

# Consistent yearly appearance of age-0 walleye pollock, *Theragra chalcogramma*, at a coastal site in southeastern Alaska, 1973–1994

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Walleye pollock, *Theragra chalcogramma*, are found throughout the North Pacific Ocean; their abundance is centered in the Bering Sea and Gulf of Alaska, where they are of great economic importance and a key species in the ecosystem. Pollock presently support the world's largest single-species fishery, averaging over 5 million metric tons (t) annual catch since the early 1980's (Lloyd and Davis, 1989). They made up 5% (4.9 million t) of the total world catch of all species in 1991 (FAO, 1993).

Adult pollock are found over the continental shelf, mainly in the mid-range of the water column; the greatest biomass has been found between 100 and 300 m deep (Smith, 1981). Most spawning takes place in spring (Kendall and Picquelle, 1990), during late March and April in the Gulf of Alaska (Kim, 1989). Spawning pollock broadcast pelagic, nonadhesive eggs in mid-water (Serobaba, 1974).

Larval pollock are found near the surface and in mid-water, above 100-m depths and they make diel vertical migrations (Serobaba, 1974; Kamba, 1977; Pritchett and Haldorson, 1989). In Southeast Alaska, abundant larvae (5–7 mm standard length [SL]) were found

during mid-May in Auke Bay; peak hatching occurred about 28 April (Haldorson et al., 1990). Later-stage larvae (4–17 mm SL) were found throughout the water column from near surface to 55 m depths during June and July in Auke Bay; they became demersal (absent from the plankton, found only near the bottom during day) after reaching 20–30 mm SL (Salveson, 1984).

The presence of young pollock has been documented from mid-water and near bottom depths during summer (Smith, 1981; Krieger and Wing, 1986; Hinckley et al., 1991) and fall (Carlson et al.<sup>1</sup>). Available information on their distribution generally covers only a few years or wide geographic areas. During August–December trawl surveys from 1969 through 1981, age-0 pollock were taken near the bottom at 30–60 m depths at various bays and inlets in southeastern Alaska (Carlson et al.<sup>1</sup>).

Although general distribution of some young pollock is documented, patterns of long-term use of specific sites by successive generations of young-of-the-year (age-0) pollock are little known. Because pollock year-class strength can be established after the larval stage (Bailey and Spring, 1992), sampling these

sites may provide useful information for establishing an index of population characteristics.

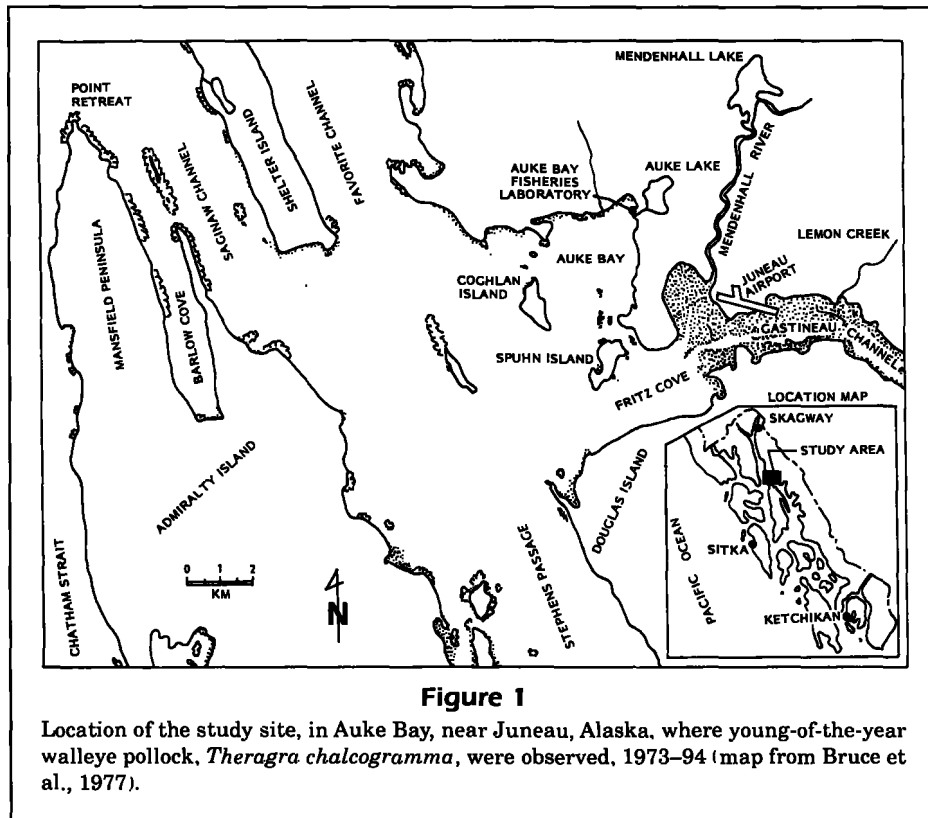
This paper documents the yearly first appearance, from 1973 through 1994, of newly metamorphosed juvenile walleye pollock at a specific site in Auke Bay, Southeast Alaska, and describes the young fish living near bottom during their initial growing season.

