Response of ICES to Request for Statistics on IUU Fisheries in the Baltic Sea

Secretariat's Note

As instructed by the 10th and 11th Meetings of the Jastarnia Group, the ASCOBANS Secretariat contacted the ICES Secretariat in February 2015 and again in January 2016. The message explained the interest of the Jastarnia Group in this issue and requested ICES to share information on the state of knowledge on IUU fisheries in the Baltic Sea. As specified by the Jastarnia Group, the interest is especially in any available statistics, if possible broken down by ICES areas.

The ICES Secretariat kindly responded on 29 January 2016, explaining that their data on IUU (Illegal, Unreported and Unregulated) fisheries are scarce, but that some estimates are available in the report of the "Baltic Salmon and Trout Assessment Working Group, WGBAST".

They referred us to tables 2.2.2. and 2.3.4 in the attached 2015 WGBAST report. The estimation method is described in Section 2.

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Report of the Baltic Salmon and Trout Assessment Working Group (WGBAST)

23–31 March 2015

Rostock, Germany

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Executive Summary

Baltic Salmon and Trout Assessment Working Group [WGBAST] (Chair: Tapani Pakarinen, Finland) met in Rostock, Germany, 23–31 March 2015. 20 persons from all Baltic Sea countries attended the meeting. The group was mandated to assess the status of salmon in Gulf of Bothnia and Main Basin (Subdivision 22–31) and Gulf of Finland (Subdivision 32) and sea trout in Subdivision 22–32, and to propose consequent management advices for fisheries in 2015. Salmon stocks in Subdivision 22–31 were assessed using Bayesian methodology, and a stock projection model was used for evaluation of the impacts of different catch options on the stocks.

Section 2 of the report covers catches and other data on salmon in the sea and also summarizes information affecting the fisheries and the management of salmon. Section 3 reviews data from salmon rivers and also stocking statistics. Salmon stocks in the Baltic Sea are assessed in Section 4. The same section also deals with sampling protocols and data needs. Section 5 presents the assessment and the status of sea trout stocks.

- The natural salmon smolt production has gradually increased in the Gulf of Bothnia. A stronger increase is predicted from 2015–2017, mainly as a result of the large spawning runs in 2012–2014. In other sea areas only little increase if any is predicted. The current total production of all Baltic Sea rivers is around 2.84 million wild smolts, which corresponds to about 65% of the overall potential smolt production capacity of salmon stocks. About 4.7 million reared salmon smolts were released to the Baltic Sea in 2014.
- Post-smolt survival has declined from the late 1980s until the mid-2000s, but indications of improvement have been noticed since then. Especially the post-smolt survival of the 2010 smolt cohort seems to be higher than average in the last years. The current survival is estimated to be about 14% for wild and 4% for reared post-smolts. The positive turn in survival will probably lead many salmon stocks to recover closer to their target state i.e. 75% of the potential smolt production capacity, by 2021.
- The group assessed the current status of wild salmon stocks by evaluating the probability that individual river stocks have reached 50% and 75% of the potential smolt production. Most of the large, northernmost stocks have likely or very likely reached the 50% objective, but only three stocks have likely reached the 75% objective. As a result of positive development in spawner abundances in 2012–2014, however, a gradual improvement in the stock status is expected for the most of the northern stocks by 2021. Southern stocks in AU4–5 and a few small northern stocks have varying and on average a poor status.
- Wild salmon stocks in Gulf of Finland show recovery. The smolt production in Estonian wild salmon river Keila was at a full capacity in 2014. A positive trend can be seen also in river Vasalemma that exceeded 50% of the potential production capacity. In the third wild Estonian river Kunda smolt production has varied from 10% to 100% of the potential capacity.
- Harvest rates in the commercial salmon fisheries have showed an overall declining trend in the last 20 years. Since 2011 the harvest rate in the offshore fishery has declined strongly and is now at an all-time low. The harvest rate in the coastal fishery has reached the lowest values in 2013–2014. In general the exploitation rates in the sea fisheries have reduced to such a

low level that most of the stocks are predicted to recover. Weak stocks need stock specific rebuilding measures including fisheries restrictions in estuaries and rivers, habitat restoration and removal of potential migration obstacles.

- Sea trout populations are in a lower than optimal status state in most of the Baltic Sea area. Bothnian Bay stocks are seriously endangered. The stock status is good only in western Baltic Sea and in part of the Gulf of Finland.
- In general in the Baltic Sea area, exploitation rates should be reduced in most of the fisheries that catch sea trout. This includes also fisheries for other species where sea trout is caught as bycatch. In the areas where stock status is good the existing fishing restrictions should be maintained in order to retain the present status.

1 Introduction

1.1 Terms of reference

2014/2/ACOM09 The Baltic Salmon and Trout Assessment Working Group (WGBAST), chaired by Tapani Pakarinen, Finland, will meet in Rostock, Germany, 23–31 March 2015 to:

a) Address relevant points in the Generic ToRs for Regional and Species Working Groups;

b) Define ranges of F_{MSY} for salmon based on the approach used by WKM-SYREF3 and in line with the advice on the same topic issued early 2015 for other fish stocks.

The assessments will be carried out on the basis of the stock annex in National Laboratories, prior to the meeting. This will be coordinated as indicated in the table below.

Material and data relevant for the meeting must be available to the group no later than six weeks prior to the meeting.

WGBAST will report by 10 April 2015 for the attention of ACOM and PGCCDBS.

Note that the working group was not able to define the ranges of F_{MSY} (ToR b) and the issue has not been dealt with in this report.

1.2 Participants

Janis Birzaks		Latvia
Johan Dannewitz	(part of meeting)	Sweden
Piotr Debowski		Poland
Harry Hantke	(part of meeting)	Germany
Stanislovas Jonusas	(Observer, part of meeting)	European Commission
Martin Kesler		Estonia
Vytautas Kesminas	(part of meeting)	Lithuania
Katarzyna Nadolna-Altyn		Poland
Tapani Pakarinen	(Chair)	Finland
Stefan Palm		Sweden
Stig Pedersen		Denmark
Wojciech Pelczarski		Poland
Christoph Petereit		Germany
Henni Pulkkinen		Finland
Atso Romakkaniemi		Finland
Harry V. Strehlow		Germany
Stefan Stridsman		Sweden
Sergey Titov		Russia
Simon Weltersbach		Germany
Rebecca Whitlock		Sweden

1.3 Ecosystem considerations

1.3.1 Salmon and sea trout in the Baltic ecosystem

Salmon (*Salmo salar*) and sea trout (*Salmo trutta*) are among the top fish predators in the Baltic Sea. Together with European eel (*Anguilla Anguilla*) and migratory whitefish (*Coregonus lavare-tus/Coregonus maraena*) they form the group of keystone diadromous species in the Baltic Sea.

As a result of precise homing of salmon and sea trout to their natal rivers, each river and even in some cases each river section may have a genetically unique population; thus the conservation of biodiversity requires safeguarding of the genetic variation and integrity of the populations. On the species level, based on the IUCN criteria salmon and the sea trout has been categorised as vulnerable (VU) by HELCOM.

Salmon and sea trout are anadromous, i.e. they hatch in fresh water, spend one to five years in river and after this migrate for a long period to the sea, then return to fresh water to spawn. Therefore, good connectivity between the sea and rivers, as well as in the rivers, is of ultimate importance for the existence of these species. Salmon has the widest migration routes over the Baltic Sea catchment area. As an example, salmon juveniles occupy the headwaters of the River Tornionjoki 400–500 km upstream from the sea, which is the northernmost point of the Baltic Sea drainage area. After 3–5 years' growth in freshwater, juveniles migrate to the sea, at first feeding on insects and other invertebrates and half a year later they shift to feed on herring and sprat in the southwestern part of the Baltic Sea proper. Salmon mature after 1–4 years' growth on the feeding grounds, after which they migrate the 2000 km distance back to their natal headwater rivers for spawning.

Sea trout basically has the same life cycle as salmon. The most important difference is that most strains do not migrate as far as the salmon. Instead they spend the time in sea in coastal waters where the majority of sea trout from a specific strain stay within a few hundred km from their home river. Some specimens, however, migrate further and in strains in the southeast Baltic most sea trout seem to migrate longer distances into the open sea. Sea trout spawn and live during the first period of life in smaller streams than salmon. For this reason the connectivity from sea to spawning areas may be even more critical, compared to salmon, due to possible minor barriers in the small streams. In the Baltic Sea area, sea trout are found in a much larger number of streams than salmon. Many of these streams are in lowland areas and are often strongly influenced by human activity. One effect from this is for example elevated siltation, deteriorated spawning possibilities and reduced survival of eggs.

At each stage of migration and life cycle, salmon occupies a specific niche which cannot be occupied by any other species in the ecosystem. For instance, salmon juveniles are one of the few species that can utilise fast-flowing freshwater habitats in the large northern rivers. No other fish species was able to replace salmon juveniles in fish production and populate the empty rearing habitats during the deep depression in salmon abundance in the latter half of the 20th century. Salmon is adopted to uniquely utilise and link the low-productive, fast-flowing river habitat, which is a good environment for reproduction, with the pelagic sea habitat, which offers good conditions for fast growth due to the high abundance of prey species (Kulmala *et al.*, 2013). Similarly sea trout has adopted to live in the smaller tributaries and at slightly lower water velocities.

All this demonstrates how connectivity between river habitat, coastal transitional zone and open sea is the lifeline for Baltic salmon and sea trout, and how the requirements imposed to biotic and abiotic habitat vary in time and space, depending on the life stage of the species concerned. Today, Baltic salmon reproduce naturally in nearly 30 rivers. In the past, however, the number of rivers with wild Baltic salmon stocks is known to have been considerably higher, i.e. around one hundred rivers. Also the number of rivers with wild sea trout stocks has declined considerably. Damming, habitat destruction, pollution and intensive fishing have been identified as the main causes of the decline. Presently, the majority of the wild salmon originates from rivers located in Sweden, Finland, Latvia and Estonia. Most of the current spawning rivers of wild sea trout stocks are located in Denmark and Sweden.

Salmon and sea trout play an important role in maintaining the balance in riverine food webs, both by harvesting invertebrate populations and also providing an important food source for other predatory species (Kulmala *et al*., 2013). The total nutrient transportation between freshwater and sea is nowadays lower than in the past due to damming and other human activities, which have decreased fish abundance, destroyed natural migration and life cycle of salmon in many spawning rivers. Salmon and sea trout turns over gravel in the river bed while spawning. This bioturbation cleans river bed from, for example, organic particles the sedimentation of which is high in the Baltic rivers. Spawning removes also macrophytes and invertebrates from the sediment, which may more easily be fed by river fish. Salmon is a top fish predator that eats nearly exclusively sprat and herring, in the south mainly sprat and towards the north increasingly herring, in the Baltic Sea. Thus salmon in one sense refines various micronutrients for use of other top predators like mammals, including humans (Kulmala *et al*., 2013). Salmon muscle indeed contains plenty of polyunsaturated fatty acids, which are beneficial for human circulatory system. However, being at the top of the food chain salmon unfortunately also accumulates harmful substances, i.e. various environmental toxicants. Salmon and sea trout are frequent prey species of grey seals, especially in the Gulf of Bothnia (e.g. Lundström *et al*., 2010). The increasing population of grey seals is likely to consume also more salmonids, which is expected to impact salmon and sea trout population principally in a similar manner as fishing.

The thiamine deficiency syndrome M74 is a reproductive disorder, which causes mortality among yolk-sac fry of Baltic salmon (see Stock Annex and Section 3.4). The development of M74 is suggested to be coupled to a diet which is characterized by a deficiency of thiamine in the eggs of salmon, primarily results from an abundant but unbalanced fish diet with too low concentration of thiamine in relation to fat and energy content (Keinänen *et al*., 2012). The intake of thiamine for Baltic salmon in relation to energy and fat remains lowest by eating young clupeids, especially young sprat (Keinänen *et al*., 2012). Total biomass of sprat in the Baltic main basin and salmon growth are positively correlated. Further, variation in the condition factor of prespawning salmon is explained by fluctuations in the biomass of sprat (Mikkonen *et al*., 2011). The high growth rate of salmon seems not as such be the cause of M74, but the abundance of prey and its quality are responsible of M74 (Mikkonen *et al*., 2011). To inhibit M74, great variation in the size of prey stocks utilized by salmon should be avoided. In the Baltic main basin, where sprat reproduce, the size of the sprat stock needs to be under control, and possibly not allowed to exceed that of herring. The safest strategy for attaining this objective would be to ensure a large, stable cod stock (Casini *et al*., 2009), to prey on the sprat. Alternatively, increased fishing on sprat would have the same inhibiting effect on M74 (Keinänen *et al*., 2012).

1.3.2 Ecosystem impacts of fisheries and mixed fisheries overview

In a timespan of about one century, salmon fishing has first moved from rivers and coastal area near the river mouths to the offshore. And again during the last two decades the balance has shifted again back to coastal and river fishing. The expansion of offshore fishing coincided with the expansion of hathery-rearing and stocking programmes of salmon juveniles for fishing. Stocking volumes have lately somewhat decreased.

Catch of sea trout, especially in the coastal gillnet fishery, both as a targeted and as a non-target species poses a problem for the recovery of threatened sea trout stocks in many Baltic Sea areas. Sea trout are also caught as bycatch of some river fishing targeting salmon.

Discarding of seal damaged salmon occurs mainly in the coastal trapnet and gillnet fishery but also in the offshore longline fishery. Some specimens of seals drown in trapnets. Seal-safe trapnets are developed, which has lately decreased seal damages, discarding and seal deaths in gear.

Salmon and sea trout are caught by several gear types, and in some cases this has raised concerns about the reliability of catch estimates of the TAC controlled salmon vs non-controlled sea trout. This may skew estimates of fishing pressure on a specific species, thus making it more difficult to manage fisheries on such species which don’t comprise extra conservation concerns.

1.4 Response to last year Technical minutes

The aim of this section is to facilitate an efficient use by the WG of the constructive criticism presented in the Technical minutes of last year report, as well as a feedback to the review group how its advice is being used to improve the assessment. Find below Technical minutes from last year report (only those comments which required a response from the WG), including responses from the WG how comments/criticism from the review group have been handled in this year assessment. Note that the sections referred to in the technical minutes below relates to the WG report from last year and are not comparable to the updated report structure that has been adopted this year.

i) Section 2.3 – Discards, misreporting and unreporting of catches

As was the case last year, there is still an issue on misreporting and unreporting of catches. The RG again points out this needs some form of resolution to ensure the WG can operate with the most robust and realistic data possible; efforts to this end should be made, in preference before the data compilation prior to the 2015 model runs, as these runs are conducted before the WG meet.

Present data indicate a further decrease in misreporting in the Polish offshore fisheries being approximately 7000 salmon in 2014. Misreporting, however, potentially occur also in the Polish coastal fisheries, where no data (catch compositions) have been available for the group. The WG will consider making some form of resolution for the 2016 meeting to improve a data supply from Poland.

Apart from expert evaluations also possibilities to utilise new data sources (e.g. VMS data) in estimation of unreporting rates should be explored. WG would need an external expertise in conducting such an exercise.

ii) **Section 4.2.3 – Status of the assessment unit 1-4 stocks and development of fisheries in the Gulf of Bothnia and the Main Basin/Figure 4.2.3.10**

As noted last year by the RG, the estimated number of spawners in cases where observed returns (counter values) are available do not always agree very well (this applies to examples of both included and non-included counts in the model-fitting), indeed there are often notable differences (e.g. Kalix, Pite, Aby and Byske). This suggests a need to field check the counters:

1) Are raising factors applied from fish being missed by counters?

2) Are raising factors applied for counters positioned mid-way up a system?

This would seem especially important for counters which are included in the analyses. It is understood that the modelling framework for the data included in the model-fitting takes account of the above facts, but some explanation of how this has been handled modelling-wise would help in the WGBAST report (to be transferred into the Stock Annex when this annex is next updated).

To make model deviations from observed data more transparent, it would be desirable to have an additional figure similar to Figure 4.2.3.10, showing the adjusted observed counts versus the model-fitted returns, to aid visual comparison. (Examples of rivers for which this would be useful are the Kalix and the Byske rivers, in which the counters are higher upstream than rather large spawning areas). For the rivers for which the observed counts are included as part of the model fitting, the easiest way to do this comparison would just be to plot observed versus model-fitted values.

The estimated number of spawners does not always seem to fit well with the observed number of salmon in the counters (Figure 4.2.3.10). Reasons for this are river specific. In most of the rivers a part of the spawning habitats exist downstream from the counter and also a proportion of salmon can pass the counter without being observed. In addition, environmental conditions at the river tend to cause a variation on the proportion of the salmon that is observed in the counter (out of the group that passes the counter).

Data from spawner counters are used as such and no raising factors are applied on count data when those are fitted with the model predicted number of spawners in the model. Additional river specific data from mark–recapture experiments or expert knowledge is used when prior distributions are given for the proportion of salmon observed in the counter out of those that that reach the river. This parameter can also be interpreted as probability that an individual salmon will be observed at the counter, given that it reaches the river. For rivers Tornionjoki, Simojoki, Kalixälven and Dalälven the same, river specific, prior distribution for this proportion is given for each year in the time-series, but the parameter is allowed to vary annually. In case of river Ume/Vindel, annual data from mark–recapture experiments are used in defining prior distribution for the annual proportion seen in the counter. Such data are valuable in rivers, where environmental conditions can have large differences between the years for the salmon's success to find the fish ladder (and fish counter there). In addition, the spawner count data in Ume/Vindel differ from other rivers since there are no spawning grounds below the counter and all spawners that succeed to reach the spawning grounds are observed in the counter at the ladder. Thus, the number of spawners observed in counter is the maximum for a spawning cohort in Ume/Vindel, as the river fishery takes a share of spawning population that reach the spawning habitats above the ladder.

For some rivers, spawner count data are not utilized in the model. In rivers Pite, Åby, Byske and Öre sufficient amount of information is not available on the probability for a salmon to be seen in the counter, given it reaches the river. In river Piteälven, spawner count data are used in estimation of smolt abundance a few years later, and thus the same information cannot be used in estimation of number of spawners.

iii) Section 4.6 – Tasks for future development of the assessment

The RG notes the ambition by the WG to continue the work to include data from established index rivers in the stock assessment model. This includes e.g. fitting the model to smolt and spawner counts from River Mörrumsån. Somewhat related to this is the need to review and possibly update the parameterization of stock–recruitment dynamics and the priors (from hierarchical metaanalysis of Atlantic salmon stock–recruit data) used in the model; this is considered important, but difficult, by the WG. The RG notes that the model predictions on poor recovery of the Emån and Mörrumsån salmon might be a model-related issue rather than a real phenomenon. It was found striking that Emån smolts do not seem to converge towards the PSPC in the long-term when zero fishing is assumed (Figure 4.3.2.8h). Additionally, the posterior distributions of steepness are centred on much lower values for Emån and Mörrumsån than for other rivers (Table 4.2.3.1), and the S–R fits displayed in Figure 4.2.3.3 for these rivers do not seem particularly appropriate (just by eye), especially for Emån. Combining this with the fact that the posterior distribution of the PSPC for these two rivers is very close to the prior distribution (Figure 4.2.3.4), the suspicion is that the prior on the PSPC is strongly driving the results for these two rivers (it could also be the prior on steepness that is being highly influential on the results, but initial checks during the RG suggested that this is not the case). This was discussed carefully during the RG, together with the WGBAST members present at the RG, and it was concluded that highest priority should be given to explore this issue carefully and to find a solution to this problem (if this is found to be a model-driven rather than a real result). If these stocks cannot be dealt with properly within the Bayesian model, it might become necessary to model them separately.

Tasks for future development of the assessment; poor fit of the stock–recruitment function for rivers. Currently, the number of eggs per recruit (SBPR) is not dependent on vital rates (natural mortality, maturation, etc.) but has a stand-alone prior. As a result, since the stock–recruit slope at the origin parameter is calculated from SBPR and steepness, the current stock–recruit parameterization could give rise to a population that is increasing or decreasing over time (i.e. not at the steady state) in the absence of fishing. In addition, spawner biomass per-recruit (SBPR) is currently estimated on a stock-specific basis; this is undesirable as the variables that contribute to SBPR do not vary by stock in the model. Posterior estimates of SBPR have differed markedly by stock, particularly in the case of rivers Emån and Mörrumsån (much higher than those for other stocks). For Mörrumsån, this appears to have been alleviated to some extent by the inclusion of a new PSPC prior with a lower median in the 2015 assessment, which leads to a higher estimate of the stock–recruit slope at the origin. The new PSPC prior for Emån did not have this effect as it has a higher median, so that the posterior estimate of SBPR for Emån is still much (and probably implausibly) higher than estimates for other stocks (Table 4.2.3.1).

The failure for smolt production to converge towards potential smolt production capacity (PSPC) under the 0 fishing scenario (scenario 5) remains unchanged for Emån, and also for Mörrumsån. The lack of an effect of the new PSPC prior on projected recovery in Mörrumsån may be related to the fact that the estimate of stock–

recruit steepness remained very similar to that in the 2014 assessment (because the change in PSPC resulted in a compensatory change in the SBPR estimate).

Specific suggestions are made in Section 4.6 of the 2015 WGBAST report, as follows:

1) Calculate SBPR within the model as a function of vital rates (natural mortality, maturation, fecundity, etc.) and remove the dependency on stock by removing the stock subscript for SBPR. This represents a different assumption about stock–recruitment dynamics than has been made previously in that the resulting stock–recruit slope at the origin would correspond to demographic equilibrium (steady state dynamics) with no fishing. Several of the variables that contribute to SBPR vary by time in the model, so that SBPR would also vary in time; if this presents computational difficulties, a hierarchical structure could be used for time varying parameters (e.g. Mps and maturation rates) so that the cross-year mean could be used in the SBPR calculation.

2) Replace the priors on steepness and PSPC with priors for the maximum survival of one egg and the stock–recruit asymptote (maximum recruitment), as in Pulkkinen and Mäntyniemi (2013). SBPR could then be calculated as in 1) to obtain PSPCs (recruitment at the stable state under unfished conditions) as a function of maximum recruitment, alpha and SBPR. Implementing this SR parameterization directly would not remove the problem of the lack of steady-state dynamics with no fishing; e.g. stock–recruit steepness (a function of the maximum survival of one egg and SBPR) would also need to vary in time, with the stock–recruitment function parameterised in terms of steepness. The effect of replacing the current prior on PSPC with the same prior on maximum recruitment needs to be investigated: this could potentially result in lower PSPC estimates if the stock-recruit relationship is not very steep.

The carrying capacity (maximum potential recruitment) in several rivers (Emån, Mörrumsån, Rickleån) is likely to have changed over time as a result of addition of new fish ladders, etc. that have opened up new habitat. For example, the lowermost dam in Emån was opened permanently in 2006. Activities are also ongoing to facilitate up- and downstream migration at the second dam counted from the sea, above which significant habitat areas regarded suitable for salmon reproduction are located. A more realistic description of stock–recruitment dynamics could be achieved by accounting for the fact that the production area has changed over the timespan of the assessment model. Accounting for such changes in production area, and thus carrying capacity, could potentially improve the fit of the estimated stock–recruit function, particularly for Emån, and aid estimation of stock–recruit steepness.

iv) Section 5.5.1 – Status of stocks

There was no update of the assessment of sea trout this year, but this is planned for the next year. The previous assessment was conducted in year 2012, based on 0+ densities in relation to habitat quality indices at the electrofishing sites. The RG was informed about a workshop on sea trout during autumn 2013 (WKTRUTTA), but the outcome of the workshop was not available during the RG meeting. Considering the problem in separating between sea run and resident brown trout in 0+ fry during electrofishing, a considerable component of expert knowledge is needed in order to perform the sea trout assessment on the basis of parr densities; this causes concern to the RG. This problem may have been addressed at the previously mentioned workshop; if this is not the case, the RG suggest further work to develop methods that are not so strongly dependent on expert knowledge. A science-based workshop with focus on developing a more reliable assessment method for sea trout is suggested to help that development.

The sea trout assessment was updated and is presented in Section 5. No new methodological development, however, was possible to carry out by the group. The assessment repeated the analysis from year 2012 with an updated data and with slight amendments in the assessment procedure. In order to develop the assessment model that was applicable to all Baltic Sea areas the group will need external expertise and support.

v) Further comments

The RG has some concerns about the 75% PSPC concept used as the basis for MSY reference points. The question came up during the RG meeting when discussing the relationship between the variation in steepness in the stock–recruit curves between the different salmon stocks, and especially between the northern and the southern stocks. The issue was discussed at length during the RG meeting, involving everyone present at the RG. The WG should verify that the 75% PSCP is consistent with the MSY-approach also for the southern stocks for which the steepness is estimated to be just around 0.3–0.4 (these estimates of steepness may, however, change once the issue of the PSPC prior is re-examined). It is recommended that the work conducted by WKBALSAL in 2008 is examined, as the issues discussed at that workshop appear to be very similar to those discussed during the RG meeting.

The working group was not able to progress the estimation of stock-specific MSY reference points and verify the consistency of 75% PSPC with MSY-approach over all stocks for this assessment. The group intends to continue the work, but it’s uncertain whether working group members will have possibility to allocate all required time for this development work by the year 2016 meeting.

The RG asked about information on individual growth of salmon in the Main Basin as there are some concerns about reduced growth rate in cod due to changes in the spatial distribution of its food item sprat (lack of sprat in the area SD 22–26). As salmon are mainly feeding in the same area as cod and have sprat as a preferred food item, one would expect a reduced growth of salmon is also possible. The WGBAST did not look into this in 2014. The general impression was however, that growth has not been reduced in recent years. It would be useful if WGBAST could come up with growth data next year, or maybe even include these as a standard content of the WGBAST report. Most assessment working groups include growth data as a standard content of their report as this is an important metric for the general state of the stock.

This issue was ignored by accident as the growth data do not belong to a regular assessment input dataset. Growth data will be presented in the WGBAST 2016 report.

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2 Salmon fisheries

2.1 Description of gears used in salmon fisheries

A description of the gears used in different fisheries, both commercial and recreational, is given in the Stock Annex . Extensive descriptions of gears used as well as historical gear development in the Baltic salmon fisheries are also available in ICES (2003). Commercial catch statistics provided for ICES WGBAST are mainly based on logbooks and/or sales notes. Non-commercial catches are mainly estimated by questionnaires or special issues. Detailed information on catch statistics (also on a country level) is given in the Stock Annex .

2.2 Catches

The catch tables include both commercial and non-commercial fisheries from sea, coast and rivers. Discards and unreported catches are not included in nominal catches but are presented separately in the catch tables. Estimation procedures for discards and unreported catches are described in the Stock Annex. More detailed information on discards and unreporting on a country-by-country level is given in Section 2.3.

The catches in weight from 1972–2014 by country, including separate columns for non-commercial catches, discards and unreported catches from 1994 and onwards, are presented in Table 2.2.1. The catches in numbers are presented in Table 2.2.2, where also the share of discards and unreported catches from 1994 and onwards are presented in separate columns. Catches by area and country in tonnes are presented in Table 2.2.3 and by Subdivision in Table 2.2.5. Nominal catches in numbers by country from sea, coast and rivers are presented in Table 2.2.4. Values on discards and unreported catches (Tables 2.2.1, 2.2.2.) are calculated using conversion factors (see Section 2.3 and also Annex 3) and are reported in terms of most likely value and 90% probability interval (PI). An overview of management areas and rivers is presented in the Stock Annex. The recreational (=non-commercial) catches in numbers by country are presented in Table 2.2.6.

There has been a decline of the total nominal catches in the Baltic Sea starting in 1990 from 5636 t decreasing to 881 t in 2010, which was the lowest catch registered since 1970. Since then catches increased to 1020 tons in 2014.

Catches by type of gear in percent (weight) are presented in Figure 2.2.1. Due to the total driftnet ban being enforced in 2008, the proportion of the total catches by driftnet has been 0% since then. During the period, the proportion of the coastal catch (mostly trapnets) has gradually increased and in 2014 it was 46% of the total nominal catches.

The proportion of non-commercial catch has grown in the total nominal catches. In 1994, non-commercial catches were 10% of the total nominal catches. In 2014 this share reached 40%. The proportion of the non-commercial part of the total catches (including river catches) from 2004 and onwards are presented in Figure 2.2.2.

Denmark: The Danish salmon fishery is a typical open sea fishery. Apart from estimated recreational catches of 3500 salmon in 2014 and a small unknown amount of salmon caught by non-professional fishermen along the coast, all salmon were caught by longline in the open sea. As usual the longline fishery took place in the cold months (December–March), when the water temperature is below 10 degrees C, and the garfish are not active.

The catches in 2014, including the recreational fishery, were 124,5 tons (2013: 133 tons), and 20 982 salmon (2013: 24 657 salmon). The number of fish caught decreased by 14,9% from 2013 to 2014. The number of salmon caught by recreational trolling boats is based on information collected from sport fishermen and from boat rental companies. Estimated catches in trolling in 2014 give a figure of 3000 salmon, 500 salmon is estimated to be caught by other recreational fishermen, mostly by longlining.

Almost all catches, including the recreational fishery, were caught in ICES Subdivision 24–25, very close to Bornholm, as the salmon fishery was very limited and the vessels targeting salmon are quite small for operating in the open sea.

Estonia: There is no fishery targeting particularly salmon in Estonia. In the costal fishery salmon is a bycatch and the main targeted species are sprat, European flounder and perch. The share of salmon in the total coastal catch is less than 1%. The salmon catch in 2014 was 8 t, which is slightly smaller than in previous year. Vast majority of salmon is caught from the Gulf of Finland (SD 32). In that region there are about 570 commercial fishermen and besides that up to 6433 monthly gillnet licenses are distributed annually for non-commercial fishers. Commercial fishermen comprise about 68% of all caught salmon. Vast majority (88%) of it is taken by gillnets and the rest is taken by trapnets. About 75% of annual salmon catch is caught in September, October and November and nearly all caught salmon at that time are spawners.

Finland: In 2014 Finnish fishermen caught 64 886 salmon (436 t) from the Baltic Sea, which was about 13 % more than in 2013. Commercial catch was 38 886 salmon (252 t). Recreational catch including river catches was 26 000 salmon (43,7% increase from 2013). Decrease in the catch occurred mainly in commercial fishery. There has been no commercial salmon fishing in the Southern Baltic Sea by the Finnish vessels after 2012. All commercial catch was taken in the coastal fishery mainly by trapnets and the catch increased about 2% from 2013. Finland had an extra quota of 5000 thousand salmon swapped from Latvia. Commercial catch data from year 2014 are preliminary. River catches (recreational) was 18 880 (144 t) and it increased 63% from 2013 and the most was taken from the river Tornionjoki. Catch estimate of the recreational fishery in sea was highly uncertain particularly in the Gulf of Finland (see confidence intervals of catch estimates in Table 2.2.6). The estimates of recreational salmon catches in sea for years 2012-2014 are based on the results of the Finnish Recreational Fishing 2012 survey. The survey method is described at http://www.rktl.fi/english/statistics/statistics_by_topic/recreational_fishery/. The river catches has been estimated by the annual surveys in rivers Tornionjoki and Simojoki, and by interviews and voluntary riverside catch statistics in other rivers.

In the Gulf of Finland commercial salmon catch in subdivision 32 was 8 522 (60 t) and recreational catch including river catches 580 salmon (4 t). Most of the recreational catch was caught in the river Kymijoki. Trapnets caught 99% the commercial salmon catch of the area. In all 56 fishermen fished salmon with 177 trapnets with the effort of 11 162 trapnetdays (about the same as in three previous years). There was only sporadic longline offshore fishing for salmon in the area (91 salmons, 397 kg).

Germany: The total reported commercial catch of salmon was 6.32 t or 1264 individuals (5 kg mean weight per salmon) in 2014 (ICES Subdivisions 22–25. However, there is currently only very little German commercial fishery directly targeting salmon and a considerable part of the salmon catch is caught as bycatch in other fisheries (particularly trawl and gillnet fisheries). There is no recreational salmon fishery data available. However, in recent years an extensive trolling fishery has been observed and a survey is planned to estimate trolling catches.

Latvia: In 2014 the total catch was 1878 (8,7 t) salmon, which was in numbers 10% less than catch in 2013. Coastal catches recreational and commercial included 1112 salmon (3,3 t). In 2014 Latvian fishing vessels were not engaged in salmon offshore fisheries. About 5,4 tons of salmon were caught in commercial fisheries in the rivers, mainly in broodstock fisheries in the rivers Daugava, Gauja and Venta.

Lithuania: In 2014 Lithuanian fishermen caught 582 salmon (1,9 t), about a half of the catch from 2013. Most of salmon were caught in in Curonian lagoon. Additionally, 28 salmon were caught in the rivers for artificial rearing and six for scientific purpose.

Poland: Overall offshore and coastal catch was 3108 fish (26,3 t), 40% less than in 2013. River catch was extremely low; only ten fish, one of the reasons was seal predation. The reported river catch originated mostly from Vistula River and Pomeranian rivers. The catch was made for brood stock purposes.

Russia: There is no fishery targeting particularly salmon in Russia. Salmon and sea trout can be caught as a bycatch in the coastal fishery (by trapnets and gillnets) where the main targeted species are herring, sprat, smelt, perch, pikeperch, etc. However, in Russia there are no official statistics of bycatches. In 2014 Russian fishermen caught 418 salmon (1,7 t) in the rivers in Subdivision 32 during broodstock fishing.

Sweden: Total weight of Swedish salmon catch decreased from 442 tonnes in 2013 to 417 tonnes in 2014 and it is the lowest recorded annual catch weight for the period 2005–2014. The catch in coastal fisheries decreased from 216 tonnes to 198 tonnes, whereas the offshore catch in the Main Basin (ICES Subdivisions 22–29) was on the same level (46 tonnes). River catches decreased from 180 tonnes in 2013 to 165 tonnes in 2014.

Of total catches (in weight), the offshore catch constituted 11%, coastal catch 49% and river catch 40%.

No offshore catch was recorded since 2009 in Gulf of Bothnia, but the coastal catch decreased from 216 tonnes in 2013 to 204 tonnes in 2014.

Total river catches decreased from 180 tonnes in 2013 to 166 tonnes in 2014.

In commercial trapnet fishery 28 187 salmon has been caught in 2014, compared to 27 922 fish in 2013. In recreational trapnet fishery 3826 salmon has been caught in 2014.

Distribution of catches by countries in comparison with the TAC

Until 1992 the TAC was given in tonnes, but from 1993 the TAC has been given in numbers. The commercial landings in numbers (excluding river catches) compared to TAC by fishing nations and by areas in 1993–2014 are given in Table 2.2.7.

Unreported catches and discards are not included in the utilisation of the TAC, but total catches of salmon including unreported catches and discards are presented in % of TAC in Figure 2.2.3.

In 2014, 80,3% of the TAC in Subdivision 22–31 was utilised (total TAC was 106 371 individuals (according to COUNCIL REGULATION (EU) No 1180/2013 of 19 November 2013). In the Gulf of Finland, 72% of the EC TAC of 13 106 individuals was utilised. The were no Russian catches. It should be noted, that there occasionally can be some quota swapping between countries, which may result in exceeded original national TAC's. In 2014 such an exchange took place in Finland, where 5000 salmon was exchanged from Latvia. There was an EC Regulation on reduction of Polish quota by 216 salmon based on estimated overfishing in 2013, thus Polish TAC for 2014 was reduced to 6484 fish. The total TAC for salmon was allocated to countries and utilized in the following manner in 2014:

	Subdivision 22–31			Subdivision 32		
Contracting party	Quota (nos.)	Sea/Coast Catch (nos.)	Utilized (%)	Quota (nos.)	Catch (nos.)	Utilized (%)
Denmark	22 087	20 982	95%	-	-	-
Estonia	2245	563	25,1%	1 344	908	67,5%
Finland	27 541	30 364*	110,2%	11 762	8 522	72,4%
Germany	2457	1264	51,43%	-	-	-
Latvia	14 089	340	2,4%	-	-	-
Lithuania	1 651	582	35,2%	-	-	-
Poland	6 484**	3 108	47,9%	-	-	-
Sweden	29 857	28 216	94,5%	-	-	-
Total EU	106 371	85 419	80,3%	13 106	9430	72%
Russia 1)	-	-		-		-
TOTAL	106 371	85 419	80,3%	13 106	9430	72%

1) No international agreed quota between Russia and EC.

*** with use of swapped quota from Latvia**

**** after reduction according to Implementing Regulation (EU) nr 871/2014**

The major part of the salmon catch in the Baltic Sea was caught by professional fishermen with longlines in the offshore areas, or by trap- and gillnets in the coastal areas. The catches in the recreational fishery using commercial gear-types are for self-consumption. These catches are usually not reported through the official channels and therefore the figures have to be estimated. Table 2.2.6 and Figure 2.2.2 give an estimate of the magnitude of this fishery and it appears from the table that non-commercial fisheries constitute a considerable and growing part of the total catch of salmon. In 2014 non-commercial catches (in numbers from coast, sea and river) constituted 35% of the total reported salmon catches.

2.3 Discards, unreporting and misreporting of catches

In general, data on discards and unreporting of salmon from different fisheries in the Baltic Sea are incomplete and fragmentary for years 1981–2000. Estimation procedures for discards and unreported catches for years 1981–2000 and misreported catches for years 1993–2000 are described in the Stock Annex. For years 2001–2014 the estimates for discards and unreporting have been computed with a new method and updated with expert evaluations that are described below The new estimation model was applied for the first time in WGBAST 2013.

The coefficient factors for unreporting and discarding by country and fisheries were updated for fishing years 2001–2012 during the IBP Salmon in autumn 2012 (ICES 2012IBP) and in addition for year 2013 and 2014 in the WGBAST 2014 and 2015 respectively. Expert evaluations were given from Poland, Denmark, Sweden and Finland for all relevant fisheries of the country concerned. These countries cover the main fisheries and together they have fished more than 95% of the total Baltic salmon catch in in the last few years. Parameter values for the elicited priors and pooled (average) probability distributions for different conversion factors by country and year period are given in the Table 2.3.1. In WGBAST 2013 and 2014 theaverage conversion factors were calculated for all parameters separately for years before and after 2008 because of the change in relative weight between the fisheries in 2008 due to ban of driftnet fishing. Finland and Sweden stopped salmon offshore fishing in the Main Basin in 2013 which further changed the relative weight between the fleets and therefore the relevant conversion were computed separately for fishing years from 2013 onwards.

In WGBAST 2015 the average conversion factors for a certain parameters were abandoned, because they were considered to give a too biased estimate for a certain fisheries and fleets. For example the average share of the seal damaged salmon in the offshore fishery based on the Swedish, Danish and Finnish data was now considered to give too high estimates for the discarded seal damaged salmon in the Polish offshore fishery before year 2012. The average values of the following parameters were seen inapplicable and consequently abandoned: share of unreported catch in offshore fishery, share of unreported catch in coastal fishery, share of discarded seal damaged salmon in longline fishery, share of discarded seal damaged salmon in driftnet fishery and share of discarded seal damaged salmon in trapnet fishery. The average values of these parameters were removed from the Table 2.3.1. Instead of average values a minimum available observed value of the parameter concerned was used for the countries and fisheries where data or expert evaluation was not available. As a result of this change the total estimates of discarding and unreporting before year 2012 changed to some extent. The expert evaluation of unreporting rate in the Polish fisheries in 2014 was updated significantly downwards in the WGBAST 2015. The rest of parameters had the same values and in fishing year 2013. Apart from the parameters listed above the average values were used for German, Lithuanian, Latvian, Estonian and Russian fisheries as country specific expert evaluations for coefficient factors were missing for those countries. The catches of these countries represent less than 5% of the total catch of Baltic salmon. The transformation method of the parameters of the expert elicited triangular probability distributions to parameters of the lognormal distributions is presented in Annex 4.

Assumptions in estimation of unreported catch and discards:

- In estimation of unreported salmon catch in the Polish fishery it was assumed that the same rate of unreporting prevails in misreported catch as in reported catch.
- In estimation of seal damages and discarded undersized salmon in all fisheries the unreporting (and misreporting in the Polish offshore fishery) was counted into the total catch i.e. similar rates were assumed for unreported catch components as to the reported salmon catch.
- In the Finnish and Swedish salmon fisheries seal damaged catch is derived from the logbook records. These catches were raised by the relevant unreporting rates i.e. the same unreporting rate was assumed for the seal damaged catch as for the unharmed catch.

Estimated unreported catch and discarding for the whole Baltic Sea are presented in Tables 2.2.1 and 2.2.2. Comparison of estimated unreporting and discard between the year period 1981–2000 and 2001–2014 shows that the main difference is in the order of magnitude of estimates in discards. This is mainly as a result of updated expert opinions and partly the adoption of new computing model which was realized at the IBP Salmon in 2012 and in the WGBAST 2013. Main part of the discards is seal damaged salmon and it occurs in the costal trapnet and gillnet fishery but also in the offshore longline fishery (Table 2.3.2.) Small amounts of undersized salmon are estimated to be discarded in the offshore longline fishery. Country specific estimates for discards and unreporting are presented in the Table 2.3.4. The estimates are uncertain and should be considered to illustrate a rather rough magnitude of discards and unreporting.

Discards

In 2014 catch approximately 10 300 salmon was discarded due to seal damages. About half of these discards (4700 salmon) took place in the Danish and Polish LLD fishery in the southern Baltic sea (Table 2.3.2). Estimate was based on the observed proportion of seal damaged catch in subsamples that has been extrapolated to the total catch. In this calculation also the potential misreporting and unreporting was included in the total catch. In the Danish LLD fishery approximately 15% (5%–30%) of the catch was seal damaged and in Polish LLD fishery in Subdivision 26 about 25% (5%–65%). Representativeness of these data is unknown to the WG. Amounts of seal damaged catches in the Main Basin have increased to significant rates in the last few years and a monitoring will be needed in order to attain reliably estimates on the total removals in this fishery.

In 2014 approximately one third of the seal damaged discards (2600 salmon in the Gulf of Bothnia and 700 salmon in the Gulf of Finland) took place in coastal trapnet fishery that mainly occurs at the Swedish and Finnish coasts in the Gulf of Bothnia and Gulf of Finland. In both of these countries the data on the seal damages are based on the logbook records. The reported amounts of seal damaged salmon should, however, be regarded as a minimum estimate. Particularly in the Swedish coastal fishery in the Gulf of Bothnia the reported rate of seal damages is unexpectedly low. Seal damages started to escalate gradually from 1993 but the introduction of seal safe trapnets has levelled off the catch losses. In 2014 in the Finnish trapnet fisheries seal damages covered about 8% of the total salmon catch The last data from Sweden is from 2011 and the same rate of damages are assumed also for the fishing years 2012–2014. The reporting rate of the seal damaged catch was assumed to be the same as for the undamaged catch in the coastal fishery.

Dead discards of undersized salmon were approximately 207 salmon in the whole Baltic Sea. Proportions of undersized salmon in the catches of different fisheries are based mostly on the sampling data and are considered to be rather accurate (Table 2.3.1). Mortality estimates of the discarded undersized salmon that are released back to the sea are based on the expert opinions but are uncertain because little studies have been carried out on the subject. Mortality of the undersized salmon released from longline hooks is assumed to be high (around 80%) but the true rate is uncertain. In the trapnet fishery the mortality is assumed to be low (around 40%) but also there the true rate is uncertain. The experiment design and setting to study these mortalities are very challenging but such studies are needed in order to better estimate the total removals caused be fisheries.

Smolt and adult salmon are frequently caught as a bycatch in pelagic commercial trawling for sprat (mostly for supplying fish for production of fish meal and oil) and are probably often unreported in logbooks because amount of salmon in catch is low and can be counted only during unloading. Polish data (Grygiel 2006) concerning foreign vessels fishing in Polish EEZ indicates that such a amount of salmon can be of 100 kg per cruise (885 t of sprat). Counting all Baltic pelagic catches aimed for fish meal in 2009 as 173 033 tons (EUROSTAT 2009) it gives 20 tonnes of salmon for 2009. About the same magnitude of discards of salmon post smolts were estimated in an exercise made in WGBAST 2011 based on the Swedish DCF sampling data from trawl surveys (WGBAST 2011). Estimates of these potential removals, however, are so uncertain because of insufficient data that they are not taken into account in the present assessment. There is either no estimate on the potential unreporting of bycatch of legal sizes salmon in pelagic trawl fishery. The reported catch from the trawls is accounted in the catch data even though it has been very small.

Misreporting of salmon as trout in the Polish salmon fishery

In the WGBAST 2014 the Polish misreporting was recomputed for years 2009–2013, because the WG got a new data on the catch compositions in the Polish longline catches. The data is collected by the Polish Marine Fisheries Research Institute in the EU Data Collection Framework (DCF) sampling trips on the Polish longline vessels which have operated at the offshore in Subdivisions 25 and 26 in years 2009–2013 (Table 2.3.3 and Figure 2.3.1). The data were available in the ICES Regional Database (RDB). The counts in the data represent to total catch on the trip concerned.

The Polish data on all offshore fishing trips and their location was not available to the WG but according to Polish expert the sampling represented 0.5% of the total number of days at sea in year 2010 and even smaller fraction in 2011–2013. With a clear under representativeness of sampling, however, the observed proportion of salmon in catches of sampled trips is consistent and have a very little variation. None of the observations indicated substantial proportion of sea trout in the catch. These data suggest that Polish longline fishery is almost pure salmon fishing where only little sea trout appear in the catches (annually 0%–3%, Table 2.3.3). The catch compositions in this data correspond to catch compositions that have been observed in the catches of other countries' vessels in the area (ICES WGBAST 2012). Based on the given data a 97% proportion of salmon was assumed in the total Polish longline catch (salmon + sea trout) for fishing years 2009–2014. This is a conservative estimate and it excludes a potential misreporting of the coastal fishery. Misreporting estimates for fishing years 1993–2008 are unchanged and they are based on the assumption that cpue in the Polish offshore fisheries (driftnet and longline) corresponds 75% of the cpue of other countries' fleets in the corresponding fishery in the area (see e.g. ICES WGBAST 2012).

The total catch of the Polish longline fishery has decreased significantly in the last few years. Estimated misreporting was 6799 salmon in year 2014, which was about half of the estimated misreporting in year 2013 (Table 2.2.2). Polish reported salmon catch in the longline fishery was 2250 salmon and 7045 sea trout in year 2014.

Misreporting in the costal fishery was not estimated even though a potential misreporting could take place there too. The new sampling data from costal gillnet fishing presents very low proportion of salmon in the catches (annually maximum 5%) and Subdivision 24 has marginal (1–2%) share of total coastal catch.

In 2014 Poland presented Regulation (EC) nr 1223/2013, which was based on results of extensive EC and national controls (45% coverage of all landings) and gave a decrease by 23% of Polish TAC in 2013. Such a percentage as an official factor was proposed to use for assessment of misreporting, Similar document (Commission Implementing Regulation (EU) No 871/2014), decreasing the Polish TAC by 3,2% in 2014, was presented to WG in 2015, which can proof the better control and lower

level of potential misreporting of salmon in Poland, however, WGBAST did not use both sources for assessment purposes.
The present misreporting estimates should be considered as a rough order of magnitude. The WG would benefit from any Polish contribution in providing with data or relevant reports that would support the estimation of misreporting rates in their offshore and coastal salmon fisheries. Polish experts in the WG didn't see the present data usable in terms of catch composition (see comments below) and therefore Poland should make sure that all fish in catch are counted during each the DCF sampling trips on LLD vessels and that the planned number of trips will be carried out with an appropriate areal and temporal coverage.

Comments provided by Poland on "Misreporting of salmon as trout in the offshore fishery"

Poland sustains most of its explanations and comments given in its statements in WGBAST Report 2012 and 2013. Data on proportion of salmon and sea trout in Polish LLD fishery, considered for use in WGBAST 2015 and based on Polish DCF sampling, have only indicative not quantitative value. DCF salmon/sea trout sampling is aimed for collecting biological measurements, not for assessing share of catch, because it is not only based on sampling at sea but also on sampling on land, where catch is already separated and did not necessary reflects the real share of both species in a single catch. Moreover, DCF sampling at sea has very low representativeness concerning days at sea comparing to yearly amount of days at sea of the whole Polish salmon LLD fleet (e.g. 0,2% in 2007, 0% in 2008, 0,5% in 2010) and thus again cannot be considered as a reliable source for obtaining the share of catch.

Below follows detailed information on discards and mis- and unreporting of catches country by country.

Denmark has no information from which it is possible to estimate discard percentages, however, it should be available to the WG from DCF data sampling. Observers from the DTU-Aqua have participated in the herring and sprat fishery in the Baltic in the winter 2007/2008 for about 50 days, and bycatches of only a few salmon were observed in this fishery. Since the quota for salmon in recent years has not been fully utilized, it seems unlikely, however uncertain, that there are unreported catches in the professional salmon fishery. On the other hand restrictions in possibilities for marketing larger salmon due to restrictions from dioxin contents could result in unreported catches. There are no records of misreporting of salmon as other species (e.g. sea trout). The reported seal damages in commercial fishery increases and varies from 2% to 40% of catch, especially in fisheries around Bornholm.

In **Estonia**, seal damage is a serious problem in the salmon and sea trout gillnet fishery. Information from fishermen shows that damages by seals have increased over time. A quantitative assessment of these damages is not available, however, as fishermen in most cases do not present claims for gear compensation.

In **Finland** the reported discards due to seal damages were 3330 salmon (19 t) salmon in 2014. This was about 3% more than in previous year. Seals caused severe damages to all fisheries mainly in Subdivisions 29–32 where seal damages made 80% of total seal damages in Finnish waters and comprised 8% of the total commercial catch in the region. In the Gulf of Finland discards of the seal damaged salmon were 682 fish (4 t), being 7% of the total commercial catch in the area. Other discards (seagulls, etc.) were 110 salmon (0,3 t).

In **Latvia** direct catch losses of salmon by seal damages increased significantly from 2003. In the most affected area, southern part of the Gulf of Riga, the percentage of salmon damaged by seal in coastal fishery increased from 5% in 2002 to 40% in 2003 and 60% in 2004. Due to increasing of catch losses salmon fisheries in the autumn of 2005–2007 carried out in the lower part of the river Daugava. Seal caused salmon damages were not observed in the river. The number of seal continues increase in the last year. Due to this reason salmon fisheries in late autumn in the coastal waters (especially by gillnets) of Latvia becomes economically unfavourable. Experimental fishing by seal-safe gear (produced in Sweden) was unsuccessful. Gear was too fragile for fishing in open coastal waters with dominating SW–NW direction winds.

In **Lithuania** information on discards, misreporting and unreporting is not available.

In **Poland** sampling in 2014 resulted in 1,5% of undersized fish caught in the longline fishery. Rapidly increasing amount of damages by seals was observed in recent years in both offshore and coastal fisheries in Gulf of Gdansk area (Subdivision 26). No cases were reported from Subdivision 24 and 25. Provisional NMFR data from 2013 indicates that share of seal damaged fish in separate catches was min. 5%, maximum 65% and average 25%. In 2014, similarly to 2013, due to seal attacks almost no catch was reported and no spawners of sea trout or salmon were collected in autumn in the Vistula River mouth, which was in the past, the best place for sea trout fishing and collecting live spawners.

In **Russia** information on discard, misreporting and unreporting is not available. However, unofficial information indicates presence of significant poaching of salmon and sea trout both in the coastal area and in rivers.

In **Sweden** the estimated amount of seal damaged salmon decreased with 26% from 2012 to 2013 (no new data for 2014). The decrease can be explained by the closing of the Swedish commercial offshore longlining in spring 2012, a fishery in which reported seal damages had increased over the years. Furthermore, the reported proportion of seal damaged salmon in the Swedish coastal trapnet fishery has decreased from about 8% in year 2000 to only 1.3% in 2011. A likely reason for the declining amount of reported seal discards in the commercial coastal fishery is the increased use of push-up traps; the yearly share of salmon captured with such 'seal safe' gears has increased from 0% in the early 2000s to about 60% in 2008–2011. However, it should be noted that the current level of seal damaged salmon in the non-commercial coastal fishery is probably higher, since push-up traps are much less common among non-commercial fishermen (the non-commercial coastal fishery was estimated to account for ca. 2.4% of the total Swedish coastal salmon catch in 2013). For year 2012–1014 there was no logbook data available on the number of seal damaged salmon in the Swedish salmon fishery. Therefore a same proportion of seal damaged catch was assumed to occur in years 2012–2014 as in year 2011 in the corresponding fisheries. Rate of seal damages was around 1% in the coastal trapnet fishery in the Gulf of Bothnia.

2.4 Fishing effort

The total fishing effort by gears and by the main three assessment areas for the commercial salmon fishery in the Main Basin (Subdivision 22–31), excluding Gulf of Finland, is presented in Table 2.4.1, which includes Baltic salmon at sea, at the coast and in the rivers in 1987–2014. Cpue in trapnets in the Finnish coast of Gulf of Finland was 0.7 salmon in 2014, which is the same like in 2013 (Table 2.4.4). The total effort and catch in the Finnish offshore fishery in Gulf of Finland (mainly longlining) has been too low since 2010 to draw any conclusion regarding development in cpue.

Development over time in the fishing effort for the offshore fishery is presented in Figure 2.4.1, and for the coastal fishery in Figure 2.4.2. The fishing effort is expressed in number of gear days (number of fishing days times the number of gear). The coastal fishing effort on stocks of assessment unit 1 (AU 1, see Section 5) refers to the total Finnish coastal fishing effort and partly to the Swedish effort in Subdivision (SD) 31. The coastal fishing effort on stocks of AU 2 refers to the Finnish coastal fishing effort in SD 30 and partly to the Swedish coastal fishing effort in SD 31. The coastal fishing effort on stocks of AU 3 refers to the Finnish and Swedish coastal fishing effort in SD 30. Because sea trout in Poland are fished with the same gear type as salmon, effort from the Polish fishery targeting sea trout was included in the table before 2003.

An overview of the number of fishing vessels engaged in the offshore fishery for salmon during the last 15 years in Subdivision 22–32 is presented in Table 2.4.2. Germany has no regular fishery targeting salmon directly, and is catching salmon mostly as a bycatch in other fisheries.

In 2014, 42 vessels were engaged in the offshore fishery and it was a 38% decrease compared to the number in 2013 (68 vessels). In 2014, nine vessels fished more than 20 days.

The total effort in the longline fishery in 2014 increased by 29% to 1 131 000 hooks compared to 874 000 in 2013 (Figure 2.4.1). The effort in the trapnet fishery has remained on a same magnitude since 1999 (Figure 2.4.2).

Catch per unit of effort (cpue) values on a country-by-country level are presented in Table 2.4.3.

2.5 Biological sampling from the catch of salmon

All EU Baltic sea countries follow the Data Collection Framework (DCF). The national data collection programmes under the DCF mostly include different fisheries regions (offshore, coastal, river), different fisheries (e.g. commercial, angling, broodstock), and different origin (wild, reared) of fish. General information on the structure of the data collection in different fisheries, including also length of time-series, is presented in the Stock Annex. An overview of samples collected for biological sampling in 2014 follows below:

	Time period			Number of sampled fish by subdivision					
Country	/ month number	Fisheries	Gear	22–28	29	30	31	32	Total
Denmark	1–12	Offshore	Longline	392					392
Finland	5-9	Coastal	Trapnet		587	274	660		1521
	5-8	River					796		796
Latvia	8–11	River	Gillnet+Trapnet	508					508
Estonia	1–12	Coastal	Gillnet					49	49
Lithuania	8–10	Coastal	Gillnet+Trapnet	118					118
Poland	2–12	Offshore	Longline	710					710
Russia	9–11	River	Gillnet+Trapnet					434	434
Sweden	5–8	Coastal	Trapnet			284	283		567
	4-9	River	Various	135		366	176		677

Time period	Number of sampled fish by subdivision					
Germany*	0					0
Total	1863	587	924	1915	483	5772

*** not counted as EU DCF.**

Denmark: There were 392 scale samples collected from Danish landings in 2014. The total number of 187 collected samples were used for DNA analyses and scale reading. Analyses were conducted in Finland (RKTL, Helsinki).

Estonia: Starting in 2005 Estonia follows the EU sampling programme. Sampling takes place occasionally, carried out by fishermen. In 2014. 49 samples were collected.

Finland: In 2014 catch sampling brought in 1521 salmon scale samples from the Finnish commercial salmon fisheries and 796 salmons from recreational river fisheries. The samples represented fisheries in terms of time and space. The whole pool of samples was resampled by stratifying according to appeared catches. The final amount of analysed samples was optimally adjusted to meet the quality criteria of DCF. Finally the total numbers of samples were analysed by scale reading and part of these also by DNA microsatellite techniques.

Germany: In the past, only catch statistics have been collected and biological data are irregularly and on a small scale sampled from the commercial salmon fishery as the reported catches are very low leading to a poor availability of commercial samples. In 2014 no sampling for biological data has been performed.

Latvia: From 2008 Latvia's vessels were not engaged in salmon offshore fisheries. In coastal fisheries salmon the main biological sampling was carried out from August to November in two coastal locations: near the rivers Daugava (reared population) and Salaca (wild population) outlets. In total 508 salmon were sampled in coastal fisheries.

Lithuania: From 2005 sampling has followed the EU Minimum programme. Lithuanian fishermen did not carry out specialized salmon fishing. In 2014 a total of 118 samples were taken in the coastal zone.

Poland: Sampling was conducted on landed fish from offshore catches. According to DCF total number of sampled fish should be 500 for the whole Polish salmon fishery, but in fact 710 fish was sampled for age, length and weight in 2014. Age was estimated based on scale readings. Data collection was conducted in ICES Subdivision 25 and 26 and covered longline fishery but also some pelagic trawl catches. Most of the samples of salmon scales (501) were sent to RKTL, Helsinki for genetic analyses.

Russia: There is no biological sampling programme in Russia. However in 2014, 434 fish collected in the river fishery (the rivers Neva, Narva and Luga) are aged, also lengths and weights are recorded.

Sweden: Biological salmon samples were collected in accordance with the EU minimum programme. The sampling also followed the Swedish National Programme for collection of fisheries data in 2011 to 2013. In 2014, samples were taken within the Swedish river and coastal fisheries for salmon within the ICES Subdivisions 22–31. The sampled fish are aged by scale reading, and at the same time it is determined if the fish is of wild or reared origin. As a preparation for studies on stock proportions in catches, genetic samples were also taken in 2014.

From the coastal commercial trapnet fishery, 567 samples were collected in 2014 throughout the whole fishing season during the second and third quarter of the year. The samples were taken by contracted fishermen and the County administrative board at four different locations in the Gulf of Bothnia; Söderhamn, Härnösand, Skellefteå, and the archipelago of Haparanda. In rivers, samples were gathered from the broodstock fishing and angling. All data are stored in a database at the Institute of Freshwater Research, Swedish University of Agricultural Sciences.

2.6 Tagging data in the Baltic salmon stock assessment

Tagging data (Carlin tags) have been used within the assessment of Baltic salmon in order to estimate population parameters as well as the exploitation rates by different fisheries (see Annex 3 for more detailed information). However, the tag return data have not been used after fishing year 2009 because of the suspected drop in the tag reporting rate starting from year 2010.

As tagging data used in the model are based on external tags, it is vital that fishermen find and report tags. However, earlier reports (summarised in e.g. ICES 2014) indicate an obvious unreporting of tags. For various reasons, the number of tag returns has become very sparse after 2009. As the tag return data influence e.g. the annual post smolt survival estimates, which is a key parameter in the Baltic salmon assessment, there is a need to supplement or replace the sparse tagging data in the near future. The WGBAST 2010 (ICES 2010) dealt with potential measures to improve and supplement the tagging data. These consist of alternative tagging methods and also supplementary catch sample data. Also, inclusion of smolt tagging in the EU DCF has been suggested. The WG also noted the need of a comprehensive study to explore potential tagging systems before a change over to a new system in the Baltic Sea area can be considered.

However, the salmon smolts are still tagged for the other monitoring purposes. The total number of Carlin tagged reared salmon released in the Baltic Sea in 2014 was 22 587 (Table 2.6.1), which was 23% less than in 2013.

The return rate shows a decreasing trend in Gulf of Bothnia and Gulf of Finland (Figures 2.6.1, 2.6.2). The return rate of 1-year old Carlin tagged salmon smolts in the Gulf of Finland in Estonian experiments varied around 0.2% in years 2000–2004 (Figure 2.6.3). There were no returns of tags in 2006, but next year the recapture rate exceeded 0.8%. In 2014 the recapture rate of Carlin tagged salmon in the Gulf of Finland was close to zero as well as in Poland (Figures 2.6.2, 2.6.3, 2.6.4).

The decline in return rate most likely has several reasons, where a decreasing reporting rate may be most important. The tagging results indicate that the long-term variation in survival seems to follow the same path in all countries. The assessment model results, however, indicate a gradual improvement in the post smolt survival since 2005, which is not visible in the tag return data. For more information see the Stock Annex.

2.7 Finclipping

Finclipping makes it possible to distinguish between reared and wild salmon in the catch. The information has been used to e.g. estimate proportion of wild and reared salmon in different mixed-stock fisheries, but is not directly utilised in the WGBAST assessment model since only part of the Baltic salmon smolt released has been finclipped for the time being. In 2014, the total number of finclipped salmon parr and smolt increased by 21% compared to 2013 and was 2 158 070. Out of this, 119 690 were parr and 2038400 were smolt. Compared to 2014, the number of finclipped smolt increased with about 15%. Number of finclipped parr increased about nine times. Most finclippings (in numbers) were carried out in Subdivisions 30 and 31 (Table 2.7.2).

From 2005 it has been mandatory in Sweden to finclip all released salmon. All reared Estonian salmon smolts were finclipped in 2014. In Poland total of 179 776 smolts were released to Vistula River with tributaries and Reda R. (Subdivision 26), 159 582 to Pomeranian rivers (Subdivision 25) and 231 600 to Odra River (Subdivision 24). Unfortunately all kinds of tagging were stopped in Poland in 2013 and 2014 because of veterinarian's objection. Finally Poland got a permission for all kind of tagging again from 2015 onwards, but new problem appeared: National Ethics Committee's objections. In Finland about 25% of released salmon were finclipped. A majority of salmon smolts released in Russia, Lithuania and Latvia in 2014 were not finclipped.

2.8 Estimates of stock and stock group proportions in the Baltic salmon catches based on DNA microsatellite and freshwater age information

Combined DNA- and smolt-age-data have been used to estimate stock and stock group proportions of Atlantic salmon catches in the Baltic Sea since year 2000 with a Bayesian method (Pella and Masuda 2001, Koljonen, 2006). For the 2014 catch analysis a quite extensive baseline updating was done. Three new wild river stocks were included; two from Sweden (Kågeälven and Testeboån) and one from Estonia (Vasalemma). In addition, data from nine other Swedish stocks and three Estonian stocks were updated (Table 2.8.1). All updated Swedish samples grouped together with the previous sample from the same stock, whereas the new and old samples from the Estonian Kunda and Keila salmon populations had changed genetically (Figure 2.8.1).

The current baseline stock dataset includes information on 17 DNA microsatellite loci for 39 Baltic salmon stocks, totalling 4453 adult individuals (Table 2.8.1). In all, 1619 DNA-samples were analysed from catches in 2014. Also two catch samples from the Gulf of Finland were included in the analysis.

As in previous years, the fish in the catch samples were divided in two classes according to smolt age information from scale reading: '1–2-year old smolts' and 'older smolts; 3–5 year old'. The salmon in the analysed catch samples with a smolt age older than two years were assumed to originate exclusively from any of the wild stocks (similarly as assumed when reading scales), whereas individuals with a smolt age of one or two years may originate either from a wild or a hatchery reared stock. The smolt age distributions in the baseline for stocks Tornionjoki wild, Kalixälven, Råneälven and Simojoki were updated to correspond to the mean distribution of smolt year classes from 2011 to 2013, of which the catches of adult salmon in 2014 were mainly composed. For the other stocks an average of smolt ages over the years was used (Table 2.8.2).

Results

In all three Baltic Sea areas studied also in previous years, the proportion of wild salmon in the catch samples from 2014 increased above the levels of the quite low years 2012 and 2013, and was near to the maximum estimates observed in years 2010 and 2011, mainly as a result of an increase in the wild Tornionjoki and Kalixälven contribution. At the same time, the share of Finnish reared stocks has decreased, especially in the Bothnian Bay and Main Basin catches. The increase in wild stock proportions and decrease in reared (Finnish) stock proportions may indicate increased wild smolt production in relation to the amount of stocking and/or decreased relative survival of reared post smolts in the sea area compared to wild.

In Åland Sea, the salmon fishery changed markedly after 2008, when the driftnet fishery was not allowed anymore. The currently analysed samples are mainly from push-up trapnet fisheries. In 2014 the proportion of wild Bothnian Bay stocks in the analysed Åland Sea catch was significantly higher (91%, 87–94%) than in 2013 (84%, 80–88%) (Table 2.8.3, Figure 2.8.2). The proportion of Finnish reared stocks has remained stable (6–7%) 2012–2014, whereas the proportion of Swedish reared stocks decreased from 8% (5–12%) to 3% (1–5%) between 2013 and 2014. The main stocks contributing to catches in the Åland Sea fishery over the years 2001–2014 (Table 2.8.4), i.e. those with an over 5% average contribution, have been Tornionjoki wild (34%), Kalixälven (25%), Tornionjoki hatchery (7%) and Iijoki hatchery (6%). In 2014, the proportion of Tornionjoki wild (42%) and Kalixälven (25%) salmon was over the long-term average. In addition, wild salmon from the Swedish stocks Åbyälven (6%) and Byskeälven (6%), and the reared Finnish Iijoki stock (4%) contributed significantly.

In the Bothnian Bay, Finnish-Swedish coastal catches were analysed both separately and in combination. In the pooled samples from 2014 the proportion of wild salmon increased from 71% (66–75%) in 2013 to 82% (78–85%). This is mainly reflecting a decrease in the overall Finnish reared stock component (from 24% to 12%; Table 2.8.3) paralleled by an increase in the proportion of Tornionjoki wild salmon (from 24% to 40%; Table 2.8.4).

When treated separately, the composition of the Finnish and Swedish 2014 Bothnian Bay catches differed markedly with respect to the stocks included (Table 2.8.3). In previous years, the overall proportion of wild salmon has been systematically higher in the Swedish compared to the Finnish analysed coastal catches, with wild and reared stocks from the respective country dominating in each catch. However, in 2014 the proportion of wild fish was at about the same level in the Swedish (83%), as in the Finnish (82%), catches. In all, 45% of the Finnish catches came from the wild Tornionjoki stock, and 30% from the Kalixälven stock. A clear decrease was seen between 2013 and 2014 in the proportions of the Iijoki and Oulujoki reared stocks. In the Swedish catch the majority similarly came from the Tornionjoki wild stock (31%) but also several other wild stocks were common, like Byskeälven (11%), Kalixälven (16%), Vindelälven (15%), and Lögdeälven (7%).

The analysed Finnish catch sample is presumed to be representative of the total Finnish coastal catch, as it is resampled from the total scale sample distribution collected annually. In contrast, the Swedish sample is not necessarily as representative of the total coastal catch. Before 2013, the coastal Swedish Bothnian Bay sample comprised a mixture of salmon from three traps spread along the coast, whereof two were located close outside Kågeälven and the potential river Moälven. In 2013, the latter two traps were replaced by others located in the same coastal areas but more distant from any river mouth. Hence, comparisons over the years of results for Swedish coastal catch samples (and pooled SE-FI samples) are not straightforward.

Furthermore, in 2013 and 2014 a detailed MSA-survey of stock composition in the Swedish coastal fishery was carried out (Östergren *et al*., 2015). In brief, these results revealed that stock compositions were found stable from 2013 to 2014 but differed markedly geographically, with local catches being dominated by salmon originating from the nearest (wild or reared) river. Only along coastal areas not close to any salmon river, a higher number of stocks in more even proportions could be found. Implications of these new results for future MSA surveys of the Swedish coastal salmon fishery are discussed further in Chapter 4.7.

In the Main Basin over half of the pooled international catch sample has originated from wild Bothnian Bay stocks since 2006 (62–74%; Table 2.8.3). The share of those wild stocks in the Main Basin catches increased markedly in 2014; from 64% (60–69%) in 2013 to 72% (67–76%). Also wild stocks from the Western Main Basin (i.e. Mörrumsån/Emån) increased; from 1% (0–2%) in 2013 to 3% (2–5%) in 2014.

The share of Swedish reared stocks (Gulf of Bothnia) continued to be higher (20%, 16–24%) than that of the Finnish reared stocks from the same region, which decreased significantly from 14% (11–18%) in 2013 to only 4% (2–8%) in 2014. The reason for this clear change in relative proportions of reared salmon of different country origin in the Main Basin is unclear, but in general it may be expected as Swedish releases of smolts in the GoB have been ca. 20–40% higher than those in Finland in recent years (cf. Table 3.3.1).

When analysing the total Main Basin catches from 2006–2014 divided into wild and reared salmon from different assessment units (Table 2.8.5; Figure 2.8.3), the most notable changes from 2013 to 2014 was a decrease in the proportion of the Finnish reared AU1 (14% to 4%), and an increase of the wild component from AU1 (49% to 58%).

Note finally that the sampling scheme of the Main Basin sample was somewhat changed in 2014 as all samples were now collected from the fishery already at the beginning of the year, and not anymore in the autumn, as the quota was filled already before autumn fishing time, which may slightly effect the result.

From the Gulf of Finland two small samples were analysed: one from the eastern (Loviisa-Pyhtää area) and one from the western part of the Finnish coast (Inkoo area). The composition of the two catches was very different, as in the western part of the coast the catch composed mostly fish from Bothnian Bay rivers (90%), whereas in the eastern catch at least half (55%) of the salmon originated from the reared "Finnish Neva" stock released mainly in River Kymijoki (Table 2.8.3). Pooling of these samples thus seemed not justified.

2.9 Management measures influencing the salmon fishery

Detailed information on international regulatory measures is presented in the Stock Annex . National regulatory measures are updated quite often, sometimes on a yearly basis, and are therefore presented below and not in the Stock Annex.

National regulatory measures

In **Denmark** no new national regulation measures were implemented in 2014. All salmon and sea trout streams with outlets wider than 2 m are protected by closed areas within 500 m of the mouth throughout the year; otherwise the closure period is four months at the time of spawning run. Estuaries are usually protected by a more extended zone. Gillnetting is not permitted within 100 m of the water mark. A closed period for salmon and sea trout has been established from November to 15 January in freshwater. In the sea this only applies for sexually mature fish.

In **Estonia** no new national regulation measures were implemented in 2014. An all year round closed area of 1000 m radius is at the river mouths of present or potential salmon spawning rivers Purtse, Kunda, Selja, Loobu, Valgejõgi, Jägala, Pirita, Keila, and Vasalemma and at the river mouths of the sea trout spawning rivers Punapea, Õngu, and Pidula. Since 2011 closed area for fishing around the river mouth was extended from 1000 to 1500 m for time period from 1 September to 31 October for rivers Kunda, Selja, Loobu, Valgejõe, Pirita, Keila, Vääna, Vasalemma and Purtse. In river Selja, Valgejõgi, Pirita, Vääna and Purtse recreational fishery for salmon and sea trout is banned from 15 October to 15 November. In the case of other most important sea trout spawning rivers (Pada, Toolse, Vainupea, Mustoja, Altja, Võsu, Pudisoo, Loo, Vääna, Vihterpadu, Nõva, Riguldi, Kolga, Rannametsa, Vanajõgi, Jämaja) a closed area of 500 m is established from 15 August to 1 December. In the case of smaller sea trout spawning streams, an area of 200 m radius around the river mouths is closed from 1 September to 30 November. Apart from lamprey fishing no commercial fishery in salmon and sea trout spawning rivers is permitted. In most of these rivers also angling with natural bait is prohibited. Besides, only licensed sport fishing is permitted. A closed period for salmon and sea trout sport fishing is established in the rivers Narva, Purtse, Kunda, Selja Loobu, Valgejõgi, Jägala, Pirita, Keila, Vasalemma, and Pärnu from 1 September to 30 November, in other rivers from 1 September to 31 October. Exceptions in sport fishing closure are allowed by decree of the Minister of Environment in the rivers with reared (the River Narva) or mixed salmon stock (the rivers Purtse, Selja, Valgejõgi, Jägala, Pirita and Vääna). Below of dams and waterfalls all kind of fishing is prohibited at a distance of 100 m. In the River Pärnu below Sindi dam this distance is 500 m.

In **Finland** no changes in the regulation for coastal fisheries since 2008 have appeared. In the Main Basin salmon fishing is forbidden for the Finnish vessels from year 2013. In the Gulf of Bothnia salmon fishing is forbidden from the beginning of April to the end of following dates in four zones: Bothnian Sea (59°30'N–62°30'N) 16 June, Quark (62°30'N–64°N) 21 June, southern Bothnian Bay (64°00'N–65°30'N) 26 June and northern Bothnian Bay (65°30'N–>) 1 July. Commercial fisherman, however, may start fishing salmon one week before these dates by two trapnets. In three weeks from the opening five trapnets per fisherman are allowed. After this for another three weeks eight trapnets at maximum are allowed per fisherman. Non-professional fisherman may start fishing salmon two weeks after the opening of the fishery by one trapnet at maximum (and only in the private water areas). In the terminal fishing area of Kemi the salmon fishing may start on 11th June. In the area outside the estuary of River Simojoki salmon fishing may start on 16th July and outside the estuary of river Tornionjoki on June 25th.

In 2013 Finland closed its offshore salmon fishery in Southern Baltic.

In **Latvia** no new fisheries regulations were implemented in 2012. In the Gulf of Riga salmon driftnet and longline fishing are not permitted. In the coastal waters salmon fishing is prohibited from 1 of October to 15 of November. Salmon fishing in coastal waters has been restricted indirectly by limiting the number of gears in the fishing season.

In the rivers with natural reproduction of salmon all angling and fishing for salmon and sea trout are prohibited with the exception of licensed angling of sea trout and salmon exists in the rivers Salaca and Venta in spring time season. Daily bag limit is one sea trout or salmon. All fisheries by gillnets is prohibited all year round in a 3 km zone around the River Salaca outlet from 2003. Fisheries restriction zones were enlarged around the rivers Gauja and Venta from 1 to 2 km in 2004. In rivers Daugava and Bullupe (connects rivers Lielupe and Daugava) angling and commercial fishing of salmon was allowed from 2007. However gillnets are not allowed for fisheries in these rivers, thus the salmon resources are not utilised or utilised by illegal fisheries.

In **Lithuania** no new fisheries regulations were implemented in 2013. The commercial fishery is under regulation during salmon and sea-trout migration in Klaipėda strait and Curonian lagoon. Fishery is prohibited the whole year round in the Klaipėda strait; from northern breakwater to the northern border of the 15th fishing bay. From September 1 till October 31, during salmon and sea trout migration, fishing with nets is prohibited in the eastern stretch of Curonian lagoon between Klaipėda and Skirvytė, in 2 km distance from the eastern shore. From September 15 till October 31 amateur fishing is prohibited within 0,5 km radius from Šventoji and Rėkstyne river mouths and from southern and northern breakwaters of Klaipėda strait. During the same period commercial fishing is prohibited within 0,5 km radius from Šventoji River mouth and 3 km from Curonian lagoon and Baltic Sea confluence.

From 1st of October till 31st of December all kinds of fishing are prohibited in 161 streams. In other larger rivers as Neris, Šventoji (twelve rivers in total) special protect zones are selected where schooling of salmon and sea trout occurs. In these selected places only licensed fishing permitted from 16th of September till 15th of October. From 16th of October till 31st of December any kind of fishing is prohibited in these areas. From 1st of January licensed salmon and sea trout kelts fishing is permitted in Minija, Veiviržas, Skirvytė, Jūra, Atmata, Nemunas, Neris, Dubysa, Siesartis, Šventoji rivers. Licence fishing is allowed from 1st January till 1st of October in designated stretches of the listed rivers. The minimum size of salmon for commercial fishery is 60 cm and for angling 65 cm.

In **Poland** additional to EC measures (seasonal closures and fixed protected areas) are in force within territorial waters managed by Regional Fisheries Inspectorates. Closed season for fishing salmon and sea trout between 15 September and 15 November in 4 miles belt of coastal zone is still in force. Since 2005 commercial fisheries for salmon/sea trout in rivers is based on new implemented rules. Fisheries opportunities were sold in 2005 by the state on a tender basis, where the bidder had to submit a fishing ten-year operational plan including restocking. It is difficult to get real figures on catch and effort from companies, which lease water areas, because they are not obliged to report their catch nor effort.

In **Russia** no changes in the national regulations were implemented in 2014. The international fishery rules are extended to the coastline. In all rivers and within one nautical mile of their mouths fishing and angling for salmon is prohibited during all year, except fishing for breeding purposes for hatcheries. No changes in fishery regulations in 2001–2014.

In **Sweden** new management measures were implemented in 2014. A few changes in the starting date of the commercial coastal fishing season have also taken place. North of latitude 62º55′N the 2014 fishing season started in the 17th of June. The change from the 19th June (used previously) to the 17th in the northern part of this area (SD 31) was motivated by that the spawning run in 2014 was predicted to be comparably early and that fishermen have problems to market their catch later in the season. The delayed opening date of the fishery in the southern part of this area (SD 30, north of latitude 62º55′N) from the 10th June to the 17th was motivated by the fact that some weak salmon populations are present in this area, and that a delayed starting date would allow more spawners to ascend the rivers before the exploitation starts. Exemptions from this seasonal regulation of the salmon fishery was allowed by the local county board to professional fishermen in the area north of latitude 62º55′N up to the border between the counties Västerbotten and Norrbotten, so that the fishery could start at the 12th of June with a maximum of two trapnets per fisherman. South of latitude 62º55′N, commercial coastal fishing in 2014 was allowed from 1st of April.

The changes in opening dates of the commercial fishery in restriction areas north of latitude 62º55′N resulted in an alignment of the starting date to the general starting date adopted in coastal areas outside restriction areas.

In 2013, recreational fishing with trapnets in the counties of Västerbotten and Norrbotten was allowed from the 1st of July until the quota of salmon within the commercial fishery was filled. In 2014, this regulation was changed to include also northern parts of the county Västernorrland (north of latitude 62º55′N). This change was motivated by the fact that weak salmon populations are exploited in the area; a delay in the starting date of this fishery would result in more spawners ascending the rivers before the exploitation starts.

As in 2013, the Swedish offshore trolling fisheries (that mainly takes place in the Main Basin) were only allowed to land salmon without an adipose fin (i.e. reared salmon).

Recreational fisheries in rivers are also managed through national regulations. In all rivers there is a general bag limit of one salmon and one trout per fisherman and day. Also fishing periods are regulated on a national level. In Gulf of Bothnian wild rivers, for example, angling for salmon is forbidden from 1 September until 31 December, and in some rivers angling is also forbidden between 1 May and 18 June. In addition to national regulations, local fishing and management organisations may stipulate more restrictive fishing regulations.

The management of the fisheries in River Torneälven, including the coastal area directly outside the river mouth, is handled through an agreement between Sweden and Finland. For example, the Swedish-Finnish agreement includes a specified time period in which the commercial coastal fishery at the river mouth is allowed to start. Regulations targeting the river fishery are also handled in the agreement. Annual deviations from the agreed fishing regulations in this area are negotiated and decided upon by the Swedish Ministry of Agriculture and the Finnish Ministry of Agriculture and Forestry. In 2014, the negotiations between Sweden and Finland resulted in regulations that for example restricted the fishery with traditional gears in the river, and a ban to land trout in the river and outside the river mouth.

In order to improve the situation for the weak sea trout stocks in SD 31, a number of changes were implemented in 1st July 2006. The minimum size for landed sea trout was raised from 40 to 50 cm in the sea. Furthermore, a ban of fishing with nets in areas with a depth of less than 3 meters during the period 1st April–10th June and 1st October–31st December in order to decrease the bycatch of trout in other fisheries. Further restrictions for rivers in Bothnian Bay (SD 31) were adopted in 2013, including shortening of the autumn period for fishing with two weeks, restrictions of catch size (window size 30–45 cm), and landing of only one trout per fisherman and day. In River Torneälven, trout fishing is completely banned (see above).

2.9.1 Effects of management measures

International regulatory measures

Minimum landing size

No change in the measures since 2005. An evaluation of the effects of the minimum landing size and minimum hook size was provided in ICES (2000). However, the changes in the regulatory measures in the EC waters (Council Regulation (EC) 2187/2005) might have changed the situation compared to the years before enforcement of this regulation. The minimum landing size in the Baltic salmon fishery is 60 cm, but the minimum landing size in Subdivision 31 has been decreased from 60 cm to 50 cm. An evaluation of this change was provided in ICES (2007). The minimum hook size for longlining in EC Baltic waters is 19 mm. Longlines do not have the same pronounced size selectivity as driftnets had, thus the minimum landing size in the offshore fishery is important.

Summer closure

The increased fishing period with longlining, especially in Subdivisions 22–29 has had small effects on the fishery. Longlining with a high cpue is possible only during the winter months, from November/December to February or possibly March. The rule concerning a maximum number of hooks per vessel (previously 2000) has also been dropped from the EC Council regulation. This measure might contribute to an increased fishing effort by longlining. As longline fishery is very labour intense, it is not possible to increase the number of hooks so much. In addition some of the boats involved in longline fishery are small and they do not have capacity to use more than 2000 hooks.

TAC

An evaluation of the TAC regulation can be found in the Stock Annex .

Driftnet ban

In the northern feeding areas Bothnian Sea (SD 30) and Gulf of Finland (SD32), offshore fishing with longlines would be theoretically possible with small boats and a small crew (1–2), but seals and a busy ship traffic practically prevent longline fishing in these areas.

The present offshore fishing of salmon takes place in the most southern part of the Baltic Main Basin. Previously important fishing took place also in the northern Baltic Sea at the Gotland Deep, and in the Bothnian Sea and Gulf of Finland. Fishermen have reported that densities of feeding salmon have been low in northern areas and therefore they have switched to more southern fishing areas where catches are higher. The reason for appearance of feeding salmon mostly in the areas of Bornholm deep and Gdansk deep is unknown. The share of discarded minimum size salmon is most likely to be larger in the present offshore longline fishery than in the past driftnet fishery. In the Danish offshore fishing in 1997–2002 undersized salmon in longline catches varied between 1.7% and 20.3% (mean 11.5%), whereas in the driftnet catch the mean percentage of salmon smaller than 60 cm was 3% (ICES 2003b). Likewise, in Polish catch samples from the Main Basin longline fishery in 2011–2014, the proportion of undersized salmon was 1,5–4%. In fact, small salmon in longline catches is not a new finding, although small salmon have often been classified as sea trout. According to Järvi (1938), for example, Polish salmon catches from the 1930s could be dominated by small salmon (post-smolts with an average weight of about 0.5 kg). Also Alm (1954) discussed the catches of small salmon with longlines in the Baltic Sea, and suggested that this fishery should be prohibited in winter (December–March) because of the high proportion of post smolts in the catches during that time of the year.

In summary, catch of undersized salmon in the present longline fishery may be noticeably, although additional information is needed on how the discard varies in time and space. Furthermore, the survival rate of undersized salmon that have been released from hook and put back to sea is not much known, however, Polish data from 2012–2013 indicate that 20–30% of undersized released fish was alive. Without information on how large proportion of released salmon that actually survives, it will be impossible to gauge the effect of this type of discard with respect to stock assessment and in terms of reduced catches (i.e. by not catching the fish later in life, when it has grown larger). Therefore studies on survival would be important. In addition on-board sampling is important to obtain further data on discards of undersized salmon.

Delayed opening of the coastal salmon fishery

ICES (2007) concluded that the delayed opening of the coastal salmon fishery is an effective measure for saving a proportion of the spawning run from the coastal harvest. However, the run timing varies between years, which mean that with multi-annually fixed opening dates, the saved proportion of spawning run is highly variable. This regulatory measure results in a higher harvest rate of late-migrating than early-migrating salmon ICES (2007). As older fish and females dominate in the early part of the spawning run, a late opening of the fishery saves the most valuable part of the run.

2.10 Other factors influencing the salmon fishery

The incitement to fish salmon as an alternative to other species is likely to be influenced by a number of factors, such as the possibilities for selling the fish, problems with damage to the catches from seal, the market price for salmon compared to other species and possibilities to fish on other species.

In the following section a number of factors which may affect the salmon fishery are considered.

Dioxin

The maximum level of dioxin and dioxin like PCB set for the flesh from salmon will be 8 pg WHO-PCDD/F-PCBTEQ (COMMISSION REGULATION (EC) No 1881/2006 and 1256/2011). Overall levels of dioxin and related substances tend to increase with size (sea age) of the salmon, but varies also in different parts of the fish flesh with fat contents (Persson *et al.*, 2007). In general, the levels found are above the maximum EU level.

Sweden, Finland and Latvia have derogation in the regulation allowing national use of the salmon if dietary advice is given to the public. The derogation is not time limited. Export of salmon to other EU countries is not permitted.

In Denmark salmon above 5.5 kg (gutted weight) were not permitted to be marketed within the EU. From 9 February 2009 it has been allowed to land and sell (to countries outside the EU) all size groups of salmon. In March 2011 deep-skinned salmon were analysed and a general decrease in the dioxin content was observed. The latest results (2013) shown high levels of dioxins, comparable to levels from 2006.

While there is no information available from Germany, Polish samples of salmon were examined in 2005, 2006 and again in 2010. The results from these have not resulted in marketing restrictions.

Table 2.2.1. Nominal catches, discards (incl. seal damaged salmons) and unreported catches of Baltic Salmon in tonnes round fresh weight, from sea, coast and river by country in 1972–2014 in Subdivision 22–32. The estimation method for discards and unreported catches are different for years 1981–2000 and 2001–2014. (95% PI = probability interval).

Year	Reported catches by country										Reported catches total	Non commercial catch. included in tot. catch	Discard		Total unreported catches 3)		Total catches	
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland 1)	Russia	Sweden	USSR			Median	90% PI	Median	90% PI	Median	90% PI
1972	1045	na	403	117	na	na	13	na	477	107	2162		na	na	na	na	na	
1973	1119	na	516	107	na	na	17	na	723	122	2604		na	na	na	na	na	
1974	1224	na	703	52	na	na	20	na	756	176	2931		na	na	na	na	na	
1975	1210	na	697	67	na	na	10	na	787	237	3008		na	na	na	na	na	
1976	1410	na	688	58	na	na	7	na	665	221	3049		na	na	na	na	na	
1977	1011	na	699	77	na	na	6	na	669	177	2639		na	na	na	na	na	
1978	810	na	532	22	na	na	4	na	524	144	2036		na	na	na	na	na	
1979	854	na	558	31	na	na	4	na	491	200	2138		na	na	na	na	na	
1980	886	na	668	40	na	na	22	na	556	326	2498		na	na	na	na	na	
1981	844	25	663	43	184	36	45	61	705		2606		318	192-495	460	138-1100	3474	3051-4063
1982	604	50	543	20	174	30	38	57	542		2058		246	147-384	355	105-864	2731	2401-3199
1983	697	58	645	25	286	33	76	93	544		2457		301	181-467	434	130-1037	3277	2877-3833
1984	1145	97	1073	32	364	43	72	88	745		3659		428	256-673	620	181-1533	4836	4254-5673
1985	1345	91	963	30	324	41	162	84	999		4039		457	270-729	660	180-1690	5304	4661-6244
1986	848	76	1000	41	409	57	137	74	966		3608		436	262-680	629	186-1520	4798	4216-5618
1987	955	92	1051	26	395	62	267	104	1043		3995		463	277-730	659	184-1673	5262	4625-6188
1988	778	79	797	41	346	48	93	89	906		3177		380	226-596	561	170-1339	4226	3713-4944
1989	850	103	1166	52	523	70	80	141	1416		4401		541	325-842	789	240-1865	5880	5161-6874

Year	Reported catches by country										Reported catches total	Non commercial catch. included in tot. catch	Discard		Total unreported catches 3)		Total catches	
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland 1)	Russia	Sweden	USSR			median	90% PI	median	90% PI	median	90% PI
1990	729	93	2294	36	607	66	195	148	1468		5636		798	477-1239	1104	323-2549	7745	6734-9091
1991	625	86	2171	28	481	62	77	177	1096		4803		651	377-1030	942	278-2170	6572	5713-7719
1992	645	32	2121	27	278	20	170	66	1189		4548		637	349-1040	919	253-2175	6290	5414-7466
1993 2)	575	32	1626	31	256	15	191	90	1134		3950		558	336-861	794	252-1796	5461	4758-6395
1994	737	10	1209	10	130	5	184	45	851		3181	302	408	244-632	674	262-1442	4370	3836-5085
1995	556	9	1324	19	139	2	133	63	795		3040	331	421	252-651	888	475-1646	4455	3923-5164
1996	525	9	1316	12	150	14	125	47	940		3138	532	473	280-735	928	478-1758	4658	4073-5435
1997	489	10	1357	38	170	5	110	27	824		3030	563	449	256-715	1022	577-1851	4619	4042-5396
1998	495	8	850	42	125	5	118	36	815		2494	332	351	212-539	777	439-1388	3709	3272-4281
1999	395	14	720	29	166	6	135	25	672		2162	296	318	189-492	1056	752-1612	3614	3220-4137
2000	421	23	757	44	149	5	144	27	771		2342	360	240	133-390	1263	950-1828	3923	3527-4444
2001	443	16	633	39	136	4	180	37	636		2124	339	198	181-218	1068	942-1345	3275	3146-3556
2002	334	16	510	29	108	11	197	66	580		1851	246	172	158-191	989	868-1254	2914	2790-3185
2003	454	10	410	29	47	3	178	22	462		1616	207	184	166-207	1120	987-1430	2818	2682-3136
2004	370	7	655	35	34	3	88	16	894		2103	349	210	190-237	1921	1712-2389	4111	3899-4590
2005	214	9	617	24	23	3	114	15	731		1749	359	150	139-165	974	854-1216	2779	2657-3026
2006	178	8	371	18	14	2	117	5	506		1218	207	115	107-125	493	424-627	1759	1689-1896
2007	79	7	409	15	26	2	95	6	492		1131	232	90	84-98	534	464-670	1694	1623-1833
2008	34	9	452	21	9	2	44	6	471		1047	365	54	50-58	220	170-304	1279	1228-1364
2009	78	8	423	14	15	1	51	2	520		1111	312	72	63-87	608	527-757	1743	1660-1894

Year	Reported catches by country										Reported catches total	Non commercial catch. included in tot. catch	Discard		Total unreported catches 3)		Total catches	
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland 1)	Russia	Sweden	USSR			Median	90% PI	Median	90% PI	Median	90% PI
2010	145	7	266	8	10	1	29	2	433		900	195	64	55-79	572	504-709	1494	1425-1634
2011	104	7	288	9	7	2	31	2	504		954	213	62	56-70	387	332-488	1358	1302-1460
2012	118	9	473	7	8	3	28	2	515		1163	382	55	50-61	295	241-383	1473	1418-1561
2013	133	9	374	7	9	5	27	2	442		1005	356	69	59-79	233	191-301	1252	1209-1320
2014	125	8	437	6	9	2	16	2	417		1020	404	62	52-71	182	143-246	1231	1191-1295

All data from 1972–1994 includes Subdivisions 24–32, while it is more uncertain in which years Subdivisions 22–23 are included. The catches in Subdivisions 22–23 are normally less than one ton. From 1995 data includes Subdivisions 22–32.

