Development Of Sablefish, *Anoplopoma fimbria*, Larvae off the West Coast of British Columbia, and Transformation to the Juvenile Stage

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ABSTRACT

The early development of sablefish larvae, from preflexion to adult stage, is described and illustrated. Sablefish used in this study were captured in surface neuston tows and bottom trawl tows off the west coast of British Columbia. The fish ranged in size from 7.6 mm standard length (SL) to 795.0 mm SL (N=134). Important physical characteristics such as development of the median and paired fins, pigmentation, gut, and lateral line were examined. Criteria were redefined for identifying small sablefish larvae, and established for determining the size at which a larva is considered a juvenile. The transformation from larvae to juveniles occurred when the body proportions—such as pectoral fin length/standard length, interorbital distance/head length, and snout length/head length—of postflexion larvae resembled those of adults. This transformational period started at 30 mm SL and continued until about 70 mm SL or 76 mm fork length, the start of the juvenile stage.

Introduction

Sablefish, *Anoplopoma fimbria*, is an important commercial species off the west coast of British Columbia. The populations and the fishery are dependent on periodic strong year classes. Studies have been conducted to examine the biotic and abiotic factors affecting year-class success (McFarlane and Beamish, 1986, 1992). Understanding how these factors affect production of larvae and survivorship to the adult stage is an important step in developing rational management strategies. By examining the developmental stages of sablefish we hoped to identify critical periods for larval success. This information could be used to predict recruitment and to enhance larval development through the critical stages to ensure successful survival for mariculture.

Information on the early life history of sablefish larvae is documented by Mason et al. (1983), McFarlane and Beamish (1983), and Kendall and Matarese (1987). In 1984, a series of annual ichthyoplankton surveys began to examine the distribution, abundance, and biology of larval sablefish in the surface waters off Vancouver Island (Shaw et al., 1985, 1987a, b). Larvae caught during those surveys provided the specimens for descriptions of the developmental stages presented in this report. Earlier descriptions of sablefish larvae by Gilbert (1915), Brock (1940), Kobayashi (1957), and Ahlstrom and Stevens (1976) provided only preliminary observations of a few larvae. Kendall and Matarese (1987) presented a review of studies describing the early life history of sablefish, with a discussion about the juvenile stage. They concluded that there was no marked transformation from the larval to juvenile stage. Their conclusions, however, were based on observations of larvae up to 26.6 mm standard length.

The purpose of this paper is to provide a more complete description of the developmental stages and other diagnostic characters of sablefish larvae, and to examine the transformation from the larval to the juvenile stage. We also discuss larval development in relation to the environment in which these fish live.

Materials and Methods

Sablefish larvae were collected off the west coast of Vancouver Island in April 1984 and 1985 (Shaw et al., 1985) using a neuston plankton sampler with mesh size of 500 microns (Sameoto and Jaroszynski, 1969). All larvae were preserved in 5% formalin and later transferred to 70% ethanol. During 1985, large juvenile and adult sablefish were captured with bottom trawl gear equipped with a 2.1-cm (stretched mesh) codend liner. The capture of these specimens enabled us to compare the ratios of body development of the larvae with those of the adults.

All larvae were examined under a compound microscope and measured with an ocular micrometer (0.1 mm). Large juvenile and adult sablefish were measured with a vernier caliper (1.0 mm). We studied sablefish morphology by measuring each fish for fork length, body length, total length, head length, snout length, eye diameter, snout-to-anus distance, interorbital distance, upper jaw length, body depth, and pectoral fin length. Morphological measurements for body length were divided into two categories: first, notochord length for larvae in preflexion stages, from the tip of the snout to the tip of the notochord; and second, standard length for flexion and postflexion larvae and juveniles, from the tip of the snout to the posterior margin of the hypural elements. Measurements of these physical characteristics were expressed either as a ratio (percentage) of standard length (SL), or as a ratio of head length (HL). Standardized terminology defined by Moser (1972), Richardson and LaRoche (1979), and Sumida et al. (1979) was used and is described in Table 1. The exception is that we defined standard length as synonymous to body length. In preflexion larvae, notochord length (NL) is equivalent to standard length (SL). Thus we used standard length as the terminology to describe the length of larvae.

Larval development, based on the flexion of the notochord during caudal fin formation, was divided into three stages: preflexion (prior to notochord flexion); flexion (from the time the urostyle begins to slant upward until the urostyle is in the final upward position and the caudal fin is formed); and postflexion (after completion of the notochord flexion where the urostyle may still extend beyond the base of the caudal fin) (Moser and Ahlstrom, 1970; Ahlstrom and Moser, 1976; Moser et al., 1977; Richardson and LaRoche, 1979). We also examined fin development, pigmentation, gut development including development of the musculature, and development of the lateral line in relation to these stages. The term *fin development* describes the changes in size and number of the fin rays of the median fins (dorsal, anal, and caudal) and paired fins (pectoral and pelvic).

