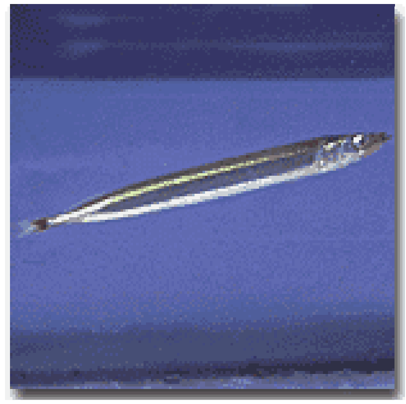
PACIFIC SAND LANCE

Ammodytes hexapterus Pallas, 1814
(Ammodytidae)



Global rank GNR
State rank S5 (23Aug2004)
State rank reasons
Widespread and abundant in coastal waters; population trend unknown. Species is closely tied to sandy substrates in the intertidal zone, therefore, pollution by oiling and other contaminants to nearshore environments is of concern.

Taxonomy
The taxonomy of the genus *Ammodytes* is debated; research is needed to establish if 1) two genetically distinct species are present in the north Pacific and if 2) *A. hexapterus* and *A. americanus* are actually distinct species, or if *A. americanus* belongs to a single trans-Atlantic species, *A. marinus*, which may be circumpolar and synonymous with *A. hexapterus* (Robards et al. 1999d, Nizinski et al. 1990 in Mecklenburg et al. 2002). Similar in external appearance, differentiation between species of *Ammodytes* relies on meristic characters such as the number of vertebrate or protein characterization with electrophoresis; this has led to some confusion in the scientific literature about species names and geographic ranges (McGurk and Warburton 1992).

General description
A small coastal forage fish with an elongate, compressed body. Metallic blue dorsally and silver ventrally, this fish routinely burrows into several centimeters of sand or gravel substrate. Identifiable features include absence of teeth and swim bladder, deeply forked caudal fin, lateral line high on the body, small cycloid scales and long, slender gill rakers. This species has a single dorsal fin which folds back into a groove, and projecting premaxilla and lower jaw. A fleshy ridge extending the length of the body on either side of the ventral midline is also sometimes present (Mecklenburg et al. 2002).
Length (cm) 20

Reproduction
Spawns intertidally and possibly subtidally once a year within proximity of burrowing habitat: in Alaska, from late August through October (Robards et al. 1999b); in Puget Sound, Washington, as late as mid February (Penttila 1997). Spawning has been documented in the same locations for decades (Robards et al. 1999b). Robards et al. (1999b) found age 1 (50%) and age 2 (31%) fish dominated spawning schools in the Gulf of Alaska and ages 3, 4, 5 and 6 made up 14, 4, 1 and < 1%, respectively, of the overall spawning school composition. Female fecundity is proportional to length, ranging from around 1,400 to 16,080 ova per female. Spawns vigorously in dense formations, leaving scoured pits in beach sediments. Slightly adhesive eggs are deposited in the intertidal zone just below the water line, and in some areas of Alaska in the subtidal zone (McGurk and Warburton 1992). Embryos develop in up to 67 days, often through periods of intertidal exposure and sub-freezing air temperatures (Robards et al. 1999d).

Ecology
Considered a key prey species for many marine predators including birds, fishes and mammals because of its high energy content (Mabry 2000). Predators include commercially valued species such as halibut (*Hippoglossus* spp.), rockfish (*Sebastes* spp.) and salmon (*Oncorhynchus* spp.) as well as seabirds such as the Rhinoceros Auklet (*Cerorhinca monocerata*), Double-crested Cormorant (*Phalacrocorax auritus*) and Red-throated Loon (*Gavia stellata*) and marine mammals including the Steller sea lion (*Eumetopias jubatus*), fur seal (*Callorhinus ursinus*) and humpback whale (*Megaptera novaeangliae*) (Field 1987). The recovery of a Pigeon Guillemot (*Cepphus columba*) colony in Prince William Sound, Alaska, appears to be limited by the availability of sand lance (Golet et al. 2002). Sand lance availability may also affect the reproductive output of Common Murres (*Uria aalge*) (Piatt and Anderson 1996). This euryhaline and eurythermic species has a short life span (up to 7 yrs), a large number of predators, and probably has correspondingly high rates of

mortality, growth and fecundity (Fritz et al. 1993). Defense tactics used against predation include burrowing into soft, wet sand in the intertidal/subtidal zones and contraction of the fish school into a ball of closely packed fish (Robards et al. 1999d).

Migration
Spawning appears to occur within habitat occupied by this species year-round, and no spawning migrations have been observed; however, offshore-onshore movements occur before spawning in the fall (Robards et al. 1999d). Exhibits high site fidelity to spawning locations, although eggs and larvae are subject to limited movement by water currents and tides.

Food
Larvae feed on phytoplankton and early zooplankton stages. Adults feed in large schools, consuming mainly copepod zooplankton within relatively short distances of fish burrowing habitat (Hobson 1986). Epibenthic invertebrates become more important in diet during autumn and winter. Adults also feed on herring (*Clupea harengus*) larvae and eggs, and may feed in mixed aggregations with herring and Pink salmon (*O. gorbuscha*) (Sturdevant et al. 2000).

Phenology
Feeds and schools diurnally and burrows nocturnally into sand substrate; also burrows into substrate to pass the winter in a dormant state. Spawning occurs during night and day, between August and February, throughout the species' range.

