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THE AGE STRUCTURE AND LENGTH-WEIGHT RELATIONSHIP OF SOUTHEASTERN ALASKA COHO SALMON (Oncorhynchus kisutch), 1969-1970

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ABSTRACT

Size and sex data, and scale samples were collected from commercial fishery landings of coho salmon *(Oncorhynchus kisutch)* throughout Southeastern Alaska, including Yakutat, during the summers of 1969 and 1970. Troll, purse seine, and gillnet landings were sampled during peak fishing periods from both mixed stock and known stock areas. Scale circuli formed through each freshwater winter, during additional freshwater "plus" growth, and through the first marine winter were counted and analyzed for each area. Age and length-weight data were analyzed by area, gear type, sex, and year.

Coho salmon in Southeastern Alaska were found to have a greater total age than those from British Columbia, Washington, Oregon, and California. While coho salmon from areas south of Alaska are predominately 3 years old at maturity (age 1.1), coho salmon from Southeastern Alaska are predominately 4 year old fish (age 2.1). Four age classes were found in scales from 5,406 fish: 26.7% age 1.1 (i.e., fish in their third year of life showing one freshwater and one marine annulus), 63.9% age 2.1, 8.9% age 3.1, and 0.5% age 4.1. Because most Southeastern Alaska coho salmon need an extra year of freshwater rearing before reaching smolt size, larger escapements of spawners may be necessary than for more southern areas to offset greater freshwater rearing mortalities.

INTRODUCTION

When the coho salmon *(Oncorhynchus kisutch)* research project was begun in 1969 by the Alaska Department of Fish and Game (ADF&G), there was a lack of age information on coho salmon in Southeastern Alaska. Age information is necessary in order to relate spawning escapements and other variables (e.g., weather data) to subsequent fish production for management of the fishery.

During the summers of 1969 and 1970, information on age, weight, length, and sex was collected from coho salmon harvested by the Southeastern Alaska commercial fishery. Fish were sampled from two mixed stock fisheries, one in northern Southeastern Alaska and one in southern Southeastern Alaska. The fish in these two areas were taken by troll and purse seine gear relatively early in the season while they were still actively feeding and far from their streams of origin. Fish were also sampled later in the season from eight known stock fisheries in or near river systems throughout Southeastern Alaska, including Yakutat; three from drift gillnet fisheries and five from set gillnet fisheries. These fish had usually ceased feeding and were approaching their spawning condition.

The primary purpose of this study was to determine the age and size of coho salmon from various fisheries throughout Southeastern Alaska for use in management of the fisheries. It was anticipated that some area or stock separating characteristics would also appear on fish scales and that these characteristics might be of use in separating coho salmon stocks or in understanding life history differences between areas.

METHODS AND MATERIALS

Fish Sampling and Fishing Locations

From past statistical catch summaries derived from fish ticket data, peak catch weeks were selected for sampling fisheries in the desired areas. Fish were sampled from the various fisheries when fishing vessels or tenders were unloading at buying stations, canneries, or cold storage plants. Fishing locations were obtained from fishermen or skippers of tenders. Two mixed stock fisheries, one in northern Southeastern Alaska and one in southern Southeastern Alaska were selected to be sampled. Known stock fisheries from eight rivers between Icy Bay (north of Yakutat) and southern Southeastern Alaska were also selected to be sampled (Figures 1 and 2; Appendix Tables 1 and 2).

Sampling for both years was conducted by one biologist assisted by a temporary employee. Fish were weighed to the nearest 10 g on a 9 kg capacity dial type Chatillon[1] autopsy balance hung from a Magic Pole Tripod. Fish were hung

[1] Use of trade names is not intended to connote endorsement by the Alaska Department of Fish and Game.

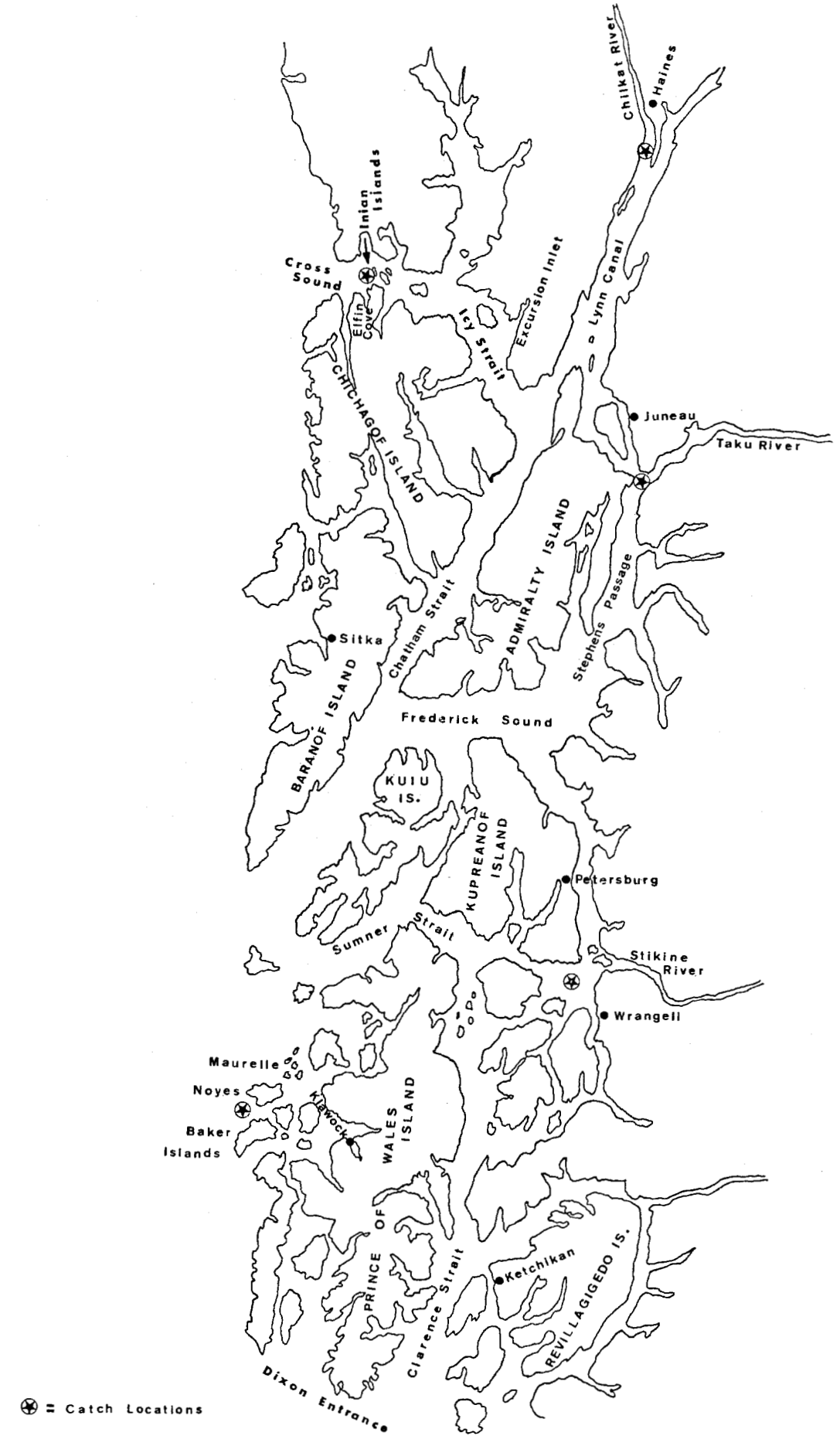

Figure 1. Sampling locations for coho salmon age, weight, and length, Southeastern Alaska commercial fishery, 1969 and 1970. Dixon Entrance to Cross Sound areas.

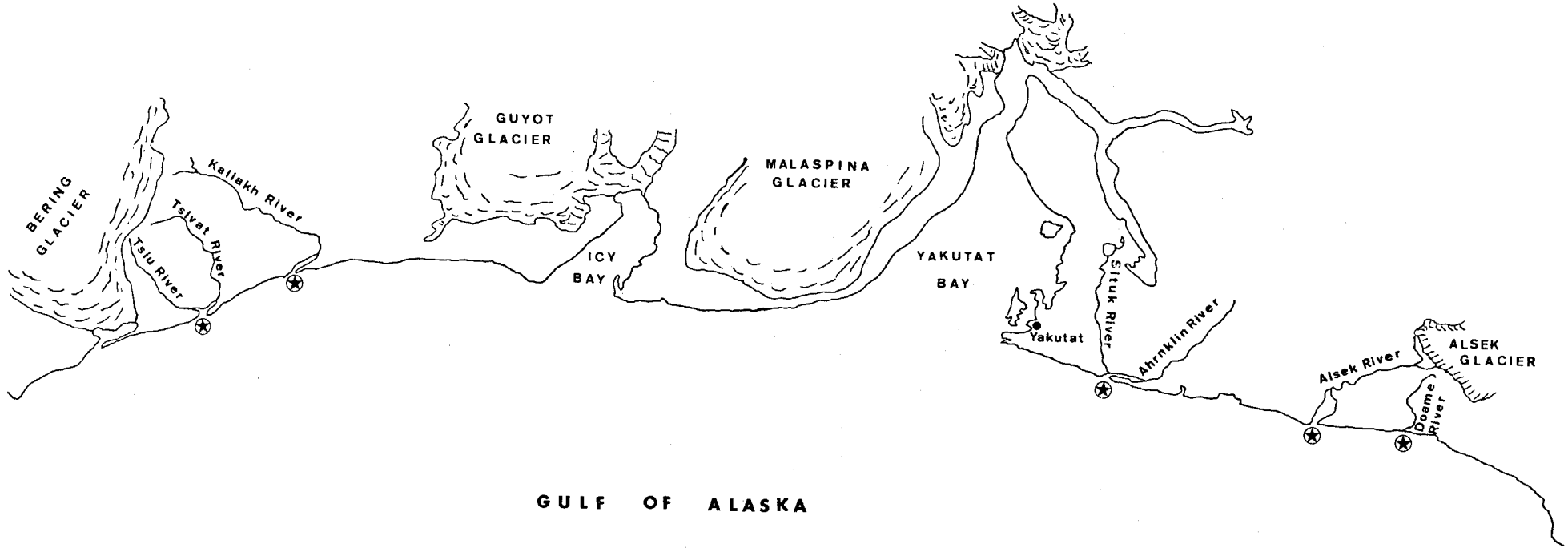

Figure 2. Sampling locations for coho salmon age, weight, and length, Southeastern Alaska commercial fishery, 1969 and 1970. Yakutat to Icy Bay areas.

from a weighted hook that zeroed the balance. A few fish were weighed to the nearest 1/4 lb on a Chatillon INST. 60 lb capacity tubular instrument scale when working on a moving tender or unstable fish buying scow, with the measurements later converted to kg. Snout-fork and mideye-fork lengths were measured to the nearest mm in a cradle type measuring board. A swing-away crossbar at the 20 cm position on the board was lined up with the pupil of the fish's eye for measuring mideye-fork length and 20 cm was later subtracted from the length measurement.

Sex on all "round" fish was determined by cutting an 8 to 10 cm slit in the belly midline, forward from the vent, and examining the gonads. Most canneries did not mind if a small slit was cut along the belly midline and it took very little time with a solid blade scalpel kept sharp with a Gerber steel.

A scalpel was also used to obtain a smear of 15 to 30 scales two and three rows above the lateral line and near a line bisecting the rear of the dorsal fin and the front of the anal fin on the left side of the fish. Scales were placed in a piece of folded adding tape paper previously cut to fit in a coin envelope with spaces for recording length, weight, sex, and sample area. The smear of scales was necessary to offset the high percentage of scale regeneration found in coho salmon.

It was necessary to work rapidly in all sampling to avoid delaying the fish processing operation. One person did all the fish handling and one recorded the data. Fish were first weighted, measured, slit open to determine sex, and finally, a smear of scales was taken. By setting the measuring board waist high and sampling from full-to-empty cannery carts, little time was wasted.

The age composition, size composition, and sex ratios that were found for the various areas sampled in this study were dependent upon the selectivity of fishing methods used to capture the fish. The smaller precocious males (jacks) were not captured by any of the fishing methods (i.e., purse seine, troll, drift or set gillnet), and this age, sex, and size group was not represented in our sampling. Since gillnets tend to be somewhat selective for males, the sex ratios that were found probably resulted from gear selectivity.

Mixed Stock Areas:

The Noyes and Baker Islands purse seine fishery is an outer coast mixed stock fishery off southern Southeastern Alaska. Most of these fish were caught between Cape Ulitka on Noyes Island and Granite Point on Baker Island. Maurelle Islands troll fish were caught in and around the Maurelle Islands group just north of where the Noyes and Baker Islands purse seine fish were taken and were considered to be in the same general sample area.

The Inian Islands purse seine fishery between Cross Sound and Icy Strait is a mixed stock fishery on coho salmon moving into northern Southeastern Alaska from outer coast areas. Inian Islands troll fish were taken in this same general area.

Known Stock Areas:

Drift gillnet fish from the Taku River south of Juneau were caught between Point Bishop and the upstream fishing boundary in Taku Inlet.

The Stikine River drift gillnet fish were caught mainly in the area in front of Wrangell and north and southeast of Zarembo Island. It was assumed that the majority of these fish were destined for the Stikine River, but some could have been going toward other small streams in the area.

Drift gillnet fish from Chilkat Inlet near Haines were caught mainly between Anchorage Point, Cannery Point, and Alexander (Kochu) Island. Some fish were caught as far south as Glacier Point, but still inside of Chilkat Inlet.

The Yakutat area fisheries are all river or river mouth fisheries. Alsek River set gillnet fish were caught in the river. Situk-Ahrnklin River fish were caught in a lagoon common to the mouths of both rivers so it was not possible to determine which river they were destined for. Fishing areas were equally divided between the Situk and Ahrnklin River regulatory markers and therefore, the fish could have been from either river or any of a half dozen smaller streams scattered in-between. Kaliakh River set gillnet fish were caught inside the mouth of the river. Tsiu-Tsivat River set gillnet fish were caught inside a common river mouth and could have been from either river. Doame River set gillnet fish were harvested inside the river mouth.

Scale Preparation and Reading

After completion of sampling, data from scale envelopes were transferred to standard age-weight-length forms with numbered columns for keypunching. Three scales were selected from each fish, washed, mounted on gum cards, and impressions made in plastic cards. Three scales per fish were mounted in a vertical row with scales from 10 fish (30 scales) per card. Techniques used in mounting and pressing coho scales in this study can be found in Appendix A.

Scale impressions were read on an Eberbach reflex projector. Scale images were magnified 80 times, projected on a lighted screen, and the age and circuli counts were read. Scale ages were interpreted by two biologists; one made the circuli counts and the other recorded. It was possible for the person recording to read and count as well. When there was an age disagreement between the two people, the freshwater age on that scale was omitted. All of the scales were read at least twice.

The number of circuli through each freshwater winter were counted and recorded on age-weight-length forms, as were the number of additional circuli after the final freshwater annulus ("plus" growth) and the number of marine circuli through the first winter. Mosher (1972) found that the best features for racial studies using salmonid scales have been in the freshwater and first ocean zones of the scale. Marine circuli were counted along a perpendicular drawn from a line bisecting the sculptured and clear portion of the scale. For counting marine circuli, a 22 x 28 cm clear plastic overlay with a black (Zip-a-Tone) perpendicular was used (Figure 3). The overlay

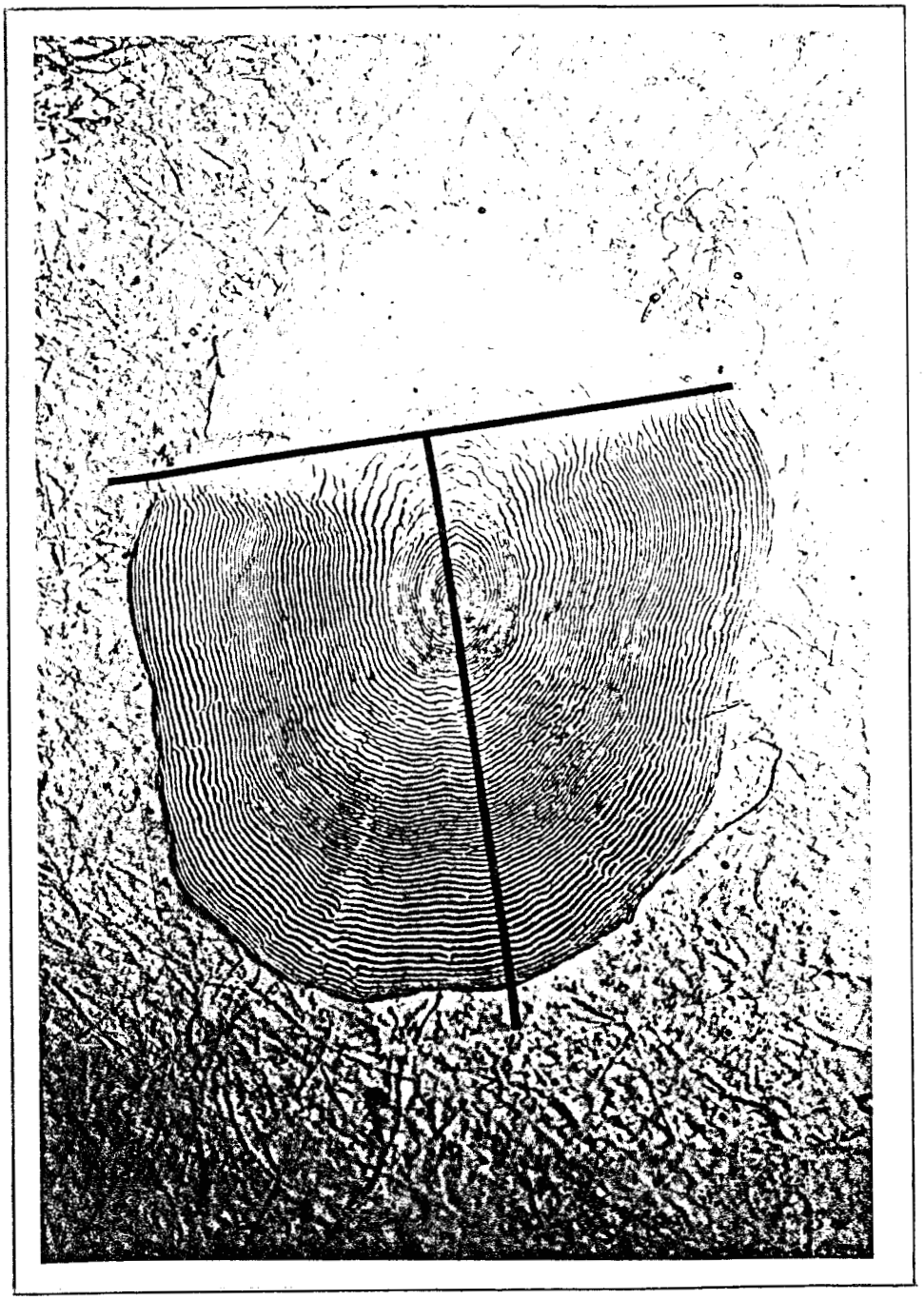

Figure 3. Coho salmon scale with overlay and perpendicular showing line along which marine circuli were counted.

with double coated Scotch tape on the back was easily attached to the projector screen over the scale image.

