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Mass marking of salmon and identification of hatchery fish in mixed stocks.

by

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Traditionally, in fishery the marking of salmon fry is used to evaluate the efficiency of hatcheries and determine the portion of the breeded fish in the mixed stock. Nowadays many methods of marking are known, that is- fins cutting, colouring and marking, using a different sort of suspended, internal and coded marks. Each method has its own merits and demerits. However, to our opinion, the most perspective method of mass fish marking is otolith marking which helps to solve the problem of identification of hatchery fish.

An otolith itself is a calcium-protein formation, formed in semicircular channels of acoustical capsules of salmon embrios at an early stage of "eye pigmentation". Environmental conditions leave the signs in the structure of an otolith by changing the rate of calcium accumulation. Different sizes of intermittent light calcium layers mixed with dark organic ones create a unique design of every otolith.

By interfering the fish environment it is possible to set a given structure mark into the otolith. Different modes of marking allow to form compact marks containing much information. There is a possibility to get dozens of mark types for different hatcheries and even different salmon parties within the same hatchery. The mark is kept for the life period of a fish and can be "read" during any stage in the course of its life circle.

The most efficient otolith area for marking is a corresponding area to the ontogeny from the early stage of eye pigmentation of an embrio until the begining of exogenous feeding of an alevin. Environmental factors influencing the embrios and salmon alevins in this period of time are sufficiently stable. That is why, on the corresponding part of the otolith there is no much a variety of contrast stripes, which will be forming during further stages of a salmon life course.

Beginning from 1992 fish biologists of Magadan branch of TINRO started an experimental complex research work on otolith and setting the artificial marks into their structure by changing the parameters of environmental conditions. Following speices are the subject for research: chum (Oncorhynchus keta), pink (O. gorbusha), coho (O. kisutch) and sockeye (O. nerka). Marking was provided for embrios, alevins and fry of the above salmon species.

First productive scale mass marking of salmon was conducted in 1994 at Yana River hatchery (Yansky); further work of this kind was continued at two other hatcheries of our area. Totally 35 million of released salmon fry has been marked in the course of 1994-1997. We have been marking all the stock of growing salmon at Yana River hatchery for three years. Otolith marking allowed to identificate easily chum fry of a hatchery origin among the joint salt water salmon groups. In 1998 first marked salmon has returned to the northen rivers of Sea of Okhotsk seaside.

Usually water temperature is used as a marking factor. Some of the hatcheries of Magadan Region (Ola and Taui hatcheries) provide marking by intermittent encreasing of water temperature to 3,0-3,5° C, using a special equipment. On Yana

River hatchery fish biologists use low water temperatures to mark salmon; they switch water supply of the incubators from "heat" to "cool" and reverse. The water temperature fluctuates 2,0-2,5° C in the process (fig.1,2).

In 1997-98 we have conducted experimental work on marking salmon otoliths not changing drasticly the water temperature conditions. We received positive results on forming the marks on the otoliths of chum and pink embrios when drained the incubators by shutting off the water supply. On this stage the "eyed" eggs were proceeding to incubate in humid environment in different time range from 8 to 24 hours. Temperature fluctuations in the incubators during the marking process did not exceed 0,5° C. High quality mark was formed when the water supply to the incubators was switched from "off" to "on" in the 24 hours/ 24 hours mode. Three-phase water supply outages resulted in getting the distinct marks on salmon otoliths (fig.3,4). No mark was found in the " non-drained" party of eggs provided for the control monitoring (fig.5).

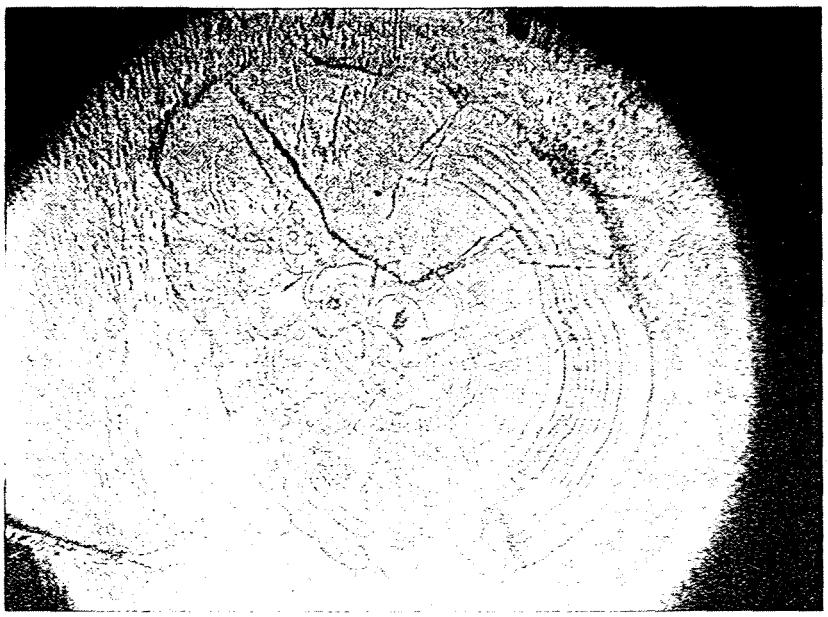

Fig. 1. Sagittae otolith from embrio chum salmon. Ola hatchery,1997. Mark is set for stage of "pigmentations an eye" by periodic encreasing a temperature of water.

