ICES STATUTORY MEETING 1993 C.M.1993/M:51, Ref. J

CHANGES IN THE STATUS OF THE SALMON STOCK IN THE RIVER TORNIONJOKI

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ABSTRACT

The River Tornionjoki forming part of the boundary between Finland and Sweden is the largest river in the Baltic area having natural salmon stock. The status of the stock have changed a lot during centuries. The river is not dammed and there have not been other environmental changes in the river-system either. Thus the major changes in the stock can be explained by changes in salmon fishery.

Effective river-fishery began in the 1600's rising the river catch to the level of 100-400 tonnes a year. In the end of the 1800's salmon fishery intensified in coastal areas and in the river-mouth dropping river catches to the level of 50-100 tonnes a year. The beginning of intensive offshore fishery in the end of the 1940's lead the salmon stock to a decreasing trend: smolt-production and river-catches decreased continuously. In the middle of the 1980's the stock was near to extinction the yearly smoltproduction being only some ten thousands instead of the original 0,5 million, and the river-catches were only 3-5 tonnes a year.

In the beginning of the 1990's the river-catches increased to the level of 20 tonnes a year. Reasons for this increase are:

1. Decrease of fishing effort in the Baltic Main Basin.
2. Good post-smolt survival since 1988.
3. Very good growth of salmon in the sea.
4. Fishing regulations in the coast and the river-mouth.
5. Release of parr and smolt to the river.
6. Increase of fishing pressure in the river.

This increase in the size of the river stock seemed to increase also reproduction: in 1991 there were essentially more 0-year old parr in the smolt-producing areas than for many years. This positive development was expected to continue also in 1992 but the amount of 0+ parr dropped dramatically. At the same time extremely high mortalitiy of fry was observed in hatcheries using salmon eggs of natural origin. This high mortality could be an effect of toxins accumulating in salmon feeding in the sea, or a diseases or some other so far unknown reason. Intensive studies are going on to find out an explanation to this extremely serious phenomenon.

Introduction

Nowadays 12 of the original 44 salmon rivers flowing to the Gulf of Bothnia have natural salmon stocks (Christensen & Larsson 1979, Report of ... 1993). One of the largest is the River Tornionjoki being located on the border between Finland and Sweden (fig. 1). The River Tornionjoki has been used as a reference river when assessing the status of the natural salmon stocks in the Baltic.

The status of the stock, i.e. smolt-production, growth and river catches, has varied highly during centuries and decades. The river is not dammed and there are no massive constructions for any other purposes either. As to the quality of water there have not been any factors that had essentially troubled salmon reproduction. Thus, the changes in the status of the salmon stock can be explained by changes in fishery.

Effective river-fishery began in the 1600's

The oldest catch data available contains information from the 1500's. At that time the river catches were under 100 tonnes a year (Luukko 1954). In the 1600's the river fishery intensified when a kind of salmon dams were taken in to use. From the 1600's to the end of the 1800's the river catches varied between 100 and 360 tonnes a year (Virrankoski 1973, Lundberg 1883, 1888, Nordqvist 1899). (Figure 2).

In the end of the 1800's salmon fishery intensified in coastal areas

In the end of the 1800's the river catches decreased. It's likely that the reasons are intensified fishery in the rivermouth and in coastal areas and timber floating in the river (Nordqvist 1899). From the beginning of the 1900's to the middle of the 1945's yearly catches were 50 tonnes a year the highest catches being over 100 tonnes (Järvi 1938, Karlström 1990), (Fig. 2).

Intensive offshore fishery started in the end of the 1940's

Intensive offshore fishery started in the end of the 1940's (Christensen & Johansson 1975). This change in exploitation pattern lead to a considerable decrease in salmon catches in the river. On the basis of the catch statistics presented by Karlsröm (1990) and Toivonen (1962) it can be concluded that in the 1950's and the 1960's average river catches were 20-30 tonnes a year (fig. 2).