Table 1

Terms referring to morphological measurements and developmental stages (after Moser, 1972; Richardson and LaRoche, 1979; and Sumida et al., 1979).

Term	Definition
Fork length	Horizontal distance from the tip of the snout through the midline of the body to the tip of the shortest median ray in the notch or fork of the tail.
Body length	Horizontal distance from the tip of the snout to the tip of the notochord, i.e., notochord length (NL) in preflexion stages. Also, to the posterior margin of the hypural elements, i.e., standard length (SL).
Total length	Horizontal distance from the tip of the snout to the tip of the longest lobe of the tail when maximally extended.
Head length	Horizontal distance from the tip of the snout through the midline of the head to the posterior margin of the cleithrum.
Snout length	Horizontal distance from the tip of the snout to the anterior edge of the bony eye socket.
Eye diameter	Horizontal width of the bony eye socket.
Snout to anus	Horizontal distance from the tip of the snout through the midline of the body to a vertical line through the anus.
Pectoral fin length	Distance midline from the base of the fin ray to the outer tip of the longest ray.
Upper jaw length	Distance from the tip of the snout to the posterior edge of the maxillary.
Body depth	Distance from a point slightly anterior of the first dorsal fin to the origin of the pelvic fins.
Interorbital distance	Narrowest distance between the bony eye sockets, measured on the dorsal surface.
Preflexion	Prior to notochord flexion.
Flexion	Undergoing notochord flexion; from the time the urostyle begins to slant upward until the urostyle is in the final upturned position and the caudal fin is formed. The angle of the urostyle was estimated during flexion and was expressed as a percent of a 90° angle.
Postflexion	After completion of notochord flexion (urostyle may still extend beyond the base of the caudal fin).

Results

Morphology

A total of 131 sablefish were measured. Of these, 94 were from surface neuston net tows, and ranged in length from 7.6 to 89.9 mm SL. The remaining 37 sablefish were caught in bottom trawls and ranged in length from 258.0 to 795.0 mm SL. A selected size range of specimens was used for illustrations. Figure 1 illustrates three larvae ranging in size from 20 to 30 mm. Figure 2 illustrates five larvae ranging from 35 to 100 mm. Early larval developmental stages smaller than 20 mm are presented in Ahlstrom and Stevens (1976).

Results from this study and from McFarlane and Nagata (1988) indicate that preflexion larvae range from 5.5 to 8.6 mm SL. However, in our surface net catches the smallest larvae were 7.6 mm SL. During preflexion the hypural elements were becoming evident. Flexion started between 8.6 and 9.9 mm SL and was about 25% complete at 11.6 mm; 50% at 12.6 mm; 75% at 13.4 mm; and 100% at 15.6 mm. During this period the caudal fin rays increased to 18, which is about half the total complement of rays in adults. Postflexion larvae started at a length of 15.7 mm SL. As the larvae grew the number of caudal fin rays also increased.

