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First Experience in Estimating Returns of the Thermally Marked Pink Salmon at Sakhalin Hatcheries

by

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Abstract

For the first time the thermal marking of salmon otoliths has been conducted at Sakhalin hatcheries. Hatchery fish were identified from catches and a proportion of these fish among salmon approaching southeastern Sakhalin was determined. Data on returns of marked fish being released from Bereznyakovsky Hatchery were obtained.

Introduction

At present, a total of 24 salmon hatcheries are operating in Sakhalin region. Annual juvenile release from Sakhalin hatcheries exceeds 0.6 billion fish. Pink salmon comprise more than a half of released juveniles.

A mass project on marking production has already been realized in the history of Sakhalin salmon fish culture. During 1973-1984, SakhNIRO and Sakhalirybvod enterprises had conducted a mass marking of hatchery pink juveniles by the amputation of some fins, and counting of fish returns. Over 9 million juvenile pink salmon were marked at 10 hatcheries of Sakhalin and Kuril islands. The works were resulted only in suggestion of temporal standard coefficients of fish returns: for southeastern Sakhalin hatcheries – 1.3%, Aniva Bay hatcheries – 0.6%, and Iturup Island hatcheries – 1.4%.

A method of thermal marking salmon embryos and larvae, which allows polyvariant marking practically all fish culture production without making any mechanical injuries, is very available (Munk et al., 1993). This method consists of periodic increase-decrease in temperature of water fed into incubators or nurseries, under which the well-recognized marks like rather distinct concentric rings are being formed on otoliths. Russian researches (Akinicheva, Rogatnykh, 1996, 1999; Akinicheva, 2001, Rogatnykh et al., 2002) also have experimental buildups in this trend. In this paper we show the first results of pink salmon marking at Sakhalin hatcheries.

Material and methods

In 1999, an experimental marking of pink salmon embryos from the production parties using the thermal method was conducted at Anivsky, Bereznyakovsky, and Lesnoy hatcheries of Sakhalinrybvod. Hatchery juvenile pink salmon were marked in two ways: thermal and “dry”. The first way had two modes: a temperature increase and decrease for water washing eggs in relation to the background temperature (Munk et al., 1993). The second way consisted of temporary drying eggs and their keeping during this period in humid conditions under the change in air temperature (Akinicheva, Rogatnykh, 1996).

At Bereznyakovsky Hatchery the marking of hatchery juvenile pink salmon has been executed in two ways. A total of 1,223 million eggs were marked by a “dry” method; a mark design contained 3 (first block) + 1 (second block) lines (Table 1). The thermal marking at this Hatchery has been conducted in two

variants. The first variant was conducted for 12,737 million eggs under the 3.5 ?C increase in water temperature; a mark design consisted of three lines. The second variant of the thermal marking was conducted for 2,260 million fry under the 3.0 ?C increase in water temperature; a mark design consisted of two lines.

The thermal marking at Lesnoy Hatchery has been conducted by two blocks. The first block consisted of three rings on otoliths, the second block included two rings. The "dry" marking has been conducted at Anivsky Hatchery. The obtained mark design consisted of 3 + 3 rings.

Otoliths were taken from pink salmon spawners sampled on the southeastern Sakhalin coast and rivers where hatcheries were located (Fig. 1). A total of 2,154 thousand otolith pairs were collected, and 1,795 were examined. Of them, 1,416 thousand otolith pairs were collected at hatcheries and base rivers of hatcheries, 379 otolith pairs were collected at the coastal fishery sites of the southeastern Sakhalin (Table 2). A part of otoliths were not examined due to the fail in polishing their cores while processing.

On otoliths from the Lesnoy Hatchery samples the thermal marks of the first block done analogously with the first variant of thermal marking at Bereznyakovsky Hatchery (3 lines) were read; rings of the second block (2 lines) were not found (Fig. 2 C). On these otoliths the second block run into a general "design" of the otolith. At Anivsky Hatchery, only the experimental "dry" marking has been carried out; mark design on the otoliths of juveniles appeared to be indistinct. No marks were found at adult pink salmon. A total number of the marked fish was calculated based on the extrapolation of their frequency proportion from samples per catches (pink salmon numbers) from the coastal zone, hatchery weirs, and a number of spawners entered for spawning.