The stock weakened continiously to the end of the 1980's

In the 1970's and 1980's river catches decreased continuously so that they were in 1985-1988 only 3-5 tonnes a year (Tuunainen et al. 1984, Pruuki et al. 1985, Nylander & Pruuki 1989a,b, Nylander et al. 1991), (Fig. 2).

The first electro fishing surveys in the River Tornionjoki were carried out in the beginning of the 1960's. Then the average parr densities in smoltproducing areas varied from 3 to 10

parr per 100 m2 the average density being 5 parr per 100 m2 for the whole river (Karlström 1988), (Fig. 3).

The potential or original smolt production has estimated to be at least 500 000 ind. a year (Toivonen 1962, Petersson 1975, Karlström 1983), (Fig. 4).This production figure is based on the amount of smolt producing areas and production capacity of rivers resembling the River Tornionjoki.

Between the beginning of the 1960's and the end of the 1980's parr densities and smolt production decreased to the level of 10-20 % of the potential density and production (Karlström 1988, 1993a,b, Romakkaniemi et al. 1993, Report of .... 1993), (Fig 3 & 4).

This decrease in the river catches, parr densities and smoltproduction can be easily explained by fishing pattern. 99 % of the catch based on salmon of the river Tornionjoki was caught in the 1960's from the sea and only 1 % from the river (Pruuki et al. 1985), (Fig. 5). The distribution of catching areas was the same in the 1980's (Ahvonen et al. 1991, Karttunen & Pruuki 1992), (Fig. 5). This high fishing efficiency means that the spawning stock has been so small that there has been a decreasing trend in the size of the stock. Kuikka (1993) has calculated that survival of salmon had to be 2,5 times higher than it was in the beginning of the 1980's to reach a sustainable status for natural salmon stocks. Just in the beginning of the 1990's the proportion of salmon caught from the river increased but those newest recaptures have not yet been analyzed.

Many factors got the stock to revive in the beginning of the 1990's

In the end of the 1980's the river catches began to increase so that the Finnish salmon catch from the river was in 1992 already 24 tonnes (Karttunen et al. 1991, Nylander & Pruuki, unpublished statistics) instead of 2 tonnes in 1985-1988. Respectively the density of 0+ parr increased considerably in 1991. The increased catches and parr densities were based on many factors that occured to be favourable at the same time:

1. Decrease of fishing effort in the Baltic Main Basin.
2. Good post-smolt survival since 1988.
3. Very good growth of salmon in the sea.
4. Fishing regulations in the coast and the river-mouth.
5. Release of parr and smolt to the river.
6. Increase of fishing pressure in the river.

(Report of ... 1992, Report of ... 1993)

In 1992 salmon 0+ -parr densities decreased dramatically

As already mentioned, in 1991 it was found high densities of 0+ -parr in smoltproducing areas by electro fishing. This was in accordance with the increased migration of brood fish to the river in 1990. This increase in parr densities was expected to continue also in 1992 because salmon catches stayed at the increased level. On the contrary, the amount of 0+ parr dropped dramatically. Also in 1993 the densities of 0+ -parr were unexpected low (Romakkaniemi et al. 1993, Karlström 1993b), (Fig. 3). This development is also seen in the index of parr year class strength (Romakkaniemi 1992) calculated on the basis of electro fishing surveys by Romakkaniemi et al. (1993),(Fig 6). The catch per unit effort in

harling that is the most important means in salmon fishery in the river has stayed rather high since 1990 indicating increased size of the spawning stock compared to the 1980's (Fig. 6).

The respective steep decrease in reproduction has been found also in the River Simojoki in Finland (Romakkaniemi et al. 1993) and in many Swedish rivers (Karlström 1993b).

The reason for this surprising drop in reproduction is not totally known but extremely high mortality of salmon fry has been observed in hatcheries using salmon eggs of natural origin. This high mortality could be the effect of toxins accumulating in salmon feeding in the sea, or diseases or due to normal natural variation. This kind of high mortality was found in Sweden in 1974 and that's why it's called as M-74. Intensive studies in Finland and Sweden are going on to find out an explanation to this extremely serious phenomenon.

