ICES SGBALANST REPORT 2009

ICES Diadromous Fish Committee

ICES CM 2009/DFC:03

Ref. SCICOM, ACOM, WGBAST, TGRECORDS

Report of the Study Group on Data Requirements and Assessment Needs for Baltic Sea Trout (SGBALANST)

3–5 February 2009

Copenhagen, Denmark

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Recommended format for purposes of citation:

ICES. 2009. Report of the Study Group on Data Requirements and Assessment Needs for Baltic Sea Trout (SGBALANST), 3–5 February 2009, Copenhagen, Denmark. ICES CM 2009/DFC:03. 97 pp.

Contents

Executive summary

The Study Group on Data Requirements and Assessment Needs for Baltic Sea Trout [SGBALANST] met by correspondence from November 2008 to February 2009, and at ICES Headquarters from 3–5 February, 2009.

The group was chaired by Stig Pedersen, Denmark and had 16 members from 9 nations representing all countries and regions round the Baltic Sea, except the Åland Islands and the Kaliningrad area. Information from these areas was supplied by Finnish and St-Petersburg representatives.

The study group was continued from 2008, when the availability of data for an assessment was investigated.

The objective of the group was to consider if the status of the trout populations in the Baltic, justifies international assessment. If appropriate, the group should furthermore propose methods for assessment, give advice on which populations to assess and suggest levels of precision in the assessment. Furthermore, if appropriate, give advice on areas and representative rivers for establishing stock-recruit relationships.

The findings of the group should be presented for WGBAST, ACOM, SCICOM and TGRECORDS.

Before meeting in February 2009, members of the group collected information available within the time frame given on the status of the trout populations (parr densities, spawning run, environmental conditions, information on migrations, fishing and catches). At the meeting the findings were presented and discussed, and a preliminary conclusion was drawn. Furthermore, it was decided what further information could and should be collected and included in the final conclusions.

After collecting additional information final conclusions were discussed and drawn.

Results were available from 295 trout populations in the Baltic, covering all sea areas and almost all countries or regions. No information was available on German trout populations as only stocked populations are monitored in Mecklenburg – Western Pommerania, no data were received from Schleswig-Holstein and not either from the Kaliningrad area.

Migration patterns are known for only few populations. While it appears that most populations make relatively short feeding migrations (distances being only a few hundred kilometres), it is known that all sea areas have populations with long migration patterns, spreading into neighbouring sea areas.

It is evident that the status of the trout populations in the Bothnian Bay and B. Sea area and to a certain extent also in the Gulf of Finland are in a severe state with very low parr densities and worryingly small runs of spawners into the rivers. Although a positive tendency in population *development* in some of the populations is observed in recent years, these populations are still at such a low level that trout populations must be considered at risk of extinction.

Also in Gulf of Finland some trout populations have a poor status.

The reason for the poor status appears to be the catch of sea trout mainly during the postsmolt stage as a by-catch in a heavy fishery targeting mainly whitefish in the Bothnian Bay and Bothnian Sea area and also pikeperch in the Gulf of Finland. In the Gulf of Finland the insecure status of the trout populations are also influenced by migration barriers, habitat quality and river flow conditions.

A worrying tendency to very early catch, just after sea migration, is also found in the south eastern area in the eastern Poland area, where a large fraction of emigrating smolts have been observed to be caught in a coastal herring fishery.

In most other parts of the Baltic the trout populations seem to be in a, if not optimal, then reasonably good state, habitat conditions taken into account.

Recommendations:

In response to the **ToR item a)** the group finds that the status of the sea trout does justify ICES assessment, being most important in the Bothnian Bay (Subdivision 31), Bothnian Sea (Subdivision 30) and Gulf of Finland (Subdivision 32) but relevant in all parts of the Baltic Sea.

In response to **ToR item b)** the group finds that:

- The model(s) used should be easy to perceive and have a transparent construction;
- Assessment should be holistic encompassing all aspects of sea trout life, i.e. access to spawning grounds, habitat and water quality, migration obstacles during seaward migration, impact from fisheries and other factors affecting survival such as natural variations in hydrologic conditions, predators.

In response to **ToR item c)** the group finds that assessment should cover all major sea areas.

In particular the Bothnian Bay (Subdivision 31), Bothnian Sea (Subdivision 30) and Gulf of Finland (Subdivision 32) are critical areas but in other parts of the Baltic Sea at least 1 river in each major sea area extended surveillance should be established with index rivers. In these rivers spawner abundance with determination of age / size / sex composition, parr abundance and smolt number should be collected, in order to establish Stock – Recruit relationships.

Information from recaptures of tagged fish will be essential to the assessment, and existing tagging programmes should be continued. These should be supplemented with additional releases of tagged wild fish in selected streams in all major sea areas.

Initially, it is recommended that streams with smolt traps and fish counters are used. In some streams established as Salmon Action Plan Index rivers, facilities are already established.

All existing electrofishing sites should be continued. In addition more electrofishing sites should be established in some of the larger salmon rivers in tributaries to ensure sufficient coverage of trout nursery areas.

To facilitate the use of information from index rivers on a wider scale, a common classification system of habitats should be established.

In sea areas, where a high fishing mortality has been observed, and in sea areas where recreational fishing is extensive, fishing effort and catches of wild fish should be examined.

With the present report the group considers the task for preparing assessment of trout populations in the Baltic to be completed, and a continuation of the SGBALANST is not needed. If the recommendations are accepted it is the opinion of the group that initiation and establishment of assessment should be encompassed in the WGBAST framework.

1 Introduction

Sea trout is an anadromous form of brown trout (*Salmo trutta* L.). Sea trout usually live in the same water system with resident brown trout, and they can be genetically isolated from each other or breed together and genetically belong to the same population.

The species is naturally distributed in North and Western Europe from the White Sea to Northern Spain, including the entire Baltic Sea area.

Populations are often partially migratory, i.e. one part of the population leaves the river for feeding in the sea (predominantly females migrate), while another part stays in the river as residents.

Sea trout spawn in gravel during autumn and winter, depending on latitude, in rivers and smaller streams, often in the upper reaches or in smaller tributaries, where the nursery areas of trout are also found. This is different to salmon, which are more frequently found in larger parts of the rivers.

They live their first (1–5) year(s) as parr in the stream, leave the stream as smolts and feeding migrate in the sea ½ and up to 5 years before returning to their natal stream for spawning. Spawning may be repeated several times (Klemetsen *et al.*, 2004).

In a Workshop on Baltic Sea trout in Kotka 31 May–2 June 2006 it was recognised that natural sea trout stocks have declined dramatically from their original abundance (Heinimaa *et al.*, 2007).

Trout populations have declined especially in the Finnish coastal area and wild populations are nowadays extremely endangered. At the same time also returns from sea trout stockings have declined and they have reached a level where they are not profitable. The phenomenon seems to be enlarging from the Finnish coast to different areas of the Baltic Sea.

In other areas of the Baltic Sea the natural stocks are in better condition. This is the case along the coast of the Main Basin and in the western part of the Baltic Sea in Denmark and Sweden.

At the First International Sea Trout Symposium in Cardiff, Wales in 2004 it was declared that immediate action should be taken to protect and conserve sea trout stocks throughout their geographical range (Harris and Milner, 2006). It was also recognized that more detailed research information is needed as the exceptional variety of trout life histories and habitat use adds significantly to the biodiversity of many types of waters. In the case of sea trout this includes rivers, lakes, estuaries, coastal waters and a huge network of otherwise neglected small coastal streams. Sea trout populations are thus particularly valuable in assessing ecosystem health in the context of the Water Framework Directive.

In the Gulf of Bothnia area ICES (2007) found the production potential and status of 51 populations in Swedish rivers to be very uncertain, while it is at a low level in 3 of only 5 Finnish rivers with sea trout populations.

The available knowledge indicates that in many rivers only a few spawners enter the rivers and electrofishing surveys in the rivers indicates considerable decreases in parr densities.

ICES (2007) concludes that the main reason for the decline is a too intensive fishery, poor habitat quality in rearing streams and restricted access to spawning areas. In the fishery, the trout are caught largely as bycatch in gillnet fishing for whitefish.

In the Gulf of Finland there are 100 rivers and streams with trout populations. The situation is reported to be similar to that in the Gulf of Bothnia. Also in this area habitat degradation and over exploitation are key factors, especially in the Finnish fishery for whitefish and pikeperch. In addition to this, part of the fish is caught in the offshore fishery before reaching maturity (ICES 2007).

In the main Basin there are 773 rivers and streams with trout populations, about half of them being wild. The status of the sea trout populations is not known in all countries and streams.

In general, it has been found that the production is much lower than the estimated potential production in a large majority of the streams.

While the naturally produced smolt numbers in some areas have increased somewhat in recent years, probably due to improvements in water quality, habitat conditions and reduction in the number of dams and other obstacles in the streams, migration barriers, poor habitats and low or varying water quality in several areas restrict populations.

A considerable professional fishery for sea trout takes place in the Baltic Sea.

The total sea trout catch in the Baltic Sea was 904 tonnes in 2007 (ICES 2008a); the major part being caught in the Main Basin. However, because of gear restrictions the catches are expected to be lower in future.

Working in 2008 the SGBALANST collected information on methods and extension of monitoring of sea trout populations in all countries around the Baltic (ICES 2008b).

It was found that monitoring of the parr populations in streams is common to all countries (most often 0+ parr), where the young trout are sampled by electrofishing.

Furthermore it was found that the intensity and variation between countries in the sampling is however quite large. Information is in some countries collected only sporadically as a spin off from other investigations, while some countries follow a regular sampling routine. Routine collection of information occurs often when focus is on salmon.

The commercial fishery, together with angling in rivers in some of the countries, was considered to provide the most precise information on catches of sea trout, while catches in the non-commercial coastal fishery needs to be improved as does knowledge on catches as bycatch in other fisheries. Also knowledge on river catches (in some countries) and on age distribution of spawners needs improvement.

1.1 Terms of Reference

At the 2008 Statutory Meeting, ICES made a resolution (Res. 2008/2/DFC03) that the Study Group on Data Requirements and Assessment Needs for Baltic Sea Trout [SGBALANST] (Chair: Stig Pedersen, Denmark) will meet by correspondence from November 2008 to February 2009 and at ICES Headquarters from 3–5 February 2009 to:

a) consider whether the status of the trout populations justifies there need for an ICES assessment for international management, taking account of variations in stock status and migration patterns; and , if appropriate

b) propose methods for assessing sea trout stocks, advise on which populations should be assessed and the appropriate levels of precision

c) select appropriate and representative geographical areas and types of rivers for establishing stock–recruit relationships

The study group had 16 participants, all being the same members as in 2008. The list of participants can be found in Annex 1.

2 Adoption of agenda

The group worked by correspondence, with all members participating from early December 2008 until meeting at ICES headquarters 3–5 February. At the meeting members representing all countries except Russia and Lithuania were present.

After the meeting work was continued by correspondence, again with all members participating.

After forming of the group (confirmation of continued activity from 2008), the group initially discussed the understanding and delimitation of the task.

Related to ToR item a)

"consider whether the status of the trout populations justifies the need for an ICES assessment for international management, taking account of variations in stock status and migration patterns"

- Regarding the status it was decided to try to collect information on populations also taking habitat quality in consideration, and to include any information available on number of spawners because of the expected scarcity of information (direct counts, catches in rivers, redd count).
- Regarding which populations to consider it was decided to try to collect information from all streams, where data were listed as available to the Study Group in 2008.
- Regarding influence from resident trout on parr densities, it was decided that the literature should be consulted for published studies on this.
- Regarding variations in stock status, it was expected that the natural magnitude of variation on population densities would emerge but that the literature should also be consulted.
- Regarding migration available information should be gathered from both published and not published studies on a national level.
- Regarding fishing information, it was decided to collect all available information on both catches and effort in any fishery that may catch sea trout

Related to ToR item b)

"propose methods for assessing sea trout stocks, advise on which populations should be assessed and the appropriate levels of precision"

- The necessary elements to conduct an assessment were discussed, such as knowledge on catch, fishing effort, abundance of the stock, mortality, growth and reproduction, and the question on which populations that should possibly be assessed, or if it should be preferred to work only with reference points such as parr densities, as suggested by Walker *et al.* (2006) for trout populations in England and Wales.

- It was decided to leave this discussion until sufficient knowledge on the available information was at hand but to try and collect available information on both spawners and smolt in order to investigate the possibility to establish a stock/recruit relationship.
- Regarding the selection of possible populations to asses and levels of assessment was also decided to discuss after collection of sufficient information.

Related to ToR item c)

"select appropriate and representative geographical areas and types of rivers for establishing stock–recruit relationships"

- It was discussed if focus should be on populations under heavy pressure, where data are (more) readily available. It was decided to wait with a decision on this until sufficient information was available.

Conclusions:

1) Each country should collect and provide information on the following items for as many streams as possible and for a time period as long as possible:

- Absolute densities of 0+ parr, stating the origin of the data (purpose of collection),
- Estimate or valuation on habitat quality/ carrying capacity,
- If available the number of spawners or an index on number of spawners

In order to try to distinguish between natural and anthropogenic influences the type and nature of known anthropogenic activities influencing trout should be included.

2) Each country should collect national information on published studies on migration routes, i.e. papers, reports and most valuable maps

3) If possible, each country should extract information from databases on recapture positions from tagging experiments, clearly dividing results into types of fish tagged (wild smolts, reared smolts (+ origin), spawners, ….). This preferably in a map format or as a database with (if possible) release position, recapture position, release time, recapture time, and recapture gear, which may be used to produce maps.

4) Each country should gather information on the amount of fishing (effort where this is available) and catches in the fishery, if possible at least for a time period equivalent to the one reported on from rivers in the area (and preferably a bit longer back in time e.g. 5 years). Information should be gathered with a precision of 1 year.

The following time table was adopted.

Time	Subject	Responsibility
8 Jan 2009	Response on work plan, understanding of tasks	All members/1 per country
11 Jan. 2009	Compilation of inputs on working method, definition of tasks, working plan, form in which to collect / submit information and decision on tasks distributed to group	Chair
14 Jan 2009	Comments on reporting format and specific tasks submitted to Stig	All members/1 per country
15 Jan 2009	Final reporting format and specific tasks distributed to group	Chair
26 Jan 2009	National results submitted to Stig	All members/1 per country
28 Jan 2009	National results on ICES Sharepoint	Chair
3–5 Feb 2009	Meeting at ICES headquarters to: Review status of the tasks explore and discuss possibilities for and necessity for the assessment of Baltic sea trout populations discuss possible assessment methods produce outline or draft report plan future work in detail	All members/1 per country
10 Mar 2009	Final report distributed to group for last review	Chair
12 Mar 2009	Response on final report returned to Stig	All members/1 per country
15 Mar 2009	Final report submitted to ICES	Chair

3 Conclusions and recommendations

The Study Group finds that

- there is overwhelming evidence of serious problems in the Bothnian Bay and Bothnian Sea with extremely low parr densities, extremely low spawning populations, high fishing mortalities in the sea and that populations are endangered
- there is evidence that in the Gulf of Finland sea trout are negatively affected by sea fisheries, migration obstacles in streams, sub-optimal habitat and water quality conditions
- there is evidence of a significant and early fishing mortality in migrating released smolts in the south-east of the Baltic east of Gdansk
- the evidence indicates that in the rest of the Baltic, sea trout populations are not seriously affected from fisheries. On a wide perspective, habitat and water conditions are not optimal but with sufficient quality to support self sustaining trout populations.

Regarding the fishery, a reduction in fishing mortality in subdivisions 31, 30 and possibly 29 is needed. The fishery catching sea trout occurs in several countries covering a large sea area, and a technical regulation measurement is likely to be needed. In the southeast Baltic in the herring fishery east of Gdansk, it is not know to what extent wild strains of sea trout are affected; if wild strains of sea trout are affected significantly, a reduction in this fishery might be needed.

Recognising the fact that these fisheries occur in national waters, it is the opinion of a majority in the group that because sea trout migrate widely and are caught in fisheries in several sea areas assessment of populations should be handled internationally.

Regarding both fisheries and quality and accessibility to habitats and water quality, an approach similar to the recommendations on salmon (ICES 2008c) should be taken, i.e. to use an integrated approach addressing factors controlling sea trout life throughout the life cycle. The approach should encompass fishing, habitat alteration, hatcheries, the role of diseases, predation, and both professional and recreational fisheries (open sea, coastal and in rivers).

3.1 Recommendations

In response to **ToR item a)** the group finds that the status of the sea trout does justify ICES assessment, being most important in the Bothnian Bay (Subdivision 31), Bothnian Sea (Subdivision 30) and Gulf of Finland (Subdivision 32) but relevant in all parts of the Baltic Sea.

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In response to **ToR item c)** the group finds that assessment should cover all major sea areas. In particular the Bothnian Bay (Subdivision 31), Bothnian Sea (Subdivision 30) and Gulf of Finland (Subdivision 32) are critical areas but in other parts of the Baltic Sea at least 1 river in each major sea area extended surveillance should be established as index rivers. In these rivers spawner abundance with determination of age/ size/ sex composition, parr abundance and smolt number should be collected, in order to establish Stock – Recruit relationships.

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4 Summary

Recruitment

The status of trout populations in different ICES Subdivisions was analysed using electrofishing data on parr densities data from 295 streams from Denmark, Estonia, Finland, Latvia, Poland and Sweden.

Low stock status was observed in subdivision 31. Also subdivisions 26/28/29 (Poland, Latvia, Lithuania, Estonia) and 32 (Gulf of Finland) populations were found to have significantly lower stock status than expected. Also in the Danish Belt area, the Sound and the Bothnian Bay stock status was lower than expected but not more than 10–20% lower than expected, allowing for latitude and size of river.

Water quality was found to explain some variation in stock status but the information and time available was insufficient to evaluate fully. In subdivision 31 the water quality could not explain the low status.

In subdivision 32 water quality alone could not explain the status but including also habitat quality explained part of the variation observed.

The variation in abundances and trend in development varied between different regions.

In subdivision 31 in Sweden and Finland trout densities are extremely low being significantly lower than what could be expected, however with a positive trend in development.

In Sweden in the Bothnian Sea area (Subdivision 30) population densities were low and the variation in densities over a longer time span was approx. 4-fold. Larger variations are found in Estonian rivers in the Gulf of Finland, with a 10-fold change in population densities and a decreasing trend in the development of population densities. The variation in population densities in this area is in part due to variations in precipitation.

Also in subdivisions 26/28/29 population densities was low but there was not a significant trend in development.

There was not a significant trend in development in populations in the remaining subdivisions.

In 145 different Baltic Sea trout rivers with at least more than 4 observation years in the period 2000–2008 the Coefficient of Variation (Standard Deviation/Mean)*100) was calculated being on average 72%, with extremes from 15 to 256%. The Coefficient of Variation was negatively correlated to abundance.

Spawners

The information on the number of spawners is very limited. Only in two rivers in Sweden manual counts are made and in a few more rivers automatic counts are made. From a few more rivers catches (either professional or recreational) are known, and in a few other rivers redds are counted.

In the large rivers in northern Sweden (area 30 and 31) very few spawners ascend the rivers. During the period 2000–2008 average numbers were between 52 and 247 in the rivers Kalixälv, Piteälv and Vindelälven. In these rivers a significant but low increase in the number was observed.

In the same area R Byskeälv has had a negative trend in the development of spawning run. In the same area the trend in sports fishing catches in 12 rivers in Sweden was positive in two rivers, however at a very low catch level and strongly negative in one river.

In the Tornionjoki, on the Finnish side, catches increased dramatically around 1990 (coinciding with increased interest in salmon fishing) and have since then had a slightly decreasing trend.

Further south, in subdivision 27 a negative trend in the development of the spawning population is found in two rivers. In subdivision 26 count of redds indicate a positive trend in two rivers in Lithuania and negative in one river in Poland.

In subdivision 25 both positive (in R Leba, Poland) and negative trends (R. Mörrum, Sweden) are indicated.

Finally in subdivision 22 the trend was positive in 3 Danish rivers.

The size composition of spawners in two Danish rivers resembles that in R. Slupia, Poland. The size composition of these populations may indicate that the spawning populations have been influenced by a selective fishery, unlike the distribution in R. Mörrum, Sweden. In Tornionjoki no change in average size of sea trout caught in the sports fishery during the period 1992–2008.

The age composition in the Danish R. Kolding has changed significantly between 1991 and 2001, possibly indicating a reduction in fishing on the trout population, coinciding with reductions in the recreational fishery.

In subdivision 31 (inter alia R. Tornionjoki) the age at maturity has been constant for decades, being mostly 3 sea winters. However, in recent years an increase catches of in younger sea trout has been observed.

Tagging data

Reaching back to the 1980s, the Finnish Carlin-tagging data on releases of hatchery-reared smolts show big variations between years and sea areas in the recapture rate and yield. In the Bothnian Bay, the recapture rate varied annually between about 6% and 10% in the 1980s and between 3% and 8% in the 1990s. The decreasing trend continued after 2000, with a mean recapture rate about 3%.

On the Finnish coast of the Baltic Sea, annual variations in recapture rate and yield have been highest from releases in the Bothnian Sea area (Subdivision 30). The recapture rate varied in the 1980s between 4% and 17%, in the 1990s between 2% and 18%, and after 2000 between 2% and 8% with a mean of 4%. Also in the Archipelago (Subdivision 29) the decreasing trend is obvious.

For smolts released in the Gulf of Finland, the recapture rate was relatively low in the first years of the 1980s but from 1983 to 1997 the recapture rate varied between 7% and 13%. After this time it dropped to a very low level, varying in recent years between 1% and 4%, having a mean of 2%.

In Sweden tagging is carried out in seven larger rivers with large stocking programmes of sea trout all situated in the Bothnian Bay (Subdivision 31) and the Bothnian Sea (Subdivision 30). The recapture rate has decreased from 16% in the period 1959–1979, to 9% in the 1980s and to 6.8% in the 1990s. In the period 1996–1998 the recapture rate was only 3.9%, and 86% of recaptures had weights below 0.4 kg.

Information from tagging experiments indicate a strong negative trend in the recapture rate and yield of sea trout in all the northern ICES subdivisions 29–32, and presently the level is the lowest recorded since the 1980s.

The age composition in the recaptures in subdivisions 30 and 31 shows a continued trend of recaptures occurring at a younger and younger age, the proportion of postsmolts increasing considerably in all Finnish coastal sea areas (Subdivision 29–32) from a level of 10–40% in the 1980s to 35–65% after 2000. At the same time the proportion of older sea trout has been reduced; especially the proportion of fish old enough to mature sexually (≥3 SW).

In the south eastern part of the Baltic Sea (Subdivisions 25 and especially 26), the age composition in catches from Polish tagging shows a catch of somewhat older fish but with a decreasing trend in age.

In the south western part of the Baltic Sea (Subdivision 22) catches during the year of sea entry was in recent years 10–25%, and 40–60% as 1 SW and approx. 20% as 2 SW trout.

Tagging results indicate a high early fishing mortality in both the sea areas around Finland (Subdivisions 29–32) and especially eastern Poland (Subdivision 26).

Analysis of gear catching tagged trout released in Finnish waters shows that in subdivisions 30 and 31 a vast majority of the trout are caught as by-catch in gillnet fishing. This corresponds to findings on the Swedish side in the same area. Gear with bar lengths 38–45 mm are common but down to 27 mm are used in subdivisions 30 and 31. For reference a bar length of 50 mm corresponds roughly to a catch size of 50 cm trout.

In Finnish tagging returns in the Bothnian Bay (Subdivision 31) more than half of recaptures was from fish with length <40 cm and over 80% of the recaptures from fish with length <50 cm fish almost continuously during the period 1980–2008. In the Bothnian Sea (Subdivision 30) area the proportion of small fish with length <40 cm was around 20–40% of total recaptures and of fish with length <50 cm mostly between 60% and 80%. In the Archipelago Sea (Subdivision 29) and in the Gulf of Finland (Subdivision 32) the share of recaptures with lengths < 40 cm was between 10% and 20%, and fish with lengths < 50 cm 30–80%.

For fish released in subdivision 22 (Denmark) during the period 2002–2004 less than 10 % were recaptured with length < 40 cm and more than 35 % with length ≥ 60 cm.

The early recapture of small fish in the northern parts of the Baltic Sea is further emphasized with only on average 6% being recaptured in freshwater in subdivision 31 and in subdivisions 29, 30 and 32 4%, excluding recapture of postsmolts. For comparison the same figure in subdivision 22 during the period 2002–2004 was 30 % from the home river.

Based on tagging results the annual fishing mortality was found to be around 70–80% in subdivisions 29 and 32. Calculation of yield per recruit showed that the optimal biomass harvested would be at approx. 30% fishing mortality, indicating that these stocks are fished too heavily.

Further calculations show that postponing onset of harvesting with 1 year would approximately double catches, even maintaining the present fishing mortality.

Migration

While the vast majority of strains have not been investigated, it appears that most sea trout stocks in the southern parts of the Baltic Sea appear to be long-migrating.

Sea trout from the R, Vistula (Subdivision 26) migrate into the central and northern parts of the Baltic Proper and even into the Bothnian Sea and Gulf of Finland. Also the sea trout in Germany (Mecklenburg - Western Pomerania) (Subdivision 25) appear to migrate rather long distances and sea trout from the Swedish R. Verke å (Subdivision 25) have feeding migrations in the central parts of the Baltic Proper, and some even to the Gulf of Riga and to the Gulf of Finland. However, some sea trout stocks, like those living in small streams in Gotland appear to be stationary having no tendency to long migrations.

The sea trout on the eastern coast of the Baltic Proper seem to stay near their native river, with at least one exception. Also strains in the Gulf of Finland (Subdivision 32) appear to migrate relatively short distances, mostly being caught in the Gulf.

At least some populations in the western parts of the Baltic Sea perform longer migrations into the Baltic proper. In this region some populations outside the actual Baltic are also known to migrate into the Baltic area.

Most of the sea trout stocks in the Gulf of Bothnia have shorter migrations than the southern stocks. In Sweden, >95% of the recaptured tagged fish from R Ume-Vindel were caught <200 km from the home river and also trout from the Isojoki river (Subdivision 30) were mostly recaptured less than 100 km from the river. However, for both Iijoki and Lestijoki trout (Subdivision 31), some were also recaptured on the other side of the Bothnian Sea / Bay in Sweden.

The Tornionjoki (Subdivision 31) sea trout migrate along both the Finnish and Swedish coast, migration being similar to both wild and hatchery raised fish.

In short it seems that all areas have both short and long migrating sea trout, and within any one strain it is likely that variation in migration pattern will exist.

Catch and effort

Effort in the fishery targeting sea trout was reported to ICES only from two countries but sea trout are to a large extent caught in the salmon fishery.

Catch of sea trout with information on year, gear, ICES subdivision, number of fish and weight is collected by each country with differentiation for sea, coastal and river fisheries and is based mostly on logbooks. River data is obtained mainly from angler's associations.

Total sea trout catch in the Baltic has decreased from a peak with 1400 tons in 2000 to 907 tons in 2007.

Until 1997 most sea trout were caught by Finnish fishermen but after this time the larger part have been caught by Poland, partly as a bycatch in the salmon fishery in the Baltic Proper. The gear used in this fishery was mostly drift nets, which are now prohibited. Presently the only gear in this area is long-lines.

In coastal areas, gillnets and trapnets are the most important gear, in the catches reported (i.e. only professional catches).

Finnish gillnet fishing effort has the highest intensity in the Bothnian Sea (Subdivision 30) with approx. 1.7 mio. gear-days in recent years. In subdivision 31 gillnet effort has decreased to approx. 0.45 mio. in 2007, while it is slightly higher in sion 29 (approx. 0.75 mio. gear days).

Over the last decade, the fishing effort with small mesh sized gillnets (36–45mm) was largest in subdivision 30, followed by 31 and 29. Also in subdivision 32 smaller mesh sizes dominate but compared to the other subdivisions a larger part of the effort is with larger mesh sizes.

In Finland the gillnet fishing with small mesh sizes generally targets whitefish but in subdivisions 29 and 32 pikeperch is also important.

While total Finnish effort with gillnets in subdivisions 29–32 has been relatively stable (approx. 3.6 mio gear days per year) the effort with trapnets has decreased in all subdivisions from approx. 0.1 mio. gear days in the late 1990s to approx. 55 000 in 2007.

Sea trout are caught by these gears only as a by-catch and mostly as undersized fish. A major part of the professional catches of sea trout are by trapnets.

Also in Poland in subdivision 26, mainly in the Gdansk Bay, a comparatively small (max. 500 gear days per month) herring fishery with anchored gillnets is known to catch sea trout postsmolt.

The effort in recreational fisheries is not well documented.

In 2007 the catch by the recreational fishery on the Swedish side in subdivisions 31 and 30 was estimated to be 316 000 trout (95% c.l. 196 000–450 000) corresponding to 243 tons and similarly, in the Finnish part of subdivision 31, approx. 125 tonnes per year (70–165 tonnes) during the period 1992–1998. A rough estimate of the total recreational catch in subdivisions 31 and 30 could be near 490 tons. This figure may be compared to a professional catch of 318 tons by Finnish and Swedish fishermen.

Anthropogenic and other factors influencing trout populations

Migration obstacles are a major threat to salmonids, not only impairing migration but also influencing habitats both up and downstream the obstacle. In many parts of the Baltic fishways have been constructed and in some cases barriers have been removed but barriers still constitute a major problem to migrating trout in many rivers.

Other factors, such as canalisation or alignment of the rivers, in some places performed for log driving, have negative influence on amongst others habitat quality, and while restoration projects have been performed in many places, there is still a widespread need for further restoration.

While most rivers are reported to have good or at least fair water quality, poor water quality due to direct eutrophication is locally a problem (reported for some rivers in Estonia). Acid from combustion of fossil fuels has been, and still has to be, counteracted by extensive liming in some areas. Locally, pH can be reduced to a critical level due to a combination of geology, drainage of fields and low precipitation. In some areas heavy loads of fine sediment is a problem, reducing spawning abilities and survival of eggs. This problem is aggravated through canalisation, urban development, farming and changed hydrology.

Natural variations in parr densities are locally often caused by variations in hydrology. Dry summers and autumns lead to reduction in number and change in quality of habitats. Due to reductions in flow access to spawning grounds may also be prevented.

In recent years the occurrence of ascending sea trout infected with ulcerative dermal necrosis has increased in many Pomeranian (Poland) rivers, resulting in additional mortality of spawning stock.

Hatchery practise

Releases of fish can have a significant influence on wild populations in several ways. If fish are released to support a small wild population the use of only few parents may result in genetic changes in the wild population (inbreeding). Releases of large numbers of fish of a different strain may also result in a genetic change in smaller populations (outbreeding).

In the Baltic, in general, a sufficient number of parents are used and it is not believed that genetic changes due to hatchery practices constitute a major problem.

Large releases of trout in the Baltic may result in a risk of overfishing wild populations, because a fishery targeting trout may be maintained artificially at a high level.

Fishery regulation

Regulation of the fishery in the Baltic is very diverse between regions. There are large differences in closed seasons, from just a couple of months in Denmark to a complete ban in Russia. Minimum landing size varies between 40 and 60 cm, and regulation on gear use is also very variable, however in general only applied for gear actually targeting trout (or salmon), not gear catching trout as a bycatch.

Outside national waters the fishery is subject to regulation through EU, stating minimum landing sizes and closed seasons for different parts of the Baltic.

5 Status on trout populations in the Baltic

5.1 Recruitment

Recruitment of sea trout is monitored by electrofishing of the young (parr) in their natal streams and rivers. In each country electrofishing is standardized but a common standard is not implemented, a part from the existing CEN (European Committee for Standardization) standard. However, it was found that methodology is so consistent and similar that comparisons are meaningful. Data were available from 295 rivers from Denmark, Estonia, Finland, Latvia, Poland and Sweden (Table 5.1.1).

Table 5.1.1 Number of rivers included in each ICES subdivision.

Subdivision	Frequency	Percent
22	59	20.0
23	6	2.0
24	10	3.4
25	23	7.8
26	7	2.4
27	21	7.1
28	26	8.8
29	5	1.7
30	48	16.3
31	34	11.5

32	56	19.0
Total	295	100.0

As only few rivers were included in subdivision 26 (Poland and Lithuania) these rivers were evaluated together with subdivision 28 (Latvia, southern Estonia and the east coast of the island of Gotland). For the same reason subdivision 29 was joined with subdivision 28, i.e. subdivisions 26, 28, 29 were evaluated together.

The parr were divided into 0+ (one summer old) and older (>0+) and calculations of abundance are carried out for the age classes separately. Calculations are normally done after two-three consecutive runs, so called successive removal. Abundance is expressed as an estimated number of parr per 100 m^2. Depending on analysis actual or transformed data were used below. Transformation with log10(x+1) was used to avoid deviation from a normal distribution.

5.1.1 Prediction of abundance at undisturbed sites

Abundance of sea trout parr is affected by several factors, such as climate, hydrology, number of spawners, habitat quality and water quality. In the Baltic region the abundance of sea trout in the available data set was well correlated to climate (Figure 5.1.1). Comparing different regions must be done with this taken into account.

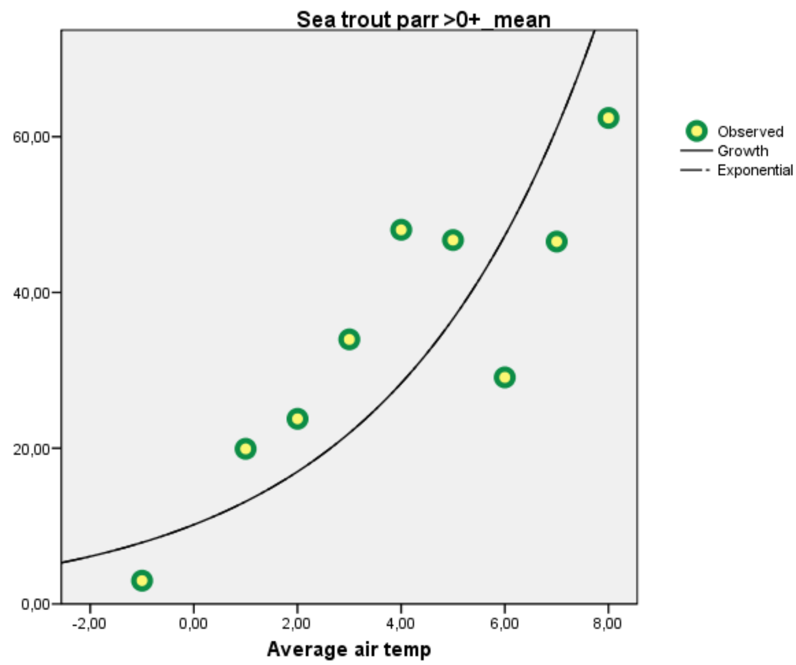


Figure 5.1.1.Correlation between abundance of parr >0+ in Swedish streams versus average air temperature.

The size of the streams also affects abundance (Figure 5.1.2). This is due to the fact that in larger rivers trout parr only occupy slower flowing waters along the banks, whereas salmon occupies the central part. With larger rivers the proportion of salmon increases (Milner *et al*. 2007, SGBALANST report 2008).

The effect of river size means that producing trends for a region by simply displaying averages, e.g. yearly average abundance, will be sensitive to the rivers included. If larger rivers are compared with smaller rivers data will be biased.

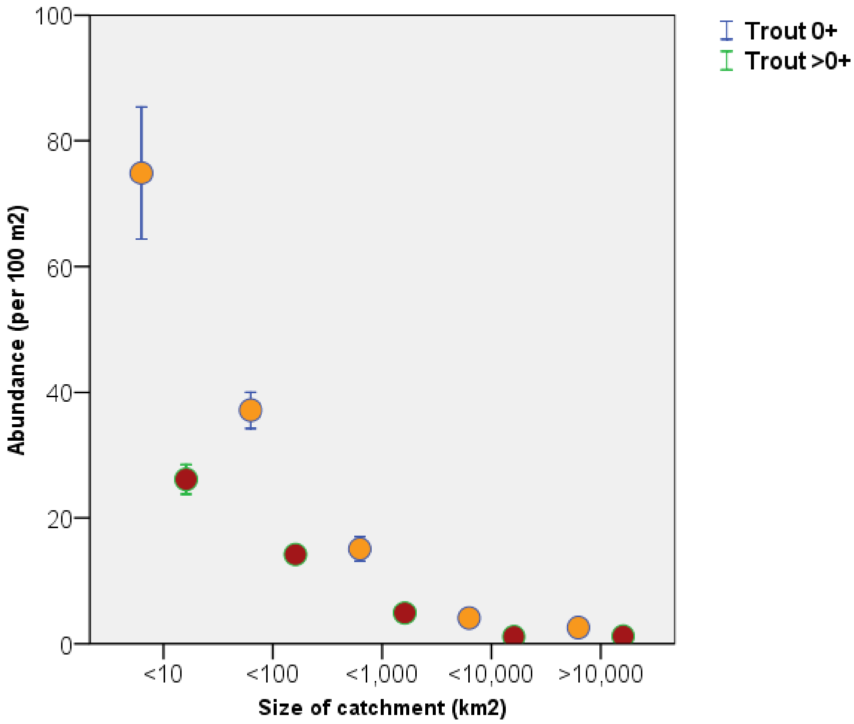


Figure 5.1.2. Abundance of sea trout parr 0+ and >0+ in Swedish streams versus size of river (given as catchment size).

The time available for the SGBALANST made it difficult to evaluate recruitment data thoroughly. More information on climate, stream size, fish size, and fish age and habitat quality would be needed. The average abundance of parr (all age classes) of rivers debouching in different subdivisions (Figure 5.1.3) showed that abundance as expected from WGBAST 2008 was low in the northern subdivisions.

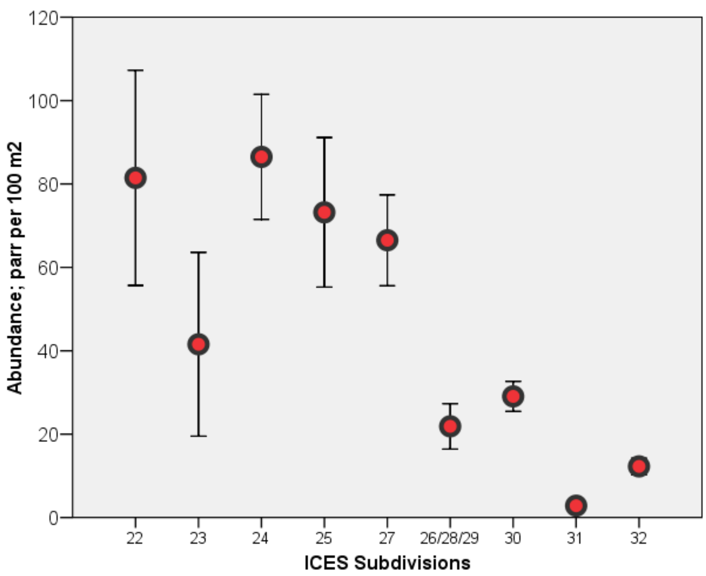


Figure 5.1.3. Average parr abundance (all ages) from electrofishing in 295 rivers debouching in different ICES subdivisions. Only data from 2000–2008. Notice that the abundance is not adjusted for differences in size of catchments.