All three scale impressions for each fish were examined before selecting the clearest one. When recording circuli counts and age the selected scale (A, B, or C) was recorded in the margin of the age-weight-length form for future reference. Notes were also taken on questionable scales for future reference.

Age Designation

The European method of age designation, as recommended by Koo (1962a), was used in this study. The European formula consists of the number of freshwater annuli separated by a decimal from the number of saltwater annuli. For example a 1.1 age designation would represent a fish in its third year of life with one winter annulus in freshwater at the time of outmigration and one winter annulus in saltwater at the time the scale was aged.

RESULTS AND DISCUSSION

Analysis of Age Data

Some difficulty in interpretation of freshwater age and freshwater circuli occurring beyond the last freshwater annulus (plus growth) was experienced when the scales were first read. After reading through all the scales once and seeing many life history types, the interpretation became much easier and by the time the scales were read twice, age on all but a small number of questionable scales had been resolved. Correct interpretation of ages from Southeastern Alaska coho salmon requires considerable experience in reading the scales and it would be easy for an inexperienced reader to misinterpret freshwater age and plus growth. The authors of this study agree with Koo (1962b), working with age determination of Bristol Bay sockeye scales, when he found that "the importance of experience in scale reading is undeniable" and Gilbert (1913) working with coho scales who found "a considerable experience is requisite for correct interpretation in many cases, and a small residue of scales of doubtful significance has always remained."

It was noticed that similar scale patterns often occurred in samples from the same fishing vessel, particularly troll-caught coho salmon, far from the stream of origin. This suggests that coho salmon originating from the same freshwater rearing area may remain together throughout their saltwater residence.

Scale Regeneration:

When salmon scales are lost by accident or injury they are rapidly replaced by new ones. Mosher (1968) found that lost coho and chinook salmon scales were replaced and had resumed normal growth within one month. A regenerated scale replaces a lost one but does not form circuli until it approximates the size of the lost scale. At this point it resumes normal growth, but without a record of fish growth prior to injury. These scales are therefore not suitable for age and growth studies.

Coho salmon have a higher incidence of scale regeneration than some other salmon species because scales are lost more easily. For this reason, more scales need to be taken from each fish for age and growth studies.

Scales were mounted from 6,431 fish, but scales from 1,025 fish (15.9%) were regenerated or otherwise unreadable (Appendix Tables 3 and 4) even though extra care was taken in selecting three scales from a smear from each fish. If only one scale had been collected from each fish the rate of regeneration would likely have been much higher. Mounting three scales from each fish made the reading much easier by allowing for comparison between scales. This also increased the probability of finding a readable scale. The percentage of older fish, particularly ages 4.1 and 3.1 may have been somewhat higher than we found in this study because scales from older age fish are both more difficult to read and more often regenerated.

Coho Salmon Ages from Other Studies:

Reviewing the work of numerous authors, the Informal Committee on Chinook and Coho Report - Volume I (1969) summarized that coho salmon matured in their second to fourth years of life and migrated to saltwater in their second or third year of life. They mentioned the occurrence of fry migrants, ages 0.1, 0.2, and 0.3[1], precocious or sexually mature males (jacks), ages 1.0 and 2.0, and mature adults that spent three summers feeding in saltwater, ages 1.2 and 2.2, but concluded that only the 1.0, 1.1, and 2.1 ages needed to be considered in the management of North American coho stocks. Godfrey (1965) reported that nearly all coho salmon in both Asia and North America spend 1 to 2 years in freshwater before migrating to sea and spend two growing seasons in saltwater, ages 1.1 and 2.1, with significant returns of precocious males (jacks), age 1.0, in some areas.

Lear, et al. (1974) reported that Atlantic salmon *(Salmo salar)* from more southern rivers have a lower freshwater age than others from more northern rivers. Gilbert (1913), Marr (1943), Drucker (1972), and Crone and Bond (1976) all noted an increase in coho age from southern to northern latitudes in North America. A majority of adult coho salmon from California, Oregon, Washington, and southern British Columbia are age 1.1 with smaller percentages of age 1.0 fish (jacks) present. In northern British Columbia and Southeastern Alaska 2.1 and 1.1 become the dominant ages, in that order of abundance.

Crone and Bond (1976) found that 66% of 136 coho salmon from Sashin Creek, Alaska were age 2.1, 26% age 1.1, and 8% age 3.1. They found Nakvassin Creek coho salmon (305 fish) to be 75% age 2.1, 13% age 1.1, and 12% age 3.1. Nelson (1968) found that 99% of 623 coho sampled in the Nushagak District of Bristol Bay, Alaska were age 2.1 and 1% were age 1.1. Drucker (1972) found 57% age 2.1, 42% age 3.1, and 1% age 4.1 coho salmon in the Karluk River, Alaska. Reed and Armstrong (1971) found 17% age 4., 55% age 3., 24% age 2., and 4% age 1. coho smolts (29 fish) migrating from Auke Lake, Alaska.

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[1] Authors reported ages by the Gilbert-Rich formula which has been converted to the European formula for consistency throughout this study.

The increase in total age of Alaskan coho salmon over that of fish from California, Oregon, Washington, and southern British Columbia is the result of a longer period of freshwater residence related to a shorter growing season. Nearly all Alaskan coho salmon (exclusive of jacks) spend two summers and one winter in saltwater before returning to spawn. The increase in total age comes from length of time spent in freshwater: 1, 2, 3, and occasionally 4 years with the proportions in each age class varying by area.

Coho jacks of age 1.0 or 2.0 spend one summer feeding in the sea before returning to spawn. Since coho jacks are not commonly taken by commercial fisheries in Alaska, the percent occurrence of this group and the possible freshwater age classes present are not known.

Age classes of coho salmon reported in the literature or that may be encountered in Southeastern Alaska are listed in Appendix Table 5.

Total Age:

Total ages of coho salmon in Southeastern Alaska obtained from this study ranged from 3 to 6 years and were dependent upon the number of years fish spent in freshwater before reaching smolt size (1 to 4 years). Saltwater age did not vary and was always two summers and one winter[1]. Four age classes (1.1, 2.1, 3.1, and 4.1) were found in scales from 5,406 coho salmon examined during 1969 and 1970 (Table 1 and Figures 4, 5, 6, and 7). Three age classes were found in varying percentages in all areas sampled for both years; the 2.1 age class was nearly always dominant, 1.1 the second most abundant, and 3.1 the third most abundant age class. In addition, a small percentage of 4.1 fish were found from a majority of the sample areas for one or both years. The four age classes, 1.1, 2.1, 3.1, and 4.1 designate fish that went to sea in their second, third, fourth, and fifth years of life, and were returning to spawn after being at sea for 12 to 18 months. Nearly 27% of Southeastern Alaska coho salmon migrated to sea in their second year, 64% in their third year, 9% in their fourth year, and 0.5% in their fifth year.

Age 1.1. As the secondary age class, age 1.1 fish ranged from 15.1% in the Alsek River to 40% in the Kaliakh River (Table 1). This age class was dominant in only one sample area (Doame River, 54.2%). When all sample areas and both years were combined, 26.7% of the fish were age 1.1. This is the dominant age class in California, Oregon, Washington, and British Columbia.

Age 2.1. This was the dominant age class, ranging from 51.1% in the Situk-Ahrnklin Rivers to 75.2% in the Alsek River. In only one sample area (Doame River, 40.7%) was this the secondary age class. When all sample areas and both years were combined 63.9% of the fish were age 2.1. This is the dominant age class over most of Alaska.

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[1] No jacks, ages 1.0, 2.0, 3.0, or 4.0 were found because their small size protects them from the commercial fishery. No coho scales showing two winters in saltwater were observed in the 5,406 scales read.

Table 1. Age class composition of Southeastern Alaska coho salmon, 1969 and 1970[1].

Catch Location	Sample Size	1.1	2.1	3.1	4.1
Noyes to Baker and Maurelle Islands (purse seine and troll)	1,305	19.6%	70.0%	9.8%	0.6%
Inian Islands Area (purse seine and troll)	1,311	24.2%	66.7%	8.8%	0.3%
In Mouth of Taku River (drift gillnet)	502	31.1%	63.9%	4.8%	0.2%
Off Mouth of Stikine River (drift gillnet)	593	31.5%	61.0%	7.3%	0.2%
Off Mouth of Chilkat River (drift gillnet)	428	39.5%	48.1%	10.9%	1.4%
In Kaliakh River (set gillnet)	60	40.0%	51.7%	8.3%	0.0%[2]
In Tsiu-Tsivat Rivers (set gillnet)	170	20.6%	68.8%	10.6%	0.0%[2]
In Doame River (set gillnet)	118	54.2%	40.7%	5.1%	0.0%[2]
In Situk-Ahrnklin Rivers Common Mouth (set gillnet)	456	36.9%	51.1%	11.1%	0.9%
In Alsek River (set gillnet)	463	15.1%	75.2%	9.5%	0.2%
Total all Areas	5,406	26.7% (1,446)	63.9% (3,454)	8.9% (481)	0.5% (25)

[1] Both years combined.
[2] Sample less than 200 fish.

Figure 4. Scale from a Southeastern Alaska coho salmon with a magnified portion of the center, age 1.1.

Figure 5. Scale from a Southeastern Alaska coho salmon with a magnified portion of the center, age 2.1.

Figure 6. Scale from a Southeastern Alaska coho salmon with a magnified portion of the center, age 3.1.

Figure 7. Scale from a Southeastern Alaska coho salmon with a magnified portion of the center, age 4.1.

Age 3.1. This was the third most abundant age class ranging from 4.8% in the Taku River to 11.1% in the Situk-Ahrnklin Rivers. When all sample areas and both years were combined, 8.9% of the fish were age 3.1. While this age class is common in Alaska, it is rarely found in areas south of Alaska.

Age 4.1. This was the least abundant age class ranging from 0% in the Kaliakh, Tsiu-Tsivat, and Doame Rivers to 1.4% in the Chilkat River. This age class was present in all areas sampled except for the three areas with relatively small sample sizes. When all sample areas and both years were combined, 0.5% of the fish were age 4.1. The only other known reports of 4.1 age coho salmon are from the Karluk River, Kodiak Island where 1.4% of the fish were this age (unknown sample size, Drucker 1972) and Auke Lake, Southeastern Alaska where 17% of 29 outmigrant smolts were age 4.1 (Reed and Armstrong 1971).

Age Class Composition by Sex:

The percentage of coho salmon in each age class differed somewhat between males and females depending on the sample area and year (Appendix Table 3). When data were combined by sex (3,490 fish) for all sample areas and both years (Table 2), there were about 5.8% more males than females in the 1.1 age class, 3.5% more females than males in the 2.1 age class, 2.3% more females than males in the 3.1 age class, and equal percentages of males and females in the 4.1 age class. The overall trend in most areas and both years appeared to be a somewhat higher percentage of males than females in the 1.1 age class and a somewhat higher percentage of females than males in the 2.1 and 3.1 age classes.

Age Class Composition by Year:

Age class differences between the two sample years were also very minor in some areas and considerably larger in other areas (Appendix Table 4). Areas in which the age composition did not vary much between the two years included the Inian Islands area; the Noyes, Baker, Maurelle Islands area; the Taku River mouth; and the Alsek River. Areas in which there was more variation in age composition between years were the Stikine River mouth, and to a lesser extent the Situk-Ahrnklin River mouth, and Chilkat Inlet. When data from all sample areas were combined for each year, there were 8.8% less fish in the 1.1 age class (range 30.6% to 21.8%), 5.2% more fish in the 2.1 age class (range 61.6% to 66.8%), 3.2% more fish in the 3.1 age class (range 7.5% to 10.7%), and 0.4% more fish in the 4.1 age class (range 0.3% to 0.7%) in 1970 than in 1969.

Freshwater Age and Circuli Number

As described above under total age, all coho salmon in this study from Southeastern Alaska were found to migrate to sea in their second, third, fourth, or fifth years of life (age 1., 2., 3., or 4.) following one, two, three, or four growing seasons and winters in freshwater. Crone and Bond (1976) found that size more than age determined when coho salmon smoltified. Their studies in Sashin Creek, Alaska showed that most coho salmon required two summers of

Table 2. Coho salmon age, combined totals by sex and year. Southeastern Alaska commercial catch sampling, 1969 and 1970[1].

1969	AGE CLASS 1.1	2.1	3.1	4.1	Total Number of Fish with Readable Scales
Males					
No. of Fish	361	644	70	5	1,080
Percent in Age Class	33.4%	59.6%	6.5%	0.5%	
Females					
No. of Fish	230	567	69	3	869
Percent in Age Class	26.5%	65.3%	7.9%	0.3%	
Total					
No. of Fish	591	1,211	139	8	1,949
Percent of Both Sexes in this Age Class	30.3%	62.1%	7.1%	0.4%	
1970					
Males					
No. of Fish	203	577	73	2	855
Percent in Age Class	23.7%	67.5%	8.5%	0.2%	
Females					
No. of Fish	133	468	82	3	686
Percent in Age Class	19.4%	68.2%	12.0%	0.4%	
Total					
No. of Fish	336	1,045	155	5	1,541
Percent of Both Sexes in this Age Class	21.8%	67.8%	10.1%	0.3%	
TOTAL					
Males					
No. of Fish	564	1,221	143	7	1,935
Percent in Age Class	29.1%	63.1%	7.4%	0.4%	
Females					
No. of Fish	363	1,035	151	6	1,555
Percent in Age Class	23.3%	66.6%	9.7%	0.4%	
Total					
No. of Fish	927	2,256	294	13	3,490
Percent of Both Sexes in this Age Class	26.6%	64.6%	8.4%	0.4%	

[1] All areas having complete sex and age data were combined.

freshwater residence to reach smolt size while Garrison (1965) found that coho salmon in a brackish pond in Oregon grew to smolt size in only three months. Most coho salmon from areas south of Alaska reach smolt size in 1 year instead of 2 or more years (73.3% of coho salmon smolts in Southeastern Alaska are age 2., 3., or 4., Table 1). The slower growth in Alaska is probably related to cooler temperatures and a shorter growing season. This results in greater freshwater mortality of pre-smolt coho juveniles because of the additional freshwater residence, thus larger escapements of adult coho salmon may be necessary in Alaska than in British Columbia, Washington, Oregon, or California to offset these losses.

Areas within Alaska with a higher percentage of age 1. smolt such as the Doame and Kaliakh Rivers may have better rearing habitat and faster growth than others such as the Alsek or Tsiu-Tsivat Rivers (Table 1).

Besides determining total age from the various sample areas, several scale characteristics were counted in an attempt to evaluate differences in stocks. Scale features analyzed were freshwater circuli through each annulus, "plus" growth, and saltwater circuli through the first annulus (first ocean zone). Mosher (1972) found that the best features for racial studies of sockeye salmon were in the freshwater and first ocean zones of the scale.

Freshwater circuli are of finer texture and are more closely spaced than saltwater circuli. This central zone of closely spaced circuli is called the nucleus of the scale. Analysis of freshwater circuli counts showed that two types of nuclear growth existed in scales from Southeastern Alaska coho salmon; scales that exhibited plus growth and scales with no plus growth.

Plus Growth:

Plus growth (Figures 8, 9, and 10) is defined as freshwater growth (after the last winter) laid down during the year in which the fish migrated seaward. Plus growth is also called transitional, intermediate, incidental, or spring growth. It is distinguished by the appearance of circuli which are intermediate in width and spacing and lie between the circuli of freshwater and ocean growth zones (Moser 1968). The amount of plus growth can vary considerably depending upon growth conditions and how late in the season a smolt reaches saltwater. This transitional zone may merge sharply, gradually, or diffusely into the saltwater growth zone and thus may be easy or difficult to identify. The plus growth zone may or may not be followed by an adventitious mark called a "migration check" which could be mistaken for another freshwater winter, were it not for the intermediate width and spacing of circuli between the fresh and saltwater growth zones.

Koo (1962b) in his studies of Bristol Bay sockeye salmon found an inverse relationship between the amount of plus growth (which he called "compensatory" growth) and the amount of growth during the preceding year. The better the first year's growth, the lesser amount of plus growth in the following year, and vice versa. He also found a proportionate decrease in the first year's growth and a gradual increase in plus growth for smolt scales as the season advanced. He concluded that the presence of plus growth on scales in freshwater life was due to the delay in seaward migration of smolts associated

Figure 8. Scale from a Southeastern Alaska coho salmon with a magnified portion of the center showing plus growth, age 1+.1.

Figure 9. Scale from a Southeastern Alaska coho salmon with a magnified portion of the center showing plus growth, age 2+.1.

