

Preliminary List of Exotic and Cryptogenic Species in Puget Sound

From **An Exotic Species Detection Program for Puget Sound** Andrew N. Cohen, San Francisco Estuary Institute, May 2004 prepared for the Puget Sound Action Team with funding from the National Estuary Program, U.S. Environmental Protection Agency

The information in these tables on native regions, transport mechanisms and collections is based on Carlton 1979, Cohen & Carlton 1995, Cohen *et al.* 1998 and Mills *et al.* 2000 unless otherwise noted.

Table B1. Exotic Organisms Established in Puget Sound	
Organism	Records
Phaeophyceae	
<i>Sargassum muticum</i> (Yendo, 1907) Fensholt, 1955	Native to Japan and introduced with oyster aquaculture. First recorded on Pacific Coast in 1944 and in Puget Sound in 1948; present throughout Puget Sound by the early 1960s (Scagel 1956; Thom & Hallum 1991).
Anthophyta	
<i>Cotula coronopifolia</i> Linnaeus, 1753	Native to South Africa and probably introduced in solid ballast. First recorded on the Pacific Coast at San Francisco in 1878 and now spread from southern California to British Columbia, including Puget Sound. Often occurs as an ephemeral colonizer in newly restored salt marshes (Frenkel 1991).
<i>Spartina alterniflora</i> Loiseleur-Deslongchamps	Native to the northwestern Atlantic and first reported on the Pacific Coast in Puget Sound, where it was planted in the 1930s for duck habitat. It probably arrived earlier in Willapa Bay, where it may have been introduced in solid ballast, as seeds accidentally transported with oysters imported for culturing, or possibly as packing material for ship-transported goods.
<i>Spartina anglica</i> C.E. Hubbard, 1968	A new species derived from accidental hybridization in southern England and northern France in the 1800s, Introduced to Puget Sound in Susan Bay for shoreline stabilization and cattle forage in 1961 (Frenkel 1987).
<i>Spartina patens</i> (Aiton)	Native to the northwestern Atlantic. Probably introduced as packing material for ship-transported goods, or possibly in solid ballast or as seeds accidentally transported with oysters imported for culturing.
<i>Zostera japonica</i> Ascherson and Graebner, 1907	Native to the western Pacific and introduced with oyster aquaculture. First recorded on the Pacific Coast in 1957 and in Puget Sound in 1974 (Harrison & Bigley 1982).
Foraminifera	
<i>Trochammina hadai</i> Uchio 1962	Native to Japan, and probably introduced either in ballast water, in hull fouling or with oyster aquaculture. First recorded on the Pacific Coast in Puget Sound in 1971 (McGann <i>et al.</i> 2000).
Cnidaria: Hydrozoa	
<i>Cladonema radiatum</i> Dujardin, 1843	Native to the Northwestern Atlantic. First collected on the Pacific Coast in Puget Sound in 1988 (Mills 1998).
<i>Cordylophora caspia</i> (Pallas, 1771)	Native to the Black and Caspian Seas. Either an early introduction with ballast water or possibly introduced in hull fouling. First recorded on the Pacific Coast in Puget

