

2014 Draft
PRINCE WILLIAM SOUND AND
COPPER / BERING RIVER

Salmon Age Interpretation Protocols



Alaska Department of Fish and Game
Division of Commercial Fisheries / Research
P. O. Box 669
Cordova, Alaska 99574-0669

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INTRODUCTION

Pacific salmon (Genus *Oncorhynchus*) from catches and escapements are sampled for scales, sex, weight, and length annually by field crews throughout the state. These data are used in forecasting run strengths, setting escapement goals, examining the productivity of each system, salmon growth analysis, estimating stock composition (based on age composition and/or scale pattern analysis), inseason run strength estimation, and to improve understanding of the biology of each stock.

An ASL (age-sex-length) sample consists of a data set collected from a specific sampling location for a single species over a relatively short time period. A catch sample will generally consist of data from a single fishery opening for a specific gear type from one district. An escapement sample will consist of data from one sampling location collected over the course of a single sampling trip.

Current sample size goals for commercial catch and hatchery cost recovery samples are presented in Table 1.

Table 1. Estimated scale, length, and weight sample goals for Prince William Sound and Copper/Bering River salmon catches.

Species common name	No. Fish and Sex	Scales per fish	No. Lengths	No. Weights
Chinook Salmon	600	3	200	NA
Sockeye Salmon	600	1	200	200
Coho Salmon	450	3	200	200
Chum Salmon	400	1	200	200

SPECIES ID AND GENERAL BIOLOGY OF SALMON

Six species of Pacific salmon occur in the Prince William Sound area. The Prince William Sound area includes the Copper Bering River (CBR) drainages and Prince William Sound (PWS). The most frequently used and least ambiguous common names for the six species are: sockeye, Chinook, coho, chum, and pink salmon; and Steelhead. Species names and characteristics present are listed in Table 2.

Table 2. Common and scientific names and typical species identification characteristics for *Oncorhynchus* sp. commonly occurring in the Prince William Sound area.

<u>Common Name</u>	<u>Scientific Name</u>	<u>Other Common Names</u>	<u>Identifying Characteristics</u>
Chinook	<i>O. tshawyscha</i>	King	Tail silver with spots on both lobes. Black gum line. Large size.
Sockeye	<i>O. nerka</i>	Red, blueback	Tail milky, no silver. Many long slender gill rakers. Bright red/orange flesh. Thick caudal peduncle.
Coho	<i>O. kisutch</i>	Silver	Tail silver, spots only on upper lobe. White gum line, small pupil.
Pink	<i>O. gorbuscha</i>	Humpy	Many large long spots on tail. Very small scale, small size.
Chum	<i>O. keta</i>	Dog, Calico	Tail silver streaked, NO spots. Caudal peduncle almost round. (Mottled mostly-black gum line)
Steelhead	<i>O. mykiss</i>	Searun Rainbow	Tail square and evenly dotted Rear edge of anal fin almost vertical, 12 or fewer anal fin rays.

Some PWS/CR Related Life History Notes:

- Sockeye -** Range 20 to 24 inches (500 to 690mm) and weigh 4 to 7 lbs. (1.8 to 3.2 kg)
Early run timing - May and June for Copper/Bering River area. Later run timing for some PWS stocks.
Frequently spawn many miles upstream on large river systems.
Generally spawn in systems with lakes or lake-like habitats.
Spawn in streams near lakes and frequently on beaches of lakes.
Fry spend 0, 1, or 2 years in freshwater and 1 to 4 years in marine waters.
Average age in catch or escapement: 4 or 5 years - range from 2 to 7.
Plankton feeders, hence the long slender gill rakers.
- Chum -** Range from 22 to 28 inches (559 to 711 mm) and weigh 7 to 10 lbs. (3.2 to 4.5 kg)
Mid-summer run timing - June and July (a few stocks into August and Sept.)
Spawn in lower reaches of streams - large and small.
Few in the Copper River area (Max ~7% of catch).
Fry migrate seaward immediately upon emergence from gravel.
Average age is 4 or 5 years - range from 3 to rarely 6.
- Chinook -** Range from 5 to 45 lbs (2.3 to 20.4 kg) but average is about 25 lbs. (11.3 kg)
Early run timing - similar to sockeye salmon.
Require fairly good current and well oxygenated gravel for spawning.
Generally in larger rivers.

Spawn more than 100 miles (161 km) up the Copper River.
Generally spend one winter in freshwater before migrating to sea.
Return at age 4 or 5 years - range from 2 to 8 years.
High incidence of early maturing males (jacks) age 2 to 4 years.

