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SALMON-BEARING RIVERS OF THE KOLA PENINSULA, THEIR REPRODUCTIVE POTENTIAL AND ATLANTIC SALMON STOCK STATE IN THE RIVER TULOMA

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ABSTRACT

Area of spawning and nursery grounds, density of juvenile salmon distribution, catch statistics, abundance.

Investigations carried out in 1992-93 allowed us to obtain more detailed data on areas of spawning and nursery grounds in the river basin; the paper also gives their qualitative characteristics and densities of distribution of various age-groups of Atlantic salmon. Data on catch statistics and spawners abundance in the parent stock during a 40-year period are analysed. It is concluded that the present-time abundance of Atlantic salmon in the R. Tuloma is in a depressed state and increased illegal fishery may negatively result in the abundance of spawning migrants in 1994-1997

INTRODUCTION

The River Tuloma is the third in length on the Kola Peninsula (236 km) and by Azbelev's data (1960) and before hydrotechnical constructions have been built Atlantic salmon spawned both in the main bed and in more than 20 tributaries. Two hydropower stations - the Lower Tuloma (built in 1936) and Upper Tuloma (built in 1965) resulted in destruction of all spawning and nursery grounds located in the river midstream and upstream. At present salmon reproduction has remained only in tributaries inflowing the Lower Tuloma reservoir (Fig.1).
A commercial fishery for salmon exists on the R.Tuloma for a long time

and catches here are slightly below those on rivers Varzuga and Kola. Meanwhile the Tuloma salmon stock state was assessed over 30 years ago (Azbelev, 1960), and in later papers (Vshivtsev et al.,1988; Sharov et al., 1990; Sharov 1990) this query was not practically considered. The materials on the river reproductive potential also required to be defined more exactly because the data on the area of spawning and nursery grounds (Vshivtsev et al., 1988) were obtained by method of extrapolation.

MATERIALS AND METHODS

The paper gives clarified data on the area of spawning and nursery grounds. Investigations were conducted in 1992-93 by method of route surveys. During the survey the borders of the grounds were mapped. Mechanical composition of the river bed was determined by the Klenova (1931) classification.

Juvenile salmon density of distribution was studied using electric fishing over 14 sites in late August - early September 1992 and 1993. Calculations were made using the
method (Zippin, 1958).

Besides, the paper presents materials on age structure, catch statistics and abundance of spawning migrants collected by PINRO and Murmanrybvod during the period 1958-1993.

All ichthyologic materials were collected in accordance with adopted techniques.

RESULTS AND DISCUSSION

As mentioned above the R.Tuloma major bed is devoid of spawning and nursery grounds because of two hydropower stations and their reservoirs. All such grounds are located in Tuloma's tributaries of which the most important are rivers Pecha (83 km), Shovna (39 km), Ulita (33 km), Piayve (30 km), Kozha (26 km), Pak (21 km), Gremyakha (11 km). The major spawning salmon-bearing tributary, R.Pecha up to its first tributary, R.Konya, has 20 large rapids with lengths from 100 to 500 m. Upstream from the R.Konya inflow rapids are so frequent that form integrated sites with length up to 4 km. The updated data give the total area of spawning and nursery grounds in this river of about 724 000 m^2. In the R.Konya rapids follow each other with short reaches in between. Only its estuary is a reach of 3 km long. The total area of spawning and nursery grounds was not estimated though by Vshivtsev et al. (1988) data it equals to 258 000 m^2.

The R. Shovna has about 20 rapids with lengths from 30 m to 1 km. The total area of spawning-nursery grounds is 238 000 m^2. The R. Ulita has only 9 rapids but they are much longer (0.3-2.5 km). The total area of the grounds is almost 495 000 m^2.

In the R.Pak rapids are evenly followed by reaches in every 100-200 m. The total area of the grounds is about 118 000 m^2.

In the R.Piayva rapids and shallows are changing each other almost regularly. The total area of the grounds is about 138 000 m^2. In the R. Gremyakha rapids and shallows are also following one another. Reaches are very seldom. The total area of the grounds is about 74 000 m^2.

Depths in rapids and shallows vary from 0.3 to 1.0 m, current velocities - from 0.5 to 1.0 m/sec. River bed is covered with stones of all fractions, large and medium-size pebble, gravel and coarse sand. Very large stones may also be found.

The grand total area of all spawning and nursery grounds in the R.Tuloma basin is about 2 045 000 m^2 which is by 463 000 m^2 more compared with the data by Vshivtsev et al.(1988). Besides, about 219 000 m_2 of potential grounds are located in upstream tributaries of the R.Tuloma which can be inhabited by salmon if they manage to pass through the Upper Tuloma HP Station damb.

As it is known the productivity of salmon-bearing rivers may be assessed by number and weight of juveniles after their downstream run to the sea (Power, 1973), though there should be a distinction between potential productivity which is estimated by the state and richness of feeding grounds and also by some biotic and abiotic factors, and actual run of smolts under impact of various anthropogenous factors. Power (1973) has developed a technique how to assess productivity of salmon-bearing rivers which is based on long-time studies of numerous rivers in Norway. These rivers are in many parameters similar to those in the Northwest Russua. He based his technique on avarage productivity of the rivers (14 kg/hectare) which should be defined more exactely for each river by introducing correction factors.

