International Council for the Exploration of the Sea

CM 1996/ M:14
ANACAT Fish Committee

SALMON RIVERS ON THE KOLA PENINSULA. PRODUCTION POTENTIAL AND STOCK STATE OF ATLANTIC SALMON IN THE BOLSHAYA ZAPADNAYA LITSA RIVER

by

A.V.Zubchenko, M.N.Neklyudov, S.I.Dolotov

Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich St., Murmansk, Russia

and

A.E.Bakulina

Regional Directorate on Conservation and Enhancement of Fish Resources and Fisheries Management, 2 Komsomolskaya St., Murmansk, Russia

INTRODUCTION

The Bolshaya Zapadnaya Litsa river is one of the biggest salmon rivers in the western part of the Kola Peninsula with the Atlantic salmon population being third big stock, in numbers, after the Kola and Tuloma rivers salmon stocks. However, despite this fact and fairly long history of fishery on this river only fragmentary information is available in the literature on the biology of salmon from B.Z.Litsa (Azbelev, 1960), numbers and dsitribution of adult salmon (Azbelev, 1964,1966). Besides, evidence on the biology and numbers of salmon in this river has been used to evaluate possible impact of drift net fishery in the Norwegian waters on Russian salmon stocks (Zubchenko et al., 1993). Completely unknown is the productive capacity of this river, there is no clear knowledge on the level of illegal fishing on the river and potential effects of fishery by a counting fence on biological parameters of the stock; possibilities to modify the established fishery regime on the river in relation to projected numbers of salmon in a spawning run have never been reviewed or justified. In this light issues considered in this paper appear to be rather important, since eventually their analysis would enable elaboration of measures required to achieve the spawning target on this river as well as to decide on optimal catch level based on projected abundance of the spawning stock.

The B.Z.Litsa drains into the Motov Bay of the Barents Sea. The length of the river from its headwaters at the Memekjavr lake to the outlet is 84.5 km, catchment area - about 1 660 sq.km, lakes

- about 8%, wetland - 15%, forests - 40%. Major tributary is the Lebyazhya river (46.0 km). The Atlantic salmon can ascend as far upstream as the headwaters at the Gorbatoe lake - 73.76 km from the outlet. A total drop of the river stretch with salmon habitat is 148 m (2%).

Surveying of catchment of the B.Z.Litsa showed 10 species, subspecies and forms of fish occurring in the river: Atlantic salmon (Salmo salar L.), sea trout (S.trutta L.), brown trout (S.t.morfa lacustris L.), brook trout (S.t.morfa fario L.), pike (Esox lucius L.), minnow (Phoxinus phoxinus (L.)), burbot (Lota lota (L.)), three-spined stickleback (Gasterosteus aculeatus L.), nine-spined stickleback (Pungitius pungitius (L.)), perch (Perca fluviatilis L.). Grayling (Thymallus thymallus (L.)) common for other rivers in the region has not been found and was never observed before. There is also no reliable evidence available on the occurrence of minnow (Salvelinus alpinus (L.)) and whitefish (Coregonus lavaretus pidschian (Gemelin)). In some years pink salmon (Oncorhynchus gorbuscha (W.)) introduced to the Kola Peninsula ascend the river. Most massive runs of pink salmon were recorded in 1965, 1975, 1977, and later after a long interval in 1989, 1991, 1993.

MATERIAL AND METHODS

The paper is based on research materials collected in the catchment of the B.Z.Litsa in 1991, as well as on the evidence made available through fishery by the counting fence during 1958-1995 (catch statistics, data for a row of years on characteristics of adult and young salmon).

Surveys of spawning and nursery grounds were conducted on the main stem of B.Z.Litsa (on a stretch between the headwaters at Gorbatoe lake and outlet of the river) and on first important tributary - Lebyazhaya river (on a stretch from the B.Nyukhchlubol lake to the joint with the B.Z.Litsa). The total length of the survey route was about 94 km. Boundaries of the spawning and nursery grounds were outlined by eye, area was estimated based on topographic maps and data from air-video surveying. Bottom was characterized in accordance with the classification suggested by M.V.Klenova (1931). Flow velocity was measured with hydrometric gauge GR-21.

