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SALMON RIVERS OF THE KOLA PENINSULA. REPRODUCTIVE POTENTIAL AND STOCK STATUS OF THE ATLANTIC SALMON FROM THE KOLA RIVER

by

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INTRODUCTION

The paper presented keeps the series of papers on reproductive potential and stock status of salmon from the rivers of the Kola Peninsula (Zubchenko, Kuzmin, 1993; Zubchenko, 1994). Salmon rivers of this area have been affected by significant fishing pressure for a long time, and, undoubtedly, these data are of great importance for assessment of optimum abundance of spawners, necessary for spawning grounds, for estimating the exploitation rate of the stock, the optimum abundance of released farmed juveniles and for other calculations. At the same time, despite the numerous papers, the problem of the stock status of salmon from the Kola River was discussed long ago (Azbelev, 1960), but there are no data on the reproductive potential of this river in literature.

The Kola River is one of the most important fishing rivers of Russia. It flows out of the Kolozero Lake, situated almost in the central part of the Kola Peninsula, and falls into the Kola Bay of the Barents Sea. Locating in the hollow of the transversal break, along the line of the Imandra Lake-the Kola Bay, its basin borders on the water removing of the Imandra Lake in the south,

the Tuloma River - in the west and the Voronya and Teriberka Rivers - in the east. The length of the river is 83 km, the drainage area - 3846 sq.km, the annual mean discharge - 41.2 m/s, lakes - 6%, swampiness - 15%, woodlands - 55%. The main affluents are the Orlovka River (24 km), the Voronya River (15 km), the Medvezhya River (15 km), the Bolshaya Kitsa River (77 km), the Tuhta River (35 km), the Kildinsky Brook (23 km). The largest lakes (Kolozero, Pulozero, Murdozero) are placed in the upper part of the basin.

According to the literature data (Berg, Pravdin, 1948; Surkov, 1966) and our observations, such fishes as lamprey (Lampetra japonica (Martens)), the Atlantic salmon (Salmo salar L.), sea trout (S.trutta L.), brook trout (S.trutta morfa fario L.), vendace (Coregonus albula L.), gwuniad (Coregonus lavaretus (L.)), grayling (Thymallus thymallus L.), pike (Esox lucius L.), minnow (Phoxinus phoxinus (L.)), burbot (Lota lota (L.)), threespine stickleback (Gasterosteus aculeatus L.), ninespine stickleback (Pungitius pungitius (L.)), perch (Perca fluviatilis L.) occur in the basin of the Kola River. Besides, acclimatized pink salmon (Oncorhynchus gorbusha (Walbaum) periodically migrate to the river.

MATERIAL AND METHODS

The data from the investigations, conducted in the basin of the Kola River in 1981-1985 and in 1992-1994, as well as the data on fish accounting, catch statistics, characteristic of spawners, collected at the accounting fence in 1959-1994, are used in the paper.

Accounting fence is placed at the distance of 25 km from the mouth and involves a net gauze, completely partitioning off the mouth of the river, in the center of which the trap of rectangular form is mounted. As a rule, the accounting fence is installed after a spring flood (late May - early June) and works untill the stable frosts (September-October).

The surveys of the spawning-nursery areas were conducted in the summer drought period. The boundaries of river reaches were visually determined, the areas were calculated using the large-scale topographic maps. The grounds were characterised in accordance with the classification, proposed by M.V.Klenova (1931). To calculate the productivity of spawning-nursery areas of salmon in the basin of the Kola River the Power's method (Power, 1973) was used, and, in compliance with characteristic, geographical position and the extent of afforestation, the following coefficients were chosen: the bottom of river (stones with the diameter in excess of 5 cm) - 1,4; the width of river (more, than 11 m) - 0.9; the valley of river (fields with some forest regions) - 1.1; prevailing species of fishes (sea trout) - 1.2; the characteristics of water (pure, transparent, cold) - 1.0; latitude of the area (68-69°N) - 1.0; coefficient of the

ratio of river productivity to the period of field investigation conducting (investigations were carried out in June-October) - 1.0.

The data on the inhabited juvenile density have been obtained with the aid of electrofishing at the 17 standard stations. Cameral processing of the data was made according to the standard methods (Pravdin, 1966). All the data obtained were statistically processed. In calculating the density of distribution the removal method was applyed (Zippin, 1958).

Reproductive potential

As part of the study it was noticed, that reliable boundary of the Atlantic salmon distribution up the Kola River is at 66 km. It is known from the inquest of inhabitants and the data by Azbelev (1960), that the salmon previously occurred all over the area from source to mouth. However, at the present moment we have no data acknowledging this.