Results and discussion

The results of analysis of the pink salmon spawners otolith structure have shown that the mark put by the thermal method at Bereznyakovsky Hatchery is quite recognizable (Fig. 2. A,B). From samples we have found only marks with three lines, that is marks being put on 12,7 million fry. No marks with two lines on otoliths occurred in samples. An insignificant number of fish marked by the "dry" method at Bereznyakovsky Hatchery and a quality of marking did not allow conducting effective works on their identification in spawner returns.

Specimens with marks of Bereznyakovsky Hatchery were found from samples in the coastal zone from Naiba River to Bakhura River (Table 2). According to the proportion of marked fish from samples, a number of the marked fish captured in the coastal zone near the Naiba River was estimated as 404,2 thousand individuals, in the south of Starodubsky fishery site – 148,1 thousand individuals, and near the Bakhura River – 173,61thousand individuals. A total number of the marked fish from the coastal catch

constituted 725,9 thousand fish (Table 3). This makes up 3.44 % of the number of released marked juveniles.

The number of samples collected in the Naiba River basin is much greater, that let us to analyze materials with the greater probability of obtaining the adequate conclusions.

A total of 0,081 million pink salmon spawners have been caught at the weir of Sokolovsky and Bereznyakovsky hatcheries. By August 20 the catch constituted 1,420 thousand fish. At the 19.74% frequency of marked fish, their total number was 0,28 thousand ind. A total of 25,338 thousand fish were captured in the third 10-day of August; a proportion of marked specimens constituted 17.30% (4,383 thousand ind.). The highest percentage of marked fish was recorded from catches in the first 10-day of September – 30.88% of their total catch (54,438 thousand ind.); marked specimens constituted 19,529 thousand ind. Thus, a return of marked fish to the hatchery weir accounted for 24,192 thousand specimens; a proportion of hatchery fish increased by the end of spawning run (Fig. 3).

A percentage of marked fish entering the Naiba River spawning grounds was 3.11%, that let us to estimate a total number of marked fish as 32,033 thousand ind. A total return of the marked pink salmon to Bereznyakovsky Hatchery constituted 782,12 thousand fish. Taking into account that the number of released marked pink salmon was 12,737 million ind., a coefficient of return constituted 6.14% (Table 4).

A full identification of the Lesnoy Hatchery marks appeared to be impossible. Nevertheless, we think that the major marked specimens found in the region with marks of the first block is related to fish marked at Lesnoy Hatchery.

Under the significant pink salmon capture, no marked fish have been found in Mordvinov Bay, that, evidently, is caused by a small number of marked specimens (1,2 million ind.). In Ochepukha River in samples the marked fish were not found (Table 2). A special interest is paid to the finding of marked fish in Bakhura River, because marking in a “dry” way has not been resulted, and it is not possible to identify fish as being marked at Bereznyakovsky or Lesnoy hatcheries. Undoubtedly, the limited scope of marking does not allow estimating pink salmon return coefficients to Lesnoy Hatchery. This is completely related to the research results at Anivsky Hatchery, where marked specimens have not been found at all.

Conclusion

A mark put by the thermal method at Bereznyakovsky Hatchery was ascertained to be recognizable. As for fish marked at Lesnoy Hatchery, only marks from the first block (3 lines) have been read on otoliths. The rings from the second block (2 lines) were not found. In this case, the second block of the mark runs into a general “design” of the otolith. Thus, the results of marking let us to estimate the return coefficients only for Bereznyakovsky Hatchery.

The conducted works resulted in the data on returns of marked fish released from Bereznyakovsky Hatchery. A coefficient of pink salmon returns constituted 6.14%.

The obtained materials have, undoubtedly, a preliminary character, because they are just the first experience in determining thermal marks put on the pink salmon embryo otoliths. But even in this case, the data on changeability of the marked fish frequency near the hatchery weirs are of great interest. Evidently, we may constant the latter terms of the marked fish run in relation to the unmarked ones. Further investigations will allow a more detail consideration of this aspect of the joint reproduction (wild and artificial) and others.

