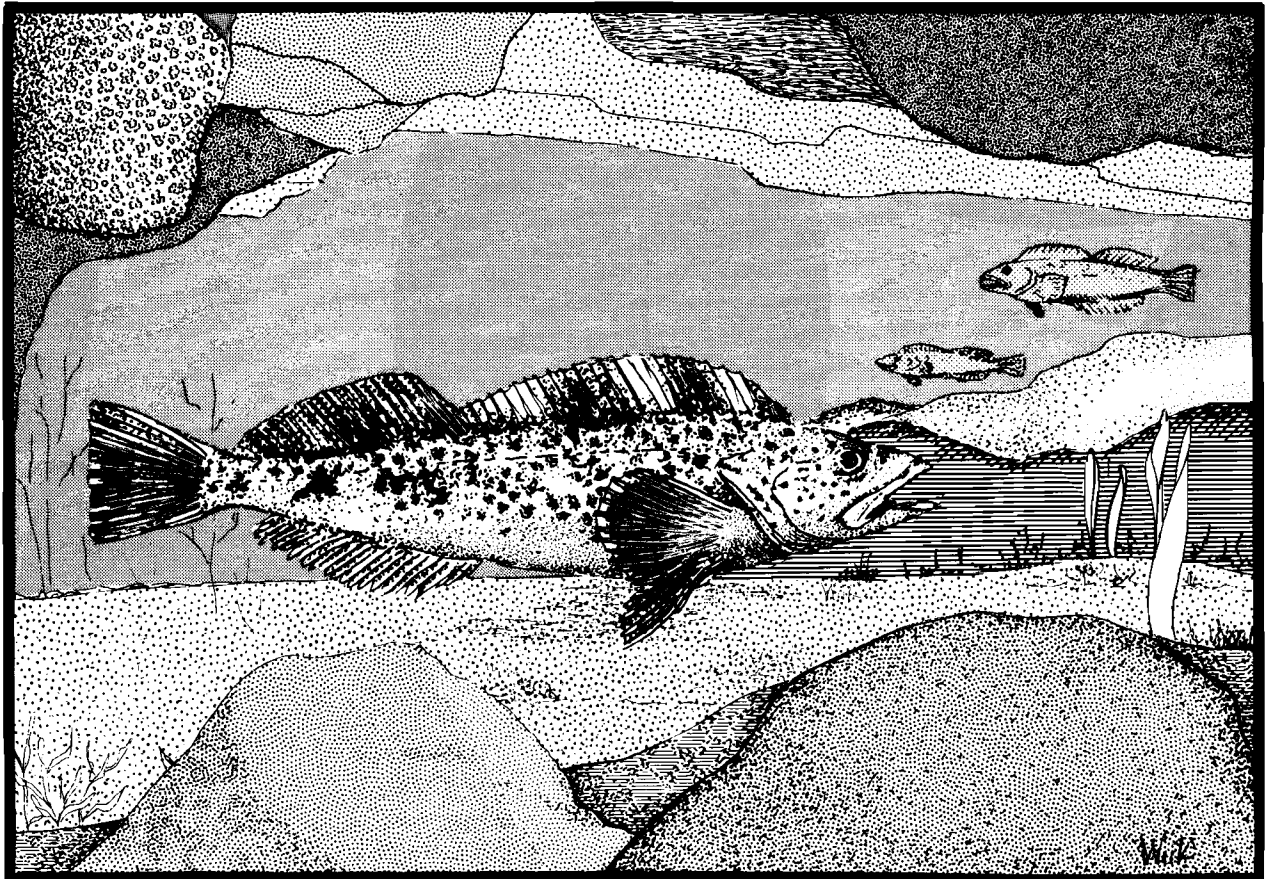


Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Northwest)

LINGCOD



Fish and Wildlife Service
U.S. Department of the Interior

Coastal Ecology Group
Waterways Experiment Station
U.S. Army Corps of Engineers

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of Coastal Fishes and Invertebrates (Pacific Northwest)

LINGCOD

by

William N. Shaw
Fred Telonicher Marine Laboratory
Humboldt State University
Trinidad, CA 95570

and

Thomas J. Hassler
U.S. Fish and Wildlife Service
California Cooperative Fishery Research Unit
Humboldt State University
Arcata, CA 95521

Project Officer
David Moran
U.S. Fish and Wildlife Service
National Wetlands Research Center
1010 Gause Boulevard
Slidell, LA 70458

Performed for
Coastal Ecology Group
U.S. Army Corps of Engineers
Waterways Experiment Station
Vicksburg, MS 39180

and

U.S. Department of the Interior
Fish and Wildlife Service
Research and Development
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DISCLAIMER

The mention of trade names does not constitute endorsement or recommendation for use by the Federal Government.