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	Sound around 1920. Reported in some literature as <i>Cordylophora lacustris</i> .
Cnidaria: Anthozoa	
<i>Diadumene lineata</i> (Verrill, 1869)	Native to Asia. First recorded on the Pacific Coast in San Francisco Bay in 1906, and in Puget Sound in 1939. Either introduced in hull fouling from Asia, or with shipments of oysters from the Atlantic, where it had been introduced (probably in hull fouling) in the late 1880s. Reported in some earlier literature as <i>Haliplanella luciae</i> .
Platyhelminthes	
<i>Pseudostylochus ostreophagus</i> Hyman, 1955	An oyster pest native to Japan and introduced in oyster aquaculture. First recorded on the Pacific Coast in Puget Sound in 1953.
Annelida: Polychaeta	
<i>Hobsonia florida</i> (Hartman, 1951)	Native to the northwestern Atlantic, and first recorded on the Pacific Coast in Puget Sound in 1940.
<i>Neanthes succinea</i> (Frey and Leuckart, 1847)	Native to the Atlantic and introduced by oyster aquaculture to San Francisco Bay by 1896. First recorded in Puget Sound around 1995.
<i>Pseudopolydora kemp</i> (Southern, 1921)	Native to Japan and probably introduced with oyster aquaculture, or possibly in hull fouling or ballast water. First recorded on the Pacific Coast at Nanaimo on the east coast of Vancouver Island in 1951, and in Puget Sound on San Juan Island in 1968. Has generally been listed as exotic on the Pacific Coast (Carlton 1979; Cohen & Carlton 1995; T N & Associates 2002); but was reported as cryptogenic in the Columbia River (Draheim <i>et al.</i> 2003).
<i>Pseudopolydora paucibranchiata</i> (Okuda, 1937)	Native to Japan and introduced with oysters, in hull fouling or in ballast water. First recorded on the Pacific Coast in southern California in 1950, and in Puget Sound in 1993.
Mollusca: Gastropoda	
<i>Batillaria attramentaria</i> (Sowerby, 1855)	A Japanese oyster pest introduced with oyster aquaculture. First recorded on the Pacific Coast in Puget Sound in 1924, or possibly 1918-19. Reported in some Pacific Coast literature as <i>B. zonalis</i> or <i>B. cumingi</i> .
<i>Crepidula fornicata</i> Linnaeus, 1758	An oyster pest native to the northwestern Atlantic and introduced with oyster aquaculture. First recorded on the Pacific Coast in Puget Sound in 1905.
<i>Crepidula plana</i> Say, 1822	Native to the northwestern Atlantic and introduced with oyster aquaculture. First recorded on the Pacific Coast in San Francisco Bay in 1901, and in Puget Sound in 1949.
<i>Myosotella myosotis</i> (Draparnaud, 1801)	Occurs on both coasts of the North Atlantic, but may be native only to Europe. First reported on the Pacific Coast in San Francisco Bay in 1871, where it was probably introduced with oyster aquaculture, although possibly carried in solid ballast or hull fouling. The first record in Puget Sound is from 1936, or possibly a 1927 specimen labeled "Juan de Fuca." It has since been reported from many locations in the Sound.
<i>Nassarius fraterculus</i> (Dunker, 1860)	Native to Japan and introduced with oyster aquaculture. First collected on the Pacific Coast in Puget Sound, in Padilla Bay in 1960 and Samish Bay in 1963 (Carlton 1979: 412).
<i>Ocenebrellus inornatus</i> (Recluz, 1851)	An oyster pest native to Japan and introduced with oyster aquaculture. First recorded on the Pacific Coast in Puget Sound in 1924. Reported in some literature as