Catches from the recreational fishery are included in reported catches as follows: Finland from 1980, Sweden from 1988, Denmark from 1998. Other countries have no or very low recreational catches.

Danish, Finnish, German, Polish and Swedish catches are converted from gutted to round fresh weight w by multiplying by 1.1.

Estonian, Latvian, Lithuanian and Russian catches before 1981 are summarized as USSR catches.

Estonian, Latvian, Lithuanian and Russian catches are reported as whole fresh weight.

Sea trout are included in the sea catches in the order of 3% for Denmark (before 1983), 3% for Estonia, Germany, Latvia, Lithuania, Russia, and about 5% for Poland (before 1997).

Estimated non-reported coastal catches in Subdivision 25 has from 1993 been included in the Swedish statistics.

Danish coastal catches are non-professional trolling catches.

1) Polish reported catches are recalculated for assessment purposes (see Section 5)

2) In 1993 fishermen from the Faroe Islands caught 16 tonnes, which are included in total Danish catches.

3) Including both unreporting for all countries and the estimated additional Polish catch.

Table 2.2.2. Nominal catches, discards (incl. seal damaged salmons) and unreported catches of Baltic Salmon in numbers from sea, coast and river by country in 1993–2014. Subdivisions 22–32. The estimation method for discards and unreported catches are different for years 1993–2000 and 2001–2014. (95% PI = probability interval).

	Country										Discard			Total unreported catches[2)]		Total catches	
Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Reported total	Median	90% PI	Estimated Polish misreported catch	Median	90% PI	Median	90% PI
1993[1)]	111840	5400	248790	6240	47410	2320	42530	9195	202390	676115	95162	57550-146900	4100	136604	44110-307000	930761	810200-1088100
1994	139350	1200	208000	1890	27581	895	40817	5800	158871	584404	74979	45150-116300	16572	126716	51191-267771	805001	706471-936071
1995	114906	1494	206856	4418	27080	468	29458	7209	161224	553113	76541	46060-118500	64046	173150	98095-310945	821265	723545-948445
1996	105934	1187	266521	2400	29977	2544	27701	6980	206577	649821	97938	58360-152200	62679	196649	103608-368478	967938	846478-1128678
1997	87746	2047	245945	6840	32128	879	24501	5121	147910	553117	81897	46910-130500	85861	202355	121361-353661	858277	752661-999961
1998	92687	1629	154676	8379	21703	1069	26122	7237	166174	479676	67571	41080-103800	60378	157603	92777-275177	720768	636677-830077
1999	75956	2817	129276	5805	33368	1298	27130	5340	139558	420548	61785	36980-95760	122836	209558	150425-317635	706612	629835-807135
2000	84938	4485	144260	8810	33841	1460	28925	5562	165016	477297	71015	39450-115200	159251	261698	190230-397350	828764	735850-955850
2001	90388	3285	122419	7717	29002	1205	35606	7392	153197	450211	41280	37980-45410	126100	227700	200900-284000	695000	667400-752300

	Country										Discard		Estimated Polish misreported catch	Total unreported catches[2)]		Total catches	
Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Reported total	Median	90% PI		Median	90% PI	Median	90% PI
2002	76122	3247	104856	5762	21808	3351	39374	13230	140121	407871	38590	35460-42590	115000	211800	186400-265700	636400	610400-691200
2003	108845	2055	99364	5766	11339	1040	35800	4413	117456	386078	42480	38440-47550	143200	237700	209500-299300	643100	614100-706000
2004	81425	1452	130415	7087	7700	704	17650	5480	195662	447575	42470	38460-48100	254300	392800	349800-489500	858800	814700-957300
2005	42491	1721	113378	4799	5629	698	22896	3069	146581	341262	30080	27790-33030	110800	196800	172900-245400	549000	524700-598700
2006	33723	1628	64679	3551	3195	488	22207	1002	98663	229136	22130	20600-24030	46900	98100	84690-124300	335100	321400-361700
2007	16145	1315	75270	3086	5318	537	18988	1408	96605	218672	18290	17120-19830	54310	106700	93080-133800	331400	317400-358800
2008	7363	1890	80919	4151	2016	539	8650	1382	92533	199443	10760	10100-11680	3295	43730	34100-60530	245700	235900-262700
2009	16072	2466	78080	2799	2741	519	10085	584	107241	220587	15420	13600-18440	62910	123400	107100-153900	348900	332400-379900
2010	29637	1941	44523	1520	1534	427	5774	491	80518	166365	13100	11300-16120	65510	112200	99160-138400	282900	269500-309500
2011	21064	2030	49567	1850	1271	546	6204	470	89978	172980	12310	11150-14030	33500	74340	64340-92050	250600	240400-268600
2012	23175	2680	73447	1362	1056	568	5689	412	84332	192721	10240	9420-11340	12200	50880	42100-65060	246400	237500-260700

	Country										Discard			Total unreported catches2)		Total catches	
Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Reported total	median	90% PI	Estimated Polish misreported catch	median	90% PI	median	90% PI
2013	24657	2291	56393	1430	2083	1210	5412	387	67082	160157	12970	11100-14890	14000	40430	33630-51410	203000	196100-214100
2014	24482	2065	64886	1264	1878	610	3118	418	62680	161401	10980	9357-12590	6800	28560	22880-37530	191500	185800-200500

All data from 1993–1994, includes Subdivisions 24–32, while it is more uncertain in which years Subdivisions 22–23 are included.

The catches in Subdivisions 22–23 are normally less than one tonnes.

From 1995 data includes Subdivisions 22–32.

Catches from the recreational fishery are included in reported catches as follows: Finland from 1980, Sweden from 1988, Denmark from 1998.

Other countries have no, or very low recreational catches.

1) In 1993 Fishermen from the Faroe Islands caught 3200 individuals, which is included in the total Danish catches.

2) Including both unreporting for all countries and the estimated additional Polish catch.

Table 2.2.3. Nominal catches of Baltic Salmon in tonnes round fresh weight, from sea, coast and river by country and region in 1972–2014. S=sea, C=coast, R=river.

	Main Basin (Subdivisions 22–29)										
Year	**Denmark**	**Finland**	**Germany**	**Poland**	**Sweden**		**USSR**			**Total**	
	S	S+C	S	S	S	R	S	C+R	S	C+R	GT
1972	1034	122	117	13	277	0	0	107	1563	107	1670
1973	1107	190	107	17	407	3	0	122	1828	125	1953
1974	1224	282	52	20	403	3	21	155	2002	158	2160
1975	1112	211	67	10	352	3	43	194	1795	197	1992
1976	1372	181	58	7	332	2	84	123	2034	125	2159
1977	951	134	77	6	317	3	68	96	1553	99	1652
1978	810	191	22	4	252	2	90	48	1369	50	1419
1979	854	199	31	4	264	1	167	29	1519	30	1549
1980	886	305	40	22	325	1	303	16	1881	17	1898

	Main Basin (Subdivisions 22–29)																								
Year	**Denmark**		**Estonia**		**Finland**			**Germany**	**Latvia**			**Lithuania**		**Poland**			**Russia**		**Sweden**			**Total**			
	S	C	S	C	S	C	R	S	S	C	R	S	C	S	C	R	S	C	S	C	R	S	C	R	GT
1981	844	*	23	0	310	18	0	43	167	17	0	36	na	45	na	na	56		401	0	1	1925	35	1	1961
1982	604	*	45	0	184	16	0	20	143	31	0	30	na	38	na	na	57		376	0	1	1497	47	1	1545
1983	697	*	55	0	134	18	0	25	181	105	0	33	na	76	na	na	93		370	0	2	1664	123	2	1789
1984	1145	*	92	0	208	29	0	32	275	89	0	43	na	72	na	na	81		549	0	4	2497	118	4	2619
1985	1345	*	87	0	280	26	0	30	234	90	0	41	na	162	na	na	64		842	0	5	3085	116	5	3206
1986	848	*	52	0	306	38	0	41	279	130	0	57	na	137	na	na	46		764	0	4	2530	168	4	2702
1987	955	*	82	0	446	40	0	26	327	68	0	62	na	267	na	na	81		887	0	4	3133	108	4	3245
1988	778	*	60	0	305	30	0	41	250	96	0	48	na	93	na	na	74		710	0	6	2359	126	6	2491
1989	850	*	67	0	365	35	0	52	392	131	0	70	na	80	na	na	104		1053	0	4	3033	166	4	3203
1990	729	*	68	0	467	46	1	36	419	188	0	66	na	195	na	na	109		949	0	9	3038	234	10	3282
1991	625	*	64	0	478	35	1	28	361	120	0	62	na	77	na	na	86		641	0	14	2422	155	15	2592
1992	645	*	19	4	354	25	1	27	204	74	0	20	na	170	na	na	37		694	0	7	2170	103	8	2281

	Main Basin (Subdivisions 22–29)																								
Year	**Denmark**		**Estonia**			**Finland**		**Germany**	**Latvia**				**Lithuania**	**Poland**			**Russia**		**Sweden**			**Total**			
1993	591	*	23	4	425	76	1	31	204	52	0	15	na	191	na	na	49		754	7	5	2283	139	6	2428
1994	737	*	2	4	372	80	1	10	97	33	0	5	na	184	na	na	29		574	11	8	2010	128	9	2147
1995	556	*	4	3	613	86	1	19	100	39	0	2	na	121	12	na	36		464	13	6	1915	153	7	2075
1996	525	*	2	4	306	53	1	12	97	53	0	14	na	124	1	na	na	35	551	8	5	1631	154	6	1791
1997	489	*	1	5	359	44	0	38	106	64	0	1	4	110	0	0	na	23	354	9	7	1458	149	7	1614
1998	485	10	0	4	324	14	0	42	65	60	0	1	4	105	9	4	na	33	442	3	7	1464	137	11	1612
1999	385	10	0	4	234	108	0	29	107	59	0	1	5	122	9	4	na	22	334	2	7	1212	219	11	1442
2000	411	10	1	7	282	87	0	44	91	58	0	0	5	125	13	6	23	0	461	2	8	1439	182	14	1635
2001	433	10	0	4	135	76	0	39	66	71	0	1	4	162	12	6	33	0	313	2	7	1181	178	13	1373
2002	319	15	0	6	154	59	0	29	47	61	0	1	9	178	9	10	64	0	228	2	6	1021	161	16	1198
2003	439	15	0	3	115	41	0	29	33	14	0	0	3	154	22	22	20	0	210	3	3	999	102	25	1126
2004	355	15	0	3	169	108	0	35	19	13	2	0	2	83	na	5	14	0	433	5	3	1108	145	11	1264
2005	199	15	0	1	188	92	0	24	15	8	0	0	2	104	5	5	12	0	314	5	2	856	129	8	993
2006	163	15	0	1	105	28	0	18	9	5	0	0	2	100	11	6	3	0	220	3	1	617	66	7	690
2007	64	15	0	2	158	18	0	15	16	3	7	0	2	75	15	5	4	0	216	4	2	548	59	14	621
2008	19	15	0	2	46	24	0	21	0	5	4	0	2	30	8	6	4	0	88	5	2	208	61	11	280
2009	63	15	0	2	38	24	1	14	0	10	5	0	1	40	9	2	0	0	120	2	1	275	64	8	346
2010	130	15	0	1	36	20	1	8	0	4	6	0	1	23	5	0	0	0	163	3	1	360	49	8	417
2011	89	15	0	2	0	38	27	9	2	0	4	4	0	2	0	20	10	0	224	3	1	340	58	52	443
2012	103	15	0	3	22	36	0	7	0	2	6	0	2	25	3	0	0	0	136	5	2	293	66	9	363
2013	133	0	0	2	0	35	0	7	0	4	5	0	5	24	3	1	0	0	46	5	1	210	54	7	271
2014	125	0	0	2	1	31	0	6	0	3	5	0	2	13	3	0	0	0	46	6	1	190	47	7	244

Table 2.2.3. Continued.

	Gulf of Bothnia											Main Basin+Gulf of		
	(Subdivisions 30–31)											Bothnia (Subdivs.		
Year	Denmark		Finland			Sweden		Total				22-31) Total		
	S	S	S+C	C	S	C	R	S	C	R	GT	S	C+R	GT
1972	11	0	143	0	9	126	65	163	126	65	354	1726	298	2024
1973	12	0	191	0	13	166	134	216	166	134	516	2044	425	2469
1974	0	0	310	0	15	180	155	325	180	155	660	2327	493	2820
1975	98	0	412	0	33	272	127	543	272	127	942	2338	596	2934
1976	38	271	0	155	22	229	80	331	384	80	795	2365	589	2954
1977	60	348	0	142	49	240	60	457	382	60	899	2010	541	2551
1978	0	127	0	145	18	212	40	145	357	40	542	1514	447	1961
1979	0	172	0	121	20	171	35	192	292	35	519	1711	357	2068
1980	0	162	0	148	23	172	35	185	320	35	540	2066	372	2438

	Gulf of Bothnia										Main Basin + Gulf of			
	(Subdivisions 30–31)										Bothnia (Subdivisions			
Year		Finland			Sweden			Total			22-31) Total			
	S	C	R	S	C	R	S	C	R	GT	S	C	R	GT
1981	125	157	6	26	242	35	151	399	41	591	2076	434	42	2552
1982	131	111	3	0	135	30	131	246	33	410	1628	293	34	1955
1983	176	118	4	0	140	32	176	258	36	470	1840	381	38	2259
1984	401	178	5	0	140	52	401	318	57	776	2898	436	61	3395
1985	247	151	4	0	114	38	247	265	42	554	3332	381	47	3760
1986	124	176	5	11	146	41	135	322	46	503	2665	490	50	3205
1987	66	173	6	8	106	38	74	279	44	397	3207	387	48	3642
1988	74	146	6	1	141	48	75	287	54	416	2434	413	60	2907
1989	225	207	6	10	281	68	235	488	74	797	3268	654	78	4000
1990	597	680	14	12	395	103	609	1075	117	1801	3647	1309	127	5083

	Gulf of Bothnia										Main Basin + Gulf of			
	(Subdivisions 30–31)										**Bothnia (Subdivisions**			
1991	580	523	14	1	350	90	581	873	104	1558	3003	1028	119	4150
1992	487	746	14	7	386	95	494	1132	109	1735	2664	1235	117	4016
1993	279	426	16	10	267	91	289	693	107	1089	2572	832	113	3517
1994	238	269	14	0	185	73	238	454	87	779	2248	582	96	2926
1995	66	302	20	0	214	97	66	516	117	699	1981	669	124	2774
1996	96	350	93	5	261	110	101	611	203	915	1732	765	209	2706
1997	44	360	110	1	295	158	45	655	268	968	1503	804	275	2582
1998	57	225	43	2	224	137	59	449	180	688	1523	586	191	2300
1999	17	175	23	1	195	133	18	370	156	544	1230	589	167	1986
2000	11	170	30	0	167	133	11	337	163	511	1450	519	177	2146
2001	9	218	26	1	175	117	10	393	143	546	1191	571	157	1919
2002	5	193	20	1	233	101	6	426	121	554	1027	588	137	1752
2003	1	167	25	2	164	73	3	331	98	432	1002	433	123	1558
2004	3	274	32	0	352	86	3	627	118	748	1111	772	129	2012
2005	6	204	37	1	275	123	6	479	160	644	862	608	167	1637
2006	1	140	17	6	195	71	7	335	88	431	625	401	95	1121
2007	3	126	27	1	161	101	4	287	128	419	552	346	142	1040
2008	0	200	78	0	198	167	0	397	245	642	208	459	256	923
2009	1	228	43	0	256	127	1	484	170	655	275	548	178	1001
2010	0	142	32	0	182	69	0	324	101	425	360	373	109	842
2011	0	140	37	0	171	81	0	311	118	429	340	369	170	879
2012	0	218	111	0	163	209	0	381	320	701	293	447	329	1069
2013	0	185	73	0	211	179	0	396	252	649	210	450	259	920
2014	0	178	144	0	198	165	0	376	309	686	190	423	316	930

Table 2.2.3. Continued.

	Gulf of Finland (Subdivision 32)					Subdivision 22–32		
Year		Finland		USSR		Total		
	S	S+C	C	S	C+R	S	C+R	GT
1972	0	138	0	0	0	1864	298	2162
1973	0	135	0	0	0	2179	425	2604
1974	0	111	0	0	0	2438	493	2931
1975	0	74	0	0	0	2412	596	3008
1976	81	0	0	0	14	2446	603	3049
1977	75	0	0	0	13	2085	554	2639
1978	68	0	1	0	6	1582	454	2036
1979	63	0	3	0	4	1774	364	2138
1980	51	0	2	0	7	2117	381	2498

	Gulf of Finland (Subdivision 32)												Subdivision 22–32			
Year	Estonia			Finland			Russia		Total				Total			
	S	C	R	S	C	R	C	R	S	C	R	GT	S	C	R	GT
1981	0	2	0	46	1	0	5	0	46	8	0	54	2122	442	42	2606
1982	0	5	0	91	7	0	0	0	91	12	0	103	1719	305	34	2058
1983	0	3	0	163	32	0	0	0	163	35	0	198	2003	416	38	2457
1984	0	5	0	210	42	0	7	0	210	54	0	264	3108	490	61	3659
1985	0	4	0	219	34	2	20	0	219	58	2	279	3551	439	49	4039
1986	24	0	0	270	79	2	28	0	294	107	2	403	2959	597	52	3608
1987	10	0	0	257	61	2	23	0	267	84	2	353	3474	471	50	3995
1988	19	0	0	122	112	2	15	0	141	127	2	270	2575	540	62	3177
1989	36	0	0	181	145	2	37	0	217	182	2	401	3485	836	80	4401
1990	25	0	0	118	369	2	35	4	143	404	6	553	3790	1713	133	5636
1991	22	0	0	140	398	2	88	3	162	486	5	653	3165	1514	124	4803
1992	6	3	0	77	415	2	28	1	83	446	3	532	2747	1681	120	4548
1993 1)	3	1	1	91	309	3	39	2	94	349	6	449	2666	1181	119	3966
1994	3	1	0	88	141	6	15	1	91	157	7	255	2339	739	103	3181
1995	1	1	0	32	200	5	25	2	33	226	7	266	2014	895	131	3040
1996	0	3	0	83	324	10	10	2	83	337	12	432	1815	1102	221	3138
1997	0	4	0	89	341	10	4	0	89	349	10	448	1592	1153	285	3030
1998	0	4	0	21	156	10	0	3	21	160	13	194	1544	746	204	2494
1999	0	10	0	29	127	7	0	3	29	137	10	176	1259	726	177	2162
2000	0	14	1	37	130	11	0	4	37	144	16	196	1486	663	193	2342
2001	0	10	2	19	111	11	0	3	19	122	16	157	1210	693	173	2076
2002	1	10	0	17	46	15	0	2	18	56	16	90	1044	643	154	1841
2003	0	7	0	3	50	8	0	1	3	57	9	69	1006	489	132	1627
2004	0	4	0	2	57	9	1	1	3	62	11	75	1114	834	139	2087
2005	0	6	0	3	72	15	1	2	3	79	17	99	865	687	184	1736
2006	0	5	1	3	65	10	1	2	3	70	13	86	628	471	108	1207
2007	0	4	1	3	64	9	0	1	3	69	11	83	555	415	153	1123
2008	0	6	1	2	94	7	1	2	2	100	10	112	210	559	267	1035
2009	0	5	0	1	74	11	1	2	1	80	13	94	276	628	191	1095
2010	0	5	0	0	34	2	0	2	0	39	4	44	360	412	114	886
2011	0	4	0	0	44	3	0	2	0	48	5	53	340	417	175	932
2012	0	5	0	0	64	4	0	2	0	69	6	75	293	517	334	1144
2013	0	6	0	0	75	5	0	2	0	81	7	89	210	531	267	1009
2014	0	5	0	0	79	4	0	2	0	84	6	90	190	507	322	1020

All data from 1972–1994, includes Subdivisions 24–32, while it is more uncertain in which years Subdivisions 22–23 are included. The catches in Subdivisions 22–32 are normally less than one tonne. From 1995 data include Catches from the recreational fishery are included as follows: Finland from 1980, Sweden from 1988, Denmark from 1998. Other countries have no, or very low recreational catches. Danish, Finnish, German, Polish and Swedish catches are converted from gutted to round fresh weight w by multiplying by 1.1. Estonian, Latvian, Lithuanian and Russian catches before 1981 are summarized as USSR catches. Estonian, Latvian, Lithuanian and Russian catches are reported as whole fresh weight. Sea trout are included in the sea catches in the order of 3% for Denmark (before 1983), 3% for Estonia, Germany, Latvia, Lithuania, Russia, and about 5% for Poland (before 1997). Estonian sea catches in Subdivision 32 in 1986–1991 include a small quantity of coastal catches. Estimated non-reported coastal catches in Subdivision 25 has from 1993 been included in the Swedish statistics. Danish coast catches are non-professional trolling catches. 1) In 1993 fishermen from the Faroe Islands caught 16 tonnes, which are included in total Danish catches.

Table 2.2.4. Nominal catches of Baltic Salmon in numbers, from sea, coast and river by country and region in 1996–2014. S=sea, C=coast, R=river.

MAIN BASIN (SUBDIVISIONS 22–29)

YEAR	DENMARK		ESTONIA		FINLAND			GERMANY	LATVIA			LITHUANIA			POLAND			RUSSIA		SWEDEN			MAIN BASIN (Subdivisions 22–29) Total			
	S	C	S	C	S	C	R	S	S	C	R	S	C	R	S	C	R	S	C	S	C	R	SEA	COAST	RIVER	GT
1996	105934		263	528	58844	8337	200	2400	19400	10577		1485	1059		27479	222			5199	121631	1322	633	337436	27244	833	365513
1997	87746		205	1023	61469	7018		6840	20033	12095		214	665		24436		65		4098	68551	1415	810	269494	26314	875	296683
1998	90687	2000	0	770	60248	2368		8379	13605	8098		288	781		23305	1927	890		6522	99407	573	940	295919	23039	1830	320788
1999	73956	2000	28	741	45652	15007		5805	24309	9059		166	1132		24435	1835	860		4330	74192	408	876	248543	34512	1736	284791
2000	82938	2000	129	1190	56141	10747		8810	24735	9106		78	1382		25051	2679	1195	4648		107719	400	1005	310249	27504	2200	339954
2001	88388	2000	122	819	26616	8706		7717	18194	10808		152	1053		33017	1764	825	6584		78874	485	890	259664	25635	1715	287014
2002	73122	3000		1171	32870	8003	25	5762	11942	9781	85	363	2988		35636	1804	1934	12804		60242	556	699	232741	27303	2743	262787
2003	105845	3000	16	681	24975	5021	25	5766	8843	2496		74	966		30886	4282	632	3982		54201	575	469	234588	17021	1126	252735
2004	81425			594	35567	11024	50	7087	4984	2316	400	49	655		16539		1111	4983		99210	900	441	249844	15489	2002	267335
2005	39491	3000		286	36917	7936	25	4799	2787	2054	788		691	7	20869	1025	1002	2433		66527	715	337	173823	15707	2159	191689
2006	30723	3000		291	19859	3152	20	3551	1705	1490		9	474	5	19953	1371	883	552		45685	546	180	122037	10324	1088	133449
2007	13145	3000		325	30390	1468	20	3086	2960	1478	880	0	529	8	14924	3098	966	888		44844	598	243	110237	10496	2117	122850
2008	4363	3000		432	9277	2324	35	4151		1410	606	0	518	21	5933	1683	1034	697		17883	1040	317	42304	10407	2013	54724
2009	13072	3000		739	7964	2510	109	2799		2549	192	0	519		7827	1952	306			24747	550	154	56409	11819	761	68989
2010	26637	3000		396	6948	1552	140	1520		1092	442	1	407	19	4464	1254	56			32620	771	210	72190	8472	867	81529
2011	18064	3000		754	7168	2364	140	1850		1013	258	0	523	23	3751	2355	98			43173	691	144	74006	10700	663	85369
2012	20175	3000		1033	4020	3628	50	1362		573	483	0	537	31	4648	957	84			23968	763	288	54173	10491	936	65600
2013	24657			757	4	2896	30	1430		1280	803	0	363	32	4772	505	135			7264	724	160	38127	6525	1160	45812
2014	20982			871	79	4026	15	1264		1112	766		582	28	2502	606	10			7232	826	147	32059	8023	966	41048

Table 2.2.4. Continued.

	Gulf of Bothnia (Subdivisions 30–31)										Main Basin + Gulf of Bothnia			
Year		Finland			Sweden			Total			(Subdivisions 22-31) Total			
	S	C	R	S	C	R	S	C	R	GT	SEA	COAST	RIVER	GT
1996	22196	84940	14000	1181	61239	20571	23377	146179	34571	204127	360813	173423	35404	569640
1997	8205	76683	17000	251	49724	27159	8456	126407	44159	179022	277950	152721	45034	475705
1998	11105	46269	5100	329	41487	23438	11434	87756	28538	127728	307353	110795	30368	448516
1999	3529	35348	3100	89	38447	25546	3618	73795	28646	106059	252161	108307	30382	390850
2000	2423	41538	4150	13	32588	23291	2436	74126	27441	104003	312685	101631	29641	443956
2001	1904	53280	3750	122	47804	25022	2026	101084	28772	131883	261691	126719	30487	418897
2002	864	44073	3900	174	57033	21417	1038	101106	25317	127462	233779	128409	28060	390249
2003	166	53562	4500	297	45075	16839	463	98637	21339	120439	235051	115658	22465	373174
2004	604	65788	5900		77904	17207	604	143692	23107	167403	250448	159181	25109	434738
2005	1045	45403	6700	99	57154	21749	1144	102557	28449	132150	174967	118264	30608	323839
2006	162	26228	2620	1150	35912	15190	1312	62140	17810	81262	123349	72464	18898	214711
2007	604	27340	3570	195	33054	17671	799	60394	21241	82434	111036	70890	23358	205284
2008	11	41589	12030		41916	31377	11	83505	43407	126923	42315	93912	45420	181647
2009	140	45331	7825		58290	23500	140	103621	31325	135086	56549	115440	32086	204075
2010	1	25479	4770	2	34931	11984	3	60410	16754	77167	72193	68882	17621	158696
2011	22	26882	5335		32425	13545	23	59307	18880	78210	74029	70007	19543	163579
2012	5	38884	12924		23943	35370	5	62827	48294	111126	54178	73318	49230	176726
2013	14	30331	10600		31332	27602	14	61663	38202	99879	38141	68188	39362	145691
2014	7	29342	18865		31536	22939	7	60878	41804	102689	32066	68901	42770	143737

Table 2.2.4. Continued.

	Gulf of Finland (Subdivision 32)												Subdivisions 22–32			
Year	Estonia			Finland			Russia		Total				Total			
	S	C	R	S	C	R	C 1)	R	S	C	R	GT	SEA	COAST	RIVER	GT
1996		396		20664	55840	1500	1485	296	20664	57721	1796	80181	381477	231144	37200	649821
1997		819		19577	54493	1500	1023		19577	56335	1500	77412	297527	209056	46534	553117
1998	22	761	76	4210	23876	1500	65	650	4232	24702	2226	31160	311585	135497	32594	479676
1999	12	1904	132	6234	19306	1100	95	915	6246	21305	2147	29698	258407	129612	32529	420548
2000	79	2833	254	7105	26920	1900	79	835	7184	29832	2989	40004	319869	131462	32630	483961
2001	62	1965	317	2804	23458	1900	82	726	2866	25505	2943	31314	264557	152224	33430	450211
2002	108	1968		3652	8269	3200	18	408	3760	10255	3608	17623	237540	138664	31668	407871
2003	17	1341		553	8862	1700	75	356	570	10278	2056	12904	235621	125936	24521	386078
2004	36	822		480	9501	1500	183	314	516	10506	1814	12837	250964	169687	26923	447575
2005	34	1298	103	536	12016	2800	213	423	570	13527	3326	17423	175537	131791	33934	341262
2006	48	955	334	506	10431	1700	121	329	554	11507	2363	14425	123903	83972	21261	229136
2007	64	764	162	451	10032	1395	120	400	515	10916	1957	13388	111551	81806	25315	218672
2008		1114	344	392	14161	1100	220	465	392	15495	1909	17796	42707	109407	47329	199443
2009		1470	257	228	11911	2063	170	414	228	13551	2734	16513	56777	128991	34819	220587
2010		1360	185	81	5152	400		491	81	6512	1076	7669	72274	75394	18697	166365
2011		1091	185	91	6965	600		470	91	8056	1255	9402	74120	78063	20798	172981
2012		1435	212	61	13285	590		412	61	14720	1214	15995	54239	88038	50444	192721
2013		1493	41	35	11553	930		387	35	13046	1358	14439	38176	81234	40720	160130
2014		1194		102	11870	580		418	102	13064	998	14164	32168	81965	43768	157901

Data from the recreational fishery are included in Swedish and Finnish data. Recreational fishery are included in Danish data from 1998. Other countries have no, or very low recreational catches. In 1996 sea trout catches are included in the Polish catches in the order of 5%.

1) Russian coastal catches have in earlier reports been recorded as sea catches.

Table 2.2.5. Nominal catches of Baltic Salmon in tonnes round fresh weight and numbers from sea, coast and river, by country and subdivisions in 2014. Subdivisions 22–32. S=sea, C=coast, R=river. *These catches were not possible to divide between Subdivision 24 and 25.

SD	Fishery		Country									Total
			DE	DK	EE	FI	LT	LV	PL	RU	SE	
24–25*	S	W		0								0
		N		3500								3500
22	S	W	2									0
		N	430									72
23	S	W	3								0	0
		N	697								4	4
24	S	W	2	25					0		0	26
		N	303	3787					7		3	3954
	C	W							0			0
		N							12			12
	R	W							0			0
		N							2			2
25	S	W		99					8		43	150
		N		17195					1530		6787	25512
	C	W							0		5	5
		N							29		690	719
	R	W							0		1	1
		N							6		145	151
26	S	W					0		5			5
		N					0		965			965
	C	W					2	3	3			8
		N					582	1112	565			2259
	R	W					0	5	0			6
		N					28	766	2			796
27	S	W									0	0
		N									1	1
	C	W									1	1
		N									136	136
	R	W									0	0
		N									2	2
28	C	W			2							2
		N			591							591
29	S	W				1					3	3
		N				79					437	516
	C	W			1	31						31
		N			280	4026						4306
	R	W				0						0
		N				15						15
30	S	W				0						0
		N				7						7

SD	Fishery		Country									Total
			DE	DK	EE	FI	LT	LV	PL	RU	SE	
	C[1)]	W				38					59	97
		N				5604					8313	13917
	R	W				1					71	73
		N				200					8480	8680
31	C	W				140					139	262
		N				23738					23223	43871
	R	W				143					94	237
		N				18665					14459	33124
32	S	W				0						0
		N				102						102
	C	W			5	79						84
		N			1194	11870						13064
	R	W				4				2		6
		N				580				418		998
TOTAL 22–31	S	W	7	125	0	1	0	0	13	0	46	185
		N	1430	24482	0	86	0	0	2502	0	7232	34531
	C	W	0	0	2	178	2	3	3	0	204	375
		N	0	0	871	33368	582	1112	606	0	32362	65811
	R	W	0	0	0	144	0	5	0	0	166	317
		N	0	0	0	18880	28	766	10	0	23086	42770
TOTAL 22–31	S+C+R	W	7	125	2	323	2	9	16	0	417	876
		N	1430	24482	871	52334	610	1878	3118	0	62680	143112
TOTAL 32	S+C+R	W	0	0	5	83	0	0	0	2	0	90
		N	0	0	1194	12552	0	0	0	418	0	14164
GRAND TOTAL	S	W	7	125	0	1	0	0	13	0	46	186
		N	1430	24482	0	188	0	0	2502	0	7232	34633
	C	W	0	0	7	257	2	3	3	0	204	459
		N	0	0	2065	45238	582	1112	606	0	32362	78875
	R	W	0	0	0	148	0	5	0	2	166	322
		N	0	0	0	19460	28	766	10	418	23086	43768
NATIONAL TOTAL	S+C+R	W	7	125	7	406	2	9	16	2	417	967
		N	1430	24482	2065	64886	610	1878	3118	418	62680	157276

[1)] **Finnish catch in SD30 includes the recreational catch in the whole Gulf of Bothnia (SD29–31).**

Table 2.2.6. Non-commercial catches of Baltic Salmon in numbers from sea, coast and river by country in 1997–2014 in Subdivision 22–31 and Subdivision 32. (S = Sea, C = Coast, CI =confidence interval).

Subdivisions 22–31

Year	Denmark	Estonia		Finland		Germany	Latvia		Lithuania		Poland		Russia		Sweden		S+C	River	Grand
	S+C	S+C	River	S+C (95% CI)	River	S+C	S+C	River	S+C	River	S+C	River	S+C	River	S+C	River	Total	Total	Total
1997	na	na	na	na	17000	na	na	na	na	na	na	0	na	na	na	0	na	17000	17000
1998	2000	na	na	9040 (±6370)	5100	na	na	na	na	na	na	0	na	na	na	0	11040	5100	16140
1999	2000	na	132	9040 (±6370)	400	na	0	0	0	0	0	0	0	0	9350	0	20390	532	20922
2000	2000	na	0	13450 (±5490)	4150	na	0	0	0	0	0	0	0	0	na	0	15450	4150	19600
2001	2000	na	0	13450 (±5490)	3750	na	0	0	0	0	0	0	0	0	14443	22216	29893	25966	55859
2002	3000	na	0	3640 (±1070)	3900	na	0	85	0	0	0	0	0	0	17906	16945	24546	20930	45476
2003	3000	na	0	3640 (±1070)	4500	na	0	0	0	0	0	0	0	0	14889	13424	21529	17924	39453
2004	3000	na	0	15820 (±7300)	5950	na	0	0	0	0	0	0	0	0	22939	14687	41759	20637	62396
2005	3000	na	104	15820 (±7300)	6725	na	0	0	0	0	0	0	0	0	17931	15260	36751	22089	58840
2006	3000	na	106	6180 (±3710)	2640	na	0	0	0	0	0	0	0	0	12757	12229	21937	14975	36912
2007	3000	na	162	6180 (±3710)	3590	na	0	0	0	0	0	0	0	0	11928	14429	21108	18181	39289
2008	3000	136	270	9090 (±4380)	12065	na	0	157	0	0	0	0	0	0	13809	24501	26035	36993	63028
2009	3000	na	257	9090 (±4380)	7934	na	0	192	0	0	0	0	0	0	18248	18505	30338	26888	57226
2010	3000	na	185	3270 (±3600)	4910	na	0	22	0	0	0	0	0	0	12827	9325	19097	14442	33539
2011	3000	na	184	3270 (±3600)	5475	na	0	0	0	0	0	0	0	0	11819	9886	18089	15545	33634
2012	3000	na	210	3090 (±2830)	14005	na	0	0	0	0	0	0	0	0	10526	25523	16616	39738	56354
2013	3500	280	na	3090 (±2830)	10630	na	758	0	0	500	0	0	0	0	11336	22057	18964	33187	52151
2014	3500	308	na	3090 (±2830)	18880	na	772	0	0	550	0	0	0	0	11336	22057	19006	41487	60493

Table 2.2.6. Continued.

Subdivision 32										Subdivision 22–32		
Year	Estonia		Finland		Russia		S+C	River	Grand	S+C	River	GT
	S+C	River	S+C (95% CI)	River	S+C	River	Total	Total	Total	Total	Total	
1997	na	na	na	17000	na	na	na	17000	17000	na	34000	34000
1998	na	na	5150 (±3630)	5100	na	na	5150	5100	10250	16190	10200	26390
1999	0	132	5150 (±3630)	1100	0	0	5150	1232	6382	25540	1764	27304
2000	0	na	14180 (±5780)	1900	0	0	14180	1900	16080	29630	6050	35680
2001	0	na	14180 (±5780)	1900	0	0	14180	1900	16080	44073	27866	71939
2002	0	na	2550 (±750)	3200	0	0	2550	3200	5750	27096	24130	51226
2003	0	na	2550 (±750)	1700	0	0	2550	1700	4250	24079	19624	43703
2004	0	na	3090 (±1430)	1500	0	0	3090	1500	4590	44849	22137	66986
2005	206	103	3090 (±1430)	2800	0	0	3296	2903	6199	40047	24992	65039
2006	138	112	180 (±110)	1700	0	0	318	1812	2130	22255	16787	39042
2007	0	257	180 (±110)	1395	0	0	180	1652	1832	21288	19833	41121
2008	294	268	730 (±350)	1100	0	0	1024	1368	2392	27059	38361	65420
2009	0	257	730 (±350)	2063	0	0	730	2320	3050	31068	29207	60275
2010	0	185	360 (±400)	400	0	0	360	585	945	19457	15027	34484
2011	0	185	360 (±400)	600	0	0	360	785	1145	18449	16330	34779
2012	0	212	3450 (±3170)	590	0	0	3450	802	4252	20066	40540	60606
2013	0	41	3450 (±3170)	930	0	0	3450	971	4421	22456	42458	64914
2014	286	0	3450 (±3170)	580	0	0	3736	580	4316	22742	42067	64809

Table 2.2.7. Nominal catches (commercial) of Baltic Salmon in numbers from sea and coast, excluding river catches, by country in 1993–2014 and in comparison with TAC. Subdivisions 22–32. Years 1993–2000 include also sea catch of the recreational fishery in Sweden and Finland. Comparison with TAC Subdivisions 22–32. Years 1993–2000 include also sea catch of the recreational fishery in Sweden and Finland.

	Baltic Main Basin and Gulf of Bothnia (Subdivisions 22–31)											
Year	Fishing Nation									Total	TOTAL	Landing in %
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden		TAC	of TAC
1993 [1,2]	111840	5400	248790	6240	47410	2320	42530	9195	202390	676115	650000	104
1994	139350	1200	208000	1890	27581	895	40817	5800	158871	584404	600000	97
1995	114906	1494	206856	4418	27080	468	29458	7209	161224	553113	500000	111
1996	105934	791	281453	2400	29977	2544	27701	5199	247793	455999	450000	101
1997	87746	1228	238263	6840	32128	879	24436	4098	169916	395618	410000	96
1998 3	92687	770	177364	8379	21703	1069	25232	6522	183612	333726	410000	81
1999	75956	769	138413	5805	33368	1298	26270	4330	151672	286209	410000	70
2000	84938	1319	149243	8810	33841	1460	27730	4648	173321	311989	450000	69
2001	88388	941	77057	7717	29002	1205	34781	6584	112842	358517	450000	80
2002	73122	1171	82171	5762	21723	3351	37440	12804	100099	337643	450000	75
2003	105845	697	80084	5766	11339	1040	35168	3982	85259	329180	460000	72
2004	78425	594	97163	7087	7300	704	16539	4983	155075	367870	460000	80
2005	39491	286	75481	4799	4841	691	21894	2433	106564	256480	460000	56
2006	30723	291	43221	3551	3195	483	21324	552	70536	173876	460000	38
2007	13145	325	53622	3086	4438	529	18022	888	66763	160818	437437	37
2008	4363	296	44111	4151	1410	518	7616	697	47030	110192	371315	30
2009	13072	739	46855	2799	2549	519	9779		65339	141651	309733	46
2010	26637	396	30710	1520	1092	408	5718		55497	121978	294246	41
2011	18064	754	33166	1850	1013	523	6106		64470	125946	250109	50
2012	20175	1033	43447	1362	573	537	5605		38148	110880	122553	90
2013	21157	486	29717	1430	522	363	5277		27985	86937	108762	80
2014	20982	563	30364	1264	340	582	3108		28216	85419	106366	80

Table 2.2.7. Continued.

	Gulf of Finland (Subdivision 32)					
Year	Fishing Nation		Total	EC	Landing	Russia
	Estonia	Finland		TAC	% of TAC	
1993 [1]	874	98691	99565	120000	83	8200
1994	800	53487	54287	120000	45	3200
1995	338	32935	33273	120000	28	5035
1996	396	76504	76900	120000	64	1485
1997	819	74070	74889	110000	68	1023
1998	783	28086	28869	110000	26	65
1999	1916	25540	27456	100000	27	95
2000	2912	29144	32056	90000	36	79
2001	2027	12082	14108.9	70000	20	82
2002	2076	9371	11447	60000	19	18
2003	1358	6865	8223	50000	16	75
2004	858	6892	7750	35000	22	183
2005	1126	9462	10588	17000	62	213
2006	865	10758	11623	17000	68	121
2007	828	10303	11131	15419	72	120
2008	820	13823	14643	15419	95	220
2009	1470	11409	12879	15419	84	170
2010	1360	4873	6233	15419	40	
2011	1091	6696	7787	15419	51	
2012	1435	9896	10013	15419	65	
2013	1254	8467	9721	15419	63	
2014	908	8522	9430	13106	72	

All data from 1993–1994, include Subdivisions 24–32, while it is more uncertain in which years Subdivisions 22–23 are included. Russia are not included in the TAC in Subdivision 31. The catches in Subdivisions 22–23 are normally less than one tonnes. From 1995 data include Subdivisions 22–32. Estonia: Offshore catches reported by numbers, coastal catches converted from weight. Catches from the recreational fishery are included as follows: Finland from 1980, Sweden from 1988, and Denmark from 1998. Other countries have no, or very low recreational catches. Estimated non-reported coastal catches in Subdivision 25, have from 1993 been included in the Swedish catches. Sea trout are included in the sea catches in the order of 5% for Poland before 1997.

1) In 1993 Polish, Russian and Faroe Islands numbers are converted from weight.

2) In 1993 Fishermen from Faroe Islands caught 3100 salmon included in the total Danish catches.

3) In 1998 German numbers are converted from weight.

Table 2.3.1. Summary of the uncertainty associated to fisheries dataseries according to the expert opinions from different countries backed by data (D) or based on subjective expert estimation (EE). The conversion factors (mean) are proportions and can be multiplied with the nominal catch data in order to obtain estimates for unreported catches and discards, which altogether sum up to the total catches. Driftnet fishing has been closed from 2008. Finland and Sweden have had no offshore fishing for salmon after 2012.

Parameter	Country	Year	Source	min	mode	max	mean	SD
Share of unreported catch in offshore fishery	DK	2001-2014	EE	0.00	0.01	0.10	0.04	0.023
	FI	2001-2014	EE	0.00	0.01	0.10	0.04	0.023
	PL	2001-2013	EE	0.00	0.25	0.40	0.22	0.082
		2014	EE	0.01	0.02	0.10	0.04	0.020
	SE	2001-2014	EE	0.05	0.15	0.25	0.15	0.041
	Others	2001-2014		0.00	0.01	0.10	0.04	0.023
Share of unreported catch in coastal fishery	FI	2001-2013	EE	0.00	0.10	0.15	0.08	0.031
	PL	2001-2012	EE	0.00	0.10	0.20	0.10	0.041
		2013-2014	EE	0.00	0.05	0.10	0.05	0.020
	SE	2001-2012	EE	0.10	0.30	0.50	0.30	0.082
	SE	2013-2014	EE	0.00	0.15	0.30	0.13	0.063
	Others	2001-2014	EE	0.00	0.10	0.15	0.08	0.031
Share of unreported catch in river fishery	FI	2001-2014		0.05	0.20	0.35	0.20	0.061
	PL	2001-2009	EE	0.01	0.10	0.15	0.09	0.029
		2010-2014	EE	0.50	0.80	1.00	0.77	0.103
	SE	2001-2014	EE	0.10	0.20	0.40	0.23	0.063
Average share of unreported catch in river fishery	Others	2001-2014					0.22	0.047
Share of discarded undersized salmon in longline fishery	DK	2001-2007	D, EE	0.10	0.15	0.20	0.15	0.020
		2008-2014	D, EE	0.01	0.03	0.05	0.03	0.008
	FI	2001-2012	D, EE	0.01	0.03	0.05	0.03	0.008
	PL	2001-2012	D	0.01	0.03	0.04	0.03	0.006
		2013-2014	D	0.01	0.02	0.04	0.02	0.006
	SE	2001-2012	D, EE	0.01	0.02	0.03	0.02	0.004
Average share of discarded undersized salmon in longline fishery	Others	2001-2007					0.06	0.007
		2008-2012					0.02	0.003
		2013-2014					0.03	0.005
Mortality of discarded undersized salmon in longline fishery	DK	2001-2014	EE	0.75	0.80	0.85	0.80	0.020
	FI	2001-2012	EE	0.50	0.67	0.90	0.69	0.082
	SE	2001-2012	EE	0.75	0.85	0.95	0.85	0.041
	PL	2001-2014	D, EE	0.60	0.72	0.90	0.74	0.062
Average mortality of discarded undersized salmon in longline fishery	Others	2001-2014					0.77	0.028
Share of	DK	2001-2007	EE, D	0.00	0.03	0.05	0.03	0.010

Parameter	Country	Year	Source	min	mode	max	mean	SD
discarded undersized salmon in driftnet fishery	FI	2001-2007	D	0.00	0.02	0.03	0.02	0.006
Average share of discarded undersized salmon in driftnet fishery	Others	2001-2007					0.02	0.005
Mortality of discarded undersized salmon in driftnet fishery	DK	2001-2007	EE, D	0.60	0.65	0.70	0.65	0.021
	FI	2001-2007	EE	0.50	0.67	0.80	0.66	0.061
Average mortality of discarded undersized salmon in driftnet fishery	Others	2001-2007					0.65	0.032
Share of discarded undersized salmon in trapnet fishery	FI	2001-2014	EE	0.01	0.03	0.05	0.03	0.008
	SE	2001-2014	EE, D	0.01	0.03	0.05	0.03	0.008
Average share of discarded undersized salmon in trapnet fishery	Others	2001-2014					0.03	0.006
Mortality of discarded undersized salmon in trapnet fishery	FI	2001-2014	EE, D	0.10	0.20	0.50	0.27	0.085
	SE	2001-2014	EE, D	0.30	0.50	0.70	0.50	0.082
Average mortality of discarded undersized salmon in trapnet fishery	Others	2001-2014					0.38	0.059
Share of discarded sealdamaged salmon in longline fishery	FI	2001-2007	D	0.00	0.00	0.02	0.01	0.004
		2008-2012	D	0.00	0.03	0.06	0.03	0.012
	SE	2001-2013	EE, D	0.02	0.05	0.08	0.05	0.012
	DK	2001-2007	EE, D	0.00	0.03	0.05	0.03	0.010
		2008-2012	EE	0.00	0.05	0.10	0.05	0.020
		2013-2014	EE, D	0.05	0.15	0.30	0.17	0.051
	PL	2001-2012	D	0.00	0.00	0.02	0.01	0.004
		2013-2014	EE, D	0.05	0.25	0.65	0.32	0.126
	Others	2001-2014		0.00	0.00	0.02	0.01	0.004
Share of discarded	DK	2001-2007	EE, D	0.00	0.03	0.05	0.03	0.010
	FI	2001-2007	D	0.01	0.02	0.04	0.02	0.006

Parameter	Country	Year	Source	min	mode	max	mean	SD
sealdamaged salmon in driftnet fishery	Others	2001-2007		0.00	0.00	0.02	0.01	0.004
Share of discarded sealdamaged salmon in trapnet fishery	FI	2001-2013	D	0.05	0.08	0.14	0.09	0.019
	SE	2004-2013	EE, D	0.01	0.02	0.04	0.02	0.006
	Others	2001-2007		0.00	0.00	0.02	0.01	0.004

Table 2.3.2. Estimated number of discarded undersized salmon and discarded seal damaged salmon by management unit in 2001–2014. Estimates of discarded undersized salmon are proportional to nominal catches by the conversion factors (see Table 2.3.1). Estimates of seal damages age based partly on the logbook records (Finland and Sweden) and partly to the estimates proportional to nominal catches by conversion factors. Estimates should be considered as a magnitude of discards.

		Discard undersized				Discard seal damaged				
Management unit	Year	Driftnet	Longline	Trapnet	Other gears	Driftnet	Longline	Trapnet	Other gears	Total
		Disc_GND	Disc_LLD	Disc_TN	Disc_OT	Seal_GND	Seal_LLD	Seal_TN	Seal_OT	
SD22–31	2001	2626	11530	1149	579	8048	2861	5704	1050	33547
	2002	1858	12010	1234	577	6145	3382	5824	358	31388
	2003	1948	15420	1186	409	6171	3880	5546	1421	35981
	2004	2283	12800	1565	742	7282	3614	5971	1106	35362
	2005	1537	7587	1068	398	7217	3178	4280	497	25762
	2006	975	5389	685	234	4008	2486	2132	1642	17551
	2007	1031	3333	701	205	3453	1666	4040	426	14856
	2008	0	715	981	308	0	1242	3330	540	7116
	2009	0	2473	1226	315	0	4284	3349	354	12001
	2010	0	2835	761	149	0	4726	2362	247	11080
	2011	0	1980	790	197	0	4861	2011	180	10018
	2012	0	1174	824	198	0	2435	2989	323	7943
	2013	0	882	722	171	0	6431	2925	222	11352
	2014	0	608	730	170	0	4777	2579	580	9445

		Discard undersized				Discard seal damaged				
Management unit	**Year**	**Driftnet**	**Longline**	**Trapnet**	**Other gears**	**Driftnet**	**Longline**	**Trapnet**	**Other gears**	**Total**
		Disc_GND	Disc_LLD	Disc_TN	Disc_OT	Seal_GND	Seal_LLD	Seal_TN	Seal_OT	
SD32	2001	3	55	109	86	3	66	2701	657	3680
	2002	10	60	63	90	100	171	2613	292	3399
	2003	2	8	73	60	19	29	3221	198	3611
	2004	3	5	75	46	40	15	3436	226	3846
	2005	3	6	104	62	24	36	1494	173	1901
	2006	5	2	119	53	89	4	1586	914	2773
	2007	3	3	121	33	41	6	1594	44	1845
	2008	0	8	163	43	0	23	1850	264	2352
	2009	0	5	135	64	0	1	1499	229	1934
	2010	0	2	63	36	0	3	829	66	999
	2011	0	2	85	27	0	0	823	67	1004
	2012	0	1	118	58	0	0	890	161	1228
	2013	0	1	103	44	0	2	723	48	921
	2014	0	2	102	37	0	0	700	43	883

Table 2.3.3. Number salmon and sea trout in the catch of sampled Polish longline vessels in 2009–2013 (SAL=salmon and TRS=sea trout).

SamplingType	Year	Month	Trip_id	SAL	TRS	% SAL
Sea sampling	2009	1	146	34	2	94%
			304	141	3	98%
		2	148	264	2	99%
			150	114	7	94%
			305	149	2	99%
			306	92	4	96%
			307	94	3	97%
	2009 Total			888	23	97%
	2010	2	1059	174	1	99%
			1222	509	0	100%
			1228	341	0	100%
		3	1223	102	2	98%
			1224	48	0	100%
	2010 Total			1173	3	100%
	2011	2	1287	81	0	100%
			1288	43	2	96%
		3	1650	169	0	100%
		11	1515	51	1	98%
		12	1528	78	0	100%
			1529	265	0	100%
	2011 Total			687	3	100%
	2012	1	1566	107	0	100%
		3	1639	89	0	100%
		12	1823	128	3	98%
			1827	36	1	97%
	2012 Total			360	4	99%
	2013	1	1830	70	0	100%
		1	1844	21	0	100%
		1	1845	50	1	98%
		1	1846	55	0	100%
		1	1877	84	1	99%
		2	1879	104	2	98%
		1	1880	46	1	98%
		1	1881	122	0	100%
		12	2076	37	3	93%
	2013 Total			589	8	99%
Sea sampling Total				3697	41	99%
Market sampling	2009	12	1034	35	1	97%
	2009 Total			35	1	97%
	2010	12	1271	20	0	100%
	2010 Total			20	0	100%
Market sampling Total				55	1	98%
Grand Total				3163	34	99%

Table 2.3.4. Estimated number of seal damaged salmon, dead discard of undersized salmon, unreported salmon in sea and river fisheries and misreported salmon by country and management unit in 2001–2014. Estimates should be considered as order of magnitude.

	Denmark			Estonia				Finland			
	Seal damage	Discard	Unreported sea	Seal damage	Discard	Unreported sea	Unreported river	Seal damage	Discard	Unreported sea	Unreported river
SD22-31											
2001	2422	8464	2843	7	29	75		9351	1383	4798	880
2002	1974	8493	2340	9	39	100		9084	1607	5041	929
2003	2867	11840	3390	5	23	59		10360	1362	5357	1071
2004	2158	6421	2511	5	20	50		9120	1867	5966	1403
2005	1066	4396	1274	2	9	24		9991	1120	4216	1585
2006	823	3803	985	2	10	25		5996	957	2543	624
2007	351	1665	419	3	11	27		6860	1034	2989	848
2008	130	90	139	2	10	25		3820	935	3316	2850
2009	388	269	417	6	20	63		2871	1303	3620	1878
2010	788	550	854	3	11	33		2257	834	2301	1156
2011	539	373	582	6	20	64		1901	629	2495	1293
2012	595	417	654	8	34	87		2950	874	3514	3059
2013	3743	436	674	6	25	64		2783	573	2528	2517
2014	3729	431	676	4	19	48		2873	486	2584	4450
SD32											
2001				16	67	172	87	3683	204	899	446
2002				16	69	177		3394	192	630	757
2003				11	45	115		3747	98	556	402
2004				7	28	73		4009	109	565	354
2005				9	37	96		1860	132	780	660
2006				7	28	71	61	2795	157	888	402
2007				6	27	70	62	1818	130	852	330
2008				6	27	70	100	2309	180	1153	260
2009				11	40	125	74	1861	160	963	488
2010				10	37	115	53	962	66	412	94
2011				8	29	92	53	922	119	566	142
2012				11	48	121	61	1049	209	841	139
2013				10	41	106	12	582	355	718	220
2014				7	30	77		740	169	721	137

	Germany			Latvia				Lithuania			
	Seal damage	Discard	Unreported sea	Seal damage	Discard	Unreported sea	Unreported river	Seal damage	Discard	Unreported sea	Unreported river
SD22-31											
2001	56	242	132	228	432	1589		9	40	103	
2002	42	180	98	173	365	1293	23	26	104	268	
2003	40	171	93	88	180	539		8	13	34	
2004	51	220	120	58	132	390	110	5	9	23	
2005	35	150	81	39	102	279	218	5	9	22	2
2006	26	111	60	26	70	190		4	6	16	1
2007	23	96	52	35	85	233	243	4	7	17	2
2008	30	130	74	11	43	120	175	4	12	31	6
2009	20	88	50	20	68	217	56	4	11	30	5
2010	11	48	27	8	35	93	128	3	10	26	7
2011	14	58	34	8	30	86	75	4	17	44	
2012	10	42	24	4	18	49	139	4	14	38	9
2013	10	45	31	4	16	44	232	3	12	31	9
2014	9	40	27	3	10	29	221	4	19	49	8
SD32											
2001											
2002											
2003											
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											

	Poland					Russia				Sweden			
	Seal damage	Discard	Unreported sea	Unreported river	Misreported	Seal damage	Discard	Unreported sea	Unreported river	Seal damage	Discard	Unreported sea	Unreported river
SD22-31													
2001	1498	3732	40630	74	126000	48	84	214		4685	1794	28790	7500
2002	1425	3509	38470	173	114900	94	164	412		3341	1578	27750	6439
2003	1657	4134	45390	57	143100	29	51	128		2521	1390	23870	5022
2004	2475	6518	68420	100	254200	36	64	161		4568	2618	43480	5130
2005	1222	3105	33480	90	110800	18	31	78		3737	1716	29790	6426
2006	642	1524	17200	79	46890	4	7	18		3191	1107	19260	4473
2007	675	1634	18250	87	54300	7	11	29		1996	1044	18410	5211
2008	357	240	2593	93	3294	5	9	22		962	758	16480	9227
2009	2606	1741	18270	27	62890					2013	1046	22480	6886
2010	2572	1717	17830	106	65490					1709	856	16590	3520
2011	1382	925	9809	186	33490					3725	983	18330	3975
2012	620	417	4408	160	12200					1763	592	11890	10330
2013	2697	425	4782	257	14000					462	368	3848	8088
2014	1077	169	418	19	6799					492	370	3881	6693
SD32													
2001						1	1	7	200				
2002						0	0	2	112				
2003						1	2	6	98				
2004						1	6	16	87				
2005						2	7	18	117				
2006						1	4	10	91				
2007						1	4	10	110				
2008						2	7	19	134				
2009						1	6	14	119				
2010									141				
2011									136				
2012									119				
2013									112				
2014									121				

Table 2.4.1. Fishing efforts of Baltic salmon fisheries at sea and at the coast in 1987–2014 in Subdivision 22–31 (excluding Gulf of Finland). The fishing efforts are expressed in number of geardays (number of fishing days times the number of gear) per year. The yearly reported total offshore effort refers to the sum of the effort in the second half of the given year and the first half of the next coming year (E.g. Effort in second half of 1987 + effort in first half of 1988 = effort reported in 1987). The coastal fishing effort on stocks of assessment unit 1 (AU 1) refers to the total Finnish coastal fishing effort and partly to the Swedish effort in subdivision (SD) 31. The coastal fishing effort on stocks of AU 2 refers to the Finnish coastal fishing effort in SD 30 and partly to the Swedish coastal fishing effort in SD 31. The coastal fishing effort on stocks of AU 3 refers to the Finnish and Swedish coastal fishing effort in SD 30.

				AU 1		AU 2		AU 3	
Effort	Offshore	Offshore	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial
	driftnet	longline	coastal	coastal	coastal	coastal	coastal	coastal	coastal
			driftnet	trapnet	other gear	trapnet	other gear	trapnet	other gear
1987	4036455	3710892	328711.25	71182.1956	263255.918	43693.675	243511.224	42704.2632	526101.318
1988	3456416	2390537	256387.23	84962.2127	245227.642	55659.4557	259404.46	58839.0468	798038.264
1989	3444289	2346897	378189.75	68332.9119	345591.607	41990.9198	384682.609	40135.1756	463066.504
1990	3279200	2188919	364326	111332.782	260768.294	71005.0631	233539.697	68152.1166	279609.926
1991	2951290	1708584	431420	103076.851	461053.39	70978.5953	360359.773	73177.4713	404326.568
1992	3205841	1391361	473579	115793.156	351517.699	68095.5212	282673.671	61703.2977	339383.744
1993	2155440	1041997	621817	119497.393	288245.189	76398.4636	161473.832	79910.9304	215710.08
1994	3119711	851530.4	581306	83935.66	194683.066	59487.5539	210927.441	55255.8063	205848.296
1995	1783889	932314.4	452858	70670.2809	152528.524	44606.5655	147258.832	42165.0023	141904.758
1996	1288081	1251637	78686	58266.0153	100409.425	42054.7965	92605.9373	29029.0771	90245.0703
1997	1723492	1571003	118207	63102.0703	107432.461	44604.5303	81922.9097	34095.111	84639.3258
1998	1736495	1148336	112393	28644.0023	8391.48351	20203.6603	5449.38768	15771.3788	5221.32587
1999	1644171	1868796	126582	43338.9937	9324.74604	31845.2145	5715.1781	20889.1278	5070.8611
2000	1877308	2007775	107008	34933.8432	8323.54641	23383.5914	5586.69101	20397.0641	5370.79826
2001	1818085	1811282	102657	40595	3878.8704	23743	2661.25485	35831	2513.78754
2002	1079893	1828389	86357	46474	3778	30333	3250.96499	31614	3152.60416
2003	1329494	1446511	95022	47319	8903	27060	7138	38179	9984
2004	1344588	786934	103650	41570	4315	28219	1610	26365	2278
2005	1378762	1081589	84223	45002	5886	33683	4914	30630	5844

				AU 1		AU 2		AU 3	
Effort	Offshore	Offshore	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial
	driftnet	longline	coastal	coastal	coastal	coastal	coastal	coastal	coastal
			driftnet	trapnet	other gear	trapnet	other gear	trapnet	other gear
2006	1177402	680090	77915.424	33817	4196	24374	3546	19831	5486
2007	413622	604134	45557	35406	4298	23920	2888	22126	4602
2008	0	1953223	0	27736	10252	16434	3917	26499	5226
2009	0	2764859	0	31895	7116	23216	5215	15552	6324
2010	0	2588730	0	31529	3755	22904	2029	16196	3760
2011	0	1372589	0	26835	3540	17013	2663	14520	4775
2012	0	845747	0	21308	2911	11712	1539	10083	1959
2013	na	610728	0	14765	3089	9317	2538	8581	2942
2014	na	1069889		16373	3672	10834	3172	7512	3705

Table 2.4.2. Number of fishing vessels in the offshore fishery for salmon by country and area from 1999–2013. Number of fishing days divided into four groups, 1–9 fishing days, 10–19 fishing days, 20–39 fishing days and more than 40 fishing days (from 2001 also 60–80 and >80 days, total six groups). Subdivisions 22–31 and Subdivision 32.

Year	Area	Country	Effort in days per ship				
			>40	20–39	10–19	1–9	Total
			Number of fishing vessels				
1999	Subdivisions	Denmark	5	7	4	4	20
	22–31	Estonia	0	0	0	na	na
		Finland	13	13	11	20	57
		Germany	na	na	na	na	na
		Latvia	4	5	6	13	28
		Lithuania	na	na	na	na	na
		Poland	23	23	8	33	87
		Russia	2	1	2	7	12
		Sweden	10	8	9	38	65
		Total	57	57	40	115	269
	Subdivision 32	Finland	2	3	3	39	47
	Subdivisions 22–32	Total	59	60	43	154	316

Year	Area	Country	Effort in days per ship				
			>40	20–39	10–19	1–9	Total
			Number of fishing vessels				
2000	Subdivisions	Denmark	8	9	2	9	28
	22–31	Estonia	0	0	0	4	4
		Finland	15	8	14	12	47
		Germany	na	na	na	na	na
		Latvia	3	4	10	14	31
		Lithuania	na	na	na	na	na
		Poland	40	23	12	22	97
		Russia	na	na	na	na	na
		Sweden	11	12	7	29	59
		Total	77	56	45	90	266
	Subdivision 32	Estonia	0	0	1	0	1
		Finland	3	6	7	20	36
	Subdivisions 22–32	Total	80	62	53	110	305

Table 2.4.2. Continued.

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2001	Subdivisions	Denmark	3	2	4	2	2	9	22
	22–31	Estonia	0	0	0	0	0	2	2
		Finland	2	1	5	12	7	10	37
		Germany	na	na	na	na	na	na	na
		Latvia	0	1	0	3	2	24	30
		Lithuania	na	na	na	na	na	na	na
		Poland	7	9	18	11	12	12	69
		Russia	na	na	na	na	na	na	na
		Sweden	4	1	2	11	8	25	51
		Total	16	14	29	39	31	82	211
	Subdiv. 32	Finland	0	0	0	4	3	15	22
	Subdivs 22–32	Total	16	14	29	43	34	97	233

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2002	Subdivisions	Denmark	3	3	2	3	5	12	28
	22–31	Estonia	0	0	0	0	0	2	2
		Finland	na	na	na	na	na	na	0
		Germany	na	na	na	na	na	na	na
		Latvia	0	0	1	3	4	20	28
		Lithuania	na	na	na	na	na	na	0
		Poland	na	na	na	na	na	na	50
		Russia	na	na	na	na	na	na	0
		Sweden	2	0	1	11	11	29	54
		Total	5	3	4	17	20	63	162
	Subdiv. 32	Finland	0	0	0	5	5	19	29
	Subdivs 22–32	Total	5	3	4	22	25	82	191

Table 2.4.2. Continued.

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2003	Subdivisions	Denmark	1	2	8	2	6	11	30
	22–31	Finland	0	3	5	10	16	21	55
		Germany	na	na	na	na	na	na	na
		Latvia	0	0	0	1	4	27	32
		Lithuania	na	na	na	na	na	na	0
		Poland	1	0	1	21	12	46	81
		Russia	na	na	na	na	na	na	0
		Sweden	1	0	1	7	8	24	41
		Total	3	5	15	41	46	129	239
	Subdiv. 32	Estonia	0	0	0	0	1	0	1
		Finland	0	0	0	3	2	12	17
	Subdivs 22–32	Total	3	5	15	44	49	141	257

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2004	Subdivisions	Denmark	0	0	1	9	1	16	27
	22–31	Finland	0	1	6	12	10	24	53
		Germany	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Latvia	0	0	0	1	1	15	17
		Lithuania	0	0	0	0	0	0	0
		Poland	0	1	10	26	15	44	96
		Russia	na	na	na	na	na	na	n.a.
		Sweden	1	2	4	7	8	24	46
		Total	1	4	21	55	35	123	239
	Subdiv. 32	Estonia	0	0	0	0	0	1	1
		Finland	0	0	0	0	1	14	15
	Subdivs 22–32	Total	1	4	21	55	36	138	255

Table 2.4.2. Continued.

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2005	Subdivisions	Denmark	0	0	3	2	5	6	16
	22–31	Finland	0	1	6	12	8	18	45
		Germany	na	na	na	na	na	na	na
		Latvia	0	0	0	0	0	12	12
		Lithuania	0	0	0	0	0	0	0
		Poland	1	3	9	25	2	16	56
		Russia	na	na	na	na	na	na	na
		Sweden	5	2	3	8	6	14	38
		Total	6	6	21	47	21	66	167
	Subdiv. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	0	2	6	8
	Subdivs 22–32	Total	6	6	21	47	23	72	175

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2006	Subdivisions	Denmark	2	1	0	3	0	3	9
	22–31	Finland	0	3	5	8	6	5	27
		Germany	na	na	na	na	na	na	na
		Latvia	0	0	0	0	3	6	9
		Lithuania	0	0	0	0	0	0	0
		Poland	na	na	na	na	na	na	na
		Russia	na	na	na	na	na	na	na
		Sweden	4	8	0	8	5	12	37
		Total	6	12	5	19	14	26	82
	Subdiv. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	1	1	14	16
	Subdivs 22–32	Total	6	12	5	20	15	40	98

Table 2.4.2. Continued.

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2007	Subdivisions	Denmark	0	1	0	4	2	5	12
	22–31	Finland	0	4	4	7	4	9	28
		Germany	na	na	na	na	na	na	na
		Latvia	0	0	0	1	2	1	4
		Lithuania	0	0	0	0	0	0	0
		Poland	na	na	na	na	na	na	na
		Russia	na	na	na	na	na	na	na
		Sweden	4	2	3	2	3	11	25
		Total	4	7	7	14	11	26	69
	Subdiv. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	0	1	7	8
	Subdivs 22–32	Total	4	7	7	14	12	33	77

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2008	Subdivisions	Denmark	0	1	0	3	3	5	12
	22–31	Finland	0	1	4	4	0	8	17
		Germany	na	na	na	na	na	na	na
		Latvia	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0
		Poland	0	0	2	3	7	30	42
		Russia	na	na	na	na	na	na	na
		Sweden	0	1	1	0	2	4	8
		Total	0	3	7	10	12	47	79
	Subdiv. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	0	0	10	10
	Subdivs 22–32	Total	0	3	7	10	12	57	89

Table 2.4.2. Continued.

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2009	Subdivisions	Denmark	0	0	2	2	13	6	23
	22–31	Finland	0	0	1	2	0	11	14
		Germany	na	na	na	na	na	na	na
		Latvia	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0
		Poland		4	12	16	9	25	66
		Russia	na	na	na	na	na	na	na
		Sweden	0	2	1	1	2	14	20
		Total	0	6	16	21	24	56	123
	Subdiv. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	0	0	9	9
	Subdivs 22–32	Total	0	6	16	21	24	65	132

Year	Area	Country	Effort in days per ship						
			>80 days	60–80	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2010	Subdivisions	Denmark	0	0	0	4	6	10	20
	22–31	Finland	0	0	1	0	1	5	7
		Germany	0	0	0	0	0	0	0
		Latvia	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0
		Poland	0	1	5	19	20	37	82
		Russia	0	0	0	0	0	0	0
		Sweden	0	2	4	5	2	12	25
		Total	0	3	10	28	29	64	134
	Subdiv. 32	Estonia	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	7	7
	Subdivs 22–32	Total	0	3	10	28	29	71	141

Table 2.4.2. Continued.

Year	Area	Country	Effort in days per ship						
			>80 days	60–79	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2011	Subdivisions	Denmark	0	0	0	2	6	7	15
	22–31	Finland	0	1	1	1	2	6	11
		Germany	0	0	0	0	0	0	0
		Latvia	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0
		Poland	0	0	3	4	21	79	107
		Russia	0	0	0	0	0	0	0
		Sweden	0	2	6	5	4	10	27
		Total	0	3	10	12	33	102	160
	Subdiv. 32	Estonia	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	9	9
	Subdivs 22–32	Total	0	3	10	12	33	111	169

Year	Area	Country	Effort in days per ship						
			>80 days	60–79	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2012	Subdivisions	Denmark	0	0	0	2	7	7	16
	22–31	Finland	0	0	1	4	4	3	12
		Germany	0	0	0	0	0	0	0
		Latvia	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0
		Poland	0	0	0	6	11	40	57
		Russia	0	0	0	0	0	0	0
		Sweden	0	0	0	3	5	15	23
		Total	0	0	1	15	27	65	108
	Subdiv. 32	Estonia	0	0	0	0	0	0	0
		Finland	0	0	0	1	0	6	7
	Subdivs 22–32	Total	0	0	1	16	27	71	115

Table 2.4.2. Continued.

Year	Area	Country	Effort in days per ship						
			>80 days	60–79	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2013	Subdivisions	Denmark	0	1	2	4	6	6	19
	22–31	Finland	0	0	0	0	0	0	0
		Germany	0	0	0	0	0	0	0
		Latvia	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0
		Poland	0	0	1	5	12	31	49
		Russia	0	0	0	0	0	0	0
		Sweden	0	0	0	0	0	0	0
		Total	0	1	3	9	18	37	68
	Subdiv. 32	Estonia	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	0	0
	Subdivs 22–32	Total	0	1	3	9	18	37	68

Year	Area	Country	Effort in days per ship						
			>80 days	60–79	40–59	20–39	10–19	1–9	Total
			Number of fishing vessels						
2014	Subdivisions	Denmark	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	22–31	Finland	0	0	0	0	0	0	0
		Germany	0	0	0	0	0	0	0
		Latvia	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0
		Poland	0	0	4	5	2	31	42
		Russia	0	0	0	0	0	0	0
		Sweden	0	0	0	0	0	0	0
		Total	0	0	4	5	2	31	42
	Subdiv. 32	Estonia	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	0	0
	Subdivs 22–32	Total	0	0	4	5	2	31	42

Table 2.4.3. Catch per unit of effort (cpue), expressed as number of salmon caught per 100 nets and per 1000 hooks, by fishing season in the Danish, Estonian, Finnish, Latvian, Russian and Swedish offshore fisheries in the Main Basin, in the Gulf of Bothnia, and in the Gulf of Finland from 1980/1981 (Denmark from 1983/1984) to 2014.

Fishing	Denmark			
season	Subdivisions 22–25		Subdivisions 26–29	
	Driftnet	Longline	Driftnet	Longline
1983/1984	10.3	26.5	11.9	52.3
1984/1985	11.7	na	18.9	35.9
1985/1986	11.4	na	24.4	30.8
1986/1987	8.8	na	22.1	44.3
1987/1988	12.9	23.6	19.8	35.6
1988/1989	11.9	51.7	12.3	30.7
1989/1990	16.4	69.9	14.2	30.0
1990/1991	13.7	80.8	13.8	49.2
1991/1992	14.7	48.7	7.2	11.5
1992/1993	19.8	49.7	7.5	32.4
1993/1994	33.7	110.1	10.5	45.6
1994/1995	17.6	75.2	8.3	64.1
1995/1996	18.8	101.5	30.3	123.6
1996/1997	13.2	109.9	47.2	135.5
1997/1998	5.6	56.6	41.4	51.7
1998/1999	19.5	138.9	39.6	121.3
1999/2000	19.2	56.5	23.2	41.5
2000/2001	12.8	50.4	26.3	36.9
2002	11.9	69.7	18.3	63.3
2003	27.6	106.3	27.2	0.0
2004	18.3	236.4	46.7	108.8
2005	9.2	136.4	22.2	67.4
2006	15.3	71.7	22.9	0.0
2007	7.3	64.7	0.0	0.0
2008	0.0	44.8	0.0	0.0
2009	0.0	50.2	0.0	0.0
2010	0.0	83.8	0.0	0.0
2011	0.0	56.5	0.0	0.0
2012	0.0	83.3	0.0	0.0
2013	0.0	93.0	0.0	0.0
2014	0.0	50.4	0.0	0.0

Table 2.4.3. Continued.

Fishing	Finland					
season	Subdivisions 22–29		Subdivisions 30–31		Subdivision 32	
	Driftnet	Longline	Driftnet	Longline	Driftnet	Longline
1980/1981	6.6	27.1	5.3	18.4	na	5.5
1981/1982	8.0	43.5	5.2	28.4	na	12.1
1982/1983	9.2	34.5	6.6	21.9	na	14.3
1983/1984	14.4	46.9	12.4	53.2	na	20.5
1984/1985	12.5	43.7	11.0	34.1	na	13.5
1985/1986	15.9	34.5	10.3	17.9	na	15.7
1986/1987	18.9	63.9	5.3	14.7	na	25.6
1987/1988	8.0	42.0	4.0	9.0	na	17.0
1988/1989	7.0	36.0	4.0	6.0	na	10.0
1989/1990	15.0	57.0	13.0	41.0	na	16.0
1990/1991	16.8	42.4	13.3	50.7	na	21.2
1991/1992	8.5	24.5	9.0	21.1	na	30.8
1992/1993	9.1	16.6	8.0	23.1	na	16.6
1993/1994	5.9	20.0	6.5	12.7	na	23.9
1994/1995	7.9	21.0	4.3	10.2	5.7	26.7
1995/1996	22.1	41.6	10.2	0.0	5.6	19.7
1996/1997	19.2	56.9	9.7	0.0	9.7	32.2
1997/1998	14.1	29.3	6.7	0.0	6.7	24.0
1998/1999	15.7	39.7	5.7	0.0	5.7	25.7
1999/2000	13.3	29.1	5.7	0.0	3.1	25.5
2000/2001	20.4	23.0	5.8	0.0	0.0	28.2
2002	11.0	43.4	3.3	0.0	7.8	22.0
2003	11.0	55.4	4.3	0.0	5.3	8.0
2004	18.0	101.6	5.8	0.0	4.9	13.6
2005	15.1	58.4	4.1	0.0	4.4	17.3
2006	7.3	38.0	0.0	0.0	5.7	12.7
2007	9.7	44.7	0.0	0.0	5.1	18.7
2008	0.0	37.5	0.0	0.0	6.3	17.9
2009	0.0	40.0	0.0	0.0	0.0	14.6
2010	0.0	57.0	0.0	0.0	0.0	5.0
2011	0.0	51.5	0.0	0.0	0	0.0
2012	0.0	56.3	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0	0.0	0.0

Table 2.4.3. Continued.

Fishing	Estonia		Latvia		Russia		Sweden	
season	Subdivisions		Subdivisions		Subdivision		Subdivisions	
	28–29	32	26 and 28		26		22–29	
	Driftnet	Driftnet	Driftnet	Longline	Driftnet	Longline	Driftnet	Longline
1980/1981	na	na	5.0	31.7	na	0.0	na	na
1981/1982	na	na	5.3	26.0	na	0.0	na	na
1982/1983	na	na	4.0	15.6	na	0.0	na	na
1983/1984	na	na	9.4	55.0	na	0.0	na	na
1984/1985	na	na	6.1	27.0	na	0.0	na	na
1985/1986	na	na	10.6	13.8	na	0.0	10.2	41
1986/1987	na	na	13.2	0.0	na	0.0	16.8	44.4
1987/1988	na	na	11.5	0.0	na	0.0	14.0	42
1988/1989	na	na	8.6	0.0	na	0.0	12.6	41.7
1989/1990	na	na	25.7	0.0	na	0.0	22.4	88.3
1990/1991	na	na	15.5	0.0	na	0.0	21.0	74.3
1991/1992	na	na	9.3	0.0	na	0.0	14.4	32
1992/1993	9.1	3.7	11.8	0.0	na	0.0	18.2	24.5
1993/1994	11.1	12.4	8.5	0.0	na	0.0	25.0	73.7
1994/1995	6.8	7.6	11.6	0.0	na	0.0	14.0	0.0
1995/1996	15.3	6.9	18.5	0.0	na	0.0	16.7	114.7
1996/1997	5.6	0.0	21.1	0.0	na	0.0	22.2	63.2
1997/1998	2.8	1.4	15.3	0.0	na	0.0	15.6	36.8
1998/1999	0.0	0.0	19.9	0.0	23.9	0.0	18.1	92.7
1999/2000	0.0	0.0	18.7	0.0	16.5	0.0	16.9	52.1
2000/2001	na	na	30.3	0.0	30.4	0.0	27.7	33.6
2002	na	na	20.9	0.0	24.7	0.0	13.9	80.9
2003	na	na	37.4	0.0	12.7	0.0	na	na
2004	na	na	20.7	22.0	22.1	0.0	24.6	120.6
2005	na	na	16.9	0.0	19.2	0.0	16.1	87.3
2006	na	na	11.8	0.0	9.3	0.0	8.3	35.9
2007	na	na	9.0	0.0	na	0.0	11.0	45.9
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.6
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.7
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.3
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.2
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

All data from 1980/1981–1993/1994 includes Subdivisions 24–32, while it is more uncertain which years Subdivisions 22–23 are included. The catches in Subdivision 22–23 are normally less than one ton. From 1995 data include Subdivisions 22–32. Estonian data from Subdivision 28–29 has earlier been given as Subdivision 24–29.

Table 2.4.4. Trapnet effort and catch per unit of effort in number of salmon caught in trapnets in the Finnish fisheries in Subdivision 32 (number of salmon per trapnet days).

	Effort	CPUE
1988		0.7
1989		1.0
1990		1.6
1991		1.5
1992		1.5
1993		1.4
1994		0.9
1995		1.2
1996		1.3
1997		1.5
1998		1.3
1999		1.3
2000	12866	0.9
2001	9466	0.9
2002	5362	1.0
2003	8869	0.7
2004	7033	0.9
2005	7391	1.1
2006	7917	1.3
2007	9124	1.0
2008	9902	1.3
2009	9413	1.1
2010	9161	0.5
2011	10818	0.6
2012	11119	0.9
2013	12062	0.7
2014	11162	0.7

Table 2.6.1. Number of tagged hatchery-reared and wild salmon smolts released in assessment units 1, 2 or 3 and used in the salmon assessment (data not updated since 2012).

RELEASE YEAR	Reared salmon stocked in			Reared salmon stocked in			Wild salmon
	rivers without natural reproduction			rivers with natural reproduction			
	AU1	AU2	AU3	AU1	AU2	AU3	AU1
1987	29267	13258	23500	6900	1987	1994	629
1988	25179	13170	31366	4611	1989	2983	771
1989	11813	13157	36851	6428	2910	0	0
1990	9825	12824	31177	7467	3995	1996	0
1991	8960	13251	36655	7969	3990	1997	1000
1992	8920	12657	34275	5348	1996	1999	574
1993	7835	12656	34325	5968	1999	1991	979
1994	8077	12964	28717	5096	1997	2000	1129
1995	6988	12971	21877	6980	2000	0	0
1996	7967	13480	22429	6956	1000	1000	0
1997	6968	13403	23788	7981	1982	1997	0
1998	6929	13448	23547	5988	1974	994	1364
1999	7908	13445	23203	8925	2005	1996	2759
2000	7661	12018	26145	8484	2000	1000	3770
2001	7903	13498	16993	8412	2000	1000	4534
2002	7458	13992	18746	5969	2000	0	3148
2003	7233	13495	21485	8938	1997	1000	6299
2004	6946	12994	21987	6922	1981	1000	9604
2005	6968	13250	19478	9994	2000	1000	6607
2006	7933	13499	22755	10644	1650	1000	8034
2007	6982	7000	17804	10701	2000	1000	7069
2008	6998	7000	22047	9929	2000	1000	7105
2009	9924	7000	20000	4988	2000	1000	4177
2010	8566	7000	23145	6352	2000	1000	3772
2011	16924	7000	22985	2000	2000	0	6064
2012	15972	7000	18982	2205	2000	0	4993

Table 2.6.2. Number of Carlin-tagged salmon released into the Baltic Sea in 2014.

Country	24	25	26	27	28	29	30	31	32	Total
Denmark										0
Estonia									2500	2500
Finland								5587		5587
Sweden							7500	5000		12 500
Poland										0
Russia			2000							2000
Lithuania										0
Germany										
Latvia										0
Total	0	0	2000	0	0	0	7500	10 587	2500	22 587

Table 2.7.1. Releases of adipose finclipped salmon in the Baltic Sea and the number of adipose finclipped salmon registered in Latvian (Subdivisions 26 and 28) offshore catches.

	Releases of adipose finclipped		Latvian offshore catches	
	salmon, Subdivs. 24–32		Subdivs. 26 and 28	
Year	Parr	Smolt	Adipose fin clipped salmon in %	Sample N
1984			0.6	1,225
1985			1.0	1,170
1986			1.2	1,488
1987	43,149	69,000	0.6	1,345
1988	200,000	169,000	1.2	1,008
1989	353,000	154,000	1.5	1,046
1990	361,000	401,000	0.8	900
1991	273,000	319,000	1.4	937
1992	653,000	356,000	5.0	1,100
1993	498,000	288,000	7.8	900
1994	1,165,000	272,000	1.6	930
1995	567,470	291,061	2.0	855
1996	903,584	584,828	0.6	1,027
1997	1,626,652	585,630	4.4	1,200
1998	842,230	254,950	4.8	543
1999	1,004,266	625,747	4.4	1100
2000	1,284,100	890,774	7.2	971
2001	610,163	816,295	6.0	774
2002	536,800	733,191	2.5	883
2003		324,002	2.4	573
2004	10,000	648,563	3.2	621
2005	794,500	2,124,628	3.0	546
2006	258,714	1,753,543	2.4	250
2007	148224	2,126,906	0.0	100
2008	95,984	2,450,774	---	---
2009	72,731	2,325,750	---	---
2010	15,123	2,084,273	---	---
2011	127,496	2,341,228	---	---
2012	185,094	1,971,281	---	---
2013	13,200	1,768,083		
2014	0	0	---	---

Table 2.7.2. Adipose finclipped salmon released in the Baltic Sea area in 2014.

Country	Species	Stock	Age	Number		River	Subdivision	Other tagging
				parr	smolt			
Estonia	salmon	Kunda	2 yr			Purtse	32	
	salmon	Kunda	2 yr	9,400		Selja	32	
	salmon	Kunda	2 yr		9,910	Selja	32	500 - Carlin
	salmon	Kunda	2 yr		5,000	Loobu	32	500 - Carlin
	salmon	Kunda	2 yr	15,000		Valgejõgi	32	
	salmon	Kunda	2 yr		10,000	Valgejõgi	32	500 - Carlin
	salmon	Kunda	2 yr		5,290	Jägala	32	500 - Carlin
	salmon	Kunda	2 yr		5,160	Pirita	32	500 - Carlin
Finland	salmon	Neva	2 yr		9,722	Karjaanjoki	29	ARS
	salmon	Tornionjoki	2 yr		14,480	Aurajoki	29	
	salmon	Neva	2 yr		11,500	Karvianjoki	30	
	salmon	Simojoki	1 yr	11,200		Karvianjoki	30	
	salmon	Tornionjoki	1 yr		80,515	Kokemäenjoki	30	4000 T-anch
	salmon	Tornionjoki	1 yr	15,000		Kokemäenjoki	30	
	salmon	Simojoki	2 yr		11,200	Kyrönjoki	30	
	salmon	Simojoki	2 yr		11,200	Perhonjoki	31	
	salmon	Iijoki	1 yr		18,076	Kiiminkijoki	31	
	salmon	Oulujoki	2 yr		1,997	Oulujoki	31	998 T-anch.999 Carlin
	salmon	Iijoki	2 yr		1,690	Iijoki	31	997 T-anch. 693 Carlin
	salmon	Iijoki	2 yr		2,000	Kymijoki	31	1000 T-anch, 1000 Carlin
	salmon	Tornionjoki	2 yr		2,000	Kymijoki	31	1000 T-anch, 1000 Carlin
	salmon	Neva	2 yr		127,981	Kymijoki	32	6000 t-anch
	salmon	Neva	2 yr		12,416	Vantaanjoki	32	
Sweden	salmon	Luleälven	1 yr		104,902	Luleälven	31	
	salmon	Luleälven	2 yr		431,826	Luleälven	31	5000 Carlin
	salmon	Skellefteälven	1 yr		127,191	Skellefteälven	31	

Country	Species	Stock	Age	Number		River	Subdivision	Other tagging
				parr	smolt			
	salmon	Skellefteälven	2 yr		4,148	Skellefteälven	31	
	salmon	Umeälven	1 yr		19,721	Umeälven	31	1000 PIT tags
	salmon	Umeälven	2 yr		93,759	Umeälven	31	1000 PIT tags
	salmon	Ångermanälv	1 yr		139,971	Ångermanälven	30	3000 Carlin
	salmon	Ångermanälv	2yr		68,100	Ångermanälven	30	
	salmon	Indalsälven	1 yr		327,310	Indalsälven	30	
	salmon	Ljusnan	1 yr	69,070	167,479	Ljusnan	30	
	salmon	Dalälven	1 yr		183,448	Dalälven	30	3500 Carlin
	salmon	Dalälven	2 yr		6,348	Dalälven	30	500 Carlin
	salmon	Dalälven	1 yr		15,000	Stockholms ström	29	
	salmon	Skellefteälven	2 yr		6,060	Gidealven	31	500 Carlin
	salmon	Gullspång (Lake Vänern)	2 yr		3,000	Motala ström	27	
Total salmon				119,670	2,038,400			

Table 2.8.1. List of Baltic salmon stocks included in the genetic stock proportion estimation of catches. Stocks for which the data were updated in 2014 are shown as grey.

	Stock	Sampling year	Propagation	N
1	Tornionjoki, W	2011	Wild	210
2	Tornionjoki, H	2006, 2013	Hatchery	187
3	Simojoki	2006, 2009, 2010	Wild	174
4	Iijoki	2006, 2013	Hatchery	179
5	Oulujoki	2009, 2013	Hatchery	135
6	Kalixälven	2012	Wild	200
7	Råneälven	2003, 2011	Wild	150
8	Luleälven	2014	Hatchery	90
9	Piteälven	2012	Wild	53
10	Åbyälven	2003, 2005	Wild	102
11	Byskeälven	2003	Wild	105
12	Kågeälven (New)	2009	Wild	44
13	Skellefteälven	2006, 2014	Hatchery	58
14	Rickleå	2012, 2013	Wild	52
15	Säverån	2011	Wild	74
16	Vindelälven	2003	Wild	149
17	Umeälven	2006, 2014	Hatchery	87
18	Öreälven	2003, 2012	Wild	54
19	Lögdeälven	1995, 2003, 2012	Wild	102
20	Ångermanälven	2006, 2014	Hatchery	79
21	Indalsälven	2006, 2013	Hatchery	144
22	Ljungan	2003, 2014	Wild	101
23	Ljusnan	2013	Hatchery	123
24	Testeboån (New)	2014	Wild	104
25	Dalälven	2006, 2014	Hatchery	98
26	Emån	2003, 2013	Wild	148
27	Mörrumsån	2010, 2011, 2012	Wild	185
28	Neva, Fi	2006	Hatchery	149
29	Neva, Rus	1995	Hatchery	50
30	Luga	2003, 2011	Wild, Hatchery	147
31	Narva	2009	Hatchery	109
32	Kunda	2009, 2013	Wild, Hatchery	170
33	Keila	2013	Wild	63
34	Vasalemma (New)	2013	Wild	60
35	Salaca	2007, 2008	Wild	46
36	Gauja	1998	Hatchery	70
37	Daugava	2011	Hatchery	170
38	Venta	1996	Wild	66
39	Neumunas	2002-2010	Hatchery	166
	Total			4453

Table 2.8.2. Prior proportion of 1–2 year old smolts used for Baltic salmon baseline stocks in catch composition analysis for 2014.