More interesting are if regions have lower abundance of parr than expected from natural conditions. As data on climate (e.g. average air temperature) were not available for all sites longitude and latitude were used. Longitude represents a gradual shift from oceanic to continental climate, whereas latitude represents a gradient from warm to cold climate. For each river also the size of the river (see Figure 5.1.2), classified in four classes, was used (1=<100, 2=100-1000, 3=>1,000, 4>10,000 km^2). Using these factors the effect of different climate and catchment size may be accounted for. The expected abundance in stocks of good status must also be due to other factors. To predict status in rivers where the freshwater habitat was not limiting parr abundance, only rivers with good water quality and good habitat as reported by the members of SGBALANST were selected. Only data from the period 2000–2008 were used as this period was available from all members that had electrofishing data. Further, only stable populations were used, i.e. those with a CV (Coefficient of variation) below 50% (calculated from log10-transformed river averages different years). This was done to eliminate rivers with large fluctuations, e.g. some rivers in the Gulf of Finland that had limited ascent of spawners in the autumn of 2002 due to low water flow. Data from ICES subdivision 31 was not used as it was the opinion of the Finnish and Swedish delegates that these stocks were extremely small, which is also indicated by the small spawning run (see Chapter 5.2) and by Figure 5.1.3. A few rivers with stocking of parr were included as it was suggested that the stocking was done to levels that were not above carrying capacity.

In a linear regression of abundance in selected rivers the effect of longitude was not significant. The abundance of parr in rivers with good ecological conditions and stable populations could be predicted from latitude and catchment size class but with only 32,5% explained variation (linear regression, $F_{2,454}$=110, p<0,001, r^2=0,325). The predicted abundance could be calculated:

*Lg10(abundance+1) = 4,746-(0,046*Latitude)-(0,307*Catchment class)*

The observed abundance for each river and year was divided by the predicted abundance and expressed as percentage; stock status. Rivers with abundance as predicted would then get a stock status of 100%, and rivers with a lower abundance than predicted would have lower percentages.

The result showed as expected low stock status in subdivision 31. Also subdivisions 26/28/29 (Poland, Latvia, Lithuania, Estonia) and 32 (Gulf of Finland) had significantly lower stock status than expected (Figure 5.1.4). Also in the Danish Belt area, the Sound and the Bothnian Bay stock status was lower than expected but not more than 10–20% lower than expected.

Although this simplistic approach may need improvement, such as possibly focusing on problematic areas, it indicates a possible way to evaluate data. Establishing such criteria for sea trout will be easier than for salmon because of the large amount of rivers available, where some good examples can be found, and due to the small size of the systems (confounding factors can be known and controlled for). During the available time frame for SGBALANST it has not been possible to elaborate further on this.

The cause of the lower than expected stock status of sea trout parr in several regions may be complex. Water quality may be important in certain areas. It was classified in four categories; good, fair, poor and variable. The status of stocks was on average significantly higher (mean stock status =99%) in rivers with “fair” water quality, than in rivers with “good” water quality (mean of stock status=80%). Rivers with poor water quality had the lowest stock status (mean 53%). Rivers with “variable” water quality did not differ in status (means 98%) from rivers with “fair” water quality (Anova,

$F_{3,995}$=15,3, p<0,001, Post-hoc SNK). This means that the water quality is of importance but does not explain all the variation observed. In subdivision 31 most of the waters were classified as having good water quality but still the average stock status was low.

Comparison of all four water quality classes in the Gulf of Finland (Subdivision 32) showed a significant difference in stock status (Anova, $F_{3,81}$=3,65, p=0,016, Post-hoc SNK). Rivers with good water quality had the lowest stock status, followed by rivers with poor water quality. Rivers with variable or fair water quality had significantly higher stock status than the other two categories, indicating that other factors were more important for stock status. In the combined area subdivisions 26/28/29 too few data on water quality were available to allow comparisons.

Using an Anova, water quality and habitat quality (and the effect of both combined, the interaction) explained only 9% of variation in stock status but the effects of both water quality and habitat quality were significant. Obviously other factors contribute to the stock status.

It should be pointed out that some regions have a high pressure from gillnet fishing. Subdivision 23, the Sound, has a ban on trawling since 1932 and instead the fishing with gillnets is extensive. Also in subdivisions 30 and 31 the extent of gillnet fishing has been high, both in Finland and Sweden. The subdivisions 23, 31 and 32 are basins with much coastline as opposed to open sea. As sea trout mainly stays close to the coast a high fishing effort with gillnets and a proportionally large coastal zone may lead to a high exploitation of sea trout.

The relatively high abundance of sea trout parr in subdivisions 24, 25 and 27, mainly Denmark and Sweden, was probably due to relatively good and improved conditions due to a combination of river restoration and fishing regulations. In Denmark fishing with gillnets is not allowed closer than 100 m from the shore-line and there are closed areas around all river mouths. In Sweden in these regions extensive areas around the river mouths are excluded from fishing, which is not the case in e.g. the Swedish and Finnish part of the Bothnian Sea.

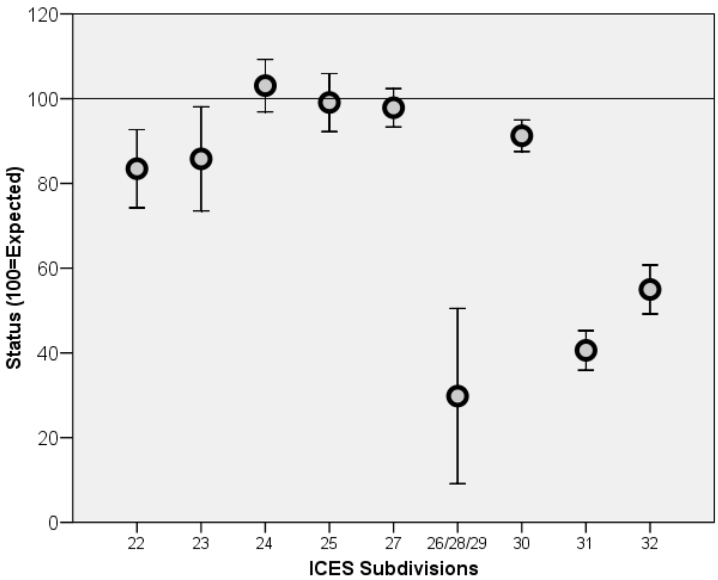


Figure 5.1.4. Stock status of sea trout parr from rivers in different subdivisions expressed as percentage of predicted abundance if the river habitat was good and the populations stable. Average and 95% confidence interval shown. Only data from 2000–2008.

To further explore the variation of stock status between regions a more complete dataset would be required, especially with data on water flow variations, fishing pressure, stocking of sea trout and other factors.

5.1.2 Trends in development of parr abundance

The variation of abundance of 0+ between years is normally large for many species; as compared to pelagic species the variations of sea trout were small. The magnitude of variation depends on scale; looking at a single site, a single river or a whole region. The variation could be expressed as CV (Coefficient of variation = (Standard Deviation/Mean)*100) or the magnitude of variation between low and high abundance. Variations of single sites are not shown as at least a river is considered as the smallest unit. Calculations were done on actual abundance as it does not make sense to calculate the CV of a variable expressed as a logarithm because the definition of zero is arbitrary.

Looking at regions, data from Sweden can be used to exemplify the normal variations. In subdivision 30 (Bothnian Sea), abundance of parr (all ages) has increased from the1980ies until the late 2000s (Figure 5.1.5). The stock status (see Figure 5.1.4) increased from an average of 71% the period 1979–1990 to 86% the period 2000–2007.

During the period 1990–2007 the yearly average of parr abundance was 28,6 (SD 10,7) with extremes from 11,6 to 47,2 (n=18 rivers). This gives a CV of 37%. The magnitude of change from the weakest to the strongest year was a factor of 4.

However, due to mainly higher fishing pressure in the sea and poorer water quality in the river, the parr densities on the Finnish side of Bothnian Sea are much lower than those in Sweden.

Figure 5.1.5. Average of sea trout parr abundance in 18 Swedish rivers in the Bothnian Sea (Subdivision 30) as an illustration of variation of stocks over larger areas.

For subdivision 32 (Gulf of Finland) a similar comparison of Estonian rivers is presented (Figure 5.1.6). In this region stocks have decreased and during the period 1993–2008 the yearly average parr abundance was 14,4 (SD 6,8) with extremes from 3 to 30,7 (n=8 to 29 rivers). This gives a CV of 47%. The magnitude of change from the weakest to the strongest year was a factor of 10. This was due to low rainfall in the autumn of 2002 which made it difficult for spawners to ascend the streams. The same problem was noted on the Finnish side of the Gulf. Thus, variations in small water bodies might be severely magnified by the climatic situation.

The negative trend of the stocks in subdivision 32 may for Estonian rivers be due to the fact of low fishing pressure during the Soviet era. Since then fishing pressure has increased. In Finland, the fishing pressure in the sea has been high already for several decades and is still much higher than in Estonia.

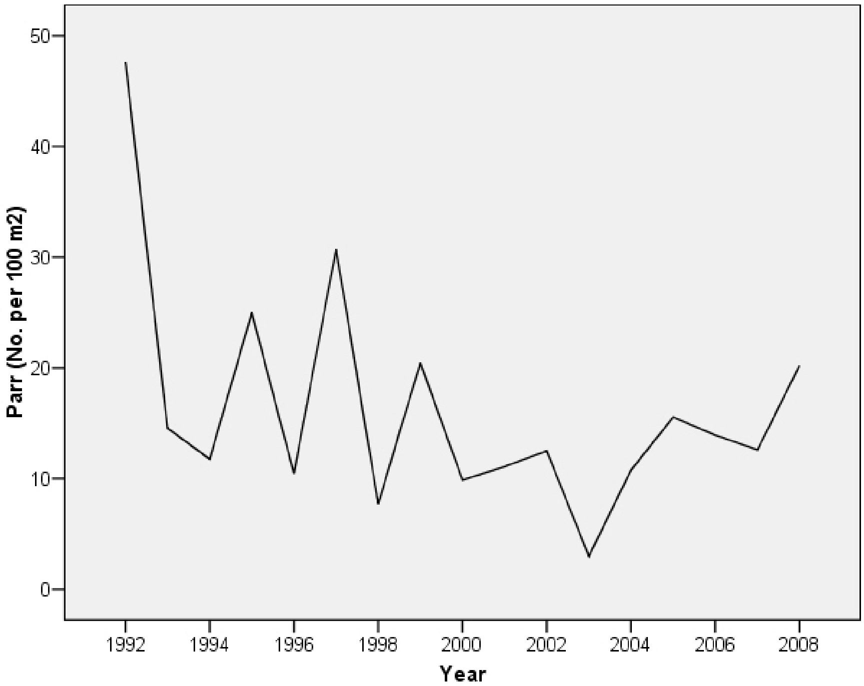


Figure 5.1.6. Average of sea trout parr abundance in 8–29 Estonian rivers in the Gulf of Finland (Subdivision 32) in 1992–2008 as an illustration of variation of stocks over larger areas.

In subdivisions 26/28/29 few rivers were available for analyses (Table 5.1.1) and the negative trend in abundance (Figure 5.1.7) was not significant (Spearman rank, n=15, spearman rho –0,068, p=0,81). However, abundance was low (c.f. Figure 5.1.3) as was stock status (Figure 5.1.4).

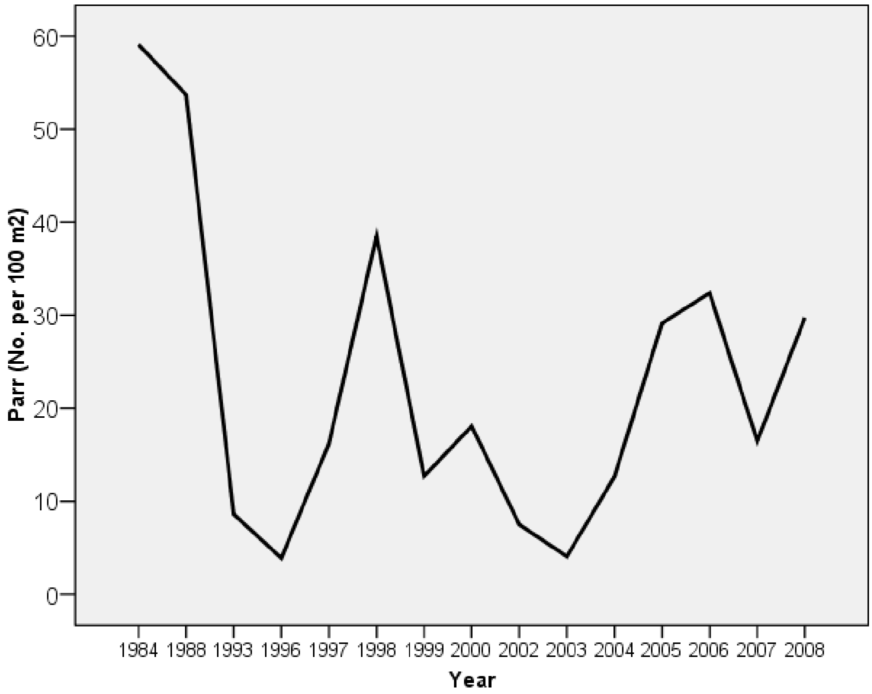


Figure 5.1.7. Average of sea trout parr abundance in rivers in subdivisions 26/28/29 in 1984–2008.

For subdivision 31 with Finnish and Swedish rivers the stock status was significantly low, compared to what could be expected (Figure 5.1.4) but there has been a positive trend in parr abundance over time since the 1970ies (Figure 5.1.8) (Spearman rank, n=31, spearman rho 0,608, p<0,001). In this region river restoration began in the 1980ies but has been more effective in the last decade. In the year 2006 the minimum legal size of sea trout was raised to 50 cm (from 40 cm) in Swedish waters, which was followed in Finnish waters in 2008. The dip in 2008 may be due to low reporting of Swedish rivers as of yet.

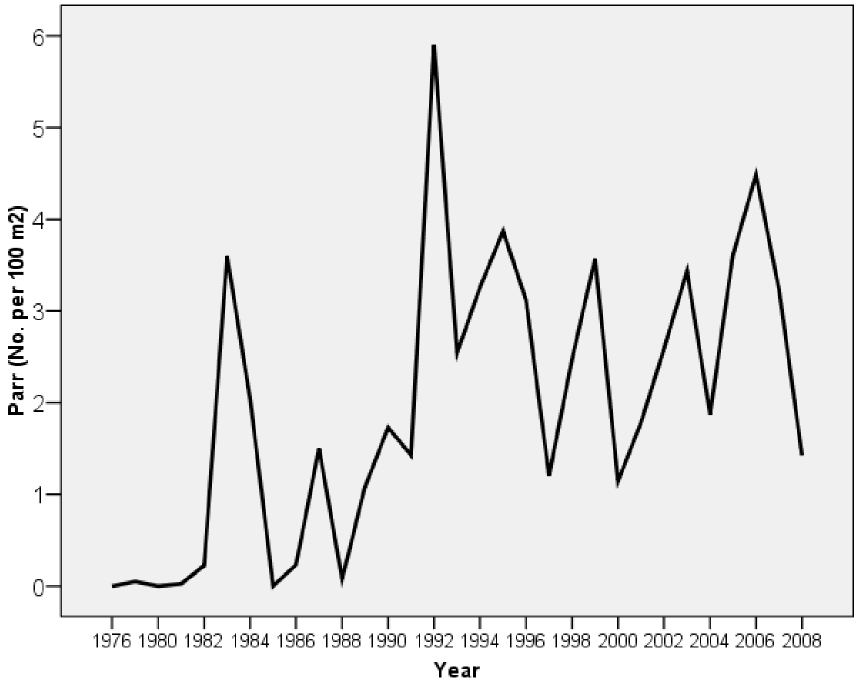


Figure 5.1.8. Average of sea trout parr abundance in rivers in subdivision 31, the Bothnian Bay, in 1976–2008.

For remaining subdivisions, i.e. **excluding** subdivisions 26, 28, 29, 30, 31 and 32, data from at least ten rivers were available from 1987–2008. No significant trend was evident in the abundance during the period (Figure 5.1.9) (Spearman rank, n=22, spearman rho 0,048, p=0,832). In this region stock status was as expected or at least more than 80% of what was expected (Figure 5.1.4), as explained earlier river restoration and fishing regulation have been undertaken in these waters in Denmark and Sweden.

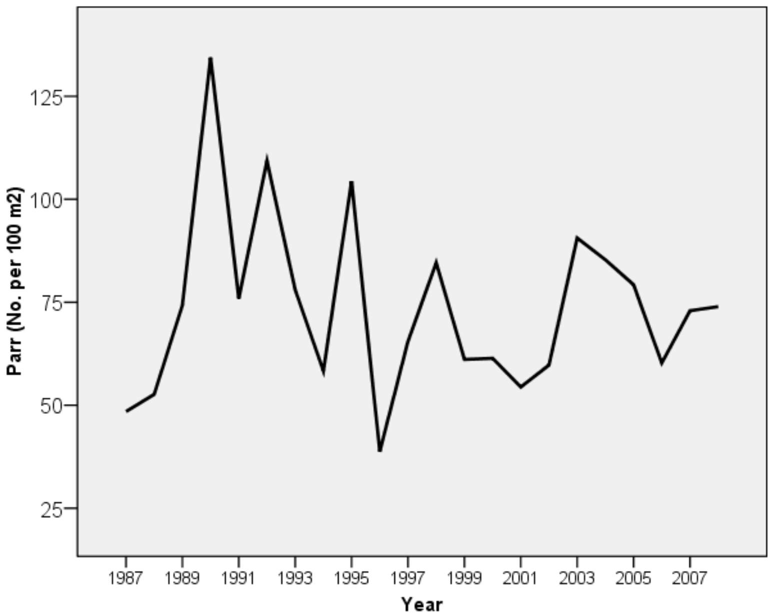


Figure 5.1.9. Average of sea trout parr abundance in rivers in south-western Baltic, subdivisions 22–25 and 27, in 1987–2008.

5.1.3 Coefficient of variation for individual rivers

In 145 different Baltic Sea trout rivers with at least more than 4 observation years in the period 2000–2008 the Coefficient of Variation (CV) was calculated (Figure 5.1.10). The average CV was 72%, with extremes from 15 to 256%. CV was negatively correlated to abundance, i.e. the rivers with high densities had lower CV. With average abundance above 50 no CV for a single river was above 100%. This effect was partly due to that when the abundance is near zero, the coefficient of variation is sensitive to small changes in the mean.

The average CV of 72% was lower than the CV of salmon parr abundance in eight Swedish salmon rivers the period 2000–2007 which averaged 101% (Degerman 2008). The CV in these rivers was influenced by the fact that salmon in general had lower abundance than sea trout. Hence, from the view of variation in abundance sea trout parr river monitoring requires smaller sample sizes than does salmon parr.

As for magnitude of variation, i.e. the highest value a year divided by the lowest values another year, for single streams the mean was 17 during the same period, with extremes from 1,5–462. Thus, single rivers displayed enormous changes between the lowest and highest values. However, only four rivers had magnitudes of variation above 100, one in Sweden and three in Estonia. 65% of rivers had a magnitude of variation below 10. In the case of the Swedish river (Gallån) it is situated only a few kilometres away from the large River Mörrum and it is suggested that occasional straying spawners was the cause of variation. As for the Estonian River Selja both the salmon and sea trout stock have varied largely, which is believed to be due to improved water quality recent years. The River Kolga suffered from the low water flow the autumn of 2002, discussed above, which explains one bad year in parr densities in the year 2003. Last of the largely varying rivers is River Höbringi which is very small and suffers from summer drought certain years. This means that magnitude of variation, and certainly CV, can be lowered on a regional basis by excluding rivers with unstable populations, due to climatic reasons.

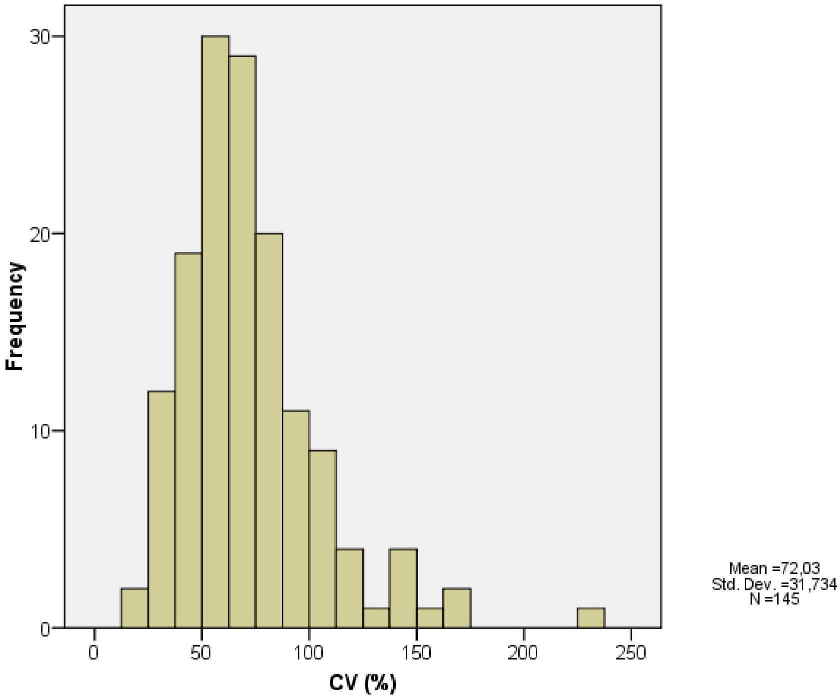


Figure 5.1.10. Histogram of coefficient of variation (CV) for 145 rivers during 2000–2008 (only rivers investigated more than 4 years). CV is calculated from yearly averages for each river.

As an example of the power of statistical comparisons using the electrofishing data, the period 2002–2005 in Estonia was used (see Figure 5.1.6). Abundance (transformed abundance of 0+ and >0+ pooled) of each year was compared with the following year (n=4). Using t-test for comparing two groups the statistical power was 95,5–99,7% with a required number of samples of 3–8 (at p<0,05). Thus, the statistical power of the electrofishing data is high and even small differences between years may be detected. A large monitoring programme of the Baltic sea trout may even be initiated from existing electrofishing data.

5.1.4 Linear trends in parr abundance

Trends for regions and certain rivers have been shown above (Figures 5.1.5–5.1.9). As was explained initially abundance differs naturally in rivers of different size. Comparing rivers for a region must be done with this taken into account. The trend in parr abundance here is given as the trend of each individual river, thus eliminating the problem of different size of the rivers. For each river with at least five years of observations (n=183) the Pearson correlation coefficient (r) was calculated (abundance versus year) for 0+ and >0+ parr. Log10-transformed data was used.

Both parr 0+ and parr >0+ showed on average a positive trend, average Pearson r +0,20 and 0,09, respectively. 72% of the trends in parr 0+ were positive (Chi-square, p<0,001), whereas only 58% of the trends for parr >0+ were positive (Chi-square, p<0,032).

But the pattern was not consistent for the different subdivisions (Figure 5.1.11). Areas with low stock status as subdivisions 30 and 31 had strong positive trends for both parr 0+ and parr >0+. This was due to the fact that stock status has been extremely low. The latter is especially evident for the Bothnian Bay (Subdivision 31) where the abundance of 0+ was 0.24 in the 1980s and rose to 1.32 parr per 100 m^2 in the period

2000–2007. The increase was evident (Figure 5.1.9) but the abundance was still extremely low, and much lower than expected (Figure 5.1.4). It was a weak tendency that the direction of the trend was correlated to stock status, with more positive trends for weak stocks (Figure 5.1.12). This is reasonable as stocks of good status by definition should not be able to increase the abundance significantly.

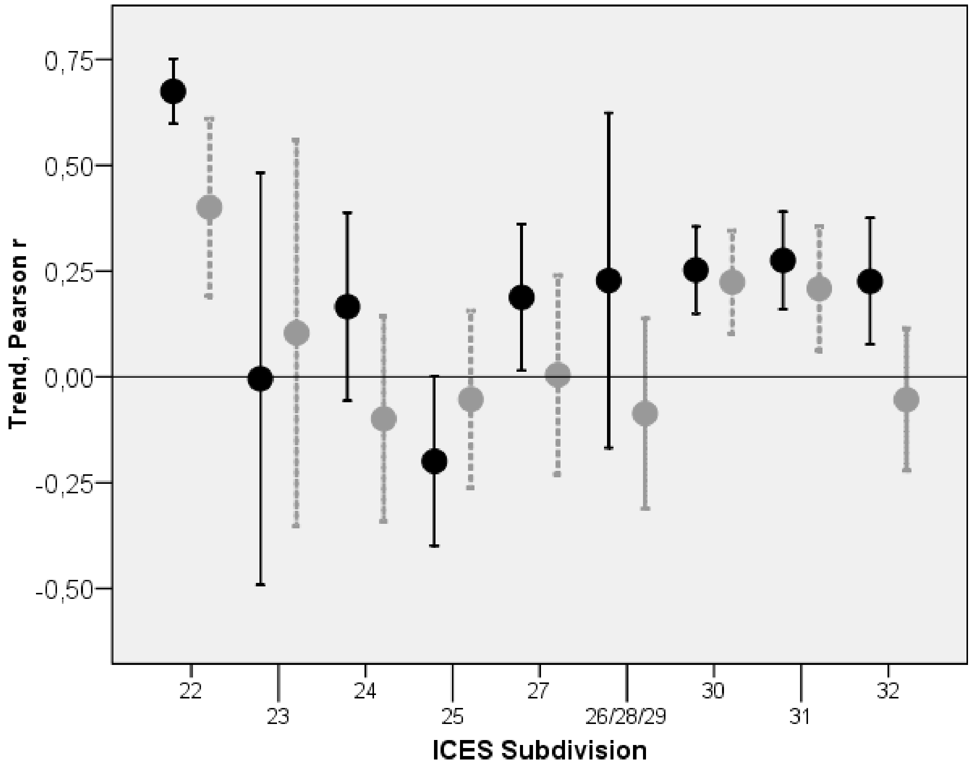


Figure 5.1.11. Plot of Pearson r correlation coefficient for sea trout parr 0+ (black) >0+ (grey) for ICES subdivision. The straight line at 0 indicates no trend.

Several subdivisions had a more positive trend for 0+ than for >0+ parr, e.g. subdivisions 22, 24, 27, 26/28/29 and 32 (Figure 5.1.11). In the latter subdivision the average trend for parr >0+ was even negative. Also in the combined area subdivisions 26/28/29 the trend of 0+ was positive and that of parr >0+ negative. The declining trend of >0+ parr may be an indication of decreased stock status but it may also be an effect of lowered smolt age due to improved growth. A decrease of parr >0+ may lead to an increase of 0+ due to less competition (Nordwall *et al.*, 2001). The exact cause of the differing trends of 0+ and >0+ in several areas needs further examination.

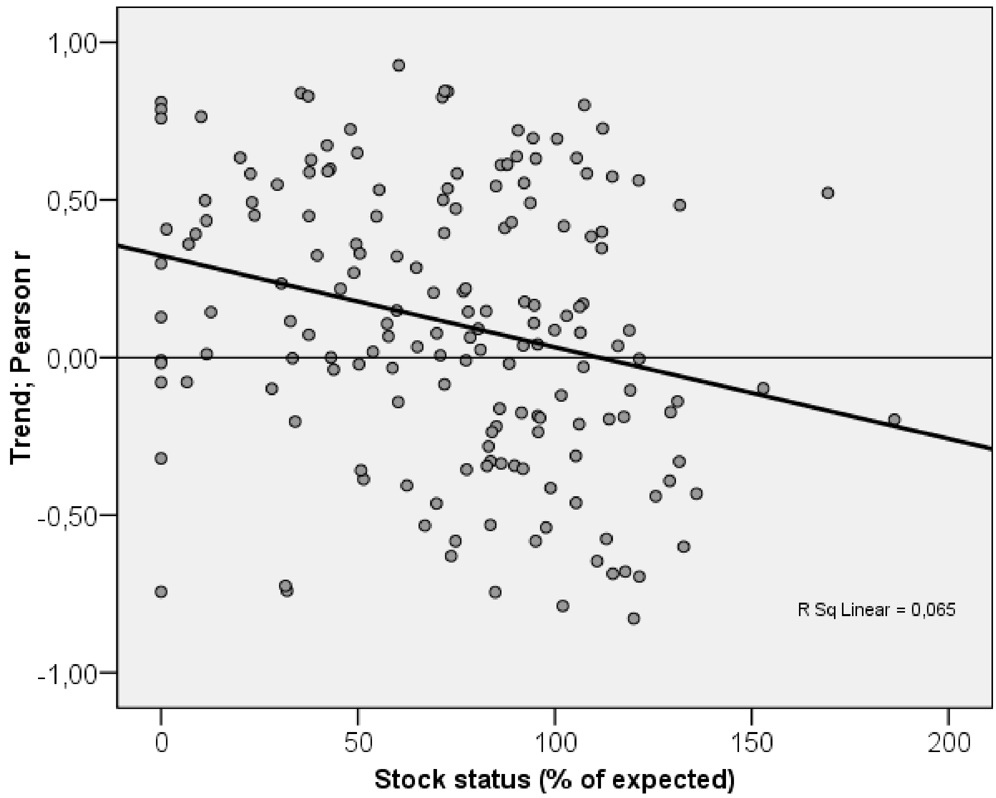


Figure 5.1.12. Plot of Pearson r correlation coefficient for sea trout parr >0+ versus stock status (c.f. Figure 5.1.4). The straight line at 0 indicates no trend.

5.1.5 Influence from resident trout

Due to lack of information the contribution from resident trout to observed parr densities could not be evaluated and a literature survey did not provide any useful references. Part of the parr found in the nursery areas will have resident trout as parents. The fraction of different populations being migratory will vary between streams and probably over time depending on a number of factors (Cucherousset *et al.*, 2005) and the contribution to observed parr densities will largely depend on the fraction of spawners that are resident trout.

Fecundity in trout depends largely on size, with female sea trout having a much higher fecundity than the normally smaller resident trout (Elliott, 1984, 1995; L'abee-Lund and Hindar, 1990).

The contribution from resident trout is therefore expected to be of minor importance but more studies are needed on this subject.

5.1.6 Summary

Data on recruitment (electrofishing data) were available from 295 rivers from Denmark, Estonia, Finland, Latvia, Poland and Sweden.

As predicted from rivers with stable populations and good freshwater habitat, recruitment (stock status) was significantly lower than expected in several regions, especially in the Bothnian Bay, the Gulf of Finland, the Sound and the south-eastern part of Main Baltic (Figure 5.1.4). This was also reflected by low densities in these areas. Populations of good status were found especially in southern Sweden and Denmark.

The results indicate different development in different regions, i.e. the sea trout population of the Baltic Sea may need a division in management units for further work.

Trends of populations over time differed between regions but a general increasing trend in recent years was evident. Several areas had declining >0+ parr abundance and increased 0+ abundance over time. The cause is not known but may be a climatic effect.

Variation of populations for single rivers showed an average CV of 72% but much of the variation was found in small rivers and in populations with low abundance. If these are excluded from monitoring the variance is lowered. The CV was lower than what is normally observed for salmon in Swedish salmon rivers.

Electrofishing gives a good and quantitative measure of recruitment but the populations are small and many. However, the statistical power when comparing the development in different regions was quite high, allowing the use of the existing data.

It would be possible for experts to establish an improved model of expected abundances of stocks of good status. However, this requires more collaboration of data (better reporting from certain regions, common habitat quality assessment, and data on climate and stream size) and expert judgement. Due to the large amount of river available good examples of stocks of good status can be found.

5.2 Ascending spawners

5.2.1 Introduction

The knowledge on the number of sea trout ascending the rivers is poor. Presently, actual (i.e. manual) counts in traps takes place only in two small rivers in Sweden. In addition automatic counts are done in three large rivers in northern Sweden (Subdivision 31) and in R. Mörrum (Subdivision 25) but data are not available for the latter river. Also in R. Slupia in Poland ascend is registered automatically but only since 2006 and data are not available.

As an index of the number of spawners in the river the catch in the river may be used – either professional or semi-professional with gear such as drifting nets (but excluding catch for breeding purposes) or by the recreational fishery – sports fishing (Pedersen *et al.,* 2007. Straying of Atlantic salmon, Salmo salar, from delayed and coastal releases in the Baltic Sea, with special focus on the Swedish west coast). The use of such data is based on the assumption that the catch is representative for the number of fish entering the river, thus assuming that effort and catchability is known or at least constant over time. In addition it requires a stable proportion of the actual catch is reported if reporting rate is less than 100 %.

The actual spawning activity is monitored in a number of rivers (mostly Lithuania and Poland) by count of redds inside a fixed section of the river.

Size composition of the spawning populations may reflect influence from fishing if this fishery is selective, catching predominantly a specific range of sizes as compared to the range of sizes available. Basically all net fishing operations are selective and the same can be true for traps, where selection may occur through the mesh sizes in the pound. Also sport fishing can be size selective.

Different populations of sea trout may mature at different ages, and a varying proportion of the spawning population may be repeat spawners. For example in the R. Tornionjoki the sea age at first maturity was 3 years for females, while in Denmark the average age at first spawning observed in a sample of sea trout in R. Kolding was 1.48 years in 2001 (DTU-Aqua, unpublished results).

5.2.2 Available information

5.2.2.1 Spawning run

In Sweden ascending spawners of sea trout have been counted in eighteen rivers. However, in several of the rivers the counting of spawners has just recently begun, and in some, the counting has stopped after just a few years. Time series extending back at least to the 1990s exist for 6 rivers. For the recent period after 2000 they are available for additionally 2 rivers.

In addition information on the population size from sport fishing catches are available from 18 rivers in Sweden, mostly for the period after 2002.

Count of redds as an index of spawning population size is available only from one river in Sweden (Åvaån).

River catch by professional or semi-professional fishing is available from one river (Ljungan, for the time period 2002–2007).

In Finland the only information on spawning number is from catch by sport fishing from river Tornionjoki, available for the time period 1983–2008.

In Estonia the number of spawners (or rather the actual successful spawning activity) is inferred from counts of parr – see section 1. Since no Finnish data are available for this area either, this means that no data are available on the development of the number of spawners in area 32.

In Lithuania an index on spawning activity is obtained from count of redds reported as number of redds pr km river length from 10 rivers.

In Poland redds have been counted in three rivers during the period 2004–2008 and in one of them, Slupia R., automatic counter has been operating since 2006.

In Denmark there are two streams with fish counters (data was not available for analysis). In addition to this, we have information on the number of spawners from catch in sport fishing in 3 rivers: R. Kolding (1991–2008), R Vejle (1988–2008) and R Halleby (2001–2007). Also, the count of spawning redds in R. Halleby is available for the same period.

There is no information available on spawning numbers in Russia, Latvia or Germany.

5.2.2.2 Size and age composition of spawners

Information on actual size composition was available from only very few rivers. In Sweden the size composition of the sport fishing catch in R. Mörrum was available for 2008. The average size of sea trout caught by the sport fishery on the Finnish side of Tornionjoki was available from 1992–2008.

From Denmark the size composition of sea trout in R. Kolding was available for the period 2001–2005 (obtained from electrofishing), and the size composition for the same river in the catch by sport fishing from the years 2006–2008. From the Danish R. Vejle the size composition was available from sports fishing catch in 2008.

Age composition of a sample of the spawning run was available for R. Tornionjoki for a long time series (1977–2007, with a reasonable number of fish aged for the period after 1989). Age composition of the sea trout in R. Kolding was available from a sample of sea trout caught by electro fishing in 2001 and from a large sample in the same river in 1989–1991.

5.2.3 Results

5.2.3.1 Spawning run

In the large rivers in northern Sweden (area 30 and 31) only very few sea trout ascend to spawn. The average number for the period 2000–2008 was 99 in River Kalixälv, 247 in River Piteälv and 52 in River Vindelälven. A significant but low increase in the number of spawners over time was evident for all three rivers (coefficient: 4.2 to 46, p=0 to 0.009) (Figure 5.2.3.1.1).

River Byskeälv in the same region has been monitored since 2002 and has shown a declining trend. There was not a significant development in the sport fishing catch in any of these rivers.

The catch in the sport fishery in Sweden is known for recent years from additionally 12 rivers in the region. Only for the rivers Råne and Sävarån the development shows a significantly positive trend, however at a very low number (catch reports of 0–25 and 20–53 sea trout, respectively).

Contrary to this the development in the catch has been strongly negative in the R. Gide (coefficient -483, p=0.043).

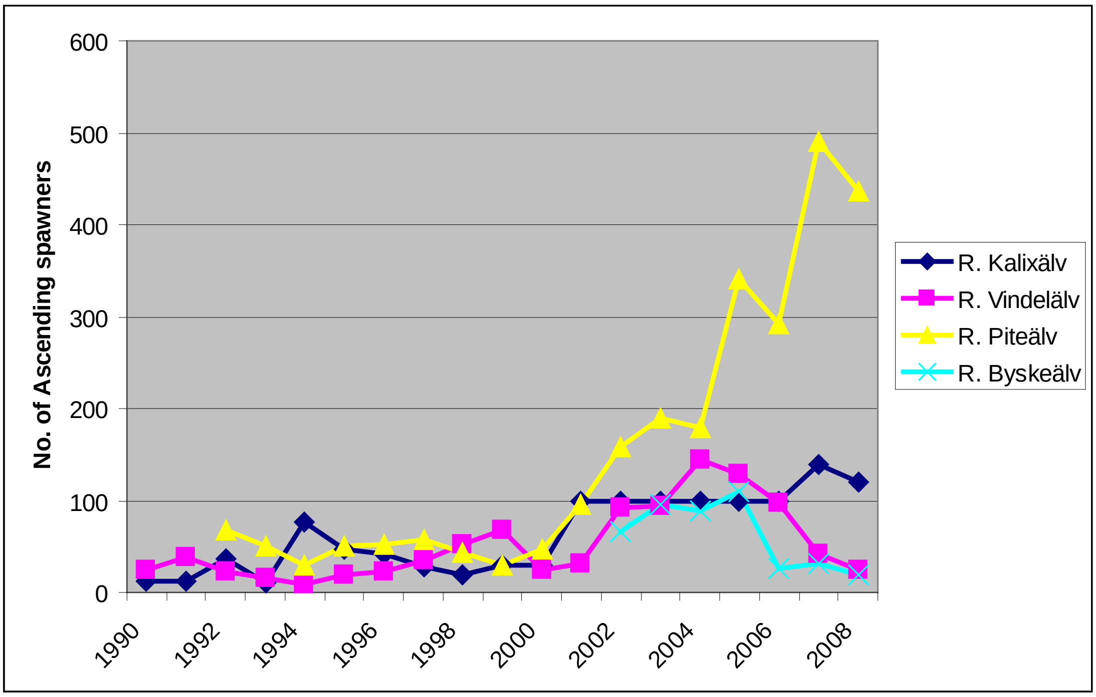


Figure 5.2.3.1.1. Number of ascending spawners in four rivers debouching in the Bothnian Bay.

In river Tornionjoki the catch in the sport fishery on the Finnish side increased dramatically around 1990 (Figure 5.2.3.1.2). This is believed to be due to a number of reasons: the smolt year classes 1988 and 1989 were relatively strong (same as salmon smolt year classes in the same year). With an increased number of salmon in the river interest for fishing in the river with rod and line increased, resulting in an increase in catches of sea trout.