The management of the stock has not been effective enough

In the situation when the natural smolt production in the River Tornionjoki is only 10-20 % of original production the stockings carried out have compensated only about 10 % of the lacking production. Despite that, by stockings it has been possible to keep the size of the salmon stock at a higher size than without stockings. Especially in the middle of the 1980's the stock was near to extinction.

Fishery regulation measures used so far have not been effective enough to improve markedly the status of the stock. However, the situation were even worse without any fishery regulation. Fishing pressure is continously too high in the sea and in the river preventing an improvement in the status of the stock. Thus more effective fishing regulatory measures are needed to safeguard the natural stock. The M-74 phenomenon makes the situation to be the most serious ever; the Baltic salmon and trout assessment working group of the ICES has recommended to stop all fisheries harvesting wild salmon if parr are scarce in 1993 because of M-74 (The Report of ... 1993). Parr were scarce in 1993 but the International Baltic Sea Fishery Comission didn't take this into consideration when deciding about fishery rules for 1994.

Effective measures are needed to survive the stock

The International Baltic Sea Fishery comission takes care of the international fishery regulation measures in the Baltic Sea. It has stated that the aim of the management is to safeguard wild Baltic salmon stocks. Furthermore, also other international and many national statements underline the importance of safeguarding the natural salmon stocks.

When the aim is to safeguard the salmon stock of the River Tornionjoki it's needed to minimize the risk of loosing the stock totally. This means that the stock has to be saved both in nature as naturally reproducing stock and in hatcheries as brood-stocks. By this way the stock is safeguarded despite a change in nature was letal to the naturallly reproducing part of the stock or there were serious problems in production in hatcheries. The Finnish Game and Fisheries Research Institute has worked according to this strategy from the middle of the 1980's and fortunately it has been founded brood stocks of the salmon of the river Tornionjoki in hatcheries. This is not the case with most of the natural samon stocks left in the Baltic area.

There is a need for fishery regulations more restrictive than those in force nowadays to get the natural stock to survive and increase. Parr and smolt production from hatcheries is needed in higher numbers than it's produced now. It's also essential to improve the brood stocks in hatcheries so that they represent genetically the stock as well as possible.