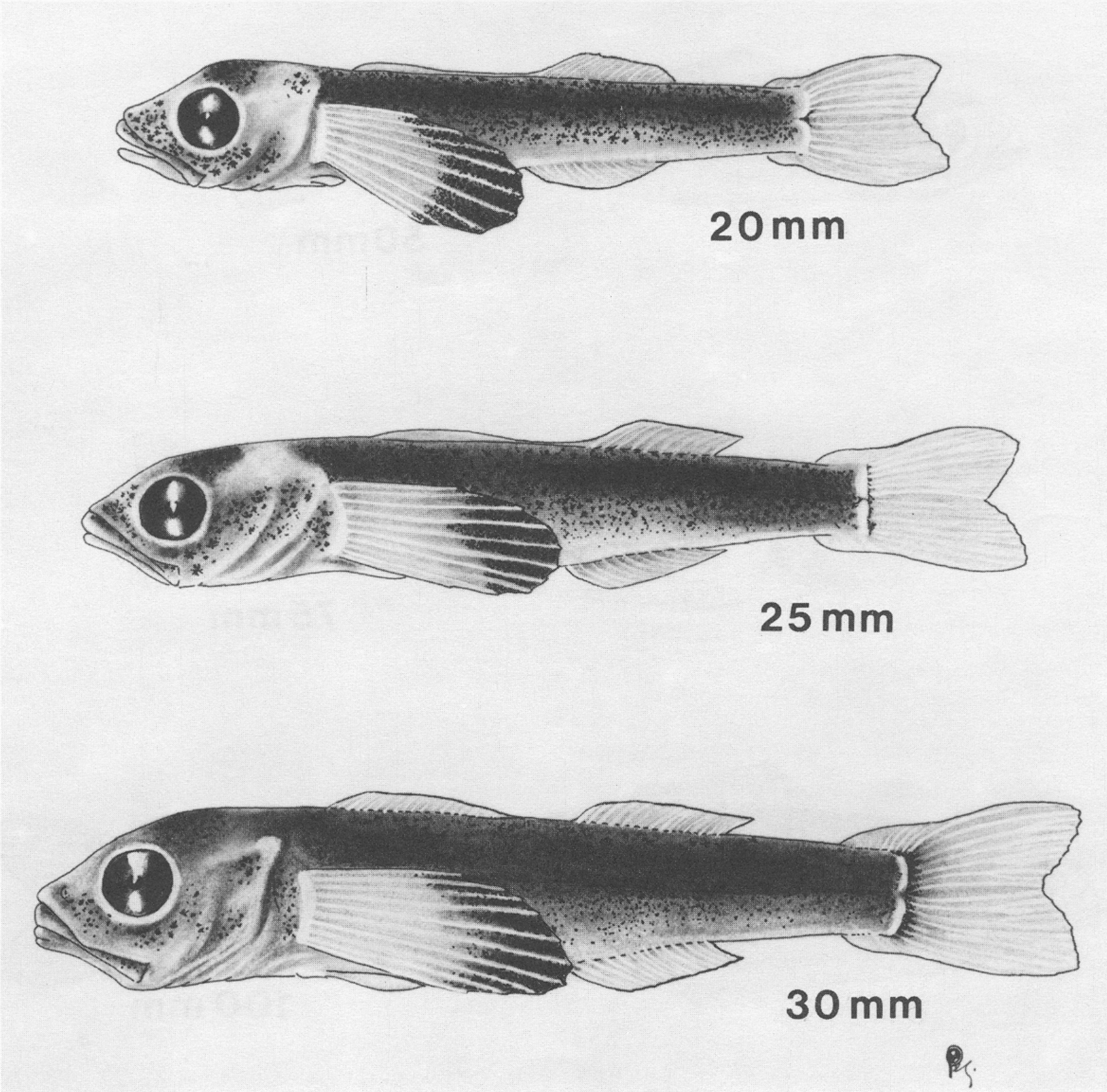

Figure 1
Sablefish development from 20 to 30 mm SL.