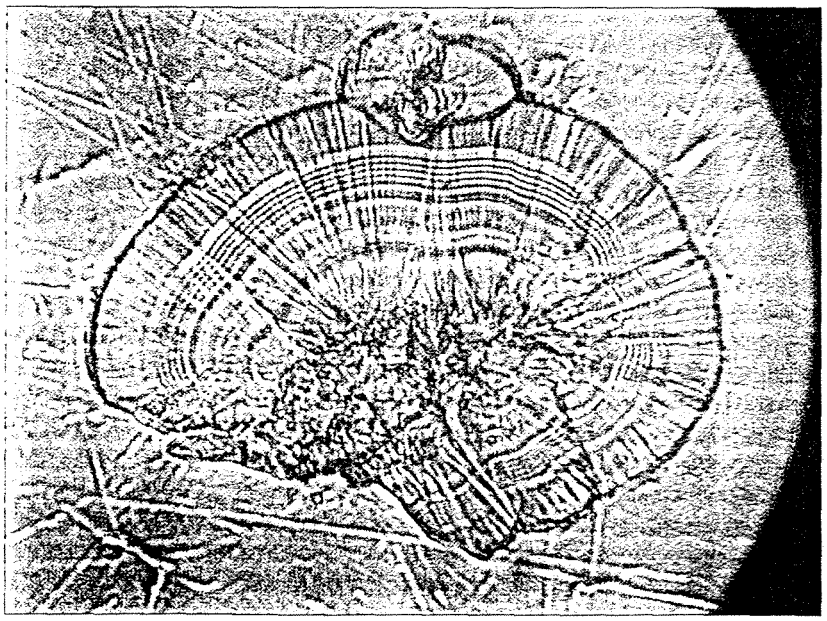

Fig. 2. Sagittae otolith from embrio chum salmon. Yana hatchery,1996. Mark is set for stage of "pigmentations an eye" by periodic reduction of temperature of water.

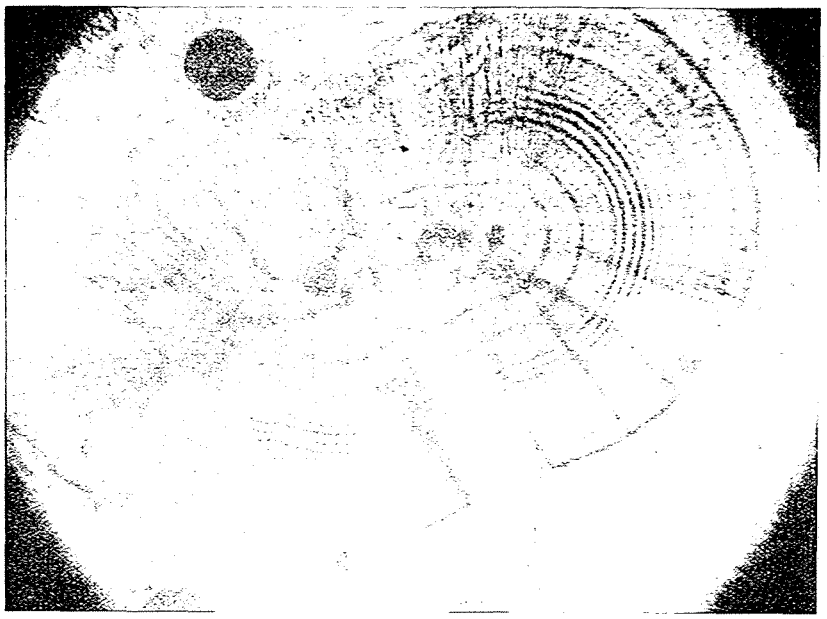

Fig. 3. Sagittae otolith from embrio chum salmon. Ola hatchery,1997. Mark is set by periodic "dranning" of eggs on stage of "pigmentations an eye".

