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Marked salmon production by the hatcheries of the Far East of Russia in 2006

by

Elena Akinicheva, Vladimir Volobuev

Magadan Scientific and Research Institute
of Fisheries and Oceanography,
Magadan, Russia

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Marked salmon production by the hatcheries of the Far East of Russia in 2006.

In Russia the aim of otolith marking of Pacific salmon is, first of all, to provide information on the number of returning of the spawning hatchery raised species, and the proportion of their returning to native rivers.

The differentiation between the hatchery raised and wild salmon during the early sea period is carried out by the Magadan hatcheries by studying some peculiar features of the young hatchery raised salmon distribution, feeding, to conduct the evaluation of the physiological parameters and, finally, to analyze fish survival rate.

The study of the differentiation of the hatchery raised and wild salmon during the period of their migration to the feeding areas is carried out in Kamchatka.

Besides, the otolith marks are used to determine the origin of the young and immature salmon during the feeding period in Bering Sea. They are collected during the sea expeditionary research.

The otolith marks are annually set for each hatchery by the Age Recording Structures Sector of the Magadan Research Institute of Fish Industry and Oceanography and after discussing the conditions of marking with the hatchery experts.

The hatcheries of the Far East produced approximately 24 million marked young salmon in 2006. They are - 13 million chum, 5 million red salmon, 2,8 million silvers, 3 million pink salmon, about 0,8 million chinook salmon, and small amount of masu.

It is necessary to note that otolith marks differ from what they had been planned to be at some hatcheries. So, marks of 50 % of the chum, raised by the Paratunskiy hatchery (Kamchatka), have an excess rings. About 25 % of chum, raised at the Armanski hatchery, on the contrary, have insufficient number of the rings, in comparison with the marking plan. Otolith mark of masu (Anyuiski hatchery, Khabarovsk region) and marks on the otoliths of the major part of the marked chum adjoins the rings formed due to natural fluctuations of water temperature of the water of the river water supply. In this connection it is not always clearly seen in the otolith structure.

Otolith marking of pacific salmon is currently widely used at the hatcheries. Total marking provides possibilities to estimate an efficiency of the hatcheries on final result, i.e. in terms of mature fish number returning for spawning. Additionaly an identification of marked fishes allows to determine migration routes and distribution of salmon during feeding period in the high sea areas as well to assess a share of fishes originated from the hatcheries in the mixed stocks.

Thermal marking is the most frequently applied method of otolith marking (Munk et al., 1993; Munk, Geiger, 1998). Russian hatcheries usually do not have an opportunity to change water temperature in the separate incubatory system what is necessary for the thermal marking. As a result the method of dry marking is widely applied (Safronenkov et al., 1999; Akinicheva et al.,1998) which provides an independent marking in each incubatory system.

The marking accomplished by the authors of the method is usually successful. At the same time annually there are some juveniles registered at the hatcheries which have markes looking inadequate to plan. Such marks could be used to determine hatchery origination of the juvenile salmon but could not provide for a clear origin identification of the fishes collected in the ocean areas where mixed stocks occur. Using information collected during 5 years we can describe major reasons leading to deviation of resulted marks from expected ones when executing dry marking.

The most frequent mistake is too early beginning of the marking when mark development occurs during forming of nucleus and rings of eyes pigmentation. Marking in that period does not result in the mark with clear and contrast rings evenly spaced each other. Such method of marking could be possibly used during short period at the early stage of juvenile development when saggital otolith has been already formed in the acoustic duct of embryo which is protected yet with egg cover. Therefore the hatcheries stuff members hurry to start marking just after the eggs separation when embryos developed up to stage of eyes pigmentation. Such actions as sorting, disinfection and stressing of the eggs could influence on otolith's microstructure and leave a trace on

them. As a result there are some fishes which have on the otoliths substantial number of the rings with varying clearness and width excepting eyes pigmentation rings.