No	STOCK	Smolt age	2.5%	Prior median proportion	97.5%	Data from years
1	Tornio-W	1-2 years	4,2	5,5	6,9	2010-2012
2	Tornio-H	1-2 years	99,8	100,0	100,0	All
3	Simojoki	1-2 years	38,2	48,1	58,2	2010-2012
4	Iijoki	1-2 years	99,8	100,0	100,0	All
5	Oulujoki	1-2 years	99,8	100,0	100,0	All
6	Kalix	1-2 years	3,7	5,5	7,9	2010-2012
7	Råne	1-2 years	2,0	6,9	16,5	2010-2012
8	Lule	1-2 years	99,8	100,0	100,0	All
9	Piteå	1-2 years	16,6	20,0	23,7	All
10	Åby	1-2 years	22,0	30,2	40,1	All
11	Byske	1-2 years	22,1	30,3	40,0	All
12	Skellefte	1-2 years	99,8	100,0	100,0	All
13	Ricleå	1-2 years	19,0	25,0	31,1	All
14	Seväråån	1-2 years	19,4	25,1	31,4	All
15	Vindel	1-2 years	30,4	37,3	43,8	All
16	Ume	1-2 years	99,8	100,0	100,0	All
17	Öre	1-2 years	14,2	21,1	30,3	All
18	Lögde	1-2 years	21,1	29,4	38,4	All
19	Ångerman	1-2 years	99,8	100,0	100,0	All
20	Indals	1-2 years	99,8	100,0	100,0	All
21	Ljungan	1-2 years	28,9	37,5	46,6	All
22	Ljusnan	1-2 years	99,8	100,0	100,0	All
23	Dal	1-2 years	99,8	100,0	100,0	All
24	Emån	1-2 years	92,5	97,1	99,3	All
25	Mörrums	1-2 years	92,8	97,1	99,2	All
26	Neva-FI	1-2 years	99,8	100,0	100,0	All
27	Neva-RU	1-2 years	86,0	90,1	93,2	All
28	Luga	1-2 years	92,9	96,0	98,1	All
29	Narva	1-2 years	99,8	100,0	100,0	All
30	Kunda	1-2 years	97,9	99,0	99,6	All
31	Keila	1-2 years	97,9	99,0	99,6	All
32	Salaca	1-2 years	97,8	99,0	99,6	All
33	Gauja	1-2 years	99,8	100,0	100,0	All
34	Daugava	1-2 years	99,8	100,0	100,0	All
35	Venta	1-2 years	99,8	100,0	100,0	All
36	Neumunas	1-2 years	99,8	100,0	100,0	All

Table 2.8.3. Medians and probability intervals of stock group proportion estimates (%) in Atlantic salmon catch samples from 2000–2014 based on microsatellite (DNA) and smolt age data. Proportions of wild salmon estimated by scale reading for the same samples are given for comparison (with range for cases where prop. wild has been calculated with/without fish with missing data). [D] Danish, [F] Finnish, [L] Latvian, [P] Polish, and [S] Swedish catches.

	Gulf of Bothnia, WILD	2.5 %	97.5 %	G. of Bothnia, HATC, FIN	2.5 %	97.5 %	G. of Bothnia, HATC, SWE	2.5 %	97.5 %	Others	2.5 %	97.5 %	Sample size	Scale reading – wild %
1. Åland Sea														
2014F	**91**	87	94	**6**	3	9	**3**	1	5	**1**	0	2	**320**	87
2013F	**84**	80	88	**7**	5	10	**8**	5	12	**0**	0	0	**404**	78
2012F	**90**	87	93	**7**	4	10	**3**	1	5	**0**	0	0	**468**	82
2011F	**92**	88	95	**4**	2	8	**3**	2	6	**0**	0	1	**282**	90
2010F	**90**	85	93	**7**	4	10	**3**	2	6	**0**	0	1	**416**	80
2009F	**79**	74	84	**13**	9	18	**7**	4	11	**0**	0	1	**271**	69
2008F	**63**	56	69	**14**	10	20	**22**	17	28	**1**	0	3	**252**	56
2007F	**80**	75	84	**14**	10	19	**6**	4	9	**0**	0	1	**398**	78
2006F	**80**	71	87	**13**	6	21	**6**	2	12	**1**	0	3	**133**	68
2005F	**69**	64	75	**24**	19	29	**6**	4	10	**0**	0	1	**315**	64
2004F	**73**	67	80	**15**	10	21	**11**	7	16	**0**	0	1	**258**	65
2003F	**70**	63	77	**24**	17	30	**6**	2	11	**0**	0	2	**209**	64
2002F	**65**	58	72	**23**	16	30	**10**	6	15	**2**	1	5	**218**	58
2000F	**23**	18	28	**37**	30	45	**39**	32	46	**1**	0	2	**412**	22
Mean	**75**	69	80	**15**	10	20	**10**	6	14	**0**	0	2		

	Gulf of Bothnia, WILD	2.5 %	97.5 %	G. of Bothnia, HATC, FIN	2.5 %	97.5 %	G. of Bothnia, HATC, SWE	2.5 %	97.5 %	Others	2.5 %	97.5 %	Sample size	Scale reading – wild %
2. Bothnian Bay														
2014FS	**82**	78	85	**12**	9	15	**6**	4	8	**0**	0	0	**612**	75-76
2013FS	**71**	66	75	**24**	19	28	**5**	3	8	**0**	0	1	**423**	62-68
2012FS	**80**	76	84	**17**	13	21	**3**	1	5	**0**	0	0	**439**	69-72
2011FS	**85**	81	89	**12**	8	16	**3**	2	5	**0**	0	0	**444**	76
2010FS	**85**	81	89	**11**	8	15	**3**	1	6	**0**	0	0	**498**	81
2009FS	**76**	70	81	**16**	11	22	**8**	6	11	**0**	0	1	**510**	67
2008FS	**74**	70	78	**21**	17	25	**5**	3	7	**0**	0	1	**600**	66
2007FS	**66**	62	71	**15**	12	19	**18**	15	22	**0**	0	0	**629**	66
2006FS	**58**	52	63	**30**	25	35	**13**	10	16	**0**	0	1	**481**	55
Mean	**75**	71	79	**17**	14	22	**7**	5	10	**0**	0	1		
Finnish and Swedish catches separately														
2014F	**82**	77	86	**18**	14	23	**0**	0	1	**0**	0	1	**319**	76-77
2013F	**59**	52	66	**39**	33	46	**0**	0	3	**0**	0	2	**220**	54-55
2012F	**62**	54	69	**36**	29	43	**2**	1	5	**0**	0	1	**212**	54-55
2011F	**78**	71	83	**21**	16	28	**1**	0	2	**0**	0	1	**220**	70
2010F	**76**	69	82	**23**	18	30	**0**	0	2	**0**	0	1	**215**	68
2009F	**66**	58	73	**32**	25	39	**2**	1	5	**0**	0	1	**252**	55
2014S	**83**	78	88	**4**	2	8	**12**	9	17	**0**	0	1	**293**	74-75
2013S	**86**	80	92	**2**	0	6	**11**	7	16	**0**	0	1	**203**	70-77
2012S	**97**	93	99	**0**	0	1	**3**	1	7	**0**	0	1	**227**	82-85
2011S	**78**	71	93	**21**	0	28	**1**	0	9	**0**	0	1	**224**	80-85
2010S	**92**	88	96	**2**	1	5	**6**	2	9	**0**	0	1	**283**	90
2009S	**82**	76	87	**0**	0	1	**17**	12	23	**0**	0	2	**258**	80

Table 2.8.3. Continued.

	Gulf of Bothnia, wild	2.5 %	97.5 %	G. of Bothnia, hatchery, FIN	2.5 %	97.5 %	G. of Bothnia, hatchery, SWE	2.5 %	97.5 %	Gulf of Finland, wild	2.5 %	97.5 %	Gulf of Finland, hatchery	2.5 %	97.5 %	Western Main B., wild, SWE	2.5 %	97.5 %	Eastern Main Basin	2.5 %	97.5 %	Sample size	Scale reading – wild %
3. Main Basin																							
2014DP	**72**	67	76	**4**	2	8	**20**	16	24	**0**	0	1	**0**	0	1	**3**	2	5	**1**	0	2	**477**	66-69
2013DP	**64**	60	69	**14**	11	18	**18**	15	22	**0**	0	1	**0**	0	1	**1**	0	2	**1**	1	2	**590**	60-63
2012DFPS	**63**	60	66	**12**	9	14	**22**	19	24	**0**	0	1	**1**	0	1	**1**	1	2	**1**	1	2	**1301**	55-57
2011DFPS	**71**	67	75	**6**	4	9	**18**	15	22	**0**	0	1	**0**	0	1	**1**	1	2	**2**	1	4	**830**	66-67
2010DFPS	**74**	69	79	**5**	2	9	**14**	11	17	**0**	0	0	**2**	1	4	**1**	0	2	**3**	2	5	**566**	62-68
2009FP	**60**	55	64	**13**	10	17	**20**	17	24	**0**	0	1	**3**	2	5	**1**	1	3	**2**	1	3	**618**	49-57
2008P	**67**	61	72	**8**	5	12	**15**	11	19	**1**	0	2	**3**	2	5	**1**	0	3	**5**	3	8	**367**	58-65
2007FPS	**62**	57	66	**7**	4	10	**21**	17	25	**2**	1	4	**4**	3	6	**1**	0	2	**3**	2	5	**486**	56-61
2006DFLPS	**64**	59	69	**16**	12	20	**12**	9	15	**1**	0	3	**3**	2	4	**1**	0	2	**2**	1	4	**521**	55-58
Mean	**66**	61	70	**10**	7	14	**18**	14	21	**1**	0	1	**2**	1	3	**1**	0	2	**3**	1	4		
4. Gulf of Finland																							
2014FWest	**60**	46	71	**17**	9	28	**12**	5	21	**0**	0	1	**10**	5	18	**0**	0	1	**0**	0	1	**75**	47
2014FEast	**31**	23	40	**12**	6	19	**0**	0	3	**0**	0	1	**55**	47	64	**0**	0	0	**1**	0	3	**135**	28
2014FAll	**41**	33	48	**14**	9	20	**5**	3	9	**0**	0	1	**39**	33	46	**0**	0	0	**0**	0	2	**210**	35

D Danish, F Finnish, L Latvian, P Polish, S Swedish catch

Table 2.8.4. Medians of individual river-stock proportion estimates in Atlantic salmon catches from the Gulf of Bothnia. Finnish and Swedish catch analysed also separately from the Bothnian Bay. Danish, ^{F} Finnish, ^{L} Latvian, ^{P} Polish, and ^{S} Swedish catch.

	Tornionj.Wild	Tornionj. Hatch.	Simojoki, W	Iijoki, H	Oulujoki, H	Kalixälven, W	Råne, W	Luleälven, H	Piteälven, W	Åbyälven, W	Byskeälven, W	Kågeälven, W	Skellefteälven, H	Ricleå, W	Sävarån, W	Vindelälven, W	Umeälven, H	Öreälven, W	Lögde, W	Ångermanälven, H	Indalsälven, H	Ljungan, W	Ljusnan, H	Testeboån, W	Dalälven, H	Neva-FI, H	Sample size
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	28	
Åland Sea																											
2014^{F}	42	0	3	4	0	25	3	0	-	6	6	-	-	0	0	2	-	-	2	-	0	-	1	-	1	0	320
2013^{F}	32	3	1	4	-	23	3	-	4	2	6		2	-	-	6	1	1	4	3	2	-	-		0	-	404
2012^{F}	42	3	5	3	-	29	1	-	-	2	4		0	1	-	5	0	0	1	1	-	-	-		0	0	468
2011^{F}	44	2	2	2	0	23	1	1	-	0	12		0	-	-	5	-	1	1	-	2	-	-		-	-	303
2010^{F}	30	3	5	3	0	40	0	0		-	6		0			4	1	-	1	1	1	3	-		0	0	416
2009^{F}	32	4	2	6	2	28	1	2		1	6		0			5	-	0	2	1	2	0	-		1	1	271
2008^{F}	28	9	0	3	1	20	0	11		3	6		-			3	-	-	0	4	4	0	-		2	1	252
2007^{F}	43	8	6	6	0	18	0	3		-	3		-			7	0	-	1	2	-	-	-		0	-	398
2006^{F}	29	4	8	6	1	24	2	2		3	6		-			4	-	1	-	-	-	-	1		2	1	133
2005^{F}	28	7	4	14	3	27	-	2		-	4		-			4	1	-	2	2	-	0	-		1	0	315
2004^{F}	38	5	7	10	-	16	-	5		-	5		-			5	-	-	-	1	2	-	-		1	-	258
2003^{F}	35	13	-	7	3	21	-	2		2	-		-			8	-	-	0	-	-	-	-		2	-	209
2002^{F}	33	10	-	8	2	32	-	5		-	-		-			4	-	-	1	-	-	-	5		-	5	218
2000^{F}	14	26	6	5	5	-	-	12		-	0		4			1	3	-	-	15	0	-	1		2	1	412
Mean	*34*	*7*	*4*	*6*	*2*	*25*	*1*	*4*	*4*	*2*	*5*	*0*	*1*	*0*	*0*	*5*	*1*	*1*	*1*	*3*	*2*	*1*	*2*	*0*	*1*	*1*	
Bothnian Bay																											
2014^{FS}	40	2	1	4	6	22	0	1	-	-	5	1	-	-	0	8	1	-	3	1	1	-	1	0	1	0	612
2013^{FS}	24	3	4	10	10	16	-	1	1	-	10		1	1	2	4	0	1	7	2	-	-	-		-	-	423
2012^{FS}	35	1	1	6	10	8	-	1	6	4	15		-	0	1	3	0	1	4	1	-	-	0		-	-	439
2011^{FS}	35	3	2	3	6	14	-	-	4	5	16		2	2	1	2	-	1	4	1	-	-	0		-	-	444
2010^{FS}	29	3	1	4	3	22	0	2		7	11		1			2	-	0	10	-	0	1	0		-	-	498
2009^{FS}	15	3	2	7	5	25	-	2		4	20		3			3	1	1	4	1	0	0	0		-	-	510
2008^{FS}	23	6	3	9	6	15	0	2		4	10		2			6	-	2	9	-	-	-	-		-	-	600
2007^{FS}	*25*	8	5	2	3	8	0	10		6	11		5			4	1	2	4	2	1	0	-		-	2	629
2006^{FS}	16	12	3	10	6	13	-	9		6	17		3			2	0	-	1	-	-	-	-		-	-	481
Mean	*27*	*5*	*3*	*6*	*6*	*16*	*0*	*4*	*4*	*5*	*13*	*1*	*3*	*1*	*1*	*4*	*1*	*1*	*5*	*1*	*1*	*0*	*0*	*0*	*1*	*1*	
2014^{F}	45	-	3	7	11	30	-	-	-	-	-	3	-	0	-	0	-	-	-	-	-	-	-	-	-	-	*319*
2013^{F}	32	-	5	17	21	18	-	-	-	-	3		-	-	-	-	-	-	-	0	-	-	-		-	-	220
2014^{S}	31	4	-	-	-	16	1	1	-	-	11	-	-	-	1	15	3	-	7	1	2	-	1	-	2	0	293
2013^{S}	20	2	2	-	-	13	-	3	1	-	18		3	2	4	7	1	2	14	4	-	-	-		-	-	203

Table 2.8.4. Continued. Medians of individual river-stock proportion estimates in Atlantic salmon catches from the Baltic Main Basin. Danish, F Finnish, L Latvian, P Polish, and S Swedish catch.

	Tornionj.Wild	Tornionj. Hatch.	Simojoki, W	Iijoki, H	Oulujoki, H	Kalixälven, W	Råne, W	Luleälven, H	Piteälven, W	Åbyälven, W	Byskeälven, W	Kågeälven, W	Skellefteälven, H	Ricleå, W	Sävarån, W	Vindelälven, W	Umeälven, H	Öreälven, W	Lögde, W	Ångermanälven, H	Indalsälven, H	Ljungan, W	Ljusnan, H	Dalälven, H	Emån, W	Mörrumsån, W	Neva–Fl, H	Luga, W	Salaca, W	Gauja, H	Daugava, H	Neumunas, H	Sample size
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	30	35	36	37	39	
Main Basin																																	
2014DP	44	1	2	2	1	11	1	5	0	1	2	1	1	1	0	5	2	1	1	3	5	0	3	1	-	3	-	0	-	-	0	0	477
2013DP	37	6	1	5	2	10	1	7	1	2	4		0	-	-	7	-	0	0	4	4	1	0	3	-	1	0	0	-	0	0	1	521
2012DF PS	35	5	2	2	4	10	1	13	2	-	4		-	0	0	7	-	-	1	1	6	1	-	1	-	1	1	0	0	0	-	1	486
2011DF PS	43	1	2	3	2	11	1	3	4	2	2		3	-	0	4	2	0	0	2	7	1	0	1	1	1	0	0	1	0	-	1	367
2010DF PS	44	4	3	1	1	15	-	4		1	3		1			5	-	-	-	3	4	2	-	2	-	1	2	-	2	0	-	1	618
2009FP	31	7	2	4	2	14	1	8		3	2		2			5	2	-	0	3	4	1	0	1	-	1	3	-	-	1	1	0	566
2008P	37	6	2	0	1	17	1	5		1	4		2			4	1	-	-	2	4	-	-	1	-	1	3	1	-	3	1	1	830
2007FPS	30	4	4	2	0	14	0	10		3	2		1			6	-	-	1	3	5	-	0	-	-	1	4	2	-	1	1	1	130 1
2006DF LPS	25	11	3	4	1	22	1	4		-	3		-			5	-	0	1	3	3	4	1	1	-	1	3	1	-	2	-	0	590
Mean	36	5	2	3	2	14	1	7	2	2	3	1	1	0	0	5	1	0	1	3	5	1	1	1	1	1	2	1	1	1	1	1	

	Tornionj.Wild	Tornionj. Hatch.	Simojoki, W	Iijoki, H	Oulujoki, H	Kalixälven, W	Råne, W	Luleälven, H	Piteälven, W	Åbyälven, W	Byskeälven, W	Kågeälven, W	Skellefteälven, H	Ricleå, W	Sävarån, W	Vindelälven, W	Umeälven, H	Öreälven, W	Lögde, W	Ångermanälven, H	Indalsälven, H	Ljungan, W	Ljusnan, H	Dalälven, H	Emån, W	Mörrumsån, W	Neva–FI, H	Luga, W	Salaca, W	Gauja, H	Daugava, H	Neumunas, H	Sample size
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	30	35	36	37	39	
Gulf of Finland																																	
2014EAST	22	11	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	-	-	-	0	-	135
2014WEST	37	7	4	4	6	13	-	5	-	-	-	-	5	-	-	4	-	-	-	-	0	-	-	-	-	-	10	-	-	-	-	-	75
2014ALL	27	10	2	2	2	10	-	2	-	-	-	-	2	-	-	1	-	-	-	-	0	-	-	-	-	-	39	-	-	-	0	-	210

Table 2.8.5. Atlantic salmon catches from the Baltic Main Basin by assessment units, from 2006 to 2014.

Year	Estimate	AU1 Wild; Fin, Swe	AU1 Hatchery, Fin	AU2 Wild, Swe	AU2 Hatchery, Swe	AU3 Wild, Swe	AU3 Hatchery, Swe	AU4 Wild, Swe	AU6 Wild, Est, Rus	AU6 Hatchery, Est, Fin, Rus	AU5 Wild, Lat, Lit	AU5 Hatchery, Lat, Pol
2014	Median	58	4	13	8	0	12	3	0	0	0	0
	2.5%	52	2	10	5	0	9	2	0	0	0	0
	97.5%	63	8	17	11	2	15	5	1	1	1	1
2013	Median	49	14	14	8	2	10	1	0	0	1	0
	2.5%	44	11	11	5	0	8	0	0	0	0	0
	97.5%	53	18	18	11	3	13	2	1	1	2	1
2012	Median	47	12	15	13	1	8	1	0	1	1	0
	2.5%	44	9	13	11	0	7	1	0	0	1	0
	97.5%	50	14	17	16	1	10	2	1	1	2	0
2011	Median	57	6	13	8	1	11	1	0	0	2	0
	2.5%	53	4	11	6	0	8	1	0	0	1	0
	97.5%	60	9	16	10	2	13	2	1	1	3	0
2010	Median	63	6	9	5	2	9	1	0	2	3	0
	2.5%	58	2	7	3	1	6	0	0	1	2	0
	97.5%	68	9	12	7	3	12	2	0	4	5	0
2009	Median	47	13	11	12	1	8	1	0	3	1	1
	2.5%	43	10	9	10	0	6	1	0	2	0	0
	97.5%	52	17	14	15	2	10	3	0	5	2	1
2008	Median	57	8	9	7	0	7	1	1	3	4	1
	2.5%	51	5	6	5	0	4	0	0	2	1	0
	97.5%	62	12	13	11	3	10	3	2	5	7	4
2007	Median	49	7	13	12	0	9	1	2	4	2	2
	2.5%	44	4	9	9	0	6	0	1	3	0	0
	97.5%	54	10	16	16	0	12	2	3	6	4	4
2006	Median	52	16	8	4	4	8	1	1	3	2	0
	2.5%	47	13	6	2	2	5	0	0	2	1	0
	97.5%	57	21	11	7	7	11	2	3	5	4	0

Table 2.8.5. Continued.

Nº	Assessment unit	Rivers		Country
1	AU1 Wild	Simojoki, TornioW, Kalix, Råne	4	Fin, Swe
2	AU1 Hatchery	TornioH, Iijoki, Oulujoki	3	Fin
3	AU2 Wild	Pite, Åby, Byske, Kåge, Ricleå, Säverån, Vindel, Öre, Lögde	9	Swe
4	AU2 Hatchery	Lule, Skellefte, Ume	3	Swe
5	AU3 Wild	Ljungan, Testeboån	2	Swe
6	AU3 Hatchery	Ångerman, Indals, Ljusnan, Dal	4	Swe
7	AU4 Wild	Emån, Mörrumsån	2	Swe
8	AU6 Wild	Luga, Kunda, Keila, Vasalemma	4	Est, Rus
9	AU6 Hatchery	Neva-FI, Neva-RU, Narva	3	Est, Fin, Rus
10	AU5 Wild	Salaca, Gauja, Venta, Neumunas	4	Lat, Lit
11	AU5 Hatchery	Daugava	1	Lat

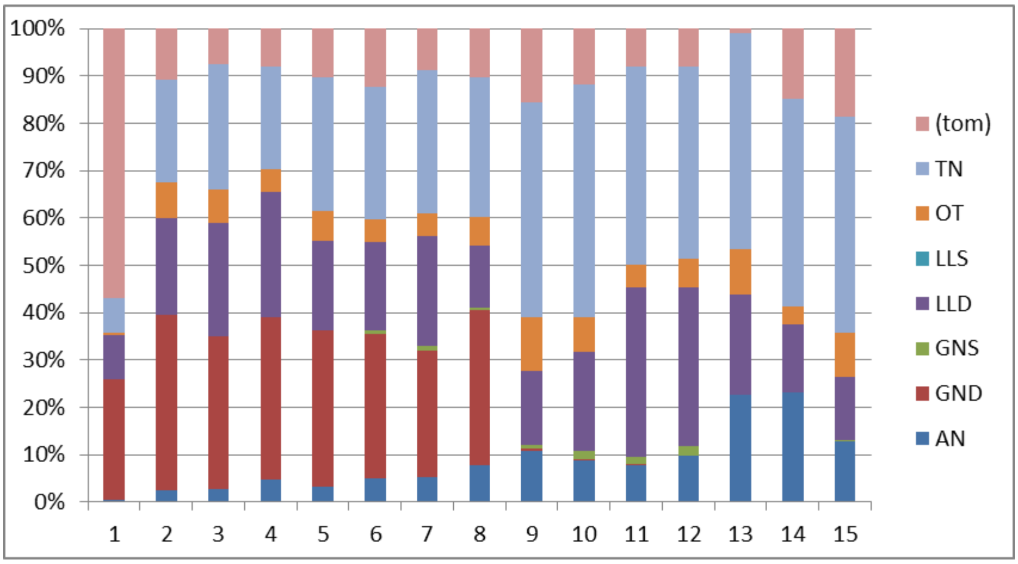


Figure 2.2.1. Proportion of catch of Baltic salmon by weight in different types of gear 2000–2014. Variables: GND=driftnet, AN=angling, GNS=gillnet, LLD=longline, OT=other, TN=trapnet, Blank=unidentified.

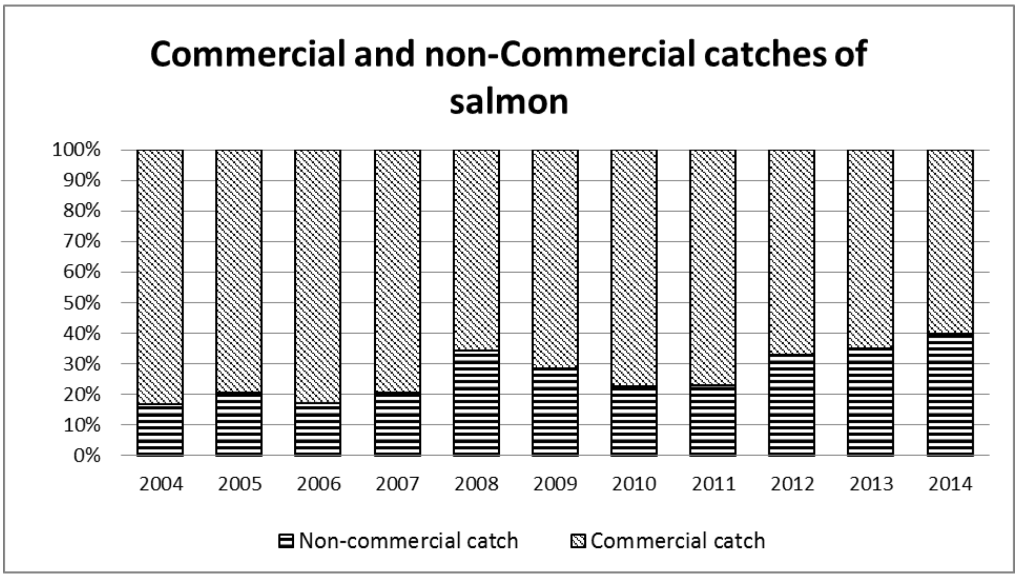


Figure 2.2.2. Commercial and non-commercial catches in percent (weight) in 2004–2014 in Subdivisions 22–32 from sea, coast and river.

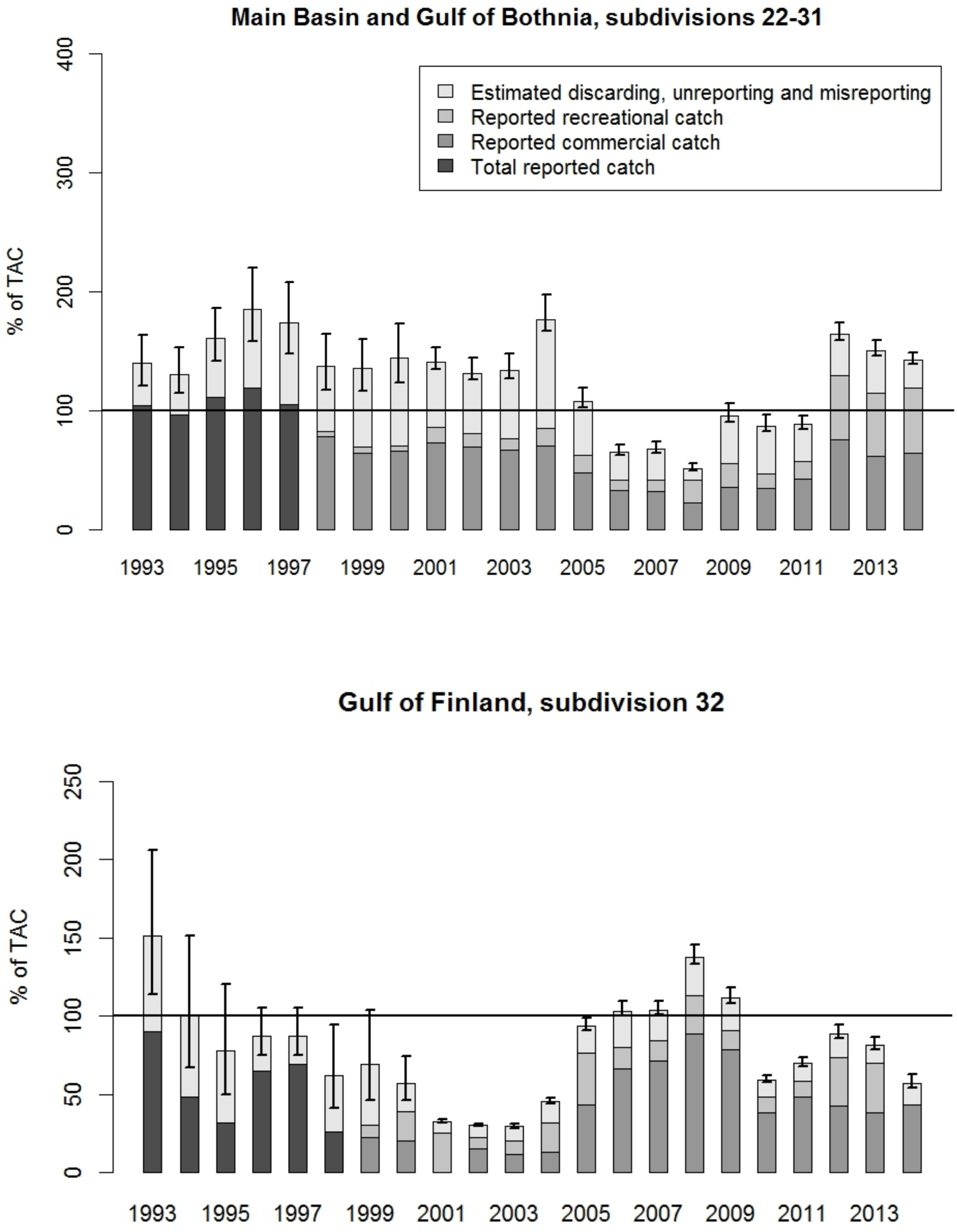


Figure 2.2.3. Catches of salmon in % of TAC. For years 1993–1997 (1993–1998 for Gulf of Finland) it is not possible to divide the total reported catch into commercial and recreational catches. Estimates of discards and unreported catches are presented separately in Table 2.2.2.

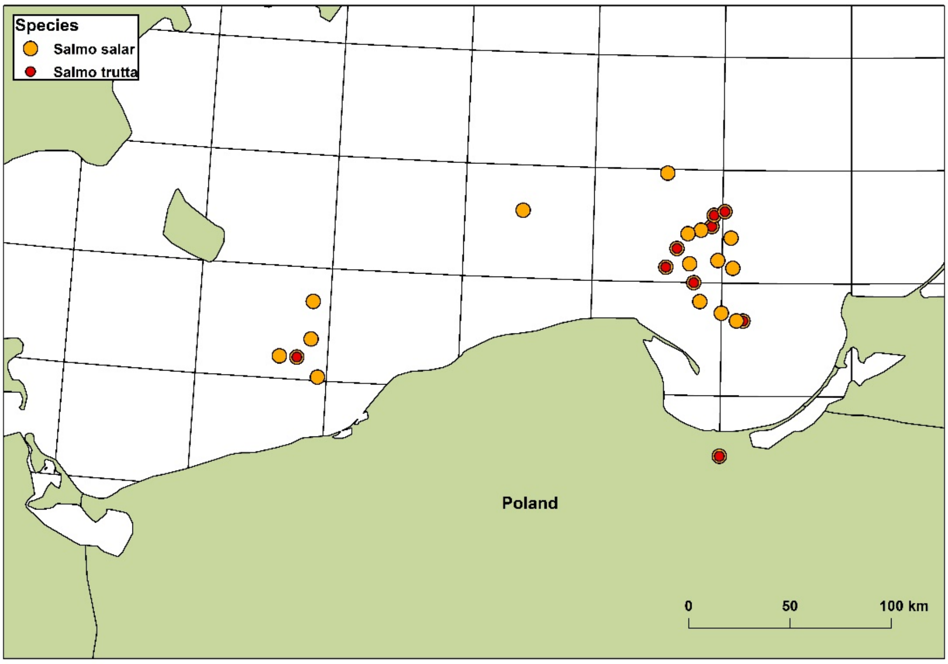


Figure 2.3.1. The locations of catch samples collected during the sampling trips on the Polish longline vessels in years 2009–2012. The sampling has been carried out by the Polish Marine Fisheries Research Institute under the EU Data Collection Framework (data source: ICES Regional Database). The size of dots does not indicate any quantities.

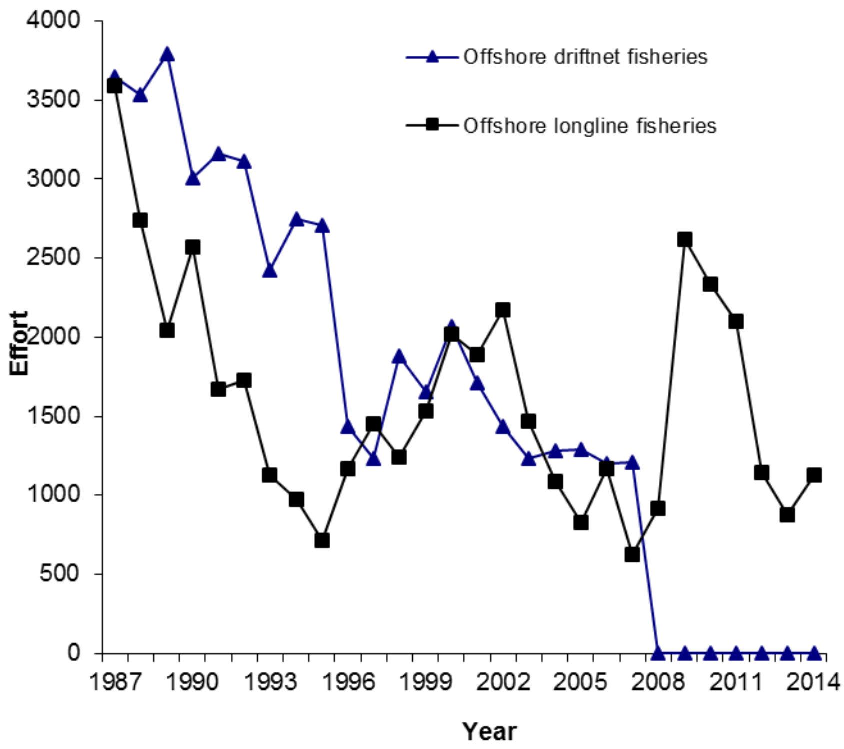


Figure 2.4.1. Fishing effort in Main Basin offshore fisheries (x 1000 geardays).

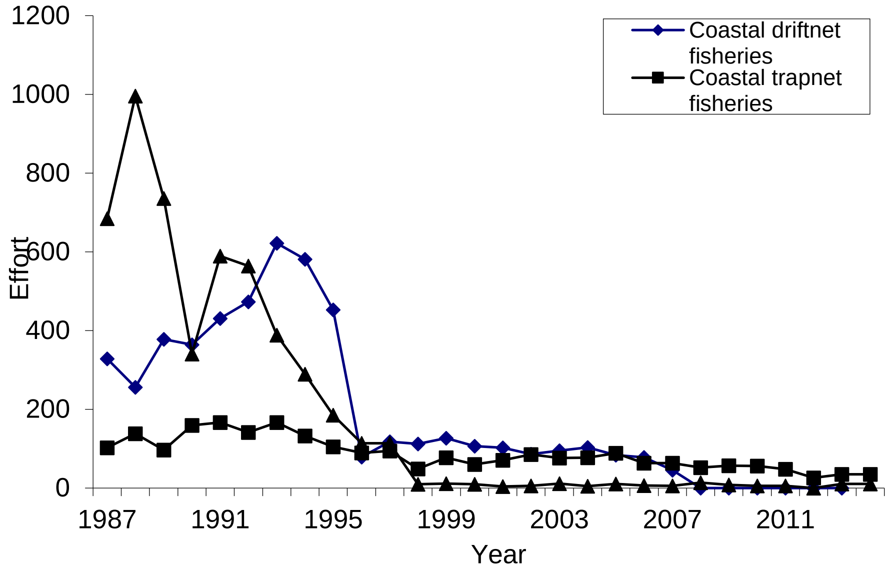


Figure 2.4.2. Effort in Main Basin and Gulf of Bothnia coastal fisheries (x 1000 geardays).

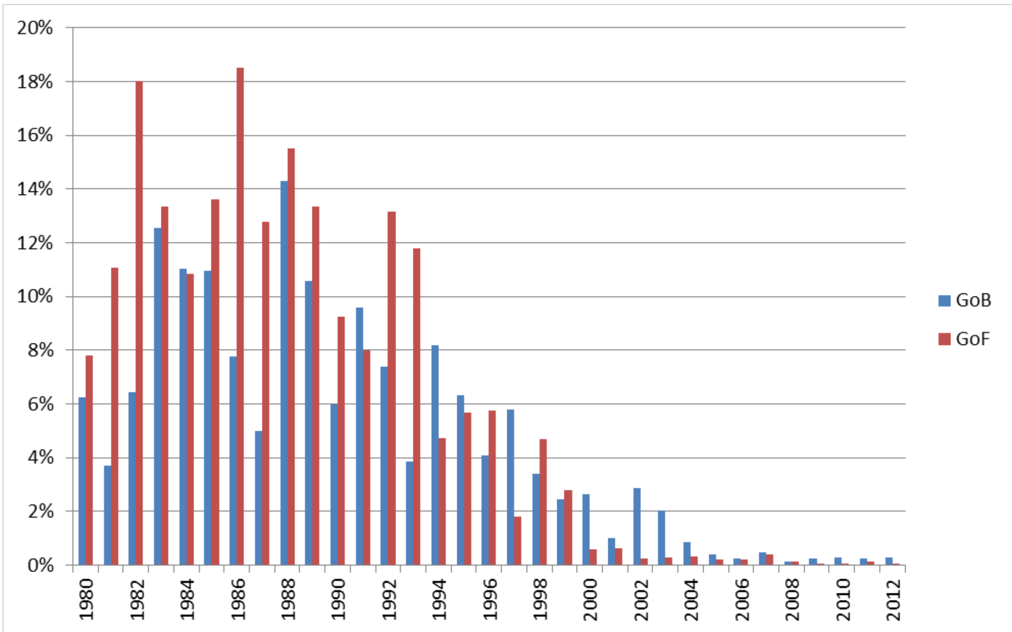


Figure 2.6.2. Return rates of Carling tagged reared salmon released in Gulf of Bothnia and Gulf of Finland in 1980–2012 (updated in March 2015 but no returns from 2013–2014 cohorts).

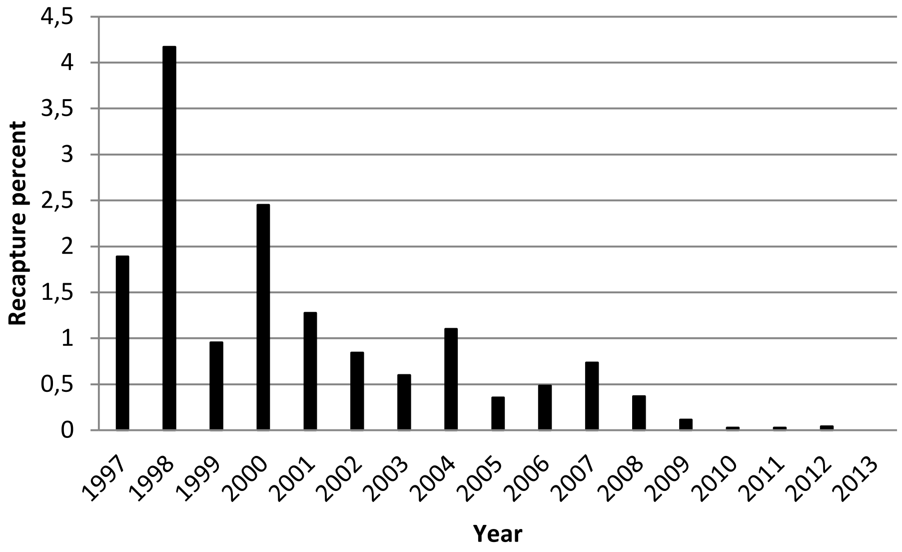


Figure 2.6.3. Recapture rate (in percent) of two-year-old Carlin tagged salmon in the Gulf of Finland (no changes in 2014).

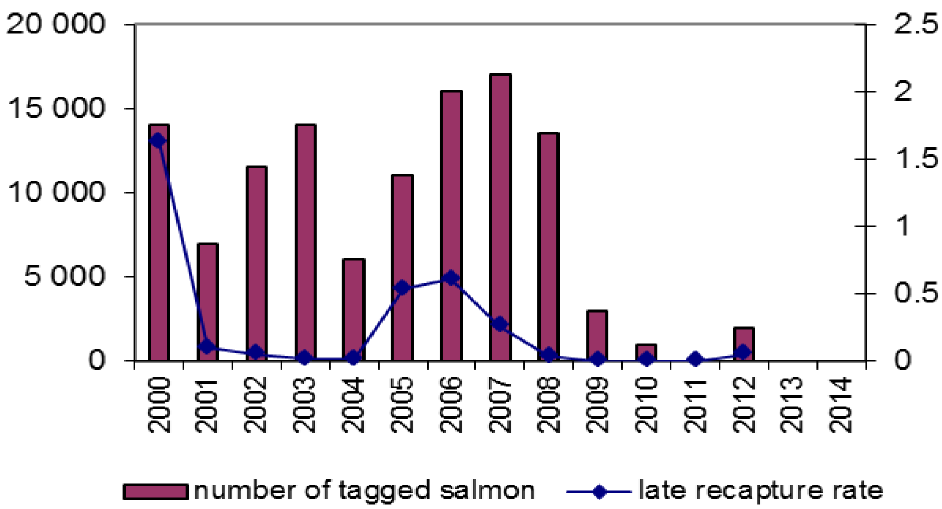


Figure 2.6.5. Return rates for salmon in 2000–2014 in Poland

Dendrogram with updated Atlantic salmon baseline stock samples in 2015.

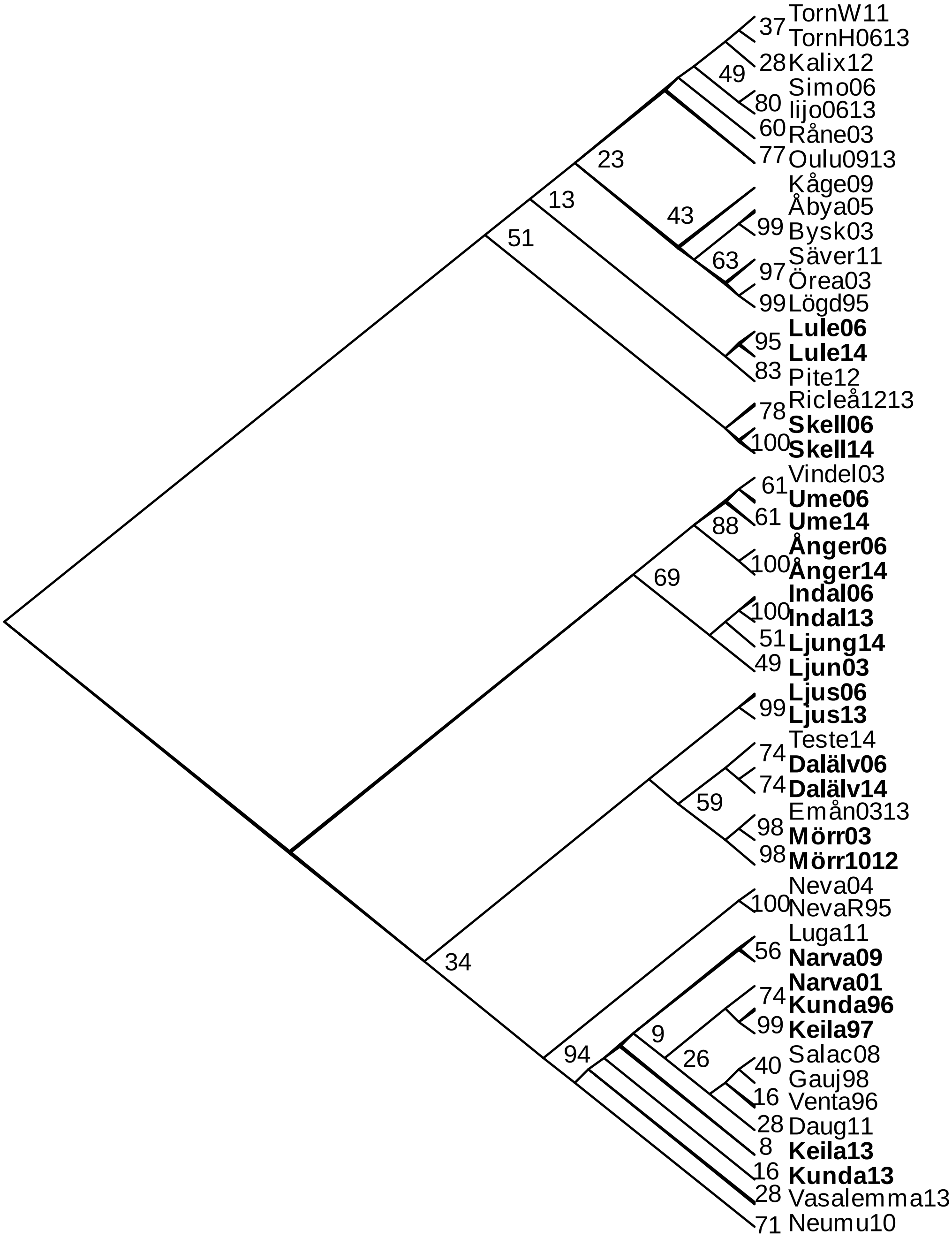
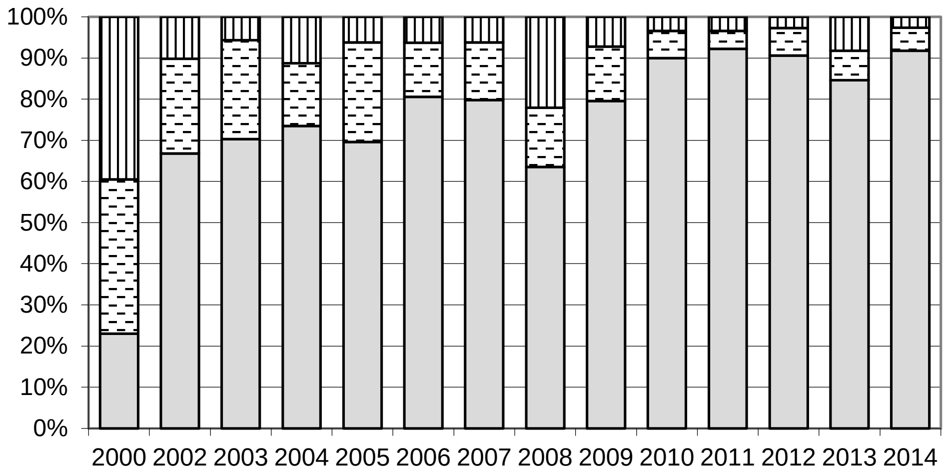
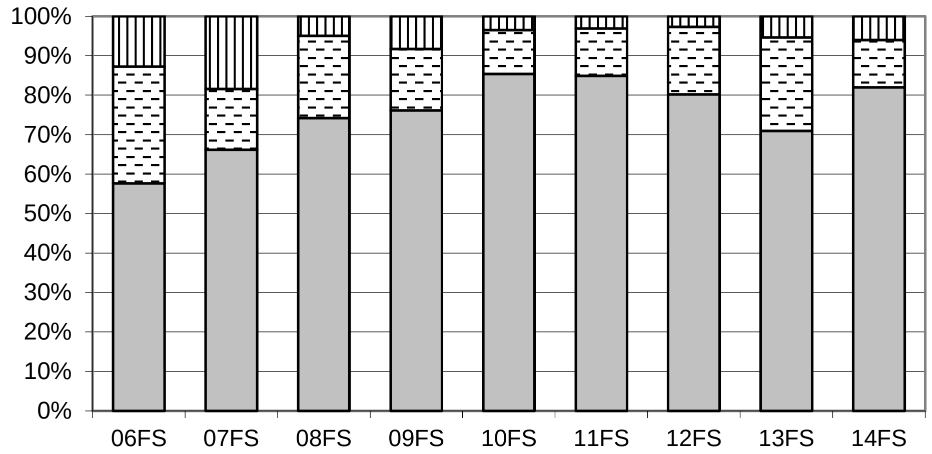


Figure 2.8.1. Neighbour joining dendrogram (based on Nei's pairwise DA genetic distances) depicting genetic relationships among Atlantic salmon baseline samples, including recent updates made before the 2014 catch analysis. Updated compared baseline stocks are shown as bold. Numbers represent percentage support values based on 1000 bootstraps.

A. Åland Sea



B. Bothnian Bay



C. Main Basin

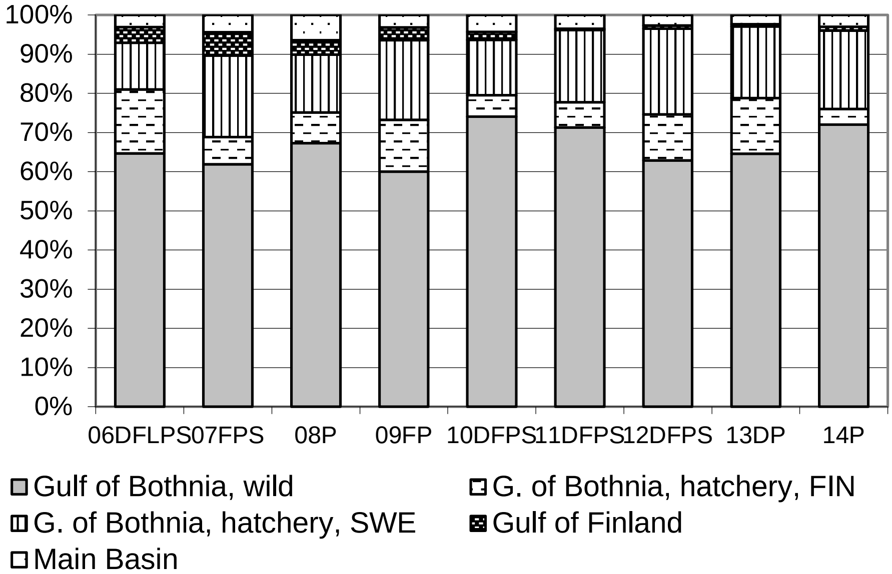


Figure 2.8.2. The proportion of Atlantic salmon stock groups in salmon catches of three Baltic Sea areas.

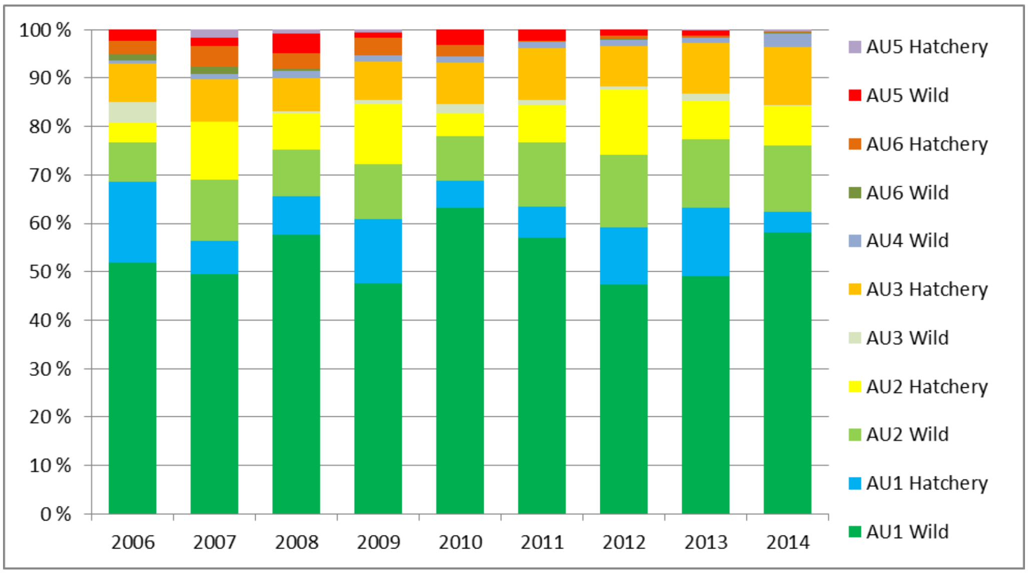


Figure 2.8.3. Proportions of Atlantic salmon assessment units in the Baltic Sea Main Basin catches in the international catch samples over the years 2006–2014.

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3 River data on salmon populations

The Baltic salmon (and sea trout) rivers are divided into four main categories: **wild**, **mixed**, **reared** and **potential**.

3.1 Wild salmon populations in Main Basin and Gulf of Bothnia

Current wild salmon rivers in Main Basin and Gulf of Bothnia are listed per country and assessment unit in the Stock Annex (Annex 3).

3.1.1 Rivers in assessment unit 1 (Gulf of Bothnia, Subdivision 31)

During the past centuries and even during the early 1900s, river catches were generally on a much higher level than during the late 1900s, as illustrated by catch statistics from **Tornionjoki** (Figure 3.1.1.1). During the 1980s, river catches were the lowest ever recorded: only 50–200 kg/year in **Simojoki**, and some tonnes/year in **Tornionjoki** and **Kalixälven**, indicating that the escapement to the spawning grounds was very low (Table 3.1.1.1, Figure 3.1.1.2). In 1994–1996 river catches increased and they peaked in 1997, when the catches were 4, 74 and 10 tonnes in **Simojoki, Tornionjoki** and **Kalixälven**, respectively. Catches decreased thereafter to 25%–60% of that of 1997, until there were two new prominent rises, first in 2008 and second in 2012–2014. Exceptional circumstances (years with warm and low vs. high and cool river water) may have affected fishing success in some years, but it is likely that catches generally reflect trends in the abundance of salmon (but see below development in fishladder data from Kalixälven).

In 2012, the catch in **Tornionjoki** was three times higher than in 2011 and exceeded for the first time 100 tonnes since the beginning of the time-series of annual catch statistics (Table 3.1.1.1). In 2013, catch dropped, but in 2014 it rose again and achieved a new record of 147 tonnes (Table 3.1.1.1). Catch levels similar to those observed in 2012–2014 were observed in the early 20th century (Figure 3.1.1.1). Salmon catch in **Simojoki** did not rise much in 2012–2013, which is partly due to the low fishing effort in those years in this river. However, in 2014 there was a clear increase in the catch (Table 3.1.1.1). The catches in **Kalixälven** increased but do not correspond to the increase in registered number of salmon that passed the fishladder in 2013.

A special kind of fishing from boat (rod fishing by rowing) dominates in salmon fishing in **Tornionjoki.** Also in **Kalixälven** this fishing occurs but is not as dominating as in **Tornionjoki**. Cpue of this fishery in **Tornionjoki** has increased tens of times since the late 1980s (Table 3.1.1.1), apparently reflecting the parallel increase in the abundance of spawners in the river. The cpue peaked in 1997, 2008 and 2012-2014, when the total river catches were also peaking. In 2014 the cpue was 2210 grams/day, which is the highest recorded, two times higher than cpue in 2012–2013. Annual changes in cpue and in total river catch follow each other rather closely.

Spawning runs and their composition

In **Kalixälven** fish passage has been controlled in the fishladder since 1980. Until 1997 the control of fish passage was carried out by manual control and from 1998 the control has been carried out by an electronic, infrared fishcounter, "Riverwatcher" (Vaki Aquaculture System Ltd, Iceland). Registration of species has been carried out during the whole migration season 2007–2014. Every species passing both up- and downstream is distinguished with video recording. Totally six species (salmon, trout, whitefish, grayling, bream, and ide) has been registered during 2007–2014.

In 2001 and 2002 over 8000 salmon passed the ladder. During the years 2007–2009 the run in the ladder was over 6000 individuals. The run in 2011 was the lowest for the ten latest years and in 2012 the run increased to the same level as in 2001 and 2002, but with the difference that number of multisea winter salmon was the highest recorded. In 2013 the run increased to the highest level observed when more than 15 000 salmon passed the ladder. The run 2014 was halved compared to previous year (Table 3.1.1.2, Figure 3.1.1.3).

A hydroacoustic split-beam technique was employed in 2003–2007 to count the spawning run in **Simojoki**. It seems evident that these counts covered a fraction of the total run, as there are irregularities in the river bottom at the counting site, allowing salmon to pass the site without being recorded. Starting in 2008, the split-beam technique has been replaced by a new echosounder called DIDSON (Dual frequency IDentification SONar). According to the monitoring results, seasonal run size has ranged from less than 1000 fish up to almost 4000 fish (Table 3.1.1.2). The spawning runs gradually increased from 2004 to 2008–2009, but dropped in 2010–2011. In 2012 the number of ascending fish increased fourfold from the previous year (to about 3600) and was almost as high in 2013 (about 3100; Table 3.1.1.2). In 2014 a new record of about 3800 salmon was observed. A lot of back-and-forth movement of salmon has been detected in Simojoki, which erodes the accuracy of the hydroacoustic counts. There have also been problems connected to differentiation of species.

The spawning runs into **Tornionjoki** have been monitored by DIDSON technique since 2009. The observed seasonal run size has ranged from 17 200 (year 2010) to 101 400 (year 2014) salmon (Table 3.1.1.2). The run size in 2014 was almost two times larger than in 2012–2013. The counting site is located about 100 km upstream from the river mouth. Therefore, those salmon which are either caught below the site or which stay to spawn below the site must be assessed and added into the hydroacoustic count in order to get an estimate of the total run size into the river (Lilja *et al.*, 2010). In 2014 the total amount of spawners entering the river probably lies somewhere between 109 000–128 000 individuals. By subtracting the river catch from this, the spawning population in the Tornionjoki is estimated to be 15-21% smaller (in 2014 about 91 000–110 000 spawners). Grilse account for a minority (7–17%) of the annual spawning runs.

In 2014 the spawning run into **Råneälven** was monitored with an ultra sound camera called SIMSONAR. The technique is the same that is used in Tornionjoki and Simojoki. The counting site is located about 35 km upstream from the river mouth and represents the total run of salmon. The total salmon run in 2014 was 3756.

About 10 100 catch samples have been collected from **Tornionjoki** fishery of salmon since the mid-1970s. Table 3.1.1.3 shows number of samples, sea age composition, sex composition and proportion of reared fish (identified either by the absence of adipose fin or by scale reading) of the data for the given time periods. Caught fish have generally become older and the proportion of repeat spawners has increased in parallel with the decreasing sea fishing pressure (see Chapter 4). The strong spawning runs into Tornionjoki in 2012–2014 were a result of fish from several smolt cohorts. The proportion of females has been stable (61–69% of total biomass) and close to long-term average during the last three years. The proportion of repeat spawners was at a record high level (14%) in 2014. Recently very few, if any, reared salmon has been observed in the catch samples and some of them are probably strayers from the nearby Finnish compensatory releases (intact adipose fins).

Parr densities and smolt trapping

The lowest parr densities were observed in the mid-1980s (Table 3.1.1.4, Figures 3.1.1.4 and 3.1.1.5). During the 1990s, densities increased in a cyclic pattern with two jumps. The second, higher jump started in 1996–1997. Between the jumps there was a few years' collapse in the densities around the mid-1990s, when the highest M74 mortality was observed. Average parr densities are nowadays 5–60 times higher than in the mid-1980s. Since the turn of the millennium, annual parr densities have varied 2–6 fold. In Simojoki, some years with higher-than-earlier densities of 0+ parr have been observed recently, but annual variation has been large and densities of older parr have not increased in this river. In the other rivers, however, the densities have continued to increase rather steadily.

In some years, like in 2003, high densities of parr hatched in spite of relatively low preceding river catches (indicating low spawner abundance) in **Simojoki, Tornionjoki** and **Kalixälven.** Similarly, highest densities of 0+ parr were observed in **Tornionjoki** in 2008 and 2011, although the river catches were not among the highest in the preceding years. Among the reasons for this inconsistency may be exceptionally warm and low summer-time river water, which might have affected fishing success in the river and even the measurements of parr densities. In the summer 2006, 2013 and 2014, circumstances for electrofishing were favourable because of very low river water levels, i.e. the circumstances were opposite to those prevailing in 2004–2005. These kinds of changes in electrofishing conditions may have affected the results and one must therefore be somewhat cautious when interpreting the results.

In Simojoki the mean density of parr was among the highest recorded in 2011. In 2012 and 2013 the density of one-summer old parr decreased to less than 50% from the 2011 level, but in 2014 the density increased again close to the all-time high value observed in 2006 (Table 3.1.1.4). In contrast, mean densities of older parr increased slightly in 2012–2013 compared to 2010–2011 densities, but dropped in 2014. In **Tornionjoki** the mean densities of one-summer old parr decreased slightly from 2011 to 2012 and then increased again in 2013 and 2014; in 2014 the density reached the highest level recorded. Densities of older parr halved from 2011 to 2012, increased slightly in 2013, but dropped again in 2014 to the same level as observed in 2012. In **Kalixälven** and **Råneälven** the densities of 0+ parr increased in 2013 even if the river catches and the spawning run in 2012 in the fishladder in **Kalixälven** indicated lower spawner abundance. The densities of 0+ parr 2014 in **Kalixälven** stayed at the same level as in 2013 and did not correspond to the high number of salmon registered in the fishladder in 2013. The density of 0+ parr in **Råneälven** in 2014 was at the same level as in previous year.

Smolt production has been monitored by partial smolt trapping and mark–recapture experiments (see Annex 3 for methodology) in **Simojoki** and **Tornionjoki** (Table 3.1.1.5). A hierarchical linear regression analysis has been applied to combine the information from electrofishing and smolt trapping results, to obtain updated estimates of the wild smolt production.

In the late 1980s, the annual estimated wild smolt run was only some thousands in **Simojoki** and less than 100 000 in **Tornionjoki** (Table 3.1.1.5). There was an increase in the production in the early 1990s, and a second, higher jump in the turn of the millenium. Thus, the run of wild smolt has followed changes in wild parr densities with the one to three years' time-lag needed for parr to transform to smolts. Since the year 2000, annual estimated runs of wild smolt have exceeded 20 000 and 500 000 smolts with high certainty in **Simojoki** and **Tornionjoki,** respectively. Since 2008, estimates of wild smolt runs have exceeded one million smolts in the **Tornionjoki**.

In 2014, successful smolt trapping was carried out only in **Simojoki**. In **Tornionjoki**, a high and late flood peak postponed (as in 2012 and 2013) the start of the trapping. The development in water temperature and daily catches (once the trap was set up) indicated that smolt migration had already started before the trapping started. In **Simojoki,** the estimated number of smolts in 2014 was almost exactly the same as in the previous year: about 37 000 smolts. The 95% PI of the posterior distribution was 29 000–58 000. The river model with the newest data updates the 2014 smolt run estimates for **Simojoki** to about 41 600 (30 700–54 600), and to 1.3 million (1.0–1.6 million) smolts for **Tornionjoki**. The model predicts about 33 000 smolts for the year 2015 for **Simojoki**, but in 2016 the smolt production is expected to increase back to the same level as in 2014. In **Tornionjoki** the river model indicates a slight decrease for smolt abundance for the years 2014–2015, which reflects the most recent parr densities observed in these rivers. The smolt production in **Tornionjoki** is expected to increase again from 2016.

3.1.2 Rivers in assessment unit 2 (Gulf of Bothnia, Subdivision 31)

River catches and fishery

The catch in **Piteälven and Åbyälven** in 2014 stayed at the same low level as in previous year. Catches in **Byskeälven** have varied during the 1980s between 251–687 kg. In the beginning of the 1990s, catches increased noticeably (Table 3.1.1.1). The highest catches occurred in 1996 (4788 kg) after which the catch shows a decreasing trend. Catches decreased in 2011 with 40% compared to 2010 to 870 kg and in 2012 the catch increased three times compared with previous year. Catches in 2014 decreased compared to previous year even though the run in the fishladder was the highest recorded. In **Kågeälven** the sportfishing has successively become a catch and release fishery, and that explains the low levels of reported salmon catches in recent years. The local administration has stated from 2012 that salmon is not allowed to be caught and retained. Catches of salmon kelt during sea trout fishing in springtime have been on average over 20 individuals per year during the last ten years.

In **Sävarån** the catches has been very low in recent years and in 2014 no salmon were caught. Catches in **Ume/Vindelälven de**creased from 105 salmon in 2013 to 79 salmon in 2014. In 2014 the catch in **Öreälven** was 150 salmon which is the same amount as in previous year. In **Lögdeälven** the catches have increased from 2013 when only 12 salmon were caught to 112 caught salmon in 2014.

Spawning runs and their composition

In almost all rivers the upstream migration in fishladders is counted by electronic, infra-red fish counters, "Riverwatcher" (Vaki Aquaculture System Ltd, Iceland). In **Piteälven** a power plant station (the only one in **Piteälven**) with a fishladder was built in the end of the 1960s about 40 km from the river mouth. In 1992 the power plant company built a new ladder and in 1998 they installed an electronic fish counter (Riverwatcher). In 2001 a camera was installed for detection of species. The run in the fishladder is the entire run. The total run 2012 increased to 1418 salmon which was three times higher than the two earlier years and the run has stayed at that level since then (Table 3.1.1.2, Figure 3.1.1.3). Low water level has no effect on the possibility for salmon and trout to enter the ladder but very high water can temporary stop and delay migration.

In the river **Åbyälven** a power plant station (the only one in Åbyälven) with a fishladder is located 30 km from the river mouth. The power plant company installed an electronic fish counter (Riverwatcher) in 2000. The run in the fishladder is only a small part of the entire run. In 2009 a fish counter with camera was installed for registration of species. The total run 2012 increased to 88 salmon compared with 36 salmon in 2011 (Table 3.1.1.2, Figure 3.1.1.3), and the run has stayed on about the same level since then. Low water levels in **Åbyälven** can cause shut down of the power plant which makes it almost impossible for fish to enter the fishladder. In the fall of 2013, the power company filled pits with stones and concrete to prevent fish from getting caught in the pits when the spill gates are closed. A test with water spill in the former river bed, to study the undertaken measurers to drain salmon back into the river when spill has occurred, attracted more fish into the former riverbed than the total season run in the fishladder. Approximately 200–300 salmon entered the former river bed. This strongly indicates that there are problems for salmon to detect the entrance of the ladder, or problems within the ladder causing "fallbacks". These issues will be studied during the next migration season.

In **Byskeälven** a new fishladder was built in 2000 on the opposite side to the old ladder. The waterfall is a partial obstacle for salmon. In 2000 an electronic fish counter (Riverwatcher) was installed in the new ladder and a Poro counter (camera) was installed in the old ladder which was replaced 2013 with a Riverwatcher (VAKI). The run in the fishladder is only part of the entire run. The water level in the natural waterfall affects the possibilities for salmon to pass the fall. In 2008 the number of counted salmon increased to 3409 which was the highest level recorded since 1996. The run in 2009 decreased almost by half to 1976 salmon and in 2010 and 2011 the run was at the same low level as in 2009. However, since 2012 the number of ascending salmon has increased and the 2014 run is the highest recorded so far (Table 3.1.1.2, Figure 3.1.1.3).

In **Rickleån** the power plant company built four ladders in the three stations in 2002. Fish passage is controlled with an electronic counter in the uppermost ladder. Before construction of ladders, salmon passage has been closed for over 100 years since the first power plant station was built in the beginning of the 1900s. The run in the fishladder is part of the entire run. The water level does not affect the migration of salmon in the four ladders except when the level is extremely low, then the migration can decline or even stop. No salmon passed the ladders in 2009–2013 compared to five, seven, two and one salmon 2008, 2007, 2006 and 2005, respectively. In 2014 the run was 27 salmon which is the highest recorded.

The ladder in **Ume/Vindelälven** was built in 1960 and in 2010 a new ladder was opened in the start of the migration period. The new ladder with its length of ca. 300 meter is one of the longest in Europe. The ladder is constructed so it will also be a passage gate for downstream migrating fish and it will be possible in the future to monitor migration of smolts and kelts through the ladder. In the river **Ume/Vindelälven** the salmon run is affected by the yearly differences in the amount of water in the old riverbed leading to the fishladder, and therefore the possibilities for salmon and trout to find their way. The run in the fishladder is the entire run. The results in 1999–2002 might in part be the result of an unusually large amount of water spilled to the riverbed at the dam in Norrfors. From the beginning of the 1970s the total run was divided into reared (absence of adipose fin) and wild salmon. In 2012 the run of wild salmon increased to 8058 which is 65% higher compared to 2011 and in 2013 the run was the highest recorded, in total 13 604 wild salmon passed the fishladder. The run decreased in 2014 to 10 407wild salmon. In addition to the wild salmon, 954 salmon of reared origin was registered in the ladder (Table 3.1.1.2 and Figure 3.1.1.3). In **Ume/Vindelälven** the new ladder has been operating for five years and some new construction modifications were carried out in 2013 in the river section below the ladder, reducing some of the thresholds by constructing concrete weirs to reduce the heights of the thresholds and also releasing different amount of water below the entrance of the fishway to attract fish into the river channel. This may have resulted in a positive effect for fish to detect the entrance and force the thresholds. In 2014 tests were carried out in the first pool section to create stronger water velocity into the diffuser to attract salmon into the fishladder.

In **Öreälven** the control of passage of fish ended in 2000 (Table 3.1.1.2). The reason was that high water level in year 2000 destroyed part of the dam where the fishtrap was located.

Parr densities and smolt trapping

Electrofishing surveys have been done with the same kind of equipment (Lugab), portable motor and a transformer until 2011 when it was exchange to the model ELT60IIHI from Hans Grassl. During the time-series, the same group of people have made most of the electrofishing in Swedish rivers in assessment unit 1–4. In the beginning of the monitoring surveys the average size of the sites was around 500–1000 m² especially in assessment unit 1 and 2. The reason for the larger size of the sites was to increase the possibility to catch parr. In 2003 and onwards, the size of the sites in assessment unit 1 and 2 has been reduced to about 300–500 m² due to the higher parr densities. In the summer 2006, 2013 and 2014, circumstances for electrofishing were extraordinary because of the very low river water level, i.e. the circumstances were opposite to those prevailing in 2004–2005. For the electrofishing carried out in 2009, 2010 and 2012 the water level was normal, but in 2011 the water level was high due to rain which prevented surveys in several rivers. The densities of salmon parr in electrofishing surveys in rivers in assessment unit 2 in the Gulf of Bothnia, Subdivisions 31, are shown in Table 3.1.2.1 and Figures 3.1.2.1 and 3.1.2.2.

In **Piteälven** no consistent electrofishing surveys have been made during the 1990s. In 2002, 2006, 2007, 2008 and 2010 surveys were carried out. The density of 0+ parr has been rather low for most of the years (Table 3.1.2.1). No surveys were done 2011 and 2012 due to high water level. In 2014 the densities of 0+ parr increased to the highest level recorded and the densities of older parr stayed at the same level as in previous year.

In **Åbyälven**, the mean densities of 0+ parr in 1989–1996 were about 3.1 parr/100 m². In 1999 the densities of 0+parr were 16.5 parr/100 m², which is about five times higher than earlier. In 2014 the densities increased to the highest recorded level this far (Table 3.1.2.1).

In **Byskeälven**, the mean densities of 0+ parr in 1989-1995 were about 4.7 parr/100 m². In 1996–1997 the densities increased to about 10.9 parr/100m². In 1999 and 2000 the densities of 0+ parr were about 70% higher than in 1996–1997. During the 2000s, the densities have been on rather high levels with a few exceptions, and in 2014 the densities of 0+ increased to the highest recorded level so far (Table 3.1.2.1).

In **Kågeälven** the last releases of reared salmon (0+) were made in 2004 which means that 0+ parr observed in the electrofishing in 2013 were wild-born and mainly offspring of salmon which themselves also were wild-born. A stable level of 0+ parr densities in recent years indicates that the population is self-sustaining. Spawning occurs in the whole river stretch and densites of 0+ parr in 2014 was the highest recorded (Table 3.1.2.1).

In **Rickleån**, mean densities of 0+ parr in 1988–1997 were about 0.6 parr/100 m² and in 1998 the mean densities increased to 2.5 parr/100 m². The densities in 2006 were almost the same as in 2005, 3.9 parr/100 m². In 2007 no 0+ parr where caught and the densities of older parr were also very low. In 2010 the densities increased to 3.7 parr/100m² compared to 1.0 in 2009, and one year old parr were found on all sites. No 0+ parr were caught in the surveys 2011 and the densities of older parr were very low. The densities are very low and in 2014 the densities decreased compared to 2013. In Table 3.1.2.1 average densities from extended electrofishing surveys in Rickleån (including also sites in the upper parts of the river that have recently been colonized by salmon) are presented (for more details see Section 4.2.2). Mean densities from the extended electrofishing surveys are used as input in the river model (see stock annex).

In **Sävarån**, the mean densities of 0+ parr in 1989–1995 were about 1.4 parr/100 m². In 1996 the densities increased to 10.3 parr/100 m² and in 2000 to 12.8 parr/100 m². No electrofishing was made in 2001 and 2004. The density in 2006 increased to 12.5 parr/100 m² which was at the same level as in 2000. The densities in 2013 were the highest recorded for 0+parr and in 2014 the densities decreased with half compared to 2013 (Table 3.1.2.1).

In **Ume/Vindelälven**, mean densities of 0+ parr in 1989–1996 were about 0.8 parr/100 m². In 1997 the densities increased to 17.2 parr/100 m². During the 2000s, densities have fluctuated a lot but have often been on levels around 15–25 parr/100 m². No surveys were carried out in 2011 due to high water level. In 2014, densities of 0+ parr increased to the highest level recorded so far. In Table 3.1.2.1, average densities from extended electrofishing surveys in Vindelälven (including also sites in the upper parts of the river that have recently been colonized by salmon) are included (for more details see Section 4.2.2). Mean densities from the extended electrofishing surveys are used as input in the river model (see stock annex).

In **Öreälven**, mean densities of 0+ parr in 1986–2000 were very low, about 0.5 parr/100 m². The 0+ parr densities increased during the 2000s, and have been on levels of 3–10 parr/100 m² in recent years (Table 3.1.2.1).

In **Lögdeälven**, mean densities of 0+ parr in 1986–1997 were about 1.4 parr/100 m². In 1998 the densities increased to 13.7 parr/100m². Densities during the 2000s have fluctuated between 3 and almost 15 parr/100m². The highest value so far was observed in 2014 (Table 3.1.2.1).

In **Rickleån,** smolts of salmon and sea trouts were caught in 2014 on their downstream migration using a ”Rotary-Screw-trap”. The trap was positioned close to the river mouth and 434 salmon smolts were caught. The calculated recapture rate was 20.3% for tagged salmon, which was used to estimate the total smolt production in the river (presented in Table 3.1.1.5).

In **Sävarån**, smolts of salmon and sea trouts have been caught on their downstream migration using ”Rotary-Screw-traps” since year 2005. The trap is positioned 15 km upstream from the mouth of the river. In total 583, 812, 823, 829, 309, 198, 289, 28 and 271 wild salmon smolts were caught in 2005–2013, respectively. Fish were caught from mid-May to mid-June. Smolts were measured for length and weight, scale samples were taken for age determination and genetic analyses. The dominating age group among caught smolts was three years. The proportion of recaptured tagged fish in the trap has varied between 4–23% during the trapping years. Estimates of total smolt production are presented in Table 3.1.1.5. No trapping of smolts was carried out in 2014 as the smolt trap was used in Rickleån instead to get basic data from this river (important to increase precision in analyses of stock status).

In **Vindelälven,** a smolt fykenet similar to the one used in Tornionjoki, has been used for catching smolts in 2009–2014. In Vindelälven, the entire smolt production area of the river is located upstream of the trapping site. In total, 2293, 1647, 2498, 2636, 2885 and 2444 salmon smolts were caught in 2009, 2010, 2011, 2012, 2013 and 2014 respectively. The number of recaptured tagged fish in the trap has varied between 2,2–3,6% during the trapping years. In 2009 the trap was operating from the end of May to beginning of July and smolts were likely caught during the whole time period with a peak in mid-June. In 2010 a pronounced spring flood caused problems to set up the fykenet and a considerable part of the smolt run was missed. In 2011, an episode late during the season with very high water flow again prevented smolt trapping. Although the break was rather short (six days) a very high smolt catch the day immediately before the break indicated presence of a significant "smolt peak" that was missed. In 2012, 2013 and in 2014, several episodes of high water flow resulted in repeated "breaks", and for those years it seems difficult to even produce a crude guess of the proportion of the total smolt run that was missed. Although direct smolt production estimates from mark-recapture experiments in the smolt trap have not been possible to produce due to the above mentioned interruptions in the function of the trap, the proportion among ascending spawners previously marked at the smolt trap have been used to estimate total smolt production in Vindelälven (see Table 3.1.1.5).

3.1.3 Rivers in assessment unit 3 (Gulf of Bothnia, Subdivision 30)

River catches and fishery

In **Ljungan**, the salmon angling catch was 228 salmon in 2014 compared to 37, 40, 21, 35, 45, 30 68 and 145 in 2006–2013, respectively. The catches have increased compared to the years 2000–2002 when 18, 2, and 1 salmon, respectively, were caught by angling.

Parr densities

Average densities of 0+ parr/100 m² in **Ljungan** have varied markedly (3.1–45.3) between 1990 and 2008 without any clear trend (Table 3.1.3.1 and Figure 3.1.3.1). Data are missing for several years due to high water levels in late autumn, making electrofishing impossible. However, in 2012 and 2014, parr densities show signs of increase although more years of data are necessary before any conclusions can be drawn. It should be noted that the relatively high value for 2012 only mirrors data from one electrofishing site as the other sites could not be fished due to high water level.

In **Testeboån** the latest releases of reared salmon (fry) were made in 2006 which means that 0+ parr observed in the electrofishing from 2012 and onwards most likely were wild-born and mainly offspring of salmon which themselves were wild-born. Fairly stable levels of 0+ parr densities in recent years, except for 2008 when 0+ parr were absent due to a very poor spawning run in 2007, indicates that the population is self-sustaining (Table 3.1.3.1). The densities of 0+ parr decreased in 2014 compared to the four previous years.

3.1.4 Rivers in assessment unit 4 (Western Main Basin, Subdivisions 25 and 27)

River catches and fishery

In **Emån**, only two salmon were caught and reported in 2014. No salmon was reported as caught and retained in 2012 and 2011. The retained catches in 2005–2010 were twelve, nine, one, 15, five and three salmon respectively. In 2004, 2003 and 2002 the catch was 89, 83 and 143 salmon respectively. In Emån fishermen have applied catch and release for the latest 10–15 years and the trend is that the rate of utilizing catch and release has increased. The sportfishing in Emån is nowadays basically catch and release fishing. This is likely an important reason for the decreasing catches.

In **Mörrumsån**, the retained salmon catches have varied during the last five years between 145 and 536 salmon. In 2014 the catch was 145 salmon. Also in Mörrumsån fishermen have applied catch and release for the latest 10–15 years and the trend is that the rate of utilizing catch and release is increasing. This could be one reason for declining catches in recent years.

Parr densities and smolt trapping

For **Emån**, densities of parr in electrofishing surveys below the first partial obstacle are shown in Table 3.1.4.1 and Figures 3.1.4.1 and 3.1.4.2. The densities of 0+ parr have varied between 13–71 parr/100 m² during the period 1992–2007, and the mean density during this period was 43 parr/100 m². The highest densities of 0+ parr occurred in 1997. The density of 0+ parr was 27 parr/100 m² in 2014 which is just below the mean value for earlier years in the time-series. The densities of older parr have varied from 1–10 parr/100 m² during the period 1992–2013 with a mean value of 3 parr/100 m² during recent years.

The smolt production estimates in River Emån have been a problem in the current assessment model used by WGBAST. According to the model the current production appears very low compared to the production capacity. The estimated production is based on electrofishing surveys in a few sites (about six) every year. In 2007 an overview of the conditions in the river concluded that probably the difficulties for particularly salmon spawners, and to a minor extent also sea trout, to ascend fishladders may give rise to low production of juveniles above the ladder. Electrofishing sites in these areas do therefore normally have low juvenile abundance. On the other hand, there is a highly successful sea trout and salmon fishery in the lower part of the river (at Em) and this fishery have not shown signs of a lower abundance of either species. On the contrary, salmon seems to have increased in abundance.

In contrast to most other Swedish rivers, the salmon smolt production in Emån river has not shown any real positive signs after the fishery regulations that were initiated in the 1990s (Michelsens *et al.*, 2007, Section 5). An analysis in order to understand why the number of smolts has not increased suggested that "migration problems" have caused this lack of effects. Earlier work in WGBAST has estimated the spawning areas available for salmon in Emån, but it has been argued that few salmon can migrate to most of these areas. Monitoring of salmon migration in one fishladder during 2001–2004 also suggested that very few salmon could reach some of the upstream potential spawning areas. In recent years, however, some actions have been undertaken to improve the conditions for fish migration in the river. In 2006 the lowermost dam was opened permanently, and since then increased electrofishing densities for salmon have been recorded at the closest upstream electrofishing site. Activities are also ongoing to facilitate up- and downstream migration at the second dam counted from the sea, above which significant habitat areas regarded suitable for salmon reproduction are located.

In order to get a quantitative estimate of the smolt run in the river, smolt traps were operated in the river Emån in 2007 and 2008. The primary purpose was to get an overview of the smolt production in the river. Two smolt wheels were installed within 200 m from the river mouth. In 2008 the smolt traps were operating through most of the smolt migration period. Almost the entire catch of salmon and sea trout smolts in the traps were utilized for mark–recapture estimation, and the trap efficiency was estimated to 6.1%. The estimated salmon smolt run in 2008 was 3473 smolts (95% confidence interval: 1536–5409).

A considerable emigration of *Salmo* sp. fry (the species was not identified more precisely) in the length interval 30–50 mm occurred in 2007 and 2008, indicating that this migration can be a common phenomenon. It was not possible to estimate the catch efficiency for small fry, but it is certainly much lower than for smolts. Assuming that the trap efficiency for fry is half that of salmon smolts, or 3%, the estimated number of fry emigrating from the river would be in the order of 97 500. However, the actual numbers might be much higher if the trap efficiency is even lower. This kind of mass emigration has not been observed in any of the other Swedish rivers where smolt wheels have been operating (Testeboån in Subdivision 30, and Sävarån and Rickleån in Subdivision 31). It is normal that high densities of fry in the early phase of the life may lead to displacement and emigration of fry, but as the parr densities in Emån are normally quite moderate it ought to be possible for a majority of the fish to find suitable places to establish territories.

In **Mörrumsån**, the densities of parr in electrofishing surveys are shown in Table 3.1.4.1 and Figures 3.1.4.1 and 3.1.4.2. The densities of 0+ have varied during the period 1973–2011 between 12–307 parr/100 m². The highest densities occurred in 1989. The densities decreased during 2006 and 2007, but in 2008 the densities of 0 + parr increased to 102 parr/100 m². In 2011 the densities of 0+ decreased to 36 parr/100m² which is the lowest value since the mid-1990s. In 2014 the densities remained at the same level as in previous year, 95 0+ parr/100 m². The probable reason for the lower density in both 2007 and 2011 was high water levels, as only part of the survey sites were possible to electrofish. In river Mörrumsån, hybrids between salmon and trout have been found during the electrofishing. In 1993–1994 the proportion of hybrids was high, up to over 50% in some sampling sites. The occurrence of hybrids has varied and was in 1995 and 1996 only some percent of the total catch. In 2005 the density of 0+ hybrids was 14 parr/100 m² which is higher than in the three years before. The amount of hybrids has decreased in 2006–2014: only two 0+ hybrid parr/100 m² were caught in 2011, but in 2012 the hybrids increased slightly and the density of 0+ was 6 parr/100 m². In 2014 the densities of hybrids was only 0.7 parr/100 m². In 2004 two new fishladders were built at the power plant station about 20 km from the river mouth which opened up about 9 km of suitable habitat for salmon, including about 16–21 ha of production area.

In 2009–2014, a smolt trap (smolt wheel) has been operated in Mörrumsån, ca. 12 km upstream of the river mouth. About 60% of the total production area for salmonids is located upstream the trap. A main reason for choosing this location was that ascending adults are counted in a fishladder close to the smolt trap site, which makes it possible to compare number of spawners and resulting smolt production in the upstream part of the river. In 2014 a total of 923 salmon smolts were caught, compared to 1600, 659, 740, 512 and 138 smolts in 2013, 2012, 2011, 2010 and 2009, respectively. Using mark–

recapture data, the trap efficiency estimated to be only 4% in 2014 (as compared to 11%, 11%, 10% and 6% in 2012, 2011, 2010 and 2009, respectively), which most likely reflects an indirect effect of the water flow that was higher than in the previous years.

In 2009–2012, the estimated smolt production in the upstream parts of the river was lower than expected (ca. 2000–8000). As a comparison, Lindroth (1977) performed smolt trapping in 1963–1965 at a site close to the one presently used and estimated the average yearly salmon smolt production to be 17 600 (range 12 400–25 000). However, in 2013, the smolt production was estimated to ca. 15 000, and in 2014 it was estimated to be the highest recorded so far (ca. 21 400; 95% PI: 15 300–32 000). This positive development in smolt production since 2009 contrasts the fairly stable (or even slightly negative) average electrofishing densities seen in the river during the past decade. The reason(s) behind this apparent inconsistency between smolt trapping and electrofishing results is unclear, but it should be noted that the development in total smolt production (including also the downstream part of Mörrumsån) may have been less positive. The salmon in the upstream part is probably in a local "building-up phase" as a result of the new fishways (since 2004) that increased the amount of available habitat considerably. However, further work, including development of a smolt production model that fully utilizes all available sources of information (smolt trapping data, electrofishing results, habitat mappings, etc.), seems needed to understand the ongoing development in River Mörrumsån.

Mörrumsån is located quite close to River Emån. When the smolt trap was operated in Mörrumsån in 2009, a total of 35 *Salmo* sp. fry were caught in the trap, and if we assume that the trap has half the catching efficiency for them compared to smolt the total number would be around 1200 fry. This is only about 1% of the number of fry estimated to emigrate from Emån in previous studies.

3.1.5 Rivers in assessment unit 5 (Eastern Main Basin, Subdivisions 26 and 28)

Estonian rivers

The River **Pärnu** is the only Estonian salmon river in the Main Basin, and it flows into the Gulf of Riga. The first obstacle for migrating salmon in the river is the Sindi dam, located 14 km from the river mouth. The dam has a fishladder, which is not effective due to the location of the entrance. Electrofishing surveys have been carried out on the spawning and nursery ground below the dam during the period 1996–2014. The number of parr/100 m² has been low during the whole period (Table 3.1.5.1 and Figure 3.1.5.1). No parr were found in 2003, 2004, 2007, 2008, 2010 and 2011. In 2013 0+ parr density below the Sindi dam was 4.9 parr/100 m² and older parr were not found (one site electrofished). In 2014 the density of 0+ parr below the Sindi dam was 4.9/100 m² and older parr were not found. Also four sites were electrofished upstream from the Sindi dam and wild salmon parr were recorded there for the first time. Average density of 0+ was 0.2/100 m² and older parr had a density of 0.06/100 m². In 2014 no 0+ parr were found in areas above the Sindi dam, older parr density was 0,04/100 m².. Future plans to restore Pärnu river salmon population include the reconstruction of Sindi dam and a juvenile release program initiated in 2012. First 63 000 0+ parr was released in 2013 and therefore the Pärnu river must be considered as mixed.

Latvian rivers

There are ten wild salmon rivers in Latvia, mainly in the Gulf of Riga. Some rivers have been stocked by hatchery reared parr and smolt every year with the result that salmon populations in these rivers are a mixture of wild and reared fish.

In 2006 the river fish monitoring programme was revised. All monitoring activities were divided in:

1) Salmon monitoring carried out in eleven rivers (two river basin districts) with 48 electrofishing stations in total, and smolt trapping in the river Salaca;
2) Fish background monitoring carried out in 28 rivers (four river basin districts) with 56 electrofishing stations in total.

In 2014, 52 sites in three river basin districts (18 rivers) were sampled by electrofishing. The salmon parr densities are presented in Table 3.1.5.1 and in Figure 3.1.5.2.

The wild salmon population in the river **Salaca** has been monitored by smolt trapping since 1964 and by parr electrofishing since 1993. From 2000, no releases of artificially reared salmon have been carried out in the river Salaca.

In 2014, eleven sites were sampled in the river **Salaca** and its tributaries. All sites in the main river hold 0+ age salmon parr. 0+ salmon parr also occurred in the **Salaca** tributaries Jaunupe, Svētupe and Korģe. Average density of 0+ salmon parr was 59,1 per 100 m². Density of 1+ and older salmon parr was 3,8/100 m².

The smolt trap in the river **Salaca** was in operation between 14 April and 23 May 2014. In total 481 salmon and 265 sea trout smolts were caught, 213 of them were marked using streamer tags for total smolt run estimation. The rate of smolt trap catch efficiency was 8,5%. In total 7100 salmon and 5500 sea trout smolts were estimated to have migrated from the river **Salaca** in 2014.

The river **Salaca** monitoring data indicate that the number of adult salmon is probably sufficient to reach quite high production of smolts in the river. It seems that fisheries management and effective fisheries control to minimize illegal fisheries on-site are determinative factors in Latvia to reach a higher wild salmon production in the rivers.

In the river **Venta**, wild salmon parr was found only below Rumba waterfall in 2013. In 2014 the number of 0+ parr increased compared to 2013 from 6,0 to 10.9 parr per 100 m². Older parr were found in low densities in 2014. In the river **Gauja** wild salmon parr production in 2014 was lower in comparison to the parr production in the tributary **Amata**.