Biological materials were collected in accordance with established methodology (Pravdin, 1966). Scales for ageing were sampled according to V.G.Martynov's technique (1983).

REPRODUCTIVE POTENTIAL

The Bolshaya Zapadnaya Litsa river is a typical river of a drop nature. From the headwaters to a 47 km point it flows on the plain, where the river drop is on the average about 1 m per 1 km. From the 47 km point to the outlet a pattern of the river flow

changes markedly, long rapids alternate with pools. A drop is on the average from 1.87 m to 4.66 m per 1 km. On this stretch the river is joined by a tributary where major spawning grounds are located - the Lebyazhya river. There are 3 waterfalls passable for salmon on the 11 km lomg most downstream stretch of the river. The river depth on the pools is as big as 5 m with flow velocity to 0.3 m/s, on rapids they are 1.2 m and 0.5-0.9 m/s respectively, on most heavy rapids the velocity can reach 1.5 m/s.

Major spawning grounds of Atlantic salmon in the B.Z.Litsa are located on a stretch from the outlet to the joint with the leftward tributary - the Sakr'javr river (Fig.1). Spawning and nursery grounds of Atlantic salmon are found on stretches with rapids in the main stem of the river, where the width is on the average 60-80 m and depth 1.5 m, flow velocity - 0.8-1.5 m/s.

All rapids on the surveyed stretch of the river are crowded with boulders mainly of 0.5 to 1.0 m in size. Gravel beats are fairly frequent. In the mid- and down-flow outcrop of fundamental rocks can be found. Spawning grounds of Atlantic salmon are located mosaicly on rapids and are of alluvial origin.

In its upper-flow the Lebjazhya river is a continuous pool with lake-like inclusions and mean flow velocity of 0.3 m/s. The river width on the upstream part of the pool stretch is 15-20 m and it is 30-50 m on the downstream one. Prevailing depth is 1.0-1.5 m. The bottom is solid and ,in the general, free of silt, boulders pedominate on the downstream part. Aquatic vegetation is scarce. Typical spawning and nursery grounds are located on 20 km stretch beginning from the Bol.Nyukhchlubol lake. The width of spawning and nursery rapids on this stretch varies from 20 to 160 m, flow velocity - 0.5-0.8 m/s, prevailing depth 0.5-0.7 m. The bottom consists of boulders, large-, medium- and small-sized gravel and pebble. Aquatic vegetation is dominated by filamentous algae.

There are several types of spawning and nursery grounds in the catchment of the B.Z.Litsa which are of different value for the production of Atlantic salmon in this river:

- stretches where nursery grounds predominate. The representation of spawning grounds there is only 2% of the total area. The spawning grounds are located on the downstream drain, less frequent in the main stem, and as an exception, the spawning grounds can be found upstream of the rapids. The bottom is represented with sparse clods, boulders of all size, large-, or more seldom, medium-sized pebble. Spawning and nursery grounds of this type most frequently can be found on typical rapids;

- stretches of high quality where representation of spawning grounds is not less than 30% of the total area. Spawning grounds are located mosaicly along the whole extent of the river stretch, alternating with nursery grounds. Bottom is represented with pebble of all size, medium- and small-sized boulders, seldom large boulders, and as an exception with clods. There are 4 stretches with spawning and nursery grounds of this type on the

river;

- stretches with nursery grounds but where spawning grounds are absent. The bottom here is represented with clods, primarily medium-sized and large boulders. Some of such stretches are separated from spawning grounds by extensive pools and are not used by young salmon. The total area of nursery grounds which are outside the spawning and nursery fund of the river is estimated at 108 220 sq.m.

The total area of spawning and nursery grounds in the catchment of the B.Z.Litsa, which can effectively be used by Atlantic salmon for production is 1 247 040 sq.m, including 1 013 360 sq.m in the main river and 233 680 sq.m in the tributary - Lebyazhya river.

Production in the B.Z.Litsa has been estimated based on the number and weight of young salmon migrating seawards (Power, 1973) and is equal 15.88 kg/ha. Mean weight of smolts is 36.5 g. Thus, the average production of Atlantic salmon smolts over the whole area of spawning and nursery grounds in the river catchment (1 247 040 sq.m) is 54.3 thou.fish. When doing this estimation we have taken into account the fact that there is a potential production related to the availability of food and a row of biotic and abiotic factors, and an actual production which takes place under the impact of various man-induced factors on the stock.

