Marine Invasive Species Identification Guide

FOR THE PUGET SOUND AREA

Puget Sound Marine Invasive Species Volunteer Monitoring Program (MISM)

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Publication No. PSP09-02, June 2009

MISM Target Species List

MARINE / ESTUARINE ORGANISMS (30 SPECIES TOTAL)

COMMON NAME	SCIENTIFIC NAME
PLANTS (5 SPECIES)	
Cordgrass	***Spartina spp.***
Japanese eelgrass	***Zostera japonica***
MACRO ALGAE (3 SPECIES)	
Japanese kelp	*Undaria pinnatifida*
Caulerpa seaweed	*Caulerpa taxifolia*
Sargassum seaweed	***Sargassum muticum***
INVERTEBRATES (22 SPECIES)	
Mollusks - Bivalves (9 sp):	
Clam, Asian	*Corbula amurensis*
Clam, Northern quahog	*Mercenaria mercenaria*
Clam, purple varnish/mahogany	***Nuttalia obscurata***
Clam, Japanese	*Neotrapezium liratum*
Mussel, Atlantic ribbed	*Geukensia demissa*
Mussel, New Zealand green	*Perna sp.*
Mussel, Japanese	Musculista *senhousia*
Mussel, gallo	***Mytilus galloprovincialis***
Gastropods (3 sp):	
Oyster drill, Atlantic/Eastern	***Urosalpinx cinerea***
Oyster drill, Japanese	***Ocinebrellus inornatus***
Asian mudsnail	***Batallaria attramentaria***
Crustaceans (4 sp.):	
Crab, European green	*Carcinus maenus*
Crab, mitten	*Eriocheir sinensis*
Crab, Japanese shore	*Hemigrapsus sanguineus*
Crab, Harris mud	*Rhithropanopeus harrisii*
Polychaeta (1 sp)	
Bamboo worm	***Clymenella torquata***
Tunicates (6 sp):	
Tunicate, club (solitary)	***Styela clava***
Tunicate (solitary)	***Ciona savignyi***
Tunicate (solitary)	***Molgula manhattensis***
Tunicate, chain (colonial)	***Botrylloides violaceus***
Tunicate, golden star (colonial)	***Botryllus schlosseri***
Tunicate (colonial)	***Didemnum vexillium.***

Bold	Species known to occur or are established in Puget Sound
Grey	Species with historic or tentative record in Puget Sound
Normal	Species to watch for - high risk - not yet recorded in Puget Sound

List extracted from Washington State Non-Native Aquatic Species Watchlist December 2008

English Cordgrass - *Spartina angelica*

DESCRIPTION	*English Cordgrass*, Atlantic native; most prevalent *Spartina* species in Puget Sound; abundant in north Puget Sound and Strait of Georgia. *S. angelica* grows in dense, circular clumps unlike native vegetation; no rhizomes; perennial; leaves have angular appearance. **Note:** All *Spartina spp*. have a hollow stem; straight hairs on ligule or joint where leaf attaches to stem.
SIZE	Tall - Plant H: 1.5 m. Blade W: 11-13 mm leaves nearly horizontal to stem (45-90 degrees).
COLOR	Leaves are bright green to grayish green; flower spikes on reddish stems; flowers colorless blooming in June-September.
HABITAT	Tidal marsh.
TIDAL HEIGHT	Occupies wide range within tidal marsh habitat form low to high elevations.
SALINITY	5-40 ppt.
TEMPERATURE	N / A
SIMILAR NATIVE SPECIES	Seashore saltgrass (*Disticlis spicata*), a common native which also has angular leaves, but only grows to 20 cm in height; stem solid.

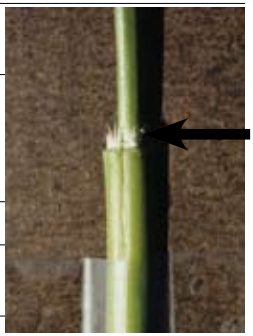
Keeley O'Connell

Keeley O'Connell

Keeley O'Connell

Smooth Cordgrass - *Spartina alterniflora*

DESCRIPTION	Atlantic native; present in Puget Sound. *S. alerniflora* grows in dense, circular clumps with erect stems; usually distinct from native vegetation. **Note:** All *Spartina spp.* have a hollow stem; straight hairs on ligule or joint where leaf attaches to stem.
SIZE	Tall grass up to 2 m. Blade L: 20-55 cm W: 2-25 cm.
COLOR	Leaves green-gray; base of shoots (leaf sheath around culmen) maroon or red; large flower spikes; colorless; blooms late in July-October.
HABITAT	Tidal marsh.
TIDAL HEIGHT	Ranges from mean high water to about 1 meter above mean low water.
SALINITY	10-20 ppt optimal; tolerant of higher 50-60 ppt.
TEMPERATURE	N / A
SIMILAR NATIVE SPECIES	1. Seashore saltgrass (*Disticlis spicata*) grows in dense patches but shorter and leaves are angular to stem; stem solid. 2. Seacoast bulrush (*Scripus maritimus*) native sedge with triangular stem.