References

1. Akinicheva E.G. 2001. The use of salmon otolith marking for evaluating hatchery efficiency. Collected Scientific Works of MagadanNIRO. V. 1: 288-296. (in Russian)

2. Akinicheva E.G., Rogatnykh A.Yu. 1996. Thermal salmon marking experience at hatcheries. Vopr. Ichthiologii 36: 693-698. (in Russian)

3. Munk K.M., Smoker W.W., Beard D.R., Mattson R.W. 1993. A hatchery water-heating system and its application to 100% thermal marking salmon. Progress. Fish-Culturist 3: 284 –288.

4. Rogatnykh A.Yu., Akinicheva E.G., Safronenkov B.P. 2002. Methods of mass salmon marking: problems and prospects of their applications in practice. Rybovodstvo and Rybolovstvo 1: 49-51. (in Russian)

Table 1

Releases of fry pink salmon marked by thermal and “dry” methods at Sakhalin hatcheries in 1999

Name of hatchery	Location of fry release	Date of marking	Fry releases, million ind.	Code of mark, RBr	Method of marking	Mode of marking
Bereznyakovsky	Naiba River (Okhotsk Sea)	9-14.11.99	12,737	1 (1.3)	.+3.5 ?	(3X) 24H :24C
Bereznyakovsky	Naiba River (Okhotsk Sea)	10-18.11.99	1,223	1 (1.3+2.1)	" dry"	(2x) 12D : 36W, (1) 12 D :60 W, (1) 24 D
Bereznyakovsky	Naiba River (Okhotsk Sea)	20-23.12.99	2,260	2 (1.2)	.+3.0 ?	(2X) 24H : 24?
Lesnoy	Ochepukha River (Okhotsk Sea)	9-14.11.99-(at Bereznyakovsky Hatchery), 8-11.12.99	1,212	1 (1.3+2.2)	.+3.0 ?	(2X) 24H :24C, (1) 24H :60C, (2x) 24H : 24C
Anivsky	Lutoga River (Aniva Bay)	10-15.11, 22-24.11.99	1,175	1 (1.3+2.3)	" dry"	(2x) 12D : 24W, (1) 24D :168W, (3x) 12D : 12W

Table 2

Proportion of marked Salmon otoliths in hatchery and marine tests, collected in fishing season in 2001

Place of collecting	Date of collecting	Collected otoliths, items	Examined otoliths items	Quantity of found marks	
				Items	%
Hatchery tests					
Mouth of river Nayba	19.07.01	98	65	3	4.62
	2.08.01	106	42	2	4.76
	14.08.01	94	76	3	3.95
	21.08.01	117	106	1	0.94
Sokol hatchery,river Belaya	20.08.01	100	76	15	19.74
	30.08.01	100	96	13	13.54
	10.09.01	100	93	17	18.28
Sokol hatchery, river Bolshoy Takoy	31.08.01	26	19	4	21.05
	10.09.01	100	43	23	53.49
Total		841	616	81	13.15
Bakhura river	15.08.01	100	88	3	3.41
Lesnoy Hatchery	21.08.01	12	12	0	
	28.08.01	100	86	1	1.16
Ochepukha river	16.09.01	50	43	0	
Znamenka river	25.09.01	50	21	1	4.76
Total		312	250	5	2.00
Taranaysky hatchery	15.09.01	50	50	0	
Anivsky hatchery	22.08.01	100	100	0	
	27.08.01	100	100	0	
	6.09.01	100	100	0	
	15.09.01	100	100	0	
Bystraya river	6.08.01	100	100	0	
Total		863	800	86	10.75
Total at hatcheries		1704	1416		
Marine tests					
Naiba river(Starodubskoye settlement)	10.08.01	100	65	5	7.69
Starodubskoye settlement(rure)	12.08.01	50	41	3	7.32
Area of Bakhura	28.08.01	100	73	4	5.48
Total		250	179	12	
Okhotskoye settlement	23.08.01	100	100	0	
	25.08.01	100	100	0	
Total of marine tests		450	379	12	

Table 3

Frequency of marked fish from pink salmon catches near southeastern Sakhalin

Region	Coastal catch by small sites, thousand ind.	Calculated number of marked fish, thousand ind.	Frequency of marked fish %
Tikhaya River – stm. Vzmorye	1193,75	-	-
Stm. Starodubskoye (Naiba River)	5255,6	404,16	7.69
Stm. Starodubskoye (Cape Rure)	2023,7	148,13	7.32
Bakhura River	3167,98	173,61	5.48
Stm. Okhotskoye	8999,22	0.00	0.00
Cape Svobodny – Cape Aniva	439,38	-	-
Total	21079,63	725,9	3.44