In accordance with Power's characteristics, geographic location and density of woods in its valley the R.Tuloma is assessed by the following coefficients: river bed (large and small gravel and scattered stones) - 1.2; river width (over 11 m) - 0.9; river valley (woods with more than 3 species of trees, over 5 m high) -1.0; predominant fish species (brown trout) - 1.2; quality of water (clear, transparent, cold) - 1.0; geographical latitude of the area - 68-69°N - 1.0; correlation between the river productivity and period of field investigations (June-October)-1.0. Considering all these coefficients the potential productivity of spawning and nursery grounds in the R.Tuloma equals to 18.144 kg/hectare. From the long-time data it is known that average weight of smolts in the R.Tuloma watershed is 33.9 grams. Thus the total downstream run of smolts from the total area of spawning and nursery grounds of the above watershed (2 045 000 m^2)equals to 109 450 spec. or about 5.4 smolts off 100 m^2. This is somewhat lower than the maximum estimate of smolt productivity in the river (130 000 - 150 000 spec) given by Sharov et al. (1990) though quite compatible with it (it should be noted that we did not take into account the grounds located in smaller tributaries and numerous streamlets inflowing the Lower Tuloma reservoir.

The data of tagging (Bakshtansky et al., 1976) show that survival of salmon in northern rivers (from smolts to adults) averages to 5%. These authors also state that increased length of downstream runners by 1 cm results in 2.8% of tag return. Average length of smolts in areas of tagging was 13 cm (Bakshtansky et al., 1976). In the R. Tuloma basin mean length of smolts is 15.4 cm, hence, return of spawners averages to 10-11%, i.e. potential abundance of the parent stock here may reach 11-12 000 specimen.

Statistical data show that from 1958 to 1992 the catch of salmon in Tuloma fluctuated from 2.7 t in 1979 to 18.7 t in 1960 (Fig.2), their abundance varied from 1207 spec. in 1958 to 6346 spec. in 1974 (in average - 3421 spec.), abundance of spawning stock varied from 2875 spec. in 1977 to 12784 spec. in 1974) (Fig.3). It should be taken into account that during the very first years after the Lower Tuloma

Hydropower station
erection abundance of Tuloma R. salmon reduced drastically and in 1945-49 averaged to 1940 specimens. From 1945 to 1960 a sparing regime of fishery was introduced (only from 9 to 33% of spawners was taken off by the fishery). This resulted in an increase of the parent stock which in 1960-64 averaged to 8.9 000 specimens. From mid-1970-ies the abundance of salmon in the river has lowered (Fig.3) that may be explained first of all by a press of foreign fishery, building of the Upper Tuloma HP station and increasing the yield up to 50%. During the last decades the abundance of salmon in the Tuloma R. has increased up to that level which existed in yearly 1960-ies (Fig.4), and a trend-analysis indicates an increase in abundance of spawning migrants (Fig.5) It is worth mentioning that after the Upper Tuloma HP station erection the spawning stock abundance compatible with the potential one was registered only three times: in 1974, 1984 and 1990 (Fig.3). The 1992 surveys showed that density of juvenile salmon distribution over various biotopes fluctuated from 0.05 to 0.4 spec./m^2 and averaged to 0.17 spec./m^2 (Figs 6-11). In 1993 it fluctuated from 0.1 to 1.05 spec/m^2 (average=0.3 spec/m^2.For comparison, density of juveniles in the R.Varzina in 1993 averaged to 0.68 spec./m^2, that in the R.Kola - 0.4 spec./m^2.

Taking into account density of juveniles distribution and total area of spawning and nursery grounds we obtain that the relative production of juvenile salmon at age 2+ was in 1992 about 120200 spec., at age 3+ - 44300 spec., at age 4+ - 4200 spec. (altogether - 168700 spec). These figures for 1993 look as follows: age 2+ -110500 spec., age 3+ - 65200 spec., age 4+ -5800 spec.(total 181500 spec.).

How many of those 158700 specimens survived and ran into the sea in 1993 and, correspondingly, of 181500 spec. will survive and run into the sea in 1994 can be calculated with great approximation, though these figures are quite demonstrative. If we take into consideration that mortality of juveniles from older age-groups is rather low and by Nikiforov's data (1959) equals to 16% a year, and the ratio of smolts at age 3+ and 4+ by mean long-term data is rather stable. It may be expected that in the number of smolts in 1993 was about 82000 specimens and in 1994 it will be about 113000 specimens, i.e. close to the potential abundance.