Wild salmon were found in the river **Vitrupe and Pēterupe**. Age structures testify that salmon reproduction occurred in the river Vitrupe at least in 2005, 2007, 2008, 2009, 2012 and 2013. The average 0+ parr density in 2014 was 16.5/100m². In the river **Aģe** no 0+ parr were caught in 2014.

Wild salmon parr has been caught with electrofishing in the rivers **Tebra** (Saka system) **Užava** and **Irbe,** and the densities of 0+ parr were 13.5, 3.5 and 2.4/100m² respectively. No older parr were caught.

Lithuanian rivers

Lithuanian rivers are typical lowland ones and many of them are tributaries in Nemunas system. These are mainly sandy, gravely rivers flowing in the heights of upper and lower Lithuania. Nevertheless, salmonids inhabit more than 180 rivers in

Lithuania. In total, 76 rivers have trout and Baltic salmon spawn in 14–16 rivers. Leaning on historical data and today's situation, salmon rivers can be divided into the following groups: 1-inhabited by wild salmon; 2-inhabited by artificially reared salmon; 3-inhabited by mixed salmon population; 4-"potential" rivers, i.e. where salmon occurs occasionally; 5-rivers where salmon has gone extinct (Kesminas *et al*., 2003).

There are twelve rivers in Lithuania inhabited by salmon populations of different abundance. The status of these rivers differs. Purely natural salmon population inhabits **Žeimena** River and its tributaries **Mera** and **Saria**. Mixed, i.e. natural and reared populations are in the rivers **Neris, Šventoji, Vilnia, B. Šventoji, Dubysa, Siesartis, Širvinta, Vokė**. Populations formed of reared salmon inhabit **Virinta, Jūra, Minija** rivers and some smaller tributaries. In these rivers, releases of artificially reared salmon juveniles have been going on in several years.

Electrofishing is the main monitoring method for evaluation of occurrence and densities of 0+ and older salmon parr. Monitoring covers all main salmon rivers (including all potential rivers). In 2013 salmon parr were found in **Zeimena, Saria** (tributary of Žeimena) **Mera** and **Neris.** Parr densities in Lithuanian rivers are presented in Table 3.1.5.2 and Figures 3.1.5.3 and 3.1.5.4.

Abundance of salmon parr depends on hydrological conditions, spawning efficiency, protection of spawning grounds. In 2014 the average density of salmon 0+ parr in the index river **Žeimena** increased to 2.9 ind./100 m²; and density of >0+ parr was 0.9 ind./100 m². Salmon parr were caught in six sites out of six. In addition, salmon parr were caught in two sites in the river **Mera** (tributary of Žeimena river). In the last two years, low abundances have been registered in **Neris** river. In 2013, wild salmon parr were caught in ten sites out of twelve in **Neris** river m²with a mean density of 0,56 ind./100 m², which was relatively low compared to the previous yearm². Abundance of 0+ parr in the **Neris** river increased somewhat in 2014 to 0.9 ind./100 m²; and >0+ amounted to 0.01 ind./100 m². It is interesting to notice that all monitoring stations of River Neris which are above Vilnius district were characterized by low density of salmon parr as compared with electrofishing stations below Vilnius district. There were no ecological conditions and negative anthropogenic factors observed in these parts of river. In 2014 salmon parr abundance was low in many sites of **Neris** river and was significantly lower than **average densities in the time-series**. Efforts to increase area of suitable habitats for salmon in Lithuania were successful with salmon restored in Šventoji, Siesartis, Vilnia, Vokė and Dubysa rivers. Salmon can also be found in many smaller rivers but in lower reaches: Mera, Kena, Musė, Širvinta, Virinta, Dūkšta, Žalesa, Saria. Salmon parr density strongly depends on climatic, hydrological conditions and water temperature, as indicated by the 2010 year data. All these factors influence salmon parr abundances and cause natural changes in abundance to occur.

Salmon restocking program in Lithuania started in 1998 and ended in 2010 year, but monitoring and stocking work is still ongoing. There are lots of measures implemented every year to increase salmon populations, including artificial rearing, construction of fishladders, protection of spawning grounds, stock monitoring, and scientific projects. Despite the measures taken, according to the data from salmon monitoring, smolt production in Nemunas basin is increasing very slowly. Notably increase in production was observed only during the recent years. Smolt production increased substantially during 2007–2010 period, from 13 111 ind. to 47 843 ind. As mentioned earlier, due to adverse ecological conditions, salmon parr density significantly decreased during 2010 in many important salmon rivers, and this resulted in that smolt production decreased in 2011 down to 6656 ind. In 2012, smolt production started to increase, but in 2013 decreased again to 14 056 individuals. In 2014 estimated total salmon smolt production in Lithuania decreased to 13 168 ind. Salmon smolt production increased slightly in some salmonid rivers in 2014; **Žeimena, Švenroji, Siesartis, Vilnia.** In some other less important salmon rivers, smolt production increased notably, e.g. **Minija** - to 2600 ind., **Dubysa** - to 1302 ind. and Musė - to 708 ind. In 2014, salmon smolt production significantly decreased in **Neris** river to 1133 ind. compared with the last year (2013) 6912 individuals.

In Index River **Žeimena** there is only natural population. This river was never stocked with artificially reared salmonids.

Also salmon smolt production is affected by surrounding factors. Water temperature in Lithuania Rivers has been substantially above average during the last few years and water levels have been below average. Also one main concerns in salmon rivers is pollution. Another important factor is the fact that Lithuanian rivers are of lowland type and there is a lack of habitats for salmon as only some stretches are suitable. Another problem is a quite high mortality rate caused by predators. Predators' density is significantly higher in Lithuanian rivers as compared with typical salmon rivers in North Baltic.

3.1.6 Rivers in assessment unit 6 (Gulf of Finland, Subdivision 32)

The three remaining wild salmon rivers: **Kunda**, **Keila** and **Vasalemma**. These rivers are small and their potential production is small. In addition there is natural reproduction supported with regular releases in ten other rivers: **Kymijoki, Gladyshevka, Luga, Purtse, Selja, Loobu, Valgejõgi, Jägala, Pirita** and **Vääna**. In these rivers, however, natural reproduction is variable. Enhancement releases have been carried out in all of these rivers in 2000–2014 (Table 3.3.1.). Salmon in the rivers **Narva, Neva** and **Vantaanjoki** are of reared origin.

Status of wild and mixed populations

All three wild salmon populations in the Gulf of Finland area are located in Estonia. Parr density in the river **Keila** started to increased significantly in 2005 and in 2013 0+ parr density reached to highest reported density (157.1 ind./100m^2). In 2014 older parr density increased also to approximately 48.9 ind./100m^2 which is the highest level ever recorded. Therefore it can be stated that the river Keila population is no longer in a critical state and with a clear positive trend (Figure 3.1.6.1). The parr densities have been varying in river **Kunda** and no clear positive trend is evident (Table 3.1.6.1). The river **Vasalemma** have been in the most precarious state and presently a small positive trend can be seen. The average 0+ parr density in 2013 was 39.8 ind./100m^2 and this is the highest recorded density. 2014 the average 0+ parr density decreased to 26,1.

The most important change in the 1990s was the occurrence of natural spawning after many years interval in the river **Selja, Valgejõgi** and **Jägala**. In 2006 wild salmon parr was found also in river **Purtse** and **Vääna**. Since then a low and varying wild reproduction has occurred in all those rivers (Table 3.1.6.2). In 2011 parr density decreased to a very low level in all mixed Estonian populations. No wild parr was found in rivers **Purtse, Valgejõgi, Jägala** and **Vääna** (Figure 3.1.6.2). In time period 2012–2014 parr density increased to a relatively high level in most of these rivers. In 2011 the parr density decreased in river **Kymijoki** because of exceptional flow conditions. In 2014 parr density increased near the long term maximum (54 ind./100m^2). In 2014 spawning salmon were counted for the first time in **R. Pirita**.

In total 2019 salmon were counted. A majority of these fish were wild (87%), and based on the size and the number of females, it was estimated that the approximate egg deposition rate was 29 per one m^2 of available spawning habitat. This is many times higher than what is commonly considered enough to ensure full production of juveniles in the river.

The restoration stocking of salmon has been annually carried out in river **Valgejõgi** since 1996, in **Selja** since 1997, in **Jägala** and **Pirita** since 1998, in **Loobu** in 2002 and in **Purtse** in 2005. In river **Vääna** releases were carried out from 1999 to 2005. Stocking was stopped due to the high risk of returning adults straying into the neighbouring river **Keila**, which is considered to be a wild stock. According to the rearing programme by Estonian Ministry of Environment (for the period 2011–2020) the releases will be continued in these rivers. Salmon used for stocking in late 1990s originated from spawners caught in the rivers Narva and Selja broodstock fisheries and in addition Neva strain was imported as eyed eggs from a Finnish hatchery in 1995–1999. In 2003-2009 brood fish were caught from the river Narva. A captive broodstock from river Kunda was established in 2007 in Polula Fish Rearing Centre and all salmon releases in Estonia in SD 32 are now done with the Kunda stock.

In the Finnish side of the Gulf of Finland all wild salmon populations were lost in 1950s due to gradual establishment of paper mill industry and closing the river Kymijoki by dams. The nearest available salmon strain, Neva salmon, was imported in the late 1970s and releases into the rivers Kymijoki and Vantaanjoki started in 1980.

The River **Kymijoki** is mainly used for hydroelectric production and pulp industries. The quality of water, however, has improved significantly since early 1980s. Reproduction areas exist on the lowest 40 kilometres of the river. Ascending spawners originating mainly from hatchery-reared smolt releases spawn in the river, and annual natural production has been estimated to vary between 7000 and 44 000 smolts in the last ten years. Along with the gradual increase in natural smolt production, the releases have decreased in the last few years. The released (195 800 smolts in 2014), however, still outnumber the natural smolt production (28 600 in 2014). The broodstock of salmon is held in hatcheries and has been partially renewed by ascending spawners.

An inventory of the rearing habitats in the river **Kymijoki** suggests 75 ha of smolt production area in the eastern branches of the river between the sea and Myllykoski (40 km from sea). About 15 ha of the rapids are situated in the lower reaches with no obstacles for migration and about 60 ha beyond the dams, accessible only in years with high discharge. The potential smolt production was assessed on the basis of parr density (max >1 parr/1 m^2) and smolt age (1–3 year). The annual mean potential was assessed to be 1340 smolts per ha, and the total potential of the river about 100 000 smolts per year. From this potential, annually about 20 000 smolts could be produced in the lower reaches and 80 000 smolts in the upper reaches of the river (Table 4.2.3.3).

Despite very rainy autumns most of the nursery areas in the lower part dry because of the water regulation between the power plants. Better production habitats are above the lowest power plants, but only a small part of the spawning salmon has access there. The smolt production areas beyond the dams are now only occasionally and partially utilised. In the most eastern branch, there is no fishladder or possibility to ascend the dam. However, there are plans to build a fishladder at Korkeakoski hydropower station. The fishladders in the neighbouring Langinkoski branch do not function well and salmon can ascend the dam only in rainy summers when the discharge is high. Trials to move ascending salmon over the dam in the Korkeakoski branch have shown that salmon can successfully ascend and spawn also in the upper reaches of the river.

Usually most of the spawning salmon ascend to the Korkeakoski branch. The success of ascending salmon to find their way to the stream supplied with the fishladder (Langinkoski) is depending on the drainage arrangements between the three main streams. Building an additional fishladder to the other main branches will allow for an access of a much higher number of spawning salmon to the better spawning and rearing habitats above the dams. This will increase the natural smolt production of the river significantly.

At present, the annual smolt production is highly dependent on the discharge and on the regulation of river flow for the electric power plants. Especially earlier the lower branches below the dams had in some winters so low discharge that the shallow parts of the rapids dried or froze and the spawn thus largely died. Now the regulation has partially been changed and the present minimum discharge of 4 m^3/s in winter allows some smolt production but does not ensure the full production of the rearing habitat.

Due to a rainy summer in year 2004 the flow in the Kymijoki was on exceptional high level and for the spawners the river was easy to ascent. The spawning areas above the lowest power stations were also occupied, and high parr densities were observed both above and below the powers stations in 2005 and 2006. In 2007 and 2008, the parr densities were on the moderate level and increased above average in the recent two years (Table 3.1.6.2).

In the river **Vantaanjoki,** electrofishing surveys in 2010–2014 have shown only sporadic occurrence of salmon parr and only at a few sites.

In Russia the **Luga** and **Gladyshevka** River are the only river supporting wild salmon reproduction. In Luga river the salmon population is supported by large long-term releases. Released smolts are based on ascending Luga and Narva river spawners as well as on the broodstock of mixed origin. In the River Luga, a smolt trapping survey has been conducted since 2001. The natural production was estimated to be from about 2000 to 8000 smolts in different yeas. There has been some increase in the wild smolt production during the last years; about 6700 wild smolts in 2010 compared to 4000 smolts in 2009 and 3000 smolts in 2008. In 2014 the smolt trapping indicated some increase (6600 wild smolts). The total potential smolt production of the river was assessed to be about 100 000–150 000 smolts and the wild reproduction is very far from this level. The main reason for such poor situation in believed to be intensive poaching in the river.

3.2 Potential salmon rivers

3.2.1 General

The current status of the restoration programmes in Baltic Sea potential salmon rivers is presented in Table 3.2.1.1. Releases of salmon fry, parr and smolt have resulted in natural reproduction in some rivers (Table 3.2.2.1). Reproduction and occurrence of wild salmon parr has in some potential rivers occurred for at least one salmon generation. Before any of these rivers will be transferred to the wild salmon river category the Working Group needs more information of river specific stock status.

3.2.2 Potential rivers by country

Finland

The rivers **Kuivajok**i, **Kiiminkijoki** and **Pyhäjoki** were selected to the Finnish Salmon Action Plan programme. All these rivers are located on the assessment unit 1

(Subdivision 31). Hatchery reared parr and smolts have been annually stocked in the rivers since the 1990s. Due to poor success of stock rebuilding to date, especially in the Pyhäjoki and Kuivajoki, the monitoring activities and stocking volumes have been decreased. Current activities include only salmon releases in the Kiiminkijoki. In 2014, 18 000 smolts and 17 600 1-year old parr of the river Iijoki origin were stocked in the Kiiminkijoki.

In the years 1999–2014 the average densities of wild (one-summer old) parr in the river **Kiiminkijok**i has have ranged between 0.7–8.2 ind/100 m² (Table 3.2.2.1). In 2012–2014 electrofishing was conducted only in the Kiiminkijoki and the observed densites in those years fall within the range observed in the earlier years. In the rivers Kuivajoki and Pyhäjoki, the correspoding densities have ranged from 0–3.2 and 0–1.9 ind/100 m², respectively (Table 3.2.2.1). The poor success of stock rebuilding is probably due to a combination of high exploitation in mixed-stock fisheries, insufficient quality of water and physical habitat in rivers and their temporally low flow, which may hinder the spawning migration of adult salmon.

Small-scale natural reproduction was observed also in the **Merikarvianjoki, Pohjajoki, Kokemäenjoki** and in its tributary **Harjunpäänjoki** at the Bothnian Sea (Subdivision 30), and in the **Vantaanjoki** at the Gulf of Finland (Subdivision 32). The density of wild salmon parr in the lower reaches of the **Kymijoki** (Subdivision 32) has been in recent years rather high, ranging from 16 to 60 parr/100 m² since 2005. In 2012 electrofishing in **Kymijoki** was not successful due to high summer flood. In all the above named rivers, salmon smolts are released annually, and there is angling of salmon and sea trout.

Lately, plans have emerged for building up fishladders and rebuilding migratory fish stocks in the large, former Finnish salmon rivers. Projects are underway to study the preconditions for these activities in the rivers **Kemijoki, Iijoki, Oulujoki** and **Kymijoki**. For instance, salmon have been caught from the mouths of **Iijoki** and **Kemijoki** and they have been tagged with radio transmitters, transported and released to the upstream reproduction areas. The in-river behaviour of these salmon were monitored until the spawning time. Also, downstream migration and survival of smolts through dams have been studied in these rivers.

Lithuania

In 2014, a total of 19.5 thousand salmon smolts were released into four rivers: **Neris, Šventoji** (Neris basin), **Dubysa** and **Jūra**. Releases of 108 thousand salmon fry were carried out in the Neris basin (**Neris, Vilnia, Muse, Vokė, Dūkšta, Kena**), 58 thousand salmon fry in the Šventoji basin (**Šventoji, Širvinta, Siesartis, Virinta**), 20 thousand salmon fry in the Dubysa basin (**Dubysa, Lapišė**), 30 thousand salmon fry in the Minija basin (**Minija**) and 15 thousand salmon fry in the Jūra basin (**Jūra river**). It has been observed that restocking efficiency in smaller rivers is much greater than in larger ones. A survey indicates that in the larger rivers mortality of juveniles is greater.

Salmon parr density was around the mean densities in the larger tributaries **Neris** and **Šventoji** (Table 3.2.2.1). The average salmon parr densities in Šventoji river did not change compared to the last year, the average densities in 2014 was 5.4/100 m² (0+ 5.3 and >0+ 0.08). In **Siesartis** river average density of salmon juveniles increased 2.7 times and was 17/100 m² (0+ 11,95 and >0+ 5.1). In **Vilnia** river density of juvenile salmonids increased significantly, up to 33,7/100 m² (0+ 31,4 and >0+ 2.3) and in **Voke;** up to 13,3/100 m². In other potential salmon rivers parr density was also high: 8,8 ind./100 m² in **B. Šventoji**; up to 9.3 ind/100 m² in **Dubysa**. However, in **Minija** river the density decreased to 3.6/100 m².

Poland

There are no officially stated potential rivers in Poland included in the former IBSFC Salmon Action Plan. However, restoration programmes for salmon in Polish rivers started in 1994, based on Daugava salmon. This programme has been carried out in seven rivers but to date there is no good evidence for successful re-establishment of self-sustaining salmon population (Table 3.2.1.1).

In 2014 the total number of released hatchery reared fry was 123 000, one-year-old parr 80 000, one-year-old smolt 358 600 and two-year-old smolt 12 000.

In 2011, spawners were observed in **Vistula** river system but there are no data on wild progeny. Totally 153 000 smolts and 121 000 fry were released into the river system (Subdivision 26).

Natural spawning has been observed in the **Drawa** river (the Odra R. system) but numbers of salmon nests were lower than in previous years and not higher than five. There is still no evidence of wild progeny resulting from this spawning. A total of 32 000 of smolts were released in the **Odra** river system (Subdivision 24).

In almost all Pomeranian rivers, stocked with salmon, ascending and spent salmon were observed and caught by anglers but wild parr was only found in **Slupia** river in 2013 at a density of 8.0 0+ parr/100m², but no older parr were caught. High water levels made electrofishing on a monitoring site impossible in 2011. In 2014, a total of 18 500 smolts and 80 000 fry were released into Pomeranian rivers (Subdivision 25).

Tributaries of upper Vistula R., Wieprza R., and some tributaries of Odra R. were also stocked with fry.

Russia

The River **Gladyshevka** has been selected as a potential river for the Salmon Action Plan. The salmon stocking with hatchery reared (Narova and Neva origin) parr and smolts are ongoing in this river. Since 2001 more than 165 000 young salmon have been released into the river. No releases were carried out in 2010. In 2014 about 15 200 one-summer old salmon parr were released in Gladyshevka.

Wild parr have occurred in Gladyshevka in previous years: in 2004–2008 salmon parr densities were on the level of 2–12 parr/100 m². In 2010, 0+ and older parr were detected during electrofishing, but the density was low and varied between 2 to 6 parr/100 m². The rapids of Gladyschevka were not electrofished in 2011 and 2012 due to very high water levels. In 2014 salmon parr densities varied from 0 to 5,6 parr/100 m² (average of 2 parr/100 m²) on the different rapids (Table 3.2.2.1).

Sweden

In recent years Testeboån (2013) and Kågeälven (2014) received status as wild salmon rivers by the WGBAST. Restoration efforts are ongoing on the regional-local level in several of the remaining potential salmon rivers in Sweden **Moälven**, **Alsterån** and **Helgeån**, but so far recent stocking activities and/or too low natural production has prevented them from having their status upgraded to wild rivers. Until next year (2016), the intention is to review and potentially update the list of Swedish potential salmon rivers.

3.3 Reared salmon populations

The reared stocks in Sweden were severely affected by the M74-syndrome from the spring of 1992 and onwards. As a result of the high level of M74 in the early 1990s, the Swedish compensatory releases of salmon smolts in 1995 were 60–70% of the normal, but already in 1996 the releases once again increased to the level prescribed in water court decisions. From 1996 and onwards to 2014 the releases have been kept on the intended level (Table 3.3.1).

The broodstock traps in three of the Swedish rivers having reared stocks (Umeälven, Ljusnan and Dalälven) are operated with equal intensity throughout the entire fishing season. This means that the catch in these traps can be considered as relative indexes of escapement.

The number of one-year-old salmon smolts has started to increase, especially in the most southern rivers. From 2007 to 2014 they made up of 23%, 34%, 40%, 45%, 49%, 59%, 60% and 63%, respectively, of the total Swedish smolt releases. This is a result of the use of high-energy feed in combination with a longer growth season due to early springs and warm and long autumns. The prediction for 2015 indicates that the Swedish releases of salmon will be at the level of the water court decisions, approximately 1.9 million smolts.

In Finland, the production of smolts is based on broodstocks reared from eggs and kept in hatcheries. The number of spawners kept in the hatcheries is high enough to secure the whole smolt production. A renewal of the broodstocks has been regarded necessary, and are consequently partly enforced occasionally by broodstock fishing in order to avoid inbreeding. The annual salmon smolt releases in Finland has been about 2 million divided in 1.5 million in Au 1 and 3 and 0.5 million in Au 6 since all compensatory release programs were enforced in the early 1980s. The four latest years the releases in Au 1 and 3 has been reduced to about 1.35 million.

In Latvia the artificial reproduction is based on sea-run wild and hatchery origin salmon broodstock. The broodstock fishery is carried out in the coastal waters of the Gulf of Riga in October-November, as well as in the rivers Daugava and Venta. The mortality of yolk-sac fry has been low indicating that M74 might be absent in this region. The annual smolt production in Latvian hatcheries has been about 0.85 million but in 2011 the releases were reduced to 0.40 million and 0.74 million were released in 2013 and 2014.

In Poland the last salmon population became extinct in the mid-1980s. A restoration programme was started in 1984 when eyed eggs of Daugava salmon were imported. Import of eggs from Latvia went on until 1990. In 1988–1995 eggs for rearing purposes were collected from a salmon broodstock kept in sea cages located in Puck Bay. Since then eggs has been collected from spawners caught in Polish rivers and from spawners reared in the Miastko hatchery. Spawners are caught mainly in the Wieprza river and in the mouth of Wisla river, but also from the rivers Drweca, Parseta, Rega and Slupia. They yearly produce 2.5 to 3.0 million eggs. Stocking material, smolt, one-year old parr and one-summer old parr are reared in five hatcheries. The total annual production of smolts has been about 0.35 million. From 2007 the smolt releases increased to 0.4 million and the releases have stayed at that level until 2010. In 2011 the releases decreased to 0.3 million and in 2012 the releases were only 0.16 million. In 2013 the releases increased to 0.38 million and stayed at that level in 2014.

In Estonia a rearing programme using the Neva salmon stock was started in 1994. Eggs were collected from the reared Narva stock, mixed Selja stock and in late 1990s also imported from Finland. Captive stock from river Kunda was established in 2007. One hatchery is at present engaged in salmon rearing. The annual smolt production has been about 40–50 thousand two year old fish and about 100 thousand one year old fish. In 2011 the releases were reduced to about 26 thousand two year old smolts and 64 thousand one year old smolts and in 2012 only 53 thousand two year old smolts were released which further was reduced to 32 thousand in 2013 and stayed at the same level in 2014.

In Denmark a rearing programme has been run in a hatchery on Bornholm. The river Mörrumsåns stock has been used. In 2004 a total of 13 100 salmon smolts were released in an experiment on artificial imprinting and establishment of a Terminal Fishery. In 2005, 16 000 tagged salmon were released. No more releases have been planned.

According to tagging results the yield from the salmon smolt releases has decreased in all Baltic Sea countries during the last 15 years (Figures 2.6.2.–2.6.4.). Lower catches have been explained by decreased offshore fishing and strong regulations in the coastal fishery. Initially, no substantial surplus of fish was observed in the rivers where compensatory releases were carried out, which most likely was due to a decreasing trend in post-smolt survival. In recent years, however, the amount of salmon returning to reared rivers has increased, in some cases dramatically.

Wild smolt production has increased considerably since the mid-1990s, and wild salmon contribute significantly to catches. Catch samples from years 2000–2014 indicate that the proportion of reared salmon has decreased and is presently well below 50% in most Baltic Sea fisheries (Table 2.8.3 and Figure 2.8.1).

Releases

The total number of released smolts in assessment units 1–5 (Subdivisions 22–31) was about 4.1 million and 0.6 million in assessment unit 6 (Subdivision 32) making a grand total of 4.7 million smolts in 2014 (Table 3.3.1).

Releases of younger life stages are presented in Table 3.3.2. These releases have consisted in many areas of hatchery surplus and releases have been carried out at poor rearing habitats. In such cases mortality among parr is high and releases correspond only to small amounts of smolts. On the other hand, when releases have taken place in the potential or wild salmon rivers with good rearing habitats, they have had a true contribution to the smolt production. The magnitude of these releases has been decreasing in the last few years in most of the assessment units except in assessment unit 5. Roughly, these releases will produce less than 100 thousand smolts in the next few years. However, the data available to the working group were not distinguishable between rivers and release categories, and therefore the corresponding number of smolts derived from the releases of younger life stages was not possible to estimate properly.

Straying rate (no update from last year)

Observations on straying rates of released salmon vary between areas and it is evidently dependent on the rearing practices and observation method. In Finland the rearing of salmon smolts is based on broodstocks that are kept in hatcheries. In Sweden rearing is based on the annually driven broodstock fishing. These differences in rearing practices may also influence straying rates. Strayers are often observed on the lower stretch of the river into which they have strayed. This may indicate that not all strayers necessary enter the spawning grounds and contribute to spawning, but instead a proportion of them may only temporally visit the river. This also implies that the place and time of collecting observations about strayers may influence the obtained estimates about the straying rate. More information is needed to study these aspects of straying.

According to the scale analysis of the catch samples collected from the Tornionjoki in 2000–2011, eight salmon out of analysed 4364 salmon have been detected as potential strayers from smolt releases in other Baltic rivers. This indicates that about 0.2% of the salmon run into the Tornionjoki are strayers, which means about 50 strayers per year (assuming a spawning run into Tornionjoki of about 25 000 salmon). Tag–recapture data of compensatory releases in the Finnish Bothnian Bay indicate that the straying rate of these reared fish is 3–4%. From all these releases, strayers were found only among the Tornionjoki hatchery strain stocked into the mouth of Kemijoki, and all these strayers were observed in the Tornionjoki. Using these tag–recaptures to calculate the amount of strayers in the Tornionjoki (and assuming no strayers from the Swedish releases into Tornionjoki), there would be annually about 200 strayers in the Tornionjoki spawning run.

In Sweden the straying rate of reared stocks has been on average 3.5–4% and in some releases straying rate seems to be as high as 10–30%. Highest straying rate of tagged salmon is often observed in rivers with annual releases, due to high exploitation rate from the commercial, recreational and broodstock fishery.

3.4 M74

Gulf of Bothnia and Bothnian Sea

In Finnish M74 monitoring data, no M74-related mortality was observed in 2014 that was verified by thiamine (vitamin B1) measurements in monitored unfertilized eggs. Hence, the M74 syndrome was non-existent for the third successive year since the beginning of the 1990s in the Gulf of Bothnia rivers. When calculated from all Swedish and Finnish data, the proportion of females whose offspring displayed increased mortality in 2014 was on average 6% (Table 3.4.1). A couple of rather high mortalities among Swedish rivers are most probably caused by too high incubation temperatures or variation in it and are thus not related to M74. The egg thiamine concentrations of salmon ascended the River Simojoki in autumn 2014 were as high as in three preceding autumns (Figure 3.4.1) indicating that there will be no M74 mortalities among offspring that will hatch in 2015.

The M74 frequency in Table 3.4.1 has predominantly been given as the percentage of those females among whose offspring increased mortalities have been recorded in hatcheries. However, especially in the last few years some rather high mortalities among Swedish rivers in Table 3.4.1 are most probable not related to M74 but are caused by unfavourable conditions in hatcheries, such as a too high temperature or its too large variation (Börjeson, 2013). In the Rivers Simojoki, Tornionjoki, and Kemijoki, mortality estimates are based on both the proportion of females affected by M74 and the mean percentage yolk-sac fry mortality (Table 3.4.2). In Finnish estimates annual M74 figures are based on female-specific experimental incubations, in which M74 symptom-related mortality is ascertained by observations of yolk-sac fry and/or comparing mortalities with thiamine concentration of eggs, and are presented as three numbers: (1) the average yolk-sac fry mortality, (2) the proportion of females with offspring affected by M74, and (3) the proportion of those females whose all offspring have died (Keinänen *et al*., 2000; 2008; 2014; Vuorinen *et al*., 2014). Usually, the M74 frequency has been higher than the offspring M74 mortality, especially in years when many offspring groups with mild M74 occur, i.e. when only a proportion of yolk-sac fry die. The mean annual yolk-sac fry mortalities and proportions of M74 females correlate significantly. However, in the years when the M74 syndrome is moderate in most offspring groups, the difference between the proportion of M74 females and mean yolk-sac fry mortality can exceed 20 percentage units (Keinänen *et al*., 2008). Swedish data are based only on the proportion of females whose offspring display increased mortality (Table 3.4.3). Because in Sweden the thiamine concentration of eggs has not been analysed to ensure that mortalities are related to M74, the figures "M74 affected females" especially in the last few years are most evidently too high.

The M74 syndrome resulted in a high mortality of salmon yolk-sac fry with over 50% of M74 frequency (i.e. the proportion of the females whose offspring were affected by M74) in most Swedish and Finnish rivers in hatching years 1992–1996 (Table 3.4.1). Since then the incidence of M74 has on average decreased. However, it has varied greatly even between successive years so that the years 1999, 2002, and 2006–2007 differ clearly from the preceding or following years on the basis of higher mortalities, and the years 1998, 2003–2005, and 2011–2014 on the grounds of lower or non-existent mortalities; in the year 2012 the incidence of M74 can be considered non-existent for the first time since its outbreak at the beginning of 1990. There was earlier a tendency that the estimate of M74-mortality was higher in Finland than in Sweden but this difference seems to have disappeared in the years when the M74 mortality has been low (Figure 3.4.2). The difference may be due to the fact that in Finland all females caught for M74 monitoring have been included in it but in Sweden females that have displayed uncoordinated swimming have been excluded from incubation. Such wiggling females are inevitably known to produce offspring that would all die of M74. The proportion of wiggling females has been high in the early and mid-1990s (Fiskhälsan, 2007). Nonetheless, the annual trends in variation have been very similar in the average data from Swedish and Finnish rivers (Figure 3.4.2). However, in recent years when M74 has been insignificant or no M74 mortality has been registered in Finnish M74 monitoring, rather high M74 frequencies have been reported for some Swedish rivers. It seems that those figures are not reliable, but instead may result from technical failures or too high temperatures or variation in it as reported by Börjeson (2013). In Finnish M74 monitoring, but not in Sweden, the mortality and female proportion figures for M74 incidence are ascertained by measuring the thiamine concentration of eggs (Figure 3.4.1). In the Finnish M74 data, the annual M74 incidence among the monitored Gulf of Bothnia rivers has been very similar. Therefore it is relevant to express the annual M74 mortality and the proportion of M74 females as an average of all individual monitored salmon females (and respective offspring groups) ascended those rivers (Keinänen *et al*., 2014).

Apart from the observations in the hatcheries and experimental incubations, effects of the syndrome was also observed as decreased parr densities in some of the wild salmon populations in 1992–1994 and also in the years 1995 and 1996 despite a high number of spawners (Karlström, 1999; Romakkaniemi *et al*., 2003; 2014). In the Swedish river Ume/Vindelälven in the Gulf of Bothnia an estimate of the egg deposition is available together with an estimate of the parr densities derived from these brood year classes. It shows that the densities of 0+ parr were low in the years 1993–1995 when the incidence of M74 was high, while parr densities were better correlated to the egg deposition in years when the incidence of M74 was low (1986–1991 and 1996–2004).

Statistics from the Swedish River Dalälven for 14 years (1997–2010) show that females (n = 1866) affected by M74 have a lower average weight than non-affected fish (Börjeson, 2011). The reason for the weight difference is not known. It could be that affected M74 fish are younger than healthy females or that they have grown less due to the nutritional conditions. In intra-annual comparisons among two sea-year salmon, only in some years with low M74 incidence, a negative correlation between the weight or size of females and yolk-sac fry mortality was found. On the contrary, a large size (weight or length) or high condition factor of mature female salmon or prespawning salmon was related to high yolk-sac fry mortality in years of relatively high M74 incidence (Mikkonen *et al.*, 2011). Although the high condition factor (CF >1.05) of prespawning salmon predicted high M74-related mortality, the high growth rate of salmon appeared not as such to be the cause of M74, but the abundance of prey and its quality (Mikkonen *et al.*, 2011).

Evidently, because cod (*Gadus morhua*) compete with salmon for food in the Baltic Sea (Larsson, 1984), the annual growth rate and the condition factor of prespawning salmon both were inversely related to the size of the cod stock (Mikkonen *et al.*, 2011). From the various stock factors of sprat (*Sprattus sprattus*) and herring (*Clupea harengus membras*) in the southern Baltic Proper, the biomass of sprat had the strongest positive relationships with the growth rate and condition factor of prespawning salmon, and the total prey biomass with yolk-sac fry mortality. However, sprat was the dominant prey species of salmon in that feeding area in years of high M74 incidence. M74 was already earlier statistically well correlated with parameters describing the sprat stock (Karlsson *et al.*, 1999).

The M74 syndrome has unquestionably been linked to a low concentration of thiamine in salmon eggs (Lundström *et al.*, 1999; Vuorinen and Keinänen, 1999; Koski *et al.*, 2001), although some other relationships have also been found. However, yolk-sac fry suffering from M74 can be restored in hatchery to a healthy condition by treatment with thiamine (Koski *et al.*, 1999). A pale egg colour of M74 eggs (Börjeson *et al.*, 1999; Keinänen *et al.*, 2000) is a result of a low concentration of carotenoids, especially astaxanthine having antioxidant property (Lundström *et al.*, 1999; Pettersson and Lignell, 1999; Vuorinen and Keinänen, 1999). An increase in the concentrations of particular organochlorines in salmon spawners ascending the River Simojoki, coincidentally with the outbreak of M74 at the start of the 1990s, was concluded to have resulted from enhanced feeding on sprat in which the concentrations of these organochlorines were also high in younger age groups with the greatest fat content (Vuorinen *et al.*, 2002). Bioaccumulation of specifically these organochlorines, coplanar PCBs, was most distinctly affected by the fat content of the prey and predator fishes (Vuorinen *et al.*, 2012).

The fat concentration of sprat is nearly twice that of herring and decreases with age, and the percentage of lipid varies more in sprat than in herring (Keinänen *et al.*, 2012). The average thiamine concentration in sprat and herring (of the size preferred by salmon as prey) sampled in different seasons and years are quite similar (Keinänen *et al.*, 2012), although in autumn samples it was lower in sprat than in herring (Vuorinen *et al.*, 2002). However, in both species it exceeded by several times the nutritional guidelines on growth of salmon. The thiamine concentration changed curvilinearly with the age of both sprat and herring being lowest in the youngest age groups (and also in the oldest herring of length >19 cm, and hence not often included as salmon prey according to Hansson *et al.*, 2001) and greatest at 6–10 years in sprat and 3–7 years in herring (Keinänen *et al.*, 2012). As thiamine has a central role in energy metabolism, its nutritional requirement is determined by the energy density of the diet, which means the fat content of prey fish. Thus, abundance of young sprat as food for salmon increases requirement of thiamine. Contrary to demand, the thiamine content per unit fat and energy in the diet of salmon has been least during years and in areas where recruitment and biomass of sprat have been high (Mikkonen *et al.*, 2011; Keinänen *et al.*, 2012). During the long spawning migration and a long prespawning fasting period

(Ikonen, 2006) thiamine reserves are further depleted. Diminished body stores do not allow adequate deposition of thiamine into developing oocytes; the development of offspring cannot be sustained until the end of the yolk-sac period, when fry start external feeding.

Because M74 is induced by the ample but unbalanced food resources for salmon (primarily sprat), the incidence of the M74 syndrome could be reduced and even prevented. The safest strategy for attaining this objective would be to ensure a large, stable cod stock (Casini *et al*., 2009), to prey on the sprat and possibly by managing the sprat fishery in years when the cod stock is weak (Mikkonen *et al*., 2011; Keinänen *et al*., 2012). Evidently, as a consequence of strengthening of the cod stock and flattening out of the sprat stock (ICES, 2012) the incidence of M74 has decreased during recent years having been virtually non-existent in 2012–2014.

In Stock Annex C.1.6, a Bayesian hierarchical model is applied to the Gulf of Bothnian (GoB) monitoring data (Tables 3.4.2 and 3.4.3) of M74 occurrence from Finland and Sweden to obtain annual estimates of the M74-derived yolk-sac fry mortality. This information is needed to fully assess the effects of M74 on the reproductive success of spawners. Besides annual estimates of M74 mortality in the rivers, where mortality has been recorded, the model provides annual estimates of the mortality for any GoB river, in which no monitoring has been carried out (Table 4.2.1.2, Figure 4.2.1.1). Most of the wild stocks and all small stocks in the GoB belong to this group. The results demonstrate that in some years the actual M74 mortality among offspring has been lower than the proportion of M74 females indicated, which apparently is related (see above) to mildness of the syndrome, i.e. to partial mortalities of offspring groups (Figure 4.2.1.2).

Gulf of Finland

The estimates of M74 have normally been lower in areas outside the Gulf of Bothnia. In the River Kymijoki in the Gulf of Finland the incidence of M74 has in many years been lower than in the Rivers Simojoki and Tornionjoki (Table 3.4.1; Keinänen *et al*., 2008; 2014), although in some years the situation has been vice versa evidently because of variation in sprat abundance between the areas; the trend has, however, been similar. The R. Kymijoki of the Gulf of Finland with introduced salmon originating from the Neva stock was included in the Finnish M74 monitoring program from the year 1995, but no data for the years 2008–2013 exist because of problems in salmon collection for monitoring (Table 3.4.1). Therefore the latest mortality data from the R. Kymijoki are thus far from spring 2007 (Table 3.4.1). However, in autumn 2013 a few Kymijoki salmon females were caught for renewing of broodstock. Based on relatively high thiamine concentrations (mean 3.2 ± 1.1 nmol/g, N = 5) in unfertilized eggs of all five salmon, M74 mortalities in spring 2014 were unlikely. In Estonia M74 has been observed in hatcheries in some years during the period 1997–2006, but the mortality has not exceeded 15%. There is no evidence to suggest that M74 occur in Latvian salmon populations. In the Latvian main hatchery Tome, the mortality from hatching until feeding starts varied in the range of 2–10% in the years 1993–1999. Parr densities in the Latvian river Salaca have not decreased during the period in the 1990s when salmon reproduction in the Gulf of Bothnia was negatively influenced by M74 (Table 3.1.5.1).

3.5 Summary of the information on wild and potential salmon rivers

Wild smolt production in relation to the smolt production capacity is one of the ultimate measures of management success. Among the rivers with wild populations flowing into the Gulf of Bothnia and the Main Basin (assessment units 1–5), wild smolt abundance is measured directly in the index rivers **Simojoki** and **Tornionjoki/Torneälven** (au 1), **Sävarån** (au 2), **Vindelälven** (au 2), **Mörrumsån** (au 4) and in the Latvian river **Salaca** (au 5). In addition, counting of smolts in other rivers will likely take place in the near future. The smolt abundance model (Annex 3), which utilises all available juvenile abundance data, is a rigorous tool for formal assessment of current smolt production.

Differences in the status of the wild stocks have become more apparent in recent years, not only in terms of the level of smolt production in relation to potential production, but also in terms of trends in various indices of abundance. These differences are particularly clear when comparing different regions: most Gulf of Bothnia (AU 1–3) rivers have shown increases in abundance while many of the Main Basin (AU 4–5) rivers have shown either decreasing or stable abundance.

Rivers in the Gulf of Bothnia (assessment units 1–3)

The parr production in the hatching years of 1992–1996 was as low as in the 1980s (Tables 3.1.1.4, 3.1.2.1 and 3.1.3.1, and Figures 3.1.1.4, 3.1.1.5, 3.1.2.1, 3.1.2.2 and 3.1.3.1), although the spawning runs were apparently larger (Tables 3.1.1.1, 3.1.1.2, and Figures 3.1.1.2, 3.1.1.3). In those years, the M74 syndrome caused high mortality (Table 3.4.1 and Figure 3.4.1), which decreased parr production considerably. In the hatching years 1997–1999, parr densities increased to higher levels, about five to ten times higher than in the earlier years. These strong year classes resulted from large spawning runs in 1996–1997 and a simultaneous decrease in the level of M74. The large parr year classes hatching in 1997–1998 resulted in increased smolt runs in 2000 and 2001 (Table 3.1.1.5). In spite of some reduction in parr densities during the years 1999–2002, parr densities and subsequent smolt runs stayed on elevated levels compared to the situation in the mid-1990s. In 2003, densities of one-summer old parr increased in some rivers back to the peak level observed around 1998, while no similar increase was observed in other rivers. From 2004–2006, densities of one-summer old parr show a yearly increase in most of the rivers but in 2007 the densities of one summer old parr decreased. Despite the relative high spawning run in 2009 the densities of one summer old parr decreased substantially in 2010 in most of the rivers compared to the densities in 2009. The densities of one summer old parr in 2012 stayed at the same level as in 2011 or even increased despite the relatively weak spawning run in 2011. The increased spawning run in 2012 did not substantially increase the densities of one summer old parr in 2013 but the increased spawning run in 2013 resulted in increased densities of one summer old parr and in many rivers the highest recorded.

Catch statistics and fishladder counts indicate some differences among rivers in the development in number of ascending spawners. There has been pronounced annual variation in the indices of wild reproduction of salmon both between and within rivers. Variation in abundance indices might partly be explained to extreme summer conditions in the rivers during some years, e.g. in 2002–2003 and in 2006, which might have affected river catches and the fish migration in some ladders. Counted number of salmon in 2007 increased with about 50% compared to 2006. The additional increase in fishladder counts in 2008 is in agreement with the increased river catches, which more than doubled in 2008 compared to 2007 and were almost as high as in the highest recorded years (1996 and 1997). The spawner counts in 2010 and 2011 in combination with information on river catches indicated weak spawning runs in those years. The large increased spawning run in Tornionjoki in 2012 and 2013, as compared to 2011, resulted in increased total river catches with 40–65% compared to the two previous years.

Most data from the Gulf of Bothnia rivers indicate an increasing trend in salmon production. Rivers in assessment unit 1 have shown the most positive development, while stocks in the small rivers in assessment units 2 and 3 do not show the same positive development. These small rivers are located on the Swedish coast close to the Quark area (northern Bothnian Sea, southern Bothnian Bay). The low M74 level in recent years has most likely affected the wild production positively. Preliminary data from two Swedish hatcheries indicate that the M74 mortality among offspring that will hatch in 2015 will likely stay at low levels (Dalälven=5%; Luleälven=0%).

Rivers in the Main Basin (assessment units 4–5)

The status of the Swedish salmon populations in the rivers **Mörrumsån** and **Emån** in the Main Basin differs, but they both show a similar slight negative trend in parr densities (Table 3.1.4.1 and Figures 3.1.4.1 and 3.1.4.2). The outbreak of M74 mortality in the early 1990s might have decreased smolt production in mid-1990s, after reaching the historical highest parr densities in the turn of the 1980s and 1990s. The juvenile production was estimated to slightly increase to the turn of the century. However, parr and smolt production has decreased in both rivers (but see discussion about Mörrumsån above). In river Emån, the smolt production has for long been below the required level, which is most likely dependent on insufficient numbers of spawners entering a fishladder which leads to reproduction areas further upstream in the river system.

Among rivers in assessment unit 5, the **Pärnu** river exhibit the most precarious state: no parr at all were found in the river in 2003–2004, in 2005–2006 the densities increased slightly, but in 2007, 2008, 2010 and 2011 again no parr were found. Reproduction occurred in 2008, 2011 and 2012 resulting in low densities of parr in 2009, 2012, 2013 and in 2014 (Table 3.1.5.1, Figure 3.1.5.1). There has been remarkable annual variation in parr densities, both within and between rivers in AU 5. Since 1997, parr densities in the river **Salaca** in Latvia have been on relatively high levels (Table 3.1.5.1, Figure 3.1.5.2), but in 2010 and 2011 the densities decreased to the lowest observed level since the mid-1990s. In 2013 and 2014 the density was on an intermediate level. In the river **Gauja,** parr production level has been on a very low level since 2004. In 2014 the 0+ parr density increased to a slightly higher level. It seems that in some of the small salmon rivers (**Saka**, **Peterupe** and **Vitrupe**) salmon reproduction occurs only occasionally, however in 2014 the 0+ parr densities increased in most of them.

Although only short time-series of parr and smolt abundance is available from Lithuanian rivers, the latest monitoring results indicate somewhat similar variation in juvenile production as the Latvian stocks (Table 3.1.5.2). The observed parr densities are very low in relation to observed parr densities in most other Baltic rivers. This illustrates the poor state of several wild salmon stocks in assessment unit 5. These stocks might be in a higher risk of extinction than any of the stocks in the assessment units 1–3 (Gulf of Bothnia). In Lithuania, measures have been carried out since 1998 to increase salmon populations. Implementation of measures has stabilized salmon populations in Lithuanian rivers and the salmon production is increasing very slowly. Pollution also affects the salmon rivers. Another important factor in Lithuanian rivers, which are of lowland type, is a lack of suitable habitats for salmon parr.

Besides regulation of fisheries, many of the salmon rivers in the Main Basin may need habitat restoration and re-establish connectivity, which aim at stabilizing and improving natural reproduction. For instance, in the **Pärnu** river, Sindi dam prevents access to over 90% of the potential reproduction areas. In the river **Mörrumsån** and **Emån,** new fish passes have increased significantly the available reproduction area to salmon.

Rivers in assessment unit 6 (Gulf of Finland, Subdivision 32)

The 0+ parr density in **Kunda** increased slightly compared to 2013 and in the river **Keila** and **Vasalemma** the density increased to a high level. The status of river Keila is considered to be good. Improvement has been modest in Vasalemma and no clear trend can be seen in Kunda. Because of the high annual variation in Vasalemma and Kunda the status of these populations must still be considered uncertain. In mixed rivers **Purtse, Selja, Loobu, Valgejõgi, Jägala, Pirita** and **Vääna** wild parr densities decreased significantly in 2011. In recent three years (2012–2014) parr density has stayed above the long-term average in all of these rivers. A positive trend can be seen in Selja, Valgejõgi, Loobu and Pirita, however because of such high fluctuations in recruitment the status of these populations remains uncertain. To safeguard these stocks additional regulatory measures were enforced in 2011 (see Chapter 2.9) and positive effect of these measures can be seen by increase in wild parr density and in the relatively high amount of ascending spawners in Pirita.

In Russia, wild salmon reproduction occurs in rivers **Luga** and **Gladyshevka**. The status of both these stocks can be considered very uncertain. Since 2003 there is no information suggesting wild reproduction in river **Neva**.

In Finland, the wild production in the mixed river **Kymijoki** has increased during the last ten years, however the present natural reproduction in the lower part of the river has still remained below the rivers potential.

Natural smolt production in Estonian, Finnish, and Russian rivers in the Gulf of Finland area was estimated to about 28 000 in 2013. In 2014 smolt production increased to 62 000 and this was caused mostly by the production in Kymijoki. It is estimated that smolt production will increase to 55 000 in 2015. The smolt releases in the period 2000–2014 has been on a stable level. The exception was the year 2011 when releases were reduced to almost half (Table 3.3.1). The reduction in Russian smolt releases was caused by exceptionally warm climatic conditions in the summer 2010 causing high parr mortality in hatcheries.

Table 3.1.1. Salmon catches (in kilos) in four rivers of the subdivision 31, and the catch per unit of effort (cpue) of the Finnish salmon rod fishing in the river Tornionjoki/Torneälven.

	Simojoki	Kalixälven	Byskeälven	Tornionjoki/ Torneälven (au 1)			
	(au1)	(au1)	(au2)	Finnish	Swedish	Total	cpue
	catch, kilo	catch, kilo	catch, kilo	catch, kilo	catch, kilo	catch, kilo	grams/day
1970	1330						
1971							
1972	700						
1973							
1974				7950			
1975				3750			
1976				3300			
1977				4800			
1978				4050			
1979	400			5850			
1980				11250	7500	18750	
1981	200	4175	531	3630	2500	6130	
1982		1710	575	2900	1600	4500	
1983	50	3753	390	4400	4300	8700	9
1984	100	2583	687	3700	5000	8700	8
1985		3775	637	1500	4000	5500	14
1986	200	2608	251	2100	3000	5100	65
1987		2155	415	2000	2200	4200	33
1988		3033	267	1800	2200	4000	42
1989		4153	546	6200	3700	9900	65
1990	50	9460	2370	8800	8800	17600	113
1991		5710	1857	12500	4900	17400	106
1992		7198	1003	20100	6500	26600	117
1993		7423	2420	12400	5400	17800	100
1994[1)]	400	0	109	9000	5200	14200	97
1995	1300	3555	1107	6100	2900	9000	115
1996	2600	8712	4788	39800	12800	57600[4)]	561[2)]/736[3)]
1997	3900	10162	3045	64000	10300	74300	1094
1998	2800	5750	1784	39000	10500	49500	508
1999	1850	4610	720	16200	7760	27760	350
2000	1730	5008	1200	24740	7285	32025	485
2001	2700	6738	1505	21280	5795	27075	327
2002	700	10478	892	15040	4738	19778	300
2003	1000	5600	816	11520	3427	14947	320
2004	560	5480	1656	19730	4090	23820	520
2005	830	8727	2700	25560	12840	38400	541
2006	179	3187	555	11640	4336	15976	311
2007	424	5728	877	22010	13013	35023	553
2008	952	10523	2126	56950	18036	74986	1215

	Simojoki	Kalixälven	Byskeälven	Tornionjoki/ Torneälven (au 1)			
	(au1)	(au1)	(au2)	Finnish	Swedish	Total	cpue
	catch, kilo	catch, kilo	catch, kilo	catch, kilo	catch, kilo	catch, kilo	grams/day
2009	311	4620	1828	30100	7053	37153	870
2010	300	1158	1370	23740	7550	31290	617
2011	334	1765	870	27715	15616	43331	773
2012	588	3855	2679	84730	37236	121966	1253
2013	260	4570	1664	57990	14313	72303	1322
2014	1205	3652	1388	124025	22707	146732	2210

[1] Ban of salmon fishing 1994 in Kalixälven and Byskeälven and the Swedish tributaries of Torneälven.

[2] Calculated on the basis of a fishing questionnaire similar to years before 1996.

[3] Calculated on the basis of a new kind of fishing questionnaire, which is addressed to fishermen, who have bought a salmon rod fishing licence.

[4] 5 tonnes of illegal/unreported catch has included in total estimate.

Table 3.1.1.2. Numbers of wild salmon in fishladders and hydroacoustic counting in the rivers of the assessment units 1 and 2 (Subdivisions 30–31, Gulf of Bothnia).

Year	Number of salmon															
	Simojoki (au 1)		**Tornionjoki (au 1)**		**Kalixälven (au 1)**		**Piteälven (au 2)**		**Åbyälven (au 2)**		**Byskeälven (au 2)**		**Ume/Vindelälven (au 2)**			**Öreälven (au 2)**
	MSW fish	**Total**	**MSW fish**	**Total**	**MSW fish**	**Total**	**MSW fish**	**Total**	**MSW fish**	**Total**	**MSW fish**	**Total**	**MSW fish**	**Females**	**Total**	**Total**
1973								45								
1974								15						716	1583	
1975														193	610	
1976														319	808	
1977														456	1221	
1978														700	1634	
1979														643	2119	11
1980					62	80							842	449	1254	1
1981					79	161							293	196	638	8
1982					11	45							216	139	424	3
1983					132	890							199	141	401	7
1984					no control								222	177	443	14
1985					no control			30					569	330	904	10
1986					no control			28					175	128	227	2
1987					no control			18					193	87	246	13
1988					no control			28					367	256	446	23
1989					no control			19					296	191	597	13
1990					139	639		130					767	491	1572	65

Year	Number of salmon															
	Simojoki (au 1)		Tornionjoki (au 1)		Kalixälven (au 1)		Piteälven (au 2)		Åbyälven (au 2)		Byskeälven (au 2)		Ume/Vindelälven (au 2)			Öreälven (au 2)
	MSW fish	Total	MSW fish	Total	MSW fish	Total	MSW fish	Total	MSW fish	Total	MSW fish	Total	MSW fish	Females	Total	Total
1991					122	437		59					228	189	356	51
1992					288	656	57	115					317	258	354	63
1993					158	567	14	27				227	921	573	1663	54
1994					144	806	14	30				258	984	719	1309	39
1995					736	1282	23	66			157	786	619	249	1164	18
1996					2736	3781	89	146	1	1	2421	2691	1743	1271	1939	24
1997					5184	5961	614	658	38	39	1025	1386	1602	1064	1780	51
1998					1525	2459	147	338	12	15	707	786	447	233	1154	30
1999					1515	2013	185	220	10	14	447	721	1614	802	2208	52
2000					1398	2459	204	534	10	31	908	1157	946	601	3367	
2001					4239	8890	668	863	40	95	1435	2085	1373	951	5476	
2002					6190	8479	1243	1378	49	81	1079	1316	3182	2123	6052	
2003	936	n/a			3792	4607	1305	1418	14	18	706	1086	1914	1136	2337	
2004	680	n/a			3206	3891	1269	1628	23	43	1331	1707	1717	663	3292	
2005	756	n/a			4450	6561	897	1012	16	80	900	1285	2464	1480	3537	
2006	765	n/a			2125	3163	496	544	20	27	528	665	1733	1093	2362	
2007	970	n/a			4295	6489	450	518	62	93	1208	2098	2636	1304	4023	
2008	1004	1235			6165	6838	471	723	158	181	2714	3409	3217	2167	5157	
2009	1133	1374	26 358	31 775	4756	6173	904	1048	180	185	1186	1976	3861	2584	5902	
2010	699	888	16 039	17 221	2535	3192	473	532	47	47	1460	1879	2522	1279	2697	

Year	Number of salmon																
	Simojoki (au 1)		Tornionjoki (au 1)		Kalixälven (au 1)		Piteälven (au 2)		Åbyälven (au 2)		Byskeälven (au 2)		Ume/Vindelälven (au 2)			Öreälven (au 2)
	MSW fish	Total	MSW fish	Total	MSW fish	Total	MSW fish	Total	MSW fish	Total	MSW fish	Total	MSW fish	Females	Total	Total
2011	791	1167	20326	23096	2202	2562	571	597	36	36	1187	1433	3992	1505	4886	
2012	2751	3630	52828	61724	7708	8162	1196	1418	74	88	2033	2442	5842	1765	8058	
2013	2544	3121	46580	53607	12247	15039	1168	1343	92	113	3137	3761	10002	5058	13604	
2014	3322	3816	93434	101387	7343	7638	1221	1339	94	94	5417	5888	7852	2633	10407	

Simojoki: Hydroacoustic counting near the river mouth, started 2003.

Tornionjoki: Hydroacoustic counting 100 km upstream from the sea, started 2009.

Kalixälven: Fishcounting in the fishladder is a part of the run. No control during 1984–1989.

Piteälven: New fishladder built 1992. Fishcounting in the ladder is the entire run.

Åbyälven: New fishladder built in 1995. Fishcounting in the ladder is the entire run above the fishladder but only part of the total run.

Byskeälven: New fishladder built 2000. Fishcounting in the the fishladders is part of the run.

Umeälven/Vindelälven: Fishcounting in the fishladder is the entire run.

Öreälven: Fishcounting in the trap is part of the run. The trap was destroyed by high water levels in 2000.

Table 3.1.1.3. The age and sex composition of ascending salmon caught by the Finnish river fishery in the River Tornionjoki since the mid-1970s.

	Year(s)									
	1974-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011	2012	2013	2014
N:o of samples	728	283	734	2114	2170	1879	268	668	529	754
A1 (Grilse)	9%	53%	35%	7%	20%	8%	9%	9%	7%	8%
A2	60%	31%	38%	59%	50%	53%	42%	44%	48%	44%
A3	29%	13%	24%	28%	26%	31%	41%	40%	38%	36%
A4	2%	2%	3%	4%	3%	6%	7%	5%	4%	8%
>A4	0%	1%	<1 %	2%	2%	2%	1%	2%	3%	5%
Females, proportion of biomass	About 45 %	49%	75%	71%	65%	67%	63%	61%	64%	69%
Proportion of repeat spawners	2%	2%	2%	6%	6%	8%	9%	7%	9%	14%
Proportion of reared origin	7%	46 %*	18%	15%	9%	1%	0.0%	0.6%	0.4%	0.0%

*** An unusually large part of these salmon were not fin-clipped but analysed as reared on the basis of scales (probably strayers). A bulk of these were caught in 1989 as grilse.**

Table 3.1.1.4 Densities and occurrence of wild salmon parr in electrofishing surveys in the rivers of the assessment unit 1 (Subdivision 31).

	Number of parr/100 m² by age group						
River year	0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
Simojoki							
1982	3.90			1.50	50%	14	No age data of older parr available
1983	0.75			2.20	57%	14	No age data of older parr available
1984	0.53			2.29	44%	16	No age data of older parr available
1985	0.10			0.98	8%	16	No age data of older parr available
1986	0.19			0.53	19%	16	No age data of older parr available
1987	0.74			0.71	27%	22	No age data of older parr available
1988	2.01	2.30	0.24	2.54	36%	22	
1989	2.32	1.15	0.34	1.49	41%	22	
1990	1.71	1.74	0.56	2.30	36%	25	
1991	3.67	1.74	0.65	2.38	32%	28	
1992						0	No sampling because of flood.
1993	0.08	0.35	0.86	1.21	19%	27	
1994	0.39	0.47	0.53	1.00	16%	32	
1995	0.66	0.32	0.13	0.45	31%	29	
1996	2.09			0.76	28%	29	No age data of older parr available
1997	10.98	1.39	0.28	1.67	72%	29	
1998	10.22	3.47	0.46	3.94	100%	17	Flood; only a part of sites were fished.
1999	20.77	10.39	2.41	12.80	93%	28	
2000	15.76	12.17	2.95	15.12	84%	30	
2001	9.03	7.38	3.29	10.67	67%	31	
2002	15.44	8.56	3.30	11.85	81%	31	
2003	19.97	5.38	1.44	6.82	84%	30	
2004	12.97	7.68	1.30	8.98	74%	19	Flood; only a part of sites were fished.
2005	18.49	7.46	1.89	9.35	70%	27	Flood; only a part of sites were fished.
2006	35.82	12.37	6.14	18.51	83%	36	
2007	4.47	2.61	1.21	3.82	37%	35	
2008	17.75	3.19	1.40	4.60	72%	36	
2009	28.56	13.14	2.15	15.29	76%	36	

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
2010	13.15	8.26	2.45	10.71	80%	35	
2011	27.93	6.87	2.58	9.45	83%	35	
2012	14.98	10.09	1.43	11.52	83%	36	
2013	11.32	10.60	3.64	14.24	78%	36	
2014	34.30	4.94	2.96	7.90	75%	36	
Tornionjoki							
1986	0.52	0.89	0.23	1.12		30	
1987	0.38	0.31	0.48	0.79		26	
1988	0.73	0.60	0.46	1.06	46%	44	
1989	0.58	0.68	0.64	1.32	47%	32	
1990	0.52	0.82	0.36	1.18	40%	68	
1991	2.35	0.63	0.48	1.12	69%	70	
1992	0.24	1.80	0.36	2.16	16%	37	Flood; only a part of sites were fished.
1993	0.52	0.44	2.49	2.94	44%	64	
1994	1.02	0.49	1.35	1.84	43%	92	
1995	0.49	1.45	0.65	2.10	48%	72	
1996	0.89	0.33	0.82	1.15	39%	73	
1997	8.05	1.35	0.74	2.09	78%	100	
1998	12.95	4.43	0.53	4.96	92%	84	
1999	8.37	8.83	4.23	13.06	85%	98	
2000	5.90	4.70	6.81	11.51	83%	100	
2001	5.91	3.13	3.82	6.94	78%	101	
2002	7.23	6.03	3.92	9.94	78%	101	
2003	16.09	4.19	2.93	7.12	81%	100	
2004	5.79	4.99	1.27	6.25	80%	60	Flood; only a part of sites were fished.
2005	8.60	2.86	4.28	7.15	81%	87	
2006	13.33	10.57	5.44	16.01	83%	80	
2007	10.33	8.62	5.61	14.23	75%	81	
2008	26.00	10.66	8.70	19.36	94%	81	
2009	19.71	11.65	5.63	17.27	96%	79	
2010	14.42	11.39	6.89	18.28	89%	81	
2011	22.18	14.35	10.06	24.41	90%	78	
2012	19.47	6.94	4.96	11.90	92%	79	
2013	24.13	9.83	6.14	15.97	95%	81	
2014	36.08	7.54	4.41	11.95	97%	75	
Kalixälven							
1986	0.55	1.59	4.10	5.69	50%	6	
1987	0.40	1.11	1.64	2.75	33%	9	
1988	0.00	0.87	2.08	2.95	0%	1	

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
1989	2.82	0.99	1.86	2.85	75%	24	
1990	4.96	5.67	2.1	7.77	91%	11	
1991	6.19	1.37	1.09	2.46	79%	19	
1992	1.08	3.54	1.87	5.41	54%	11	Flood; only a part of sites were fished.
1993	0.59	0.66	3.05	3.69	42%	19	
1994	2.84	1.16	3.08	4.24	69%	26	
1995	1.10	3.16	0.94	4.10	67%	27	
1996	2.16	0.77	1.15	1.92	71%	28	
1997	10.16	2.98	1	3.98	86%	28	
1998	31.62	9.81	2.6	12.41	78%	9	Flood; only a part of sites were fished.
1999	4.41	7.66	6.36	14.02	87%	30	
2000	10.76	4.99	8.31	13.30	93%	29	
2001	5.60	5.48	6.3	11.78	79%	14	
2002	6.21	6.22	3.77	9.99	93%	30	
2003	46.94	12.51	5.2	17.71	87%	30	
2004	13.58	14.65	3.25	17.90	88%	24	
2005	15.34	5.53	8.63	14.16	87%	30	
2006	15.96	19.33	8.32	27.65	90%	30	
2007	11.63	7.65	6.53	14.18	80%	30	
2008	25.74	15.91	8.40	24.31	97%	30	
2009	28.18	10.17	5.76	15.93	80%	30	
2010	14.87	10.96	4.71	15.67	83%	30	
2011	36.92	29.62	15.68	45.30	89%	9	Flood; only a part of sites were fished.
2012	16.07	10.07	6.42	16.49	87%	30	
2013	29.51	15.45	11.95	27.40	100%	30	
2014	25.69	14.44	6.03	20.47	100%	30	
Råneälven							
1993	0.00	0.08	0.83	0.91	0%	9	
1994	0.17	0	0.27	0.27	22%	9	
1995	0.06	0.13	0.21	0.34	18%	11	
1996	0.52	0.38	0.33	0.71	25%	12	
1997	3.38	1.00	1.14	2.14	90%	10	
1998	2.22	0.35	0.35	0.70	100%	1	Flood; only a part of sites were fished.
1999	1.05	2.22	1.66	3.88	50%	12	
2000	0.98	1.67	1.99	3.66	69%	13	
2001	0.23	0.53	2.39	2.92	40%	10	
2002	1.65	0.92	1.32	2.24	43%	14	

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
2003	4.71	3.34	1.11	4.45	57%	14	
2004						0	No sampling because of flood.
2005	2.83	1.14	2.10	3.24	64%	14	
2006	6.75	4.06	5.12	9.18	50%	14	
2007	2.74	2.36	2.83	5.19	57%	14	
2008	6.25	1.83	3.64	5.47	64%	14	
2009	4.13	4.66	3.67	8.33	86%	7	
2010	5.87	3.57	7.79	11.36	64%	14	
2011	2.92	2.52	2.63	5.15	57%	14	
2012	3.30	2.16	3.21	5.37	71%	14	
2013	8.19	4.15	7.76	11.91	79%	14	
2014	7.42	3.85	4.12	7.97	79%	14	

Table 3.1.1.5. Estimated number of smolt by smolt trapping in the rivers Simojoki and Tornionjoki (assessment unit 1), and Sävarån, Ume/Vindelälven and Rickleån (assessment unit 2). The coefficient of variation (CV) of the trapping estimates has been derived from the mark–recapture model (Mäntyniemi and Romakkaniemi, 2002) for the last years of the time-series. In the Ume/Vindelälven, however, another technique has been applied, in which smolts are tagged during the smolt run and recaptures has been monitored from adults ascending the year 1–2 years later. The ratio of smolts stocked as parr/wild smolts in trap catch is available in some years even though total run estimate cannot be provided (e.g., in the cases of too low trap catches). The number of stocked smolts is based on stocking statistics.

	Tornionjoki (AU 1)				Simojoki (AU 1)				Sävarån (AU 2)		Ume/Vindelälven (AU 2)		Rickleån (AU 2)	
	Smolt trapping, original estimate	CV of estimate	Ratio of smolts stocked as parr/wild smolts in catch	Number of stocked reared smolts (point estimate)	Smolt trapping, original estimate	CV of estimate	Ratio of smolts stocked as parr/wild smolts in catch	Number of stocked reared smolts (point estimate)	Smolt trapping, original estimate	CV of estimate	Smolt trapping, original estimate	CV of estimate	Smolt trapping, original estimate	CV of estimate
1977	n/a				29,000				n/a		n/a		n/a	
1978	n/a				67,000				n/a		n/a		n/a	
1979	n/a				12,000				n/a		n/a		n/a	
1980	n/a				14,000				n/a		n/a		n/a	
1981	n/a				15,000				n/a		n/a		n/a	
1982	n/a				n/a				n/a		n/a		n/a	
1983	n/a				n/a				n/a		n/a		n/a	
1984	n/a				19,000				n/a		n/a		n/a	
1985	n/a				13,000				n/a		n/a		n/a	
1986	n/a				2,200				n/a		n/a		n/a	
1987	50,000	*)	1.11	32,129	1,800		1.78	14,800	n/a		n/a		n/a	
1988	66,000		0.37	11,300	1,500		3.73	14,700	n/a		n/a		n/a	
1989	n/a		1.22	1,829	12,000		0.66	52,841	n/a		n/a		n/a	

	Tornionjoki (AU 1)				Simojoki (AU 1)				Sävarån (AU 2)		Ume/Vindelälven (AU 2)		Rickleån (AU 2)	
	Smolt trapping, original estimate	CV of estimate	Ratio of smolts stocked as parr/wild smolts in catch	Number of stocked reared smolts (point estimate)	Smolt trapping, original estimate	CV of estimate	Ratio of smolts stocked as parr/wild smolts in catch	Number of stocked reared smolts (point estimate)	Smolt trapping, original estimate	CV of estimate	Smolt trapping, original estimate	CV of estimate	Smolt trapping, original estimate	CV of estimate
1990	63,000		0.20	85,545	12,000		1.41	26,100	n/a		n/a		n/a	
1991	87,000		0.54	40,344	7,000		1.69	60,916	n/a		n/a		n/a	
1992	n/a		0.47	15,000	17,000		0.86	4,389	n/a		n/a		n/a	
1993	123,000		0.27	29,342	9,000		1.22	5,087	n/a		n/a		n/a	
1994	199,000		0.16	17,317	12,400		1.09	14,862	n/a		n/a		n/a	
1995	n/a		0.38	61,986	1,400		7.79	68,580	n/a		n/a		n/a	
1996	71,000		0.60	39,858	1,300		28.5	140,153	n/a		n/a		n/a	
1997	50,000 **)			20,004	2,450		6.95	144,939	n/a		n/a		n/a	
1998	144,000		0.57	60,033	9,400		2.28	75,942	n/a		n/a		n/a	
1999	175,000	17%	0.67	60,771	8,960		0.75	66,815	n/a		n/a		n/a	
2000	500,000	39%	0.17	60,339	57,300		0.48	50,100	n/a		n/a		n/a	
2001	625,000	33%	0.09	4,000	47,300		0.15	49,111	n/a		n/a		n/a	
2002	550,000	12%	0.08	3,998	53,700		0.29	51,300	n/a		n/a		n/a	
2003	750,000	43%	0.06	4,032	63,700		0.26	18,912	n/a		n/a		n/a	
2004	900,000	33%	0.02	4,000	29,100		0.30	1,900	n/a		n/a		n/a	
2005	660,000	25%	0.00	4,000	17,500	28%	0.10	4,800	3,800	15%	n/a		n/a	
2006	1,250,000	35%	0.00	3,814	29,400	35%	0.11	809	3,000	12%	n/a		n/a	
2007	610,000	48%	0.00	8,458	23,200	20%	0.01	8,000	3,100	18%	n/a		n/a	

	Tornionjoki (AU 1)				Simojoki (AU 1)				Sävarån (AU 2)		Ume/Vindelälven (AU 2)		Rickleån (AU 2)	
	Smolt trapping, original estimate	CV of estimate	Ratio of smolts stocked as parr/wild smolts in catch	Number of stocked reared smolts (point estimate)	Smolt trapping, original estimate	CV of estimate	Ratio of smolts stocked as parr/wild smolts in catch	Number of stocked reared smolts (point estimate)	Smolt trapping, original estimate	CV of estimate	Smolt trapping, original estimate	CV of estimate	Smolt trapping, original estimate	CV of estimate
2008	1,490,000	37%	0.00	6,442	42,800	29%	0.00	4,000	4,570	18%	n/a		n/a	
2009	1,090,000	42%	0.00	4,490	22,700	29%	0.00	1,000	1,900	49%	n/a		n/a	
2010	n/a		0.00	4,965	29,700	28%	0.00	23,240	1,820	32%	193,800	21%	n/a	
2011	1,990,000	27%	0.00	3,048	36,700	13%	0.00	0	1,643	28%	210,000	14%	n/a	
2012	n/a		0.00	4,437	19,300	37%	0.00	0	n/a		352,900	19%	n/a	
2013	n/a		0.00	4,800	37,000	11%	0.00	0	3,548	31%	302,600	25%	n/a	
2014	n/a		0.00	2,000	36,600	19%	0.00	0	n/a		n/a		2,149	16%

Table 3.1.2.1. Densities and occurrence of wild salmon parr in electrofishing surveys in the rivers of the assessment unit 2 (Subdivisions 30–31). Detailed information on the age structure of older parr (>0+) is available only from the Åbyälven and Byskeälven.

	Number of parr/100 m² by age group				Sites with 0+ parr (%)	Number of sampling sites	
River year	0+	1+	2+ & older	>0+ (sum of two previous columns)			Notes
Piteälven							
1990	0			0		1	
1991							No sampling
1992							No sampling
1993	0			0		1	
1994	0			0		4	
1995							No sampling
1996							No sampling
1997	0.31			0.2		2	
1998							No sampling because of flood.
1999							No sampling
2000							No sampling
2001							No sampling
2002	5.37			1.24		5	
2003							No sampling
2004							No sampling
2005							No sampling
2006	3.92	1.39	0.30	1.69	71%	7	
2007	0.00	2.08	0.42	2.50	0%	5	
2008	5.06	0.81	1.04	1.85	100%	6	
2009							No sampling
2010	2.22	1.69	0.99	2.68	86%	7	
2011							No sampling because of flood.
2012							No sampling because of flood.
2013	6.56	6.55	2.08	8.63	100%	7	
2014	12.15	6.39	2.92	9.31	100%	5	
Åbyälven							
1986	1.11	1.15	0.00	1.15	100%	2	
1987	1.69	0.75	0.79	1.54	100%	4	
1988	0.28	0.11	0.69	0.80	67%	3	
1989	2.62	0.17	2.26	2.43	100%	4	
1990	0.9	2.13	0.25	2.38	50%	4	
1991	5.36	0	4.47	4.47	100%	2	
1992	2.96	3.65	0.17	3.82	100%	1	
1993	1.01	0.56	4.62	5.18	75%	4	
1994	1.53	0.67	1.95	2.62	67%	6	

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
1995	3.88	1.53	1.42	2.95	86%	7	
1996	3.77	3.89	1.10	4.99	71%	7	
1997	3.09	1.99	3.06	5.05	67%	7	
1998						0	No sampling because of flood.
1999	16.51	6.57	1.74	8.31	71%	7	
2000	5.85	4.43	3.62	8.05	71%	10	
2001	6.31	1.58	3.76	5.34	100%	4	
2002	8.16	1.63	2.10	3.73	100%	10	
2003	2.93	3.73	0.83	4.56	80%	10	
2004	5.40	0.49	0.83	1.32	70%	10	
2005	6.36	1.40	0.62	2.02	90%	10	
2006	27.18	10.37	2.77	13.14	90%	10	
2007	5.26	6.30	4.76	11.06	80%	10	
2008	12.48	2.19	3.95	6.14	80%	10	
2009	16.79	4.21	3.24	7.45	90%	10	
2010	7.16	3.83	2.06	5.89	100%	10	
2011	27.01	9.07	5.65	14.72	100%	10	
2012	12.82	7.54	4.36	11.90	90%	10	
2013	16.29	7.32	5.22	12.54	100%	10	
2014	28.73	6.73	5.67	12.40	100%	10	
Byskeälven							
1986	0.10	0.85	0.54	1.39	29%	7	
1987							No sampling
1988							No sampling
1989	2.39	0.48	1.15	1.63	75%	8	
1990	1.45	1.14	0.39	1.53	80%	5	
1991	5.14	1.25	0.83	2.08	73%	11	
1992	1.46	5.85	2.65	8.50	50%	10	
1993	0.43	0.21	1.35	1.56	57%	7	
1994	2.76	0.97	2.5	3.47	80%	10	
1995	3.42	2.15	1.42	3.57	91%	11	
1996	8.64	2.53	1.26	3.79	83%	12	
1997	10.68	4.98	1.18	6.16	100%	12	
1998						0	No sampling because of flood.
1999	16.28	7.45	4.55	12.00	100%	15	
2000	8.72	8.38	3.72	12.10	100%	12	
2001						0	No sampling because of flood.
2002	15.84	4.3	2.25	6.55	93%	14	
2003	33.83	4.89	1.7	6.59	93%	15	

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
2004	12.32	6.83	2.33	9.16	93%	15	
2005	26.18	8.78	7.02	15.80	100%	15	
2006	13.20	14.39	4.01	18.40	87%	15	
2007	6.76	5.49	6.09	11.58	93%	15	
2008	20.49	6.80	5.61	12.41	93%	15	
2009	36.59	10.55	4.28	14.83	100%	15	
2010	18.71	9.14	3.47	12.61	93%	15	
2011							No sampling because of flood.
2012	18.35	5.50	3.77	9.27	93%	15	
2013	24.00	14.27	9.48	23.75	93%	15	
2014	37.78	6.79	6.19	12.98	100%	15	
Kågeälven							
1987	0.00			0.00	0%	5	
1988	0.00			0.00	0%	1	
1989	0.00			0.00	0%	3	
1990	0.00			0.00	0%	1	
1991	0.51			0.00	25%	4	
1992	1.62			0.54α	50%	2	
1993	0.00			1.13α	0%	5	
1994	0.00			0.46α	0%	5	
1995						0	No sampling
1996						0	No sampling
1997						0	No sampling
1998						0	No sampling
1999	19.74			14.07α	58%	26	
2000	1.46			3.02α	30%	10	
2001	9.47			7.05α	33%	9	
2002	8.73			5.64α	54%	26	
2003	8.34			1.17α	46%	26	
2004	7.00			6.17α	44%	25	
2005	13.95			1.52α	58%	26	
2006	30.65			27.03α	82%	17	
2007	4.10			6.20	40%	25	
2008	2.49			7.07	29%	14	
2009	8.16			2.87	85%	12	
2010	5.81			2.69	69%	12	
2011	2.76			2.09	38%	12	
2012	18.10			10.34	69%	12	
2013	10.02			14.03	92%	12	
2014	26.35			9.78	100%	13	

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
Rickleån		* 0+	* >0+				
1988	0.00	0.00	0.11	0.23	0%	2	
1989	0.34	0.16	0.00	0.00	33%	6	
1990	0.69	0.32	0.11	0.24	29%	7	
1991	0.30	0.14	0.04	0.09	29%	7	
1992	0.22	0.10	0.02	0.05	43%	7	
1993	1.63	0.77	0.08	0.18	50%	8	
1994	0.63	0.30	0.56	1.18	38%	8	
1995	0.64	0.30	0.11	0.23	50%	8	
1996	0.00	0.00	0.05	0.10	0%	7	
1997	0.17	0.08	0.43	0.90	29%	7	
1998	2.56	1.21	0.47	0.99	86%	7	
1999	2.32	1.10	0.23	0.49	86%	7	
2000	3.41	1.61	1.90	4.04	100%	7	
2001						0	No sampling because of flood.
2002	2.42	1.14	1.22	2.58	43%	7	
2003	1.05	0.50	0.19	0.39	43%	7	
2004	1.13	0.53	1.53	3.24	43%	7	
2005	4.88	2.30	0.16	0.34	43%	7/*11	
2006	3.88	1.83	2.69	5.70	86%	7	
2007	0.00	0.00	0.09	0.19	0%	7/*11	
2008	4.16	1.96	1.02	2.16	43%	7/*11	
2009	1.09	0.51	0.00	0.00	57%	7	
2010	3.73	1.76	2.94	6.23	100%	7	
2011	0.00	0.00	0.46	0.97	0%	7	
2012	0.91	0.43	0.98	1.96	86%	7/*14	
2013	4.94	2.59	2.01	2.98	57%	7/*13	
2014	2.66	1.56	0.65	0.77	86%	7/*9	

***) Average densities from extended electrofishing surveys in Rickleån, including also number of total sites when the sites from the upper parts of the river is added which have recently been colonized by salmon (for more details see Section 4.2.2).**

These mean densities are used as input in the river model (see stock annex).

α) stocked and wild parr. Not possible to distinguish socked parr from wild.

Table 3.1.2.1. Continued.

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
Sävarån							
1989	0.60			0.90	25%	4	
1990	1.50			3.10	56%	9	
1991	0.70			4.50	29%	7	
1992	0.20			3.00	43%	7	
1993	1.80			1.90	29%	7	
1994	1.50			2.90	33%	6	
1995	0.40			1.00	33%	9	
1996	10.30			2.50	44%	9	
1997	0.40			3.50	33%	9	
1998	2.70			2.70	63%	8	
1999	0.80			5.00	44%	9	
2000	12.80			7.40	100%	4	
2001						0	No sampling because of flood.
2002	4.60			5.20	63%	8	
2003	2,30			4.40	56%	9	
2004						0	No sampling because of flood.
2005	3.30			3.80	56%	9	
2006	12.49			16.89	67%	9	
2007	4.70			9.20	67%	9	
2008	7.30			8.10	78%	9	
2009	10.22			12.06	78%	9	
2010	4.99			14.09	67%	9	
2011	6.87			8.46	67%	9	
2012	14.43			21.70	89%	9	
2013	20.17			18.31	89%	9	
2014	9.04			9.97	75%	8	
Ume/Vindelälven		* 0+	* >0+				
1989	1.57	1.13	1.41	1.97	67%	3	
1990	0.57	0.41	2.09	2.91	50%	12	
1991	2.28	1.64	0.80	1.11	50%	6	
1992							
1993	0.29	0.21	0.71	0.99	33%	6	
1994	0.51	0.37	0.79	1.10	24%	25	
1995	0.39	0.28	0.17	0.23	37%	19	
1996	0.30	0.94	0.69	0.95	14%	21	
1997	17.23	12.40	1.31	1.82	79%	19	
1998	21.59	15.53	8.00	11.12	100%	6	Flood; only a part of sites were fished.

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
1999	3.29	2.36	12.14	16.88	28%	18	
2000	4.53	3.26	2.87	3.99	75%	12	
2001	3.54	2.54	5.83	8.10	72%	18	
2002	21.95	15.79	13.10	18.21	89%	18	
2003	24.00	17.27	2.76	3.84	89%	18	
2004	12.09	8.69	7.45	10.36	83%	18	
2005	3.71	2.67	3.11	4.32	79%	19	
2006	16.44	11.83	6.85	9.52	63%	19/*25	
2007	15.30	11.00	6.07	8.43	79%	19/*25	
2008	8.46	6.09	3.99	5.55	79%	19/*25	
2009	15.05	10.86	4.23	5.42	74%	19/*30	
2010	12.60	9.11	13.67	18.48	100%	19/*32	
2011							No sampling because of flood.
2012	21.15	15.25	8.71	11.65	95%	19/*25	
2013	15.78	11.35	12.83	17.83	95%	19/*26	
2014	39.35	30.76	9.34	11.82	100%	18/*34	
Öreälven							
1989	0			0.01	0%	14	
1990	0			0.00	0%	8	
1991	0			0.25	0%	8	
1992	0			0.25	0%	6	
1993	0			0.03	0%	13	
1994	0			0.00	0%	8	
1995	0.21			0.04	30%	10	
1996	0.44			0.00	30%	10	
1997	0.23			0.70	50%	10	
1998	1.02			0.34	75%	8	
1999	0.44			0.47	40%	10	
2000	0.60			0.80	67%	9	
2001						0	No sampling because of flood.
2002	6.73			1.35	60%	10	
2003	3.39			2.62	60%	10	
2004	2.12			0.16	56%	9	
2005	8.02			1.41	44%	9	
2006	5.91			4.84	60%	10	
2007	1.36			0.39	30%	10	
2008	1.16			1.09	40%	10	
2009	10.69			1.64	100%	10	
2010	3.59			2.45	80%	10	
2011	3.69			1.06	89%	9	

River year	Number of parr/100 m² by age group				Sites with 0+ parr (%)	Number of sampling sites	Notes
	0+	1+	2+ & older	>0+ (sum of two previous columns)			
2012	7.35			4.32	80%	10	
2013	3.96			1.89	56%	9	
2014	6.04			2.05	100%	10	

***) Average densities from extended electrofishing surveys in Vindelälven, including also number of total sites when the sites from the upper parts of the river is added which have recently been colonized by salmon (for more details see Section 4.2.2).**

These mean densities are used as input in the river model (see stock annex).

Table 3.1.2.1. Continued.

River year	Number of parr/100 m2 by age group				Sites with 0+ parr (%)	Number of sampling sites	Notes
	0+	1+	2+ & older	>0+ (sum of two previous columns)			
Lögdeälven							
1989	0.69			0.53	50%	8	
1990	2.76			0.46	44%	9	
1991	3.16			0.37	88%	8	
1992	0.14			0.79	38%	8	
1993	0.53			0.79	38%	8	
1994	0.42			0.66	38%	8	
1995	2.17			1.71	88%	8	
1996	2.64			0.87	89%	9	
1997	2.59			2.79	88%	8	
1998	13.7			3.69	100%	6	
1999	5.67			0.48	100%	8	
2000	4.80			4.10	86%	7	
2001						0	No sampling because of flood.
2002	5.01			1.54	100%	7	
2003	11.14			3.47	100%	8	
2004	13.26			3.64	100%	8	
2005	11.19			5.06	100%	8	
2006	6.73			3.91	88%	8	
2007	2.86			2.70	63%	8	
2008	9.68			3.76	100%	8	
2009	11.63			5.72	100%	8	
2010	12.19			2.44	100%	8	
2011	10.9			2.93	88%	8	
2012	5.42			3.20	100%	8	
2013	9.55			1.49	100%	8	
2014	14.85			7.43	100%	8	

Table 3.1.3.1. Densities and occurrence of wild salmon parr in electrofishing surveys in the assessment unit 3 (Subdivisions 30). Detailed information on the age structure of older parr (>0+) is not available.

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+	Sites with 0+ parr (%)	Number of sampling sites	Notes
Ljungan							
1990	5.5			4.8	67%	3	
1991	16.5			0.6	100%	3	
1992							
1993							
1994	6.9			0.2	100%	3	
1995	11.9			0.9	100%	3	
1996	8.6			6.5	100%	3	
1997	19.6			2.1	100%	6	
1998						0	No sampling because of flood
1999	17.4			7.9	80%	5	
2000	10.6			6.5	86%	7	
2001						0	No sampling because of flood
2002	23.9			2.6	100%	8	
2003	11.6			0.2	100%	8	
2004	3.1			1.4	56%	9	
2005	45.3			2.3	100%	9	
2006						0	No sampling because of flood
2007	7.7			2.0	89%	9	
2008	18.9			0.3	100%	3	Flood; only a part of sites were fished.
2009						0	No sampling because of flood
2010						0	No sampling because of flood
2011						0	No sampling because of flood
2012	91.1			5.6		1	Only one site fished because of flood
2013							No sampling because of flood
2014	48.9			0.70	100%	6	
Testeboån							
2000	17.6			n/a		10	
2001	32.7			n/a		10	
2002	40.0			n/a		10	
2003	16.7			n/a		10	
2004	17.8			n/a		10	
2005	12.3			n/a		5	
2006	8.2			n/a		5	
2007	10.8			17.8		10	
2008	0.0			4.9		11	
2009	8.8			0.8		11	
2010	12.3			6.9		11	

River year	Number of parr/100 m² by age group				Sites with 0+ parr (%)	Number of sampling sites	Notes
	0+	1+	2+ & older	>0+			
2011	11.1			2.4		11	
2012	10.2			6.0		11	
2013	15.7			9.9		11	
2014	5.2			7.9		11	

n/a = reared parr, which are stocked, are not marked; natural parr densities can be monitored only from 0+ parr.

Table 3.1.4.1. Densities of wild salmon parr in electrofishing surveys in the rivers of the assessment unit 4 (Subdivisions 25–26, Baltic Main Basin).

River year	Number of parr/100 m² by age group		Number of sampling sites
	0+	>0+	
Mörrumsån			
1973	32	33	
1974	12	21	
1975	77	13	
1976	124	29	
1977	78	57	
1978	145	49	
1979	97	65	
1980	115	60	
1981	56	50	
1982	117	31	
1983	111	74	
1984	70	67	
1985	96	42	
1986	132	39	
1987			
1988			
1989	307	42	11
1990	114	60	11
1991	192	55	11
1992	36	78	11
1993	28	21	11
1994	34	8	11
1995	61	5	11
1996	53	50	11
1997	74	15	14
1998	120	29	9
1999	107	35	9
2000	108	21	9
2001	92	22	9
2002	95	14	9
2003	92	28	9
2004	80	21	7
2005	98	29	9
2006	61	34	9
2007*	54	10	4
2008	102	16	9
2009	61	14	8
2010	97	27	8
2011	36	18	5

River year	Number of parr/100 m² by age group		Number of sampling sites
	0+	>0+	
2012	96	14	5
2013	99	30	7
2014	95	23	8

*** Flood, only a part of sites were fished.**

Table 3.1.4.1. Continued.

River year	Number of parr/100 m² by age group		Number of sampling sites
	0+	>0+	
Emån			
1967	52	4.0	
1980-85	52	8.0	
1992	49	10.0	
1993	37	9.0	2
1994	24	7.0	2
1995	32	4.0	4
1996	34	8.0	4
1997	71	6.0	4
1998	51	6.0	2
1999	59	7.0	4
2000	51	3.0	4
2001	37	3.0	4
2002	57	4.0	4
2003	46	4.0	7
2004	45	4.0	6
2005	60	4.0	7
2006	13	1.3	7
2007	36	1.7	5
2008	35	2.9	6
2009	61	3.0	4
2010*			
2011	25	1.8	6
2012	47	3.7	4
2013	30	9.9	4
2014	27	3.0	7

*** no sampling because of flood.**

Table 3.1.5.1. Densities of wild salmon parr in electrofishing surveys in the Latvian and Estonian wild salmon rivers of the assessment unit 5 (Gulf of Riga, Subdivisions 28).

River year	Number of parr/100 m² by age group		Number of sampling sites
	0+	**>0+**	
Pärnu			
1996	3.8	1.0	1
1997	1.0	0.1	1
1998	0.0	0.0	1
1999	0.2	0.4	1
2000	0.8	0.4	1
2001	3.1	0.0	1
2002	4.9	0.0	1
2003	0.0	0.0	1
2004	0.0	0.0	1
2005	9.8	0	1
2006	4.2	0	1
2007	0	0	1
2008	0	0	1
2009	18.4	0	1
2010	0	0	1
2011	0	0	1
2012	1.7	0	1
2013	4.3	0	1
2014	2.7	0	1
Salaca			
1993	16.7	4.9	5
1994	15.2	2.6	5
1995	12.8	2.8	5
1996	25.3	0.9	6
1997	74.4	3.1	5
1998	60	2.8	5
1999	68.7	4	5
2000	46.3	0.8	5
2001	65.1	4.4	5
2002	40.2	10.3	6
2003	31.5	1.3	5
2004	91.3	2.7	5
2005	115	3.8	7
2006	77.3	17.9	6
2007	69.4	6.9	10
2008	92.5	4.9	5
2009	70	10.3	5
2010	26.5	7,4	5
2011	34.5	1.2	5
2012	72	1.9	5
2013	43.4	10.4	5

River year	Number of parr/100 m² by age group		Number of sampling sites
	0+	>0+	
2014	59.1	3.8	5
Gauja			
2003	<1	<1	5
2004	7.9	<1	7
2005 [2]	2.7	1.3	5
2006	<1	0	7
2007	<1	0	5
2008	0.1	0.1	5
2009	0.7	0.3	5
2010	0.1	0.9	5
2011	0.4	1.6	5
2012	0.8	0	5
2013	0.3	0.1	5
2014	3.9	0.1	4
Venta			
2003	0.5	0.2	7
2004	20.8	0.7	7
2005	29.9	1.1	6
2006	2.6	2.9	5
2007	10.1	0.1	5
2008	18	1.5	5
2009	9.7	0.1	5
2010	0.2	0.2	5
2011	4.4	0	5
2012	12.3	0.7	5
2013	6	0.1	5
2014	10.9	0.4	5
Amata*			
2003	0.0	<1	3
2004	7.9	3,4*	3
2005	2.7	1.3	3
2006	16.7	3.4	3
2007	0.0	5.8	3
2008	6.2	1.8	3
2009	8.5	6.3	3
2010	3.3	3.9	3
2011	1.2	0.5	3
2012	1.0	1.4	3
2013	4.6	2.1	3
2014	4.6	2.1	3

[2]) tributaries to Gauja.

