THE ENGLISH SOLE

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INFORMATION REPORT - ENGLISH SOLE

INTRODUCTION

The English sole is a major contributor to Pacific Ocean trawl fisheries off the United States and Canada. Only Dover sole and sometimes petrale sole provide greater annual landings in Oregon.

English sole are considered fine eating sole and usually enjoy a good market. In British Columbia, local consumers of this popular fish have learned to relish the "iodine" flavor that can be detected in fish from some inshore waters.

In Canada it is known as the lemon sole because of its resemblance in shape and color to the lemon sole found off Europe. In California it has been called the point sole because of its characteristic pointed head.

The development of the Oregon trawl fishery in the late 1930's produced the first large landings of English sole. Demand for English sole increased during World War II and Oregon landings peaked at about four million pounds in 1946. There was an abrupt drop in landings in 1949 to about one million pounds reflecting a declining demand for bottom fish. Since then, annual landings have fluctuated around two million pounds with the exception of low landings in the mid 1950's and an exceptional 3.5 million pounds in 1966.

Total U.S. and Canadian landings have maintained a ten-year average of 10 million pounds a year. Oregon ranks third in production with California leading in annual landings.

DESCRIPTION

English sole are easily recognized by their pointed head and jaws. Both eyes are on the right side. The fish is slender and pointed, with brown color restricted to the right side; its left (blind) side is pale yellow to white, tinged with reddish brown, especially on the head.

Mature females can be sexed by "candling". When a mature female is held up to the light the long ovary can be seen from below the stomach area tapering toward the

tail. The absence of this feature in fish caught by commercial trawl almost always indicates a male. Immature fish are usually sexed internally. The immature male gonad is similar to the larger gonad found in a mature male and is a solid, bean-shaped organ found at the back part of the stomach cavity. The ovary of an immature female is small and pink and contains a hollow center.

REPRODUCTION

Some Oregon female English sole mature after 3 years (12½-inches) and most are mature at 4 years of age. Most males mature at about 10¼-inches and 4 years of age. California English sole mature about one year earlier. Egg production increases with size of fish from about 150 thousand (12-inches) to 2 million (17½-inches) per female.

Spawning occurs from December through April but the majority off Oregon spawn in December through February. Spawning fish are concentrated in somewhat deeper water than is the case during the summer. At Cape Lazo off British Columbia, a mean spawning depth of 42 fathoms has been observed.

EARLY LIFE HISTORY

The eggs are small and average about 1/30 inch (0.9 millimeters) in diameter. These transparent white to pale bluish-purple eggs drift with currents. Time of hatching depends upon water temperature but generally starts after 90-98 hours, and continues for about 10 hours for a batch of eggs. Upon hatching, larvae are almost 0.11 inch (2.8 millimeters) long.

The young fish are at the mercy of water movement for 6-10 weeks. The fish then metamorphose to the adult form; that is, the left eye "migrates" to the right side of the head, the body takes on the flattened appearance and the fish assumes a side swimming behavior. They then settle to the bottom.

Reproductive success varies from year to year. The Canadians have found that

population survival of young is related to development time, and possibly extremes in water temperature and transport by water movements from spawning grounds to nursery grounds.

Their early life is spent in protected inshore areas, bays and estuaries. With growth the fish move into deeper water. Several Oregon bays are apparently important nursery areas for fish during their first year of life.

ADULT LIFE HISTORY

Distribution and Abundance

English sole occur from Baja California to Unimak Island in western Alaska. They are found to a depth of 300 fathoms although commercial quantities are normally found at less than 90 fathoms. Largest catches typically occur between 30 and 70 fathoms. Major areas of abundance are found from Santa Barbara, California to northern Hecate Strait, British Columbia. English sole are also the most abundant of commercially important flatfish in the Puget Sound area.

There is a shift of the adult concentration to shallow water in spring and back to deeper water in winter. Research was done by the Oregon Department of Fish and Wildlife in 1967 and 1968 off the Columbia River. Adults were found in 10 to 40 fathoms in August but in winter they were found in 20 to 50 fathoms. Canadian studies showed that adult English sole are generally found around 20 fathoms in the summer and 40 fathoms in winter.

English sole occur almost entirely over sand bottoms or mixed sand and mud bottom. Aquarium observations of juveniles suggested that, given a choice, they bury themselves thus limiting them to a sand bottom into which they can easily "burrow".

In the area from the Columbia River to Cape Blanco in 10 to 100 fathoms we estimated there were about 42 million pounds of English sole, but only about 14 million pounds of this is usable or available to the fishery. Our data suggests a

sustainable yield of approximately 3-4 million from the survey area without harm to the English stocks.

Three million pounds of English sole is not a magic number. Allowable commercial catch will vary with the status of the fish and the fishery. If we have one or more very successful year classes, the commercial harvest could be increased. Likewise the catch would require reduction following year class failures. Since English sole males are now underharvested, development of a commercial use for small males could also increase the sustainable catch.

Feeding Habits

English sole have a small mouth with incisor teeth best suited for cutting. Their diet consists mainly of small bottom organisms, such as clams and clam siphons, other small molluscs, marine worms, small crabs and shrimp, brittle stars and occasionally other invertebrates and small fish.