U.S. Department of Agriculture

Fritzi Grevstad

USDA-NRCS PLANTS Database

Dense Flower Cordgrass - *Spartina densiflora*

DESCRIPTION	Present but uncommon in Puget Sound. *S. densiflora* grows in dense tufts or clumps, with erect form; no rhizomes. Usually distinct from native vegetation. **Note:** All *Spartina spp.* have a hollow stem; straight hairs on ligule or joint where leaf attaches to stem.
SIZE	Tall - Plant H: up to 1.5 m. Blade L: 12-43 cm; long narrow leaves with curled edges.
COLOR	Leaves are tough, grayish green; flowers colorless; blooming in April-July.
HABITAT	Sheltered bays and estuaries; commonly associated with *Z. marina* and the green alga, Ulva; colonizes historically unvegetated intertidal zones above *Z. marina* and significantly altered physical habitat structure; has established in many areas.
TIDAL HEIGHT	Among pickleweed (*Salicornia*) or just below it on open mud.
SALINITY	Tolerates brackish to moderate salinity.
TEMPERATURE	N / A
SIMILAR NATIVE SPECIES	American dunegrass (*Leymus mollis*): bluish color, height up to 1.5 m; leaf blades 6-15 mm, wider than *Spartina*.

Keeley O'Connell

Dave Heimer

Salt Meadow Cordgrass - *Spartina patens*

DESCRIPTION	Rare in Puget Sound; occurs in Strait of Georgia. Rhizomatous grass with fine, flexible stems growing in low clumps; **difficult to identify**; usually distinct from native vegetation. **Note:** All *Spartina spp.* have a hollow stem; straight hairs on ligule or joint where leaf attaches to stem.
SIZE	Plant H: up to 1.2 m (shorter than other Spartina); thin leaves rolled inward. Blade: L: 10-50 cm; W: 0.5-2 mm.
COLOR	Leaves are green; flowers small branching and delicate.
HABITAT	High salt marsh or backshore, infrequently inundated.
TIDAL HEIGHT	Middle to upper tidal marsh zones; favors higher elevations than other Spartina.
SALINITY	N / A
TEMPERATURE	N / A
SIMILAR NATIVE SPECIES	1. Seaside Arrow grass (*Triglochin maritimum*): plant 20-120 cm tall; fleshy leaves extend from rhizome base, grows in low to high intertidal areas. 2. Seashore saltgrass (*Disticlis spicata*): leaves alternate and angular; grows in dense patches; stems are solid.

Keeley O'Connell

Debbie Pickering

Japanese Eelgrass - *Zostera japonica*

DESCRIPTION	Japanese native, one of two eelgrasses; widespread in Puget Sound. Marine intertidal adapted vascular plant with fine leaf blades, shorter and thinner blade than native *Z. marina*.
SIZE	Leaves thin, flat, straight, limp; length to 30 cm and width 0.8-1.3 mm
COLOR	Olive green.
HABITAT	Sheltered bays and estuaries; commonly associated with *Z. marina* and the green alga, *Ulva*; colonizes historically unvegetated intertidal zones above *Z. marina* and significantly altered physical habitat structure; has established in many areas.
TIDAL HEIGHT	Upper intertidal above *Z. marina*; on sandy or muddy substrates at depths of up to 1-3 m.
SALINITY	Marine and estuarine waters.
TEMPERATURE	N / A
SIMILAR NATIVE SPECIES	*Zostera marina* - wider blade, usually deeper water.

Z. japonica, Mary Jo Adams

Z.japonica (top), Displayed Z.japonica left, *Zostera marina, right (bottom), Mary Jo Adams*

Japanese Kelp (wakame) - *Undaria pinnatifida*

DESCRIPTION	Japanese native introduced as popular Asian food. Status in Puget Sound not known, no records to date. Annual algae; broad blade with obvious midrib and fluted sporophylls (reproductive structure) on stem base above holdfast. Mature plant blade deeply divided; young plant blade undivided. Large flat fronds with leaf-like pinnea are easily recognized.
SIZE	Length 1-3 m.
COLOR	Golden-brown; midrib lighter in color.
HABITAT	Protected waters such as bays and harbors. Colonizes numerous substrates including: rock reefs, cobble, piles, docks, floats, buoys and boats; abundant at waterline on floating objects. May also be found in association with kelp, seagrass and other seaweeds. Spores may attach to any surface.
TIDAL HEIGHT	Low intertidal to 18 m depth. Most common between 1-3 m depth; subtidal.
SALINITY	Marine waters
TEMPERATURE	Optimal growth in 12° C or cooler.
SIMILAR NATIVE SPECIES	Winged kelp (*Alaria marginata*): similar appearance with midrib or stipe; linear blades not divided or pinnate; smaller wing-like blades at base only.

Clockwise: Rick Cooper, Kathy Ann Miller

Sargassum - *Sargassum muticum*

DESCRIPTION	Japanese native; brown algae established in Puget Sound. Distinct small spherical float bladders attached individually to stipe. Frequently drifts to shore.
SIZE	Grows to 2 m or more in length; forms floating mats.
COLOR	Yellowish brown or olive brown.
HABITAT	Protected rocky areas; observed on sea surface as floating mats.
TIDAL HEIGHT	Intertidal zone to subtidal.
SALINITY	7-34 ppt.
TEMPERATURE	10-13° C.
SIMILAR NATIVE SPECIES	Northern Bladder Chain (*Cystoseira geminate*): distinguished by chain of small flat floats forming a chain-like structure, rather than individual floats attached to the stem of *Sargassum*.

