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DISTRIBUTION, SIZE RELATIONSHIPS, AND FOOD HABITS OF JUVENILE KING-OF-THE-SALMON, *TRACHIPTERUS ALTIVELIS*, CAUGHT OFF THE OREGON COAST

The king-of-the-salmon is a strikingly colored ribbonfish of the family Trachipteridae that occurs in the oceanic and coastal waters of the eastern Pacific Ocean, from Chile to Alaska. Captures have been recorded from the coastal regions and offshore halfway to the Hawaiian Islands. Specimens have also been taken in coastal waters and estuaries along the United States and Canadian shores on rare occasions (Hart 1943; Walker 1953). Their lower depth limit is not known, but individuals have been taken from the surface down to at least 650 m (Fitch 1964).

Spawning apparently occurs in the open ocean throughout the year, but is probably concentrated in the spring. Plankton surveys off California have recorded the largest catches of larvae during the months of June and July (Fitch 1964). Bongo net and neuston net collections from northern California, Oregon, and Washington frequently contained eggs in April and May 1980, but larvae were rarely taken (Kendall and Clark[1]). August 1980 samples contained relatively few eggs (Kendall and Clark[2]). Egg densities during the spring sampling reached 25 eggs/10 m^2, and the eggs were found from 5 to 320 km offshore (Kendall[3]).

Throughout the early life stages, allometric growth reduces the proportionate size of the fins and alters the body form by increasing the relative size of the posterior portion of the fish (Sette 1923; Hubbs 1926). Fitch (1964) examined the otoliths of five individuals to determine their ages. His fish ranged from a 400 mm juvenile with an estimated age of 1 yr to a 1.5 m adult with an age of 7 yr.

The stomach contents of several adults show that these fish eat whole micronectonic organisms (e.g., small squid, epi- and mesopelagic fishes) as well as macrozooplankton such as euphausiids (Fitch 1964). Roedel (1938) presented a qualitative list of the gut contents of five juveniles (about 100-200 mm long) taken from the stomach of a longnose lancetfish, *Alepisaurus ferox*, caught off Santa Monica, Calif. Copepods were found in three of the stomachs, while polychaetes and fish larvae were each found in one stomach.

During 1980 and 1981, 44 juvenile king-of-the-salmon were collected with a purse seine during a study of the ecology and migration of juvenile salmonids off the Oregon coast. This paper presents an analysis of the spatial distribution, size relationships, and the feeding habits of these unusual fish.

[1]Kendall, A. W., Jr., and J. Clark. 1982. Ichthyoplankton off Washington, Oregon, and Northern California April-May 1980. Northwest and Alaska Fish. Cent. Process. Rep. 82-11, 44 p. Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Blvd. East, Seattle, WA 98112.

[2]Kendall, A. W., Jr., and J. Clark. 1982. Ichthyoplankton off Washington, Oregon, and Northern California August 1980. Northwest and Alaska Fish. Cent. Process. Rep. 82-12, 43 p. Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Blvd. East, Seattle, WA 98112.

[3]Arthur W. Kendall, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Blvd. East, Seattle, WA 98112, pers. commun. January 1983.

Materials and Methods

In June 1980 and May, June, July, and August 1981, 10-d sampling cruises were conducted. In 1980, 44 collections were made with a purse seine. Six sets were made during the night at two stations in 2,100-2,200 m of water about 100 km offshore from the mouth of the Columbia River. Thirty-five sets were made during the day along three transects located north and south of the mouth of the Columbia River and off the mouth of the Yaquina River. These transects extended from the 40 m isobath to 40 km offshore. An additional three sets were made along the shore 40-50 km south of the Columbia River. During the 1981 cruises, 273 sets of the purse seine were made along 12 transects, from north of the Columbia River to south of Coos Bay (Fig. 1). Transects were sampled from the 40 m isobath to distances ranging from 10 to 50 km offshore. Because of time constraints, not all 12 transects were sampled on each cruise. Both day and night samples were taken in 1981. Secchi depths were determined during day hauls made in June, July, and August 1981.

Samples were collected with herring purse seines operated from chartered commercial fishing vessels. The cruises in 1980 and in May and June 1981 used a 457 m long purse seine borrowed from the National Marine Fisheries Service in Seattle. This net fished about 9 m deep and sampled about 150,000 m^3 of water. A 457 m long commercial herring seine was used in July and August 1981; it fished about 15 m deep and enclosed about 250,000 m^3 of water. Both nets were constructed of 30 mm stretched mesh.

Immediately after capture, king-of-the-salmon were preserved in 10% Formalin[4] and returned to the laboratory. Preserved lengths and weights were then measured, and stomachs were removed for analysis. Stomach contents were sorted to the lowest practical taxonomic level. Prey were then counted, blotted dry, and weighed to the nearest 0.001 g.