It should be also noted that density of distribution of the 0+ age-group is lower compared with other age-groups (Figs 6-11). In 1992 it averaged to 0.4 spec./m^2, in 1993 -0.06 spec./m^2 (e.g. in the R.Varzina in 1993 it was 0.13 spec./m^2, in R.Kola -0.21 spec./m^2. Back calculation (similar calculation we have done for the R.Umba (Zubchenko, Kuzmin, 1993) shows that about 1330 females took part in the 1991 spawn (altogether 2735 females have passed through the counting fence) whereas in 1992 - about 1020 females spawned (1364 passed upstream). Even taking into consideration that the coefficients used were averaged and some assumptions were taken for calculations it should be noted that the press of illegal fishery in the river under discussion is enormously high and in 1992 was about 25% and in 1991 - about 50%. It is quite possible that the last figure is somewhat high because by Sharov et al., 1990) an optimum number of females for efficient spawning is about 1500 spec. This means that the number of salmon spawned in the R.Tuloma depends also on capacity of spawning grounds.

Thus, the analysis of data available shows that in spite of intensive fishery (its share in 1985-93 was about 49%) and high enough illegal fishery the R.Tuloma salmon stock is fairly stable. At the same time the level of poachery requires to take urgent protective measures.

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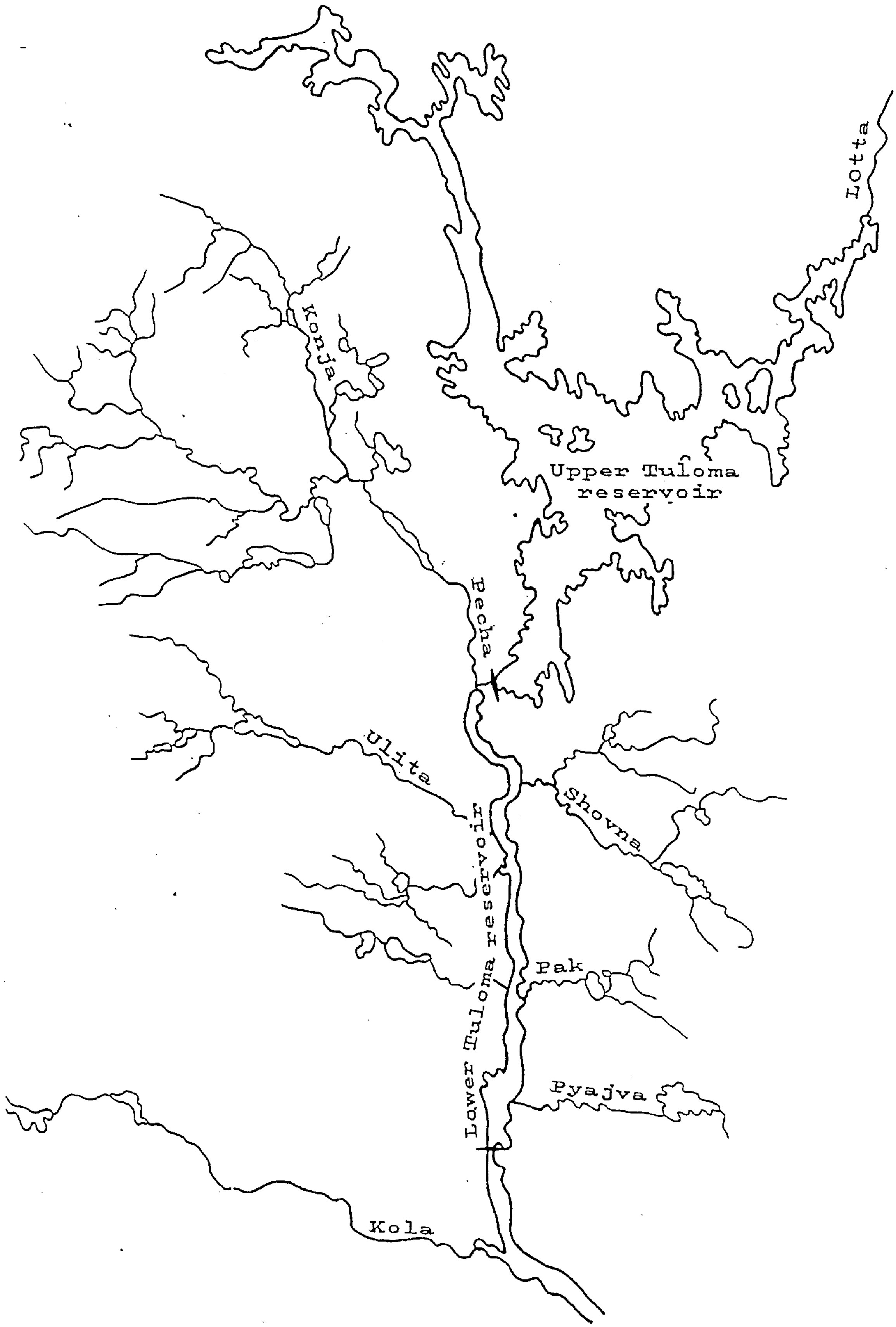