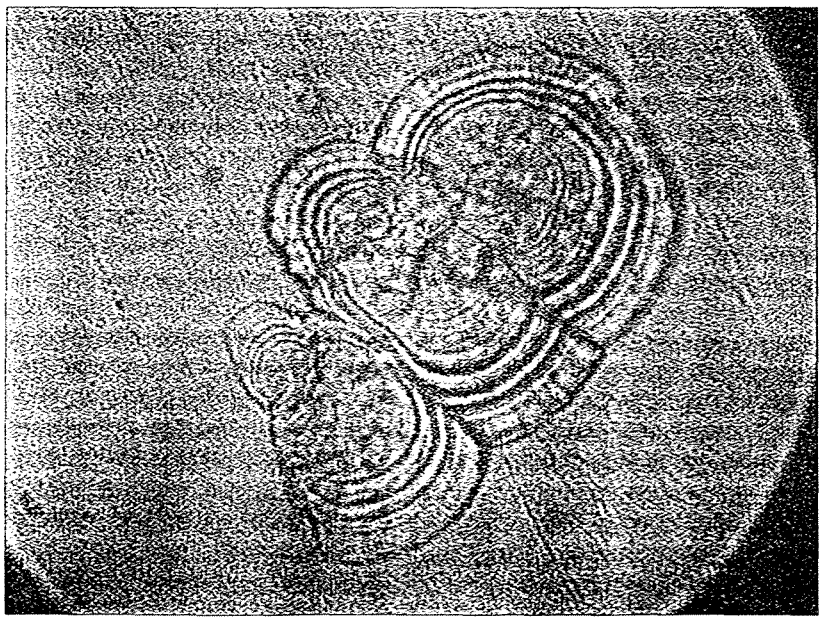

Fig. 4. Sagittae otolith from embrio pink salmon (53 days of incubations). Mark is set in field conditions by periodic "dranning" of eggs on stage of "pigmentations an eye". Kulkuty River,1998.

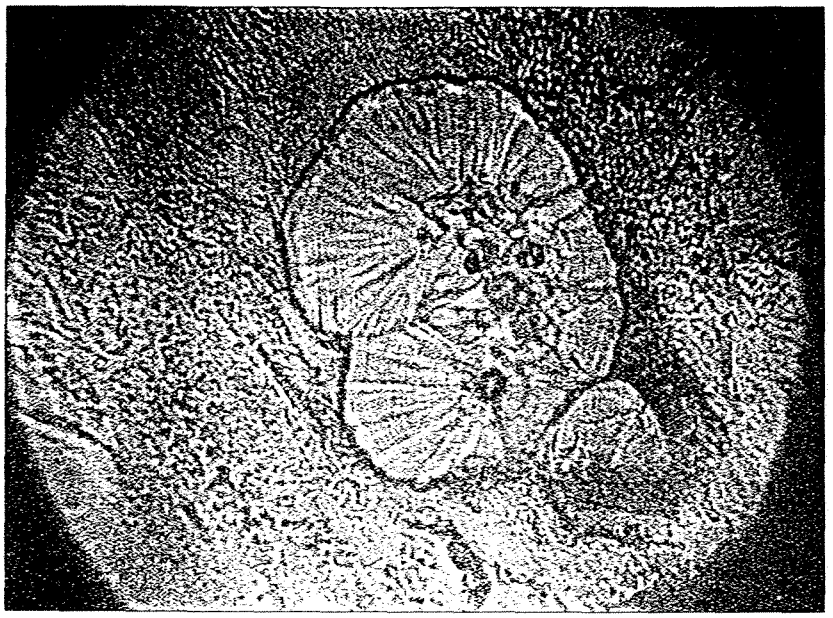

Fig. 5. Sagittae otolith from embrio pink salmon (53 days of incubations) without the mark. Control party. Kulkuty River,1998.

It should be mentioned that the process of egg draining on the certain stages of their development is often used, with no damage, at the hatcheries during the transportation and sorting of growing embrios. Our experiments have shown the equal rate of salmon mortality in both experimental and regular parties in the course of incubation and fry growing periods.

Testing the physiological status of fry did not show up the difference between marked and non-marked fish. By using this method, requiring no special pieces of equipment we got distinct marks both at the hatcheries and field worksite.

The mass marking method gives the opportunity to solve the critical issues of salmon fishery, such as follows:

1. To determine more real portion of hatchery origin salmon in the total stock of salmon during the anadromous migration of fish in rivers. Based on this data we can estimate the return rate of the grown fish and evaluate the efficiency of work provided by a certain hatchery. The above is a very important problem to evaluate every hatchery or farm contribution into the rehabilitation of the fish stock in our area in the light of the development of salmon fishery.

2. It will become workable to evaluate the efficiency of the applied biotechnology of breeding if to have the data on the return rate of the marked fish.

3. It appeares an opportunity to identify the marked fish in the mixed stock of fish in the course of a salt water life time. If we know the place of origin of salmon, which was caught in different areas of the Pacific, we can research the problem of differentiation of the salt water salmon stock and its migration.

Based on the research work data, we recommend otolith marking at the hatcheries and farms as a mass marking method, to be provided in all areas of the Far East, and establish a data bank of mark types being used.

To our opinion, the problem of otolith marking should be discussed on the international level. Taking into consideration many hatcheries and fish farms, working in the Pacific coast, existing methods, allowing to conduct mass marking, and the experience accumulated by American and Canadian biologists first, it is possible to coordinate the work of the experts in different countries in order to terminate disputes in regard to the origin of salmon population, appearing in one or another area of the Pacific.

Apparantly, the ways of migration and sealife areas of wild and hatchery stocks, coming from the same fresh water places are coincided. Hatchery marked fish, caught in the ocean, may indicate the presence in the certain spot a salmon population from the certain part of areal.

For activation of this plan it is necessary to provide a joint work on mass marking of many million of fish, breeded in the fish farms and hatcheries of the countries, located on the Pacific coast.

Becides, the types of marks, specific for every country, as well as for separate, small areas of salmon location, must also be coordinated. We think it is workable, if all of us have the same interest to regulate the fish catch and use efficiently the resourses of the Pacific salmon.