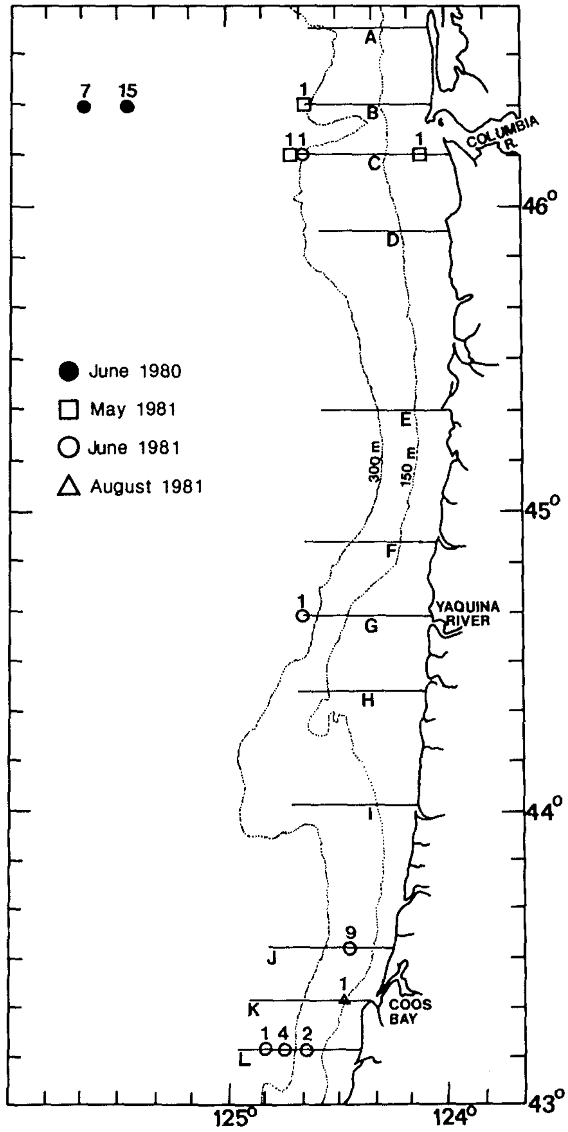

FIGURE 1.—Transects off the Oregon coast sampled during 1980 and 1981, and locations of capture of juvenile king-of-the-salmon. Numbers above symbols indicate how many juveniles were taken at that station.

Results and Discussion

In June 1980, 22 juvenile king-of-the-salmon were collected in five of the six night sets made 100 km offshore from the mouth of the Columbia River. No other specimens were collected in any of the sets made closer to the shore in 1980. In 1981, specimens were taken in both day and night sets. Sixteen juveniles were taken from the Coos Bay region in June and one was taken in August, which were the only months that this area was sampled. Four juveniles were taken offshore from the Columbia River in May and June, and a single fish was caught at the westernmost station of the Yaquina River transect in June (Fig. 1).

[4]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Forty-three of the 44 juveniles collected throughout this study were taken in May and June, while none were caught in July, and only one was taken in August. The high abundance of these fish in the late spring and early summer samples may indicate the presence of seasonal variation in their distribution.

During the sampling of each transect, a distinct boundary separating green coastal water from blue oceanic water was generally observed. All but one of the juveniles were taken west of this front, on or beyond the 150 m isobath. Secchi depths at the locations of capture of juveniles in June and August 1981 ranged from 11 to 25 m. In contrast, Secchi depths in the green coastal water were generally <10 m. The abundance of juveniles in the Coos Bay region is probably a reflection of the narrow continental shelf there and the steep depth gradient within several kilometers of shore. Blue oceanic water with Secchi depths of 10-25 m was found to extend to within 5-10 km of the coast in June, and right up to the beach in August.

The fish taken offshore in 1980 ranged in size from 68 to 509 mm SL, and weighed from 1.0 to 78.4 g. Juveniles collected inshore in 1981 ranged in length from 70 to 245 mm SL and weighed from 1.8 to 17.5 g. All 11 of the specimens >250 mm SL were taken offshore. The preserved length-weight relationship of 40 undamaged specimens can be summarized by a power curve regression equation: $W = 2.04 \times 10^{-4} L^{2.06}$ ($r^2 = 0.99$; Fig. 2).

The specimens collected offshore in 1980 and inshore in 1981 relied, as would be expected, on different planktonic food sources. All specimens contained at least some items in their stomachs, but the total biomass per stomach was generally <0.20 g and never exceeded 0.85 g. These low weights are more a reflection of the size and morphology of the fish than of low feeding rates. Many of the specimens had their simple, tubelike stomachs fully packed with prey.