***) reard fish.**

Table 3.1.5.2. Densities of salmon parr in electrofishing surveys in rivers in Lithuanian of the assessment unit 5 (Baltic Main Basin).

	Number of parr/100 m2 by age group		
River year	0+	>0+	Number of samplingsites
Neris			
2000	0.19	0.06	10
2001	2.51	0.00	10
2002	0.90	0.00	11
2003	0.27	0.00	11
2004	0.41	0.05	10
2005	0.10	0.03	9
2006	0.06	0.02	9
2007	1.68	0.36	9
2008	7.44	0.32	9
2009	7.31	0.27	9
2010	0.10	0.16	9
2011	1.19	0.16	10
2012	3.30	0.20	9
2013	0.56	0.02	10
2014	0.90	0.01	12
Žeimena			
2000	4.10	0.46	7
2001	1.40	0.10	7
2002	0.66	0.00	6
2003	0.72	0.00	6
2004	3.10	0.30	6
2005	1.33	0.47	5
2006	2.52	0.06	5
2007	4.20	0.80	5
2008	2.80	0.10	7
2009	3.50	0.40	7
2010	0.20	0.00	7
2011	5.70	1.20	5
2012	1.40	0.60	6
2013	2.37	0.30	6
2014	2.90	0.90	6
Mera			
2000	0.13	0.00	3
2001	0.27	0.00	3
2002	0.08	0.00	4
2003	0.00	0.00	4
2004	0.00	0.00	3
2005	0.00	0.00	2

River year	Number of parr/100 m2 by age group		Number of samplingsites
	0+	>0+	
2006	0.00	0.05	2
2007	0.22	0.22	2
2008	0.00	0.50	2
2009	0.00	0.25	3
2010	0.00	0.00	3
2011	0.00	0.05	3
2012	0.00	0.00	3
2013	0.08	0.00	3
2014	0.00	0.30	4
Saria			
2000	2.50	0.00	1
2001	0.70	0.00	1
2002	0.00	0.00	1
2003	0.40	0.00	1
2004	3.00	0.00	1
2005	0.00	0.40	1
2006	n/a	n/a	
2007	0.00	0.00	1
2008	n/a	n/a	
2009	1.96	0.00	1
2010	n/a	n/a	
2011	n/a	n/a	
2012	0.80	0.00	2
2013	n/a	n/a	
2014	n/a	n/a	

Table 3.1.6.1. Estonian wild and mixed salmon rivers in the Gulf of Finland.

River	Wild or mixed	Water quality1)	Flow m³/s		First obstacle km	Undetected parr cohorts 1997–2013	Production of >0+ parr 1997–2013
			mean	min			
Purtse	mixed	IV	6.7	3.7	4.9	1 (since 2006)	0-5.2
Kunda	wild	III	4.3	0.8	2	1	0.3-21.5
Selja	mixed	V	2.4	0.8	42	6	0-4.9
Loobu	mixed	II	2.0	0.3	10	2	0-15
Valgejõgi	mixed	IV	3.4	0.6	8	2	0.8-7.2
Jagala	mixed	II	7.3	0.7	2	6	0-0.9
Pirita	mixed	V	6.8	0.4	24	4	0-8.1
Vaana	mixed	V	1.9	0.3	21	9	0-3.8
Keila	wild	V	6.2	0.5	2	3	0-25.8
Vasalemma	wild	II	3.5	0.2	4	3	0-5

1) **Classification of EU Water Framework Directive**

Table 3.1.6.2. Densities of salmon parr rivers with only wild salmon populations, Subdivision 32.

River	Year	Number of parr/100m2		Number of sites	River	Year	Number of parr/100m2		Number of sites
		0+	**1+ and older**				**0+**	**1+ and older**	
Kunda	1992	8.3	7.7	1	Vasalemma	1992	4.3	3.1	1
	1993	0.0	5.3	1		1993	*	*	0
	1994	3.1	0.0	1		1994	2.4	0.0	1
	1995	19.5	3.6	1		1995	23.7	0.5	1
	1996	28.6	16.2	1		1996	6.1	5.9	1
	1997	1.9	25.4	1		1997	0.0	1.8	1
	1998	17.5	1.0	1		1998	0.0	0.1	1
	1999	8.2	21.4	1		1999	17.1	0.0	1
	2000	26.4	8.9	1		2000	4.4	2.0	1
	2001	38.4	17.4	1		2001	0.5	1.0	1
	2002	17.0	5.9	1		2002	8.9	0.4	1
	2003	0.8	4.3	1		2003	0.0	0.0	1
	2004	30.1	0.4	1		2004	0.0	0.0	1
	2005	5.0	49.3	1		2005	21.4	0.0	1
	2006	27.2	14.6	3		2006	9.9	1.0	2
	2007	5.5	5.8	3		2007	5.2	0.3	2
	2008	5.5	0.4	1		2008	2.5	1.1	2
	2009	46.5	0.8	1		2009	37.6	0.0	2
	2010	2.5	1.2	1		2010	26.0	1.9	2
	2011	16.6	14.6	1		2011	7.3	4.1	2
	2012	12.1	13.8	1		2012	6.8	1.1	2
	2013	13.5	6.5	3		2013	39.8	3.5	2
	2014	29.0	8.9	1		2014	26.1	4.2	2

River	Year	Number of parr/100m2		Number of sites	River	Year	Number of parr/100m2		Number of sites
		0+	1+ and older				0+	1+ and older	
Keila	1994	1.2	1.1	1		*) = no electrofishing			
	1995	8.9	0.4	1					
	1996	14.9	1.3	1					
	1997	0.0	6.2	1					
	1998	0.0	6.6	1					
	1999	120.3	1.5	1					
	2000	4.8	5.4	1					
	2001	0.0	1.5	1					
	2002	8.4	0.4	1					
	2003	0.0	0.0	1					
	2004	0.6	0.0	1					
	2005	31.9	3.0	1					
	2006	6.3	8.0	1					
	2007	18.9	2.8	1					
	2008	44.2	4.3	1					
	2009	55.8	25.8	1					
	2010	110.1	12.3	1					
	2011	25.0	24.7	1					
	2012	43.5	3.9	3					
	2013	157.1	33.8	1					
	2014	82.2	48.9	1					

***) = no electrofishing**

Table 3.1.6.3. Densities of wild salmon parr in rivers where supportive releases are carried out, Subdivision 32.

River	Year	Number of parr/100m²		Number of sites	River	Year	Number of parr/100m²		Number of sites
		0+	1+ and older				0+	1+ and older	
Purtse	2005	0.0	0.0	2	Valgejõgi	1998	0.0	0.0	2
	2006	3.5	1.1	2		1999	1.7	0.9	6
	2007	12.5	0.2	3		2000	0.3	0.7	5
	2008	0.6	4.9	3		2001	2.4	0.7	4
	2009	1.8	4.1	3		2002	8.9	0.0	1
	2010	0.1	0.7	3		2003	0.1	0.3	3
	2011	0.0	2.1	3		2004	0.8	3.6	2
	2012	36.3	0.0	3		2005	7.4	3.3	3
	2013	15.3	8.4	3		2006	12.4	3.0	3
	2014	36.6	5.7	3		2007	8.8	6.7	3
						2008	8.5	5.2	3
Selja	1995	1.7	7.7	1		2009	20.2	5.7	3
	1996	0.0	0.5	1		2010	5.6	7.2	3
	1997	0.0	0.0	1		2011	0.0	3.6	3
	1998	0.0	0.0	1		2012	11.0	0.8	3
	1999	0.0	2.3	7		2013	19.2	3.5	3
	2000	1.5	0.3	3		2014	21.6	5.1	3
	2001	1.8	4.4	2					
	2002	0.0	0.0	2	Jägala	1998	0.0	0.0	1
	2003	0.0	0.1	3		1999	1.3	0.0	1
	2004	0.0	0.9	2		2000	0.0	0.0	1
	2005	5.2	2.1	4		2001	18.9	0.0	1
	2006	0.9	0.2	3		2002	0.0	0.0	1
	2007	0.3	0.1	4		2003	0.0	0.1	1
	2008	19.3	5.1	3		2004	0.6	0.0	1
	2009	19.8	4.9	4		2005	4.4	0.0	1
	2010	9.3	1.4	4		2006	0.0	0.2	1

River	Year	Number of parr/100m²		Number of sites	River	Year	Number of parr/100m²		Number of sites
		0+	1+ and older				0+	1+ and older	
	2011	1.9	1.0	4		2007	0.0	0.0	1
	2012	22.8	3.4	4		2008	6.6	0.0	1
	2013	38.2	4.0	4		2009	0.4	0.9	1
	2014	14.6	4.4	3		2010	4.4	0.0	1
						2011	0.0	0.0	1
Loobu	1994	1.5	3.3	2		2012	11.6	0.0	1
	1995	2.9	0.7	2		2013	0.3	0.0	1
	1996	0.0	1.9	3		2014	1.5	0.0	1
	1997	0.0	0.0	1					
	1998	0.2	0.0	2	Pirita	1992	2.4	0.8	1
	1999	6.3	0.5	4		1993	*	*	0
	2000	0.5	0.7	4		1994	0.0	0.0	1
	2001	0.0	0.3	4		1995	0.0	0.0	1
	2002	0.2	0.1	3		1996	0.0	0.1	1
	2003	0.0	2.4	4		1997	*	*	0
	2004	1.5	4.2	4		1998	0.0	0.0	6
	2005	3.0	7.8	5		1999	7.7	0.1	5
	2006	0.8	1.7	5		2000	0.0	0.6	4
	2007	3.1	0.0	5		2001	1.5	0.1	6
	2008	17.7	0.2	4		2002	0.0	0.3	6
	2009	26.8	15.0	4		2003	0.0	2.8	6
	2010	57.1	6.4	4		2004	0.2	0.8	4
	2011	0.4	5.1	4		2005	24.0	8.7	4
	2012	28.3	3.9	4		2006	8.9	3.0	4
	2013	64.5	5.0	4		2007	3.2	3.4	4
	2014	1.8	16.6	4		2008	14.6	5.8	4
						2009	23.1	6.5	7
Kymijoki	1991	4.1	NA	5		2010	12.2	5.4	4

River	Year	Number of parr/100m²		Number of sites	River	Year	Number of parr/100m²		Number of sites
		0+	1+ and older				0+	1+ and older	
	1992	24.1	NA	5		2011	0.6	1.8	4
	1993	5.8	NA	5		2012	11.2	0.3	8
	1994	4.3	NA	5		2013	38.3	8.1	4
	1995	24.8	NA	5		2014	15.8	3.7	4
	1996	2.9	NA	5					
	1997	4.0	NA	5	Vääna	1998	0.0	0.1	5
	1998	2.3	NA	5		1999	0.0	0.4	4
	1999	18.0	NA	5		2000	0.1	0.0	4
	2000	19.0	NA	5		2001	0.0	0.0	2
	2001	29.7	NA	5		2002	0.0	0.2	4
	2002	19.4	NA	5		2003	0.0	0.0	4
	2003	9.1	NA	5		2004	0.0	0.0	2
	2004	34.3	NA	5		2005	0.0	0.0	4
	2005	59.5	NA	5		2006	17.6	0.0	4
	2006	28.5	NA	5		2007	0.0	0.6	3
	2007	17.5	NA	5		2008	12.1	0.0	3
	2008	15.7	NA	5		2009	9.0	4.2	3
	2009	36.6	NA	5		2010	0.0	1.1	3
	2010	37.8	NA	5		2011	0.0	0.3	3
	2011	13.0	NA	5		2012	3.3	0.0	3
	2012	12.7	NA	5		2013	4.7	0.6	3
	2013	23.1	NA	5		2014	12.1	1.5	3
	2014	54	NA	5					

***) = no electrofishing**

Table 3.2.1.1. Current status of reintroduction programme in Baltic Sea potential salmon rivers. Potential production estimates are uncertain and currently being re-evaluated.

River	Description of river						Restoration programme					Results of restoration			
	Country	ICES sub-division	Old salmon river	Cause of salmon population extinction	Potential production areas (ha)	Potential smolt production (num.)	Officially selected for reintroduction	Programme initiated	Measures	Releases	Origin of population	Parr and smolt production from releases	Spawners in the river	Wild parr production	Wild smolt production
Moälven	SE	31	yes	3,4	7	2000	no	yes	c,l	2	Byskeälven	yes	yes	>0	>0
Alsterån	SE	27	yes	2,3	4	4000	no	no	c,g,l	4	**	**	yes	>0	>0
Helgeån	SE	25	yes	2,3	7	3200	no	yes	c,e,m	2	Mörrumsån	yes	yes	>0	>0
Kuivajoki	FI	31	yes	1,2	58	17000	yes	yes	b,c,f	2	Simojoki	yes	yes	yes	0
Kiiminkijoki	FI	31	yes	1,2	110	40000	yes	yes	b,c,d,f	2	Iijoki	yes	yes	yes	>0
Siikajoki	FI	31	yes	1,2,3	32	15000	no	yes	b,g,m	1,4	mixed	yes	*	0	0
Pyhäjoki	FI	31	yes	1,2,3	98	35000	yes	yes	b,c,d,f,m	2	Tornionjoki/Ouloj	yes	yes	yes	0
Kalajoki	FI	31	yes	1,2,3	33	13000	no	yes	b,e, m	1,4		no	*	0	0
Perhonjoki	FI	31	yes	1,2,3	5	2000	no	yes	b,f	2	Tornionjoki/Ouloj	yes	*	0	0
Merikarvianjoki	FI	30	yes	1,2,3	8	2000	no	yes	b,c,e	2	Neva	yes	yes	>0	*
Vantaanjoki	FI	32	no?	2	16	8000	no	yes	b,c,f,m	2	Neva	yes	yes	0	0
Kymijoki	FI	32	yes	2,3,4	75	100000	no	yes	b,c,m	2	Neva	yes	yes	yes	25000
Valgejögi	EE	32	yes	4	15	16000	yes	yes	c,l	2	Neva, Narva	yes	yes	yes	500
Jägala	EE	32	yes	2,4	2	1500	yes	yes	c,g	2	Neva, Narva	yes	yes	yes	>0
Vääna	EE	32	yes	4	4	5000	yes	yes	c,k	2	Neva, Narva	no	yes	yes	500
Venta	LI	28	yes	2,3	*	10000	no	no	m,c	4	Venta	no	no	0	0
Sventoji	LI	26	yes	2,3	7	12000	yes	yes	m,c	2	Nemunas	yes	yes	6020	2730
Minija/Veivirzas	LI	26	yes	*	*	15000	yes	yes	c	2	Nemunas	no	no	0	0
Wisla/Drweca	PL	26	yes	1,2,3,4	*	*	yes	yes	b,l,m	2	Daugava	yes	yes	*	*
Slupia	PL	25	yes	1,2,3,4	*	*	yes	yes	b,l,m	2	Daugava	yes	yes	yes	*
Wieprza	PL	25	yes	1,2,3,4	*	*	yes	yes	b,m	2	Daugava	yes	yes	*	*
Parseta	PL	25	yes	1,2,4	*	*	yes	yes	b,n	2	Daugava	yes	yes	*	*
Rega	PL	25	yes	1,2,3,4	*	*	yes	yes	b	2	Daugava	yes	yes	*	*
Odra/Notec/Drav	PL	24	yes	1,2,4	*	*	yes	yes	b	2	Daugava	yes	yes	*	*
Reda	PL	24	yes	1,2,3,4	*	*	yes	yes	b	2	Daugava	yes	yes	*	*
Gladyshevka	RU	32	yes	1,2,4	1,5	3000	no	yes	a,g,k,n	2	Narva, Neva	yes	yes	yes	>0

Table 3.2.2.1. Densities of wild salmon parr in electrofishing surveys in potential rivers.

Country	Assessment unit	Subdivision	River and year	Number of parr/100 m²		Number of sampling sites
				0+	>0+	
Sweden	4	27	Alsterån			
			1997	13.3	0	1
			1998	23.8	5.4	1
			1999	6.8	7.0	1
			2000	8.0	3.4	1
			2001	1.5	1.3	1
			2002	36.2	0.4	1
			2003	0	4.4	1
			2004	0	0	1
			2005	13.2	0	1
			2006	0	3.6	1
			2007	0	0	1
			2008	0	0	1
			2009	0	0	1
			2010			no sampling
			2011	8.5	6.0	1
			2012	0	4.3	1
			2013	0	0	1
			2014	1.9	0	1
Finland	1	31	Kuivajoki			
			1999	0	n/a	
			2000	0	n/a	8
			2001	0	n/a	16
			2002	0.2	n/a	15
			2003	0.4	n/a	15
			2004	0.5	n/a	15
			2005	0.6	n/a	14
			2006	3.2	n/a	14
			2007	0.2	n/a	14
			2008			no sampling
			2009			no sampling
			2010			no sampling
			2011			no sampling
			2012			no sampling
			2013			no sampling
			2014			no sampling
Finland	1	31	Kiiminkijoki			
			1999	1.8	n/a	
			2000	0.8	n/a	31
			2001	1.9	n/a	26
			2002	1.5	n/a	47
			2003	0.7	n/a	42

Country	Assessment unit	Subdivision	River and year	Number of parr/100 m²		Number of sampling sites
				0+	**>0+**	
			2004	3.9	n/a	46
			2005	8.2	n/a	45
			2006	2.3	n/a	41
			2007	0.7	n/a	17
			2008	2.3	n/a	18
			2009	3.8	n/a	19
			2010	2.0	n/a	19
			2011			no sampling
			2012	6.6	n/a	2
			2013	3.0	n/a	20
			2014	1.8	n/a	12
Finland	1	30	Pyhäjoki			
			1999	0.3	n/a	
			2000	0.2	n/a	23
			2001	0.9	n/a	18
			2002	1.9	n/a	20
			2003	0	n/a	22
			2004	0.2	n/a	13
			2005	0.7	n/a	16
			2006	0.2	n/a	17
			2007	0.0	n/a	13
			2008			no sampling
			2009	0.2	0	6
			2010	0.0	0.4	6
			2011	0.0	0	4
			2012			no sampling
			2013			no sampling
			2014			no sampling
Estonia	6	32	Jägala jõgi			
			1999	0.5	0	1
			2000	0	0	1
			2001	16.2	0	1
			2002	0	0	1
			2003	0	0	1
			2004	0.5	0	1
			2005	1.9	0	1
			2006	0	0.1	1
			2007	0.1	0	1
			2008	6.6	0	1
			2009	0.4	0.9	1
			2010	4.3	0	1
			2011	0	0	1
			2012	11.6	0	1
			2013	0.3	0	1

Country	Assessment unit	Subdivision	River and year	Number of parr/100 m²		Number of sampling sites
				0+	>0+	
			2014	1.5	0	1
Russia	6	32	Gladyshevka			
			2001	0	0	2
			2002	0	0	2
			2003	0	0	3
			2004	6	0	2
			2005	15.6	4.1	3
			2006	7.7	6.2	2
			2007	3.1	3.7	4
			2008	0	2	1
			2009	0.9	0.3	1
			2010	1.2	2	4
			2011			no sampling
			2012			no sampling
			2013	3.0	3	
			2014	2.0	3.0	

*** = stocked and wild parr. Not possible to distinguish socked parr from wild.**

n/a = reared parr, which are stocked, are not marked; natural parr densities can be monitored only from 0+ parr.

Table 3.2.2.1. Continued.

Country	Assessment unit	Subdivision	River year	Number of parr/100 m² by age group		Number of sampling sites
				0+	>0+	
Lithuania	5	26	Šventoji			
			2000	1.90	0.00	6
			2001	0.25	0.00	6
			2002	2.00	0.10	6
			2003	0.10	0.00	6
			2004	0.62	0.28	6
			2005	0.50	0.46	4
			2006	3.15	1.35	4
			2007	4.80	0.10	4
			2008	5.80	0.30	5
			2009	6.10	1.40	5
			2010	0.94	0.84	5
			2011	6.30	2.30	5
			2012	4.00	1.50	5
			2013	4.80	0.80	5
			2014	5.32	0.08	5
Lithuania	5	26	Siesartis			
			2000	1.84	0.00	2
			2001	3.35	0.35	2

Country	Assessment unit	Subdivision	River year	Number of parr/100 m² by age group		Number of sampling sites
				0+	>0+	
			2002	2.50	0.00	2
			2003	0.45	0.00	2
			2004	3.40	0.00	3
			2005	7.30	3.00	2
			2006	0.27	0.94	2
			2007	6.30	1.20	2
			2008	18.90	17.50	2
			2009	44.10	4.00	2
			2010	0.15	3.40	2
			2011	6.80	1.90	3
			2012	0.60	3.10	3
			2013	5.00	1.30	3
			2014	11.95	5.10	4
Lithuania	5	26	Virinta			
			2003	0.95	0.00	2
			2004	0.17	0.00	2
			2005	0.55	0.49	2
			2006	0.14	0.00	2
			2007	0.00	0.00	2
			2008	0.00	0.00	2
			2009	6.80	3.60	2
			2010			no sampling
			2011	13.70	0.38	2
			2012	0.00	0.50	2
			2013	2.40	0.00	2
			2014	5.00	0.00	2
Lithuania	5	26	Širvinta			
			2004	1.00	0.00	2
			2005	1.00	0.00	2
			2006	0.00	0.00	2
			2007	6.35	0.35	2
			2008	10.90	0.00	2
			2009	11.20	0.00	2
			2010			no sampling
			2011	4.70	0.30	2
			2012	0.00	0.00	2
			2013	0.80	0.00	2
			2014	2.70	0.15	2
Lithuania	5	26	Vilnia			
			2000	0.00	0.00	3
			2001	0.70	0.00	3
			2002	1.30	0.00	4
			2003	0.00	0.00	3

Country	Assessment unit	Subdivision	River year	Number of parr/100 m² by age group 0+	>0+	Number of sampling sites
			2004	0.36	0.15	3
			2005	4.48	0.13	3
			2006	0.49	2.63	3
			2007	0.58	0.00	3
			2008	1.53	0.28	3
			2009	3.10	2.14	3
			2010	3.60	1.00	5
			2011	3.30	1.60	3
			2012	3.50	1.00	3
			2013	3.70	1.70	3
			2014	31.40	2.30	4
Lithuania	5	26	Vokė			
			2001	4.30	0.00	2
			2002	0.16	0.00	2
			2003	0.00	0.00	2
			2004	9.50	0.00	2
			2005	0.77	0.00	2
			2006	0.00	0.80	2
			2007	4.10	0.00	2
			2008	4.50	0.00	2
			2009	3.40	0.50	2
			2010			no sampling
			2011	3.80	0.00	2
			2012	5.20	0.80	2
			2013	3.40	0.70	2
			2014	9.50	3.80	2
Lithuania	5	26	B. Šventoji			
			2003	1.12	0.00	8
			2004	2.52	0.00	8
			2005	0.00	0.22	9
			2006			no sampling
			2007	0.02	0.00	5
			2008	0.02	0.00	3
			2009	2.60	0.00	4
			2010	0.59	0.00	4
			2011	2.94	0.15	2
			2012	3.00	0.00	2
			2013	2.80	0.33	2
			2014	8.00	0.80	2
Lithuania	5	26	Dubysa			
			2003	2.12	0.00	9
			2004	0.75	0.00	9
			2005	1.47	0.00	8

Country	Assessment unit	Subdivision	River year	Number of parr/100 m² by age group		Number of sampling sites
				0+	>0+	
			2006	0.00	0.06	9
			2007	0.02	0.00	8
			2008	0.53	0.09	10
			2009	0.79	0.00	7
			2010	2.79	0.00	5
			2011	0.52	0.29	3
			2012	1.10	0.50	2
			2013	3.70	1.00	3
			2014	9.00	0.30	8

Table 3.3.1. Salmon smolt releases by country and assessment units in the Baltic Sea (x1000) in 1987–2014.

Assessment unit	Country	Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
		1yr								73																				
1	Finland	2yr	1632	2030	1542	1228	1263	1348	1302	1216	1635	1554	1478	1618	1680	1804	1787	1677	1443	1661	1383	1579	1593	1484	1398	1310	1225	1301	1331	1238
		3yr	19		21	5			0			1	1	1			1						1	1						
1 Total			1651	2030	1564	1233	1263	1348	1302	1289	1635	1555	1478	1619	1680	1804	1788	1677	1443	1661	1383	1579	1594	1484	1398	1310	1225	1301	1331	1238
2	Sweden	1yr	292			8					22						5							84	98	150	195	194	207	252
		2yr	976	901	771	813	809	816	901	804	675	711	786	803	784	693	795	802	758	748	779	685	780	784	698	680	648	550	502	530
2 Total			1267	901	771	821	809	816	901	804	698	711	786	803	784	693	800	802	758	748	779	685	780	867	795	830	843	744	709	782
3	Finland	1yr	140						6		15	5												0	67	2				
		2yr	123	132	178	154	107	112	61	112	44	107	80	103	72	82	84	77	74	45	77	100	50	106	49	51	81	42	41	15
		3yr																				0								
	Sweden	1yr			10	12	11	41	10		103	43	69	43	38	35	47	84	162	96	273	268	391	564	628	688	711	847	795	818
		2yr	1026	983	1170	973	962	1024	1041	808	457	1011	1063	1072	864	1060	933	867	902	808	888	719	494	461	361	322	250	173	164	81
3 Total			1026	983	1179	985	973	1064	1050	808	559	1054	1132	1115	901	1095	980	951	1063	904	1162	987	885	1025	989	1010	961	1020	959	899
4	Denmark	1yr	62	60	46	60	13	64	80		70		103	30	35	72			14	13	16									
		2yr	8	10	10	12	11																							
	EU	1yr		25	107	60	109	40				7																		
		2yr		26	192	149	164	124	332	165	2	28																		
	Sweden	1yr	117	89	136	96	41	84	103	14	12	37	55	3		11		1				20							15	15
		2yr	129	113	18	58	69	25	33	68	3	4	9	2		1	9	5	5	6	7	8	31	8	17	20	11	9	3	3
4 Total			317	323	509	435	407	337	548	246	87	76	167	35	35	84	9	7	19	19	23	28	31	8	17	20	11	9	18	18
5	Estonia	1yr			17	18	15	18	15																					
	Poland	1yr		1						22	129	40	280	458	194	309	230	186	262	207	161	385	310	374	463	380	275	155	325	359
		2yr								2	107	77	30	80	175	60	24	86	53	58	69	79	98	30	32	41	31	11	55	12
	Latvia	1yr	686	1015	1145	668	479	580	634	616	793	699	932	902	1100	1060	1069	867	961	777	566	814	868	944	752	756	394	649	737	738
		2yr	224	49	39	36	31	34	86	58	33	60	8	49	41	46		64	34	38	175	61	5	23	7					
	Lithuania	1yr													11				9	4	11	30			38		25	25	10	20

Assessment unit	Country	Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
5 Total			910	1065	1201	722	525	632	735	698	1062	876	1250	1489	1521	1475	1324	1203	1317	1084	983	1371	1281	1371	1292	1177	724	839	1127	1129
Assessment units 1-5 Total	5171	5302	5223	4196	3977	4198	4536	3845	4041	4272	4813	5061	4922	5150	4899	4639	4601	4417	4330	4651	4571	4756	4492	4346	3763	3912	4143	4065		
6	Estonia	1yr							22	33		30	18	52	36	69	129	101	86	82	96	125	80	122	125	77	64			
		2yr		1									29	90	58	35	34	40	35	46	46	48	0	49	45	33	26	53	32	35
	Finland	1yr	20	26	23	30	67	26	114	66	48	40		15				65	80	58	84	13								
		2yr	410	410	342	363	316	305	185	192	280	337	222	247	318	345	394	335	264	272	321	275	222	337	266	271	146	218	199	150
		3yr	12																						3					
	Russia	1yr	85	113	81	100	102	13	128	78	124	102	174	85	165	77	103	136	70	271	233	247	278	270	230	238	129	315	466	427
		2yr	3	2	2	30			9	22	18	18	6	12	12	41	135	1	107	85	81	33	55	1	31		1		1	0,4
6 Total			530	552	448	524	485	344	458	391	470	527	449	501	589	567	795	678	642	814	861	741	635	778	700	617	366	586	698	613
Grand Total			5701	5854	5671	4720	4462	4542	4994	4236	4512	4799	5262	5562	5511	5717	5694	5317	5243	5231	5191	5391	5206	5533	5192	4963	4129	4498	4841	4678

Table 3.3.2. Releases of salmon eggs, alevin, fry and parr to the Baltic Sea rivers by assessment unit in 1995–2014.

		age						
Assessment unit	year	eyed egg	alevin	fry	1s parr	1yr parr	2s parr	2yr parr
1	1996	73	278	92	338	685	15	
	1997		1033	459	321	834	14	
	1998		687	198	690	582		
	1999		1054	25	532	923	15	
	2000		835	27	402	935		
	2001				98	1079		
	2002			19	145	775	5	
	2003					395	10	
	2004				63	266		
	2005		98		96	451	15	21
	2006		330	11	14	896		
	2007		201	30	82	482		
	2008		89	220	19	489		
	2009		210			212		
	2010		354	1		172		
	2011	22	614			68		
	2012		556			64		
	2013		129		1	63	0.3	
2	1996			362	415	117		
	1997			825	395	87		
	1998			969	394	190	3	
	1999			370	518	67	4	
	2000			489	477	71		
	2001			821	343	83		
	2002			259	334	127		
	2003			443	242	45		
	2004			200	155			
	2005			712	60			
	2006				80	36		
	2007				41	57		
3	1996	255		614	414	43	61	
	1997	482	2	596	390	60	93	
	1998	691		468	359	99	184	
	1999	391		16	443	4	29	
	2000	516		158	239	30	34	
	2001	177		736	263		16	
	2002	74		810	161		17	
	2003			655	56	0	31	
	2004			503	6		7	
	2005			151	2	48	27	

		age						
Assessment unit	**year**	**eyed egg**	**alevin**	**fry**	**1s parr**	**1yr parr**	**2s parr**	**2yr parr**
	2006			295		18	4	
	2007			126	43	28	7	
	2008			210		101	4	
	2009			174	8	22	5	
	2010		74	215	5	15	5	
	2011	86		61	79	40		
	2012			573	116	60		
	2013				216	79		
	2014			22	155	444		
4	1996			114	7	20	56	
	1997			159				
	1998				7		4	
	1999					3	1	
	2001			40			2	
	2002			88				
	2003			42				
	2005			70				
	2006			45				
	2007			69				
	2008			145				
	2012				20			
5	2001			100	96	14		
	2002			160	106	33		
	2003			109	515			
	2004			120	52	11	10	
	2005		420	199	224			
	2006		30	376	236	1		
	2007		200	418	125			
	2008		364	295	483	17		
	2009		240	863	81	56		
	2010		31	639	81	84		
	2011		50	866	441	25		
	2012		201	645	194	128		
	2013			522	381	16		
	2014			354	282	62		
6	1996	449	20		15	124		
	1997		8		6	236		
	1998	514		50		166		
	1999		277			267		
	2000	267	51			233		
	2001		74			250		
	2002	20	102		640	272	13	5
	2003	21	120	120	240	248	35	

		age						
Assessment unit	**year**	**eyed egg**	**alevin**	**fry**	**1s parr**	**1yr parr**	**2s parr**	**2yr parr**
	2004		294		229	208	3	
	2005	80	26		263	110		
	2006				197			
	2007		98		90	148	28	
	2008		6		355	50	40	
	2009	610			260	63	143	
	2010				560	41	138	
	2011	94			212	55		
	2012				199	70	75	
	2013			99	112	95	7	28
	2014			98	22	15	24	

Table 3.4.1. The M74 frequency (in %) as a proportion of M74 females (partial or total offspring M74 mortality) or the mean offspring M74-mortality (see annotation 2) of searun female spawners, belonging to reared populations of Baltic salmon, in hatching years 1985–2014. The data originate from hatcheries and from laboratory monitoring.

River	Subdivision	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Simojoki (2)	31		*7*	*3*	*7*	*1*	*14*	*4*	*53*	*74*	*53*	*92*	*86*	*91*	*31*	*60*	*44*	*42*	*42*	*6*	*7*	*3*	*18*	*29*	*10*	*10*	*3*	*3*	*0*	*0*	*0*
Tornionjoki (2)	31				5	6	1	29	70	76	89	76			*25*	*61*	34	41	*62*	0	*0*		*27*	9	*10*	4	10		*0*	0	
Kemijoki	31																						*38*	*54*	*25*	30	7	*6*			
Iijoki	31																									23					
Luleälven	31								58	66	62	50	52	38	6	34	21	29	37	4	4	1	18	21	10	16	34	2	2	1	2
Skellefteälven	31								40	49	69	49	77	16	5	42	12	17	19	7	0	2	3	13	0	0	5	3	3	22	2
Ume/Vindelälven	30	40	20	25	19	16	31	45	77	88	90	69	78	37	16	53	45	39	38	15	4	0	5	14	4	25	24	11	0	8	20
Angermanälven	30								50	77	66	46	63	21	4	28	21	25	46	13	4	3	28	30	16	8	23	7	1	4	4
Indalsälven	30	4	7	8	7	3	8	7	45	72	68	41	64	22	1	20	22	6	20	4	0	3	18	16	18	14	11	5	0	0	4
Ljungan	30								64	*96*	*50*	56	28	29	10	25	10	0	55	0											
Ljusnan	30							17	33	75	64	56	72	22	9	41	25	46	32	17	0	0	25	15	9	16	10	3	0	2	4
Dalälven	30	28	8	9	20	11	9	21	79	85	56	55	57	38	17	33	20	33	37	13	4	7	15	18	7	24	18	4	0	3	13
Mörrumsan	25	47	49	65	46	58	72	65	55	90	80	63	*56*	23																	
Neva/Åland (2)	29									70	50																				

River	Subdivision	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Neva/Kymi joki (2)	32								45	60–70		*57*	*40*	*79*	42	*42*	23		*43*	*11*	*6*	*6*	*0*	26							
Mean River Simojoki and Tornionjoki			7	3	6	4	8	17	62	75	71	84	86	91	28	61	39	42	52	3	4	3	23	19	10	7	7	3	0	0	0
Mean River Luleälven, Indalsälven, Dalälven		16	8	9	14	7	9	14	61	74	62	49	58	33	8	29	21	23	31	7	3	4	17	18	12	18	21	4	1	1	6
Mean total		30	18	22	17	16	23	27	56	77	66	59	61	38	15	40	25	28	39	8	3	3	18	22	11	15	15	5	1	4	6

1) All estimates known to be based on material from less than 20 females in italics.

2) The estimates in the rivers Simojoki, Tornionjoki/Torne älv and Kymijoki are since 1992, 1994 and 1995, respectively, given as the proportion of females (%) with offspring affected by M74 and before that as the mean yolk-sac fry mortality (%).

Table 3.4.2. Summary of M74 data for Atlantic salmon (*Salmo salar*) stocks of the rivers Simojoki, Tornionjoki and Kemijoki (hatching years 1986–2014), indicating the percentage of sampled females with offspring that display M74 symptoms (%), the total average yolk-sac-fry mortality among offspring of sampled females (%) and the percentage of sampled females with 100% mortality among offspring (%). Data from less than 20 females is given in italics. NA = not available.

	Total average yolk-sac fry mortality among offspring (%)			Proportion of females with offspring affected by M74 (%)			Proportion of females without surviving offspring (%)		
	Simojoki	**Tornionjoki**	**Kemijoki**	**Simojoki**	**Tornionjoki**	**Kemijoki**	**Simojoki**	**Tornionjoki**	**Kemijoki**
1986	7	NA		NA	NA		NA	NA	
1987	3	NA		NA	NA		NA	NA	
1988	7	5		NA	NA		NA	NA	
1989	1	6		NA	NA		NA	NA	
1990	14	1		NA	NA		NA	NA	
1991	4	29		NA	NA		NA	NA	
1992	52	70		53	NA		47	NA	
1993	75	76		74	NA		74	NA	
1994	55	84		53	89		53	64	
1995	76	66		92	76		58	49	
1996	67	NA		86	NA		50	NA	
1997	71	NA		91	NA		50	NA	
1998	19	26		31	25		6	19	
1999	55	62		60	61		39	56	
2000	38	34		44	34		25	24	
2001	41	35		42	41		27	21	
2002	31	61		42	62		25	54	
2003	2	4		6	0		0	0	

	Total average yolk-sac fry mortality among offspring (%)			Proportion of females with offspring affected by M74 (%)			Proportion of females without surviving offspring (%)		
	Simojoki	**Tornionjoki**	**Kemijoki**	**Simojoki**	**Tornionjoki**	**Kemijoki**	**Simojoki**	**Tornionjoki**	**Kemijoki**
2004	4	2		7	0		0	0	
2005	5	NA		3	NA		3	NA	
2006	11	9	25	18	27	38	6	0	19
2007	26	8	40	29	9	54	16	5	31
2008	14	21	18	10	10	25	7	10	6
2009	11	7	21	10	4	30	7	0	7
2010	10	14	8	3	10	7	0	3	4
2011	3	NA	6	3	NA	6	0	NA	6
2012	2	1	NA	0	0	NA	0	0	NA
2103	4	5	NA	0	0	NA	0	0	NA
2014	6	NA	NA	0	NA	NA	0	NA	NA

Table 3.4.3. Summary of M74 data for nine different Atlantic salmon stocks (hatching years 1985–2014), in terms of the number of females sampled with offspring affected by the M74 syndrome in comparison to the total number of females sampled from each stock.

	Luleälven		Skellelteälven		Ume/Vindel älven		Angermanälven		Indalsälven		Ljungan		Ljusnan		Dalälven		Mörrumsån	
	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total
1985	NA	NA	NA	NA	14	35	NA	NA	9	219	NA	NA	0	78	19	69	23	50
1986	NA	NA	NA	NA	16	82	NA	NA	18	251	NA	NA	0	49	4	49	24	50
1987	NA	NA	NA	NA	16	64	NA	NA	20	245	NA	NA	0	84	8	88	32	50
1988	NA	NA	NA	NA	12	64	NA	NA	15	202	NA	NA	0	75	16	79	23	50
1989	NA	NA	NA	NA	6	38	NA	NA	6	192	NA	NA	0	78	7	65	29	50
1990	NA	NA	NA	NA	18	59	NA	NA	15	198	NA	NA	0	86	4	45	39	55
1991	NA	NA	NA	NA	32	71	NA	NA	14	196	NA	NA	14	88	16	78	35	55
1992	161	279	16	40	55	71	78	157	85	190	14	22	29	89	50	63	33	60
1993	232	352	44	89	60	68	98	128	149	206	5	5	89	119	69	81	54	60
1994	269	435	54	78	146	164	52	79	148	208	6	12	105	163	70	126	4	5
1995	209	418	38	77	148	215	58	126	97	237	15	27	79	142	22	40	17	27
1996	202	392	54	70	68	87	36	57	107	167	6	22	92	128	102	178	10	18
1997	156	409	8	50	26	71	38	183	39	178	5	17	28	130	360	159	5	22
1998	22	389	2	48	6	37	3	81	2	155	2	20	7	82	14	83	NA	NA
1999	108	316	22	53	27	51	30	108	25	126	5	20	19	46	27	82	NA	NA
2000	67	320	7	57	27	60	29	136	27	125	1	10	29	114	36	131	NA	NA
2001	96	322	9	51	24	62	31	122	7	100	0	10	47	102	27	82	NA	NA
2002	119	300	8	42	20	53	56	122	25	123	6	11	23	60	56	150	NA	NA
2003	12	270	4	60	8	53	15	120	5	128	0	2	17	100	22	164	NA	NA
2004	10	270	0	59	2	56	4	114	0	125	NA	NA	0	47	5	112	NA	NA

	Luleälven		Skellelteälven		Ume/Vindel älven		Angermanälven		Indalsälven		Ljungan		Ljusnan		Dalälven		Mörrumsån	
	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total	M74	Total
2005	3	250	1	58	0	55	4	114	4	128	NA	NA	0	7	11	151	NA	NA
2006	40	228	1	40	2	39	19	67	18	98	NA	NA	15	60	25	132	NA	NA
2007	45	219	5	40	5	37	24	79	17	105	NA	NA	8	55	17	93	NA	NA
2008	22	212	0	40	2	50	13	80	19	106	NA	NA	7	81	8	108	NA	NA
2009	33	212	0	40	13	50	6	80	5	108	NA	NA	14	85	32	131	NA	NA
2010	78	226	2	40	9	38	17	74	13	120	NA	NA	9	90	24	136	NA	NA
2011	5	220	1	40	5	44	5	76	6	120	NA	NA	3	93	5	128	NA	NA
2012	5	260	1	40	0	50	1	80	0	120	NA	NA	0	92	0	111	NA	NA
2103	2	220	10	45	5	60	2	80	0	120	NA	NA	2	92	3	121	NA	NA
2014	4	220	1	50	12	60	3	80	5	125	NA	NA	4	92	13	103	NA	NA

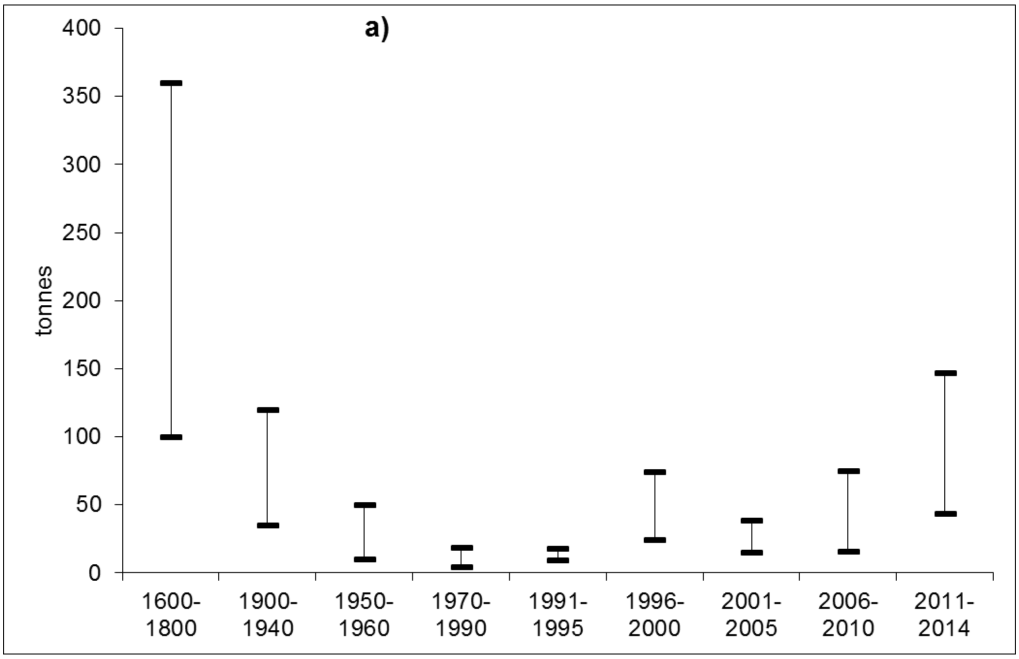

Figure 3.1.1.1. Total river catches in the River Tornionjoki (assessment unit 1). a) Comparison of the periods from 1600 to present (range of annual catches). b) from 1974 to present. Swedish catch estimates are provided from 1980 onwards.

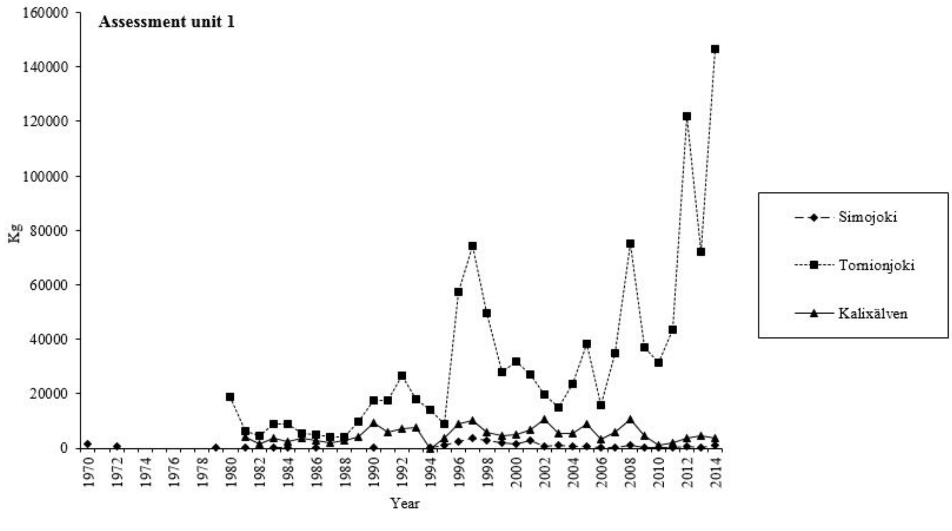

Figure 3.1.1.2. Salmon catch in the rivers Simojoki, Tornionjoki (finnish and swedish combined) and Kalixälven, Gulf of Bothnia, assessment unit 1, 1970–2014. Ban of salmon fishing 1994 in the river Kalixälven.

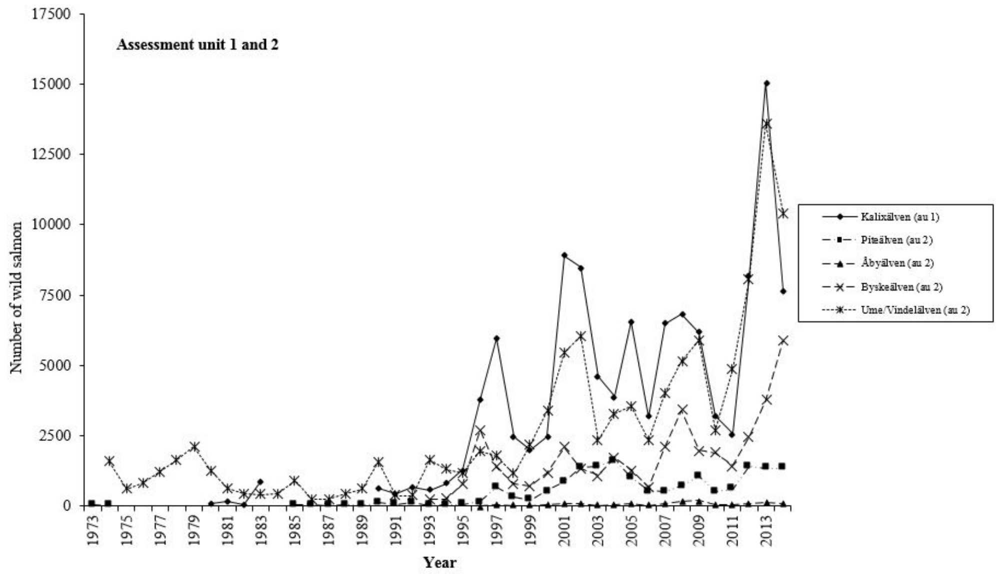

Figure 3.1.1.3. Total wild salmon run in fishladders in rivers in assessment unit 1 and 2, in 1973–2014.

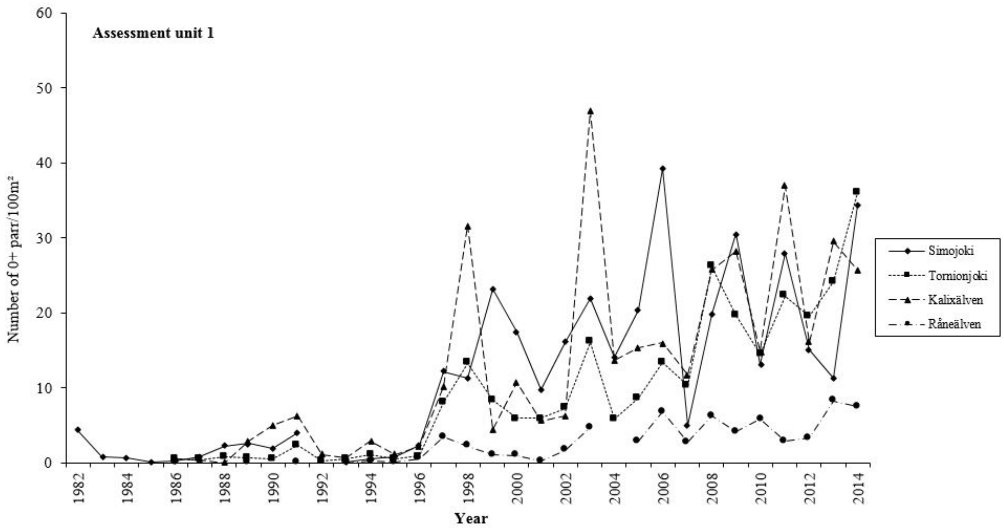

Figure 3.1.1.4. Densities of 0+ parr in rivers in Gulf of Bothnia (Subdivision 31), assessment unit 1, in 1982–2014.

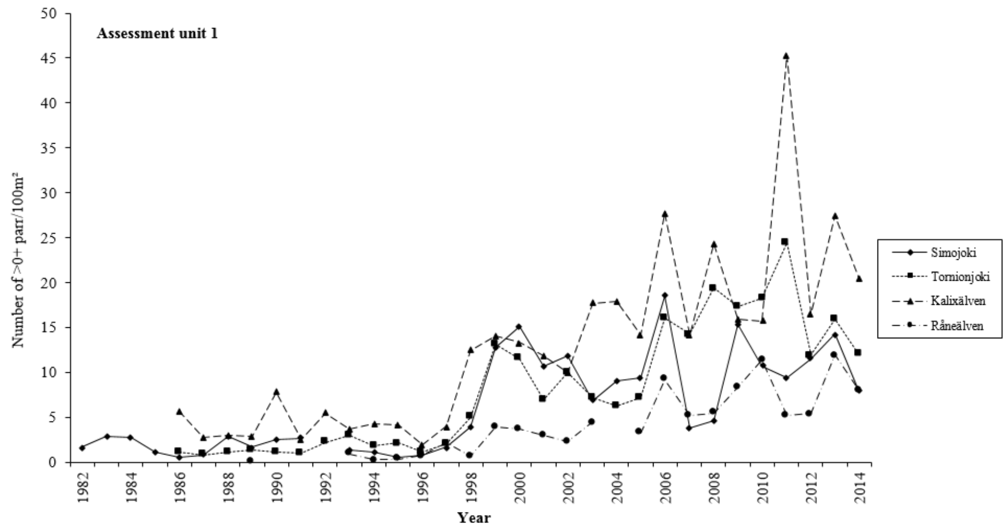

Figure 3.1.1.5. Densities of >0+ parr in rivers in Gulf of Bothnia (Subdivision 31), assessment unit 1, in 1982–2014.

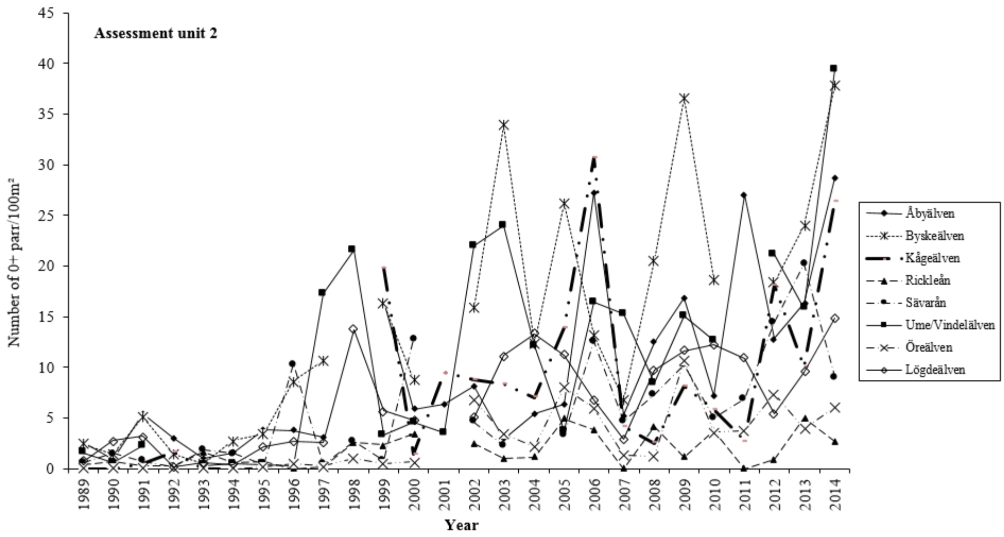

Figure 3.1.2.1. Densities of 0+ parr in rivers in Gulf of Bothnia (Subdivision 31), assessment unit 2, in 1989–2014.

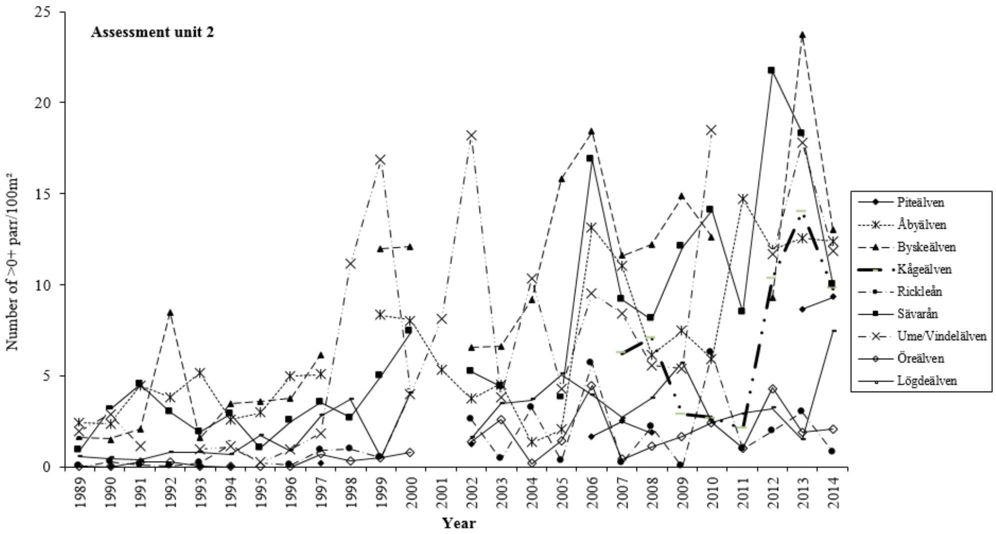

Figure 3.1.2.2. Densities of >0+ parr in riveres in Gulf of Bothnia (Subdivision 31), assessment unit 2, in 1989–2014.

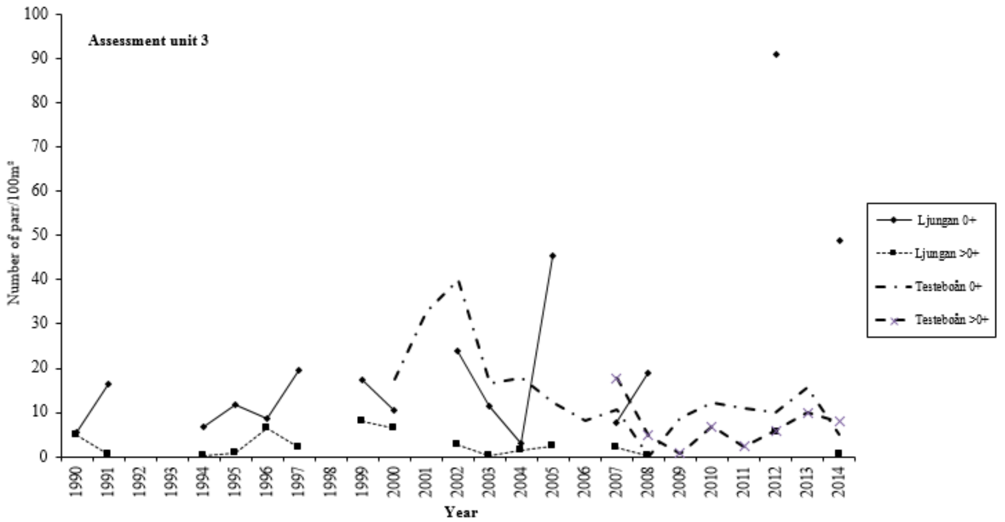

Figure 3.1.3.1. Densites of parr in Ljungan and Testeboån in the Gulf of Bothnia (Subdivision 30), assessment unit 3, in 1990–2014.

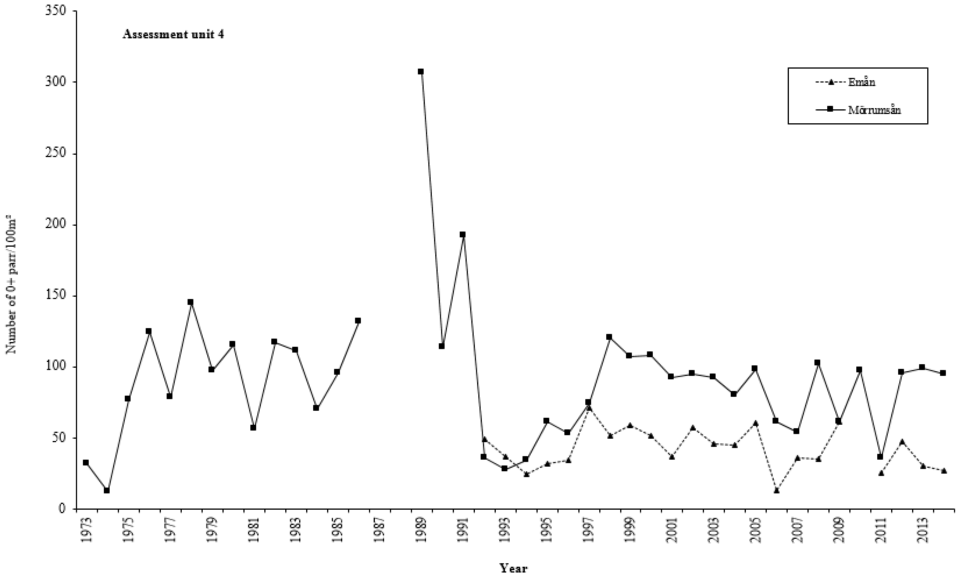

Figure 3.1.4.1. Densities of 0+ parr in rivers in the Main Basin (Subdivision 25–27), assessment unit 4, in 1973–2014.

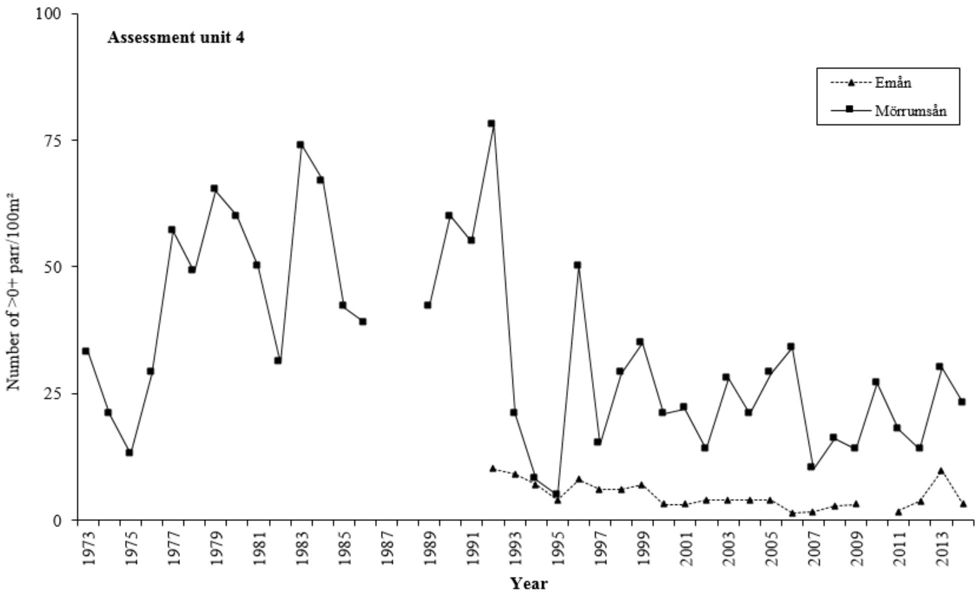

Figure 3.1.4.2. Densities of >0+ parr in riveres in the Main Basin (Subdivision 25–27), assessment unit 4, in 1973–2014.

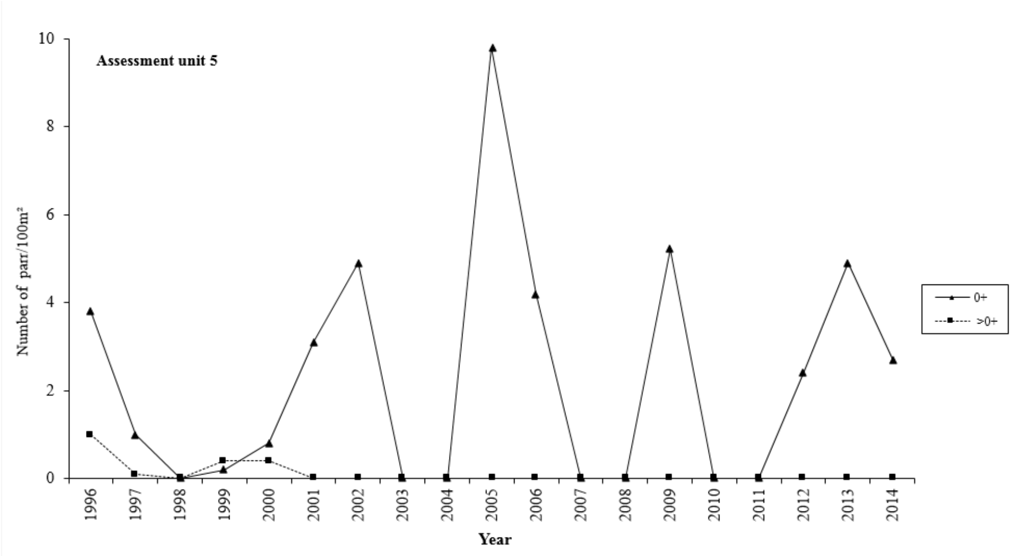

Figure 3.1.5.1. Densities of parr in the river Pärnu Main Basin (Subdivision 22–29) assessment unit 5, in 1996–2014.

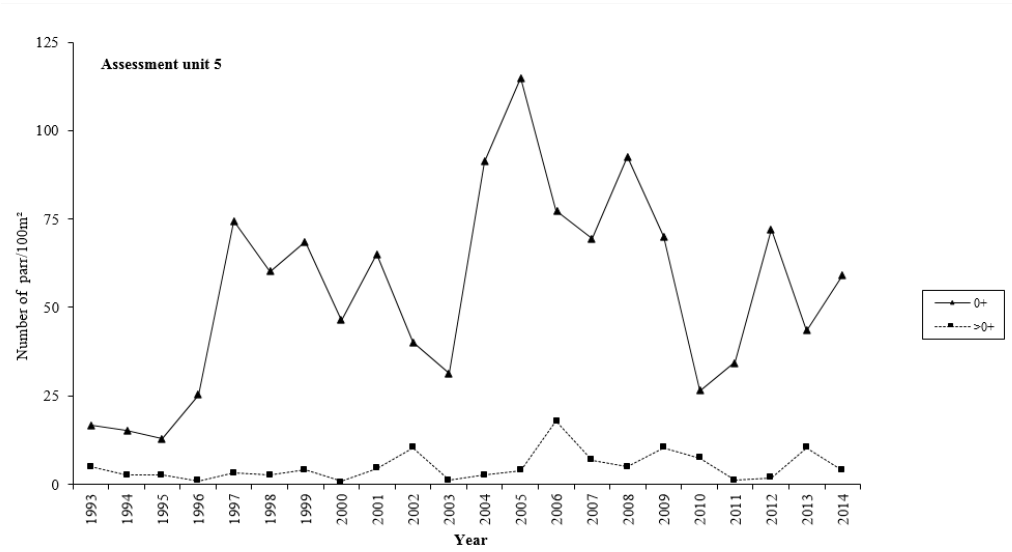

Figure 3.1.5.2. Densites of parr in the river Salaca Main Basin (Subdivision 22–29) assessment unit 5, in 1993–2014.

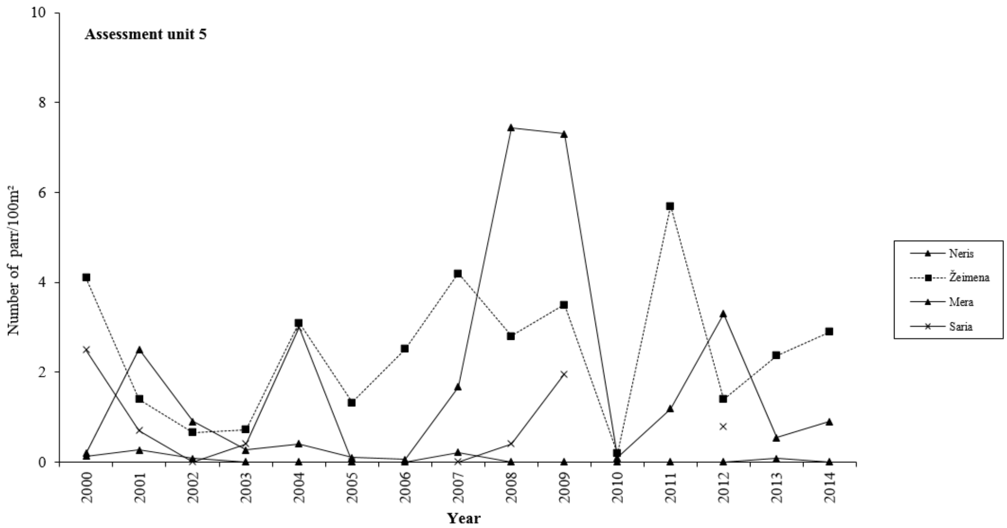

Figure 3.1.5.3. Densites of 0+ parr in Lithuanian rivers in Main Basin (Subdivision 22–29) assessment unit 5, in 2000–2014.

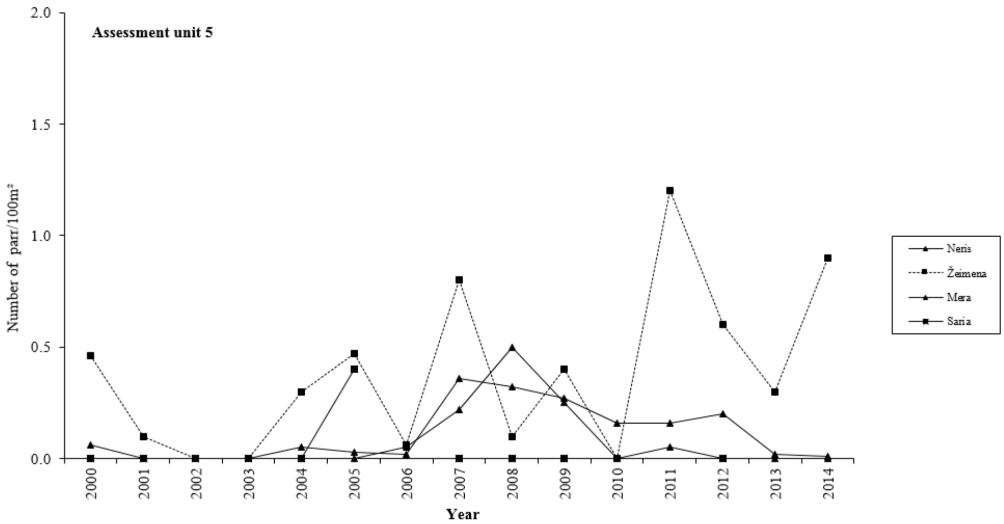

Figure 3.1.5.4. Densities of >0+parr in Lithuanian rivers in Main Basin (Subdivision 22–29) assessment unit 5, in 2000–2014.

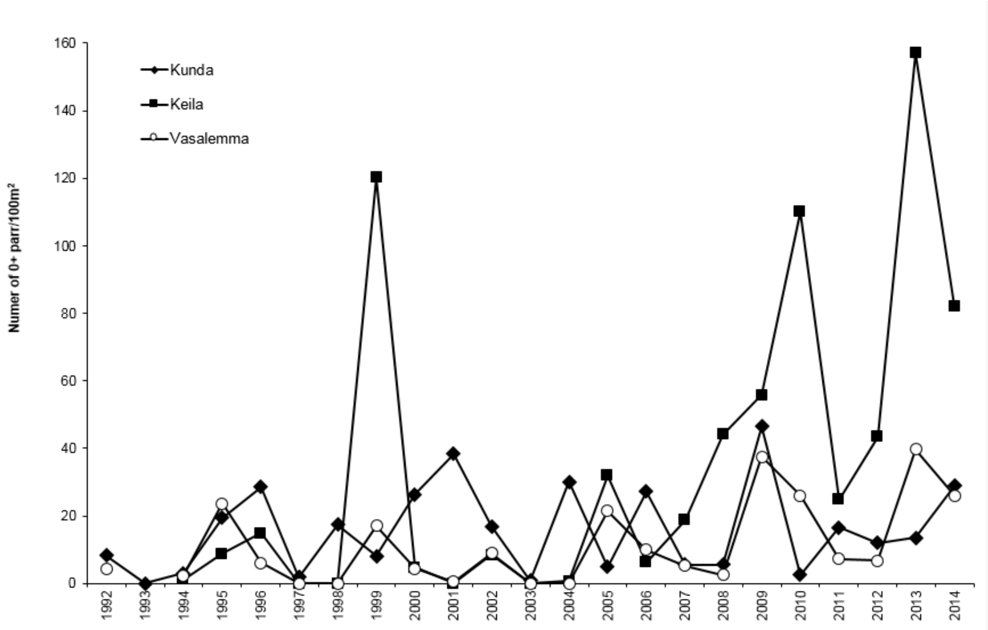

Figure 3.1.6.1. Densities of 0+ (one-summer old) salmon parr in the three wild Estonian salmon rivers.

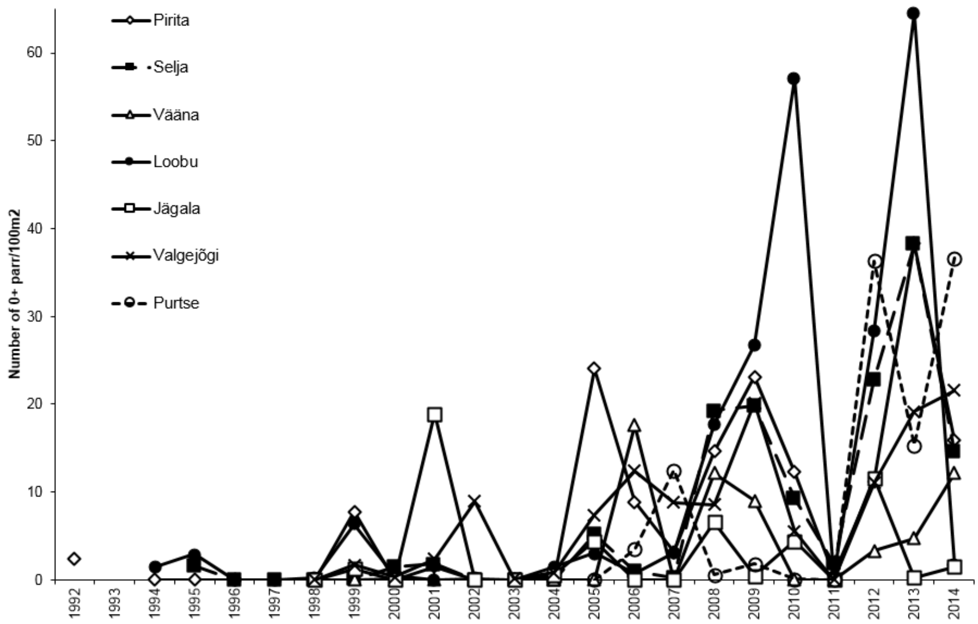

Figure 3.1.6.2. Densities of 0+ (one-summer old) salmon parr in seven Estonian salmon rivers where supportive releases are carried out.

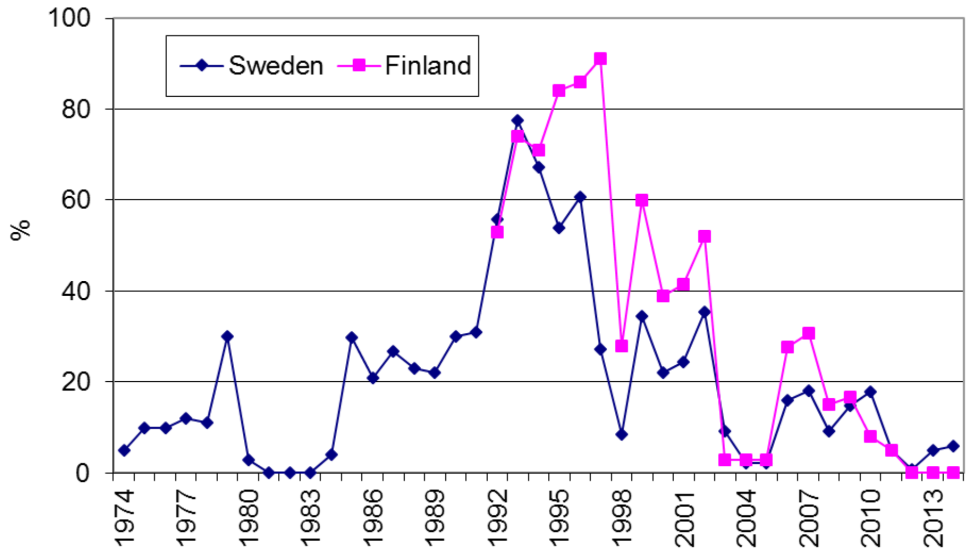

Figure 3.4.1. Proportion of M74 positive females in Swedish and Finnish hatcheries.

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4 Reference points and assessment of salmon

4.1 Introduction

In this chapter results of the assessment model and alternative future projections of salmon stocks in assessment units (AU) 1–4 are presented. Furthermore, the current status of salmon stocks in AUs 5–6 is evaluated against the reference points.

The methodological basis and details of the assessment model and stock projections are given in the Stock Annex (Annex 3). Here, only the methodological updates are described. Also the applied procedures for the current evaluation of stocks which are not included in the life-cycle model (all AUs 5–6 rivers and new wild rivers in AUs 2–3) are described here.

4.2 Historical development of Baltic salmon stocks (assessment units 1–6)

4.2.1 Updated submodels

The **river model** provides input about smolt production into the lifecycle model by analysing all the juvenile survey data from the rivers in AUs 1–3. Also river Kågeälven is now included in the river model, starting from year 2008. For rivers in AUs 4–6, other methods are used to estimate smolt production (see Stock Annex, Section C.1.5). Results of the river model indicate a substantial increase in smolt abundance of AUs 1–2 rivers since the late 1990s. In spite of some decrease in abundance 2013–2015 in AU 1, the increasing trend is expected to continue in the near future (Table 4.2.1.1). The long-term increase in smolt production in AU 3 (R. Ljungan) is less apparent than in AU 1–2 rivers. For the rivers Tornionjoki, Simojoki, Ume/Vindelälven and Sävarån the results of the river model are more informative than for the other rivers, because of the availability of smolt trapping data. Also smolt estimates of years without smolt trapping have become somewhat more precise in these rivers. Smolt trapping has been conducted only in one year (2014) in Rickleån, which increases the precision of Rickleån smolt abundances mainly in that specific year.

A **model for M74 mortality** provides input about mortality due to M74 into the lifecycle model by analysing all data on incidence of M74 in the stocks (see Stock Annex, Section C.1.6). Figure 4.2.1.1 shows the estimates for M74 mortality (median and 95% probability interval); the mortality has decreased and is currently at a very low level. In general the percentage of females with offspring affected by M74 overestimates the M74 mortality due to the fact that part of the offspring will die due to normal yolk-sac fry mortality, unrelated to M74. Also, not all offspring necessarily die when affected by M74. Because of the decreasing trend in mortality among offspring of females affected by M74, the data on proportion of females affected by M74 especially overestimates M74 mortality in recent years. Data on the total average yolk-sac-fry mortality are much better at tracking the general trend but overestimate the actual M74 mortality because these data do not distinguish between normal yolk-sac fry mortality and yolk-sac fry mortality caused by the M74 syndrome. Table 4.2.1.2 shows the actual values of the M74 mortality for the different salmon stocks. Figure 4.2.1.2 illustrates the probability that offspring of M74-affected females would die, which has been possible to calculate for Simojoki, Tornionjoki and an unsampled salmon stock.

4.2.2 Changes in the assessment methods

Extended time-series of smolt abundance estimates from river model

Previously, smolt abundance estimates obtained from the river model have been used two years into the future from the last year with data, although in AUs 1–3 it is possible to predict smolt abundances three years ahead from (the most common smolt age is three years). In order to utilise the whole time-series of annual smolt abundance estimates in this year's assessment, the life-cycle model is extended by one extra year into the future. This is carried out simply by adding year/cohort indices into the model.

This update to the life-cycle model is currently well motivated by the fact that the most recent parr year classes are offspring from the largest spawning stocks, hence, they are crucial in updating the knowledge about the stock–recruit dynamics.

Updates to the prior distributions of PSPC's

Prior probability density functions (hereafter "priors") were formulated for five Swedish salmon rivers using expert opinions elicited from experts at the Swedish University of Agricultural Sciences. One of these rivers (Kågeälven) has only recently received its status as a wild salmon river, thus no PSPC prior existed formerly. Updating the PSPC priors for the four remaining rivers is justified on a variety of grounds, as new information has indicated that the existing priors may be too low (Vindelälven and Rickleån), too high (Mörrumsån) and/or too precise (Emån, Mörrumsån). Another river that recently gained the status of a wild salmon river, River Testeboån, was not included in this exercise as there is information missing for this river that prevents its inclusion in the assessment model. The plan is to estimate the PSPC prior for Testeboån (and compile also other necessary information) and include this river in the assessment model in 2016.

Prior distributions for PSPC were formulated as function of several expert-elicited variables. These variables were maximum smolt density (number of smolts produced per hectare or 100 m^2); the area of habitat suitable for salmonid production; survival or natural mortality during the downstream smolt migration; passage efficiencies for any obstacles to downstream migration and, where applicable, mortality rates associated with passage of migration obstacles. Where estimates of the area of salmonid habitat were available by habitat class (a qualitative evaluation of salmonid habitat quality), experts were asked to provide maximum smolt density estimates by habitat class.

Where available, experts considered relevant data to help inform their opinion; they also consulted other experts when necessary. Experts were asked for summaries (mode, 0.025 and 0.975 quantiles) of distributions describing their knowledge and uncertainty about quantities of interest. Parametric distributions were then fitted, plotted and shown to experts for feedback and possible revision. Priors elicited from experts and the final PSPC priors for each river can be found in Table 4.2.2.2; a more detailed description of the methods can be found in Annex 4.

For Rickleån and Vindelälven, the production area used for the PSPC prior formulation was updated upwards to include areas upstream in the rivers found to be colonized by salmon in recent years. The electrofishing program was updated to take into account these recently colonized areas and to arrive at representative data. New electrofishing sites in upstream parts were added, and weighted average densities (based on data from 'old' vs. 'newly colonized' areas) were calculated in order to take into account changes over time in the distribution and density of salmon, as well as in the distribution of electrofishing sites (less sites were sampled back in history). We used estimated production areas given by experts as weights in these calculations.

For River Mörrumsån, the updated PSPC prior became lower (and less precise) than the one formerly used. An important reason behind this reduction is that a recent habitat survey has revalead that the total accessible habitat in the river seems to be clearly lower than according to earlier less detailed inventories. Probably as a consequence of the changed PSPC prior, the status of the Mörrumsån salmon stock was assessed to be considerably higher than in previous years (Section 4.2.3). However, as described in Section 4.6, work is currently ongoing to also improve the prior smolt estimates for Mörrumsån (and Emån). Before those updated smolt prior estimates are available and have been used within the assessment, the stock status for Mörrumsån should be regarded as tentative.

Carlin tag recaptures

Because of a sudden drop in the tag returns starting from 2010, the tag–recapture data from the calendar year 2010 and onwards is left out from the life-cycle model, as has been done also in the last years' assessments. It is evident that the drop in tag returns is a result of a decreased reporting rate, and not because of increased natural mortality. The reason for the decrease in tag reporting activity is unknown and may vary between the countries. Potentially fishermen don't find it rewarding any longer to return tags. In addition, in some countries national fisheries laboratories don't campaign any more to motivate fishermen for tag returning. More fishery-independent data (mostly spawner counts, see Annex 3) has been collected in the most recent years, and these data have lately also been brought into the assessment, which has decreased the need to use tag–recapture data.

Yearly variation in maturation rates, temperature as a covariate

Various observations support the hypothesis that the age-specific maturation rates of Baltic salmon are affected by annually varying seawater temperatures at the feeding ground (ICES, 2012). At least among the youngest sea ages a cold winter seems to decrease maturation to the next summer's spawning run, while after a warm winter the maturation rate seems to be higher. Until the 2013 assessment, the maturation rate was assumed to be fixed over time in the assessment model. If the climate variation and maturation rate are strongly associated but this connection is not accounted for in the model (assuming a fixed maturation rate over time), fitting the model to spawner counts in rivers introduces a risk that salmon survival and abundance become underestimated in years following cold winters and vice versa.

In 2013 assessment the sea age group specific maturation rates were allowed to vary annually, but without using winter sea surface water temperatures (SST) to explain the variation. Thus, the resulting variation in maturation rates was fully driven by the existing biological data about stock dynamics. In 2014 and this year the approach has taken a step further by incuding April SST as a covariate for maturation. April SST is chosen because it is considered to have strongest influence on the maturation rates (ICES, 2013), and also because it is preferred that first approach for the inclusion of the SST information will be kept relatively simple. Annual January, February and March SST data from nine stations at Baltic Main Basin is used in estimating/predicting the annual April SST. Description of the temperature model and issues regarding modelling of maturation rates can be found in last year's WG report (Annex 4 in ICES 2014).

Since the assessment is made in March, April SST for 2015 is predicted using SST data from January, February and early March. This results as median of the predicted SST being 5.6 degrees of Celcius, with 5.2–5.5 as the 95% probability interval. It is noted that the current temperature model does not predict very well extreme April SSTs in situations when SST data from January–March period has not been able to capture similar behaviour (see Figure 2.3, Annex 4 in ICES, 2014). Thus it may be useful to consider later some alternative model choices for prediction of April SSTs.

Updates for the prior distributions on Ume/Vindel fish ladder counter

In order to obtain prior distributions for the annual probability that returning salmon find the fishladder in river Ume/Vindel, the same method is used as in the last year's assessment (ICES, 2014).

Mark–recapture studies have been carried out roughly every second year starting from 1996, and studies indicate high variation in probability to find the ladder between different years. Since all salmon must pass the fishladder to obtain the spawning grounds (no spawning grounds exist downstream and there's no optional route to pass the dam), observed number of salmon in the fish counter is the maximum number of spawners in river Ume/Vindel.

A small hierarchical Bayesian model is used to analyse the time-series of the mark–recapture data and to estimate the annual probabilities that salmon find the ladder. For years in which mark–recapture study has not taken place, predictive distribution for the probability to find the ladder is calculated. Resulting probability distributions are set as prior distributions in the life-history model, where those update based on the information from other datasets. Figure 4.2.2.1 illustrates the prior and posterior distributions and the mark–recapture datasets for the annual probabilities for the returning salmon to find the fish ladder. The new data available for the 2015 assessment update the priors from those obtained in the last year's assessment.

Timing of winter fisheries

The main fishing season for offshore fishing is January and February, but some fishing takes place also during November, December, March and April. As the majority of offshore fishing takes place during the first months of a calendar year, removals due to this fishery should be assumed to occur during January–February in the assessment model. However, in the model used until 2013 the removals were assumed to occur already in October (driftnetting) and December (longlining; Michielsens *et al*., 2006).

Since 2013 assessment the offshore fishing has been moved in the assessment model so that driftnetting (before 2008) is assumed to take place in January and longlining in February. This increases the realism of the modelling approach and is consistent with the scenario assumptions which are based on the allocation of the whole winter (offshore) fishery to the first months of a calendar year. The change has a minor effect on the model results, however; the main effect is that in the updated model fish are subject to natural mortality 2–3 months longer before being harvested.

Sea age specific fecundities

Prior to the WGBAST meeting, the fecundity values (priors) used in the life-cycle model were critically reviewed against the existing data on fecundity of salmon collected in Sweden and Finland. The review revealed some inconsistences between the model input and the empirical data, both in terms of the average total number of eggs per female spawner (by sea age) and the sea age specific sex ratio. Based on this new fecundity values were decided to be calculated from the data. However, in this year's assessment only the sea age specific numbers of eggs per female were revised and the sex ratios need to be revised in the next year's assessment.

First, a joint Swedish-Finnish database on available fecundity data was assembled. It consists of the number of eggs from 548, 197 and 127 females of known size from rivers Dalälven, Tornionjoki and Ume/Vindelälven, respectively. Since the individuals in the Swedish part of dataset are without age information, Finnish independent data on size (weight) distributions for mature females by sea age were used to calculate size class-specific fecundities within each sea age.

In principle, expected fecundity values and the associated s.d.'s could be directly used as prior distributions in the life-cycle model. However, as the available data are limited in time and space (only some years and rivers included) one must some add more uncertainty into the priors by considering the possibility that fecunties may vary more than observed in the data. This was carried out by eliciting the associated uncertainties from two experts (Stefan Palm and Atso Romakkaniemi). The Table 4.2.2.1 shows statistics of the fecundity values (i) used previously in the life-cycle model; (ii) fecundity values from the datasets; and (iii) the new fecundity values used in the model based on the dataset and expert elicitation. The Figure 4.2.2.2 illustrates the shapes of the new fecundity priors. The new priors are substantially lower than those used in the earlie assessments, especially among 1SW, 4SW and 5SW females. This probably affects the assessment results by somewhat rescaling the other key variables associated with reproduction dynamics, including general egg-to-smolt survival levels, age composition of spawners, and possibly also spawner numbers.

Estimate of number of misreported salmon by Polish offshore longline fishery

In the 2014 assessment, the estimates for Polish misreporting were recomputed for years 2009–2013, because the WG got access to a new data on the catch compositions in the Polish longline catches. The new data suggested at minimum a 97% share of salmon in the annual catches. These were considered as a conservative estimate and they include only off-shore fishery. A potential misreporting in the coastal fishery was not estimated because a detailed data on the areal distribution of coastal catches were not available for the WG. From the coastal fishery only reported catches were accounted in the assessment (ICES, 2014).

The differences in results between the old and new calculations are reported for 2009–2012 by ICES (2014). This year, the working group applied the new calculation method also for misreporting in 2014.

Unreporting coefficients

Proportional correction factors of unreporting were used in order to derive estimates for total catches in offshore, coastal and river fisheries. Discards and unreporting of recreational fisheries were not taken into account in the estimation of total catches. The basis for the conversion factors was expert opinions elicited in autumn 2012 during the process of IBPSalmon. Similar expert elicitation was repeated during the preparation of WGBAST 2014 meeting and consequently some conversion factors were updated for the year 2013 fisheries. In the WGBAST 2015 meeting the unreporting rate in the Polish sea fisheries for 2014 was updated. In other fisheries was assumed the same unreporting rates as for fishing years before 2014. However, different to previous years' assessments in this year the conversion factor of unreporting rate for German, Lithuanian, Latvian, Estonian and Russian sea fisheries was changed for whole range of fishing years 2001–2013. For these countries was now used the same rate of unreporting as in Danish (off-shore) or Finnish fisheries (coast). In earlier assessments we used an averige unreporting rate of Polish, Danish and Finnish fisheries, which was now seen unfounded for the other countries. This change, however, made only marginal change in the estimated unreported catches in 2001–2013 since the reported sea catches in these countries (DE, LT, LV, RU) have been low or zero (e.g. Table 2.3.4). For years 1987–2000 the same conversions factors were used as in previous years' assessments (ICES, WGBAST 2013 and Annex 3). The average conversion factor on discarded undersized salmon in longline fishery have been calculated separately for the years 2004–2007 and 2008–2012, respectively, because of the change in relative weight between the fisheries in 2008 when driftnetting was banned in the Baltic Sea. Finland and Sweden have closed salmon off-shore fishing in the Main Basin from year 2013 which further changed the relative weight between the fleets and therefore the relevant conversion were computed separately for fishing years 2013–2014.

The estimated conversion factors for unreporting in offshore, coastal and river fisheries in different year periods are presented in Table 2.3.1. Despite of computed probability distribution estimates for the unreporting, the point estimates of the conversion factors were used in the assessment to derive total catch estimates. This was because we were not able to make the needed amendments to the assessment model in a given time. However, our intention is to use the probability distribution estmates of the different catch components including discards and potentially recreational fisheries in future assessments (see Section 2.3).