Fig. 1. The R.Tuloma map

Fig.2. Catches of salmon in Tuloma'R. in 1958-1993

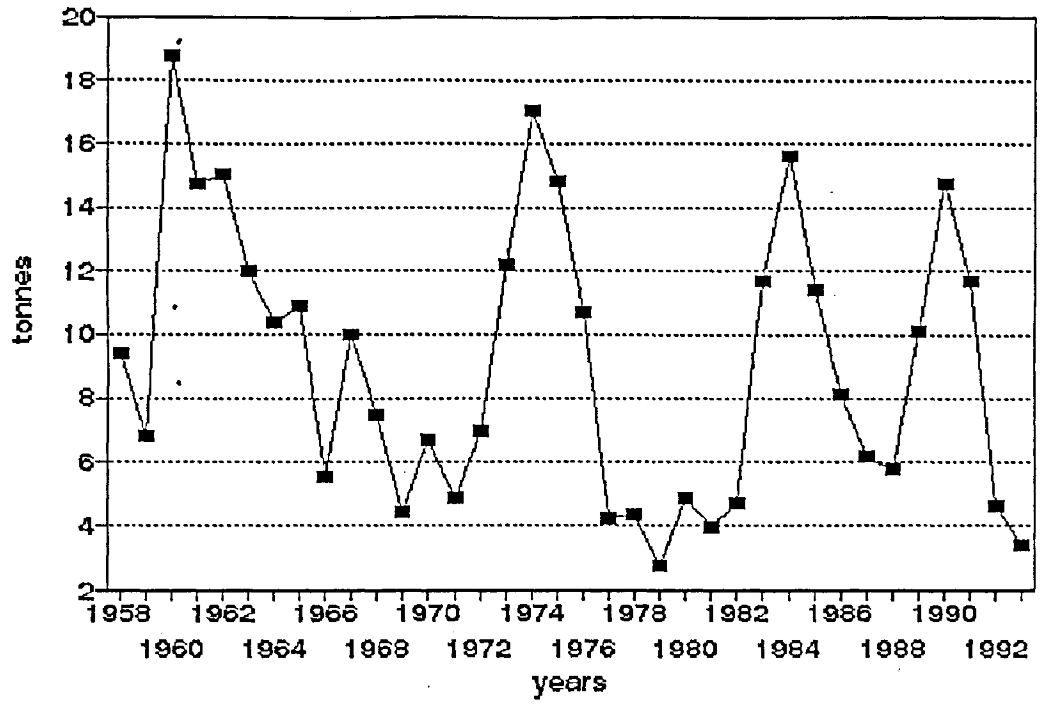

Fig. 3. Catch and abundance of atlantic salmon in the Tuloma R. in 1958-1993

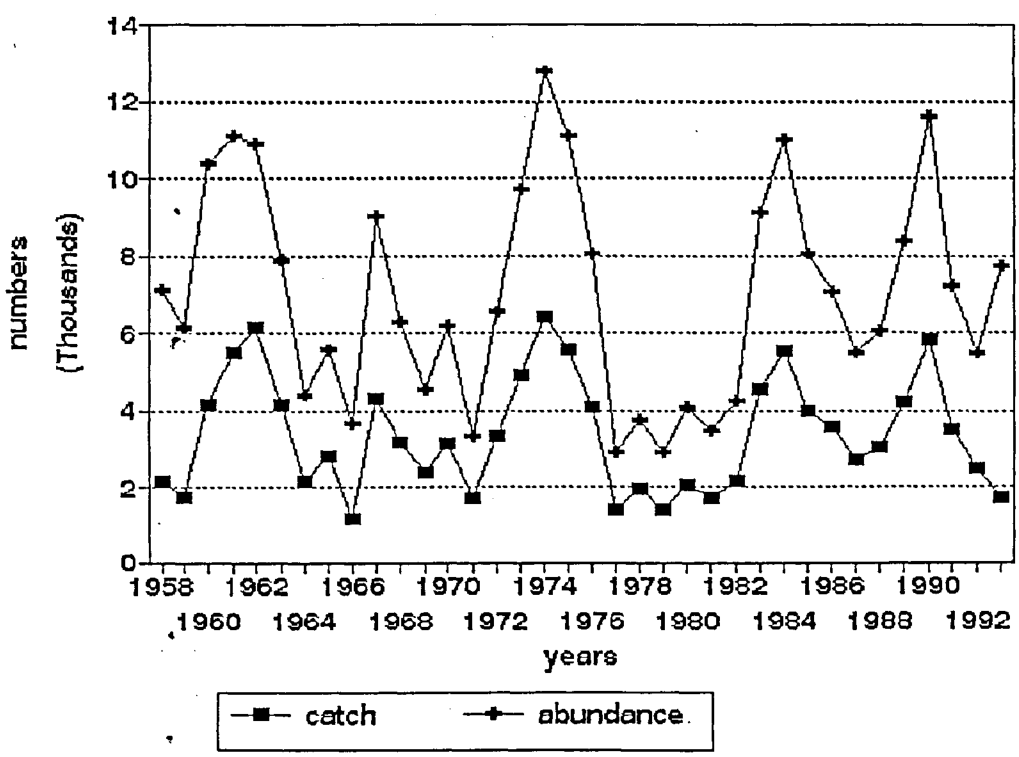

