

1984) and common in the Delta (Herbold & Moyle, 1989). They are also abundant in Lake Del Valle in Alameda County, probably pumped in from the Delta via the State Water Project pumps and the South Bay Aqueduct (Moyle et al., 1974).

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*Pimephales promelas* Rafinesque, 1820 [CYPRINIDAE]

#### FATHEAD MINNOW

The native range of the fathead minnow runs from Quebec to the Northwest Territories and south to Alabama, Texas and New Mexico (Page & Burr, 1991). The first record of it in California is from a bait tank near the Colorado River in 1950. In 1953, 40,000 were imported by a fish breeder in Turlock. The California Department of Fish and Game purchased 1,000 of these fish, spawned them at the Central Valleys Hatchery, and planted the progeny in various water bodies as forage fish (Shapovalov et al., 1959). The fathead minnow is one of California's three legal freshwater bait fish, and it has been further spread through the state as bait releases by anglers (McGinnis, 1984; Herbold & Moyle, 1989). Herbold & Moyle (1989) report it first appearing in the Delta in the 1950s, where it is now occasionally collected and common only in localized patches, generally in small creeks.

The fathead minnow is tolerant of high temperatures, low oxygen and organic pollution (McGinnis, 1984). It has the potential to compete with the ecologically-similar native, the California roach *Hesperoleucus symmetricus*, whose distinct forms may actually be separate species (Moyle, 1976b). McGinnis (1984) warned that its "ability to establish populations readily in pools of intermittent streams and backwater areas in California poses a serious threat to several native cyprinids adapted to such habitats."

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*Pomoxis annularis* Rafinesque, 1818 [CENTRARCHIDAE]

#### WHITE CRAPPIE

*Pomoxis nigromaculatus* (Lesueur, 1829) [CENTRARCHIDAE]

SYNONYMS: *Pomoxis sparoides*

#### BLACK CRAPPIE, CALICO BASS, STRAWBERRY BASS

The black crappie is native to the eastern United States from Virginia to Texas and north through the Mississippi River basin to the Great Lakes. The white crappie's native range runs from the Gulf coast between Alabama and Texas north through the Mississippi River basin to the Great Lakes and Hudson Bay (Goodson, 1966a; Page & Burr, 1991). The history of the introduction and spread of these fish in California is uncertain because there were numerous attempted introductions, both

successful and unsuccessful, and because some authors failed to distinguish (or confused) the two fish.

The first recorded introduction of these fish on the Pacific coast was near Seattle, Washington in 1890. In 1891, 285 yearling black and white crappie from the U. S. Fish Commission station at Quincy, Illinois were planted in Lake Cuyamaca near San Diego. Vogelsang (1931) and Goodson (1966a) state that this introduction was unsuccessful. In 1895 a second shipment, of 50,000 fry, was sent to the Sisson Hatchery, but none survived (Smith, 1895; Shebley, 1917; Curtis, 1949). Goodson (1966a) states that another unsuccessful attempt was made in 1901 (citing Vogelsang (1931) who, however, makes no reference to a 1901 attempt). In 1908, crappie from the Illinois station were planted in Honey Lake in Lassen County, Vera Lake in Nevada County, Clear Lake in Lake County, in sloughs and tributaries of the Feather, Sacramento, San Joaquin, Kings and Kern rivers (including the San Joaquin River near Stockton in the Delta), and possibly at other sites in southern California (Shebley, 1917; Vogelsang, 1931; Goodson, 1966a). Of this effort, Vogelsang (1931) implies that both species of crappie were introduced (Vogelsang introduces his paper as an account of "the first successful introduction of the crappie, calico bass [=respectively, the white crappie and the black crappie; Smith (1896) and Shebley (1917) use the same nomenclature], blue gill and green sunfishes and the yellow perch" into California, although in the rest of the paper he only refers to "crappie"). Shebley (1917) states only that the white crappie was introduced, and Goodson (1966a) argues that probably only the black crappie was introduced, since white crappie were not reported north of the Tehachapi Mountains until 1951.