In the upper current the river represents short and full of rapids side channels, connecting lakes. Here the rapids continuously run, only rarely being uncoupled by small water holes. The length of rapids varies from 100 to 400 m. Middle and lower currents of the river are characterised by the long rapids and developed water holes. There are four large rapids in this river reach: in the area of the Medvezhya River mouth, with the length of nearly about 4 km; in the area of inflow of the Bolshaya Kitsa River, stretching for about 7 km; down the Tuhta River mouth, with the length of nearly about 9 km; and in the mouth, with the length of about 3.5 km (Fig.1).

In the upper current the width of the river at the rapids is 25-80 m, the depth is 0.5-0.9 m, the velocity of the current - up to 2.5 m/s; at the water holes the wigth of the river reaches 100 m, the depths increase up to 2.5 m, and the velocities of the current decrease down to 0.3 m/s. In the middle and lower current the prevailing width of the river is 40-50 m, the largest one is 150 m and the least one - 8 m. The depths at the water holes are equal to 1.5-2.0 m, at the most deepwater ones they reach 6 m and decrease down to 0.2-0.5 m at the rapids. The velocities of the current at the rapids range from 0.5 to 3.0 m/s, at the water holes - from 0.1-0.4 m/s. The grounds at the rapids in the main stream bed are presented by boulders and cobblestones of all fractions. Small cobblestones, shingles of all fractions and gravel are more typical of the side channels.

The total area of spawning-nursery areas in the basin of the Kola River is estimated at 2 169 500 sq.m, including in the stream bed - 1 715 000 sq.m, in the Medvezhya River - 85 000 sq.m, in the Kitsa River - 274 000 sq.m, in the Tuhta River - 40 500 sq.m, in the Orlovka River - 55 000 sq.m.

According to the Power's calculations (1973), the potential production of salmon spawning-nursery areas in the basin of the Kola River is equal to 23.285 kg/ha. In accordance with long-term data, the mean weight of wild smolts in this river is estimated at 31.3 g. Thus, the potential abundance of the Atlantic salmon wild smolts from the total area of spawning-nursery areas (2 169 500 sq.m) is equal to 161 400 spec. or, on the average, 7.4 smolts from 100 sq.m. For comparison, in the adjacent Tuloma River with the area of spawning-nursery areas, being equal to 2 045 000 sq.m, the total potential abundance of smolts is about 109.5 thou.spec. or 5.4 smolts from 100 sq.m (Zubchenko, 1994).

According to the data by V.V.Azbelev (1960), the mean value of spawner return for the rivers of this region is estimated at about 10%. It is well correlated with the data on the survival of salmon in the northern rivers by E.L.Bakshtansky and others (1976). According to the data of these authors, the mean return of spawners with the mean length of smolts, being equal to 13 cm, is 5% and increases by 2.8% when increasing the smalt length by 1 cm. In the Kola River the mean length of smolts is 14.5 cm. Thus, the calculated potential abundance of the spawning stock of the Atlantic salmon from the Kola River amounts to around 16 000 specimens.

Density of the Atlantic salmon juvenile distribution

The density of the Atlantic salmon juvenile distribution in the different river reaches in 1992-1994 ranged from 0.02 to 1.62 spec./sq.m (Fig.2). On the whole, even taking into account the fingerlings, mean indices of the distribution density for the river have appeared to be fairly low (0.27 - 0.4 spec./sq.m). In spite of this, it should be noticed, that the densities of juvenile distribution up the accounting fence (it is placed between Stations 11 and 12), are considerably over those ones at the lower river reach, though since 1959 only insignificant number of spawners, migrating there during the spring flood till the accounting fence placing, run to the head river.

It would be interesting, in our opinion, to compare the data on the density of distribution of juveniles from the same year-class during the certain period. In this case the density of the Atlantic salmon juvenile distribution in a year is compared (Figs.3-6). Probably, the data, collected for the longer period will allow the survival of juveniles at the different stages of its river period of life to be more precisely estimated. But at the present momen the relative abundance of juveniles in 1994 was: 1+ - 39%, 3+ - 22.9%, 4+ - 7%, comparing to the same age groups in 1993. The differencies in the relation of abundance of juveniles aged 1+ (1993) and 2+ (1994) were not observed, that might be caused by a number of natural reasons, but, probably, related to the shortcomings of the method.

