Otolith Marking at Kamchatka Salmon Hatcheries

Nickolay A. Chebanov and **Marina A. Kudzina**
Kamchatka Research Institute of Fisheries and Oceanography (KamchatNIRO)
Naberedznaya St., 18, Petropavlovsk-Kamchatsky, 683000 Russia

Keywords: Otolith, thermal mark, dry mark, salmon hatchery, Kamchatka

Rational use of fish stocks is impossible without their reliable differentiation. In Kamchatka most of the hatcheries are oriented to release small juveniles after a short rearing period. After a detailed analysis of all present methods of fish marking, we concluded that the most acceptable method for the hatcheries in Kamchatka should be otolith marking (Chebanov and Kudzina 1999). The purpose of this study was to provide background history and estimate the results of thermal and "dry" otolith marking at Kamchatka salmon hatcheries in 1999 and 2000.

At the Kamchatka hatcheries, otolith marked fish are regionally identified by 3 stripes in the first marking block with additional blocks used to identify where the fish was released, the year of marking, or, in some cases, the rearing techniques or transportation. Rogatnykh et al. (2000) suggested several marks for Kamchatka hatcheries according to maximum age of salmon. Since some age classes are uncommon in returning fish it is possible to reduce the number of marks and reuse them later when there are no conflicts between brood years. Based on these considerations we have worked out a scheme of salmon marking at Kamchatka hatcheries providing identification of species, generation, and hatchery origin for individuals in mixed catches (Table 1).

Thermal marking in Kamchatka was first applied in 1995 and 1996 at Malkinsky hatchery (Vasilkov 1995, 1996). Marking has continued since then with juvenile sockeye marked in March and chinook salmon in January (Table 2). The examination of the standards collected after marking showed that only the marks of sockeye salmon

Table 1. The scheme of salmon marking in Kamchatka salmon hatcheries.

№	Year of marking (release)	Chinook			Sockeye			Chum		
		Rbr-coding	Marking time (days)	Calendar period	Rbr-coding	Marking time (days)	Calendar period	Rbr-coding	Marking time (days)	Calendar period
Malkinsky hatchery										
1	1999 (2000)	2:1.3,2.5	16	14.10-	1:1.3,2.3	12	14.10-			
2	2000 (2001)	2:1.3,2.1	8	09.11	1:1.3,2.1	8	09.11			
3	2001 (2002)	2:1.3,2.2	10		1:1.3,2.4	14				
4	2002 (2003)	2:1.3,2.3	12		1:1.3,2.1,3.1	12				
5	2003 (2004)	2:1.3,2.4	14		1:1.3	6				
Ozerky hatchery										
1	1999 (2000)				1:1.3,2.2	10	20.10-	1:1.3,2.2	10	20.10-
2	2000 (2001)				1:1.3,2.2n+2n	12	22.11	1:1.3,2.2n+2n	12	15.11
3	2001 (2002)				1:1.3,2.5	16		1:1.3,2.5	16	and
4	2002 (2003)				1:1.3,2.1,3.2n	12		1:1.3,2.1,3.2n	12	15.11-
5	2003 (2004)				1:1.3,2.2n, 3.1	12				10.12
Ketkinsky hatchery										
1	1999 (2000)							1:1.3,2.4	14	17.10-
2	2000 (2001)							1:1.3,2.1	8	06.11
3	2001 (2002)							1:1.3,2.3	12	18.11-
4	2002 (2003)							1:1.3,2.1,3.1	12	13.12
Paratunsky hatchery										
1	2000 (2001)							1:1.3	6	16-28.10
2	2001 (2002)							1:1.3,2.2n	8,5	and
3	2002 (2003)							1:1.3,2.2n,3.1	12	10-22.11
4	2003 (2004)							1:1.3,2.3n	9,5	

All correspondence should be addressed to N.A. Chebanov.
e-mail: mail@kamniro.kamchatka.su

Table 2. The scheme and approximate number of juvenile chinook and sockeye salmon marked in Malkinsky hatchery from the egg incubations of 1994–1998.

