August 26, 2006

Denis A. Wiesenburg, Dean
School of Fisheies and Ocean Sciences
University of Alaska Fairbanks
P..O. Box 757220
Fairbanks, , Alaska 99775-7220

Dear Dean,

I was asked by a small school district at the shore of Lake Iliamna in Bristol Bay,, Pedro Bay with 19 students, to develop a salmon course for the older students. I proposed a program centered at a spring fed pond and I prepared a manual for observations throughout one year. See attachment.

During the course of preparing a manual I realized that the sockeye salmon in Bristol Bay is touching everyone living there. I thought first about preparing a text book for the seniors in the high schools for an elective course in sockeye salmon biology. This would not fill the need of fishers, fish processors and everyone associated with management of this resource.

The solution seems to be to develop a book on the biology of sockeye salmon both in freshwater and in the ocean, the changing nature of processing and trading of sockeye salmon from Bristol Bay an0d finally take a critical look at the management of this resource .

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With the many experts within the SFOS. ADFG, NMFS, and AlAska Science Center it should not be difficult to find a team for updating previous books on the sockeye salmon. Do you see any merit in such a proposal?.

Siincerely, Ole A. MAthisen

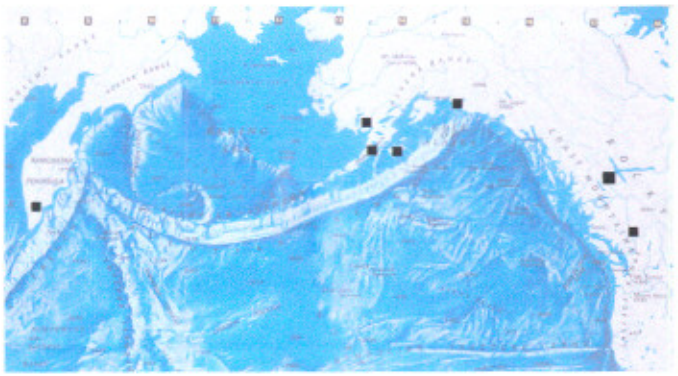
The Life of Sockeye Salmon
In
Pedro Pond,
Lake Iliamna
Bristol Bay
Alaska

A Manual for Self Study

Prepared for the Pedro Bay School District
By
Ole A. Mathisen, Professor, Emeritus
University of Alaska, Fairbanks

If you look at the chart of the Bering Sea, you will notice that the flat foreland of Alaska from Bristol Bay to Nome extend to midway of the Bering Sea. This is one of the broadest coastal shelves (Fig. 1) in the World, with a very high production of crabs and fish. When ice started to retreat, it left piles of rocks as end moraines. The end moraine at Igiugig was formed about 12,000 years ago. These dammed valleys are the basis for the magnificent system of lakes in Bristol Bay. Here the sockeye salmon spend its freshwater period. On the map below, important sockeye salmon districts are, from left to right: Kamchatka, Chignik, Karluk, Bristol Bay, Copper River, Skeena and Fraser River.

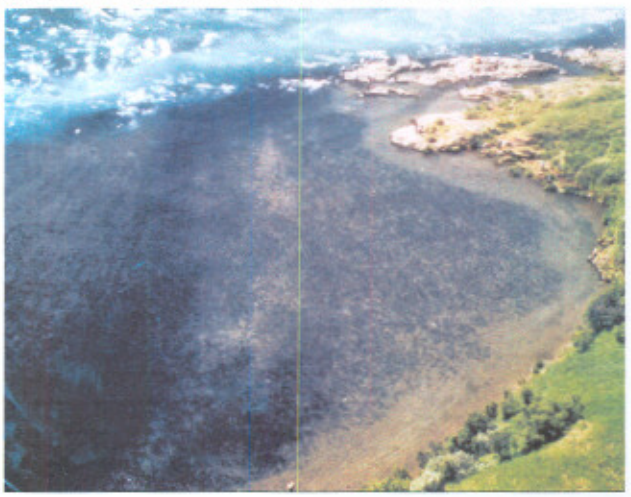
Fig. 1 Bathymetric Map of the Bering Sea and the North Pacific



All salmon entering Lake Iliamna are counted manually at Igiugig. About twenty per cent of the escapement is bound for the Newhalen River, which is swift and with some steep waterfalls. In years with high water flow, the sockeye salmon is delayed below the first water fall. Thus in 1979 more than one and a half million salmon were delayed and milled around in Newhalen River. (Fig. 2) Passage became possible only after the water level dropped.

Fig. 2 Sockeye salmon accumulated before the first fall in the Newhalen River.