Fishing and stock status

The fishing of salmon in the basin of the Kola River has existed as long as the human settlings have existed there. The reliable information dates back to the 17-th century, when, according to the data by Ovsyannikov (1938), about 400 tonnes of salmon were caught at the environs of Kola. Later, in the period from 1898 to 1902 the catches of salmon in the Kola Bay varied from 13.8 to 58.9 tonnes (Soldatov, 1903). In 1916-1928 the catches were equal to 16.5 - 41.6 tonnes (Ovsyannikov, 1938), in the period from 1944 to 1957 - 9.6 - 22.7 tonnes (Azbelev, 1960). There are no data on the abundance of salmon caught in the Kola River immediately. Only Azbelev (1960), basing on the accounting operations, pointed out, that in 1950-1958 the stock abundance of salmon from the Kola River ranged from 1700 to 5300 specimens. This abundance niticeably gives the way to the potential for this river abundance, that indicates the excessive fishing exploitation of the salmon stock in the previous years.

In 1959-1994 the catches of salmon in the Kola River fluctuated from 6.5 t in 1958 to 57.5 in 1984 (on the average, - 24.8 t) (Fig.7), and the abundance of fish being caught ranged from 997 spec. in 1958 to 14 225 spec. in 1974 (Fig.8), and, on the average, it amounted to 6 470 spec. These data show, that the fishing of salmon at the single place of the accounting fence, having been started in 1959, and the improvement of the river protection had a favourable influence on the stocks of salmon in the Kola River, and its abundance noticeably increased in 70s. In the subsequent years the trend to increase in salmon abundance in this river was valid, and presently it has become stable at the reasonably high level. The trend-analysis (Fig.9) shows it, though recently insignificant as yet trend to the decrease in stocks has been noticed.

Discussing the question on the stock status of salmon from the Kola River it is essential to remember, that the farmed fish made up the definite part of catches. The data analysis indicated, that in the separate years the farmed fish predominated in catches (Fig.10). In spite of this, it should be noticed, that in the catches only fish with removed fatty fin were considered, while, starting since 1988, the fatty fins were removed in 30% of farmed fish released. That is, the portion of farmed fish in catches, starting since 1989, was, at least, in three times higher. On the whole, in 1982-1994 the mean abundance of farmed salmon was 1231 specimens, that is equal to 14.7% from the mean abundance of catches.

Despite the stable stock status of salmon, one of the main problems for the Kola River is illegal fishing or poaching. It was noted as early as 50s (Azbelev, 1959), that the reduction in salmon abundance in the Kola River "has nothing or almost nothing in common with periodical fluctuations of abundance", and is caused by the influence of local factors, in particular, by the increasing press of poaching. This problem is more

significant at present.

The Kola River is located in the densely populated region of the Kola Peninsular and, as it was mentioned above (Zubchenko, 1994), there is a steady-state operating conditions of fishing in the Kola River according to the fishing rules, in which all the spawners are caught. That was done to improve the protection of the lower part of the river, where the natural reproduction has been maintained, and the reproduction at the part of river, located up the accounting fence is effected due to the juveniles, released by the Taibolsky fishing farm. Nevertheless, as investigations showed, these measures turned out to be not effective. In particular, in the spawning-nursery areas, located down the accounting fence, the density of fingerling (juveniles aged 0+) distribution was lower, than at the parts, located up that (Fig.6). This indicates, that at the lower river reach the most of spawners are caught by poachers. According to the calculations in 1991-1993, the illegal fishing was equal to 25-33% from the abundance of the spawning stock. Thus, the noticeable reduction in the wild salmon abundance in the Kola River since 1996 should be expected.