Evidence from tagging experiments undertaken by E.L.Bakshtansky, L.F.Zaguraeva and V.D.Nesterov (1976) showed that survival of Atlantic salmon in northern rivers from smolt to mature fish was on the average 5% and under the increase smolt length by 1 cm the return rate increased by 2.8%. The mean length of smolts from those rivers was 13 cm. In the catchment of the B.Z.Litsa the mean smolt length is 14.4 cm. Hence, to calculate the potential abundance of the spawning stock in this river the return rate could be assumed at 9%. In this case potential abundance of spawning stock under optimal conditions could be estimated at 4.9 thou.fish or 18.3 t with the mean weight of one salmon being 3.74 kg (catch data).

FISHERY AND STATE OF THE STOCK

Long-term research evidence shows that the spawning run to the B.Z.Litsa commences during melting of ice and continues until late August - mid-September. As a rule, spawners are dominated by males (in the last 7 years representation of males in the spawning stock varied between 58% and 70%). Catches contained fish from 15 age groups (2+1+ - 7+1+; 2+2+ - 6+2+; 3+3+ - 6+3+) Total age varied between 3 and 9 years. Major part of the spawning stock was represented by fish at age 5-7 years. By sea age, 1+ fish prevailed among males and 2+ and 3+ fish among females. Males feed at sea for 1.27 year on the average, females for 2.06 years. For males and females together the time of sea

residence is 1.55 year, on the average. Total age in males is 5.52 years, females 6.33 years, two sexes together - 5.81 years. Due to longer risedence at sea females are almost one year older (total age) than males. Repeat spawners account for 0.4-2.2% of the total stock. Among spawners age groups 4+1+ and 5+1+ prevail with males (35.1% and 25.9%, respectively), and 4+2+ (49.5%) with females.

The mean length of 1SW salmon is 55.7 cm, weight 1.79 kg. There is no significant difference between males and females (1SW females account on the average for 2.7% of all counted fish of this age). At age 2SW and 3SW males and females differ both in length (76.9 and 77.8 cm; 94.3 and 91.6 cm, respectively), and by weight (4.8 and 5.3 kg; 9.1 and 7.9 kg, respectively). Mean weight of salmon in the period from 1958 to 1995 was 3.7 kg. Total fecundity of Atlantic salmon from the B.Z.Litsa varies from 7.19 to 15.97 thou.eggs (9.78 thou.eggs on the average).

It became feasible to assess the abundance of adult Atlantic salmon in the B.Z.Litsa due to commencement of the concentrated fishery by a counting fence in 1958, under which not less than 50% of spawning salmon were allowed for escapement.

In 1958 to 1995 salmon catch varied between 0.54 t in 1981 to 6.01 t in 1975 (Fig.2), and abundance of the spawning stock in the same period varied from 344 salmon in 1981 to 2 714 salmon in 1975, it was 2 230 salmon on the average (Fig.3). The trend-analysis has shown that initially there was a declining trend in the stock of Atlantic salmon from the B.Z.Litsa in this period (Fig.4), where the decline rate was the highest until the 80s, and only beginning from the 80s a steady increasing trend in the spawning run had established.

Experience from the fisheries shows that under a lengthy overfishing the stock inevitably goes into a period when the commercial stock declines abruptly and spasmodicly, whereafter its recovery is in fact impossible or requires cardinal measures as heavy as cessation of fisheries. The analysis of data available for salmon rivers on the Kola Peninsula has provided an estimate of a critical level for those rivers at 10% of the potential abundance of salmon. For the Atlantic salmon stock in the B.Z.Litsa this critical level has been estimated at 490-500 fish. For the whole period of operation of the counting fence on this river only once, in 1981, the counted number of salmon in a spawning run was below the critical level (344 individuals) and at least twice, in 1980 and 1988, it was close to it (546 and 574 individuals, respectively). In the last 7 years (estimated time interval virtually completely covering the life history of one yearclass until its return to the river) average abundance of the spawning stock in the B.Z.Litsa was 2 070 salmon or 42.2% of an optimal one. This is on the average higher, than for a number of other surveyed rivers on the Kola Peninsula, where the present average abundance of salmon is as low as 20-25% of the potential abundance. This suggests that presently the state of Atlantic salmon stock in the B.Z.Litsa is satisfactory.

