F-07108-56

McMullen (194)

NOTES ON KOKANEE REDD EXAMINATION AND FRY EMERGENCE IN RELATION TO HUNGRY HORSE RESERVOIR DISCHARGE

1975

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Kokanee begin their upstream movement in the Flathead River system above Flathead Lake in late July and early August. The main spawning migration begins in mid-September and continues through the middle of December. Peak spawning activity probably occurs in mid-November. Fluctuating flow releases affect the selection of spawning sites in the lower river below Hungry Horse Reservoir. Flow releases from Hungry Horse Reservoir during this peak spawning and early incubation period, October through mid-December, 1974, ranged from 2,800 to 10,100 cfs. During the late incubation period in March and April of 1975, Hungry Horse flows ranged from between 400 and 10,400 cfs.

Primary objectives of this study were (1) to check egg incubation progress to determine the time fry emerged and (2) measure a selected kokanee spawning bar to determine the wetted perimeter covering kokanee redds during minimum discharge (Hungry Horse Reservoir) in late winter and early spring, as compared to maximum discharge flows for the same period. Kokanee spawning redds were located in the vicinity of spawning concentrations observed the preceding fall.

Kokanee spawning areas in the Flathead System can be classified into four categories. These include: (1) outlet streams of lakes (McDonald Creek below McDonald Lake), (2) spring seeps in backwater sloughs, (3) the main river along the bank or side channels of the Flathead River and (4) lakeshore spawning (Flathead Lake). All, but the latter category, will be discussed.

(1) McDonald Creek (Apgar) --- McDonald Creek's flow remains at a fairly constant level from spawning through early egg incubation. Water temperatures in this outlet stream are influenced by the lake surface and are warmer than those of the Flathead River in late fall. Consequently, early salmon egg incubation occurs at a more rapid rate until the lake water cools to near freezing temperatures. Incubation is then slowed considerably.

Several redds were examined in the area above the Apgar Bridge on March 7, 1974. A cursory examination was made to determine egg development. About 90 percent of the eggs observed were in the late eyed-stage with approximately five percent hatched and in the early sac-fry-stage. The water temperature of McDonald Creek was 34° F. Outlet creek temperatures were probably influenced by the ice covering the lower end of McDonald Lake.

Redd locations in McDonald Creek were out of the main current in water depths from six to eighteen inches, at velocity flows less than 2 cfs. None were observed at depths greater than two feet. Selection of redd areas seemed to be determined more by stream substrate type than water velocities. Redd densities were greatest where loose gravel was deposited along the edge of the main current. These gravels can be easily turned with a shovel and range in size from one to two inches. Compacted gravel areas or cobble size gravel were not selected for spawning.

Further examination of McDonald Creek redds was made on April 3rd and April 11th. Observations made on the 3rd of April indicated a wide variety of egg development. Eggs developing in some redds were entirely in the late eyed-stage while others were one-half alvins and one-half late eyed-eggs. Stream temperatures had increased to 37° F., but ice cover at the lower end of McDonald Lake was still prevalent.

By April 11th, about 95 percent of the eggs had hatched with some of the fry beginning to absorb their yolk sac. Lake McDonald was completely free of ice on this date and stream temperature was 37° F. Several redds containing dead eggs were uncovered in loose gravel below riffle areas. It is believed that anchor ice formation, during extremely cold weather, was responsible for the failure of egg development.

On April 16th, a live trap designed for trapping downstream salmon smolts described by Craddock, 1961, was suspended from bridge pilings at the Quarter Circle Bridge. This bridge is located near the mouth of McDonald Creek where it enters the Middle Fork of the Flathead River and is approximately two miles below the major spawning area and the outlet of McDonald Lake. A tow net, a meter in diameter and covered with plastic window screen, was suspended in mid-stream adjacent to the live trap. Both traps were set at approximately 3:00 P.M. and were lifted the following day at 10:00 A.M.. The meter net collection represented about 60 percent of the total numbers collected, with an estimated 3,000 swim-up fry taken collectively from both traps. Aquatic weeds, lodged in the throat of the live trap, may have hampered the effectiveness of the trap. Fish collected from both traps were returned to the stream.

