NPAFC

Doc. 508

Rev.

Distribution and some Biological Characteristics of Mikizha (*Parasalmo mykiss*) in May-August 1996-2000 in the Kuril Islands Waters of Pacific Ocean and the Waters of Okhotsk Sea

by

Sergey A. Kovalenko and **Alexander O. Shubin**

Sakhalin Research Institute of Fisheries and Oceanography
196, Komsomolskaya St., Yuzhno-Sakhalinsk, 693023, Russia

submitted to the

North Pacific Anadromous Fish Commission

by

RUSSIA

November 2000

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER. Distribution and some Biological Characteristics of Mikizha (*Parasalmo mykiss*) in May-August 1996-2000 in the Kuril Islands Waters of Pacific Ocean and the Waters of Okhotsk Sea. 2000. (NPAFC Doc. 508). 13p. Sakhalin Research Institute of Fisheries and Oceanography, 196, Komsomolskaya St., Yuzhno-Sakhalinsk, 693023, Russia

INTRIDUCTION

Salmon from genus *Parasalmo* are distributed amphipacifically and presented by the complex of close species (Pavlov, Kuzishcin, 1999). Mikizha - *Parasalmo mykiss* (*Oncorhynchus mykiss*, "steelhead trout " by American authors) is reproductively connected as with rivers of Eastern Asia, so, evidently, with rivers of Northern America. In the Asian part of the area, this species spawns in rivers of Kamchatka. In the recent ten-year periods, many Russian researchers studied biology and ecology of the anadromous form of mikizha during the freshwater period of life (Savvaitova, Lebedev, 1966; Savvaitova, Maximov,1969; Maximov, 1972, 1976; Savvaitova, 1975; Kuzishcin, Savvaitova and Gruzdeva, 1999). The sea life period of mikizha off the shores of Eastern Asia is less known (Myers et al., 1993; Welch et al., 1998). During the counting surveys of 1996-2000 on Pacific salmon carried out by the vessels of drift fishery in the Kuril Islands waters of Pacific Ocean and the Okhotsk Sea, we have caught 280 mikizhae. During 1996-1999 we accumulated the material, and began to summarize it for the first time in 2000. The first preliminary results of our analysis on distribution, ecology and biology of mikizhae during their sea life period off the shores of Eastern Asia are presented in this work.

MATERIAL AND METHODS

The material was collected in 1996-2000 during investigations of Pacific salmon carried out at the vessels of drift fishery in the exclusive economic zone of Russia in the Kuril Islands waters of Pacific Ocean ($44^0$50-$50^0$50 N) and in the waters of Okhotsk Sea between northern Sakhalin and northern Kuril Islands (Fig. 1). The period of works was from May 15 to August 15 in the Pacific Ocean, and during August in the Okhotsk Sea. Gill nets with the mesh of 120-135 mm were used. They were settled at night in the water layer of 0-10 from the commercial vessels operating by the programs of SakhNIRO. In 1996-1998, the material on mikizha was collected only in the Pacific Ocean in the region located to the south from 48^0 00 N using one vessel. In 1999, two vessels carried out researches – in the Pacific Ocean from 44^0 50 to $50^0$50 N and in the Okhotsk Sea. In 2000, the works were carried out by five vessels. From 20 to 32 kilometers of gill nets were settled daily from each vessel. A standstill of nets was 10-12 hours. During investigations, 280 mikizhae (125 males and 155 females) were taken for biological analysis including 57 specimens for morphometrical analysis.

Biological analysis included measurements of fork length, weight, sex, gonad-somatic index (GSI – ratio of the gonad weight to the weight of trunk multiplied 100), visual estimation of stomachs. The length of fish was measured up to the nearest 1 cm, weight – to 50 g, gonad weight – to 1 g. Scales were collected between the back edge of the dorsal fin and the front edge of the anal fin from the 2-3 rows above the lateral line. In 1996-1999, 1-3 scales were taken from the left side of the body. Since 2000, we began to take 10 scales from each side of the body. The scales were watched under the binocular microscope MBS-9 with magnification of 2 x 8, and the number of annual zones was analyzed. 57 fish (males and females) of 55-81 cm in length were taken for morphological analysis (35 fish in 1999 and 22 fish in 2000). Morphometrical analysis was done by the scheme of I.F. Pravdin (1966), earlier used by K.A. Savvaitova and V.D. Lebedev (1966) for analysis of mikizha from the rivers Utka and Kikhchik (Western Kamchatka). The ocean (sea) surface temperature at the sites of the net settling was measured by the vessel remote sensors located at the depth of 3-4 m.