Mary Jo Adams

Mary Jo Adams

Caulerpa - *Caulerpa taxifolia*

DESCRIPTION	Northern Australian native; not yet found in Puget Sound; present on southern California coast. Toxic, spreads rapidly, may spread from fragments, forms dense mats; capable of growing up to one inch per day, may survive up to 10 days out of water. Leaves are distinct, bright-green, feather-like leaf fronds, flat and extending upward from main stem. Requires warm temperatures to grow, may not survive in Puget Sound.
SIZE	Fronds about 1 cm wide, up to 65 cm high, spaced 2 cm apart along root-like stem.
COLOR	Bright green.
HABITAT	May colonize on any surface including rock, sand, or mud; from shallow to deep ocean waters. Adaptable, occupies polluted and non-polluted waters.
TIDAL HEIGHT	Subtidal; shallow to deep - maximum depth 150 m.
SALINITY	Marine waters only - greater than 20 ppt.
TEMPERATURE	Optimum growth 20-30° C, lethal minimum at 7-14° C depending on strain.
SIMILAR NATIVE SPECIES	None.

G. Peters

A. Meinesz

Asian Clam or Amur River Clam
Corbula amurensis *(previously Potamocorbula amurensis)*

DESCRIPTION	Asian native; found in San Francisco Bay; not yet reported in Puget Sound; considered high risk. Occurs in dense aggregations with shells partly exposed near sediment surface in lower intertidal zone. Shell halves of unequal size create a distinct overbite, a feature unique to this species among Pacific clams.
SIZE	Small 2-3 cm; shell halves are unequal in size giving an appearance of an overbite.
COLOR	Shell are white, tan, yellow or stained from sediment; no distinct markings; no periostracum.
HABITAT	Bays and estuaries: most abundant near the surface on a variety of substrates: mixed mud-sand, mud, clay and sand.
TIDAL HEIGHT	Primarily subtidal - occasionally abundant on low-intertidal mudflats.
SALINITY	Found in brackish to high salinity waters 1-33 ppt. Reproduction requires 5-25 ppt. Tolerates polluted areas, sediment and water.
TEMPERATURE	Found from tropical to cold temperate waters 8 to 23° C.
SIMILAR NATIVE SPECIES	NONE: May be confused with juvenile clams of other species - examine closely, check for overbite, shell is not coated with periostracum.

(top) Andrew Cohen, (bottom) California Academy of Sciences *U.S. Geological Survey*

Northern Quahog Clam
Mercenaria mercenaria

DESCRIPTION	Native to Atlantic - eastern N. America. Intentionally introduced to Georgia Strait in British Columbia and established in Boundary Bay. Status in Puget Sound unkown. Hard, thick shell; off-set beak point with obvious concentric groov and striations; each valve has three conspicuous teeth; heart-shaped lunule.
SIZE	Up to 15 cm wide; long lived.
COLOR	Exterior: light brown to gray; varying concentric bands and ridges on the shell; light brown film or periostracum. Interior: mostly white with a violet border near valve.
HABITAT	Bays and estuaries. Burrows (shallow) into sand or mud sediment.
TIDAL HEIGHT	Lower shore from intertidal to 10-15 m subtidal. Prefers sandy environments.
SALINITY	20-35 ppt for optimal larval development; adults with wide tolerance range.
TEMPERATURE	Tolerant 9° to 31°C; 4°C causes hibernation; reproduction requires 23°C; growth 20° C.
SIMILAR NATIVE SPECIES	Butter clam (*Saxidomus gigantea*)

U.S. Geological Survey

All photos courtesy of www.jaxshells.org

Purple Varnish Clam - *Nuttallia obscurata*

DESCRIPTION	Native to Japan; introduced to Georgia Strait, British Columbia, in mid-1990s; now widespread in Puget Sound. Also known as dark mahogany clam. Shell is distinct and easy to identify with rich brownish covering that peels; interior violet-purple.
SIZE	Shell length from 4 to 6.5 cm.
COLOR	Shell exterior: thin, smooth brown periostracum, peels like old varnish when dry. Shell interior: purple or violet, color fading when dry or sun bleached.
HABITAT	Sand or mixed sand and gravel are optimal substrates. Also found in cobble to sandy mud; burrows to 30 cm deep.
TIDAL HEIGHT	Upper to middle third of intertidal; found in intertidal areas where summer temperatures can be quite high.
SALINITY	Marine; often associated with fresh water seeps.
TEMPERATURE	Broad thermal tolerance.
SIMILAR NATIVE SPECIES	None - could be confused with non-native Manila clam, *Venerupis phillippinarum*, which also has some purple on shell interior (right), but ...;no periostracum.