Similarly to other salmon stocks in the Barents Sea rivers the B.Z.Litsa stock is affected by both Norwegian and Faroese fisheries (Zubchenko et al., 1995), however, since tagging experiments on this river were only sporadic, the impact of these fisheries can only be evaluated indirectly. However, even such an assessment can be interesting, since data available on other rivers enable to evaluate this impact fairly accurately, and besides this assessment allows to decide on the efficiency of concervation measures in action and the need for further measures.

Data available in the literature (Bakshtansky, 1970; Bakshatansky, Nesterov, 1973; Grinyuk, 1977; Jakovenko, 1977; Antonova, Chuksina, 1985, 1987; Bakshatansky et al., 1985; Bugaev, 1987; Zubchenko et al., 1995) suggest that before 1989 the annual decline of catch on this river was on the average 300 to 550 salmon or from 20% to 33%. Such a decline of numbers of feeding salmon was as a rule caused by increased fishing effort. A ban on the drift net fishing by Norway and a reduction of fisheries near the Finnmarken coast as well as a heavy reduction of catch in the Faroese fishing zone produced notable positive effect on the strength of spawning run into the river. In the recent years the average abundance of salmon in the B.Z.Litsa increased approximately one-third, which is in general indicative of a fairly accurate assessment of the impact of foreign fisheries on the salmon stock in this river.

The Bolshaya Zapadnaya Litsa river is located in the vicinity of big communities and is one of the best accessible rivers on the Kola Peninsula, therefore a pressure from illegal fishing on this river is high. Fishing gears used are large-meshed gill nets, spin rods and rods. The impact of illegal fishing on the number of spawners can be evidenced by data from smolt counts, which show the actual number of smolts 20% less than estimated based on the number of spawning escapees. It can be assumed that the illegal catch on the B.Z.Litsa would be around 20% of the total number of spawning escapees.

In the recent years illegal fishing has become a very acute problem on many Russian rivers, while protection measures applied to huge areas are ineffective and imply considerable costs. On certain rivers over the Kola Peninsula, and in particular, on the Varzuga river, the conservation of salmon stocks is to a great extent achieved through modification of the fishing regime aimed to increase the number of spawning escapees and through development of recreational fishing. In this light modification of the fishing regime on the B.Z.Litsa implying a reduction of commercial catch to 33% and development of licensed sport fishing could probably be an effective measure to reduce the pressure from illegal fishing and to creat prerequisites for enhanced production of salmon in this river.

REFERENCES

ANTONOVA V.P., CHUKSINA N.A., 1985. Impact of foreign fisheries on the state of stock of the Pechora river salmon.In: Studies of population biology and ecology of salmonids in reservoirs of the North. Leningrad, 5 p. (in Russian)

ANTONOVA V.P., CHUKSINA N.A., 1987. Impact of foreign fisheries on the abundance of spawning stocks of the Pechora river salmon. In: Issues related to salmon culture in the European North. Petrozavodsk, p. 20-26 (in Russian).

BAKSHANTSKY E.L., 1970. Development of sea fisheries for Atlantic salmon. In: Trudy VNIRO, v.74, p.156-176 (in Russian).

BAKSHANSKY E.L., NESTEROV V.D., 1973. Some data to assess the impact of foreign fisheries on Atlantic salmon stocks. In: Rybnoe khozyaistvo, No.7, p.18-21 (in Russian).

