SITKA PERIWINKLE

Littorina sitkana Philippi, 1846
(Littorinidae)

Global rank GNR – suggested change to G5 (14Jul2005)
State rank S5 (14Jul2005)
State rank reasons
Overall population and trends unknown, but apparently locally abundant and widespread. Threats include contamination as a result of coastal development, industrial pollution and oil spills. Effects of climatic warming on species' habitat are unknown, but of concern.

Taxonomy
Gastropod systematics is difficult due to considerable within-species variation in shell morphology (Boulding et al. 1993, Reid 1996). Closest known relatives are *Littorina kurila* (another North Pacific species) and *L. subrotundata* (from Humboldt Bay, CA to the Gulf of Alaska; Reid 1996, O'Clair and O'Clair 1998).

General description
Marine snail with rounded, almost globose shell shape (diameter almost equal to height); shell up to 2 cm long with four whorls (Kozloff 1983, Harbo 1997, O'Clair and O'Clair 1998). Shell generally has some strong spiral sculpturing in the form of continuous ridges and furrows. Color is highly variable: commonly very dark, almost black, or dark purple, uniform brown, red-brown, or gray; there are also paler forms, gray with lighter bands, or with some yellow or orange on lighter parts (Kozloff 1983, Reid 1996, Oceanlink 2005). Shell interior is brown or orange (Harbo 1997). Snail body is dark with black tentacles on head (O'Clair and O'Clair 1998). Rounder shell shape and definite raised spiral ridges distinguishes it from the checkered periwinkle (*L. scutulata*), which overlaps much of range (Kozloff 1987).
Length (cm) 1-2; max. 2.5

Reproduction
Adults are dioecious and may spawn several times per year. Peak spawning is variable among different geographic locations; peaks in spring and fall around Vancouver Island, B.C. and in summer on Oregon coast, although eggs may be found in the field year-round (Behrens 1971, Buckland-Nicks et al. 1973, Behrens Yamada 1989, Rochette and Grand 2004). Reported to spawn near dawn and dusk in laboratory

experiments (Buckland-Nicks et al. 1973). After copulation females lay 50-400 fertilized eggs which are enclosed in a thick, transparent, gelatinous material; individual egg masses measure 5-15 mm but communal laying by several females often results in large egg masses measuring up to 10 cm, containing 2,000 or more eggs (Buckland-Nicks et al. 1973, Boulding 1990). In Washington, females laid up to 4 egg masses in a 3-week period (Behrens 1971). Egg masses usually attached to and under rocks and seaweed in the upper intertidal zone. Veliger (snail larva) develops shell within a week inside egg case, then hatches in around 30 days and begins to consume jelly of egg mass and diatoms which may have colonized the jelly surface (Buckland-Nicks et al. 1973). In the laboratory, sexual maturity attained at 5.5-7.0 mm (females) and 4.2-6.0 mm (males; Boulding et al. 1993).

Ecology
Preyed upon by numerous aquatic and terrestrial organisms including fishes, crabs, sea stars, other molluscs, and birds; primary predators include the red rock crab (*Cancer productus*) and pile perch (*Rhacochilus vacca*; Behrens Yamada and Boulding 1996, Boulding et al. 2001, Rochette et al. 2003). See O'Clair and O'Clair (1998) for discussion of predators in Alaska. At Barkley Sound, B.C., mortality from predation was as high as 60%/3 days in summer months, lower mortality (5-10%/3 days) was reported during fall and winter months (Rochette and Grand 2004). This species may be more resistant to crab predation than close relative species *L. subrotundata*, due to its thicker shell. Empty shells of this species are used as homes by hermit crabs (O'Clair and O'Clair 1998).

Although abundant in inside, protected marine waters, adults and especially juveniles are very susceptible to desiccation, which excludes this species from more exposed microhabitats. High temperatures and desiccation (thermal stresses) are also considered important causes of egg mortality. Under favorable conditions, can add 80% of its body weight in two months (O'Clair and O'Clair 1998, Behrens Yamada 1989). Lifespan is approximately 2 years (Buckland-Nicks et al. 1973).

Direct development of young (compared to floating, planktonic-developing larvae such as *L. scutulata*) limits geographic dispersal; therefore, individual populations show greater geographic differentiation in life history characteristics than species with planktonic larval stage and may adapt more easily to local conditions over time (Behrens Yamada 1989). However, it was found that genetic differentiation of *L. sitkana* populations is less than for planktonic developers in the mitochondrial Cyt *b* gene (Kyle and Boulding 2000).

Migration
Populations generally sedentary (most individuals move less than 1 meter per month), although individuals may move frequently in response to environmental conditions (O'Clair and O'Clair 1998). Heavy rains during low tide discourage movement, but this species is very active on foggy days in Washington State (O'Clair and O'Clair 1998).