Coho - Approximately same size as chum salmon.
Spend a variable number of years in freshwater (1 to 3).
Generally territorial in freshwater.
Inhabit backwaters and beaver ponds.
Only one winter in saltwater (practically invariant).
Average age 3 to 4 years.

Pink - Average weight about 3 lbs. (1.4 kg)
Migrate seaward immediately upon emergence from gravel.
Return after one winter in marine water.
(ALL 2 year olds).
Virtually no crossover between year cycles (even and odd).
Spawn mainly in lower reaches of any available flowing body of water.
Voracious predators.

Steelhead - Occasionally seen in Copper River harvests.
About the same size as chum and coho salmon.
Usually long and thin.
Sea-run version of rainbow trout.
Repeat spawners, do not always die after spawning.
Previously classified as a trout (*Salmo gairdnerii*).
Highly variable life history.
Freshwater residence from 0 to 3 years.
Marine residence from 2 to 4 years, maximum total age about 9 years.

IDENTIFYING SALMON SPECIES BY SCALE CHARACTERISTICS

There are recognizable differences in the scales of the 5 species of Pacific Salmon found in Alaska. Some of these differences reflect variations in the life history and behavior of various species while others are differences in visual appearance inherent in a particular species. These variations may be utilized to determine species, age individuals or separate stocks by river of origin.

Features used in age determination are found on the anterior portion of the scale (**Figure 1**) and consist of circuli and their pattern of growth. Circuli are concentric ridges separated by valleys and are located on the outer surface of the scale. The nature and spacing of these circuli relate directly to the growth characteristics of the fish, which in turn reflect the environment and

behavior of the fish.

On a salmon scale a year's growth is represented by a zone of widely spaced circuli, the summer growth, followed by a zone of closely spaced circuli, the winter growth. When fish are growing rapidly during the summer, circuli are wide with broad spaces between them. During the winter when the fish and its scales grow slowly, the circuli are close together and broken. This winter growth zone is called the annual mark, winter zone, annulus or check.

In fresh water the growth of the fish and its scales is much slower than at sea. Circuli formed in fresh water are finer lined and more closely spaced than those formed in marine water. This makes it possible to define the periods the fish spends in each environment.

The posterior field, or the clear area of the scale has certain features that assist in species identification. Among these are:

1. The number of circuli that are completely below the focus.
2. The presence of broken circuli or fragments of circuli in the posterior field.
3. Whether the circuli continue into the posterior field from the anterior.
4. The appearance of radial striations or "scalloping".
5. The presence and nature of reticulations.

Life History Features that Influence Scale Characteristics

Pacific Salmon spawn and deposit their eggs in suitable fresh water gravel in the late summer and fall. Fry hatch in the gravel during the winter or spring emerging when the yoke sac has been absorbed.

Young Pink salmon (*Oncorhynchus gorbuscha*) and Chum salmon (*O. keta*) migrate to the sea shortly after emerging from the gravel and usually before the fresh water circuli have begun to form. Young of other species usually remain in fresh water from 1 to 4 years before migration. This migration generally takes place in the spring just as rapid growth begins to take place. Since growth at sea is much greater, it is possible to define the boundary between the fresh and salt-water portions of the life cycle.

After a period at sea which ranges from a few months to as much as 5 years depending on the species, salmon return to their natal streams to spawn and subsequently die. When salmon enter freshwater they generally cease feeding and rely on protein and fat stored in the body. This results in resorption of the scales which progresses from the outside edge towards the focus. By the time spawning is completed only a small central section of the scale may remain.

Species Identification

Pink Salmon (*O. gorbuscha*) **Figure 2.**

Pink salmon scales may be distinguished by the small size relative to the size of the fish, the

absence of any freshwater growth zone and the single winter check. Size of the posterior portion of the scale is more variable than in other species. Reticulation, when present, is ladder-like and there are less than 5 unbroken circuli extending into the posterior portion of the scale.

Chum Salmon (*O. keta*) **Figure 3.**

Scales of the Chum salmon can be distinguished by the absence of the freshwater growth zone, less than 7 (usually 0-3) unbroken circuli in the posterior between the anterior and posterior portions and radial striations and scalloping in the posterior field. The scale has a more circular shape than the elongated oval shape of the scales of other species.

Sockeye Salmon (*O. nerka*) **Figure 4.**

The scales of the Sockeye salmon generally have a pronounced fresh water growth zone with one or more winter checks. The marine portion generally has 2-3 winter checks. No more than 6 circuli are complete below the focus and reticulation is ladder-like. Circuli are not as distinct as those found on Chum salmon and scales are not as broad on the line where the posterior and anterior sections meet. The posterior field is without prominent markings.

