 180 meters. Burrows just below the surface of fine sediment (muddy or sandy substrates).
ALASKA DISTRIBUTION	Bering Sea (St. Lawrence Island), eastern Aleutian Islands, and Gulf of Alaska including Southeast Alaska.

Clinocardium nuttallii

NUTTALL COCKLE

II. INTERNAL ANATOMY:

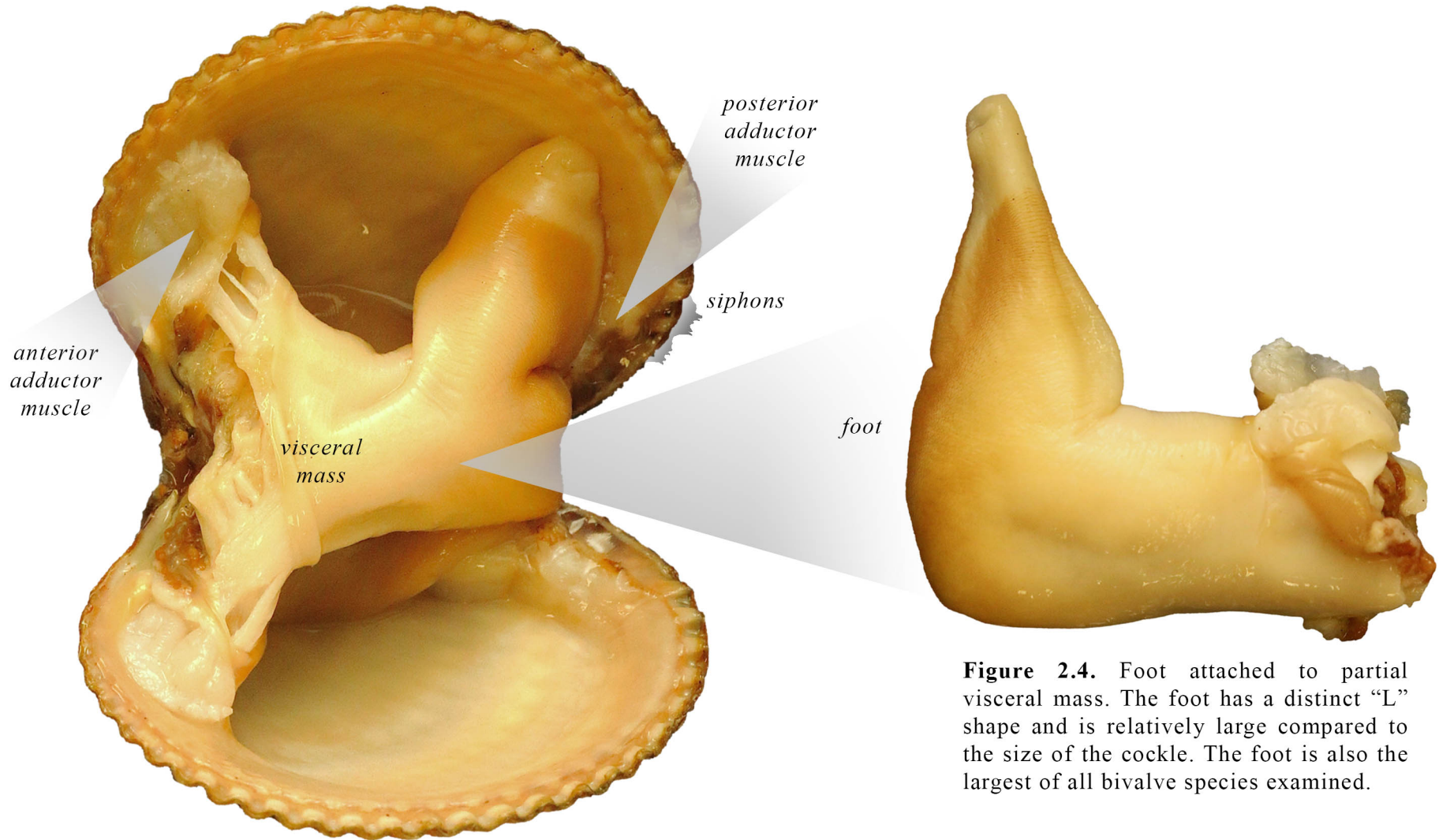


Figure 2.3. Internal view. The siphons are so small and delicate that they fall apart when the valves are opened; however, the location of the siphons are shown for reference. The inside of the siphons are not shown because they were too small to dissect.

Figure 2.4. Foot attached to partial visceral mass. The foot has a distinct “L” shape and is relatively large compared to the size of the cockle. The foot is also the largest of all bivalve species examined.

|| *Macoma inquinata* ||

POINTED MACOMA

I. EXTERNAL ANATOMY:

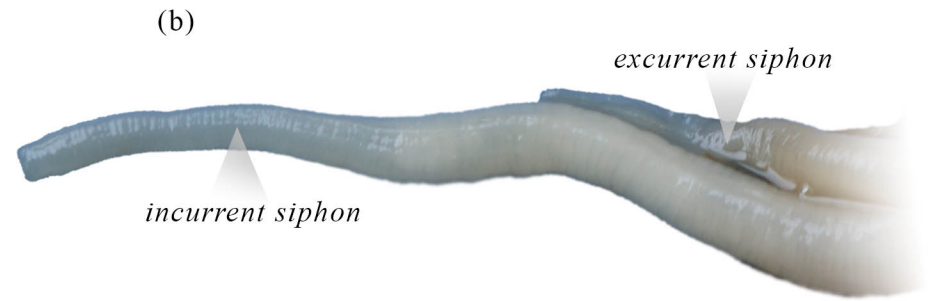


Figure 3.1. (a) External view of right valve. (b) Pointed Macoma siphons have no distinguishable sheath. Incurrent and excurrent siphons were most notably not fused together, but separated and of unequal length.

Table 3. Species profile for the Pointed Macoma.

LENGTH	Up to 6.5 cm. The specimen shown is 4.8 cm.
SHELL COLORATION	Varying shades of white and cream; may have dark patches and occasionally small patches of flaky, fine greyish-brown periostracum.
HABITAT	Low intertidal zone to 50 meters. Prefers silty or sandy silt in bays and offshore shelves.
ALASKA DISTRIBUTION	Throughout the Bering Sea including the Pribilof Islands, the Aleutian Islands, and Gulf of Alaska including Southeast Alaska.

Figure 3.2. Dorsal view showing the umbo and hinge.