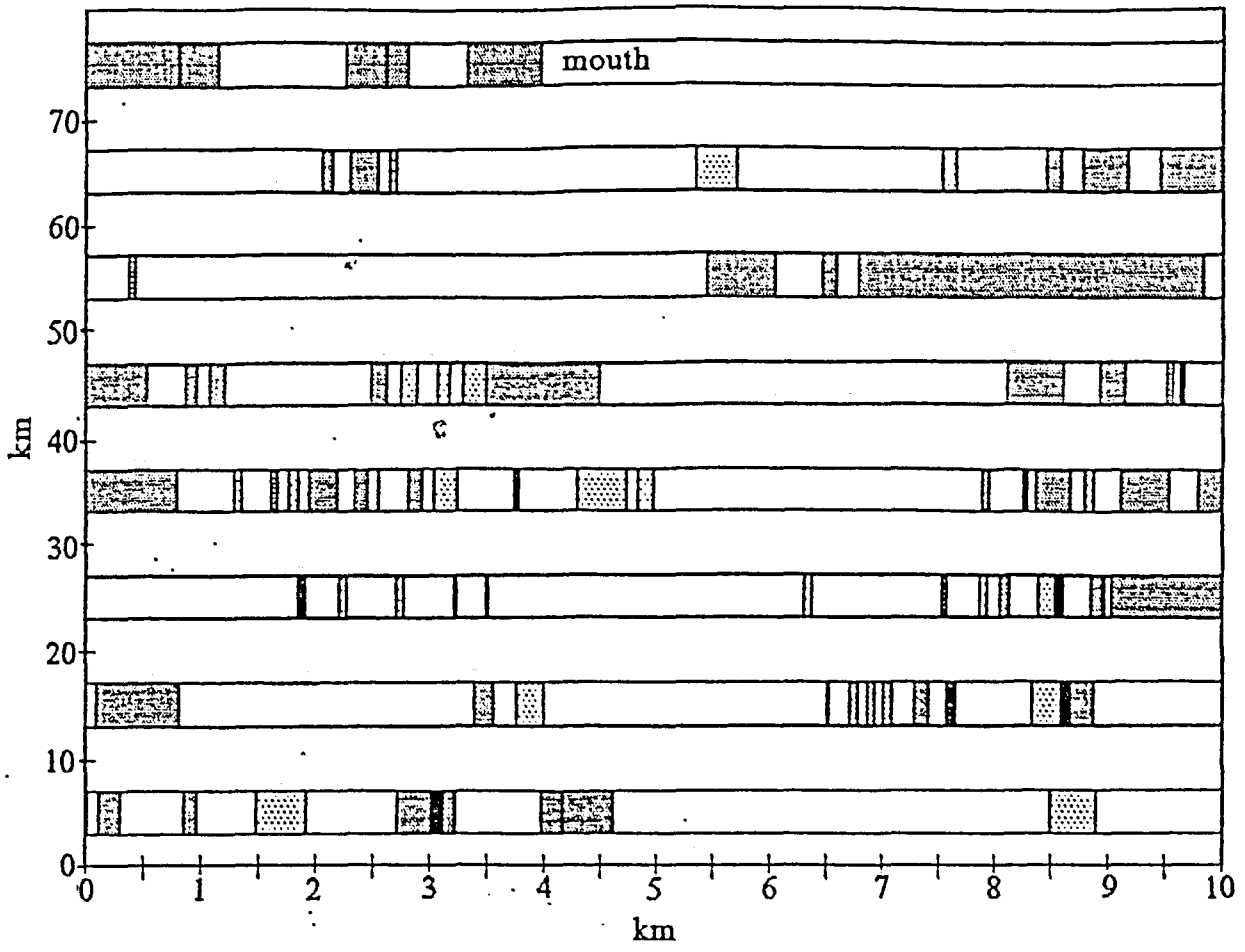
BAKSHTANSKY E.L., ZAGURAEVA L.F., NESTEROV V.D., 1976. Results from tagging experiments on young Atlantic salmon in 1960-1974. In: Trudy PINRO, v.113, p.19-23 (in Russian).

BAKSHTANSKY E.L., KLOVACH N.V., LEPSKAYA V.A., 1985. Migration of salmon in the North Atlantic. In: Issues related to the study of rational utilization and conservation of natural resources of the White Sea. Abstarcts of papers to the regional conference. Archangel, p.206-208 (in Russian).

BUGAEV V.F., 1987. Impact of foreign fisheries on the stock of Atlantic salmon in the Keret river. In: Issues related to salmon culture in the European North. Petrozavodsk, p.26-30 (in Russian).

GRINYUK I.N., 1977. Fishery, production and projection of the spawning stock size of Atlantic salmon from the Ponoi river. In: Trudy PINRO, v.32 (in Russian).