Figure 10. Scale from a Southeastern Alaska coho salmon with a magnified portion of the center showing plus growth, and a migration check, age 2+.1.

with poor growth attained by the fish during their first year's residence. Fish without plus growth were early season migrants and fish with plus growth were mid- to late-season migrants.

Percentage of Plus Growth by Area. Plus growth was present in scales from 59.5% of Southeastern Alaska coho salmon (Table 3). The lowest percentage of plus growth was found in the mixed stock areas of Inian Islands (42.3%) and Noyes, Baker, and Maurelle Islands (44.7%); Taku, Stikine, and Chilkat Rivers ranged from 61.4 to 70.3%; and the highest percentage was found in the more northerly Yakutat to Icy Bay area rivers (81.6 to 89.3%). Plus growth averaged 51.5% for all samples between Cross Sound and Dixon Entrance and 85.7% for all samples from Yakutat and Icy Bay areas. This indicated that a higher percentage of the more northerly Yakutat to Icy Bay coho salmon were mid- to late-season smolt outmigrants than for the rest of Southeastern Alaska.

Percentage of Plus Growth by Age Class. As shown in Table 3, the percentage of fish having plus growth in each age class decreased as freshwater age increased, for all areas combined, from 81.9% (for age 1+.1 fish) to 53.8% (age 2+.1), 35.8% (age 3+.1), and 12.0% (age 4+.1). This indicated less dependency on plus growth for older age coho salmon to reach migratory size and smoltification, probably because each older age class averaged larger in size than the preceding age class. The percentage of plus growth in each age class also differed significantly between the Cross Sound to Dixon Entrance areas and the Yakutat to Icy Bay areas, which had a considerably higher percentage of plus growth, indicating later smolt outmigration.

Plus Growth Circuli Number. The mean circuli counts of plus growth also decreased as freshwater age increased (Table 4) from a mean of 6.1 circuli (for age 1+.1 fish) to 4.5 (age 2+.1), 3.9 (age 3+.1), and 3.7 circuli (age 4+.1). This again indicates less dependency on plus growth for older age coho salmon, probably because of the increase in mean juvenile size with age. The range in circuli counts of plus growth was fairly wide for all sample areas (1 to 16 circuli), but decreased as freshwater age increased. The wide range in counts of plus growth are related to the amount of time spent feeding in freshwater in spring and summer before the smolts reached saltwater. Mean circuli counts of plus growth were also significantly higher for the Yakutat to Icy Bay areas (5.7 circuli) than those for the Cross Sound to Dixon Entrance areas (4.7 circuli), indicating later outmigration of smolts in the more northern areas.

Circuli Number for Each Year of Freshwater Life, Excluding Plus Growth Circuli:

Mean circuli counts for each year of freshwater life through each winter check (plus growth circuli not included) are shown by age class for scales without and scales with plus growth in Table 5 and Appendix Tables 6 and 7. There was a wide range in circuli counts for each year of freshwater life, ranging from 3 to 21 circuli for fish without plus growth to 4 to 20 circuli for fish with plus growth, but excluding plus growth circuli.

Table 3. Number and percent of Southeastern Alaska coho salmon having plus growth on scales, by age class and area, 1969 and 1970.

Sample Area	Age Class 1.1 Number of Fish 1. & 1+.	1.1 Number of Fish 1+.	1.1 Percent 1+.	2.1 Number of Fish 2. & 2+.	2.1 Number of Fish 2+.	2.1 Percent 2+.	3.1 Number of Fish 3. & 3+.	3.1 Number of Fish 3+.	3.1 Percent 3+.	4.1 Number of Fish 4. & 4+.	4.1 Number of Fish 4+.	4.1 Percent 4+.	Ages Combined Number of Fish 1., 2., 3., 4. 1+.,2+.,3+.,4+.	Ages Combined Number of Fish 1+.,2+., 3+.,4+.	Ages Combined Percent 1+., 2+. 3+., 4+.	Mean Number of Circuli through First Ocean Zone
Noyes, Baker and Maurelle Is. Area (1,2,15,16)	256	186	72.7	913	366	40.1	128	30	23.4	8	1	12.5	1,305	583	44.7	37.1
Inian Is. Area (3,4,13,14)	318	219	68.9	874	311	35.6	115	25	21.7	4	0	0	1,311	555	42.3	35.9
Mouth of Taku River (5,17,18)	156	138	88.5	321	161	50.2	24	9	37.5	1	0	0	502	308	61.4	37.4
Mouth of Stikine River (6,19,20)	187	140	74.9	362	219	60.5	43	25	58.1	1	0	0	593	384	64.8	36.0
Mouth of Chilkat River (12,24)	169	150	88.8	206	132	64.1	47	18	38.3	6	1	16.7	428	301	70.3	35.5
Kaliakh River (7)	24	24	100.0	31	26	83.9	5	3	60.0	0	0	0	60	53	88.3	33.1
Tsiu-Tsivat Rivers (8)	35	35	100.0	117	103	88.0	18	6	33.3	0	0	0	170	144	84.7	33.2
Situk-Ahrnklin Rivers Common Mouth (9,10,23)	167	164	98.2	234	209	89.3	51	33	64.7	4	1	25.0	456	407	89.3	33.0
Alsek River (11,21)	70	70	100.0	348	290	83.3	44	18	40.9	1	0	0	463	378	81.6	30.6
Doame River (22)	64	58	90.6	48	41	85.4	6	5	83.3	0	0	0	118	104	88.1	31.9
Subtotal for Cross Sound to Dixon Entrance Areas [1]	1,086	833	76.7	2,676	1,189	44.4	357	107	30.0	20	2	10.0	4,139	2,131	51.5	36.4
Subtotal for Yakutat to Icy Bay Areas [2]	360	351	97.5	778	669	86.0	124	65	52.4	5	1	20.0	1,267	1,086	85.7	32.0
Total All Areas	1,446	1,184	81.9	3,454	1,858	53.8	481	172	35.8	25	3	12.0	5,406	3,217	59.5	35.4

[1] Noyes, Baker, and Maurelle Islands; Inian Islands Area; Mouth of Taku River; Off mouth of Stikine River; in Chilkat Inlet.
[2] Kaliakh River; Tsiu-Tsivat Rivers; Situk-Ahrnklin Rivers common mouth; Alsek River; Doame River.

Table 4. Mean circuli counts of plus growth by freshwater age class from Southeastern Alaska coho salmon scales, 1969 and 1970.

Catch Location	Age 1+.1	Age 2+. 1	Age 3+.1	Age 4+.1	Totals
Noyes, Baker, and Maurelle Islands (1, 2, 15, 16)	186 [1] 5.7 [2] (2-15) [3]	366 4.4 (1-11)	30 4.4 (2-9)	1 4.0 (4-4)	583 4.8 (1-15)
Inian Islands Area (3, 4, 13, 14)	219 5.3 (1-12)	311 3.8 (1-10)	25 3.8 (2-6)	--	555 4.4 (1-12)
Mouth of Taku River (5, 17, 18)	138 5.4 (2-9)	161 3.9 (1-8)	9 3.0 (2-4)	--	308 4.5 (1-9)
Off Mouth of Stikine River (6, 19, 20)	140 5.7 (2-16)	219 4.6 (1-13)	25 4.3 (2-8)	--	384 5.0 (1-16)
In Chilkat Inlet (12, 24)	150 5.9 (2-14)	132 4.0 (2-7)	18 3.3 (2-5)	1 2.0 (2-2)	301 4.9 (2-14)
In Kaliakh River (7)	24 8.6 (4-10)	26 5.6 (2-9)	3 5.3 (3-7)	--	53 6.9 (2-10)
In Tsiu-Tsivat Rivers (8)	35 7.1 (3-10)	103 5.4 (2-9)	6 4.3 (3-7)	--	144 5.8 (2-10)
Situk-Ahrnklin Rivers Common Mouth (9, 10, 23)	164 7.4 (2-14)	209 5.6 (2-10)	33 4.0 (2-8)	1 5.0 (5-5)	407 6.2 (2-14)
Alsek River (11, 21)	70 6.6 (2-9)	290 4.6 (2-9)	18 3.6 (2-6)	--	378 4.9 (2-9)
Doame River (22)	58 7.5 (3-11)	41 5.1 (2-9)	5 3.6 (3-4)	--	104 6.4 (2-11)
Subtotal Dixon Entrance to Cross Sound Areas [4]	833 5.6 (1-16)	1,189 4.2 (1-13)	107 3.9 (2-9)	2 3.0 (2-4)	2,131 4.7 (1-16)
Subtotal Yakutat-Icy Bay Areas [5]	351 7.3 (2-14)	669 5.1 (2-10)	65 4.0 (2-8)	1 5.0 (5-5)	1,086 5.7 (2-14)
Total All Areas	1,184 6.1 (1-16)	1,858 4.5 (1-13)	172 3.9 (2-9)	3 3.7 (2-5)	3,217 5.1 (1-16)

1/ Number of fish in this age class.
2/ Mean circuli count for each year.
3/ Range in circuli counts for this age class and year.
4/ Noyes, Baker, and Maurelle Islands; Inian Islands Area; mouth of Taku River; Off mouth of Stikine River; in Chilkat Inlet.
5/ Kaliakh River; Tsiu-Tsivat Rivers; Situk-Ahrnklin Rivers common mouth; Alsek River; Doame River.

Table 5. Summary of mean circuli counts for each year of freshwater life, by age class, from Southeastern Alaska coho salmon scales, 1969 and 1970. [1/]

All Scales Having No Plus Growth

Catch Location	Age 1.1	Age 2.1		Age 3.1			Age 4.1				Total Number of Fish in Sample
	1st Year	1st Year	2nd Year	1st Year	2nd Year	3rd Year	1st Year	2nd Year	3rd Year	4th Year	
Total all Areas	262 [2/]	1,596			309			22			2,189
	10.8 [3/]	7.7	9.6	6.7	7.7	7.7	6.7	7.2	6.8	7.0	
	(5-19) [4/]	(4-16)	(3-21)	(4-12)	(5-13)	(5-15)	(4-11)	(5-13)	(5-11)	(5-11)	
		17.3 ÷ 2 = 8.7 avg/yr			22.1 ÷ 3 = 7.4 avg/yr				27.7 ÷ 4 = 6.9 avg/yr		

All Scales Having Plus Growth [5/]

Catch Location	Age 1+.1	Age 2+.1		Age 3+.1			Age 4+.1				Total Number of Fish in Sample
	1st Year	1st Year	2nd Year	1st Year	2nd Year	3rd Year	1st Year	2nd Year	3rd Year	4th Year	
Total all Areas	1,184	1,858			172			3			3,217
	9.4	6.9	8.8	6.1	7.2	7.2	6.7	8.3	7.0	7.7	
	(4-19)	(4-17)	(4-20)	(4-12)	(5-13)	(5-14)	(6-6)	(7-11)	(5-9)	(7-8)	
		15.6 ÷ 2 = 7.8 avg/yr			20.5 ÷ 3 = 6.8 avg/yr				29.7 ÷ 4 = 7.4 avg/yr		

1/ All sample areas (#1-24) are combined in this table and are broken down by individual areas in Appendix Tables 6 and 7.
2/ Number of fish in this age class.
3/ Mean circuli count for each year
4/ Range in circuli counts for this age class and year.
5/ Plus growth circuli counts are not included.

Coho salmon that went to sea as smolts in their second year of life (age 1.1) demonstrated the highest mean circuli count for the first year of freshwater growth, averaging 10.8 for scales with no plus growth and 9.4 for scales with plus growth (Table 5). Mean circuli counts for the first year of freshwater life decreased as freshwater age increased (except 4+.1), from 10.8 (age 1.1), to 7.7 (age 2.1), 6.7 (age 3.1), and 6.7 (age 4.1) for fish without plus growth and 9.4 (age 1+.1), 6.9 (age 2+.1), 6.1 (age 3+.1), and 6.7 (age 4+.1) for fish with plus growth.

Coho salmon that went to sea as smolts in their third year of life (age 2.1) showed the greatest amount of growth in their second year of freshwater residency. Circuli counts for the second year of growth averaged 9.6 for scales with no plus growth and 8.8 for scales with plus growth as compared to 7.7 and 6.9, respectively, for the first year of freshwater growth. Mean circuli counts for the second year of freshwater life also decreased as freshwater age increased (except 4+.1), from 9.6 (age 2.1), to 7.7 (age 3.1), and 7.2 (age 4.1) for fish without plus growth and 8.8 (age 2+.1), 7.2 (age 3+.1), and 8.3 (age 4+.1) for fish with plus growth.

Coho salmon migrating to sea in their fourth year of life (age 3.1) had the greatest amount of growth in the second or third year of life, averaging 7.7 circuli for fish without plus growth and 7.2 circuli for fish with plus growth. Mean circuli counts for the third year of freshwater life decreased as freshwater age increased, from 7.7 (age 3.1) to 6.8 (age 4.1) for scales without plus growth, and from 7.2 (age 3+.1) to 7.0 (age 4+.1) for fish with plus growth.

Coho salmon migrating to sea in their fifth year of life (age 4.1) had the greatest amount of growth in the second year of life, averaging 7.2 circuli for scales without plus growth and 8.3 for scales with plus growth.

The overall trend was for mean circuli counts for each year of freshwater life to decrease as freshwater age increased, for scales both with and without plus growth, but excluding plus growth circuli. When all areas were combined, mean freshwater circuli counts for each year of life were 10.8 circuli for age 1.1 fish, 8.7 (age 2.1), 7.4 (age 3.1), and 6.9 circuli (age 4.1 fish) for scales without plus growth and 9.4 circuli (age 1+.1), 7.8 (age 2+.1), 6.8 (age 3+.1), and 7.4 (age 4+.1) for scales with plus growth, but excluding plus growth circuli (Table 5).

The range in circuli counts for each year of freshwater life was very wide, for both individual areas and all areas combined, from 5 to 19 circuli for age 1.1, 3 to 21 circuli (age 2.1), 4 to 15 circuli (age 3.1) to 4 to 13 circuli (age 4.1) for fish without plus growth (Table 5 and Appendix Table 6); from 4 to 19 circuli for age 1+.1, 4 to 20 circuli (age 2+.1), 4 to 14 circuli (age 3+.1), to 5 to 11 circuli (age 4+.1) for fish with plus growth, but excluding plus growth circuli (Table 5 and Appendix Table 7); and from 1 to 16 circuli for age 1+.1, 1 to 13 circuli (age 2+.1), 2 to 9 circuli (age 3+.1), and 2 to 5 circuli (age 4+.1) for plus growth counts only (Table 4). The wide range in individual circuli counts for each full year of freshwater life is probably a result of the following:

1) Amount of time spent feeding in freshwater, determined by time of emergence from the gravel, which ranges from early spring to late summer.

2) Quality of the rearing habitat, which ranges from rich weedy sloughs and shallow lakes, to rocky barren looking streams and lakes.

3) Condition and growth rate of the individual fish.

Circuli Number for Total Freshwater Residency, Excluding Plus Growth Circuli:

Total mean freshwater circuli counts for each age class (excluding plus growth circuli) increased as freshwater age increased, from 10.8 circuli for age 1.1 fish to 17.3 (age 2.1), 22.1 (age 3.1), and 27.7 circuli (age 4.1) for fish without plus growth and 9.4 (age 1+.1), 15.6 (age 2+.1), 20.5 (age 3+.1), and 29.7 (age 4+.1) for fish with plus growth (Table 5). At the same time, as seen above, mean freshwater circuli counts for each year of life decreased as freshwater age increased, indicating that younger age coho salmon smolts were faster growing than older age coho salmon smolts, and this rate of growth determined or influenced the age at migration. In addition, mean circuli counts for each year of freshwater life and total mean freshwater circuli counts (excluding plus growth circuli) for each age class were always greater for scales without plus growth than for scales with plus growth. Fish without plus growth were thus faster growing than fish with plus growth.

The Yakutat to Icy Bay areas had a tendency towards significantly lower mean circuli counts for each year of freshwater life and for lower total mean freshwater circuli counts (excluding plus growth circuli) for each age class than the Cross Sound to Dixon Entrance areas (Appendix Tables 6 and 7). This was true for scales both with and without plus growth and indicates that Yakutat to Icy Bay coho salmon tended to be slower growing in freshwater than coho salmon from the area between Cross Sound and Dixon Entrance.

Saltwater Age and Circuli Number

As previously described under the section on total age, all coho salmon in this study from Southeastern Alaska spent two summers and one winter (saltwater age .1) feeding in saltwater before being harvested by the commercial fishery as they returned to spawn. Mean saltwater circuli counts were made through the first ocean zone[1] to determine if there were differences between sample areas. Mosher (1972), after extensive studies, found first ocean zone counts to be the most reliable racial separating parameter in the saltwater portion of salmon scales from different areas. Mean saltwater circuli counts are shown by area, by freshwater age class, for fish with and without plus growth, and combined for all Yakutat to Icy Bay areas and for all Cross Sound to Dixon Entrance areas in Appendix Table 8.

[1] Includes first summer and first winter of ocean residency.

The mean saltwater circuli count through the first ocean zone for scales with and without plus growth for all areas combined (5,404 fish) was 35.3 and ranged from 18 to 51 circuli. The mean circuli count through the first ocean zone was considerably greater for scales from Cross Sound to Dixon Entrance (36.3 circuli, range 18 to 51 for 4,137 fish) than for scales from Yakutat to Icy Bay fish (32.0 circuli, range 21 to 43 for 1,267 fish). As shown above in the section on plus growth, the Cross Sound to Dixon Entrance scales also had both a lower incidence and lower mean counts of plus growth than the Yakutat to Icy Bay scales. The amount and incidence of plus growth are directly related to mean saltwater circuli counts through the first ocean zone. Koo (1962b) found that the presence of plus growth in scales from Bristol Bay sockeye salmon smolt resulted in their late entry into saltwater and less growth in the first saltwater summer. The sockeye salmon with plus growth averaged six less saltwater circuli in the first saltwater summer than fish having no plus growth. Adult coho salmon, in this study, from early smolt outmigrants which exhibited no plus growth had greater circuli counts in the first year of saltwater growth as a result of increased time in the saltwater environment. Adults from mid to late season smolt outmigrants showing plus growth had fewer circuli in the first year of saltwater growth due to a shorter growing season.