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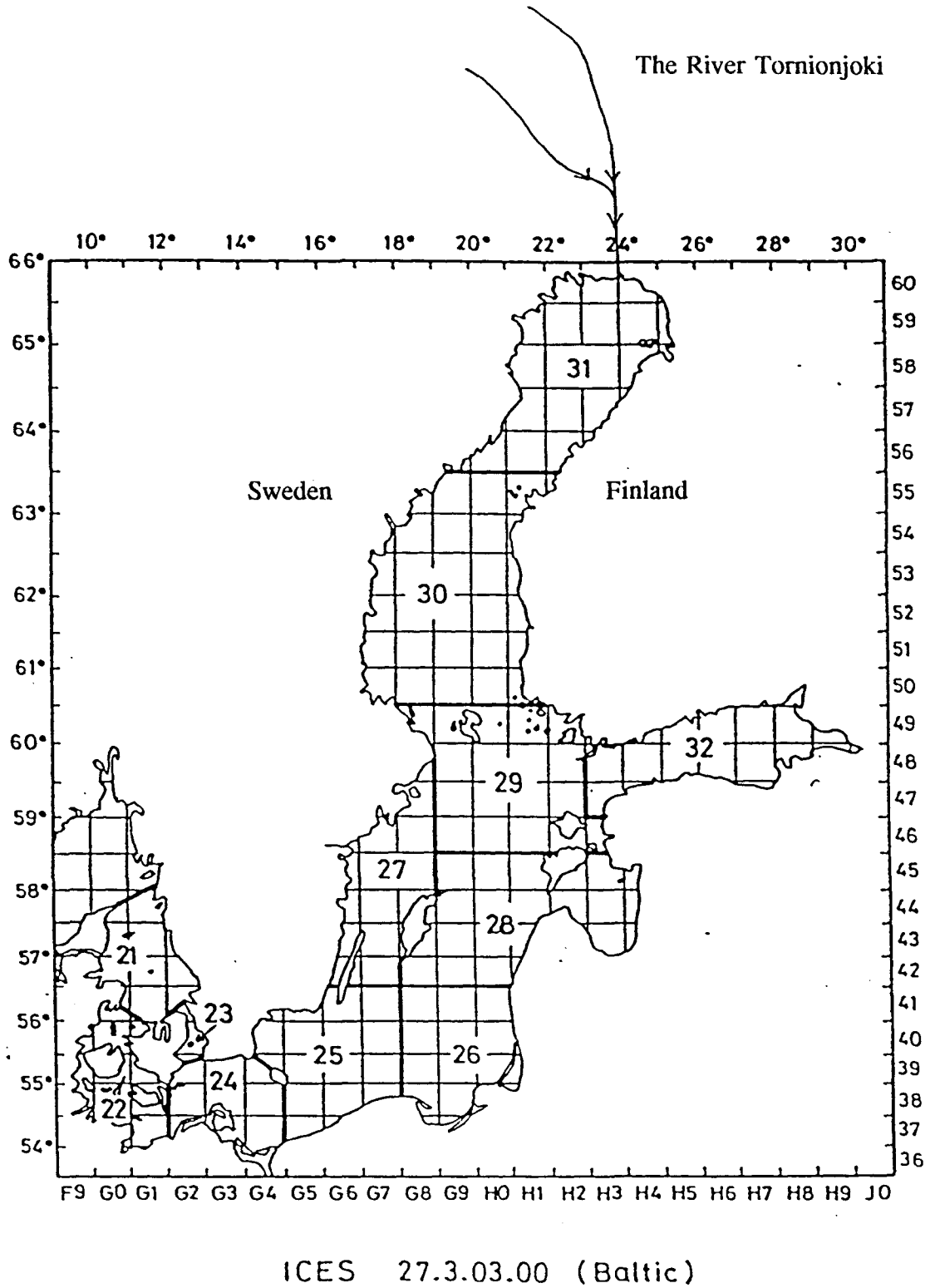
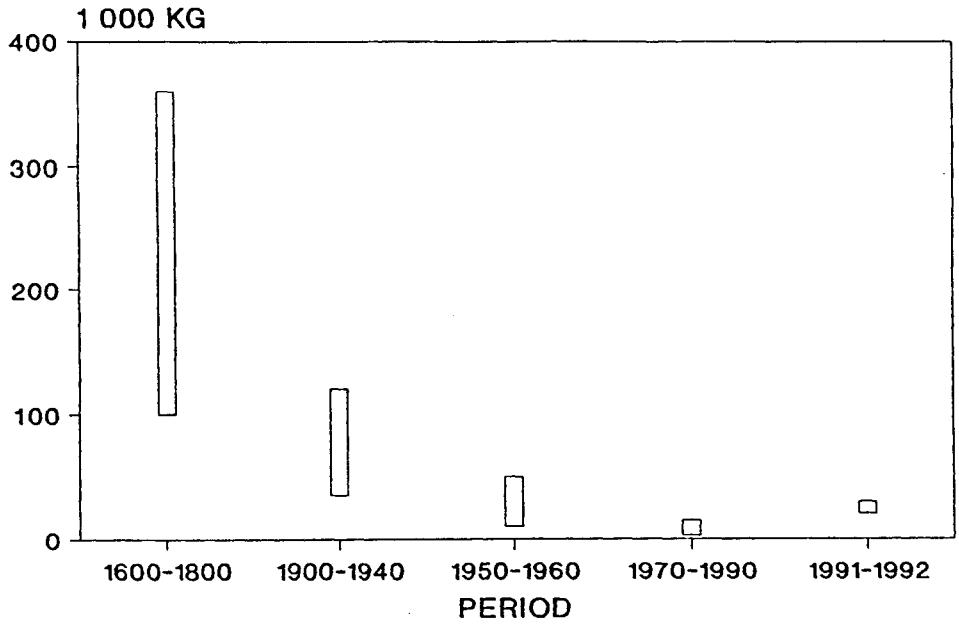