RESULTS

In the summer period of 1996-2000, additionally to five species of genus *Oncorhynchus* – pink, chum, sockeye, coho and chinook salmon – one more species of salmonids occurred in catches of drift gillnets from the Kuril Islands waters of the Pacific Ocean and the Okhotsk Sea (Fig. 1). It is a big silver fish with a small round head (19.1% of the length AC). Its postorbital bones do not reach the preopercular bone, ethmoid bone is bisected, frontal bones are closed in, premaxillary bone is with a well expressed rising crest. A maxillary bone turns down at angle to the eye and goes behind its back edge. A caudal peducle is relatively short (17.7% of the length AC) and high (8.5% of the length AC). A caudal fin is weakly forked, black, spotted, its central rays are silver colored. Many small round or oblong spots occur on the caudal fin. Infrequent big round spots also occur on the back, head, dorsal and adipose fins. There are no pink line along the lateral line and orange spot on the intergill space. The bones of upper and lower jaws and also palatine and glossohyal bones are with the well expressed large teeth. There are 3-4 hard and 9-11 (average 9.9) soft rays in the dorsal fin. In the anal fin – 3-4 hard and 8-11 (average 9.7) soft rays. In pectoral fins – 1 hard and 12-14 (average 13.0) soft rays. In ventral fins – 1 hard and 8-9 (average 8.9) soft rays. The number of scales on the lateral line is 125-136, average 129.6. The number of gill rakers is 17-21, average 19.1. The number of gill rays on the left is 9-13, average 11.6, on the right - 9-12,

average 11.1. The number of vertebrae is 57-65, average 61.8, pyloric caeca - 24-55, average 36.3. We have examined 36 fish caught in 1999 by morphometrical analysis according to 27 plastic characteristics. The results of this work will be published individually because of the large volume. Now we can note that the comparison of results of our analysis with the results of analysis of the mikizha from the rivers Utka and Kikhchik (Western Kamchatka) earlier made by K.A. Savvaitova and V.D. Lebedev (1966) showed a great similarity by the all used characteristics.

The first individuals of the examined salmon occur in the north and south of the Kuril Islands waters of Pacific Ocean in the late June – early July at the ocean surface temperature of 4-5^{0}C and higher. By the end of July, this species is distributed all over the water area of Kuril Islands. The majority of fish were caught at the temperature range from 6 to 10^{0}C (Fig.2) after July 10. In August 1999 and 2000, we watched this salmon species in the Okhotsk Sea between northern Kuril Islands and northern Sakhalin Island. Its abundance is rather little – a usual daily catch was not more than 4-6 individuals per 28-32 km of nets. The length of fish from the catches varied from 47 cm to 91 cm, weight – from 1.0 kg to 8.5 kg. Fish maturity ranged widely – GSI of males was 0.1-4.5 %, females 0.1-17.8 % (Fig. 3).

Among immature and maturing males (121 individuals at the maturity stage of II to IV) we have distinguished two groups conditionally named "small-sized" and "large-sized" by the size-weight indices, age, and maturity. Fish from a small-sized group (43 ind.) were 47-65 cm long, average 58.1 cm, and 1.0-3.7 kg weigh, average 2.3 kg. As a rule, one (age 2.1 or 3.1), rarely two (age 2.2 or 3.2) complete marine zones of growth can be observed on their scales. The majority of those fish (73 %) were characterized by low maturity – GSI 0.05-0.4% (gonad weight to 5 g). The rest 27% of fish were more mature - GSI 0.6-3.5% (gonad weight 6-80 g).

The males of a large-sized group (78 ind.) were 66-91 cm long, average 74 cm, and 2.2-8.5 kg weigh, average 4.6 kg. One can see two (age 2.2, 3.2 or 4.2) or three (age 2.3 or 3.3) complete marine zones of growth on their scales. More than half fish from this group (56 %) were characterized by high maturity – GSI 0.6-4.5% (gonad weight 16-260 g). The rest 44% of fish were less mature - GSI 0.1-0.6% (gonad weight to 15 g).