The mean circuli count through the first ocean zone of Southeastern Alaska coho salmon scales decreased as freshwater age increased, for scales with and without plus growth (Appendix Table 8). Mean saltwater circuli counts through the first ocean zone decreased from 39.0 for age 1.1 coho to 36.6 (age 2.1), 34.9 (age 3.1), to 34.7 (age 4.1) for scales with no plus growth, and from 35.2 for age 1+.1 to 34.0 (age 2+.1), and 33.8 (age 3+.1) for scales having plus growth. This indicates that younger freshwater age coho salmon probably migrate to sea earlier in the season than older freshwater age coho salmon. Mean saltwater circuli counts through the first ocean zone for fish with and without plus growth combined did not change much (Appendix Table 8). They ranged from 35.9 (1. and 1+.), 35.2 (2. and 2+.), 34.5 (3. and 3+.), to 34.9 (4. and 4+.), decreasing only one circuli. Adult mean lengths and weights, which will be discussed in more detail in the following section, also did not change much for each freshwater age class (when plus and non-plus growth fish were combined, Appendix Table 9), from 67.2 cm and 4.06 kg (1. and 1+.), 67.0 cm and 4.00 kg (2. and 2+.), 67.9 cm and 4.13 kg (3. and 3+.), to 70.1 cm and 4.51 kg (4. and 4+.). If mean lengths and weights had been analyzed separately for fish having plus growth (lower first ocean zone counts) and no plus growth (higher first ocean zone counts) a difference in fish size may have shown up for the fish having higher marine circuli counts.

The wide range in individual circuli counts through the first ocean zone (18 to 51 circuli for 5,404 coho salmon) is probably the result of the following variables:

1) Amount of time spent feeding in saltwater, determined by time of smolt outmigration which ranges from early spring to late summer. Smolts may thus have either a full or partial first summer of growth in saltwater.

2) Size of smolts at time of entry into saltwater. This usually

averages 85 to 90 mm, but can range as high as 160 mm and influence saltwater growth.

3) Area of feeding in saltwater, which is also influenced by time of smolt outmigration, can range from open ocean to inside waters. Studies by the Washington State Department of Fisheries have shown that coho salmon that remain inside Puget Sound to feed attain a relatively small size as adults while coho salmon migrating to the open ocean to feed attain a much larger size as adults (Jensen 1956).

4) Condition and growth rate of the individual fish.

Analysis of Fish Size

Coho salmon maturing late in their last year of life after two summers in the ocean are reported by different authors to range from 53.3 to 76.2 cm (21 to 30 in) in length. Average round weights of coho salmon are reported as 2.27 to 3.18 kg (5 to 7 lb) in mid-June and 2.72 to 4.54 kg (6 to 10 lb) in September. Coho salmon growth in length is described as "rapid" and growth in weight as "spectacular" and is the basis for delaying the troll season opening until 15 June (I.C.C.C., Vol. I, U.S. Section 1969). The saltwater growth rate of coho salmon exceeds that of all other Pacific salmon species except pinks (Godfrey 1965).

The size of coho salmon sampled in this study (Appendix Table 10) was partly dependent on the time and location of sampling and partly dependent on gear selectivity (no jacks retained). Comparisons of fish size between sample areas or years should allow for differences between sample dates. Because coho salmon grow very rapidly during their last summer in saltwater, a few weeks would make a considerable difference in fish size. Fish were sampled from the end of July to mid-September (Appendix Tables 1 and 2).

There was little difference in mean fish size between male and female coho salmon in most areas (Appendix Table 10). In 1969, Kaliakh River females were 0.58 kg larger than males and, in 1970, Doame River males were 0.47 kg heavier than females. In 1970, Inian Island purse seine caught females were 0.34 kg larger than males and Situk-Ahrnklin males were 0.45 kg larger than females, but in 1969 there was little difference. There was a considerable difference in the size range between male and female coho salmon, however. In all sample areas and both years, the males were always the smallest and largest individuals, i.e., had the widest range in sizes in both length and weight (Table 6 and Appendix Table 10).

The difference in mean weight between years for combined sexes (Table 7) ranged from 0.16 to 0.79 kg round weight heavier in 1970 than in 1969 depending on the sample area. The only exception was the Inian Islands purse seine fish which were 0.45 kg round weight smaller in 1970 than 1969, probably because they were sampled 12 days earlier in 1970. The combined (all areas) average increase in weight was 0.24 kg for round weight fish and 0.61 kg for dressed weight fish heavier in 1970 than in 1969, probably due partly to better growing conditions and partly because

Table 6. Coho salmon length and weight, combined totals by sex and year. Southeastern Alaska commercial catch sampling, 1969 and 1970. 1/

		Snout-Fork Length (in centimeters)			Mideye-Fork Length (in centimeters)			Round Weight (in kilograms)		
		Males	Females	Total	Males	Females	Total	Males	Females	Total
1969	Number of Fish	1,264	993	2,257	1,264	993	2,257	1,264	993	2,257
	Mean	66.4	66.6	66.5	60.5	61.8	61.0	3.85	3.86	3.86
	Range	44.2-80.2	54.8-76.1	44.2-80.2	40.6-72.5	51.3-69.7	40.6-72.5	1.04-7.82	1.84-6.24	1.04-7.82
1970	Number of Fish	1,039	828	1,867	1,039	828	1,867	1,039	828	1,867
	Mean	66.2	67.2	66.7	60.3	62.3	61.2	3.99	4.10	4.04
	Range	44.5-82.9	53.7-77.9	44.5-82.9	40.7-73.4	50.4-71.2	40.7-73.4	1.22-7.74	1.88-6.86	1.22-7.74
Total	Number of Fish	2,303	1,821	4,124	2,303	1,821	4,124	2,303	1,821	4,124
	Mean	66.3	66.9	66.6	60.4	62.0	61.1	3.91	3.97	3.94
	Range	44.2-82.9	53.7-77.9	44.2-82.9	40.6-73.4	50.4-71.2	40.6-73.4	1.04-7.82	1.84-6.86	1.04-7.82

1/ All areas having complete sex and size data were combined.

Table 7. Coho salmon length and weight, sexes combined for yearly totals and combined totals by area and gear. Southeastern Alaska commercial catch sampling, 1969 and 1970.

Catch Area	Gear	Year	Sample Group	Sample Size	Mean Length (cm) Snout-Fork	Mean Length (cm) Mideye-Fork	Difference Between Snout-Fork and Mideye-Fork (cm)	Mean Weight (kg)	Difference Between Years in Weight (kg)
Noyes Island to Baker Island	Purse Seine	1969	1 M & F [1]	518	64.3	59.9	4.4	3.49	0.16
		1970	15 M & F	479	63.9	59.3	4.6	3.65	
		Total		997	64.1	59.6	4.5	3.57	
Maurelle Islands Group & Noyes Island	Troll	1969	2	506	63.1	58.7	4.4	2.81 [2]	0.58 [2]
		1970	16	65	65.6	60.7	4.9	3.39 [2]	
		Total		571	63.4	58.9	4.5	2.88 [2]	
Inian Islands Area	Purse Seine	1969	3 M & F	170	63.8	59.1	4.7	3.58	0.45
		1970	13 M & F	324	61.2	56.7	4.5	3.13	
		Total		494	62.1	57.5	4.6	3.28	
Inian Islands Area	Troll	1969	4	515	65.3	60.5	4.8	3.09 [2]	0.53 [2]
		1970	14	540	67.5	62.4	5.1	3.62 [2]	
		Total		1,055	66.4	61.5	4.9	3.36 [2]	
Mouth of Taku River	Drift Gillnet	1969	5 M & F	268	68.0	62.0	6.0	4.34	0.39
		1970	17 M & F	154	70.2	64.1	6.1	4.73	
		1970	18	152	66.8	61.0	5.8	3.34 [2]	
		Total		574	68.3	62.3	6.0	4.48 [3]	
								3.34 [4]	
Off Mouth of Stikine River	Drift Gillnet	1969	6 M & F	447	68.0	62.5	5.5	4.31	0.47
		1970	19	20	70.5	64.5	6.0	4.09 [2]	
		1970	20 M & F	255	69.6	63.6	6.0	4.78	
		Total		722	68.6	62.9	5.7	4.48 [5]	
								4.09 [6]	
Kaliakh River	Set Gillnet	1969	7 M & F	72	67.3	61.2	6.1	3.80	
Tsiu-Tsivat Rivers	Set Gillnet	1969	8 M & F	209	67.8	61.8	6.0	3.83	
In Doame River	Set Gillnet	1970	22 M & F	130	70.1	63.7	6.4	4.51	
In Situk River	Sport Gear	1969	9 M & F	9	70.5	64.2	6.3	4.36	
Off Situk-Ahrnklin Rivers common mouth	Set Gillnet	1969	10 M & F	281	68.9	62.6	6.3	4.12	0.37
		1970	23 M & F	251	69.9	63.7	6.2	4.49	
		Total		541	69.4	63.0	6.4	4.30	
In Alsek River	Set Gillnet	1969	11 M & F	283	64.5	58.6	5.9	3.29	0.79
		1970	21 M & F	274	68.8	62.4	6.4	4.08	
		Total		557	66.6	60.5	6.1	3.68	
Off mouth of Chilkat River	Drift Gillnet	1969	12	260	70.1	63.7	6.4	4.40	0.59
		1970	24	249	72.1	65.2	6.9	4.99	
		Total		509	71.1	64.4	6.7	4.69	
All Areas Combined 1969 Year	-	1969	1-12 inc.	3,538	66.1	60.8	5.3	3.91 [7]	0.24
								2.95 [8]	
All Areas Combined 1970 Year	-	1970	13-24 inc.	2,893	67.3	61.7	5.6	4.15 [9]	0.61 [2]
								3.56 [10]	
Total - All Areas and Both Years Combined		1969 & 1970	1-24 inc.	6,431	66.6	61.2	5.4	4.02 [11]	
								3.21 [12]	

1/ M = Male, F = Female.
2/ Dressed weight (head on, with viscera and gills removed).
3/ 422 fish rd. wt. = 68.8 cm SFL, 62.8 cm MFL.
4/ 152 fish dr. wt.
5/ 702 fish rd. wt. = 68.6 cm SFL, 62.9 cm MFL.
6/ 20 fish dr. wt.
7/ 1969: 2,517 fish rd. wt. = 66.8 cm SFL, 61.5 cm MFL.
8/ 1,021 fish dr. wt. = 64.3 cm SFL, 59.7 cm MFL.
9/ 1970: 2,116 fish rd. wt. = 67.3 cm SFL, 62.0 cm MFL.
10/ 777 fish dr. wt. = 67.3 cm SFL, 62.0 cm MFL.
11/ Combined: 4,633 fish rd. wt. = 67.1 cm SFL, 61.7 cm MFL.
12/ 1,798 fish dr. wt. = 65.5 cm SFL, 60.7 cm MFL.

most samples were taken 5 to 9 days later in 1970 than 1969. The larger increase in size of dressed fish was due partly to 7 day later samples in 1970 and also an additional sample of gillnet fish from the Taku River later in the season on 27 August.

Snout-Fork Length:

The mean snout-fork length for both sexes, both years, and all sample areas combined (Table 8) was 66.6 cm (6,431 fish). The range in length was 43.2 to 83.5 cm. There was a difference of only 1.2 cm in mean length between the two sample years, the 1970 fish averaging a little larger. From the total sample of 6,431 fish, sex data was obtained from 4,124 round weight seine and gillnet fish (Table 6). The mean snout-fork length for 2,303 males was 66.3 cm and for 1,821 females was 66.9 cm. The range in snout-fork length for males was 44.2 to 82.9 cm and for females was 53.7 to 77.9 cm. The mean snout-fork length of female coho salmon was a little larger, probably because they did not have such a wide range in size composition, particularly the smaller sizes.

Mideye-Fork Length:

The mideye-fork length may be a more comparable measurement between sample areas. As salmon become more sexually mature the snout (kype) becomes elongated and deformed, giving a length reading that may not be comparable between fish of different degrees of maturity. The mideye-fork length measurement in this study ranged from 4.5 to 4.9 cm less than the snout-fork length measurement for the combined 1969-70 early season troll and seine fish to 5.7 to 6.7 cm less for the later season gillnet fish (Table 7) reflecting the change in shape of the snout and the influence on the snout-fork length measurement. It can be calculated from Table 6 that male coho salmon had a greater difference between snout-fork length and mideye-fork length (5.9 cm) than female coho salmon (4.9 cm). The difference between sexes in these two length measurements (calculated from Appendix Table 10) ranged from 0.5 cm in early season seine fish to 1.9 cm in later season gillnet fish, demonstrating that while snouts (kypes) are getting longer on both sexes as the spawning season approaches, they are increasing proportionately faster in the males.

The mean mideye-fork length for both sexes, both years, and all sample areas combined (6,431 fish) was 61.2 cm (Table 8). This was 5.4 cm less than the mean snout-fork length measurement of 66.6 cm. The range in mideye-fork length was 40.2 to 73.9 cm. There was a difference of only 0.9 cm in mean mideye-fork length between the two sample years, the 1970 fish averaging a little larger. For the 4,124 fish with sex data the mean mideye-fork length of 2,303 males was 60.4 cm and for 1,821 females was 62.0 cm (Table 6). The range in mideye-fork length for males was 40.6 to 73.4 cm and for females was 50.4 to 71.2 cm.

Round Weight:

All purse seine, set gillnet, and most drift gillnet fish were landed round (undressed). The mean round weight for both sexes, both years, and all sample

Table 8. Summary of mean length and weight of Southeastern Alaska coho salmon, all areas combined, 1969 and 1970.[1/]

	Round Weight Fish [2/]						Dressed Weight Fish [3/]						Total Fish					
	1969	No. of Fish	1970	No. of Fish	Total	No. of Fish	1969	No. of Fish	1970	No. of Fish	Total	No. of Fish	1969	No. of Fish	1970	No. of Fish	Total	No. of Fish
Mean Snout-fork length (in centimeters)	66.8	2,517	67.3	2,116	67.1	4,633	64.3	1,021	67.3	777	65.5	1,798	66.1 (43.2-80.2)	3,538	67.3 (44.5-83.5)	2,893	66.6 (43.2-83.5)	6,431
Mean mideye-fork length (in centimeters)	61.5	2,517	62.0	2,116	61.7	4,633	59.7	1,021	62.0	777	60.7	1,798	60.8 (40.2-72.5)	3,538	61.7 (40.7-73.9)	2,893	61.2 (40.2-73.9)	6,431
Mean Weight (in kilograms)	3.91 (1.04-7.82)	2,517	4.15 (1.22-7.74)	2,116	4.02 (1.04-7.82)	4,633	2.95 (0.90-5.64)	1,021	3.56 (1.32-6.62)	777	3.21 (0.90-6.62)	1,798	--	3,538	--	2,893	--	6,431

1/ All sample areas (#1-24) are included in this table and are broken down by gear type, year, and sex in Appendix Table 10.
2/ All round weight sample groups (#1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 17, 20, 21, 22, 23, 24) are combined.
3/ All dressed weight sample groups (#2, 4, 14, 16, 18, 19) are combined.

areas combined (4,633 fish) and 4.02 kg round weight (Table 8). These fish averaged 67.1 cm in snout-fork length and 61.7 cm in mideye-fork length.

The range in round weight was 1.04 to 7.82 kg. There was a difference of 0.24 kg in mean round weight between the two sample years, the 1970 fish averaging, as described previously, a little heavier (Table 7).

For the 4,124 fish with sex data the mean round weight of 2,303 males was 3.91 kg and for 1,821 females was 3.97 kg (Table 6). The range in round weight for males was 1.04 kg to 7.82 kg and for females was 1.84 to 6.86 kg.

Dressed Weight:

All troll and some gillnet fish were landed dressed (with heads on, viscera and gills removed). The mean dressed weight for both sexes, both years, and all sample areas combined (1,798 fish) was 3.21 kg (Table 8). These fish averaged 65.5 cm in snout-fork length and 60.7 cm in mideye-fork length. The range in dressed weight was 0.90 to 6.62 kg. There was a difference of 0.61 kg in mean dressed weight between the two sample years, the 1970 fish averaging heavier (Table 7). Most samples were taken about one week later in 1970 plus an additional later season gillnet sample from the Taku River on 27 August 1970 (Appendix Tables 1 and 2).

The wide range in fish size within each sample area is probably for the same reasons as the wide range in saltwater circuli counts for coho salmon scales mentioned previously (pp. 27-28, 1-4). These include length of time spent feeding in saltwater, size at time of entry into saltwater, area of feeding in saltwater, and condition and growth rate of individual fish.

Length-Weight Relationships:

Predictive regression equations relating snout-fork length to round weight were calculated for males and females in each sample area and all the areas combined. The regressions were obtained using the equation $W = cL^b$, in which W = weight (kg), L = snout-fork length (cm), and c and b are constants. The values of c and b were estimated using a least squares regression of the logarithic transformation, $Y = a + bX$ in which $Y = \log_{10}W$; $a = \log_{10}c$; and $X = \log_{10}L$.

Ricker (1973) states that the functional regression is more suitable than the ordinary least squares regression because the latter underestimates the exponent (b) in the length-weight relationship. For this reason, functional regressions, according to Ricker (1973), were calculated for each sample area for comparison with the predictive regressions (Table 9). In each case, the exponent (v) of the functional regression is higher than the corresponding exponent (b) for the predictive regression.

The hypothesis that one common regression line applies to both sexes was first tested for the total data. An analysis of covariance (Snedecor 1956) indicated that there was no significant difference ($P>.01$) between sexes

Table 9. Predictive and functional regressions of round weight on snout-fork length for Southeastern Alaska coho salmon, 1969 and 1970.