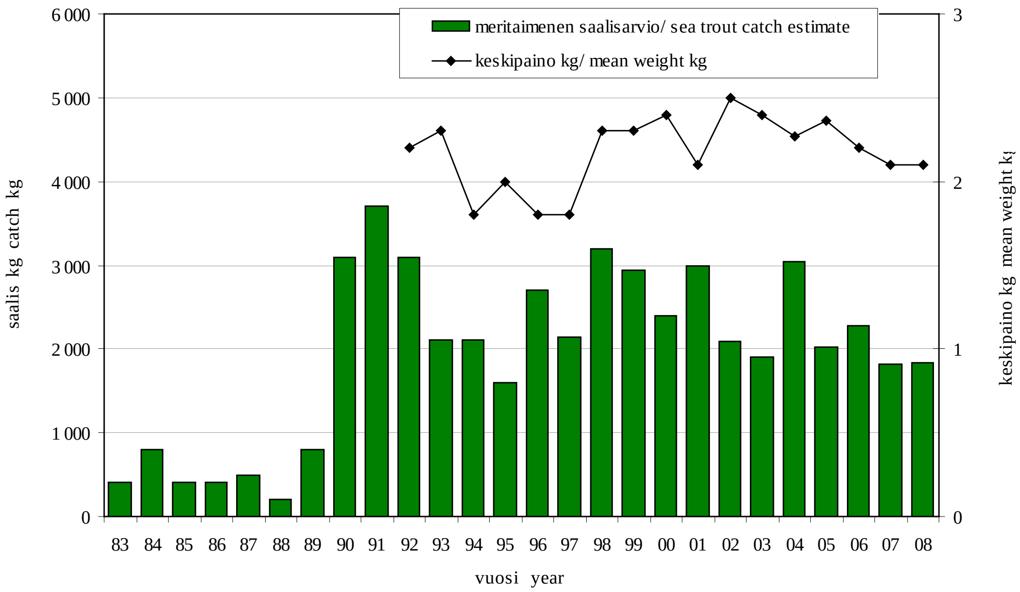


Figure 5.2.3.1.2. Annual sea trout catch and mean weight of fish on the Finnish side of the Tornionjoki river system in 1983–2008.

The development in the number of spawners in Tornionjoki during the period 1990–2008 has been negative (coefficient in regression -48.4, p=0.048). The development in the sports fishing catch on the Swedish side was not significant.

Further south in Sweden, in subdivision 27 in the river Åvaån the spawning run was showed a slightly negative (however not significant) trend for the period 1998–2008. Also R. Emån had a negative trend in development of catches (coefficient -66, p=0.019).

The development in the last river with information in this area (Själsöån) was not significant (Figure 5.2.3.1.3).

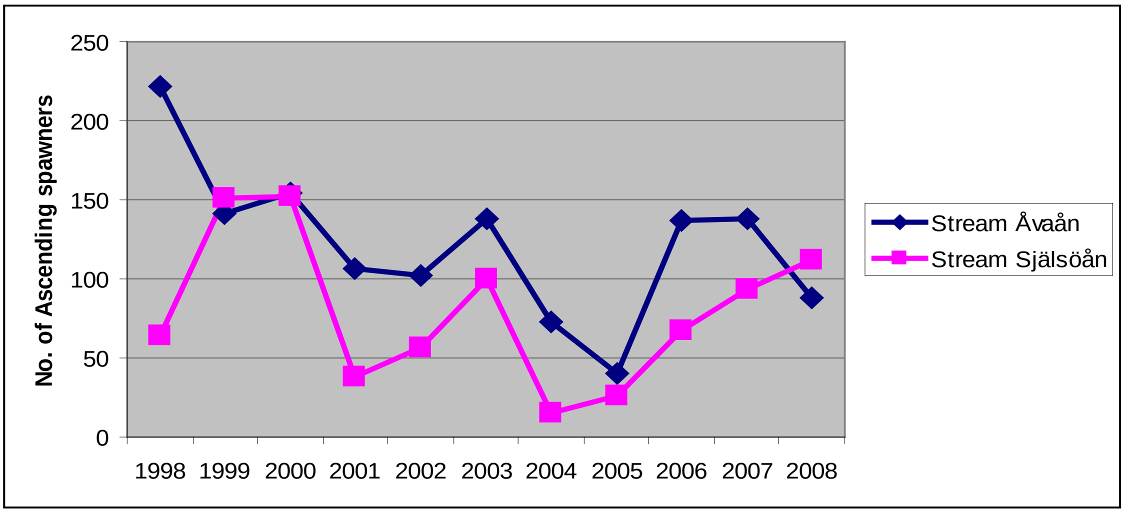


Figure 5.2.3.1.3. Number of ascending spawners in two streams debouching in ICES subdivision 27.

In subdivision 26 information on spawning intensity (redd count: number of redds per 1 km river) was available from 11 rivers (10 in Lithuania and 1 in Poland). A significant positive trend in the development in the spawning activity was found in R. Veivizas (coefficient: 2.4, p=0.04) indicating an increase from year to year in spawning activity of 2.4, while R. Minija showed a non significant trend (coefficient: 2, p=0.08) and in the R. Reda in Poland spawning activity seems to have decreased during the last 4 years (reduction of 100 redds pr year, p=0.096). In the same area the catch in the R. Vistula did not show a significant trend.

In subdivision 25 numbers of spawners entering R. Slupia, obtained from counters, were at least 5047 in 2006, 7038 in 2007 and 7191 in 2008. Information on spawning activity (redds number) is available also from two rivers in Poland, both had a positive trend in last few years.

In area 25 in Sweden data are available on the catch in sport fishing in R. Mörrum indicating a negative trend in development of the population (coefficient: -318, p=0.041). This was also reflected in electro fishing results that has shown a decline in sea trout parr abundance during the last 20 years.

In River Nybroån, subdivision 24, the number of spawners is known from 1974 until 2005 (Figure 5.2.3.1.4). In the river extensive fishery management operations have been undertaken by the local fishing organisation along with improved water quality. Stocking affected the number of returning spawners until the beginning of the 2000s. If the decline from the late 1990ies continues after the year of 2005 is not known. The data show that the number of ascending spawners may be high even in a small river (catchment size 316 km^2, length of river accessible to sea trout 37 km, average stream width 6 m).

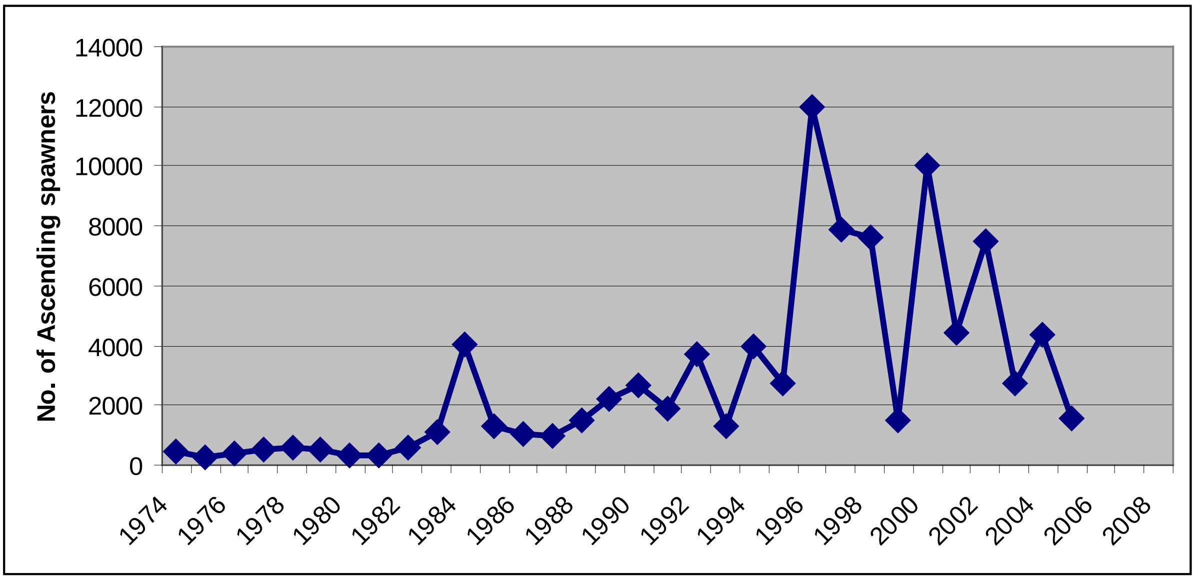


Figure 5.2.3.1.4. Number of ascending spawners in River Nybroån, ICES area 24. Data from 2006–2008 is lacking.

In subdivison23 in River Höje å, the Sound, the average number of ascending spawners was 1054 during 2003–2005. The river is quite small, catchment size 316 km², length of river accessible to sea trout 42 km, average stream width 5.8 m. Also in River Råån, the Sound, the average number of spawners was high, an average of 3547 in the years 2003–2006. The river has a catchment of 193 km² and 28 km of the river length accessible to sea trout with a mean width of 5.8 m.

Although scattered, the data from the area 23–25 show a high number of ascending spawners.

Sport fishing catch is available for the rivers Kolding and Vejle for the period from 1991 and 1988 respectively (Figure 5.2.3.1.5).

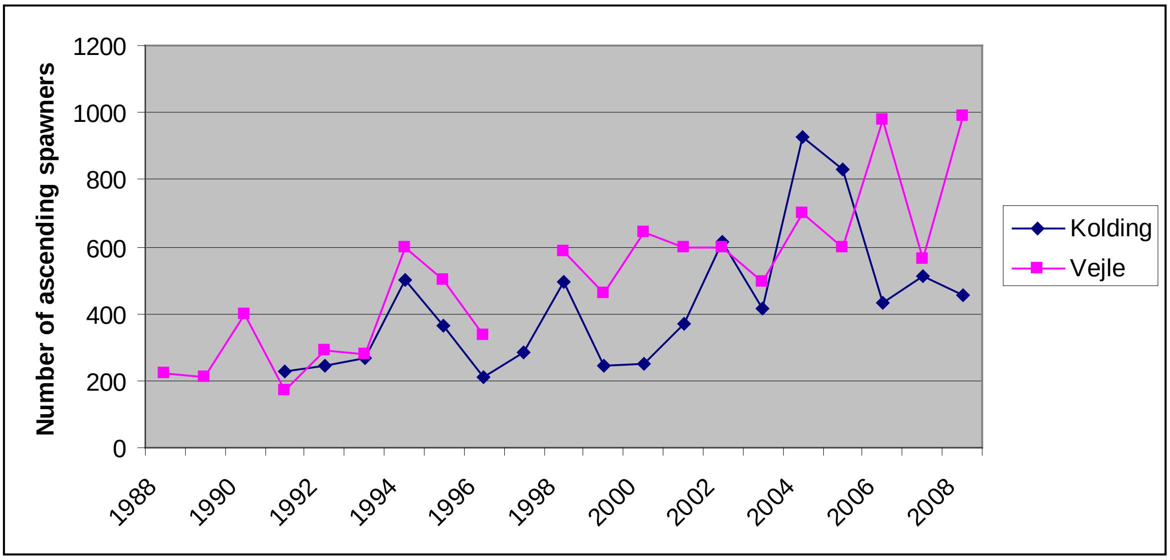


Figure 5.2.3.1.5. Catches in sport fishing in rivers Kolding and Vejle. ICES area 22.

A clear and positive trend was observed in the catch in these rivers (coefficient: 22 and 30 respectively, p= 0.011 and 0.0).

Data on the spawning activity in R. Halleby was available for the period 2001–2007, showing a non-significant increase in spawning activity (coefficient 13.8, p=0.084), while there was no significant trend in the development in sport fishing catches in this river.

The results are summarized in table 5.2.3.1.1.

Table 5.2.3.1.1. Linear regression on spawning number, sportsfishing catch, count of redds or other river catch vs. year. Positive regression coefficient indicates increasing spawning population and negative decreasing.

Area	Country	River	Time – period	Regression Coefficient	Observation method	Remarks
31	FI	Tornionjoki	1990–2008	−48.4**	SF	
31	SE	Åby	2002–2007	−2	SF	
31	SE	Bure	2003–2006	4	SF	
31	SE	Byske	2002–2008	−11.82*	SC	
31	SE	Byske	2002–2007	10	SF	
31	SE	Kåge	2003–2006	13	SF	
31	SE	Kalix	1990–2008	6.35**	SC	
31	SE	Kalix	2002–2007	23	SF	
31	SE	Pite	1990–2008	45.99**	SC	
31	SE	Pite	2004–2007	12	SF	
31	SE	Råne	2002–2007	6**	SF	Numbers very low
31	SE	Torne	2002–2007	28.8	SF	
30	SE	Gide	2003–2005	−483**	SF	
30	SE	Hörnån	2002–2007	2.7	SF	
30	SE	Ljungan	2002–2007	-14	SF	
30	SE	Ljungan	2002–2007	43	OC	
30	SE	Lögde	2003–2007	0	SF	
30	SE	Öre	2003–2007	60	SF	
30	SE	Säverån	2002–2007	6.4**	SF	Numbers very low
30	SE	Testeboån	2002–2007	-2.5	SF	
30	SE	Vindel	1990–2008	4.18**	SC	
30	SE	Vindel	2002–2007	37.5	SF	
27	SE	Åvaån	(1995) 1998–2008	-6.7*	SC	
27	SE	Åvaån	(1995) 2000–2007	2.3	RC	
27	SE	Emån	2002–2007	-66**	SF	
27	SE	Själsöån	1994 (1998–2008)	-1.54	SC	
26	LT	Bonė	2005–2008	-0.25	RC	Redd count (redds pr km)
26	LT	Degalas	2005–2008	0.96	RC	-"-
26	LT	Juodupis (Ipiltis)	2005–2008	14.23	RC	-"-
26	LT	Kulšė	2005–2008	3.4	RC	-"-
26	LT	Minija	2003–2008	2*	RC	-"-
26	LT	Ringelis	2005–2008	8.76	RC	-"-
26	LT	Šalpė	2003–2008	-0.96	RC	-"-

26	LT	Sausdravas	2003–2008	-0.2	RC	-"-
26	LT	Veiviržas	2003–2008	2.4**	RC	-"-
26	LT	Žvelsa	2003–2008	0.78	RC	
26	PL	Reda	2005–2008	-100.4*	RC	
25	PL	Leba	2004–2008	74**	RC	
25	PL	Slupia	2004–2008	-24.2	RC	
25	PL	Wiepraza	2004–2007	74	OC	
25	SE	Mörrum	2002–2008	-318**	SF	
24	SE	Nybroån	1988–2005	156.9	SC	
23	SE	Råån	2002–2005	-1535	SC	
22	DK	Halleby Å	2001–2007	-11.6	SF	
22	DK	Halleby Å	2001–2007	13.8*	RC	
22	DK	Kolding å	1991–2008	22**	SF	
22	DK	Vejle å	1988–2008	30**	SF	

5.2.3.2 Size composition.

The information available on the size composition is very scattered.

In Tornionjoki the average size of sea trout caught by rod and line for the period 1992–2008 did not seem to change (Figure 5.2.3.2.1). In R. Mörrum size composition in the sports fisheries catch in 2008 seems close to a normal distribution, except for the cut off at a minimum size of 50 cm.

In R. Slupia (Subdivision 25) spawners caught in non-selective trap were in 2007 from 35 to 89 cm (Figure 5.2.3.2.2).

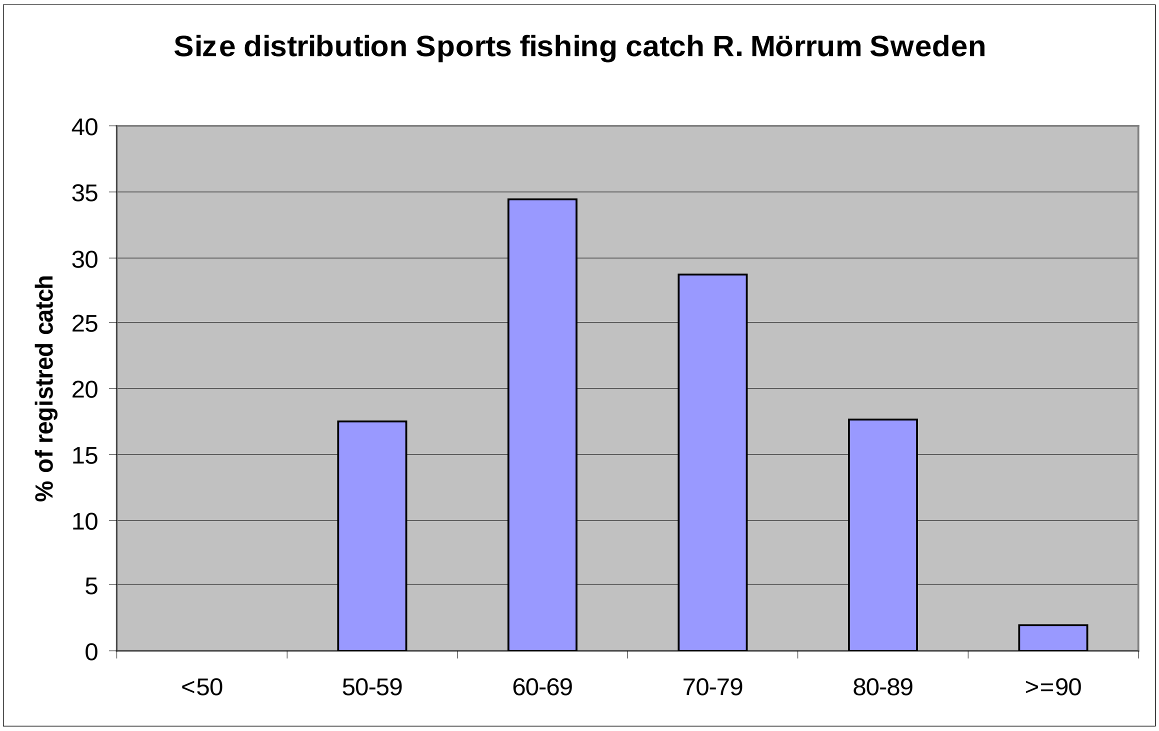


Figure 5.2.3.2.1. Size composition in sea trout caught in R. Mörrum on the sections controlled by Kronolaxfisket.

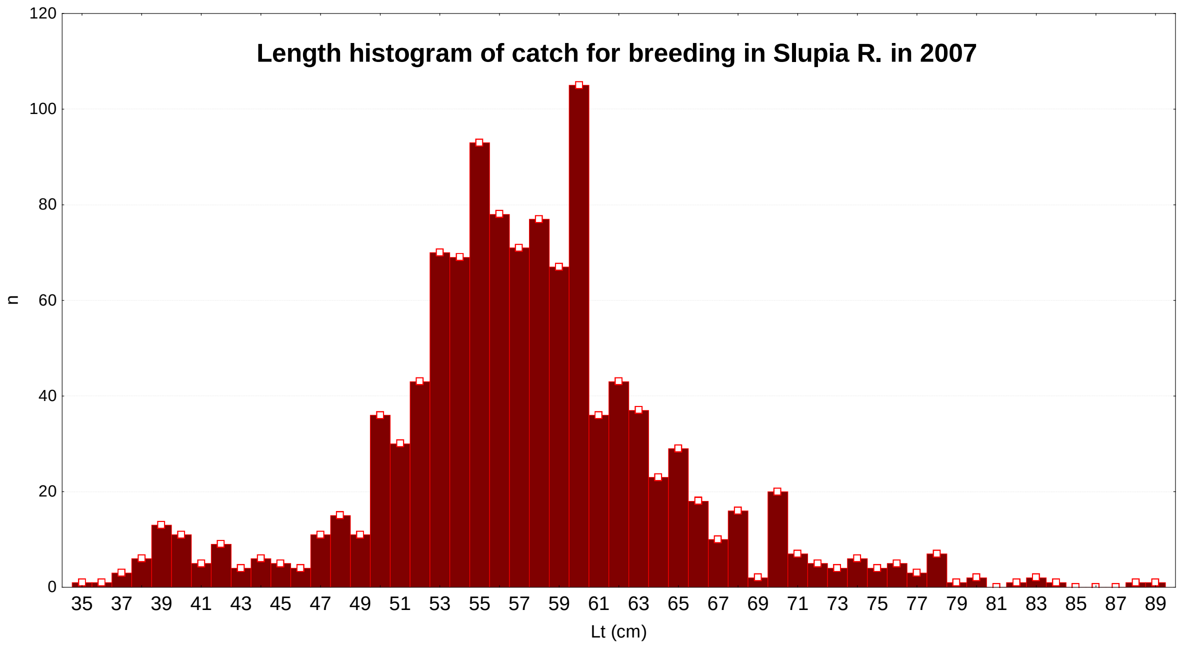


Figure 5.2.3.2.2. Size composition of trap caught sea trout in R. Slupia, Poland.

In the Danish rivers Vejle and Kolding the effect of the minimum landing size was obvious when comparing to an unbiased sample caught by electro fishing (Figures 5.2.3.2.3 and 5.2.3.2.4). The size composition in the sample from R. Kolding resembles the size composition in R. Slupia somewhat, however with a larger fraction of larger sized fish.

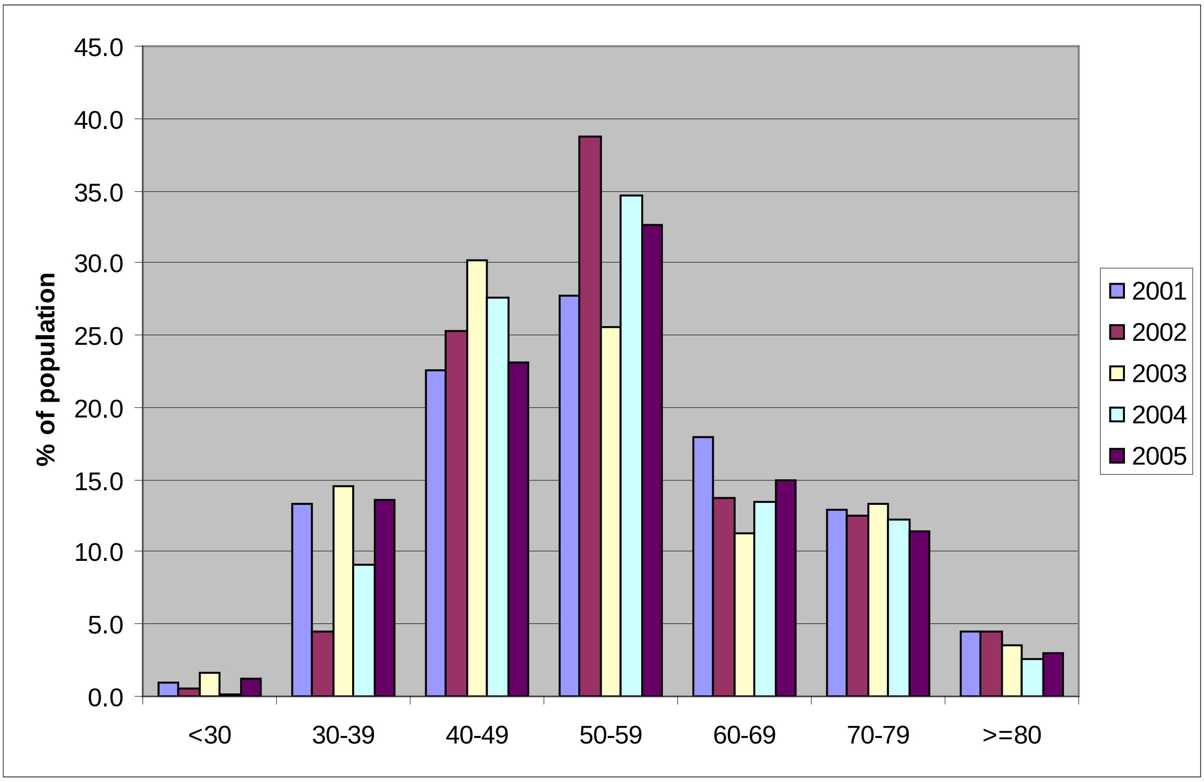


Figure 5.2.3.2.3. Size composition in R. Kolding in sample of sea trout collected by electro fishing (n= 862-1193).

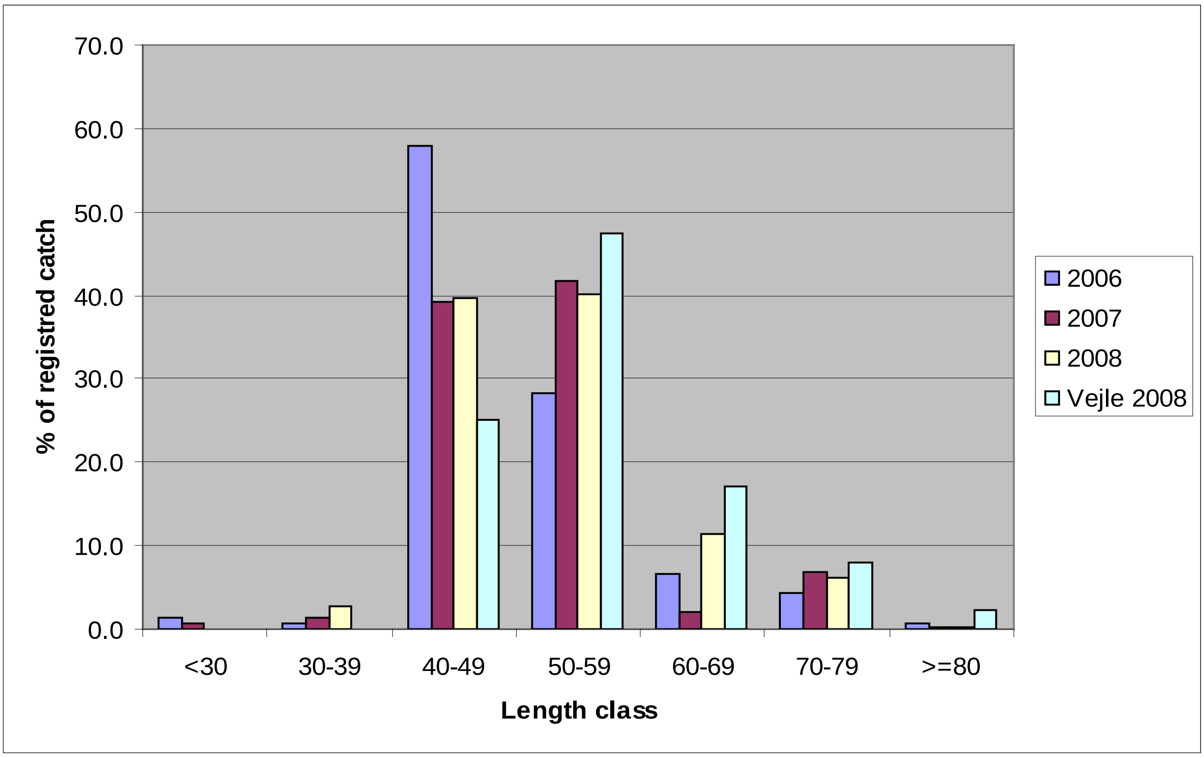


Figure 5.2.3.2.4. Size composition in R. Kolding (2006–2008, n=435–514) and R. Vejle (2008, n=835).

The size composition seems to vary somewhat between years in both the unbiased sample and in the sport fishing catch. Apparently, fish below the minimum size are either not caught in the same proportions as they are present in the river or they are not reported as catch by the anglers. The same seems to be the case for trout lager than 60 cm in R. Kolding, especially in the years 2006 and 2007.

Between the two rivers size distribution in R. Vejle seems more ‘dome-shaped’, the fish possibly being less affected by fishing than R. Kolding. In the area outside R. Kolding extensive illegal fishing has been observed, especially in 2007 and this may be part of the explanation of the observed decrease in the frequency of large fishes this year.

The size composition in 1171 ascending (fin-clipped) stocked sea trout spawners in River Ume/Vindelälven showed a normal distribution being a lot more narrow than in the other rivers with information (Figure 5.2.3.2.5).

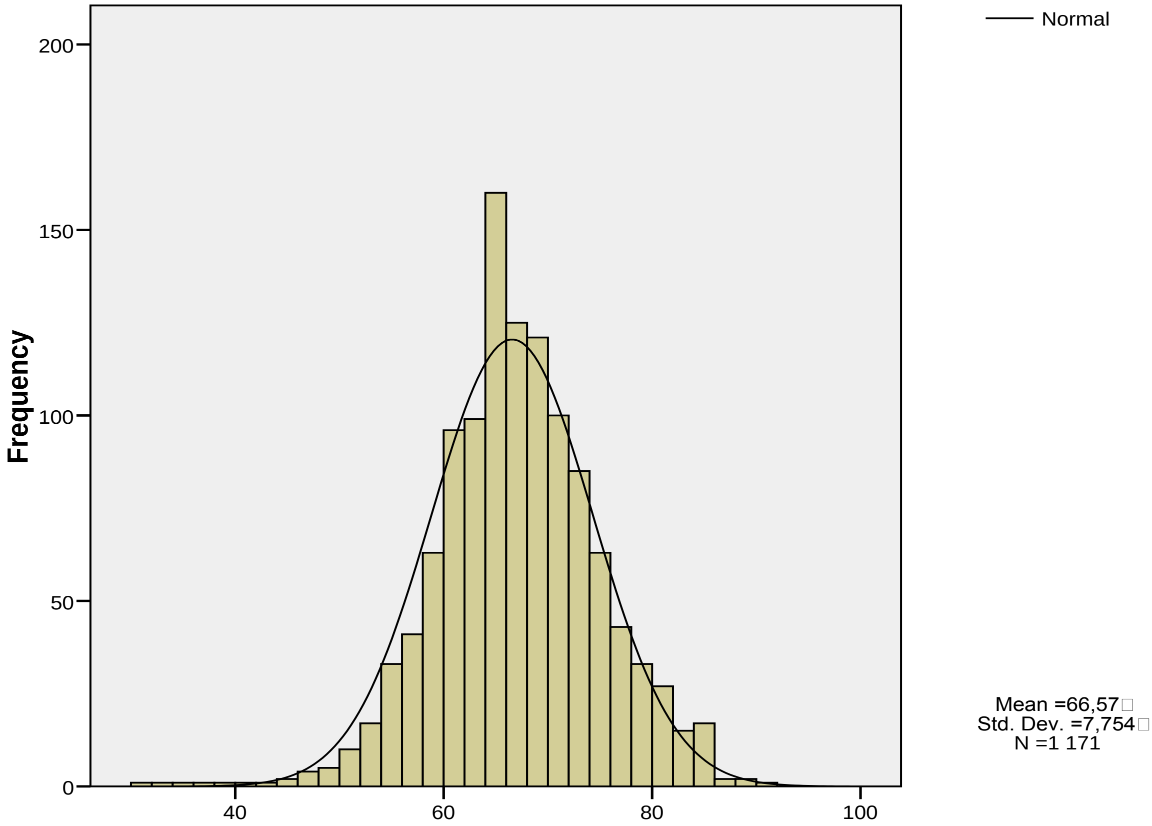


Figure 5.2.3.2.5. Size composition in 1171 stocked sea trout in R. Ume/Vindelven, Sweden.

In sea trout caught in the sea, gillnets are predominant fishing gear especially in the Gulf of Bothnia and in the Gulf of Finland. The size of the sea trout caught by gillnets is greatly depending on the mesh sizes used. Because sea trout may be entangled in the nets also by teeth, the size distribution of fish in each mesh bar length is rather broad. However, the smaller is the mesh size, the smaller are also the sea trout caught by these gillnets. In Figure 11 selectivity curves from gillnets towards trout are illustrated. Nets with mesh size of 45 mm bar length predominantly catch sea trout averaging 45 cm and the mean length of sea trout caught by mesh bar length 50 mm is 50 cm. Especially in Finland, where small mesh sizes are commonly used in catching of pikeperch and whitefish, the fishing mortality is very high among small sea trout.

This is in agreement with Swedish data (Degerman *et al.*, 1998). On the Swedish west coast the minimum size of sea trout is 45 cm and the smallest allowed mesh size in shallow waters (<3 m) is 60 mm. This is to eliminate the risk of catching fish below minimum size.

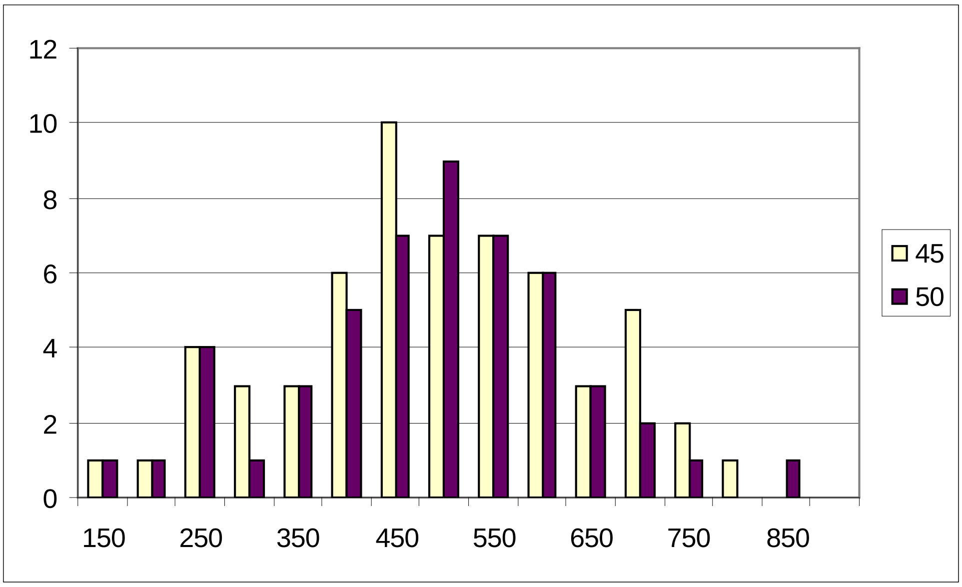


Figure 5.2.3.2.6. Selectivity curve for sea trout with 45 and 50 mm bar length gillnet (Finnish Game and Fisheries Research Institute).

Because all populations to some extent are likely to be subjected to some fishing that will influence size composition, it is not possible to establish a reference size distribution. However, both the size composition in the two Danish rivers and in Poland (Figures 5.2.3.2.2–4) have a shape apparently differing from a normal distribution that might be a result of selective fishing with large meshed selective gear such as gill nets with a mesh size above approximately 60 mm (bar length).

Contrary to this lengths observed in the Swedish samples seem to follow a normal distribution.

5.2.3.3 Age composition of the spawning populations.

In R. Kemijoki both historical (1920s–1940s) and more recent (1980s) age and size composition of the spawning run shows that the spawners were mostly large fish with a sea age of 2 or more years (Figures 5.2.3.3.1 and 5.2.3.3.2).

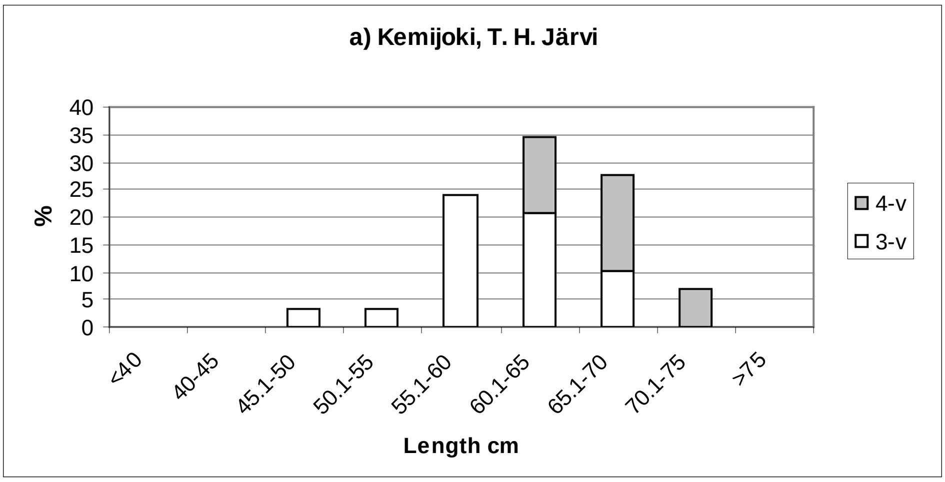


Figure 5.2.3.3.1. Length and sea age distribution of ascending female sea trout based on historical data by T. H. Järvi in the Kemijoki river in the 1920s–1940s.

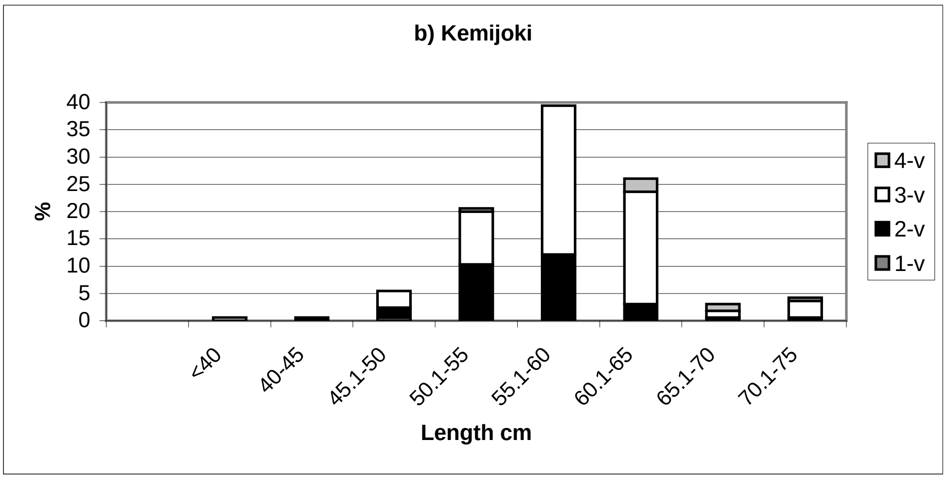


Figure 5.2.3.3.2. Length and sea age distribution of ascending female sea trout in the fishery at the Kemijoki river mouth for egg production in the 1980s.

In R. Tornionjoki a slightly larger proportion of smaller sea trout was found in the late 1990s and first years after 2000 partly being immature sea trout entering the river without spawning (Figure 5.2.3.3.3). Also in R. Tornionjoki a number of sea trout caught in the river each year from 1977 has been aged (Figure 5.2.3.3.4), consisting predominantly of 2–3 SW trout.

Overall, it is evident that size and age of the actual spawning population in the area has not changed for decades.

