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THE SAND SOLE

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INFORMATIONAL REPORT 83-1

Oregon Department of Fish & Wildlife

October, 1983

INTRODUCTION

The sand sole (*Psettichthys melanostictus*) is one of the finest quality sole species harvested by Oregon trawlers. It commands a correspondingly high price in the market, second only to petrale sole. The sand sole gets its name for its known affinity for sandy, shallow stretches of the ocean floor. A majority of the total annual catch of sand sole by Oregon trawlers is made off the northern Oregon and southern Washington coasts. Since 1969 annual landings in Oregon have fluctuated from a low of 314,000 pounds (142 mt) in 1974 to a high of 848,000 pounds (385 mt) in 1976.

DESCRIPTION

The sand sole is a member of the family Pleuronectidae, commonly known as the righteye flounders. Sand sole have the typical flattened body with both eyes on the right side and coloration confined to the eyed side. They are identified by their relatively large mouth, dark brown to gray or greenish coloration mottled with small black speckles, and the first few rays of the dorsal fin being long and mostly free of the fin membrane. The jaw extends to the middle of the eye.

REPRODUCTION

Sand sole, as a species, have a long spawning period with individuals spawning from winter to early spring in our region. In Washington waters, the majority of fish spawn from January through March. Probably fish have a similar spawning period elsewhere. There are some records of July spawning off British Columbia. Very little research has been conducted on sand sole reproduction, and information concerning fecundity (number of eggs per female) and age at reproductive maturity is presently unavailable.

EARLY LIFE HISTORY

The eggs of the sand sole are released by the female and subsequently fertilized by the male. Eggs are about 1 millimeter (mm) in diameter, pelagic (free floating), and clear. The eggs have a density slightly less than seawater. In Puget Sound, Washington eggs are most abundant in surface waters from January through March. They hatch in about 5 days at 7 to 9 degrees celcius. Sole hatch out quickly in a very primitive condition, followed by a relatively long period of larval development. Larvae grow from 3 mm in length to approximately 27 mm, at which size most have completed metamorphosis into the flattened juvenile form which looks much like the adult form. At this time the juvenile fish becomes essentially a bottom dweller. During the period of metamorphosis, the left eye migrates towards the right side of the head and the right eye shifts downward. The skull is twisted, but the jaw bones remain symmetrical. The most conspicuous change made after metamorphosis is the development of permanent pigmentation patterns. Larvae were found to be most abundant at depths of from 5 to 10 meters (16 to 33 feet) in Puget Sound. They are essentially at the mercy of prevailing currents during the egg and pelagic larval stages. The larvae and juveniles are usually found in the nearshore areas of the ocean, as well as in the lower reaches of some estuaries. In surveys of larval abundance out to 17 miles off the Oregon coast, sand sole ranked third in abundance of all flatfish larvae and sixth in overall larval fish abundance.

Although age at maturity is not known, the fish certainly spend at least one year and probably two as immature juveniles. Studies of juvenile food habits indicate that they feed exclusively off the bottom, primarily on mobile crustaceans.

ADULT LIFE HISTORY

Sand sole occur along the northeast Pacific coast from southern California to the Alaskan peninsula. It is truly a shallow water bottomfish, and has not been recorded from depths greater than 100 fathoms. The majority of the commercial catch is obtained from depths of 30 fathoms or less. Sand sole are found almost exclusively over sandy bottom, and appear to be generally distributed wherever this substrate type occurs.

Average size at age three is 25 centimeters (cm) for males, 28 cm for females; at age five it is 31 cm for males, 35 cm for females; at age seven, females average 37 cm. The maximum size record is 63 cm, or 24.8 inches. Early studies by Canadian researchers provide some insight into actual sand sole growth rates. A tagged 30-cm fish grew 2 cm in one year, while a 45-cm fish increased 2 cm in a two-year period. Aging of sand sole by our Department showed a maximum age of 10 years from fish collected during the early 1970's. Calculations based on this data showed sand sole to have the highest growth completion rate of eight flatfish species examined. Thus, the sand sole appears to be a relatively fast-growing and short-lived species compared to other flatfish found in our region.

Sand sole do not appear to make annual migrations of any great extent, but no detailed tagging study has even been conducted. A Canadian tagging study in the 1940's put out 91 tagged sand sole, with only 5 subsequent recoveries. Two of these fish traveled 25 miles in 63 and 65 days. Since these two movements were made after a November 22 tagging, it is possible that they represent a spawning migration since spawning generally occurs in late winter or early spring in this region. Three of the five recaptured fish moved 6 miles or more after tagging. There appears to be a shift to slightly deeper water in the fall and winter, possibly as a result of the frequent heavy turbulence encountered during these seasons in the very shallow nearshore zone preferred by the fish in the summer months. Sand sole feed primarily off-bottom, unlike many of the flatfishes. Adults are known to feed on fish such as sanddabs, herring, juvenile tomcod, and anchovies, as well as mysids (a shrimp-like crustacean), shrimps, squid and their eggs. Fish, especially herring, were found to be the most important prey items year-round in Puget Sound. Mysids and shrimp are seasonally important during summer months, while squid were preyed upon during winter months. Sand sole appear to feed actively throughout the year. Fish were found to be ingested tail-first in most cases.

FISHERY

A commercial bottom trawl fishery exists for sand sole off northern California, Oregon, and Washington. Off California, it is of very minor importance, while in Oregon and Washington, it forms a minor but valuable portion of the total sole catch. Oregon appears to have been the largest producer over the years, with Washington landings close behind. Annual Oregon landings averaged 571,500 pounds (259 mt) from 1969 to 1982, with peaks of

over 840,000 pounds (381 mt) in 1976 and 1982. Washington landings have averaged 401,000 pounds (182 mt) from 1975 to 1982, with a peak of 631,000 pounds (286 mt) in 1979. In Washington, an average of 68% of annual landings were harvested in coastal waters and the remainder from Puget Sound waters. California landings averaged 266,000 pounds (121 mt) from 1971 to 1976. In British Columbia waters, sand sole landings are insignificant, with incidental amounts landed from shallow inside waters. Of the 13 species of flatfish landed in Oregon in 1982 (including Pacific halibut), sand sole ranked sixth in pounds landed and fifth in value at approximately 445,000 dollars to the fishermen. Catch records show Astoria to be the leading producer of sand sole. This is probably because the nearshore region in the vicinity of Astoria has the broadest sandy bottom off Oregon. Newport landings ranked second and Coos Bay's third on the long-term average. Most of the commercial catch is made in the spring and summer. The majority of the summer catch is made in water depths of thirty fathoms or less. Because of its shallow water habits over sandy bottoms, gear conflicts sometimes exist between commercial crabbers' pots and the mobile trawl nets. This may keep the sand sole landings down somewhat by reducing trawling during the ocean crab season.

Recreational fishermen pick up an occasional sand sole when surf fishing or bottomfish fishing near the mouth of a bay, but it has not been a consistently important sport fish in Oregon.

ACKNOWLEDGMENTS

I wish to thank the commercial bottomfish fishermen and processors, without whom our knowledge of fish life histories would be much less.

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