Catch Locations	Predictive Regressions		Functional Regressions		r	N
	Slope (b)	Intercept (a)	Slope (v)	Intercept (u)		
Noyes, Baker, and Maurelle Islands	3.2228	-5.2801	3.4176	-5.6319	0.943	997
Stikine River	3.3065	-5.4304	3.4659	-5.7230	0.954	702
Inian Islands	3.2138	-5.2598	3.3098	-5.4326	0.971	494
Taku River	3.1076	-5.0654	3.2574	-5.3407	0.954	422
Kalikh River	3.1870	-5.2569	3.2654	-5.4002	0.976	72
Alsek River	3.1566	-5.1988	3.2677	-5.4014	0.966	557
Tsiu-Tsivat Rivers	3.1144	-5.1257	3.2852	-5.4382	0.948	209
Situk-Ahrnklin Rivers	3.1893	-5.2459	3.3572	-5.5551	0.950	541
Doame River	3.1832	-5.2267	3.3262	-5.4907	0.957	130
Chilkat River	3.1173	-5.1073	3.3198	-5.4828	0.939	509
All Areas Combined	3.1066	-5.0805	3.2573	-5.3554	0.953	4,633

when the data was tested for all areas combined. Each sample area was then tested separately for a difference in sexes within areas. Four of the ten sample areas showed a statistically significant difference ($P<.01$) between males and females. They were the Situk-Ahrnklin Rivers; Alsek River; Doame River; and the Noyes, Baker, and Maurelle Islands samples. Using the functional regression equations for males and females from these sample areas, the differences in predicted weights were found to be less than 100 grams in each case. Although there was a statistically significant difference between sexes in these areas, a difference of less than 100 grams was not considered to be practically significant and the sexes were assumed to have a common regression line in all sample areas.

A second hypothesis that all the areas have a common regression line was then tested. An analysis of covariance indicated that the slopes of the regressions were significantly different ($P<.01$) when the samples from each area were tested. The ten individual regression lines were then compared and samples showing similar regression equations were grouped and tested again. An analysis of covariance indicated that there was no significant difference ($P>.01$) between the slopes of the regression lines for the Noyes, Baker, Maurelle Islands group, and the Stikine River samples; the Inian Islands and the Taku River samples, the Kaliakh, Alsek, and Tsiu-Tsivat River samples; and the Situk-Ahrnklin, Doame, and Chilkat River samples (Table 10). Four functional regression equations for these area groups were calculated and their logarithmic transformations are shown in Figure 11. The data from all sample areas were combined to calculate an average length-weight relationship for all Southeastern coho salmon (Figure 12).

Conversion Factors:

Both snout-fork length and mideye-fork length measurements were taken from all coho salmon sampled in 1969 and 1970. When snouts are damaged or when large kypes (hooked snouts) are developed the mideye-fork length measurement can be converted into an accurate snout-fork length measurement by a conversion factor. Ricker (1973) states that conversion equations should be obtained from the functional regression line when one length is plotted against the other. Functional conversion equations were calculated predicting snout-fork length from mideye-fork length for each of the four area groups and one for the total data (Table 11).

Dressed weights were obtained from troll and gillnet caught coho salmon in the Noyes, Baker, Maurelle Islands, Inian Islands, Taku River, and Stikine River fisheries. Ricker (1973) states that in order to obtain conversion factors, the same fish must be measured in two or more different ways. Due to the operational procedures of canneries and cold storage plants where most sampling was conducted, it was not possible to obtain round and dressed weights from the same fish. Statistically valid conversion equations predicting round weight from dressed weight cannot be obtained from the data. However, an estimate of round weight can be obtained from the length of a dressed fish using the functional regressional equations in Table 10.

Table 10. Functional regression equations for Southeastern Alaska coho salmon by area groups, 1969 and 1970.

Catch Locations	Functional Regression Equation	r	N
Noyes, Baker, Maurelle Islands, and Stikine River	W [1/] $= 2.2993 \times 10^{-6} L^{3.4207}$	0.956	1,699
Inian Islands and Taku River	$W = 4.4300 \times 10^{-6} L^{3.2659}$	0.975	916
Kaliakh, Alsek, and Tsiu-Tsivat Rivers	$W = 4.0300 \times 10^{-6} L^{3.2633}$	0.965	838
Situk-Ahrnklin, Doame, and Chilkat Rivers	$W = 2.8721 \times 10^{-6} L^{3.3514}$	0.948	1,180
All Areas Combined	$W = 4.4116 \times 10^{-6} L^{3.2573}$	0.954	4,633

1/ W = round weight in kg
L = snout-fork length in cm

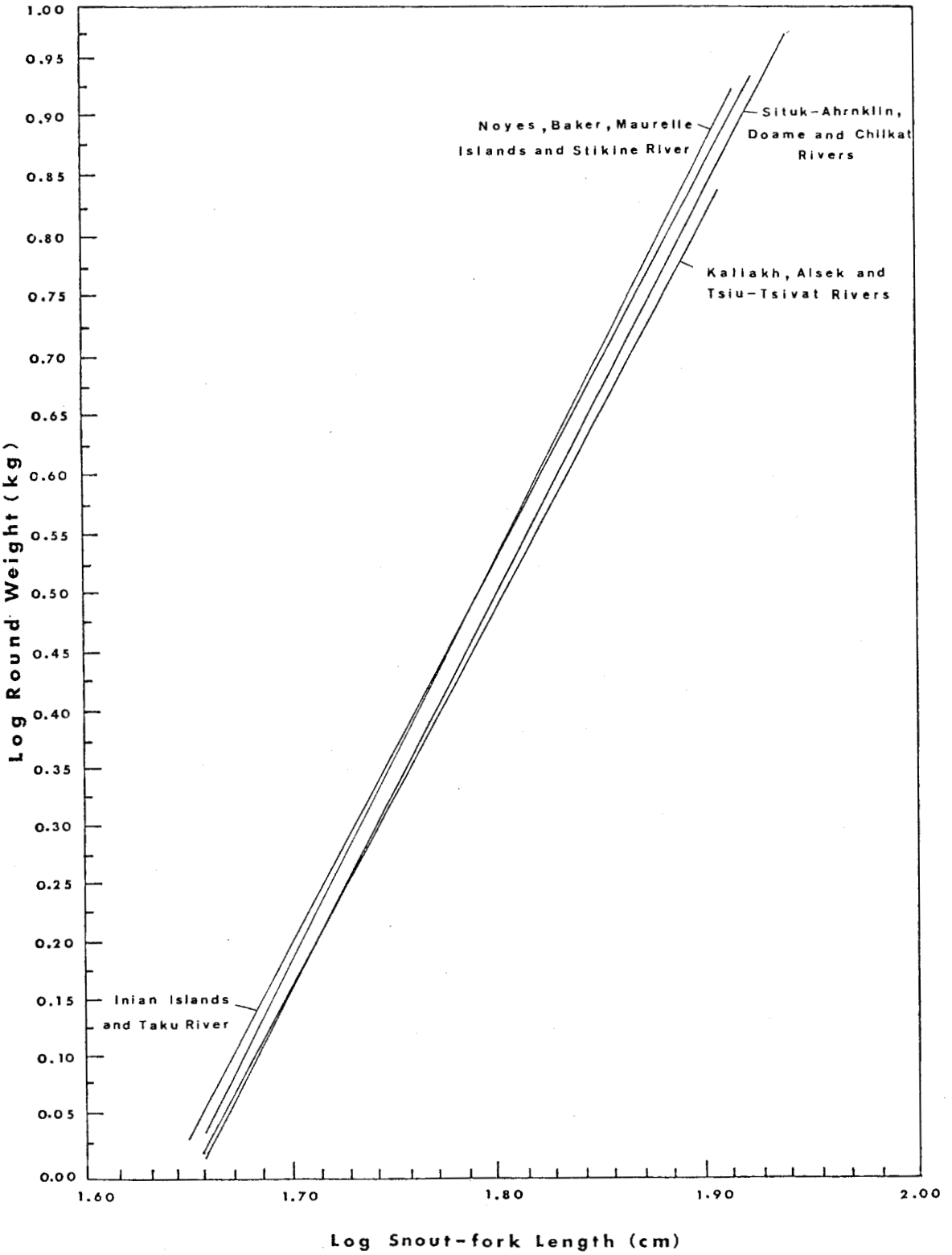

Figure 11. Functional log-log regressions of round weight (kg) versus snout-fork length (cm) for Southeastern Alaska coho salmon by area groups, 1969 and 1970.1/

1/ Equations are summarized in Table 10.

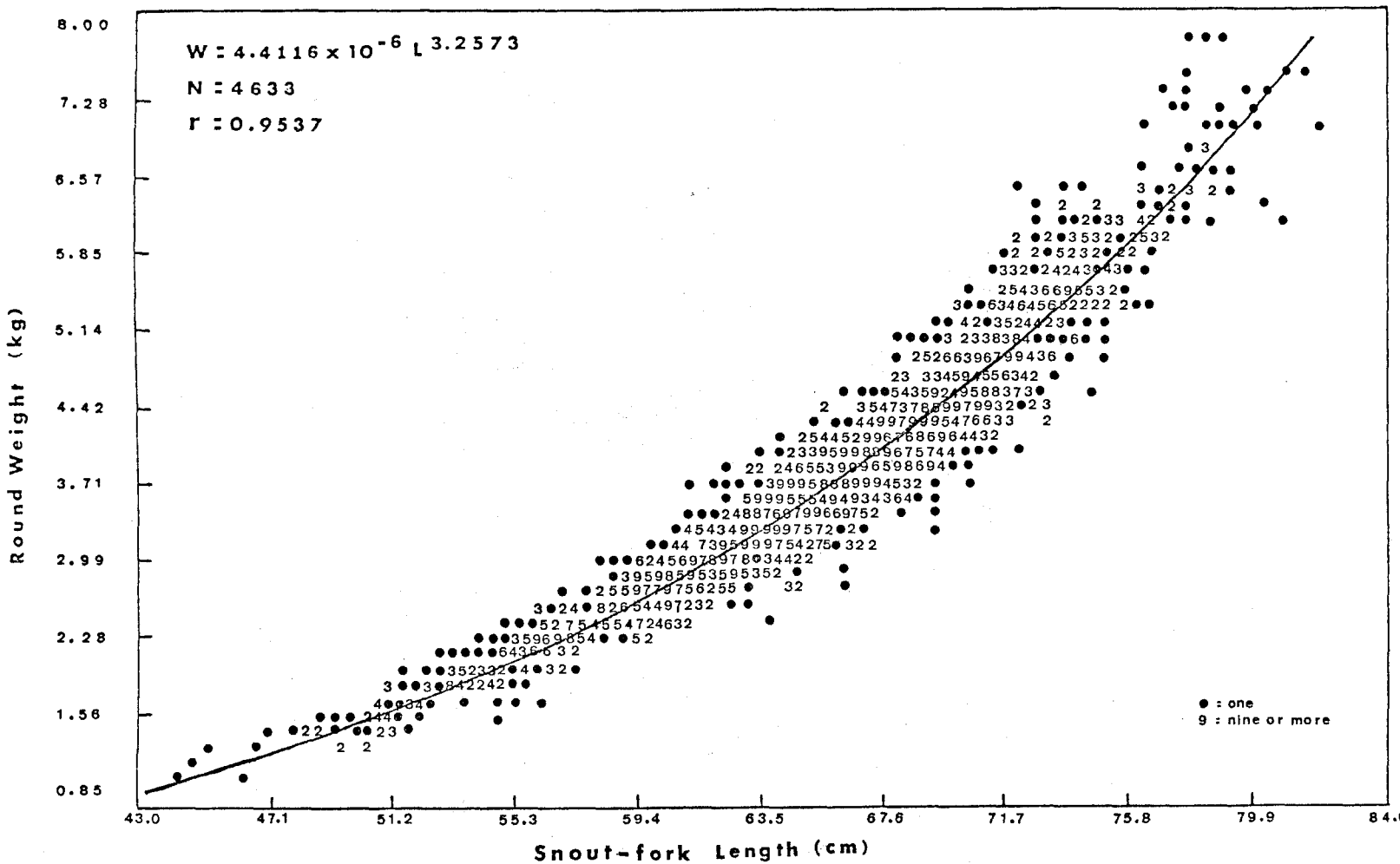

Figure 12. Functional regression fit of round weight (kg) versus snout-fork length (cm) of Southeastern Alaska coho salmon, 1969 and 1970.1/

1/ Fitted curve obtained from total data.

Table 11. Functional conversion equations predicting snout-fork length from mideye-fork length for Southeastern Alaska coho salmon, 1969 and 1970.

Catch Locations	Functional Conversion Equation	r	N
Noyes, Baker, Maurelle Islands, and Stikine River	SF [1/] = -4.1596 + 1.1497 ME	0.986	1,699
Inian Islands and Taku River	SF = -3.6559 + 1.1482 ME	0.989	916
Kaliakh, Alsek, and Tsiu-Tsivat Rivers	SF = -2.9380 + 1.1488 ME	0.977	838
Situk-Ahrnklin, Doame, and Chilkat Rivers	SF = -6.7027 + 1.2059 ME	0.968	1,180
All Areas Combined	SF = -5.4086 + 1.1791 ME	0.980	4,633

1/ SF = snout-fork length in cm
ME = mideye-fork length in cm

SUMMARY

(1) This study presents size, sex, and age data on commercially landed coho salmon from 1969 and 1970 troll, purse seine, and gillnet fisheries from mixed and known stocks throughout Southeastern Alaska and Yakutat.

The two mixed stock areas sampled were: Noyes, Baker, Maurelle Islands, and Inian Islands. The eight known stock areas sampled were Taku, Stikine, Chilkat, Alsek, Situk-Ahrnklin, Doame, Kaliakh, and Tsiu-Tsivat Rivers.

(2) Total age, freshwater circuli counts through each winter, "plus" growth, marine circuli through the first winter, and length-weight relationships were analyzed by sample area, gear, sex, and year.

(3) Total age of Southeastern Alaska coho salmon ranged from 3 to 6 years and was dependent on the number of years fish spent in freshwater before reaching smolt size (1 to 4 years). Saltwater age did not vary, but was always two summers and one winter (saltwater age .1). Four age classes were found in scales from 5,406 fish; 26.7% age 1.1, 63.9% age 2.1, 8.9% age 3.1, and 0.5% age 4.1. There was little difference in age composition between sexes or sample years.

(4) Coho salmon have a higher incidence of scale regeneration than some other salmon species because scales are lost more easily. For this reason, a number of scales (15-30) need to be taken from each fish for age and growth studies.

(5) Considerable experience in reading coho scales was found to be necessary for correct interpretation of freshwater age and plus growth.

(6) Similar scale patterns often occurred in samples from the same fishing vessel, particularly troll caught coho far from the stream of origin, suggesting that coho originating from the same freshwater rearing area may remain together throughout their saltwater residence.

(7) A higher percentage of mid- to late-season smolt migrants and a shorter period of first year marine residency was found in Yakutat to Icy Bay coho salmon than in Cross Sound to Dixon Entrance. This was demonstrated by the higher percent occurrence of plus growth (85.7%), the larger mean amount of plus growth (5.7 circuli), and the lower mean circuli count through the first ocean zone (32.0) in scales from Yakutat to Icy Bay coho salmon than in scales from Cross Sound to Dixon Entrance coho salmon (51.5%, 4.7 circuli, and 36.3 circuli).

(8) Plus growth was present in scales from 59.5% of Southeastern Alaska coho salmon. Both percent occurrence and mean circuli counts of plus growth decreased as freshwater age increased (81.9% and 6.1 circuli age 1+.1, 53.8% and 4.5 circuli age 2+.1, 35.8% and 3.9 circuli age 3+.1, 12.0% and 3.7 circuli age 4+.1). This indicated that each older

age class had less dependency on plus (compensatory) growth to reach migratory size and smoltification than the preceding age class, probably because of the increasing mean size of the fish with age.

(9) Total mean freshwater circuli counts for each age class (excluding plus growth circuli) increased as freshwater age increased from 10.8 circuli (age 1.1) to 17.3 (age 2.1), 22.1 (age 3.1), and 27.7 circuli (age 4.1) for scales without plus growth and from 9.4 (age 1+.1), 15.6 (age 2+.1), 20.5 (age 3+.1), and 29.7 (age 4+.1) for scales with plus growth. Mean freshwater circuli counts for each year of life (excluding plus growth circuli) decreased as freshwater age increased, from 10.8 circuli (age 1.1), 8.7 (age 2.1), 7.4 (age 3.1), and 6.9 circuli (age 4.1) for scales without plus growth and 9.4 (age 1+.1), 7.8 (age 2+.1), 6.8 (age 3+.1), and 7.4 (age 4+.1) for scales with plus growth, indicating that younger age coho salmon smolts were faster growing than older age coho salmon smolts, and this faster rate of growth determined or influenced the age at migration. Mean circuli counts for each year of freshwater life and total mean freshwater circuli counts (excluding plus growth circuli) for each age class were always greater for scales without plus growth than for scales with plus growth. Fish without plus growth were thus faster growing than fish with plus growth.

(10) Coho salmon from the Yakutat to Icy Bay area tended to be slower growing in freshwater than coho salmon from the area between Cross Sound and Dixon Entrance, as demonstrated by lower mean circuli counts for each year of freshwater life and lower total mean freshwater circuli counts (excluding plus growth circuli) for each age class.

(11) There was a wide range in freshwater circuli counts for each year of life for fish without plus growth (4 to 21 circuli), with plus growth, but excluding plus growth circuli (3 to 21 circuli), for plus growth only (1 to 16 circuli), and for saltwater circuli through the first ocean zone (18 to 51 circuli). The wide range in individual freshwater and plus growth circuli counts were probably the result of the amount of time spent feeding in freshwater, the quality of freshwater habitat, and condition and growth rate of the individual fish. The wide range in individual saltwater circuli counts through the first ocean zone was probably due to the amount of time spent feeding in saltwater determined by time of smolt outmigration, size of smolts at time of entry into saltwater, area of feeding in saltwater, and condition and growth rate of the individual fish.