Mary Jo Adams

Mary Jo Adams (top), Ann Eissinger (bottom)

Japanese Clam - *Neotrapezium liratum*

DESCRIPTION	Native to Asian Pacific; introduced to the Salish Sea in early 1900s with Pacific oysters, *Crassostrea gigas*, and established in Boundary Bay, British Columbia Reported to be common at certain sites in Georgia Strait. Occurrence and distribution in Puget Sound not known. Watch for presence; unlikely to be invasive. Species information is scarce and will be updated.
SIZE	Shell length to 53 mm.
COLOR	Shells tan or white with brown periostracum and vague purple rays from umbone to shell margins. Shell shape tends to be variable due to nestling lifestyle.
HABITAT	Byssally attached to rocks and oyster shells.
TIDAL HEIGHT	Mid- to lower intertidal.
SALINITY	Found in estuaries with variable salinity depending on tide cycle.
TEMPERATURE	Fairly broad tolerances; appears to withstand freezing temperatures in Boundary Bay.
SIMILAR NATIVE SPECIES	None - unique shell shape and appearance.

Linda Schroeder PNWSC

REEVE

Atlantic Ribbed Mussel - *Geukensia demissa*

DESCRIPTION	Native to Atlantic Coast of North America; present on southern California shorelines. Status in Puget Sound not known. Shell, small, off-set beak point; distinctive fine ridges or radial ribbing on shell surface. May form clumps or dense aggregations, partly buried in mud or sand. Potentially confused with native California mussel, *Mytilus californianus*.
SIZE	Shell length 1-1.3 cm.
COLOR	Shell: exterior olive-brown, yellowish-brown, dark brown or black, usually covered with olive-brown periostracum; interior: purplish. Soft tissues are yellow.
HABITAT	Bays and estuaries: most often in saltmarsh, muddy substrates with posterior of shell protruding; anchors to plants, pebbles, shells, rocks or other firm objects.
TIDAL HEIGHT	Most abundant mid-intertidal to lower saltmarsh edge. Range from subtidal to upper intertidal; varies by region.
SALINITY	Wide tolerance from brackish to 70 ppt (twice as salty as open ocean).
TEMPERATURE	Wide tolerance: 13 to 22° C - survives up to 56° C.
SIMILAR NATIVE SPECIES	1. Pacific blue mussel *Mytilus trossulus*: does not have ribbing. 2. California mussel *Mytilus californianus*: usually found on surf-exposed rocky shore, much larger, with rounded ribbing and blue-gray shell interior. Forms large, dense beds attached to rocks.

Andrew N. Cohen

Andrew N. Cohen

New Zealand Green Mussel - *Perna sp.*

DESCRIPTION	Native to Indo-Pacific region of Asia; present in Puget Sound, recently reported in Edmonds (2008). Distinctly different from native mussels. Shell exteriors are smooth, glossy with green coloration, particularly along edges, including interior edge. Very fleshy, popular food shellfish due to large size.
SIZE	Shell length 8-10 cm - up to 15 cm.
COLOR	Young mussels: brilliant green. Adults: darker green to olive brown.
HABITAT	Estuarine and marine, rocks, hard substrates including man-made structures: boats, docks, pilings, floats.
TIDAL HEIGHT	Wide range: from low intertidal to subtidal zones >18 m depth.
SALINITY	Wide range: 18-33 ppt with extremes from 27-33 ppt high to 16 ppt low.
TEMPERATURE	Range between 11 to 32° C, with 26 to 32° C optimal; may survive short periods of extremes 10 to 35° C.
SIMILAR NATIVE SPECIES	None are green

www.floridaconservation.org

Ann Eissinger

Japanese Mussel - *Musculista senhousia*

(also commonly known as green mussel and Asian date mussel)

DESCRIPTION	Native to Asian Pacific coast; established in San Francisco Bay and Boundary Bay, British Columbia Historical records in Puget Sound, current status unknown. Unusual shell: small size, with unique striped pattern. Highly adaptive, forms dense mats on or near substrate surface.
SIZE	Shell 10-25 mm length to max 35 mm-12 mm width.
COLOR	Shell exterior: pale olive-green, yellow-green or greenish-brown with darker purple stripes radiating from center of growth out to shell margin; lustrous purplish-gray interior.
HABITAT	Hard and soft substrates; natural beach and man-made structures including macro algae, rocks, docks and pilings.
TIDAL HEIGHT	Intertidal and shallow subtidal zones to 20 m depth.
SALINITY	Ranges from 17-37 ppt.
TEMPERATURE	Ranges from 17 to 27° C.
SIMILAR NATIVE SPECIES	None have similar shell coloration or pattern.

Hiroshima University Fish Laboratory

Hiroshima University Fish Laboratory

Gallo Mussel - *Mytilus galloprovincialis*

DESCRIPTION	Mediterranean native; introduced to Puget Sound for aquaculture. Naturalized throughout Salish Sea and hybridizes with *Mytilus spp*.
SIZE	Large mussel usually 5-7 cm - up to 15 cm.
COLOR	Dark blue or brown to almost black.
HABITAT	Byssally attached to hard surfaces. Common on rocky shoreline with high wave energy and water flow; also found in protected bays, in both marine and estuarine habitats. Will utilize artificial surfaces such as pilings and docks.
TIDAL HEIGHT	Low intertidal to subtidal
SALINITY	Marine waters.
TEMPERATURE	Mean annual water temp. 13 to 14° C. Tolerates higher range (16 to 25° C) than native *Mytilus*.
SIMILAR NATIVE SPECIES	Identical to and indistinguishable from Pacific blue mussel *Mytilus trossulus* due to hybridization