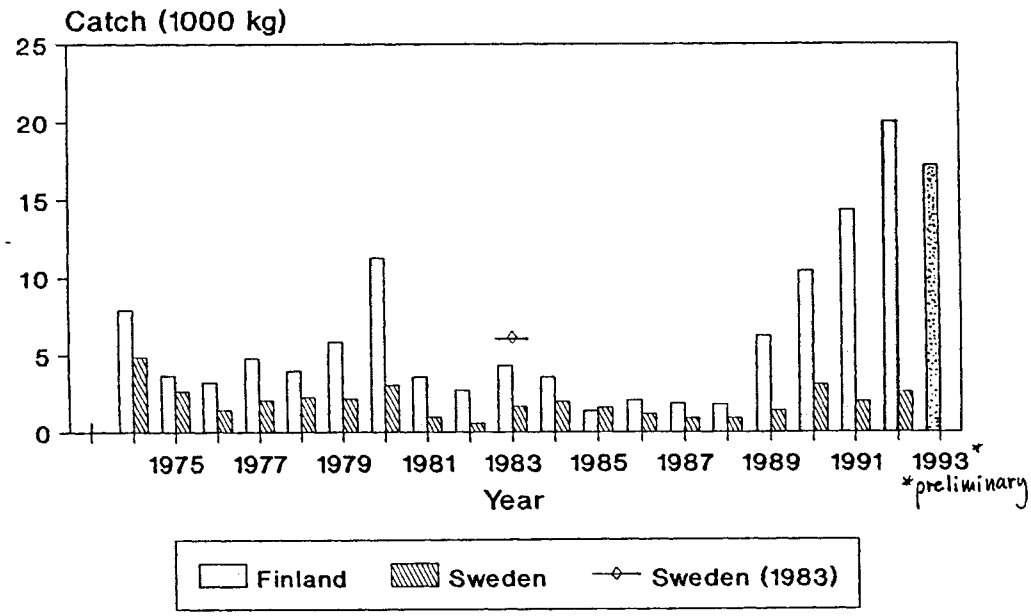
Fig. 1 The Baltic Sea
Sub-div 24-29 = The Baltic Main Basin
Sub-div 30-31 = The Gulf of Bothnia
Sub-div 32 = The Gulf of Finland
The biggest of the Baltic rivers having original salmon stock left is the River Tornionjoki.

