SUMMARY OF LIFE HISTORY OF PACIFIC SAND LANCE (*Ammodytes hexapterus*) AND ITS DISTRIBUTION IN RELATION TO PROTECTION ISLAND NATIONAL WILDLIFE REFUGE

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Pacific sand lance (*Ammodytes hexapterus*) is a significant prey species for certain seabirds, salmonid fishes, and possibly marine mammals. Rational management of this food base requires a knowledge of sand lance life history and habitat requirements. In particular, the sand lance resource available to the seabird populations of Protection Island is of interest because this island provides one of the few significant nesting habitats for rhinocerus auklet (*Ceratorhincus monoceras*) in the State of Washington. Knowledge of the distribution and habitat requirements of the local sand lance population is a natural complement to the preservation of auklet habitat.

All life history information published prior to May of 1984 on Pacific sand lance has been reviewed by Field (1984). Microhabitat preference, spawning behavior, and response to oil contamination has been studied locally (Pinto 1984; Pinto et al. 1984). Subjective evaluation of distribution, abundance, and importance to Protection Island seabirds based on incidental catches in WDF's annual herring trawl surveys, was provided by Washington Department of Fisheries (WDF) biologists Bob Trumble and Dan Penttila. The following summary is drawn from the above sources.

Pacific sand lance are commonly found along the Pacific Rim from Japan to California, in nearshore areas of less than 100 m in depth. This species, together with herring (*Clupea harengus*), comprises the major part of the neritic forage fish assemblage in Puget Sound. Sand lance do not appear to make large-scale seasonal migrations. Rather, they are associated throughout the year with areas having a sandy substrate, which they utilize for both cover and spawning.

The substrate provides cover during the dormant period which lasts from early fall to spring, during which the fish remain buried in the sand. Thus, their availability as prey for marine fish, birds, and mammals is limited to the spring and summer months when sand lance are actively schooling and foraging throughout the water column. Activity in Puget Sound appears to commence in late March. Timing of emergence from the substrate appears temperature-dependent but food availability could also play a role. Activity may start to decrease as early as August, as suggested by behavior of another *Ammodytes* species in the Atlantic. This decline may be related to fat buildup or to decreasing food availability. The sandy substrate also provides

nocturnal cover during that period of the year during which the fish are active, since sand lance exhibit diurnal movement into the substrate during hours of darkness.

Spawning occurrs once a year, apparently from early February to late March in the Puget Sound area. Spawning is apparently accomplished prior to adult entry into the water column. Sexual maturity occurred at age-I or II in individuals with a total length of 110 mm or more in a Japanese population of this species. Eggs are demersal and adhesive, and exhibit a tendency to disperse along the surface of the substrate and become coated with sand.

Preferred spawning habitat in laboratory studies consisted of fine sand free of mud or gravel. More specific habitat requirements may exist but have not yet been defined. Neither has the depth distribution of spawning been well defined for this species. The intertidal zone recieves at least a portion of the spawning activity, but the literature on Atlantic species suggests that Pacific sand lance spawning may occur primarily in the subtidal zone, down to a depth of several hundred feet.

Spawning distribution is of particular interest with a view toward habitat preservation, since various human activities have the potential of restricting the natural recruitment of sand to the marine environment. Such activities include walling off actively-eroding bluffs and dredging, filling, walling-off, or riprapping along naturally-shifting sandy beaches. The potential impact of developments of this nature on surf smelt (Hypomesus pretiosus), an obligate intertidal spawner, is fairly well understood in light of the available data on distribution and life history. The effects of development on sand lance cannot be accurately assessed because knowledge of its distribution, especially in regard to spawning, is relatively incomplete.

Incubation lasts approximately three weeks, after which larval fish of about 5 mm total length emerge. The larvae probably complete metamorphosis to the juvenile stage within three to four months, when a length of about 30 millimeters is reached, based on an Atlantic population of another Ammodytes species. Growth is accompanied by a shift in both the prey organisms and the habitat. Smaller individuals feed on phytoplankton and copepod nauplii but later shift to adult calanoid copepods. In Puget Sound these copepods appear to remain their primary food source throughout adulthood.

Juveniles may at times inhabitat shallower areas than adults. Juveniles have been observed over sandy beaches, kelp beds, and other nearshore areas. As the juveniles grow they assume the typical adult pattern of diurnal activity. Mixed schools of adults and juveniles have been observed inshore over mud or gravel bottoms during the day but more typical foraging habitat is characterized by sandy beaches in unprotected areas. Mixed schools of juvenile sand lance and herring have also been reported.

Several specific geographical areas of relatively high sand lance density may be of importance as food resources to seabirds, especially to rhinoceros auklets. Port Townsend Bay is undoubtedly the primary feeding area, due to its proximity to Protection Island (Figure 1). However, other sand lance concentrations are available that are within the presumed daily migrational range of an auklet. Such areas would include Ediz Hook, Dungeness Harbor, the western San Juan Islands, Fidalgo Bay, Admiralty Inlet, Port Susan, Holmes Harbor, Possession Point, and Kilisut Harbor. Discovery Bay and Sequim Bay and their adjacent sandy beaches appear relatively insignificant as actual sand lance habitat, despite their apparent suitability.

The sand lance population is not now considered to be in a depressed status attributable to human intervention, primarily because no fishery is operating on this species. Moreover, in the judgement of individuals involved in herring surveys, the occurrence of sand lance in annual experimental trawl catches has not exhibited a declining trend over the last several years. However, no estimates of the local population have been made. Large annual variations in year class strength can be expected, based on the occurrence of such variations in the Japanese and eastern Atlantic commercial and experimental catches.