Coho Salmon (*O. kisutch*) **Figure 5.**

The scales are generally large for the size of the fish. The freshwater zone is variable with 1-2 winter checks. The marine zone is usually large with 1-2 checks (approx. 95% have 1 check). Circuli are fairly distinct. Often the scales are pinched in where the anterior and posterior portions meet. Coho salmon may be distinguished from sockeye salmon because they generally have more than 6 complete circuli below the focus in the posterior zone. Circuli or segments of circuli are usually prominent in the posterior zone.

Chinook Salmon (*O. tshawytscha*) **Figure 6.**

Chinook salmon scales usually have more than 6 complete circuli and as many as 18 broken circuli in the posterior field of the scale. Outside the area of the focus circuli seldom project into the posterior field although some of the first marine circuli may be followed into this area as weak irregular markings unlike true circuli. Chinook salmon scales are large for the size of the fish with a large first ocean zone. Mature Chinook salmon often have 3-4 winter checks in the ocean zone. Reticulation is uncommon. Strong radial striations are often present.

AGING PROCEDURES

Detailed methods about the development of the program to collect age, sex, and size data for salmon in Prince William Sound area are described in Brenner and Moffitt (2014). Scales for determination of age will be collected and analyzed according to methods described by INPFC (1963), Clutter and Whitesel (1956) and as shown in Appendix A1. The preferred scale collection area on the fish develops scales first and thus represents the most complete record of growth. Scarred areas are avoided because scales in these areas are typically regenerated and unsuitable for aging. If scales are not present in the preferred area on the left side of the fish, scales from the right side will be used. Scales will be mounted on gum cards, which will be covered with wax paper after drying and placed in a press to keep from curling.

Preparing Acetate Card LABELS

- Have the scale gum cards in hand.
- Turn on the computer and the printer.
- Load up SALMONCARDLABELS in EXEL. Double click the labels icon.
- Change the species, district, location code, and other label information.
- Enter the beginning card number and ending card number.

Labels are color coded for species: blue=Chinook, red=sockeye, green=chum, yellow=coho, and pink salmon are almost never collected (No scales, No color).

The array of labels in the worksheet is set up such that two columns of 15 labels each can be printed at one time. The top label in column one consists of absolute formulas that repeat the info in the highlighted cells at the top of the worksheet. Each subsequent label consists of formulas for each cell which return the contents of the label prior to it with 1 added to the card number.

This setup assumes you are using flat sheets to print 30 labels at one time. If this is not the case (either you are printing less than 30 cards for one sample or species/location/date information changes in the middle) you will need to edit specific cells to get the labels required.

When the labels in the worksheet are ready to print, erase all extraneous labels so that only the desired labels print. This will leave sheets of labels with some labels blank. These can be printed on later by deleting the labels in the spreadsheet which correspond to the empty slots on the sheet.

Pressing and Labeling Acetate Scale Cards

1. Check labels and make sure the information matches that on the gum cards to be processed.
2. Turn the scale press on, and with the pressure surfaces together, let it heat up to about 225 degrees F. This usually takes about 15 or 20 minutes.
3. Organize your gum cards and ensure they are all in sequential order to line up with the labels.

4. Carefully peel off the wax paper on the back of the gum card, but do not throw it away.
5. Have a stack of acetates at hand (they should be stored below the scale press). Wet the acetate card on the top center, and stick the gum card to it, making sure that they line up with each other.
6. Place two gum cards, with acetates, in the center of an aluminum plate with about two inches between them. Place the other aluminum plate on top, being careful not to move the gum cards. Now place a rubber pad on each side of the aluminum plates, and put the assembly in the press.
7. Using the lever on the right side of the press, "pump it up" to about 16 tons of pressure for about 1 1/2 – 2 minutes. Do not leave it in for more than two minutes or you may have a hard time peeling off the gum cards and scales will pop off the card.
8. Release the pressure by turning the yellow knob on the left side of the press counter clockwise. When there is about a two inch gap between the press plates, turn the yellow knob clockwise to stop it from opening any further.
9. Sometimes the gum cards tend to stick to the acetates. It is important to carefully, but quickly, peel them off **before they cool**, as they peel off much easier while still warm. Place the gum card on top of the acetate it came off of so you know which label to put on it.
10. Place the left edge of the label even with the left edge of the first scale, but do not cover any of the scales! Put a flat-bottomed object, like a Scotch tape dispenser, on top of the finished acetate's to keep them flat as this makes them much easier to read.
11. Check impressions for clarity and quality by viewing under a microfiche or by holding the acetate up to the light. It is difficult to interpret age from a lightly pressed or foggy scale.
12. Re-attach the wax paper to each gum card and finish pressing the rest of the scales.