Fig. 4. Average abundance of salmon in R.Tuloma in 1945-1993

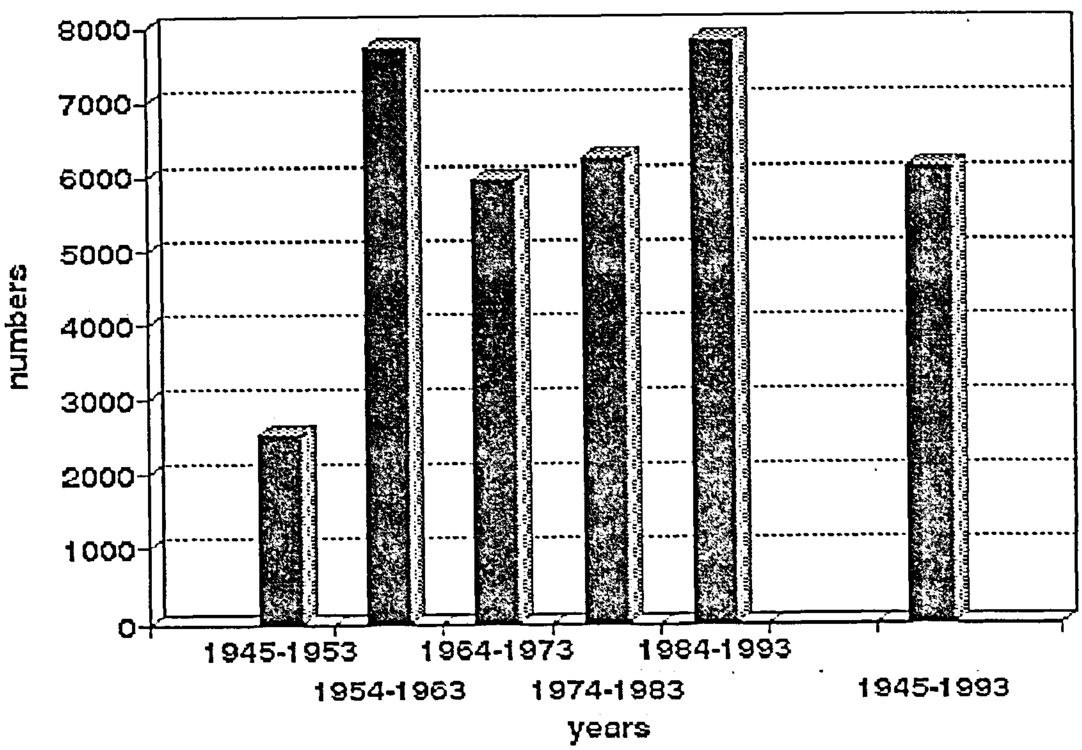

Fig.5. Trend-analysis of atlantic salmon abundance in the Tuloma R. in 1958-1993

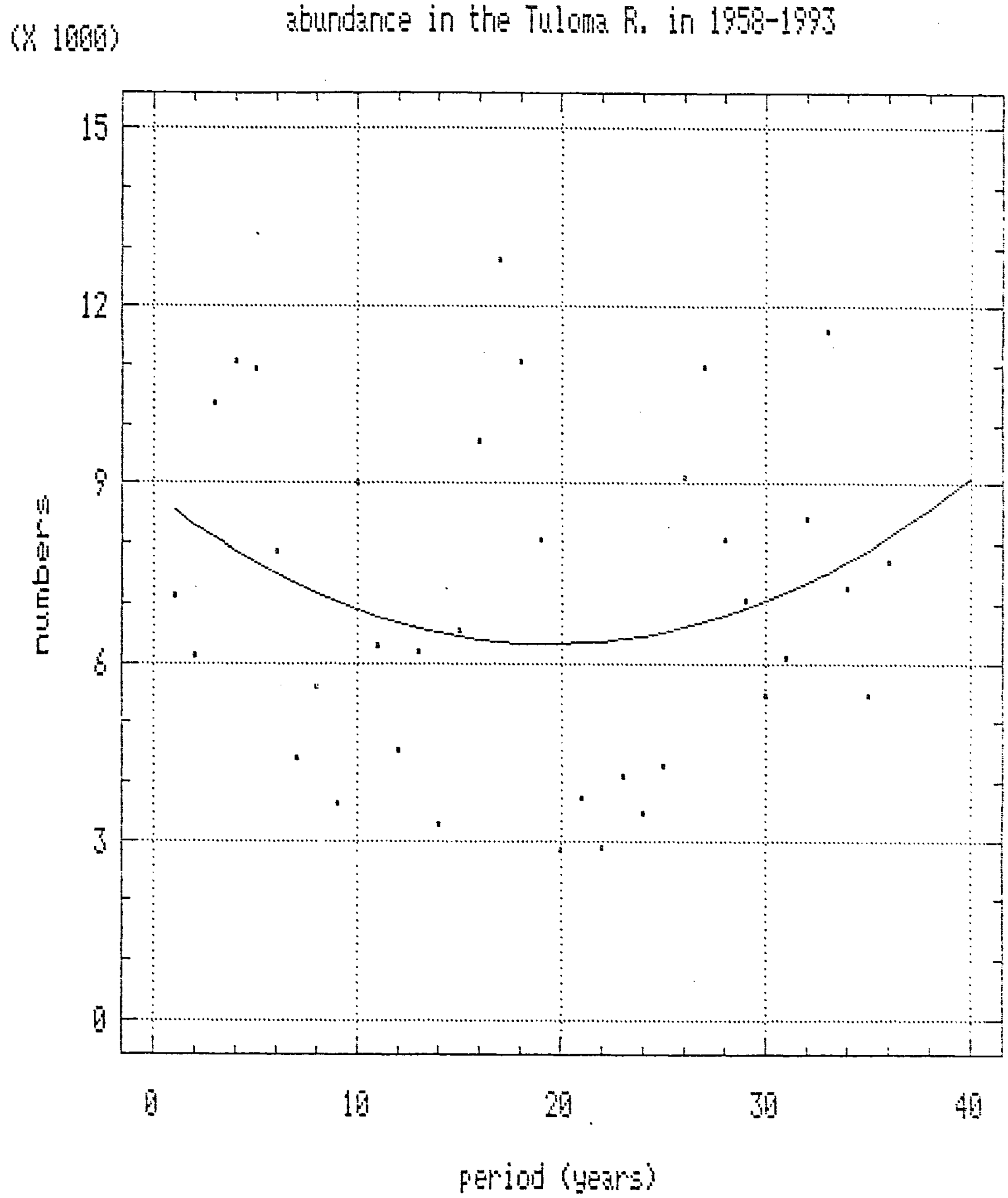