Ann Eissinger

Atlantic/Eastern Oyster Drill
Urosalpinx cinerea

DESCRIPTION	Native to northwestern Atlantic; introduced with oyster culture in early 1900s. Multiple historical records from 1930-40s in Georgia Strait and Puget Sound from Tacoma north to Boundary Bay. Current status in Puget Sound not known. Identifiable by 5 whorls with 9-12 vertical rounded ribs per whorl. Aperture oval with open canal at base.
SIZE	Shell length 30-35 mm length; females larger than males.
COLOR	Shell varied - yellow with brown streaks, occasionally orange; will bleach on beach. Interior is purple, reddish brown or yellow; operculum is orange or yellow-brown.
HABITAT	Marine bays and estuaries. Common on rocks and oyster reefs. Feeds on barnacles, oysters, mussels, and sometimes snails. Likely associated with oyster beds.
TIDAL HEIGHT	Intertidal to shallow subtidal to a maximum, depth of 15 m.
SALINITY	Marine and estuarine tolerates salinities as low as 13-15 ppt.
TEMPERATURE	20° C optimal for development, 25° C optimal for feeding.
SIMILAR NATIVE SPECIES	Frilled welk or Dogwinkle, *Nucella lamellosa*, which typically presents stronger spiral ridges (one or two dominant per whorl) and less axial structure, which is sometimes obscured with frilled lamella as the axial sculpture. Eggs are tear-shaped and slightly larger, with no edges or angles. Also similar to Leafy hornmouth, *Ceratostoma foliatum*, of rocky shores, but smaller and less conspicuously ornamented.

www.jaxshells.org

Japanese Oyster Drill

Ocinebrellus inornatus *(previously Ceratostoma inornatum)*

DESCRIPTION	Native to Asia; present in Georgia Strait and Puget Sound. Associated with historic Pacific oyster (*Crassostrea gigas*) introduction and aquaculture areas. Voracious predator of young oysters (all species), leaving a tell-tale, 1/16-inch drill hole; also preys on small benthic bivalves (mussels and hardshell clams) and barnacles. Shell is solid-looking. Whorls about 5 or 6, each with about 8 low transverse ribs that come to characteristic points at the top edge of the body whorl, less so for whorls on the spire. Faint spiral ridges, some more like raised threads. Aperture oval with thick outer lip; canal rather short and open in the early stages of growth, usually closed later.
SIZE	Length to 5 cm; juveniles typically cryptic (less than 25 mm).
COLOR	Exterior ranges from white to yellow and brown; inside of aperture brown or yellow; operculum light brown; no periostracum on shell exterior.
HABITAT	Estuarine and marine habitats: associated with historic Pacific oyster beds - gravel, mud, sand and shell substrates.
TIDAL HEIGHT	Intertidal + 7 ft to -2 MLLW.
SALINITY	N / A
TEMPERATURE	N / A
NOTE	Mature adults aggregate in spring to lay egg masses on emergent surfaces of any hard, barnacle-encrusted substrate. Egg masses are distinguished from the native welk, *N. lamellosa*, by their edges.
SIMILAR NATIVE SPECIES	Frilled welk or Dogwinkle, *Nucella lamellosa* (see Atlantic oyster drill).

Ruesink Laboratory

Ann Eissinger

Ann Eissinger

Asian mudsnail - *Batillaria attramentaria*

(previously B. zonalis)

DESCRIPTION	Asian Pacific native found in Puget Sound. Small shell elongated, tapered with 8-9 whorls. Displaces native snail and abundantly populates invaded areas, particularly shallow bays and mudflats.
SIZE	Shell length 1.5 cm in first year; up to 3.5 cm in 8-10 years.
COLOR	Shell is gray with brown, bead-like finish, narrow, light-colored band swirl upward from aperture to tip.
HABITAT	Marine and estuarine habitats, including riparian areas. Mudflats and salt marshes, including associated channels and ponds.
TIDAL HEIGHT	High to mid-intertidal zones.
SALINITY	Wide salinity tolerance from brackish to marine waters.
TEMPERATURE	Broad temperature and exposure tolerance.

Mary Jo Adams

European Green/Shore Crab
Carcinus maenas

DESCRIPTION	European native; has invaded North American Atlantic and Pacific coasts to northern Vancouver Island British Columbia Not yet detected in Georgia Strait or Puget Sound, but poses high risk for invasion and rapid spread. Hairless shorecrab with 5 distinct points on leading edge of carapace, radiating between eye and forearm on both sides; hind legs (last pair) flat; not always green.
SIZE	Small first-year, 3-6 cm carapace width; adult up to 10 cm or 3.5 inches; males are larger in same age class - measure carapace at widest point.
COLOR	Carapace dorsum (back) mottled dark green with yellowish spotting (variable); ventrum (underbody) lighter greenish, yellow to red, or orange.
HABITAT	Protected shorelines, shallow bays, mudflats, lagoons, estuaries or near fresh water seeps and outfalls; associated with Spartina, eelgrass and oyster beds; may seek cover of shell bags, rocks or large debris. Burrows by backing part way into mud or sediment. Young settle in saltmarsh margins.
TIDAL HEIGHT	From high intertidal saltmarsh to subtidal, moves seasonally. Shallow subtidal to intertidal in summer - deeper water (subtidal) in winter; young recruits found in higher zones in/near saltmarsh.
SALINITY	Tolerates wide salinity range 4-54 ppt; optimal 15-34 ppt.
TEMPERATURE	Tolerates wide temperature range but requires >10° C to grow/molt; moves seasonally with temperature fluctuations.
SIMILAR NATIVE SPECIES	Most often confused with Helmet crab, *Telmessus cheiragonus*; also native shore crabs, young Dungeness and others - see comparative ID sheet for green crab.