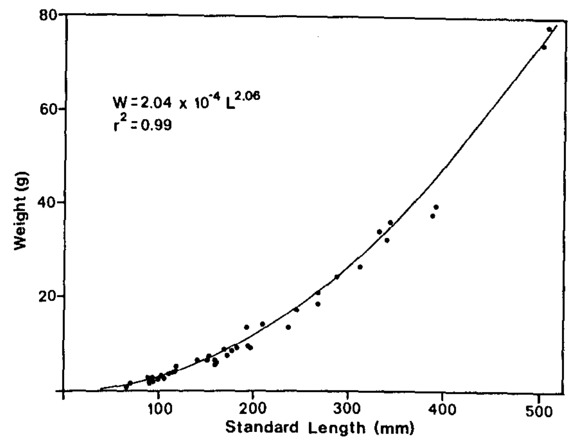

FIGURE 2.—Length-weight relationships of 40 undamaged, preserved juvenile king-of-the-salmon.

The offshore specimens fed extensively on an hyperiid amphipod, *Phronima* sp. (Table 1). Prey identified as *Phronima* were found in 15 of the 21 stomachs examined, with a maximum of 16 *Phronima* per stomach. Crustacean parts were found in 20 of these stomachs. These parts, particularly leg and chela segments, generally closely resembled *Phronima*. Other hyperiids

TABLE 1.—Frequency of occurrence of prey taxa and maximum abundance of prey taxa in juvenile king-of-the-salmon stomachs collected at offshore stations (1980; N = 21) and inshore stations (1981; N = 20) off the Oregon coast.

Prey taxa	1980 Number of stomachs	1980 Maximum number per stomach	1980 Maximum biomass per stomach (g)	1981 Number of stomachs	1981 Maximum number per stomach	1981 Maximum biomass per stomach (g)
Unidentified material	21	—	0.220	17	—	0.087
Crustacean parts	20	—	0.512	2	0	0.027
Amphipods						
Phronima	15	16	0.495	1	1	0.001
other	6	4	0.029	2	1	0.001
Copepods	12	12	0.002	18	184	0.215
Euphausiids	3	2	0.003	10	37	0.148
Shrimp larvae	1	1	0.001	0	0	0
Crab megalops	1	1	0.044	3	5	0.021
Squid (tentacle)	1	1	0.027	0	0	0
Chaetognaths	0	0	0	2	5	0.011
Fish						
larvae	0	0	0	13	19	0.241
scales	11	6	0.004	0	0	0

were occasionally eaten, but did not constitute a major component of the diet. Copepods were present in 12 stomachs, but were in low numbers and probably were not very important as a dietary item. Fish scales were taken from 11 stomachs. The scales did not appear to come from other fish collected in the same net hauls and may indicate that these small-toothed juveniles consume scales floating free in the water. One fish stomach contained a piece of a squid tentacle, further suggesting that these fishes occasionally act as scavengers by picking up debris from predation events.

This reliance on *Phronima* as the dominant food organism is notable because of the parasitoid relationship between the Phronimidae and gelatinous zooplankton. Laval (1980) summarized the data known about this relationship and showed that *Phronima* spp. generally mature and live within the bodies of pelagic salps and siphonophores. Both the hosts and the amphipods are virtually transparent, and exceptional visual acuity is probably necessary to locate these prey. Traces of the hosts were not found in the fish stomachs, indicating that the fish either rapidly digest the host, pick the amphipods from the host, or eat the amphipods while the amphipods are moving between the hosts.

The inshore fishes caught in 1981 consumed a more varied range of prey (Table 1). Copepods were the most important prey item and were found in 18 of the 20 stomachs analyzed, in numbers ranging up to 184 copepods per stomach. Fish larvae were another important component of the diet and were found in 13 stomachs. These larvae ranged from tiny (2-3 mm) unidentifiable fish to 20 mm flatfish larvae (*Hippoglossoides* sp.). Up to 19 larvae were taken from a single stomach. Juvenile and a few adult euphausiids (*Euphausia pacifica* and *Thysanoessa spinifera*) were taken from 10 stomachs, in numbers up to 35 euphausiids per stomach. Unlike the oceanic specimens, the inshore fish rarely ate hyperiid amphipods and never consumed fish scales.

The dietary differences observed between the offshore and inshore collected specimens are an expected feature that reflects the availability of different prey taxa in different environments. The offshore stations had blue, clear water of relatively low particulate content, while the inshore stations were influenced by higher coastal productivity as well as river and estuarine input. The 1981 juveniles were collected in the transition zone between the oceanic and coastal environments. Utilization of this ecotone perhaps enabled these fish to take advantage of a portion of the coastal productivity and yet remain in a relatively clear oceanic habitat.

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