## Methods

The 1,344 diving observations reported in this study took place in or near northeastern Auke Bay (Fig. 1), 20 km west of Juneau, Alaska, and focused on two adjacent, submerged (20–25 m depths) rocky ledges at a site within 200 m of the Auke Bay Laboratory. The diving effort included sites within a 15-km radius of Auke Bay that were surveyed periodically to explore possible presence of age-0 pollock elsewhere in the area.

Conventional scuba gear was used and no decompression procedures were followed. I averaged 8.8 (range 0–17) diving days per month from June through December and covered intertidal to 20–30 m depths for 22 consecutive years (Table 1). Nearly all dives took place during daylight until November and December, when night dives became equally routine. Most diving days involved a single dive; an average dive was made to a depth of 23 m and lasted 25 minutes. On each dive, I routinely swam the equivalent of transects over a set of underwater landmarks (e.g. rock ledges, cobble slope), noted and later recorded all identi-

<sup>1</sup> Carlson, H. R., R. E. Haight, and K. J. Krieger. 1982. Species composition and relative abundance of demersal marine life in waters of southeastern Alaska, 1969–81. U.S. Dep. Commerce, NMFS, NWAFC Processed Rep. 82-16, 106 p.



fiable fish and invertebrate species, and documented life stage and relative abundance of commercially valuable species. For age-0 walleye pollock, I visually estimated total length (TL) of individuals to the nearest cm. These size-composition estimates were corroborated by Salvesson (1984), who collected and measured hundreds of young pollock concurrently with my diving observations in 1978 and 1979, during growth and distribution studies in northern Stephens Passage, including my site in Auke Bay. These samples included 511 age-0 pollock collected (by using explosives) during August and September 1979 from the same shoals that I observed.

## Results

The first sightings of demersal age-0 walleye pollock (Table 2) occurred most often in July (14 years) and sometimes in August (5 years); the first sighting was later than August in only 3 of 22 years.

General appearance and behavior of the young pollock at the Auke Bay study site was similar throughout summer and fall and from year to year. Over the course of the study, size estimates of individual fish were consistently 3–6 cm TL in July and 8–10 cm TL by October (Table 2). No size differences

or environmental anomalies (sea temperature, salinity profiles) were apparent in the three years of later first sightings. The young fish formed shoals composed of hundreds to a few thousand loosely aggregated individuals within 1 m above the bottom or off rocky ledges at 20–30 m. Currents were normally slight, and these shoals moved and milled slowly, apparently feeding on zooplankton.

Each year, just before the shoals of demersal young pollock appeared, I observed great sculpins, *Myoxocephalus polyacanthocephalus*, distributed over the slope and rocky ledges where the young pollock later appeared. These large (many >60 cm) predators were unusually abundant, often numbering as many as 20–30 sculpins along a 15–20 m length of rocky ledge. They lay in wait on the bottom and after the young pollock appeared, were often seen pursuing and capturing them. Some sculpins appeared so gorged with young pollock that their gut was greatly distended.

As the juvenile pollock grew, they moved down the slope into deeper waters. After reaching approximately 10 cm TL by October or November, they were seen less frequently. By then the pollock were inhabiting waters 30 m or deeper, approaching the limits of normal scuba operations. By December and into winter, the juvenile pollock were seen infrequently

**Table 1**

Survey effort (number of diving days) in Auke Bay and vicinity, Southeast Alaska, to observe juvenile walleye pollock, *Theragra chalcogramma*. June–December 1973–94.