FIG. 2

SALMON CATCH LEVELS IN THE R. TORNION-JOKI BEGINNING FROM THE 1600'S



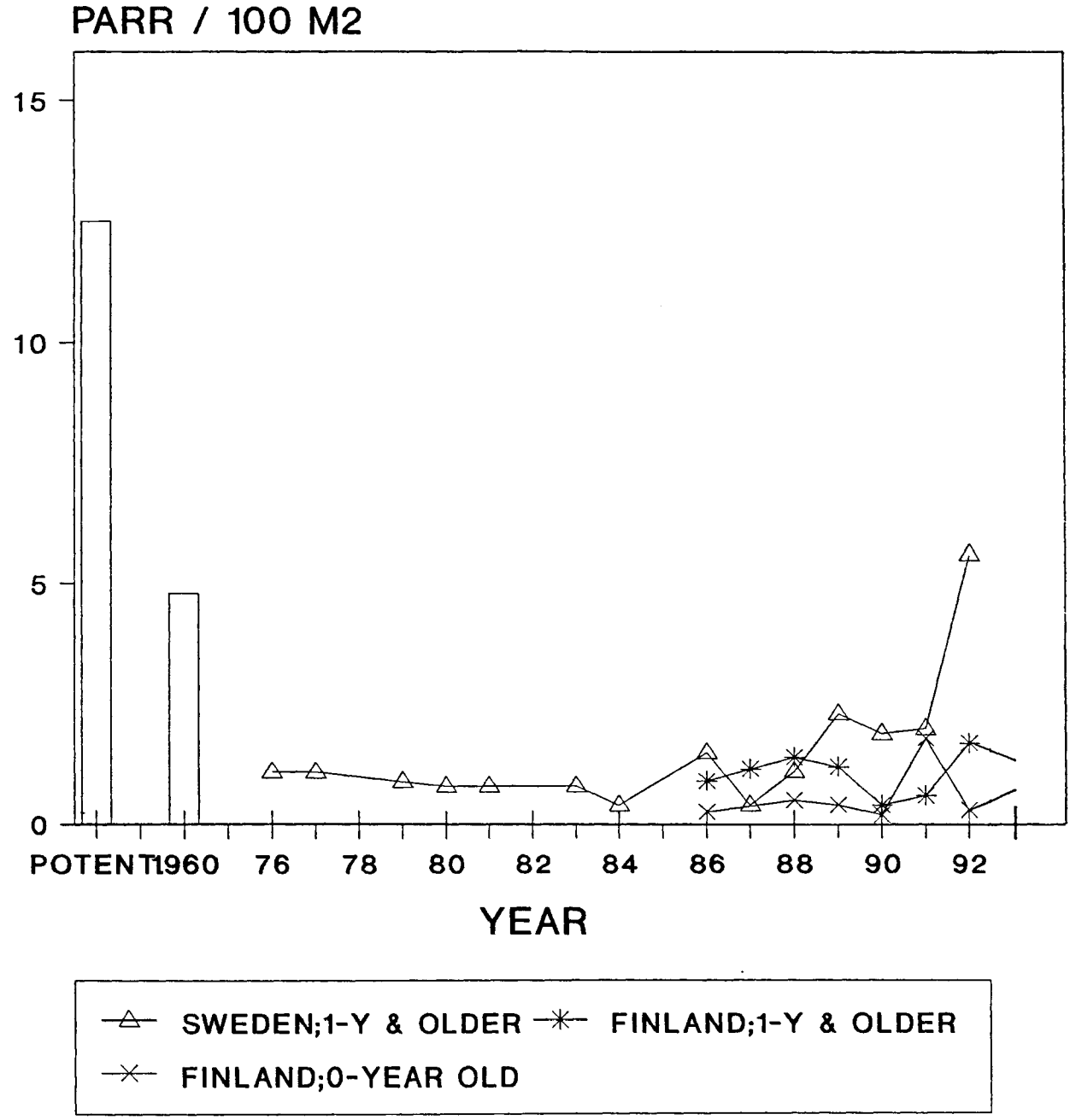
SALMON CATCHES FROM THE RIVER TORNIONJOKI IN 1974-1993