Ann Eissinger

Brent Dumbauld

Chinese Mitten Crab - *Eriocheir sinensis*

DESCRIPTION	Native to China; has invaded San Francisco Bay watershed and is expanding its range. Not yet in Puget Sound or Georgia Strait, but considered high risk. Display distinct, hairy, mitt-like appendages; claws equal in size with white tips and hair. Four spines on carapace either side of eye stalk; u-shaped intend between eyes; has leg hair. Catadromous species, reproducing in estuaries, then migrating up streams and rivers, sometimes great distances.
SIZE	Carapace width 2 - 4.5 cm - maximum 8.0 cm.
COLOR	Light brown to olive green in color with distinct, dark, hairy "mitts."
HABITAT	Spend 2-5 years upstream in fresh water. Migrate downriver to reproduce in estuaries. Will burrow in banks and levees along estuaries and streams/rivers.
TIDAL HEIGHT	Riverine and estuarine associated but may drift into neighboring marine shorelines with outflow, or travel far upstream along streams and rivers.
SALINITY	In fresh and salt water - reproduces in saltwater, offspring migrate to fresh water – Zoea (larvae) require 10-22 ppt.
TEMPERATURE	Zoea (larvae) require >11.7° C.
SIMILAR NATIVE SPECIES	None with "mitts" or tolerant of fresh water. Similar to non-native Japanese mitten crab, *Eriocheir japonica* also of concern.

Photos courtesy of U.S. Fish and Wildlife Service

Japanese Shore Crab
Hemigrapsus sanguineus *(also known as Asian shore crab)*

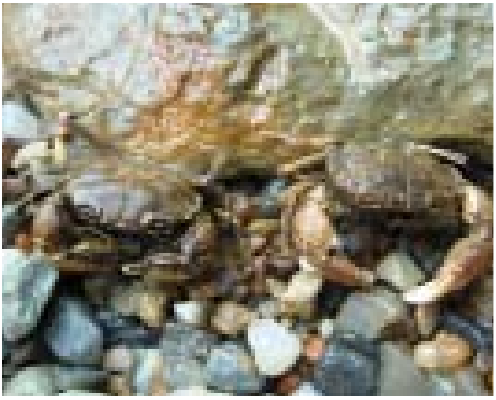
DESCRIPTION	Native to coastal western Pacific (Japan-Russia); not yet on North American West Coast or Puget Sound, but has invaded U.S. East Coast. Small shore crab with distinctly striped legs and spotted claws; hairless body/legs; carapace has 3 points on each side of eye along leading edge. Males have distinctive fleshy, bulb-like structure at the base of the moveable finger on the claws. Easily confused with native *H. nudus* or *H. oregonesis* - requires close examination.
SIZE	Carapace width 3.5-4.2 cm.
COLOR	Pink to green, brown or purple, with distinct dark bands on all legs; red spots on claws; no hair on body.
HABITAT	Aggregate under rocks. Can also live on artificial structures and on mussel beds and oyster reefs.
TIDAL HEIGHT	Versatile species ranging from upper intertidal to subtidal, rocky areas, shallow hard bottom.
SALINITY	Tolerates wide range of salinities.
TEMPERATURE	Tolerates wide range of temperatures.
SIMILAR NATIVE SPECIES	1. *Hemigrapsus nudus* 2. *Hemigrapsus oregonensis*

Native species. #1 Hemigrapsus nudus (top) #2 Hemigrapsus oregonensis (bottom) Ann Eissinger

Jerry Prezioso

Harris Mud Crab - *Rhithropanopeus harrisii*

DESCRIPTION	Native to Atlantic Coast of North America; introduced and established in coastal California and Oregon. Not yet found in Washington or Puget Sound. Small crab - well defined asymmetrical claws with white tips; 4 irregular spines on leading edge of carapace on either side of eye, plus a notch between the eyes; legs with sparse hair.
SIZE	Carapace width up to 2.0 cm.
COLOR	Brown to olive green.
HABITAT	Found in brackish estuaries and fresh water; shallow water with mud or sand substrates. Adults may migrate upstream.
TIDAL HEIGHT	Information pending.
SALINITY	Broad tolerance - brackish to fresh water measured at extremes of 0.5 to 15 ppt.; generally requires > 2.5 ppt. for reproduction.
TEMPERATURE	Adult broad tolerance; optimal larval development ~23°C.
SIMILAR NATIVE SPECIES	None - no native crabs utilize fresh water. May be confused with native *Hemigrapsus nudus* and *Hemigrapsus oregonensis*.



