Life History Information on Some Groundfish Species

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FISHERIES RESEARCH BOARD OF CANADA

TECHNICAL REPORT NO. 105

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Biological Station, Nanaimo, B. C.

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INTRODUCTION

Investigation of the groundfish resources off the west coast of Canada has been conducted by Fisheries Research Board personnel since 1943. A large amount of information on the species involved has been accumulated in the 25 years since then. Much of it has been reported in formal publications, but much remains in "file" status. During this period the magnitude of the fisheries has grown from an annual catch by Canadians of about 25 million lb in the years 1945-49 to between 40 and 50 million lb annually during the period of 1964-68. In addition to the Canadian catch, there is a slightly larger catch of the same species by the United States vessels which exploit the same stocks. Recent years have also seen the development of intensive fishing operations by fleets of Japanese and USSR trawlers off the west coast of North America (Ketchen, 1968). With this broad interest in the groundfish resource, it seems desirable to consolidate available information on the life histories of the species being exploited.

As can be seen in the extensive bibliography, much of the information contained herein has been previously published, but some has not. The information for each species is not complete and information on many commercially important species is still needed. The manuscript does not pretend to be definitive and should be considered as only a preliminary summary of the biological information available on the groundfish species and their fishery.

ACKNOWLEDGMENTS

The material in this report, while still far from complete, represents an enormous amount of work by a number of workers. The list of authors might well include most of the personnel who have worked in the groundfish investigation in the past 25 years.

ENGLISH OR LEMON SOLE — Parophrys vetulus Girard 1854

Distinguishing Characters: Long pointed head, dorsal branch to lateral line, scales on lateral line, 89 to 105; high ridge in narrow space between eyes. Colour, yellowish-brown on eyed side, light yellow to white on blind side.

Geographic Distribution: Sebastian Vizcaino Bay, Baja California to Unimak Island in western Alaska.

Depth Distribution: Found between the surfline and 200 fathoms but commercial abundance is between 20 and 70 fathoms. There is evidence of intra-seasonal bathymetric movements, i.e. a shift to water deeper than 40 fathoms in winter months and a return to shallower water in the spring.

Economic Importance: During the period 1956-65 the English sole represented almost one-third of flatfish landings by Canadian and United States vessels from the Pacific coast. About 1.6 million lb per year were landed in British Columbia during 1956-65, with the bulk of the catch coming from Hecate Strait. Widely used in the fillet trade. A trawl fishery for this species operates throughout the year.

Maturity and Fecundity: Females spawn for the first time at age 3 years (about 30 cm or 12 inches in length) and produce approximately 150,000 eggs. Fish of average age of 5 or 6 years (36-38 cm or 14-15 inches) will produce about 1,000,000 eggs, and a large fish (43 cm or 17 inches) close to 2,000,000 eggs. Male fish mature at a smaller size than females and most males 10 inches or greater in length are mature. Spawning takes place during the winter months between December and March.

Egg Type and Development: Egg has a diameter of about 1.0 mm, is non-adhesive, and pelagic in water of 28‰ salinity or higher. Density of the egg increases slightly just prior to hatching. Hatching occurs in about 6 days at 8 C (46.5 F).

Larvae: Larvae are about 2.8 mm (1/10 inch) in length at time of hatching. Yolk sac is absorbed 5 to 6 days after hatching. Larvae are probably pelagic for about 6 to 10 weeks. Metamorphosing larvae are not encountered on the beaches until mid-April (in the Strait of Georgia). Metamorphosis (assumption of side-swimming behaviour) complete in fish of 10 mm (less than 1/2 inch) in length. Fish of 8 to 9 mm are in an intermediate stage, swimming half-way between vertical and horizontal positions.

Juveniles: During the summer months of their first year, English sole in southern British Columbia waters grow approximately 23 mm (1 inch) per month and attain length of about 100 mm (4 inches) by August. Some of the young inhabit the intertidal zone but have moved into deeper water by November. At the end of their second year they are about 20 cm (8 inches) in total length and are found in deeper water than in their earlier life.

Size and Age of Commercial Exploitation: British Columbia fisheries regulations restrict retention of English sole to those which are 30.5 cm (12 inches) in total length or larger. For females this would correspond to fish in their fourth year and, for males, to fish completing their fourth or fifth year. In recent years, average age of females, which predominate in the commercial landings, has been about 5-1/2 to 6 years, and average size about 34 to 38 cm (13.3-15.0 inches). Longest fish recorded was 57 cm (22.5 inches), a female of unknown age. Males do not get as large as females, the largest recorded was 49 cm (19.3 inches).