SWEDEN: NOT TOTAL CATCHES EXCEPT 1983

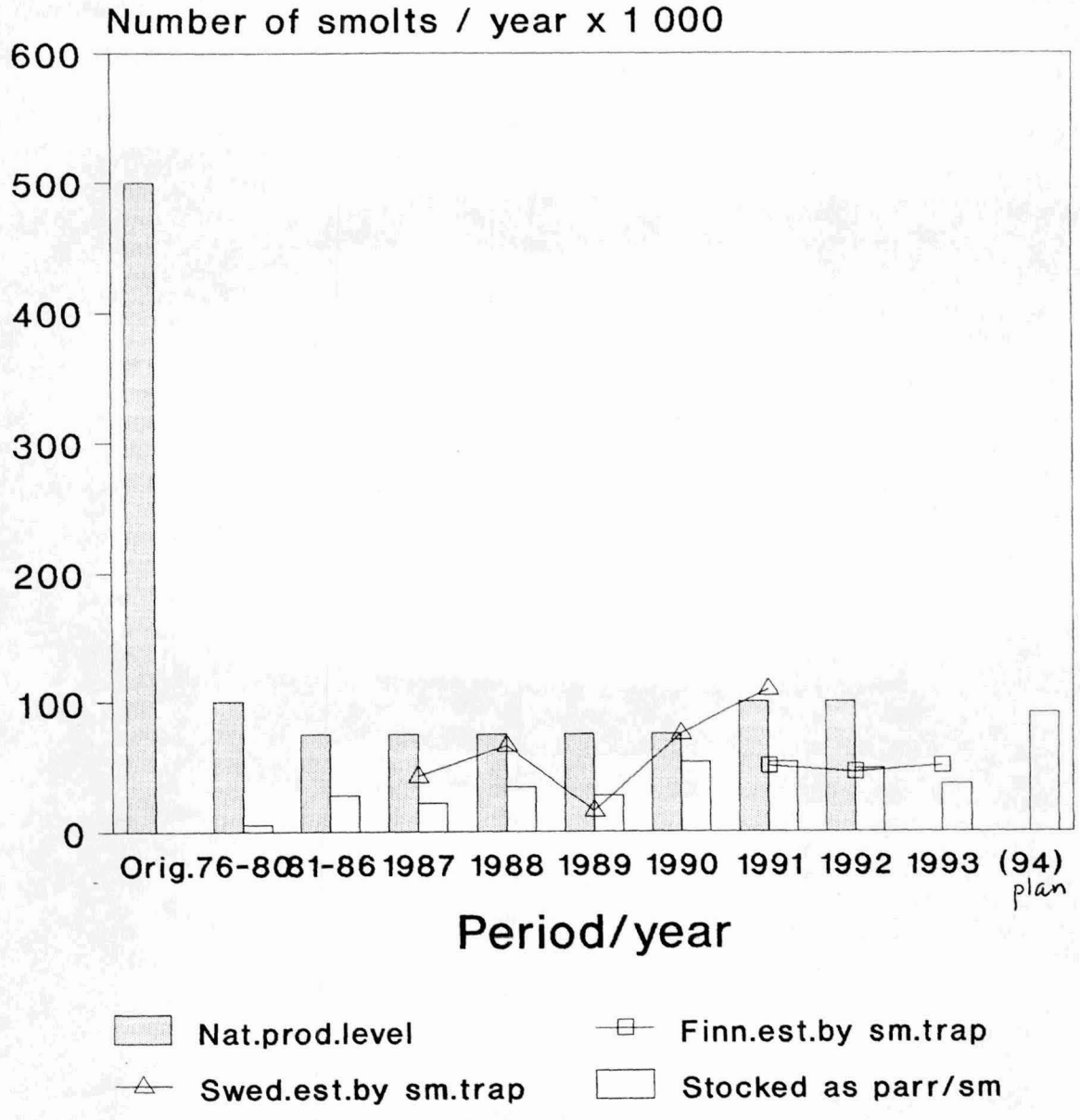
FIG. 3

NATURAL SALMON PARR DENSITIES IN THE R. TORNIONJOKI/EL.FISH.