Goodson (1966a) reports the introduction of 16 crappie from an unknown source into a pond in San Diego County in 1917, and the subsequent stocking of nine San Diego County reservoirs from that pond. Since only white crappie have since been reported from these reservoirs, he argues that the original plant of 16 fish were all white crappie, and that all white crappie in California are descended from those 16 fish. Curtis (1949) reported the white crappie surviving only in the San Diego area and the Colorado River drainage, and the black crappie widespread in the state. Nearly 3 million crappie were caught in the state in 1948, mainly in southern California. In 1951 white crappie from one of the San Diego reservoirs were planted in a reservoir in Colusa County, and subsequent plants were made in other California waters (Goodson, 1966a).

Moyle (1976b), more-or-less consistent with Goodson, lists the black crappie as introduced in 1908 (citing Vogelsang, 1931) and the white crappie as introduced, from Illinois, in 1917 (citing Curtis, 1949, who, however, describes both species as introduced in 1891). Herbold & Moyle (1989) list the "year of introduction or first capture" in the Delta as 1908 for the black crappie and 1951 for the white crappie. We relied on Moyle's dates for our analysis.

Black crappie are today present in low and middle elevation reservoirs and slow streams (McGinnis, 1984). They are common in the Delta, accounting for 71% of the 11,750 centrarchids collected in the Delta in 1963-1964 (Turner, 1966b), and have on occasion been collected downstream to Martinez (Gannslé, 1966). McGinnis (1984) reported the white crappie's distribution as throughout southern California and in Clear Lake. It is apparently uncommon in the Delta, with only one white

crappie out of 11,750 centrarchids collected there in 1963-1964 (Turner, 1966b).

A large crappie can produce more than 200,000 eggs per spawning (McGinnis, 1984). In a study of their feeding habits in the Delta, black crappie mainly ate threadfin shad and striped bass, along with small numbers of chinook salmon, Delta smelt and other fish (Turner, 1966b). Curtis (1949) reported that crappie compete with bass for food.

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*Tridentiger bifasciatus* Steindachner [GOBIIDAE]

#### SHIMOFURI GOBY

It was discovered in 1994 that the introduced gobies in California called chameleon gobies consisted of two different species. The shimofuri goby, native to Japan and China, is adapted to fresher water than the chameleon goby and was first recorded in 1985 from Suisun Bay, having probably arrived in ballast water. By 1989 it was the most abundant fish in Suisun Bay, and by 1990 the most abundant larval fish in the upper Estuary. By 1990 it had also been transported 513 km south via the California Aqueduct to Pyramid Reservoir, and thence into Piru Creek by 1992 (Matern & Fleming, in prep.).

Experiments indicate that if the shimofuri goby disperses to coastal waters harboring the endangered tidewater goby *Eucyclogobius newberryi*, it could have a substantial impact by preying on juvenile tidewater gobies, competing for food, and disturbing mating activities (Swenson & Matern, 1995).

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*Tridentiger trigonocephalus* (Gill, 1859) [GOBIIDAE]

#### CHAMELEON GOBY, TRIDENT GOBY, SHIMAHAZE

The chameleon goby is native to marine and brackish waters of Japan, China and Siberia (Eschmeyer et al., 1983). One specimen (70.4 mm standard length) was collected from Los Angeles Harbor in June 1960, with others were collected there in 1977 (Haaker, 1979). It was collected from the Redwood City docks in southern San Francisco Bay in 1962 (Matern & Fleming, in prep.)

Various workers have suggested that the goby could have been transported across the Pacific in ballast water, in ships' seawater systems, as eggs laid on fouling organisms on ships' hulls, or (for transport to San Francisco Bay) as eggs laid on imported Japanese oysters (Hubbs & Miller, 1965; Haaker, 1979). However, except for occasional experimental plants, Japanese oysters have not been planted in San Francisco Bay since the 1930s, and have never been planted in Los Angeles Harbor (Carlton, 1979a)

The chameleon goby has also become established in Sydney Harbor, Australia (Haaker, 1979).