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PREFACE

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A three-ring binder is used for this series so that new profiles can be added as they are prepared. This project is jointly planned and financed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Suggestions or questions regarding this report should be directed to one of the following addresses.

Information Transfer Specialist
U.S. Fish and Wildlife Service
National Wetlands Research Center
NASA-Slidell Computer Complex
1010 Gause Boulevard
Slidell, LA 70458

or

U.S. Army Engineer Waterways Experiment Station
Attention: WESER-C
Post Office Box 631
Vicksburg, MS 39180

CONVERSION TABLE

Metric to U.S. Customary

<i>Multiply</i>	<i>By</i>	<i>To Obtain</i>
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
meters	0.5468	fathoms
kilometers (km)	0.6214	statute miles
kilometers	0.5396	nautical miles
square meters (m ²)	10.76	square feet
square kilometers (km ²)	0.3861	square miles
hectares (ha)	2.471	acres
liters (l)	0.2642	gallons
cubic meters (m ³)	35.31	cubic feet
cubic meters	0.0008110	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	2205.0	pounds
metric tons	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees (° C)	1.8 (° C) + 32	Fahrenheit degrees

U.S. Customary to Metric

inches	25.40	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
statute miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft ²)	0.0929	square meters
square miles (mi ²)	2.590	square kilometers
acres	0.4047	hectares
gallons (gal)	3.785	liters
cubic feet (ft ³)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28350.0	milligrams
ounces	28.35	grams
pounds (lb)	0.4536	kilograms
pounds	0.00045	metric tons
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees (° F)	0.5556 (° F - 32)	Celsius degrees

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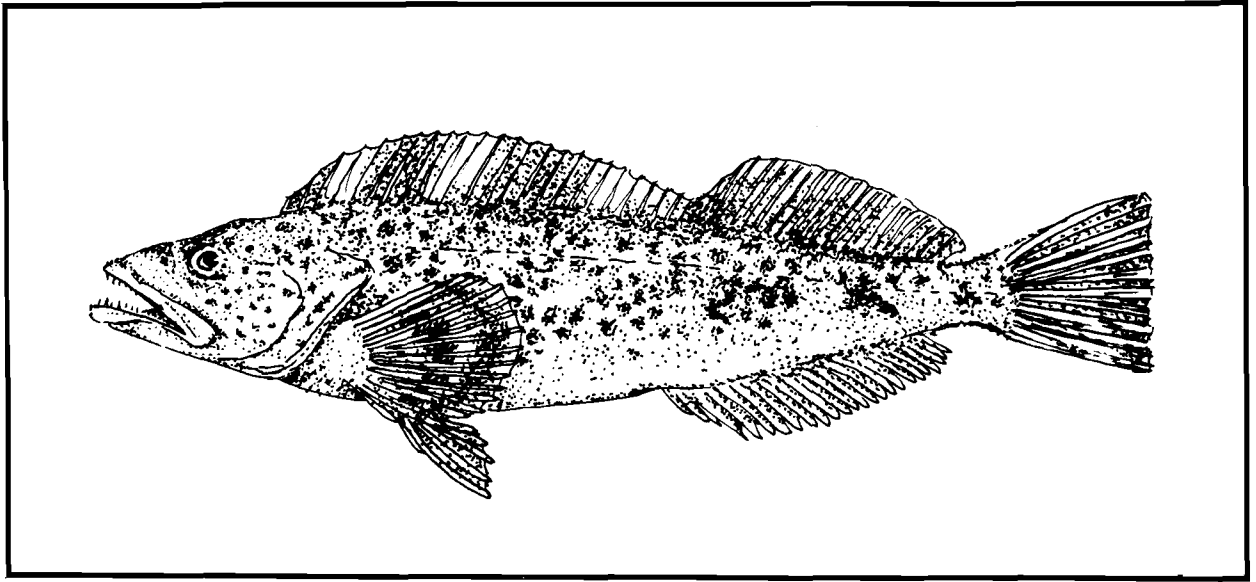


Figure 1. Lingcod.

