



Photo credit: © John Hoover.

KEY INFORMATION

Areas of Concern

Kaneohe Bay, Hawaii.

Year Identified as “Species of Concern”
2004

Factors for Decline

- Habitat degradation and alteration
- Overexploitation
- Pollution
- Sedimentation
- Vulnerable life history
- Limited distribution

Conservation Designations

IUCN: Not Evaluated

Species of Greatest Conservation Need: HI



Figure 1. Three siphon holes of *Lingula reevii* in sand. Photo credit: © Fred Farrell.

Brief Species Description:

Brachiopods (lamp shells) are common as marine fossils and also include about 352 extant species. *Lingula* represents one of the oldest extant genera on Earth. It was once widely distributed, but today exists only in a small area of the Pacific. Members of this genus are found mostly in shallow marine or brackish waters from the intertidal zone to about 66 feet (20 m) depth. Hammen and Lum (1977) found that they can survive a week or more in 18 ppt salinity. Their phylum is included as one of three lophophorate phyla because of its feeding structure, a filtering lophophore; however, it also resembles a bivalve mollusc in possessing a mantle and a calcareous shell with two valves. *Lingula* is an inarticulated brachiopod (its bilaterally symmetrical shell is held together only by muscles and not teeth) that lives within a burrow and feeds on plankton. Davidson's (1888) description of *L. reevii* is as follows: “Shell oblong oval, broadest about the middle, longer than wide, rather narrow; sides very gently curved outwardly, front rounded; posterior edge obtusely acuminate [tapering to a sharp point]; valves moderately convex. Surface smooth, blue-green or emerald and verdigris-green, especially along the middle; peduncle thick, much longer than the length of the shell.” The lophophore consists of a fold of the body wall that possesses a crown of ciliated tentacles surrounding the mouth. The lateral cilia create a water current and fine plankton are transported down the tentacles to the brachial groove and into the mouth. They burrow vertically in sand, leaving a three-hole siphonal opening at the surface (Figure 1). When disturbed, a rapid contraction of the pedicle pulls the animal below the surface and these siphonal openings are reduced to a slit (Emig 1987). Emig (1981) found that this species is capable of upward burrowing through a sediment layer, even if the animal has to autotomize (detach) the pedicle (a new one then regenerates).

Lingula has separate sexes, and gametes are shed into the water column for external fertilization. Embryos develop into a free swimming larva that looks like a tiny adult; they develop a shell while planktonic. As additional shell material is laid down, the animal becomes heavy, sinks to the bottom, and takes up its adult existence. There is no metamorphosis in *Lingula*. The lifespan of *Lingula* spp. is estimated to be five to



Species of Concern

NOAA National Marine Fisheries Service

eight years (Emig 1997).

Rationale for “Species of Concern” Listing:

Demographic and Genetic Diversity Concerns:

The species is rare and is only known to occur in shallow, sandy reef flats in Kaneohe Bay, Oahu, Hawaii (Figure 2), with a few reports from other areas within the bay (Emig 1978). The species has declined in density from 500/m² in the 1960s (Worcester 1969) to 100/m² (Emig 1981). Recent work shows a continuing decline in density to a maximum of 4 *Lingula* per m² (Cindy Hunter, personal communication).

Factors for Decline:

The main threats are: 1) habitat degradation and alteration; 2) overexploitation; 3) pollution and sedimentation; 4) a vulnerable life history; and 5) a limited distribution.

Because of its intertidal and shallow subtidal habitat, *Lingula* has been severely affected by increases in human population. *Lingula reevii* is threatened by habitat degradation and over-collection (during the 1970s-1980s approximately 200-500 individuals were collected by researchers and sent to Carolina Biological Supply for biomedical research; pers. obs., C. L. Hunter). The continued decline may be attributed to decreased organic enrichment from sewage discharge more than two decades ago, as well as the more recent reduction of suitable habitat by the invasion of mat-forming alien algae species. Because the animals are sessile and reproduction involves broadcast spawning, individuals must maintain a sufficient density to ensure successful fertilization of gametes.

Status Reviews/Research Underway:

In August 2006, the National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) Protected Resources Division held its first Species of Concern workshop in Honolulu, Hawaii, for species in the Pacific Islands Region. The purpose of the workshop was to gather pertinent researchers and resource managers to share their knowledge or research, thereby providing overall information on the species, their habitat, threats, research, or conservation ideas. After the open discussion on the species, threats were prioritized, recovery actions/conservation efforts addressing each threat were identified, and data and research needs for each species were identified. These efforts will ultimately lead to the development of a conservation action plan for the species. This conservation action plan will be a living document which will aid NMFS PIRO to identify, prioritize, and fund conservation and research projects over the coming years.