The Bolshaya Zapadnaya Litsa



The Lebyazhya River

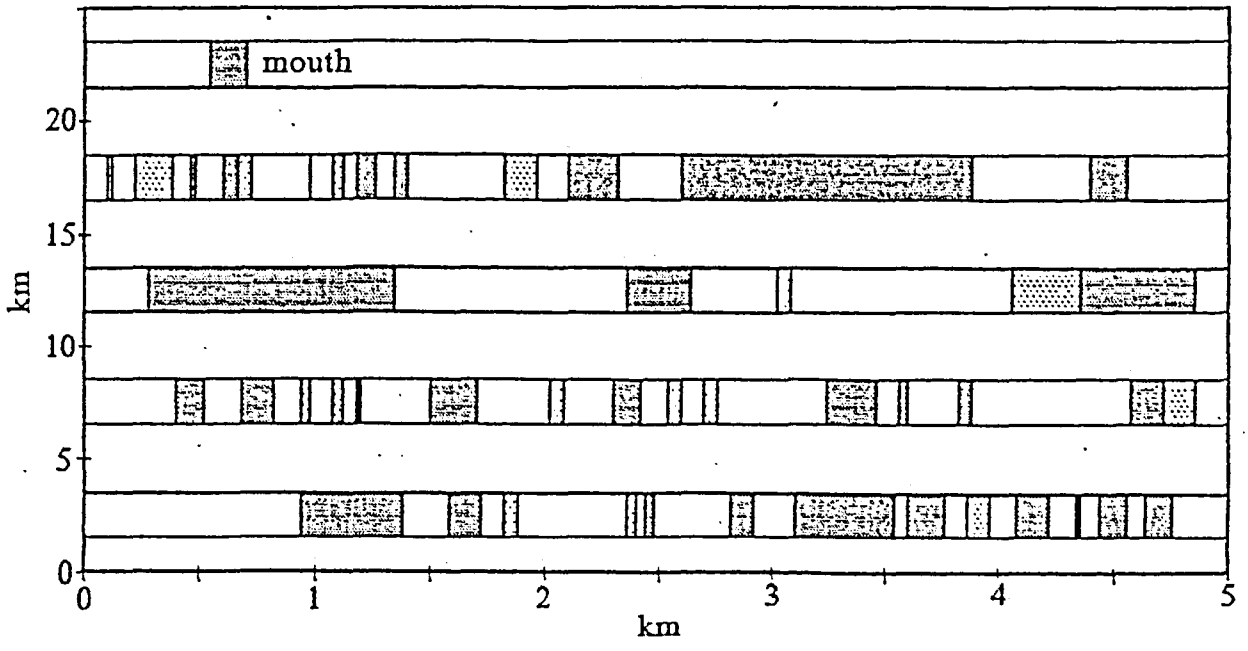


Fig. 1. The scheme of spawning-nursery areas

- Spawning-nursery areas · Spawning areas - Nursery areas - Water holes

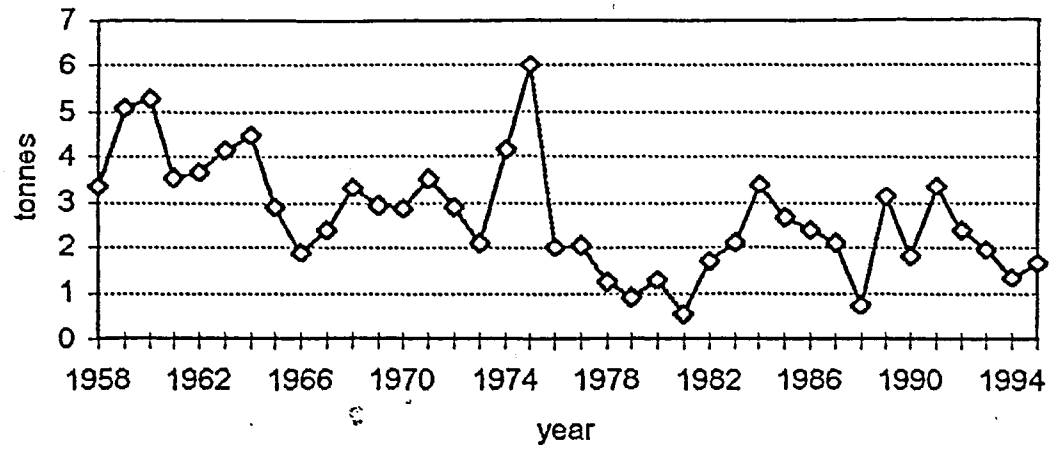


