

THE DOVER SOLE

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INFORMATIONAL REPORT - DOVER SOLE

INTRODUCTION

The Dover sole has been the most important flatfish in Oregon's trawl fishery since its beginning in 1938. At that time the fish was called slime sole, because the animal produces great quantities of the stuff. The term Dover sole apparently comes from the north Atlantic where a similar creature lives.

Oregon landings of Dover sole have fluctuated substantially over the years but the Dover sole has always been the dominant flatfish in trawl landings. The major reason for this is the excellent keeping quality once the fillet is frozen. It is also quite abundant off Oregon, and an excellent eating fish. Last year (1974), landings of Dover sole in the northeastern Pacific totalled nearly 28 million pounds, of which Oregon's share was 5.6 million pounds. The largest share was landed in California, 19.1 million pounds. In recent years, 1964-73, the peak year of production was 1972, when 5.9 million pounds were landed in Oregon ports.

In the winter of 1948 biological information was first gathered from Dover sole landed in Oregon. The information obtained was length, weight, sex, age and maturity. Along with other studies, the information obtained from sampling has supplied a substantial body of knowledge about the biology of this flatfish.

REPRODUCTION

Dover sole females are 12 inches in length and about 6 years old before they first spawn. By the time they are 17 inches in length and 12 years old they are all mature. Males reach maturity at 12 inches in length at an age of 6 years.

Spawning takes place apparently at specific sites in the deeper off-shore waters between 200-400 fathoms, perhaps deeper. The period of spawning ranges from November to March or April but the peak occurs in January.

The number of eggs produced annually by a single female will range from about 52,000 to 266,000 depending on the size of the fish. Larger fish produce more eggs than smaller fish.

EARLY LIFE HISTORY

Larvae

Eggs, about 3/32 inches (2.25 millimeters) in diameter hatch several weeks after spawning. Most larvae will spend nearly a year in the water column before settling to the bottom to assume life on the sea bed. During the time larvae are in the water column they are at the mercy of currents and even though they may move actively up and down in the water column the movement inshore-offshore and north-south is mainly by currents. Larvae have been found out to nearly 300 miles offshore.

Before the larvae settle to the bottom, they undergo drastic changes in form. When hatched they look much like any other fish larvae but then the left eye gradually "migrates" over to the right side of the head and the width of the body becomes much less. Most larvae are about $2\frac{1}{2}$ -inches in length when they assume the bottom life, but are now called juveniles. Off the Columbia River, settling out occurs in January and February (about a year after they were spawned) near the edge of the continental shelf.

Juveniles

By mid-summer of the first year on the bottom young Dover sole are found mostly inside of 60 fathoms with the bulk of young fish found between 30 and 50 fathoms. By fall, in their first year on the bottom they will have grown to about $4\frac{1}{2}$ -inches in length.

ADULT LIFE HISTORY

Distribution

Dover sole occur from Baja California to the eastern Bering Sea. Areas of major abundance are off northern California, Coos Bay and the Columbia River. They are also fairly abundant off northern Washington and British Columbia.

Adults rarely are found inside 20 fathoms. They range to at least 600 fathoms deep. They show a strong preference for mud and muddy-sand bottom.

During the spawning period most fish will be found between 200 and 400 fathoms. After spawning most females return to shallower water and summer feeding grounds while large numbers of males remain in the deeper water. Based on survey catches in 1974 off Coos Bay the percentage of males at depths less than 110 fathoms was 42% but at depths greater than 110 fathoms the percentage of males nearly doubled to 82%. Samples of the landings show a similar picture. These deep water males make up a substantial portion of the summer fishery off southern Oregon-northern California.

Age and Growth

Dover sole live to a ripe old age - at least to 30 years, but fish of this age are rare. Age is determined by counting annual rings that are laid down on scales. The otolith or ear bone is also used to determine age. The rings (called annuli) actually are narrowing "bands" of growth formed in winter when the fish (and scales) grow more slowly than in other months. At the end of the second year of life Dover sole are about $4\frac{1}{2}$ -inches in length. At age four when they begin to enter the fishery they are about 9.5 inches in length and weigh 0.3 pounds. At age 8 when most fish are of a size to be retained by trawl nets they are 14 inches in length and weigh 1 pound. By now the females are considerably larger than the males and this difference in size increases throughout the life of the fish. At an age of 20 years females are 21 inches in length and weigh about 3.2 pounds but males are only 18 inches in length and weigh about 1.9 pounds.