|| *Macoma inquinata* ||
POINTED MACOMA

II. INTERNAL ANATOMY:

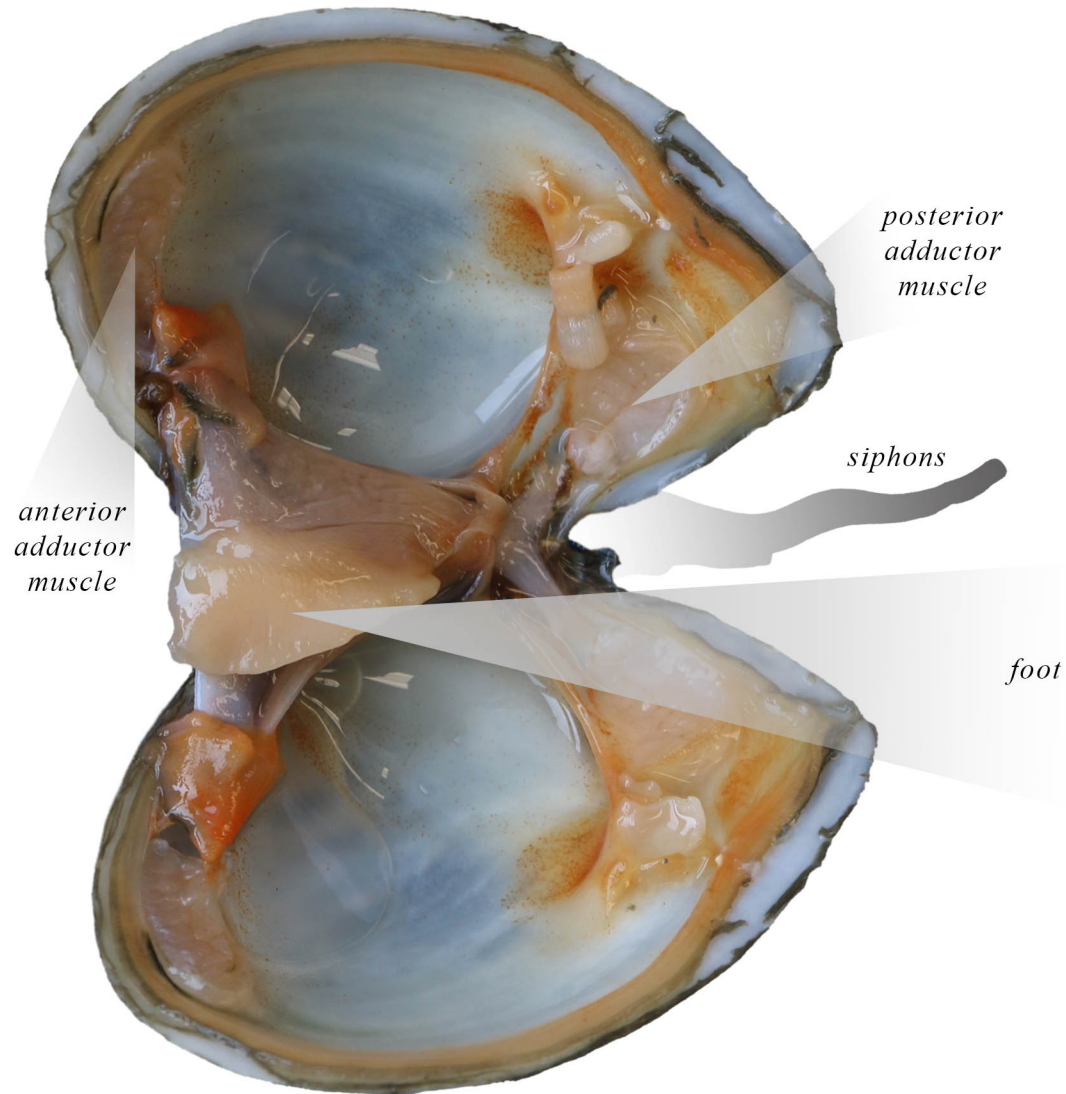


Figure 3.4. Foot attached to partial visceral mass.

Figure 3.3. Internal view. The siphons were too small and contracted to be visible when the clam was dissected; however, the location of the siphons are shown for reference. The inside of the siphons are not shown because they were too small to dissect.

|| *Mactromeris polynyma* ||

ARCTIC SURFCLAM

I. EXTERNAL ANATOMY:

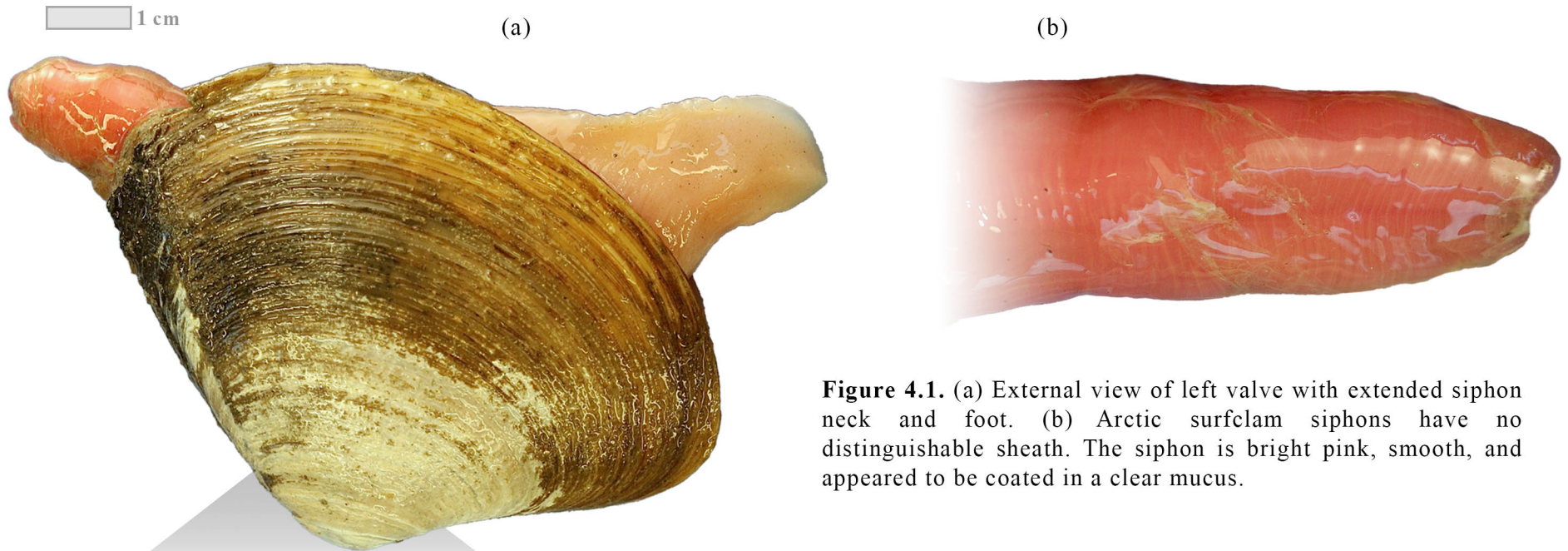


Figure 4.1. (a) External view of left valve with extended siphon neck and foot. (b) Arctic surfclam siphons have no distinguishable sheath. The siphon is bright pink, smooth, and appeared to be coated in a clear mucus.



Figure 4.2. Dorsal view showing the umbo and hinge.

Table 4. Species profile for the Arctic surfclam.

LENGTH	Up to 16 cm. The specimen shown is 7.7 cm.
SHELL COLORATION	Chalky white but often covered with an olive-green or tan periostracum.
HABITAT	Low intertidal zone to 110 meters. Prefers exposed areas of sand, gravelly-sand, or mud substrates.
ALASKA DISTRIBUTION	Point Barrow (Arctic Ocean) throughout the Bering Sea (Including the Pribilof Islands), the Aleutian Islands, and Gulf of Alaska including Southeast Alaska.