Table 4

Coefficient of return for pink salmon released from Bereznyakovsky Hatchery

Region	Total fish return, million ind.	Calculated number of marked fish, thousand ind.	Percentage of marked fish, %	Coefficient of return,%
Okhotsk Sea coast	21,080	725,9	3.04	5.7
Natural spawning grounds of Naiba River	1,030	32,03	3.11	0.25
Hatchery weirs	0,081	24,19	30.36	0.19
Total:	22,191	782,12	3.53	6.14

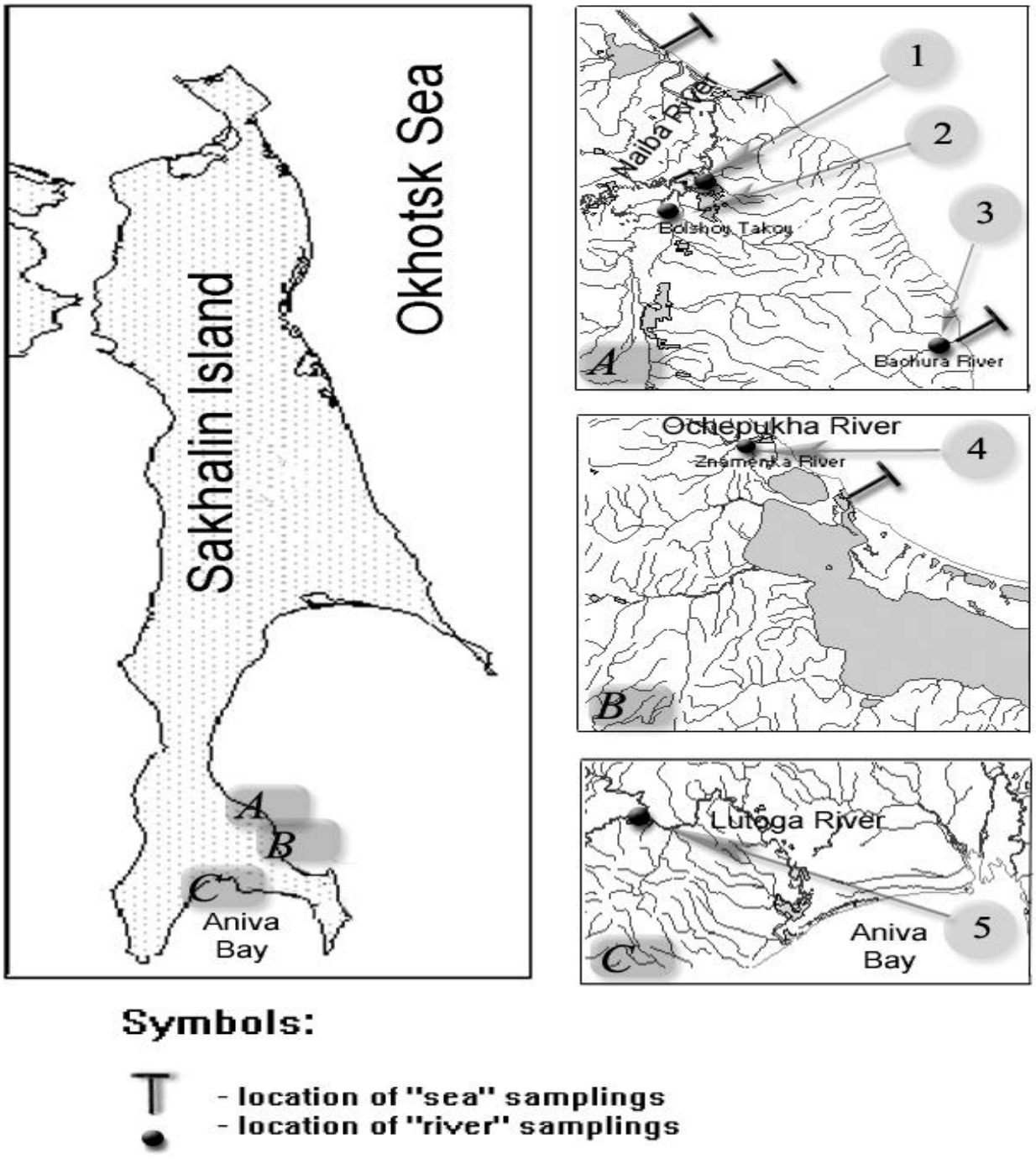

Fig. 1. Map of the study region.