One more mistake leading to appearance of unscheduled marks is an absence of pause between disinfection and marking. Embryo develops from the stage of eyes pigmentation to the stage of emerge from the egg no less than 30 days, more often about two months. The number of rings in the marks which usually applied in the far eastern hatcheries does not exceed 9, so the most prolonged marking process goes on no more than 22-23 days.

The method of dry marking has been developed at the hatcheries in Magadan region which use the water from the wells with stable temperature in the incubation systems. That resulted in forming of clearly distinguishable marks with evenly spaced rings if the time period of marking was selected correctly. Deviations could be conditioned only by such breakdowns of the marking process as

- a presence of water in the lower layer of eggs while the stop beams were insufficiently raised during exposing of eggs in wet air;
- deviations from the schedule of water supply, an absence of regular mixing after each water inflow and as a result – insufficient water circulation.

In other regions at the hatcheries where river water has being used for incubation it's necessary for high-quality marking to prevent an effect of varying of both air temperature during exposing of eggs in wet air and water temperature during water pause in marking schedule. Early in fall range of temperature change during 24 hours (supplying incubation systems with river waters) reaches $3\text{-}4^0$C and more that effects on otoliths as thermal marking. While applying dry marking such effect appears to be an additional factor which can create additional rings among those which compose a mark and break evenness of interval between them. At present time the thermal marking has been temporarily suspended at the Sakhalin hatcheries where effect of daily temperature dynamics on marking quality looks the most pronounced. We recommend to make marking those portions of eggs which development takes place at constant temperature and to reject marking ones of early incubation.

Increase of water temperature inside of layer of eggs could also make additional influence on process of marks development during waterless exposing. Temperature increment depends upon both time of eggs drying and air temperature in the incubation facility. So using Atkins apparatus of extended type it's necessary to provide passing of water along the bottom in such manner that prevents contact it with eggs. In NOPAD-type apparatus water should wash its sides. Practice reveals that even such insignificant cooling reduces increase of temperature in the eggs layer. Minor temperature increase (up to 1^0C) occurring in the eggs layer in the drying period usually does not influence on mark quality. More pronounced temperature increment (2^0c and more) occurring due to daily fluctuation of air temperature in fall is the factor that forms the rings on the otoliths as well as exposing in the wet air.

To make successful marking by means of dry method in the all hatcheries some investigations should be undertaken for clarifying terms and reasons of forming structures in the central part of otoliths the nearest years and also it's necessary to prevent a violation of marking method.

Table1 shows the list of the otolith marks, which is supposed to be used while marking salmon of the brood year 2005.

The description of the marks is shown as the RBr-code (Munk and Geiger 1998) and the Hatch-code (Hagen 1999).

Table1. Otolith marks released from Russia for 2005 brood year stocks of salmon.