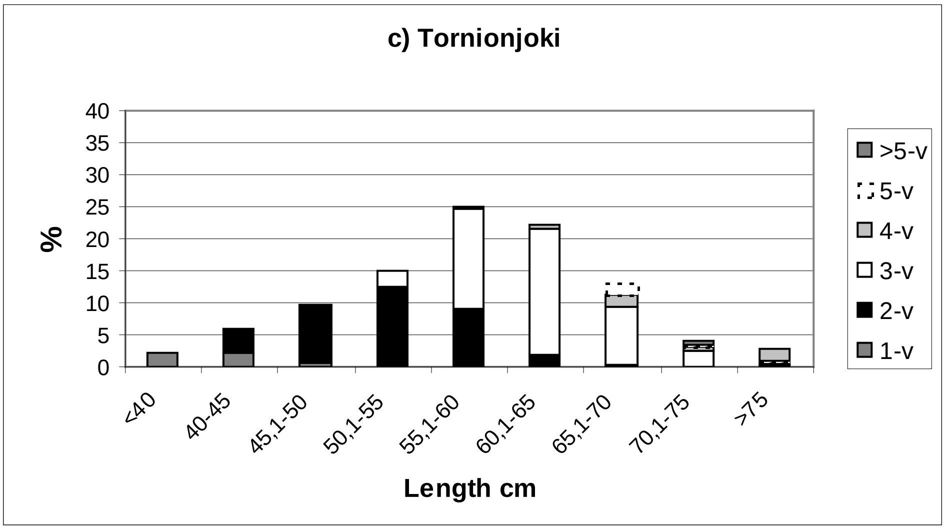


Figure 5.2.3.3.3. Length and sea age distribution of ascending female sea trout in the catches from the Tornionjoki river collected from the 1990s and early 2000.

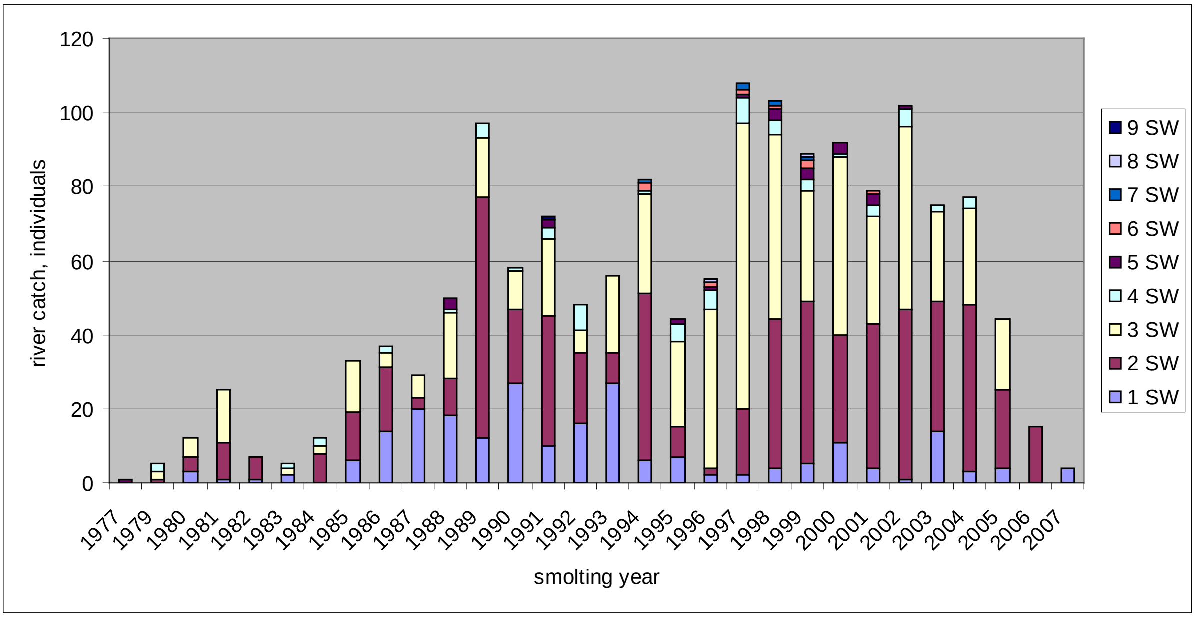


Figure 5.2.3.3.4. Age composition of sea trout caught in R. Tornionjoki

Female sea trout in this river mature with an age of 3 sea winters, and females dominate the run of sea trout in the same way as is observed in many other populations. The proportion of trout with this age and older increased somewhat after 1990, constituting a large part of the aged specimens in the mid 1990s and up to approx. year 2002, after which time it has decreased considerably.

This observation was very much in line with observations of the age composition of tagged sea trout caught in the sea (see section 5.3).

In R. Kolding the age composition of sea trout in the river was determined as part of a study carried out in 1989–1991 (Kristiansen 1991, and it was determined for a sample collected during electro fishing in 2001 (Figure 5.2.3.3.5).

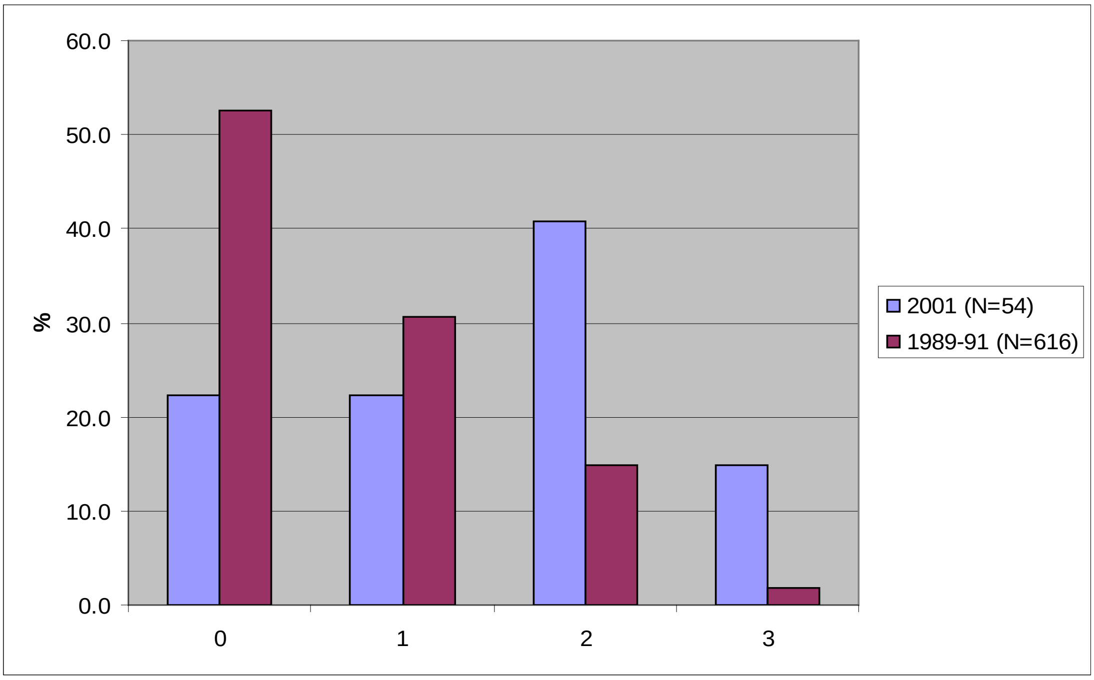


Figure 5.2.3.3.5. Age composition at first spawning of sea trout in R. Kolding 1989–1991 and 2001. Proportion of fish with age 0, 1, 2, 3 SW at first spawning.

A huge difference in the age composition was observed with more than 50 % of the population being age 0 SW in the 1989–1991 samples decreasing to just a few % being age 3 SW at first spawning. In the 2001 sample age 2 SW dominated the population and age 3 constituted approximately 15 % of the population. Also the frequency of first time spawners differed between the two samples, constituting close to 78 % in 1989–1991 and only 46 % in 2001 indicating a huge increase in survival.

In R. Slupia present spawning run consist mainly from 1SW fish with small addition of 0SW and 2SW fish.

In Denmark extensive restrictions on net fishing came to effect in the late 1980s (nets closer than 100 m to the shore and an extension of closed areas around river mouths in larger rivers - see that section). In 1993 the number of nets allowed for each non-commercial fisherman was reduced to a maximum of 3 gillnets.

5.2.3.4 Summary

Summing up the results, direct counts indicate an increase in the spawning run in the large rivers in the north Baltic (Areas 31 and 30) but still with very small runs of spawners. This is only in part supported by the development in catches in the area. In the Tornionjoki sport fishing catches are still quite high on the Finnish side.

In the south eastern part of the Baltic, the populations in some rivers seem to have a positive trend a indicated by catches and redd counts, while some populations could be diminishing.

In south Sweden at least some of the populations seem to be decreasing, however still with comparatively high numbers of spawners entering the rivers, with catches of more than 1000 sea trout annually in R. Mörrum and several thousand sea trout entering the R. Nybroån. Also in the Sound (area 23) in the small R. Höjeå, the average number of ascending spawners was 1054 during 2003–2005 and in River Råån, an average of 3547 spawners was observed in the years 2003–2006.

In Denmark (area 22) populations seem to have increased considerably in recent years.

There is no information on the spawning population size in Gulf of Finland area, Kaliningrad area or from Germany. From the Schleswig - Holstein area in Germany continued releases of reared trout are apparently necessary to maintain populations, while some populations seem to have been restored in Mecklenburg - Western Pomerania.

5.3 Tagging results

The Finnish tagging results evaluated in this section include only the recaptures received from 2–3 year old sea trout smolts released in spring. The results comprise of recaptures received both by professional and recreational fishermen. The recreational fishermen catch at least 2/3 of the Finnish sea trout catches. The recreational fishermen use mainly gillnets and rod and line in fishing of sea trout, while trapnets are almost solely used in professional fishery in addition to gillnets. In addition to the Finnish data, data on the age at recapture were available from the taggings performed in some Polish rivers and on the development of the recapture rate in Swedish rivers.

5.3.1 Recapture rate and yield

Reaching back to the 1980s, the Finnish Carlin-tagging data on releases of hatchery-reared smolts show big variations between years and sea areas in the recapture rate and yield per 1 000 smolts. In the Bothnian Bay, the recapture rate varied annually between about 6% and 10% in the 1980s and between 3% and 8% in the 1990s (Figure 5.3.1.1). This decreasing trend continued in the 2000s, when the mean recapture rate has been about 3%. A similar negative trend can also been seen in the yield, which ranged in the 1980s between 44 kg and 85 kg but in the 2000s between 13 kg and 43 kg, resulting in on average 26 kg per 1000 smolts.

On the Finnish coast of the Baltic Sea, annual variations in the recapture rate and yield have been highest among smolts released in the Bothnian Sea area (Figure 5.3.1.2). The recapture rate varied in the 1980s between 4% and 17%, in the 1990s between 2% and 18%, and in the 2000s between 2% and 8% with a mean of 4%. The yield varied in the 1980s between 34 kg and 227 kg, in the 1990s between 20 kg and 184 kg but in the 2000s between 26 kg and 87 kg per 1000 smolts having a mean of 54 kg. This indicates a considerable reduction in the recapture rate and yield in the 2000s in this sea area.

The growth of sea trout is normally better in the southern than in the northern sea areas. In the south-western sea areas of Finland, in the Archipelago Sea (Subdivision 29), the decreasing trend in recapture rate and yield is even more obvious than in the Bothnian Bay (Figure 5.3.1.3). The recapture rate varied between 6% and 15% from the 1980s to the early 1990s but in the 2000s between 1% and 4% with a mean of 3%. The yield has correspondingly strongly reduced from between 119 kg and 445 kg until the early 1990s, to between 16 kg and 67 kg in the 2000s averaging 45 kg.

Among tagged smolt groups released in the Gulf of Finland, the recapture rate and yield per 1 000 smolts have been rather similar as in the Archipelago Sea (Figure 5.3.1.4). Both the recapture rate and the yield were relatively low in the first years in the 1980s but from 1983 to 1997 the recapture rate varied between 7% and 13% and yield between 137 kg and 405 kg per 1 000 smolts. After that both of them have dropped to a very low level, the recapture rate varying in recent years between 1%

and 4%, having a mean of 2%, and yield between 12 kg and 67 kg with a mean of 33 kg.

In Sweden tagging (6000–13 000 2yr smolts annually) is carried out in seven larger rivers with large stocking programmes of sea trout. They are all situated in the Bothnian Bay and the Bothnian Sea. The recapture rate has decreased from 16% in the period 1959–1979, to 9% in the 1980s and to 6.8% in the 1990s. Data are lacking after 1999. In the period 1996–1998 the recapture rate was only 3.9%, i.e. the negative trend continues. In the same data in the period 1996–1998 86% of the recaptured sea trout were below 0.4 kg in weight.

To summarize; according to the Carlin-tagging data, there is a strong negative trend in the recapture rate and yield of sea trout in all the northern ICES Subdivisions 29–32, and the present level is the lowest recorded there since the 1980s.

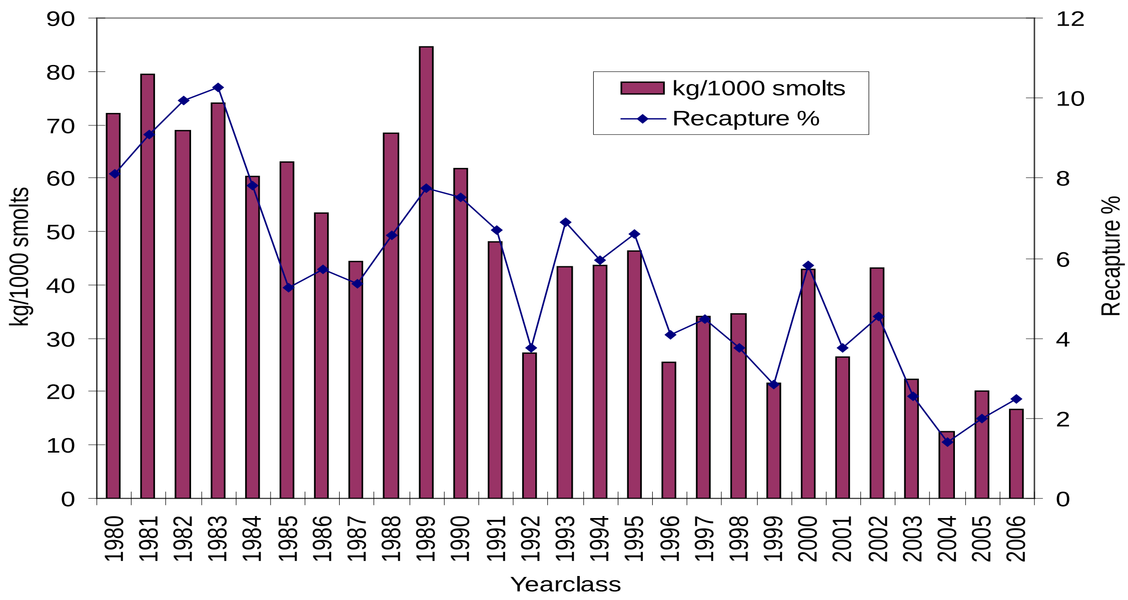


Figure 5.3.1.1. Recapture rate and yield/1 000 smolts in Finnish releases of Carlin-tagged sea trout smolts done in the Bothnian Bay area (Subdivision 31).

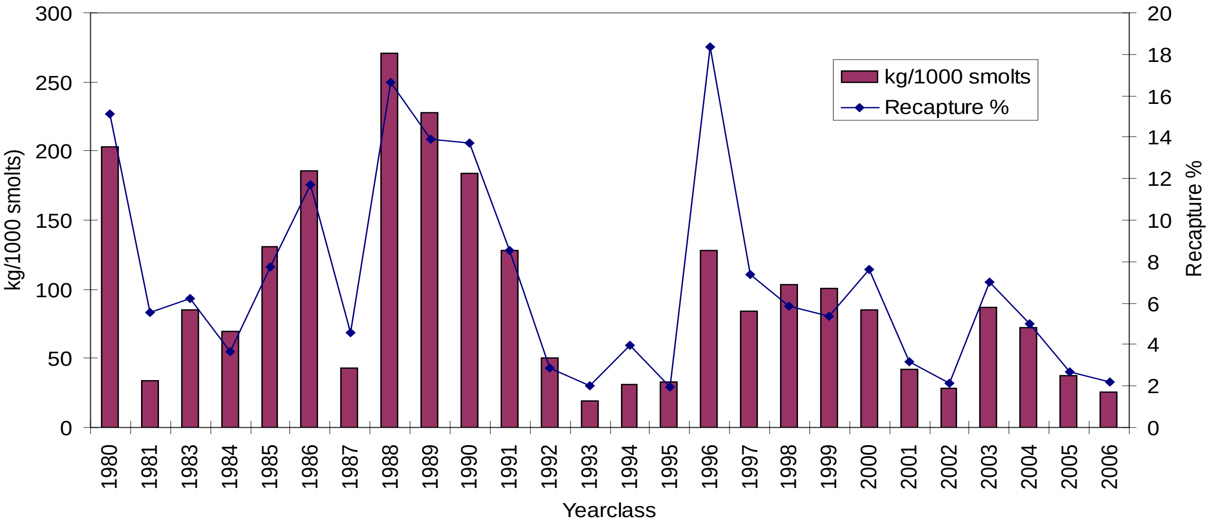


Figure 5.3.1.2. Recapture rate and yield/1 000 smolts in Finnish releases of Carlin-tagged sea trout smolts done in the Bothnian Sea area (Subdivision 30).

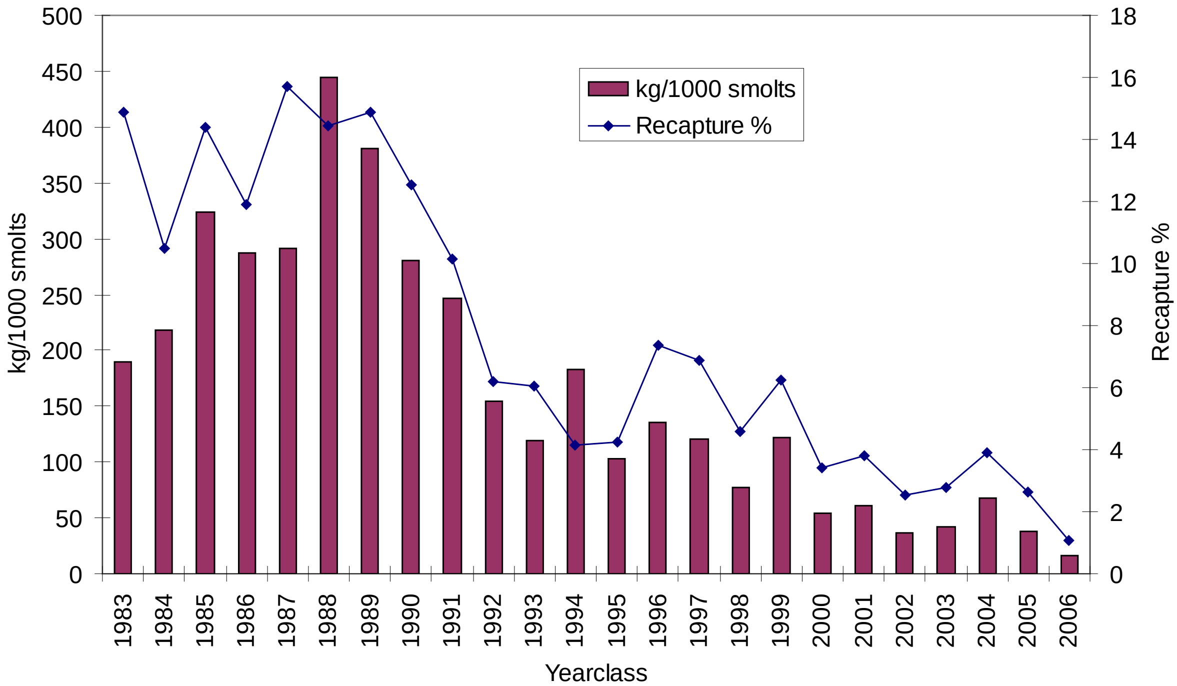


Figure 5.3.1.3. Recapture rate and yield/1 000 smolts in Finnish releases of Carlin-tagged sea trout smolts done in the Archipelago Sea area (Subdivision 29).

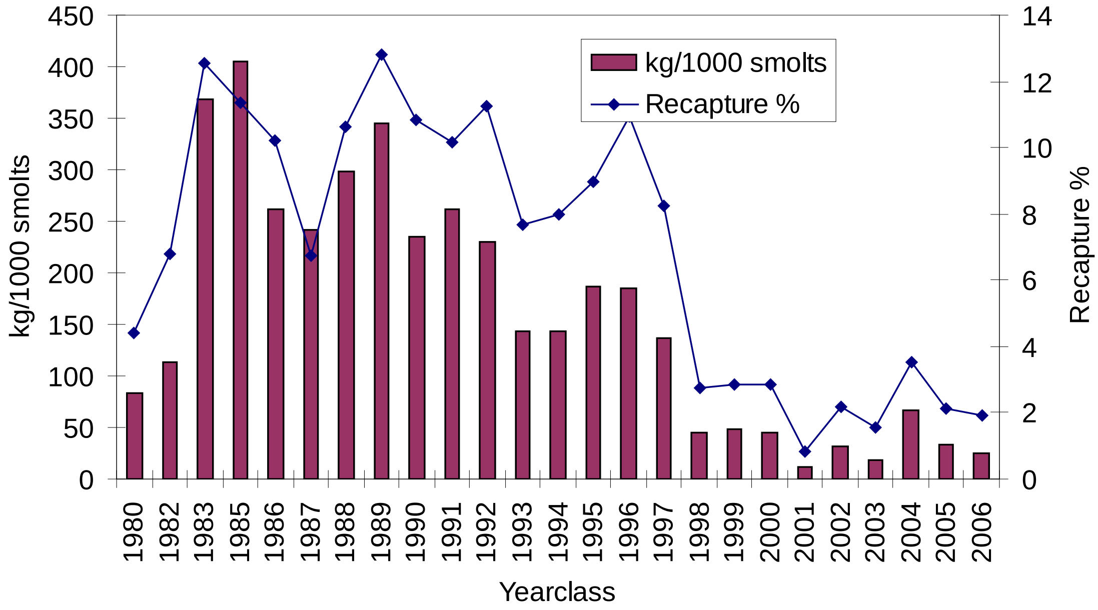


Figure 5.3.1.4. Recapture rate and yield/1 000 smolts in Finnish releases of Carlin-tagged sea trout smolts done in the Gulf of Finland area (Subdivision 32).

5.3.2 Age at recapture

On the basis of the tagging data, the age at recapture is lowest in the Bothnian Bay in all the Baltic Sea area. The proportion of sea trout caught during the year of sea entry as postsmolt (0 SW) was mostly less than 50% in the 1980s, varied between from 41% and 67% in the 1990s and has been continuously over 50% in the 2000s (Figure 5.3.2.1). The proportion of 1 SW fish constituted at the largest over 40% of the recoveries in the 1980s but has since then been mostly 25–40% of all the recoveries. The proportion of elder age groups has decreased from the level of 20–30% in the 1980s to 5–15% of the recaptures in recent years.

Like in the recapture rate, large annual variations are typical also for the age at recapture of the tagged sea trout smolts released in the Bothnian Sea (Figure 5.3.2.2). The age at recapture was here earlier in the 1980s notably elder than in the Bothnian Bay. The proportion of 0 SW trout was then mostly 10–30% but has later increased to the level of 30–60%. The share of 1 SW and elder trout was in the 1980s at the highest 60% together but nowadays 40–70%. From these elder age groups the proportions of 1 SW and 2 SW fish were earlier predominant and about equal but nowadays the share of 0 SW and 1 SW fish is often roughly similar, while the oldest age groups constitute mostly together 5–25% of all the recaptures.

Both in the Archipelago Sea and in the Gulf of Finland the situation and development in age at recapture are similar (Figures. 5.3.2.3 and 5.3.2.4). The age at recapture is nowadays notably younger than earlier in the 1980s, when the proportion of 0 SW trout was 15–25% at the maximum. Nowadays the proportion of 0 SW trout is commonly 35–60%. In the early 1980s the share of 2 SW and elder trout was 30–70% or more, now it comprises about 5–15% of all recaptures.

The age composition in Polish tagging results of sea trout released in the Vistula river and Pomeranian rivers has varied considerably from year to year.

In sea trout released in the R. Vistula, the proportion of 0 SW fish was around 70–90% in 1989–1991, dropped to the level of 20–50% in 1992–1999 but has since 2000 been again 50–80% (Figure 5.3.2.5). The proportion of elder trout was correspondingly very low in 1989–1991, constituted over half of the recaptures in 1992–1999 and decreased after that to the level of 20–50%.

The proportion of 1 SW has in recent years been 10–30% and that of 2 SW and elder fish 10% at the most.

The mean age of recaptured fish has been a bit elder in the Pomeranian rivers (Figure 5.3.2.6). In these rivers the share of 0 SW fish has ranged from 20% to 50%. 1SW trout have in some years constituted the majority of the catch, the proportion varying between 20% and 70%. Annually 10–40% of the recaptures have come from 2 SW and elder sea trout.

In conclusion, the Polish tagging results show on average a higher mean age at catch in the releases in the Pomeranian rivers than in the R. Vistula, where the proportion of 0 SW is high. This could be the result of a herring fishery in the Gulf of Gdansk (see Section 5.5), being important in the early catch of sea trout in this area (Figure 5.3.2.7). The share of 0 SW fish seems to increase from 1992 and onwards, however these differences may also be affected by a rather low number of recaptured fish for some years.

It should be noted; however that Carlin tagged smolts will be more vulnerable to fine meshed gear due to the external tag that will easily get entangled in the fine meshed nets. This will result in an apparently higher and earlier catch of the sea trout than what is the case for not tagged fish.

Comparable information from the western part of the Baltic is scarce. In recent years results are limited to 3 years of tagging sea trout after 2000 in R. Kolding. In these releases catches during the year of sea entry was between approx. 10 and 25 %, and 40–60% being caught in the second year in the sea (1 SW). Few sea trout were caught as 3 SW and older but some 20 % as 2 SW trout (Figure5.3.2.8).

In spite of the short time span available, the results indicate a significant difference to both Finland and Poland, probably reflecting differences in the fishery in the different sea areas.

To summarize; the proportion of postsmolts (sea trout caught during the year of sea entry) from all recaptures has increased considerably in all Finnish coastal sea areas (Subdivisions 29–32) from a level of 10–40% in the 1980s to 35–65% after 2000 (Figure 5.3.2.9). Correspondingly the proportion of elder sea trout has been reduced, especially that of the 2 SW and elder fish, being important as returning spawners in the rivers, since most sea trout in the area attain sexual maturity after three years at sea. I.e. there is a continued increase in the catch of sea trout before attaining reaching the age of first spawning.

In the south eastern part of the Baltic sea (subdivison25 and especially 26), the age composition in catches from Polish tagged trout shows a catch of somewhat older fish but with a decreasing trend in age. However, these results seem more uncertain due to a small number of recoveries for some years but they also give rise to some concern.

Together with the results from Denmark a significant early fishing mortality is strongly indicated in both the sea areas around Finland (Subdivisions 29–32) and especially of eastern Poland (Subdivision 26).

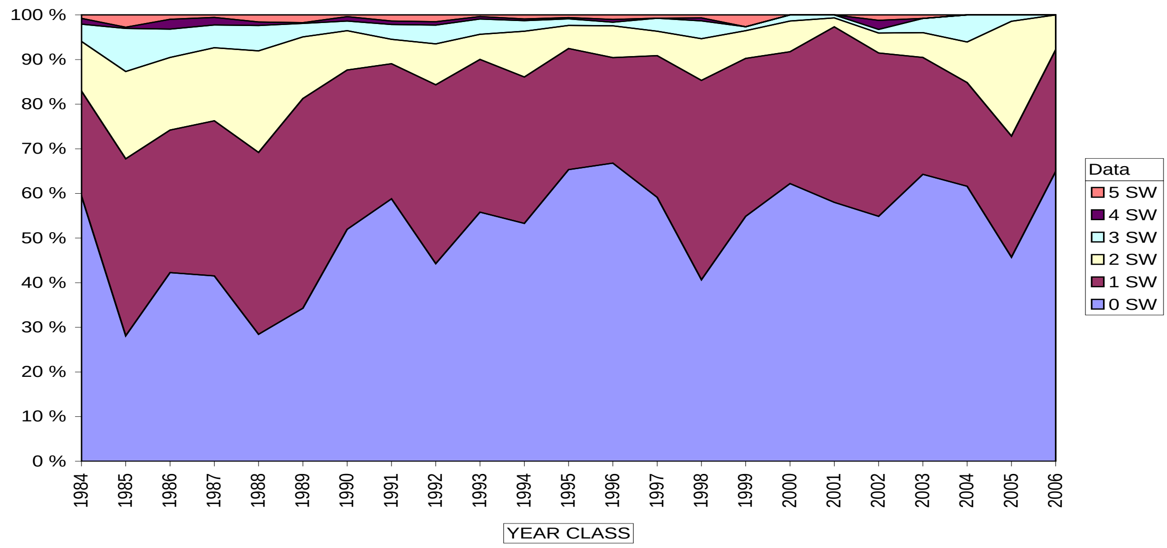


Figure 5.3.2.1. Recaptures of sea trout by sea age in Finnish Carlin-tagging experiments done in the Bothnian Bay area (Subdivision 31).

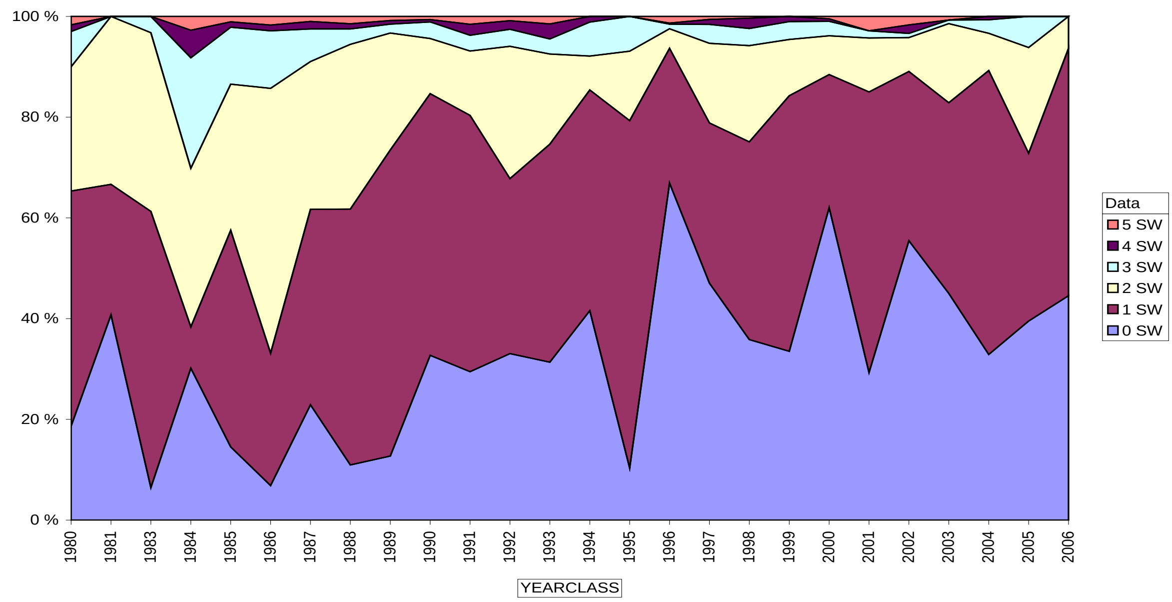


Figure 5.3.2.2. Recaptures of sea trout by sea age in Finnish Carlin-tagging experiments done in the Bothnian Sea area (Subdivision 30).

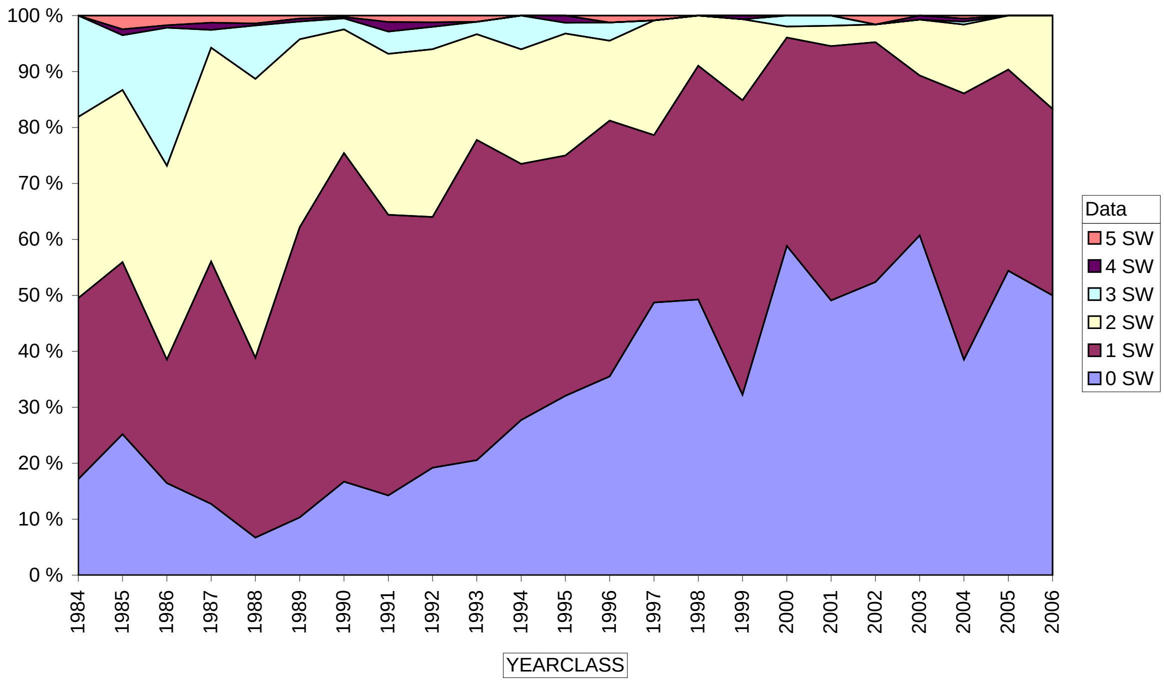


Figure 5.3.2.3. Recoveries of sea trout by sea age in Finnish Carlin-tagging experiments done in the Archipelago Sea area (Subdivision 29).

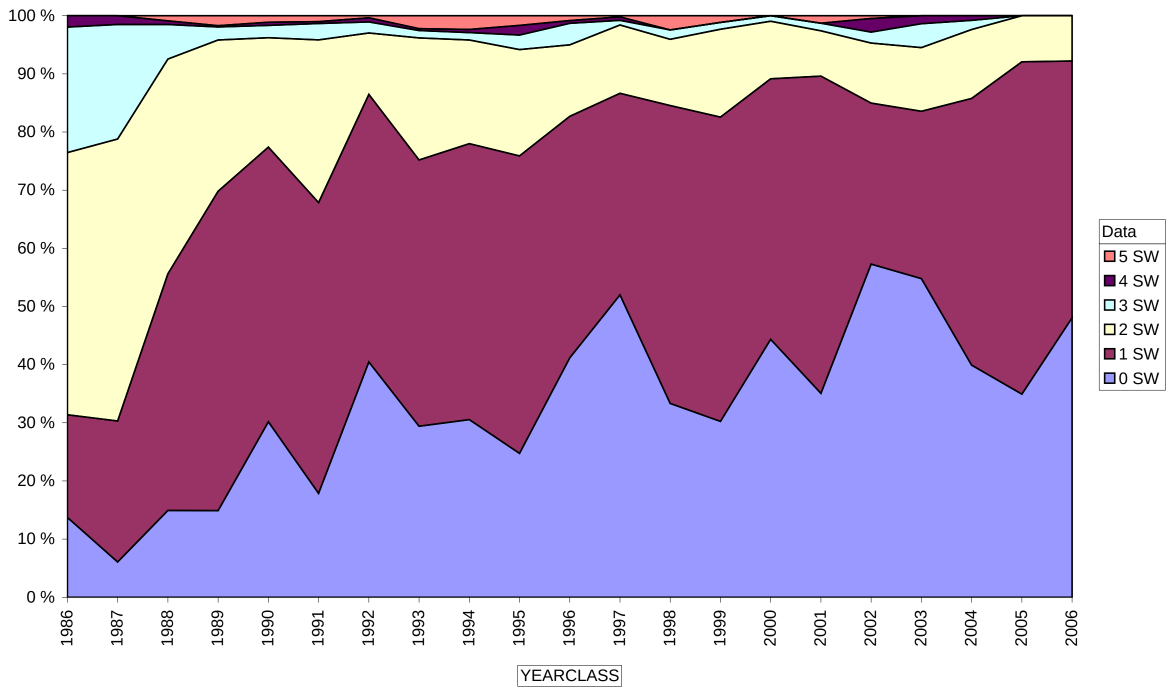


Figure 5.3.2.4. Recoveries of sea trout by sea age in Finnish Carlin-tagging experiments done in the Gulf of Finland area (Subdivision 32).

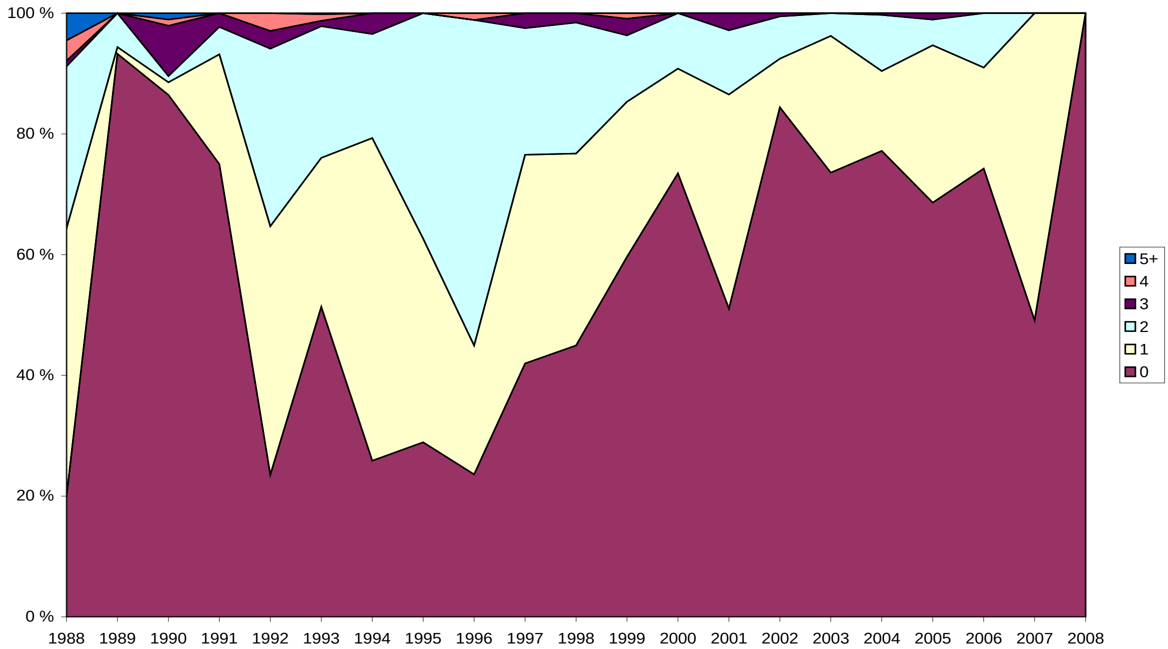


Figure 5.3.2.5. Age composition from Polish releases of Carlin-tagged sea trout in the Vistula river (Subdivision 26).