When a scale sample has been pressed, finished gum cards must be placed in a coin envelope and the **appropriate sample information**, including the log number, should be written in blank spaces stamped on the outside of the envelope:

Species - (e.g., Chinook)
Log # - (e.g., 001)
Data Description - (e.g., Copper R. Dist. Comm. Catch)
Location Code - (e.g., 212-00-000-800)
Gear Type - (e.g., Drift Gillnet)
Fish period Date - (e.g., 0700 May 13 - 0700 May 14)
ASL # - (e.g., 001-016)

(b) Attach corresponding acetates to coin envelope with a rubber band..

There were problems in past years with the wrong information on the coin envelopes. Please concentrate on putting the correct information on the envelopes. The gum card packet and acetates should be placed in the top bin ("To Be Read") of the horizontal file in the AWL Scale Reading Room.

Scale Age Interpretation

Scale samples will be interpreted for age (read) using a microfiche reader. Two readers should participate in production reads unless age data are required quickly and only one reader is available. All ages will be recorded in European notation (the number of freshwater annuli followed by a period followed by the number of marine annuli, e.g., 1.2, 1.3, or 2.3). Ages will be recorded on the Scale Age Data Entry form to facilitate computer entry. Ensure the correct filename as listed in the ASL Sample Log is written at the top of the form.

When all scales for a sample have been “read” (the age interpreted), the gum card packet and acetates should be filed in the appropriate drawer of the file cabinet in the ASL scale reading room with date aged and the age readers name written on it. The finished Age Data entry forms should be placed in the "to be entered" slot of the horizontal file in the AWL office.

Training of Inexperienced Personnel

Prior to any production scale reading, inexperienced personnel are required to complete the following:

1. Read (or skim) thoroughly all references in the Scale Readers Manual.
2. Take one-on-one lessons from the crew leader and other experienced scale readers in the office. This will be required for each species and area as the patterns differ significantly among species and may differ significantly among areas for the same species.
3. When inexperienced readers are somewhat familiar with age patterns by species and area, additional training exercises should be conducted to include:
 - Read repetitions of a subset of scales (~50 per species) from a number of distinct spawning populations that have already been read by the instructor or another experienced reader.
 - The first reading should be blind to the interpretations by experienced readers.
 - After the first reading, compare with experienced readers age interpretations.
 - Review the differences in interpretation with an experienced reader.
 - Repeat reading the same until you are interpreting the age of nearly all scales in the subsample the same way on each pass.

Although these exercises may seem boring and tedious at times (at times?!), they are very important to the success of the project. Time spent training at the outset of the season will help considerably to reduce the heartache of the crew leader when the field season is over and data analysis begins.

Preseason Testing of All Readers

Blind, independent reading of a subset of scales for each major species should be completed prior to production reads. This should be completed shortly prior to beginning production reading for a species if possible. For example, coho salmon samples are not collected until after mid-August, so it would be better to complete the reading test in early August rather than mid-May. The following process should be used for the preseason testing:

- The project biologist will choose scale acetates for blind, independent readings.
- These will be read independently by each reader that will be assisting in production reading of scales for the year.
- Ages will be entered and examined for differences by the project biologist.
- Readers and the project biologist will examine the scales where age interpretations differed and to come to a consensus about the appropriate age.
- This should be repeated until all readers are assigning the same ages more than 90% of the time.

Second Reads

Second reads should be completed on a subset of the total samples collected each year. These should be completed blind to the first read results. Our goal is 10% of the total by species and area; however, second reads should also be completed if any age compositions differ significantly from historical results.

References

- Brenner, R. and S. Moffitt. 2014. Salmon age, sex, size and stock of origin sampling from Prince William Sound area fisheries and Escapements. Alaska Department of Fish and Game, Regional Operational Plan 2A.14.02, Cordova.
- Clutter, R., and L. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. Bulletin of the International Pacific Salmon fisheries Commission 9. Vancouver, British Columbia.
- Cochran, W. 1977. Sampling Techniques, 3rd edition. John Wiley & Sons, Inc. New York.
- INPFC (International North Pacific Fisheries Commission). 1963. Annual Report for 1961. Vancouver, British Columbia.

Appendix A1.—Preferred area for obtaining scales from salmon.