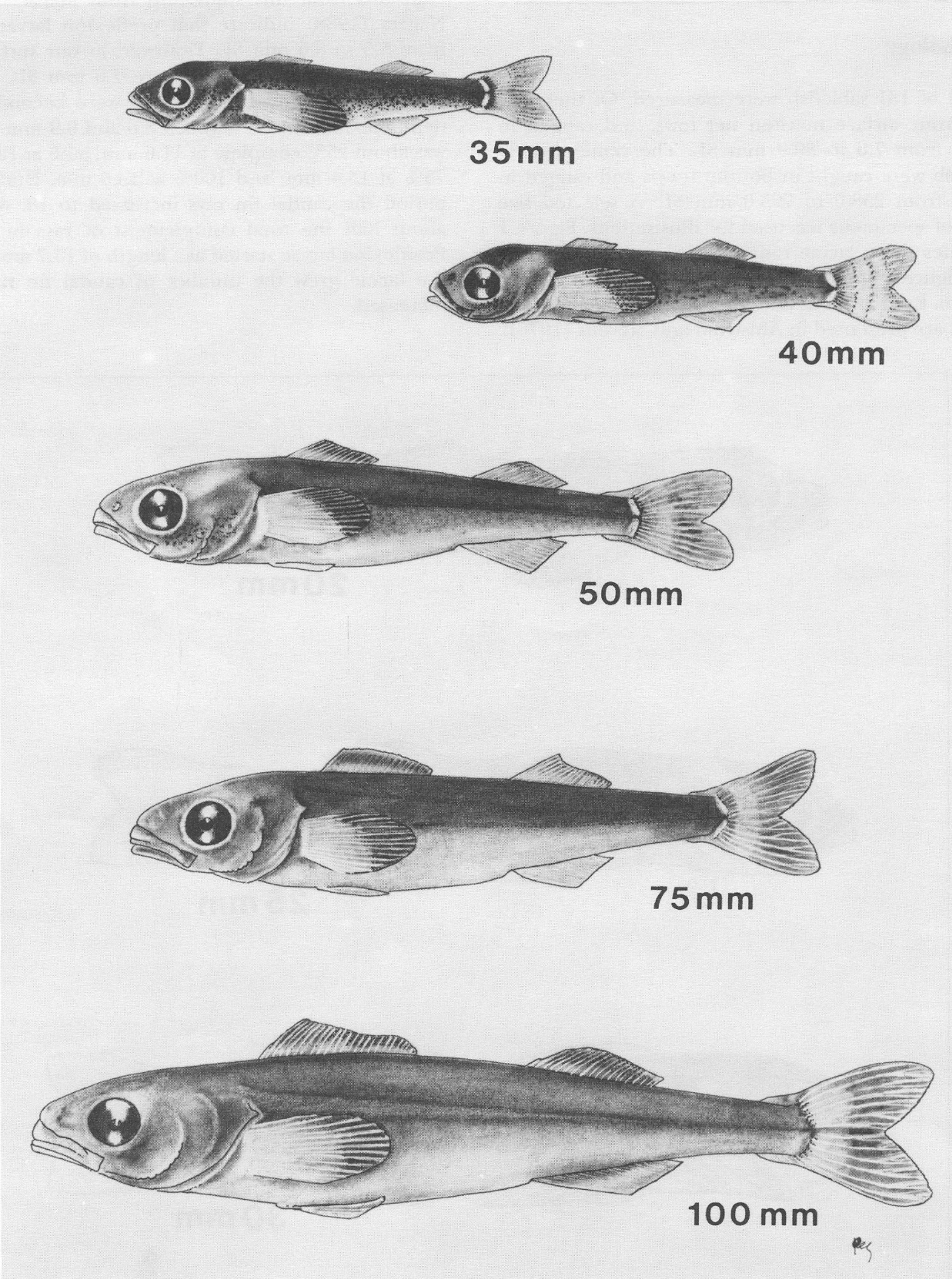

Figure 2
Sablefish development from 35 to 100 mm SL.

Body Proportions vs. Head Length—Snout length, interorbital distance, eye diameter, and upper jaw length expressed as a proportion of HL by developmental stage are presented in Figure 3. During preflexion, snout length and interorbital distance increased rapidly as the head started to conform to adult proportions. The eye diameter and upper jaw length were very large at time of hatch, but decreased rapidly, particularly eye diameter. The change in body proportions for flexion larvae continued the same trend as in preflexion larvae, but less rapidly. During postflexion the snout length and interorbital distance continued to increase in relation to HL, up to 20 mm HL (74 mm SL) and 8 mm HL (32 mm SL), respectively. There was no increase in the snout length ratio for larger fish, but interorbital distance decreased until 19 mm HL (70 mm SL), then increased slightly for larger fish. Eye diameter and upper jaw length proportions decreased until they became similar in late juvenile and early adult fish at 8 mm HL (32 mm SL) and 80 mm HL (288 mm SL), respectively.

Body Proportions vs. Standard Length—Snout-to-anus length, head length, body depth, and pectoral fin length expressed as proportions of SL by developmental stage are presented in Figure 4. During preflexion, all of the body proportions increased rapidly in relation to SL. This increase continued through flexion, but at a reduced rate for snout-to-anus length and body depth. During postflexion, snout-to-anus length and body depth increased more slowly than during flexion; snout-to-anus length peaked for larvae measuring about 50 mm SL, and body depth peaked at 65 mm SL. There was little change thereafter in the snout-to-anus to SL ratio, but the body depth ratio decreased gradually for larger fish. Head length and pectoral fin length proportions increased rapidly into the early phases of postflexion and peaked at 25 mm SL and 30 mm SL, respectively. There was little change thereafter in the head length proportion. The most dramatic change in morphology for larval sablefish was the metamorphosis of the pectoral fins. After 30 mm SL the pectoral fin proportion decreased until larvae reached about 70 mm SL (76.5 mm FL), after which the pectoral fin proportion was similar to that of late juvenile and adult fish.

Fin Development

Preflexion—The hypural bud and pectoral fin rays were visible in the smallest larvae sampled (7.6 mm SL; Table