(2) Backwater spring seep areas --- Two spawning areas in this category were examined. One area is located on the main Flathead River and upstream of the Reserve Drive fishing access area. Several redds were examined on March 14th and both eyed-eggs and sac-fry were uncovered. The water temperature on this date was 41° F. with river flows at 1300 cfs. Flows at low stage exposed an estimated 20 percent of the available spawning area. Numerous spawning pockets in the water were observed in an area approximately 120 feet by 90 feet. A heavy layer of silt settling in this backwater area probably renders additional spawning gravel unsuitable for redd construction.

All, but one of the several pockets of eggs uncovered above the low water mark, were dead. In this case, viable eyed-eggs were found approximately two and one-half feet vertically from the water edge in moist, sandy gravel.

Brenneman's Slough, located in the lower river, was the second backwater spring seep area selected for kokanee redd observations. Water levels in the lower river are influenced by Kerr Dam at the outlet of Flathead Lake. In late winter and early spring, water levels near the mouth of the Flathead River recede when Flathead Lake is drafted down to minimum pool elevation (2,883 ft). Consequently, about one-half of the redds constructed in the fall at maximum pool elevation (2,893 ft.) were dry when observed in early spring (March 13, 1975). Eggs in redds covered by more than two inches of water were successful in hatching and producing alvins. The water temperature in Brenneman's Slough was 46° F. on March 13th. It is believed that the majority of fry had emerged and become free-swimming by this date.

(3) River side channels -- Flathead River (approximately three miles below Columbia Falls). Three spawning sites approximately three miles below Columbia Falls were selected for redd inspection. On March 19th, viable eggs in the late eyed-stage were collected from redds uncovered in the water of the stream channel near the south end of Eleanor Island. Cursory measurements at this site, at low flow releases, indicated a suitable spawning area (200 x 50 feet) was dry. It was estimated that 90 percent of potential spawning area at this site was dry when flow releases from Hungry Horse are at 400 cfs.

About one-fourth mile upstream from this point, several isolated redds were observed approximately four feet from the edge of the river bank and 150 feet from the wetted perimeter of the channel. Excavation of these redds revealed eggs in a deteriorated condition. This would indicate utilization of spawning gravels, during maximum flow releases, along the bank edge and the ensuing effects of spawning habitat loss at minimal flow discharge.

At a third site, where extensive spawning had taken place in 1974, stream cross sections of suitable spawning gravels were measured. This area is adjacent to a small side channel near the north side of Eleanor Island. The spawning area was measured at minimum Hungry Horse flow release. Figure 1 shows the relation of wetted perimeter comprising suitable spawning gravels where viable eggs were uncovered to spawning gravels in the dry outside the wetted perimeter. At this particular site, 54 percent of suitable spawning area was dry at a flow of 1,358 cfs (400 cfs Hungry Horse Reservoir discharge). The toal spawning area lost by reduced flows on this site comprised an estimated 11,600 square feet.

SUMMARY

Water released from Hungry Horse Reservoir is used for power generation, flood control and storage capacity for downstream uses. These widely fluctuating flows have undoubtedly taken a drastic toll on kokanee fry production in the lower Flathead River above Flathead Lake. High flow releases maintained during spawning migration have induced kokanee to utilize gravels that will be dry during reduced flows in late winter. The subsequent wetting and drying of these outside perimeter spawning areas greatly reduce kokanee fry production.

The influence of extreme Hungry Horse flow fluctuations to downstream river flows at Columbia Falls from October 1, 1974, to March 30, 1975, is shown in Figure 2. It would appear that in the 1974-75 incubation period, significant low flow releases from Hungry Horse Dam (1,600 cfs) did not occur until late January. These flows were further reduced to a minimum of 400 cfs for extended periods during February and March. Egg mortality from this reduced flow probably occurred during the first week of February.