Migration: Tagging studies have shown that mature English sole make limited migrations to and from spawning areas during winter and spring months. The migrations are generally contranatant prior to spawning, i.e. against the current, and more passive and with the current after spawning. The winter migrations are also to slightly deeper water than that inhabited during summer. Some English sole have shown extensive wandering habits. A few fish tagged off northern British Columbia and in the Strait of Georgia have been recovered off northern California. However, these long migrations are rare and appear to be primarily of fish which were tagged in summer months.

Food Habits: This is a small-mouthed flounder that feeds primarily on bottom-dwellers such as polychaete worms, clams, and brittle stars. Numerous other items such as sandlance, crab, amphipods, shrimp, squid, small fish, etc. have been observed in stomachs, but their incidence is low in comparison with the three items noted above.

Life Span: Greatest age recorded for females is 17 years, for a 52-cm (20.5 inches) individual. Greatest age recorded for males is 15 years, for two fish of 37 and 38 cm (14.5 and 15.0 inches), respectively.

ROCK SOLE — Lepidopsetta bilineata

Distinguishing Characters: A broad body with rough scales on the eyed side. High arch in lateral line over the pectoral fin. Dorsal branch to lateral line. Scales on lateral line, 72 to 85. Colour, mottled dark brown, sometimes with light blotches and, occasionally, with scattered small red spots. Dark bars or streaks on dorsal, anal, and caudal fins.

Geographic Distribution: Southern California to Bering Sea.

Depth Distribution: Found between the surfline and 200 fathoms but scarce in depths greater than 100 fathoms. Commercial abundance in 10 to 40 fathoms. Some evidence of intraseasonal bathymetric movements, i.e. movement to shallow water in summer (10-15 fathoms) and return to deeper water in winter.

Economic Importance: Extensively used in fillet trade. Ranks next to English sole in importance among flounders on the Pacific coast. During the period 1956-65 about 3.4 million lb per year were landed in British Columbia, with the bulk coming from waters north of Vancouver Island. Fishery, which is by trawl net, takes rock sole chiefly in spring, summer, and fall months.

Maturity and Fecundity: Smallest observed mature individuals were 31 cm (12-1/4 inches) for females and 28 cm (11 inches) for males. These sizes are about those for age 4 fish. The largest immature individuals were 43 cm (17 inches) in females and 36 cm (14-1/4 inches) in males. Fish of 35 cm produce about 400,000 eggs and those of 46 cm about 1.3 million eggs. Spawning is believed to take place during late winter or early spring, but spawning grounds for the largest stocks which lie north of Vancouver Island and in Hecate Strait have not yet been located.

Egg Type and Development: Egg has a diameter of about 0.9 mm, is adhesive and demersal (specific gravity, 1.047). Hatching occurs in about 18 days at 7 C (44.6 F). Off Kamchatka eggs hatch in 25 days at 3 C (37.4 F).

Larvae: About 5 mm (1/5 inch) in length at time of hatching. Yolk sac absorbed 10 to 14 days after hatching. Off Kamchatka rock sole larvae have progressed to their side-swimming, bottom-dwelling form at about 20 mm (close to 1 inch) in length.

Juveniles: In July of the year following spawning, rock sole reach a length of 7 to 10 cm (3-4 inches) and at completion of their third year are close to 22 cm (9 inches). Juveniles above age 1 are generally found with adults on the grounds.

Size and Age of Commercial Exploitation: Landings are restricted to fish of 30.5 cm (12 inches) or more in length. For males and females this would correspond to fish in their fifth year. Average age in commercial samples is 5-1/2 to 7 years, which for females (the bulk of the landings) corresponds to about 35 to 39 cm (13-3/4 to 15-1/2 inches). Largest fish recorded was 60 cm (23-1/2 inches) in total length, a female probably 15 years old. Largest male was 53 cm (21 inches).

Migration: There is no evidence that rock sole make extensive migrations, as do other flounders such as the petrale sole. The apparent lack of movement of fish between fishing grounds suggests the presence of a number of discrete subpopulations.

Food Habits: Rock sole up to 30 cm (ca. 12 inches) in length feed most heavily on polychaete worms. The principal diet of larger rock sole is fish, the most important being the sandlance.

