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Goldeye flushing experiment

Author

W. M. Sprules

Central Fisheries Research Station

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INTRODUCTION

On August 14, 1945 seining operations carried out behind the control dams on Baptizing and McKenzie Creeks in the Saskatchewan River delta disclosed the presence of large numbers of goldeye of the year which had developed from the spring spawn. These dams which are units of an extensive series of similar structures erected throughout the delta region to control water levels in the marshes, act as artificial barriers to the movement of young goldeye from spawning areas in the lakes and streams of the marsh, to the Saskatchewan River. Adult goldeye have access both into and out of these areas during the early spring and summer periods of high water since in most instances the control gates are opened during these periods to allow a flow of fresh water into the marshes. However, by the time the spring-spawned goldeye of the year begin to move the control gates are closed and prevent passage of these fish into the river.

It was thought that ecological conditions prevailing in the marshes might prove limiting to the successful overwintering of these fish during the winter stagnation period and thus lead to a considerable loss of stock. In order to obtain an indication of this loss, if any, a trip was made to Baptizing Creek early in April, 1946, at which time the river and creeks were still frozen. On April 7th many brook sticklebacks, one 7-inch jackfish and a frog were found dead in the few inches of open water close to the dam where a small flow occurred between two stop logs. By April 16th the snow cover had melted from the streams, the ice honeycombed, and a foot or two of open water appeared along the shore lines.

At this time 57 partly decomposed jackfish were counted along a 30-yard stretch of one bank in McKenzie Creek and dead jackfish, ling, pickerel and frogs were seen in Baptizing Creek. Within the next day or two all traces of this winter kill disappeared as the water overflowed dams and the streams began to run. Although no specimens of goldeye were found at this time the existence of unfavourable winter water conditions in the marsh was evidenced from the winter kill of other species.

It is proposed to visit this area during February, 1947, and carry out a series of water analyses to determine the dissolved oxygen content of the water under stagnation conditions. In addition physiological experiments on the oxygen tolerance of goldeye will be carried out during the summer of 1947. From these data it will be determined whether or not conditions prevailing in the marsh waters during the winter period are unfavourable for goldeye forced to overwinter there.

A known loss of goldeye of the year which may be attributed in part to the control dams occurs through predation by other fish. Large numbers of jackfish of all age groups, as well as smaller numbers of pickerel and sauger, also are obstructed by the dams during low water. This abnormal concentration of both predator and prey likely leads to a greater utilization of small goldeye as food by these predators than would be found if the species were more normally distributed throughout the stream. From April 15 to August 13, 1946, a total of 1141 jackfish stomachs were examined and of these 218 contained food, with goldeye found only in 4 stomachs representing a percentage frequency of 1.8%. Between

September 17 and 20, 39⁴ jackfish stomachs were analysed and of these 132 contained food, with 29 specimens of goldeye of the year found in 19 stomachs giving a percentage frequency of 14.4%. At this season goldeye rank third in recognizable food items utilized by jackfish, with small jackfish representing 34.1% and ling 17.4%. No goldeye were found in pickerel stomachs taken between May 7 and August 6, while between September 17 and 20, 19 pickerel were taken of which 12 contained food and of these, 4 stomachs contained 9 goldeye of the year which gives a percentage frequency of 33.3%. This was the most important food element of pickerel at this season. No goldeye were found in sauger stomachs during the summer of 1946 but an occasional individual was found during the previous summer.

During the third week of July the ten control dams on the Saskatchewan and Summerberry Rivers between The Pas and Cedar Lake were visited, and goldeye of the year were obtained in seine hauls made behind 7 of these, including Baptizing, McKenzie, Willow Creek, Pullover, Rat Hunting, Red Rock and Red Earth. Although no specimens were obtained at Big Bend, some were taken there late in August, 1945. Seining conditions were poor at Trader's Lake dam which may have accounted for the absence of goldeye in the seine hauls there and Ravensnest dam was the other dam where no goldeye were taken. The results of this investigation showed clearly that the condition found at Baptizing Creek was repeated at most of the dams throughout the delta region and any policy applicable to one dam would be suitable for all the others.

In an effort to establish a practical method of releasing these goldeye of the year from the marsh into the Saskatchewan River, an experiment was carried out at Baptizing dam from September 17 to

20, 1946, in company with Dr. K. H. Doan. A screen was constructed, using $\frac{1}{4}$ -inch mesh, heavy gauge wire fastened to a wooden framework, which could be placed securely across the dam face and thus act as a "catch-all" through which the water must flow when one or more stop log was removed from any one section of the dam. When in operation the screen hung in bag fashion from the top stop log and the fish which were washed over the log were trapped in the screen. Some small fry, mostly lake shiners and spottail minnows, were washed through the mesh of the screen but goldeye of the year averaged over 4 inches in length at this time and were unable to escape. The screen also proved ineffective in stopping many of the larger jackfish since these were observed jumping the dam rather than being carried passively by the flow. An indication of this loss was obtained by placing a vertical wire screen and a canoe below the dam so that the majority of jumping fish struck the screening and fell into the canoe.