Figures denote:

1-Sokolovsky Hatchery

2-Bereznyakovsky Hatchery

3- Bakhura Hatchery

4-Lesnoy Hatchery

5-Anivsky Hatchery

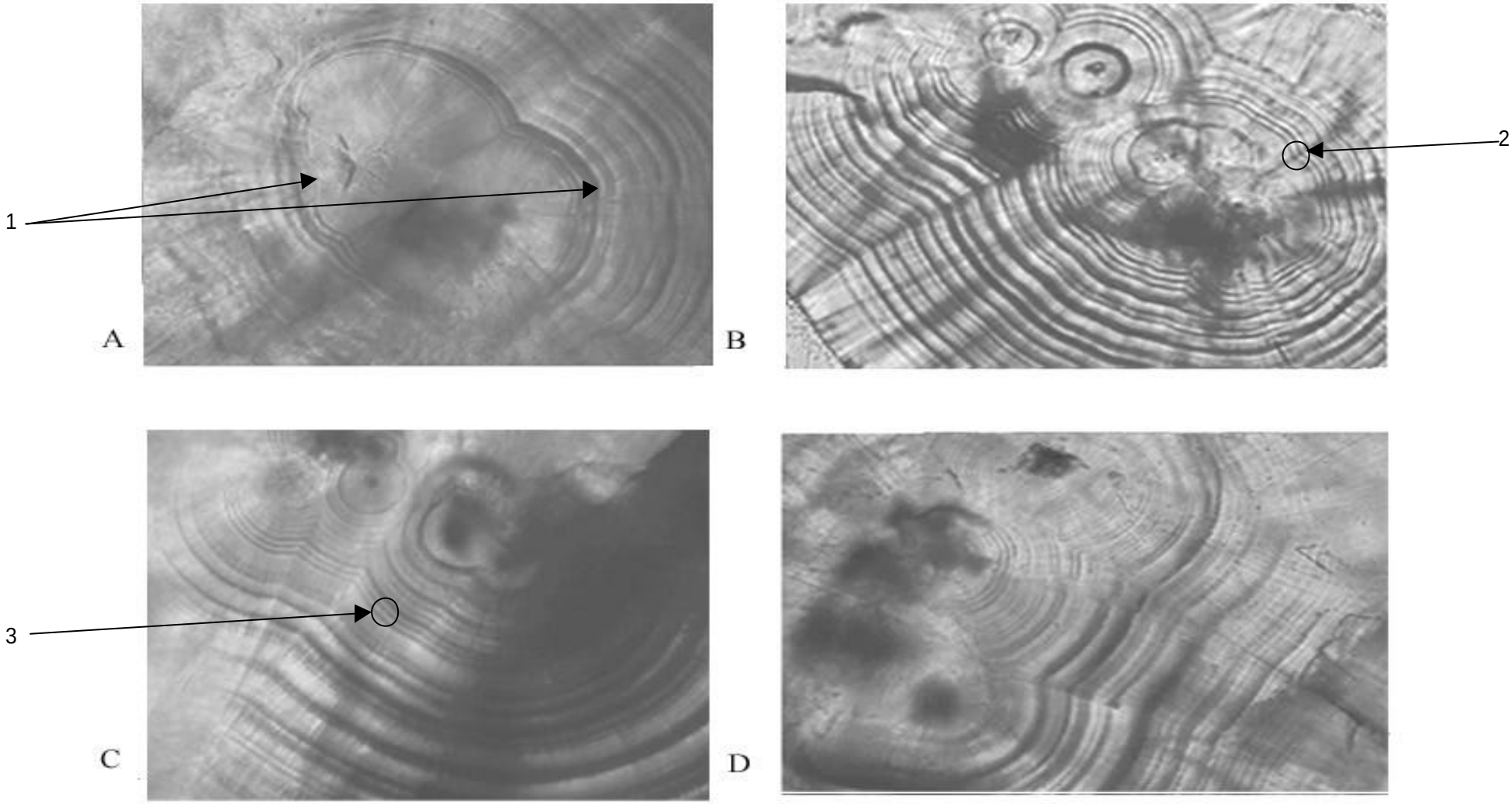

Fig. 2. Thermal otolith marks of salmon spawners from the 2001 catch

A - Bereznyakovsky Hatchery (magnification 10X50)
B - Bereznyakovsky Hatchery (magnification 10X100)
C - Lesnoy Hatchery (magnification 10X100)
D – otolith without a mark (magnification 10X100)