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**AMPHIBIANS***Rana catesbeiana***AMERICAN BULLFROG**

The bullfrog is native to North America east of Colorado and New Mexico, and has become established in most western states, Hawaii, Mexico, Cuba, Japan and Italy (Stebbins, 1966). The bullfrog appears to have been independently introduced to California several times between 1910 and 1920. Bullfrogs were reported, but not confirmed, from Little Lake, Inyo County in 1918, and from ponds on the Stanford University campus in 1920. In July, 1922, adult and tadpole bullfrogs were collected from Sonoma Creek near El Verano, Sonoma County. These frogs were believed to be the descendants of 132 frogs purchased from New Orleans and 12 frogs purchased from a San Francisco frog merchant in 1914 and 1915 and planted in a nearby reservoir. Bullfrogs were also collected from Mockingbird Lake, Riverside County in 1922 and then from other lakes and streams in the area, possibly derived from a stock of Illinois and Louisiana bullfrogs kept by the physiology instructor at the Loma Linda College of Medical Evangelists since at least 1914 (Storer, 1922; George, 1927). Moyle (1979) reports that in 1929 bullfrogs were collected from the Kings River and planted in the San Joaquin River near Friant, and were introduced to two ponds at the San Joaquin Experimental Range in Madera County in 1934.

The bullfrog was well established in the San Joaquin Valley by 1930, and is now common in many parts of California, including the Delta (Moyle, 1973; Herbold & Moyle, 1989). Although several authors have reported that reductions in populations of the California red-legged frog *Rana aurora*, and possibly of the foothill yellow-legged frog *Rana boylei*, may be due to predation by or competition from bullfrogs (Moyle, 1973; Herbold & Moyle, 1989; Anon., 1993; BDOC, 1994), other factors (including overharvesting of red-legged frog prior to the introduction of bullfrog, habitat changes, and predation by introduced fish) make it difficult to assess the bullfrog's true impact (Harvey et al., 1992).

REPTILES

*Pseudemys scripta*

POND SLIDER, RED-EARED SLIDER

Pond sliders are native to the eastern United States south to Panama (Stebbins, 1966). They were presumably introduced to California as released or escaped pets and are common in the Delta and elsewhere in California (Herbold & Moyle, 1989; Harvey et al., 1992, p. 180). The frequency with which they are encountered, our (ANC) observations of a female laying eggs and of live, hatched young in a nest at San Pablo Reservoir in Alameda County in July 1994, and reports of reproducing populations at sites surrounding the Estuary (in Putah Creek in Solano County, Walnut Creek and Jewel Lake in Contra Costa County, Boronda Lake in Santa Clara County and Stow lake in San Francisco County; Harvey et al., 1992), suggest that they are almost certainly established in the Delta as well. Although reportedly banned in the early 1970s (Harvey et al.), we (ANC) have recently seen live sliders for sale in Asian markets in San Francisco.

MAMMALS

*Ondatra zibethicus*

MUSKRAT

The muskrat, native to the eastern United States, is common in the Delta and other parts of California in riparian woodland, freshwater and brackish marsh, and aquatic habitats (Josselyn, 1983; Herbold & Moyle, 1989, Harvey et al., 1992). Muskrat can damage banks and levees with their burrowing.

Skinner (1962, p. 161) reported that over the previous twenty years muskrat had "risen to the status of the most important fur bearer in the state, in terms of number of animals and total value of the raw furs...Originally introduced into the northeastern counties, they have moved down the Sacramento and into the San Joaquin system since 1943." He reports trap data for the state beginning in 1921-22, and for the San Francisco Bay Area starting in 1939-40, with the number trapped annually in the Bay Area rising from less than 100 until 1950 to between 6,000 and 9,500 in 1951-56. Herbold & Moyle (1989, citing a 1962 report) reported about 11,000 trapped annually in the Delta.