Habitat
Found in nearshore and intertidal marine environments. Burrowing habitat is typically well washed fine sand and fine gravel, free of mud, usually with a strong bottom current keeping oxygen levels high (Emmett et al. 1991). Sand lance distribution in Kodiak, Alaska, was associated with freshwater influence and not on beaches composed entirely of fine, hard packed sand (Dick and Warner1982). Prefer well-lighted habitat and are most common at depths less than 50 m, but may be found up to depths of 275 m. Feeding schools are found in littoral waters within proximity of burrowing habitat. Highest abundance found in burrowing habitat that is sheltered from onshore wave action and disturbance by winter storms (Robards et al. 2002).

Global range
Throughout the coastal North Pacific; in the Sea of Japan and Sea of Okhotsk in the western North Pacific and the Beaufort Sea south to Balboa Island (near Baja California) in the eastern North Pacific.

State range
Throughout coastal Alaska extending as far north as the Beaufort Sea.

Global abundance
Species often escapes inventory survey measurement using standard hydroacoustic and trawl methods because they burrow into sand when not feeding (especially at night and during the winter), making determination of abundance difficult (Penttila 1997). Emmet et al. (1991) surveyed 32 U.S. Pacific coast estuaries and found Pacific sand lance distribution patchy throughout its range; considered common to highly abundant in Puget Sound, Washington, and rare in San Francisco Bay, California. The highest relative abundance was recorded in the Gulf of Alaska.

State abundance
Considered common to abundant throughout its range with patchy distribution due to specific habitat selection (Robards et al. 1999d). Large fluctuations in abundance are observed every few years (Litzow et al. 2000). Orsi and Landingham (1985) found adult Pacific sand lance consistently abundant throughout their sampling in southeast Alaska in 1981-1982. The most abundant forage fish caught in nearshore habitats north of the Alaska Peninsula in 1984 and 1985 (Houghton 1987); the most abundant forage fish in Kachemak Bay in 1995-1996 (Robards et al. 1999a). Also periodically abundant in Bristol Bay, Norton Sound and the eastern Chukchi Sea (Sanger 1987).

State trend
Large fluctuations in abundance are observed every few years (Litzow et al. 2000). Although a large scale regime shift of forage fishes in the Northern Gulf of Alaska occurred during the late 1970's and early 1980's (Anderson et al. 1997), examination of seabird diets does not suggest that sand lance populations declined during this period. Robards et al. (1999a) analyzed beach seine data collected in Kachemak Bay in 1976, 1995 and 1996, and found no decline in sand lance catch per unit effort (CPUE) or percent occurrence over this time (Golet et al. 2002).

Indirect evidence suggests that populations in Prince William Sound were negatively impacted by the *Exxon Valdez* oil spill in 1989 (i.e. sand lance declines as seen in percentage of Pigeon Guillemot [*Cepphus columba*] chick diet from 1989 to 1999 after the oils spill) (Golet et al. 2002).

Global protection
North American coastal waters are currently closed to commercial fishing for Pacific sand lance.

State protection
In 1999, with the exception of a few very minor extant fisheries, the Alaska Department of Fish and Game (ADFG), Board of Fisheries, banned all commercial fishing for forage fishes, noting their importance in marine ecosystems. This placed a year-round closure on non-pelagic trawls in nearshore waters of the central and western Gulf of Alaska and southeastern Bering Sea and limited bycatch to 2% retainable. Bycatch typically does not exceed this level (Kruse et al. 2000).

Pacific sand lance occur in intertidal zones in coastal areas of Alaska Maritime and Kodiak National Wildlife Refuges and Glacier Bay and Wrangell-St. Elais National Parks.

Global threats
This species may be particularly vulnerable to pollution in coastal areas and development of beach-front habitats (Robards et al. 1999c). Sand lance avoid oiled substrates (Pinto et al. 1984) and their site fidelity, spawning habitat requirements and burrowing behavior make them especially sensitive to beach pollution. Indirect evidence suggests that populations in Prince William Sound were negatively impacted by the *Exxon Valdez* oil spill in 1989 (Golet et al. 2002). In Puget Sound, Washington, habitat is threatened by urbanization; placement of shoreline armoring structures and other development activities eliminate sand and gravel intertidal spawning and burrowing habitat (Penttila 1997).

Commercial fishing in Japan may impact this species, as 100,000 tons are harvested per year; in the U.S. limited recreational use of Pacific sand lance as bait is permitted (Emmet et al. 1991). Commercial fishing bycatch for this species is relatively low (Kruse et al. 2000).

May compete for food with salmon and herring. In Prince William Sound, Alaska, sand lance changed their diets when feeding in sympatric aggregations with Pink Salmon and herring; sand lance total food consumption declined in the presence of both species (Sturdevant et al. 2000).

Global research needs
Basic research needed on species life history parameters including reproductive ecology and productivity, and habitat requirements. Genetic studies needed to differentiate population structure. Identify sources of mortality.

State research needs
Basic research needed on species life history parameters including reproductive ecology and productivity, and habitat requirements. Genetic studies needed to differentiate population structure. Identify sources of mortality.

Global inventory needs
An accurate assessment of global abundance and trends is needed.

State inventory needs
Species distribution in the state is incomplete, needs study, including mapping of important burrowing habitat. An accurate assessment of the Alaska population is needed. Develop a monitoring program to identify and track population trends.

Global conservation and management needs
Develop programs to monitor recruitment and survey populations throughout species' range.

State conservation and management needs
Current needs include development of a statewide index, recruitment surveys and establishing a network of monitoring sites. Enhanced stewardship of Alaska's forage fish resources through education, public awareness and information exchange efforts should be a priority.

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