Among immature and maturing females (145 individuals at the stage from II to V) two groups are distinguished as well. The females from a small-sized group (16 ind.) had smaller size-weight indices comparing to the males from the same group – length from 51 to 60 cm., average 56.0 cm., weight from 1.2 to 3.0 kg, average 2.1 kg. As a rule, one (age 2.1 or 3.1), rarely two (age 2.2 or 3.2) complete marine zones of growth can be observed on their scales.

The majority of those fish (73 %) were characterized by low maturity – GSI 1.0% (gonad weight to 20 g). The rest 27% of fish were more mature - GSI 1.1-4.3% (gonad weight 25-110 g).

The females from a large-sized group (129 ind.) also had smaller size-weight indices comparing to the males from the same group – length from 61 to 84 cm., average 70 cm., weight from 2.3 to 5.8 kg, average 3.9 kg. One can see two (age 2.2, 3.2 or 4.2) or three (age 2.3, 3.3 or 4.3) complete marine zones of growth on their scales. The majority of those fish (74 %) were characterized by high maturity – GSI 1.1-17..9% (gonad weight 30-500 g). The rest 26% of fish were less mature - GSI to 1.0% (gonad weight to 40 g) (Fig.4).

In addition to 276 immature and maturing fish (stage of maturity from II to V), we have caught 14 fish more which spawned in the year of capture (stage of maturity VI-I). All those fish were caught in 2000, 13 of them in July in the region located to the north from 48°00 N. One fish was caught in August, 2000 in the region located to the south from 48°00 N. The males from this group (4 individuals) were 65-81 cm long, and 2.6-5.2 kg weigh. The age of fish was 2.2 (3 ind.) and 2.3 (1 ind.). The females (10 individuals) were 70-84 cm long, and 3.2-5.6 kg weigh. The age of fish was 2.1 (1 ind.), 2.2 (6 ind.), 2.3 (2 ind.), and 3.3 (1 ind.).

In salmon stomachs we observed only juvenile squids and fish. In July, 2000 in the southern part of Kuril Islands waters their stomachs consisted of 1-2 squids by the length of 10-12 cm and (or) 10-35 fry greenling by the length of 6-8 cm.

4 individuals of this salmon species were caught in 2000. They looked like the tagged fish by the amputation of some fins. Two individuals were without the adipose fins. The fish were 61 and 76 cm long, 2.6 and 4.2 kg weigh, at the age of 2.1 and 2.2. One individual was without the adipose and dorsal fins. This fish was 62 cm long, 2.3 kg weigh, and 2.1 at the age. One individual was without the adipose and left ventral fins. This fish was 61 cm long, 2.3 kg weigh, and 3.1 at the age.

DISCUSSION

All 280 caught fish were morphologically common, and we had no doubts as for their belonging to the same species. By the aggregate characteristics we referred them to mikizha - *Parasalmo mykiss*.

In the Kuril waters of Pacific Ocean mikizhae behave as thermophyle fish. They occur in 200-mile zone of Kuril Islands only in the late June – early July, later than all early and

summer forms of species from genus *Oncorhynchus*, including the early form of coho salmon, the most thermophyle of them. Mikizhae are absent in this region during May and the major part of June when the ocean surface temperature is usually lower than 4-5^{0}C (Shubin, Kovalenko, 2000). In July when the temperature of the ocean surface rises to 6-10^{0}C, mikizhae are observed all over the area of Kuril waters of Pacific Ocean. Our data on the terms of mikizha runs to the Kuril Islands prove the earlier researches (Welch et al., 1998).

By the character of feeding mikizha is a predator. Only squids and fish are found in their stomachs. It resembles the chinook salmon in this respect.

By the level of maturity all caught fish were presented by 3 groups: immature, maturing, and those who spawned in the year of capture from the sea. Three quarters of small-sized males and females were immature. Among the large-sized fish about a half of males and a quarter of females were immature. Immature fish return to winter into the regions of Pacific Ocean located far to the east from Kuril Islands. A quarter of the small-sized males and females, about a half of the large-sized males and three quarters of the large-sized females were related to the maturing fish. Some part of them, undoubtedly, is connected with the rivers of Kamchatka. These are, first of all, large fish occurred in the sea during 2-3 years and characterized by the high maturity. Unlikely, that the males with GSI of 2-3% and higher and females with GSI of 4-6% and higher, inhabiting the area 100-200 miles from the southern shores of Kamchatka in July-August, will run for spawning to rivers of North America. Evidently, the fish caught from the sea after their spawning are of native origin. It is difficult to determine the origin of fish being at early stages of maturation.