NO FISHING IN 1978 AND 1985 (HIGH WATER)

FIG. 4 Salmon smolt-production in the River Tornionjoki



Nat.prod.: based on el.fish. and sm.tr.
Reared prod.: sm.surv. 50%, parr 10-15%

FIG. 5 DISTRIBUTION OF THE TAG RECOVERIES OF THE SALMON OF THE R. TORNIONJOKI

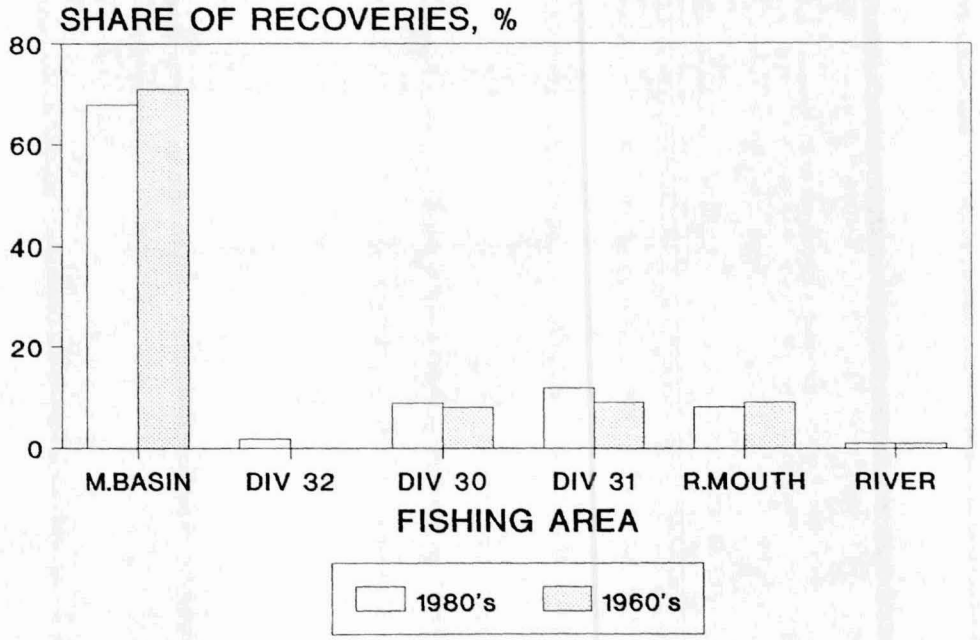
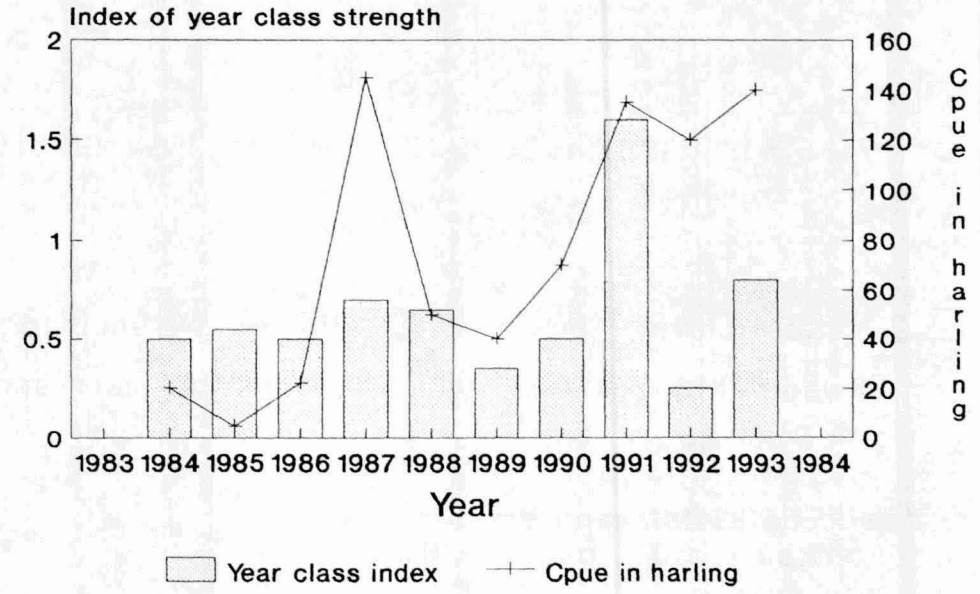


FIG. 6 The River Tornionjoki Salmon
Year class strength & cpue in harling



CPUE (g/day): year-n-1