|| *Mactromeris polynyma* ||
ARCTIC SURFCLAM

II. INTERNAL ANATOMY:

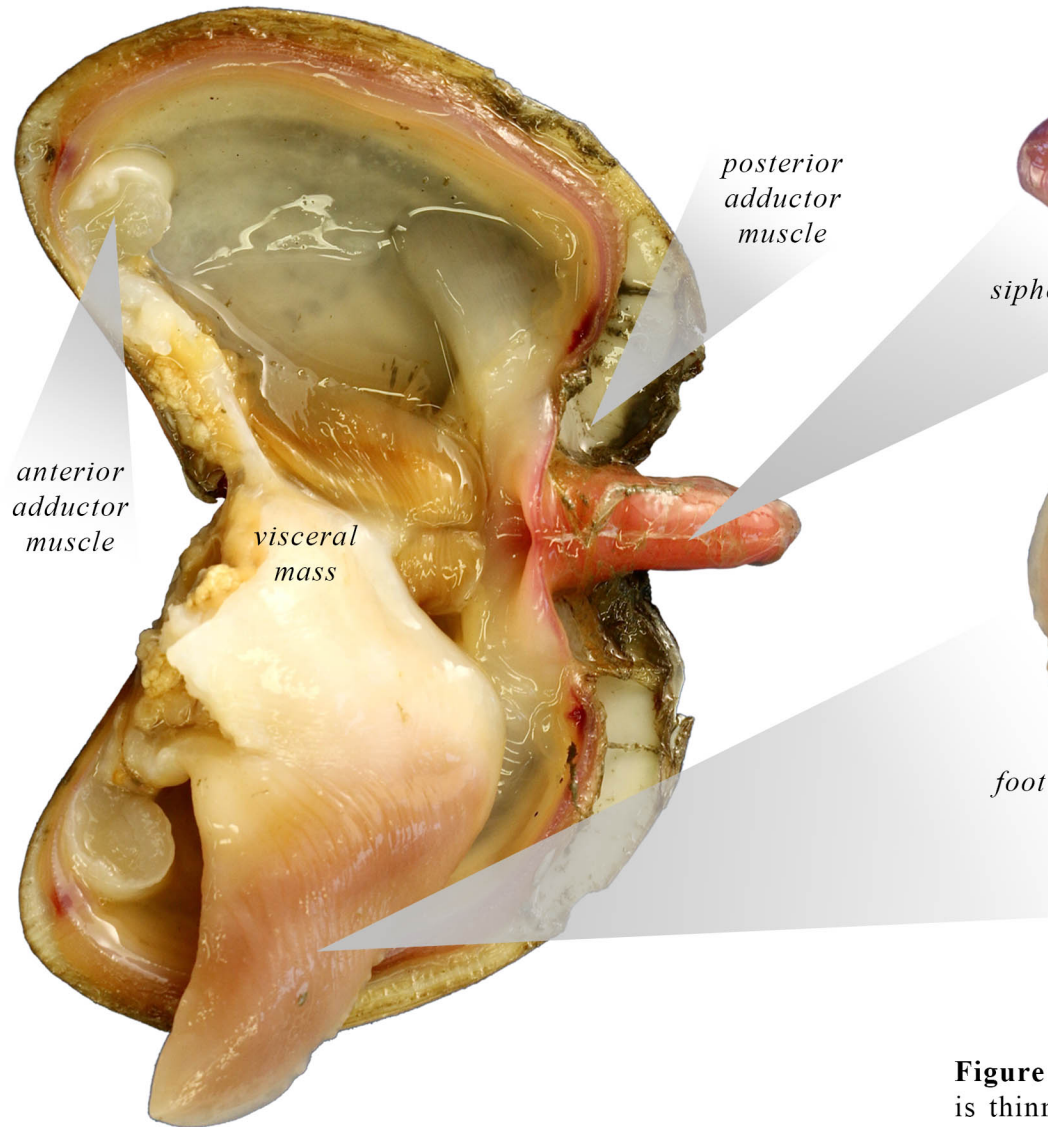


Figure 4.3. Internal view. The adductor muscles are relatively large compared to the size of the clam.



Figure 4.4. Dissected siphons. Interior is dark pink with subtle horizontal striations. Siphons appeared to be covered in a clear mucus.



Figure 4.5. Foot attached to partial visceral mass. Foot is thinner and more elongated compared to the rounder butterclam foot and the stubbier fat gaper foot. Most distinctly, the foot has a rough texture (the roughest of all species examined).

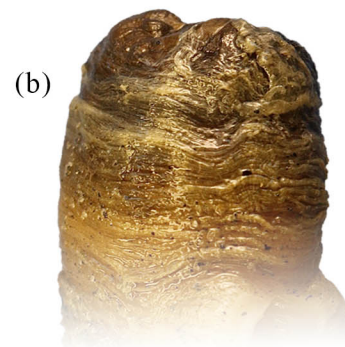
|| *Mya arenaria* ||
SOFTSHELL CLAM

I. EXTERNAL ANATOMY:

1 cm



(a)



(b)

Figure 5.1. (a) External view of right valve. (b) Softshell clam siphons have a tough, wrinkled sheath firmly attached to the neck. The fully extended neck of the siphon is firm and barely reaches past the valves.



Figure 5.2. Dorsal view showing the umbo and hinge.

Table 5. Species profile for the softshell clam.

LENGTH	Up to 17 cm. The specimen shown is 5.9 cm.
SHELL COLORATION	Thin white valves but often covered with a light-gray to straw-colored papery periostracum.
HABITAT	Middle intertidal zone to 192 meters. Can burrow up to 50 cm deep. Prefers areas of reduced salinity with sand, gravelly sand, sandy-mud, or mud substrates, such as the mouths of rivers and creeks.
ALASKA DISTRIBUTION	Chukchi Sea (Icy Cape) through Southeast Alaska.

|| *Mya arenaria* ||
SOFTSHELL CLAM

II. INTERNAL ANATOMY:

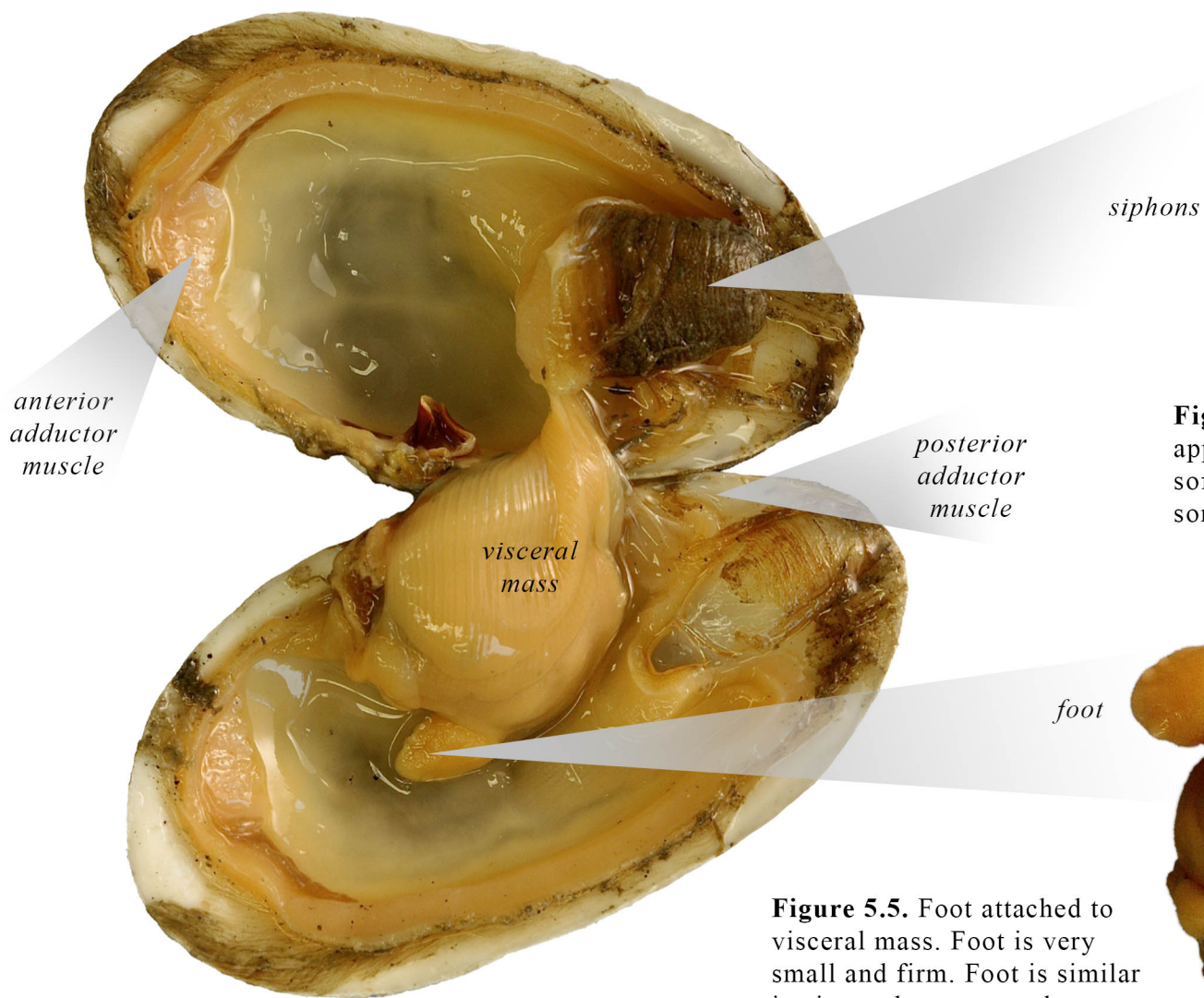


Figure 5.3. Internal view.