Taxon	Species	Common Name	Native Range	Date	Mechanism
<b>PLANTS</b>					
Seaweeds					
Chlorophyta	<i>Bryopsis</i> sp.	dead man's fingers	?	1951	SF
	<i>Codium fragile tomentosoides</i>	Japanese weed	Japan	1977	SF
Phaeophyta	<i>Sargassum muticum</i>		Japan	1973 [1963] (1944)	OJ
Rhodophyta	<i>Callithamnion byssoides</i>		Nova Scotia to Florida	1978-83	SF,SW
	<i>Polysiphonia dendrodata</i>		nw Atlantic	1963-64	SF,(BW)
<b>Vascular Plants</b>					
Dicotyledones					
	<i>Chenopodium macrospermum</i>		S America	≤1993 [≤1959]	?
	f. var. <i>halophilum</i>				
	<i>Coltula coronopifolia</i>	brass buttons	S Africa	1878	SB
	<i>Lepidium latifolium</i>	broadleaf peppergrass	Eurasia	1978 [1936]	?
	<i>Limosella subulata</i>	awl-leaved mudwort	Europe, e N America	≤1979 [≤1959]	GS
	<i>Lythrum salicaria</i>	purple loosestrife	Europe	≤1993 [≤1968]	GS
	<i>Myriophyllum aquaticum</i>	parrot's feathers	S America	≤1979 [≤1957]	RI
	<i>Myriophyllum spicatum</i>	Eurasian milfoil	Eurasia, N Africa	1976	RI
	<i>Polygonum patulum</i>	smartweed	e Europe	≤1993 [≤1959]	?
	<i>Rorippa nasturtium aquaticum</i>	watercress	Europe	≤1959 [≤1944] (≤1941)	GS,RI
	<i>Salsola soda</i>		Europe	1968	?
	<i>Spergularia media</i>	sand spurrey	Europe	≤1979 [≤1959]	?
	<i>Egeria densa</i>	elodea	Europe	≤1979 [≤1944]	RI
	<i>Eichhornia crassipes</i>	water hyacinth	S America	1904	RI
	<i>Iris pseudacorus</i>	yellow flag	tropical S America	1978-79 [≤1957]	RI
	<i>Polygonum elongatum</i>		Europe	≤1959	?
	<i>Potamogeton crispus</i>	curly-leaf pondweed	S America	1988-90* [≤1959]	AC
	<i>Spartina alterniflora</i>	smooth cordgrass	Europe	1970-73 (1910)	SB [MR]
	<i>Spartina anglica</i>	English cordgrass	nw Atlantic	1977 (1961-62)	MR
	<i>Spartina densiflora</i>	dense-flowered cordgrass	England	1976 (=1850*)	SB [MR]
	<i>Spartina patens</i>	saltmeadow cordgrass	Chile	≤1968 (1930)	MR
	<i>Typha angustifolia</i>	narrow-leaf cattail	se U S	≤1983 [≤1951]	?
Monocotyledones					



Taxon	Species	Common Name	Native Range	Date	Mechanism
<b>PROTOZOANS</b>					
free-living	<i>Trochammina hadai</i>		Japan	1991*	?
on molluscan hosts	<i>Ancistrocoma pelseuerci</i>		Europe	1936* (1894)	OA
	<i>Ancistrum cyclidioides</i>		Europe	1946* (1894)	OA
	<i>Boveria teredinii</i>		n Atlantic	1927* (1913)	SF
on crustacean hosts	<i>Sphenophyra dosinia</i>		Europe	1946* (1894)	OA
	<i>Cathurnia limnorae</i>		?	1927* (1871)	SF
	<i>Lobochona prorates</i>		?	1927* (1871)	SF
	<i>Mitrofolliculina limnorae</i>		?	1927* (1871)	SF
<b>INVERTEBRATES</b>					
Porifera	<i>Cfiona</i> sp.	boring sponge	n Atlantic?	1891	OA
	<i>Halichondria boverbanki</i>	Bowerbank's halichondria	n Atlantic	1950-53*	OA,SF
	<i>Haliclona loosanoffi</i>	Loosanoff's haliclona	n Atlantic	1950*	OA,SF
	<i>Microclona prolifera</i>	red beard sponge	nw Atlantic	1945-49	OA,SF
	<i>Prosuberites</i> sp.		nw Atlantic	1953*	OA,SF
Cnidaria	<i>Blackfordia virginica</i>		Black & Caspian Seas	1970	BW,SP
Hydrozoa	<i>Cladonema uchidai</i>		Japan	1979	BW,OJ,SF
	<i>Clava multicornis</i>	club hydroid	n Atlantic	1895	SF
	<i>Cordylophora caspia</i>	freshwater hydroid	Black & Caspian Seas	1930 (1920)	BW,SP
	<i>Corymorpha</i> sp.		n Atlantic?	1955-56	BW,OA,SF
	<i>Garveia franciscana</i>		n Indian Ocean?	1901	SF
	<i>Gonothyrax clarki</i>		n Atlantic	1895	OA,SP
	<i>Mneotias inexpectata</i>		Black Sea	1992	BW,SP
	<i>Obelia ?bidentata</i>		New England?	1912	OA,SF
	<i>Obelia ?dichotoma</i>		Europe?	1894	OA,SF
	<i>Sarsia tubulosa</i>		n Atlantic	1860 (1859)	SF
	<i>Tubularia crocea</i>		n Atlantic	1859	SF
Scyphozoa	<i>Aurelia "aurita"</i>	moon jelly	n Atlantic	1897*	BW,SP
Anthozoa	<i>Diadumene ?cincta</i>	orange anemone	nw Pacific	1955-75	BW,SF
	<i>Diadumene franciscana</i>	San Francisco anemone	Europe?	1925-40	BW,SP
	<i>Diadumene leucolela</i>	white anemone	?	1936	BW,OA,SF
	<i>Diadumene lineata</i>	orange-striped green anemone	n Atlantic	1906	OA,SF