Photos courtesy of Donald E. Keith

Bamboo Worm - *Clymenella Torquata*

DESCRIPTION	Native to Asian Pacific. Introduced by aquaculture and established in certain locations in northern Puget Sound. Subsurface marine worm concentrates in high densities, creating soft pockets in sediment and mounding of sediment. When stepping on infested area, feet sink to about ankle height. Infected sediment feels lumpy to touch and is filled with worms and tubes.
SIZE	Body length 10 cm with tubes up to 20 cm; usually not visible.
COLOR	Light color - difficult to see; tubes are made of consolidated sediment.
HABITAT	Shallow, low-gradient enbayments, associated with eelgrass (*Z. marina*) and fine silt or sand substrate; may be associated with clam and oyster beds.
TIDAL HEIGHT	Low intertidal to shallow sub-tidal.
SALINITY	Optimum 25-35 ppt; low tolerance 15 ppt or less.
TEMPERATURE	Spawns at 12 to 14° C, tolerant of higher temperatures.
SIMILAR NATIVE SPECIES	Native bamboo worm occurs in low densities and is difficult to detect.

Washington Department of Fish & Wildlife

Tunicate (sea grapes) - *Molgula manhattensis*

DESCRIPTION	Native to Atlantic coast of N. America. Was introduced to West Coast and is established from California to Washington. First reported in Puget Sound in 1998; locally abundant in certain areas (Shelton and Des Moines), also in north sound, (Anacortes). Body globular or spherical, stemless with distinct siphons. Even when contracted, the siphons are easy to see. Solitary, may occur in dense clusters, fibrils adhere to hard or course surfaces.
SIZE	Body 10 to 30 mm diameter; can occur in dense clusters or aggregations.
COLOR	Gray or greenish-blue; tunic usually muddy.
HABITAT	Attached to hard substates: bedrock, boulders, stones, shells, piles or loosely attached on sandy sediments. Found in ports and harbors; tolerates polluted conditions.
TIDAL HEIGHT	Generally subtidal to 90 m depth; may be exposed on extreme low tides.
SALINITY	Marine waters - one of few tunicates that tolerates brackish conditions.
TEMPERATURE	Tolerates broad temperature range.
SIMILAR NATIVE SPECIES	*Chelysoma productum* is more barrel-shaped with a distinctly flat top. The siphons are simple holes in the surface of a flat plate - there is no tube-shaped siphon, different enough from *Molgula* to tell apart.

Mary Jo Adams

Andrew Cohen

Club Tunicate (solitary) - *Styela clava*

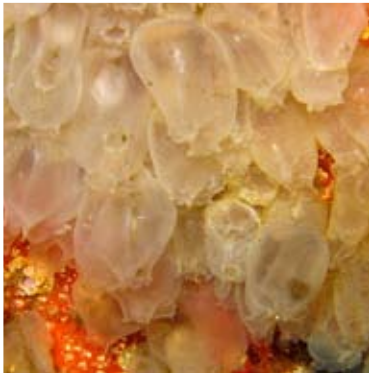
DESCRIPTION	Native to Japan and Korea; reported in Puget Sound in 1998, now spread from south Puget Sound, Hood Canal to Georgia Strait. Solitary tunicate; club shape with cylindrical body tapering to narrow stalk at base; often found with other fouling organisms.
SIZE	Body 8-12 cm long - up to 20 cm max. Stalk 1/3 of total length.
COLOR	Brown to yellowish, leathery, often wrinkled with stout stalks at base; two siphons with light-dark streaking.
HABITAT	Attached to bedrock, boulders, stones, shells, pilings, docks, boat hulls or other hard surfaces, but predominately artificial substrates. Found in protected waters including harbors and marinas.
TIDAL HEIGHT	Low intertidal to shallow subtidal.
SALINITY	Tolerant of wide range above 21 ppt, generally 22-23 ppt; may be found in estuaries.
TEMPERATURE	11 to 27° C.
SIMILAR NATIVE SPECIES	1. *Styela montereyensis*: longer, up to 30 cm – slender stock, siphons closely spaced, one is curved, no banding. 2. *Styela gibsii* - short < 4cm - stalkless.

Simon Geerlofs

(clockwise) Native Styela gibbsii, Invasive Styela: Janna Nichols, Lucie Hannah

Tunicate (solitary) - *Ciona savignyi*

DESCRIPTION	Native to Japan; reported in Puget Sound in 1998; also in Hood Canal and San Juan Islands. Solitary tunicate with long, clear, tubular body; tunic is thin, gelatinous and easily damaged; uneven siphons with scalloped edges. May form dense aggregations and found with other fouling organisms.
SIZE	Body length 6-8 cm - up to 15 cm.
COLOR	Body is translucent with yellow dots or stripes. Siphon-scalloped edge is yellow.
HABITAT	Found primarily on shaded undersides of docks and floats, also on submerged lines and stationary objects.
TIDAL HEIGHT	Subtidal only to 60 m.
SALINITY	Tolerant of wide range above 21 ppt, generally 22-36 ppt; may be found in estuaries.
TEMPERATURE	11 to 27°C.
SIMILAR NATIVE SPECIES	*Native Corella sp.*, a clear solitary tunicate with shorter and stubbier body, much shorter siphons and no flecks of yellow or orange.