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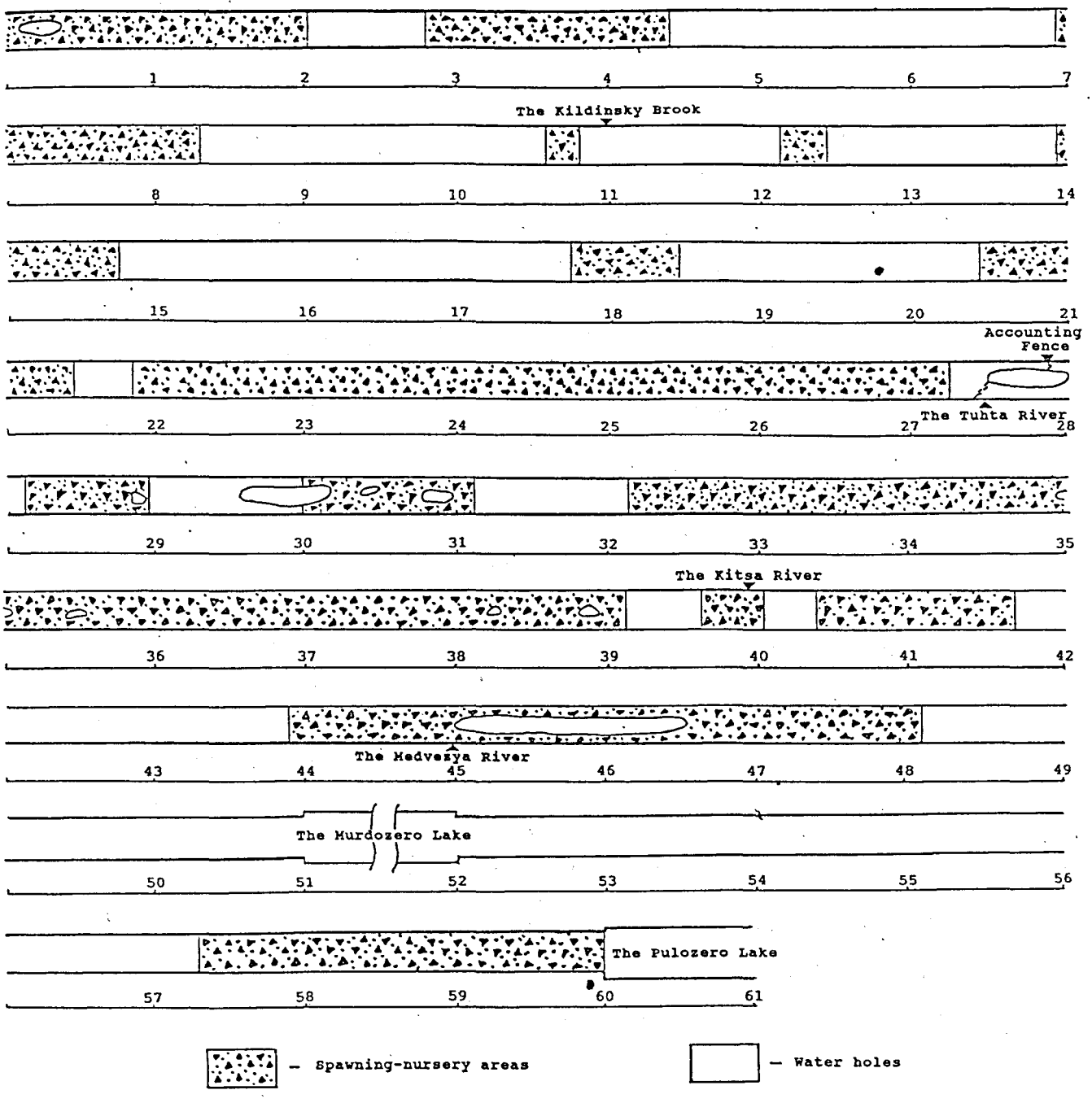

Fig. 1. The scheme of the Kola River

Fig.2.S.salar Parr distribution density
in the Kola'R. in 1992-1994

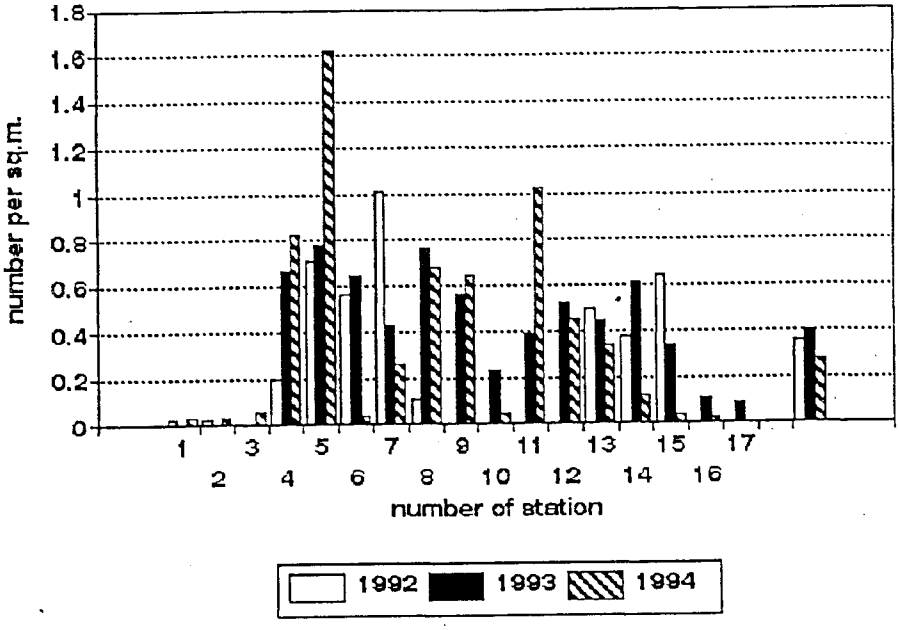

Fig.3.S.salar Parr distribution density
in the Kola'R. in 1993-1994 (0+, 1+)