Taxon	Species	Common Name	Native Range	Date	Mechanism
Annelida Oligochaeta	<i>Branchiura sowerbyi</i>		Asia	1963* [1950*]	BW, RI, SB
	<i>Limnodrilus monotheicus</i>		nw Atlantic	≤1985 (1960*)	BW, OA, SB
	<i>Paranais friti</i>		Caspian & Black Seas	1961-62*	BW, RI, SB
	<i>Potamoilix bavaricus</i>		Eurasia	≤1965	BW, RI, SB
	<i>Tubificoides apectinatus</i>		n Atlantic	1961-62*	BW, OA, SB
	<i>Tubificoides brownae</i>		n Atlantic	1961-62*	BW, OA, SB
	<i>Tubificoides wasselli</i>		nw Atlantic	1961-62*	BW, OA, SB
	<i>Varichaetadrilus angustipennis</i>		e US	1982	BW, RI
	<i>Boccardiella ligerica</i>		nw European coast	≤1954 [1935]	BW
	<i>Ficopomatus enigmaticus</i>	Australian tubeworm	Australia	1920	SF
	<i>Heteromastus filiformis</i>		nw Atlantic	1936*	BW, OA
	<i>Manayunkia speciosa</i>		e N America	1963* (1961*)	AG, BW
	<i>Marenzelleria viridis</i>		nw Atlantic	1991	BW
	<i>Marphysa sanguinea</i>		n Atlantic?	1969	BW, OA
	<i>Nereis succinea</i>	pile worm	n Atlantic?	1896	OA, SF
	<i>Polydora ligni</i>	mud worm	n Atlantic	1933* (1932*)	BW, OA, (SF)
<i>Potamilla</i> sp.		?	1989	BW	
<i>Pseudopolydora kempfi</i>		Indian Ocean or nw Pacific	1972 [1960] (1951)	BW, OJ, SF	
<i>Pseudopolydora paucibranchiata</i>		Japan?	1973 [1950]	BW, OJ, SF	
<i>Sabaco elongatus</i>	bamboo worm	nw Atlantic	1950s*	BW, OA	
<i>Streblospio benedicti</i>		Atlantic	1932*	BW, OA, (SF)	
Mollusca: Gastropoda					
Prosobranchia	<i>Busycotypus canaliculatus</i>	channeled whelk	nw Atlantic	1938	OA, (RI)
	<i>Cipangopaludina chinensis malleana</i>	Chinese mystery snail	China, Japan	1938 [1900]	RI
	<i>Crepidula convexa</i>	convex slipper shell	nw Atlantic	1898	OA
	<i>Crepidula plana</i>	eastern white slipper shell	nw Atlantic	1901	OA
	<i>Ilyanassa obsoleta</i>	eastern mudsnail	nw Atlantic	1907	OA
	<i>Littorina saxatilis</i>	rough periwinkle	n Atlantic	1993*	SW
	<i>Melanoides tuberculata</i>	red-rim melania	Africa to East Indies	1988 [1972]	RI
	<i>Urosalpinx cinerea</i>	Atlantic oyster drill	nw Atlantic	1890	OA