Figure 5.4. Dissected siphons. Texture and appearance are similar to that of the truncate softshell clam, but much shorter and with some coloration at the openings.



Figure 5.5. Foot attached to visceral mass. Foot is very small and firm. Foot is similar in size and texture to the truncate softshell clam but appears to have a more rounded shape (versus the triangular shape of the truncate softshell's foot).

|| *Mya truncata* ||
TRUNCATE SOFTSHELL CLAM

I. EXTERNAL ANATOMY:

1 cm



Figure 6.1. External view of the right valve. A thick, wrinkly and flaky sheath is loosely attached to the siphon neck. The sheath peels off easily and in one whole piece during dissection. The siphon neck is relatively large compared to the valves and never fully retracts.



Figure 6.2. Dorsal view showing the umbo and hinge.

Table 6. Species profile for the truncate softshell clam.

LENGTH	Up to 9 cm. The specimen shown is 6.9 cm.
SHELL COLORATION	The valves are chalky white with a papery light or dark brown periostracum.
HABITAT	Low intertidal zone to 100 meters. Prefers protected bays and inlets in areas of muddy or sandy substrate.
ALASKA DISTRIBUTION	Beaufort Sea (Arctic Ocean) through Southeast Alaska.

|| *Mya truncata* ||
TRUNCATE SOFTSHELL CLAM

II. INTERNAL ANATOMY:

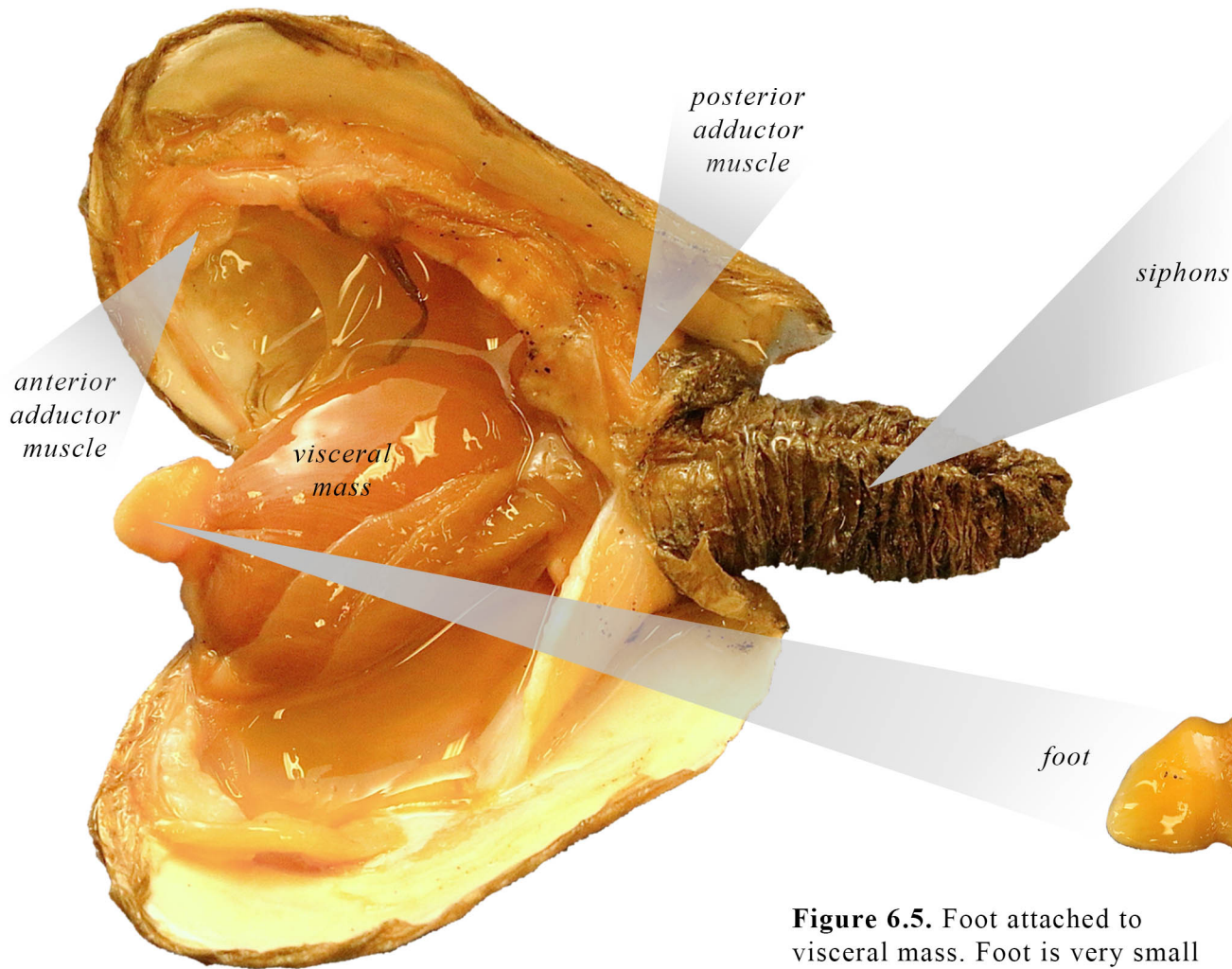


Figure 6.3. Internal view.



Figure 6.4. Dissected siphons. Interior walls are thick and the wrinkly sheath peels off easily.

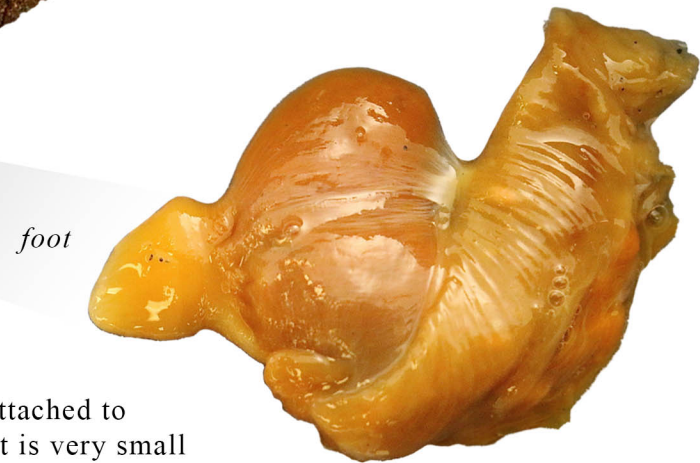
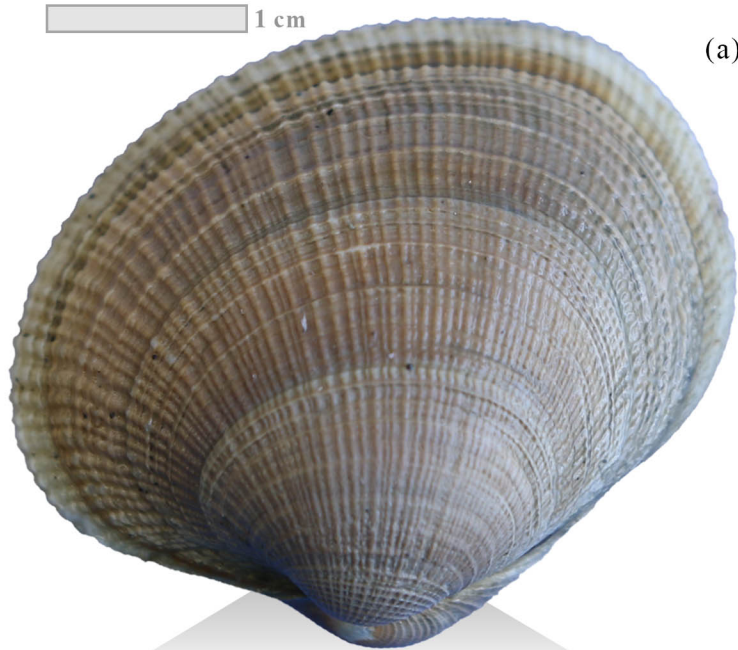


Figure 6.5. Foot attached to visceral mass. Foot is very small and firm, pictured above as the triangle-shaped mass attached to the bulbous visceral mass. The foot is very similar to that of the softshell clam.