Life Span: Off British Columbia 50 cm (19-3/4 inches) fish are about 15 years of age but greatest age recorded for females is 16 years and this was a 43 cm (17 inches) individual from Bristol Bay, Alaska. The oldest recorded male was 15 years at 41 cm (16-1/4 inches).

PETRALE SOLE OR BRILL — Eopsetta jordani

Distinguishing Characters: Moderately large mouth with teeth in two rows on each side of upper jaw, small scales, slight curve in lateral line over pectoral fin with no dorsal branch. Scales on lateral line, 88 to 100. Colour, generally uniform brown or olive brown, sometimes with paler blotches, white on blind side.

Geographic Distribution: Southern California to Gulf of Alaska.

Depth Distribution: Found from surfline to 250 fathoms. Commercial abundance in 40 to 70 fathoms during spring, summer, and fall, and in 170 to 250 fathoms in winter.

Economic Importance: Extensively used in the fillet trade. At one time the petrale sole was the highest valued flatfish (other than halibut) on the Pacific coast and was landed in the highest volume. In 1948 almost 14 million lb were caught off British Columbia by Canadian and United States trawl vessels. In 1966 catch in the same area was 3.6 million lb and abundance was greatly reduced in comparison with earlier years. The species is still valued highly, and Canadian fishermen land about 1.3 million lb per year, mainly from the west coast of Vancouver Island and waters north of Vancouver Island. The fishery for the species operates year round.

Maturity and Fecundity: In British Columbia waters the point of 50% maturity is reached at about age 7 in males and age 8 in females (38 cm (15 inches) and 44 cm (17-1/4 inches), respectively). Some females mature as early as age 5 (35 cm or 13-3/4 inches) and some males at age 4 (32 cm or 12-1/2 inches). At the other extreme, some individuals of both sexes may still be immature at age 10. Spawning takes place during January to April in deep water (170-250 fathoms) generally south of the shallower inshore summer feeding grounds. Preliminary fecundity studies show that a female of 42 cm (16-1/2 inches) produces about 400,000 eggs and one of 57 cm (22-1/2 inches) at least 1,200,000 eggs.

Egg Type and Development: Egg has a diameter of about 1.3 mm, is non-adhesive, plastic, and almost transparent. It is pelagic in water of 32.4‰ salinity or over. In other words, in deep water where spawning takes place the egg will commence rising slowly to the surface. It probably hatches before it reaches the low-salinity, surface water. No larval or early post-larval forms have yet been identified in nature. The egg hatches in about 8-1/2 days at 7 C (44.5 F), under laboratory conditions.

Larvae: About 3.0 mm (1/8 inch) in length at time of hatching and virtually unpigmented. Grows to about 5 mm (1/5 inch) in 6 days and yolk sac is absorbed 10 days after hatching. Nothing is known of the whereabouts of petrale sole larvae but they are believed to inhabit midwater. Post-larval individuals (2 only) have been taken in midwater in April off northern California. They measured 21 and 22 mm, respectively, in total length.

Juveniles: Small numbers of juveniles (age 1 and 2 years) have been found on the bottom in waters of 10 to 39 fathoms in depth. However, it is not until the fish reach sizes greater than 25 cm (10 inches) or age 3 and greater that they are susceptible to capture in any quantities.

Size and Age of Commercial Exploitation: Minimum size permitted by British Columbia regulations for commercial utilization is 30.5 cm (12 inches). For males and females, this would correspond to fish in their fourth year. In recent years, average age of females, which predominate in the commercial landings, has been about 7 years, and average size about 42 cm (16-1/2 inches). Largest fish recorded was 70 cm (27-1/2 inches) in total length, a female of unknown age. The largest recorded male was 53 cm (21 inches).

Migration: Makes extensive geographic migrations. For example, fish which feed in shallow water (40 to 70 fathoms) in summer in the Goose Island-Hecate Strait region of British Columbia accumulate for spawning in winter in deep water (170 to 250 fathoms) off the west coast of Vancouver Island.

Food Habits: This large mouth flounder feeds largely on fish and pelagic or semi-pelagic invertebrates. Euphausiids (shrimp-like animals) are eaten extensively on west coast grounds, followed in preference by herring and sandlance. On grounds north of Vancouver Island the lance and herring predominate as the food.

Life Span: Greatest age recorded for females is 25 years, for a 64-cm (25-1/4 inches) individual. The oldest recorded male was 19 years, a fish of 50 cm (19-3/4 inches).