ID#	Mark Type	BROOD YEAR	YEAR OF RELEASE	SPECIES	OUNTR	STATE/ PROVINCE	AGENCY	FACILITY	FINAL RELEASE SITE	STAGE	NUMBER OF RELEASED	RBr	ATCH COI	RAPHIC IMAGE	
														PREHATCH	OSTHATC
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
R05-1	DM	2005	2006	PINK	Russia	Magadan	Okhotskrybvod	Yanskiy Hatchery	Yana River	Fed Fry	3136500	1[1.5]	5H	I I I I I	
R05-2	DM	2005	2006	CHUM	Russia	Magadan	Okhotskrybvod	Armanskiy Hatchery	Arman River	Fed Fry	440820	1[1.5]	5H	I I I I I	
R05-3	DM	2005	2006	CHUM	Russia	Magadan	Okhotskrybvod	Armanskiy Hatchery	Shirokaya River	Fed Fry	899850	1[1.5]	5H	I I I I I	
R05-4	DM	2005	2006	CHUM	Russia	Magadan	Okhotskrybvod	Armanskiy Hatchery	Staraya Vesyelaya	Fed Fry	730450	1[1.5]	5H	I I I I I	
R05-5	DM	2005	2006	CHUM	Russia	Magadan	Okhotskrybvod	Yanskiy Hatchery	Yana River	Fed Fry	1652260	1[1.6]	6H	I I I I I I	
R05-6	DM	2005	2006	CHUM	Russia	Magadan	Okhotskrybvod	Olskiy Hatchery	Uglikanka River	Fed Fry	1043720	1[1.7]	7H	I I I I I I I	
R05-7	DM	2005	2006	CHUM	Russia	Magadan	Okhotskrybvod	Olskiy Hatchery	Staraya Vesyelaya	Fed Fry	708900	1[1.7]	7H	I I I I I I I	
R05-8	DM	2005	2006	CHUM	Russia	Magadan	Okhotskrybvod	Olskiy Hatchery	Uglikanka River	Fed Fry	610360	1[1.7]	7H	I I I I I I I	
R05-9	DM	2005	2006	CHUM	Russia	Magadan	MagadanNIRO	Olskiy Hatchery	Gulf Odyan	Fed Fry	1900000	1[1.5,2.2]	5,2H	I I I I I I I	
R05-10	DM	2005	2006	COHO	Russia	Magadan	Okhotskrybvod	Armanskiy Hatchery	Arman River	1+	2960	1[1.5]	5H	I I I I I	
R05-11	DM	2005	2006	COHO	Russia	Magadan	Okhotskrybvod	Yanskiy Hatchery	Yana River	Fed Fry	84860	1[1.5]	5H	I I I I I	
R05-12	DM	2005	2006	COHO	Russia	Magadan	Okhotskrybvod	Olskiy Hatchery	Uglikanka River	Fed Fry	500000	1[1.5]	5H	I I I I I	
R05-13	DM	2005	2006	COHO	Russia	Magadan	Okhotskrybvod	Olskiy Hatchery	Uglikanka River	Fed Fry	714360	1[1.5]	5H	I I I I I	
R05-14	DM	2005	2006	COHO	Russia	Magadan	Okhotskrybvod	Olskiy Hatchery	Kulkuty River	1+	2000	1[1.5]	5H	I I I I I	
R05-15	DM	2005	2006	COHO	Russia	Magadan	Okhotskrybvod	Olskiy Hatchery	Uglikanka River	1+	28520	1[1.5]	5H	I I I I I	
R05-16	DM	2005	2006	CHUM	Russia	Kamchatka	Sevvostrybvod	Ozerkovskiy Hatchery	Плотникова	Fed Fry	743950	1[1.3,2.1,3.2]	3,1,2H	I I I I I I	
R05-17	DM	2005	2006	CHUM	Russia	Kamchatka	Sevvostrybvod	Ketkinskiy Hatchery	Avacha River	Fed Fry	835952	1[1.3,4]	3,4H	I I I I I I I	
R05-18	DM	2005	2006	CHUM	Russia	Kamchatka	Sevvostrybvod	Paratunskiy Hatchery	Paratunka River	Fed Fry	1406000	1[1.3, 2.1]	3,1H	I I I I	
R05-19	DM	2005	2006	CHUM	Russia	Kamchatka	Sevvostrybvod	Viluyskiy Hatchery	Bolshoy Viluy	Fed Fry	1340133	1[1.3,2.1,3.1]	3,1,1H	I I I I I	
R05-20	DM	2005	2006	COHO	Russia	Kamchatka	Sevvostrybvod	Ketkinskiy Hatchery	Avacha River	Fed Fry	50902	1[1.3,4]	3,4H	I I I I I I I	
R05-21	DM	2005	2006	COHO	Russia	Kamchatka	Sevvostrybvod	Paratunskiy Hatchery	Paratunka River	Fed Fry	325300	1[1.3,2.2]	3,2H	I I I I I	
R05-22	DM	2005	2006	COHO	Russia	Kamchatka	Sevvostrybvod	Viluyskiy Hatchery	Bolshoy Viluy	Fed Fry	897744	1[1.3]	3H	I I I	
R05-23	DM	2005	2006	COHO	Russia	Kamchatka	Sevvostrybvod	Viluyskiy Hatchery	Bolshoy Viluy	1+	185939	1[1.3,2.2]	3,2H	I I I I I	
R05-24	TM	2005	2006	SOCKEYE	Russia	Kamchatka	Sevvostrybvod	Malkinskiy Hatchery	Klyuchyevka	Fed Fry	560600	1[1.3,2.4]	3,4H	I I I I I I I	
R05-25	DM	2005	2006	SOCKEYE	Russia	Kamchatka	Sevvostrybvod	Ozerkovskiy Hatchery	Bolshaya River	Fed Fry	4824570	1[1.3,2.2,3.2]	3,2,2H	I I I I I I I	
R05-26	TM	2005	2006	CHINOOK	Russia	Kamchatka	Sevvostrybvod	Malkinskiy Hatchery	Bolshaya River	Fed Fry	779300	2[1.3,2.1]	H3,1		I I I I
R05-27	DM	2005	2006	CHUM	Russia	Khabarovsk	OOOKometa	Kometa	Tikhoye Lake	Fed Fry	530000	1[1.3,2.3]	3,3H	I I I I I I	
R05-28	DM	2005	2006	MASI	Russia	Khabarovsk	OOOKometa	Kometa	Tikhoye Lake	Fed Fry	49600	1[5n]	5nH	IIIII	