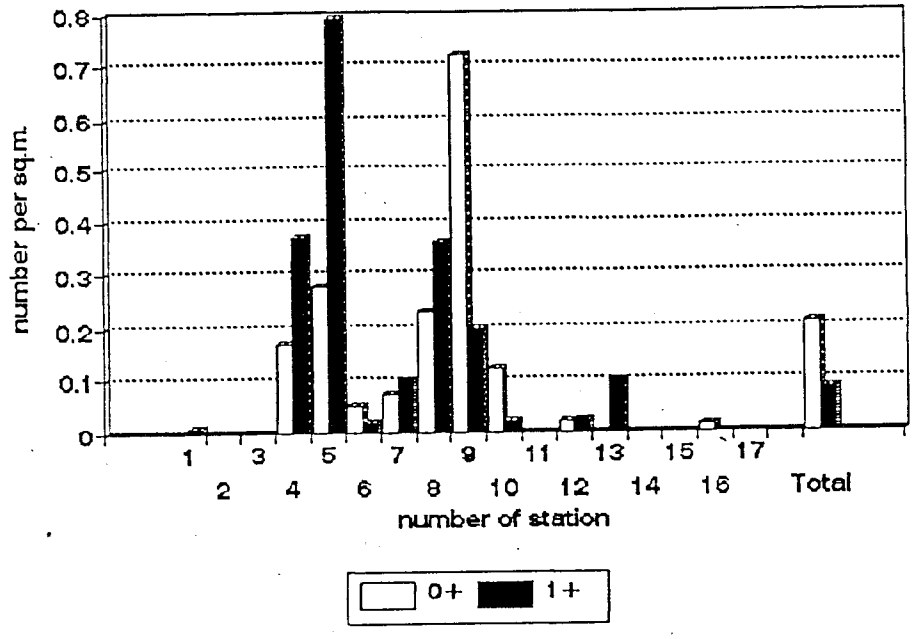

Fig.4.S.salar Parr distribution density
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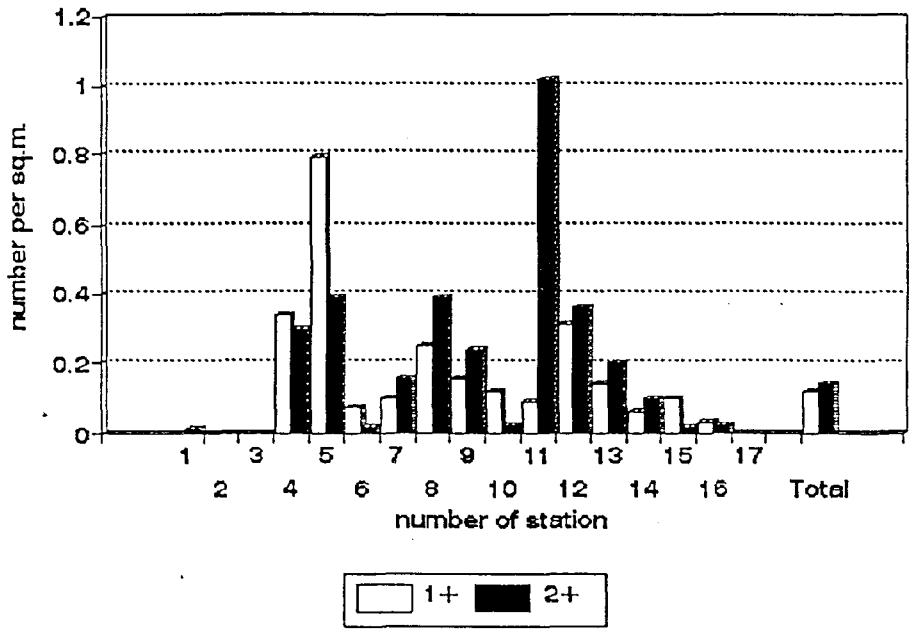

Fig.5.S.salar Parr distribution density
in the Kola'R. in 1993-1994 (2+, 3+)