Fig. 2. Catches of Atlantic salmon in the B.Z.Litsa in 1958-1995

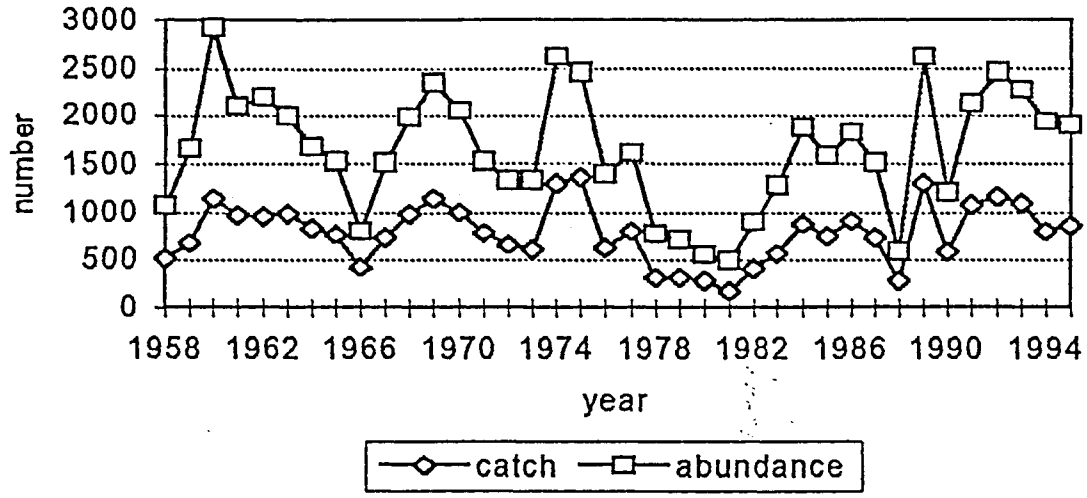


Fig. 3. Catches and abundance of Atlantic salmon in the B.Z.Litsa in 1958-1995

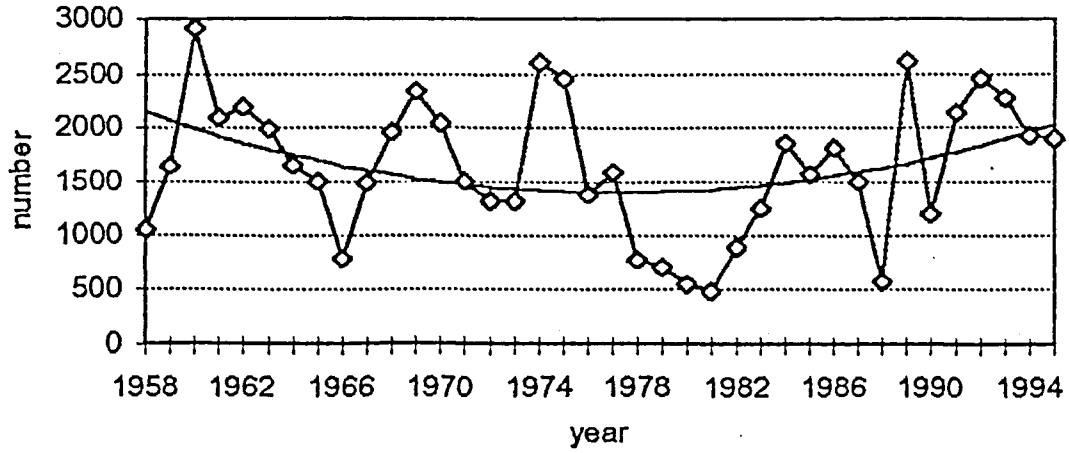


Fig. 4. Trend-analysis of Atlantic salmon abundance in the B.Z.Litsa