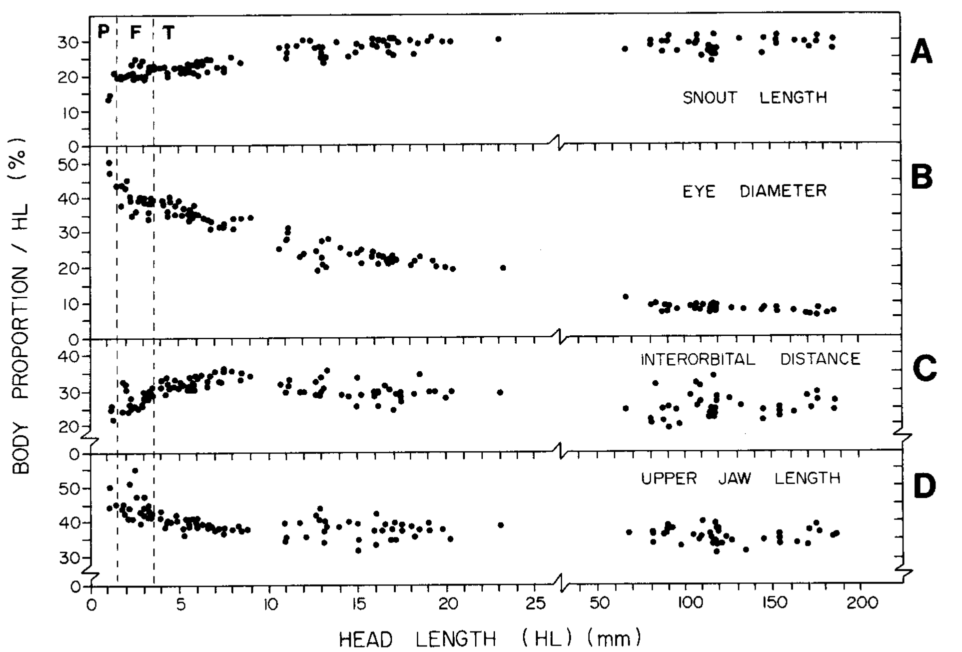

Figure 3
Body proportions for (A) snout length, (B) eye diameter, (C) interorbital distance, and (D) upper jaw length in relation to head length (HL) for fish in the preflexion (P), flexion (F), and postflexion (T) stages.

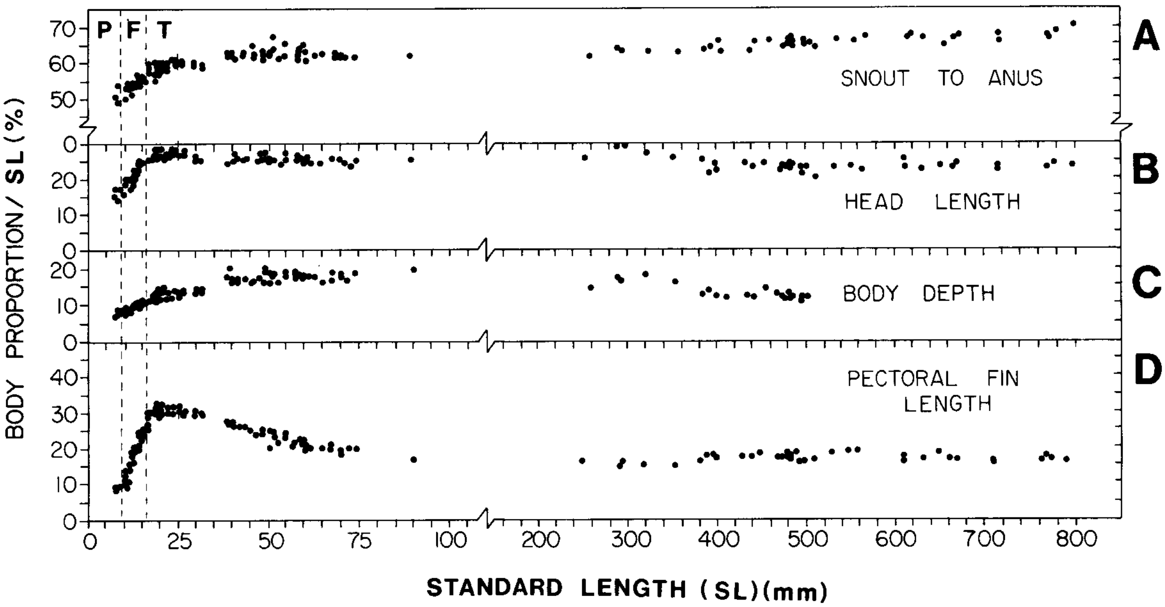

Figure 4
Body proportions for (A) snout-to-anus length, (B) head length, (C) body depth, and (D) pectoral fin length in relation to standard length (SL) for fish in the preflexion (P), flexion (F), and postflexion (T) stages.

2). The pectoral fin was round, and contributed only 9% of the SL. The fin fold was very prominent, extending the full length from the nape of the neck dorsally to the tip of the notochord, and ventrally along the gut to below the pectoral fin base.

Flexion—The number of rays in the pectoral fin increased from 12 for larvae measuring 10.8 mm SL and to 14 for 15.6-mm larvae (Table 3). The pectoral fin elongated from 8.8% to 26.2% SL, resulting in a long, paddle-shaped fin. During flexion the fin fold reduced posteriorly at a quicker rate on the dorsal surface than on the ventral surface. At the end of flexion (15.6 mm SL) the fin fold was greatly reduced from the nape of the neck to the start of the second dorsal fin. The first dorsal fin was visible in 12.6-mm larvae, and ray development started at 15.6 mm. The fin fold on the ventral side was present from the vent to the anterior portion of the anal fin. Between 14 and 16 rays were counted in the second dorsal fin, and from 16 to 18 rays in the anal fin. The anal fin rays were longer than the second dorsal fin rays. Pelvic fin buds were evident, with no ray development at 12.6 mm SL. The caudal fin fold differentiated into the caudal fin by 12.1 mm. At this size the caudal fin had 10–12 rays, which increased to 19 rays at the end of flexion. The fork, or indentation, on the caudal fin was noticeable in larvae measuring 13.9 mm SL.

Table 2
Physical developmental changes of preflexion larvae.