Evaluation of the current status of stocks not included in the life-cycle model

To assess current status of stocks that are not included in the full life-history model (all AUs 5–6 stocks and two new wild stocks in AUs 2–3), current smolt production estimates (most likely values provided by experts) are displayed against the most likely values of 50% and 75% of the PSPC estimates (also provided by experts). This approach does not provide any analytical evaluation of the associated risks/uncertainties, but summarizes the best available understanding about the past and current status of these stocks in relation to the same reference points used for AU 1–4 stocks. Due to the limited background data on AUs 5–6 stocks, the results must however be considered with caution.

Among AUs 5–6 stocks, smolt production can be predicted only one year ahead (i.e. for the year of assessment). Thus, the consequences of future management options cannot be properly evaluated for these stocks. However, as the AU 4 stocks (Mörrumsån, Emån) are meeting a similar sea environment and are presumably harvested similarly as the AU 5 stocks, the results of the projection of AU 4 stocks may be used as a proxy also for the AU 5 stocks.

4.2.3 Status of the assessment unit 1–4 stocks and development of fisheries in the Gulf of Bothnia and the Main Basin

By the time of the working group meeting the MCMC sampling from the assessment model had reached the level needed to properly approximate posterior distributions, being roughly 200 000 iterations after 6000 burn-ins. However, as in last years' assessments, high autocorrelation was found in the MCMC samples of the PSPC estimates of Tornionjoki/Torneälven, and to lesser extent also of Kalixälven and Ume/Vindelälven. Caution must therefore be taken in the interpretation of these results. The final sample was thinned with 200 to result in a sample of 1000 iterations for each parameter on which the modelling results are based. Whenever possible, the medians and 90% probability intervals (PI's) are shown as statistics of the resulting probability distributions.

The results indicate a decreasing long-term trend in the post-smolt survival until mid-2000, after which survival has somewhat improved (Figure 4.2.3.1). The lowest survival (median estimate about 10% among wild and 2–3% among reared smolts) was estimated for salmon that smolted in years 2004–2006 and 2008. Thereafter the survival has increased to 12–15% for wild smolts and 3–7% for reared smolts (median estimates in 2010–2013). Survival improved especially among salmon that smolted in 2010. The current survival is slightly lower than in the early 2000s, and less than half of the estimated survival level prevailing two decades ago. It should be noted, however, that since the post-smolt survival is one of the few parameters in the model that vary from year to year, the estimates can contain such variation that actually takes place in some other stage of the life cycle (in natural or fishery induced survival).

The adult natural annual survival of wild salmon (median 95%, PI 93–97%) is estimated to be higher than that of reared salmon (median 81%, PI 72–90%). The survival estimates of wild and reared salmon are reasonably stable in the 2011–2014 period.

Maturation of 1-sea winter salmon (grilse) has in most years been around 20% and 20–30% among wild and reared individuals, respectively, i.e. close to the average level of the whole time-series (Figure 4.2.3.2). Among 2-sea winter salmon maturation is estimated to have been mostly 30–45% and 40–60% for wild and reared salmon, respectively. Salmon of both origins have had rather similar maturation rates (50–60% and 50–70% for wild and reared, respectively) among 3-sea winter salmon and the maturation rates of 4-sea winter are even more similar. The estimated maturation rates of 4-sea winter are on average lower but more uncertain than those of 3-sea winter salmon. This is against intuition but might be an artefact due to the inconsistency between the model assumptions (no repeat spawners, all fish mature at latest after five sea winters) and the biology of salmon (some repeat spawners exist and some salmon have a longer lifespan than five years at sea). The maturation rates for reared salmon were higher-than average during the period 2005–2009. Another fairly conspicuous feature in the time-series is the low maturation rate of wild salmon during 2010–2011.

The full life-history model allows estimation of steepness of the stock–recruit relationship (Table 4.2.3.1) and the PSPC (Table 4.2.3.2) for different salmon stocks. Figure 4.2.3.3 gives an indication of river-specific stock–recruit dynamics. The blue clouds in the figure panels indicate posterior probability distributions of all the historical estimates of yearly egg deposition and corresponding smolt abundance (the density of the cloud indicates the probability). Curves added in the figure panels are draws from the posterior distribution of the Beverton–Holt stock–recruit function. Adding the latest information about spawner and smolt abundance together with the latest changes in the model structure has resulted in some changes in posterior probability distributions of the PSPC's as compared to in last year (Figure 4.2.3.4, Table 4.2.3.2). PCPC's of several rivers were signifiantly updated from last year's assessment. The largest update was in the PSPC of Lögdeälven (59% decrease in median value), Emån (55% increase in median), Öreälven (34% decrease in median) and Rickleån (34% increase in median). Also the PSPC estimate of Mörrumsån changed considerably (23% decrease in median).

Some of these changes are reflecting the updates of the priors distributions of PSPC's (see previous section; Rickleån, Emån and Mörrumsån). The rest of the updates were maximum 15% compared to the last year's assessment. As in the assessments of 2012–2014, the PSPC estimate of Tornionjoki is dubious because the MCMC sampling was inadequate for a proper approximation of this parameter at the time of the working group meeting. It also appears that some of the information from Tornionjoki supports considerable higher level of PSPC than the rest of the information (Figure 4.2.3.3), which results in a thick and long right tail for the posterior distribution (Figure 4.2.3.4). The posterior of PSPC for Ume/Vindelälven has not changed much from last year's assessment (12% increase in median), in spite of the substantial change made to the prior.

The likely underestimation of PSPC (and overestimation of stock status) for Ume/Vindelälven may have several explanations. One reason could be that the prior of the PSPC contains much uncertainty, while the spawner count data from Ume/Vindelälven are very precise and it likely dominate in the estimation of stock dynamics. Furthermore, Walters and Korman (2001) have pointed out that for depleted stocks when the spawning stocks increase rapidly after long periods of low abundance, this may result in locally intense competition within those reproduction areas that are being used. The patchy habitat use may impose local density-dependent effects, which may diminish in the longer run (after several generations) once spawners have dispersed to fully re-establish the natural or most productive habitats (Walters and Korman, 2001). If this phenomenon is valid for Baltic salmon populations, our analysis utilising the recently available stock–recruit information underestimates long-term (full) carrying capacity of the Baltic rivers.

The AU specific total PSPC estimates changed from the last year's assessment only by a few percent. The PSPC estimates of AUs 5 and 6 are not updated in this year's assessment. The total PSPC estimate of AUs 1–6 (median 4.38 million) is only 175 000 smolts lower than the corresponding estimate from the last year's assessment.

Since the mid-1990s, the status of many wild salmon populations in the Baltic Sea has improved and the total wild production has increased from less than 0.5 to about three million smolts (Figure 4.2.3.5, Table 4.2.3.3). There are significant regional differences in trends in smolt production. For the wild salmon stocks of AUs 1–2, the very fast recovery of smolt production indicates high productivity of these rivers. The smolt abundance time-series of Rickleån is notably updated towards higher abundances, which is apparently due to the results of smolt trapping conducted in 2014 in Rickleån (see Section 3.1.2). This did not result in change to the perceptions of the status of stock in Rickleån because also the PSPC estimate became updated upward (see below). The only wild stock in AU 3 evaluated in the assessment model (Ljungan) has also recovered, but the estimates of both the current and the potential smolt production of this river are highly uncertain. AU 4 stocks have improved since the drop occurred in the latter half of the last decade, and the smolt abundance is now back on the level prevailing around the turn of the millennium. Most of the AU 5 stocks are showing a decreasing trend in abundance, but the stocks of AU 6 show improvements similar to the AU 3 stock (see Section 4.2.4). Smolt production in AUs 1–4 rivers is expected to jump to a higher level starting 2016, which is a reflection of the recent jump in the number of spawners.

By comparing the posterior smolt production (Table 4.2.3.3) against the posterior PSPC it is possible to evaluate current (year 2014) status of the stocks in terms of their probability to reach 50% or 75% of the PSPC (Figure 4.2.3.7, Table 4.2.3.4). Table

4.2.3.4 contains also AU 5–6 stocks and the two new wild rivers Kågeälven and Testeboån. The smolt abundance in relation to PSPC estimates of Testeboån, however, is unknown. AUs 5–6 stocks have not been analytically derived, but expert judgments are used to classify their current status. The perception about the overall status of stocks (amount of stocks in different status classes) has changed only slightly compared to the last year's assessment. However, there are many changes in the perception about the status of individual stocks. Among the stocks of AU 1, only the perception of the status of Tornionjoki has changed (downward); it is uncertain and unlikely if the stocks reached 50% and 75% of its PSPC in 2014, respectively. The drop is partly due to the estimated decrease in the smolt abundance from 2013 to 2014, but also due to the updated PSPC estimate, which assigns some probability for very high PSPC levels (Figure 4.2.3.4). It is also important to note that the PSPC estimate of Tornionjoki is not reliable due to the poor convergence of the MCMC chain. The perception of status of seven AU 2 stocks have changed from last year; upward in six stocks (Piteälven, Byskeälven, Sävarån, Ume/Vindelälven, Öreälven and Lögdeälven) and downward in one stock (Åbyälven). However, the changes are remarkable only for Lödgeälven, the PSPC estimate of which was heavily updated downward (see above). In AU 3, the updated status of Ljungan indicates that it has likely reached 50% of its PSPC. In AUs 4-6, only the perception of status of Mörrumsån has changed from 2013 to 2014: from uncertain and unlikely to reach 50% and 75% in 2013 to very likely to reach both of the reference points in 2014. This change is due to both an increase in the smolt proruction estimate from 2013 to 2014 and due to the updated PSPC estimate (Table 4.2.3.3 and Figure 4.2.3.4).

Out of the 40 assessed stocks in Table 4.2.3.4, 17 stocks are likely or very likely to have reached 50% of PSPC, and 5 stocks are likely or very likely to have reached 75% of PSPC. Generally, the probability to reach targets is highest for the largest northern stocks. However, the probabilities vary widely also among the northern stocks. Eleven stocks are considered unlikely to have reached 50% of PSPC, i.e. they are considered to be weak. Most of the weak stocks (9) are located in the AUs 5–6. While most of the AUs 1–2 stocks show strong indications of recovery over the years, the stocks in AUs 4–5 have been unable to recover (but see comment on assessed status of Mörrumsån in Section 4.2.2). Stocks in rivers situated between these areas (i.e. AU 3 and AU 6 stocks) have mostly shown modest indications of recovery (Figures 4.2.3.6, 4.2.3.7 and Section 4.2.4).

The model captures quite well the overall historic fluctuation of catches in various fisheries (Figure 4.2.3.8). However, the offshore catches from the early and mid-2000s become underestimated. In this year's assessment the fit to the coastal catches is good, although there is some tendency for the older part of time-series of the coastal catches to become overestimated. Concerning river catches, the model does not fully capture the high catches of the years 2008–2009.

The model is fitted to the proportion of wild and reared salmon (separately for ages 2SW and 3SW) in the offshore catch. The posterior estimates of wild vs. reared proportions follow closely the observed proportions (Figure 4.2.3.9).

An increasing trend in the number of spawners is seen in most of the rivers of AUs 1–4 (Figure 4.2.3.10). Spawner abundance has increased particularly in the years 2012–2014. In Simojoki, the very high estimates of spawners around the turn of the millennium are a result of very intensive stocking of hatchery-reared parr and smolts in the river during the late 1990s. The model captures trends seen in fish ladder counts, even short-term variation in rivers where the data is not used for model fitting (e.g.

Byskeälven). Annual variation in the river conditions affect the success of fish to pass through ladders and therefore the ladder counts themselves are not ideal indices of spawner abundance. For Ume/Vindelälven, however, the fish counts are good approximations of the total amounts of fish reaching the spawning grounds, and the model based spawner estimates follow closely these observations. In Kalixälven, the development of spawner abundance estimated by the model is more optimistic than the development observed in the fishladder counts. The drop from 2009 to 2010–2011 and a drastic increase in 2012 observed in spawner counts are well captured by the model. The improvement is probably a consequence of fitting the model to spawner counts in combination with assuming annually varying maturation rates. From 2013 to 2014 the spawner abundance markedly increased further in some but decreased in some other rivers of the AUs 1–2 (e.g. Tornionjoki vs. Kalixälven). It is difficult to explain this contrasting development observed even between neighboring rivers. Torniojoki salmon is by far the highest in abundance among Baltic stocks and even a modest under/overestimation of the abundance at relative scale in this stock may result in differences of up to tens of thousands of spawners.

In spite of fluctuations, there was a long-term decreasing trend in the harvest rate of longlines (and driftnets during the years drifnetting was allowed) (Figures 4.2.3.11a and 4.2.3.12). After the ban of driftnets in 2008 longlining harvest rate increased rapidly and reached the all-time high around 2010. In 2009–2011 the harvest rate of longlines was almost as high as the combined harvest rate of longlines and driftnets in 2003–2006 (Figure 4.2.3.12). Thereafter, the harvest rate of longlining quickly dropped until 2013 and in 2014 the harvest rate is slightly higher than in 2013. The harvest rate of coastal trapnetting dropped in the late 1990s. Since mid-2000s the coastal harvest rate has started to decrease again, and after 2010 the decrease accelerated (Figure 4.2.3.11b). In 2012 and 2013 this is at least partly a result of closing the coastal fisheries during the fishing season due to filling up of quotas. In 2014 the coastal harvest rate was on the same level as in 2013. Estimates of harvest rates in the rivers are inaccurate and lack trends since the mid-1990s (Figure 4.2.3.11c). River-specific data indicates that there can be substantial variation in the harvest rate between rivers (see Section 3.2.1), which is not taken into account in the model.

4.2.4 4.2.4. Status of the assessment unit 5–6 stocks

Smolt production in relation to PSPC **in the AU 5 stocks** shows a negative trend in almost every wild and mixed river (Figures 4.2.4.1 and 4.2.4.2). In a decade smolt production has generally dropped from the level of 50% or higher to below 50% of PSPC. In 2014 most rivers were estimated to produce just about 10–30% of their PSPCs and are therefore either unlikely or uncertain to reach 50% (given the associated uncertainties in estimation; Table 4.2.3.4). In river Pärnu the smolt production level is almost zero. The only river which shows signs of a positive development in AU 5 is the river Nemunas. This river is a large watercourse with several tributaries, and many of them have been subject to long-term restoration efforts (habitat restorations, restocking etc. see Sections 3.1.5 and 3.2.2). In spite of the positive trend, the observed smolt production in the Nemunas in relation to PSPC is still far below 50% level. River Salaca in AU 5 and Mörrumsån in AU 4 are both well-known salmon rivers with the most extensive and the longest time-series of monitoring data in the Main Basin area (see Sections 3.1.4 and 3.1.5). The developments of parr densities in these two rivers roughly resemble each other since the early 1990s; an increase in the densities from the early to the late 1990s and a subsequent decrease starting in the early2000s.

Smolt production **in the AU 6 stocks** shows a positive trend in most of the rivers but also a large interannual variation, especially in the smallest rivers (Figures 4.2.4.3 to 4.2.4.7). In spite of the overall positive development, a majority of the AU 6 rivers are still not likely to be over 50% of their PSPCs (Table 4.2.3.4).

Among the wild Estonian stocks (Figures 4.2.4.3 and 4.2.4.6), the increase in smolt production has been the highest in river Keila; in this river parr densities have in some years even exceeded the previously estimated PSPC, and for this reason it has been necessary to revise (increase) the PSPC estimate on several occasions. No apparent trend in smolt production can be seen in river Kunda where the estimated smolt production varies annually from below 10% up to 100%. The smolt production in 2003–2005 was low because in 2003 the lowermost hydropower station in the river released high amounts on fine sediments from the reservoir to the salmon spawning and rearing areas. This resulted in high parr mortality and poor spawning conditions for several years. In 2006 the conditions in the river were improved and the smolt production also increased. However, a second period of low smolt production occurred in 2009–2011, which may reflect a low number of spawners originating from the weak earlier year classes that occurred in 2003–2005 (Figure 4.2.4.3).

In the small Estonian mixed stocks the trend has also been is also positive in recent years (Figures 4.2.4.4 and 4.2.4.7). However the current PSPC in some of these rivers is severely limited by migration barriers and there is also a lot of annual variation in these small populations. In the Finnish mixed river Kymijoki no clear positive trend can be seen, although occasional stronger year classes have occurred. The smolt production has nevertheless remained far below the 50% level (Figure 4.2.4.5). In Russian river Luga wild smolt production is stable but low, and it has remained below 10% of PSPC despite large scale annual smolt releases using salmon of local origin.

4.2.5 Harvest pattern of wild and reared salmon in AU 6

Salmon originating from the Gulf of Bothnia and Baltic Sea Main Basin contribute to the catches in the Gulf of Finland (Bartel, 1987; ICES, 1994). Salmon from the Main Basin stocks migrate to the Gulf of Finland for feeding, and salmon from Gulf of Bothnian stocks visit the Gulf of Finland area in the early summer during their spawning migration to the Gulf of Bothnia.

In 2002–2011 and 2014 samples has been collected from Finnish commercial fisheries in the Gulf of Finland. These catch samples have been aged and wild/reared origin have been determined by scale reading. Stock proportions were also estimated by DNA-analysis (MSA) in 2002–2007 and again in 2014. The MSA results from the earlier years (2002–2007) suggested that the clearly largest stock contribution (on average 70%) was from locally released reared Neva salmon, whereas the average proportion of wild stocks originating from the Gulf of Bothnia was 22% (ICES, 2008). In 2014, the overall proportion of reared Neva salmon was lower (39%) whereas the share of wild GoB salmon was higher (41%), but at the same time there were pronounced differences between sampling sites (Chapter 4.8).

So far, salmon from wild Gulf of Finland stocks (Estonia, Russia) have not been recorded in any of the catch samples analysed genetically from the GoF. The numbers of feeding wild salmon from these rivers are expected to be low, and the probability to observe them is probably minimal in samples collected from different fisheries in the feeding area in the Gulf of Finland (and the Main Basin). According to Carlin tag recaptures from releases made in Estonian rivers in the area (smolt cohorts 2005–2010), only 19% of the stocked fish are harvested outside Gulf of Finland, 68% are harvested in the Gulf of Finland's Estonian coast and 13% of the recaptures originate from the Finnish side of the gulf (Figure 4.2.5.1). Substantial share of these returns, however, came from recreational fishery off the coastal area (trolling, etc.).

The reduction of harvest rate in the Main Basin in the last few years has had a positive effect on the status of the gulf's wild stocks (see Chapter 3).The harvest rate in the Main Basin was estimated to be 25–40% in 1990s (ICES, 2013), while currently the harvest rate is estimated to be around 10% (Figure 4.2.3.11a). Most Estonian stocked parr and all stocked smolts have been adipose finclipped since late 1990s. The share of adipose finclipped salmon in Estonian coastal fishery is monitored by gathering catch samples. If the relative production of wild and reared smolt is compared with the share of finclipped fish in the coastal catch samples in Estonia, it shows that the share of finclipped fish is clearly smaller than expected and show a clear downward trend (Figure 4.2.5.2). This indicates that reared fish have had very low survival in recent years and wild fish are harvested in significant numbers. However, the origin of the wild fish is not known. To further reduce the harvest rate on the regions' wild stocks, the closed area at river mouths was extended to 1500 m during the main spawning migration period (from 1st September to 31st October) in Estonian wild (Kunda, Keila, Vasalemma) and in most of the mixed (Selja, Loobu, Valgejõe, Pirita, Vääna, and Purtse.). The new regulation was set in force in 2011 and it has ensured a lower harvesting on the regions wild stocks.

Harvesting in the Main Basin has declined particularly in 2011–2012. Taking into account a rather high proportion of salmon from the Gulf of Bothnia and Main Basin observed in Finnish catch samples from the Gulf of Finland (collected in 2002–2011 and 2014) the exchange of recruits between the areas has been considered to be significant. The exchange of salmon between the areas has, however, not yet been quantified. Comparison of the spatial distribution of tag recaptures from a Gulf of Bothnian and a Gulf of Finland stock provides a qualitative overview on the rate of exchange (Figure 4.2.5.3), although this information is dependent not only on the distribution of salmon but also on the distribution of fisheries.

Status of Estonian wild salmon stocks has improved in the last years (Figures 4.2.4.3 and 4.2.4.6). This indicates that the total harvest rate in the sea fisheries in combination with recently established closed fishing areas at the river mouth areas can be considered as sustainable, and that it may allow for further recovery for these wild stocks.

4.3 Stock projection of Baltic salmon stocks in assessment units 1–4

4.3.1 Assumptions regarding development of fisheries and key biological parameters

Table 4.3.1.1 provides a summary of the assumptions in which the stock projections are based on. Please note that the new wild river Kågeälven is left out from the river specific scenario results (Figures 4.3.2.6–4.3.2.8) because of lack of time during the WG meeting (caused by computational problems). The plan is to include results from river Kågeälven into the scenarios in next year.

Fishing scenarios

The base case scenario (scenario 1) for future fishing (2016 and onwards) equals to the commercial catches adviced by ICES for 2015, i.e. the median commercial removal would equal to 116 000 salmon. Scenarios 2 and 3 correspond to 20% decrease and

20% increase from the scenario 1, respectively. Scenario 4a equals to F=0.1 harvest rule applied for commercial (total) removals whereas in scenario 4b F=0.1 harvest rule contains both commercial and recreational fisheries. Finally, scenario 5 illustrates stock development in case all fishing both at sea and in rivers was closed.

Fisheries in the interim year (2015) follow the scenarios, except for longline fishing during the first months of the year, which is estimated based on the effort observed during the corresponding months of 2014.

Scenarios were computed by searching such effort that results in the desired median catches. As the scenarios are defined in terms of future fishing effort, the predicted catches have probability distributions according to the estimated population abundance, age-specific catchabilities and assumed fishing effort. Scenarios 1–3 and 4a–b assume the same fishing pattern (division of effort between fishing grounds) as realized in 2014. Figure 4.3.2.1a–b shows the harvest rates prevailing in the scenarios.

In all scenarios it is also assumed that the commercial removal covers 66% of the total sea fishing mortality, whereas 34% of this mortality consists of discards, misreported, unreported, and recreational sea fisheries. This corresponds to the situation assessed to prevail in 2014 (Figure 4.3.2.9). According to the expert evaluation, unreporting has to some extent decreased from 2012 to 2013, but the share of other sources of extra mortality (dead discards, misreporting and recreational catches) has slightly increased from 2012. This results in a 5% smaller share of the total removal originating from the reported commercial catches in 2013 than in 2012.

Survival parameters

In both M74 and Mps projections autoregressive model with one year lag (AR(1)) is fitted at the logit-scale with the historical estimates of the survival parameters. Mean values of the mean of the post-smolt survival over years 2010–2013 (14%), variance over the time-series and the autocorrelation coefficient are taken from the analysis into future projections. Method for M74 is otherwise similar, but the stable mean for the future is taken as the mean over the whole time-series (96%). In addition, the forward projection for Mps is started from 2014 to replace the highly uncertain model estimate of the last year of the historical model. The starting point of M74 projections is 2015. Time-series for Mps and M74 survival are illustrated in Figure 4.3.2.2.

Adult natural mortality (M) is assumed to stay constant in the future, equalling the values estimated from the history. Different fisheries occur at different points in time and space and many catch only maturing salmon, which has been subject to several months' natural mortality within a year. Thus, in order to increase comparability of abundances and catches, the abundances at sea have been calculated by letting M first to decrease the PFA (stock size in the beginning of year) of multi-sea-winter salmon for six months. Moreover, the stock size of grilse has been presented as the abundance in after the period of post-smolt mortality and four months of adult natural mortality. This period is considered because the post-smolt mortality period ends in April, after which there remain eight months of that calendar year during which grilse are large enough to be fished. Half of that, i.e. four months is considered best represent the natural mortality that takes place before the fishing. Calculations for F=0.1 scenarios (scenarios 4a and 4b) are also based on stock sizes which are first affected by M as described above.

Maturation

The annual sea age group specific maturation rates are given the average level computed over the historical period, separately for wild and reared salmon. This projection starts from 2016, as the maturation rates of 2015 can be predicted based on the SST information from the early 2015 (indicating higher than average maturation rates for 2015). The time-series of maturation rates are presented in Figure 4.3.2.3.

Releases of reared salmon

The number of released reared salmon per assessment unit is assumed to remain at the same level in the future as in 2014 (Table 3.3.1).

4.3.2 Results

According to the projections, stock size on the feeding grounds will be about 1.01 (0.5–2.3) million salmon (wild and reared, 1SW and MSW fish in total) in 2016 (Figure 4.3.2.4). Of this amount, MSW salmon (i.e. fish which stay on the feeding area at least one and half years after smolting) will account for 0.56 (0.31–1.17) million salmon. These MSW fish will be fully recruited to both offshore and coastal fisheries in 2016. From the predicted amount of 1SW salmon (0.43 million, 0.15–1.17 million) at sea in spring 2016, a relatively large fraction (most likely 20–40%) is expected to mature and become recruited to coastal and river fisheries. It must be noted, however, that the predicted high maturation rate is estimated (only) based on high winter sea surface temperatures on January–March 2015.

The abundance of wild salmon at sea has fluctuated in the past without any apparent trend, but the highest abundances, around 1 million (median, both 1SW and MSW wild salmon), are is estimated to have occured in 2012–2014 (Figure 4.3.2.4). As one of the simplifying assumptions of the life cycle is that all salmon die after spawning, a lower maturation rate will increase the survival of the cohort to the next year compared to years with the same abundance but with average maturation. Similarly, a high maturation rate will decrease the abundance of MSW salmon in following years. Because of this feature it is important to note that the predicted abundance may become heavily over- or underestimated because of the (predicted) development of maturation rates. In contrast to wild salmon, the abundance at sea of reared salmon has decreased considerably since the mid-1990s, mainly due to the decline in post-smolt survival. Currently the abundance of reared salmon is decreasing further, mainly due to recent reductions in the amount of stocked smolts (Table 3.3.1). The combined wild and reared abundance declined substantially from mid-1990s until late 2000s, but the abundance has shown great increase in recent years (Figure 4.3.2.4).

Table 4.3.2.1 illustrates the predicted total commercial sea catches (also broken down to its parts: wanted catch, consisting of reported, unreported and misreported and unwanted catch, consisting of previously discarded undersized and seal damaged salmon) and recreational catches, and also the catches and number of spawners in the rivers in 2016 with the given fishing scenarios. The amount of unreporting, misreporting and discarding in 2016 is assumed based on the expert evaluated share of those catch components compared to the reported catches in 2014 fisheries. In 2014 the wanted catch reported (commercial) accounted for about 66% from the corresponding estimated total sea catch, this percentage being slightly higher than the one estimated for 2013 (60%). Unreporting, misreporting, discarding and recreational fishing are considered to take, respectively, about 9%, 10% and 8% and 13% share of the total sea catch. The share of the total catch by these components (including also river fishery) for the period 2001–2014 is illustrated in Figure 4.3.2.9. It is important to keep in mind that changes in either fishing pattern or in fisheries control may easily lead to changes in the share of catch caught under the quota regulation.

With the given set of scenarios (excluding zero fishing scenario), the predictions indicate that the wanted catch reported (commercial) in year 2016 would be 66–111% (63 000–107 000 salmon) compared to the TAC of 2014 (Table 4.3.2.1). The corresponding total sea removal (including recreational fishing) would range from 107 000–160 000 salmon. The amount of spawners would be about 11% higher in the scenario 3 than in the scenario 2, and the zero fishing scenario indicates about 70% increase in the number of spawners compared to the scenario 2. The harvest rule of $F_{0.1}$ for commercial catch (scenario 4a) falls between scenarios 1 and 3, indicating a wanted catch reported of 74 000 salmon. This is close the same as the corresponding $F_{0.1}$ scenario calculated last year for 2015 (75 000 salmon). Figure 4.3.2.5 illustrates the longer term development of (reported) future catches given each scenario.

Figure 4.3.2.6a–d presents the river-specific annual probabilities to meet 75% of the PSPC under each scenario (note that river Kågeälven is left out from river specific results). Under the scenarios 1–4, different amount of fishing has an influence mostly on the level but not so much on the trend of the probability of meeting 75% over time. Only the zero fishing scenario diverges clearly from the other scenarios; several of the weakest rivers show a stronger positive effect in trends than the other scenarios. As expected changes in fishing has smallest effect to those stocks which are close to their PSPC. As the level of fishing effort is rather low in these scenarios compared to the history, the levels of post–smolt and adult natural mortalities will have a high relative impact on the resulting chances of reaching the management objective with a high certainty. Table 4.3.2.2 compares the probabilities to reach 75% target around the year 2021, which is approximately one full generation ahead from now. Evidently, the probabilities are higher for effort scenarios with low exploitation, but differences between scenarios are small except in the zero fishing scenario. Figure 4.3.2.7a–b illustrates by scenario the rate and the direction of change in smolt abundance in 2020/2021 compared to the smolt abundance in 2014. Predictions about smolt abundance are naturally more uncertain than the estimated abundance in 2014. However, in those stocks which are close to their PSPC also the predictions are rather certain, indicating that smolt abundance will stay close to PSPC in these rivers under different fishing scenarios.

Figures 4.3.2.8a–h show longer term predictions in the river-specific smolt and spawner abundances for two scenarios (1=removal which corresponds to ICES advice for 2015; and 5=zero fishing). These two rather extreme scenarios (only the scenario 3 has a stronger fishing than in scenario 1) illustrate the predicted effects of contrasting amounts of fishing.

4.4 Additional information about the development in stock status

Independent empirical information is important to evaluate model predictions of central parameters. Over the years repeated comparisons with different kinds of such independent information have been performed, and in several cases these comparisons have prompted modifications or extensions to the full life-history model. For example, in the last year's assessment sea temperature data were successfully introduced as a covariate of age-specific maturations rates, based on the analyses and development work carried out in the last inter-benchmark protocol (IBP) and thereafter.

Also, comparisons between model predictions and empirical results from genetic mixed-stock analyses (MSA) have been used over the years to verify model performance (e.g. ICES, 2014).

4.4.1 Weak rivers

Last year, the working group compiled additional information about so-called weak rivers. These are rivers which, according to the latest assessment, have not clearly reached 50% of their estimated PSPC and/or show declining trends in smolt production. Most of the extra information that was reported last year about weak rivers is still valid. Here we present only a brief summary of last year's reporting and supplement it with any new knowledge that has been obtained.

Until recently, the positive development of wild stocks was mainly restricted to Gulf of Bothnian populations (AUs 1–3). In contrast, some populations in these AUs and the majority of the populations in AUs 4–6 did not respond positively or showed only weak indications of recovery. Most of these populations are found in relatively small rivers (in terms of discharge and available habitats).

According to the current assessment, the number of weak rivers in AUs 1–4 is decreasing. The currently weak rivers are Rickleån, Emån, Öreälven and the new wild river Kågeälven. Even in most of these rivers, abundance has been increasing and is expected to increase further in the near future (Figures 4.3.2.6–4.3.2.8). In some of the recent years also a few other rivers like Simojoki and Sävarån have not reached 50% of their PSPC with a high probability. Simojoki has also shown a slight negative trend with respect to smolt production. However, smolt abundance in most years in Simojoki does not fulfil the criteria for having a weak status, and recent spawner counts indicate a further recovery of the stock. Moreover, the slightly negative trend in the smolt abundance is likely reflecting the large-scale stocking occurring in Simojoki in the past. The status of Sävarån has been updated upwards and the stock has shown recovery. Among AU 5 rivers there is no other change to the list of weak rivers except that Mörrumsån is not assessed to be weak (but see comment in Section 4.2.2). There are no changes in the list of weak rivers in AU 6, but as noted in the past 1–2 years, the abundances are increasing in many of these rivers.

A number of potential factors affecting the development of the stocks, related to e.g. fishing or quality of the river habitat, were identified by the working group last year, when national experts gave their opinions/judgments about whether particular factors are likely to be of importance in explaining the development of weak stocks in their respective countries. Many local factors, independently but most often in combination with others, were seen to affect the development of these salmon stocks. It is also clear that the importance of different factors may vary between regions. Local fishing pressure, in the river and/or in the river mouth, is considered to be of significance mainly in south-eastern Baltic Sea (AUs 5–6), but also in and/or outside a few rivers in AUs 1–4. Another important factor negatively affecting the development is migration obstacles/problems preventing salmon from reaching suitable freshwater habitats. Migration obstacles/problems is actually the factor which effects are most often listed as "considerable" by national experts. Negative effects of previous alterations of river habitats by e.g. removal of stones and canalization for timber floating are most common in rivers in AUs 1–4, whereas eutrophication seems to be a problem mainly in southeastern Baltic Sea.

In addition to the local factors, more general factors affecting salmon on a wider geographical scale are likely also of significance. One possibility is that southern stocks have a lower natural survival at sea, thus making exploitation possibilities lower for these stocks. There are fewer sources of information to assess stocks in AUs 4–6, making our knowledge of the status and development of these stocks less reliable than those for AUs 1–3. However, a comparison in last year of MSA results of Main Basin catches and expected stock proportions (based on smolt production estimates) did not suggest presence of any significant differences in natural sea survival for salmon from different AUs in the Baltic Sea (ICES, 2014).

From the above it seems likely that different areas/rivers need different measures to improve the situation for the weak salmon stocks. Whatever is the underlying reason for the poor status and the lack of response to management measures, the overall lifetime survival of salmon from weak rivers is lower compared to the survival of salmon from the other rivers. In order to recover weak rivers, possibilities to reduce any type of mortality (whether it is related to fishery or not) at various life stages must therefore be considered.

4.5 Conclusions

4.5.1 Development of fisheries and stock status

The Baltic Sea salmon fishery has changed considerably since the beginning of the 1990s. Catches from the offshore fishery (driftnets and longlines) dominated at the beginning of the period, but for various reasons the effort in the offshore and coastal fisheries has decreased thereafter. Catches in the river fishery have been relatively stable during the period except for in 1997 and again in 2012–2014, when the high number of ascending spawners resulted in substantial increases in river catches. Mainly because of a decreasing trend in the total catches of salmon, the share of the river fishery has increased successively.

In parallel with changes in the composition of fisheries, the total exploitation rate of salmon decreased substantially from the beginning of the 1990s to the end of the last decade. The driftnet ban in 2008 reduced the offshore catches into a record low level in that year. However, a considerable effort increase in the longline fishery, starting from year 2008, counteracted the effects of the driftnet ban, and as a result the harvest rate of longlines in 2009–2011 was almost as high as the combined harvest rate for longlines and driftnets in the early and mid-2000s. The longline effort decreased in 2012 and further in 2013–2014 compared to previous years, due to e.g. a ban for Swedish and Finnish fishermen to use longlines from 2013 and onwards. The coastal trapnet fishery has been rather stable in the early and mid-2000s. Thereafter fishing mortality has declined with a decrease that has been substantial in the last three years. Enforced management measures, especially decreased TACs, have contributed to this development.

The estimated post-smolt survival has decreased substantially over the two last decades. The reasons behind the long-term decrease in post-smolt survival are still unclear, but analyses indicate that especially seal abundance and recruitment of 0+ herring correlate with the survival rate of post-smolts (ICES, 2009; Mäntyniemi *et al.*, 2012). Changes in the sea temperature may also be an important driver of survival (ICES, 2012 IBP). A substantial bycatch of salmon may occur in the pelagic trawling fishery in the Main Basin, but most likely this could not explain the dramatic decrease in post-smolt survival observed during in the last 15 years (ICES, 2011). The improvement in estimated post-smolt survival seen in recent years (especially in the 2010 smolt cohort) indicates a positive turn in the overall development and it probably will lead many salmon stocks to recover closer to their PSPCs (Figure 4.3.2.7).

Out of the 40 assessed stocks there are 17, mostly in northern rivers, which are either likely or very likely to have reached 50% of the PSPC in 2015 (Table 4.2.3.4). For 12 stocks it is uncertain and for eleven stocks unlikely that they reached the 50% objective in 2015. Most of the stocks with weaker status are situated in rivers of the southern Baltic Sea area. Five stocks have likely or very likely reached 75% of the PSPC in 2015, whereas for 60% (24/40) of the stocks it is considered unlikely that they reached this higher reference point in 2015.

For a majority of the wild salmon stocks of AUs 1–2, their very fast recovery with clear increases in smolt production indicates high productivity in these rivers. Also the rest of the AU 1–2 stocks have recovered, albeit at slower speed, and their recovery has continued almost without exceptions also during the last years. This is an indication of a rather successful adaptation of the overall fishing pressure to the natural conditions these stocks are facing (which is determining, e.g. their productivity). The same applies also to the stocks in AU 3, and more recently to several AU 6 stocks. However, except Mörrumsån (but see Section 4.2.2), almost every stock in AU 4–5 and some stocks in AU 6 have weakened and this trend has continued until today. It is therefore important to allocate extra efforts in planning and enforcing directed management measures, which could help these southern stocks to start their recovery.

4.5.2 Conclusions for future management

Salmon abundance was peaking in 2012–2014, declined somewhat in 2015 and is expected to decline further in 2016 among multi-sea winter salmon. The decline in abundance is, however, much dependent on the assumed postsmolt survival for salmon smolting in 2013–2014 and later. The assumption about postsmolt survival is neither optimistic nor pessimistic (average from 2010–2013) because of only a slight positive trend in survival during the last ten years (Figure 4.2.3.1). Given the still large number of stocks with weak current status (Table 4.2.3.4), any positive effects of a higher-than-expected post-smolt survival would need to be directed to the increase of spawners in these stocks, rather than increasing fishing possibilities. This holds especially for fisheries which take place on the migration routes of the weakest stocks.

The results of the 2014 and 2015 ICES assessments differ only slightly from each other in terms of their projected stock developments at various exploitation levels. In general, wild stocks are rather unresponsive to differences between the scenarios 1–4. This reflects the fact that the examined differences in fishing mortality are modest (Figure 4.3.2.1a–b) in relation to other sources of (natural) mortality in the salmon's life cycle and their associated uncertainties (Figures 4.3.2.2 and 4.2.3.1). Also the scenario with harvest rule of $F_{0.1}$ (scenario 4) falls within this category of scenarios. Only a handful of stocks are either likely or very likely to meet the 75% of PSPC by 2020/2021 in these scenarios (Table 4.3.2.2). It is, however, important to keep in mind that the future projections indicate how certain/uncertain various stock developments are at the moment with the knowledge at hand. The further into the future stock development is predicted, the more uncertain all estimates become. In other words, it is impossible now to fully secure the achievement of a management target by, say, year 2020.

The zero fishing scenario diverges clearly from the other scenarios and predicts remarkably faster recovery for all other but AU 4 stocks and the stocks which are already close to their PSPC. Although not studied here, it is likely that a scenario with clearly higher than current fishing mortality would, in turn, predict negative future projections for more stocks. The $F_{0.1}$ scenario for commercial catch indicates a reported commercial catch of 74 000 salmon, corresponding to a total commercial removal of 96 000 and a recreational catch at sea of 16 000 salmon. This scenario predicts somewhat lower total commercial removal than the adviced catch level and fishing mortality for 2015 (ICES Advice for 2015).

The reported commercial catch at sea is anticipated to make up a larger proportion of the total commercial sea catch in 2016 as compared to what was assumed in ICES advice for 2015. A total commercial removal of for example 116 000 salmon (scenario 1) corresponds to a reported commercial catch of 89 000 salmon in 2016. In ICES advice for 2015, the same total commercial sea catch corresponded to a reported commercial catch of 79 000 salmon. In the scenario with a TAC of 85 000–90 000 salmon (scenario 1, which formed the basis for ICES advice for 2015), smolt production is predicted to continue to increase in most rivers and several weak stocks will likely keep on recovering in the future. However, this management scheme would also require special actions (not only fishery-related) directed to the weakest stocks, especially in AUs 4–6.

The fast recovery of many Gulf of Bothnian stocks in recent years in combination with the absence of such positive responces among most southern stocks has resulted in a situation with pronounced differences in stock status. A few northern stocks are close to or above the MSY-level, and the surplus produced by these stronger stocks could in theory be directed towards stock-specific fisheries. However, the current management system with a single TAC for SD22–31 that is set at relatively low levels to safeguard weaker salmon stocks prevents this surplus to be fully utilised, at least within the commercial fishery. In a similar way, the surplus of reared salmon can not be fully utilised today because reared salmon is also included in the TAC. At the same time, the management of Baltic salmon is becoming more and more focused on status and development of individual stocks (cf. COM/2011/0470 final).

Stock-specific management could be developed further by implementation of more flexible systems for regulation of commercial fisheries, with the aim of steering exploitation towards harvesting of reared salmon and stronger wild stocks through e.g. area-specific quotas and/or exclusion of certain single-stock fisheries from the quota system (such as fisheries in estuaries targeting reared salmon). Also non-commercial coastal fishing, not regulated by international quotas, could be steered towards stock-specific harvesting. A higher degree of stock-specific exploitation will also be necessary in the future if different management objectives should be decided upon for individual stocks (e.g. if to allow for a higher number of spawners than needed to fulfil the MSY-level in certain wild rivers).

4.6 Tasks for future development of the assessment

The tasks listed below refer to potential updates of the assessment method. The time frame for carrying out these tasks may differ from short term (1–2 years) to long term (several years).

Urgent issues, to be dealt with over next few years if possible:

- *Development of a smolt production model for AU4 stocks*. Important updates of production areas and potential smolt production capacities for Mörrumsån and Emån were carried out in 2015. So far, the yearly smolt production in these rivers has been estimated from parr densities and previous expert opinions about production areas and within river mortalities, and the quality of these estimates is questionable. A more ambitious production model, similar to the one used for AU1–3 stocks (see stock annex), including available smolt counts and updated information on habitats and within river mortalities, will be developed for Mörrumsån and Emån before next year assessment (2016). A similar smolt production model will also be developed for the recent wild river Testeboån in AU3, which will facilitate inclusion of this river in the full life-history model.

- *Inclusion of AU5 and 6 stocks in the full life-history model*. At present, these stocks are treated separately from the AU1–4 stocks. Inclusion in the full life-history model will require updated information from these stocks regarding e.g. smolt age distributions, maturation rates, exploitation rates, post-smolt survival and information about exploitation of stocks from Gulf of Bothnia and Main Basin in the Gulf of Finland (and vice versa). In addition, increased amounts of basic biological data (e.g. smolt and spawner counts, additional electrofishing sites) may be needed for some rivers.
- *Inclusion of recreational sea fishery (mainly trolling)*. Because of the increase in recreational sea fishing, it would be important to include it as an independent fishery to the model framework. However, this would require good quality data both from the effort and catches.

Important issues, no time frame planned:

- *Continuing the work of including data from established index rivers*. This includes e.g. fitting the life-history model to smolt production estimates (see above) and spawner counts from River Mörrumsån. In parallel with the data collection in index rivers, additional data collection of smolt and spawner abundances in other wild rivers is expected to reduce biases and improve precision in assessment results. Therefore, it would be desirable to initiate a "rolling" sampling programme that regularly collects abundance data from rivers where no such data is presently available.
- *Improved information on stock proportions in coastal catches*. The exploitation of salmon stocks in the Swedish and Finnish coastal fisheries could be modelled more accurately by including accumulating information on stock composition in catches from various coastal areas based on genetic results, proportions of finclipped (reared) fish and tag recaptures (see Section 4.7 for more details).
- *New parameterization of stock–recruitment dynamics and new priors from hierarchical meta-analysis of Atlantic salmon stock–recruit data in the model*. Currently, the number of eggs per recruit (SBPR) is not dependent on vital rates (natural mortality, maturation, etc.) but has a stand-alone prior. As a result, since the stock–recruit slope at the origin parameter is calculated from SBPR and steepness, the current stock–recruit parameterization could give rise to a population that is increasing or decreasing over time (i.e. not at the steady state) in the absence of fishing. In addition, spawner biomass per-recruit (SBPR) is currently estimated on a stock-specific basis; this is undesirable as the variables that contribute to SBPR do not vary by stock in the model. Posterior estimates of SBPR have differed markedly by stock, particularly in the case of rivers Emån and Mörrumsån (much higher than those for other stocks). For Mörrumsån, this appears to have been alleviated to some extent by the inclusion of a new PSPC prior with a lower median in the 2015 assessment, which leads to a higher estimate of the stock–recruit slope at the origin. However, the new PSPC prior for Emån has had

no such effect as it has a higher median, so that the posterior estimate of SBPR for Emån is still much higher than that for other stocks.

Possible solutions:

1) Calculate SBPR within the model as a function of vital rates (natural mortality, maturation, fecundity, etc.) and remove the dependency on stock by removing the stock subscript for SBPR. This represents a different assumption about stock–recruitment dynamics than has been made previously in that the resulting stock recruit slope at the origin would correspond to demographic equilibrium (steady state dynamics) with no fishing. Several of the variables that contribute to SBPR vary by time in the model, so that SBPR would also vary in time; if this presents computational difficulties, a hierarchical structure could be used for time varying parameters (e.g. Mps and maturation rates) so that the cross-year mean could be used in the SBPR calculation.

2) Replace the priors on steepness and PSPC with priors for the maximum survival of one egg and the stock–recruit asymptote (maximum recruitment), as in Pulkkinen and Mäntyniemi (2013). SBPR could then be calculated as in 1) to obtain PSPCs (recruitment at the stable state under unfished conditions) as a function of maximum recruitment, alpha and SBPR. Implementing this SR parameterization directly would not remove the problem of the lack of steady-state dynamics with no fishing, e.g. stock–recruit steepness (a function of the maximum survival of one egg and SBPR) would also need to vary in time, with the stock–recruitment function parameterised in terms of steepness. The effect of replacing the current prior on PSPC with the same prior on maximum recruitment needs to be investigated: this could potentially result in lower PSPC estimates if the stock–recruit relationship is not very steep.

3) The carrying capacity (maximum potential recruitment) in several rivers (Emån, Mörrumsån, Rickleån) is likely to have changed over time as a result of addition of new fish ladders, etc. that have opened up new habitat. For example, the lowermost dam in Emån was opened permanently in 2006. Activities are also ongoing to facilitate up- and downstream migration at the second dam counted from the sea, above which significant habitat areas regarded suitable for salmon reproduction are located. A more realistic description of stock–recruitment dynamics could be achieved by accounting for the fact that the production area has changed over the time span of the assessment model. Accounting for such changes in production area, and thus carrying capacity, could potentially improve the fit of the estimated stock–recruit function, particularly for Emån, and aid estimation of stock–recruit steepness.

Important, but attempts to solve these have turned out to be difficult:

- Improving estimates of post-smolt survival by fitting the model to explanatory variables like information on herring recruitment and development in sea surface temperatures. This will increase precision in short-term projections. However, this far, our attempts to include covariates to the post-smolt mortality have failed, because removing the current structure that assumes four year moving average causes the simulations to slow down at a level that is undesirable.

Less urgent issues, good to keep in mind:

- *Inclusion of data on composition of stocks at sea*. The life-history model has already been fitted to information on return rate of reared salmon from River Dalälven and River Luleälven, as well as information on proportions of wild and reared salmon in Main Basin as determined from scale readings. The next step would be to include genetic information on proportions of fish from different AUs, separating also wild and reared salmon from those areas. Subsequently, information on the representation of single stocks may be included.
- *Further use of scale reading data*. In addition to wild/reared proportions, age data from catch samples could be used to get improved knowledge on year-class strength, maturation and natural mortality rates.
- *Investigating time-varying catchabilities and tag reporting rates*. Catchabilities are generally expected to increase over time owing to improvements in boat power, fishing gears, etc. There is also a possibility that tag reporting rates have decreased over time, based on recapture rates standardised for releases and effort, although this decrease may reflect other factors (e.g. temporal changes in post-smolt survival). It would be instructive to running the model with a) time varying catchabilities and b) time varying reporting rates (possibly fishery-specific and/or for a subset of fisheries) to assess potential effects on estimated stock status and development.

4.7 Needs for improving the use and collection of data for assessment

The working group has discussed data needs in previous reports (e.g. ICES, 2005) and a partial update is provided also in this report. As the requirement for data will always exceed the available resources, preferences must be given. The decisions regarding which investigations should be prioritised are normally made on a national, regional or local level, and they are normally based on a number of factors. Decisions could be based on factors such as need of the data for management, or availability of resources to carry out certain investigations in certain areas.

It is possible for the working group to give guidelines regarding which kind of data collection should be given priority. Such guidelines should ideally be based on evaluations of what data will give maximum improvement of accuracy and precision to the present assessment model.

It has a high priority to establish one index river in each Assessment Unit. Currently, few rivers in the Baltic provide a full set of information (monitoring of spawning runs, smolt runs and river catches, and parr densities) required from index rivers. This type of monitoring takes place only in Finland and Sweden and covers AUs 1, 2 and 4. Finland has established both of its wild salmon rivers as index rivers and the longest time-series exists from these rivers. In response to the EU data collection framework (DCF) requirements, Sweden established two additional index rivers in 2009, and attempts to establish one additional full index river are ongoing. The collection of data concerning parr densities, smolt counts and number of spawners have high priority in these rivers. Electrofishing surveys in index rivers should preferably cover more sites than in non-index rivers, and should be distributed over all parr rearing habitats of different quality to give representative estimates. Tagging of smolts has also high priority.

Electrofishing surveys in non-index salmon rivers should be carried out, but in the present assessment model it is not necessary to have annual surveys in every river. They could be carried out for instance every second or third year. A decision whether monitoring would be carried out in a particular year should by no means be influenced by expected changes in abundance of salmon. Smolt trapping may be carried out in a river for a couple of years and then moved along to another river. This could have a high priority in relation to annual high intensity electrofishing surveys in non-index rivers. Monitoring in all non-index salmon rivers should be arranged so that each juvenile cohort is sampled at least once before smoltification.

Tagging data are currently used for many purposes by the Working Group. Carlin tagging data are the basis of the current assessment models for the Main Basin and the Gulf of Bothnia. However, the tag return data have not been used in the assessment after fishing year 2009 because of the suspected drop in the tag reporting rate starting from year 2010. Because the quality of the tag–recapture data seems to have decreased considerably (see Annex 3 for more information), there is a need in the future to replace the current large-scale Carlin tagging by other tagging systems.

Also catch data on recreational fisheries in sea is used in the salmon stock assessment. Area specific catch estimates, however, are rather uncertain and improvements in survey applications should be considered by the national statistics agencies in order to obtain more accurate estimates. For example, the trolling fishery in the Main Basin has developed considerably and involves an increasing number of fishermen in several countries. To assess the total exploitation rate in this recreational fishery, increased efforts are needed from all countries involved. Catch data from recreational fisheries in rivers also need to be improved. The working group would be able to provide a list of rivers, which preferably should be surveyed in order to obtain more accurate catch and effort estimates.

Compatibility of the DCF with the data needs for WGBAST

Section B.2 in the Stock Annex (see Annex 3) provides an outline of the data requirements by the Working Group and to what extent such data are provided by the DCF and used in the assessment. Problems with stock data that are relevant to the data collection under the DCF are presented in Table 4.7.1.

The current management regime requires an evaluation of the status of individual salmon stocks. This implies that river-specific information would need to be collected within all wild salmon rivers. The current DCF does not explicitly cover river monitoring in non-index rivers even though river sampling also in these is recognized to be important by the WG and by other salmon biologists in ICES (ICES, 2012). Data collection within index rivers is currently included in the national programmes of Estonia, Finland and Sweden.

The renewed DCF also gives obligation to sample catches to those countries where catches are landed. Estimates of stock proportions in catches from mixed stock analyses (MSA), using data from DNA markers combined with smolt age information, have been presented each year by the WG since year 2000. On average a total of about 1500 individuals have been analysed annually, representing catches from salmon fishing areas around the Baltic Sea. The genetic baseline needed for estimation of stock proportions in catches also has been updated continuously, and at present it includes 39 wild and reared Baltic salmon stocks (Chapter 2.8).

So far no MSA results have been directly incorporated into the Baltic salmon stock assessment. Still they have served as a valuable source of independent information for various comparisons and evaluations. As an example, in 2010–2014, a series of comparisons between model predictions and empirical MSA results were carried out with respect to predicted and observed proportions of salmon from different rivers and AUs in catches from the Main Basin. Initial comparisons revealed that the life-history model at that time tended to underestimate the proportion of wild salmon significantly (ICES, 2010; 2011). Following inclusion in the life-history model of scale reading results on annual proportions of wild and reared salmon in catch samples, the expected and observed wild/reared proportions in the Main Basin became much more similar (ICES, 2012).

Continued MSA-monitoring of Baltic salmon catches, including further evaluations of basic assumptions and comparisons with results from the stock assessment, is expected to provide valuable information also in the future, especially given the strong drop in conventional tag returns that has occurred over time (Chapter 2.6). However, the necessity of actually including MSA-results directly into the stock assessment model (and how this may be done technically) has to be evaluated further. Likewise, several questions related to when, where and how samples for MSA should be collected, to be as useful as possible for stock assessment and management, have to be resolved before planning the next period of data collection (DCMAP). In general, samples have to be collected so that it is possible to obtain a representative picture of the stock proportions in the entire catch from that area. It is also important to make sure that the genetic baseline (including smolt age data) is continuously updated so that it reflects the current allele frequency distributions in wild and reared stocks.

Listed below are some specific issues of importance for the planning of future MSA on salmon catches from various parts of the Baltic Sea:

- Inclusion of samples from the **Gulf of Finland** would be valuable as a recurrent element in MSA studies on Baltic Salmon. At present there is no analytical assessment model based on stock–recruit dynamics developed for salmon in the GoF (i.e. AU 6), mainly because of a lack of data on catch compositions in different fisheries in that area. There is a wish, however, to include the wild and reared AU 6 stocks; when developing and evaluating such an extended version of the current model (that so far only includes AU 1–4 stocks), empirically based MSA estimates and comparisons to model results is expected to provide import information.

  Until 2007, stock proportions in GoF catches were estimated regularly using MSA, but after that only two catch samples from a single year (2014) have been analysed. Those results together with findings from earlier Carlin-tagging studies have shown that a significant portion of stocks from other parts of the Baltic Sea occur in the GoF catches (Chapter 4.2.5). At the same time, stock proportions have been found to differ clearly between coastal areas, with an increasing share of local (reared Neva) salmon towards the east. Based on these previous findings, it is central that catches for MSA are taken from locations spread from west to east along both the Finnish and Estonian coasts, where the major GoF salmon fisheries occur. Previous observations of temporal changes in stock composition also highlight the importance of collecting samples continuously during the fishing season.

- As described above, MSA on catches from the **Main Basin** has been useful for several evaluations over the past years, and it appears important to continue this sampling also in the future. As before, it is important that the samples from the Main Basin are collected so that they are as representative as possible for the whole fishery. This may be achieved by sampling from multiple (Danish and Polish) catches from fishing trips to various parts in the Main Basin, spread across the fishing season (cf. ICES, 2011; Table 4.7.2). It is possible, though, that genetic analysis need not be performed in every year. Most observed year-to-year changes in relative stock abundance in the Main Basin have been relatively small (e.g. Figure 2.8.3), which is not particularly surprising given that a majority of the salmon stays in the sea for more than one fishing season. If the sampling interval was reduced (e.g. to every second year) additional resources could be made available for extended analyses of samples from other areas (e.g. from the Gulf of Finland).

- A major part of the Baltic Sea salmon fishery takes place in the **Gulf of Bothnia**, with the largest catches taken in the **Bothnian Bay**. For several years, pooled samples from a limited number of Finnish and Swedish coastal traps have been included in MSA. A recent and more detailed survey of catch compositions along the Swedish coast revealed that stock compositions are relatively stable among subsequent years (2013 vs. 2014) but differ markedly geographically, with most local catches being dominated by salmon from the nearest river (Chapter 2.8). Hence, it appears very difficult, if at all possible in practice, to collect a yearly sample that is representative for the entire Swedish coastal catch. Rather, there is need for a model that can provide predictions of the stock composition in time and space, using available genetic samples and taking appropriate account of uncertainty (see below). Such a model may be used to assess what type of sampling strategy would yield the most information (greatest reduction in uncertainty), given current knowledge. For example, this might be some combination of sampling at new locations to "fill in the gaps", or involve continued sampling at existing sites to improve estimates of inter-annual variability.

With respect to the Finnish coastal fishery, the stock composition may be more geographically homogenous than on the Swedish side, as there are no wild or reared salmon rivers along the Finnish Bothnian Bay coast south of Oulujoki (located far to the north). On the other hand, tagging results have shown that several Swedish stocks tend to migrate along the Finnish coast until they reach the Kvarken region (border between Bothnian Sea and Bothnian Bay) where they turn west. Therefore, a comparison of stock composition for single catches (traps) from different locations along the Finnish coast, similar to in the recent Swedish study, appears to be warranted as a basis for deciding upon a future sampling strategy. Such an analysis could be based largely on raw data already available.

As the samples from the Finnish and Swedish coastal Bothnian Bay fishery represent quite different stock compositions, continued pooling of those estimates is not justified. Separate sampling programs are needed for each coast, which may need increased sampling sizes in total.

A spatially- and temporally-structured Bayesian population dynamics model that tracks the migration of Baltic salmon stocks from their feeding grounds in the Baltic Sea to their natal rivers is currently under development. The model will use information about the proportions of different stocks in the trap catches of fishermen at different points in space and time, based on samples taken from salmon in these traps, as well as information from finclipping data about the proportions of wild and reared fish in catches (also traps for which no genetic data is available). The potential for incorporation of tag recapture data to further inform migration patterns will also be investigated. If successful, the model may be used for estimation of stock-specific exploitation rates in the coastal fisheries that, in turn, can serve as input data in the current assessment model. Furthermore, the migration-catch model can be used to evaluate (by simulations) effects of changes in fishing patterns/management on the exploitation and development of wild salmon stocks. It may thus serve as an important tool for salmon management which is anticipated to become more stock-specific when a new multi-annual management plan will be decided upon (cf. COM/2011/0470 final).

Table 4.2.1.1. Prior probability distributions for the wild smolt production (*1000) in different Baltic salmon rivers. The prior distributions are described in terms of their median, the 90% probability interval (PI) and the method on how these prior probability distribution have been obtained. These priors will be updated in Section 4.2.3.

	Wild smolt production (thousand)														
	1987	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Assessment unit 1															
1 Tornionjoki	69	81	73	78	87	92	131	205	136	103	101	123	209	605	847
95% PI	42-112	54-121	46-113	54-112	62-119	62-136	95-179	144-289	91-203	74-142	71-145	90-166	161-268	481-761	683-1052
2 Simojoki	2	2	9	10	8	12	10	10	2	2	3	7	12	38	51
95% PI	1-3	1-3	5-15	6-15	4-12	7-19	6-16	6-16	1-3	0-2	1-4	4-12	7-18	26-55	36-69
3 Kalixälven	230	144	123	95	169	129	227	138	134	125	86	141	324	438	458
95% PI	55-960	32-643	35-427	32-284	52-548	44-378	77-673	45-440	44-404	40-380	29-247	47-420	91-1143	147-1257	165-1332
4 Råneälven	39	28	25	13	13	12	10	9	3	3	4	9	16	27	31
95% PI	4-358	1-357	2-275	1-126	0-150	1-80	1-52	2-42	0-16	0-12	1-14	2-30	4-55	8-90	9-98
Total assessment unit 1	388	297	262	216	299	262	390	377	285	237	200	288	570	1129	1417
95% PI	161-1232	135-956	135-688	129-442	159-723	156-525	227-835	252-679	174-557	144-495	130-363	181-564	324-1396	793-1947	1052-2295
Assessment unit 2															
5 Piteälven	1	1	1	1	1	1	1	1	3	3	6	6	5	6	21
95% PI	0-4	0-5	0-2	0-2	0-2	0-2	0-2	0-2	1-6	1-6	3-10	3-12	2-9	3-11	11-39
6 Åbyälven	3	4	3	2	3	4	7	10	4	4	7	8	6	11	16
95% PI	0-18	0-16	0-11	0-9	0-15	1-16	1-34	2-38	1-16	1-16	1-24	2-28	1-21	3-39	4-51
7 Byskeälven	27	22	19	15	19	20	50	29	31	28	29	50	70	93	106
95% PI	6-115	5-82	5-67	4-51	5-69	6-64	14-164	8-97	9-102	8-87	9-88	15-167	21-230	30-284	35-319
Kågeälven															
95% PI															
8 Rickleån	1,9	0,9	0,6	0,3	0,2	0,1	0,1	0,1	0,2	0,2	0,2	0,3	0,3	0,4	0,7
95% PI	0-25	0-8	0-4	0-2	0-1	0-1	0-0	0-1	0-1	0-1	0-1	0-2	0-2	0-2	0-4
9 Sävarån	2,0	1,4	1,2	0,9	1,0	1,1	0,8	0,5	0,6	0,4	0,5	1,3	1,1	1,5	1,6
95% PI	0-11	0-9	0-7	0-4	0-4	0-4	0-3	0-2	0-3	0-2	0-2	0-5	0-4	0-5	0-5
10 Ume/Vindelälven	67	56	54	55	56	45	40	34	24	14	19	22	78	216	191
95% PI	20-227	9-337	12-241	14-211	20-155	12-162	9-173	12-88	10-55	4-38	7-49	9-51	26-224	90-506	83-440
11 Öreälven	2,9	1,3	0,8	0,4	0,3	0,4	0,4	0,2	0,2	0,2	0,2	0,9	0,9	1,4	1,6
95% PI	0-32	0-10	0-7	0-4	0-2	0-5	0-4	0-2	0-2	0-4	0-3	0-6	0-10	0-10	0-13
12 Lögdeälven	2,5	1,5	1,3	1,1	0,9	1,1	2,1	1,5	1,3	2,0	1,5	3,3	4,1	4,9	6,8
95% PI	0-14	0-8	0-7	0-5	0-4	0-5	0-9	0-7	0-6	0-9	0-8	0-14	1-16	1-19	1-25
Total assessment unit 2	137	107	94	86	93	84	121	89	73	61	72	105	188	367	379
95% PI	62-324	41-390	38-282	36-241	45-202	39-210	53-300	46-178	40-149	32-124	41-137	58-226	95-405	196-702	218-701
Assessment unit 3															
13 Lungan	1,2	0,9	0,9	1,2	1,5	0,9	1,2	0,8	0,4	0,6	1,1	1,1	1,8	2,3	2,1
95% PI	0-11	0-8	0-5	0-7	0-8	0-5	0-7	0-6	0-2	0-4	0-7	0-6	0-11	0-12	0-11
Total assessment unit 3	1,2	0,9	0,9	1,2	1,5	0,9	1,2	0,8	0,4	0,6	1,1	1,1	1,8	2,3	2,1
95% PI	0-11	0-8	0-5	0-7	0-8	0-5	0-7	0-6	0-2	0-4	0-7	0-6	0-11	0-12	0-11
Assessment unit 4															
14 Emån	5	5	5	5	5	16	5	5	3	3	4	4	4	5	3
95% PI	3-6	3-6	3-6	3-6	3-6	11-20	3-6	3-6	2-4	1-3	3-5	2-4	3-5	3-6	2-4
15 Mörrumsån	125	124	125	125	125	104	93	62	31	36	62	62	79	102	73
95% PI	91-168	91-169	90-169	91-168	91-170	76-142	68-127	45-84	22-42	26-49	45-84	45-84	57-107	74-137	53-98
Total assessment unit 4	130	130	130	130	130	120	98	67	34	39	66	66	83	107	76
95% PI	96-173	96-174	96-174	97-173	96-176	91-157	73-132	50-89	25-45	29-51	49-89	49-88	61-111	79-142	56-102

	Wild smolt production (thousand)																Method
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**of estimation**
Assessment unit 1																	
1 Tornionjoki	646	613	660	662	706	748	1092	1248	1386	1556	1628	1551	1294	1217	1526	1895	1,2
95% PI	547-761	490-766	530-819	545-802	554-900	598-938	876-1359	1035-1510	1154-1671	1298-1865	1352-1961	1248-1943	1044-1593	976-1519	1066-2180	839-4397	
2 Simojoki	48	45	33	26	34	34	37	22	35	39	32	37	41	35	50	42	1,2
95% PI	35-66	31-62	23-46	19-35	24-46	25-43	26-50	15-30	25-47	32-47	23-44	32-43	32-52	22-53	23-107	11-154	
3 Kalixälven	443	377	497	726	629	902	648	828	716	769	967	852	961	887	993	732	1
95% PI	155-1263	132-1065	168-1487	237-2230	220-1782	319-2623	226-1809	291-2319	254-2076	273-2168	324-2767	303-2400	343-2735	317-2599	338-2958	137-3772	
4 Råneälven	25	18	26	42	37	46	52	44	56	67	58	56	57	64	75	78	1
95% PI	7-87	5-60	8-82	13-126	11-124	15-138	17-155	13-142	18-168	21-198	19-177	18-170	19-168	21-191	23-242	13-460	
Total assessment unit 1	1180	1072	1236	1476	1433	1752	1867	2176	2235	2478	2723	2547	2398	2253	2756	3106	
95% PI	856-2003	779-1777	868-2230	956-2989	975-2568	1136-3479	1352-3054	1568-3697	1665-3593	1866-3893	1994-4544	1854-4118	1686-4173	1578-3992	1822-4780	1526-7009	
Assessment unit 2																	
5 Piteälven	13	8	10	9	22	33	28	22	19	12	14	22	25	15	26	26	5
95% PI	7-25	4-14	5-19	4-16	14-33	18-60	18-43	14-34	12-29	7-18	8-21	13-33	15-38	10-23	16-40	16-39	
6 Åbyälven	12	8	8	6	4	13	21	16	13	15	18	23	24	23	29	23	1
95% PI	3-39	2-26	2-25	1-20	1-16	3-45	6-65	4-52	3-41	4-50	5-59	7-70	7-75	7-69	8-97	2-189	
7 Byskeälven	86	76	76	103	119	158	131	121	127	143	156	134	168	140	203	140	1
95% PI	29-258	25-226	25-229	32-333	40-355	51-488	43-377	41-354	42-376	47-421	53-477	46-394	56-491	47-403	61-682	32-609	
Kågeälven							16	15	10	8	7	10	17	18	25	20	1
95% PI							4-60	3-62	2-42	1-35	1-31	2-40	4-65	4-71	5-98	3-107	
8 Rickleån	0,8	1,0	0,7	0,8	0,4	0,9	0,6	0,6	0,5	1,0	1,0	1,1	2,2	0,7	0,7	0,9	1,2
95% PI	0-5	0-5	0-4	0-5	0-3	0-5	0-3	0-3	0-3	0-5	0-5	0-5	1-2	0-4	0-5	0-14	
9 Sävarån	1,6	1,9	2,3	3,8	3,0	3,2	4,5	2,8	2,3	2,2	3,3	4,2	5,1	5,6	6,2	5,9	1,2
95% PI	0-6	0-6	0-7	3-4	2-3	2-4	3-6	1-5	1-3	1-3	1-9	2-6	2-12	2-14	2-15	1-21	
10 Ume/Vindelälven	226	265	118	190	174	203	207	170	159	204	277	260	316	284	380	387	1,2
95% PI	109-456	118-600	56-250	103-349	91-326	111-360	114-371	104-279	119-209	165-252	209-368	195-342	191-516	176-455	197-712	137-1085	
11 Öreälven	1,6	2,5	3,8	3,3	3,5	5,1	4,1	3,6	3,3	4,4	4,1	5,1	5,2	4,4	4,8	4,2	1
95% PI	0-12	0-16	0-22	0-19	0-19	0-26	0-24	0-19	0-18	0-25	0-23	0-27	0-31	0-27	0-29	0-37	
12 Lögdeälven	6,2	5,1	5,8	7,3	9,3	10,5	9,5	7,8	8,4	7,8	8,3	9,4	7,1	10,1	12,0	9,3	1
95% PI	1-23	1-21	1-22	1-27	2-34	2-38	2-35	1-30	2-29	2-29	2-30	2-34	1-27	2-37	3-47	1-66	
Total assessment unit 2	377	394	249	350	364	463	460	391	363	419	517	498	618	543	753	734	
95% PI	222-657	215-755	146-444	214-612	224-631	289-815	300-746	261-643	254-617	300-708	374-840	363-765	405-971	365-851	464-1334	365-1614	
Assessment unit 3																	
13 Lungan	1,7	1,1	1,0	0,9	0,7	1,9	1,3	0,9	1,6	0,9	0,8	1,0	1,4	0,8	2,3	1,9	1
95% PI	0-9	0-6	0-6	0-5	0-4	0-11	0-7	0-5	0-10	0-9	0-7	0-7	0-9	0-5	0-14	0-13	
Total assessment unit 3	1,7	1,1	1,0	0,9	0,7	1,9	1,3	0,9	1,6	0,9	0,8	1,0	1,4	0,8	2,3	1,9	
95% PI	0-9	0-6	0-6	0-5	0-4	0-11	0-7	0-5	0-10	0-9	0-7	0-7	0-9	0-5	0-14	0-13	
Assessment unit 4																	
14 Emån	3	3	3	3	3	1	2	4	2	2	2	2	2	4	4	4	3,4
95% PI	2-4	2-4	1-3	2-4	2-4	0-1	1-2	2-5	1-2	1-2	1-2	1-2	1-2	2-4	2-4	2-4	
15 Mörrumsån	70	57	78	52	68	88	38	44	63	65	65	35	82	73	73	73	3,4
95% PI	51-95	41-78	57-106	38-70	49-91	75-101	32-44	38-50	53-74	50-81	50-82	27-45	64-105	57-93	57-93	57-93	
Total assessment unit 4	73	60	81	55	71	88	40	48	65	66	67	37	84	77	77	77	
95% PI	54-99	44-81	59-109	41-73	52-95	76-101	34-46	42-54	55-75	52-83	52-84	29-46	66-107	60-97	60-96	61-96	

Method of estimation of prior pdf of current smolt production: 1. Bayesian linear regression model (see Annex 3) 2. Sampling of smolts and estimate of total smolt run size. 3. Estimate of smolt run from parr production by relation developed in the same river. 4. Estimate of smolt run from parr production by relation developed in another river. 5. Inference of smolt production from data derived from similar rivers in the region.

Table 4.2.1.2. Median values and coefficients of variation of the estimated M74 mortality for different Atlantic salmon stocks (spawning years 1985–2013). The values in bold are based on observation data from hatchery or laboratory monitoring in the river and year concerned. Grey cells represent predictive estimates for years from which no monitoring data were available.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Simojoki	**8**	**3**	**6**	**2**	**11**	**4**	**43**	**64**	**50**	**64**	**53**	**55**	**8**	**44**	**25**	**27**	**23**	**1**	**2**	**2**	**4**	**13**	**7**	**5**	**4**	**2**	**0**	**1**	**1**
cv	0,61	0,91	0,54	1,07	0,50	0,74	0,17	0,13	0,16	0,10	0,15	0,14	0,31	0,11	0,21	0,22	0,22	0,56	0,57	0,88	0,49	0,30	0,48	0,50	0,65	0,74	2,05	1,41	1,18
Tornionjoki	11	8	**10**	**6**	**12**	**14**	**44**	**62**	**76**	**53**	**42**	**24**	**7**	**44**	**20**	**26**	**34**	**0**	**0**	2	**5**	**5**	**7**	**3**	**7**	**3**	**0**	**0**	3
cv	0,74	0,85	0,74	0,99	0,74	0,67	0,32	0,25	0,07	0,10	0,32	0,49	0,43	0,18	0,22	0,22	0,23	1,11	1,39	1,25	0,51	0,49	0,64	0,62	0,48	1,02	2,04	1,51	1,12
Kemijoki	11	8	9	6	12	15	42	63	60	43	42	24	4	31	17	19	24	1	1	2	**10**	**21**	**14**	**11**	**6**	**3**	0	2	4
cv	0,77	0,85	0,81	0,97	0,72	0,68	0,33	0,25	0,23	0,31	0,30	0,48	0,86	0,41	0,51	0,53	0,45	1,03	1,49	1,26	0,32	0,29	0,40	0,33	0,54	0,71	1,89	1,30	1,07
Luleälven	11	8	10	6	12	14	**46**	**56**	**54**	**38**	**35**	**28**	**2**	**27**	**14**	**21**	**25**	**1**	**1**	**1**	**5**	**10**	**7**	**7**	**21**	**1**	**1**	**1**	**1**
cv	0,79	0,84	0,78	0,97	0,75	0,66	0,14	0,16	0,08	0,13	0,18	0,15	0,34	0,11	0,17	0,14	0,20	0,59	0,40	0,65	0,38	0,25	0,24	0,26	0,19	0,41	0,62	0,77	0,61
Skellelteälven	11	8	9	6	12	14	**34**	**44**	**61**	**38**	**51**	**14**	**2**	**33**	**9**	**13**	**14**	**1**	**0**	**1**	**1**	**7**	**2**	**1**	**4**	**2**	**1**	**10**	**1**
cv	0,77	0,86	0,77	0,96	0,76	0,66	0,20	0,18	0,09	0,16	0,19	0,30	0,64	0,17	0,32	0,29	0,32	0,69	1,52	0,86	0,72	0,40	0,86	0,88	0,56	0,74	0,96	0,46	0,81
Ume/Vindelälven	**16**	**18**	**13**	**10**	**23**	**30**	**60**	**73**	**77**	**51**	**52**	**27**	**5**	**40**	**28**	**26**	**24**	**2**	**1**	**0**	**2**	**7**	**3**	**10**	**14**	**6**	**0**	**4**	**10**
cv	0,24	0,30	0,29	0,47	0,27	0,31	0,14	0,15	0,07	0,13	0,19	0,19	0,46	0,15	0,19	0,19	0,24	0,61	0,72	1,43	0,62	0,41	0,56	0,31	0,32	0,41	2,12	0,56	0,44
Ångermanälven	12	9	9	6	12	14	**40**	**65**	**58**	**35**	**43**	**16**	**2**	**23**	**14**	**18**	**29**	**2**	**1**	**2**	**7**	**14**	**11**	**3**	**13**	**4**	**1**	**1**	**2**
cv	0,77	0,81	0,80	0,96	0,74	0,68	0,15	0,15	0,10	0,15	0,21	0,19	0,57	0,17	0,21	0,19	0,21	0,58	0,53	0,59	0,40	0,27	0,28	0,41	0,27	0,42	0,97	0,73	0,63
Indalsälven	**6**	**6**	**5**	**2**	**6**	**5**	**36**	**61**	**62**	**31**	**44**	**17**	**1**	**17**	**14**	**6**	**14**	**1**	**0**	**2**	**5**	**8**	**12**	**2**	**7**	**3**	**0**	**0**	**2**
cv	0,23	0,29	0,29	0,51	0,30	0,37	0,15	0,16	0,08	0,14	0,19	0,19	0,65	0,19	0,21	0,33	0,24	0,67	1,50	0,59	0,41	0,29	0,24	0,44	0,30	0,39	2,20	1,34	0,54
Ljungan	11	9	9	6	12	14	**48**	**70**	**50**	**42**	**25**	**23**	**4**	**23**	**12**	**9**	**29**	**1**	1	2	5	11	8	6	9	4	0	2	4
cv	0,76	0,81	0,78	0,97	0,74	0,68	0,20	0,20	0,19	0,19	0,29	0,32	0,58	0,29	0,49	0,56	0,29	1,16	1,38	1,22	0,75	0,61	0,84	0,82	0,73	1,07	1,91	1,37	1,12
Ljusnan	2	1	1	1	1	**11**	**28**	**64**	**56**	**42**	**49**	**17**	**3**	**32**	**16**	**31**	**24**	**2**	**0**	**1**	**7**	**8**	**6**	**7**	**6**	**2**	**0**	**1**	**2**
cv	0,85	0,91	0,87	1,03	0,82	0,38	0,19	0,16	0,09	0,14	0,19	0,22	0,44	0,18	0,21	0,16	0,25	0,59	1,55	1,39	0,42	0,36	0,36	0,32	0,35	0,52	2,07	0,76	0,60
Dalälven	**8**	**7**	**14**	**7**	**8**	**14**	**61**	**71**	**49**	**42**	**39**	**28**	**6**	**27**	**18**	**23**	**23**	**2**	**1**	**4**	**5**	**9**	**5**	**10**	**11**	**2**	**0**	**1**	**7**
cv	0,43	0,38	0,27	0,45	0,45	0,36	0,14	0,15	0,10	0,17	0,19	0,18	0,35	0,17	0,20	0,19	0,21	0,56	0,52	0,47	0,40	0,29	0,36	0,26	0,25	0,43	2,08	0,68	0,44
Mörrumsån	**36**	**43**	**29**	**35**	**51**	**40**	**43**	**74**	**63**	**46**	**39**	**19**	4	31	18	19	24	1	1	2	5	10	8	6	9	4	0	2	3
cv	0,16	0,25	0,22	0,35	0,22	0,31	0,17	0,16	0,18	0,17	0,24	0,32	0,88	0,41	0,52	0,51	0,45	1,04	1,38	1,35	0,72	0,63	0,79	0,79	0,72	1,01	2,01	1,31	1,16
Unsampled stock	11	9	10	6	12	15	43	62	59	44	42	24	4	31	17	20	24	1	1	2	5	11	8	6	9	4	0	2	4
cv	0,78	0,82	0,75	0,97	0,73	0,67	0,31	0,24	0,24	0,29	0,32	0,49	0,90	0,41	0,53	0,52	0,47	1,12	1,36	1,28	0,74	0,63	0,88	0,77	0,73	1,03	1,99	1,39	1,06

Table 4.2.2.2. Potential smolt production capacity (PSPC) Priors used in the 2014 Baltic salmon assessment model, and revised priors used in 2015's assessment. Priors are summarized in terms of their mode (most likely value), median and 90% probability interval (90% PI). Kågeälven was included in the assessment for the first time in 2015.

River (AU)	2014 PSPC prior			2015 PSPC prior		
	Mode	Median	90% PI	Mode	Median	90% PI
Kågeälven (2)	na	na	na	48.571	53.637	31,708-89,915
Rickleån (2)	3.500	13.120	2,108-28,690	13.067	15.063	8,115-27,859
Vindelälven (2)	77.488	232.700	43,840-1,162,000	349.599	521.884	182,545-1,489,501
Emån (4)	14.919	15.300	11,850-19,880	24.359	27.723	14,986-51,262
Mörrumsån (4)	90.101	92.740	70,480-123,200	60.356	67.508	39,248-116,860

Table 4.2.3.1. Posterior probability distributions for steepness, alpha and beta parameters of the Beverton–Holt stock–recruit relationship and eggs per recruit (EPR, millions) for Baltic salmon stocks. Posterior distributions are summarised in terms of their mean and CV (%).

		Steepness		Alpha parameter		Beta parameter		EPR	
		Mean	cv	Mean	cv	Mean	cv	Mean	cv
Assessment unit 1									
1	Tornionjoki	0,62	13	48	25	0,000	33	327	29
2	Simojoki	0,54	18	128	25	0,014	24	623	36
3	Kalixälven	0,79	10	19	39	0,001	21	307	41
4	Råneälven	0,71	13	40	39	0,011	43	404	38
Assessment unit 2									
5	Piteälven	0,84	8	14	38	0,047	14	322	40
6	Åbyälven	0,74	15	36	58	0,050	37	393	40
7	Byskeälven	0,78	12	25	52	0,006	28	363	39
8	Kågeälven	0,71	20	51	93	0,017	34	422	42
9	Rickleån	0,62	15	72	24	0,064	42	496	37
10	Sävarån	0,71	15	42	48	0,178	39	413	39
11	Ume/Vindelälven	0,88	5	9	29	0,002	14	292	38
12	Öreälven	0,68	15	50	38	0,076	80	438	38
13	Lögdeälven	0,73	14	38	54	0,068	49	405	39
Assessment unit 3									
14	Ljungan	0,69	20	55	75	0,424	51	444	42
Assessment unit 4									
15	Emån	0,32	20	524	16	0,022	65	1014	29
16	Mörrumsån	0,46	30	145	53	0,011	27	447	35

Table 4.2.3.2. Posterior probability distributions for the smolt production capacity (* 1000) in AU1–4 rivers and the corresponding point estimates in AU5–6 rivers. The posterior distributions are described in terms of their mode or most likely value, the 90% probability interval (PI) and the method by which the posterior probability distribution was obtained. These estimates serve as reference points to evaluate the status of the stock. For the updated estimates of AU1–4 rivers except Kågeälven and Testeboån, medians as estimated by last years stock assessment are also shown. This enables comparison of how much the estimated medians have changed compared to last year.

		Smolt production capacity (thousand)				Method of	Last year´s median	% change
		Mode	Median	Mean	90% PI	estimation		
Assessment unit 1								
1	Tornionjoki	1703	2020	2537	1563-4816	1	2298	-12%
2	Simojoki	51	55	59	39-88	1	54	2%
3	Kalixälven	811	847	864	600-1186	1	735	15%
4	Råneälven	60	83	101	45-222	1	72	15%
	Total assessment unit 1	2810	3084	3561	2489-5894		3188	-3%
Assessment unit 2								
5	Piteälven	20	20	21	16-26	1	22	-6%
6	Åbyälven	13	18	21	11-41	1	19	-5%
7	Byskeälven	142	157	170	110-269	1	157	0%
8	Kågeälven	49	54	57	33-89	1	-	-
9	Rickleån	12	14	15	7-27	1	10	34%
10	Sävarån	3	5	7	3-13	1	5	-2%
11	Ume/Vindelälven	382	390	398	318-510	1	347	12%
12	Öreälven	5	14	26	4-82	1	22	-34%
13	Lögdeälven	5	13	21	7-66	1	33	-59%
	Total assessment unit 2	649	661	678	556-845		689	-4%
Assessment unit 3								
14	Ljungan	0,6	2,2	3,6	1-10	1	2,0	13%
15	Testeboån	10	10	10	-	3	-	-
	Total assessment unit 3	10,6	12,2	13,6	11-20		12,0	2%
Assessment unit 4								
16	Emån	19	23	24	11-43	1	15	55%
17	Mörrumsån	61	63	64	47-87	1	82	-23%
	Total assessment unit 4	85	87	89	67-118		97	-10%
Total assessment units 1-4		**3628**	**3872**	**4332**	**3226-6665**		**4020**	-4%
Assessment unit 5								
18	Pärnu		4			2	4	0%
19	Salaca		30			3	30	0%
20	Vitrupe		4			3	4	0%
21	Peterupe		5			3	5	0%
22	Gauja		29			3	29	0%
23	Daugava		11			3	11	0%
24	Irbe		4			3	4	0%
25	Venta		15			3	15	0%
26	Saka		8			3	8	0%
27	Uzava		4			3	4	0%
28	Barta		4			3	4	0%
29	Nemunas river basin		164			3	164	0%
	Total assessment unit 5		282				282	0%
Assessment unit 6								
30	Kymijoki		100			2	100	0%
31	Luga		100			4	100	0%
32	Purtse		8			2	8	0%
33	Kunda		2			2	2	0%
34	Selja		11			2	11	0%
35	Loobu		11			2	11	0%
36	Pirita		10			2	10	0%
37	Vasalemma		1			2	1	0%
38	Keila		5			2	5	0%
39	Valgejögi		2			2	2	0%
40	Jägala		0,3			2	0,3	0%
41	Vääna		2			2	2	0%
	Total assessment unit 6		252				252	0%
Total assessment units 1-6			**4378**				**4554**	-4%

Methods of estimating potential production

1. Bayesian stock-recruit analysis
2. Accessible linear stream length and production capacity per area.
3. Expert opinion with or without associated uncertainty
4. Estimate inferred from stocking of reared fish in the river

Table 4.2.3.3. Salmon smolt production in Baltic rivers with natural reproduction of salmon grouped by assessment units. Median number (x 1000) of smolts from natural reproduction with the associated uncertainty (90% Probability interval). Note that in WGBAST report 2011 and earlier, distributions were described in terms of their modes (single most likely value) instead of their medians. From this year (2015) also reproductive areas are shown as medians with 90% PI (previously modes with 95% PI). Note finally that some Swedish rivers have new/updated habitat areas (i.e. Rickleån, Ume/Vindelälven, Kågeälven, Emån, Mörrumsån).