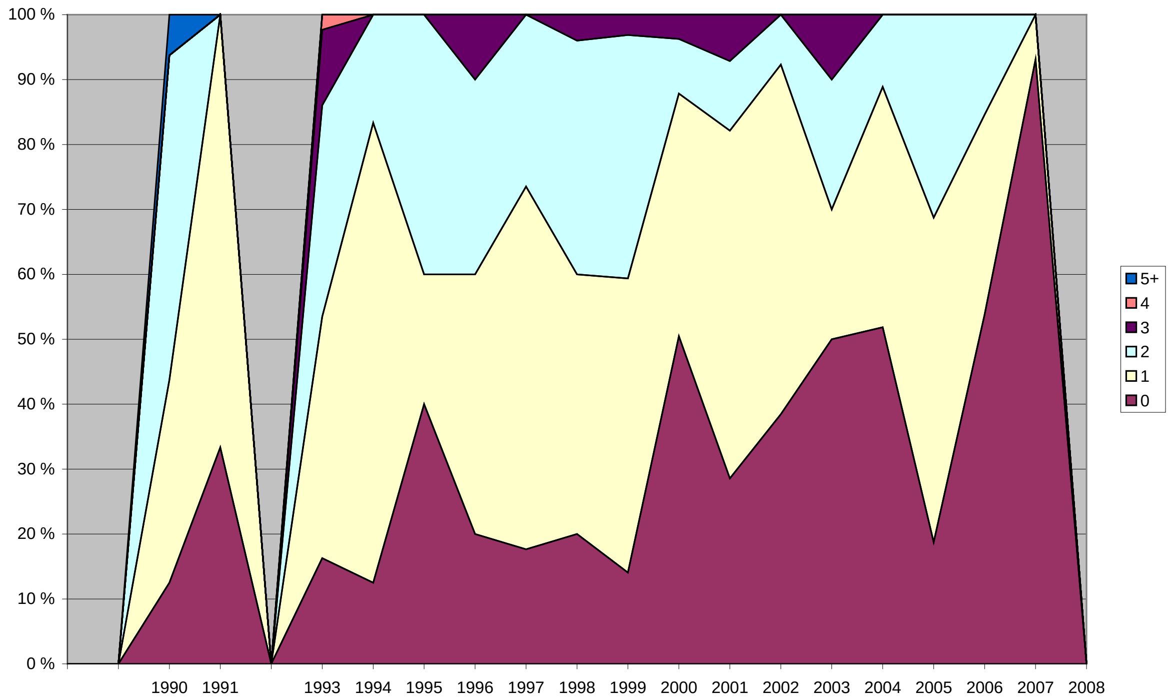


Figure 5.3.2.6. Age composition from Polish releases of Carlin-tagged sea trout in the Pomeranian rivers (Subdivision 25).

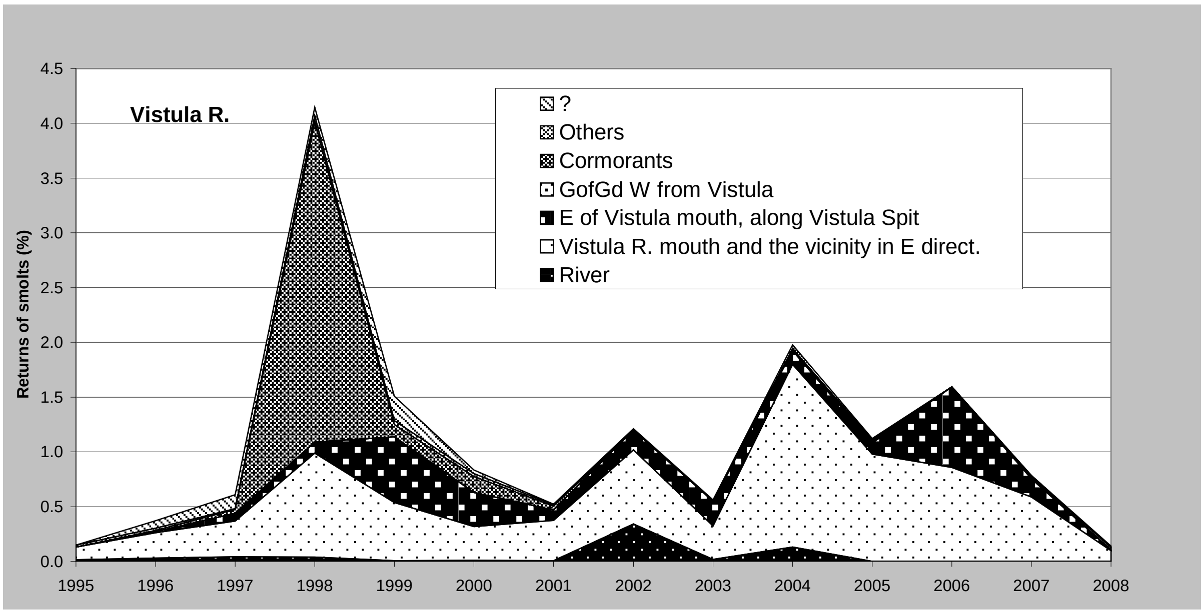


Figure 5.3.2.7. Place of recapture from release to 1. August same year for sea trout smolt released in R. Vistula (Subdivision 26).

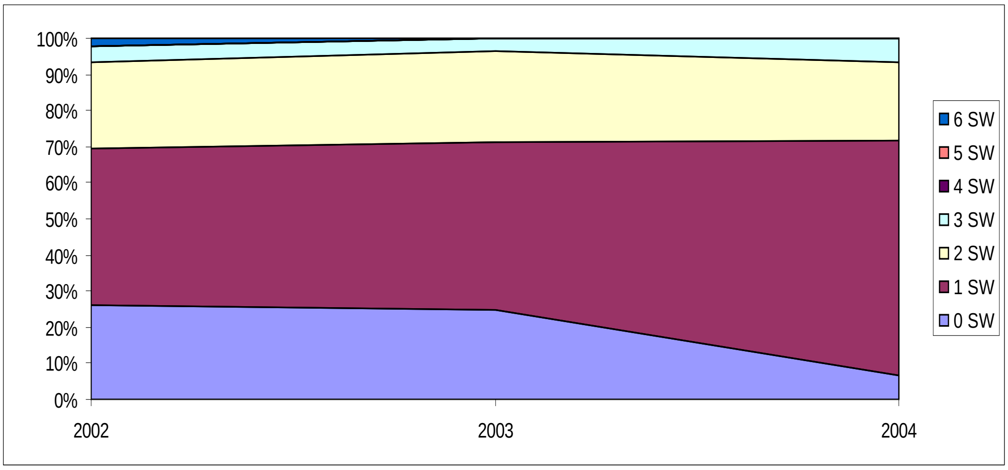


Figure 5.3.2.8. Sea age composition in recaptures of sea trout smolts released in R. Kolding, Denmark (Subdivision 22) caught in the sea.

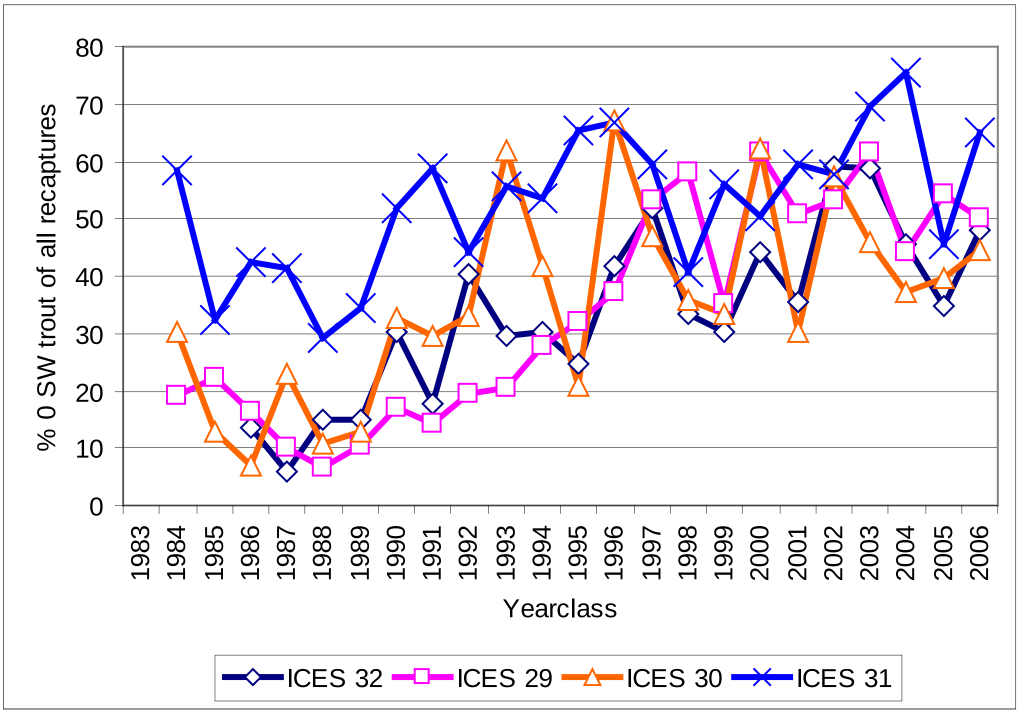


Figure 5.3.2.9. The proportion of 0 SW fish in recaptures of Carlin-tagged sea trout by sea areas based on Finnish tagging data (Subdivision 29–32).

5.3.3 Recaptures by fishing gear

In Finland, sea trout are mainly caught as by-catch of gillnet and trapnet fishery. In the southern sea areas (Subdivisions 29 and 32), the main targets in the gillnet fishery are pikeperch and migratory whitefish. These species are mainly caught by mesh sizes 45–55 mm (bar length) in the Gulf of Finland (Subdivision 32) but in the Archipelago Sea (Subdivision 29) the mesh sizes are smaller, 38–45 mm.

In the Gulf of Bothnia, the main target in gillnet fishing is whitefish, which are usually caught with gillnets mesh bar length 38–40 mm in the northern Bothnian Sea (Subdivision 30), in the southern Bothnian Sea 38–45 mm. In the Bothnian Bay (Subdivision 31), gillnets with 38–45 mm bar length are normally used in fishing of whitefish but in late autumn also mesh sizes 27–30 mm in the fishery for small-sized sea-spawning whitefish.

Gillnets are used in all sea areas; also in fishing of pike, perch, burbot, herring, and some other species, and the mesh sizes may be very variable. Gillnet fishing is general all year round, also in winter under the ice. In particular in the Gulf of Bothnia, it is common in spring and summer but the gillnet fishing in autumn has nowadays decreased because of increased damages caused by seals. Both recreational and professional fishermen use gillnets but trapnet fishing is almost completely a professional fishery. Trapnet fishing is used from spring to autumn and it is targeted mainly towards salmon and whitefish. Even though sea trout are mostly caught as a by-catch, sport fishing (rod and line) for sea trout have increased in recreational fishing at sea since the 1990s. Recreational fishing of sea trout is nowadays common also in some rivers like in the Tornionjoki and Kymijoki.

Based on Finnish tagging results, it is evident that the gillnet fishery has a central role in sea trout fishing. Fish caught by gillnets comprise over half of all the recaptures of sea trout. In the Bothnian Bay area, the proportion of gillnets has decreased from the level of 70–80% in the 1980s to the level of 50–70% in the 2000s (Figure 5.3.3.1). Almost all gillnets used here are bottom gillnets. The proportion of trapnets has remained rather steady comprising 20–30% of the recaptures, while the proportion of rod and line has increased from less than 5% to the level of 5–10% in the 2000s.

In the Bothnian Sea, the prevalence of gillnet fishing is most obvious. 80–90% of all recaptures of tagged sea trout have been caught by gillnets and the rest mostly by trapnets (Figure 5.3.3.2). Bottom gillnets are clearly overwhelming fishing gear, the proportion of surface gillnets varies in recoveries mostly between 5% and 20%.

Bottom gillnets are most important fishing gear also in the Archipelago Sea area, tagged trout caught by them have varied normally between 60% and 70% (Figure 5.3.3.3). The proportion caught in trapnets has decreased from 10–30 % in 1980s to around 5–10% nowadays, while the importance of rod and line has increased correspondingly from less than 5% to the present level of 20–30% of all recaptures.

In the Gulf of Finland, the proportions of different fishing gear have changed much during past three decades but gillnets have always been also there most important fishing gear among recaptures (Figure 5.3.3.4). The proportion of fish caught by gillnets was at the lowest in the late 1980s and early 1990s about 50–60% of all recaptures but nowadays the share has increased to 60–90%. The bottom gillnets are clearly the most common gear. Nowadays less than 5% all recoveries come from surface gillnets but until the mid-1990s their share was commonly 10% or more. The importance of trapnets and longlines was at the highest together 25–45% all recaptures in the late 1980s and early 1990s but has reduced to some few % in the 2000s. The proportion of rod and line was in the early 1980s mostly 10–30%, and during the years after that lower but has in recent years again increased to around 20%.

In conclusion, the results presented indicate a vast majority of sea trout being caught in the sea as by-catch in gillnet fishing, which corresponds to findings on the Swedish side (Petersson *et al.,* 2009) and see section 5.5. The mesh sizes used in the gillnets are so small that as a result a large part of the sea trout are caught as postsmolts during the year of sea entry as undersized fish. Releasing of undersized undamaged fish is possible from other gear types (e.g. traps) but trout entangled in gillnets are usually injured and their mortality is high if released after catch.

Regulating the catch of sea trout in the Bothnian Bay, Bothnian Sea, Archipelago and Gulf of Finland is therefore only possible if the fishing for other species is regulated. To avoid extensive by-catch of undersized trout the use of the small mesh sizes needs to be restricted in all gillnet fishing to prevent early by-catch of, and to increase the recruiting age of sea trout to the fishery. A mesh size of 50 mm bar length corresponds roughly to the catch size of 50 cm in sea trout.

It has been estimated that whitefish fishing would actually benefit from the use of larger mesh sizes by increasing stocking results, and actually a mesh size of 45 mm bar length has been proposed the minimum in fishing of whitefish (Jokikokko *et al.*, 2007).

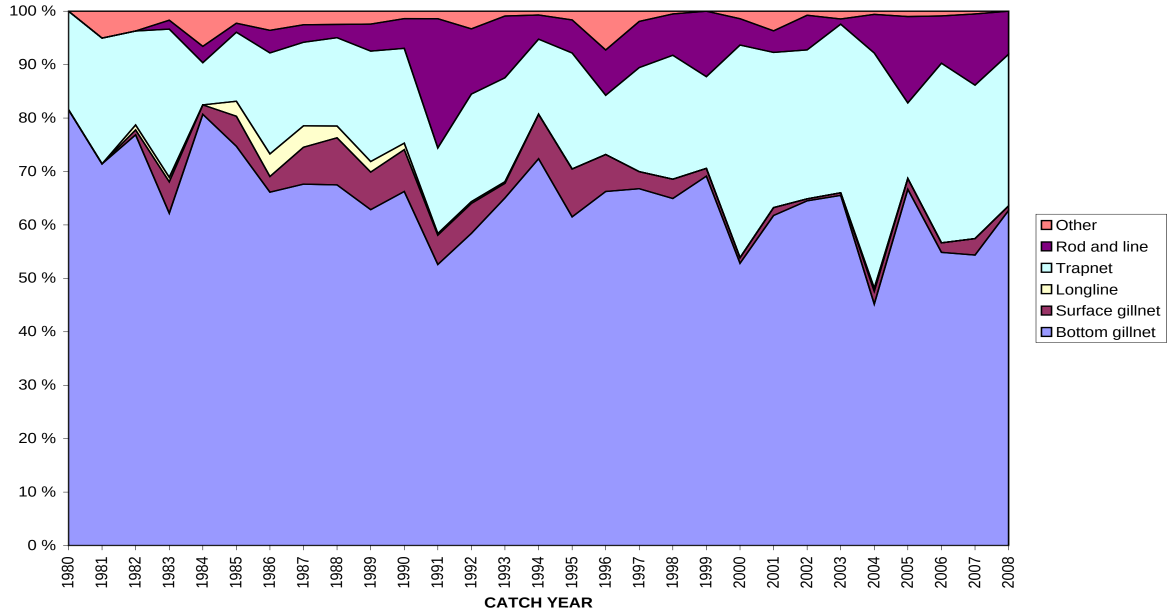


Figure 5.3.3.1. Recaptures of sea trout by fishing gears in Finnish Carlin-tagging experiments done in the Bothnian Bay area (Subdivision 31).

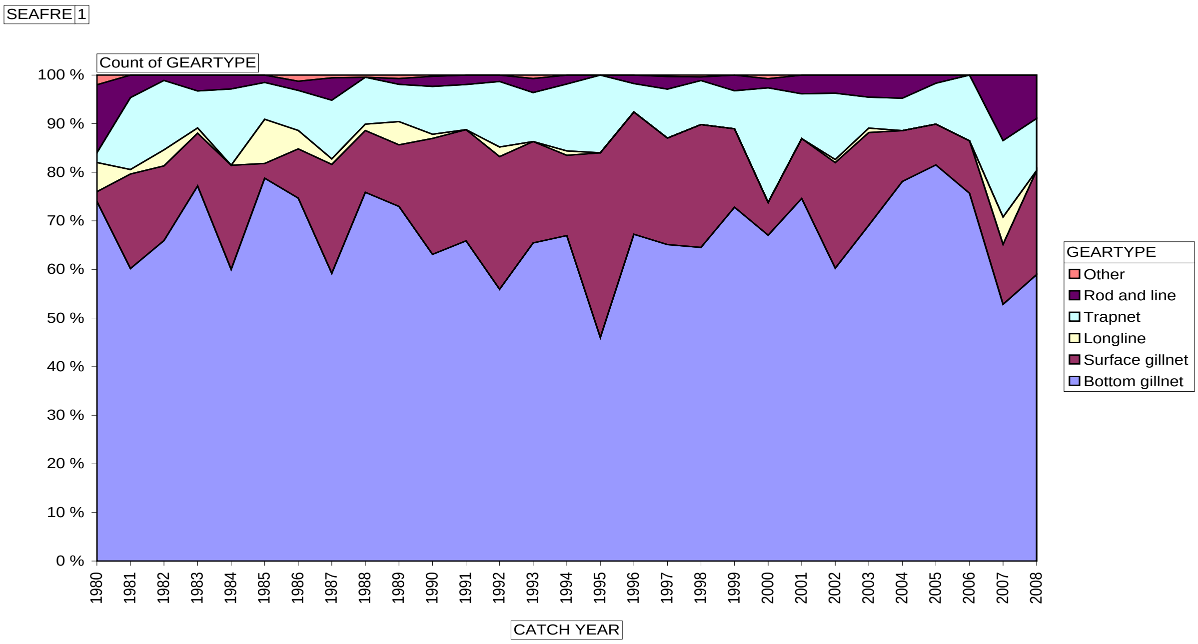


Figure 5.3.3.2. Recaptures of sea trout by fishing gears in Finnish Carlin-tagging experiments done in the Bothnian Sea area (Subdivision 30).

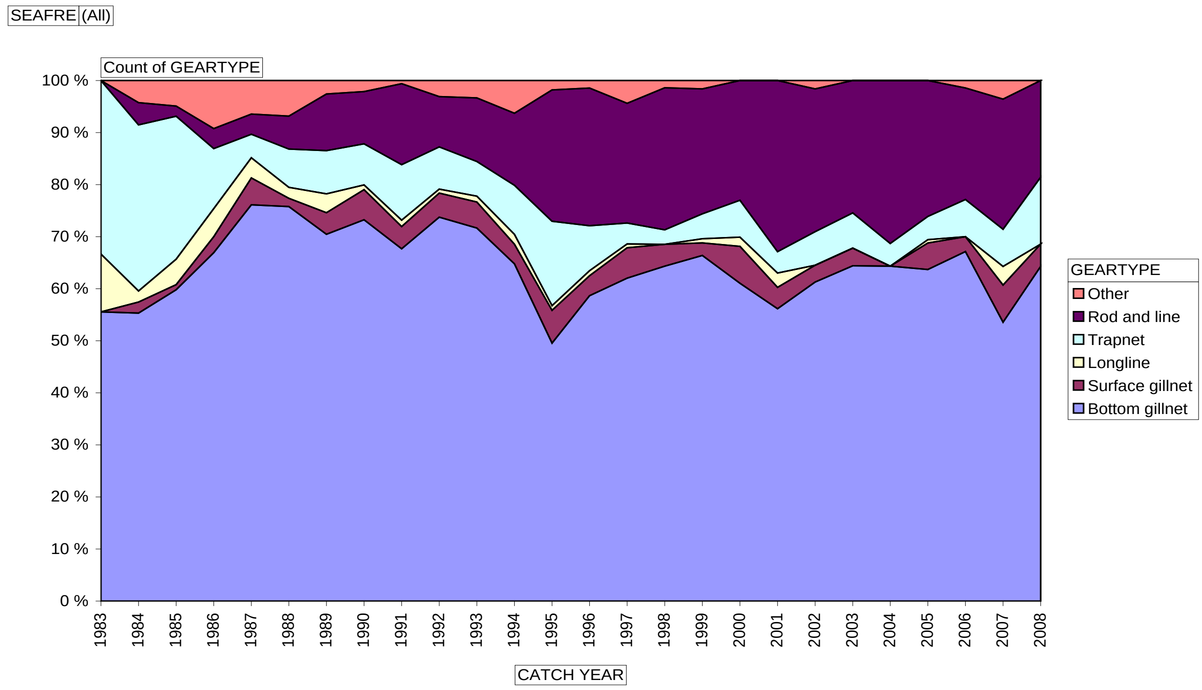


Figure 5.3.3.3. Recaptures of sea trout by fishing gears in Finnish Carlin-tagging experiments done in the Archipelago Sea area (Subdivision 29).

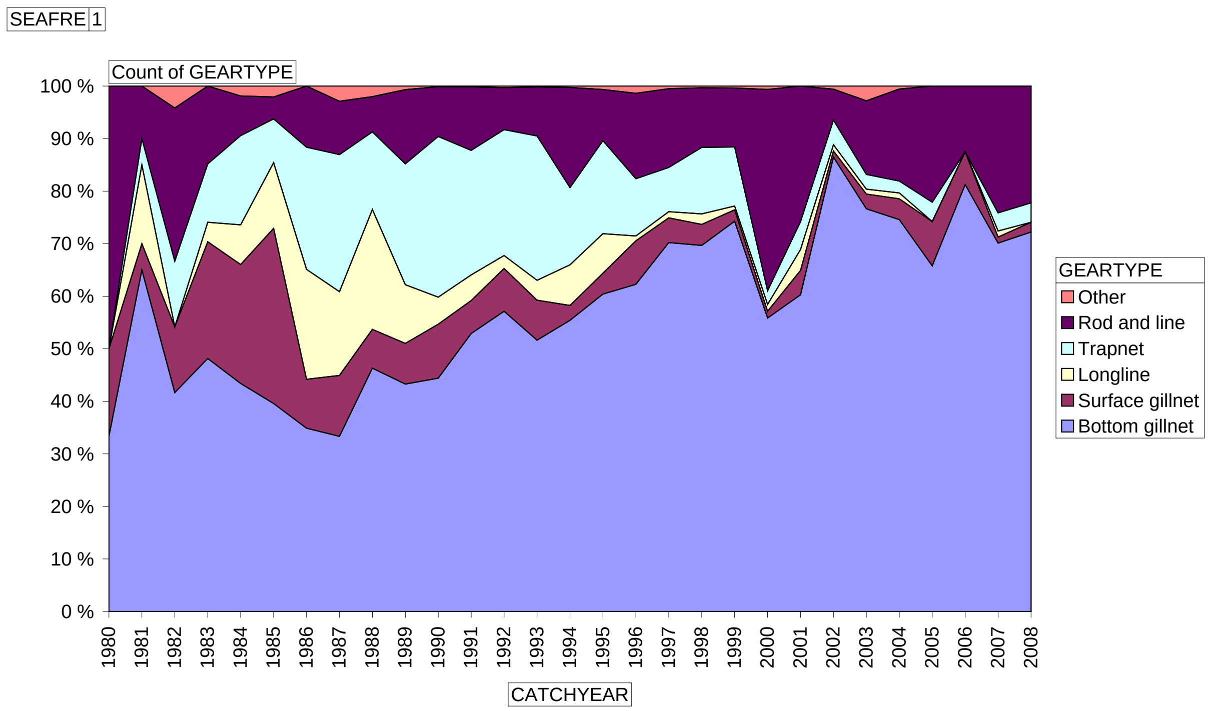


Figure 5.3.3.4. Recaptures of sea trout by fishing gears in Finnish Carlin-tagging experiments done in the Gulf of Finland area (Subdivision 32).

5.3.4 Size at recapture

In Finland, the size (length) at recapture has always been lowest in sea trout released in the Bothnian Bay. Over half of the recaptures in the area was almost continuously from <40 cm fish, and over 80% of the recaptures from <50 cm fish during the period

1980–2008 (Figure 5.3.4.1). Correspondingly, the proportion of ≥50 cm fish has frequently been only 10–15% of all recaptures.

In the Bothnian Sea area the proportion of small fish (<40 cm) is considerably lower, comprising mostly 20–40% of total recaptures (however in some years much higher) (Figure 5.3.4.2). The proportion of fish <50 cm has varied mostly between 60% and 80%, and less than 20% of them have been 60 cm or larger.

The proportion of recaptures of small sea trout (<40 cm) was lower in the Archipelago Sea and in the Gulf of Finland, compared to catches in subdivison31 and 30 (Figure 5.3.4.3 and 5.3.4.4). It has usually ranged between 10% and 20% but has in some years been much higher. Also the proportion of recaptures of larger fish has varied much between years. Between approx. 30 and 80% of all recaptures have been from sea trout <50 cm. The proportion of larger (≥60 cm) sea trout is also highly variable between years, with a maximum of close to 50% but usually varying between 20% and 40%, and in recent years 10–20 % .

Data from Danish experiments in subdivison22 during the period 2002–2004 show a completely different composition of sizes (Figure 5.3.4.5), with less than 10 % being reported captured as small (l<40 cm), and more than 35 % as large trout with length ≥ 60 cm.

The high proportion of undersized sea trout is a complicated problem, especially in the Bothnian Bay. Already with a minimum legal size of 40 cm (that was in effect in Finnish waters up to 2008), more than half of the recaptured trout were caught as undersized fish.

After minimum legal size was raised to 50 cm in 2008 in Finnish sea areas, the proportion of undersized trout comprises >80% of the sea trout caught.

Even though the situation in the other coastal areas of Finland is less critical, in 2008 about 60% of the sea trout caught in these areas were smaller than the existing legal size.

The small size of caught sea trout means that the growth potential of the fish is not properly utilized. Furthermore, as the sea trout mostly do not attain sexual maturity before a length of more than 60 cm is reached, the low proportion of larger trout (l>60 cm) indicates that also reproduction is endangered, particularly in recent years.

The frequent catch of sea trout as postsmolts and the high percentage of undersized fish is due to the use of small mesh sizes in gillnet fishing. On a longer time perspective the shortage of spawners poses a fatal risk of extinction for the wild sea trout stocks, which must be avoided.

Abandonment of fishing undersized sea trout would necessitate removing or significantly reducing effort from the smallest mesh sizes in the gillnets to reduce fishing pressure of sea trout at the sea.

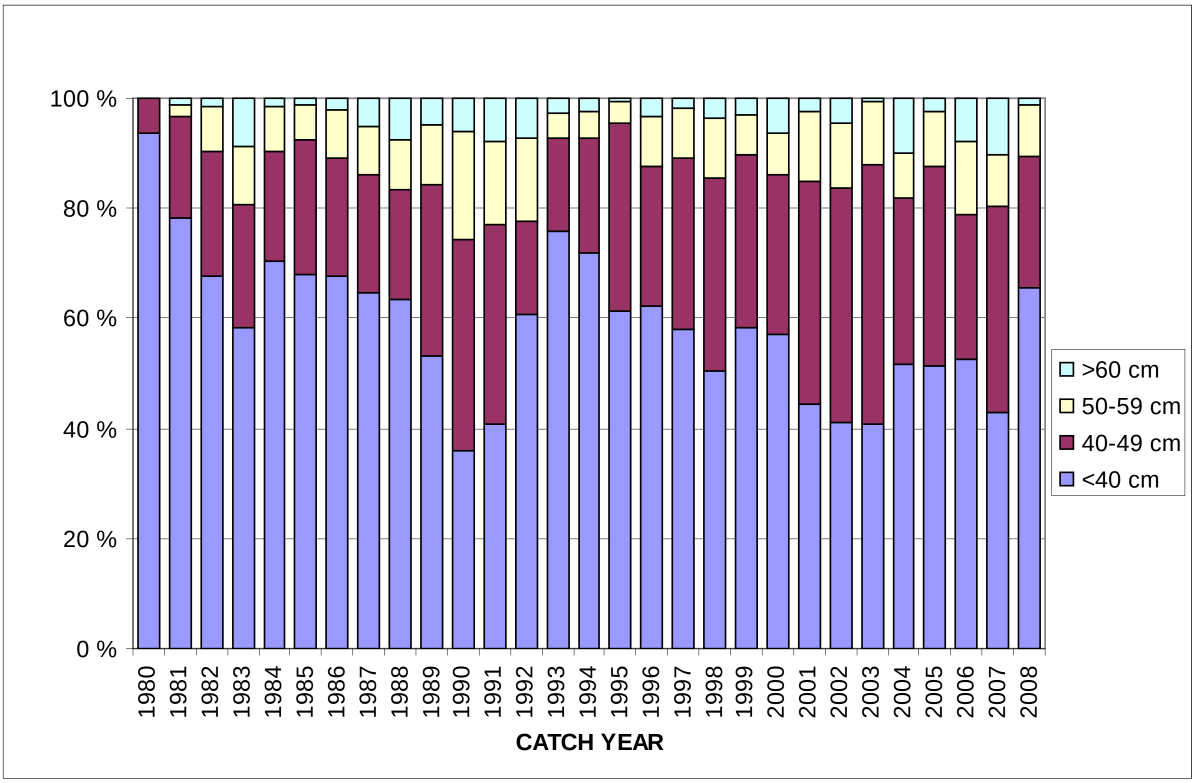


Figure 5.3.4.1. Recaptures of sea trout by length in Finnish Carlin-tagging experiments done in the Bothnian Bay area (Subdivision 31).

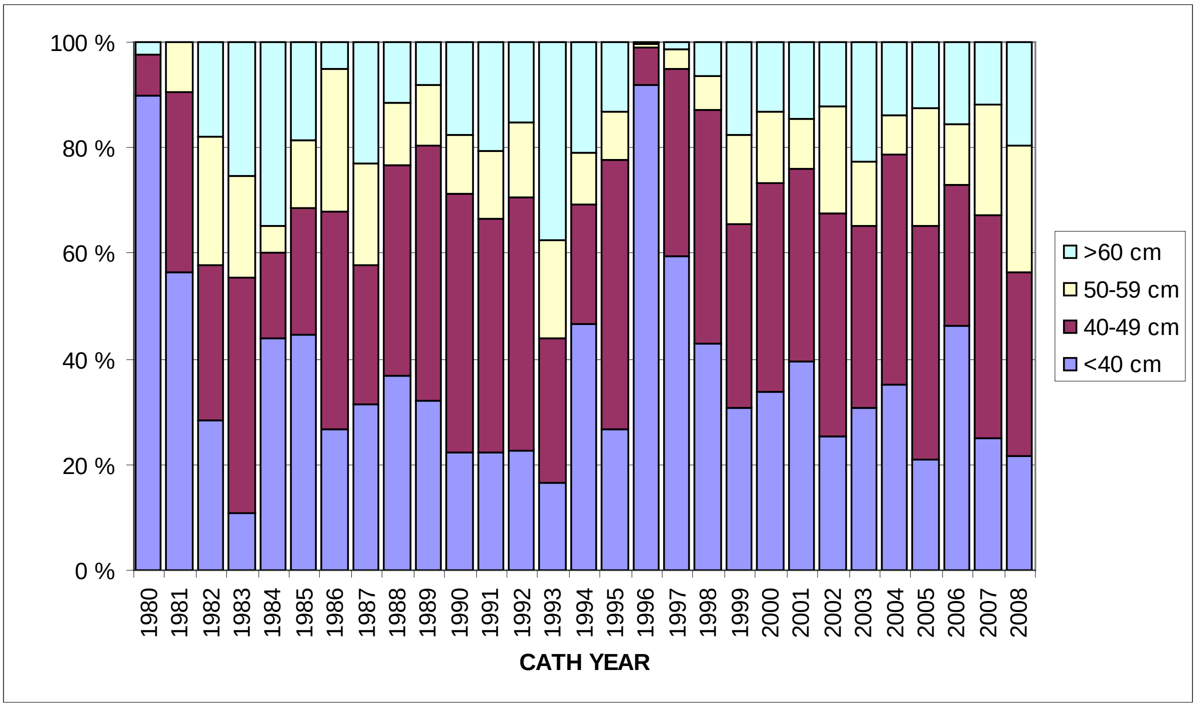


Figure 5.3.4.2. Recaptures of sea trout by length in Finnish Carlin-tagging experiments done in the Bothnian Sea area (Subdivision 30).

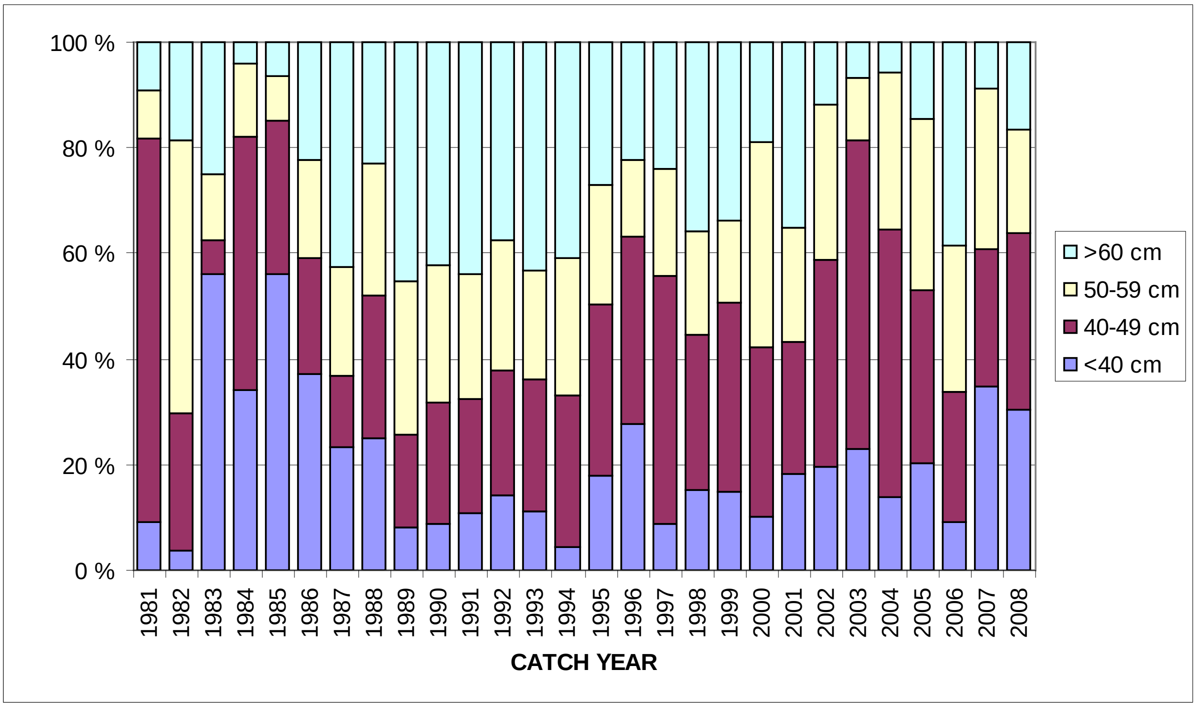


Figure 5.3.4.3. Recaptures of sea trout by length in Finnish Carlin-tagging experiments done in the Archipelago Sea area (Subdivision 29).

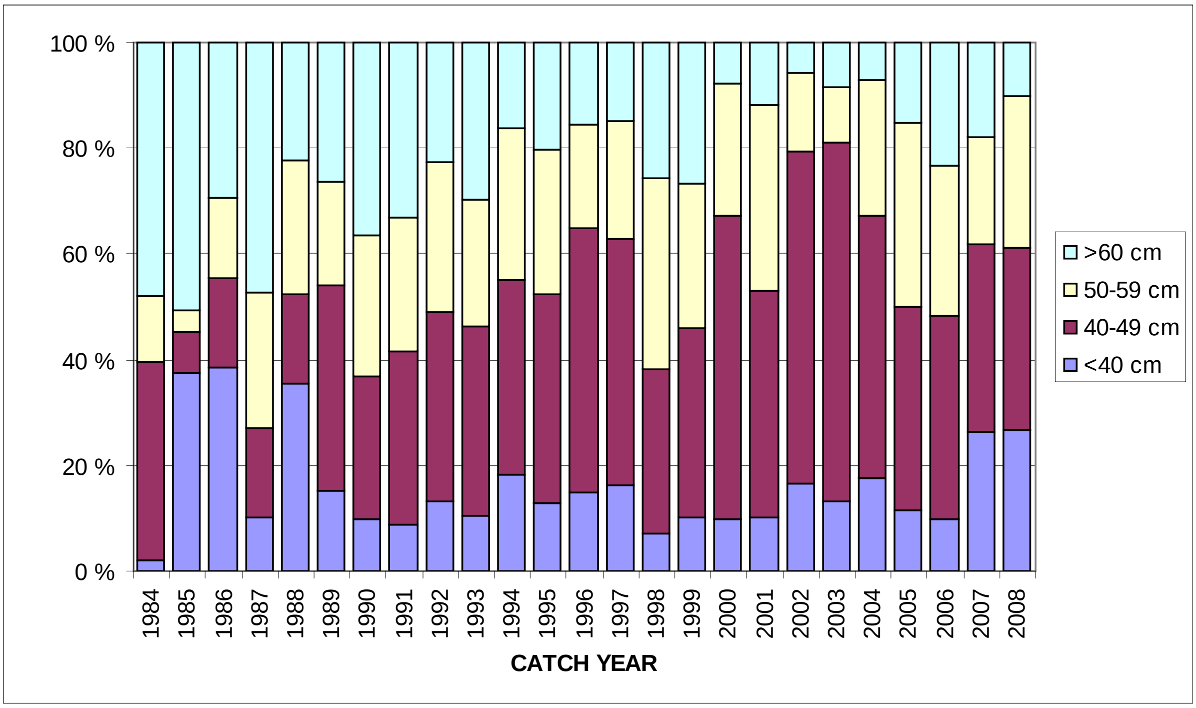


Figure 5.3.4.4. Length distribution of recaptured sea trout in Finnish Carlin-tagging experiments done in the Gulf of Finland area (Subdivision 32).