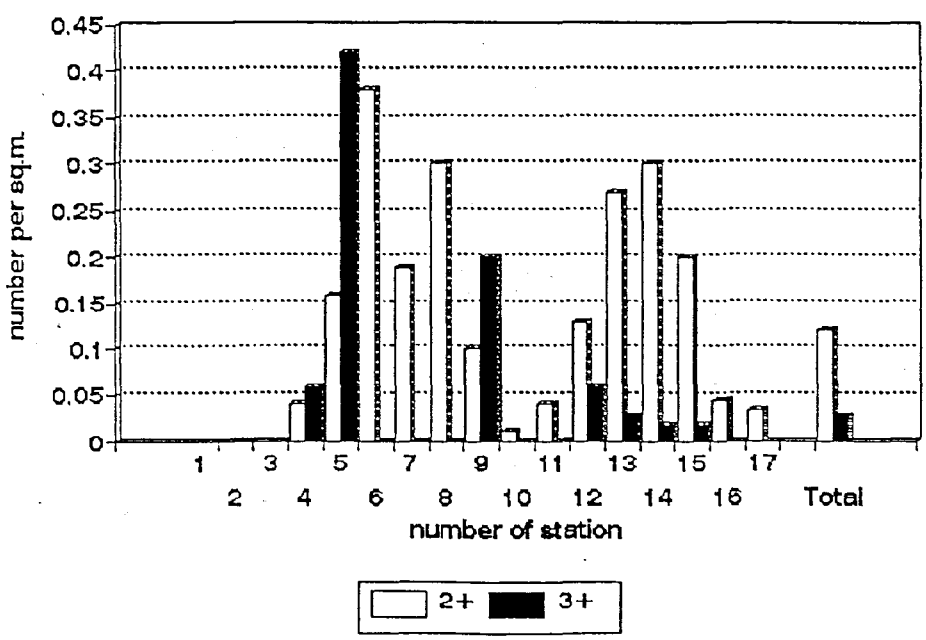

Fig.6.S.salar Parr distribution density
in the Kola'R. in 1993-1994 (3+, 4+)