LINGCOD

NOMENCLATURE/TAXONOMY/RANGE

Scientific name *Ophiodon elongatus*
 Preferred common name lingcod
 (Figure 1)
 Other common names cultus cod, blue
 cod, bluefish, green cod, buffalo cod, bocalao,
 greenling, white cod (Roedel 1948)
 Class Osteichthyes
 Order Scorpaeniformes
 Family Hexagrammidae

Geographic range: Pta. San Carlos, Baja
 California, to Kodiak Island, Alaska (Miller
 and Lea 1972; Figure 2).

MORPHOLOGY/IDENTIFICATION AIDS

Lingcod are elongated fish tapering toward
 the caudal peduncle. They are recognizable by
 a long single moderately notched dorsal fin,
 large mouth, large teeth, thoracic pelvic fins,

and small cycloid scales that cover the body and
 head (Hart 1973).

Dorsal fin rays XXIV-XXVII, 21-24, spinous
 part slightly incised; anal III, 21-24, spines in
 adults buried in flesh; pectorals much expanded;
 pelvics I, 5; vertebrae 55-57 (Hart 1973).
 (Note: Miller and Lea (1972) reported dorsal
 fin rays XXV-XXVIII, 19-24 and vertebrae 56-
 58.) Color varies from gray-brown to green and
 bluish, with darker spotting and mottling on
 upper parts (Miller and Lea 1972). Juveniles
 may retain fluorescent grid marks for 3 months
 (Phillips and Barraclough 1977). Total length
 to 152 cm. Body depth about 1/4.5 (standard
 length (SL)); head large, conical, depressed, its
 length about 1/3 SL (Hart 1973). Mouth
 terminal, large with great gape, directed slightly
 upward. Maxillary extended beyond posterior
 part of eye with lower jaw projecting. Teeth
 large, canine. Eye oval, rather small, length
 about 1/6 (length of head). Gill membranes
 briefly united anteriorly, free from isthmus.
 Anal papilla in male.