SL (mm)	Development
6.1[1]	Eye pigmentation
7.6	Hypural bud visible
7.6	4 melanophore zones on cranial cap
7.6	1 melanophore over each operculum
7.6	20 melanophores from anal vent to caudal
7.6	Pectoral fin rays visible
7.6	Angle of vent about 90°
7.7[1]	Pigmentation of alimentary canal

[1] Data from McFarlane and Nagata (1988).

Postflexion—The ratio of pectoral fin to body length decreased to 17% for 70-mm SL larvae, becoming similar to that in larger fish. A total of 17 rays were counted in the pectoral fin for 24.9-mm larvae, as in larger fish (juvenile/adult fish have 17 rays; Table 4). The fin fold receded at a slower rate on the ventral side and disappeared by the time larvae reached 24.1 mm. The second dorsal fin continued developing before the first dorsal fin: 17 rays were visible on the second dorsal fin for 17.0-mm larvae, and 18 rays were visible for larvae >35.0 mm (juvenile/adult fish have 18 rays). Longer

Table 3
Physical developmental changes of flexion larvae.

SL (mm)	Development
10.8	Pectoral fin with 12 rays
12.1	Second dorsal fin with 14 rays visible
12.1	Caudal fin developed with 10–12 rays
12.1	Anal fin and rays visible
12.1	Angle of anal vent decreasing from 90°
12.6	Pelvic fin visible
12.6	First dorsal fin visible
12.6	Distal portion of pectoral fin is black
13.4	Melanophore color changed from olive brown to blue green
13.4	Half of pectoral fin is black
13.9	Fork in caudal fin is noticeable
15.1	Lateral line visible, and 2% SL
15.6	Dorsal fin fold disappears
15.6	First dorsal fin rays are visible
15.6	Anal fin with 16–18 rays

rays were found in the anterior portion of the second dorsal fin for 19.0-mm larvae; the fin looked like the adult fin by 21.0 mm SL. The spines in the first dorsal fin initially appeared in 21.0-mm larvae, with the longest spines on the anterior and posterior margins of the fin. A total of 18 spines were evident in the first dorsal fin for 47.5-mm larvae (juvenile/adult fish, 19 rays). The number of rays in the anal fin totaled 19 for 19.2-mm larvae (juvenile/adult fish, 19 rays). Pelvic fin rays (I,5) were visible in 17.5-mm larvae (juvenile/adult fish, 6 rays). New ray development in the dorsal and ventral caudal peduncle region was noticed for 16.4-mm larvae, and by 26.4 mm SL the caudal peduncle had 36 rays (juvenile/adult fish, 36 rays). The indentation on the caudal fin increased such that the proportion of FL to TL decreased from 98.7% to 93.3% for 30-mm SL (34-mm FL) larvae, similar to this proportion in adult fish.

Pigmentation

Preflexion—Preflexion larvae (7.6 to 8.6 mm SL) had four melanophore zones on the cranial cap (Table 2). The interorbital area had one melanophore. The operculum had two melanophores, one over each side. Both lateral sides had light pigmentation, which became more concentrated in the caudal region. The ventral surface and the entire digestive tract were unpigmented except for 20 melanophores located on the ventral midline, extending posterior from the anal vent to the caudal peduncle.

Table 4
Physical developmental changes of postflexion larvae.

SL (mm)	Development
17.0	Second dorsal fin with 17 rays
17.5	Pelvic fin with rays
19.2	Anal fin has 19 rays, similar to larger fish
24.1	Ventral fin fold disappears
24.9	Pectoral fin has 17 rays
25.0	Head length ratio similar to larger fish
26.4	Caudal fin has 36 rays, similar to larger fish
29.9	Second dorsal fin pigmented
30.0	Caudal fin fork ratio similar to larger fish
32.0	Upper jaw ratio similar to larger fish
35.4	First dorsal fin with 17 rays, similar to larger fish
47.0	Second dorsal fin with 18 rays
47.0	Three-quarters of pectoral fin is black
47.5	Scales visible along body
47.5	Lateral line extends full length of body
50.0	Snout-to-anus ratio similar to larger fish
65.0	Body depth ratio similar to larger fish
67.0	Caudal fin heavily pigmented
70.0	Pectoral fin ratio similar to larger fish
70.0	Interorbital distance ratio similar to larger fish
74.0	Snout length ratio similar to larger fish
89.9	Black pigmentation on pectoral fin less noticeable