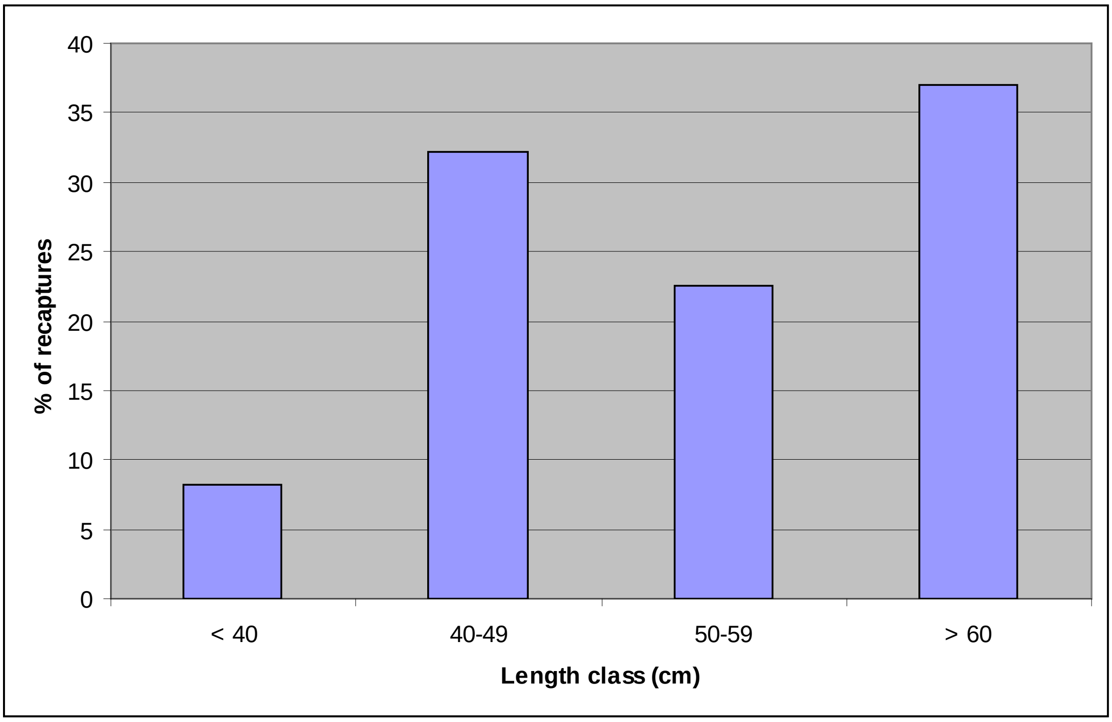


Figure 5.3.4.5. Length distribution of recaptured sea trout in Danish Carlin tagged sea trout smolt released in Subdivision 22 during the period 2002–2004.

5.3.5 Proportion of sea and river recaptures

If the recaptures of postsmolts are omitted, almost all the recaptures of tagged sea trout have come from the sea fishing (Figure 5.3.5.1). The mean proportion of tag recoveries in the river fishing was 6% in the Bothnian Bay, in other areas 4%. The proportion of mature spawners among them is probably still lower, because many 1 SW fish recaptured in the river are immature, and as mentioned previously sea trout generally do not attain sexual maturity until their third year.

This may be compared to the tagging experiments in R. Kolding, Denmark (Subdivision 22) during the period 2002–2004. In these experiments, also excluding recaptures as postsmolts, 30% were reported from the home river (fresh water) and 70% from the sea.

In conclusion, the small proportion of river catches in subdivisions 29–32 indicates high fishing pressure and reproduction overfishing at sea, which implies severe risks of extinction for the natural sea trout stocks.

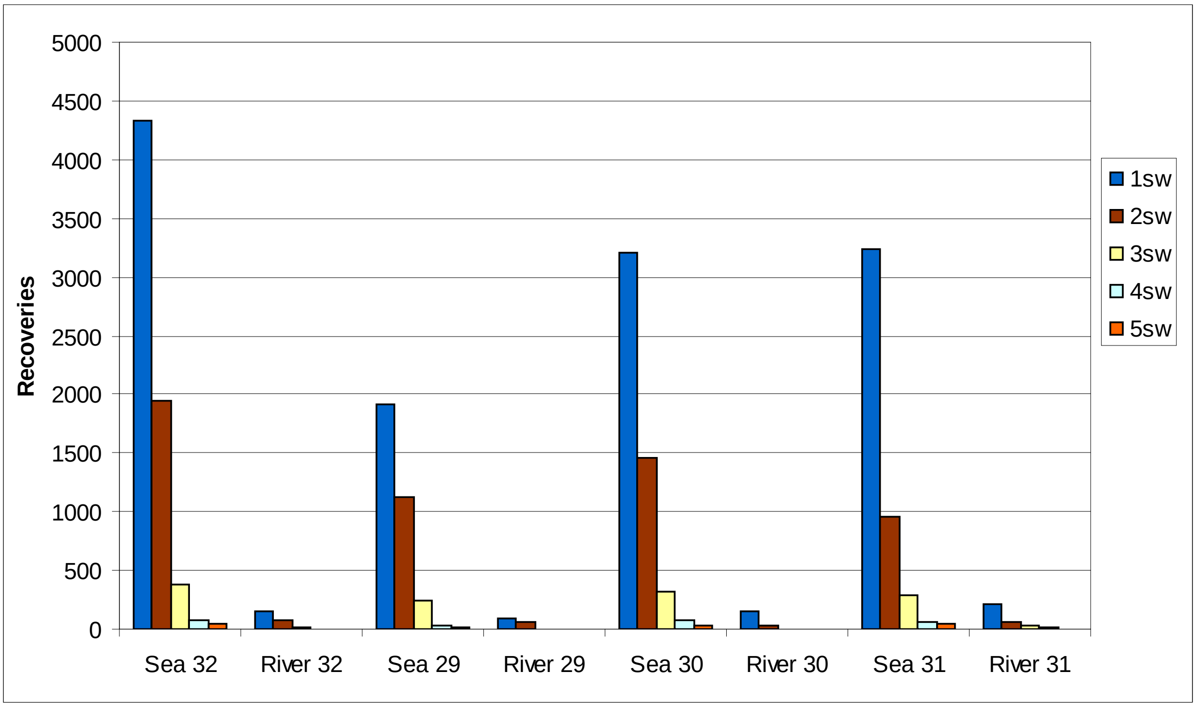


Figure 5.3.5.1. Distribution of all tag recoveries between sea and river in the ICES Subdivisions 29–32 based on Finnish Carlin-tagging since the 1980s, 0 SW fish omitted. (Proportions of river catches: Subdivision 29 = 4%, Subdivision 30 = 4%, Subdivision 31 = 6%, Subdivision 32 = 4%).

5.3.6 Yield per recruit

When the need for fishing regulation is considered, the yield per recruit curve is useful in assessing the prevailing fishing mortality and catch level in relation to the optimal catch. The yield per recruit curve was constructed for the Finnish coastal sea areas (Subdivisions 29–32) from the number of released smolts, Carlin-tagging data from the period 1980–2000 on the proportions of different year classes in the catch, and postsmolt mortality of 80% (calculated from Carlin tagging results). The age structure in tag recoveries showed that the annual fishing mortality is at present about 70–80% in the Bothnian Bay (Subdivision 31), and the situation is similar also in ICES subdivisions 29, 30 and 32 (Figure 5.3.6.1).

The optimal yield would be obtained with an annual fishing mortality of about 30 % on all ages of sea trout. Due to the high fishing mortality at sea both the biomass and the survival of female spawners are so low that the maintenance and survival of the natural sea trout stocks in the rivers are seriously endangered. Reducing of the present fishing mortality is a prerequisite to increase the escapement of spawners to the rivers.

Using more selective fishing gear with larger mesh sizes that would result in a delay in age of recruitment into the fishery of sea trout by one or two years would result in at least a twofold increase in annual catches, even with the present fishing mortality, i.e. the onset of fishing mortality is after 3 sea winters (Figure 5.3.6.2).

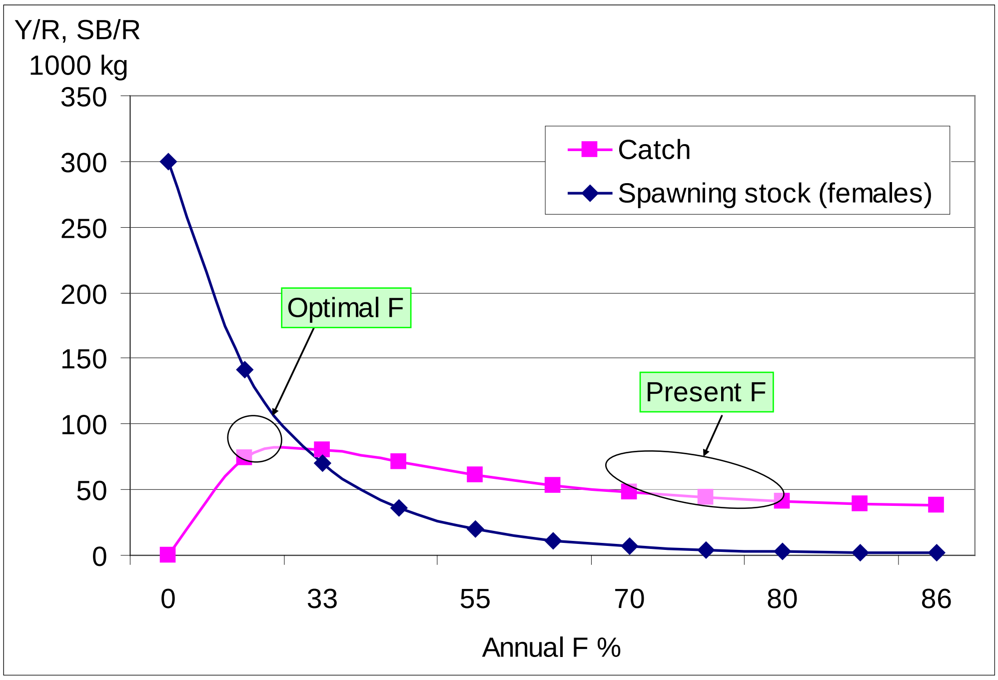


Figure 5.3.6.1. Yield per recruit (Y/R) and spawning stock per recruit (SB/R) curves for Bothnian Bay sea trout at different levels of annual fishing mortality. The curves are based on Finnish Carlin tagging results and mean annual stocking numbers (350 000 smolts/yr), 70 000 fish recruiting yearly into the fishery after a natural postsmolt mortality of 80%.

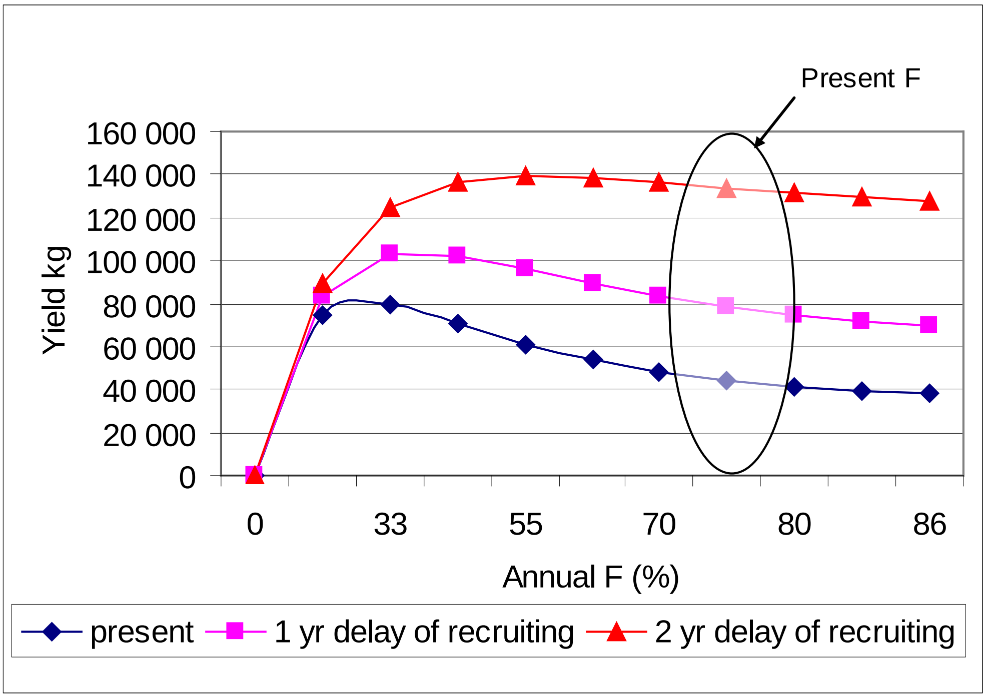


Figure 5.3.6.2. Yield per recruit curve for a mean annual number of 350 000 stocked sea trout smolts and yield for the same number of smolts with 1 and 2 years´ delay of recruitment to the fishery in the Bothnian Bay at the present level of annual fishing mortality. The curves are based of Finnish Carlin tagging results.

5.4 Migration patterns

5.4.1 Introduction

Sea trout is an anadromous form of brown trout (*Salmo trutta* L.). Sea trout usually live in the same water system with resident brown trout, and they can be genetically isolated from each other or breed together and genetically belong to the same population. Populations are often partially migratory, i.e. one part of the population leaves the river for feeding in the sea (predominantly females migrate), while another part stays in the river as residents. Sea trout spawn in autumn in rivers and streams, live their first year(s) as parr in the stream, leave the stream as smolts and feeding migrate in the sea ½ to more years before returning to their natal stream for spawning. Spawning may be repeated several times (Klemetsen *et al.*, 2004).

Sea migration patterns of sea trout vary considerably between different sea trout populations, rivers and sea areas around the Baltic Sea. Tagging experiments with different stocks into the same place or with the same stock into different areas demonstrate that their migration patterns and growth are depending on both genetic traits and environmental conditions (Svärdson and Fagerström, 1982, Bartel *et al.*, 2001, Kallio-Nyberg *et al.*, 2002). The migration patterns may also vary within the stock between males and females, as precocious males have a higher tendency to stay in the river (Klemetsen *et al.*, 2003). In addition, tagging experiments have shown differences in postsmolt survival between wild and hatchery-reared smolts, the survival being higher among wild smolts (Atso Romakkaniemi, *pers. comm.*).

5.4.2 Observations in the Baltic

Most sea trout stocks in the southern parts of the Baltic Sea appear to be long-migrating. According to the Polish tagging experiments with Vistula river (Subdivision 26) sea trout, they extend their migrations into the central and northern parts of the Baltic Proper and even into the Bothnian Sea and Gulf of Finland (Figure 5.4.2.1) (Skrochowska, 1969, Bartel *et al.*, 2001). When Vistula sea trout and Finnish Isojoki sea trout were released at the same time into the Vistula river mouth, the Vistula sea trout grew better in the sea than the Isojoki sea trout, which may indicate genetic differences in their growth traits (Bartel *et al.*, 2001).

Also the sea trout stocks on the coast of Mecklenburg Western Pomerania (Subdivision 25), Germany, migrate rather long distances (Harry Handtke, *pers. comm.*). Tagging experiments with the sea trout of the Swedish R. Verke å (Hanöbukten, Subdivision 25) show that they feeding migrate in the central parts of the Baltic Proper but some of them extend their migration even to the Gulf of Riga and to the Gulf of Finland (Figure 5.4.2.2) (Svärdson and Fagerström 1982). However, some sea trout stocks, like those living in small streams in Gotland appear to be stationary having no tendency to long migrations (Limburg *et al.*, 2001).

The sea trout stocks of the rivers on the eastern coast of the Baltic Proper have feeding migrations mostly rather near their native river. Preliminary tagging results on the southern side of Gulf of Finland indicate short migrations, with few fish being recaptured further away on Finnish and Russian coast. The sea trout stocks of the Gulf of Finland are relatively short-migrating and stay mostly in the Gulf of Finland. As an example the Finnish Ingarskila river sea trout migrate mostly near the shore, while a strain from the Bothnian Sea area, the Isojoki sea trout migrate much longer on both coasts of the Gulf (Figure 5.4.2.6) (Kallio-Nyberg *et al.*, 2002) Tagging experiment in R.

Pidula (Subdivision 28, south-western part of island Saaremaa) in the 1970s indicate some longer migration as some fish were recaptured around Gotland and Åland.

Also some populations in the western parts of the Baltic Sea perform longer migrations into the Baltic proper (Figure 5.4.2.3) (Stig Pedersen, *pers. comm.*, Pedersen and Rasmussen, 1997, Glüsing and Rasmussen, 1996, Kristiansen and Rasmussen, 1993). In this region some populations outside the actual Baltic are also known to migrate into the Baltic area (Figure 5.4.2.4; Pedersen *et al.*, 2006, Pedersen and Rasmussen, 2004).

The sea trout stocks in the Gulf of Bothnia perform commonly shorter migrations than the southern stocks. In Sweden, >95% of the recaptured tagged fish were caught <200 km from the home river (Ume-Vindel) (Jonsson, 2001). The tagging experiments at the mouth of the Isojoki river with its own sea trout stock (Subdivision 30) showed that the migration were directed mostly northwards along the coast (Figure 5.4.2.7). Most recaptures came <100 km from the releasing site but some of them came also from Sweden. In the Bothnian Bay, the migrations of the Lestijoki sea trout (Subdivision 31) are as well directed north along the coast (Figure 5.4.2.8) but also with some recaptures on the Swedish side. The hatchery stock of Iijoki sea trout has largely similar migration patterns (Kallio-Nyberg *et al*. 2007). The Finnish tagging experiments of hatchery-reared and wild sea trout in the Tornionjoki river indicate that the migration of the postsmolts takes place along both the Finnish and Swedish coast and there are no big differences in migration patterns between reared and wild smolts (Figure 5.4.2.9 and 5.4.2.10). The Swedish recaptures constituted 5–10% of the tag recaptures in the Bothnian Sea area and 5–29% in the Bothnian Bay in the Finnish tagging experiments performed in the Gulf of Bothnia in 1980–2000 (Kallio-Nyberg *et al*., 2002b).

In conclusion, the tagging results show that both short and long migration types exists among different sea trout stocks around the Baltic Sea, and the vast majority of strains have not been investigated.

In each sea area there is at least one or more long migrating sea trout stocks which reach their migrations outside their own sea area or into the sea area of the neighbouring country. Consequently fishing regulations in different sea areas and between countries should be balanced with each other.

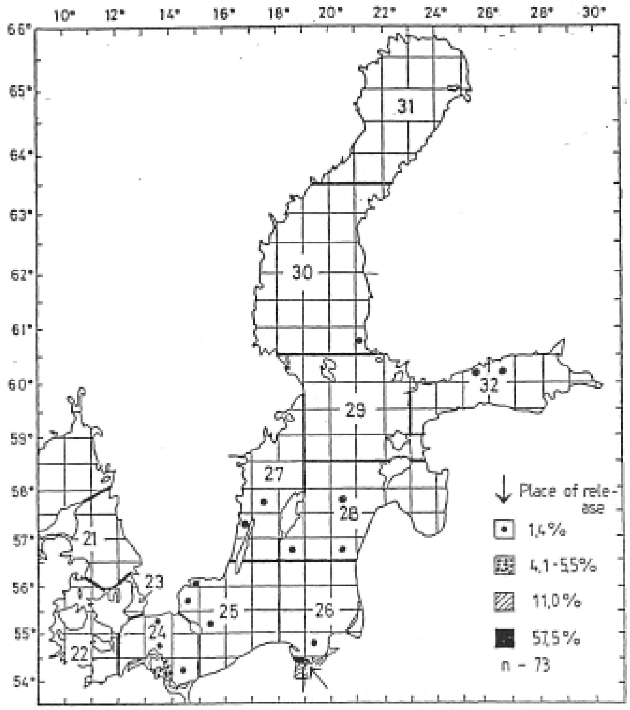


Figure 5.4.2.1. Recaptures from tagged Vistula sea trout released in the Vistula river mouth in 1980. Rectangles show the percentages of the recoveries (Bartel *et al.*, 2001)

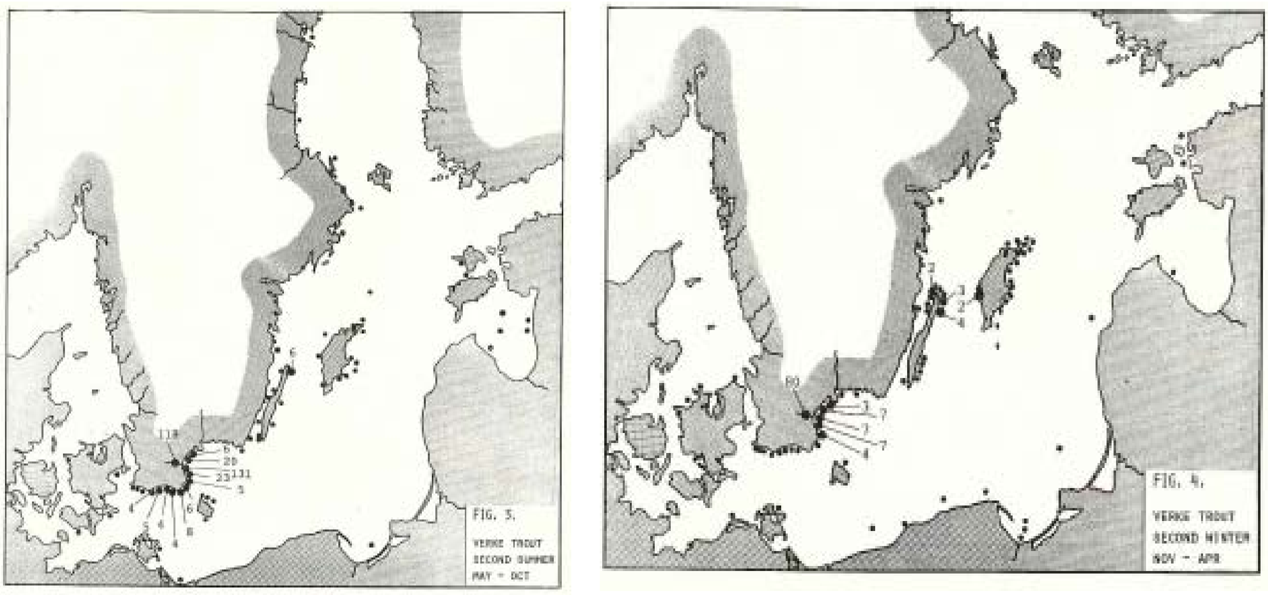


Figure 5.4.2.2. Recaptures from wild sea trout, tagged and released in 1960–1964 in the Verke river and received during the second summer (on the left) and winter (on the right) (Svärdson and Fagerström, 1982)

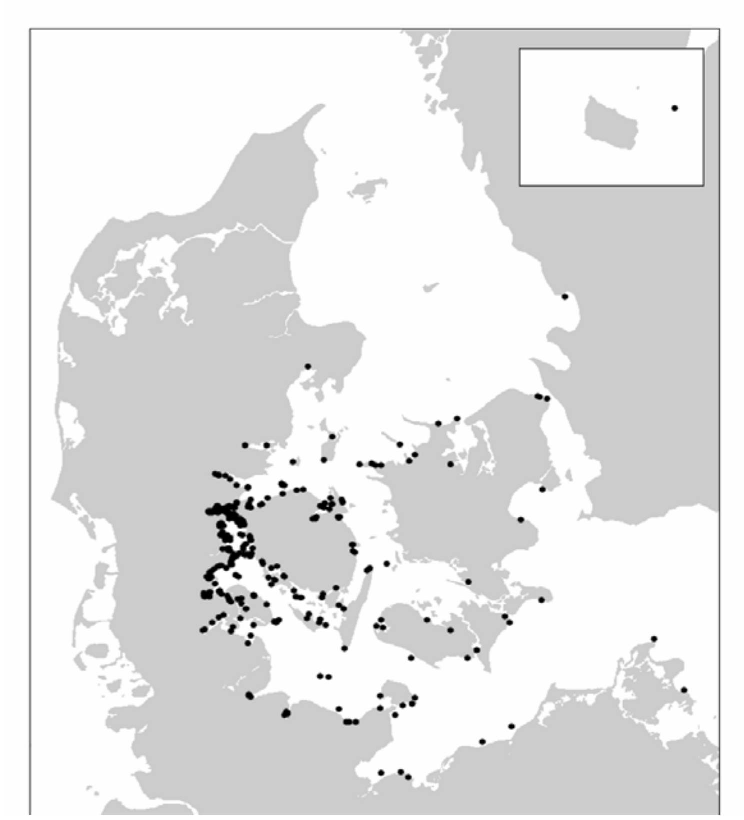


Figure 5.4.2.3. Recapture positions of sea trout released in R. Kolding (Subdivision 22) 2001–2005.

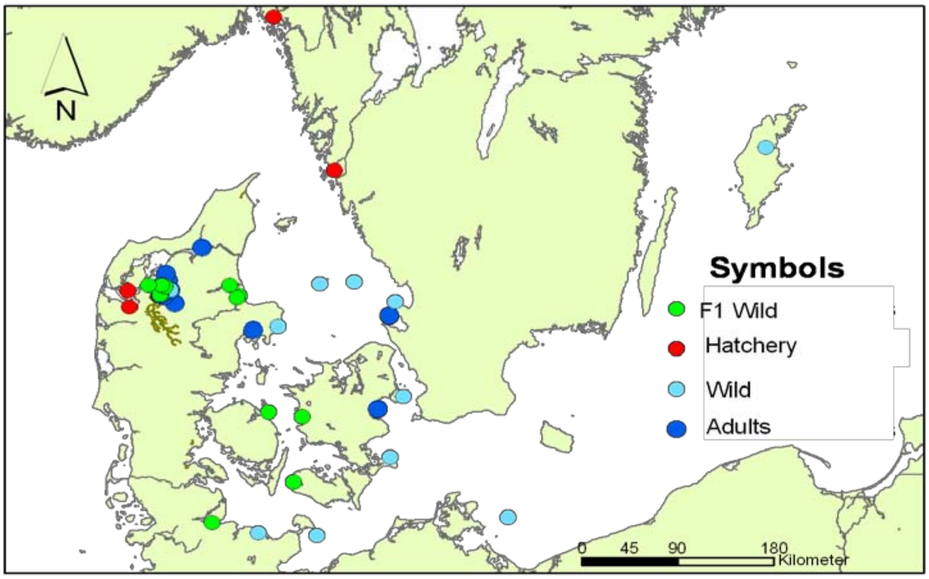


Figure 5.4.2.4. Recapture positions in the sea of sea trout released in R. Karup, North Jutland. F1: smolts, hatchery raised offspring from wild spawners, Hatchery: hatchery strain, Wild: wilds smolts collected in the river, Adults: adult sea trout tagged during spawning migration.

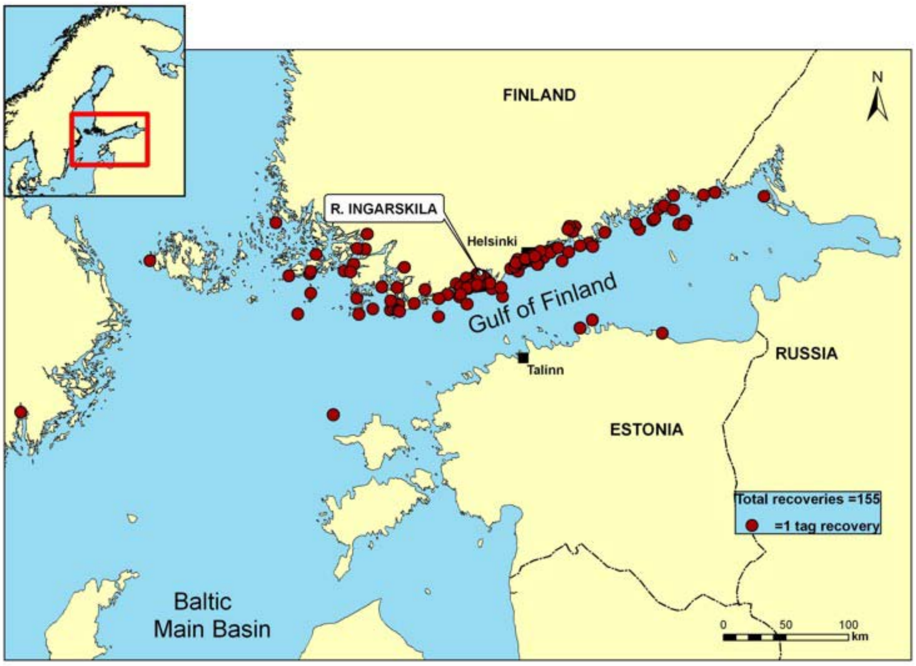


Figure 5.4.2.5. Recoveries of sea trout from releases of Carlin-tagged hatchery-reared smolts in the Ingarskilanjoki river since 1980.

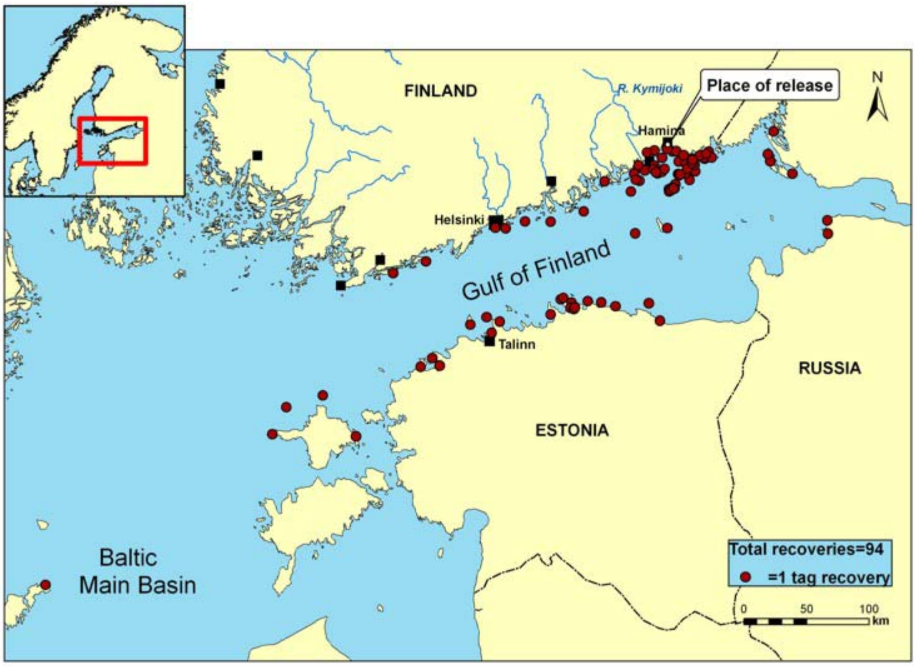


Figure 5.4.2.6. Recoveries from a release of Carlin-tagged hatchery-reared Isojoki trout smolts in the Kymijoki river in 2004.

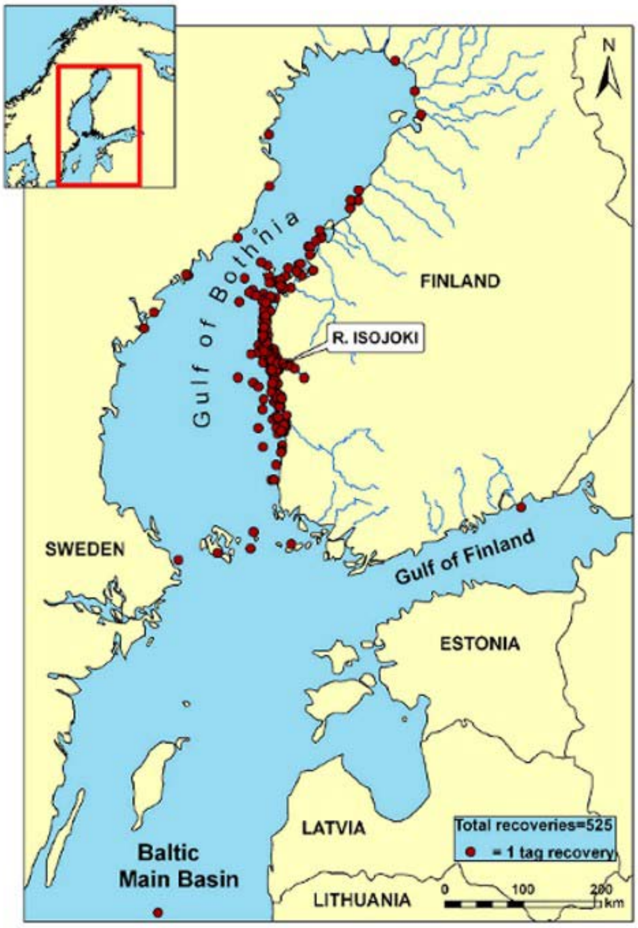


Figure 5.4.2.7. Recoveries of sea trout from Finnish releases of Carlin-tagged hatchery-reared smolts in the Isojoki river since 1980.

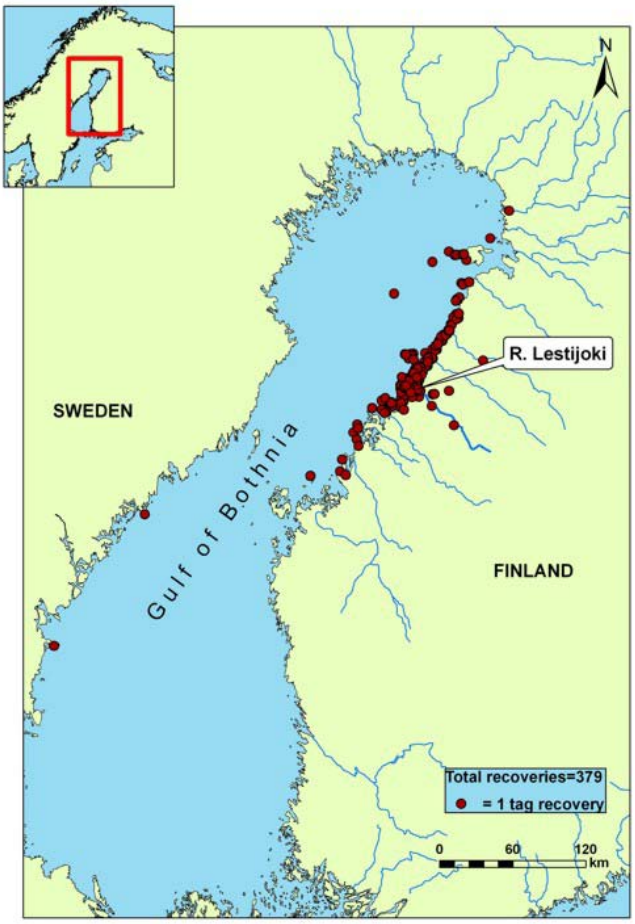


Figure 5.4.2.8. Recoveries of sea trout from releases of Carlin-tagged hatchery-reared smolts in the Lestijoki river since 1980.

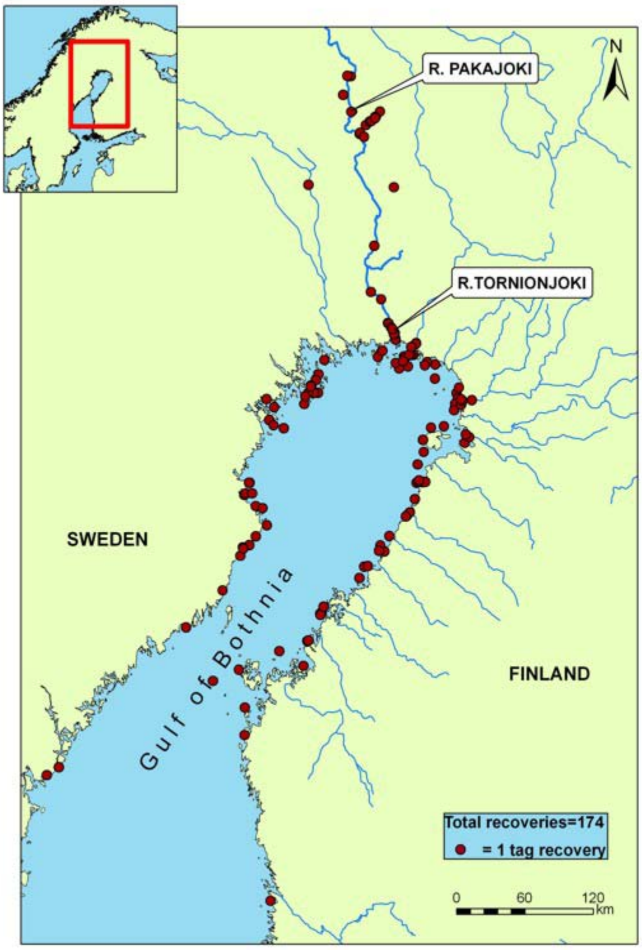


Figure 5.4.2.9. Recoveries of sea trout from releases of Carlin-tagged hatchery-reared smolts in the Tornionjoki river since 1980.

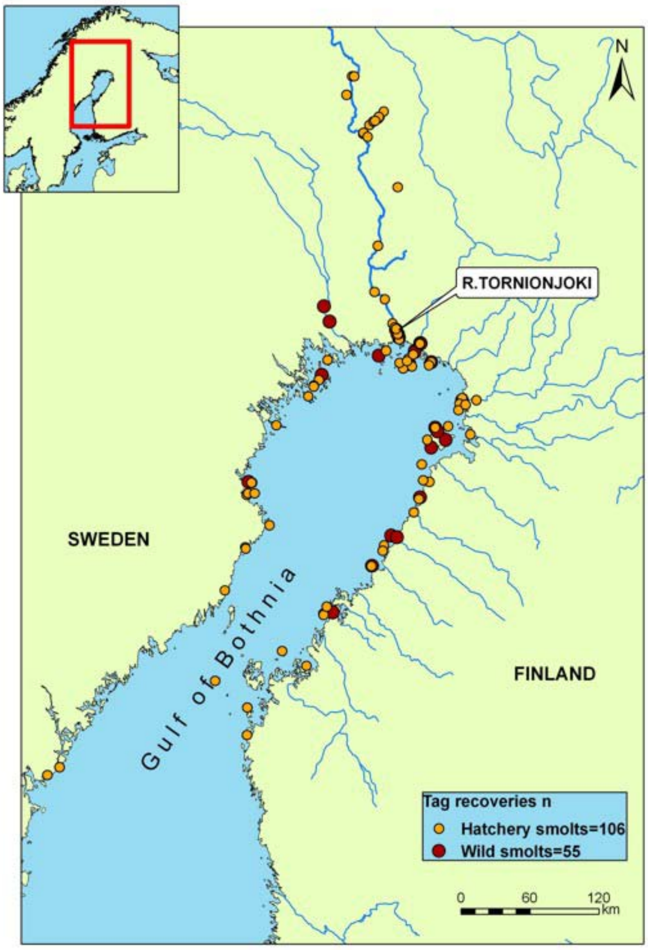


Figure 5.4.2.10. Recoveries of sea trout from releases of Carlin-tagged hatchery-reared and wild smolts in the Tornionjoki river in 2000–2007.

5.5 Fishing effort and catch

5.5.1 Professional fishery

Data on sea trout effort by year, gear and ICES subdivision have been reported to WGBAST until now only by Poland and Latvia. Those data is limited mainly to sea and coastal fisheries and are based on official logbooks. It is very difficult to obtain full range of effort data from recreational and angling fisheries. There is a need for better coverage of effort from the rest of Baltic countries.