Fig. 6. Density of juvenile salmon distribution in R.Pecha in 1992-1993

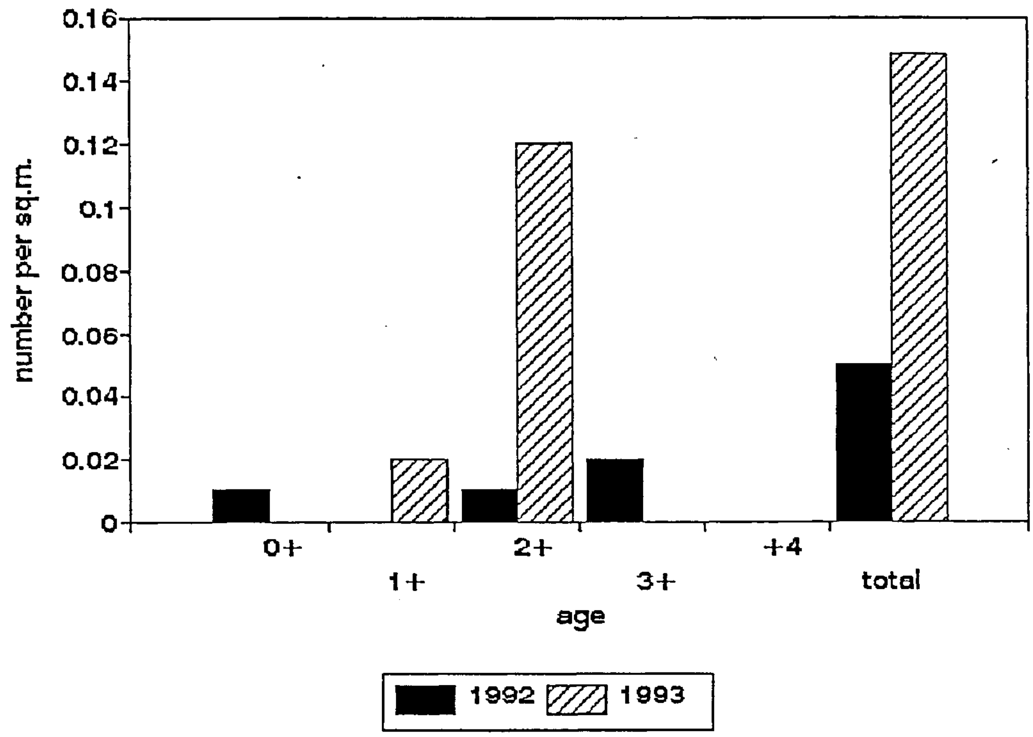

Fig. 7. Density of juvenile salmon distribution in R.Konja in 1992-1993