BUTTER SOLE (BELLINGHAM SOLE) Isopsetta isolepis

Distinguishing Characters: Rough scales on eyed side of body, head and fins (78 to 84 on lateral line). Lateral line curves upward over pectoral fin but does not have a high arch. Dorsal branch to lateral line. Colour, grey or brownish, irregularly blotched and spotted with yellow or green on eyed side, white on blind side, bright yellow on tips of dorsal and anal fin rays.

Geographic Distribution: Southern California to southeastern Alaska.

Depth Distribution: Found from surfline to 200 fathoms but at depths greater than 60 fathoms catch rates for this species fall off rapidly. Commercial abundance is at 15 to 35 fathoms.

Economic Importance: Used extensively as animal food, and occasionally for the fillet trade, but it is generally not suitable for filleting because of the thinness of the fish and thus low yield. During the period 1956-65 about 1.1 million lb per year were landed in British Columbia and, of this, 68% was utilized for animal food. The bulk of the landings are taken by trawl vessels from spawning concentrations which may be found in Skidegate Inlet, Queen Charlotte Islands, during February, March, and April. The fishery for this species occurs only at this time of year except for some landings which are made from the Washington coast in early winter.

Maturity and Fecundity: The butter sole which accumulate for spawning in Skidegate Inlet mature at small sizes and young ages relative to other commercially important flounders. In males, almost all fish greater than 10 cm (4 inches) in length are mature or maturing, i.e. fish in their second year or older. In females, fish of 25 cm (10 inches) or larger, which corresponds to the largest fish of age 3 and older, are mature. Females of 32 cm (12-1/2 inches) produce from 350,000 to 650,000 eggs and those of 38 cm (15 inches) produce about 1 million eggs. Butter sole which spend most of the year in Hecate Strait congregate for spawning in Skidegate Inlet in late winter.

Egg Type and Development: Egg has a diameter of about 1.01 mm, is non-adhesive, transparent, and demersal in Skidegate Inlet (specific gravity, 1.021). Development time unknown.

Larvae: No knowledge of species at this stage.

Juveniles: The inshore area along the east coast of Graham Island, Queen Charlotte Islands, is the major nursery ground for young butter sole in Hecate Strait. In deeper water in Hecate Strait, larger and older butter sole can be found. At the end of their first three completed years of growth, they are about 6.3, 13.3, and 19.0 cm (2-1/2, 5-1/4, and 7-1/2 inches), respectively, in total length. The immature juveniles do not participate in the spawning migration to Skidegate Inlet.

Size and Age of Commercial Exploitation: There are no regulations restricting size of butter sole landed in British Columbia. The only restrictions are those imposed by companies as to amount they will handle for animal food and sizes they will accept for filleting. Average age and length of fish landed by commercial vessels will vary, therefore, according to company requirements. When a company wants fillet fish only, the age structure of the landings may be composed of fish chiefly older than 7 years of age and larger than 30 cm (about 12 inches) in length. When animal food is accepted, fishermen will retain and land younger, and smaller, fish. Largest male recorded from landings was 39 cm (15-1/4 inches), and the largest female, 45 cm (17-3/4 inches).

Migration: The butter sole does not make extensive migrations. However, mature individuals which congregate for spawning in Skidegate Inlet have come from the summer feeding grounds in Hecate Strait.

Food Habits: This is a small mouth flounder which feeds extensively on polychaete worms, small clams and crabs. Large individuals (greater than 30 cm in length) also feed on sandlance.

Life Span: Off British Columbia greatest age recorded for females is 11 years, for a 35-cm (13-3/4 inches) individual from Skidegate Inlet. The oldest recorded males were 10 years of age at lengths from 34 to 39 cm (13-1/4 to 15-1/4 inches).

LINGCOD Ophiodon elongatus

Distinguishing Characters: Long continuous notched dorsal fin, large mouth and large canine-like teeth, small smooth scales covering body, two large fleshy flaps over eyes and large pelvic fins. Colour, extremely variable, colours and colour patterns varying with habitat and subject to rapid change. Ranges from black, brown, blue to dusky green or greenish-grey. Darkish blotches outlined in orange or pale blue, small orange spots or blotches scattered among larger colour patches. Flesh, turquoise-green to whitish. The green-coloured flesh is not harmful and turns white when cooked.