Photo: Tom Kline



The arrival of the first salmon is eagerly awaited by the subsistence users around the lake. But the same is true for the 250 harbor seals living in the lake, who are great fish eaters. (Fig. 3)

Fig. 3 Land Locked Harbor Seal in Lake Iliamna Hauled Out On the Sandbar Mid-Way to Iliamna

Photo: Tom Klein

The spawning grounds of the sockeye salmon in the Kvichak District are diversified. Basically we have three categories. You have all seen the salmon spawn in creeks and small streams. It is more difficult, due to turbidity of the water, to observe spawning in large streams like the Pile River or the Newhalen River. Then, there are the beach spawners. A good example is Knudson Bay with beach spawning at both ends.

Common to all beach spawning is that it only takes place where there are upwellings of ground waters. The third groups of spawning grounds are the spring fed ponds. These are usually very shallow and small in an area like the pond next to the landing strip in Pedro Bay. They are quite common on the spawning grounds reaching from the Fraser River to the spawning grounds on the Kamchatka Peninsula and may accommodate up to ten percent of a salmon run.

Observations You Can Make Every Month of the Year

June

Our study of spawners in Pedro Pond can conveniently begin in the month of June. The surface of the pond is covered with a thick mat of filamentous algae. This is the time to make a map of the pond and establish a grid system as done in Fig. 4. Strings are fastened over the pond surface. They can conveniently be 3 ft. apart. Make several copies of the pond with its grid system. They will be used later for making notations.

Fig. 4 Grid System in Salmon Pond

July

Usually the first salmon enter the pond. The most striking changes are the shape and body forms of the males. Why do you think that the teeth become so well developed in the males?

Common to both males and females are the red spawning colors. Part of the red pigment (Fig. 5), which was found in the flesh during feeding in the ocean wanders to the skin which becomes thick and difficult to tear apart. Consider that the sockeye salmon lived earlier in salt water of the ocean. Then after entering freshwater with hardly any salt content, the salmon body tends to absorb the freshwater and swell. But the thick hide developed at the spawning ground prevents this uptake of water.

Fig. 5 Mature Salmon Waiting in the Stream

Scientists often measure the length of the salmon, and the usual measurement is from the tip of the snout to the fork of the tail. This is not feasible if you compare measurements taken in the sea with those taken on the spawning grounds. Therefore, you must now measure from the middle of the eye to the fork of the tail. Your measurements are based on the skeleton which does not change. Keep track of how many males and females have entered and if there are any dead ones at this time. Describe the morphological changes you see in males and females. (Fig. 6)

Fig. 6 Male Sockeye Salmon on Spawning Grounds

Photo: Richard Russel

August

This will be the busiest time of this course. The spawners should all be in the pond and you can obtain a good estimate of the total number of live males and females and the same for the dead sockeye salmon. Your main emphasis should be on the spawning activities.

Watch for females selecting a spawning site and starting excavate an egg pocket. Females which have been feeding in the ocean for three years will on the average produce 4,000 eggs. They are deposited in five pockets, each with about 800 eggs. When all the fine gravel has been washed away you see only larger stones in the egg pockets. (Fig. 7)

Fig. 7 Female Sockeye Salmon Excavating an Egg Pocket

Fig. 8 Sockeye Salmon Spawning

During the spawning act (Fig. 8) one female and one male will line up side by side and extrude their eggs or sperm over the egg pocket. The fertilized eggs will sink between the larger rocks. (Fig. 9)

Fig. 9 Pocket with Eggs

Immediately after spawning the female will start covering up the eggs. Since you shall recover some of the developing eggs, many egg pockets must be marked. You'll write down their position in relation to the grid system, but you will also place rocks painted with bright colors next to the egg pocket.

September

Spawning is now over and the salmon start to die off. (Fig. 10) Examine some of the dead females and see how many eggs have been retained. Mark some of the recent dead salmon with tags and see how fast the salmon carcasses disintegrate and release nutrients which they accumulated during their ocean residence. Thus the decaying salmon fertilize water in the pond and Lake Iliamna in general.

Fig. 10 Dead Sockeye Salmon at Finney Beach, 1960

October

Your observations have settled down to routine. You always measure the water temperature of the pond and the depth of the water. You may try to excavate a couple of egg pockets to see how far the embryo inside the egg shell has developed. (Fig. 11)

Fig. 11 Sockeye Salmon Fertilized Eggs Developing the Eye Pigment is Clearly Visible

Photo: Tom Hyde

November–December

Everything is peaceful and quiet at the Pond. The temperature of the water remains the same. Some filament algae strings are developing along the banks of the pond.