The age of Dover sole differs by port, not so much because of market conditions or size limits, but more because of how long a fishery has been operating. For example, in 1967 the average age of fish landed in Coos Bay was 10.6 years while in Astoria it was 9.5 years. In 1974 the average age was 10.0 years in Coos Bay and 10.1 years in Astoria. What happens is that an unfished stock has many old fish, which are largely eliminated after a few years. The faster growth of younger fish then "compensates" for the fishery - caused reductions and a more or less stable population of medium age fish then supports the fishery. Incoming year-classes of comparatively abundant young fish also balances the steady removals of older fish.

Another factor that changes the age composition and affects landings is brood strength or year class strength. For example, the fish hatched in the winter of 1961-62 were more abundant than in any year since 1943. The 1961 year class was also dominant in several other species of fish. The exact cause of an exceptionally strong or weak year class is not well known, but we believe that the success or failure of a year class mostly takes place during the egg and larval stage. It probably is dependent on the ocean environment which may be much more favorable (or unfavorable) some years than in others.

Migrations

Tagging studies off the Columbia River and off Coos Bay indicate that Dover sole do not generally make long migrations. Fish tagged on spawning grounds show an inshore northerly movement, but this applies mostly to females. Males show little movement. In the Coos Bay area, fish tagged just north of Cape Blanco show some movement to the south of Cape Blanco, but fish tagged further to the north show little movement south of Cape Blanco. This supports our belief that water mass differences at about Cape Blanco act as somewhat of a "barrier" to fish mixing north and south of that area.

Incidentally, the longest a tagged Dover sole has been at liberty was 14 years and 59 days. This fish had been tagged in March 1955 in Willapa Deep. It was caught in June 1969, 18 miles inshore from where it was tagged.

Feeding Habits

Larval Dover sole feed on plankton but once on the bottom feed exclusively on small invertebrate animals like worms and especially a small clam-like animal. The teeth of Dover sole are incisors much like our own front teeth and best suited to snipping or grazing type feeding.

Aquarium observations on feeding behaviour show that they tend to pounce on their prey after slowly stalking what they will eat. The eyes move independently of each other but, just before they grasp food, both eyes rotate forward and the animal looks right over its nose.

THE FISHERY

The distribution of Dover sole is such that most fish are caught beyond depths of 40 or 50 fathoms. The areas of major abundance are adjacent to the Columbia River and off the bight from the southern edge of Heceta Bank to the bank off Bandon. Considerable quantities are also found inshore of Heceta Bank off the Siuslaw River.

From a study conducted in 1974 aboard commercial drag boats, we documented that a certain portion of fish caught were discarded at sea. On the average 78% of the females and 62% of the males were utilized. In deeper water nearly all fish caught were utilized, but in shallower water where juveniles occur the utilization was less. This was related to market imposed limits on size (length) of fish desirable for filleting and sole.

Based on the groundfish surveys of 1971-74 between the Columbia River and Cape Blanco, stocks of Dover sole could support a fishery of 7-8 million pounds annually. These figures are conservative but we feel they are realistic.

In a study of the stocks off the Columbia River preliminary results indicated that if the age at first capture was age 5 (instead of 4) there would be a 6% increase in yield from a given population of fish. This study took into account the rate at which fish grow and the rate of death caused by fishing as well as natural causes. Mesh size is the key factor here. A larger mesh, say 5 inches between knots, would nearly eliminate small fish from the catch, but this saving has to be weighed against the loss in yield of other desirable species such as rex sole, sanddab, and English sole because these fish are smaller sized than Dover sole.

ACKNOWLEDGEMENTS

We want to thank the Oregon drag fishermen for their conscientious and generous help over the years in adding to the scientific knowledge of Dover sole and other fishes. Their logbook information especially has been an essential aid in our knowledge of distribution, life history, and catch as well as estimates of abundance of the resource and year classes.