Sex products of the majority of fish related to the group of maturing fish were at stages II-III, rarely at III-IV. But some fish, about 1%, had the running sex products at stage V. Those fish are supposed to spawn not in the spring of the next year, as it is typical for mikizha (Savvaitova, Lebedev, 1966), but in the year of their capture from the sea. The fact of capture of the already spawned fish in July, 2000 from the ocean waters shows that such fish can run far from the site of spawning.

We have not presented the detail data on the age composition of mikizha, as they are preliminary. This is because of the bad "reading" of annual growth zones. In addition, a central part of many scale patterns is destroyed. At present, we continue to study the scales of mikizha using the "BioSonics" system.

In conclusion we'd like to note that during the whole period of researches we have caught no fish living in the sea during its first year of life (age 2.0+ or 3.0+). The absence of such fish in catches we explain by selectivity of the used nets.

ACKNOWLEDGMENTS

The authors thank the staff of SakhNIRO L.D. Khorevin, V.M. Chupakhin, E.V. Tarasyuk, Yu.I. Ignatiev, L.V. Koryakovtsev, who took part in collecting the material at the vessels of drift fishery in 2000.

REFERENCES

Kuzishcin K.V, Savvaitova K.A. and Gruzdeva M.A. 1999. Scale structure as a criterion of differentiation of local population of *Parasalmo mykiss* in the rivers of West Kamchatka and North America. Jour. Ichthyol. 39:809-818.

Maximov V.A.. 1972. Some data on ecology of mikizha (*Salmo mykiss* Walbaum) from the River of Utkholok (West Kamchatka). Jour. Ichthyol. 12: 827-834.

Maximov V.A. 1976. Ecology of the population of mikizha (*Salmo mykiss* Walbaum) from the River of Bolshaya (West Kamchatka). Vopr. Ihtiologii. 16:16-20.

Pavlov S.D., Kuzishcin K.V. 1999. Morphobiological and genetic features of *Parasalmo mykiss* from the River of Voyampolka (West Kamchatka). Jour. Ichthiol.39:748-760.

Pravdin I.F. 1966. Manual on fish study. 235 p.

Savvaitova K.A., Lebedev V.L. 1966. On the systematic position of *Salmo penshinensis* Pallas and *Salmo mykiss* (Walbaum) and their relationship with the American representatives of genus Salmo. Vopr. Ihtiologii 6:593-608.

Savvaitova K.A., Maximov V.A. 1969. Age and growth of *Salmo penshinenesis* Pallas and *Salmo mykiss* Walbaum. Vopr. Ihtiologii. 9: 665-677.

Savvaitova K.A. 1975. Population structure of *Salmo mykiss* Walbaum within their natural range. Vopr. Ihtiologii. 15: 984-997.

Myers K.W., Harris C.K., Y.Ishida, L.Margolis and M.Ogura. 1993. Review of the Japanese driftnet salmon fishery in the Western North Pacific Ocean and the continent of origin of salmonids in the area. Int. North Pac. Fish. Comm. Bull. 51:17-19.

Welch D.D., Y.Ishida, K.Nagasawa and J.P.Eveson. 1998. Thermal limits on the ocean distribution of steelhead trout (*Oncorhyncus mykiss*). NPAFC Bull. 1:396-404.

Shubin A., Kovalenko S. 2000. Identification of pink salmon (*Oncorhynchus gorbuscha*) runs in the ocean off the Kuril Islands, Russia. NPAFC Bull. 2 (in publish).

Figures

Figure 1. Map of research area and locations of *Parasalmo mykiss* catches in May-June (A) and July-August (B), 1996-2000.

Figure 2. Distribution of *Parasalmo mykiss* per sea surface temperature.

Figure 3. Distribution of fork length (A), body weight (B) and gonad somatic index (C) of *Parasalmo mykiss* from driftnet catches in Pacific ocean off the Kuril Islands and Okhotsk Sea, 1996-2000.

Figure 4. Ratio of gonad weight to fork length of *Parasalmo mykiss* (A-male, B-female)

Fig. 1.