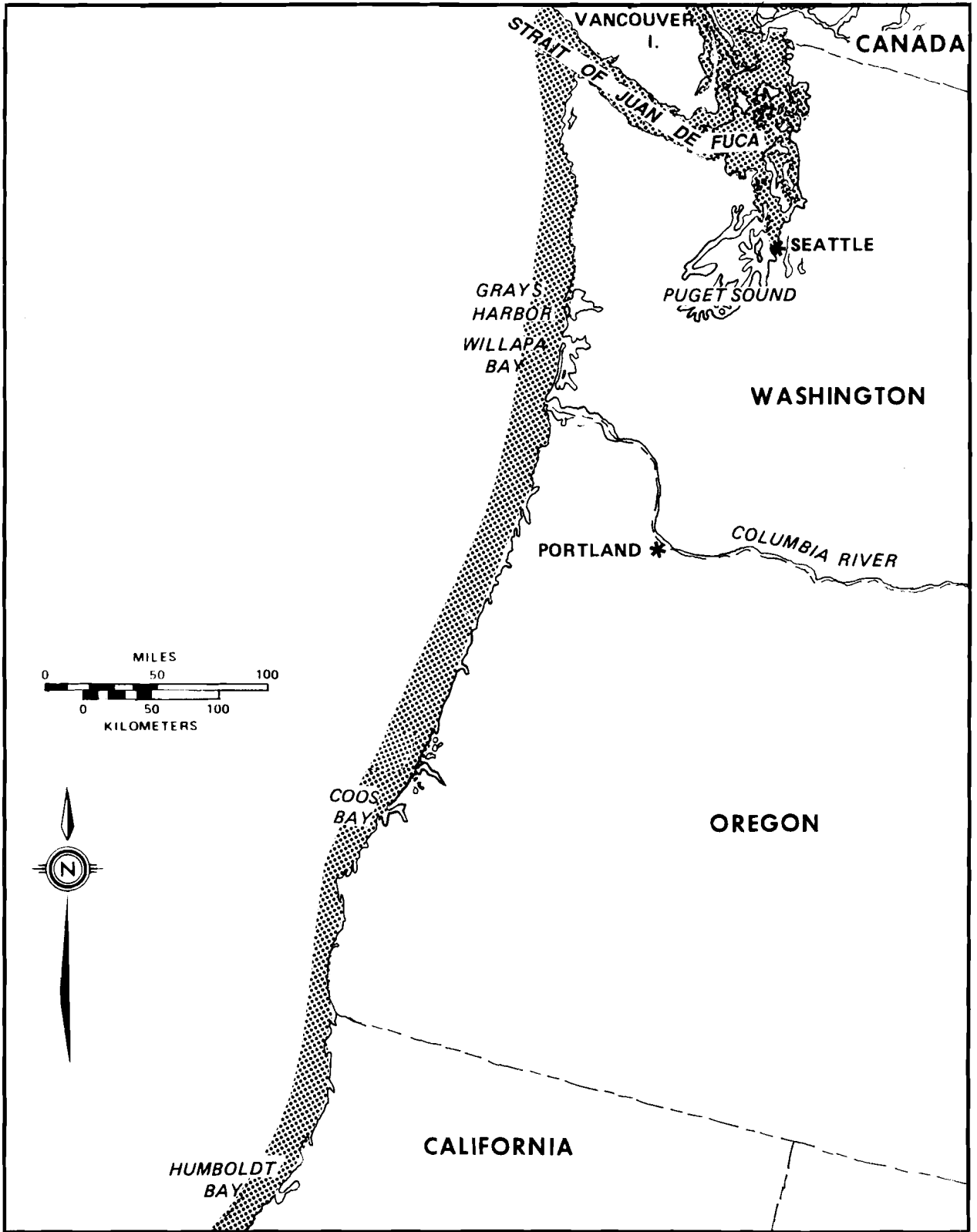


Figure 2. Distribution of lingcod in the Pacific Northwest.

REASONS FOR INCLUSION IN SERIES

The lingcod is an important sport and commercial fish, highly esteemed in the fresh seafood market. It occupies a special coastal niche generally in rocky locations and sand bottoms where there is considerable current (Wilby 1937). Any disruption of the coastal habitat by humans could seriously affect this important fishery. Consequently, careful consideration must be given to any proposed coastal manipulation.

LIFE HISTORY

Spawning

Biological information about lingcod was summarized by Wilby (1937), Miller and Geibel (1973), and Bargmann (1982). The spawning season extends from about mid-December to mid-March, although most of the fish have laid their eggs before the end of January. Prior to spawning time, males move into the nesting area to establish territories (Bargmann 1982). Females are rarely seen on the spawning grounds, and are assumed to move into the area long enough to deposit their eggs and leave (Adams 1986). Females deposit their eggs in crevices between large rocks or slightly under a boulder or rocky shelf from 3 to 10 m below the lowest tide level and where there are strong currents (Wilby 1937). A transparent, yellowish, highly viscous secretion is extruded with the eggs which, upon contact with salt water, forms a strong adhesive for the attachment of eggs to the rocky surface. Each time the female lays a layer of eggs, the male fertilizes them with short successive jets of milt. When spawning is completed, the female leaves the area and the male remains to guard the eggs.

Lingcod eggs are about 2.8 mm in diameter when first extruded but swell to about 3.5 mm shortly after contact with water (Forrester 1969). A female 76 cm long and weighing 4.5 kg had about 60,000 eggs, and another that was 92 cm long and weighed 11.1 kg produced about 518,000 eggs (Wilby 1937). Hart (1967)

reported that a 100-cm female carried about 290,000 eggs. An egg mass, after being laid, can be up to 5 liters in volume (Giorgi and Congleton 1984). The exact incubation time is not known (Wilby 1937) but has been estimated to be 6-8 weeks (Jewell 1968).

Larval Stage

Larvae are about 7-11.5 mm long at hatching (Figure 3). The yolk sac is absorbed about 10