(12) The mean saltwater circuli count through the first ocean zone for scales with and without plus growth and all areas combined was 35.3 and averaged 36.6 for scales without plus growth and 34.4 for scales with plus growth.

(13) Mean circuli counts through the first ocean zone decreased as freshwater age increased for scales both with and without plus growth, indicating that younger freshwater age coho salmon migrated to sea earlier in the season than older freshwater age coho salmon.

(14) Differences in mean size of adult coho salmon between sample areas in this study were mainly dependent on the stock of fish and the time of sampling.

(15) Size of adult coho salmon was found to range widely within each sample area. The combined mean snout-fork length of 6,431 coho salmon from all areas was 66.6 cm (range 43.2 to 83.5), the mideye-fork length was 61.2 cm (range 40.2 to 73.9), the round weight of 4,633 fish was 4.02 kg (range 1.04 to 7.82), and the dressed weight of 1,798 fish was 3.21 kg (range 0.90 to 6.62).

(16) There was little difference in mean size between males and females though males had the widest range in sizes, the smallest, and largest fish for all areas sampled. The wide range in size of adult coho salmon within each sample area was probably the result of the amount of time spent feeding in saltwater as determined by time of smolt entry into saltwater (early spring to late summer), size of smolts at time of entry into saltwater, area of feeding in saltwater (varies from inside waters to open ocean), and condition and growth rate of the individual fish.

(17) Predictive length-weight regressions were calculated for each sex and sample area. No practical difference in regression equations were found between sexes, but significant differences were found between some of the sample areas. A combined functional regression equation of round weight (kg) on snout-fork length (cm) was calculated for Southeastern Alaska coho salmon ($W = 4.4116 \times 10^{-6} L^{3.2573}$). A functional conversion equation for predicting snout-fork length from mideye-fork length of Southeastern Alaska coho salmon was also calculated (S.F. = -5.4086 + 1.1791 ME).

(18) Three age classes are important in management of Southeastern Alaska coho salmon, ages 1.1, 2.1, and 3.1, which comprise 99.5% of the fish. Two age classes (1.1 and 2.1) are of major importance and comprise nearly 91% of the fish. Only one age class (age 1.1) is important to the commercial fishery in areas south of Alaska.

(19) Coho salmon in Southeastern Alaska usually require two or more years to reach smolt size (73.3% are age 2., 3., or 4.), while only one year is required in areas south of Alaska (British Columbia, Washington, Oregon, and California). This indicates slower growth, related to cooler temperatures and a shorter growing season in Alaska.

(20) Because most Southeastern Alaska coho salmon need an extra year of freshwater rearing before reaching smolt size, larger escapements of spawners may be necessary than for British Columbia, Washington, Oregon, and California to offset greater freshwater rearing mortalities.

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APPENDICES

Appendix Table 1. Sampling locations for coho salmon age, weight, and length, Southeastern Alaska commercial fishery, 1969.

Catch Area	Gear	Place Sample Taken	Sample Group	Daily Sample Number	No. of Fish Sampled	Number by Sex	Date Sampled	Data Collected [1]
Noyes Island to Baker Island	Purse Seine	Klawock Oceanside Packing Co.	#1	1-3 inc	193	(90M:103F) [2]	7-29, 30, 31-1969	Length, weight, sex, scales
				9-12	254	(121M:133F)	8-5, 6, 7, 9-1969	
		New England Fish Co., Tender From Steamboat Bay, Noyes Is.		8A-D	71	(33M:38F)		
					518	(244M:274F)	8-4-1969	
Maurelle Islands Group and Noyes Island	Troll	Scott's fish buying scow At-Hole-in-the-Wall	#2	4A-7D	506	------	7-31, 8-1, 2, 3-1969	Length, dressed weight, scales
Inian Islands Area	Purse Seine	Excursion Inlet Packing Co., Tender in Inian Is.	#3	13A-15C	170	(96M:74F)	8-11, 12, 13-1969	Length, weight, sex, scales
Inian Islands Area	Troll	Conrad's Fish buying scow -Elfin Cove	#4	16A-18D	515	------	8-14, 15, 16-1969	Length, dressed weight, scales
Mouth of Taku River	Drift Gillnet	Juneau Cold Storage	#5	19B-C	113	(64M:49F)	8-20-1969	Length, weight, sex, scales
				22A-22B	155	(98M:57F)	8-27-1969	
					268	(162M:106F)		
Off Mouth of Stikine River	Drift Gillnet	Harbor Seafoods Co., Wrangell	#6	20A-21C	374	(215M:159F)	8-25, 26-1969	Length, weight, sex, scales
				33	73	(23M:50F)	9-2-1969	
					447	(238M:209F)		
In Kaliakh River	Set Gillnet	Aboard Factory Ships "Teddy" (Theodore Seafoods) & "Kayak" (Kayak Packing Co.) in Kaliakh River	#7	23A	72	(48M:24F)	8-29-1969	Length, weight, sex, scales
In Tsiu-Tsviat Rivers	Set Gillnet	Aboard Factory Ship "Kayak" (Kayak Packing Co.) in Kaliakh River	#8	23B	209	(135M:74F)	8-29-1969	Length, weight, sex, scales
In Situk River	Sport Gear	Lower Situk Near USFS Cabin	#9	24-25	9	(6M:3F)	8-30, 31-1969	Length, weight, sex, scales
In Situk-Ahrnklin River Common Mouth	Set Gillnet	Aboard Marine Foods Packing Co., Tender "Rolff II" Mouth of of Situk-Ahrnklin	#10	26A-27D	281	(174M:107F)	9-1, 2-1969	Length, weight, sex, scales
In Alsek River	Set Gillnet	Marine Foods Packing Co. Buying Station at Dry Bay near Alsek River	#11	28A-29D	283	(161M:122F)	9-3, 4-1969	Length, weight, sex, scales
Off Mouth of Chilkat River	Drift Gillnet	Aboard Haines Packing Co., Tender "Pacific Queen" in Chilkat Inlet	#12	30A-32G	260	-----	9-8, 9, 10-1969	Length, weight, scales
		Juneau Cold Storage (Tender Delivery)		34	(253) [3]	(134M:119F)	9-11, 12-1969	sex ratio

1/ Both snout-fork and mideye-fork length collected on all fish and weights all round unless listed otherwise.
2/ M = Males; F = Females.
3/ Same fish as sample group #12 resampled for mideye-fork length and sex.

Appendix Table 2. Sampling locations for coho salmon age, weight, and length, Southeastern Alaska commercial fishery, 1970.

Area	Gear	Place Sample Taken	Sample Group	Daily Sample Number	No. of Fish Sampled	Number by Sex	Date Sampled	Data Collected [1/]
Inian Islands Area	Purse Seine	Excursion Inlet Packing Co.	#13	1-4 inc.	324	(239M:85F) [2/]	7-28, 29, 30-1970	Length, weight, sex, scales
Inian Islands Area	Troll	Carr's Fish Buying Scow-Elfin Cove	#14	5-6	26	--------	7-30, 31-1970	Length, dressed weight, scales
				15-16	514	--------	8-21, 22-1970	
					540	--------		
Noyes Island to Baker Island	Purse Seine	Klawock Oceanside Packing Co.	#15	7-8	293	(162M:131F)	8-4, 6-1970	Length, weight, sex, scales
				12-14	186	(96M:90F)	8-11, 13-1970	
					479	(258M:221F)		
Maurelle Islands Group & Noyes Island	Troll	Scott's Fish Buying Scow at Hole-in-the-Wall	#16	9-11	65	--------	8-6, 7, 8-1970	Length, dressed weight, scales
Mouth of Taku River	Drift Gillnet	Juneau Cold Storage	#17	17	154	(83M:71F)	8-25-1970	Length, weight, sex, scales
			#18	18	152	-------	8-27-1970	Length, dressed weight, scales
Off Mouth of Stikine River	Drift Gillnet	Harbor Seafoods Co., Wrangell	#19	19A	20	-------	8-31-1970	Length, dressed weight, scales
			#20	19B	255	(136M:119F)	8-31-1970	Length, weight, sex, scales
In Alsek River	Set Gillnet	Marine Foods Packing Co. in Yakutat	#21	20	84	(46M:38F)	9-8-1970	Length, weight, sex, scales
				22	119	(49M:70F)	9-9-1970	
				23	71	(33M:38F)	9-10-1970	
					274	(128M:146F)		
In Doame River	Set Gillnet	Marine Foods Packing Co. in Yakutat	#22	21	130	(67M:63F)	9-9-1970	Length, weight, sex, scales
In Situk-Ahrnklin River Common Mouth	Set Gillnet	Marine Foods Packing Co. in Yakutat	#23	24	251	(128M:123F)	9-11-1970	Length, weight, sex, scales
Off Mouth of Chilkat River	Drift Gillnet	Aboard Haines Packing Co. Tender "Pacific Queen" in Chilkat Inlet	#24	25	249	--------	9-14-1970	Length, weight, scales

1/ Both snout-fork and mideye-fork length collected on all fish and weights all round unless listed otherwise.
2/ M = Males; F = Females.
3/ Same fish as sample group #12 resampled for mideye-fork length and sex.

Appendix Table 3. Coho salmon age, separated by catch area, gear, year, and sex, Southeastern Alaska commercial catch sampling, 1969 and 1970.

Catch Area	Gear	Year	Sample Group	Sample Size	Number and Percent of Fish in Each Age Class								Number of Fish with Readable Scales	Number and Percent of Fish with Regenerated or Unreadable Scales	
					1.1		2.1		3.1		4.1				
Noyes Island to Baker Island	Purse Seine	1969	IM [1/]	244	49	23.6%	142	68.3%	15	7.2%	2	1.0%	208	36	14.8%
		1969	IF	274	51	20.4%	166	66.4%	32	12.8%	1	0.4%	250	24	8.8%
Maurelle Islands Group and Noyes Island	Troll	1969	2	506	105	25.1%	277	66.1%	37	8.8%	0	0	419	87	17.2%
Inian Islands Area	Purse Seine	1969	3M	96	25	27.8%	64	71.1%	1	1.1%	0	0	90	6	6.3%
		1969	3F	74	20	28.6%	45	64.3%	5	7.1%	0	0	70	4	5.4%
Inian Islands Area	Troll	1969	4	515	127	28.3%	282	62.8%	40	8.9%	0	0	449	66	12.8%
Mouth of Taku River	Drift Gillnet	1969	5M	162	58	38.4%	89	58.9%	4	2.6%	0	0	151	11	6.8%
		1969	5F	106	21	21.9%	72	75.0%	3	3.1%	0	0	96	10	9.4%
Off Mouth of Stikine River	Drift Gillnet	1969	6M	238	89	44.1%	107	53.0%	5	2.5%	1	0.5%	202	36	15.1%
		1969	6F	209	70	40.9%	95	55.6%	6	3.5%	0	0	171	38	18.2%
In Kaliakh River	Set Gillnet	1969	7M	48	13	32.5%	23	57.5%	4	10.0%	0	0	40	8	16.7%
		1969	7F	24	11	55.0%	8	40.0%	1	5.0%	0	0	20	4	16.7%
In Tsiu-Tsivat Rivers	Set Gillnet	1969	8M	135	27	25.0%	66	61.1%	15	13.9%	0	0	108	27	20.0%
		1969	8F	74	8	12.9%	51	82.3%	3	4.8%	0	0	62	12	16.2%
In Situk River	Sport Gear	1969	9M	6	1	33.3%	1	33.3%	1	33.3%	0	0	3	3	50.0%
		1969	9F	3	0	0	3	100.0%	0	0	0	0	3	0	0
In Situk-Arhnklin River Common Mouth	Set Gillnet	1969	10M	174	75	51.0%	56	38.1%	15	10.2%	1	0.7%	147	27	15.5%
		1969	10F	107	38	40.0%	43	45.3%	12	12.6%	2	2.1%	95	12	11.2%
In Alsek River	Set Gillnet	1969	11M	161	24	18.3%	96	73.3%	10	7.6%	1	0.8%	131	30	18.6%
		1969	11F	122	11	10.8%	84	82.4%	7	6.9%	0	0	102	20	16.4%
Off Mouth of Chilkat River	Drift Gillnet	1969	12	260	105	50.0%	95	45.2%	10	4.8%	0	0	210	50	19.2%
Inian Islands Area	Purse Seine	1970	13M	239	57	27.9%	130	63.7%	16	7.8%	1	0.5%	204	35	14.6%
		1970	13F	85	15	20.3%	55	74.3%	4	5.4%	0	0	74	11	12.9%
Inian Islands Area	Troll	1970	14	540	74	17.5%	298	70.3%	49	11.6%	3	0.7%	424	116	21.5%
Noyes Island to Baker Island	Purse Seine	1970	15M	258	28	13.9%	154	76.2%	19	9.4%	1	0.5%	202	56	21.7%
		1970	15F	221	18	10.2%	139	78.5%	18	10.2%	2	1.1%	177	44	19.9%
Maurelle Islands Group & Noyes Island	Troll	1970	16	65	5	10.2%	35	71.4%	7	14.3%	2	4.1%	49	16	24.6%
Mouth of Taku River	Drift Gillnet	1970	17M	83	18	27.3%	45	68.2%	3	4.5%	0	0	66	17	20.5%
		1970	17F	71	21	36.2%	29	50.0%	8	13.8%	0	0	58	13	18.3%
		1970	18	152	38	29.0%	86	65.6%	6	4.6%	1	0.8%	131	21	13.8%
Off Mouth of Stikine River	Drift Gillnet	1970	19	20	1	6.3%	14	87.5%	1	6.3%	0	0	16	4	20.0%
		1970	20M	136	16	14.4%	81	73.0%	14	12.6%	0	0	111	25	18.4%
		1970	20F	119	11	11.8%	65	69.9%	17	18.3%	0	0	93	26	21.8%
In Alsek River	Set Gillnet	1970	21M	128	20	19.2%	74	71.2%	10	9.6%	0	0	104	24	18.8%
		1970	21F	146	15	11.9%	94	74.6%	17	13.5%	0	0	126	20	13.7%
In Doame River	Set Gillnet	1970	22M	67	31	51.7%	26	43.3%	3	5.0%	0	0	60	7	10.4%
		1970	22F	63	33	56.9%	22	37.9%	3	5.2%	0	0	58	5	7.9%
In Situk-Ahrnklin River Common Mouth	Set Gillnet	1970	23M	128	33	30.6%	67	62.0%	8	7.4%	0	0	108	20	15.6%
		1970	23F	123	20	20.0%	64	64.0%	15	15.0%	1	1.0%	100	23	18.7%
Off Mouth of Chilkat River	Drift Gillnet	1970	24	249	64	29.4%	111	50.9%	37	17.0%	6	2.8%	218	31	12.4%
All Areas Combined		1969	1-12 inc.	3,538	928	30.6%	1,865	61.6%	226	7.5%	8	0.3%	3,027	511	14.4%
All Areas Combined		1970	13-24 inc.	2,893	518	21.8%	1,589	66.8%	255	10.7%	17	0.7%	2,379	514	17.8%
Total - All Areas and Both Years Combined		1969 & 1970	1-24 inc.	6,431	1,466	26.7%	3,454	63.9%	481	8.9%	25	0.5%	5,406	1,025	15.9%

1/ M = Males; F = Females.

Appendix Table 4. Coho salmon age, sexes combined, for yearly totals and combined totals by area and gear. Southeastern Alaska commercial catch sampling, 1969 and 1970.