Geographic Distribution: Southern California to Bering Sea.

Depth Distribution: Near the bottom of the intertidal zone to 230 fathoms in depth but highest commercial abundance in region of 30 to 60 fathoms and relatively abundant to depths of 90 fathoms. Abundance greatly reduced at depths greater than 100 fathoms. Larger fish inhabit slightly deeper water than smaller fish.

Economic Importance: This species is exploited by commercial trawl and line fishermen, sport fishermen, and scuba divers. During the period 1956-65 about 6 million lb per year were landed by Canadian and United States trawl fishermen from grounds adjacent to British Columbia. A further 2.5 million lb per year was taken by line fishermen. Total non-commercial catch is unknown. Most of the trawl catch is taken from grounds off the west coast of Vancouver Island while the bulk of the line catch is taken in inshore waters of the Strait of Georgia. Highly esteemed as a fresh fish and used extensively in restaurants. The commercial fishery operates throughout the year in offshore waters but is restricted (along with the non-commercial fishery) by a closed season in the Strait of Georgia during December, January and February.

Maturity and Fecundity: Smallest observed mature individuals were 70 cm (27-1/2 inches) in total length for females and 46 cm (18 inches) in males. These sizes correspond to 5-year-old females and 2-year-old males. The number of eggs produced by female lingcod of the same size varies considerably. However, larger fish generally produce considerably more eggs than smaller fish. A 70-cm (27-1/2 inches) female produces approximately 60,000 eggs while a fish of 118 cm (46-1/2 inches) produces about 500,000 eggs. Spawning occurs during winter (late December to March) and eggs are attached to the substrate below the low-tide mark in large masses which are guarded by the males until the eggs hatch.

Egg Type and Development: Egg diameter is about 2.8 mm (1/8 inch) when first extruded but swells to about 3.5 mm shortly after contact with water. Eggs are adhesive and are laid in large clumps. One such clump observed was approximately 15 lb in weight and measured over 2-1/2 feet across. Hatching from the mass is progressive, i.e. outside eggs hatch and egg capsules disintegrate, allowing inner layer of eggs to hatch, etc. In a cross-section of the mass, the inner eggs are less advanced in development than the outer eggs. Development time unknown.

Larvae: Larvae are about 10 mm (almost 1/2 inch) in length at time of hatching. Yolk sac absorbed about 10 days after hatching. Larvae can be identified by the small yolk sac, the bright yellow oil globule near the liver, large blue eyes and elongate body.

Juveniles: In the Strait of Georgia, lingcod are about 1 to 3 cm in length during April. By the end of the year these "0" age-group fish are 17 to 35 cm (7-14 inches) in length and at the end of their first year (March) average about 27 cm (10-1/2 inches). By the end of their second year, their average size is about 47 cm (18-1/2 inches). By age 3 there is some difference in growth between the sexes which becomes more marked with increasing age. At age 3, females will be close to 58 cm (23 inches) and males slightly smaller.

Size and Age of Commercial Exploitation: British Columbia fisheries regulations prohibit the retention of any lingcod less than 58 cm (23 inches) in total length for commercial or non-commercial use. This corresponds to about age 3 in females and age 3-1/2 in males. The size range of lingcod taken by the trawl and line fisheries is about 58 to 115 cm (23-45 inches). This range covers ages 3 to 15 years in females and ages 3-1/2 to 13 years in males. Maximum recorded length of males is 90 cm (35-1/2 inches) and for females, about 122 to 137 cm (4 to 4-1/2 feet). Maximum recorded weight of lingcod is 105 lb and 50-60 pounders were frequently caught by commercial gear during the biggest years of the line fishery. Average length of lingcod in trawl catches from the west coast of Vancouver Island is about 72 cm (28 inches). Based on the same growth rate as in the Strait of Georgia, these fish would be an average of almost 6 years of age.

Migration: The lingcod has a reputation for being a sedentary species. Seasonal movements on and off major lingcod reefs in relation to spawning are suspected but this is not evident from tagging because of the closed season in the Strait of Georgia around the spawning time. Small lingcod seem to inhabit relatively shallow banks or shallow water adjacent to the shoreline while the larger fish are on deeper reefs or banks.

Food Habits: The lingcod is a voracious, piscivorous feeder. The most important fish in its diet are sandlance, herring, flounders, Pacific cod, whiting, and small lingcod. Besides these and other fish, stomachs have been found to contain crabs, shrimps, and squid. Herring is the principal bait used by the longline fishermen for this species.