Leukoma staminea
PACIFIC LITTLENECK

I. EXTERNAL ANATOMY:



(a)



(b)

Figure 7.1. (a) External view of right valve. (b) Siphons have no distinguishable sheath. The neck greatly resembles that of the butterclam in color but is more bulbous, firm, and stubby.



Figure 7.2. Dorsal view showing the umbo and hinge.

Table 7. Species profile for the Pacific littleneck.

LENGTH	Up to 8 cm. The specimen shown is 3.6 cm.
SHELL COLORATION	Off-white, cream, grey or light brown outer valves.
HABITAT	Middle intertidal to 10 meters. Burrows shallowly, up to 20 cm deep. Prefers bays and coves with sand or muddy-sand substrates, but can be found around cobbles in exposed areas.
ALASKA DISTRIBUTION	Western Aleutian Islands (Attu Island) through Southeast Alaska.

|| *Leukoma staminea* ||
PACIFIC LITTLENECK

II. INTERNAL ANATOMY:

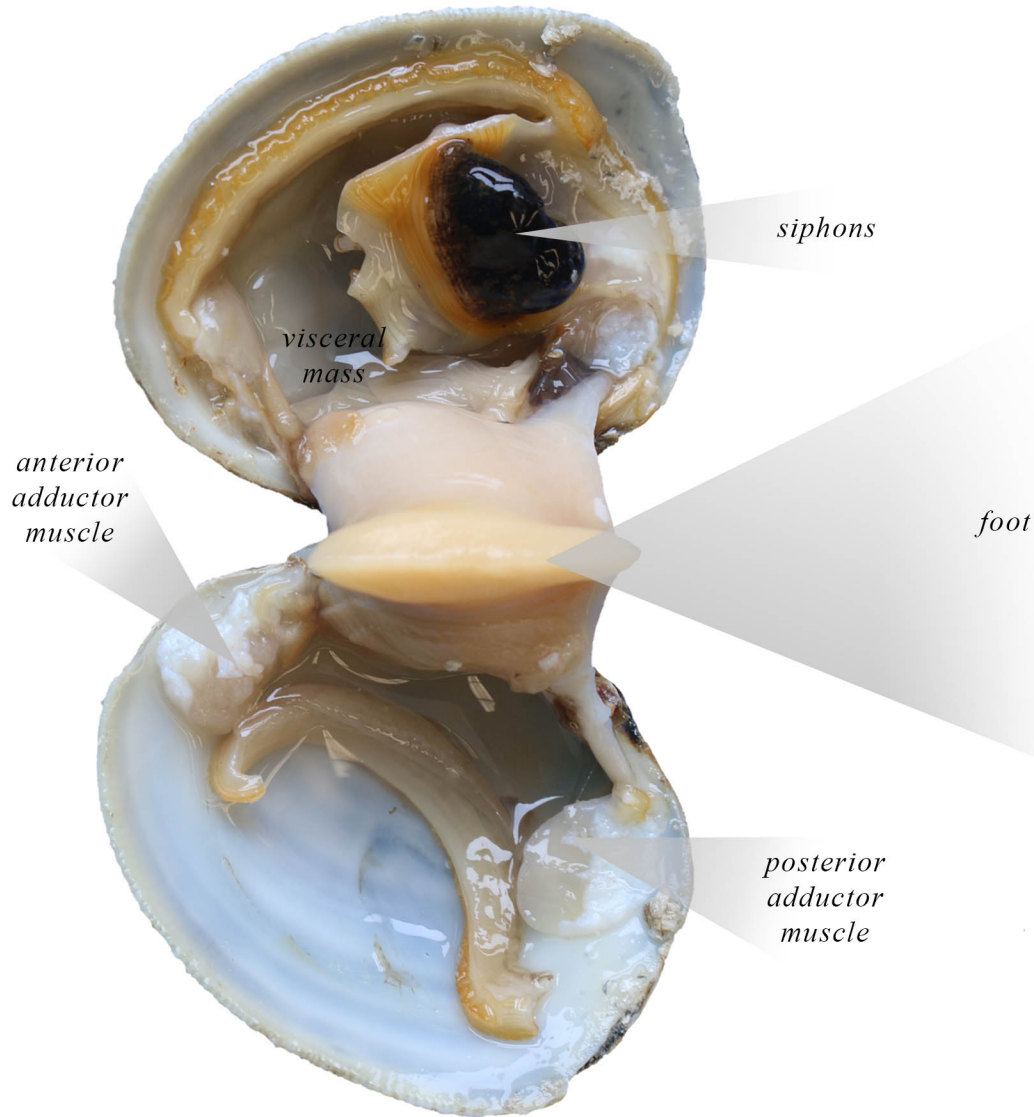


Figure 7.3. Internal view. The inside of the siphons are not shown because they were too small to dissect.



Figure 7.4. Foot attached to visceral mass. The foot is firm and appeared as a strip coming up from the visceral mass. There was a large degree of variation in the texture of the foot among the specimens dissected.

Saxidomus gigantea
WASHINGTON BUTTERCLAM

I. EXTERNAL ANATOMY:

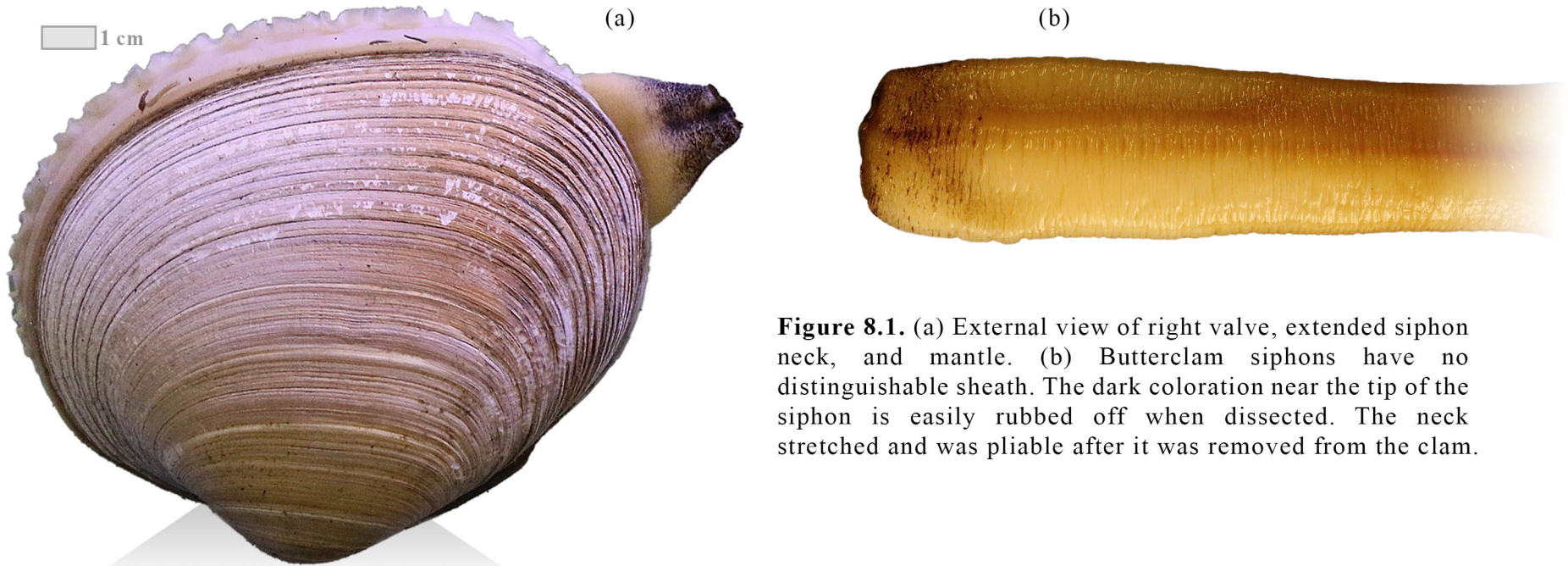


Figure 8.1. (a) External view of right valve, extended siphon neck, and mantle. (b) Butterclam siphons have no distinguishable sheath. The dark coloration near the tip of the siphon is easily rubbed off when dissected. The neck stretched and was pliable after it was removed from the clam.