Flexion—First noticed on the upper and lower jaw in 9.9-mm larvae, pigmentation continued to spread with the size of the fish. Throughout flexion, individual melanophores on the cranial cap became less distinct as the pigmentation spread over the cap. The interorbital area contained more than one melanophore (9.9-mm larvae). Each operculum still contained a single large melanophore (12.9 mm SL) and numerous smaller melanophores, which covered the operculum by the end of flexion. Black pigmentation was visible between the rays of the distal portion of the pectoral fin on 12.6-mm larvae. By 13.4 mm SL, half of the pectoral fin was covered by black pigmentation (Table 3). The anterior portion of the hypural elements was pigmented (11.9 mm SL). At the start of flexion, the dorsal surface darkened as pigmentation began to spread; by 13.9 mm SL, about 1/4 of the dorsal surface from the nape to the caudal fin contained solid pigmentation. At this stage the dorsal pigmentation changed from olive brown to dark blue green. Simultaneously, the ventral surface was silver with the 20 melanophores, and the ventral midline was almost totally covered by the developing musculature. A row of melanophores covered the dorsal surface of the intestinal tract and the entire stomach region except for the ventral midline in 12.1-mm larvae. As the larvae grew longer, the musculature developed ventrally and covered the intestinal tract and the pelvic girdle.

Postflexion—The cranial cap, interorbital region, and operculum continued to darken as a result of increased pigmentation. Melanistic pigmentation covered about three-quarters of the pectoral fin in 47.5-mm larvae; by 89.9 mm SL this pigmentation could not be differentiated from the coloration of the fin (Table 4). By 15.6 mm SL, the 20 melanophores posterior to the anal vent were difficult to see. On the first dorsal fin, a few melanophores were visible on the distal fringe in 21.4-mm larvae. The pigmentation darkened on the anterior rays and distal fringe of the first dorsal fin in 30-mm larvae, and became black as the larvae reached 89.9 mm SL. By 35.4 mm SL, the pigmentation had spread to the base of all spines in the first dorsal fin, as in larger fish. The second dorsal fin was pigmented for 29.9-mm larvae. In larvae between 47.0 and 89.0 mm SL, the distal quarter of the fin was unpigmented. By 67.0 mm SL the caudal fin was heavily pigmented; the distal fringe was unpigmented. The lateral surface had dark pigmentation above the lateral line, while the ventral surface remained silver with light spotting.

Gut Development

Preflexion—The intestine in larvae from 7.6 to 8.6 mm SL was long, straight, and ended at the anal vent located midway (51% SL) along the body, and angled at 90° (Table 2). The entire gut was visible from the liver to the vent.

Flexion—In flexion larvae, musculature developed along the ventral side and started covering the gut area. For 12.1-mm larvae, the angle of the vent started to decrease from 90° (Table 3); the vent was located at about 54% SL. The concentration of melanophores increased around the stomach and liver area. The intestinal tract was still visible at the end of flexion.

Postflexion—In 18.1-mm larvae, the musculature enveloped the stomach area to the anal vent, and myomeres were differentiated. The anal vent was anterior to the anal fin at about 59% SL.

Lateral Line Development

Preflexion—The lateral line was not visible on preflexion larvae.

Flexion—The lateral line was visible on 15.1-mm larvae during late flexion (Table 2). The line first appeared high on the dorsolateral surface anterior of the pectoral fin insertion and measured about 2% SL.

Postflexion—The lateral line increased to 10% SL (17.0 mm SL) and was completely visible along the body, as in the adult form, for 47.5-mm larvae (Table 3). Interestingly, scales were initially visible in 47.5-mm larvae.

Discussion

Identification Characteristics

Identification of sablefish larvae was initially based on criteria developed by Brock (1940) and Kobayashi (1957), and highlighted the large, pigmented pectoral fins and the anal vent. As we examined the larvae it was apparent that a number of additional characteristics could help with identification, particularly in the larval to early juvenile stages. The additional characteristics include the 20 melanophores on the ventral midline posterior to the anal vent; the elongated body form with the long, straight intestine terminating at a 90° angle midway along the body; the long, paddle-like pectoral fins measuring about 30% of the body length, with black pigmentation on their distal half; and the four melanophore zones on the cranial cap.

Fish in the initial postflexion stage were easily identified. Their bodies were elongated and relatively slim, with long pectoral fins. Each pectoral fin still had black pigmentation on its distal half. This feature made the fins look like black-tipped wings. During this stage the pigmentation changed from olive to blue green on the dorsal half, and to silver white on the ventral half of the body. Also, by studying how the body proportions relate to adult proportions, we could determine the period of transformation.

In summary, we believe that these characteristics will enhance our ability to identify sablefish. In addition, although not all species will have proportions similar to sablefish, we have provided a technique for defining the transformation period for other species.

Transformation to Juvenile Stage

The criteria for determining the transition from the late larval to the juvenile stage were based on characteristics that gave the fish an adult appearance, such as formation of the full complement of fin rays (Berry 1959; Harya 1980) and an increase in body pigmentation and scale formation (Richardson and Washington 1980). In addition, we used the body proportions for postflexion larvae to determine at what size the larval body began to resemble that of adults. For example, pectoral fin length/SL, interorbital distance/HL, and snout length/HL proportions started to change around 30 mm SL and resembled the proportions of adults around 70 mm. Other body proportions that resembled the adult stage at 30 mm, with little change thereafter, were the ratio of snout-to-anus length/SL, head length/SL, and upper jaw length/HL. The period of change, or "transformation," to the juvenile stage, when the larvae start to resemble adults, therefore is defined as occurring from 30 to 70 mm. During this period the scales were becoming evident; body pigmentation became very concentrated; the body narrowed; and the fins took on adult proportions. On the basis of these criteria, we propose that the transformation stage is complete at 70 mm SL (76.5 mm FL).