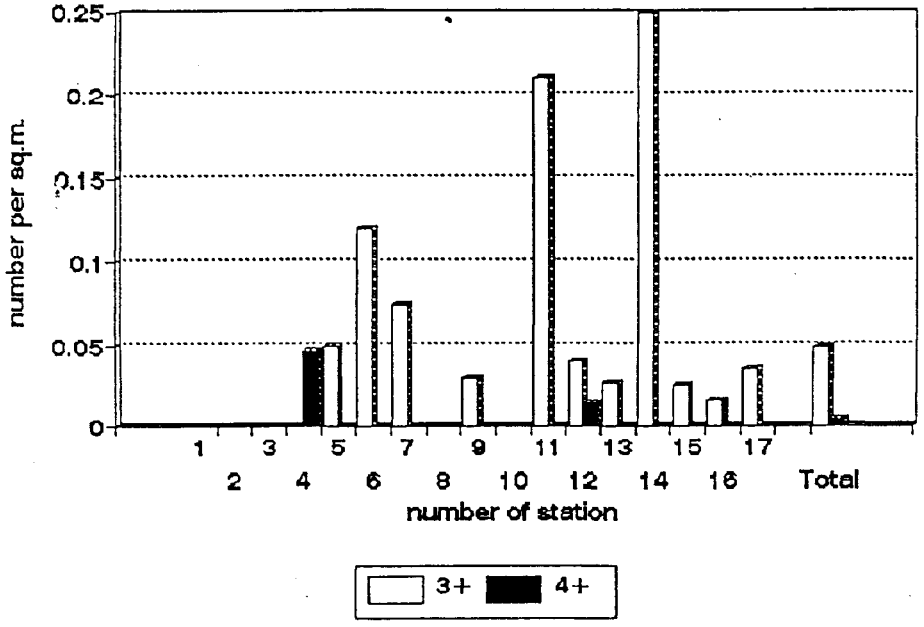

Fig. 7. Catches of Atlantic salmon in
the Kola R. in 1959-1994

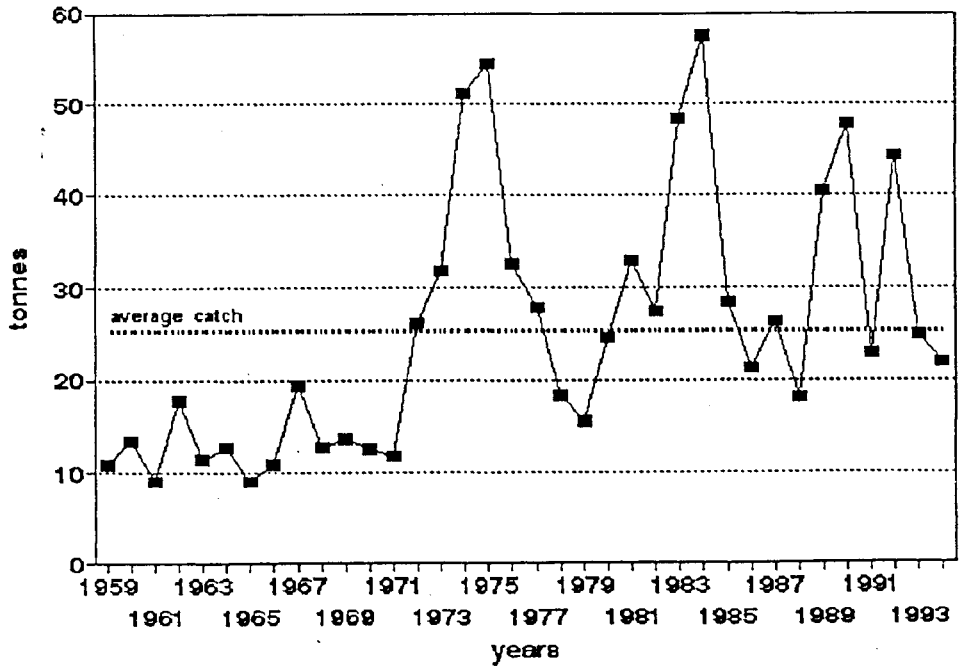

Fig.8.Catches and abundance of Atlantic salmon in the Kola R. in 1959-1994

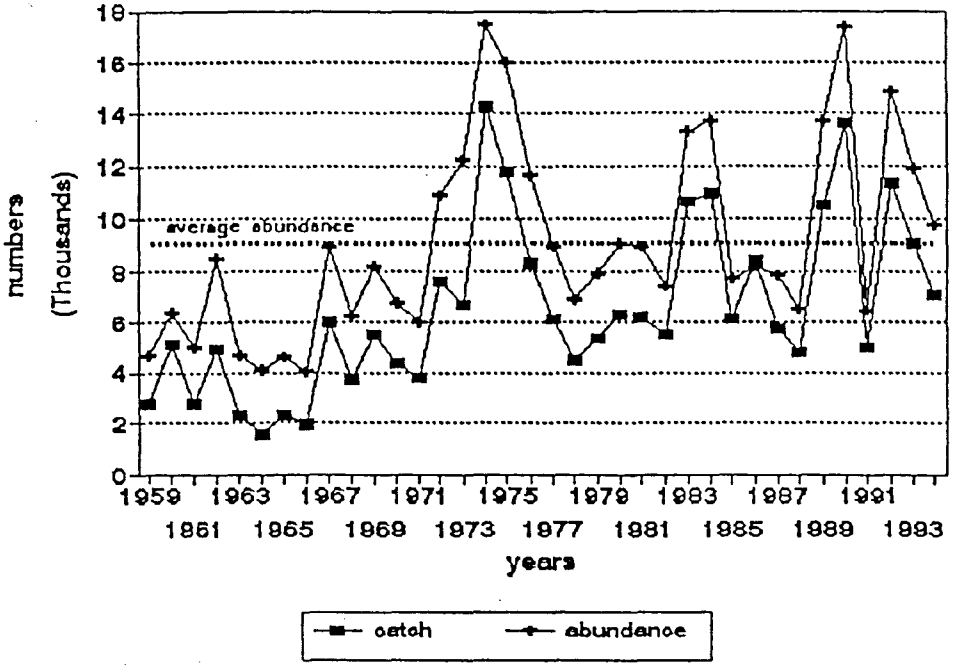