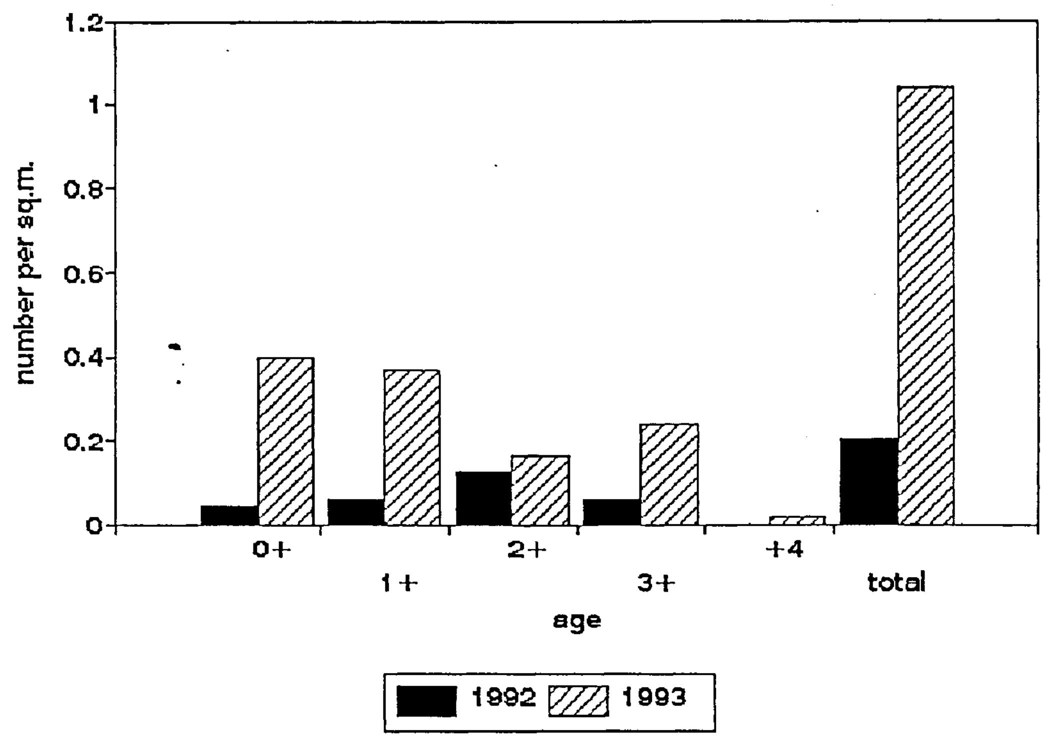

Fig. 8. Density of juvenile salmon distribution in R.Pyajva in 1992-1993

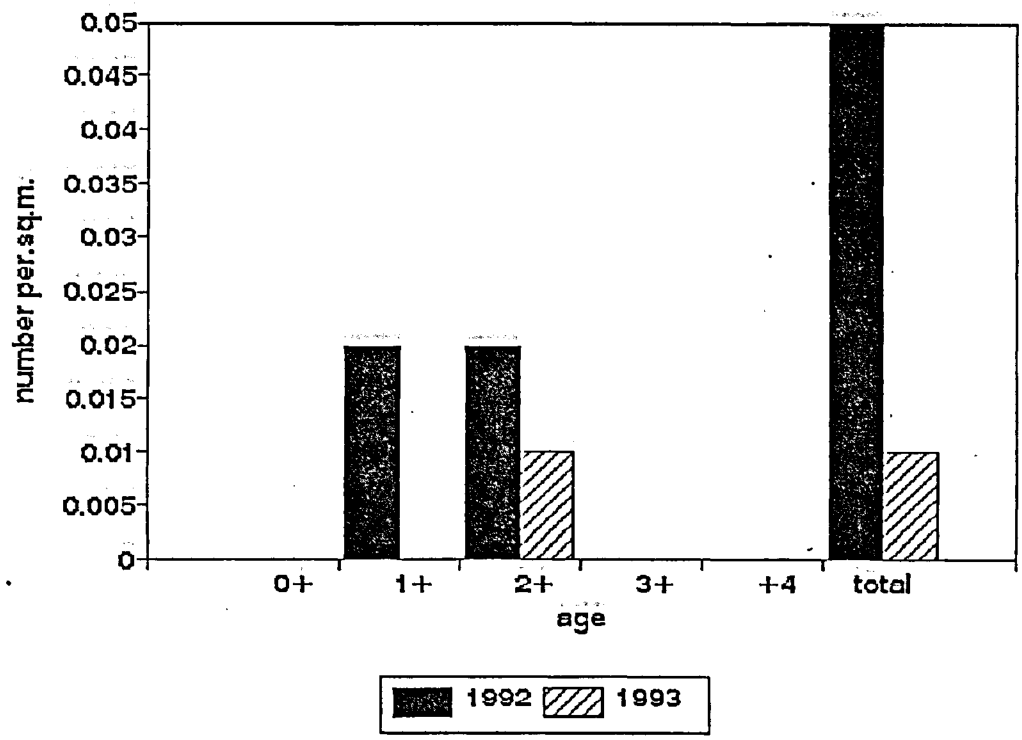

Fig. 9. Density of juvenile salmon distribution in R.Pak in 1992-1993