The variations in abundance in other sand lance populations have been tentatively attributed to a variety of circumstances, most of them natural and uncontrollable. For example, red tide (Gonyaulax sp) infestations have affected populations of a sand lance species in Europe. Abundance of food has been suggested as a limiting factor in the survival of juveniles. Unsuitably high water temperatures and insufficient wave action during incubation have also been proposed in connection with a related Japanese species. Abundance at all life history stages may be influenced by predator density. This was apparently the case with sand lance in the eastern Atlantic, where the population increased with increased exploitation of cod, a major predator.

The primary human-related threat to sand lance abundance in Washington is considered that of petrochemical spills. Spawning habitat has been mentioned as the primary critical area, but the diurnal burrowing habit of this species subjects all but the larval stages to sediment-borne contaminants. Sand lance may be expected to avoid oiled sediments by moving into clean areas or to deeper waters, but such a shift in distribution could adversely affect local fisheries, marine birds, and mammals associated with sites such as Protection Island.

Additional information is needed regarding the distribution of spawning and resting habitat of this species in Puget Sound and the Straits of Juan de Fuca. Information on the microhabitat quality required for spawning (especially on sand texture and porosity) would also be of interest. Until such information is available, benefits of habitat protection will probably accrue only incidentally from efforts directed toward species that must use the intertidal zone of sandy beaches.

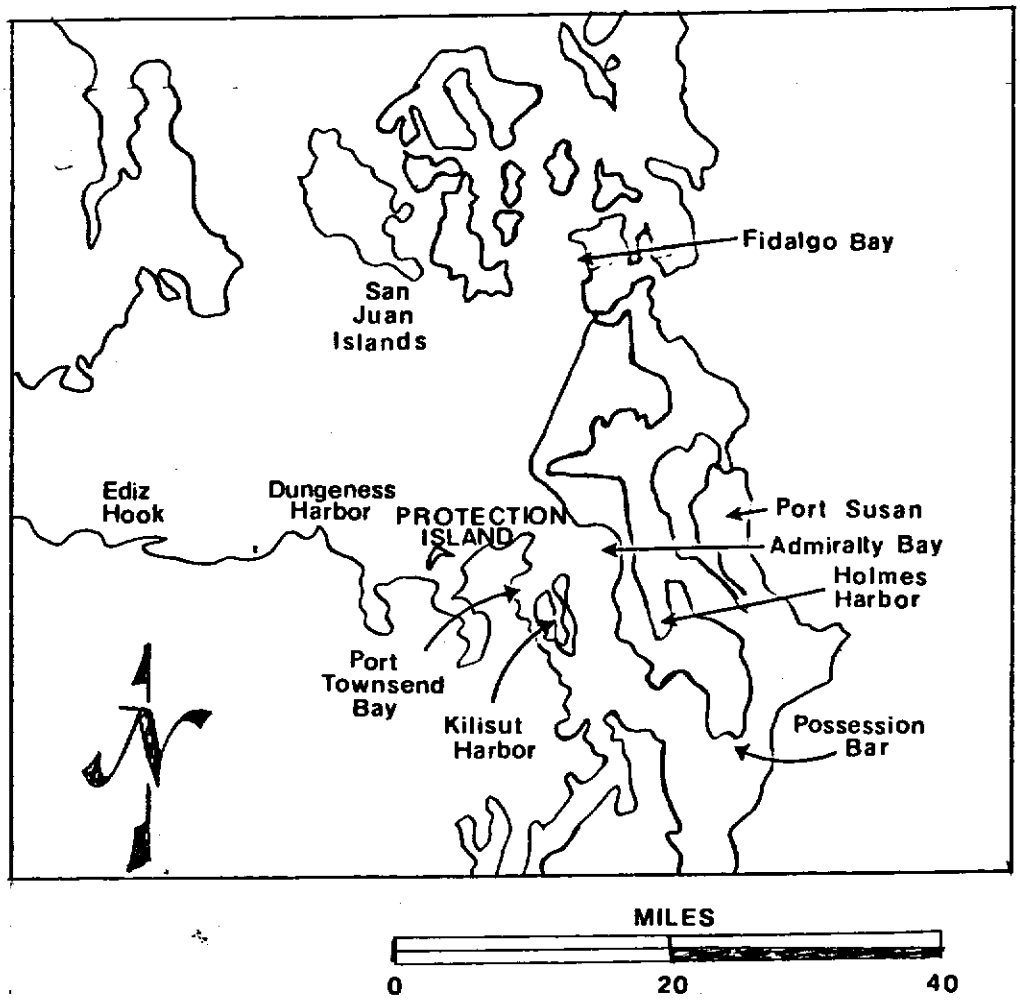

Figure 1. Principal areas of relatively high abundance of sand lance (Ammodytes hexapterus) in the vicinity of Protection Island, Jefferson County, Washington.

REFERENCES

Field, L.J. 1984. International recruitment investigations in the subarctic: species schemata: Pacific sand lance, Ammodytes hexapterus, and other Ammodytes species. University of Washington, School of Fisheries, Seattle.

Pinto, J.M., W.H. Pearson, and J.W. Anderson. 1984. Sediment preferences and oil contamination in the Pacific sand lance Ammodytes hexapterus. Marine Biology 83: 193-204.

Pinto, J.M. 1984 Laboratory spawning of Ammodytes hexapterus from the Pacific Coast with a description of its eggs and early larvae. Copeia 1984 (1):242-244.