Taxon	Species	Common Name	Native Range	Date	Mechanism
Mollusca: Gastropoda continued					
Opisthobranchia	<i>Boonea bisuturalis</i>	two-groove odostome	nw Atlantic	1977*	OA,(BW)
	<i>Cafriona rickettsi</i>		?	1974	BW,SF
	<i>Cuthiona perca</i>	Lake Merritt cuthona	?	1979	BW,SF
	<i>Eubrancheus misakiensis</i>	Misaki balloon aeolis	Japan?	1962	BW,OJ,SF
	<i>Okenia plana</i>	flat okenia	Japan	1950-60	BW,OJ,SF
	<i>Philine auriformis</i>	tortellini snail	New Zealand; Australia?	1992	BW
	<i>Sakuraeolis enosimensis</i>	white-tentacled Japanese aeolis	Japan	1972	BW,SF
	<i>Tenellia adspersa</i>	miniature aeolis	Europe	1953	BW,SF
	<i>Ovatella myosotis</i>		Europe?	1871	OA,(SB,SF)
Pulmonata					
Mollusca: Bivalvia					
	<i>Arcuatula demissa</i>	ribbed mussel	nw Atlantic	1894	OA
	<i>Corbicula fluminea</i>	Asian clam	China, Korea, Japan	1945 (1924)	RI
	<i>Gemma gemma</i>	amethyst gem clam	nw Atlantic	1893	OA
	<i>Lyrodus pedicellatus</i>	blacktip shipworm	?	1920 [1871]	SF
	<i>Macoma petalum</i>	Baltic clam	nw Atlantic	<1988*	OA,SB
	<i>Musculista senhousia</i>	Japanese mussel	Japan, China	1946 (1924)	OJ
	<i>Mya arenaria</i>	soft-shell clam	n Atlantic	1874	OA
	<i>Mytilus galloprovincialis</i>	Mediterranean mussel	Mediterranean Sea	1985-87* [1947*]	BW,SF
	<i>Petricolaria photadiformis</i>	false angelwing	nw Atlantic	1927	OA,(BW)
	<i>Potamocorbula amurensis</i>	Amur River corbula	s China to s Siberia, Japan	1986	BW
	<i>Teredo navalis</i>	naval shipworm	?	1913	SF
	<i>Theora fragilis</i>	Asian semele	w Pacific	1982 [1968-69]	BW
	<i>Venerupis philippinarum</i>	Japanese littleneck clam	w Pacific	1946 (1924)	OJ
Arthropoda: Crustacea					
Ostracoda	<i>Eusarsiella zostericola</i>		nw Atlantic	1953*	OA,(BW)
Copepoda	<i>Acartiella sinensis</i>		China	1993	BW
	<i>Limnithona sinensis</i>		Yangtze River, China	1979	BW
	<i>Limnithona tetraspina</i>		Yangtze River, China	1993	BW
	<i>Mytilicola orientalis</i>	parasitic copepod	w Pacific	1974* (1938) (1875)	OJ
	<i>Oithona davisae</i>		Japan	1979	BW
	<i>Pseudodiaptomus forbesi</i>		Yangtze River, China	1987	BW
	<i>Pseudodiaptomus marinus</i>		China, Japan	1986	BW
	<i>Sinocalanus doerrii</i>		Chinese rivers	1978	BW
	<i>Tortanus</i> sp.		?	1993	BW

Taxon	Species	Common Name	Native Range	Date	Mechanism
Arthropoda: Crustacea continued					
Cirripedia	<i>Balanus amphitrite</i>	striped barnacle	Indian Ocean	1938-39 [1921]	SF
	<i>Balanus improvisus</i>	bay barnacle	n Atlantic	1853	SF
Nebaliacea	<i>Epinebalia</i> sp.		?	1992	BW
Mysidacea	<i>Acanthomysis aspera</i>		Japan	1992	BW
	<i>Acanthomysis</i> sp.		?	1992	BW
Cumacea	<i>Deltamysis holmquistae</i>		?	1977	BW
Isopoda	<i>Nippoleucon himmensis</i>		Japan	1986 (1979)	BW
	<i>Dynoides dentisimus</i>		Japan, Korea	1977	BW,SF
	<i>Eurylana arcuata</i>		New Zealand or Chile	1978	BW,SF
	<i>Iais californica</i>		Australia, New Zealand	1904 (1893)	SF
	<i>Limnoria quadripunctata</i>		?	1873 [1871?]	SF
	<i>Limnoria tripunctata</i>		?	1875 [1871?]	SF
	<i>Paranthura</i> sp.		w Pacific?	1993*	BW,SF
	<i>Sphaeronia quoyanum</i>		Australia, New Zealand	1893	SF
	<i>Synidotea laevidorsalis</i>		nw Pacific	1897	SF
Tanaidacea	<i>Sinelobus</i> sp.		?	1943	BW,SF
Amphipoda	<i>Ampelisca abdita</i>		nw Atlantic	1954	BW,OA
	<i>Ampithoe valida</i>		nw Atlantic	1941 [1941]	BW,OA,SF
	<i>Caprella nautica</i>		Japan to Vladivostok	1976-77 [1973-77]	BW,OJ
	<i>Chelura terebrans</i>		?	1948	SF
	<i>Corophium ochersicum</i>		?	1912-13* (1905)	OA,SF
	<i>Corophium alienense</i>		Southeast Asia?	1973	BW
	<i>Corophium heteroceratum</i>		China	1986	BW
	<i>Corophium insidiosum</i>		n Atlantic	1931 (1915)	OA,SF
	<i>Gammarus daiberi</i>		nw Atlantic	1983	BW,(SF)
	<i>Grandidierella japonica</i>		Japan	1966	BW,OJ,SF
	<i>Jassa marmorata</i>		nw Atlantic	1977 [1941]*	BW,SF
	<i>Leucothoe</i> sp.		?	1977*	SF,(OA,OJ)
	<i>Melita nitida</i>		nw Atlantic	1938	BW,OA,SB,SF
	<i>Melita</i> sp.		?	1993*	BW,SF
	<i>Paradexamine</i> sp.		w Pacific?	1993*	BW,SF
	<i>Parapleustes derzhavini</i>		w Pacific?	1904	SF
	<i>Stenothoe valida</i>		subtropics?/tropics?	1941	BW,SF
	<i>Transorchestia enigmatica</i>	shorehopper	Chile? or New Zealand?	1962*	SB