Table1.(Continued) Otolith marks released from Russia for 2005 brood year stocks of salmon.

ID# CH	MARK SCHEDULE	QUALITY OF MARK	COMMEENTS
	17	18	19
R05-1	(5X)24D:24W	10 % bad	the rings are located non-uniformly, too early marking, weak bands
R05-2	(5X)24D:24W	60 % bad	the rings are located non-uniformly, too early marking, weak bands
R05-3	(5X)24D:24W	30 % bad	the rings are located non-uniformly, too early marking, weak bands
R05-4	(5X)24D:24W	30 % bad	the rings are located non-uniformly, too early marking, weak bands
R05-5	(6X)24D:24W	40 % bad	the rings are located non-uniformly, too early marking, weak bands
R05-6	(7X)24D:24W	50 % bad	too early marking, weak bands
R05-7	(7X)24D:24W	10 % bad	too early marking, weak bands
R05-8	(7X)24D:24W	5 % bad	too early marking, weak bands
R05-9	(4X)24D:24W,(1X)24D:48W, (2X)24D:24W	30 % bad	too early marking, weak bands
R05-10	(5X)24D:24W	10 % bad	the rings are located non-uniformly, too early marking, weak bands
R05-11	(5X)24D:24W	10 % bad	the rings are located non-uniformly, too early marking, weak bands
R05-12	(5X)24D:24W	5 % bad	too early marking, weak bands
R05-13	(5X)24D:24W	10 % bad	too early marking, weak bands
R05-14	(5X)24D:24W	good	
R05-15	(5X)24D:24W	good	
R05-16	(2X)24D:24W,(1X)24D:48W,(1X)24D:48W,(2X)24D:24W	30 % bad	30% rings are located non-uniformly
R05-17	(2X)24D:24W,(1X)24D:48W, (4X)24D:24W		
R05-18	(2X)24D:24W,(2X)24D:48W	30 % bad	There is no ring
R05-19	(2X)24D:24W,(1X)24D:48W, (1X)24D:24W		
R05-20	(2X)24D:24W,(1X)24D:48W, (4X)24D:24W		
R05-21	(2X)24D:24W,(1X)24D:48W, (1X)24D:24W	30 % bad	additional rings near to mark
R05-22	(3X)24D:24W		
R05-23	(2X)24D:24W,(1X)24D:48W, (1X)24D:24W		
R05-24	(2X)24C:24H,(1X)24C:48H, (4X)24C:24H		
R05-25	(2X)24HD:24W,(1X)24D:72W,(1X)24D:24W,(1X)24D:72W,(2X)24D:24W	30 % bad	30% rings are located non-uniformly
R05-26	(2X)24C:24H,(2X)24C:48H		
R05-27	(2X)24D:24W,(1X)24D:48W,(3X)24D:24W	15 % bad	additional rings near to mark
R05-28	(5X)12D:12W	70 % bad	additional rings near to mark