Figure 8.2. Dorsal view showing the umbo and hinge.

Table 8. Species profile for the Washington butterclam.

LENGTH	Up to 14 cm. The specimen shown is 10.7 cm.
SHELL COLORATION	Thick white, light grey or brown valves often with well-worn brownish periostracum. Occasionally blackened by sulfides when living in oxygen-deficient sediments.
HABITAT	Low intertidal zone to 40 meters. Often found in shallow water, typically buried to 30 cm deep. Prefers sheltered areas of sand, sandy-mud, pebble, or mixed-shell substrates.
ALASKA DISTRIBUTION	Western Aleutian Islands (Attu Island) through the Gulf of Alaska, including Southeast Alaska.

|| *Saxidomus gigantea* ||
WASHINGTON BUTTERCLAM

II. INTERNAL ANATOMY:

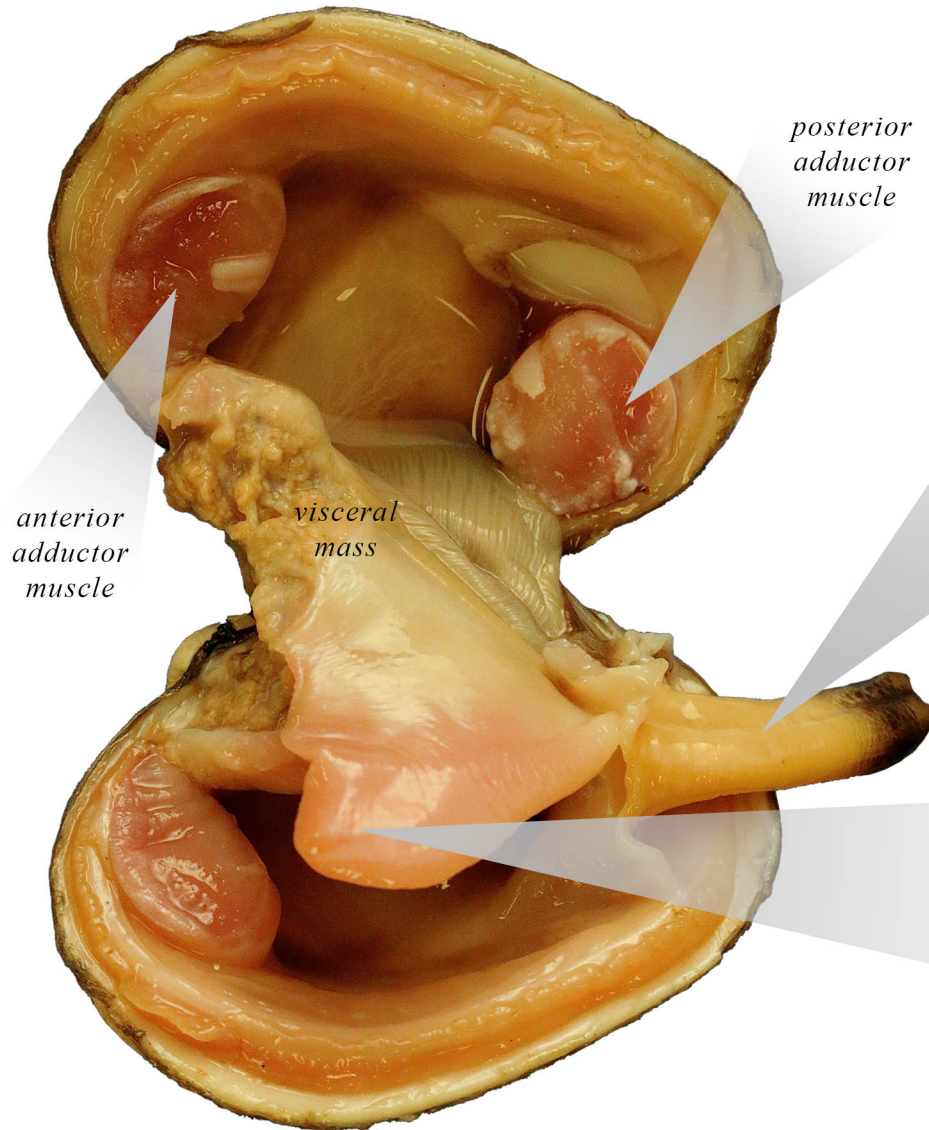


Figure 8.3. Internal view. The adductor muscles are relatively large compared to the size of the clam.



Figure 8.4. Dissected siphons. Interior is smooth and appeared to be coated in a clear mucus.



Figure 8.5. Foot attached to partial visceral mass. Foot is thick with no distinct texture.

|| *Tresus capax* ||
FAT GAPER

I. EXTERNAL ANATOMY:

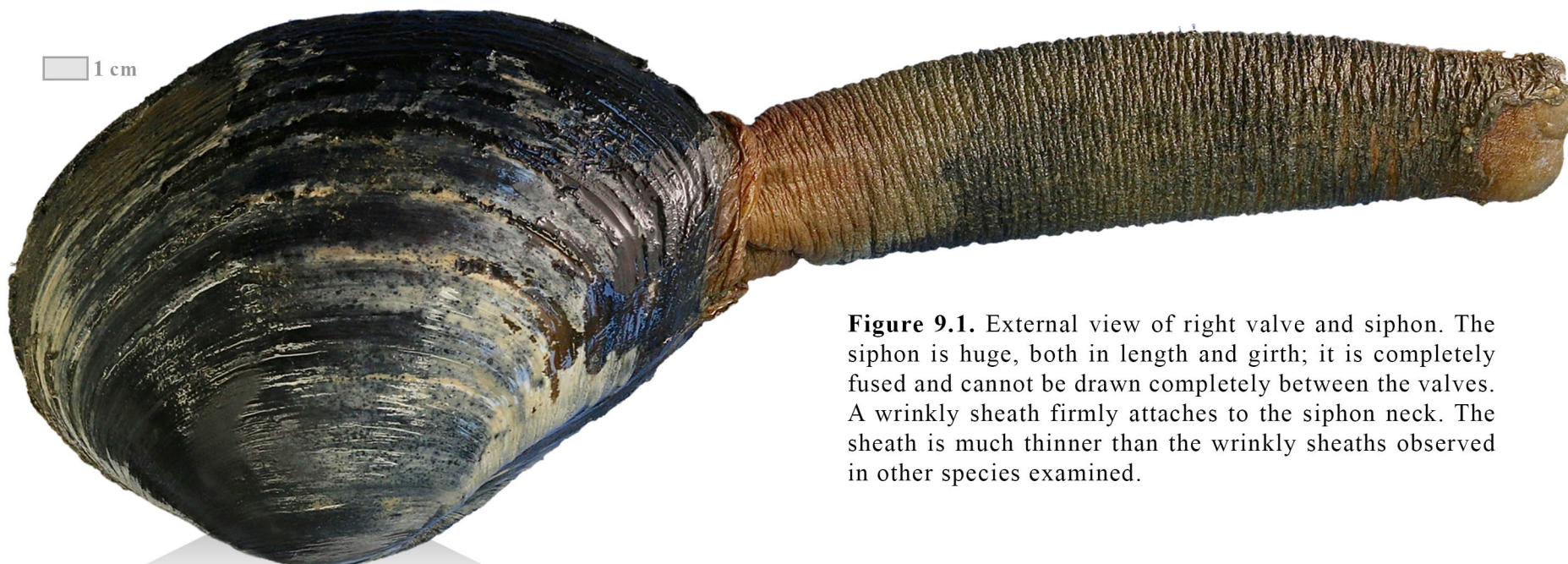


Figure 9.1. External view of right valve and siphon. The siphon is huge, both in length and girth; it is completely fused and cannot be drawn completely between the valves. A wrinkly sheath firmly attaches to the siphon neck. The sheath is much thinner than the wrinkly sheaths observed in other species examined.