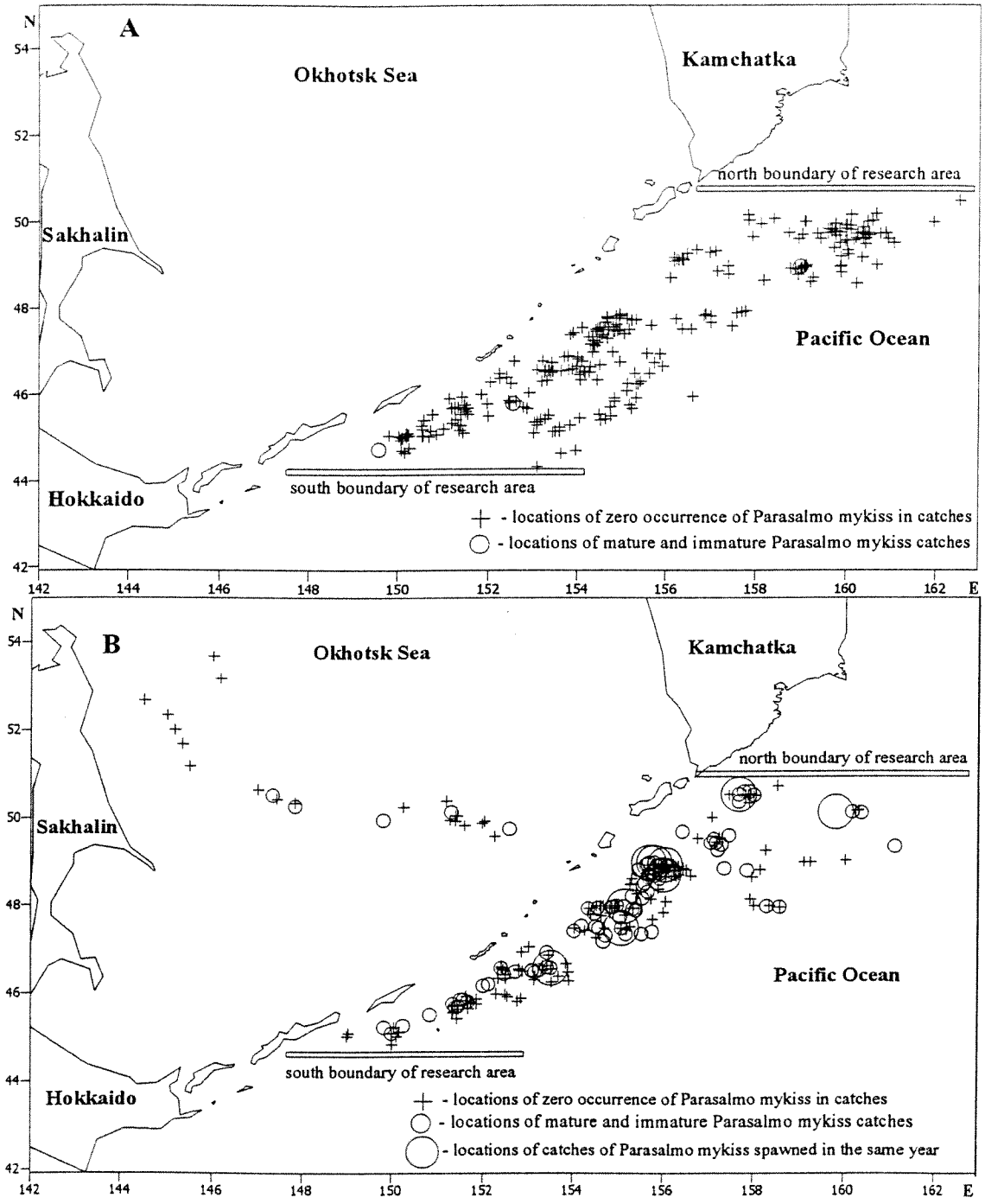

A
Okhotsk Sea
Kamchatka
north boundary of research area
Sakhalin
Pacific Ocean
south boundary of research area
Hokkaido
+ - locations of zero occurrence of Parasalmo mykiss in catches
○ - locations of mature and immature Parasalmo mykiss catches
N
54
52
50
48
46
44
42
142
144
146
148
150
152
154
156
158
160
162
E
B
Okhotsk Sea
Kamchatka
north boundary of research area
Sakhalin
Pacific Ocean
south boundary of research area
Hokkaido
+ - locations of zero occurrence of Parasalmo mykiss in catches
○ - locations of mature and immature Parasalmo mykiss catches
○ - locations of catches of Parasalmo mykiss spawned in the same year

Fig. 2.