During the experiment the screen attached to the dam was visited regularly and cleared of debris and fish since these retarded flow through the screen and raised the water level therein so that the larger fish entering the screen were able to swim out against the current if this matter were allowed to accumulate.

RESULTS

Flow was started through one gate of Baptizing Creek control dam at 11.15 C on September 17 and was continued intermittently until 13.30 C on September 20. During this time a $1\frac{1}{2}$ -inch flow was maintained for a 7 hour and a fifteen minute period, a $\frac{3}{4}$ -inch flow for 1 hour and a 9-inch flow for 32 hours. A total of 2260 fish belonging to 14 species was obtained, including gold-eye, jackfish, pickerel, sauger, common sucker, northern sucker, redhorse sucker, ling, tullibee, fathead minnow, lake shiner, spot-tail minnow, trout perch and spoonhead muddler. In addition to fish, muskrats, crayfish, and water beetles were swept into the screen.

Preliminary runs made during the first 24 hours of the experiment showed that the smaller flows of $\frac{3}{4}$ and $1\frac{1}{2}$ -inches, were unsatisfactory from the standpoint of releasing goldeye, since only one individual was flushed during the $8\frac{1}{2}$ hours of flow. Further, it was found that goldeye were carried into the screen with the 9-inch flow and that the greatest numbers were obtained during the night hours with distinct peaks found at dawn and sundown. In order to obtain more detailed information on the diurnal activity of goldeye, the 9-inch flow was begun at 1720C on September 18 and allowed to run until 2030C, September 19 during which time the screen was cleared each hour, with the exception of between 1310 and 1810 on the latter date, when the screen was cleared after a 5-hour interval. Once again goldeye were taken in larger numbers during the hours of darkness than in daylight hours with a peak at sundown and sunrise. A third peak was obtained in this diurnal run at 2350 C.

Analysis of the number of goldeye obtained during the 32 hours that a 9-inch flow was used shows that an average of 14.8 goldeye were flushed per hour. However, only 3.7 per hour were obtained during daylight hours and 29.1 per hour during hours of darkness. When the hours of changing light intensity at sundown and sunrise were considered it was found that an average of 55.6 per hour were washed into the screen in these periods.

Pickereel, sauger and trout perch also were most abundant during the hours of darkness while common sucker, fathead minnow, lake shiner and spottail minnow were taken in larger numbers during the day. Jackfish were active at all hours of the day and night. The other species obtained, which included northern sucker, redhorse sucker, tullibee, ling and spoonhead muddler, were not taken in sufficient numbers to determine accurately their period of greatest activity. Crayfish, water beetles and muskrats occurred most frequently during hours of darkness.

From the data obtained from this short experiment it seems probable that the number of goldeye that go over the dam increases as the time the water has been flowing increases. On September 17 the water flowed for 2 hours at mid-day and then was shut off until evening. It was opened again at sundown and 16 goldeye were obtained from 1915 to 2015 C. A reduced flow was maintained during the night and the full 9-inch flow restored for 2 hours at dawn. The stop logs were replaced during the day on September 18 and removed again at 1700 C. A total of 27 goldeye was obtained that evening from 1930 to 2030 C which showed a small numerical increase over the number obtained during the corresponding

period the previous day. The flow was maintained for the next 24 hours, and between 1930 and 2030 C on September 19, 140 goldeye were flushed into the screen. Weather conditions were almost identical at sundown on the three days mentioned with a completely overcast layer of low cloud from which light rain was falling on the last two days with nearly overcast middle cloud but no rain on the first day. It would seem from this that as the time of flow increased the current influence was felt by the goldeye in areas farther upstream from the dam and thus a larger number were brought under this influence and made their way to the dam.

No estimation of the standing population behind the dam could be made so that it is impossible to determine the approximate percentage of the population that was flushed at any time. Seine hauls were made twice during the experiment, once in daylight and once in the dark but no goldeye were taken either time. The water temperature was too low to permit extensive seining operations at this time of the year. It is probable at this time of the year that the goldeye, which averaged $4\frac{1}{2}$ -inches in length, were active enough to avoid the seine. This postulation is substantiated somewhat since the seine haul made during the night was made at a time when goldeye could be seen in the water and were occurring in the screen in numbers. During the latter part of July and early August, when the fish averaged about $2\frac{1}{2}$ -inches, they were taken readily in seine hauls made at the dam.