Figure 9.2. Dorsal view showing the umbo and hinge.

Table 9. Species profile for the fat gaper.

LENGTH	Up to 26 cm. The specimen shown is 16.0 cm.
SHELL COLORATION	Chalky or creamy white, occasionally yellowish with a dark flaky periostracum. Occasionally blackened by sulfides when living in oxygen-deficient sediments.
HABITAT	Middle intertidal zone to 20 meters. Can burrow up to one meter deep. Prefers muddy or sandy substrate with small amounts of pebble and shell.
ALASKA DISTRIBUTION	Gulf of Alaska (Shumagin Islands) through Southeast Alaska.

|| *Tresus capax* ||
FAT GAPER

II. INTERNAL ANATOMY:

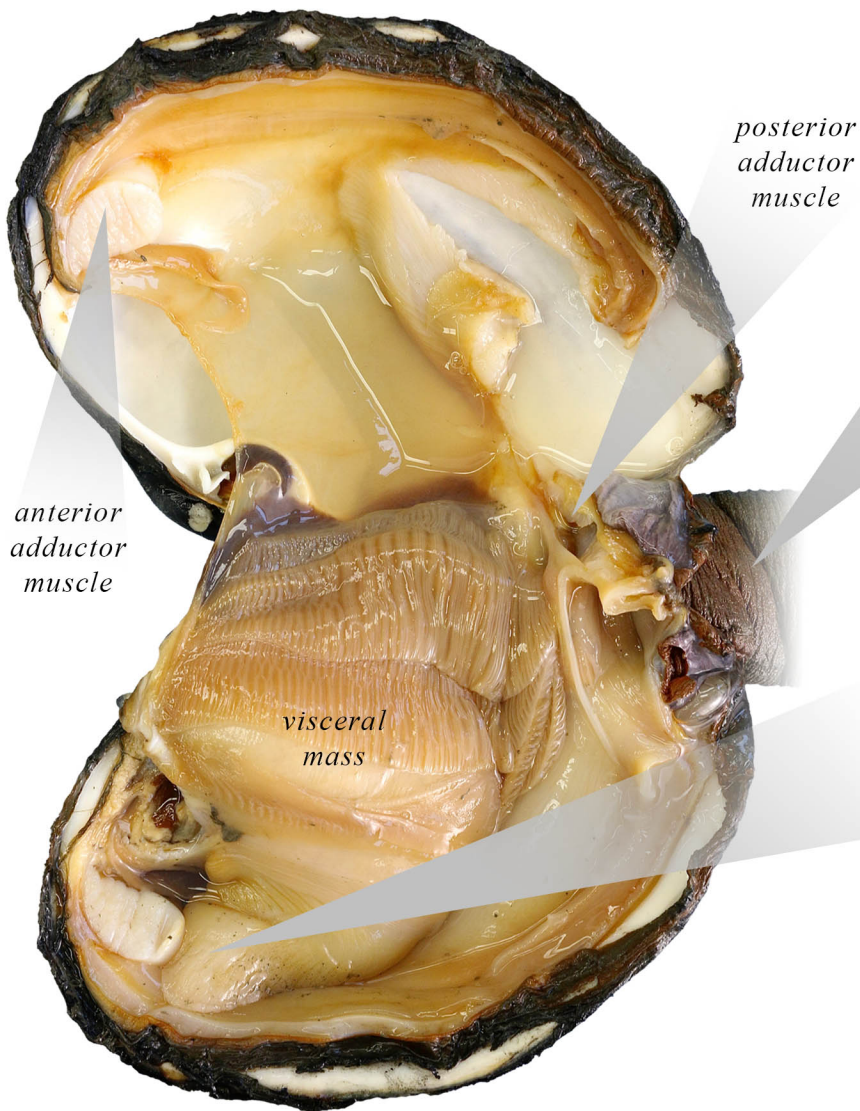


Figure 9.3. Internal view. The adductor muscles are relatively small compared to the size of the clam.



Figure 9.4. Dissected siphons. Interior walls are thick and the sheath could not be easily removed.



Figure 9.5. Foot attached to visceral mass. The foot is finely textured with “V” shaped striations.

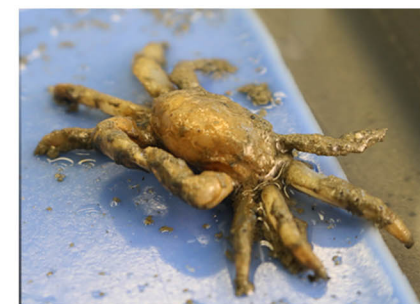


Figure 9.6. Male and female pea crabs (*Pinnixia faba*) live within the mantle cavity of fat gapers and were found in most specimens dissected.

|| *Modiolus modiolus* ||

NORTHERN HORSEMUSSEL

I. EXTERNAL ANATOMY:



Figure 10.1. External view of right valve.

Table 10. Species profile for the northern horse mussel.

LENGTH	Over 15 cm. The specimen shown is approximately 12.3 cm.
SHELL COLORATION	Shiny dark bluish purple or chestnut brown and often with a thick, coarse blackish-brown periostracum and smooth long hairs. Often encrusted with sand, coralline algae, and other organisms.
HABITAT	Low intertidal zone to at least 300 meters depth. Attaches to cobbles or sandy-pebble substrate and may form small beds burying shallowly in muddy habitats.
ALASKA DISTRIBUTION	From the Arctic Ocean through Southeast Alaska.