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<i>Urosalpinx cinerea</i> (Say, 1822)	<i>Ocenebra japonica</i> or <i>Ceratostoma inornatum</i> . An oyster pest native to the northwestern Atlantic and introduced with oyster aquaculture. First recorded on the Pacific Coast in San Francisco Bay in 1890-91 and in Puget Sound in 1929.
Mollusca: Bivalvia	
<i>Crassostrea gigas</i> (Thunberg, 1793)	Native to Japan and introduced for aquaculture. First planted on the Pacific Coast in Puget Sound in 1875. It is cultured extensively in South Puget Sound and reproduces successfully in Dabob Bay (Emmett <i>et al.</i> 1991).
<i>Musculista senhousia</i> (Benson, 1842)	Native to Asia and introduced with oyster aquaculture. First recorded on the Pacific Coast in Samish Bay on planted Japanese oysters, and found in the wild in central California in 1941 and in Puget Sound at Olympia in 1959. Reported in some literature as <i>Musculus senhousia</i> .
<i>Mya arenaria</i> Linnaeus, 1758	Native to the northwestern Atlantic and introduced with oyster aquaculture. First recorded on the Pacific Coast in 1874, and in Puget Sound in 1888-89, where it is widely established (Emmett <i>et al.</i> 1991).
<i>Nuttallia obscurata</i> (Reeve, 1857)	Native to the northwestern Pacific and probably introduced in ballast water. First recorded on the Pacific Coast in 1991 and in Puget Sound in 1993 (Forsyth 1993).
<i>Venerupis philippinarum</i> (Adams & Reeve, 1850)	Native to the northwestern Pacific, accidentally introduced with oyster aquaculture. First recorded on the Pacific Coast in Puget Sound in 1924, where it is both widely cultivated and established in the wild (Emmett <i>et al.</i> 1991). Reported in some earlier literature as <i>Ruditapes philippinarum</i> , <i>Tapes japonica</i> or <i>Venerupis japonica</i> .
Arthropoda: Crustacea: Copepoda	
<i>Mytilicola orientalis</i> Mori, 1935	Native to Asia and introduced in oyster aquaculture. First recorded on the Pacific Coast in Willapa Bay in 1938, and in Puget Sound in 1943.
Arthropoda: Crustacea: Cumacea	
<i>Nippoleucon hinumensis</i> (Gamo, 1967)	Native to Japan and introduced in ballast water. First recorded on the Pacific Coast in 1979, and in Puget Sound in the mid-1990s. Reported in some earlier literature as <i>Hemileucon hinumensis</i> .
Arthropoda: Crustacea: Tanaidacea	
? <i>Sinelobus stanfordi</i> (Richardson, 1905)	Origin unknown. Possibly introduced in ship fouling or ballast water. First recorded on the Pacific Coast in 1943, and in Puget Sound since the mid-1990s.
Arthropoda: Crustacea: Isopoda	
<i>Caecidotea racovitzae</i> (Williams, 1970)	Native to the northwestern Atlantic and possibly introduced in ballast water or with aquarium or ornamentals pond plants. Primarily occurs in fresh water, but has been collected in brackish water including the Snohomish River Estuary in 1997 (Toft <i>et al.</i> 2002).
<i>Limnoria tripunctata</i> Menzies, 1951	Origin unknown. Introduced in hull fouling. First recorded on the Pacific Coast in California in the 1870s and in Puget Sound in 1962.
Arthropoda: Crustacea: Amphipoda	

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<i>Ampithoe valida</i> Smith, 1873	Native to the northwestern Atlantic, and introduced by ballast water, oyster aquaculture or hull fouling. First recorded on the Pacific Coast in 1941, and in Puget Sound in 1966.
<i>Caprella mutica</i> Schurin, 1935	Native to the Sea of Japan and introduced by ballast water or oyster aquaculture. First recorded on the Pacific Coast in 1973-77, and in Puget Sound in 1998. Reported in some literature as <i>Caprella acanthogaster</i> .
<i>Eochelidium</i> sp.	Probably native to Japan or Korea, and introduced in ballast water. First recorded on the Pacific Coast around 1993, and in Puget Sound in 1997.
<i>Grandidierella japonica</i> Stephensen, 1938	Native to Japan, and introduced by ballast water, oyster aquaculture or hull fouling. First recorded on the Pacific Coast in 1966, and in Puget Sound in 1977.
<i>Jassa marmorata</i> Holmes, 1903	Native to the northwestern Atlantic and introduced in ballast water or hull fouling. First recorded on the Pacific Coast in 1938, and in Puget Sound around 1995.
<i>Melita nitida</i> Smith, 1873	Native to the northwestern Atlantic, and introduced by ballast water, oyster aquaculture, solid ballast or hull fouling. First recorded on the Pacific Coast in 1938.
<i>Monocorophium acherusicum</i> Costa, 1857	Native to the northern Atlantic, and introduced by oyster aquaculture or hull fouling. First recorded on the Pacific Coast in 1905, and in Puget Sound in 1974-75. Reported in the literature as <i>Corophium acherusicum</i> until recently.
<i>Monocorophium insidiosum</i> Crawford, 1937	Native to the northern Atlantic, and introduced by oyster aquaculture or hull fouling. First recorded on the Pacific Coast in 1915 and in Puget Sound in 1949. Reported in the literature as <i>Corophium insidiosum</i> until recently.
<i>Parapleustes derzhavini</i> (Gurjanova, 1938)	Native to the western Pacific and introduced in hull fouling. First recorded on the Pacific Coast in 1904, and in Puget Sound in 1998.
Kamptozoa	
<i>Barentsia benedeni</i> (Foettinger, 1887)	Native to Europe, and introduced by oyster aquaculture or hull fouling. First recorded on the Pacific Coast in 1929, and in Puget Sound in 1998.
Bryozoa	
<i>Bowerbankia gracilis</i> Leidy, 1855	Probably native to the western Atlantic, and introduced by oyster aquaculture or hull fouling. First recorded on the Pacific Coast by 1923, and in Puget Sound by 1953.
<i>Bugula</i> sp. A	First recorded on the Pacific Coast in Puget Sound in 1993.
<i>Bugula</i> sp. B	First recorded on the Pacific Coast in Puget Sound in 1998.
<i>Bugula stolonifera</i> Ryland, 1960	Native to the northwestern Atlantic and introduced in hull fouling. First recorded on the Pacific Coast by 1978, and in Puget Sound in 1998.
<i>Cryptosula pallasiana</i> (Moll, 1803)	Native to the northern Atlantic, and introduced with oyster aquaculture or in hull fouling. First recorded on the Pacific Coast in 1943-44 and, in Puget Sound in 1998.
<i>Schizoporella unicornis</i> (Johnston, 1847)	Native to the northwestern Pacific, and introduced by oyster aquaculture or hull fouling. First recorded on the Pacific Coast in Puget Sound in 1927.
Urochordata: Tunicata	
<i>Botrylloides violaceus</i> Oka, 1927	Native to Japan, and introduced by oyster aquaculture or hull fouling. First recorded on the Pacific Coast in 1973, and in Puget Sound in 1977.
<i>Botryllus schlosseri</i> (Pallas,	Native to the northeastern Atlantic, and introduced by oyster aquaculture or hull