Functional Aspects

Changes during the developmental stages of sablefish larvae affect their adaptation to their environment. According to McFarlane and Beamish (1992), sablefish spawn along the continental slope, deeper than 300 m. Eggs hatch in deep water and the larvae sink to approximately 1,000 m, remaining there until they begin feeding (McFarlane and Beamish, 1992). At this time the alimentary canal, eyes, head, and body become pigmented. The mouth is functional, and the larvae begin showing prey-capture movements. After about 20 days (preflexion stage) at this depth, the larvae begin to swim up in the water column to follow prey, attracting predators.

Pigmentation—Pigmentation began early in the preflexion stage. This is considered an important adaptation of sablefish larvae to their environment. Newly-hatched larvae (4.5 mm) were transparent but quickly became camouflaged as they reached surface waters (7.6 mm SL) and pigmentation developed. During this stage they were elongated, with a linear pattern of 20 melanophores posterior to the anal vent. Pigment was visible inside the body cavity along the dorsal side of the gut. Also, some pigmentation occurred externally along the dorsal surface of the body. The linear postanal pigment probably functions to confuse a predator with the phenomenon of "flicked fusion," which depends on the rapidly beating tail fin (Moser, 1981). Pigmentation dorsal to the gut helps to mask light refracting through the gut contents, especially in shallow waters. Early pigmentation on the dorsal surface is probably an adaptation by the larvae to their habitat in surface waters, which is characterized by predators and solar radiation. Moser (1981) suggested that ultraviolet (UV) radiation is the primary factor selecting for the heavy melanistic pigmentation found universally among neustonic fish larvae. In the case of sablefish, the heavy melanistic pigment at an early stage probably contains a high concentration of xanthic pigment, characterized by a brown-black color. This pigment would cloak the dorsal surface of the larvae and protect against the destructive effects of UV rays, and also against visible light radiation. As the larvae continued to grow (13.4 mm), the color on the dorsal surface changed from olive brown to blue green with black melanophores. By 35.4 mm SL, the fish were relatively well cloaked in the dark pigment, thus beginning to resemble adults.

Fin Development—Contraction of the fin fold appeared to coincide with enlargement of the pectoral fins. In the earlier stages of larval development, particularly in deep water, the fin fold probably helps larvae overcome negative buoyancy (larvae have no swim bladder), acting as preliminary dorsal and ventral fins. During preflexion and flexion, the enlargement of the pectoral fins could have a hydrostatic function for conserving energy by acting as wings to glide the larvae through the water; provide rapid mobility, since the tail fin is not fully differentiated; and deter potential predators by enhancing larval size.

We speculate that as the larvae begin to inhabit shallower waters, the black pigmentation on the tips of the pectoral fins acts as a form of mimicry, changing the appearance of the larvae when the fins are extended and making them look like predators. When the pectoral fins are beside the body, the black pigmentation helps to break the pattern of the body color and possibly to mislead predators. Around the start of the transformation period (30 mm SL), survival techniques such as camouflage and mimicry probably begin to be less important to the larvae.

Adapting to Food Availability—Survival of sablefish larvae is closely linked with calanoid copepod production, and an increase in copepod abundance would be expected to improve sablefish survival (McFarlane and Beamish, 1992). During the preflexion stage, larvae equipped with a generous fin fold, large mouth, and large eyes prey on copepod eggs and nauplii in the depths from 600 to 800 m. Grover and Olla (1986) noted that sablefish larvae between 12.5 and 20.5 mm SL changed the size of prey they consumed. The diet of larger larvae is more diverse than that of smaller larvae. In order to respond to varying abundance and availability of prey at the time of hatching, the larvaes' rounded caudal fin develops early into the deeply forked tail, thus enabling these small fish to increase their swimming speed and maneuverability. This period coincides with the onset of transformation.

As the larvae grow in length, the mouth-opening ratio decreases, and becomes similar to that of adult sablefish.

The reduced pectoral fin and increased forked tail would allow these fish to catch food more easily and to target different prey species and sizes, thus becoming more efficient feeders. This period coincides with the end of transformation and the onset of the juvenile stage.

In this report we have described the development of sablefish larvae to the juvenile stage. We have also proposed how the development from larvae to juvenile relates to their environmental adaptability. We believe that determining the developmental stages of sablefish larvae will facilitate the study of factors that influence larval year-class success.

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