II. INTERNAL ANATOMY:

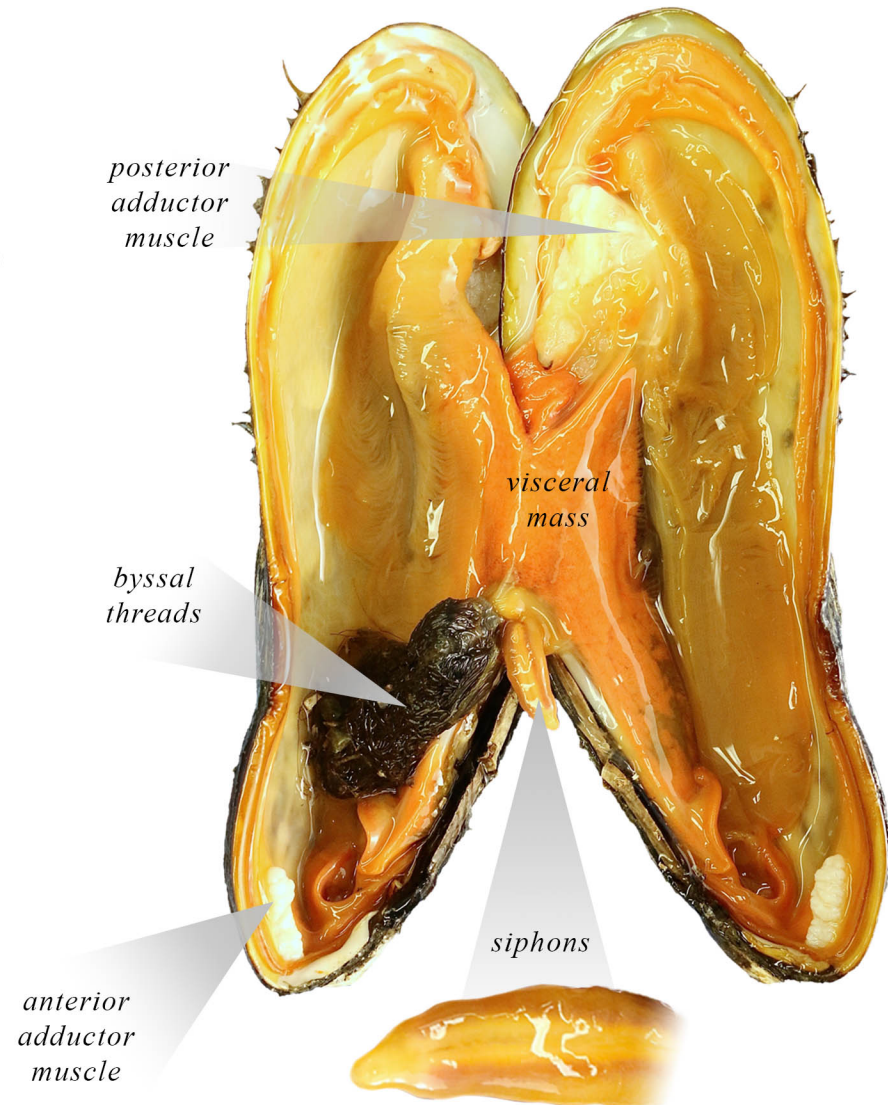


Figure 10.2. Dissected mussel with close-up view of the completely fused, non-pigmented siphons.

|| *Mytilus trossulus* ||

FOOLISH MUSSEL

I. EXTERNAL ANATOMY:



Figure 11.1. External view of right valve.

II. INTERNAL ANATOMY:

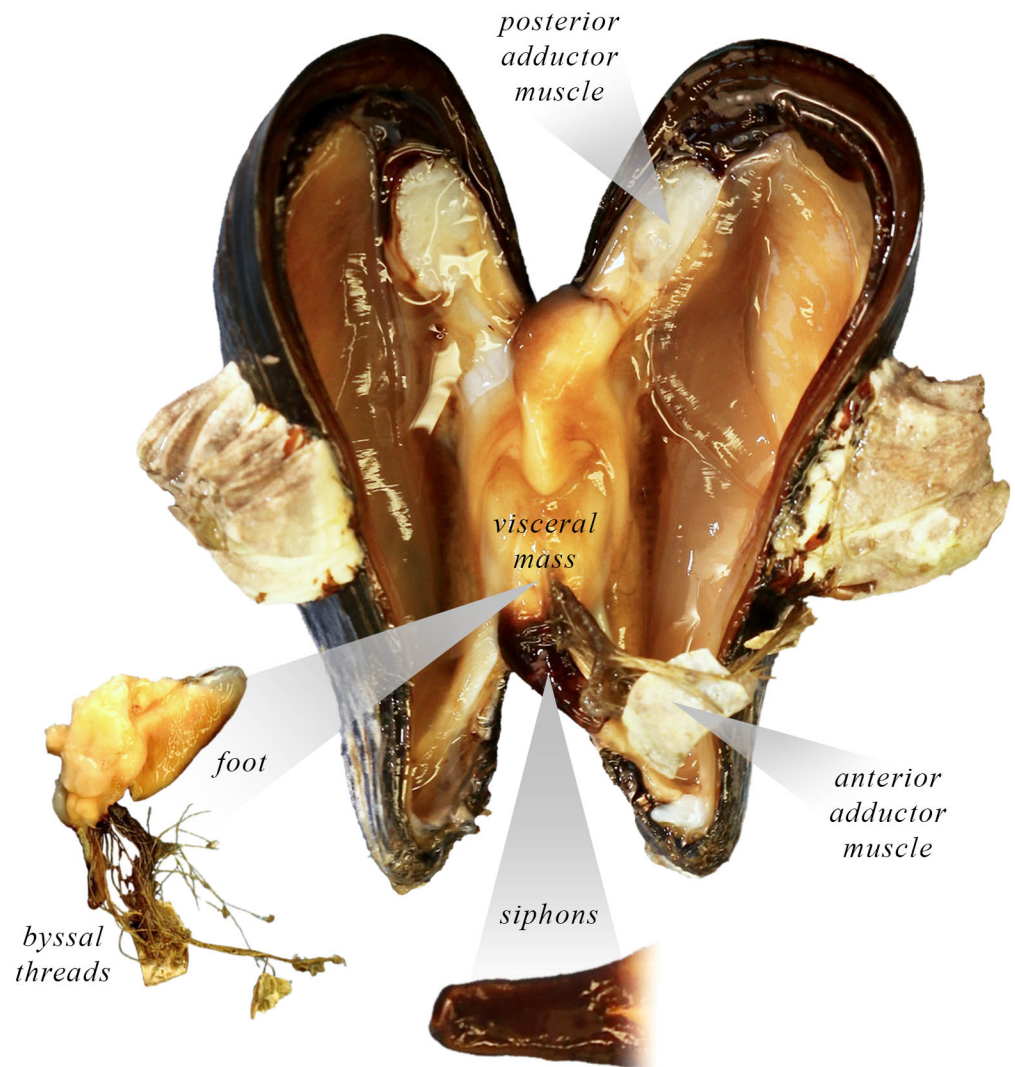


Table 11. Species profile for the foolish mussel.

LENGTH	Typically 6 to 10 cm but can grow to 13 cm. The specimen shown is 4.9 cm.
SHELL COLORATION	Blue or blue-black, sometimes brownish and often with encrusting organisms.
HABITAT	Middle intertidal zone to 40 meters. Prefers quiet bays with rocky or mixed-soft sediment habitats where dense beds will form, or mud flats where sparse beds will form. Also attaches to wharves, docks, and pilings.
ALASKA DISTRIBUTION	Beaufort Sea (Point Barrow) through Southeast Alaska.

Figure 11.2. Dissected specimen with a close-up view of the foot and completely fused, dark-colored siphons.

BIVALVE SIPHONS: *Quick Guide*

Comparison of the siphons for seven bivalve species. Due to their small size, the mussel siphons and internal views of the Pacific littleneck and pointed macoma clams are not shown. Images are not to scale. In order for all of the siphons to be clearly viewed, they are shown at proportions independent of one another.



BIVALVE FEET:

Quick Guide

Comparison of feet with attached sections of visceral mass for eight bivalve species. The feet of the two mussel species are not shown due to their small size. Images are not to scale. In order for all of the feet to be clearly viewed, they are shown at proportions independent of one another.



FAT GAPER



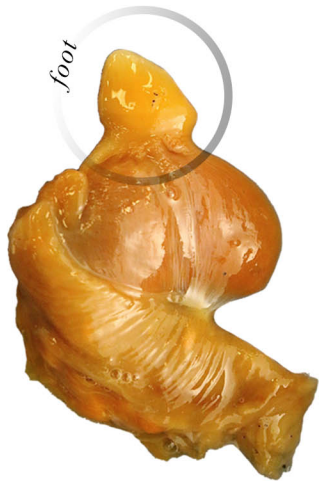
WASHINGTON BUTTERCLAM



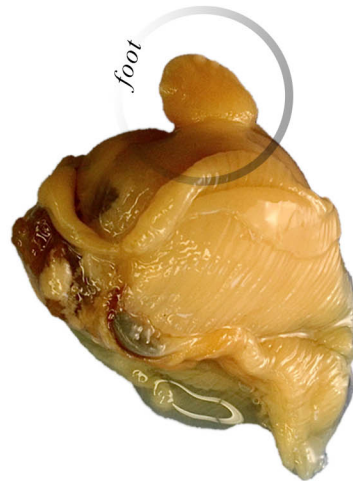
ARCTIC SURFLAM



NUTTALL COCKLE



TRUNCATE SOFTSHELL CLAM



SOFTSHELL CLAM



PACIFIC LITTLENECK



POINTED MACOMA

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Background Photo: Siphon neck of a butterclam.

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