Catch Area	Gear	Year	Sample Group	Sample Size	Number and Percent of Fish in Each Age Class								Number of Fish with Readable Scales	Number and Percent of Fish with Regenerated or Unreadable Scales	
					1.1		2.1		3.1		4.1				
Noyes Island to Baker Island	Purse Seine	1969	IM & F[1/]	518	100	21.8%	308	67.2%	47	10.3%	3	0.7%	458	60	11.6%
		1970	15M & F	479	46	12.1%	293	77.3%	37	9.8%	3	0.8%	379	100	20.9%
			TOTAL	997	146	17.4%	601	71.8%	84	10.0%	6	0.7%	837	160	16.0%
Maurelle Islands Group & Noyes Island	Troll	1969	2	506	105	25.1%	277	66.1%	37	8.8%	0	0	419	87	17.2%
		1970	16	65	5	10.2%	35	71.4%	7	14.3%	2	4.1%	49	16	24.6%
			TOTAL	571	110	23.5%	312	66.7%	44	9.4%	2	0.4%	468	103	18.0%
Inian Islands Area	Purse Seine	1969	3M & F	170	45	28.1%	109	68.1%	6	3.7%	0	0	160	10	5.9%
		1970	13M & F	324	72	25.9%	185	66.5%	20	7.2%	1	0.4%	278	46	14.2%
			TOTAL	494	117	25.3%	294	67.1%	26	5.9%	1	0.2%	438	56	11.3%
Inian Islands Area	Troll	1969	4	515	127	28.3%	282	62.8%	40	8.9%	0	0	449	66	12.8%
		1970	14	540	74	17.5%	298	70.3%	49	11.6%	3	0.7%	424	116	21.5%
			TOTAL	1,055	201	23.0%	580	66.4%	89	10.2%	3	0.3%	873	182	17.3%
Mouth of Taku River	Drift Gillnet	1969	5M & F	268	79	32.0%	161	65.2%	7	2.8%	0	0	247	21	7.8%
		1970	17M & F	154	39	31.5%	74	59.7%	11	8.9%	0	0	124	30	19.5%
		1970	18	152	38	29.0%	86	65.6%	6	4.6%	1	0.8%	131	21	13.8%
			TOTAL	574	156	31.1%	321	63.9%	24	4.8%	1	0.2%	502	72	12.5%
Off Mouth of Stikine River	Drift Gillnet	1969	6M & F	447	159	42.6%	202	54.2%	11	2.9%	1	0.3%	373	74	16.6%
		1970	19	20	1	6.3%	14	87.5%	1	6.3%	0	0	16	4	20.0%
		1970	20M & F	255	27	13.2%	146	71.6%	31	15.2%	0	0	204	51	20.0%
			TOTAL	722	187	31.5%	362	61.0%	43	7.3%	1	0.2%	593	129	17.9%
In Kaliakh River	Set Gillnet	1969	7M & F	72	24	40.0%	31	51.7%	5	8.3%	0	0	60	12	16.7%
In Tsiu-Tsivat Rivers	Set Gillnet	1969	8M & F	209	35	20.6%	117	68.8%	18	10.6%	0	0	170	39	18.7%
In Doame River	Set Gillnet	1970	22M & F	130	64	54.2%	48	40.7%	6	5.1%	0	0	118	12	9.2%
In Situk River	Sport Gear	1969	9M & F	9	1	16.7%	4	66.7%	1	16.7%	0	0	6	3	33.3%
Off Situk-Ahrnklin Rivers Common Mouth	Set Gillnet	1969	10M & F	281	113	46.7%	99	40.9%	27	11.2%	3	1.2%	242	39	13.9%
		1970	23M & F	251	53	25.5%	131	63.0%	23	11.1%	1	0.5%	208	43	17.1%
			TOTAL	541	167	36.6%	234	51.3%	51	11.2%	4	0.9%	456	85	15.7%
In Alsek River	Set Gillnet	1969	11M & F	283	35	15.0%	180	77.3%	17	7.3%	1	0.4%	233	50	17.7%
		1970	21M & F	274	35	15.2%	168	73.0%	27	11.7%	0	0	230	44	16.1%
			TOTAL	557	70	15.1%	348	75.2%	44	9.5%	1	0.2%	463	94	16.9%
Off mouth of Chilkat River	Drift Gillnet	1969	12	260	105	50.0%	95	45.2%	10	4.8%	0	0	210	50	19.2%
		1970	24	249	64	29.4%	111	50.9%	37	17.0%	6	2.8%	218	31	12.4%
			TOTAL	509	169	39.5%	206	48.1%	47	10.9%	6	1.4%	428	81	15.9%
All Areas Combined: 1969	-----	1969	1-12 inc.	3,538	928	30.6%	1,865	61.6%	226	7.5%	8	0.3%	3,027	511	14.4%
All Areas Combined: 1970	-----	1970	13-24 inc.	2,893	518	21.8%	1,589	66.8%	255	10.7%	17	0.7%	2,379	514	17.8%
Total All Areas and Both Years Combined	-----	1969 & 1970	1-24 inc.	6,431	1,446	26.7%	3,454	63.9%	481	8.9%	25	0.5%	5,406	1,025	15.9%

1/ M = Males, F = Females.

Appendix Table 5. Possible age classes of Southeastern Alaska coho salmon.

Possible Occurrence	Life History Category	Age 1/
Very rare or ?	fry migrant	0.1
Very rare or ?	fry migrant with 3-Ocean summers	0.2
Common	Jacks	1.0
?	Jacks	2.0
?	Jacks	3.0
?	Jacks	4.0
Common	Normal Southeastern Alaska Adults	1.1
Common	Normal Southeastern Alaska Adults	2.1
Common	Normal Southeastern Alaska Adults	3.1
Common	Normal Southeastern Alaska Adults	4.1
Very rare or ?	3-Ocean cohos	1.2
Very rare or ?	3-Ocean cohos	2.2
Very rare or ?	3-Ocean cohos	3.2
Very rare or ?	3-Ocean cohos	4.2

1/ European formula = number of freshwater annuli - decimal - number of saltwater annuli.

Appendix Table 6. Mean circuli counts for each year of freshwater life by age class, from Southeastern Alaska coho salmon scales having no plus growth, 1969 and 1970.

Catch Location	Age 1.1 1st Year	Age 2.1 1st Yr.	Age 2.1 2nd Yr.	Age 3.1 1st Yr.	Age 3.1 2nd Yr.	Age 3.1 3rd Yr.	Age 4.1 1st Yr.	Age 4.1 2nd Yr.	Age 4.1 3rd Yr.	Age 4.1 4th Yr.	Total Number of Fish in Sample
Noyes, Baker, and Maurelle Islands (1, 2, 15, 16)	70 1/ 10.4 2/ (6-19) 3/	547 8.3 (4-16)	9.5 (3-21)	7.3 (4-12)	98 8.0 (5-12)	7.8 (5-12)	7.3 (6-11)	7 8.0 (6-10)	7.0 (5-11)	7.6 (5-11)	722
Inian Islands Area (3, 4, 13, 14)	99 11.1 (6-18)	563 7.3 (4-15)	9.6 (3-21)	6.3 (4-9)	90 7.3 (5-13)	7.5 (5-13)	7.8 (5-11)	4 8.3 (5-13)	7.0 (6-8)	6.2 (5-8)	756
Mouth of Taku River (5, 17, 18)	18 10.6 (7-13)	160 7.4 (4-12)	9.8 (4-16)	6.1 (4-9)	15 7.7 (5-12)	7.3 (6-11)	7.0 (7-7)	1 6.0 (6-6)	6.0 (6-6)	7.0 (7-7)	194
Off Mouth of Stikine River (6, 19, 20)	47 10.6 (5-16)	143 7.5 (5-15)	10.0 (6-20)	6.7 (4-11)	18 7.4 (5-10)	8.5 (5-13)	6.0 (6-6)	1 6.0 (6-6)	6.0 (6-6)	7.0 (7-7)	209
Off mouth of Chilkat River (12, 24)	19 12.2 (8-19)	74 7.6 (5-13)	9.5 (5-17)	6.7 (5-9)	29 7.3 (5-11)	8.1 (5-15)	6.0 (4-8)	5 6.4 (5-8)	7.2 (5-10)	7.4 (6-9)	127
Kaliakh River (7)	----	5 8.4 (7-11)	8.6 (7-11)	6.5 (6-7)	2 7.0 (7-7)	7.5 (7-8)	---	---	---	---	7
Tsiu-Tsivat Rivers (8)	---	14 7.8 (5-13)	10.9 (7-16)	7.4 (5-9)	12 8.1 (6-12)	7.5 (6-11)	---	---	---	---	26
Situk-Ahrnklin Rivers Common Mouth (9, 10, 23)	3 8.0 (7-9)	25 7.5 (5-12)	8.3 (6-13)	6.2 (4-9)	18 7.9 (6-12)	7.7 (6-10)	5.7 (5-6)	3 6.0 (5-7)	6.0 (5-7)	6.0 (5-7)	49
Alsek River (11, 21)	---	58 7.0 (4-13)	9.8 (7-17)	6.4 (4-10)	26 8.4 (6-12)	7.4 (6-10)	5.0 (5-5)	1 8.0 (8-8)	7.0 (7-7)	7.0 (7-7)	85
Doame River (22)	6 8.8 (7-11)	7 8.6 (6-12)	8.1 (6-11)	7.0 (7-7)	1 9.0 (9-9)	10.0 (10-10)	---	---	---	---	14
Subtotal for Cross Sound to Dixon Entrance Areas 4/	253 10.9 (5-19)	1,487 7.7 (4-16) 17.3 ÷ 2 = 8.7 avg/yr	9.6 (3-21)	6.7 (4-12)	250 7.6 (5-13) 22.1 ÷ 3 = 7.4 avg/yr	7.8 (5-15)	7.0 (4-11)	18 7.4 (5-13) 28.5 ÷ 4 = 7.1 avg/yr	6.9 (5-11)	7.2 (5-11)	2,008
Subtotal for Yakutat-Icy Bay Areas 5/	9 8.5 (7-11)	109 7.4 (4-13) 16.8 ÷ 2 = 8.4 avg/yr	9.4 (6-17)	6.5 (4-10)	59 8.1 (6-12) 22.2 ÷ 3 = 7.4 avg/yr	7.6 (6-11)	5.5 (5-6)	4 6.5 (5-8) 24.6 ÷ 4 = 6.1 avg/yr	6.3 (5-7)	6.3 (5-7)	181
Total All Areas	262 10.8 (5-19)	1,596 7.7 (4-16) 17.3 ÷ 2 = 8.7 avg/yr	9.6 (3-21)	6.7 (4-12)	309 7.7 (5-13) 22.1 ÷ 3 = 7.4 avg/yr	7.7 (5-15)	6.7 (4-11)	22 7.2 (5-13) 27.7 ÷ 4 = 6.9 avg/yr	6.8 (5-11)	7.0 (5-11)	2,189

1/ Number of fish in this age class.
2/ Mean circuli count for each year.
3/ Range in circuli counts for this age class and year.
4/ Noyes, Baker, and Maurelle Islands; Inian Islands area; mouth of Taku River; off mouth of Stikine River; off mouth of Chilkat River.
5/ Kaliakh River; Tsiu-Tsivat Rivers; Situk-Ahrnklin Rivers common mouth; Alsek River; Doame River.

Appendix Table 7. Mean circuli counts for each year of freshwater life by age class, from Southeastern Alaska coho salmon scales having plus growth, 1969 and 1970.[1/]

Catch Location	Age 1+.1	Age 2+.1		Age 3+.1			Age 4+.1				Total Number of Fish in Sample
	1st Year	1st Yr.	2nd Yr.	1st Yr.	2nd Yr.	3rd Yr.	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	
Noyes, Baker, and Maurelle Islands (1, 2, 15, 16)	186 [2/] 9.7 [3/] (4-19) [4/]	366 7.6 (4-17)	9.1 (4-19)	30 6.8 (5-11)	8.2 (5-13)	7.3 (5-14)	1 6.0 (6-6)	11.0 (11-11)	5.0 (5-5)	8.0 (8-8)	583
Inian Islands Area (3, 4, 13, 14)	219 10.2 (6-16)	311 7.1 (4-13)	9.5 (5-20)	25 6.6 (4-12)	7.3 (5-10)	6.9 (5-12)	---	---	---	---	555
Mouth of Taku River (5, 17, 18)	138 9.8 (4-14)	161 6.9 (4-11)	8.9 (5-19)	9 5.7 (4-7)	6.8 (6-8)	7.0 (5-9)	---	---	---	---	308
Off Mouth of Stikine River (6, 19, 20)	140 10.3 (6-16)	219 6.9 (4-13)	9.1 (5-15)	25 6.2 (4-9)	7.0 (5-11)	7.5 (5-12)	---	---	---	---	384
Off mouth of Chilkat River (12, 24)	150 9.2 (4-13)	132 6.8 (4-11)	8.5 (4-15)	18 5.9 (4-8)	7.6 (5-11)	7.3 (5-11)	1 8.0 (8-8)	7.0 (7-7)	7.0 (7-7)	7.0 (7-7)	301
Kaliakh River (7)	24 9.1 (6-14)	26 6.3 (4-9)	8.3 (6-13)	3 5.3 (4-7)	7.0 (6-8)	7.0 (6-8)	---	---	---	---	53
Tsiu-Tsivat Rivers (8)	35 9.8 (6-13)	103 6.8 (4-12)	9.1 (6-14)	6 6.2 (4-9)	6.8 (6-10)	8.3 (6-10)	---	---	---	---	144
Situk-Ahrnklin Rivers Common Mouth (9, 10, 23)	164 8.0 (4-17)	209 6.2 (4-11)	7.7 (4-13)	33 5.8 (5-8)	6.4 (5-10)	7.0 (5-10)	1 6.0 (6-6)	7.0 (7-7)	9.0 (9-9)	8.0 (8-8)	407
Alsek River (11, 21)	70 8.1 (5-12)	290 6.2 (4-10)	8.2 (5-19)	18 5.1 (4-6)	7.0 (5-11)	6.9 (5-9)	---	---	---	---	378
Doame River (22)	58 9.0 (6-13)	41 6.7 (4-10)	7.9 (5-12)	5 5.6 (4-7)	8.2 (7-10)	7.6 (6-9)	---	---	---	---	104
Subtotal for Cross Sound to Dixon Entrance Areas [5/]	833 9.9 (4-19)	1,189 7.1 (4-17)	9.1 (4-20)	107 6.4 (4-12)	7.5 (5-13)	7.2 (5-14)	2 7.0 (6-8)	9.0 (7-11)	6.0 (5-7)	7.5 (7-8)	2,131
		16.3 ÷ 2 = 8.1 avg/yr			21.1 ÷ 3 = 7.0 avg/yr			29.5 ÷ 4 = 7.4 avg/yr			
Subtotal for Yakutat - Icy Bay Areas [6/]	351 8.4 (4-17)	669 6.3 (4-12)	8.2 (4-19)	65 5.6 (4-9)	6.8 (5-11)	7.1 (5-10)	1 6.0 (6-6)	7.0 (7-7)	9.0 (9-9)	8.0 (8-8)	1,086
		14.5 ÷ 2 = 7.3 avg/yr			19.5 ÷ 3 = 6.5 avg/yr			30.4 ÷ 4 = 7.5 avg/yr			
Total All Areas	1,184 9.4 (4-19)	1,858 6.9 (4-17)	8.8 (4-20)	172 6.1 (4-12)	7.2 (5-13)	7.2 (5-14)	3 6.7 (6-6)	8.3 (7-11)	7.0 (5-9)	7.7 (7-8)	3,217
		15.6 ÷ 2 = 7.8 avg/yr			20.5 ÷ 3 = 6.8 avg/yr			29.7 ÷ 4 = 7.4 avg/yr			

1/ Plus growth counts are not included.
2/ Number of fish in this age class.
3/ Mean circuli count for each year.
4/ Range in circuli counts for this age class and year.
5/ Noyes, Baker and Maurelle Islands; Inian Islands area; mouth of Taku River; off mouth of Stikine River; off mouth of Chilkat River.
6/ Kaliakh River; Tsiu-Tsivat Rivers; Situk-Ahrnklin Rivers common mouth; Alsek River; Doame River.

Appendix Table 8. Saltwater circuli counts through the first ocean zone[1/] by age class and area, from Southeastern Alaska coho salmon scales, 1969 and 1970.

Catch Location	Age Class 1.1	2.1	3.1	4.1	Subtotal: All Ages without Plus Growth	Percent of Scales with No Plus Growth	Age Class 1+.1	2+.1	3+.1	4+.1	Subtotal: All Ages with Plus Growth	Percent of Scales with Plus Growth	Total: All Ages with and without Plus Growth
Noyes, Baker, and Maurelle Islands (1, 2, 15, 16)	70[2/] 40.8[3/] 31-51[4/]	547 37.5 27-47	98 36.4 26-47	7 33.6 26-40	722 37.6 26-51	55.3	186 37.2 23-50	366 36.0 22-49	30 36.3 28-46	1 34.0 34-34	583 36.4 22-50	44.7	1,305 37.1 22-51
Inian Islands Area (3, 4, 13, 14)	99 37.6 30-44	563 36.2 24-47	90 35.5 27-45	4 35.8 32-39	756 36.3 24-47	57.7	219 35.7 25-46	311 35.0 18-47	25 35.2 25-45	--- --- ---	555 35.3 18-47	42.3	1,311 35.9 18-47
Mouth of Taku River (5, 17, 18)	18 39.2 33-46	160 37.3 27-46	15 36.2 30-46	1 28.0 28-28	194 37.4 27-46	38.6	138 36.7 26-47	161 35.9 25-46	9 36.3 31-45	--- --- ---	308 36.3 25-47	61.4	502 36.7 25-47
Off Mouth of Stikine River (6, 19, 20)	47 40.3 32-49	143 36.7 24-46	18 35.5 29-49	1 43.0 43-43	209 37.4 24-49	35.4	140 36.5 24-46	217 34.5 25-48	25 34.1 27-42	--- --- ---	382 35.2 24-48	64.6	591 36.0 24-49
Off mouth of Chilkat River (12, 24)	19 37.1 32-45	74 36.5 29-46	29 34.5 28-42	5 36.2 34-39	127 36.1 28-46	29.7	150 35.2 27-47	132 35.5 27-46	18 33.0 26-38	1 35.0 35-35	301 35.2 26-47	70.3	428 35.5 26-47
In Kaliakh River (7)	--- --- ---	5 33.8 30-38	2 33.0 33-33	--- --- ---	7 33.6 30-38	11.7	24 34.2 26-39	26 31.9 28-39	3 32.7 29-37	--- --- ---	53 33.0 26-39	88.3	60 33.1 26-39
In Tsiu-Tsivat Rivers (8)	--- --- ---	14 34.1 27-39	12 32.1 28-41	--- --- ---	26 33.2 27-41	15.3	35 33.3 27-41	103 33.2 27-41	6 31.8 28-35	--- --- ---	144 33.2 27-41	84.7	170 33.2 27-41
Situk-Ahrnklin Rivers Common Mouth (9, 10, 23)	3 37.7 34-40	25 35.3 28-43	18 33.7 28-42	3 33.7 29-37	49 34.7 28-42	10.7	164 33.0 21-43	209 32.5 24-43	33 32.7 26-42	1 40.0 40-40	407 32.7 21-43	89.3	456 33.0 21-43
Alsek River (11, 21)	--- --- ---	58 30.9 24-39	26 28.7 22-37	1 32.0 32-32	85 30.3 22-39	18.4	70 31.6 23-39	290 30.4 21-40	18 30.6 26-37	--- --- ---	378 30.6 21-40	81.6	463 30.6 21-40
Doame River (22)	6 36.3 30-41	7 32.4 28-38	1 37.0 37-37	--- --- ---	14 34.4 28-41	11.9	58 31.7 26-38	41 31.4 25-41	5 31.4 26-37	--- --- ---	104 31.6 25-41	88.1	118 31.9 25-41
Subtotal for Cross Sound to Dixon Entrance Areas[5/]	253 39.1 30-51	1,487 36.8 24-47	250 35.8 26-49	18 35.0 26-43	2,003 37.0 24-51	48.5	833 36.3 23-50	1,187 35.4 18-49	107 35.0 25-46	2 34.5 34-35	2,129 35.7 18-50	51.5	4,137 36.3 18-51
Subtotal for Yakutat to Icy Bay Areas[6/]	9 36.8 30-41	109 32.6 24-43	59 31.2 22-42	4 33.3 29-37	181 32.3 22-43	14.3	351 32.6 21-43	669 31.6 21-43	65 31.9 26-42	1 40.0 40-40	1,086 32.0 21-43	85.7	1,267 32.0 21-43
Total All Areas	262 39.0 30-51	1,596 36.6 24-47	309 34.9 22-49	22 34.7 26-43	2,189 36.6 22-51	40.5	1,184 35.2 21-50	1,856 34.0 18-49	172 33.8 25-46	3 36.3 34-40	3,215 34.4 18-50	59.5	5,404 35.3 18-51

Totals for fish both with and without plus growth combined.