Taxon	Species	Common Name	Native Range	Date	Mechanism	
Arthropoda: Crustacea continued Decapoda	<i>Carcinus maenas</i>	green crab	Europe	1989-90 [1989]	BW,RR,SW BW,RI	
	<i>Eriocheir sinensis</i>	Chinese mitten crab	China, Korea	1992	RR	
	<i>Orconectes virilis</i>	virile crayfish	midw US	≤1959 [1939-41]	FS	
	<i>Pacifastacus leniusculus</i>	signal crayfish	Oregon to British Columbia	≤1959 [1912? 1898?]	BW	
	<i>Palaemon macrondactylus</i>	oriental shrimp	Korea, Japan, n China	1957	RI	
	<i>Procambarus clarkii</i>	red swamp crayfish	se US	≤1966 [1924]	BW,OA,SF	
	<i>Rhithropanopeus harrisi</i>	Harris mud crab	nw Atlantic	1937		
	Arthropoda: Insecta	<i>Anisolabis maritima</i>	maritime earwig	n Atlantic	1935 [1921] (1920)	SB
		<i>Neochetina bruchi</i>		Argentina	1982	BC
		<i>Neochetina eichhorniae</i>		Argentina	1982-83	BC
<i>Trigonotylus uhleri</i>		cordgrass bug	nw Atlantic coast	1993*	AG	
Entoprocta	<i>Barentsia benedeni</i>		Europe	1929	OJ,SF	
	<i>Urnatella gracilis</i>		e & midw US	1982-84 [1972]	RI	
Bryozoa	<i>Alcyonidium polyotum</i>	ambiguous bryozoan	nw Atlantic	1951-52	BW,OA,SF	
	<i>Anguinella palmata</i>	creeping bryozoan	n Atlantic	1993* [1933-42] (1933-42)	SF	
	<i>Howerbankia gracilis</i>		nw Atlantic?	1963 [≤1953] (≤1923)	OA,SF	
	<i>Bugula "neritina"</i>		?	≤1983 [≤1905]	SF, (OA)	
	<i>Bugula stolonifera</i>		nw Atlantic	≤1978 [≤1978]	SF	
	<i>Conopetium tenuissimum</i>		nw Atlantic	1951-52*	BW,OA,SF	
	<i>Cryptosula pallasiana</i>		n Atlantic	1944-47 [1943-44]	OA,SF	
	<i>Schizoporella unicornis</i>		nw Pacific	1963 [1938] (1927)	OJ,SF	
	<i>Victorella pavida</i>		Indian Ocean?	1967*	OA,OJ,SF	
	<i>Watersipora "subtorquata"</i>		nw Pacific?	1992 [1963]	SF	
	<i>Zoobotryon verticillatum</i>		subtropical?	1993 [1905]	SF	
	Chordata: Tunicata	<i>Ascidia</i> sp.		?	1993-94* [1983]	BW,SF
<i>Botryllus aurantius</i>			Japan	1973	OJ,SF	
<i>Botryllus schlosseri</i>		golden star tunicate	ne Atlantic	1944-47	OA,SF	
<i>Botryllus</i> sp.		sea vase	?	≤1983	OJ,SF	
<i>Ciona intestinalis</i>			n Atlantic	1932 [1897]	BW,SF	
<i>Ciona savignyi</i>			Japan?	1993-94*	BW,SF	
<i>Molgula manihattensis</i> <i>Styela clava</i>			nw Atlantic n China to Okhotsk Sea	1950s [1949] 1949 [1932-33]	BW,OA,SF BW,OJ,SF	