Catch data by year, gear, ICES subdivision, number of fish and weight is collected by each country with differentiation for sea, coastal and river fisheries and is based mostly on logbooks. River data is obtained mainly from angler's associations, however, those data are sometimes to a high degree estimated, due to lack of proper reporting.

All historical fishing effort and catch data is kept in WGBAST database in similar manner as it is in case of salmon data.

Total Baltic sea trout catch has decreased since 2000 and in 2007 the catch reached 904 tons (Figure 5.5.1.1), in which sea catches, both coastal and offshore are dominating.

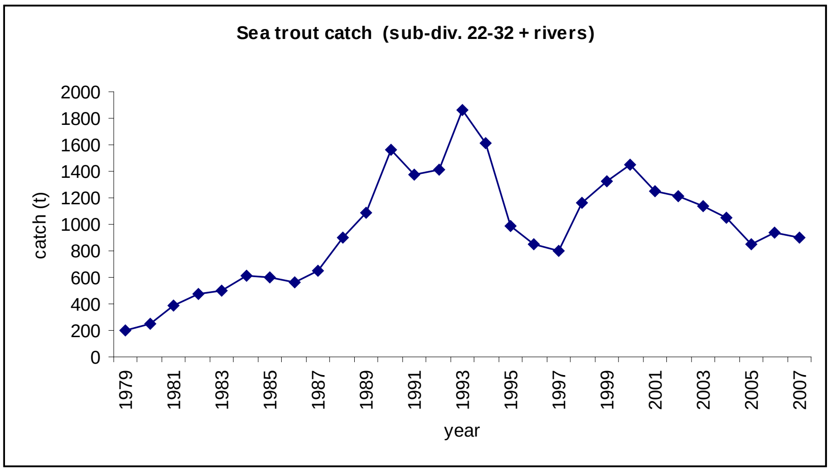


Figure 5.5.1.1. Sea trout catch in Baltic, including rivers in (t).

Until 1998 the bulk of catch was reported by Finland, since then most of the catch has been reported by Poland and in 2007 the Polish catch was 58% of total reported sea trout catch in the Baltic (Figure 5.5.1.2).

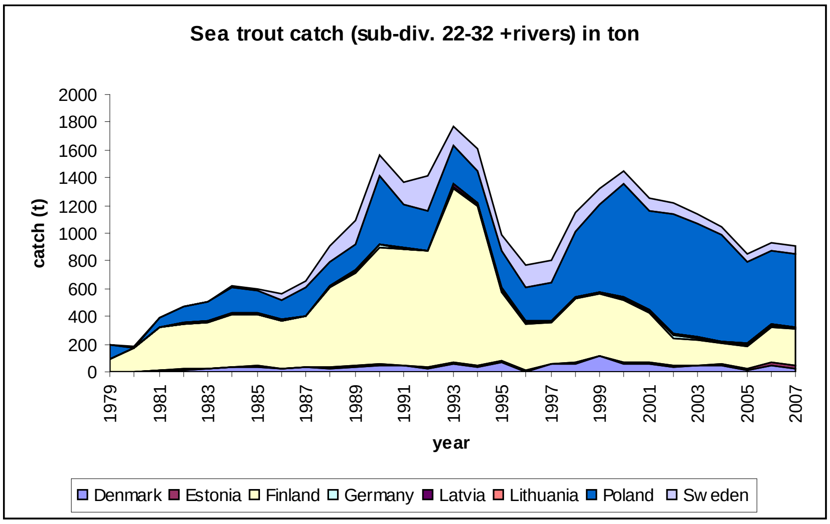


Figure 5.5.1.2. Sea trout catch in Baltic (including rivers) by countries in (t).

Until 2007 main gears used in offshore fishery were drifting gillnets (GDN) and longline (LL). In coastal fisheries fixed gillnets (GN) and different types of traps (TN) are in use.

As an effect of EC Regulation 812/2004 a ban on use of GDN has been introduced in January 1, 2008 and since then the main gear in offshore fisheries is only LL.

In Polish fishery, which is a main player in sea trout catch, a drastic drop both in effort and catch was observed in 2008 due to the ban and to some extent by program of scrapping the vessels as a part of effort reduction in the Baltic. However, the ban on GDN effort in 2008 was partially compensated by increased LL effort (Figure 5.5.1.3). The sea catch in 2008 dropped from 357 tons in 2007 to only 23 tons in 2008 (Figure 5.5.1.4), while coastal and river catch remained stable.

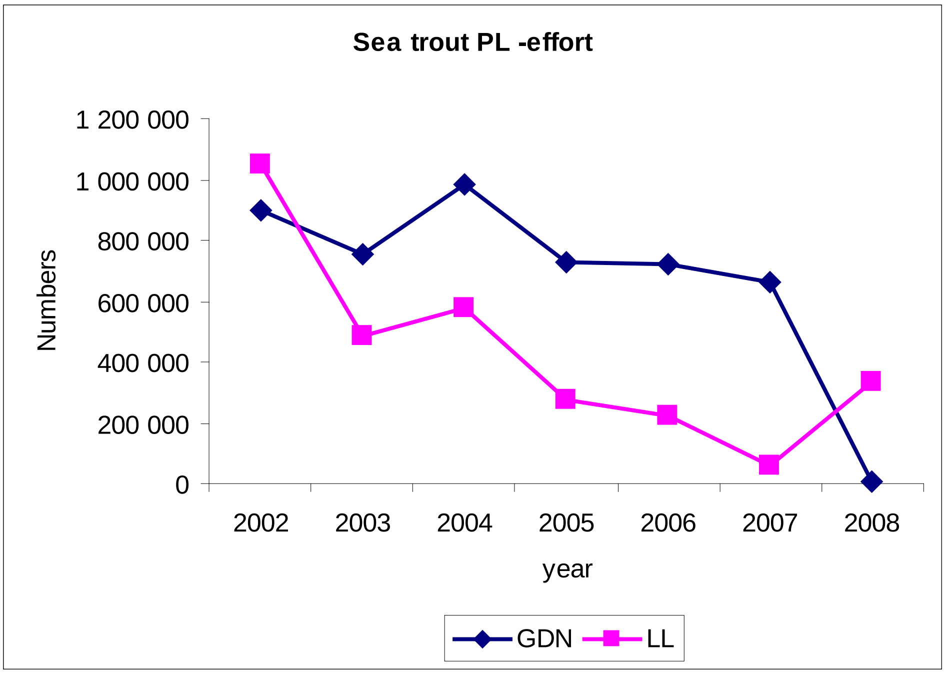


Figure 5.5.1.3. Effort in Polish sea trout fishery in 2002–2008 (in number of gear days)

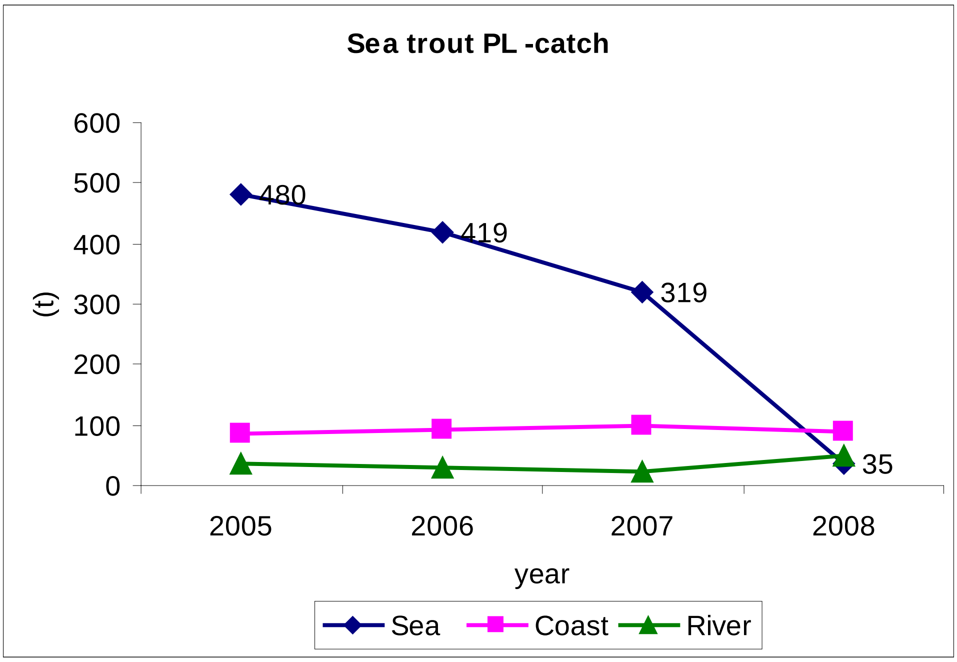


Figure 5.5.1.4. Catch in Polish sea trout fishery in 2005–2008 (in tons)

5.5.2 Effort in Finnish professional fishery.

The annual effort is presented in figures 5.5.2.1–5.5.2.8 and summary effort in figures 5.5.2.9–5.5.2.12.

Finnish gillnet fishing effort is highest in the Bothnian Sea (Subdivision 30) with approx. 1.7 mio. gear-days in recent years (Figure 5.5.1.2) .

In subdivision 31 gillnet effort has decreased from approx. 0.6 mio. gear days to approx. 0.45 mio. in 2007, while it is slightly higher in subdivision 29 (approx. 0.75 mio. gear days).

The effort with small mesh sized gillnets (36–45mm) has over the last decade been largest in the subdivision 30, followed by 31 and 29. In subdivision 32 smaller mesh sizes also dominate but a proportionally larger part of the effort is with larger mesh sizes (Figure 5.5.1–5.5.4).

Overall, the Finnish gillnet fishing with small mesh sizes targets mostly whitefish but in subdivision 32 pikeperch is also important.

The total Finnish effort with gillnets in subdivision 29–32 has over the last decade been relatively stable around 3.6 mio. gear days. About half of these are from subdivision 30 (Figure 5.5.2.12).

In contrast to this the Finnish effort with trapnets has been reduced in all subdivisions (29–32) from approx. 0.1 mio. gear days in the late 1990s to approx. 55 000 in 2007 (Figure 5.5.2.11). The largest Finnish effort with trapnets is found in the Bothnian Bay area (Subdivision 31), with approx. 28 000 gear days, most of which are whitefish traps (Figure 5.5.2.5).

Sea trout are caught by these gears only as a by-catch, and a major part of the catches of sea trout are caught in trapnets.

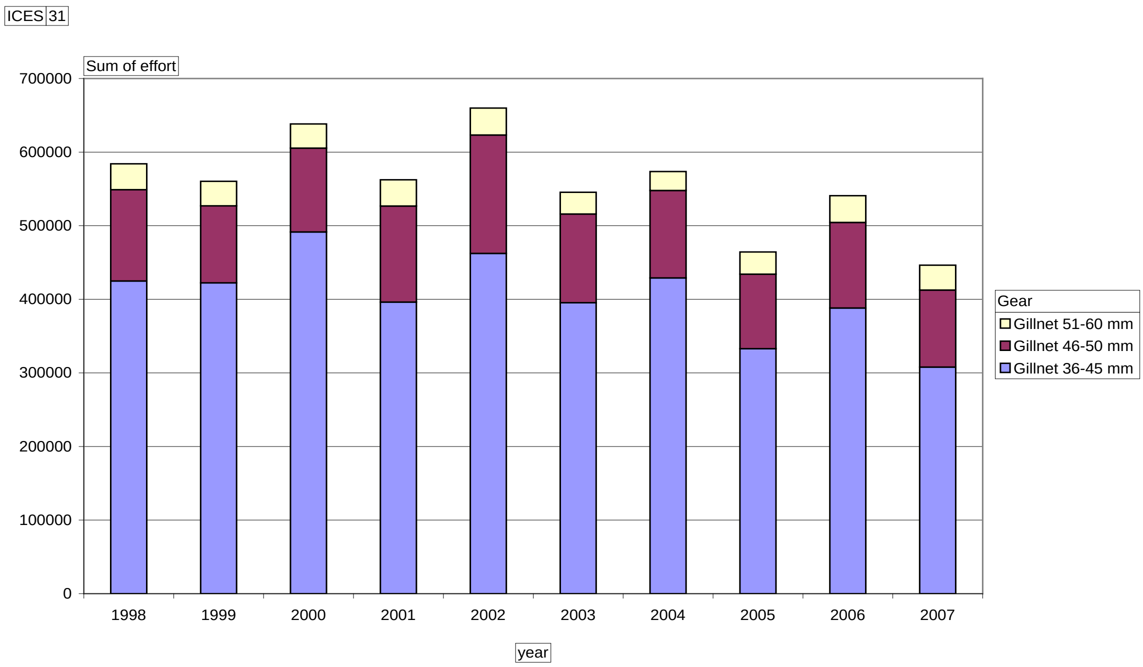


Figure 5.5.2.1. Annual effort of gillnets with bar length 36–45 mm, 46–50 mm and 51–60 mm used in Finnish professional fishery in the Bothnian Bay (Subdivision 31) in 1998–2007.

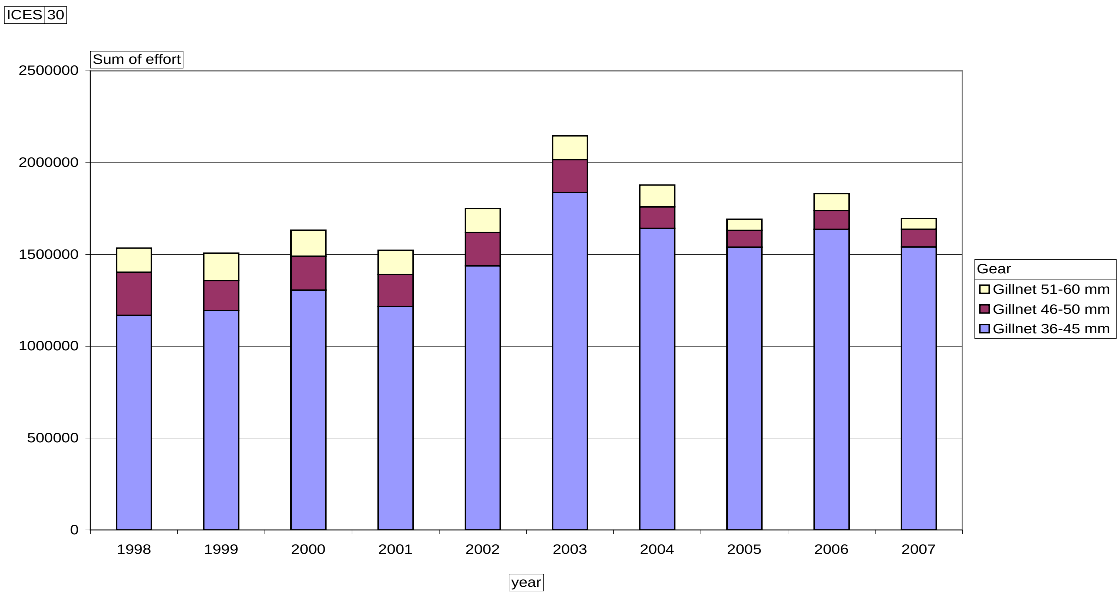


Figure 5.5.2.2. Annual effort of gillnets with bar length 36–45 mm, 46–50 mm and 51–60 mm used in Finnish professional fishery in the Bothnian Sea (Subdivision 30) in 1998–2007.

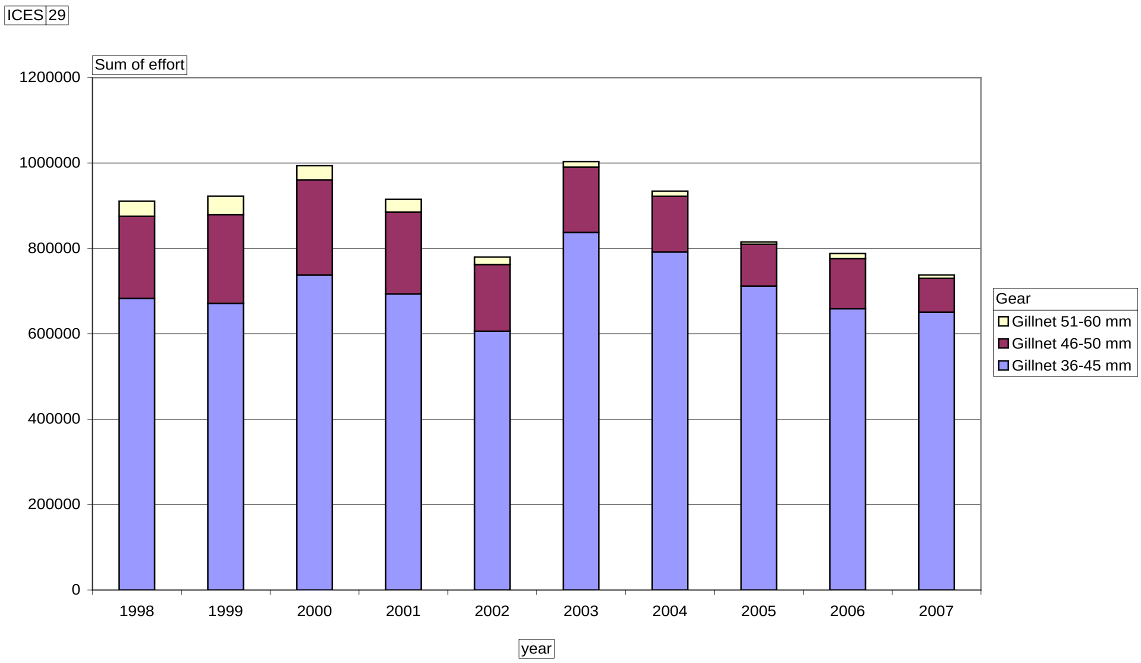


Figure 5.5.2.3. Annual effort of gillnets with bar length 36–45 mm, 46–50 mm and 51–60 mm used in Finnish professional fishery in the Archipelago Sea (Subdivision 29) in 1998–2007.

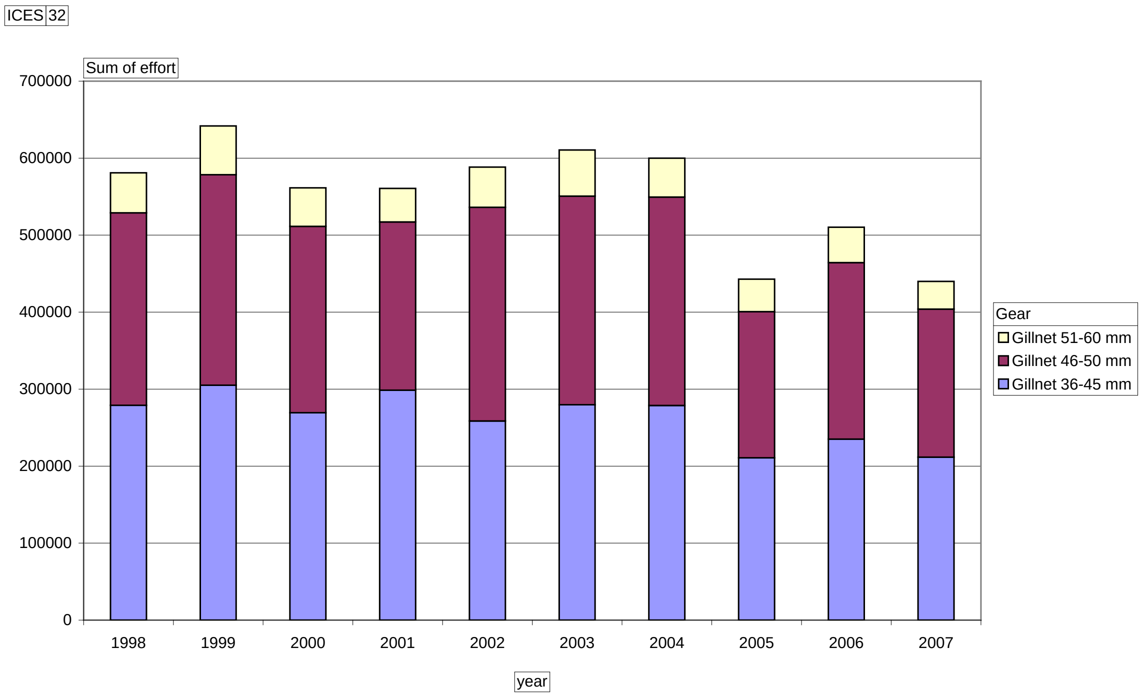


Figure 5.5.2.4. Annual effort of gillnets with bar length 36–45 mm, 46–50 mm and 51–60 mm used in Finnish professional fishery in the Gulf of Finland (Subdivision 32) in 1998–2007.

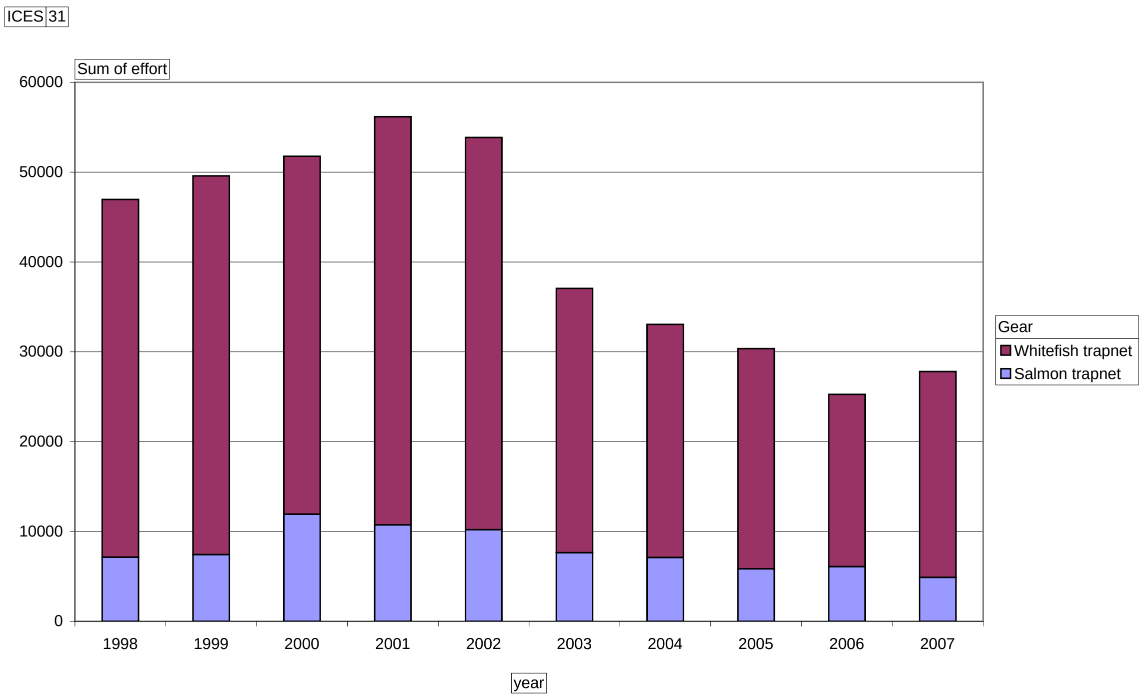


Figure 5.5.2.5. Annual effort of salmon and whitefish trapnets used in Finnish professional fishery in the Bothnian Bay (Subdivision 31) in 1998–2007.

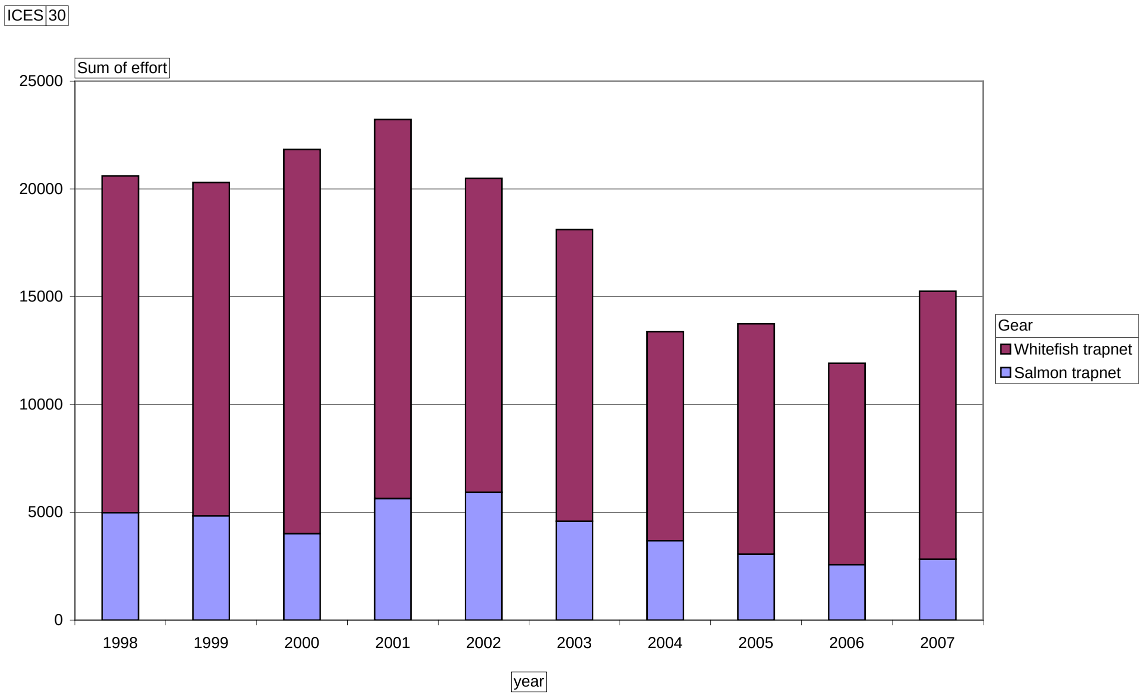


Figure 5.5.2.6. Annual effort of salmon and whitefish trapnets used in Finnish professional fishery in the Bothnian Sea (Subdivision 30) in 1998–2007.

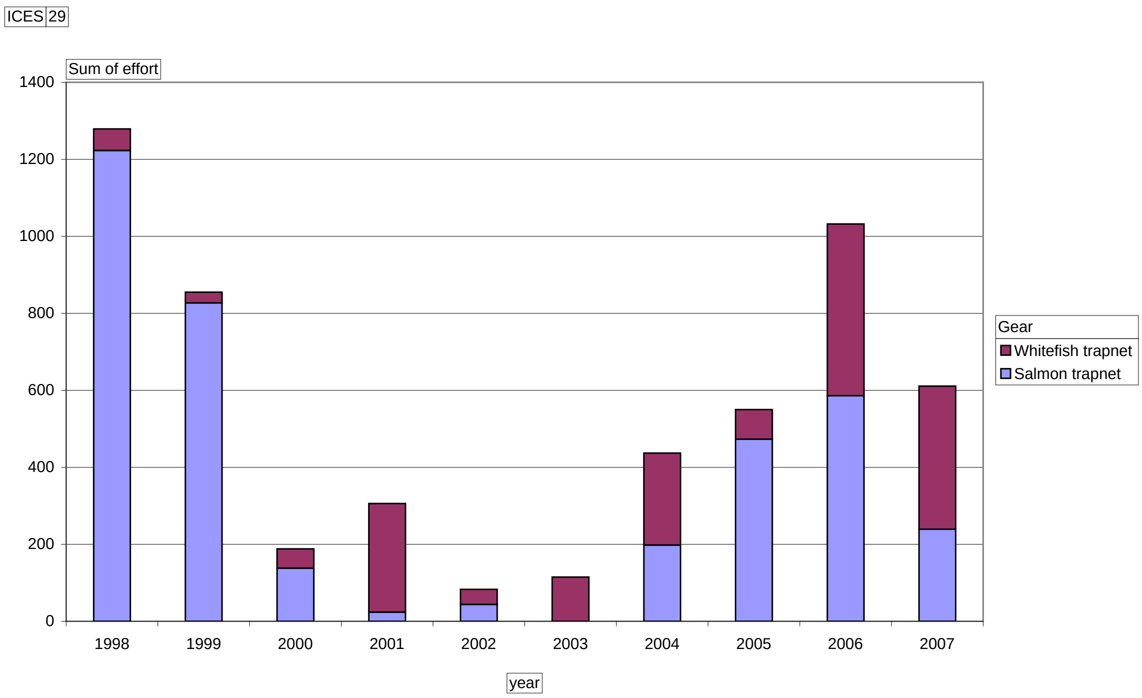


Figure 5.5.2.7. Annual effort of salmon and whitefish trapnets used in Finnish professional fishery in the Archipelago Sea (Subdivision 29) in 1998–2007.

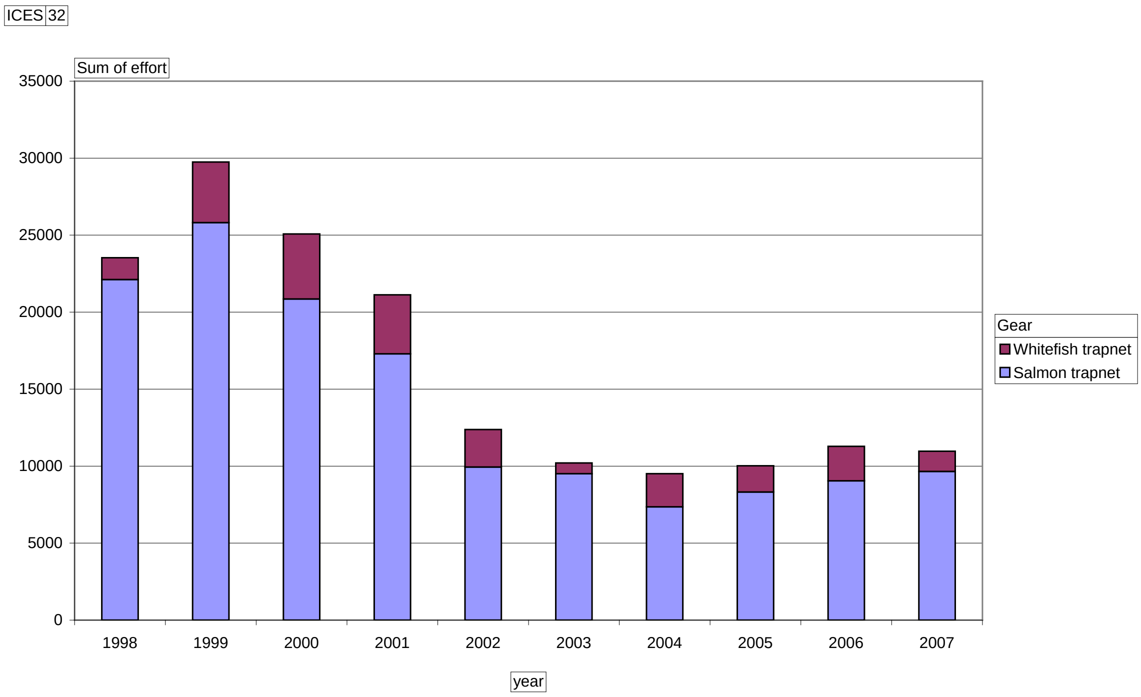


Figure 5.5.2.8. Annual effort of salmon and whitefish trapnets used in Finnish professional fishery in the Gulf of Finland (Subdivision 32) in 1998–2007.

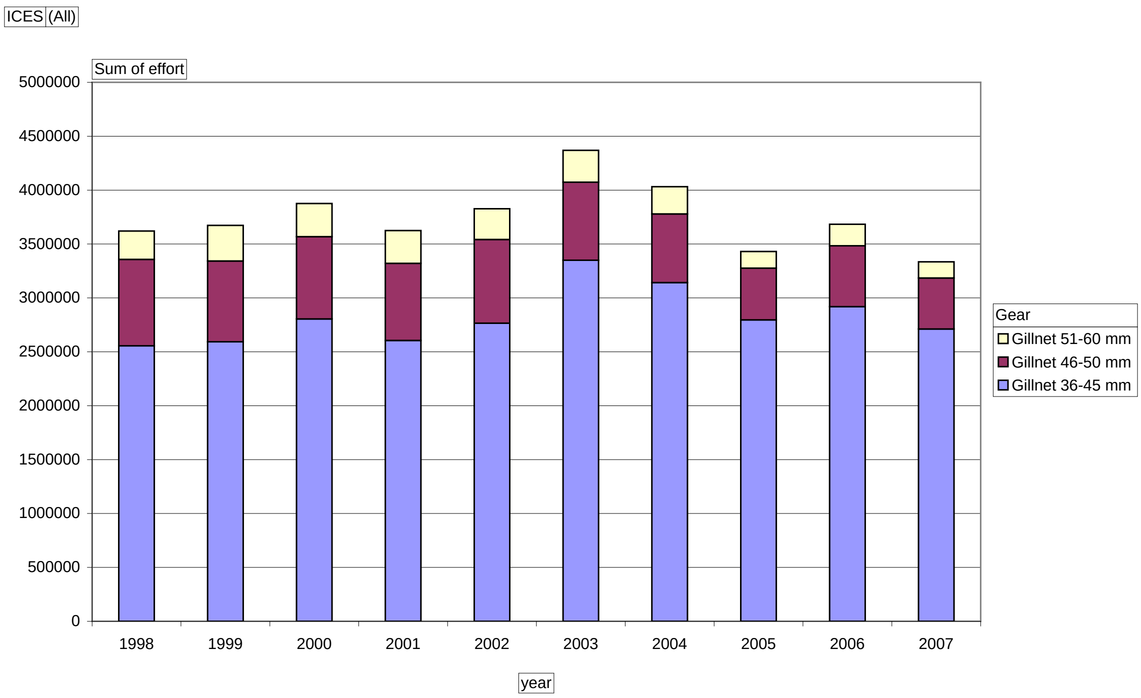


Figure 5.5.2.9. Annual total effort of gillnets with bar length 36–45 mm, 46–50 mm and 51–60 mm used in Finnish professional fishery in the Baltic Sea in 1998–2007.

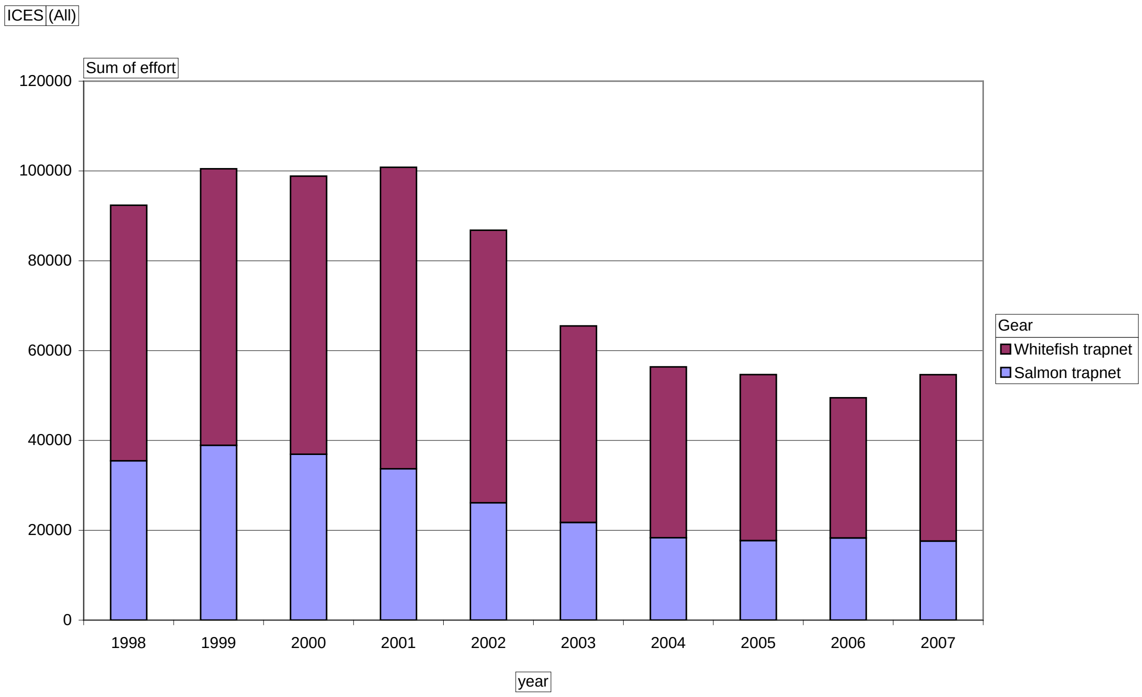


Figure 5.5.2.10. Annual total effort of salmon and whitefish trapnets used in Finnish professional fishery in the Baltic Sea in 1998–2007.

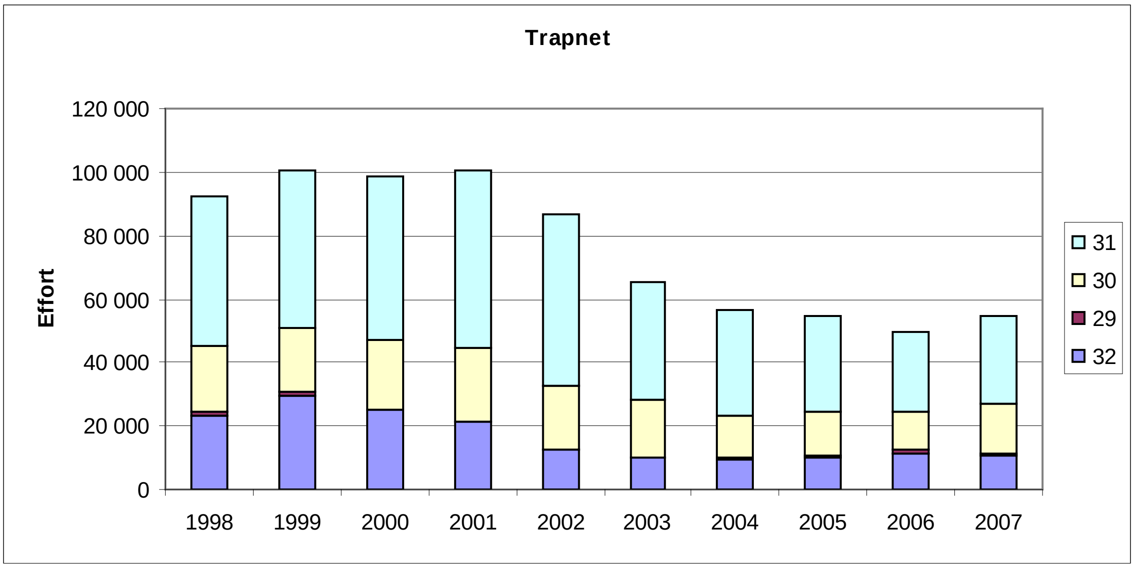


Figure 5.5.2.11. Annual total effort of salmon and whitefish trapnets used in Finnish professional fishery by sea areas in 1998–2007.