Fig.9. Trend-analysis of atlantic salmon abundance in the Kola'R. in 1958-1994

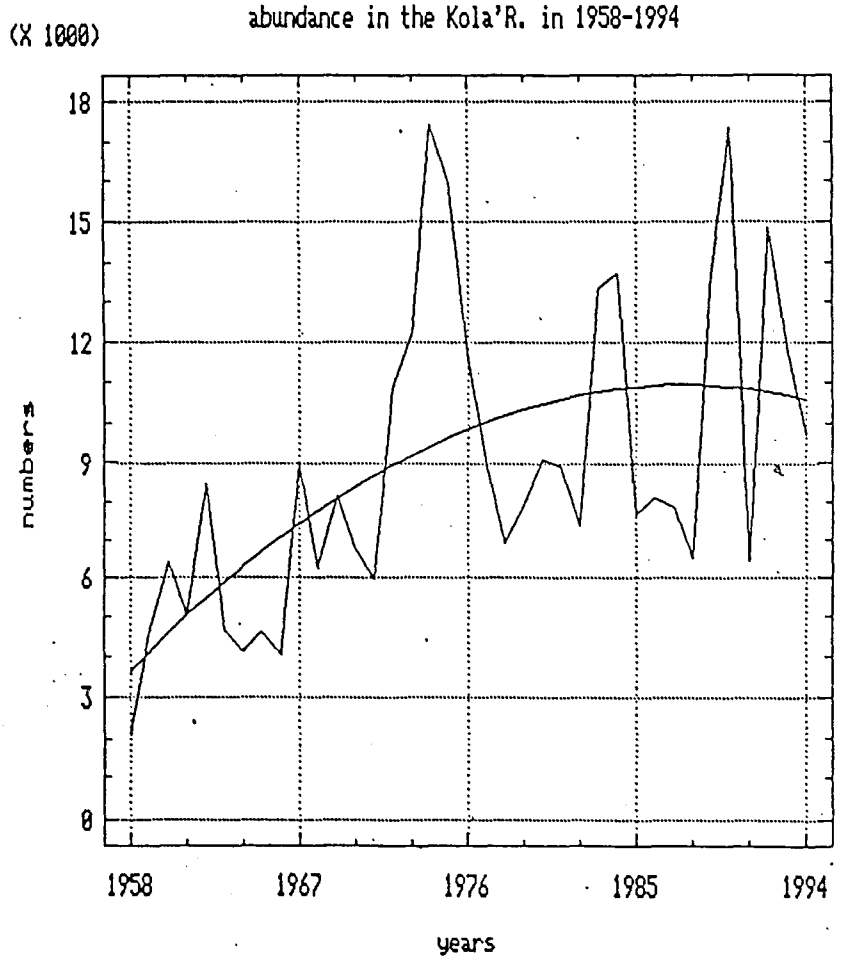

Fig.10.Ratio of wild & hatchery salmon
In catches in the Kola R. In 1982-1994

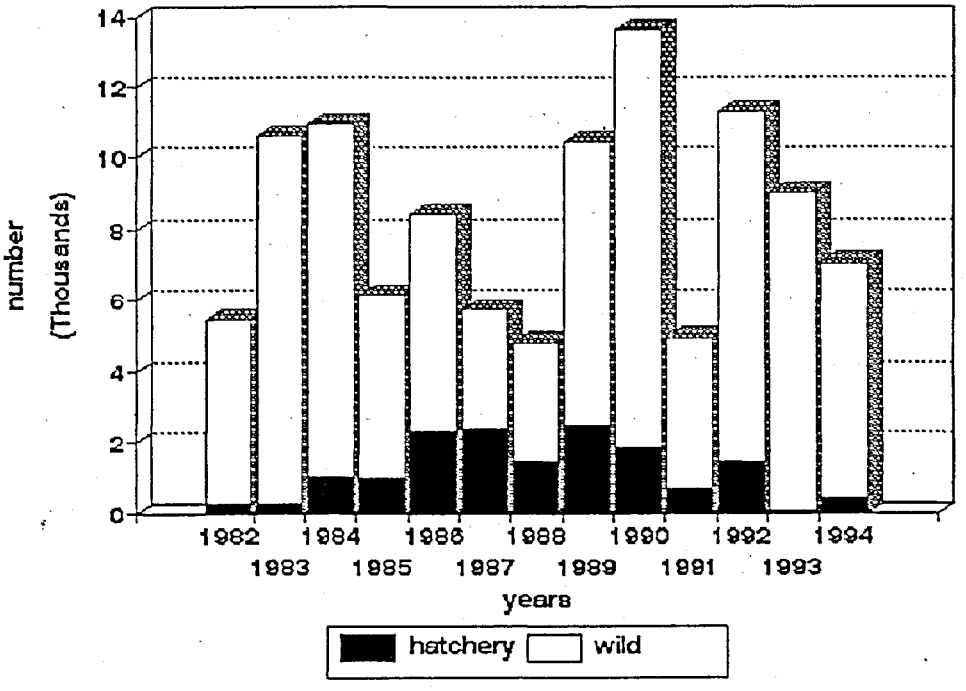

Fig.11.Density of S.salar fingerling
distribution In the Kola'R. In 1992-94