Year	Month							Total
	June	July	August	Sept	Oct	Nov	Dec	
1973	0	1	1	3	6	6	5	22
1974	3	4	3	2	5	10	6	33
1975	7	9	8	0	0	0	0	24
1976	4	5	13	7	7	7	15	58
1977	10	5	9	9	4	7	5	49
1978	6	7	10	11	8	11	13	66
1979	17	14	14	13	17	14	17	106
1980	16	4	9	15	9	6	10	69
1981	9	4	11	17	17	14	16	88
1982	3	6	14	9	7	4	11	54
1983	16	7	8	9	12	10	8	70
1984	7	2	7	8	6	6	6	42
1985	8	1	4	6	6	7	12	44
1986	5	3	4	5	9	13	15	54
1987	16	17	8	9	15	13	16	94
1988	6	16	10	13	16	11	17	89
1989	9	5	9	10	15	12	15	75
1990	14	14	8	15	5	11	16	83
1991	4	12	8	11	8	15	17	75
1992	6	10	12	6	8	9	13	64
1993	3	3	5	6	8	9	7	41
1994	6	9	3	8	14	4		44
Total	175	158	178	192	202	199	240	1,344

during daylight. During darkness in November and December, they moved into shallows of 9 m or less and became more loosely aggregated; some individuals remained on the bottom and motionless under a light beam. At dawn the loose aggregations became shoals and moved downslope again to depths >30 m.

## Discussion

The consistent appearance of the age-0 pollock that I observed each year for 22 years at the Auke Bay site agrees during 1986–89 with the earlier appearance for those years of pollock larvae observed in Auke Bay by Haldorson et al. (1990). They found that little hatching occurred after the major larval cohort appeared and concluded that pollock spawn during the relatively short period when larval feeding conditions are optimal.

By July, I observed that the larvae had usually settled out from a planktonic existence and had become demersal juveniles. Typically at this time, sea surface temperatures in Auke Bay are near a yearly peak (Bruce et al., 1977), a thermocline has formed around 12 m depth, zooplankton abundance in the upper water column approaches its yearly maximum (Carlson, 1980), and 3–4 cm juvenile pollock feed mostly on the copepod *Acartia clausi* (Krieger, 1985). Similar to my findings, the sculpin *Myoxocephalus* sp. is a major predator of age-0 juvenile pollock in the Bering Sea (Smith, 1981).

By October, when the young pollock were 8–10 cm TL, they appeared sufficiently motile to evade most bottom-dwelling predators. They moved to deeper water in the fall around the time that, typically, storms mix the surface and mid-water strata, the thermocline breaks down, and sea temperatures decrease sharply and become nearly uniform through-

**Table 2**

Dates of first sightings and estimated size range of young-of-the-year walleye pollock, *Theragra chalcogramma*, in Auke Bay, Southeast Alaska, 1973–1994. No est. = no estimate; TL = total length.

Year	Date	Size range (TL, cm)
1973	2 August	7
1974	11 October	5–6
1975	17 July	3
1976	15 July	3–5
1977	2 August	5–6
1978	19 July	3–4
1979	14 July	3–4
1980	12 August	4–8
1981	27 July	4–5
1982	27 July	no est.
1983	10 July	4–6
1984	12 September	no est.
1985	28 August	no est.
1986	4 November	no est.
1987	18 July	3
1988	23 July	4–5
1989	2 July	4–5
1990	14 July	5
1991	17 August	5
1992	7 July	4–6
1993	24 July	3–6
1994	16 July	3–5

**Summary****Month of first sightings**

July	14 years
August	5 years
September	1 year
October	1 year
November	1 year
Total	22 years

out the water column (Bruce et al., 1977). Generally, by this time zooplankton abundance had declined, daylight was greatly reduced (Carlson, 1980), and juvenile pollock feeding had shifted from copepods to larger prey—mainly mysids and euphausiids (Krieger, 1985). The young pollock appeared to move deeper in response to these changing oceanographic and trophic conditions.

Each year, this pattern of appearance of juvenile pollock repeated itself with few exceptions and with remarkable predictability; it was generally consistent in timing, location, depth, and size of fish. The consistent residency at the same site, around the same time, by young-of-the-year walleye pollock for 22 consecutive years, demonstrates the long-term significance and potential importance of locales such as Auke Bay as nursery grounds for this species.

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