Migrations & Tagging

Tagging has provided evidence of segregated major stocks. Most tag recoveries occurred near the tag release site, indicating little exchange between most stocks. Some tagged English sole made extensive migrations, suggesting a small highly migratory element. Extensive migrations were more usual of females than of males.

Probable factors affecting migration are the necessity to concentrate for spawning, and dispersal for summer feeding. In Canada, English sole have generally been found to travel against currents to reach spawning areas and to disperse with the current for feeding. Most Washington and California tagging showed fall southerly movement with a return migration in the spring. A portion of the stocks displayed little north-south movement.

About 4,600 English sole were tagged and released at 58-71 fathoms off Cape Lookout, Oregon in April 1975. Tag returns have shown a concentration of fish off central Oregon and a second off northern Washington. There is evidence of a resident

(fish that don't migrate) population and a spawning concentration in both areas. Also, a portion of the fish migrate between the two areas. These conclusions are supported by tagging off northern Washington.

Some interesting highlights from our tagging program were that 755 fish were recovered (16.4%) and that the greatest speed of travel was 125 miles in 56 days or 2.2 miles per day. Most distant movement was confined to the north, but recoveries came from Cape Flattery, Washington to Eureka, California. The deepest recovery was in 200 fathoms off Eureka California. The furthest movement was southwest of Eureka about 265 miles from the tagging site.

California, Oregon, Washington and Canada have tagged English sole. Tag returns provide valuable information on movement and stock size. Tagging is costly when considering cost of tags, vessel time and man hours. Therefore, tag recoveries are valuable and we must obtain as much good, complete information as possible. Full recovery data includes date and location of capture (loran and depth), tag number, sex and length of fish. We also like to obtain the fish to determine sex and age.

As an incentive for good tag recoveries, all English tagging programs offer rewards and information regarding tag release-recovery information.

Age and Growth

The interopercle bone is used to determine age of English sole. This is a thin flat bone found on the gill cover. The bone is "aged" much like a tree. The prepared bone displays broad opaque bands representing rapid summer growth separated by narrow translucent bands of slow winter growth. The bone is aged by counting the number of winter growth bands.

While English sole are one of the smaller commercially used flatfish, the record female was measured at 22.5 inches and the largest male measured 19.3 inches. The oldest female and male English sole we have aged were 17 years old.

The growth rate is about the same for both males and females during the first

two years. By the end of the first summer young English sole are 4 to 5 inches long. They are 8 inches long by the end of their second year of life. Thereafter, females grow much faster than males, and females become larger than males in head length, total length, and body depth. Few males ever attain commercial size.

English sole first enter the commercial fishery at the age of three. At this time they are about 12 inches long and weigh 1/2 pound. Usually 4 through 7 year old fish support the bulk of Oregon landings for fillets. These fish average about 13 to 15 inches and weigh 3/4 to 1 pound. Male English sole, being much smaller than the females, are usually discarded at sea or utilized as mink food.

Mortality

Mortality (death) rate is high for fish and is made up of fishing and natural mortality. A yearly mortality of about 32% for male and 36% for female English sole occurs off Oregon. Since our commercial fishery mostly catches or retains female English sole we would expect greater total mortality on females.

Diseases and Parasites

English sole are attacked by several diseases. A protozoan (one celled animal) causes "milky" flesh and destroys market acceptability. This disease is not toxic to humans, however.

Red colored nematode "worms" may infest the flesh and inner margins of the fin rays. This produces an unappetizing appearance that usually causes the fish to be unmarketable. These "worms" are not harmful to man.

THE FISHERY

Oregon trawlers usually fish for English sole inside of 50 fathoms. Our survey work during the last five years has shown major areas of English sole abundance from Cape Foulweather south to Coos Bay and from Tillamook Head to Destruction Island. Good catches are also made off Brookings. There are several major fishing areas both north and south of Oregon as well.

Small English sole are particularly vulnerable to the trawl because of their protruding anal spine. Many of these small fish are mistaken for juveniles and discarded at sea, but the great majority are actually mature males. Males are therefore underutilized; in fact, we have observed that under 25% of males as old as 13 years are kept. In comparison, over 30% of females are utilized at age 3 and 80% are utilized at 5 years old.

Strong year classes have greatly affected the commercial catch. A strong year class is an exceptionally large number of fish that result from a single years' spawning.

The 1961 year class was the strongest English sole year class noted for Oregon. These fish dominated the landings in 1966 when Oregon trawlers landed an impressive 3.5 million pounds and continued to dominate the catch for the next three years. In 1975 we observed an impressive number of these fish in the catch which were then 14 years old. Lately we have not found exceptionally strong year classes, but they would not appear in our surveys for at least 3 years and in the commercial landing for about 5 years after birth.

Most English sole are filleted and sold fresh. They also are often used as mink food; however, market problems in the U.S. mink fur industry in recent years have made this a relatively minor market.

MANAGEMENT

Juvenile English sole could possibly benefit from protected "nursery" areas, but unfortunately they are found in the same areas as mature fish, such as sanddabs and sand sole. We feel management is best served by mesh size regulations. Through mesh regulations we attempt to allow the escapement of most juveniles without overly hampering the catch of mature marketable fish.

ACKNOWLEDGEMENTS

We want to thank the fishing industry for its aid. Much of our knowledge of the English sole and its fishery has been obtained through industry help, including logbook records and returns of tags.