Life Span: Female lingcod live to an age of about 15 years and males about 12 years.

PACIFIC COD — Gadus macrocephalus

Distinguishing Characters: Three dorsal fins, the long barbel on the lower jaw and the position of the anus below the second dorsal fin.

Geographic Distribution: Around the rim of the North Pacific Ocean from west coast of Korea to California.

Depth Distribution: Off the western shore of North America, traces of Pacific cod have been found in depths greater than 200 fathoms. Commercial abundance, however, is found between 20 and 70 fathoms. There is a decided intraseasonal bathymetric movement. During the winter months cod move to relatively deep water (60 to 70 fathoms). Following spawning they move towards shallow water and reach shallowest depths in late spring or early summer.

Economic Importance: In the area off British Columbia that is fished by Canadian and United States trawlers, the Pacific cod was the most important single species in overall trawl production during the period 1956-65. Average landings were 18.0 million lb or about 18% of the mean annual production. In 1966, there was almost 27 million lb of Pacific cod landed in British Columbia, and this constituted 49% of the total trawl landings in the province in that year. The species is widely used in the fresh fillet, fish stick, and frozen-block fillet trade in both Canada and the United States. The fishery for this species operates throughout the year.

Maturity and Fecundity: Off British Columbia, male and female cod reach sexual maturity at different length and age. Fifty per cent of male fish are mature at 49 cm (19-1/4 inches), which corresponds to age 2. Apparently all are mature by 3 years. Only 15 to 25% of female fish are mature by the time they reach age 2 (about the same size at age 2 as males), but almost all are mature at age 3. The 50% maturity level for females is at 55 cm. A fish of 55 cm (almost 22 inches) in length will produce about 860,000 eggs while one of 80 cm (31-1/2 inches) produces about 3,350,000 eggs. Spawning takes place during the winter months.

Egg Type and Development: Egg has a diameter of about 1.0 mm, is demersal (specific gravity, 1.049 at 20 C), and is adhesive during early part of development. Hatching occurs in about 11-1/2 days at 8 C (46.4 F), but in more northern waters (Gulf of Alaska) will take about 28 days to hatch at 2 C (35.6 F).

Larvae: Larvae are about 3.5 to 4.0 mm (1/7 inch) in length at time of hatching. Yolk sac is absorbed approximately 6 to 10 days after hatching, depending on temperature.

Juveniles: Small-meshed trawl surveys in the Strait of Georgia have shown that cod in their first year of life achieve a length of 8 to 14 cm (3-1/2 to 5-1/2 inches) by mid-July. By late autumn they exceed 20 cm (8 inches) in length, and on completion of their first year in March, are about 26 cm (10-1/4 inches). At the end of their second year they average 50 cm (19-3/4 inches) in length.

Size and Age of Commercial Exploitation: Age and size at commercial exploitation varies with area fished and also varies with market requirements. In recent years catches from the Gulf Islands area of the Strait of Georgia in winter quite frequently contain substantial numbers of cod which have not yet, or have just, completed their second year of life, i.e. they are about 40 to 50 cm in length. Catches from the Nanoose Bay spawning grounds, however, contain very few such small fish because the spawning aggregation is composed chiefly of fish of age 3 and older. On this ground Pacific cod are an average of 65 cm in length. At all ports, sizes of fish landed will be smaller when demand for animal food is high and, conversely, larger when there is little demand for animal food. In general, however, the cod are exploited chiefly when they are at age 3 or 4 (sizes about 60 cm and over). Largest cod recorded was 93 cm (36-1/2 inches).

Migration: Within the Strait of Georgia there appears to be considerable mixing of cod among fishing grounds. There is also evidence of movement between Canadian and United States waters in the southern strait, and the suggestion that some individuals may emigrate to fishing grounds off the west coast of Vancouver Island. In Hecate Strait, there is also evidence of considerable movement between some grounds, but no evidence of emigration out of the strait.

Food Habits: Samples of cod for analysis of stomach contents have been taken mainly during the winter months from widely scattered locations on the British Columbia coast. Most important food organisms noted were shrimps. Herring, sandlance, flatfish, and crabs followed in that order of importance. A variety of other organisms was also noted.

Life Span: Because the Pacific cod is close to the southern limit of its range in British Columbia, the species grows very rapidly and has a short life span. Probably maximum age is about 6.

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