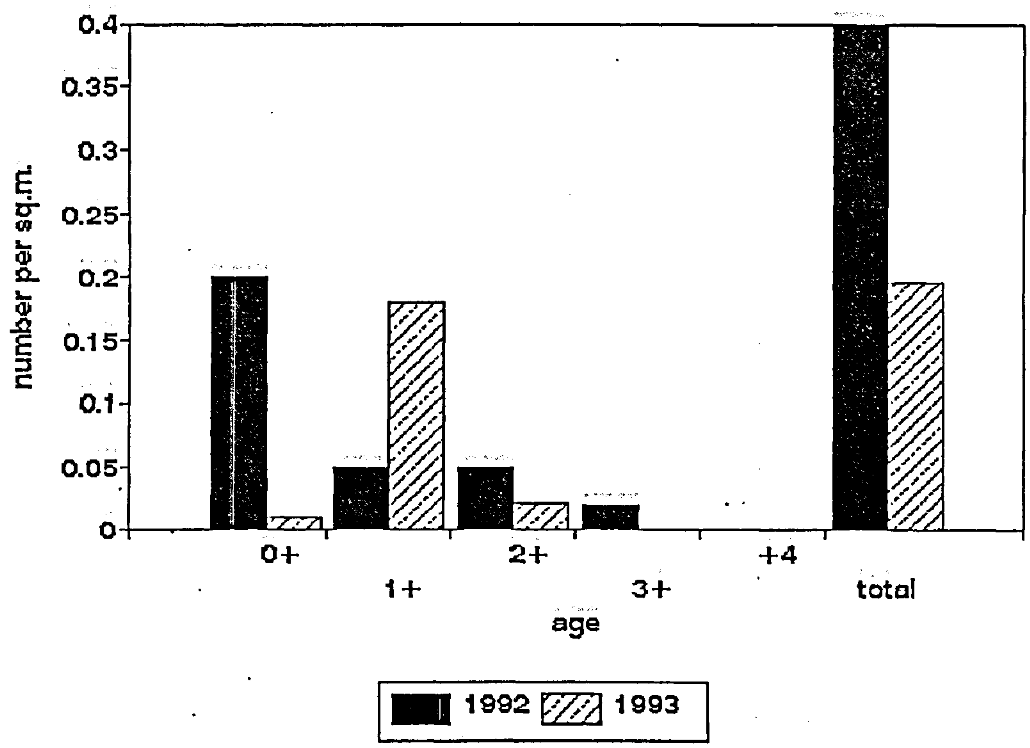

Fig. 10. Density of juvenile salmon distribution in R.Shovna in 1992-1993

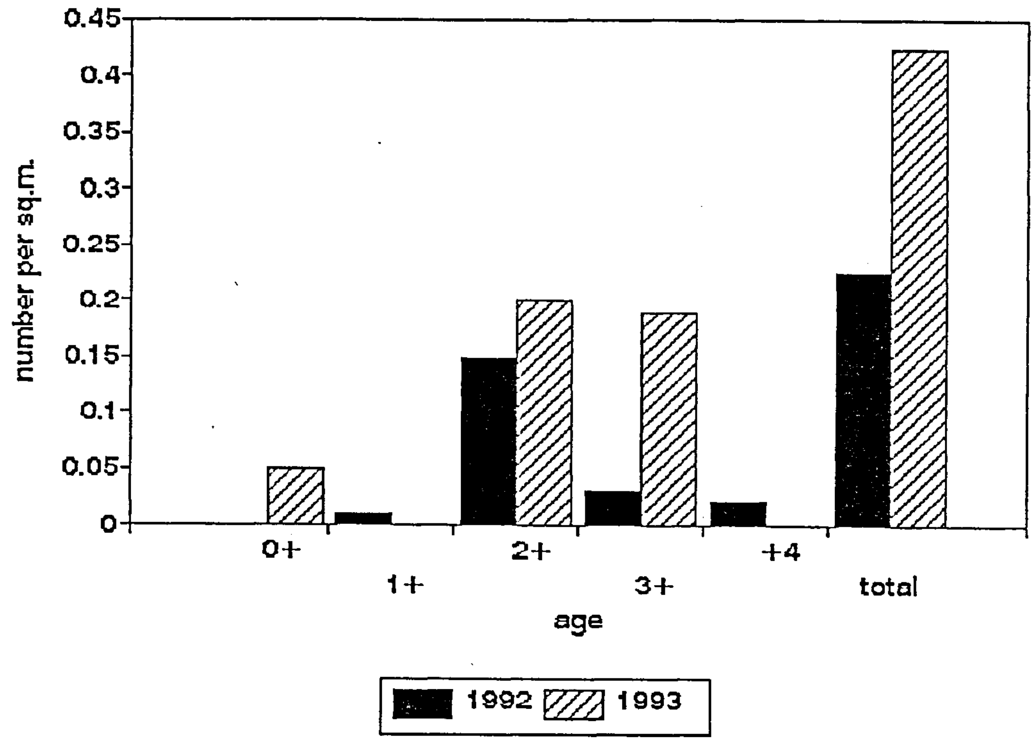

Fig.11. Density of juvenile salmon distribution in 1992-1993 (general data)