Food
Herbivorous grazer that eats diatom films and scrapes filamentous algae and lichens from rocks and rockweed (*Fucus gardneri*) using radular teeth. Consumes *Nereocystis* spp., *Verrucaria maura*, and sometimes rockweed, although this is not a preferred food (Behrens Yamada 1989, O'Clair and O'Clair 1998).

Habitat
Found in upper to mid-intertidal zones and splash zone (the uppermost intertidal band), on sheltered to moderately exposed shores among rockweed and other algae; in eelgrass from high to low intertidal; and in salt-marshes in the Pacific Northwest (Harbo 1997, Kozloff 1993, Reid 1996, O'Clair and O'Clair 1998, Callahan 2000). At Berners Bay, Southeast Alaska, species occurred in a band from 4.2 to 5.0 m above mean low water, and slightly higher in summer than other seasons (O'Clair and O'Clair 1998). Restricted to habitats that offer protection from waves for adults, and protection from desiccation for juveniles and egg masses (Behrens Yamada 1989). Common in tidepools and crevices of bedrock, also mud flats of inland seas and bays (Rochette and Grand 2004); isolated populations are occasionally found on protected rocky outcroppings in some Oregon bays (Behrens Yamada 1989). Often occurs in protected estuaries along the Oregon coast (e.g. Coos Bay, Siletz Bay and Salmon River) so may apparently tolerate low water salinity (Lee pers. comm.). Most common on cobble, rock and bedrock substrates, less common on mud and sand. Not considered an indicator species for a single intertidal zone; on Kodiak Island periwinkles selected different habitat zones along two adjacent shores that were similar except for exposure to incoming waves (Nybakken 1967).

Global range
East Pacific: southern Bering Sea to Charleston, Oregon coastline. West Pacific: northern Japan and Sea of Okhotsk coastline (O'Clair and O'Clair 1998).

State range
From northwestern Alaska in the Chukchi sea to Southeast Alaska, including the Aleutian Islands as far west as Kiska Islands (Foster 1981, Baxter 1983, O'Clair and O'Clair 1998).

Global abundance
Unknown, but generally common throughout geographical range. On Pebble Beach in Barkley Sound, Vancouver Island, snail densities in 1980 were 10 individuals/m² at 1.5 m tidal height and 970/m² at 2.2 m (McCormack 1981 in Boulding et al. 2001); in 1999, Boulding et al. (2001) found very few individuals at the same beach, and hypothesize that *L. sitkana* densities likely undergo large fluctuations at this location. In Three Saints Bay, Kodiak Island, Alaska, highest abundance was detected at 0-2 m tidal height (Nybakken 1969).

State abundance
Unknown, but generally common throughout range. Over 1,400 individuals per 0.2 ft. (0.06 m) tide interval were counted along beach transects at around 2 ft. (0.61 m) tidal height at Three Saints Bay, Kodiak Island (Nybakken 1969).

Global trend
Unknown; large density fluctuations over time likely occur in localized populations (Boulding et al. 2001).

State trend
Unknown.

State protection
Habitat is protected where species occurs in intertidal areas of national and state parks, preserves, and national wildlife refuges. The Coastal Zone Management Act (CZMA) of 1972 protects against coastal pollution, provides for restoration, and manages land use and development in coastal areas.

State threats
Natural perturbations such as earthquakes and scouring incurred by major storms adversely affect subtidal and intertidal communities. Although little understood, the effects of global warming will likely change intertidal community structure and diversity. In California, researchers have attributed declines in cold-water species in intertidal communities to warming water temperatures (Tindall 2004). Preliminary studies indicated that silt accumulation is responsible for mortality in juveniles (Behrens Yamada 1989); thus, coastal pollution and development, which weaken shoreline stability and lead to increased siltation, are potential threats. Oil spills pose serious threats to slow moving or sessile coastal organisms. Periwinkles recovered slowly from oiling and subsequent cleanup efforts on beaches in Prince William Sound following the 1989 *Exxon Valdez* oil spill; abundance was lower at oiled beaches treated by hot water washing than at oiled beaches that were not hot washed (Houghton et al. 1997).

State research needs
Baseline life history information needed. Research needed on the effects of human impacts and threats to survival. Effects of global warming on species dynamics need study. Continue study of periwinkle habitat requirements.

Global inventory needs
Determine northern range limits in both east and west Pacific.

State inventory needs
An accurate assessment of range-wide population status is needed, including surveys to determine the northern range limit for this species in Alaska. Monitoring of localized populations at index locations should be initiated to assess long- and short-term trends in abundance.

State conservation and management needs
Conserve and manage coastal habitats to protect them from erosion, industrial pollution and development. Cleanup following oil spills should incorporate the results of Houghton et al. (1997), which indicate that hot water scouring treatments may not be the best method to aid in recovery of intertidal communities following a major spill.

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