Assessment unit, sub-division, country	Category	Reprod. area (ha, median)	Potential (*1000)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Pred 2015	Pred 2016	Pred 2017	Method of estimation	
																										Pot. prod.	Pres. prod.
Gulf of Bothnia, Sub-div. 30-31:																											
Finland																											
Simojoki	wild	252	55	3	6	9	11	28	45	48	48	39	31	35	32	37	31	39	39	33	36	35	29	45	44	1	1
90% PI		222-285	39-89	1-4	4-9	5-12	7-15	20-37	35-57	37-61	36-61	30-50	24-39	27-44	26-40	29-47	23-40	30-49	32-45	25-41	31-41	28-42	22-39	30-66	29-65		
Finland/Sweden																											
Tornionjoki;Torneälven	wild	5409	2020	101	78	120	195	542	706	636	648	668	647	828	779	1069	1142	1196	1408	1468	1399	1267	1277	1955	1998	1	1
90% PI		4282-6835	1564-4816	75-133	58-104	93-153	156-241	446-660	591-844	543-739	529-781	549-808	544-767	677-1022	634-944	895-1252	941-1363	1001-1412	1211-1635	1261-1722	1164-1705	1052-1518	1050-1544	1242-3608	1271-3745		
Sweden																											
Kalixälven	wild	2604	847	137	120	228	289	746	655	687	631	677	633	802	700	758	730	654	702	742	732	771	791	842	845	1	1
90% PI		2124-3200	600-1186	67-263	61-226	129-387	166-472	519-1156	459-972	461-1016	417-908	443-1091	412-958	539-1204	482-1019	519-1139	503-1036	445-932	474-1004	480-1100	484-1094	510-1169	517-1215	530-1354	530-1367		
Råneälven	wild	386	83	7	6	14	17	30	35	28	29	28	33	41	40	48	45	48	50	56	54	53	59	75	75	1	1
90% PI		332-449	46-222	2-16	2-15	6-27	8-34	16-51	20-57	15-48	16-48	15-47	18-54	25-65	25-62	30-76	28-72	30-76	30-80	33-92	33-90	32-88	35-100	40-149	40-155		
Assessment unit 1, total			**3084**	**251**	**213**	**369**	**518**	**1353**	**1455**	**1400**	**1357**	**1424**	**1346**	**1721**	**1562**	**1930**	**1955**	**1950**	**2200**	**2314**	**2238**	**2142**	**2188**	**3018**	**3043**		
90% PI			2489-5895	172-389	148-325	271-522	385-707	1110-1762	1226-1785	1157-1753	1118-1661	1147-1809	1105-1697	1397-2141	1287-1915	1625-2328	1664-2315	1650-2303	1901-2559	1977-2728	1891-2703	1771-2608	1816-2653	2134-4600	2141-4621		
Piteälven	wild	441	20	3	4	5	5	8	16	15	13	14	13	18	20	22	20	19	16	17	20	21	18	21	20	1	1
90% PI		374-484	17-26	1-5	2-6	3-8	3-8	5-12	11-22	10-20	8-17	9-19	9-18	13-24	14-28	16-29	14-26	14-25	11-20	12-22	14-26	15-28	13-23	13-31	13-31		
Åbyälven	wild	86	18	4	4	6	8	13	15	13	12	11	11	13	13	15	14	14	14	15	15	15	16	18	18	1	1
90% PI		70-105	11-42	1-8	1-9	3-12	3-14	7-20	9-24	7-20	7-19	6-17	6-17	7-20	8-21	9-25	9-22	9-22	9-22	9-25	9-25	9-24	9-27	10-35	10-35		
Byskeälven	wild	563	157	32	30	51	69	103	115	111	105	106	112	131	122	140	134	132	137	143	137	137	143	158	158	1	1
90% PI		482-659	110-270	15-65	13-61	26-92	36-116	63-160	75-174	71-170	65-163	65-165	70-172	85-200	79-185	90-214	87-204	85-202	88-212	91-224	86-214	88-217	90-229	94-279	94-279		
Rickleån	wild	31	14	0,3	0,2	0,3	0,3	0,4	0,8	0,8	0,7	0,7	0,7	0,7	0,9	1,4	1,2	1,4	1,4	1,7	1,6	1,9	2,2	4,7	4,9	1	1
90% PI		22-44	7-27	0-0	0-0	0-0	0-0	0-0	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-2	0-2	0-2	0-2	0-3	0-2	1-2	1-3	2-8	2-8		
Sävarån	wild	22	5	1	1	2	2	2	3	2	2	2	3	3	3	4	3	3	3	4	4	4	4	5	5	1	1
90% PI		14-36	3-14	0-2	0-1	0-2	0-3	1-3	1-4	1-3	1-3	1-3	2-4	2-3	2-3	3-5	2-4	2-3	2-3	2-5	2-5	2-5	2-6	2-8	2-8		
Ume/Vindelälven	wild	1768	390	18	44	92	130	333	284	167	316	185	224	303	309	297	284	217	251	345	309	306	323	363	377	1	1
90% PI		1394-2246	319-510	8-33	20-84	55-140	80-199	244-451	214-373	114-238	234-423	128-259	155-316	219-425	231-416	210-398	205-379	171-269	204-302	277-435	245-388	226-411	239-434	245-548	252-564		
Öreälven	wild	107	14	0,6	0,5	0,8	0,8	2	2	2	2	2	2	3	3	4	4	4	4	5	5	5	6	10	10	1	1
90% PI		88-131	5-82	0-1	0-1	0-1	0-2	0-3	1-4	0-4	1-4	0-4	1-4	1-5	1-5	2-7	2-7	2-8	2-8	2-10	2-10	2-10	3-13	4-24	4-25		
Lögdeälven	wild	106	13	1,8	1,6	2,6	3,8	6	7	6	6	6	7	8	8	9	9	9	9	10	10	10	11	13	13		
90% PI		86-131	8-66	0-4	0-3	1-5	1-7	2-10	4-12	3-11	3-10	3-10	3-11	4-13	4-13	5-15	5-14	5-14	5-15	6-17	5-17	5-16	6-19	6-29	6-31		
Kågeälven	wild	96	54													17	15	10	8	8	10	17	19	24	39	1	1
90% PI		67-139	33-89													4-70	3-59	2-39	1-33	1-31	2-42	4-67	4-71	5-98	17-73		
Assessment unit 2, total			**719**	**62**	**89**	**163**	**222**	**472**	**450**	**322**	**466**	**328**	**380**	**487**	**485**	**500**	**495**	**418**	**453**	**562**	**527**	**534**	**559**	**641**	**669**		
90% PI			612-904	40-99	56-138	114-226	161-305	372-602	364-550	250-416	363-590	253-426	285-481	388-626	393-612	399-624	394-611	342-515	383-537	464-678	435-638	424-655	444-702	493-866	508-894		
Ljungan	wild	20	2	0,39	0,78	0,91	1,24	1,57	1,63	1,44	1,46	1,33	1,22	1,47	1,36	1,57	1,49	1,57	1,48	1,51	1,53	1,47	1,56	1,97	1,96	1	1
90% PI		11-35	1-10	0-1	0-1	0-1	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	1-4	1-4		
Assessment unit 3, total			2	**0,39**	**0,78**	**0,91**	**1,24**	**1,57**	**1,63**	**1,44**	**1,46**	**1,33**	**1,22**	**1,47**	**1,36**	**1,57**	**1,49**	**1,57**	**1,48**	**1,51**	**1,53**	**1,47**	**1,56**	**1,97**	**1,96**		
95% PI			1-10	0-1	0-1	0-1	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	1-4	1-4		
Total Gulf of B., Sub-divs.30-31			**3833**	**317**	**308**	**541**	**745**	**1839**	**1912**	**1728**	**1828**	**1751**	**1738**	**2217**	**2055**	**2431**	**2451**	**2371**	**2660**	**2881**	**2774**	**2679**	**2756**	**3670**	**3722**		
90% PI			3202-6646	230-462	223-429	418-710	579-959	1547-2289	1649-2249	1476-2084	1556-2151	1466-2142	1456-2103	1872-2673	1757-2435	2099-2861	2144-2827	2053-2745	2353-3025	2537-3318	2416-3253	2303-3179	2347-3265	2734-5322	2800-5401		

Assessment unit, sub-division, country	Category	Reprod. area (ha, median)	Potential (*1000)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Pred 2015	Pred 2016	Pred 2017	Method of estimation Pot. prod.	Method of estimation Pres. prod.
Sweden																											
Emån	wild	40	14	2	4	4	4	6	3	3	3	3	3	3	1,5	2,1	2,8	2,0	2,0	1,7	1,5	1,7	3,5	2,9	3,4	1	1
90% PI		30-49	10-20	1-3	3-5	3-5	3-5	4-7	2-3	2-3	2-3	2-3	2-4	2-3	1-2	1-2	2-3	1-2	1-2	1-2	1-2	1-2	2-4	1-4	2-5		
Mörrumsån	wild	56	82	43	63	64	76	88	66	66	57	70	57	64	83	42	46	63	64	65	41	72	73	72	76	1	1
90% PI		44-75	60-115	32-55	49-79	50-81	59-96	69-112	51-83	52-84	44-72	55-88	45-72	50-80	72-94	35-48	40-52	54-72	52-78	52-79	33-50	58-89	59-89	48-107	50-114		
Assessment unit 4, total			**87**	**45**	**67**	**67**	**81**	**94**	**68**	**69**	**60**	**73**	**61**	**67**	**84**	**44**	**49**	**65**	**66**	**66**	**43**	**74**	**76**	**76**	**81**		
90% PI			67-118	35-58	53-83	54-85	65-102	74-120	54-86	55-86	48-76	58-92	48-76	52-85	74-96	38-50	43-55	56-74	55-81	54-80	35-52	60-92	62-92	50-111	55-118		
Estonia																											
Pärnu	wild	3	4		4,30	1,83	0,95	0,15	0,25	0,23	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00		2	3, 4
Latvia																											
Salaca	wild	47	30	22,3	22,2	31,9	29,5	21,1	33,1	32,7	28,4	11,7	29,1	31,0	18,9	26,2	25,7	12,6	3,5	4,5	12,0	5,7				3	2
Vitrupe	wild	5	4						2,8	2,7	2,6	2,7	2,8	1,3	1,3	1,2	1,2	1,1	1,1	1,0	1,0	1,0				3	5
Peterupe	wild	5	5						2,8	2,7	2,7	2,7	2,7	2,7	1,3	1,2	1,2	1,1	1,1	1,0	1,0	1,0				3	2, 5
Gauja	mixed	50	29	15,5	15,4	14,3	14,3	14,3	13,7	13,8	13,6	11,6	11,6	11,6	11,4	10,7	10,5	8,4	7,4	6,0	8,0	4,0				3	2, 5
Daugava***	mixed	20	11						2,8	2,7	2,7	2,7	2,7	2,7	1,3	1,2	1,1	1,1	1,1	1,0	1,0	1,0				3	5, 6
Irbe	wild	10	4						6,8	6,7	6,5	5,4	6,7	2,9	3,0	2,4	2,3	2,3	2,3	2,0	2,0	2,0				3	5
Venta	mixed	30	15						12,1	11,9	11,9	11,9	11,9	11,8	9,7	8,7	8,7	8,6	7,6	6,0	8,0	5,0				3	2, 5
Saka	wild	20	8						2,4	2,4	2,4	2,4	2,4	2,4	2,4	1,4	1,4	2,1	2,1	2,1	2,0	1,0				3	5
Uzava	wild	5	4						2,8	2,8	2,7	2,7	2,7	2,7	1,3	1,2	1,2	1,1	1,1	1,0	1,0	1,0				3	5
Barta	wild	10	4						2,7	2,7	2,6	2,7	1,7	1,5	0,8	1,0	1,1	0,0	0,0	0,0	0,0	0,0				3	5
Lithuania																											
Nemunas river basin	wild		164	10	10	10	2	2	5	8	4	2	6	7	5	13	42	48	7	28	14	13				3	3, 4
Assessment unit 5, total			285						**87**	**90**	**80**	**59**	**80**	**77**	**56**	**68**	**96**	**86**	**34**	**53**	**50**	**35**					
Total Main B., Sub-divs. 22-29			385						**156**	**158**	**137**	**130**	**143**	**143**	**138**	**112**	**145**	**151**	**100**	**125**	**78**						

Assessment unit, sub-division, country	Category	Reprod. area (ha, median)	Potential (*1000)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Pred 2015	Pred 2016	Pred 2017	Method of estimation Pot. prod.	Method of estimation Pres. prod.
Finland:																											
Kymijoki	mixed	151)+602)	20[1)]+80[2)]					2	12	13	20	13	6	24	41	20	12	11	25	26	9	29	16	37		7	4
Russia:																											
Neva	mixed	0	0					7	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0		7	7
Luga	mixed	40	100					5	2,5	8	7,2	2	2,6	7,8	7	3	4	6,7	4,3	6,3	5	6,6	2,5			7	2
SE			51-144					4.8-5.2	2.4-2.6	7.7-8.3	6.9-7.5	1.9-2.1	2.0-35	5.1-16.5	4-10	1.9-4.1	2.8-6.1	4.8-8.6	2.7-5.9	1.9-4.1	3.2-6.8	4.3-8.9					
Estonia:																											
Purtse	mixed	7,6	7,6													0,05	2,6	2,2	0,4	1,1	0,0	4,3	3,1			7	4
Kunda	wild	1,9	2,1(2,8)					2,8	1,2	2,3	0,8	0,6	0,1	2,2	1,9	0,9	0,1	0,1	0,2	2,1	2,0	1,0	1,3			7	3
Selja	mixed	11,3	11,0					2,3	0,3	0,0	0,0	0,1	0,9	2,1	0,2	0,1	4,0	3,9	1,1	0,8	2,7	3,1	3,4			7	4
Loobu	mixed	9,9	10,5 (17)					0,5	0,7	0,3	0,1	2,4	4,2	7,8	1,7	0,0	0,1	10,5	4,5	3,5	2,7	3,5	11,6			7	4
Pirita	mixed	9,6	10,0					0,1	0,6	0,1	0,3	2,8	0,8	3,0	1,6	2,5	5,7	8,5	1,6	1,9	5,7	5,1	3,2			7	2, 3
SE														2.5-3.5	1.0-2.2	2.3-2.7	5.4-6.0	6.9-10.1	1.1-2.1	1.6-2.1	4.7-6.4	4.6-5.7					
Vasalemma	wild	2,4	1,0					0,0	0,3	0,2	0,1	0,0	0,0	0,0	0,2	0,0	0,2	0,1	0,3	0,7	0,2	0,6	0,7			7	4
Keila	wild	3,5	5,4 (12)					0,4	1,3	0,4	0,1	0,0	0,0	0,7	2,0	0,7	1,1	6,3	3,0	6,0	1,0	8,3	12,0			7	4
Valgejögi	mixed	1,5	1,7					0,1	0,1	0,1	0,0	0,03	0,4	0,3	0,3	0,7	0,5	0,6	0,8	0,4	0,1	0,4	0,5			7	4
Jägala	mixed	0,3	0,3					0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			7	4
Vääna	mixed	2	2,0					0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,6	0,2	0,1	0,0	0,2	0,3			7	4
Assessment unit 6, total		**165**	**252**					**20**	**25**	**30**	**34**	**21**	**15**	**48**	**56**	**28**	**30**	**51**	**41**	**49**	**28**	**62**	**55**				
Gulf of B.+Main B.+ Gulf of F., Sub-divs. 22-32			**4459**						**2094**	**1916**	**2003**	**1903**	**1893**	**2412**	**2254**	**2572**	**2626**	**2571**	**2801**	**3051**	**2899**	**2837**					
90% PI			3818-7261						1826-2436	1664-2278	1730-2322	1614-2304	1614-2262	2060-2864	1950-2637	2240-3000	2321-3002	2255-2942	2494-3166	2702-3488	2535-3378	2459-3345					

Table 4.2.3.4. Overview of the status of the Gulf of Bothnia and Main Basin stocks in terms of their probability to reach 50 and 75% of the smolt production capacity in 2014. Stocks are considered very likely to have reached this objective in case the probability is higher than 90%. They are likely to have reached the objective in case the probability is between 70 and 90%, uncertain when the probability is between 30 and 70 % and unlikely if the probability is less than 30%. For the AU1-4 stocks except Testeboån, the results are based on the assessment model, whilst the categorization of AU5-6 stocks and Testeboån is based on expert judgments - for those rivers there are no precise probabilities (column 'Prob').

		Prob to reach 50%					Prob to reach 75%				
		Prob	V.likely	Likely	Uncert.	Unlikely	Prob	V.likely	Likely	Uncert.	Unlikely
Unit 1	Tornionjoki	0,69			X		0,16				X
	Simojoki	0,78		X			0,23				X
	Kalixälven	1,00	X				0,82		X		
	Råneälven	0,73		X			0,34			X	
Unit 2	Piteälven	1,00	X				0,96	X			
	Åbyälven	0,90		X			0,61			X	
	Byskeälven	0,97	X				0,72		X		
	Kågeälven	0,31			X		0,17				X
	Rickleån	0,00				X	0,00				X
	Sävarån	0,83		X			0,51			X	
	Ume/Vindelälven	0,98	X				0,57			X	
	Öreälven	0,37			X		0,15				X
	Lögdeälven	0,76		X			0,44			X	
Unit 3	Ljungan	0,74		X			0,46			X	
	Testeboån	n.a.			X		n.a.				X
Unit 4	Emån	0,00				X	0,00				X
	Mörrumsån	1,00	X				0,96	X			
Unit 5	Pärnu	n.a.				X	n.a.				X
	Salaca	n.a.		X			n.a.			X	
	Vitrupe	n.a.			X		n.a.				X
	Peterupe	n.a.			X		n.a.				X
	Gauja	n.a.			X		n.a.				X
	Daugava	n.a.			X		n.a.				X
	Irbe	n.a.			X		n.a.				X
	Venta	n.a.			X		n.a.				X
	Saka	n.a.				X	n.a.				X
	Uzava	n.a.				X	n.a.				X
	Barta	n.a.				X	n.a.				X
	Nemunas	n.a.				X	n.a.				X
Unit 6	Kymijoki	n.a.				X	n.a.				X
	Luga	n.a.				X	n.a.				X
	Purtse	n.a.	X				n.a.			X	
	Kunda	n.a.		X			n.a.			X	
	Selja	n.a.			X		n.a.				X
	Loobu	n.a.			X		n.a.				X
	Pirita	n.a.	X				n.a.			X	
	Vasalemma	n.a.	X				n.a.			X	
	Keila	n.a.	X				n.a.	X			
	Valgejögi	n.a.			X		n.a.				X
	Jägala	n.a.				X	n.a.				X
	Vääna	n.a.				X	n.a.				X

Table 4.3.1.1. Key assumptions underlying the stock projections. The same post-smolt survival scenario and M74 scenario are assumed for all effort scenarios. Survival values represent the medians to which Mps and M74 are expected to return.

Scenario	Total commercial removal (dead catch) for year 2016
1	Removal that corresponds to ICES advice for fishing year 2015
2	20% increase to scenario 1
3	20% decrease to scenario 1
4(a)	F0.1 approach (commercial removal)
4(b)	F0.1 approach (total removal)
5	zero fishing
	In all scenarios we assume that the commercial removal covers 66% of the total sea fishing mortality, whereas 34% of this mortality consists of discards, misreported, unreported, and recreational sea fisheries. (See text for details)

Post-smolt survival of wild salmon
Average survival between 2010-2013 (14%)

Post-smolt survival of reared salmon
Same relative difference to wild salmon as on average in history

M74 survival
Historical median (96%)

Releases
Same number of annual releases in the future as in 2014

Maturation
Age group specific maturation rates in 2015 are predicted using january-march SST data. For other years, average maturation rates over the time series are used, separately for wild and reared salmon.

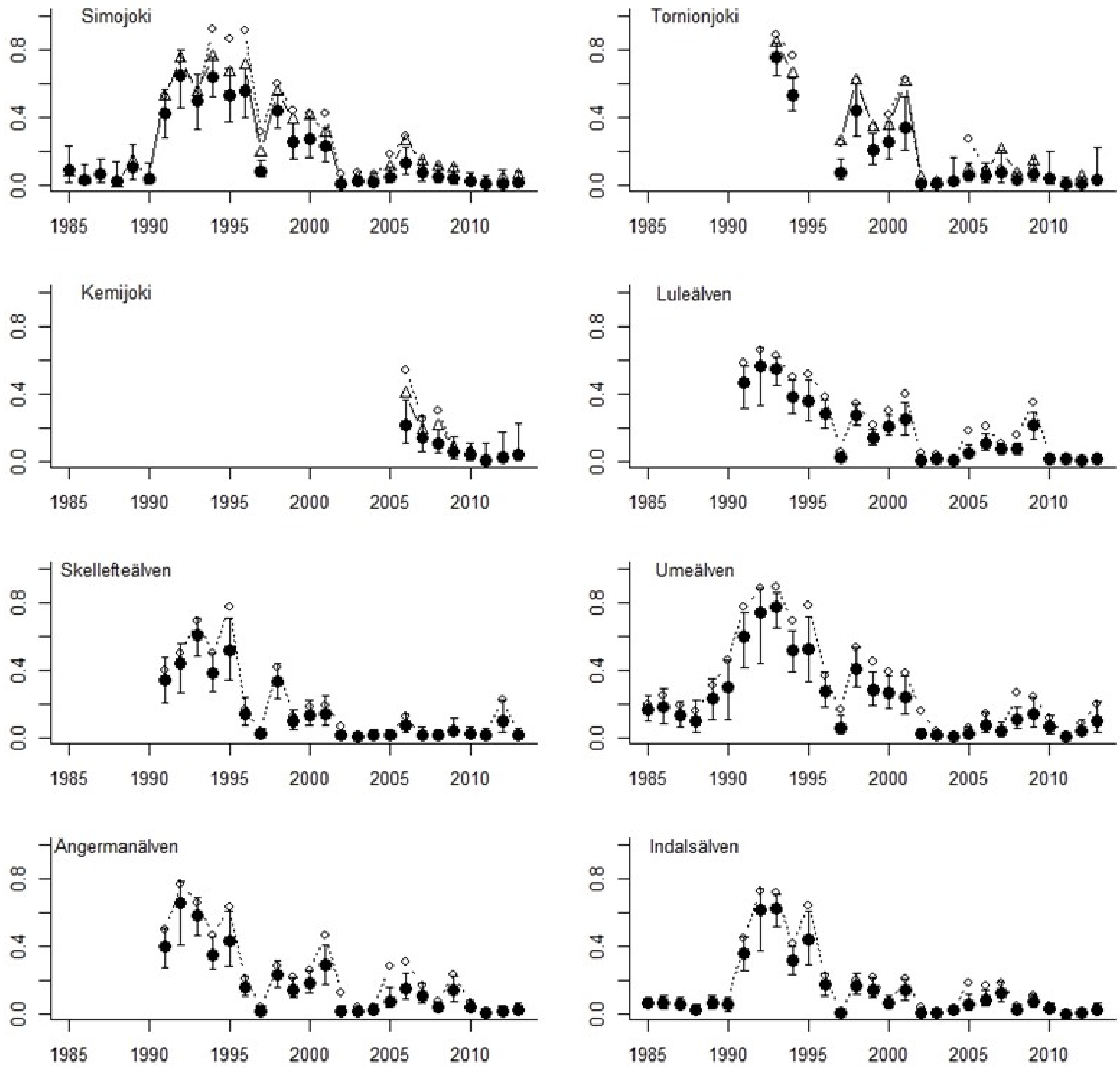
Table 4.3.2.1.

Scenario	Total commercial catch at sea	Wanted Catch Reported (% of 2015 EU TAC)		Unwanted Catch (Dead+Alive) Undersized	Unwanted Catch (Dead+Alive) Seal damaged	Wanted Catch Unreported	Wanted Catch Misreported
Commercial catches (thousands of fish) at sea in SD 22-31 in 2016							
1	116	89	93%	3,1	9	9	7
2	139	107	111%	3,7	10	10	8
3	93	71	74%	2,5	7	7	6
4(a)	96	74	77%	2,6	7	7	6
4(b)	83	63	66%	2,2	6	6	5
5	0	0	0%	0,0	0	0	0

Scenario	Recreational catch at sea 2016	Total sea catch (comm. + recr.) 2016	River catch 2016	Spawners 2016
1	20	136	39	136
2	23	163	36	125
3	16	108	43	148
4(a)	16	113	42	146
4(b)	14	96	44	153
5	0	0	0	245

Table 4.3.2.2. River specific probabilities in different scenarios to meet 75% of PSPC in 2020/2021 (depending on the assessment unit) Probabilities higher than 70% are presented in green.

River	Year of comparison	Probability to meet 75% of PSPC – Scenario 1	2	3	4(a)	5
Tornionjoki	2021	0,55	0,51	0,59	0,58	0,81
Simojoki	2021	0,16	0,13	0,21	0,22	0,52
Kalixälven	2021	0,88	0,85	0,88	0,88	0,92
Råneälven	2021	0,61	0,55	0,66	0,65	0,84
Piteälven	2021	0,88	0,86	0,90	0,87	0,93
Åbyälven	2021	0,74	0,72	0,78	0,76	0,87
Byskeälven	2021	0,80	0,80	0,86	0,85	0,90
Rickleån	2021	0,02	0,02	0,04	0,03	0,12
Sävarån	2021	0,65	0,65	0,70	0,69	0,81
Ume/Vindelälven	2021	0,89	0,88	0,90	0,90	0,91
Öreälven	2021	0,38	0,34	0,40	0,40	0,59
Lögdeälven	2021	0,68	0,64	0,68	0,68	0,81
Ljungan	2021	0,57	0,52	0,59	0,59	0,71
Mörrumsån	2020	0,70	0,69	0,73	0,73	0,88
Emån	2020	0,00	0,00	0,00	0,00	0,00


Simojoki
Tornionjoki
Kemijoki
Luleälven
Skellefteälven
Umeälven
Ångermanälven
Indalsälven
0.0
0.4
0.8
1985
1990
1995
2000
2005
2010

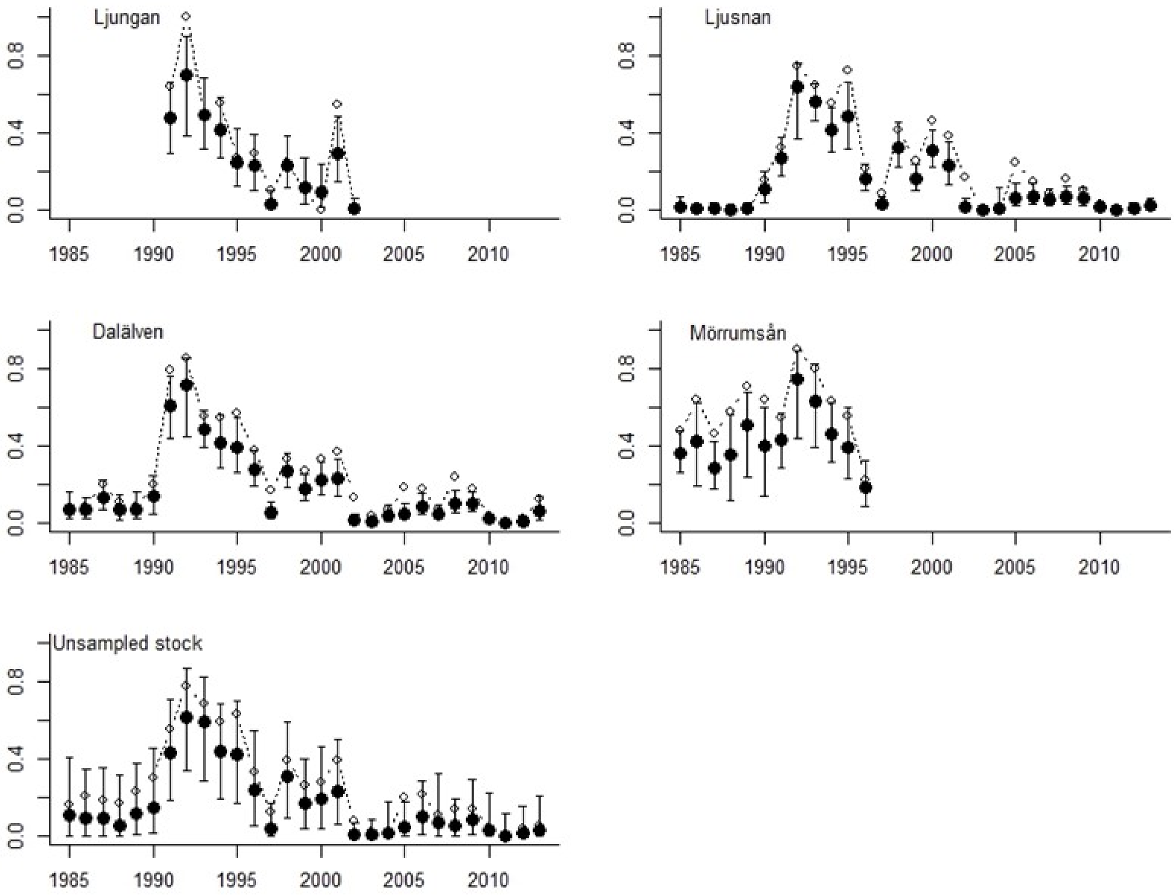


Figure 4.2.1.1. M74 mortality among Atlantic salmon stocks within the Baltic Sea by spawning year class in 1985–2013. Solid circles and whiskers represent the medians and 95% probability intervals of the estimated M74 mortality, respectively. Open circles represent the proportion of females with offspring affected by M74 and triangles the total average yolk-sac-fry mortalities among offspring.

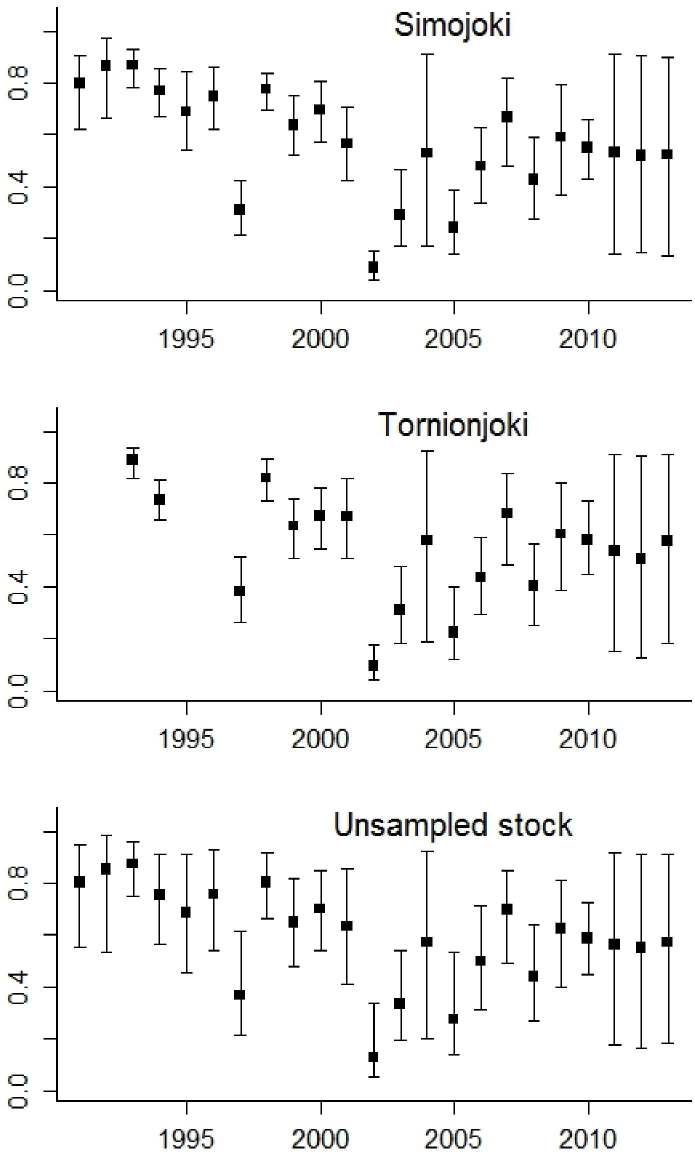


Figure 4.2.1.2. Estimated proportion of M74-affected offspring that die (i.e. mortality among those offspring that are from M74 affected females) by spawning year class in 1985–2013.

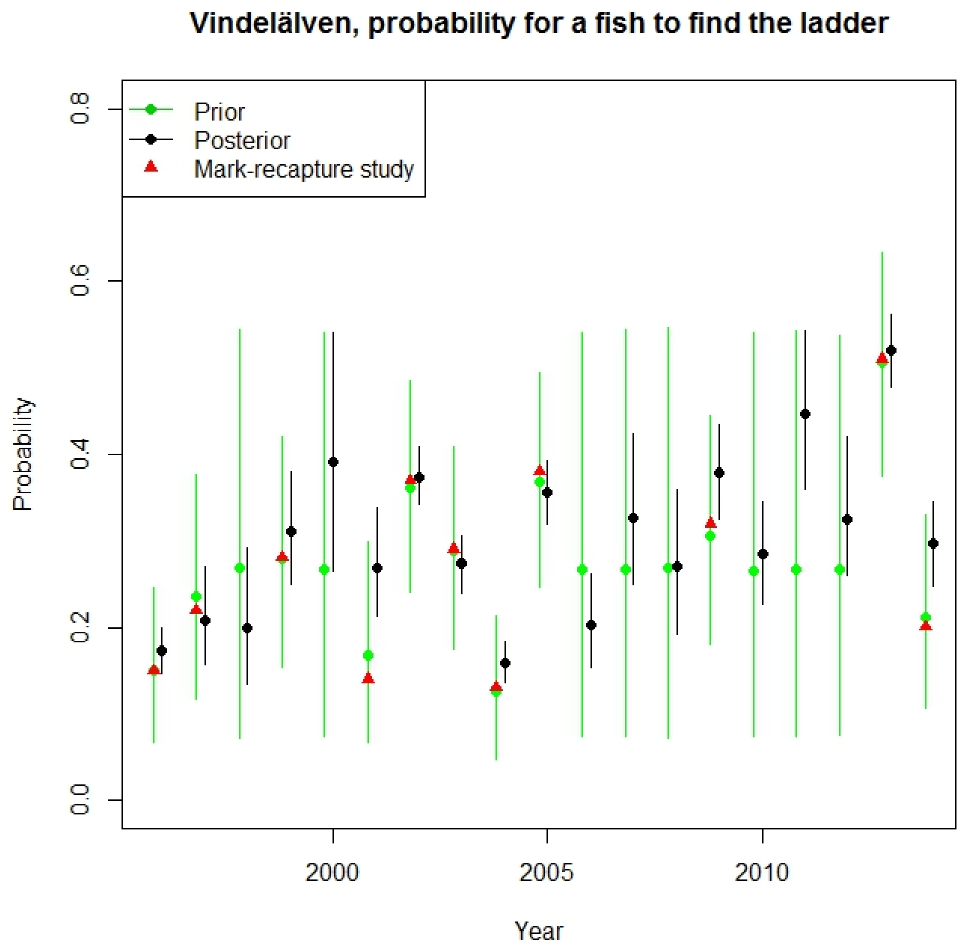


Figure 4.2.2.1. Probability that returning salmon find the fishladder in river Ume/Vindel. For years in which mark-recapture study has not taken place, prior distribution is the predictive distribution that is based on other year's mark–recapture studies.

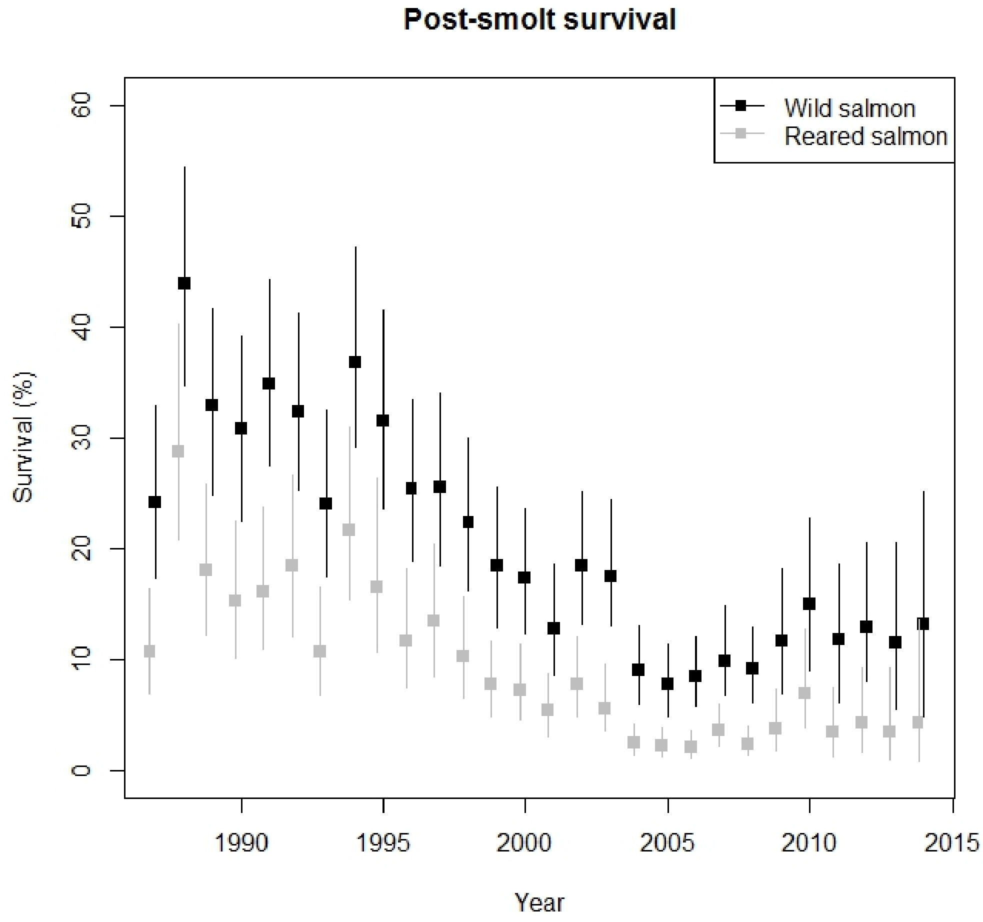


Figure 4.2.3.1. Post‒smolt survival for wild and hatchery-reared salmon.

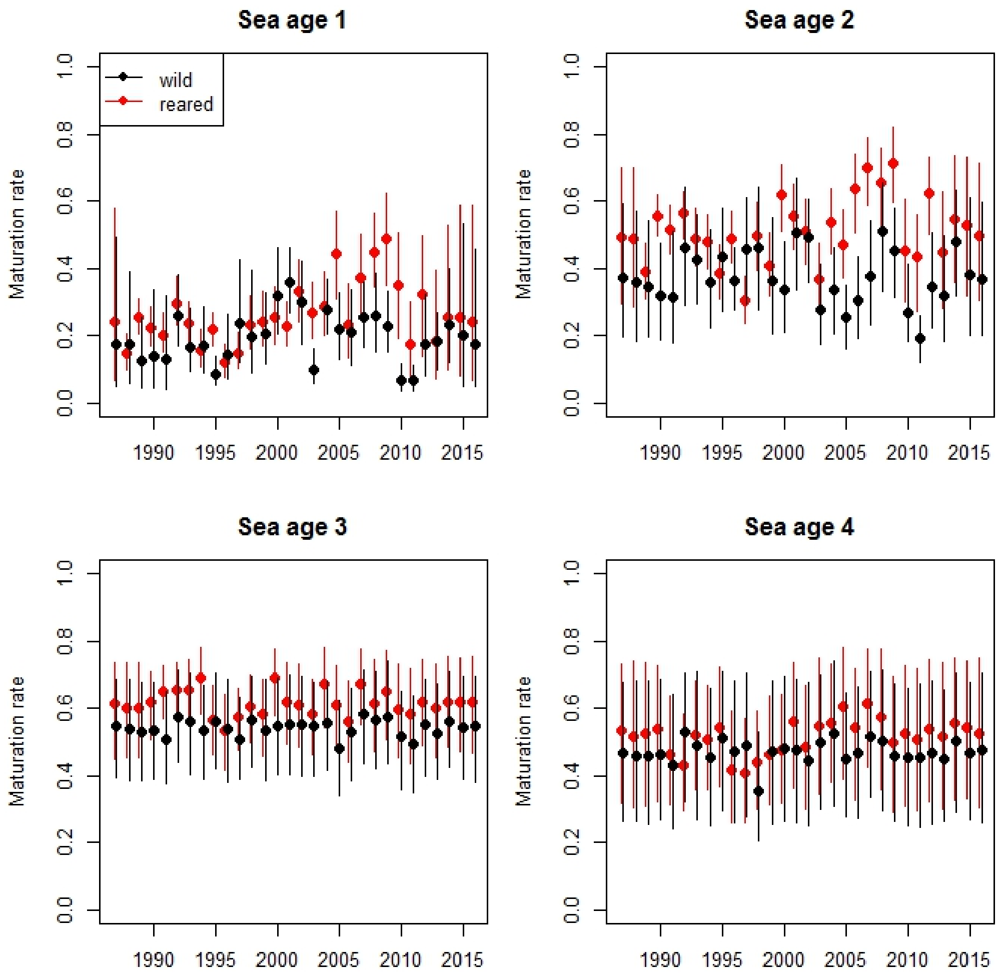


Figure 4.2.3.2. Proportion maturing per age group and per year for wild and reared salmon.

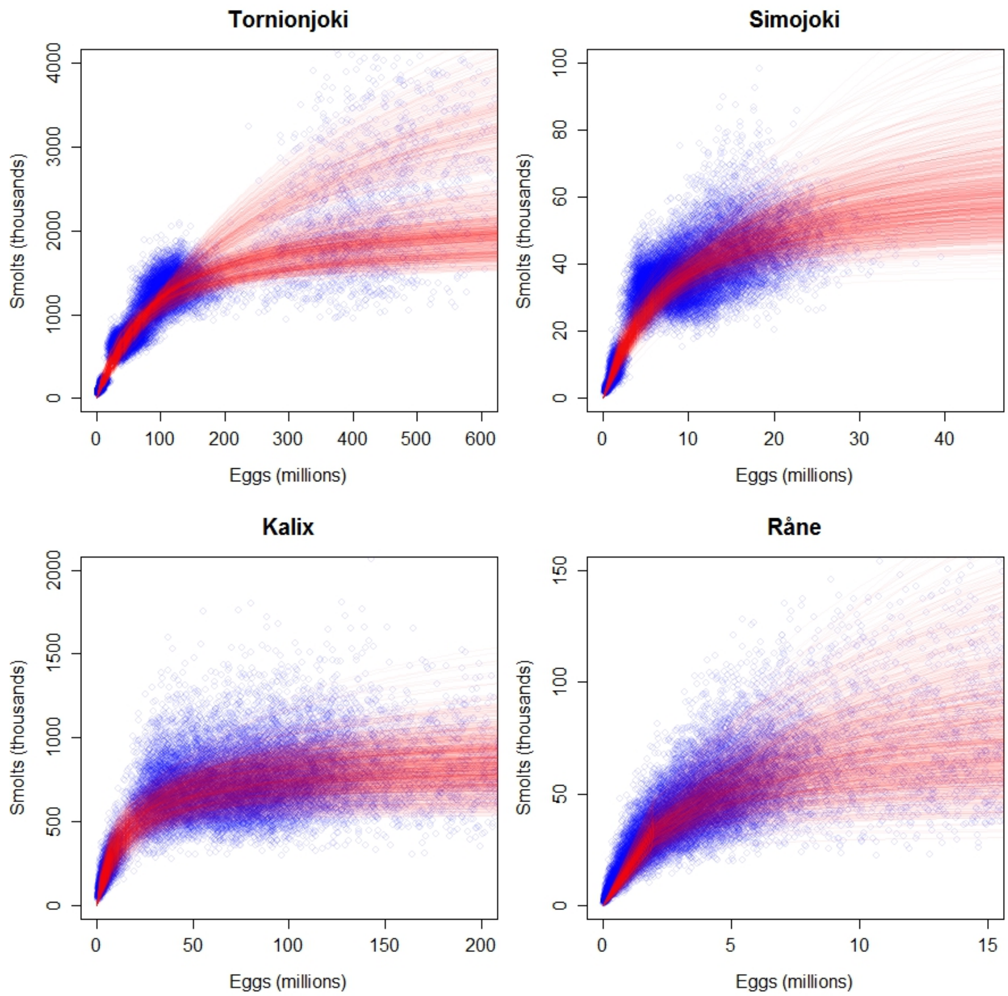


Figure 4.2.3.3a. These graphs show the distributions for egg abundance (million), plotted against the smolt abundance (thousand) for stocks of assessment units 1, 2, 3 and 4. Blue dots present the posterior distributions of annual smolt and egg abundances, red curves indicate the distributions of stock–recruit relationship.

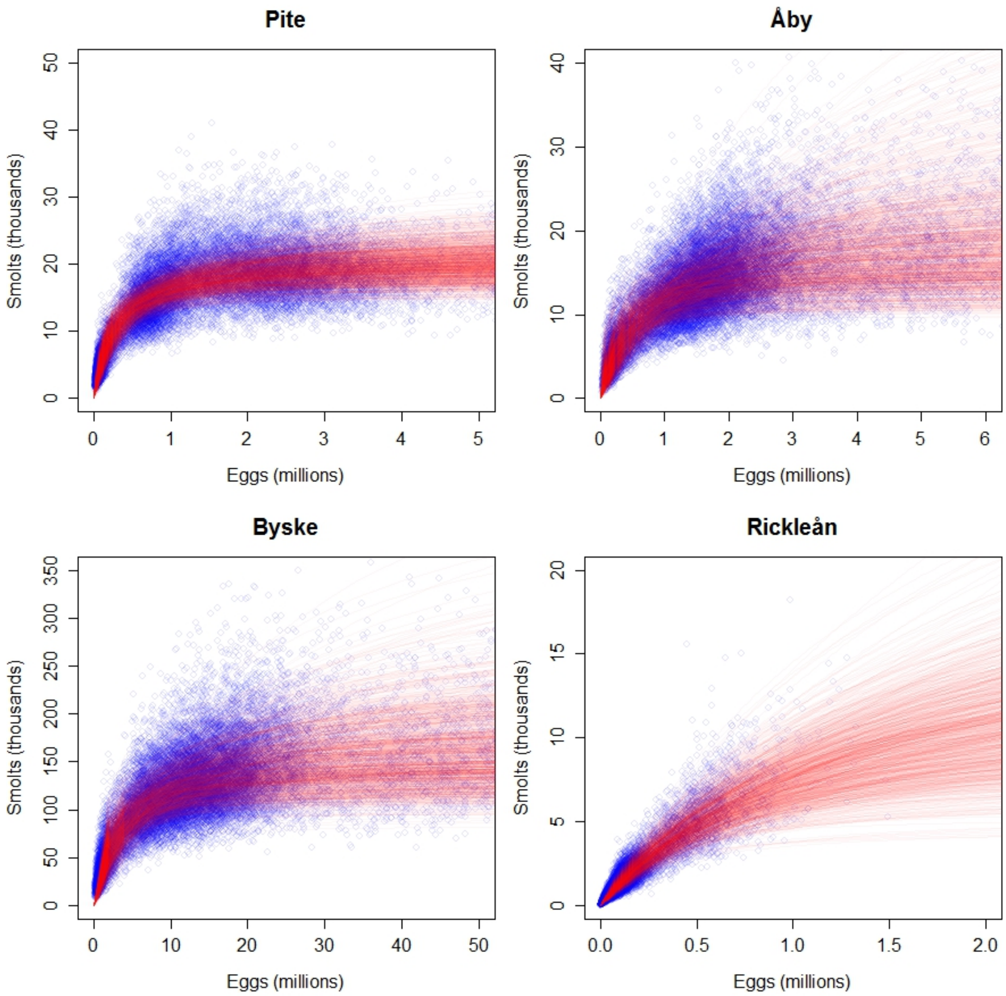


Figure 4.2.3.3b. These graphs show the distributions for egg abundance (million), plotted against the smolt abundance (thousand) for stocks of assessment units 1, 2, 3 and 4. Blue dots present the posterior distributions of annual smolt and egg abundances, red curves indicate the distributions of stock–recruit relationship.

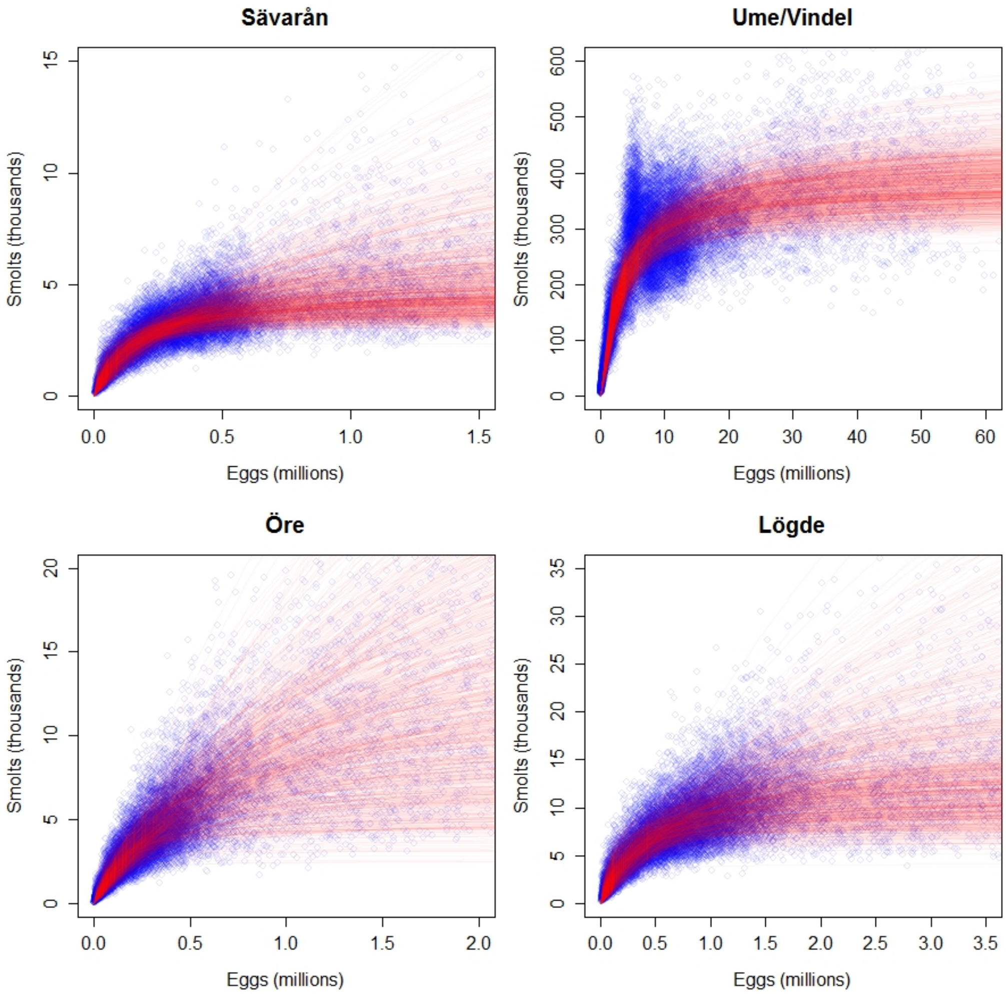


Figure 4.2.3.3c. These graphs show the distributions for egg abundance (million), plotted against the smolt abundance (thousand) for stocks of assessment units 1, 2, 3 and 4. Blue dots present the posterior distributions of annual smolt and egg abundances, red curves indicate the distributions of stock–recruit relationship.

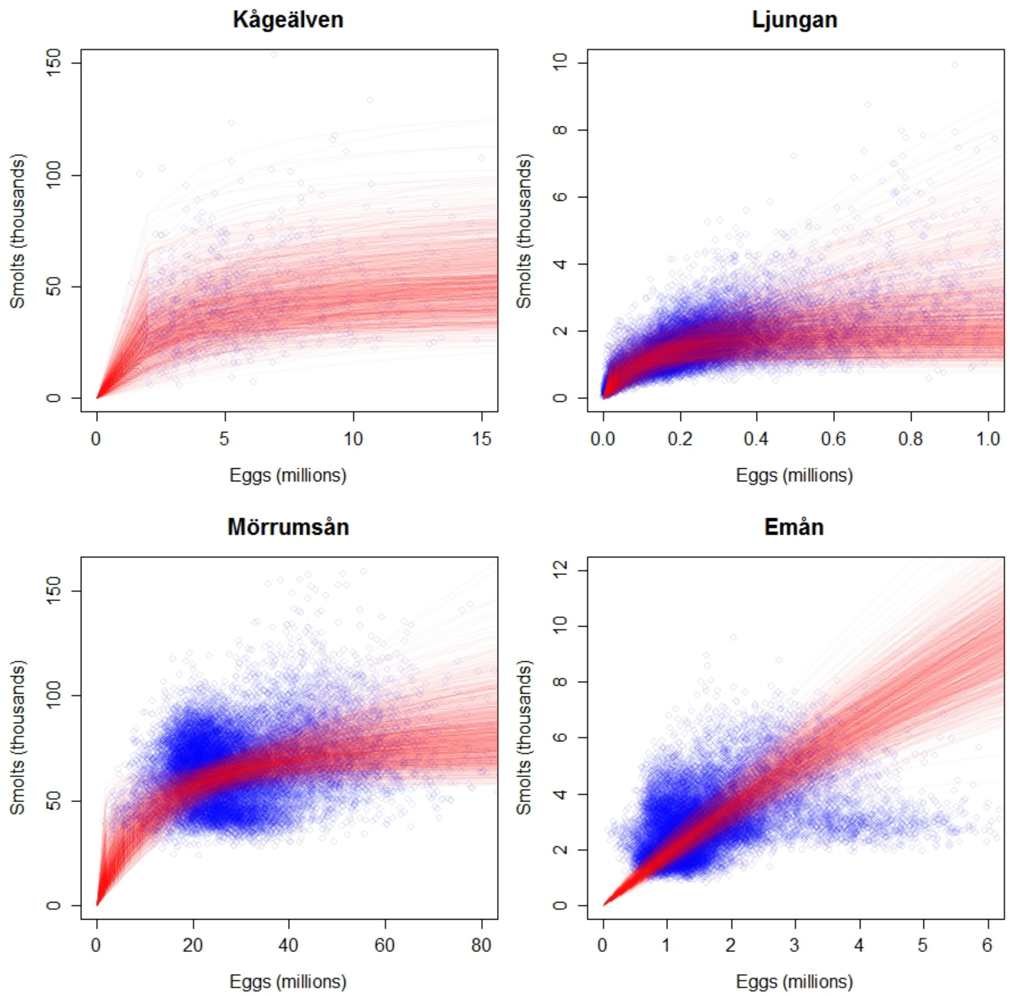


Figure 4.2.3.3d. These graphs show the distributions for egg abundance (million), plotted against the smolt abundance (thousand) for stocks of assessment units 1, 2, 3 and 4. Blue dots present the posterior distributions of annual smolt and egg abundances, red curves indicate the distributions of stock–recruit relationship.

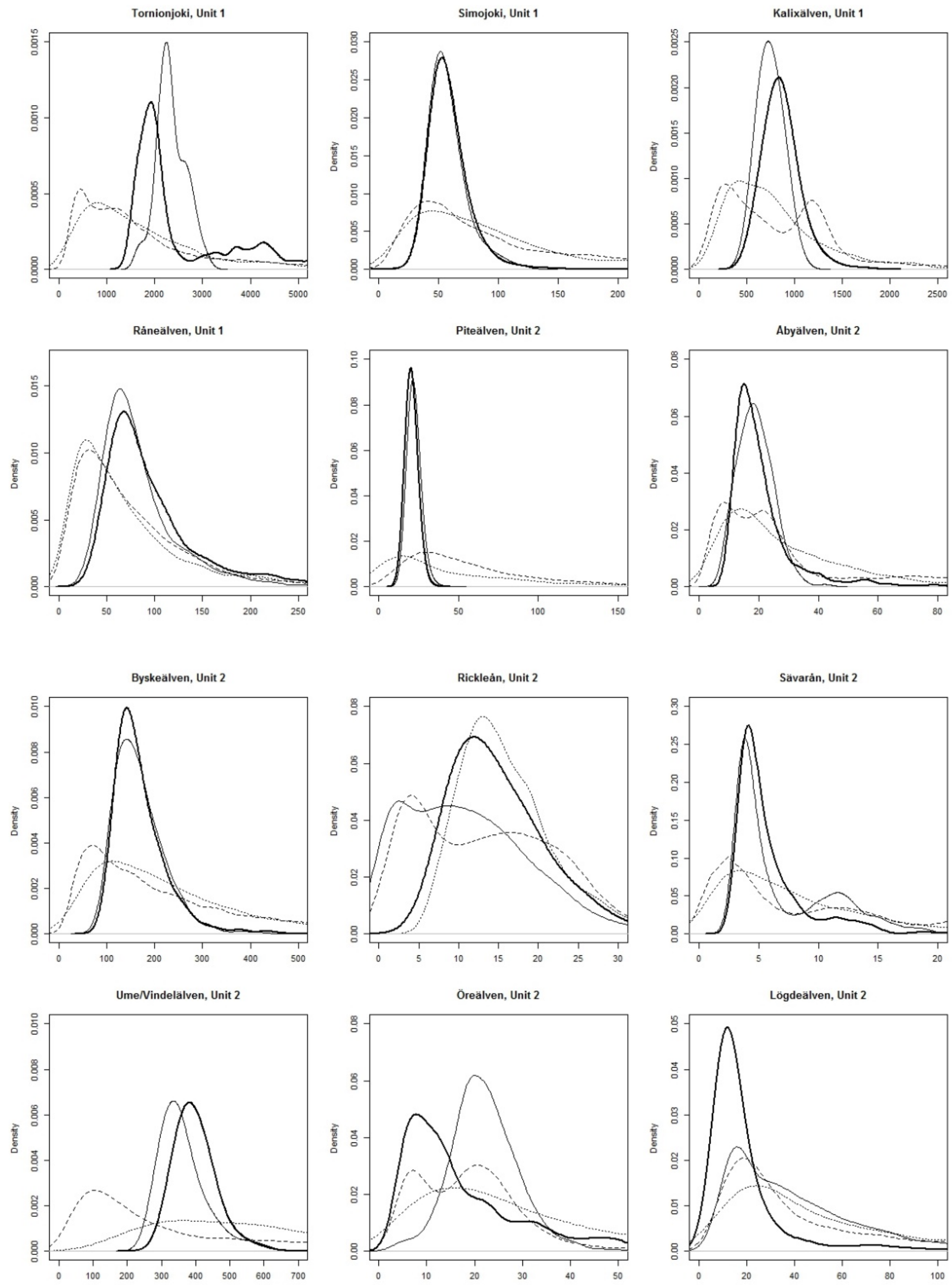


Figure 4.2.3.4a. Prior and posterior probability distributions of the potential smolt production capacity obtained in the assessment in 2013 (thin line) and 2014 (bold line). New prior distributions are illustrated with dotted lines whereas previously used priors are illustrated with dashed lines.

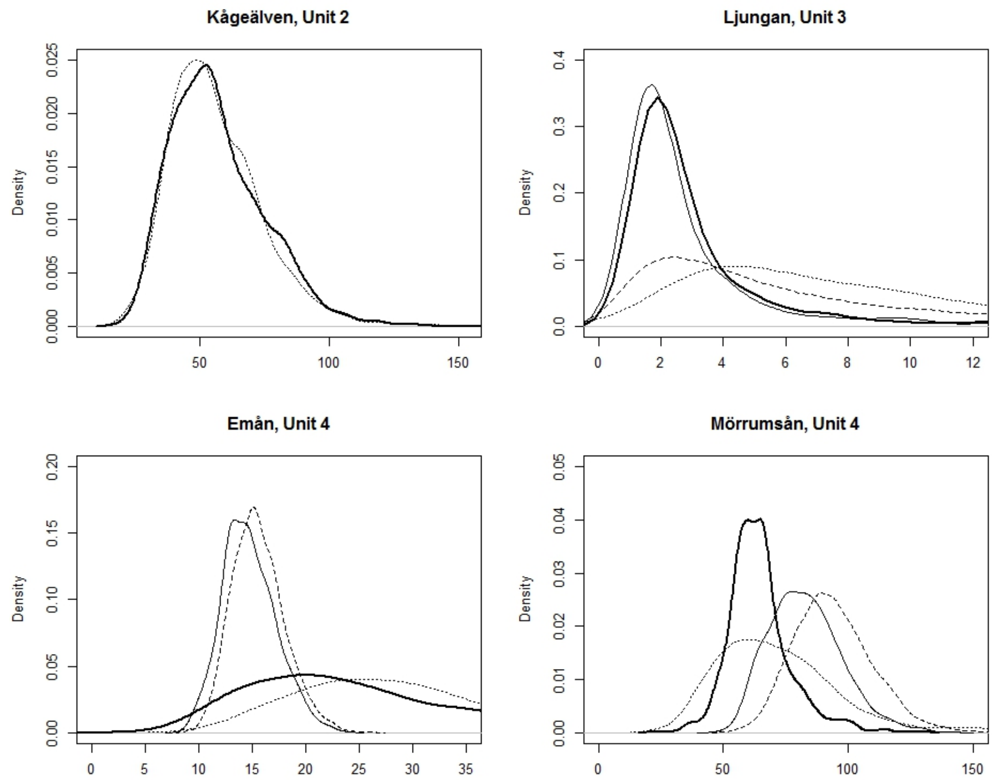


Figure 4.2.3.4b. Prior and posterior probability distributions of the potential smolt production capacity obtained in the assessment in 2013 (thin line) and 2014 (bold line). New prior distributions are illustrated with dotted lines whereas previously used priors are illustrated with dashed lines.

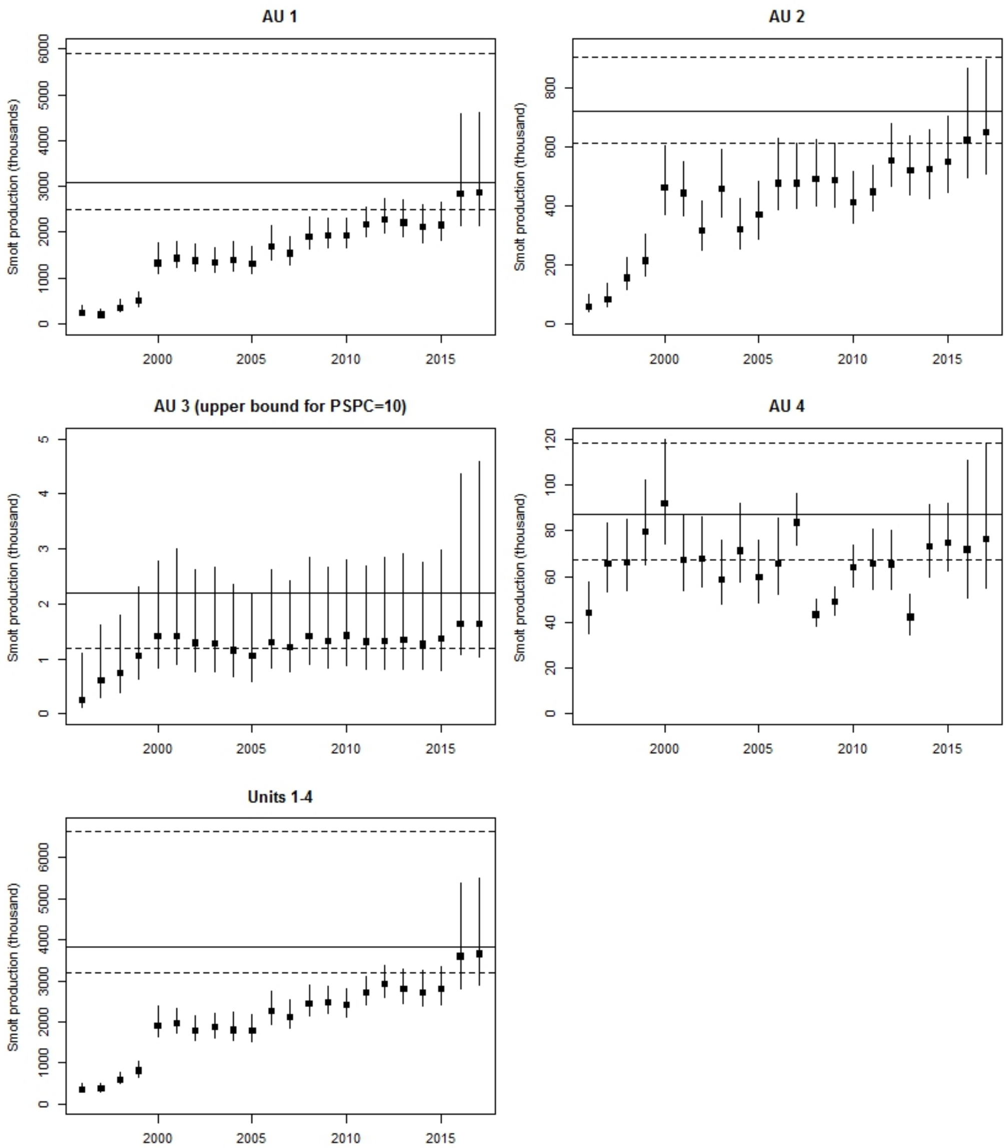


Figure 4.2.3.5. Posterior probability distribution (median and 90% PI) of the total smolt production within assessment units 1–4 and in total. Vertical lines show the median (solid line) and 90% PI (dashed lines) for potential smolt production capacity (PSPC).

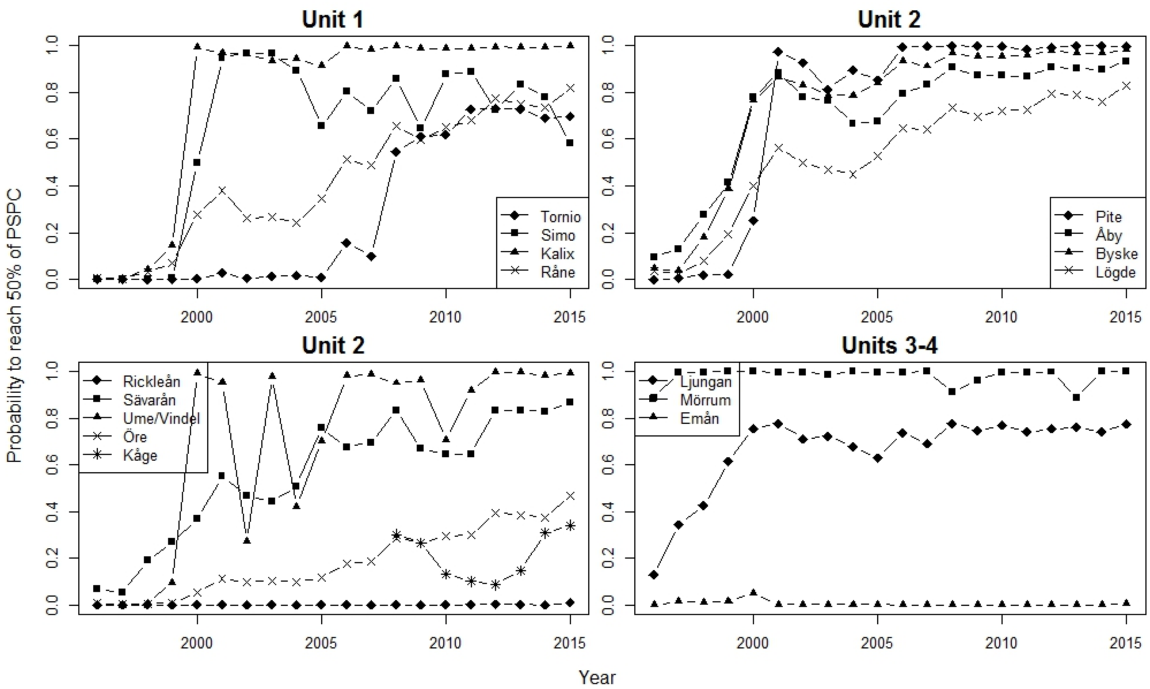


Figure 4.2.3.6. Probability of reaching 50% of the smolt production capacity for different stocks of assessment units 1–4.

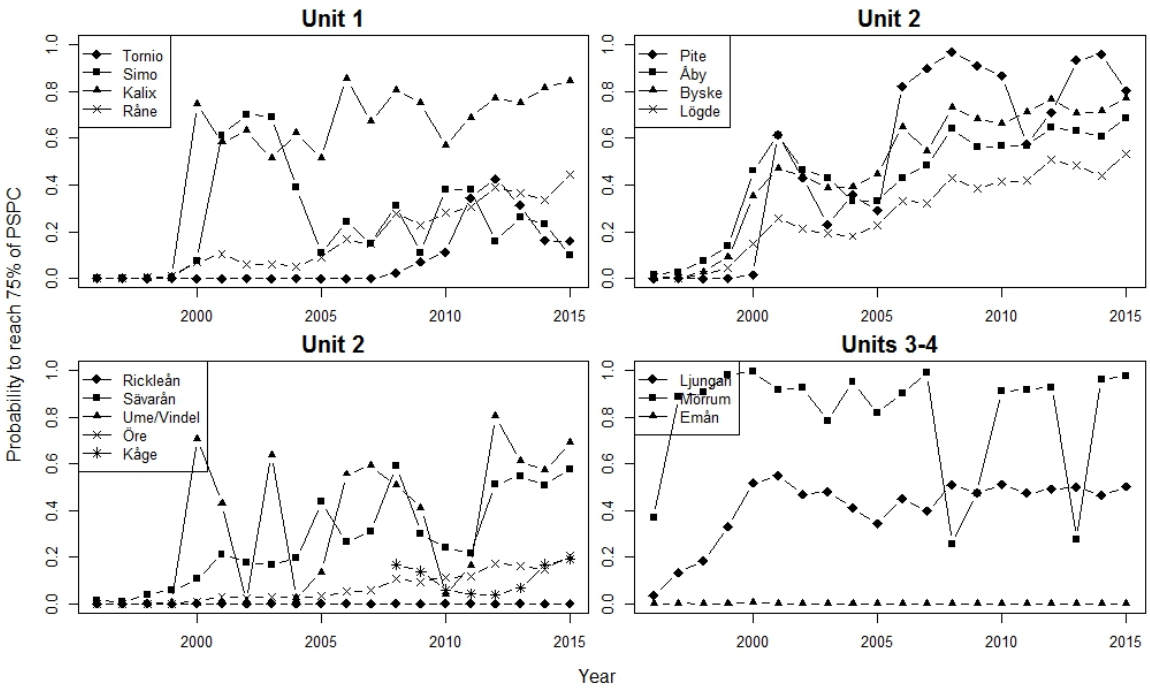


Figure 4.2.3.7. Probability of reaching 75% of the smolt production capacity for different stocks of assessment units 1–4.

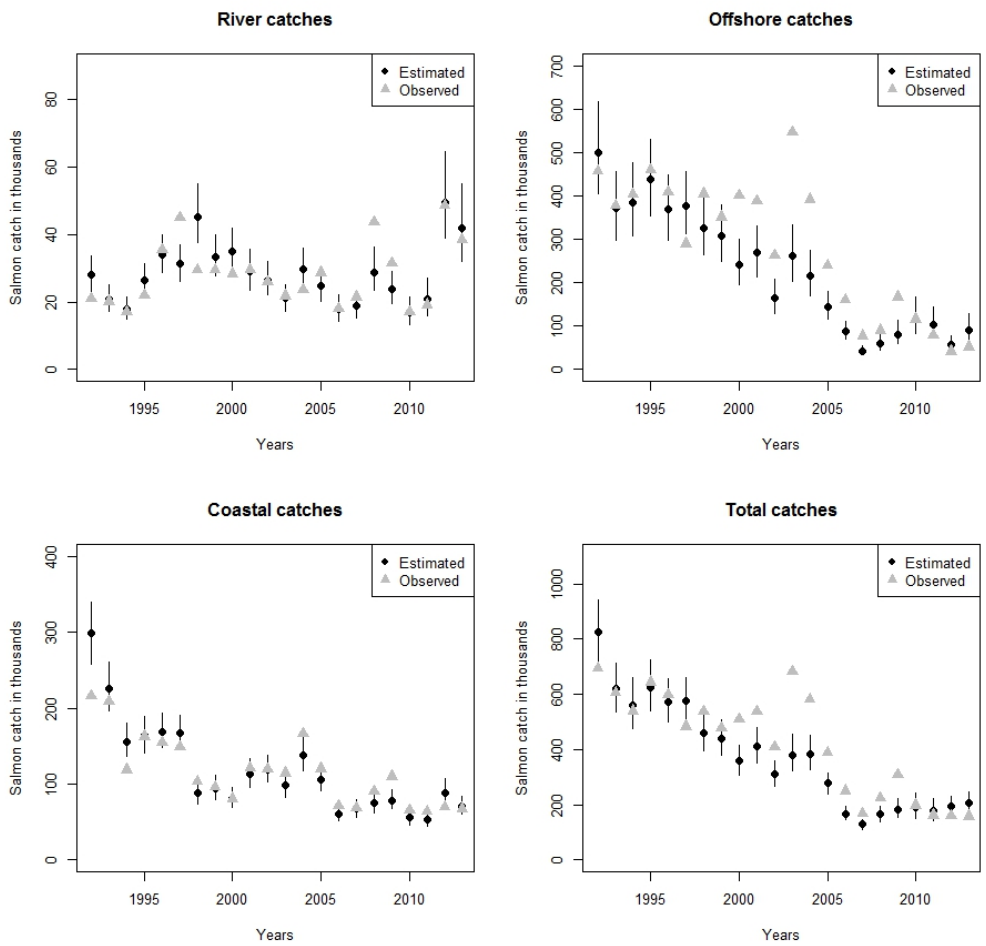


Figure 4.2.3.8. Estimated posterior distributions of catches in comparison to corresponding observed catches. Observed catches refer to reported commercial catches recalculated to take into account unreported catches in the longlining fishery.

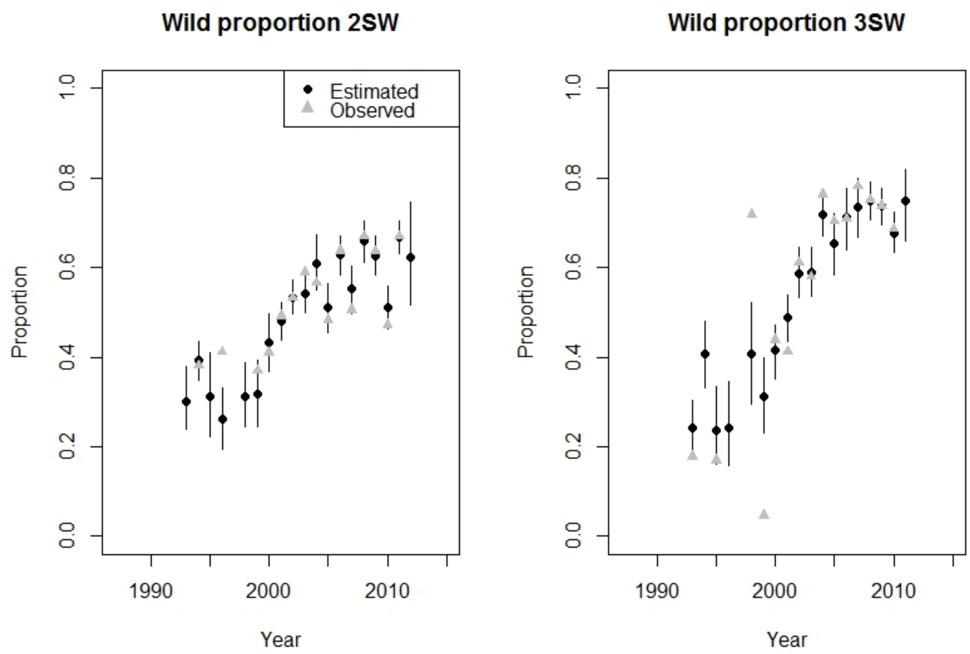


Figure 4.2.3.9. Estimated proportions of wild in offshore catches in comparison to wild proportions observed in the catch samples among 2SW and 3SW salmon.

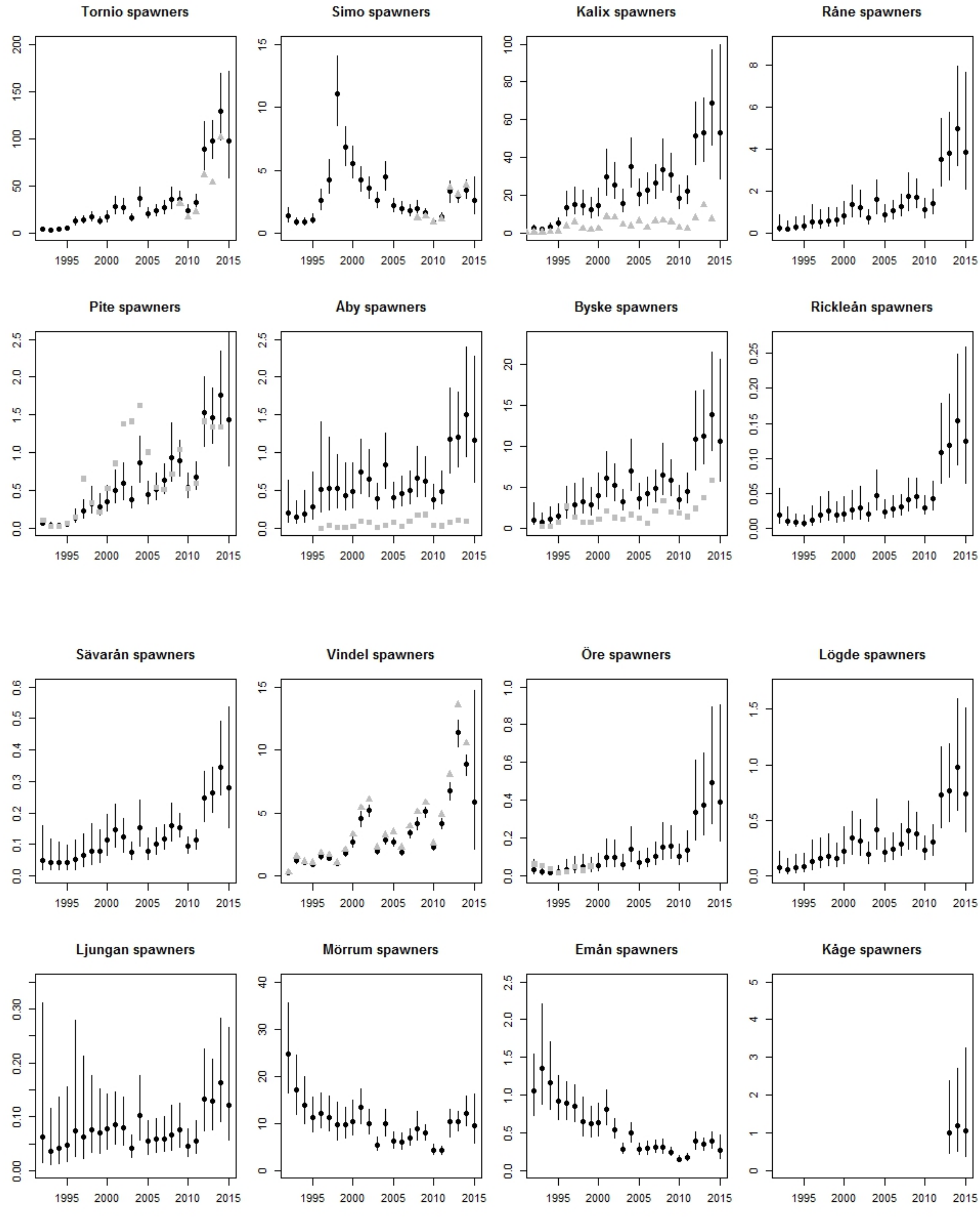


Figure 4.2.3.10. Estimated posterior distributions of the amount of spawners (in thousands) in each river vs observed numbers of spawners in fish counters. River observed numbers indicated with triangles are used as input in the full life-history model. In rivers with fish counters a varying proportion of spawning takes place in the river section below the counting site. In addition a part of spawners can pass the counting site without being observed in the counter. These explain partly the differences between observed and estimated number of spawners.

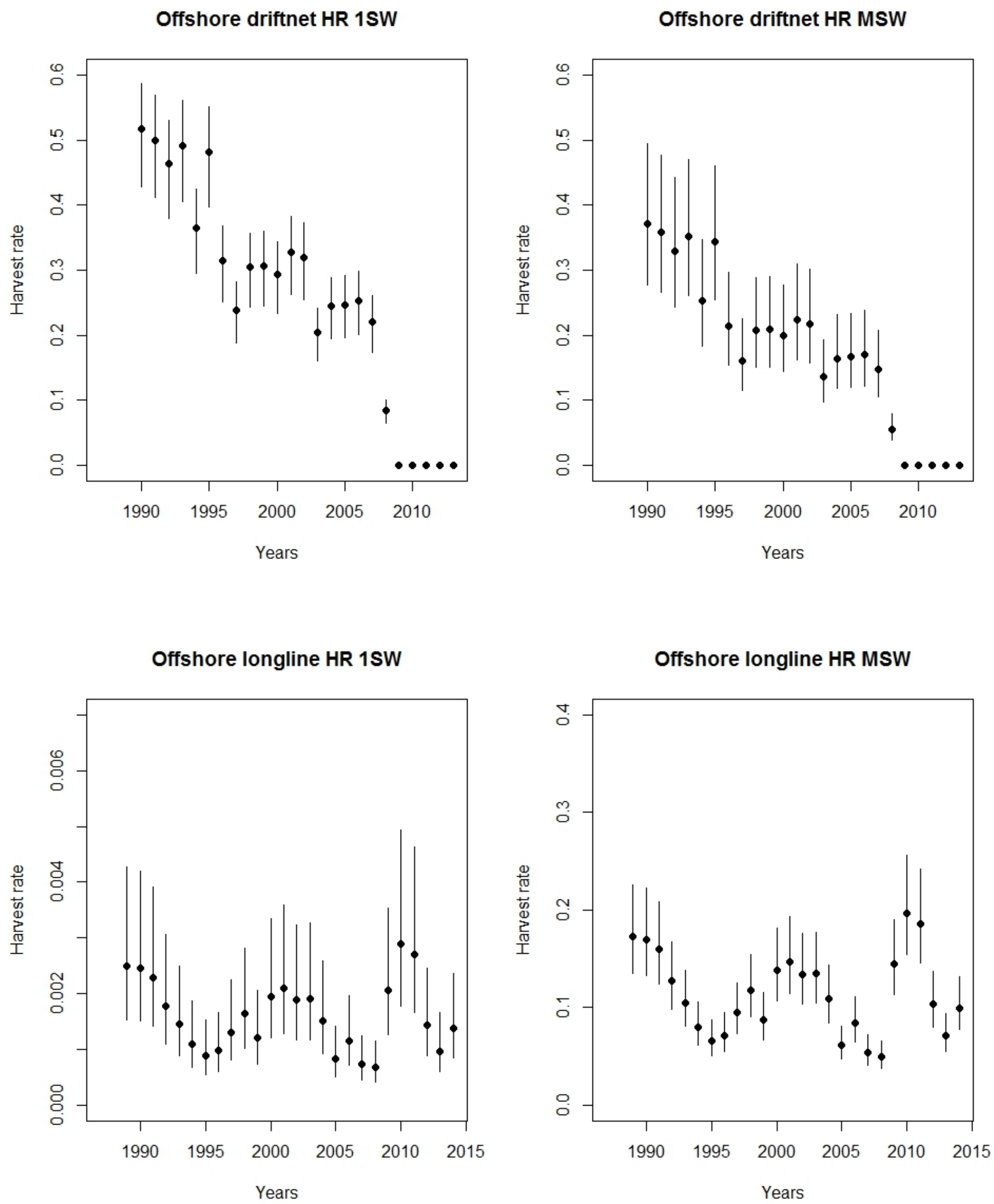


Figure 4.2.3.11a. Estimated posterior distributions of the harvest rates (harvested proportion of the available population) in offshore driftnet and offshore longline fisheries separately for one-sea-winter and multi-sea-winter salmon. Note that the driftnet harvest rate in 2008 is not zero, since due to computational reasons it contains fishing effort from the second half of year 2007.

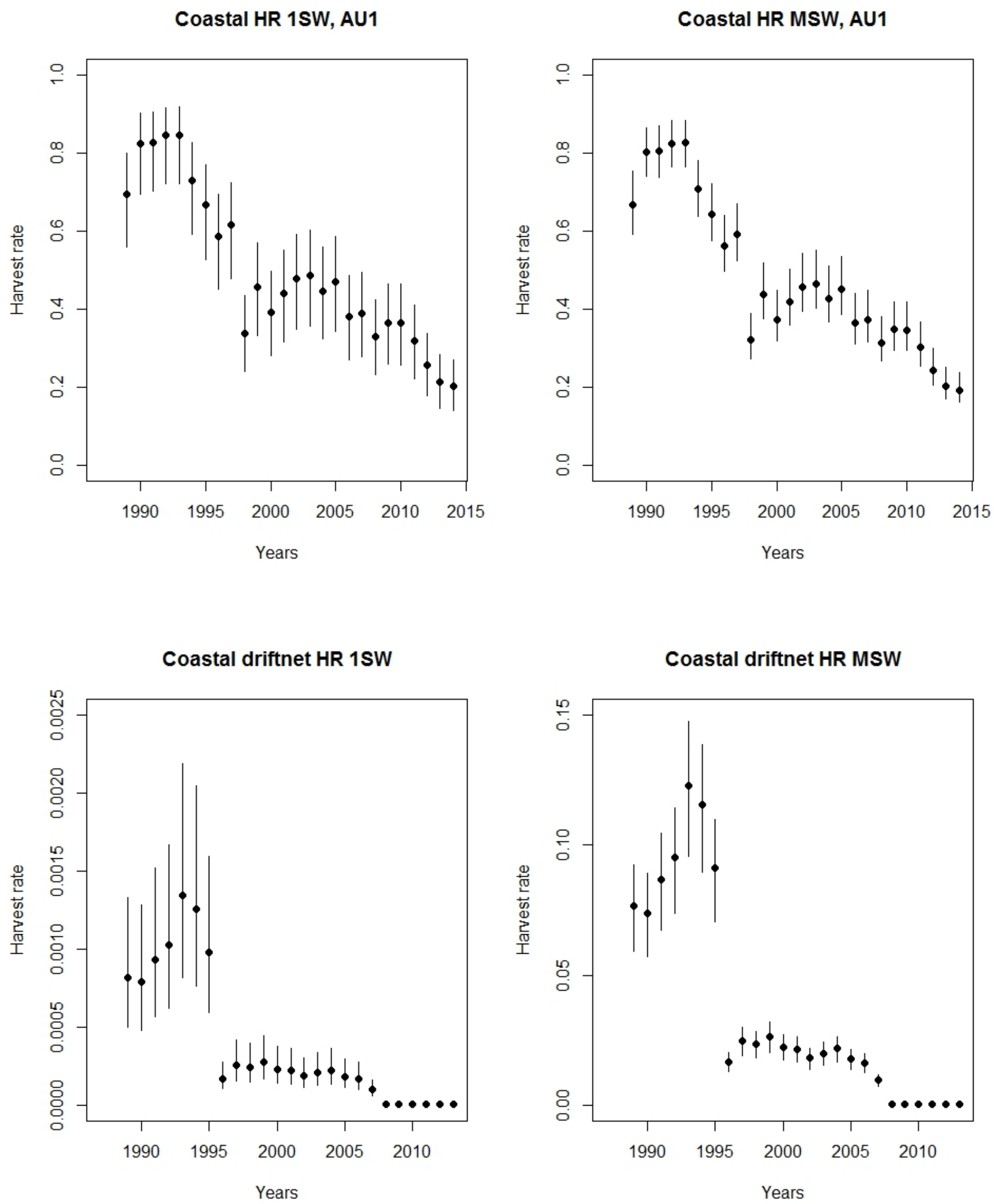


Figure 4.2.3.11b. Estimated posterior distributions of the harvest rates (harvested proportion of the available population) in other coastal fisheries than driftnetting in AU1 and in coastal driftnetting (all AU's together) separately for one-sea-winter and multi-sea-winter salmon.

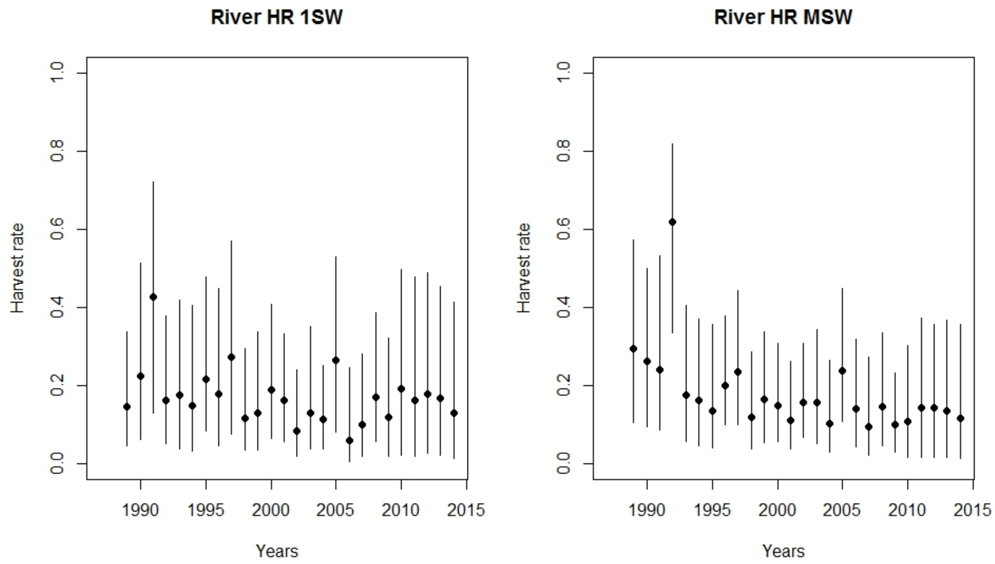


Figure 4.2.3.11c. Estimated posterior distributions of the harvest rates (harvested proportion of the available population) in the river fishery separately for one-sea-winter and multi-sea-winter salmon.

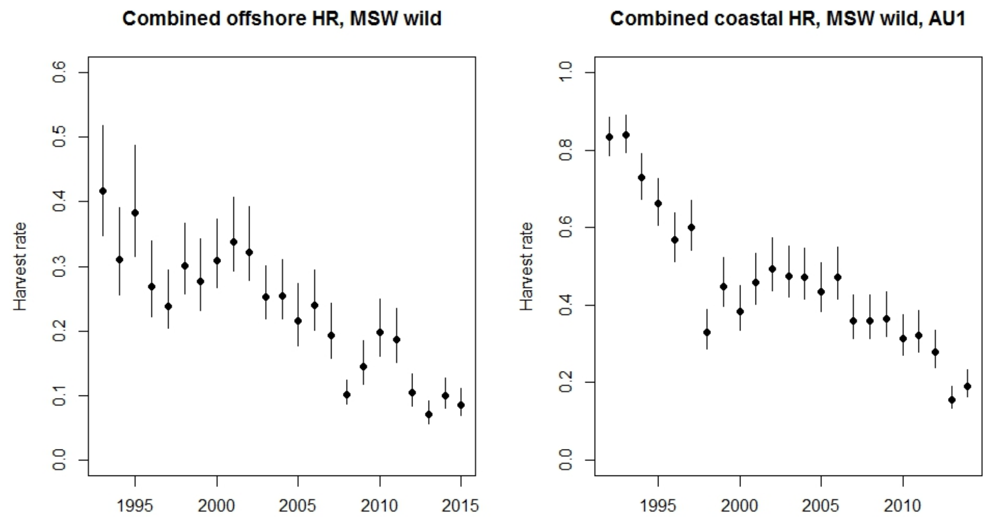


Figure 4.2.3.12. Combined harvest rates (harvested proportion of the available population) for offshore and coastal fisheries for MSW wild salmon in 1993–2014.

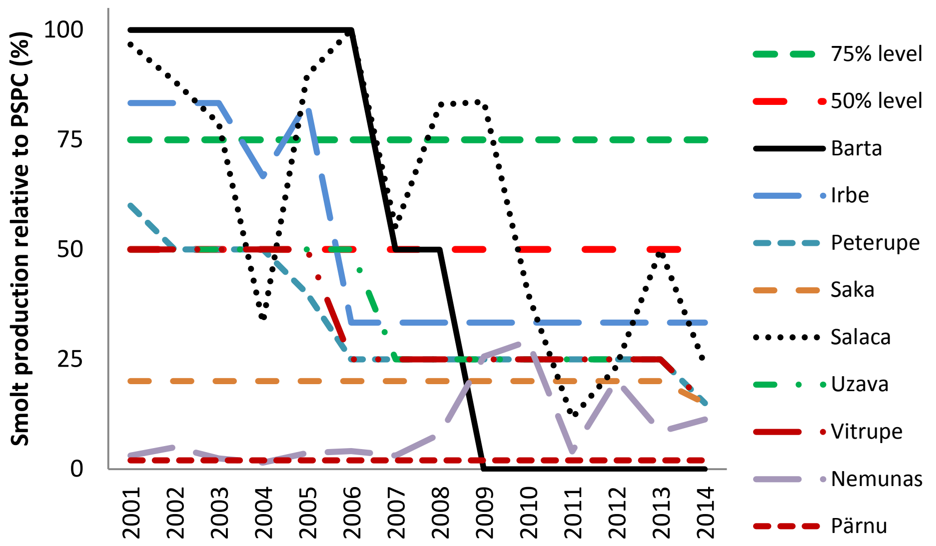


Figure 4.2.4.1a. Wild smolt production level in relation to the potential in AU5 wild salmon populations.

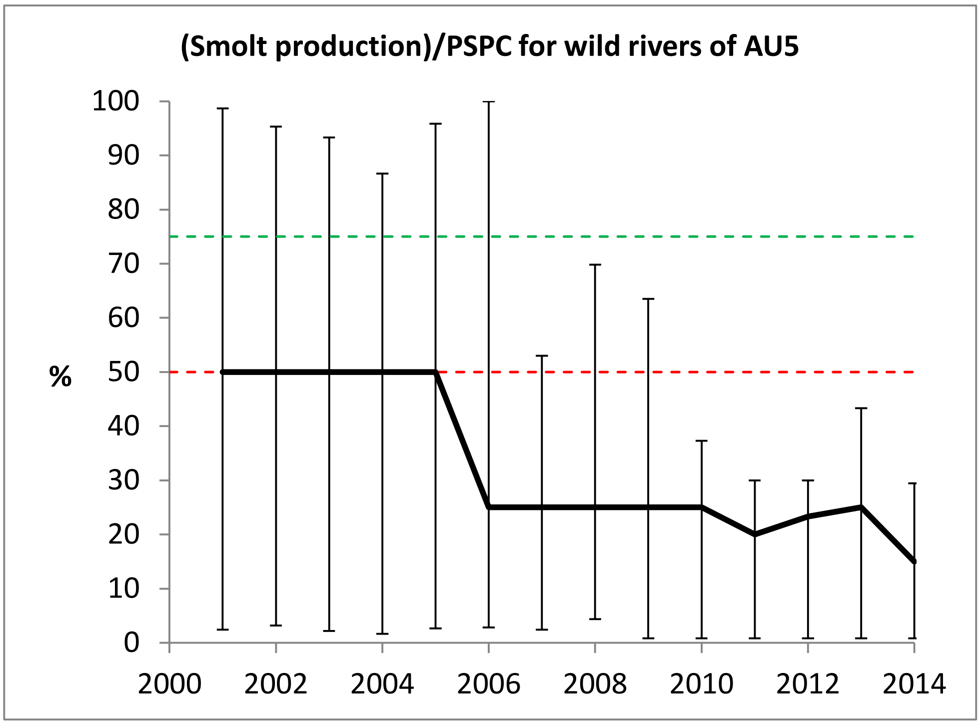


Figure 4.2.4.1b. Combined smolt production relative to PSPC for AU5 (median estimate across all wild rivers and 90% probability interval).