From the standpoint of present management of these marsh areas for muskrat ranching the effect of flushing the control dams on the maintained water levels must be considered. At the start of

the present experiment the marsh gauge at Baptizing control dam read 7.85 feet. The same reading was obtained 1 hour after the stop logs were replaced at the end of the experiment so that there was no appreciable reduction in marsh water level brought about by this flushing operation. During the experiment the gauge reading dropped to a low of 7.1 feet when the stop logs were out, but rapidly returned to the original reading when the logs were replaced. Several hours of light rain occurred during the experiment which may have been instrumental in maintaining the original level. The discharge used at Baptizing can be determined from the formula for discharge over a broad-crested weir, $Q = CLH^{3/2}$ c.f.s., where Q = discharge, C = a constant, L = length of weir and H the height of water above the crest of the weir at 2.5 H upstream from the weir. The clear opening at Baptizing dam is 10 feet so that the 9-inch flow used represents a discharge of $3.24 \times 10 \times .75^{3/2} = 3.24 \times 10 \times .649 = 21.0$ cu. ft. hr. The water level in Head River and Littlefish Lake is controlled by Baptizing dam and these lakes have a combined area of about 12 square miles, which does not include the surrounding marsh regions. Thus a conservative estimate of the time required to lower the water level 1 inch in this system, at the volume of flow utilized in the experiment, would be in the neighbourhood of 380 hours. Thus in this instance a continuous flow could be maintained for about 16 days with a loss of only 1 inch in marsh level. As this figure is far in excess of that required to release a reasonable percentage of the small goldeye it is safe to assume that annual flushing of the dams would not have a deleterious effect on the marshes. A dam which controlled only 1

square mile of water could be flushed by removal of 1 stop log, which would give an 8-inch flow, for two days or four 12-hour night intervals with a decrease in marsh level of 1 inch.

SUMMARY

The control dams throughout the Saskatchewan River delta area act as barriers to goldeye of the year as well as other fish and prevent their movement from the marsh areas into the Saskatchewan River during late summer and winter periods of low water.

Evidence was obtained at the control dams in Baptizing and McKenzie Creeks during the spring of 1946 which showed that there was a winter kill of some species of fish in these areas. Experimental physiological work must be done in the future to prove whether or not the ecological conditions during the winter in the marshes are limiting to the successful survival of goldeye of the year.

During the late summer period the concentration of goldeye of the year behind the dams leads to a higher rate of loss of fish through predation by carnivorous species.

Goldeye have been found behind 8 of the 10 control dams in this area during the late summer.

These fish can be successfully released into the Saskatchewan River by removing one stop log from one control gate. Goldeye are most active throughout the hours of darkness and especially so during the hours of changing light intensity represented by sundown and sunrise. Within limits, the number of fish released increases as the period during which a flow has been maintained, increases.

The change in water level in the marshes brought about by any practical period of flushing would be negligible.

RECOMMENDATIONS

1. In order to release goldeye of the year from the marsh regions of the Saskatchewan River delta, the water resource control dams should be flushed annually.

2. The flushing should consist of the removal of sufficient stop logs from one control gate in each dam to permit a flow at least equivalent to the depth of one stop log.

3. The logs should be removed about the middle of August or at such time thereafter as the water level on the outside of the dams has lowered sufficiently to allow a free water drop when the logs are removed. This date will depend on the annual fluctuations in water level in the Saskatchewan River.

4. The flow should be maintained for a period of from 3 to 7 days, depending on the area of water controlled by the dam and the length of time required to lower the marsh level an appreciable amount. If personnel are living in the vicinity of the dams the stop logs could be removed only at night in order to conserve the water supply.

5. Since large numbers of jackfish and other species will move out of the streams during this flushing, fishermen could probably be interested in fishing below the dams during this period. If it is considered advantageous to remove such fish, hoop nets placed across the streams below the dams should effectively stop most of the larger fish escaping. Since a considerable amount of

vegetative debris will move with the current, a surface screen should be installed to prevent this matter from fouling the nets.

Table 1. List of common and scientific names referred to in this report.

<u>Common Name</u>	<u>Scientific Name</u>
goldeye	Amphiodon alosoides
brook stickleback	Eucalia inconstans
jackfish	Esox lucius
ling	Lota lota
pickerel	Stizostedion vitreum vitreum
sauger	Stizostedion canadense
common sucker	Catostomus commersonii
redhorse sucker	Moxostoma sp.
northern sucker	Catostomus catostomus
tullibee	Leucichthys sp.
fathead minnow	Pimephales promelas
lake shiner	Notropis atherinoides
spottail minnow	Notropis hudsonius
trout-perch	Percopsis omisomaycus
spoonhead muddler	Cottus