Year of incubation	Year, month of marking	Approximate number of juveniles marked	Graphic image of the mark
Sockeye salmon			
1994	1995, March	370.100	III I II
1995	1996, March	669.500	II I III
1996	1997, March	331.700	II III
1997	1998, March	716.700*	III II
1998	1999, March	592.300	II III
Chinook salmon			
1994	1995, January ?	228.800	III I II
1995	1996, January ?	530.900	II I III
1996	1997, January ?	757.500	II III
1997	1998, January ?	336.900	III II
1998	1999, January ?	601.500	II III

* Note: - additionally to the mentioned number 17.100 juvenile chinook salmon were left at the hatchery for one more year; released in 1999.

released in 1997 and 1999 were readable. Chinook salmon marks for the same years were poor. One of the reasons for poor quality marks might be that they took place late, during a period when unexpected stripes formed in the otolith, making the process of detection more complicated. Another reason for poor marks is that fish were held in big pools, and it took a rather long time to change water temperatures. That lead to a "smearing" of the marks, which also made identification difficult.

Akinicheva and Rogatnykh (1997) determined that the optimal stage for sockeye salmon otolith marking is the eye pigmentation stage and for chinook salmon the pro-larva stage. Based on that study and the poor quality of earlier marks, we began to mark fish during the year of incubation (October–December). In the fall of 1999, research on marking started in three Kamchatka hatcheries – Malkinsky, Ozerki and Ketkino. In Malkinsky hatchery, 770 thousand sockeye salmon were thermally marked at about 422–394 degree-days in an expanded-type Atkins incubator. Marking consisted of 2–3°C temperature change with periodicity of 24 hours at a starting ambient temperature of about 7.6°C. Two blocks of equidistant rings were created by using a 3-day break during marking. This produced the Rbr code 1:1.3,2.3 (Table 1.) A photo of the mark is shown in Fig. 1. Chinook salmon marking at Malkinsky hatchery began at about 600–706 degree-days, using a temperature drop of 4.6°C. Pro-larvae were allocated on a tubular substrate in the plastic pools of the "bath-spring" type. Water circulation period in the pools and incubators was 60 minutes. Two blocks of equidistant rings 3 and 5 were produced (Table 1, Fig 2).

Ozerki hatchery is equipped with cold-water supply, therefore an experiment using the dry marking method was conducted on 422 thousand chum salmon embryos and 92 thousand juveniles sockeye salmon. For chum salmon marking began 379–354 degree-days, and consisted of periodically draining the water for 24 hour periods. Water temperature was approximately 5.3°C, and air temperature in the incubation chamber was 5.3–5.6°C. The dry mark did not differ fundamentally from thermal mark in appearance, and similar code structure was used (Table 1, Fig. 3 and Fig 4).

Fig. 1. Otolith mark in juvenile sockeye salmon released from Malkinsky hatchery in 2000.

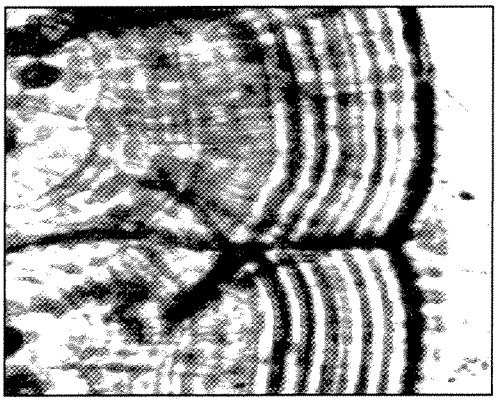


Fig. 2. Otolith mark of juvenile chinook salmon released from Malkinsky hatchery in 2000.

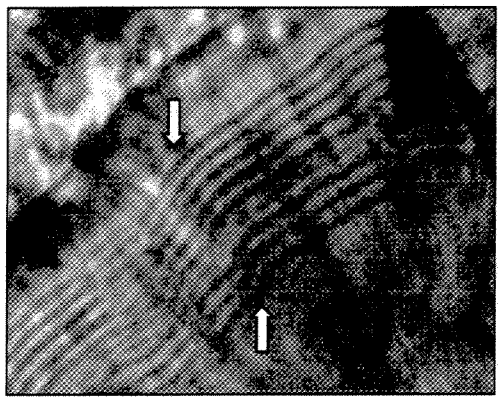


Fig. 3. Otolith mark in juvenile chum salmon released from the Ozerki hatchery in 2000.