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Organism	Records
1766)	fouling. First recorded on the Pacific Coast in 1944-47, and in Puget Sound in the 1970s.
<i>Ciona savignyi</i> Herdman, 1882	Native to Japan, and introduced in ballast water or hull fouling. First recorded on the Pacific Coast in 1985, and in Puget Sound in 1998.
<i>Molgula manhattensis</i> (DeKay, 1843)	Native to the northwestern Atlantic, and introduced by ballast water, oyster aquaculture or hull fouling. First recorded on the Pacific Coast in 1949, and in Puget Sound in 1998.
<i>Styela clava</i> Herdman, 1881	Native to the region from China to the Sea of Okhotsk, and introduced by ballast water, oyster aquaculture or hull fouling. First recorded on the Pacific Coast in 1932-33, and in Puget Sound in 1998.
Chordata: Pisces	
<i>Alosa sapidissima</i> (Wilson, 1811)	Native to the northwestern Atlantic, and intentionally introduced to the San Francisco Bay watershed in 1871. Collected in the Columbia River in 1876 (Smith 1896), and fry were stocked there in 1906 (Draheim 2002: 11). Adults and juveniles are common in Skagit Bay, and rare in other parts of Puget Sound (Emmett <i>et al.</i> 1991).

Table B2. Exotic Organisms Reported but not Known to be Established in Puget Sound

