THE POTENTIAL FOR INTRODUCING

ANADROMOUS SOCKEYE SALMON

INTO LAKE TOYA, JAPAN

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Environmental changes in Lake Toya

Lake Toya, a large, oligotrophic, caldera lake, is located in southwestern Hokkaido, with an elevation of 84 m, a surface area of 70.44 km^2, a maximum depth of 179 m, and an average depth of 116 m. The lake belongs to the Osaru River system; the only inflow from the river is an artificial water tunnel, which was built in 1939. One outlet is to the river, the Sobetsu Waterfall at a height of 18 m, and the other is the Abuta hydroelectric power station, which sends outflow directly to Funka Bay. A gradual decrease in Lake Toya pH began in 1939 when the inflow of Osaru River water began to contain acid waste from sulfur mining. Lake Toya reached its lowest level, pH 5.0, in 1970. After neutralization began in 1972, the pH rapidly increased and now is about 7.0. The main fishery in the lake is for lacustrine sockeye salmon (*Oncorhynchus nerka*), which were introduced from Lake Akan in 1893. The annual catches of this species fluctuated widely before and after lake acidification and are currently very low, likely because of the over-release of juveniles, which caused a rapid decrease of zooplankton (Fig. 1). There is no direct method for improving lacustrine sockeye salmon resources and we are seeking other alternatives to improve the fishery.

Production of anadromous sockeye salmon from lacustrine form

In Japan, wild anadromous sockeye salmon had not been found since 1900, but lacustrine sockeye salmon are distributed in several lakes. Anadromous sockeye salmon have been produced by artificial releases of smolts derived from lacustine form in Lake Shikotsu (Kaeriyama, 1989). Since May of 1995, anadromous sockeye salmon smolts derived from lacustrine sockeye salmon have been released directly into the Osaru River to investigate their homing ability and the possibility for a new fishery resource. In October of 1999, one female and one male maturing sockeye salmon, which had been released as smolts with a fin-clip mark in 1997, were found and captured in the Osaru River. Their body size and GSI (gonad weight x100/body weight) were relatively small, but the number of ovulated eggs was about 4 times greater than lacustrine sockeye salmon. These fish demonstrated their homing ability as well as the likelihood of success in introducing anadromous sockeye salmon into Lake Toya.

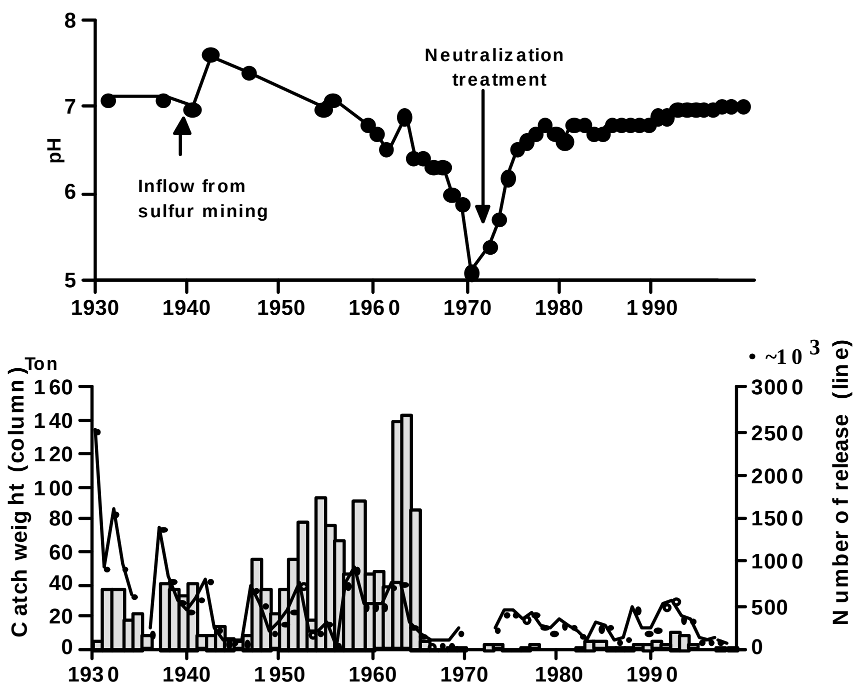

Fig. 1. Changes in pH, catch weight and number of release of lacustrine sockeye salmon in Lake Toya from 1930 to 1999.

The main barrier for down- and up-stream migrations between Lake Toya and the Osaru River is the Sobetsu Waterfall. It is possible to build a fishway specifically designed for anadromous sockeye salmon beside the waterfall, and a model fishway has already been built. The Sobetsu Town residents are expecting to utilize anadromous sockeye salmon for new fisheries resources and the fishway for a new sightseeing spot. We have investigated seawater tolerance related to smoltification of 1^+ and growth accelerated 0^+ lacustrine sockeye salmon and demonstrated that both groups have the ability to become smolts in May (Fig. 2), suggesting that smolts can be effectively produced from the stock available. We will also investigate possible influences of this introduction of anadromous sockeye on the ecological environment of Lake Toya.

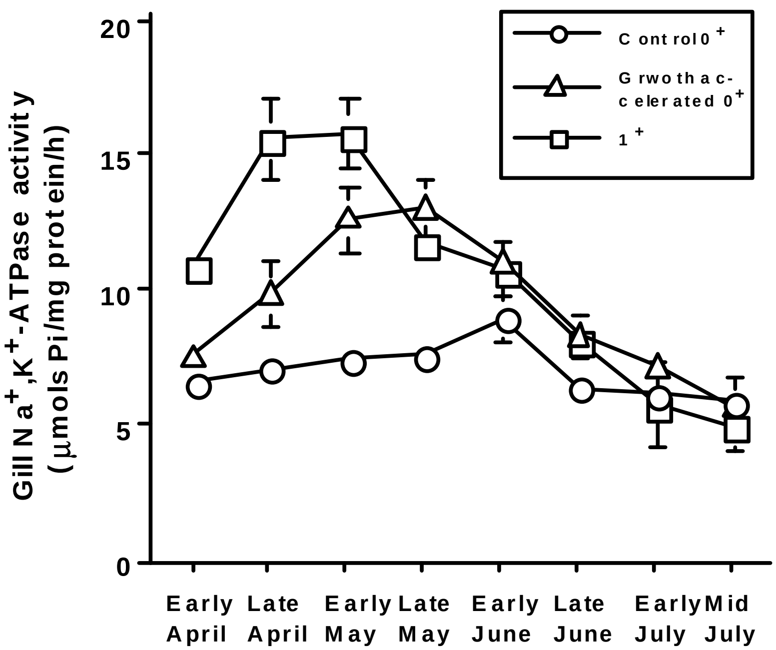

Fig. 2. Changes in gill Na^+,K^+-ATPase activity of control 0^+, growth accelerated 0^+, and 1^+ lacustrine sockeye salmon.

References

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