Taxon	Species	Common Name	Native Range	Date	Mechanism	
<b>VERTEBRATES</b>						
Fish	<i>Acanthogobius flavimanus</i>	yellowfin goby	Japan, South Korea, China	1963	BW,SF	
	<i>Alosa sapidissima</i>	American shad	Labrador to Florida	1871	FS	
	<i>Ameiurus catus</i>	white catfish	New York to Mississippi	1874	FS	
	<i>Ameiurus melas</i>	black bullhead	central N America	1874	FS	
	<i>Ameiurus natalis</i>	yellow bullhead	central N America	1874	FS	
	<i>Ameiurus nebulosus</i>	brown bullhead	central N America	1874	FS	
	<i>Carassius auratus</i>	goldfish	China	1963-64* [early 1900s*]	RI	
	<i>Cyprinus carpio</i>	carp	Eurasia	≤1917 [1872]	FS, RI	
	<i>Dorosoma peltense</i>	threadfin shad	midw U S, Florida to Guatemala	1961 [1953]	FS	
	<i>Gambusia affinis</i>	mosquitofish	midw & se U S, Mexico	1964-65* [1922]	BC	
	<i>Ictalurus furcatus</i>	blue catfish	midw & se U S, Rio Grande, Mexico	1979 [1969]	FS	
	<i>Ictalurus punctatus</i>	channel catfish	central N America	1940s [1891?]	FS	
	<i>Lepomis cyanellus</i>	green sunfish	midw & se U S, n Mexico	1963-64* [1891]	AG	
	<i>Lepomis gulosus</i>	warmouth	midw & se U S, Rio Grande	after 1921* [1891]	FS	
	<i>Lepomis macrochirus</i>	bluegill	midw & se U S, Rio Grande, n Mexico	1908 [1891?]	FS	
	<i>Lepomis microlophus</i>	redear sunfish	midw & se U S	after 1949* [1948-49]	FS	
	<i>Lucania parva</i>	rainwater killifish	Mass. to Mexico, Rio Grande	1958	AG	
	<i>Menidia beryllina</i>	inland silversides	midw & se U S, Rio Grande	1971 [1967]	BC	
	<i>Micropterus dolomieu</i>	smallmouth bass	central N America	≤1948 [1874]	FS	
	<i>Micropterus salmoides</i>	largemouth bass	central N America	≤1948 [1891] (1890)	FS	
	<i>Morone saxatilis</i>	striped bass	St Lawrence River to Louisiana	1879	FS	
	<i>Nolemionus crysoleucas</i>	golden shiner	central & e N America	≤1964 [1891]	FS	
	<i>Percina macrolepida</i>	bigscale logperch	Louisiana to New Mexico	1972-73 [1953]	AG	
	<i>Pimephales promelas</i>	fathead minnow	central N America	1950s [1953-59]	FS	
	<i>Pomoxis annularis</i>	white crappie	midw & se U S	1951 [1917] (1890)	FS	
	<i>Pomoxis nigronaculatus</i>	black crappie	midw & se U S	1908 [1908] (1890)	FS	
	<i>Tridentiger bifasciatus</i>	shimofuri goby	Japan	1985	BW	
	<i>Tridentiger trigonocephalus</i>	chameleon goby	Japan, China, Siberia	1962 [1960]	BW,SF	
	Amphibians	<i>Rana catesbeiana</i>	bullfrog	e N America	≤1989 [1910-20]	RI,RR
	Reptiles	<i>Pseudemys scripta</i>	pond slider	se U S	≤1989	RI
	Mammals	<i>Ondatra zibethicus</i>	muskrat	e N America	1943 [1921-22*]	GS