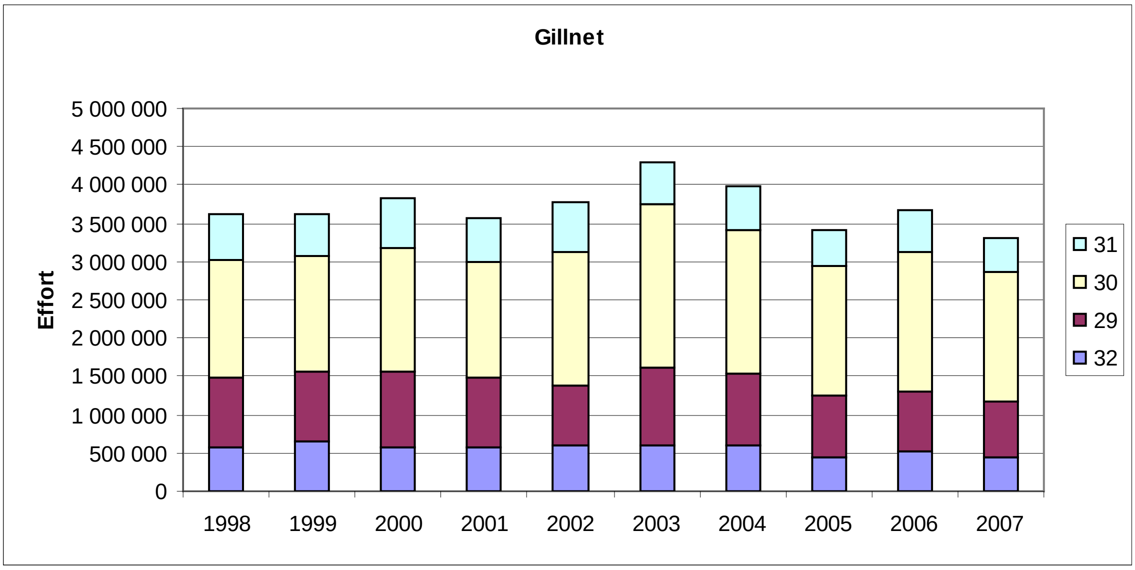


Figure 5.5.2.12. Annual total effort of gillnets with bar length 36–60 mm used in Finnish professional fishery by sea areas in 1998–2007.

5.5.3 Herring fishery in Poland

On the coast of Poland in subdivison26, mainly in the Gdansk Bay, a comparatively small herring fishery uses anchored gillnets. This fishery is most intensive during the spring with up to 500 gear days per month (Figure 5.5.3.1), coinciding with smolt migration and significant numbers of tagged smolt are recaptured in this fishery.

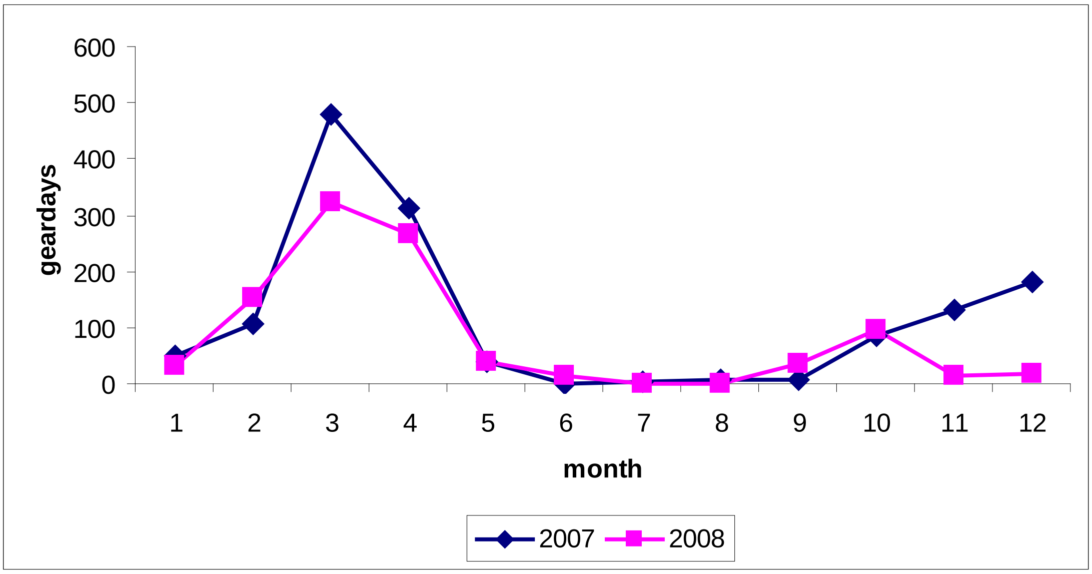


Figure 5.5.3.1. Monthly effort in herring fishery (GNS) on the Polish coast of subdivision 26 in 2007 and 2008

5.5.4 Recreational fishery

The actual effort in the recreational fishery and types of fishery, not reported officially (targeting other species), e.g. German coastal fishing (Schulz and Dumke, 2006) or in northern Sweden where net fishing for whitefish is very intensive (Petersson *et* *al.*, 2009) is not well documented but in certain areas both effort and catch seems to be very high (Petersson *et al.*, op.cit.).

The catch by the recreational fishery on the Swedish side in subdivisions 31 and 30 was in 2009 estimated to be 316 000 trout (95% c.l. 196 000 – 450 000) (Petersson *et al,.* op.cit.), corresponding to 243 tons (95% c. l. 150–340 tonnes) with an average weight of 0.769 kg. Similarly a Finnish investigation estimated recreational catch on the Finnish side of subdivision 31 to be approx. 125 tonnes per year (70–165 tons) during the period 1992–1998 (Jokikokko, 2003). Assuming a similar size in the Finnish catch this corresponds to an annual catch of 162 500 trout in this subdivision.

Doubling this value to estimate roughly the possible Finnish catch in subdivision 30 a total of some 325000 trout are caught annually. In total for both countries this gives a catch of more than 600000 trout annually or about 490 tons. For comparison the total reported catch in the entire Baltic sea was in 2007 904 tons (Finland + Sweden alone 318 tons).

In Denmark the extent of recreational fishing is not known but in order to fish with fixed gear recreational fishermen must pay a fee and likewise anglers must pay a state fee. This way the number of recreational fishermen is known. In 2007 a total 34000 recreational fishermen were registered each allowed to use up to 6 fixed gears (three of which may be gillnets). It is not known how many of the fishermen actually fish inside the Baltic area and neither how active they are (Subdivision 22).

Catches in the Danish recreational fishery using fixed gear was investigated during the period 2002–2004 (Pedersen *et al.,* 2005), where selected recreational fishermen voluntarily reported their catch in different parts of the country. According to Pedersen *et al.* (2005) catches of trout are relatively rare but may be substantial in certain areas. Unfortunately the total catch of trout was not estimated. Catch of trout was almost exclusively in gillnets.

In Denmark, both in recent experiments, and in experiments from the 1990s with tagged trout about half of the sea catch is reported from sports fishermen (rod and line) about 20 % are reported from the recreational fishery and the remaining tags are reported without information on gear (Glüsing and Rasmussen 1996, Pedersen and Rasmussen 1997, Pedersen and Rasmussen 2004). The number of anglers holding a license in Denmark has been relatively stable for a number of years (approx. 161000) but in recent years fishing with rod and line in the sea targeting sea trout has become increasingly popular.

Before this period larger catches from recreational, professional and semi-professional fishery were more frequent.

Thus it appears that catch of trout in fixed gears in Denmark has been reduced during the last decades but locally may be substantial, and catch in the sports fishery increased.

5.5.5 Future sea trout fishing

Due to the ban on drift nets the overall effort in the Main Basin from the professional sea fishery will almost certainly be very low for the next years, especially due to a reduction in the south eastern part of the Main Basin. This is expected to result in reduced catches of trout in this area.

The restrictions in gear is expected to result also in a reduced catch of salmon in the open sea fishery, which will likely promote an increase in coastal fishing effort in Finland and Sweden.

An increase in effort in the coastal fishery will also result in an increase in catches of sea trout.

5.6 Anthropogenic and other factors affecting trout populations

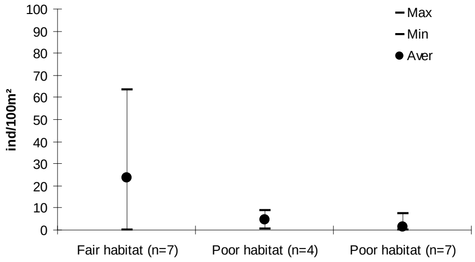
In general terms human impact is the most significant factor influencing sea trout populations.

5.6.1 Migration barriers

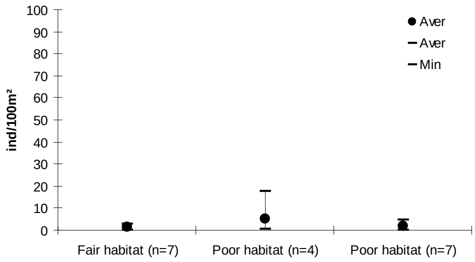
Migration obstacles represent a serious threat to several sea trout stocks in all countries around the Baltic Sea. To restore migration, a number of fish passes have been built in Finland, Sweden, Denmark, Poland and Lithuania. Relatively high success is achieved in helping adult fish to migrate upstream. It is necessary to construct more fish ways for promoting the re-establishment of the sea trout populations in the dammed rivers, because the best spawning and nursery areas are situated in the upper reaches in most rivers. The need to improve migration possibilities is particularly urgent in Estonia and to some extent in Latvia and Finland. In Estonia about 30% of the sea trout rivers and streams have unnatural migration obstacles. Also more attention should be paid to reduce the mortality of descending fish as several studies (e.g. Aarestrup and Koed, 2003, Koed *et al.*, 2002) have shown high mortality of descending smolts negotiating the lake-like reservoirs above the dams. Besides dams being migration obstacles, they also reduce the size and quality of the spawning area upstream by flooding potential rapids. The closest remaining rapid upstream from the impounded lake most often becomes deeper in water column, has a slower flow and increased deposition of fine sediment. In some cases the habitat quality downstream from dam has also decreased. The habitat quality decreases due to the flow regulation in combination with hydropower, increase in water temperature and silting of spawning grounds. If hydropower station is not properly managed, the sediment release from the reservoir can occur. All these problems exist in operating hydropower stations in around the Baltic.

5.6.2 Habitat quality

Canalizing of the rivers usually results in profound changes in riverbed structure, removal of the larger rocks and bank vegetation. This in turn increases the fine sediment load which reduces available gravel for spawning and increase egg mortality during incubation. Modified habitat generally results in reduced physical variation and uniform depth conditions that provides less hiding possibilities for the parr and therefore carrying capacity is decreased (Figures 5.6.2.1 and 5.6.2.2). Almost all Finnish and Swedish rivers have in former times been used for log driving. Therefore the rapids have usually been either dredged using bulldozers or by man power. Especially in the Gulf of Bothnia area, many rivers have also been dredged for preventing floods. The largest dredgings using bulldozers have been done in the 1950s and 1960s in northern Finland. These measures have largely destroyed the spawning grounds and remarkably reduced the wetted area in the rapids and their suitability for parr production. The restoring of the dredged rapids for compensating damages caused to migratory fish began in Finland and Sweden in the late 1970s after ending of the log driving and has continued since then. However, additional restoring is still necessary and going on especially in small streams.



A



B

Figure 5.6.2.1. The effect of habitat quality to parr density in a channelized r. Riguldi (A for 0+ and B for older parr).

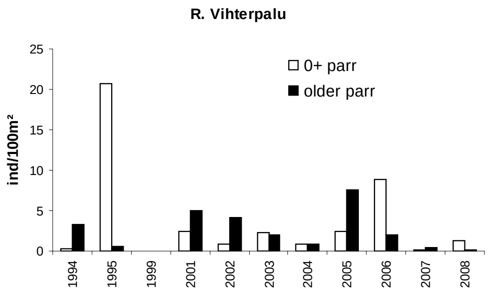


Figure 5.6.2.2. In poor quality habitat 0+ parr densities never exceed 25 parr/100m².

5.6.3 Water quality

Reduced water quality can severely reduce parr abundance. Out of 245 studied sea trout rivers 171 had information about water quality available (estimated as good, fair, poor or variable). Good status was stated for 74.8%, fair for 11.7%, poor for 5.8% and variable for 7.6% of the rivers (national water monitoring programmes). High share of rivers stated with good water quality are located in Sweden and therefore the overall situation around the Baltic is not as optimistic.

Acidification has been a severe threat to salmon and sea trout stocks in Sweden. In the Baltic region extensive liming operations are carried out to counter-act the acidification process in certain areas of Sweden, especially in rivers flowing to ICES subdivisions 25, 27 and 30. Although the acid deposition has decreased substantially, still problems with too low pH occur, especially during spring high flow after snow melt. Due to the extensive liming programme it can be stated that the effect on stocks is low but would increase strongly if liming ceased. It is expected that liming is required for several decades in the worst affected areas. On the Swedish west coast approximately 49–75% of the wild salmon smolt production would have been lost without liming. The situation for the sea trout in the Baltic is not of this magnitude but a precise evaluation cannot be carried out.

In the Finnish sea trout rivers water quality varies from river to river from excellent to poor being mostly good or satisfactory. There are commonly plenty of peat lands and bogs especially in the catchments of the Gulf of Bothnia rivers, resulting in polyhumic and mostly at least slightly acid river water. In the rivers flowing into the middle parts of the Gulf of Bothnia, special problems are caused by acid lowland clay soils formed in the Litorina Sea phase during the development of the present Baltic Sea. Due to dry summers or deeper drainage of fields, the acidity of river water may sometimes drop even below pH 4 causing fish kills. Also on the south-western and southern Finnish coast the rivers flow on clay soils resulting in clayish water and occasionally high sediment load but there are no acidity problems. Agriculture, forestry, settlements and diffuse pollution cause nutrient and sediment load in most rivers. Especially in autumn and winter fine sediment can cause silting of the spawning grounds that is harmful for incubating eggs in the redds. This problem has been observed also in Lithuania, Sweden and Denmark. The water quality in many former sea trout rivers has been rated in environmental assessments only satisfactory, passable or even poor. To re-establish sea trout populations in these rivers it is necessary to improve water quality or at least remove the acidity risks. In the present sea trout rivers it is common that water quality and also spawning and nursery habitats are better in the upper reaches and in the headwater streams than lower in the river near the sea.

In Estonia water quality data is available for 13 larger sea trout rivers. Good status was stated for 38%, fair for 8% and poor for 54% of the rivers. One of the main problems of water protection in Estonia is eutrophication caused by increased nutrient load of anthropogenic origin. The main sources of nutrients are agriculture and insufficiently treated sewage water. Due to slight improvement in water quality (still considered as poor) the parr densities have increased in River Vääna (Figure 5.6.3.1).

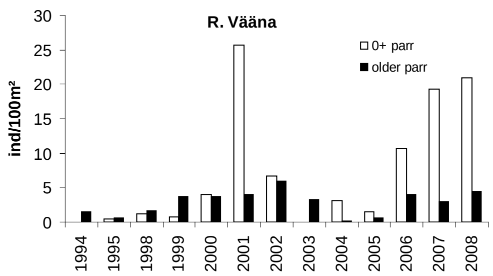


Figure 5.6.3.1. Due to slightly improved water quality in r. Vääna, the average parr density has increased.

5.6.4 Hydrological conditions

The parr densities can have large natural variations, which mainly depend on changes in habitat quality, hydrological regime and presence of potential predators. In good quality habitat the 0+ parr density can reach above 100 parr/100m², for the older parr the higher densities typically remain around 60–70 parr/100m².

The hydrological conditions play an important role in year class strength. Dry summers and autumns strongly reduce the discharge in rivers and streams. The wetted area in the rapids decreases considerably, reducing also food and shelter available for parr and thus the parr and smolt production. The reduced flow also diminishes the possibility of returning spawners to ascend the rivers. Delayed migration at the river mouth makes fish vulnerable to the coastal fishery. Reduced discharge may prevent ascent to the river completely, if the flow does not rise before the spawning time. Rainy summers and years in turn are favourable for ascent to the river and parr production of sea trout in these rivers. The lowest densities occur usually a year after drought when densities can be close to zero (also in the good quality habitat). The effect of dry summers 2002 and 2003 could be seen e.g. in the Isojoki river (Subdivision 30) in the considerably reduced densities of 0+ parr in the following years. In the Gulf of Finland area, recent drought occurred in 2002 which had a severe effect on 0+ densities in 2003 (Figure 5.6.4.1).

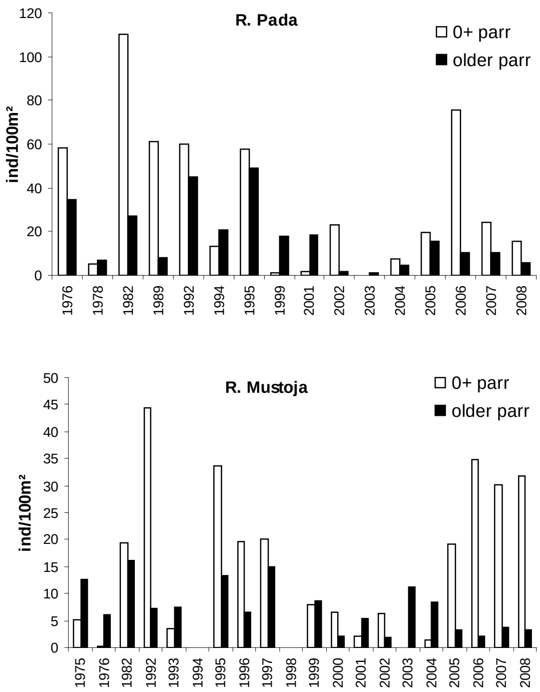


Figure 5.6.4.1. Monitoring sites in r. Pada and Mustoja (Subdivision 32) of very good habitat quality have large natural variation in parr density. The absence of 0+ year class in 2003 was due to extreme drought in 2002 when spawning conditions were very poor.

Beavers can significantly affect habitat quality and availability. Particularly in smaller rivers and streams the beaver dams represent migration obstacles and flood potential rapids upstream, thus reducing the habitat quality. During droughts the impounded lake cannot be considered as a potential refuge area for fish, because the oxygen level rapidly deteriorates in the lake as the flow reduces.

5.6.5 Predators

The predation pressure for sea trout probably varies from river to river, depending on the local conditions, e.g. how much biotope is available for potential predators and amount and quality of the hiding places available. For sea trout as well as salmon the critical period for survival is during smolt migration when smolts are forced to pass unsuitable habitat to reach the sea. In the Baltic Sea many river mouths and coastal areas in the estuary are often very shallow and bordered with wide reed belt providing suitable habitat for potential predators such as northern pike (*Esox lucius* L.), burbot (*Lota lota* L.), herring gull (*Larus argentatus* Pont.), grey heron (*Ardea cinerea* L.), goosanders (*Mergus merganser* L.), cormorant (*Phalacrocorax carbo*) and sterns (Sterna sp). According to Keikäläinen *et al.* (2008) northern pike caused 29% mortality of stocked salmon smolts in the river Pyhäjoki. In the river Pirita salmon and trout constituted 5% of northern pikes' overall food composition.

Studies in the River Kävlingeån, the Sound, revealed that smolt mortality was negatively correlated to the migration speed of smolt, which mainly depended on water velocity (Figure 5.6.5.1). Smolt mortality in the lotic parts of the river was below 5 % per km, whereas mortality increased to above 80% per km in lentic parts, as dams, due to pike predation (Degerman *et al*., 2009, in prep). As more dams are being built, even in sea trout streams, productive areas upstream of dams loses importance, even if fish passage is assured by fish passes or ladders. Goosanders are reported to consume up to 16% of total salmon smolt run (Feltham, 1995) in the river North Esk, feeding especially on Carlin-tagged and adipose fin-clipped reared smolts (Feltham and MacLean, 1996). Grey herons and gulls are also known to feed on smolts (Koed *et al.,* 2002, Ruggerone, 1986). Similar observations were made in case of black cormorants in the Gulf of Gdansk (Bzoma 2004)

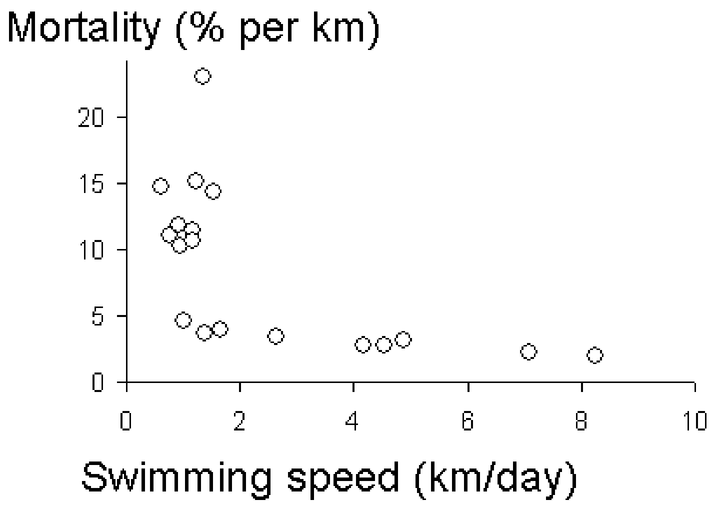


Figure 5.6.5.1 Mortality (% per km) of migrating sea trout smolt in relation to the average swimming speed per day. Dams and structures delaying migration rapidly reduces smolt production (Degerman *et al*., 2009, in prep.)

5.6.6 Diseases

Ulcerative dermal necrosis (UDN) is a chronic dermatological disease of salmonid fish. Infected fish develop severe lesions on the skin which penetrate into the skeletal muscle. In the fresh water the lesions become additionally infected with *Saprolegnia* fungus (Johansson 1982). The infected ascending adults are frequently reported to die before spawning, thus reducing the effective population size. Recently the UDN have been found on ascending sea trout adults in the Polish rivers Słupia, Parsęta, Rega, and Wieprza. In 2007 UDN became much more intensive, especially in Slupia R. resulting in death of more than half of spawners caught for stripping. In 2008 situation repeated in Slupia and also in other rivers: almost all except Vistula, Leba and Reda. UDN was observed already in summer on spawners in lower parts of rivers. Many observations suggest that in some rivers (e.g. Slupia) a large part of spawning run died resulting e.g. in very low catch of kelts in majority of Pomeranian rivers.

5.6.7 Summary

The non natural migration obstacles can have a remarkable negative influence on sea trout stocks in all countries around the Baltic Sea. Further construction of fish ways is needed to re-establish the sea trout populations in the dammed rivers but the effect of predation on smolts in dams and lentic areas upstream dams still constitutes a problem.

Reduced habitat quality and fine sediment load have reduced parr abundance in many Finnish, Swedish and Danish sea trout rivers. Further habitat restoring is still necessary and going on especially in many small streams.

Acidification can be considered a threat in Sweden and Finland in the Gulf of Bothnia drainage area. In Sweden the extensive liming programme has probably reduced the acidification threat on stocks.

Naturally occurring dry summers and autumns can significantly decrease parr abundance. In some areas further climate change may induce more frequent dry periods and thus reduce parr abundance.

The occurrence of ascending sea trout infected with ulcerative dermal necrosis (UDN) has increased in many Pomeranian (Poland) rivers, resulting in additional mortality of spawning stock.

In Sweden a manual for restoration of rivers has been prepared in 2008 (Degerman, 2008). Along with measures to e.g. reduce fishing mortality a joint exchange of restoration methods for sea trout streams would be valuable. It is suggested that a joint Baltic sea trout river restoration handbook should be prepared to increase and optimize restoration work.

5.7 Hatchery practice and genetics

5.7.1 Introduction

Large size of the effective population size (N*e*) is the primary management option to conserve genetic variability. Genetic variation is a normal phenomenon resulting in adaptation to specific local conditions, which is deposited in gene pools and inherited from generation to generation via successful spawners.

It is generally stated that at least 50 parental individuals is the critical size for small populations to ensure a sufficient gene pool to avoid inbreeding (loss of genetic variability due to insufficient number of spawners) in process of evolution. Taking into account that also other factors (anthropogenic and others) may affect the gene pools the effective population size required is estimated to be at least 100 spawners.

These considerations should be implemented in hatchery practices with fish released in the wild.

5.7.2 Baltic Sea

Sea trout in the Baltic is represented with hundreds of small populations (487 wild and 451 mixed, WGBAST report 2008, Table 7.2.3.1.) as opposed to salmon which has relatively few populations in the area.

In rivers where sea trout are released, originating in other rivers, small locally adapted populations may be threatened (outbreeding).

The following recommendations should be implemented in hatchery practices to protect the sea trout populations from loss of genetic variability:

- -use as many parent fishes as possible;
- -use random mating and equal number of males and females;
- -broodstock used for producing of fish for stocking into natural waters should have N*e* exceeding 100;
- -in broodstock management include all reproductive age groups in the same relative proportion as they occur in the natural founder population;
- -hatchery broodstock should when possible be re-stock with wild fish.

The recapture rate of tagged sea trout shows a decreasing trend in the last years in the Gulf of Bothnia, Gulf of Finland and Main Baltic. As a hypothesis, it has been put forward that one of reason for decreasing survival rate in hatchery reared sea trout could be inadequate hatchery practices.

In general, however, hatcheries around the Baltic follow the recommendations stated, although the practice is not reported in general but in some rivers the stocking material originates from neighbouring rivers.

In Finland the brood stocks are completed, depending on the availability of fish, either by using spawn of returning spawners caught at the river mouth or parr caught in the river. In establishing new brood stocks, a minimum number of 25 female and male spawners are used.

It has also been put forward as a hypothesis explaining an observed reduced postsmolt survival for Atlantic salmon released in the Baltic that the fish stocked could be very different to wild fish. This could be due to several reasons, e.g. the feed given in the hatchery was developed for raising fish in aquaculture having an elevated fat content and likewise that fish being raised in hatchery conditions have a behaviour making them less adapted to a free life.

It has been demonstrated in several studies that the survival in wild salmonids is in general much better than it is in hatchery raised fish (Jonsson *et al.*, 2003, Saloniemi *et al.*, 2004, Jokikokko *et al.*, 2006). The reasons for this may be due to both. A study on the influence of the feed in salmon is planned in Finland.

5.7.3 Number of wild and reared sea trout smolt production

The number of hatchery reared sea trout smolts increased in the 90's from 1.5 to 4.0 million (Figure 5.7.2.1). Unfortunately, an estimate of the total wild production is not available but it is likely substantially less than the number of released sea trout. With small wild populations and massive releases to support a fishery, a real risk of overfishing the wild populations do exist because a fishery targeting trout may be artificially maintained at a high level.

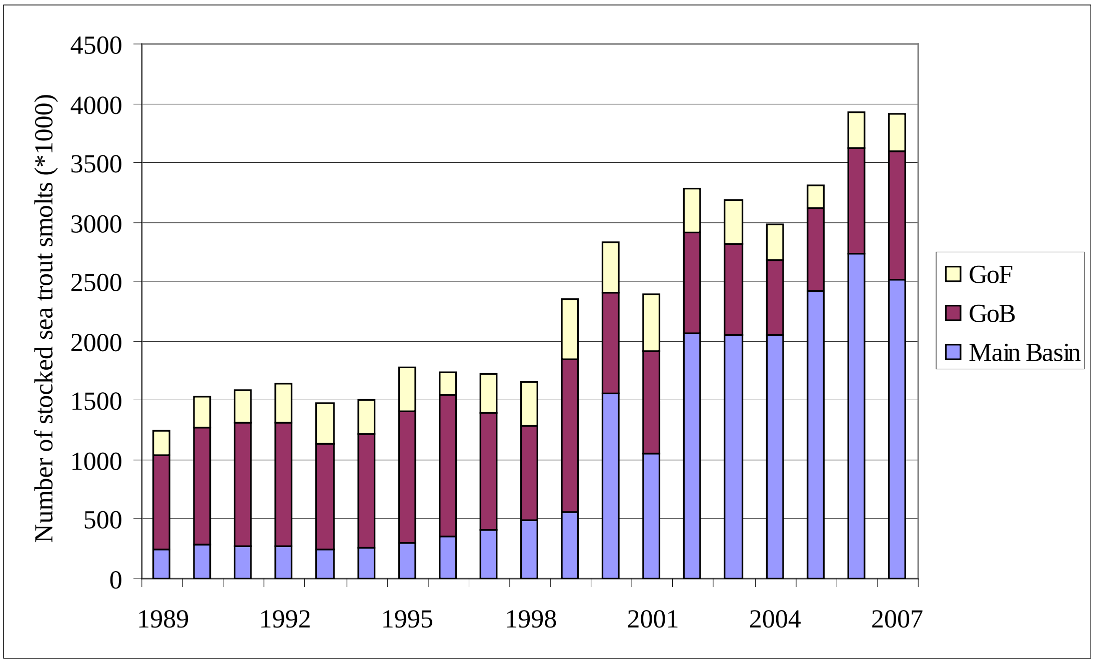


Figure 5.7.2.1 Number of stocked sea trout smolts in the Baltic Sea 1989–2007.

5.8 Regulation of sea trout fishery

5.8.1 Regulations in the sea fishery for trout

5.8.1.1 Introduction

Fishing for sea trout in national waters is regulated through national measures and in off shore waters through EU regulations (EU 2187/2005). National measures comprise a wide series of regulations including e.g. minimal landing size, closed season and closed areas, while the EU regulation solely states minimal landing size and closed seasons in different subdivisions.

The above EU regulation sets minimum landing size at 40 cm for subdivisions 22–25 and 29–32 and minimum landing size 50 cm for subdivisions 26–28. Closed season is 1 June to 15 September in subdivisions 22–31 and from 15 June to 30 September in subdivisions 32.

5.8.1.2 Regulation measures in different sea areas

In the following regulations are summarized 1) by subdivision and 2) by country based on Heinimaa *et al.* 2007, partly updated by information from members of the SGBALANST Study Group.

In the Bothnian Bay and Bothnian sea (Subdivisions 31 and 30):

- Finnish side:
    - Legal catch size is 50 cm
    - Much of the sea area is legally private water
    - At river mouths 1/3 of the main stream at river mouths must be kept open, and in many private waters there is also a summer / autumn closure of the fishery
    - Surface gillnets targeting sea trout must have a minimum mesh size (bar length) of 80 mm

- Swedish side:
  - Water closer than 300 m from shore or, if situated further out, at a water depth of < 3 m is privately owned
  - Other waters are common (public)
  - Non-commercial fishermen operating on common waters may only use six gillnets (maximum 180 m, max. height 3 m)
  - Legal minimum size of sea trout is in general 50 cm, if not otherwise stated
  - In subdivision 30 minimum landing size is 40 cm
  - Closed season 1 of October – 31 of December in both subdivisions
  - Net fishing is prohibited on water with less than 3 m depth during the periods 1 April – 10 June and 1 October – 31 December in subdivision 31
  - Closed areas around all river mouths with salmon
  - Smaller rivers with only trout in some cases have closed areas
  - All other rivers and streams have closed areas effective at a 200 m radius from the mouth during 1st of September – 31 of December

- In the Archipelago (Subdivision 29):
  - Swedish side: Minimum landing size 50 cm
  - closed areas around all a few river mouths
  - Finnish side: same restrictions as for subdivisions 31 and 30
  - Estonian side: Same regulations as for subdivision 32 (below) also apply for subdivision 29
  - Åland islands: Minimum legal size 50 cm. There are no other limitations in fishing of sea trout.

- In the Gulf of Finland (Subdivision 32):
  - On the Finnish side: Minimum landing size 50 cm
  - Based on the decision of local fishing authorities, bottom gillnets targeting sea trout must have a bar length of 65 mm off private waters close to the shore (many private waters enforce minimum bar length of 60 mm in bottom gillnets targeting sea trout)
  - In Russia: All catch of sea trout is prohibited
  - Estonia: Minimum landing size 50 cm total length (or 45 cm standard length)
  - 2/3 of straits must be kept open
  - Minimum bar length 35 mm in gillnets
  - Minimum bar length 24 mm in cod end of traps with leader net
  - closed areas:
    - 12 rivers 1000 m radius, permanently
    - 15 rivers 500 m radius, 17.08 – 31.12
    - 30 rivers 500 m radius, 1.09 – 30.11, and
  - Minimum distances between fishing gears
  - Maximum number of gears
  - Drift nets and anchored floating nets minimum total mesh size > 157 mm

- In subdivision 28:
  - Latvia (also northern part of subdivision 26): Minimum landing size is 50 cm
  - Closed season 1.10 – 15.11
  - Closed areas with radius of 2–3 km around outlet from some large rivers
  - Closed areas 200 – 500 m around outlet from small rivers
  - Closed area 100 m from the shoreline
  - Swedish side: Minimum landing size 50 cm
  - Restricted areas outside 50 rivers
  - No closed season

- In subdivision 27 (Sweden):
  - Minimum landing size 50 cm
  - Restricted areas outside 50 rivers
  - No closed season

- In subdivision 26:
  - Lithuania:
    - Minimum landing size is 60 cm
      - In the Curonian lagoon:
        - Outer strait is permanently closed for fishing
        - Inside this in the eastern stretch of Curonian lagoon, between Klaipeda and Skirvyte, nets are prohibited in 2 km distance from eastern shore from 1.09 – 31.10
        - Closed areas (1000 m) at the rivers Šventoji and Rėkstyne 1.09 – 31.10
        - Closed area at southern and northern breakwaters of Klaipėda strait 1.09 – 31.10
  - Kaliningrad: fishing for sea trout is prohibited
  - Poland:
    - minimum landing size 50 cm
    - Minimum bar length in gillnets targeting sea trout is 80 mm
    - Closed areas 250 – 500 m at river outlets except R. Vistula where this is 1 NM (1852 m)
    - Closed season 15 .09–15.11 within 4 miles territorial waters except Gulf of Gdansk and Vistula Lagoon
- In subdivision 25:
  - Poland: same restrictions as in subdivision 26
  - Sweden: minimum landing size 50 cm
  - Restricted areas outside 33 rivers
  - In Scania and Blekinge closed season 16.09–31.12

- In subdivision 24:
  - Poland : same restrictions as in 25 and 26 except that minimum landing size is 40 cm
  - Sweden: same restrictions as in subdivision 25

- Germany (Mecklenburg – Western Pommerania, i.e. also part of subdivision 22):
  - Minimum landing size 45 cm
  - Closed areas (100 – 500 m) outside 20 rivers and in addition certain specific areas
  - Closed season 15.09 – 14.12
  - Gillnets targeting sea trout minimum bar length 60 mm
- Denmark:
  - Minimum landing size 40 cm
  - Closed season (only maturing fish) 16.11 – 15.01
  - Closed areas at river mouths with width at outlet < 2 m 500 m from 16.09 – 15.03
  - Closed areas at river mouths with width at outlet > 2 m 500 m all year (expanded areas at many rivers)
  - Gillnets minimum distance to shore 100 m
  - Minimum distance between gears
  - Maximum 3 gillnets per fisherman (recreational fishing only)
  - Locally pound nets (mainly targeting herring) must have upper edge at least 10 cm below the surface

- In subdivision 23:
  - Sweden:
    - Minimum landing size 50 cm
    - Closed areas at the 18 most important trout rivers
    - Closed season 16.09 – 31.12
  - Denmark: same restrictions as in subdivision 24

- In subdivision 22:
  - Germany (Schleswig – Holstein):
    - Minimum landing size 40 cm
    - Closed season 1.10 – 31.12 (only maturing fish)
    - Closed areas at outlet of 36 rivers (200 m on both sides of the outlet and 200 m into the sea) extended areas at 2 rivers
  - Denmark: same restrictions as in subdivision 24

5.8.2 Regulations of the river fishery for sea trout

In Finland

- Gillnet fishing forbidden in most of the sea trout rivers
- 1/3 of the main stream must be kept open in gill netting or when fishing with fixed gear
- All kind other fishing than fishing with rod and line is prohibited 1 September – 30 November
- Fishing with rod and line is prohibited 10 September – 30 November
- Angling with worm is forbidden in rapids
- Minimum landing sizes are the same as for sea fishery

The border river Tornionjoki between Finland and Sweden has its own regulations:

- Sea trout fishing is allowed only from 1 May to 15 August
- Fishing of sea trout is prohibited weekly from Monday 6 PM to Wednesday 6 PM during the allowed fishing season.

In Sweden the rules differ between the different subdivisions:

- In subdivision 31:
    - Most of the rivers are closed from fishing 1 September – 17 June.
    - Rivers with only hatchery production has longer fishing season.
    - A maximum catch of 1 salmon is allowed per day in rivers with wild stocks.
    - In rivers with hatchery production, local rules apply.
    - Minimum size of legal sea trout is 35 cm but will be increased during 2009 to 50 cm.
    - Fishing with gillnets is only allowed in lake-like sections and not for salmon or trout.

- In subdivision 30:
    - Most rivers are closed from 1 September – 31 May
    - Rivers with only reared stocks are open for fishing for a longer period
    - The same rules for gillnets and for minimum size as subdivision 31 applies, minimum size will probably be raised to 50 cm in 2009

- In subdivisions 29, 28, 27 and 25:
    - Most rivers are closed for fishing 1 October – 31 March

- In subdivision 23:
    - Rivers are closed to fishing 1 October – 28 (29) February

In Estonia:

- Gillnets and trapnets are forbidden in all sea trout rivers.
- In salmon and sea trout rivers, rod fishing for salmon and sea trout is forbidden from 1 October to 30 November, except in 6 rivers where rod fishing is allowed with special licence.
- In only sea trout rivers, rod fishing for sea trout forbidden from 1 **September to 31 October.**
- Wading is forbidden in salmonids' spawning rivers during the closed season.
- Fishing in 32 rivers and brooks is forbidden all year round.
- Fishing in 15 rivers is forbidden downstream from first definite migration obstacle.
- Fishing in fish ladders and 50 m upstream is forbidden.
- Fishing downstream from dams in distance of 100–500 m is forbidden.

In Latvia river fishing for sea trout is in general prohibited – except in R. Daugava which has a hatchery strain.

In Lithuania:

- Sports fishing is only allowed in 9 rivers on designated stretches
- The rivers are closed for fishing from 1 May – 31 December
- Maximum allowed catch of 750 sea trout in total

In Poland:

- Minimum legal size in freshwater is 35 cm
- Closed season:
  - In R. Vistula including tributaries above the Wloclawek Dam:
    - 01.10 – 31.12
    - Rest of year all Thursdays–Sunday
  - In Vistula river from Wloclawek Dam to the river mouth:
    - 01.12–28(29).02
    - 01.03–31.08 Friday–Sunday
  - In other rivers: 01.10–31.12

In the Vistula a regulated professional fishery takes place using drifting gears.

In rivers managed by anglers associations only fishing with rod and artificial lure is allowed and a maximum daily catch of 2 sea trout is allowed.

In Germany:

- Mecklenburg – Western Pommerania:
  - Minimum legal size in freshwater is 45 cm
  - Closed season in freshwater
    - 01.07 – 31.03

- Schleswig Holstein:
  - Minimum legal size in freshwater is 40 cm
  - Closed season in 38 Rivers
    - 01.10 – 31.12

In Denmark:

- Closed season 15.11– 15.01 (in most rivers voluntarily extended to 01.11–28 (29).02)
- 2/3 of the main stream must be kept when fishing with fixed gear
- Minimum distance between fixed gears in streams 100 m
- Mesh size (bar length) in the cod end of fyke nets must be at least 32 mm.
- Around dams 50 m both up and downstream are closed to fishing

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Annex 2: Terms of Reference for SGBALANST 2008

Terms of reference for SGBALANST 2008:

a) consider whether the status of the trout populations justifies there need for an ICES assessment for international management, taking account of variations in stock status and migration patterns; and , if appropriate;

b) propose methods for assessing sea trout stocks, advise on which populations should be assessed and the appropriate levels of precision; and

c) select appropriate and representative geographical areas and types of rivers for establishing stock–recruit relationships.