1. and 1+.	2. and 2+.	3. and 3+.	4. and 4+.	1., 1+., 2., 2+., 3., 3+., 4., 4+.
1,446 35.9 21-51	3,452 35.2 18-49	481 34.5 22-49	25 34.9 26-43	5,404 35.3 18-51

1/ First ocean zone includes first summer and first winter of marine growth.
2/ Number of fish in this age class.
3/ Mean circuli count through first ocean zone.
4/ Range in circuli count through first ocean zone.
5/ Noyes, Baker, and Maurelle Islands; Inian Islands area; mouth of Taku River; off mouth of Stikine River; in **off mouth of Chilkat River.**
6/ Kaliakh River; Tsiu-Tsivat Rivers; Situk-Ahrnklin Rivers common mouth; Alsek River; Doame River.

Appendix Table 9. Mean length and weight of Southeastern Alaska coho salmon adults by freshwater age class, 1969 and 1970.[1/]

Catch Location	Age 1.1 Sample Size	Age 1.1 Snout-Fork Length (cm)	Age 1.1 Round Weight (kg)	Age 2.1 Sample Size	Age 2.1 Snout-Fork Length (cm)	Age 2.1 Round Weight (kg)	Age 3.1 Sample Size	Age 3.1 Snout-Fork Length (cm)	Age 3.1 Round Weight (kg)	Age 4.1 Sample Size	Age 4.1 Snout-Fork Length (cm)	Age 4.1 Round Weight (kg)	Total Sample Size	Total Snout-Fork Length (cm)	Total Round Weight (kg)
Noyes, Baker, and Maurelle Islands (1, 15)	146	63.8	3.56	601	64.3	3.56	84	64.6	3.61	6	67.2	3.94	837	64.2	3.57
Inian Islands Area (3, 13)	117	62.2	3.38	294	62.4	3.31	26	62.2	3.26	1	63.0	3.12	438	62.3	3.32
Mouth of Taku River (5, 17)	118	68.0	4.37	235	69.0	4.52	18	68.7	4.36	-	---	---	371	68.7	4.47
Off Mouth of Stikine River (6, 20)	186	67.6	4.28	348	69.0	4.54	42	70.7	4.89	1	74.0	5.40	577	68.7	4.49
Off Mouth of Chilkat River (12, 24)	169	70.3	4.57	206	71.9	4.81	47	71.9	4.80	6	73.5	5.22	428	71.3	4.72
In Kaliakh River (7)	24	67.9	3.92	31	66.4	3.65	5	67.1	3.65	-	---	---	60	67.1	3.76
In Tsiu-Tsivat Rivers (8)	35	66.2	3.48	118	68.4	3.92	18	67.9	3.80	-	---	---	171	67.9	3.82
In Situk-Ahrnklin Rivers, Common Mouth (9, 10, 23)	167	69.3	4.28	234	69.5	4.31	51	70.3	4.43	4	71.4	4.75	456	69.5	4.31
In Alsek River (11, 21)	70	66.0	3.58	348	66.9	3.73	44	66.8	3.70	1	---	---	463	66.8	3.71
In Doame River (22)	64	69.0	4.30	48	70.2	4.49	6	75.0	5.66	-	---	---	118	69.8	4.44
Subtotal: Cross Sound to Dixon Entrance Areas[2/] (1, 15, 3, 13, 5, 17, 6, 20, 12, 24)	736	66.7	4.08	1,684	66.5	4.01	217	67.4	4.14	14	70.1	4.53	2,651	66.7	4.04
Subtotal: Yakutat to Icy Bay Areas[3/] (7, 8, 9, 10, 23, 11, 21, 22)	360	68.2	4.04	779	68.1	3.98	124	68.8	4.11	5	70.1	4.44	1,268	68.2	4.01
Total: All Southeast Alaska (1, 15, 3, 13, 5, 17, 6, 20, 12, 24, 7, 8, 9, 10, 23, 11, 21, 22)	1,096	67.2	4.06	2,463	67.0	4.00	341	67.9	4.13	19	70.1	4.51	3,919	67.2	4.03

1/ Includes fish both with and without plus growth.
2/ Noyes, Baker, and Maurelle Islands; Inian Islands area; Mouth of Taku River; off mouth of Stikine River; off mouth of Chilkat River.
3/ In Kaliakh River; in Tsiu-Tsivat Rivers; Situk-Ahrnklin Rivers Common Mouth; in Alsek River; in Doame River.

Appendix Table 10. Coho salmon length and weight, separated by catch area, gear, year, and sex. Southeastern Alaska commercial catch sampling, 1969 and 1970.

Catch Area	Gear	Year	Sample Group	Sample Size	Snout-Fork Length (in centimeters) Mean	Snout-Fork Length Range		Mideye-Fork Length (in centimeters) Mean	Mideye-Fork Length Range		Weight (Round or Dressed)[1] (in kilograms) Mean	Weight Range	
Noyes Island to Baker Island	Purse Seine	1969	1 M[2]	244	64.1	45.2	78.5	59.5	43.0	72.5	3.53	1.12	7.11
			1 F	274	64.5	54.8	72.3	60.4	51.3	67.3	3.46	1.84	5.85
Maurelle Islands Group & Noyes Island	Troll	1969	2	506	63.1	49.1	73.2	58.7	45.8	67.8	2.81[1]	1.42[1]	4.91[1]
Inian Islands Area	Purse Seine	1969	3 M	96	63.1	49.4	76.0	58.1	45.8	68.6	3.49	1.33	6.55
			3 F	74	64.8	57.5	70.8	60.4	53.6	65.8	3.68	2.33	5.76
Inian Islands Area	Troll	1969	4	515	65.3	43.2	79.7	60.5	40.2	72.3	3.09[1]	0.90[1]	5.64[1]
Mouth of Taku River	Drift Gillnet	1969	5 M	162	67.5	48.5	78.7	61.2	44.2	71.0	4.28	1.46	7.82
			5 F	106	68.6	60.1	74.7	63.3	55.5	68.3	4.45	3.12	6.21
Off Mouth of Stikine River	Drift Gillnet	1969	6 M	238	67.8	48.9	80.2	61.8	44.9	72.0	4.31	1.62	7.80
			6 F	209	68.3	56.5	75.9	63.3	52.7	69.5	4.31	2.19	6.24
In Kaliakh River	Set Gillnet	1969	7 M	48	66.1	49.4	77.3	59.7	45.1	69.3	3.60	1.38	6.23
			7 F	24	69.5	65.1	73.1	64.1	59.4	66.9	4.18	3.42	4.96
In Tsiu-Tsivat Rivers	Set Gillnet	1969	8 M	135	67.6	50.5	76.6	61.1	46.3	69.4	3.79	1.40	5.73
			8 F	74	68.2	63.5	74.6	63.0	58.1	68.0	3.90	2.86	5.62
In Situk River	Sport Gear	1969	9 M	6	71.0	61.5	73.8	64.1	56.1	67.0	4.38	2.66	4.88
			9 F	3	69.7	67.7	70.8	64.4	62.6	65.4	4.31	4.03	4.52
In Situk-Ahrnklin River Common Mouth	Set Gillnet	1969	10 M	174	69.1	50.6	78.9	62.3	46.0	70.0	4.11	1.78	6.81
			10 F	107	68.6	58.3	76.1	63.3	54.7	69.7	4.13	2.50	5.69
In Alsek River	Set Gillnet	1969	11 M	161	64.6	44.2	76.6	58.1	40.6	68.4	3.29	1.04	5.42
			11 F	122	64.4	56.6	72.4	59.3	52.4	66.4	3.29	1.98	4.74
Off Mouth of Chilkat River	Drift Gillnet	1969	12[3]	260	70.1	51.8	79.7	63.7	47.3	71.7	4.40	1.81	6.15
Off Mouth of Chilkat River (Subsample for size by sex data. Taken from the same 260 fish sampled earlier)	Drift Gillnet	1969	12[4]	134 M 119 F 253 - Total	- -	- -	- -	62.7 64.4	47.4 56.1	70.4 71.0	- -	- -	- -
Inian Islands Area	Purse Seine	1970	13 M	239	60.5	46.6	76.2	55.9	40.7	69.8	3.04	1.30	6.56
			13 F	85	63.1	53.7	72.0	59.0	50.4	67.1	3.38	1.88	5.38
Inian Islands Area	Troll	1970	14	540	67.5	52.6	78.1	62.4	49.2	71.0	3.62[1]	1.32[1]	6.62[1]
Noyes Island to Baker Island	Purse Seine	1970	15 M	258	63.6	44.5	76.1	58.8	41.7	69.8	3.62	1.22	6.47
			15 F	221	64.2	56.6	72.8	60.0	52.6	67.5	3.68	2.23	6.32
Maurelle Islands Group and Noyes Island	Troll	1970	16	65	65.6	50.8	75.1	60.7	47.2	69.0	3.39[1]	1.42[1]	5.25[1]
Mouth of Taku River	Drift Gillnet	1970	17 M	83	70.0	51.0	81.9	63.3	47.0	72.8	4.71	1.67	7.56
			17 F	71	70.3	62.3	76.1	65.0	58.7	70.0	4.75	3.30[1]	6.11[1]
			18	152	66.8	51.4	81.2	61.0	47.2	71.2	3.34[1]	1.38[1]	5.86[1]
Off Mouth of Stikine River	Drift Gillnet	1970	19	20	70.5	64.5	75.8	64.5	58.9	68.8	4.09[1]	2.87[1]	5.95[1]
			20 M	136	69.4	51.6	80.0	62.7	47.7	72.1	4.73	1.68	7.74
			20 F	119	69.8	60.3	77.9	64.5	56.4	71.2	4.83	2.62	6.86
In Alsek River	Set Gillnet	1970	21 M	128	69.1	57.0	78.1	61.7	51.9	69.4	4.11	2.02	6.64
			21 F	146	68.5	58.4	74.8	62.9	54.0	68.7	4.06	2.58	5.34
In Doame River	Set Gillnet	1970	22 M	67	71.3	52.5	82.9	64.1	47.9	73.4	4.74	1.72	7.08
			22 F	63	68.7	61.4	74.2	63.4	57.1	68.9	4.27	2.82	5.68
In Situk-Ahrnklin River Common Mouth	Set Gillnet	1970	23 M	128	71.0	57.0	80.0	63.9	52.5	71.1	4.71	2.12	6.70
			23 F	123	68.8	58.0	77.0	63.5	54.1	70.5	4.26	2.34	6.12
Off Mouth of Chilkat River	Drift Gillnet	1970	24	249	72.1	63.6	83.5	65.2	56.6	73.9	4.99	3.10	7.68
All Areas and Both Sexes Combined		1969	1-12 inc.	3,538	66.1	43.2	80.2	60.8	40.2	72.5	3.91[5] 2.95[6]	1.04 0.90	7.82 5.64
All Areas and Both Sexes Combined		1970	13-14 inc.	2,893	67.3	44.5	83.5	61.7	40.7	73.9	4.15[7] 3.56[8]	1.22 1.32	7.74 6.62
Total - All Areas, Both Sexes and Both Years Combined		1969 & 1970	1-24 inc.	6,431	66.6	43.2	83.5	61.2	40.2	73.9	4.02[9] 3.21[10]	1.04 0.90	7.82 6.62

1/ Dressed weight (head on, with viscera and gills removed).
2/ M = Males, F = Females.
3/ Round weight, but no sex data obtained from original sample.
4/ The same fish were subsampled as in 3/ at a later date for size by sex.
5/ 1969: 2,517 fish rd. wt. = 66.8 cm. SFL, 61.5 cm. MFL.
6/ 1,021 fish dr. wt. = 64.3 cm. SFL., 59.7 cm MFL.
7/ 1970: 2,116 fish rd. wt. = 67.3 cm. SFL, 62.0 cm. MFL.
8/ 777 fish dr. wt. = 67.3 cm. SFL, 62.0 cm. MFL.
9/ Combined 4,633 fish rd. wt. = 67.1 cm. SFL, 61.7 cm. MFL.
10/ 1,798 fish dr. wt. = 65.5 cm. SFL, 60.7 cm. MFL.

APPENDIX A. Scale Mounting and Pressing Techniques Used in this Study

Because of the high percentage of regeneration of individual coho salmon scales it was best to collect a smear of scales in the field and mount them later, back in the laboratory. A solid blade dissecting scalpel (#25853-003 Van Waters and Rogers) was used to obtain a smear of 15 to 30 scales from the second and third rows of scales above the lateral line and near a line bisecting the rear of the dorsal fin with the front of the anal fin. It is important to avoid scales from the lateral line, deformed scales from the first row above it, and fish with injuries and scale regeneration in the preferred area. It is also important to wipe the scalpel and each fish clean of loose scales to prevent mixing scales from different fish. Extra care here greatly speeded up the mounting and reading of scales. Scales were placed in a folded piece of adding tape paper previously cut to fit inside a coin envelope (6 x 11 cm) that had spaces for recording length, weight, sex, and sample area. After completion of sampling, data from scale envelopes were transferred to standard age-weight-length forms with numbered columns for IBM keypunching.

To mount the scales, a well lighted desk with an extendible type lamp was selected and a piece of black paper (about 46 x 56 cm) taped to the desk top for a background. Ten glass coasters were set in two rows on the black paper, numbered from one to ten, and filled with a solution of soapy water (just enough to feel slippery between the fingers) made from Labtone or Sparkleen Laboratory soap for glassware. A gum card (6 x 14 cm) made from gummed mailing tape and stamped with three rows of numbers from one to thirty and a sample number written in pencil (in the upper right corner) was taped to the black paper to stick the scales to. Finally, a beaker of clear water was set beside the paper to rinse the scales, a paper towel to blot some of the excess water from the scales after rinsing set aside, a pinning needle selected to separate scales that were stuck together, and a pair of fine pointed, curved forceps (#25714-007 Van Waters and Rogers) selected for handling the scales.

The scales were mounted after selecting three that when held up to the light with forceps appeared to have complete freshwater zones. Regenerated scales had a blank center where part or all of the freshwater growth had been lost and these were discarded. Three selected scales from fish number one were placed in dish number one to soak, three selected scales from fish number two in dish number two, and so on up to fish number ten.

After all ten dishes had scales from different fish in them, scales from dish number one were stuck to the gum card. It was important to grasp only the outer edges of scales with the forceps. Centers of scales grasped by the forceps were sometimes damaged and became unreadable. The freshwater portion of the scale seemed to be much softer than the saltwater portion. After picking up the scale from the soapy water with the forceps, it was rubbed between the thumb and forefinger of the opposite hand to remove slime and dirt. The scale was next dipped in freshwater to rinse off the soap or the scale wouldn't stick to the gum card. Finally, the rough, circuli side of

the scale was blotted dry on the paper towel, the smooth side of the scale stuck directly over the number one on the gum card with the proximal (part imbedded in the fish) part of the scale facing toward the top of the card, and the scale blotted dry with the towel. We found it much easier to read the scales if all of them faced (anterior edge up) the top of the card and thus were projected with anterior edge facing downward on the scale projector, but some others prefer them facing in the opposite direction. The second and third scales from fish number one were stuck to the gum card in the same way, over the numbers 11 and 21 so that the three scales from the fish were in a vertical row. The scales from fish number two were mounted on the gum card over numbers 2, 12, and 22 and so on up to fish number ten, which had the three scales mounted over numbers 10, 20, and 30 on the gum card. It was important to have three scales mounted from each fish to reduce chances of all scales being regenerated and to have two or three to compare to select the best one to read. Having several scales to compare solved many questions of age on difficult scales. After mounting each batch of scales from ten fish, the glass coaster dishes were carefully checked to make sure no scales were left in them before putting in a new group. Sometimes an extra scale was accidentally put into a dish and stuck to the side.

After all the scales were mounted on gum cards, impressions were made in clear plastic cards, 6 x 14 x .051 cm (Universal Plastics Co., Seattle, Washington 98108). Gum cards were each stuck to a plastic scale card with a 13 x 2 mm piece of double coated scotch tape running up and down 6 mm from the center of each end of the gum card. The small pieces of tape used were sufficient to stick gum cards to the plastic sheets without interferring with pressing scales or gumming up the scale press. The press used to make scale impressions was built for the Alaska Department of Fish and Game by Fisheries Research Institute in Seattle and was described by Koo (1962b). Between heating plates were placed two asbestos sheets, two pieces of hard rubber flooring, and two photographers tin plated brass plates to prevent melting the scale cards. Four scale cards were pressed at one time and were placed side by side between preheated tin plates of the heated press, the truck jack was cranked up to 1,800 kg of pressure for 5 minutes followed by 3,200 kg for an additional 5 minutes. Pressure was released, the four scale cards removed, four new cards placed in the press, and pressure cranked up again. Heat and pressure caused ridges (circuli) and valleys of scales to be impressed into the softened plastic cards and made negative impressions of the scales. Immediately after removing hot plastic cards from the scale press they were placed on a flat surface under a heavy weight to cool causing them to harden in a flat instead of curved shape. Before removing the gum card with scales on it, an asterisk was scratched over the number one scale and a card identification number on top of the plastic card with a pinning needle. Gum cards with scales were filed for making duplicate impressions in case they were ever needed. Proper plastic impressions had a uniform frosted appearance over the whole surface of the card, sharp edges on the scales and no clear areas in the plastic.