The Use of the Method of Mass Marking of Salmon for the Studies of Age Structure of Wild and Hatchery Adult Sockeye Salmon

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Both wild and hatchery sockeye salmon return to the basin of the Bolshaya River. Two hatcheries (Ozerki and Malki) in addition to numerous natural spawning grounds, release from 5 to 15x10^6 juvenile sockeye salmon annually. Differentiation of wild and hatchery fish requires accurate age reading based on reliable criteria. It has been found that the age marks in the registering structures, including bones, otoliths and scale, can be created not only as a result of seasonal periodic growth, but by using artificial conditions that cause a delay or acceleration of the growth rate (Mina and Klevezel 1970). A reliable method to test the concordance of the number of annual rings in scales and the real age is to study the scales of fish of known age (Nikolsky 1974). Therefore, for the hatchery fish, the most accurate method of aging is from reading code-bearing otoliths. Thus, the hatchery mass otolith marking (Akinicheva and Rogatnykh, 1996), in our view, can resolve the problem of reading the age from scales. Every year since 1995 mass sockeye salmon marking according to this method has been used in the Malki Hatchery, and has been used since 2000 for the identification of coded fishes. The age of 300 adult sockeye salmon returning to the hatchery in 2000 were based on their otolith codes as the difference between the year of return and the year of juvenile release. Principal differences have been found in the estimation of total (freshwater plus oceanic) age of these fish from the scale structure and their otolith mark. The method of determination of the freshwater and the oceanic growth zones in the otolith has been worked out.

The purpose of this work was to verify the scale-read sockeye salmon ages according to the results of the hatchery otolith mark reading.

The work on the studies of the age structure of wild and hatchery salmon was launched in 2000. The analysis of sockeye salmon returning to Malki Hatchery in 2000 indicated for the first time that the age estimated from scales often did not coincide with the age estimated from the otoliths. Deviation took place in 40% of the cases. The otolith mark method (Akinicheva and Rogatnykh 1999; Chebanov and Kudzina 2000; Kudzina 200, 2001) provided us with the possibility to check both ocean and freshwater periods in the study of sockeye salmon age (Fig.1). The photo was made in incident light. Dark stripes should characterize the growth for the summer period. Three dark rings seen in the center of the otolith (a-d) characterized the freshwater zone. Oceanic period of sockeye salmon life should be characterized by the d-g parts of the otolith. At the thin section the distance from the center to the otolith edge (a-g) was equal to 1.486mm. The largest increment appeared for the first ocean year (d-e) and was equal to 0.394mm. The distances a-b, b-c, c-d were 0.186, 0.187 and 0.172mm respectively, and the distances e-f and f-g were 0.287 and

Fig. 1. Photo of the otolith of 2.3+ sockeye salmon (ocular 10\(^\times\)22, objective 2.5). A – otolith center, b – first summer in the river – yearling, c – first annual freshwater ring, d – second annual ring, the end of freshwater period, beginning of migration to the sea, e – first ocean summer, f – second ocean summer, g – third summer, return to the river for spawning.
0.260\text{mm}. The otolith itself and its’ center ($a$) had been initiated much earlier compared to the time of embryonic “eyed” stage initiation. The distance $a-b$ should characterize the period from the “eyed” stage to the yearling. The ring $b$ is not annual, and it characterizes the first summer of sockeye salmon growth indicating the time of scale formation. Scale-read age of this fish was 2.3+.

In 2002 the otoliths of 193 adult sockeye salmon from Malki Hatchery were analyzed. It was found that fish in the return, had marks indicating they were mostly released in 1999. All sockeye salmon which otoliths were analyzed immigrated to as yearlings. The otoliths of these fishes bore three ocean zones; maximum growth was noted for the first ocean year (Fig. 2). As the year of juvenile release was known we had estimated the correct age of the fish (3-year-old). Reading the age from the scale was difficult because the scales were collected from prespawning fish in which the scales were partially destroyed including the scale edge (underestimated by one ocean year). In other circumstances, some scales had a ring of sclerites situated close to each other in the center of the scale, and could be mistakenly identified as a freshwater ring. That additional ring appeared in the scale structure of Malki Hatchery fish as a result of special conditions of juvenile rearing in this hatchery (Bugaev et al. 2001).

In 2002 the otoliths and the scales from 328 sockeye salmon were collected within the area of the Bolshaya River outlet. Analysis of the otoliths indicated that 14 fish were of hatchery origin. These were 0.3+ fishes released in 1999 according to the Malki Hatchery code observed. Age parameters in the otolith were similar to the parameters demonstrated in figure 2. In the course of the age reading from scale for these fish by the standard method, there were two age categories subdivided – 1.3+ (1) and 1.2+ (2) (Fig. 3). If we did not know these fish were of hatchery origin, determination of their age from scales would have been incorrect.

Fig. 3. Photo of 0.3+ sockeye salmon scale (the fish bears Malki Hatchery mark in the otolith), $a$, $b$, $c$, $d$ – the zones of sclerites situated close to each other.
REFERENCES