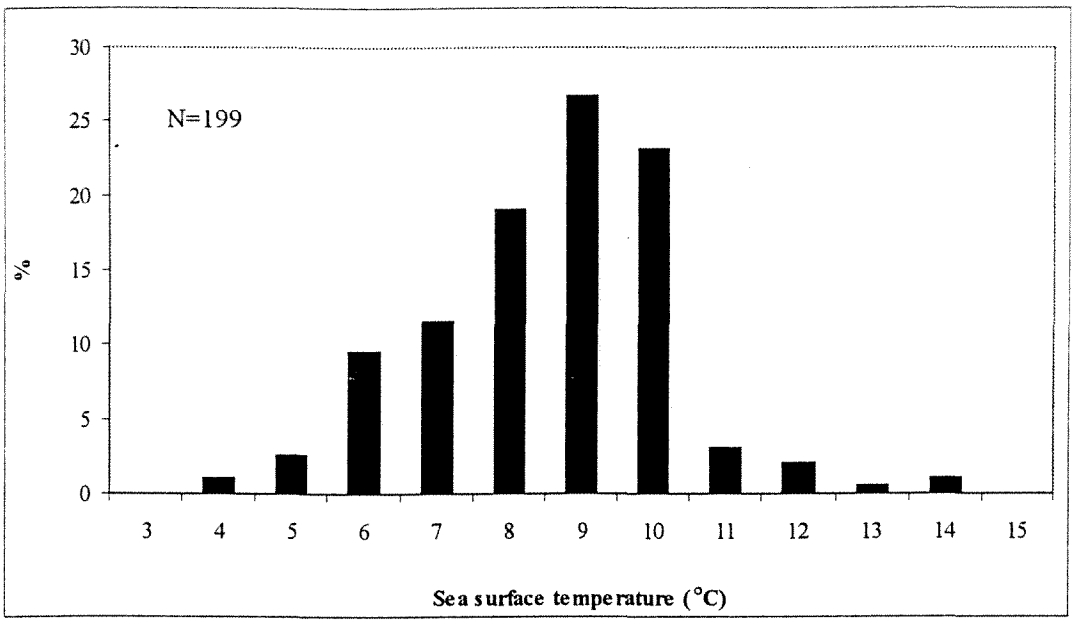

30
25
20
15
10
5
0
%
N=199
3
4
5
6
7
8
9
10
11
12
13
14
15
Sea surface temperature (°C)

Fig. 3.