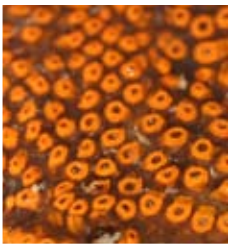


California Science (top) Georgia Arrow (bottom)

Corella / Rich Zade

Tunicate (colonial) - *Botrylloides violaceus*

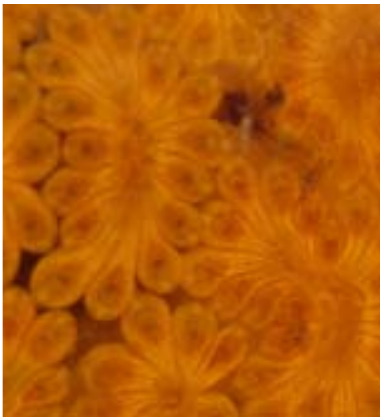
DESCRIPTION	Native to Japan; found in Puget Sound in 1977; currently widespread. Colonies form irregularly shaped, thin, rubbery mats made up of systems of zooids in chain, row or other patterns; colonies adhere to solid substrates.
SIZE	Colonies range in size up to 0.3 m diameter.
COLOR	Solid color - varies from orange, red, yellow, purple or tan, occasionally brown or lavender.
HABITAT	Grows in protected waters on a variety of surfaces: docks, boat hulls, buoys, ropes, pilings, underside of rocks, eelgrass blades and seaweeds. Overgrows mussels, barnacles, encrusting bryozoans and solitary sea squirts. Tolerates polluted water.
TIDAL HEIGHT	Shallow subtidal < 50 m.
SALINITY	26-34 ppt.
TEMPERATURE	8 to 25° C.



James T. Carton (top left), Gretchen Lambert (top, middle), Luis A. Solorzano (top right, and bottom two)

Tunicate, golden star - *Botryllus schlosseri*

DESCRIPTION	Native to Mediterranean; found in Puget Sound in 1970; primarily in central Sound and Hood Canal. Colonial tunicate: colonies organized into star- or flower-shaped patterns, beginning as soft, flat patches, maturing to loose, blob-like rolls and lobes.
SIZE	Forms flat, irregular sheets 3-4 mm thick and up to 10 cm across.
COLOR	Orange, yellow, red, white, gray-green, purple, dark gray or black, or combinations of these colors. All zooids in a colony are the same color.
HABITAT	Docks, boat hulls, buoys, ropes, pilings, the underside of rocks, on mussels, solitary sea squirts, seaweeds and eelgrass.
TIDAL HEIGHT	Subtidal to 200 m.
SALINITY	3-44+ ppt; found in marine and estuarine habitats.
TEMPERATURE	Die below 3° C, need at least 11° C to reproduce.



Styela clava covered in botryllus. Simon Geerlofs, University of Washington

Tunicate (colonial) - *Didemnum vexillum*

DESCRIPTION	Probably native to Japan; first detected in south Puget Sound in 2000. Currently found in Puget Sound, Hood Canal and Georgia Strait. Colonial tunicate and aggressive invader. Forms dense, mat-like growth with tiny white dots and darker channels visible below a transparent, gelatinous surface. Slimy to touch, may have drippy appearance.
SIZE	Flat mats or sheets, forming irregular lobes as much as 1 m in length. Extensively lobed or rope-like form.
COLOR	Tan, cream, yellow, orange, pinkish, with dark lines separating colonies of zooids.
HABITAT	Bays and harbors on natural and artificial surfaces including docks, boat hulls, ropes, piling and other surfaces. Also grows on seafloor of rocks, gravel, boulders. Not reported on mud or sand. Dense growth smothers other organisms including seaweeds, sponges, shellfish, and native sea squirts.
TIDAL HEIGHT	Intertidal to shallow subtidal to less than 6 m.
SALINITY	Collected at salinities above 26 ppt in San Francisco Bay; not known in Puget Sound.
TEMPERATURE	Ranges from -2 ° C to 24 ° C. Growth slows in winter and may die back in colder temperatures.
SIMILAR NATIVE SPECIES	Native sponges.

USGS (top), Native Species, Ann Eissinger (bottom) *Janna Nichols*

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ACKNOWLEDGEMENTS

This identification guide was compiled by Ann Eissinger, Nahkeeta Northwest for the Puget Sound Marine Invasive Species Volunteer Monitoring Program. Funding for this program is provided by Washington Department of Fish and Wildlife - Aquatic Nuisance Species Program. Printed with funding from Puget Sound Partnership.

A special acknowledgement is extended to: Sharon Riggs, Padilla Bay National Estuarine Research Reserve; Paul Dinnel, Western Washington University; Brian Allen, Puget Sound Restoration Fund; Graham Gillespie, Fisheries and Oceans Canada; and Paul Sund, Skagit Marine Resource Committee for their time and contribution. Graphic Design by Rae A. McNally, Puget Sound Partnership.

Photographs were kindly contributed by: Mary Jo Adams, WSU Beach Watchers; Sharon Riggs, Padilla Bay NERR; Brian Bingham, Western Washington University, Shannon Point Marine Center; Keeley O'Connel, People for Puget Sound; Jana Nichols, PNW Scuba/REEF; Andrew Cohen, San Francisco Estuary Institute; Jaxshells.org; Kathy Ann Miller, University of California - Berkeley; Jennifer Ruesink, University of Washington; Donald Keith, Tarleton State University; Ann Eissinger, Nahkeeta Northwest Wildlife Services.

May 2009 (revised)

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