Data Deficiencies:

Current and future needs include: 1) a quantitative survey of Kaneohe Bay, Hawaii to determine location and population size; 2) comprehensive surveys of the Northwestern Hawaiian Islands; 3) successful captive propagation of the species; 4) research on habitat preferences; 5) confirmation of the species presence/absence in Ambon, Indonesia (Cals and Emig 1979) and Japan (Emig 1997); and 6) if captive propagation of the species is successful, determine if eventual reintroduction of the species to Kaneohe Bay is feasible and if so, begin test reintroductions.



Species of Concern

NOAA National Marine Fisheries Service

Existing Protections and Conservation Actions: Currently there are no existing protections. Existing conservation actions include developing necessary husbandry techniques to maintain collected specimens at the Waikiki Aquarium, (University of Hawaii, Honolulu, Hawaii) alive and growing, and eventually determine how to breed captive specimens.

Inarticulated Brachiopod SOC Range

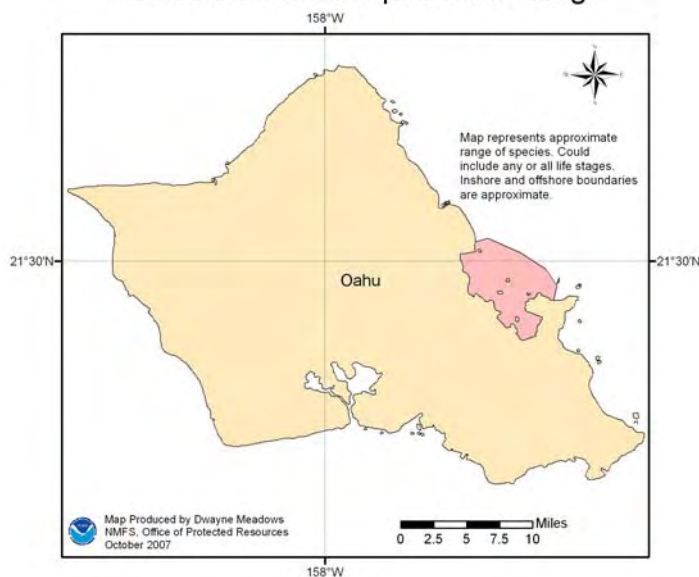


Figure 2. Range of the Inarticulated brachiopod species of concern.



Photo credit: © Fred Farrell.



Photo credit: © Cory Pittman.

References:

- Cals, P. and C.C. Emig. 1979. Lingules d'Amboine, *Lingula reevii* Davidson et *Lingula rostrum* (Shaw), donnees ecologiques et taxonomiques concernant les problemes de speciation et de repartition. Cah. Indo-Pac. 1:153-64.
- Davidson, T. 1888. A monograph of recent Brachiopoda. Part 3. Trans. Linn. Soc. London 4:183-248.
- Emig, C.C. 1981. Observations on the ecology of *Lingula reevei*. JEMBE. 52:47-61.
- Emig, C.C. 1987. Chapter V. Phylum Brachiopoda: p. 167-169. In: D.M. Devany & L.G. Eldredge (ed.). Reef and Shore Fauna of Hawaii. Section 2: Platyhelminthes through Phoronida and Section 3: Sipuncula through Annelida. Bishop Museum Special Publication 64 (2 and 3). Honolulu, HI. 461.



Species of Concern

NOAA National Marine Fisheries Service

Emig, C.C. 1997. Ecology of inarticulated brachiopods. In: Kaesler R.L. (ed). Treatise on Invertebrate Paleontology. Vol. 1, Part H. Brachiopoda. Geological Society of America and University of Kansas. Boulder, Colorado, and Lawrence, Kansas. p 473-495.

Hammen, C.S. and S.C. Lum. 1977. Salinity tolerance and pedicle regeneration of *Lingula*. J. Paleon. 51:548-551.

Worcester, W.S. 1969. Some aspects of the ecology of *Lingula* (Brachiopoda) in Kaneohe Bay, Hawaii. M.S. Thesis, Univ. Hawaii. 49 p.

Point(s) of contact for questions or further information:

For further information on this Species of Concern, or on the Species of Concern Program in general, please contact NMFS, Office of Protected Resources, 1315 East West Highway, Silver Spring, MD 20910, (301) 713-1401, soc.list@noaa.gov; or <http://www.nmfs.noaa.gov/pr/species/concern/>, Krista Graham, NMFS, Pacific Islands Regional Office, 1601 Kapiolani Blvd., Suite 1110, Honolulu, HI 96814, (808) 944-2238, Krista.Graham@noaa.gov; or John Henderson, NMFS, Pacific Islands Fishery Science Center, 1601 Kapiolani Blvd., Suite 1110, Honolulu, HI 96814, (808) 944-2173, John.R.Henderson@noaa.gov.