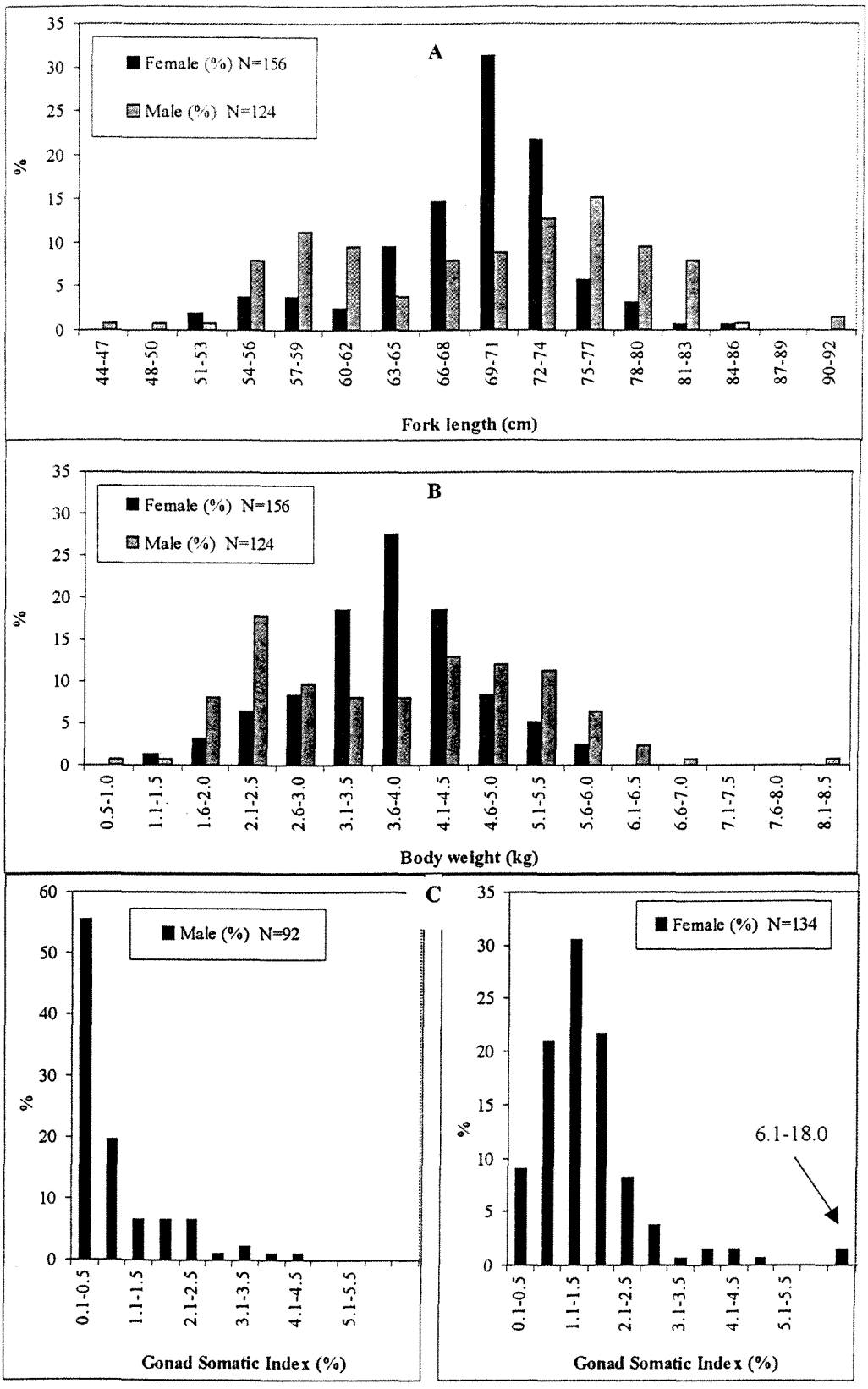
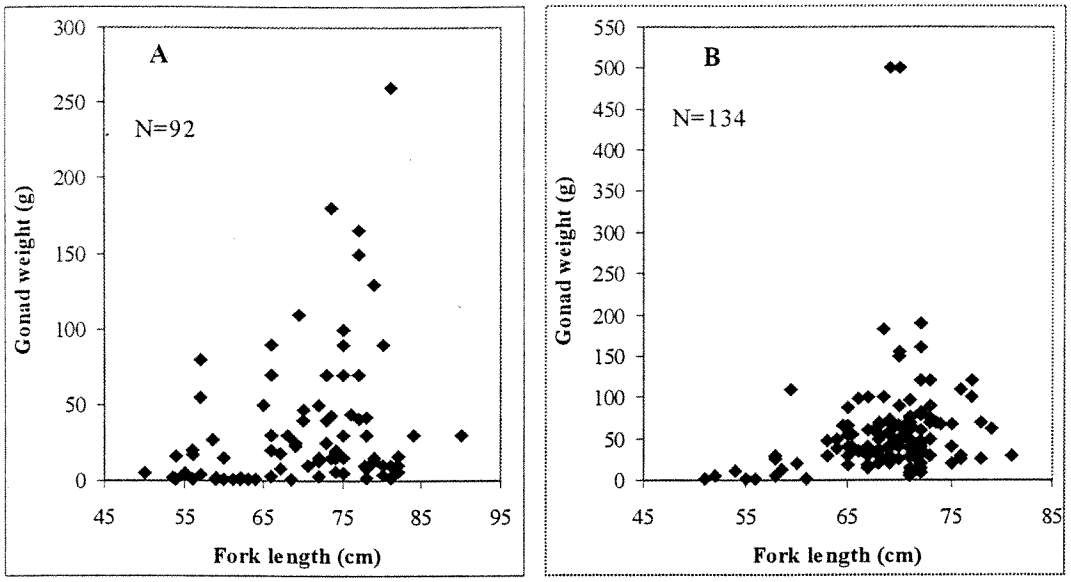

A
Female (%) N=156
Male (%) N=124
%
Fork length (cm)
B
Female (%) N=156
Male (%) N=124
%
Body weight (kg)
C
Male (%) N=92
%
Gonad Somatic Index (%)
Female (%) N=134
%
6.1-18.0
Gonad Somatic Index (%)

Fig. 4.


A
N=92
Gonad weight (g)
300
250
200
150
100
50
0
45
55
65
75
85
95
Fork length (cm)
B
N=134
Gonad weight (g)
550
500
450
400
350
300
250
200
150
100
50
0
45
55
65
75
85
Fork length (cm)