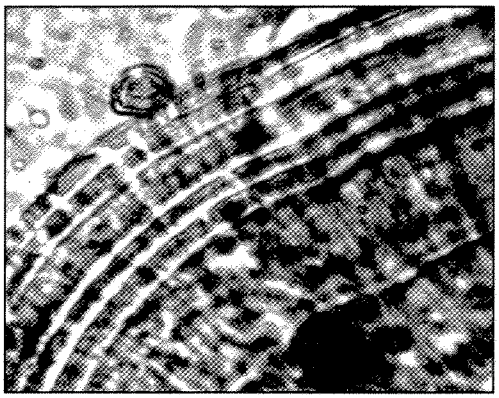
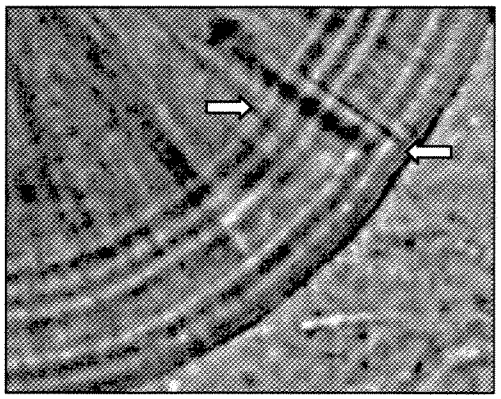


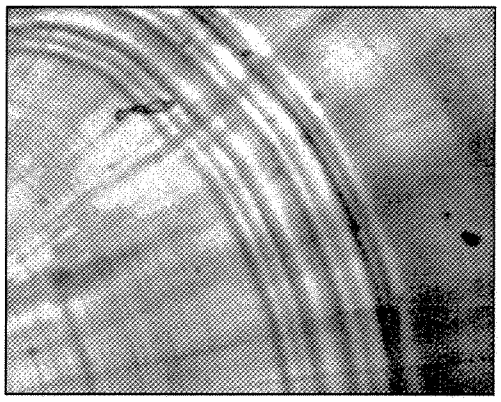
Fig. 4. Otolith mark of juvenile sockeye salmon released from Ozerki hatchery in 2000.



At Ketkino hatchery 621 thousand chum salmon were also experimentally marked using the "dry" method. Marking began 101 days after fertilization and also consisted of two blocks of equidistant rings (Table 1., Fig. 5)

In November–December 2000, marking continued at the three Kamchatka hatcheries using the same methods as in the previous year. About 591 thousand chinook salmon pro-larvae and 785 thousand of sockeye salmon embryos were marked at Malkinsky hatchery; 5.508 thousand sockeye salmon embryos and 2.627 thousand of chum salmon embryos marked at Ozerki hatchery; and about 3.283 thousand chum salmon embryos marked at Ketkino hatchery. The patterns are shown in Table 1. The marks formed on embryos and eggs in all cases were "readable" and conformed to international standards.

Fig. 5. Otolith mark of juvenile chum salmon released from Ketkino hatchery in 2000.



Otolith analysis of sockeye salmon from the return to Malkinsky hatchery in 2000 produced an estimated total of 2375 adults from individuals with the otolith mark introduced in 1995–1998. The analysis of otoliths in 299 individuals showed that the percent of adult fish from the incubation of 1994, 1995, 1996 and 1997 in the return of 2000 was respectively 0.7%, 35.1%, 36.5% and 14%; the percent of undetermined fish was 13.7%. The return of hatchery fish by the generations released was 0.004% in 1995, 0.12% in 1996, 0.26% in 1997, and 0.05% in 1998.

REFERENCES

Akinicheva, E.G., and A.Y. Rogatnykh. 1997. The experience of the mass marking of the hatchery salmon using the method of otolith thermal coding. Magadan TINRO Tech. Rep, Magadan: 36 (In Russian).

Chebanov, N.A., and M.A. Kudzina. 1999. Preliminary estimation of differentiation criteria for adult wild and hatchery chum and chinook salmon in the rivers Bolshaya-Bystraya and Avacha and of optimum methods to mark hatchery juvenile. KamchatNIRO Tech. Rep. Petropavlovsk-Kamchatsky: 56 (In Russian).

Rogatnykh, A.Y., E.G. Akinicheva, I.A. Boyko, B.P. Safronenkov, and V.I. Zaytsev. 2000. Working out of the recommendations to the use of the otolith thermal marking at hatcheries of Kamchatka and Sakhalin. Magadan TINRO Commercial Rep. N. 45-02/99. Magadan: 45 (In Russian).

Vasilkov, V.P. 1995. The method of thermal marking and identification of salmon in Kamchatkan hatcheries from the otolith marks. Kamchatrybvod Tech. Rep. Petropavlovsk-Kamchatsky: 48 (In Russian).

Vasilkov, V.P. 1996. Recommendations to the thermal marking of juvenile salmon at Malkinsky hatchery. Kamchatrybvod Tech. Rep. Petropavlovsk-Kamchatsky: 22 (In Russian).