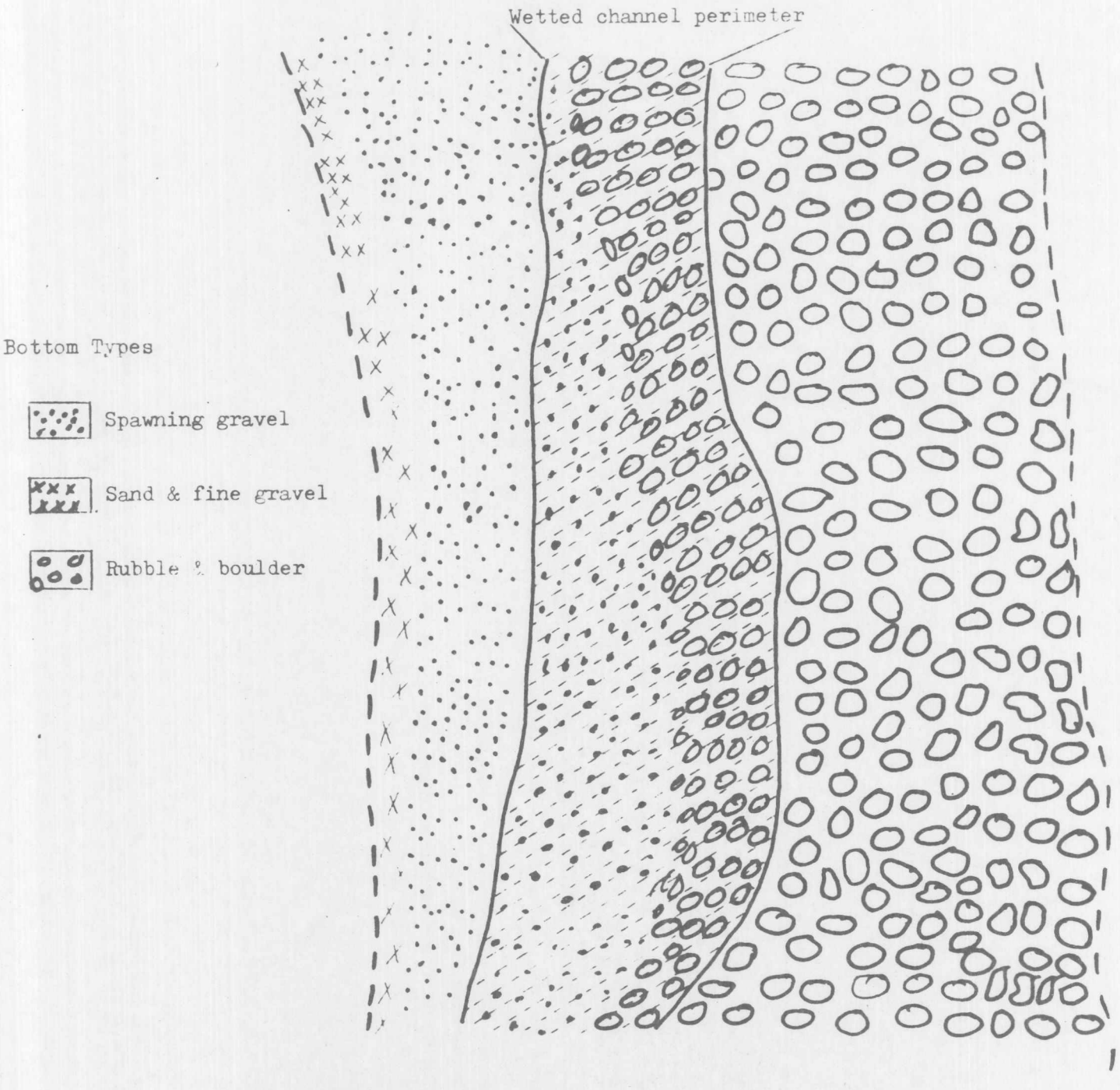

Figure 1. Diagramatic view of bottom types comprising a 330 foot kokanee spawning channel above and below the wetted channel perimeter at low flow.

Recommendations for further study:

1. Investigate the major elements effected on the aquatic community of the Flathead River from storage and discharge of Hungry Horse Reservoir water.

   A. Determine the percent of the total spawning type gravels between Foy's Bend and the South Fork, exposed at 1300 cfs; 1800 cfs; 2300 cfs and 2800 cfs gauge stages.

   B. Determine the quantities of these other gravels used.

   C. Determine, for study year, the percent of redds with dead eggs from exposure at flow volumes of 1300 cfs; 1800 cfs; 2300 cfs and 2800 cfs.

   D. Establish criteria for estimating optimum recruitment from other areas adequately covered with water to insure hatching.