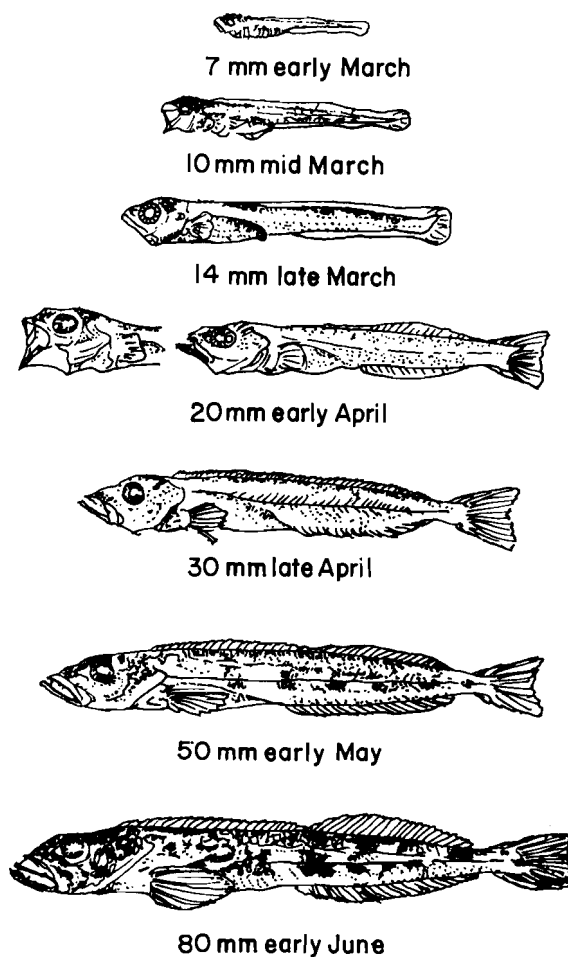


Figure 3. Development of lingcod from their first appearance in the surface plankton to their disappearance from inshore surface waters off British Columbia (from Phillips and Barraclough 1977).

days after hatching. The larvae can be identified by the small yolk sac, bright yellow oil globule near the liver, large blue eyes, elongated body, large mouth, and bright green gallbladder (Wilby 1937; Forrester 1969). Larvae are extremely active and move rapidly along the bottom. They feed on small copepods and copepod eggs; as they grow, their diet expands to include larger copepods, fish larvae, and larvaceans which are a type of pelagic tunicate (Grosse 1982).

Juvenile Stages

Juvenile stages have been extensively studied by Phillips and Barraclough (1977) for the area around Vancouver Island, Canada. While in these open waters, they grow about 1 mm per day. Around 70-80 mm long, the juveniles congregate in inshore locations. Small juveniles shift their feeding from zooplankton, mainly copepods, to juvenile herring. Captive juveniles held in aquariums keep their fluorescent grid marks for 3 months. The captive fish grow rapidly when fed live or frozen juvenile fish (Phillips and Barraclough 1977). In the Strait of Georgia, the total length (TL) of juvenile lingcod are 1-3 cm by April and 17-35 cm by December; the average is 27 cm by the end of the first year of life (March) and 47 cm at the end of the second year.

Adult Stage

Males mature at a smaller size and younger age than females. Wilby (1937) observed that the smallest mature male was 52 cm TL and the smallest female 77 cm. Phillips (1959) observed that both male and female lingcod start to mature at 58 cm TL and that practically all were mature at 65 cm. Forrester (1969) stated that the smallest mature male was 46 cm TL (age II) and female 70 cm (age V). Adult lingcod can be sexed externally: males have a distinct papilla just forward of the anus.

The life span is shorter in male lingcod than in females. Males live to an average of 12

years and females 15 years (Forrester 1969) or males 14 years and females 16 years (Phillips 1959).

GROWTH AND SIZE AT AGE

Fin rays, scales, vertebrae, and tag and recovery data have been used to estimate the age and growth of lingcod. Phillips (1959) reported that the use of scales and otoliths to estimate age was unsuccessful but that vertebrae showed promise. Chatwin (1954, 1956) used vertebrae to estimate age; Beamish and Chilton (1977) used fin rays successfully but wrote that the use of scales to age fish older than age V was difficult. Chatwin (1956) found that age determinations from vertebrae yielded growth curves similar to those of tagged lingcod.

The average length attained at different ages (estimated from vertebrae) for male and female lingcod from British Columbia waters is shown in Figure 4 (Chatwin 1954, 1956).

At age III, differential growth between sexes in some populations becomes more marked; females are about 58 cm long and males slightly smaller (Forrester 1969). Miller and Geibel (1973) aged California fish using otoliths. They found that a 3-year-old lingcod of either sex averaged around 50 cm TL, but thereafter male and female growth patterns diverged widely (Figure 5).

THE FISHERY

Lingcod are consistently caught along the Pacific coast. From 1948 to 1967, the total average annual catch was 4,775 t: 579 t from California, 1,778 t from Washington, and 2,063 t from Canada (Miller and Geibel 1973). Total catch from the United States was 4,046 t (valued at \$2.3 million) in 1984, and 3,672 t (valued at \$2.2 million) in 1985. In both years, the catch off Washington was the largest--2,038 t in 1984 and 1,931 t in 1985 (Korson 1986). The commercial landings of lingcod off Washington from 1970 to 1985 ranged from a