Try to excavate a few egg pockets and you will find most eggs have hatched and you see the young larvae with a large yolk sack attached to its abdomen. (Fig. 12)

Fig. 12 Chinook Alevin Hatching

Photo: Alaska Fish & Game
March-April, 1989

January-February

Hatching is in full gang at the beginning of the year. When you excavate an egg pocket you should be able to find fry with yolk sacks left (Fig. 13.) or sometimes only the scar where the yolk sack was attached.

Fig. 13 Chinook Salmon Fry with the Yolk Sack Attached to the Ventil Side

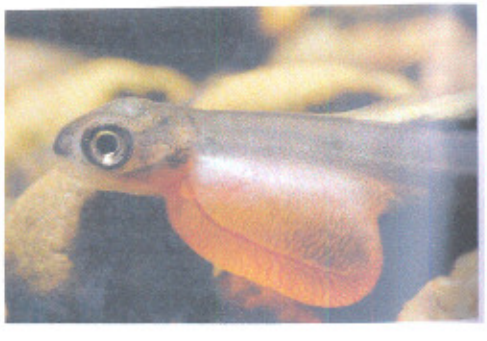


Photo: Richard Bell

Note that fry can move in the gravel, and they may be difficult to catch with a handheld dip net.

March-April

Hatching is over and the yolk sacks have been absorbed. (Fig. 14) The number of days required from fertilization to emergence is governed by the temperature. At 2°C it takes 282 days and at 5°C which is similar to your pond temperature, 171 days are required. The fry start to feed along the banks of the pond. They are good swimmers and difficult to catch.

Fig. 14 Chinook Fry with the Yolk Sack Nearly Absorbed

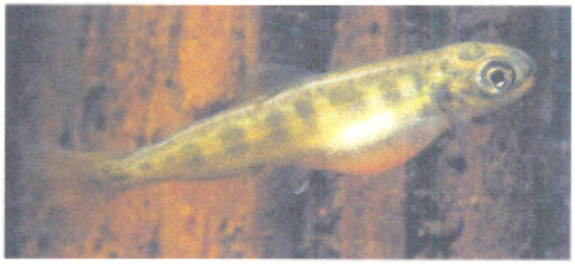


Photo: Richard Bell

If you succeed in catching fry, you will notice marks along the side, the so-called par marks. They are distinct for the different species of Pacific salmon. (Fig. 15)

Fig. 15 Par Marks on Different Species of Pacific Salmon

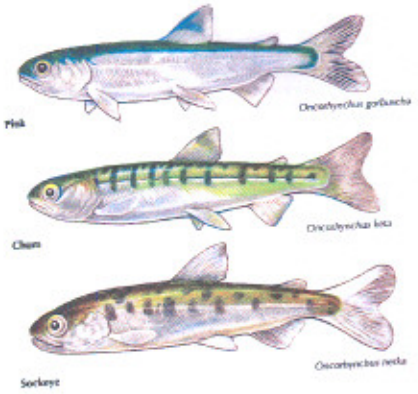


Photo: T. Quinn

The fry is getting ready to leave the pond and move down to Lake Iliamna where they will spend one or two years before leaving the lake and its nursery grounds for the open sea. (Fig. 16)

Fig. 16 Sockeye Yearling Prior to Going to Sea

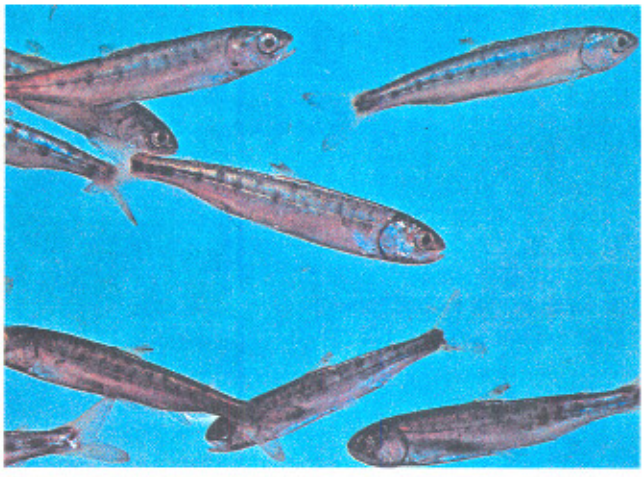


Photo: International Pacific Salmon Fisheries Commission, 1974

May

There are no more salmon left in the pond. A thick blanket of algae is covering the pond surface.

Your assignment this month will be to write a report on your observations during the year and include all material that you have collected.

This pamphlet is intended to serve as a study aid for the school children in the Pedro Bay School District as they embark upon a year long study of sockeye salmon in Pedro Pond.

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