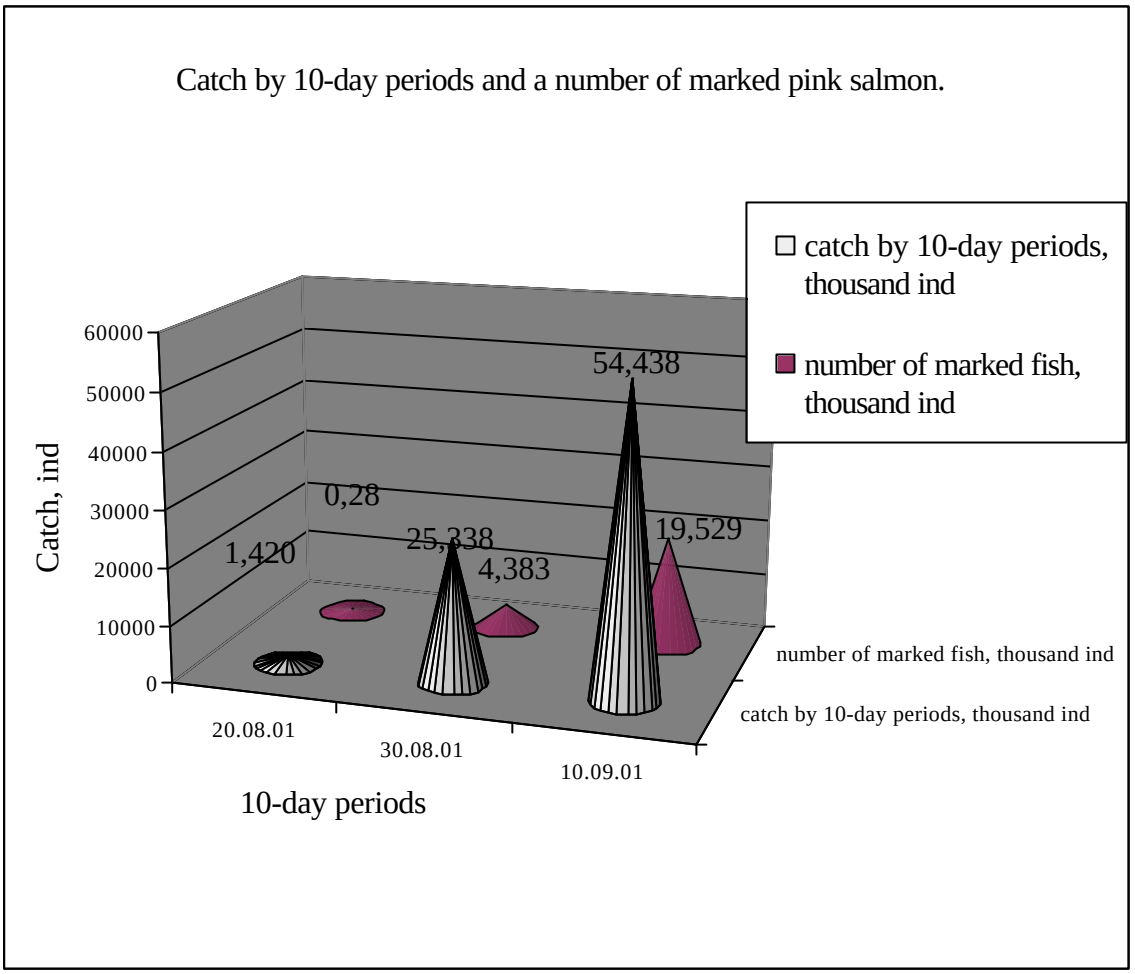

Fig. 3. The dynamics of total catch and marked salmon catch at Bereznyakovsky hatchery in August-September 2001

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