Organism	Records
Cnidaria: Hydrozoa	
<i>Ectopleura crocea</i> (Agassiz, 1862)	Native to the Atlantic and collected in the San Juan Islands in the 1930s. No records since, and apparently not established (Mills 1998).
Mollusca: Gastropoda	
<i>Cecina manchurica</i> Adams, 1861	Native to the northwestern Pacific and introduced by oyster aquaculture. Collected in Puget Sound in Chuckanut Bay in 1961 and Birch Bay in 1963; not known if established (Carlton 1979: 362-363)
<i>Ilyanassa obsoleta</i> (Say, 1822)	Native to the northwestern Atlantic and introduced with oyster aquaculture. First recorded on the Pacific Coast in San Francisco Bay in 1907, reported in Boundary Bay in British Columbia in 1952, and collected in Birch Bay in Puget Sound in the 1950s, though it is not known if it is still present there.
<i>Littorina brevicula</i> (Philippi, 1844)	On oyster beds in Samish Bay in 1924 and in Bellingham Bay ≤1926 (Carlton 1979: 358). Apparently not established.
<i>Littorina littorea</i> (Linnaeus, 1758)	Sixteen specimens collected at Deception Pass in 1937, and 8 more in 1949 (Carlton 1979: 359-360, suggesting the 1949 date may be a cataloging or receipt date). Apparently not established.
<i>Monodonta labio</i> (Linnaeus, 1758)	Abundant on recently planted oyster beds in Samish Bay in 1924 (Kincaid 1947). Apparently not established.
<i>Neptunia arthritica</i> (Valenciennes, 1858)	Native to Japan and introduced with oyster aquaculture. One specimen collected in Samish Bay oyster beds in 1952 (Carlton 1979: 396). Apparently not established.
<i>Patelloida striata</i> Quoy & Gaimard, 1834	Abundant on planted oyster beds in Samish Bay in 1924 (Kincaid 1947). Apparently not established.
<i>Rapana venosa</i> (Valenciennes, 1846)	Native to Japan and introduced with oyster aquaculture. Collected in Bellingham Bay in 1926 (Carlton 1979: 394). Apparently not established.
<i>Thais clavigera</i> (Küster, 1860)	Native to Japan and introduced with oyster aquaculture. Collected in Samish Bay oyster beds in 1924 (Carlton 1979: 396). Apparently not established.
<i>Turbo coronatus coreensis</i> Recluz, 1853	Fairly abundant on planted oyster beds in Samish Bay in 1924 (Kincaid 1947). Apparently not established.
<i>Turbo marmoratus</i> Linnaeus, 1758	A few on planted oyster beds in Samish Bay in 1924 (Kincaid 1947). Apparently not established.
Mollusca: Bivalvia	
<i>Anadara satowi</i> (Dunker, 1882)	Native to Japan and either discarded from a laboratory or introduced with oyster aquaculture. One specimen collected in Puget Sound by 1966 (Carlton 1979: 438). Apparently not established.
<i>Anomia chinensis</i> Philippi, 1849	Native to Japan and introduced with oyster aquaculture. Collected in Samish Bay in 1924 (Carlton 1979: 483-483). Apparently not established.
<i>Crassostrea rivularis</i> (Gould, 1861)	Native to Japan. Planted in Puget Sound in 1953, and possibly also accidentally introduced with shipments of <i>Crassostrea gigas</i> . There is no clear evidence of an established population in the Sound (Carlton 1979: 476). Apparently not established.
<i>Crassostrea virginica</i>	Native to the northwestern Atlantic and introduced for culturing, with the first plantings being in San Francisco Bay in 1869. Planted in Puget Sound in the 1870s-80s and 1899-1920s (Carlton 1979, p. 78).

Table B2. Exotic Organisms Reported but not Known to be Established in Puget Sound

Organism	Records
<i>Gemma gemma</i> (Totten, 1834)	Native to the northwestern Atlantic and introduced with oyster aquaculture; however, all records from Puget Sound and San Juan Islands appear to be the native species <i>Nutricula tantilla</i> (Carlton 1979: 491-492).
<i>Mysella ?tumida</i> (Carpenter, 1864)	Native to Japan and introduced with oyster aquaculture. Collected in Puget Sound by 1950 (Carlton 1979: 487-488). Apparently not established.
<i>Ostrea edulis</i> Linnaeus, 1758	Native to Europe and widely introduced; stock from France, Maine, Connecticut and Japan was planted in various Pacific Coast bays between 1951 and the 1970s, but apparently not established anywhere. Puget Sound received plantings of stock from Maine in 1951 and from an unknown source in 1961-62 (Carlton 1979: 479-482).
Arthropoda: Crustacea: Copepoda	
<i>Pseudodiaptomus inopinus</i>	Collected in the fall of 1991 in the Snohomish River estuary (J.R. Cordell 1998 pers. comm.).
<i>Pseudodiaptomus marinus</i> (Sato, 1913)	Collected in the spring of 1998 in Elliott Bay (J.R. Cordell 1998 pers. comm.).
Chordata: Pisces	
<i>Morone saxatilis</i> (Walbaum, 1792)	Native to the northwestern Atlantic, and intentionally introduced to the Pacific Coast in the San Francisco Bay watershed in 1879. Rare in Puget Sound, not clear if established there (Emmett <i>et al.</i> 1991). Reported in earlier literature as <i>Roccus saxatilis</i> .