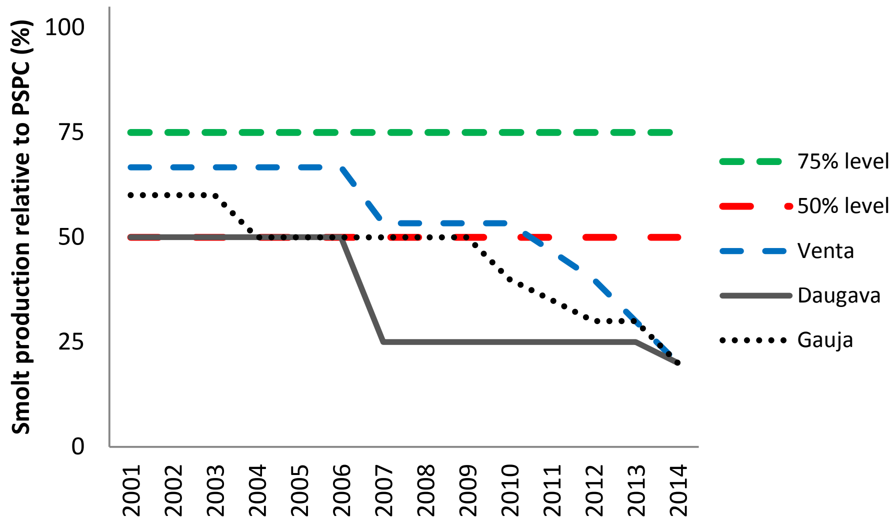


Figure 4.2.4.2. Wild smolt production level in relation to the potential in AU5 mixed salmon populations.

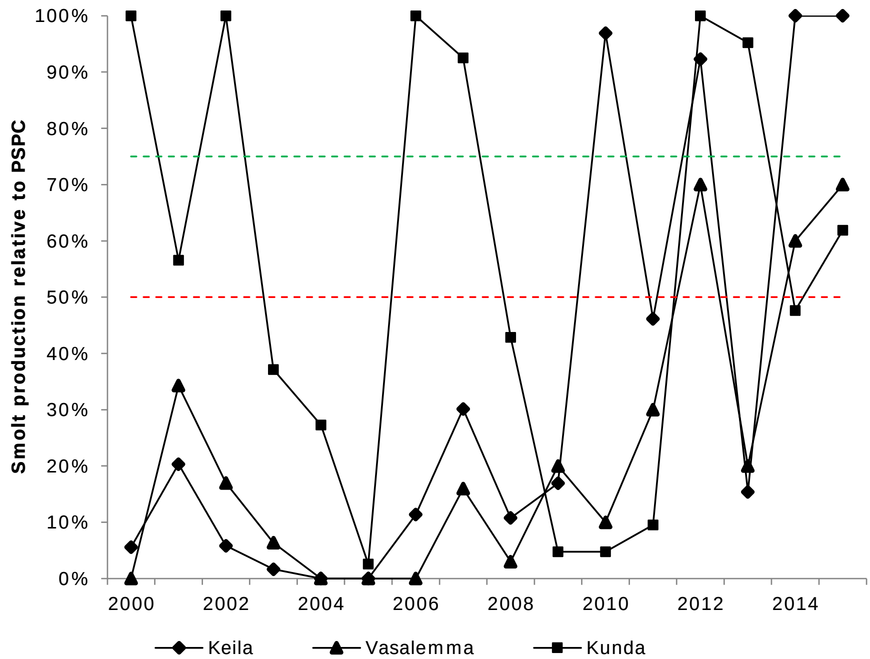


Figure 4.2.4.3. Smolt production level in relation to the potential in AU6 wild salmon populations. Note that the potential is calculated only up to the lowermost migration obstacle and that rivers have substantial rearing habitat areas above migration obstacles.

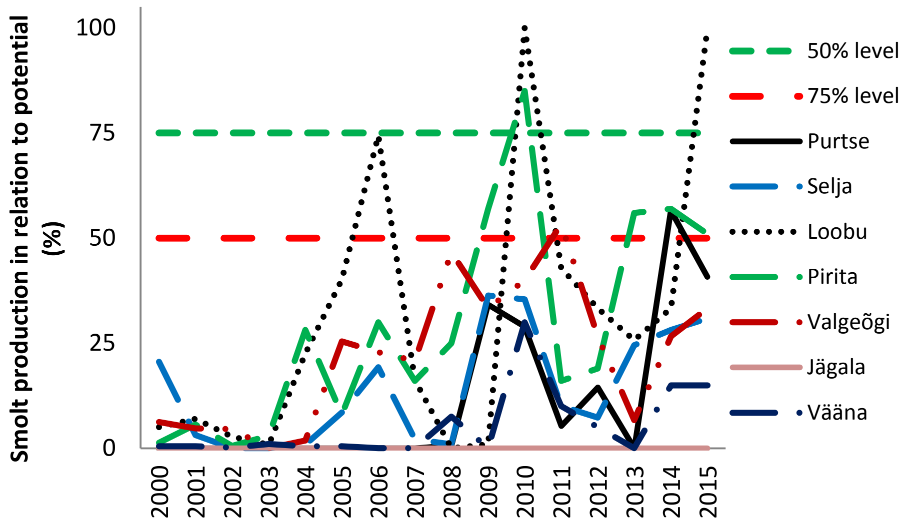


Figure 4.2.4.4. Smolt production level in relation to the potential in Estonian AU 6 mixed salmon populations. Note that the potential is calculated only up to the lowermost impassable migration obstacle and that many rivers have considerably higher total potential.

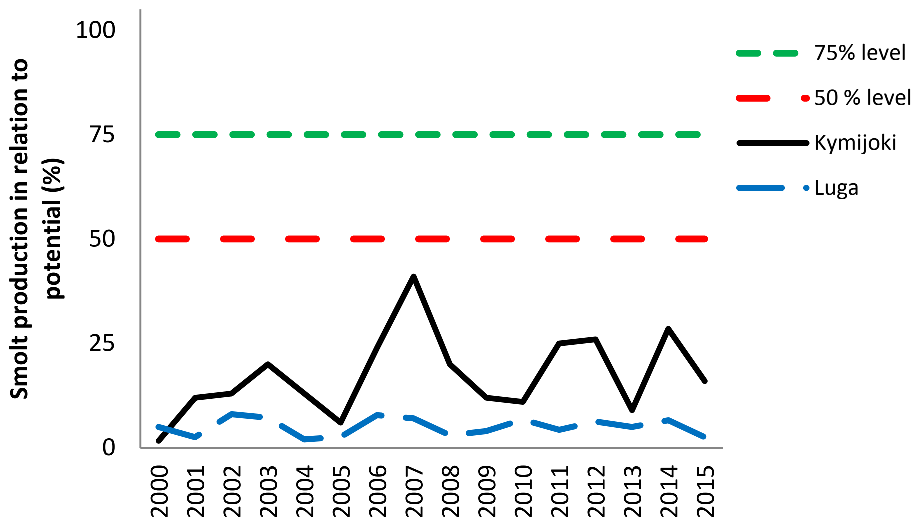


Figure 4.2.4.5. Wild smolt production level compared to potential in river Kymijoki (Finland) and in river Luga (Russia).

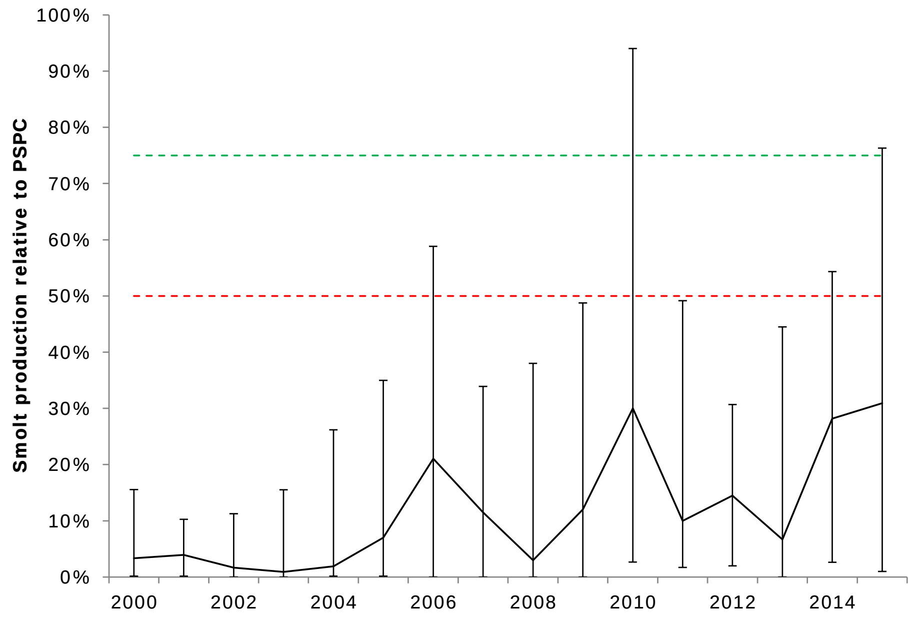


Figure 4.2.4.6. Average smolt production level in relation to the potential in AU6 mixed salmon populations (with 90% probability interval). Note that the potential is calculated only up to the lowermost impassable migration obstacle and many rivers have considerably higher total potential.

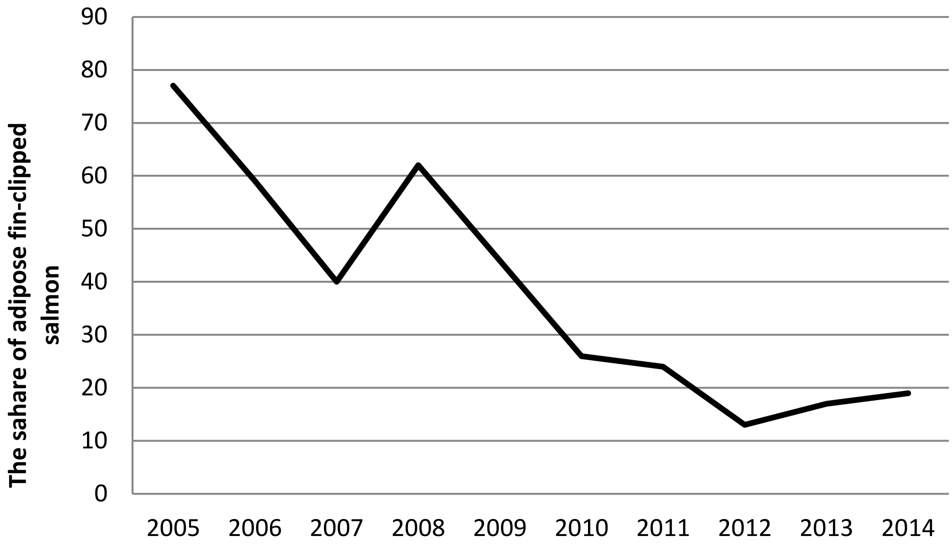


Figure 4.2.5.2. Share of adipose fin-clipped salmon caught on the southern coast of the Gulf of Finland.

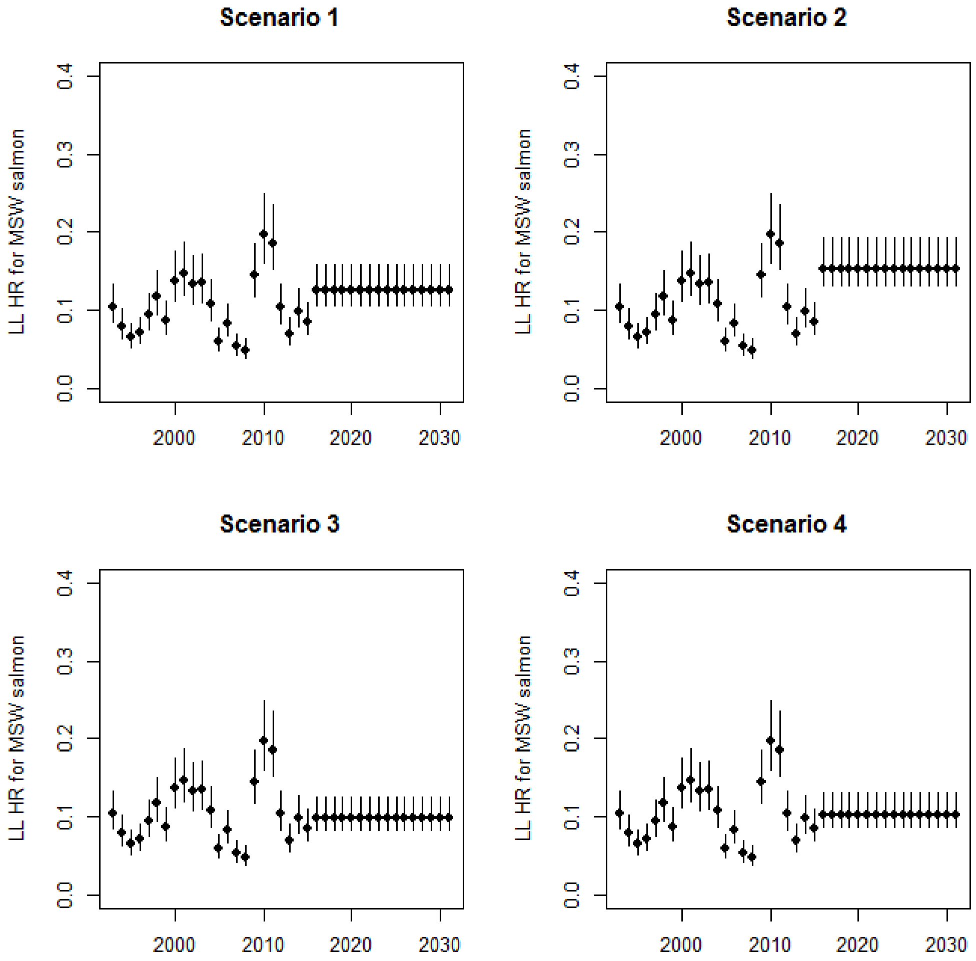


Figure 4.3.2.1a. Harvest rates (median values and 90% probability intervals) for wild multi-sea winter salmon in offshore longline fishery within scenarios 1–3 and 4a.

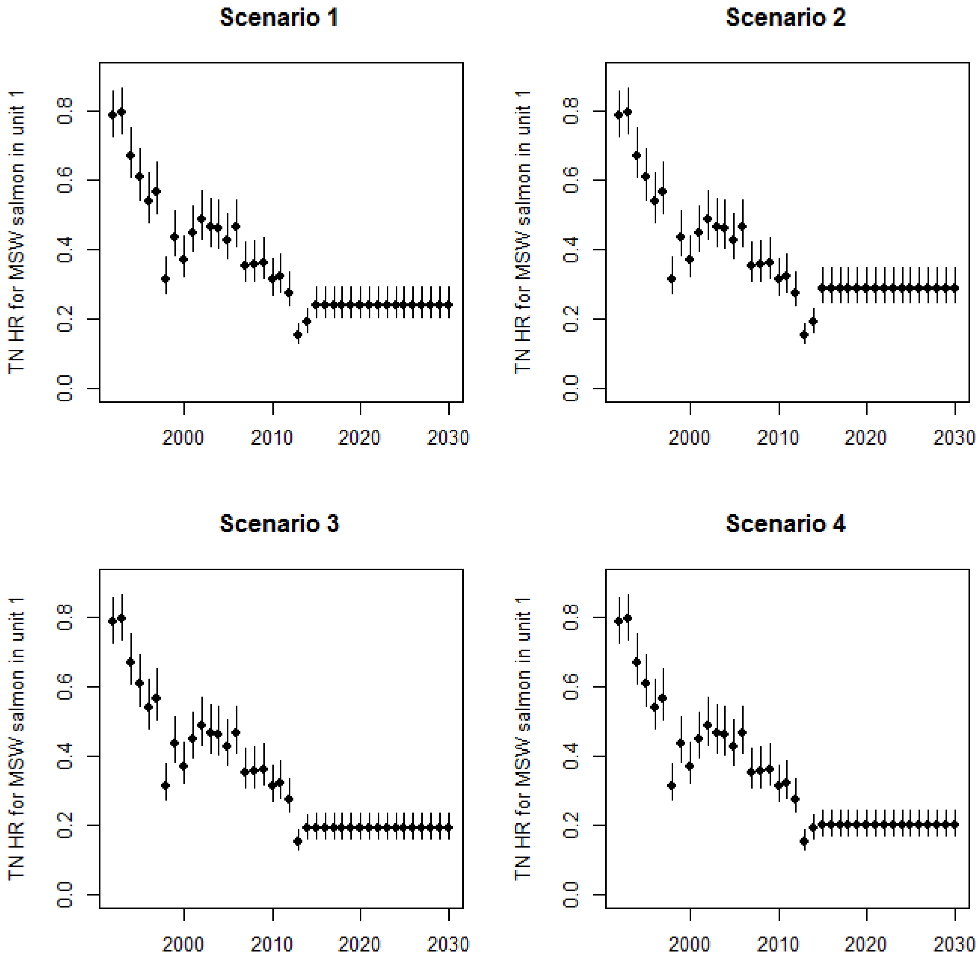
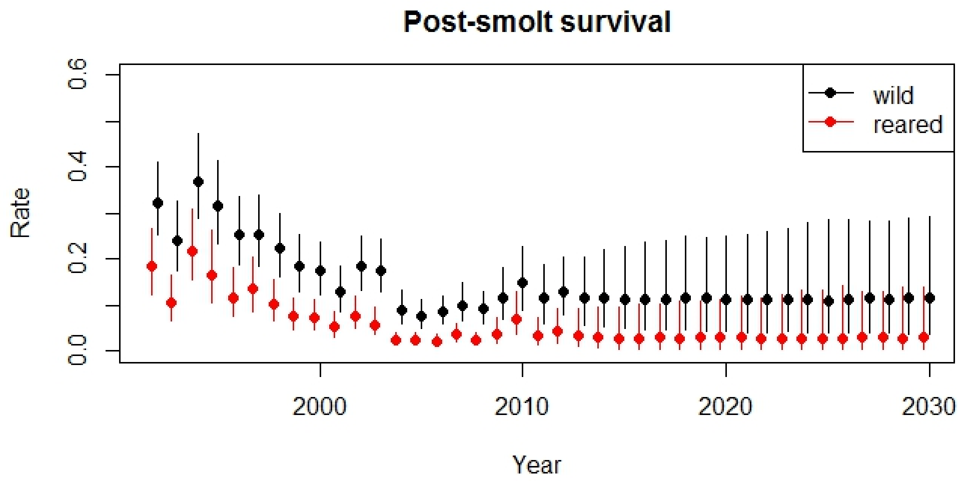


Figure 4.3.2.1b. Harvest rates (median values and 90% probability intervals) for wild multi-sea winter salmon in coastal trapnet fishery within scenarios 1–3 and 4a.



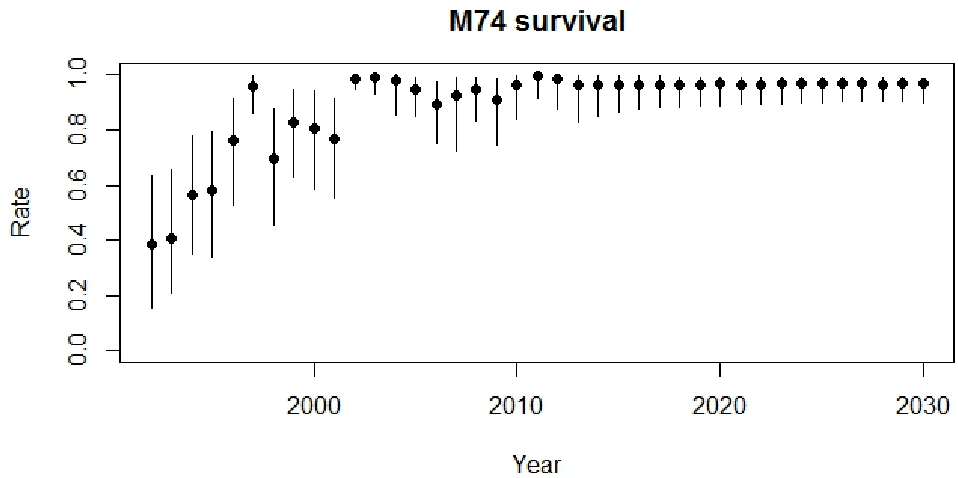


Figure 4.3.2.2. Median values and 90% probability intervals for post-smolt survival of wild and reared salmon and M74 survival assumed in all scenarios.

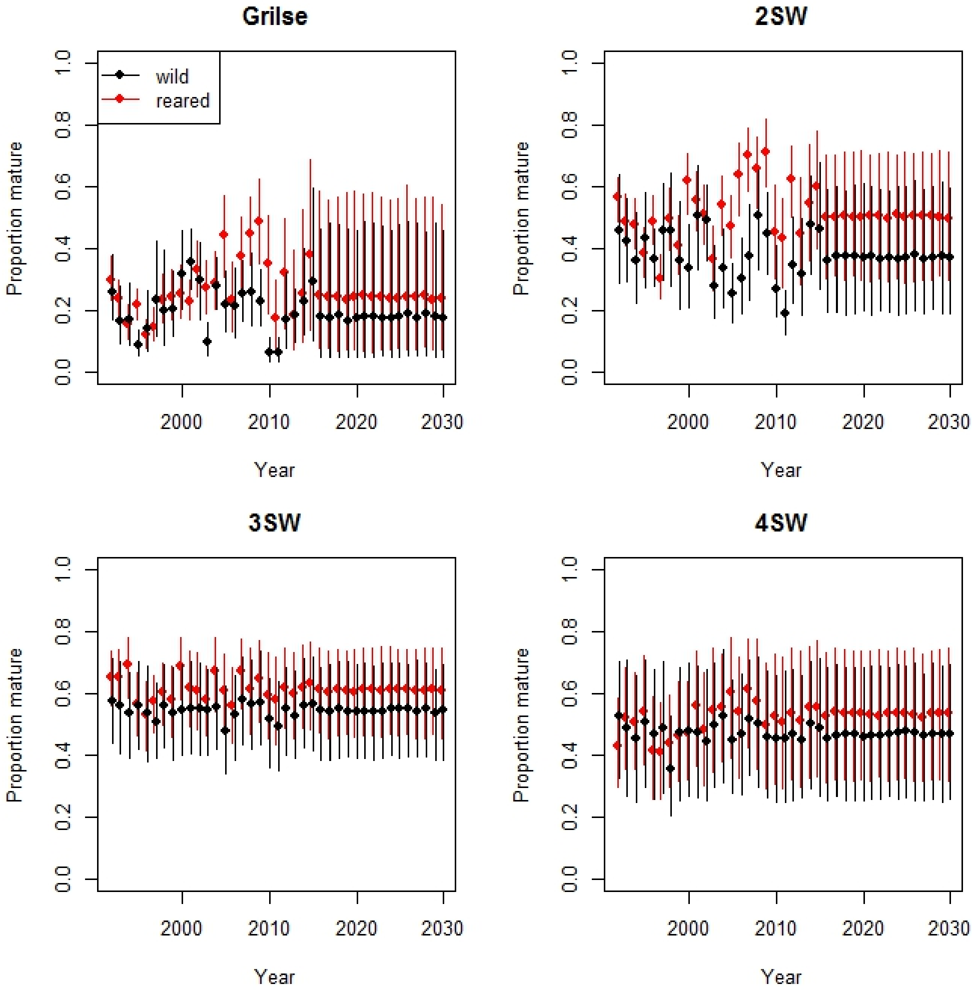


Figure 4.3.2.3. Median values and 90% probability intervals for annual proportions maturing per age group for wild and reared salmon in all scenarios.

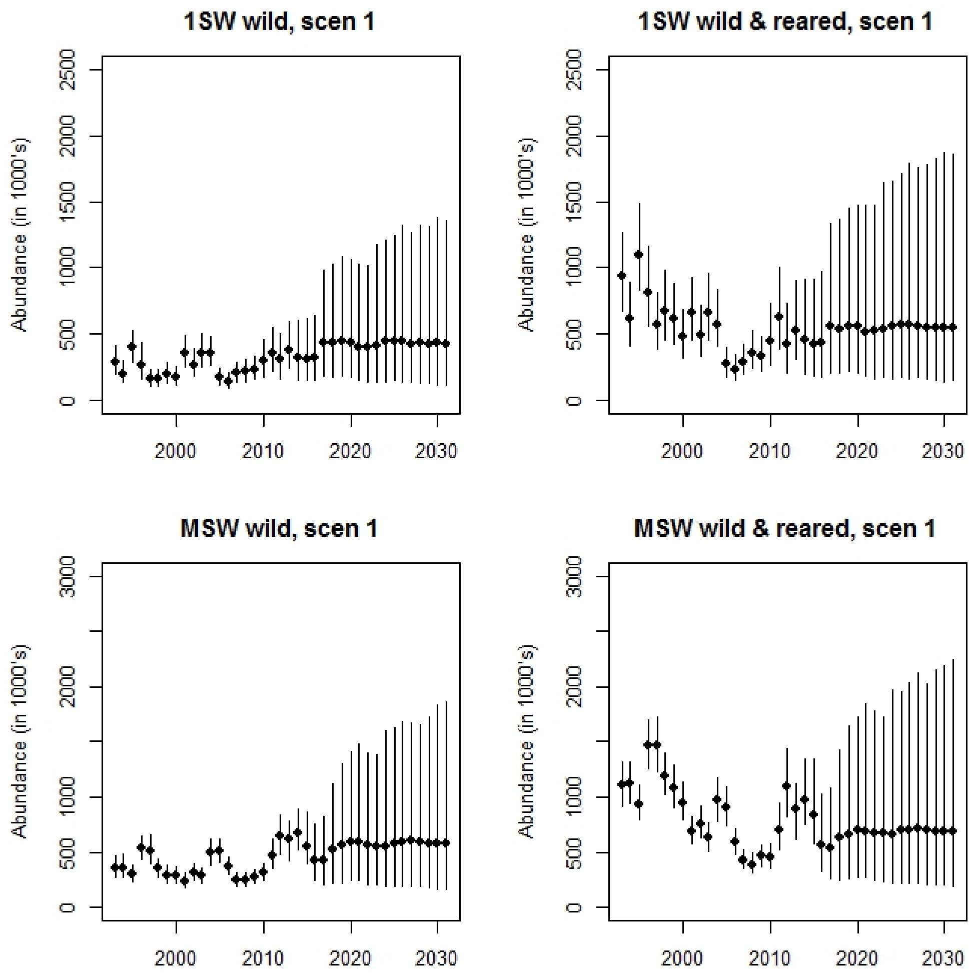


Figure 4.3.2.4a. Pre-fishery abundances of MSW and 1SW wild salmon and wild and reared salmon together based on scenario 1. PFA's reflect the abundance that is available to the fisheries. In case of MSW salmon natural mortality is taken into account until end of June of the fishing year and in case of post-smolts, until end of August (four months after post-smolt mortality phase). See text for details.

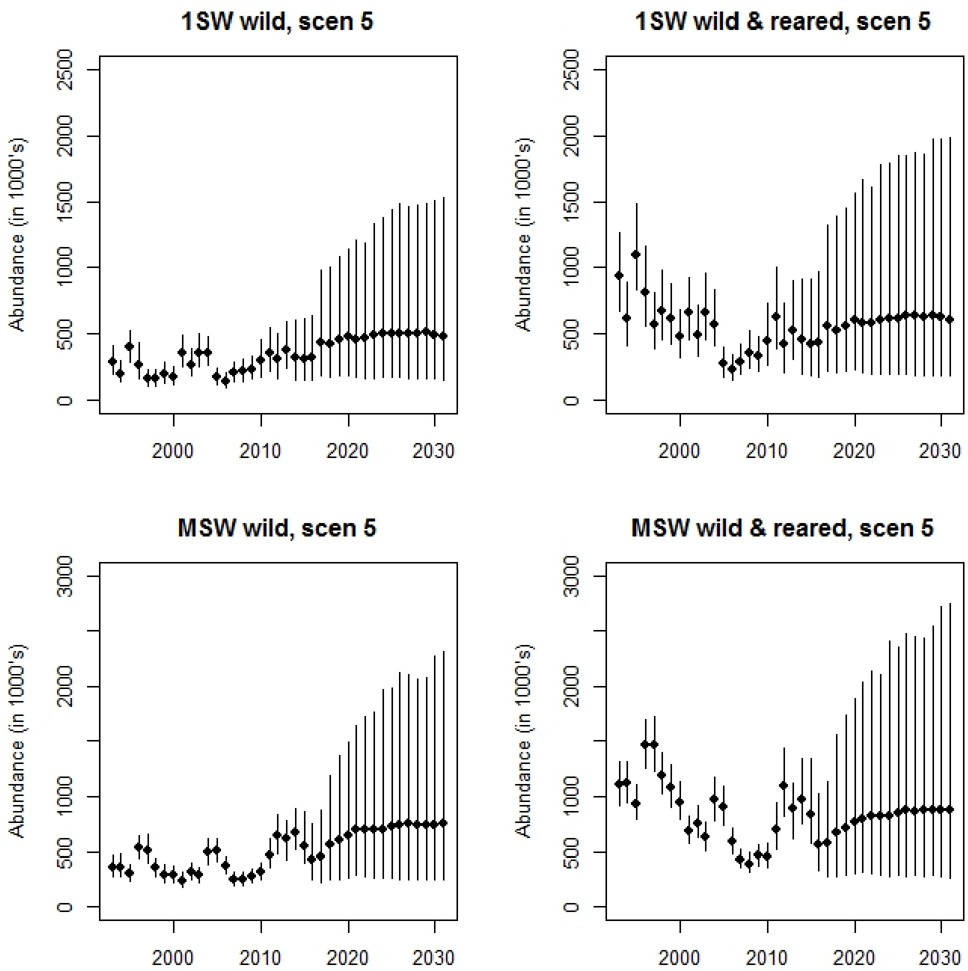


Figure 4.3.2.4b. Pre-fishery abundances of MSW and 1SW wild salmon and wild and reared salmon together based on scenario 5 (zero fishing). PFA's reflect the abundance that is available to the fisheries. In case of MSW salmon natural mortality is taken into account until end of June of the fishing year and in case of post-smolts, until end of August (four months after post-smolt mortality phase). See text for details.

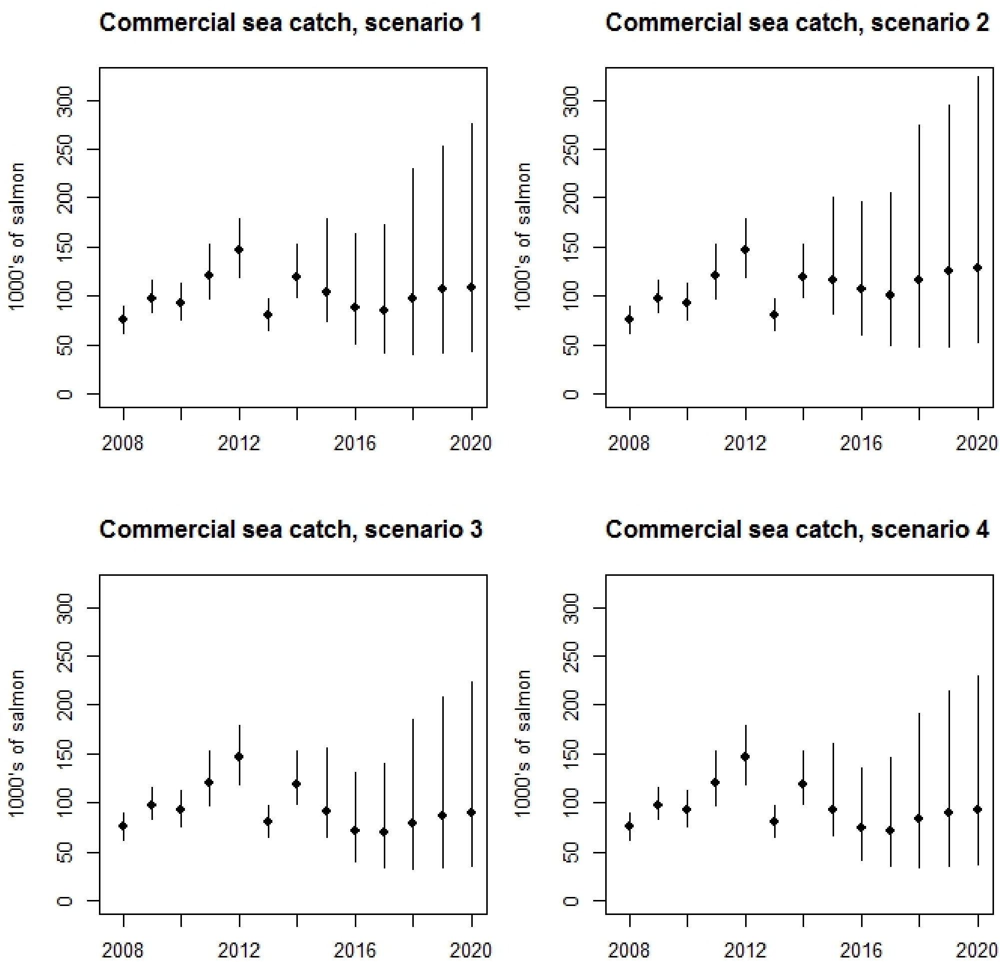


Figure 4.3.2.5. Estimates of reported commercial sea catches (all gears) based on scenarios 1–3 and 4a.

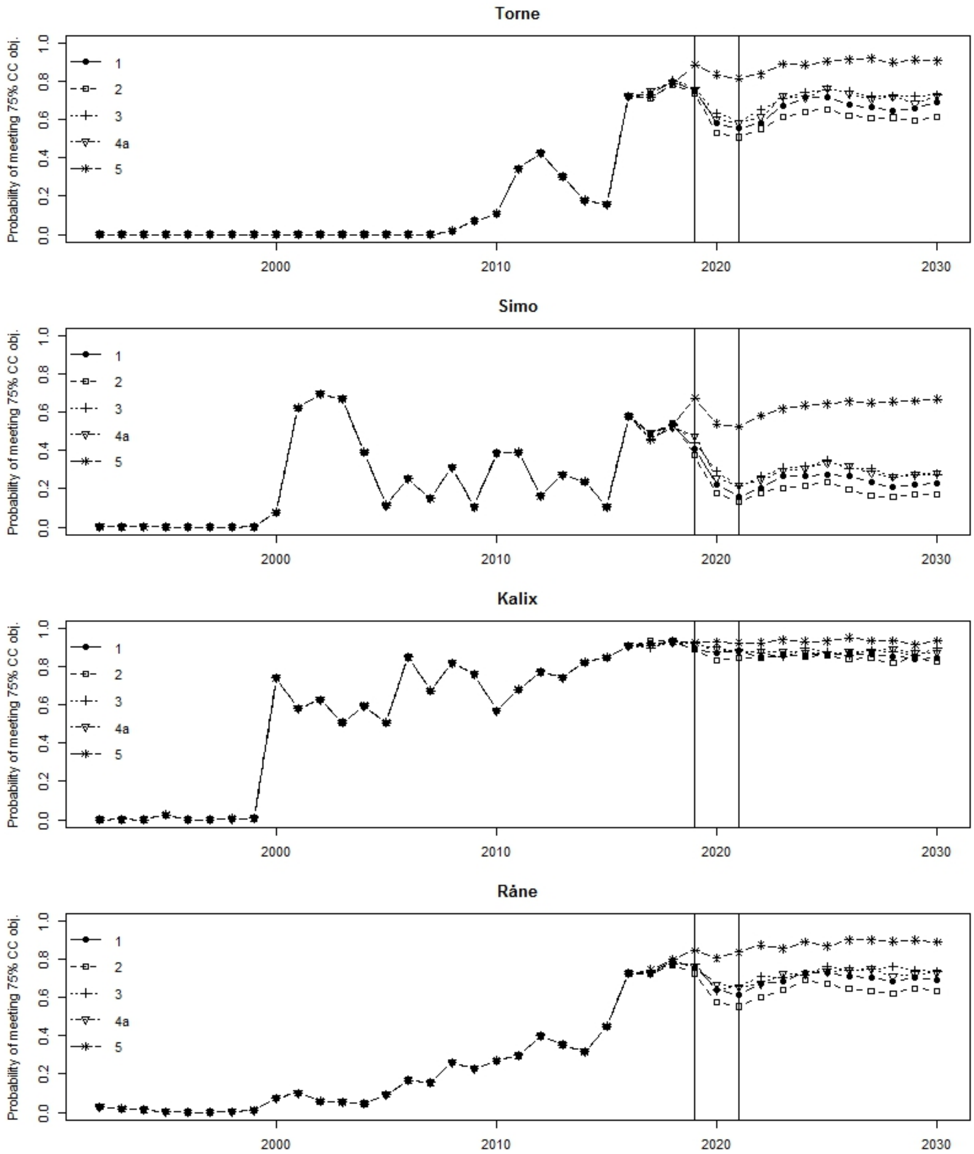


Figure 4.3.2.6a. Probabilities for different stocks to meet an objective of 75% of potential smolt production capacity under scenarios 1–3, 4a and 5. Fishing in 2015 affects mostly years 2019–2021.

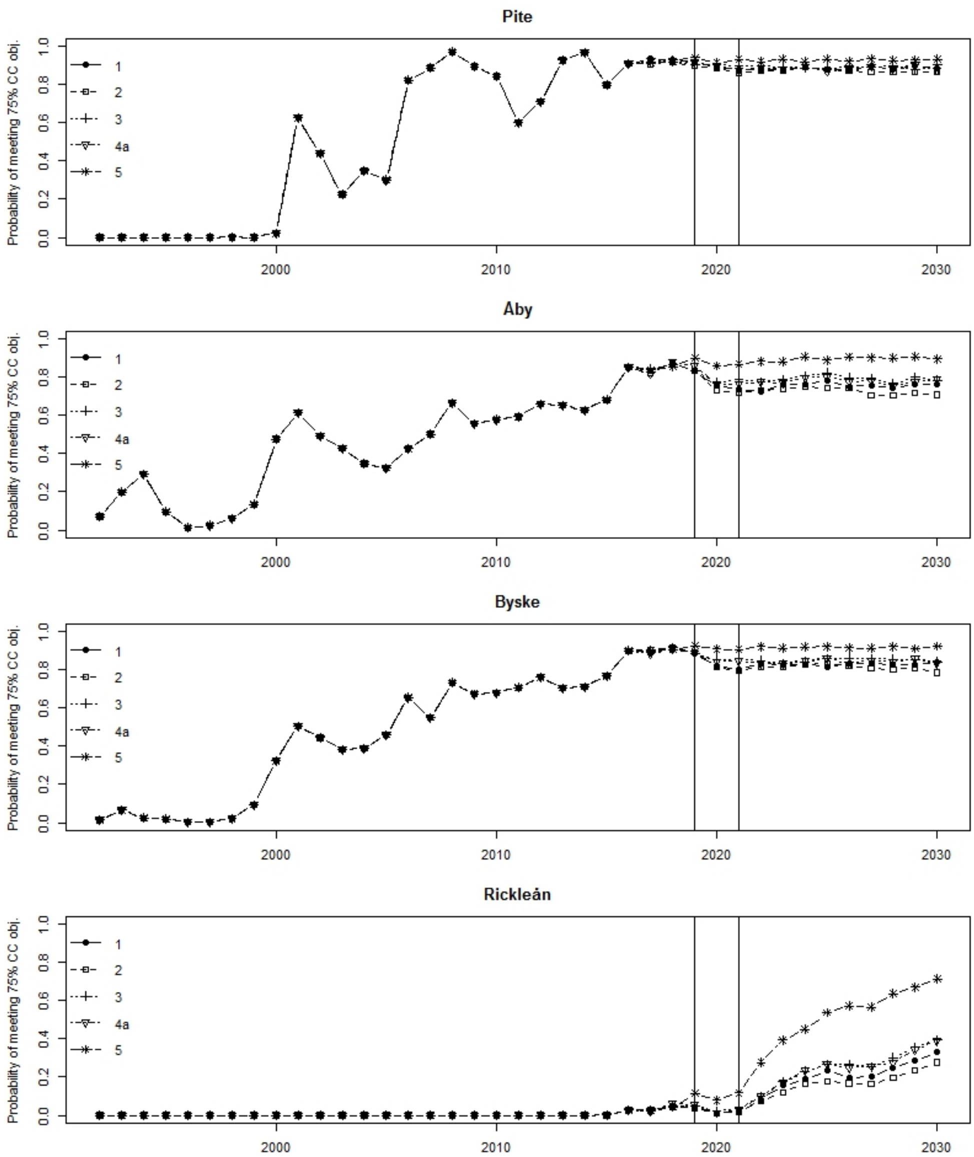


Figure 4.3.2.6b. Probabilities for different stocks to meet an objective of 75% of potential smolt production capacity under scenarios 1–3, 4a and 5. Fishing in 2015 affects mostly years 2019–2021.

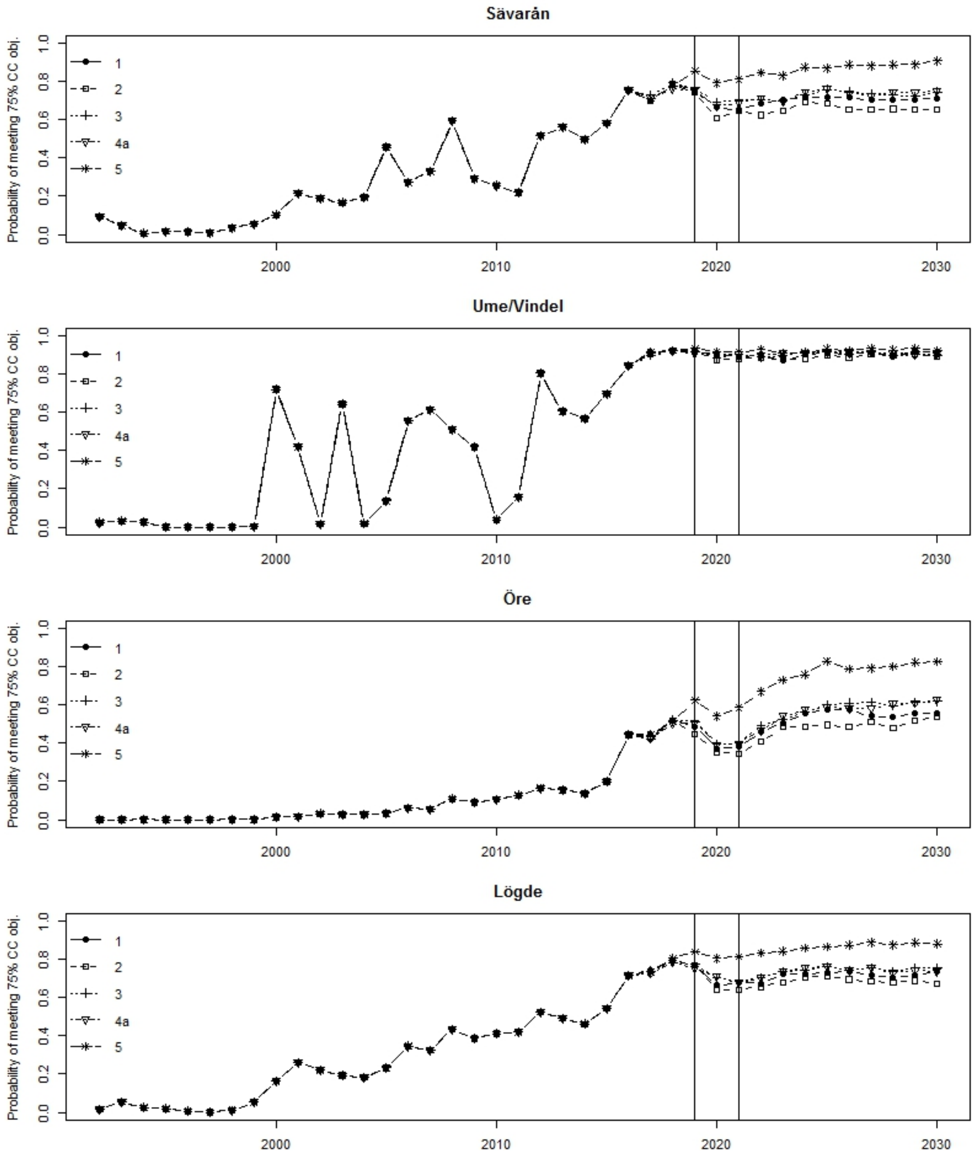


Figure 4.3.2.6c. Probabilities for different stocks to meet an objective of 75% of potential smolt production capacity under scenarios 1–3, 4a and 5. Fishing in 2015 affects mostly years 2019–2021.

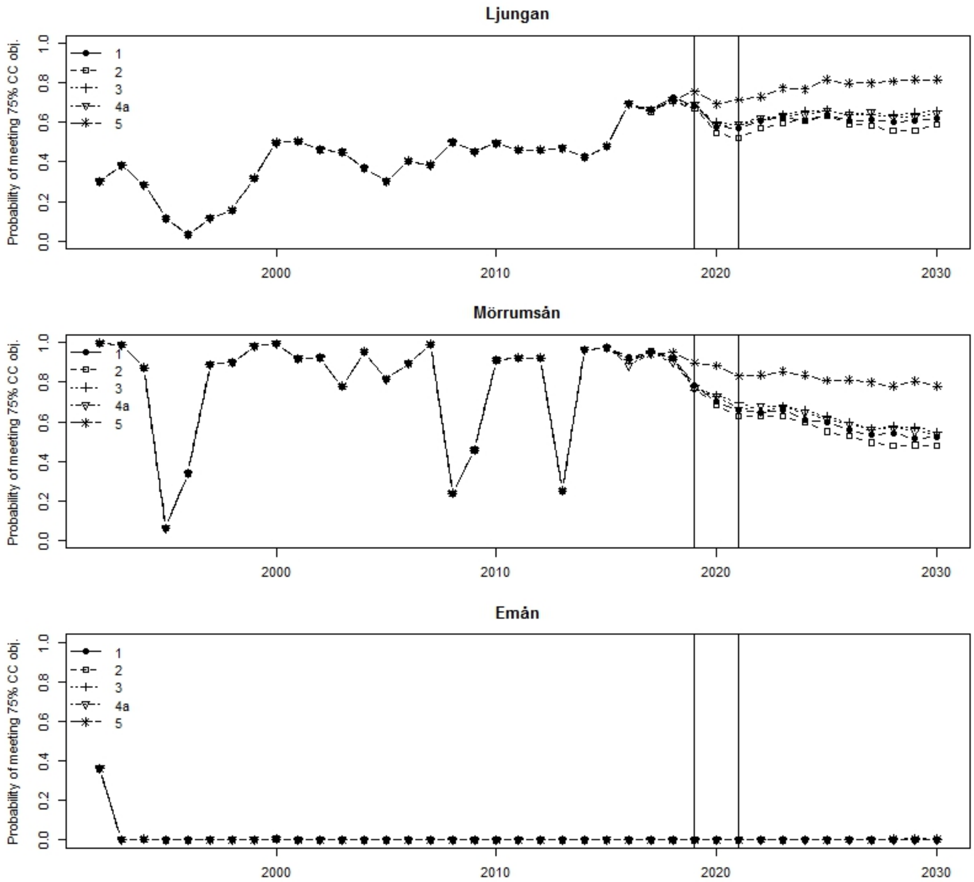


Figure 4.3.2.6d. Probabilities for different stocks to meet an objective of 75% of potential smolt production capacity under scenarios 1–3, 4a and 5. Fishing in 2015 affects mostly years 2019–2021.

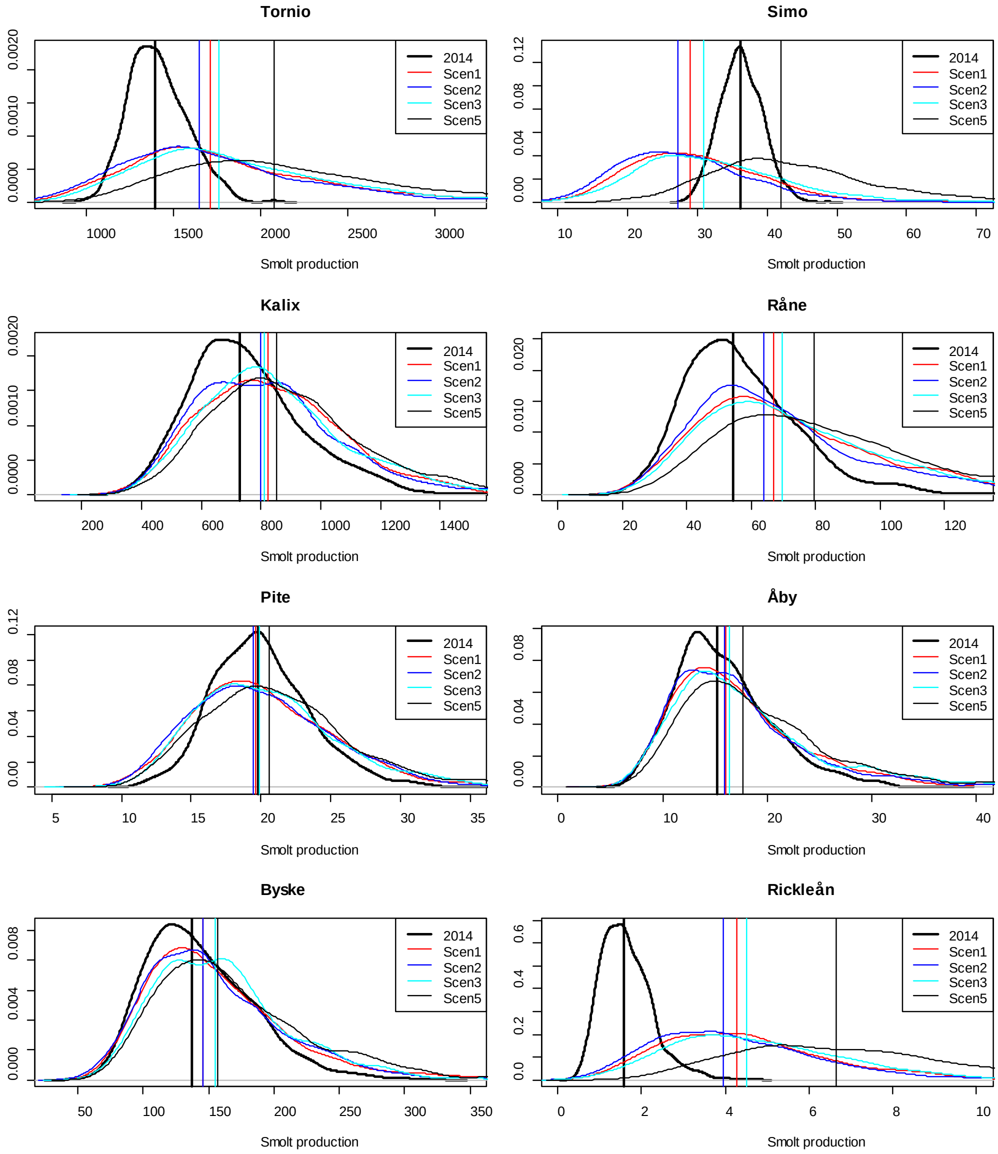


Figure 4.3.2.7.a. Predicted smolt production in 2020 under fishing scenarios 1–3 and zero fishing scenario 5 (thin lines) compared to estimated production in 2014 (bold line). Medians of distributions are illustrated with vertical lines.

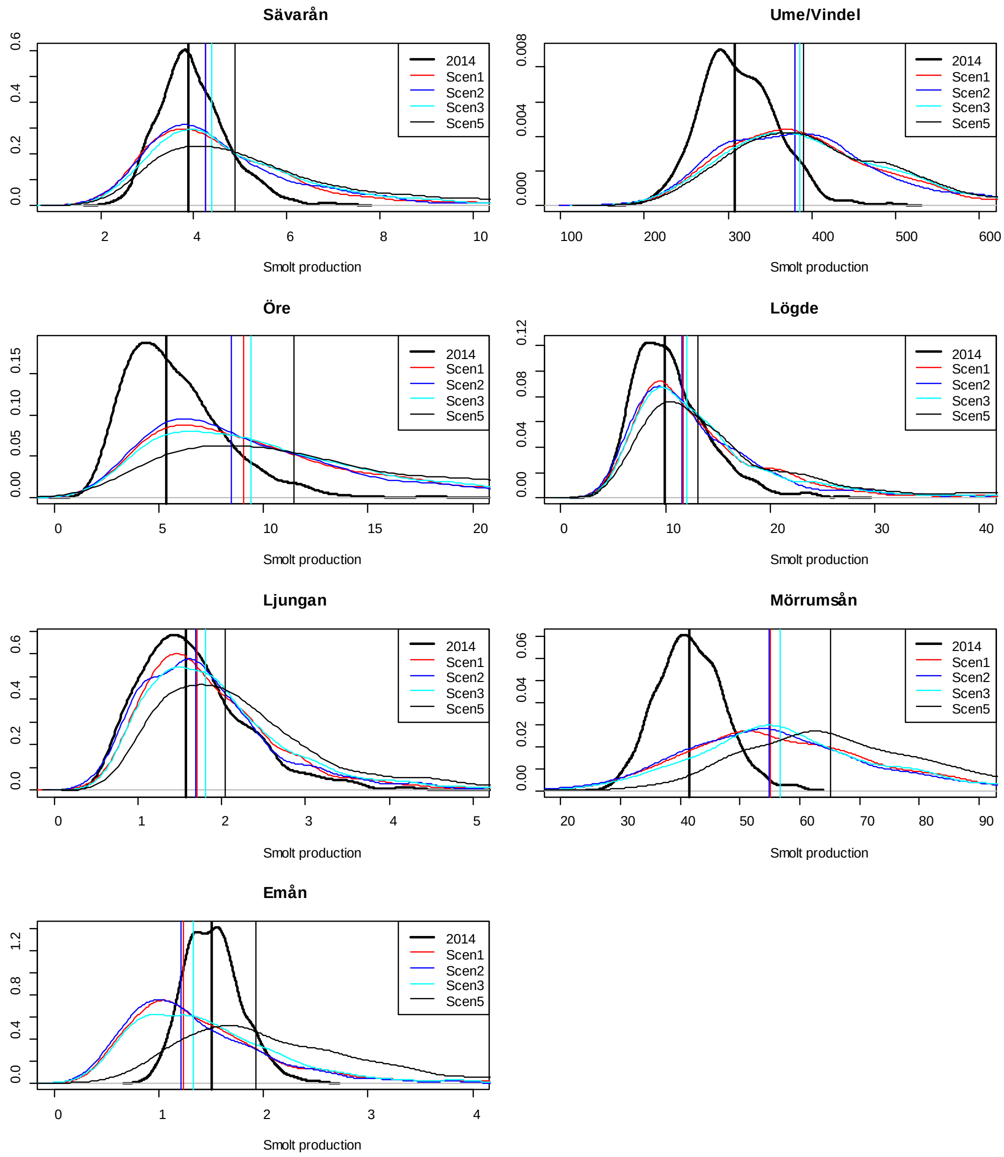


Figure 4.3.2.7.b. Predicted smolt production in 2020 under fishing scenarios 1–3 and zero fishing scenario 5 (thin lines) compared to estimated production in 2014 (bold line). Medians of distributions are illustrated with vertical lines.

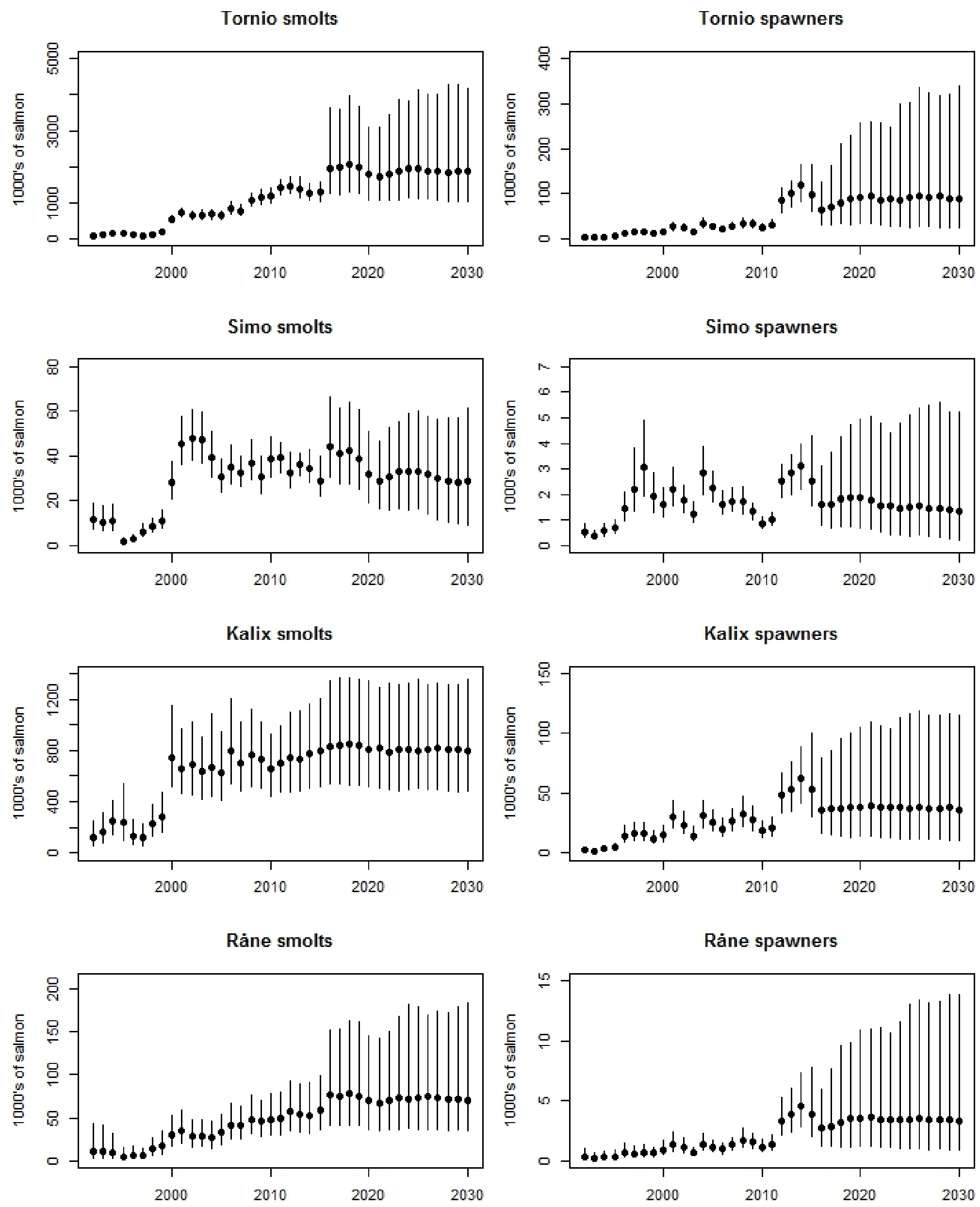


Figure 4.3.2.8a. Median values and 90% probability intervals for smolt and spawner abundances for rivers Tornionjoki, Simojoki, Kalixälven and Råneälven in scenario 1.

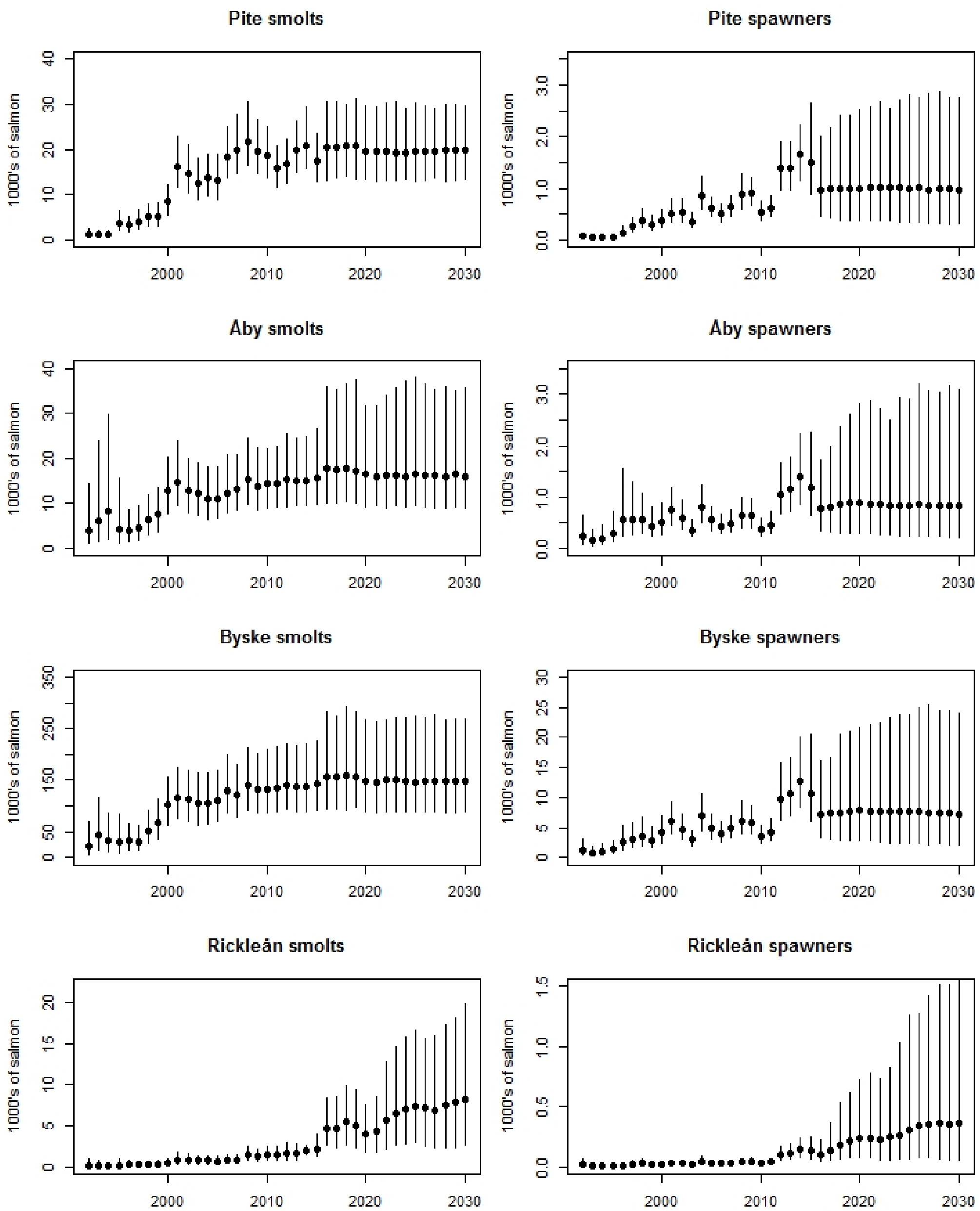


Figure 4.3.2.8b. Median values and 90% probability intervals for smolt and spawner abundances for rivers Piteälven, Åbyälven, Byskeälven and Rickleån in scenario 1.

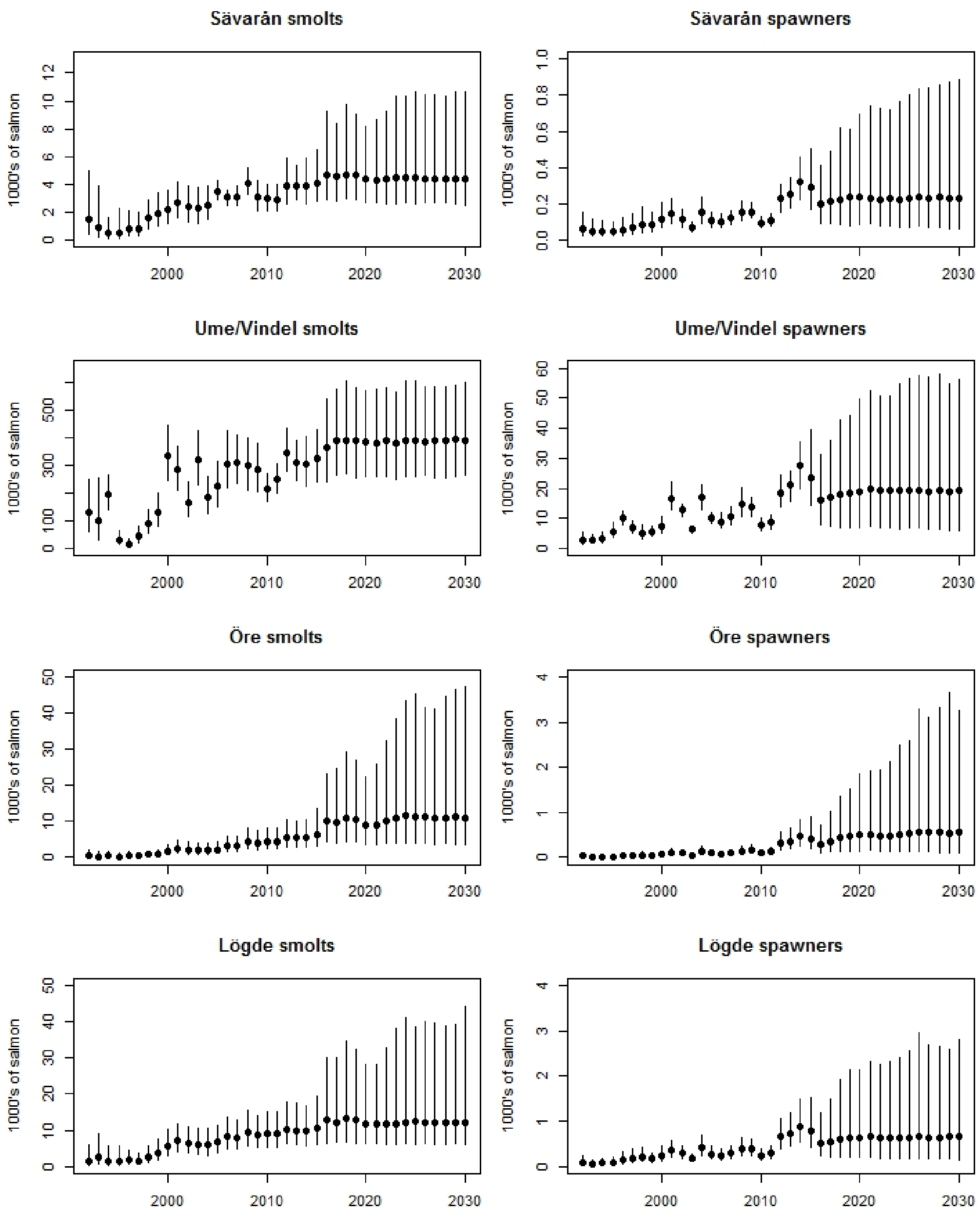


Figure 4.3.2.8c. Median values and 90% probability intervals for smolt and spawner abundances for rivers Sävarån, Ume/Vindelälven, Öreälven and Lögdeälven in scenario 1.

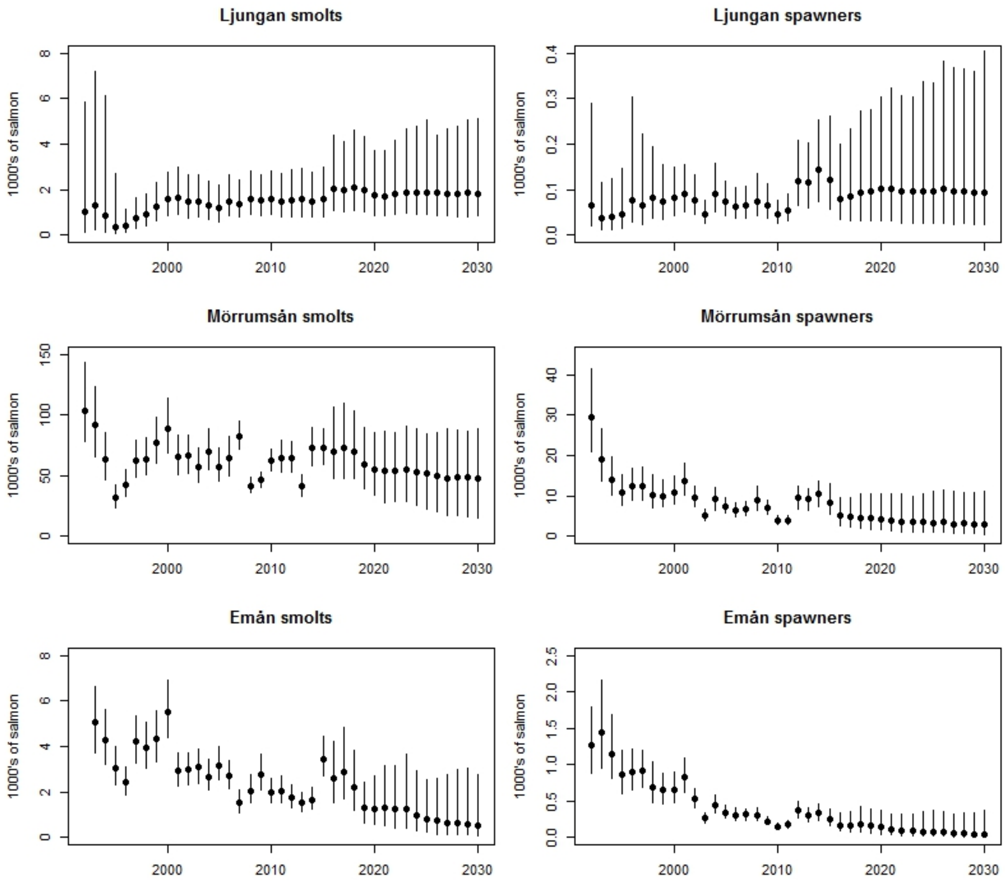


Figure 4.3.2.8d. Median values and 90% probability intervals for smolt and spawner abundances for rivers Ljungan, Mörrumsån and Emån in scenario 1.

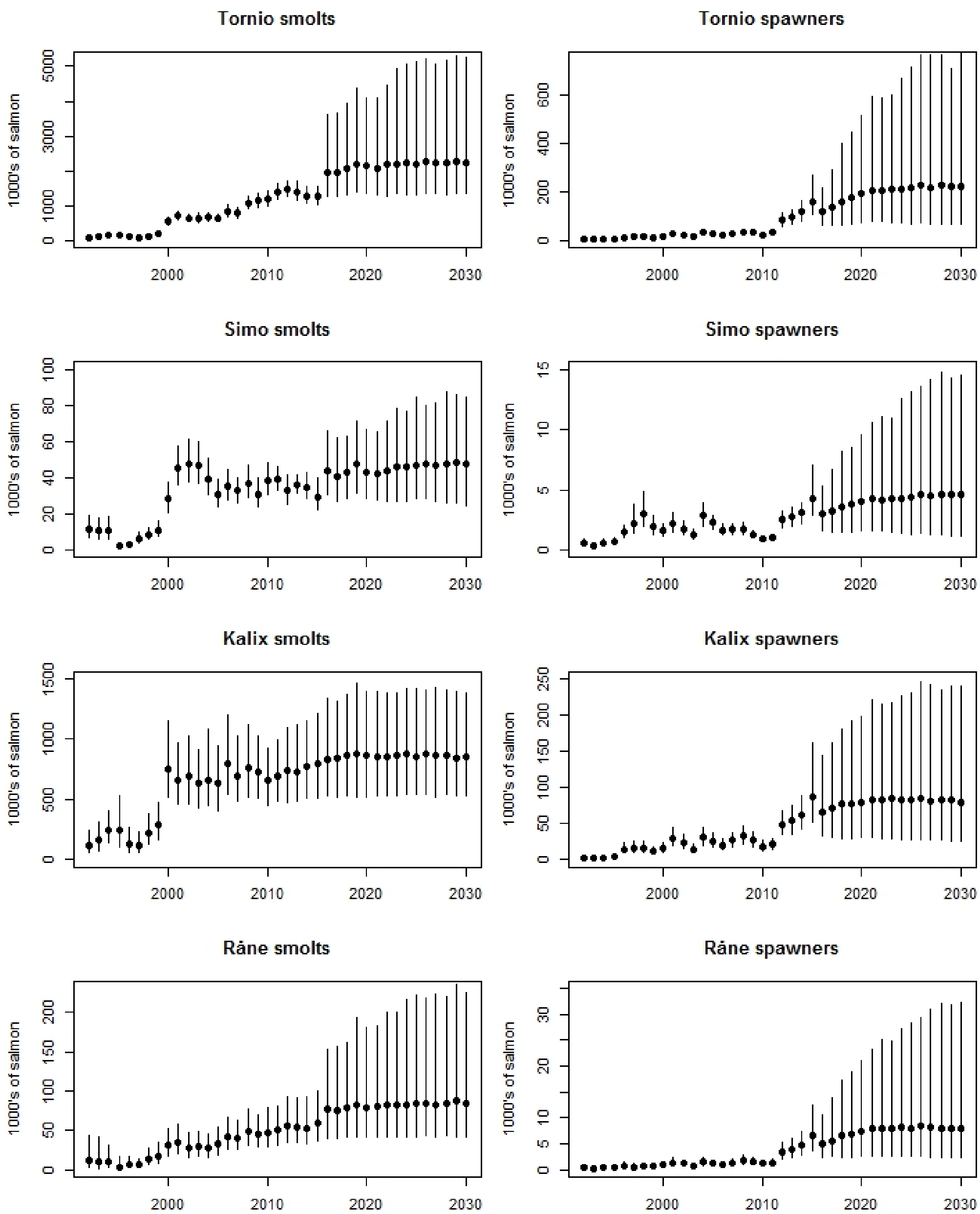


Figure 4.3.2.8e. Median values and 90% probability intervals for smolt and spawner abundances for rivers Tornionjoki, Simojoki, Kalixälven and Råneälven in scenario 5 (zero fishing).

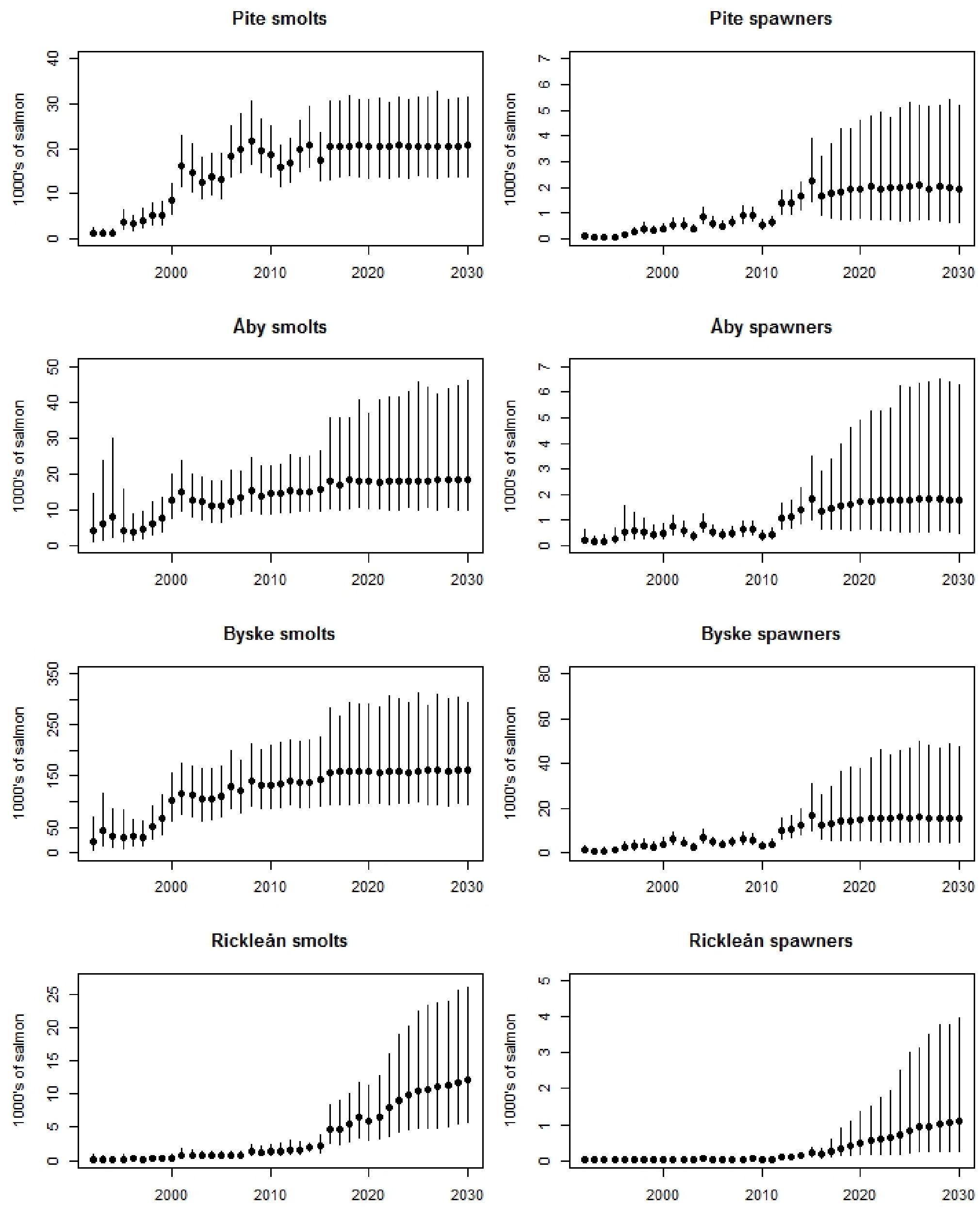


Figure 4.3.2.8f. Median values and 90% probability intervals for smolt and spawner abundances for rivers Piteälven, Åbyälven, Byskeälven and Rickleån in scenario 5 (zero fishing).

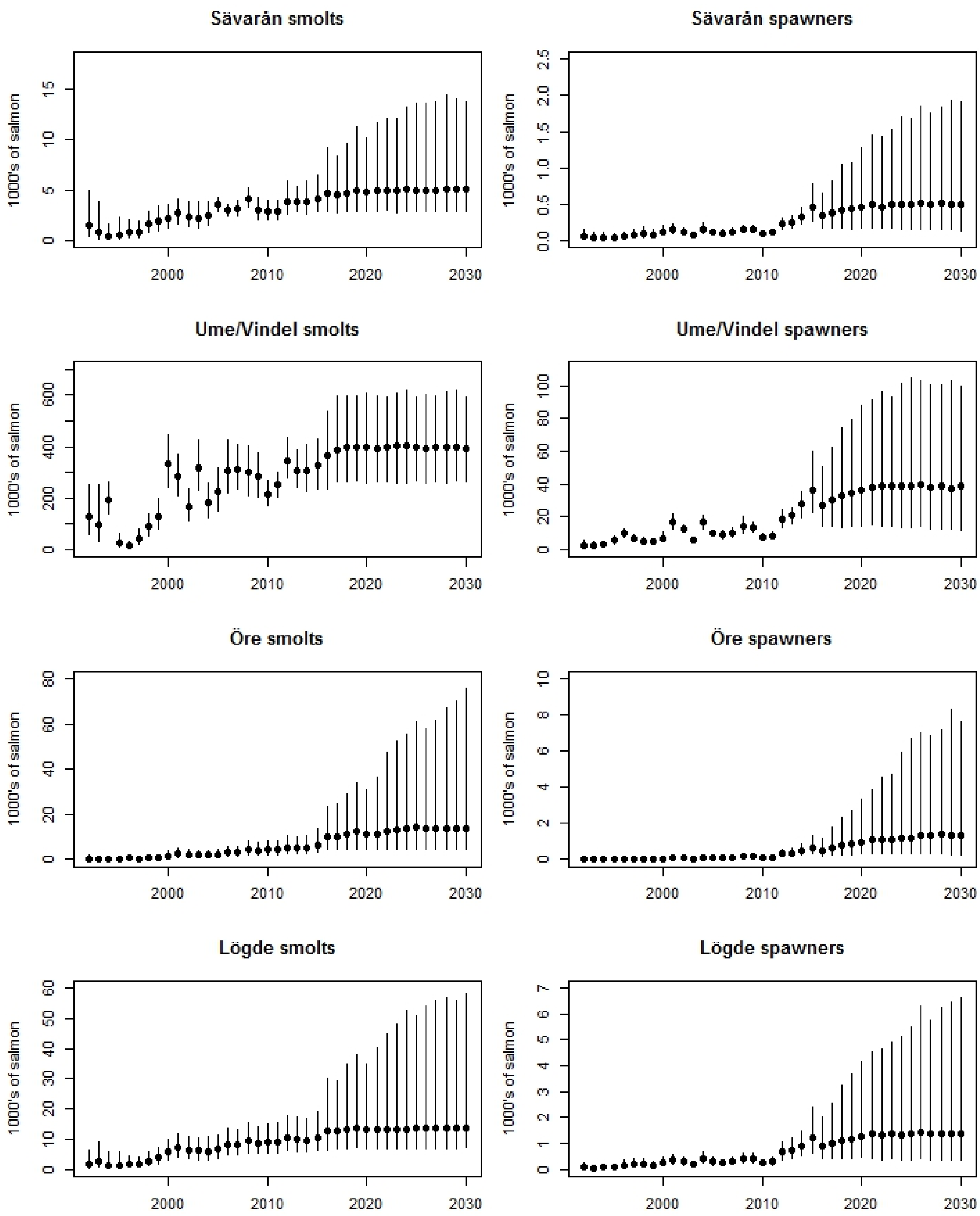


Figure 4.3.2.8g. Median values and 90% probability intervals for smolt and spawner abundances for rivers Sävarån, Ume/Vindelälven, Öreälven and Lögdeälven in scenario 5 (zero fishing).

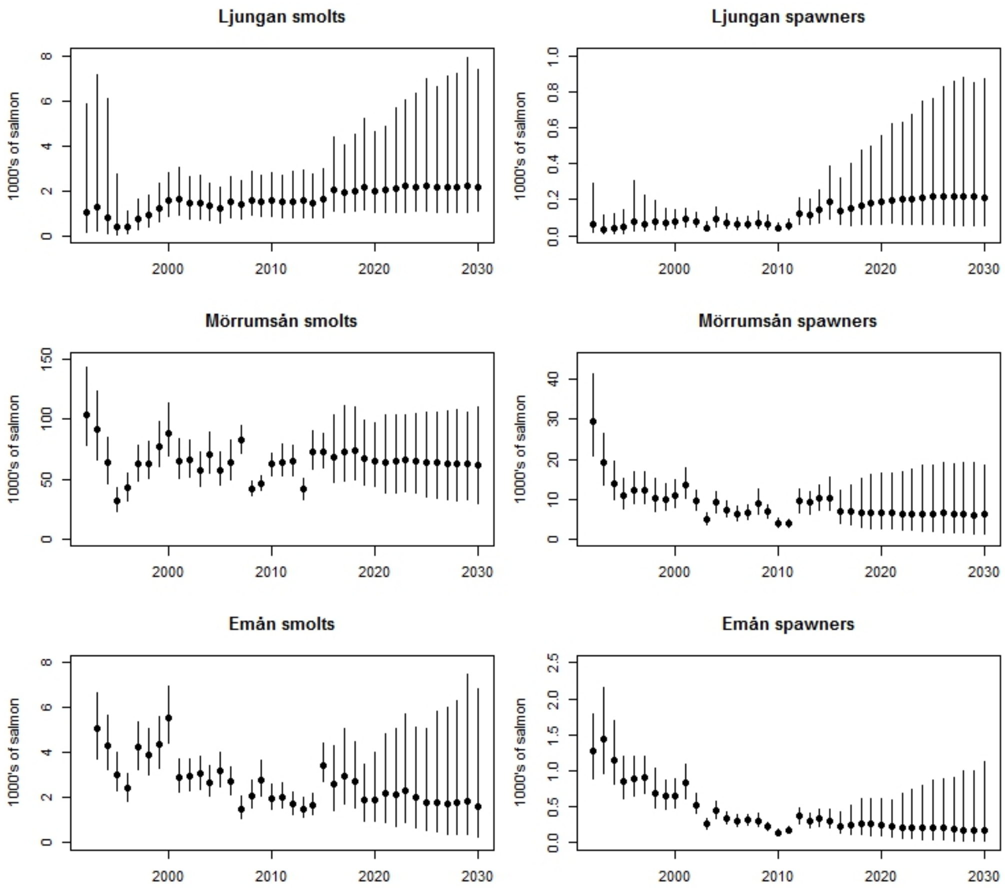


Figure 4.3.2.8h. Median values and 90% probability intervals for smolt and spawner abundances for rivers Ljungan, Mörrumsån and Emån in scenario 5 (zero fishing).

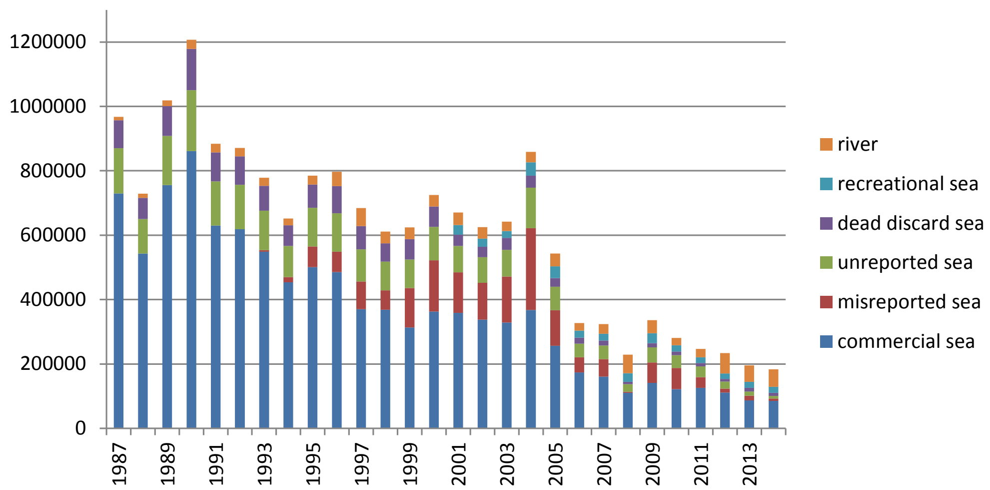


Figure 4.3.2.9. Share of commercial and recreational catches at sea, river catches (including misreporting and also some commercial fishing), and discard/unreporting/misreporting of total sea catches in Subdivisions 22–31 in years 1987–2014.

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5 Sea trout

The assessment of sea trout populations in the Baltic is based on a model developed by the study group Study Group on Data Requirements and Assessment Needs for Baltic Sea Trout (ICES, 2011), first implemented at the assessment in 2012 (ICES, 2012). For the evaluation of the assessment results basic observations such as i.a. tagging data, spawner counts and catch statistics are taken into account.

5.1 Nominal catch

The highest total (commercial and recreational) catches, above 1300 tons, were in early and late 1990s (Table 5.1.1). It has been decreasing in the new century and now is below 500 tons (Tables 5.1.2 and 5.1.3).

The total commercial catch of sea trout has increased a little from 202 in 2013 to 219 t in 2014. 77% of it was caught in the Main Basin. The Main Basin catch has dropped from 954 t in 2002 to 236 t in 2008. After two years of somewhat higher catches around 450 t, the catch again fell, reached a minimum of 148 t in 2013 and was 170 in 2014. The commercial catch in the Gulf of Bothnia was 33 t in 2014, 11 t less than in 2013, and below the ten year average catch of 60 t. In the Gulf of Finland catches dropped below 20 tons in the last two years (Table 5.1.2).

About 56 % of the total commercial Baltic catch was taken by the coastal fishery, offshore catches were almost exclusively in the Main Baltic, mainly by Polish vessels. They caught 45 tons, similar to last two years but almost eight times less than four years ago.

River commercial fishery caught 29 t in 2014. It's almost exclusively Polish catch (partly brood stock) which is close to the average for last few years.

Recreational catches in the Gulf of Bothnia were in 2014 above 116 t, which is less than in 2013 and little more than ten years average (Table 5.1.3). The main parts of it are Finnish coastal and Swedish river catch.

Finnish coastal recreational catch in Gulf of Finland was 23 t, and together with small Finnish river and Estonian coastal catch formed a total of 26.8 t.

In the Gulf of Bothnia the recreational catches are much larger than commercial catches.

According to the data, recreational catch in Main Baltic was 25 t, mainly Finnish costal catch. It is similar to the previous year. Catches in the recreational fishery is known with little accuracy but certainly are substantially underestimated. The catch in Denmark was estimated in 2010 to be 346 t, in 2011 224 t, and in 2012 260 t (Sparrevohn *et al*., 2011, 2012; Storr-Paulsen, 2014 unpublished)). Assuming these figures, recreational catches constituted almost half of total Baltic catch in 2010 and 2011 and even 60% in 2012. These estimations are based on questionnaires and are not available neither for 2014 nor 2013. In Germany this is currently being investigated.

It is important to note that the actual catch of sea trout by Poland may be heavily overestimated due to possible misreporting salmon as trout. This is discussed in Section 2.3 in the present report.

5.1.1 Biological sampling of sea trout

Sampling strategies for biological samples and procedures are very similar to those of salmon and are described in Section 2.6. In total approximately 1300 sea trout were sampled. Most of them were sampled in the Main Baltic (SD 22–28) from Latvian (311), Polish (188 inds) and Swedish (108 inds) catches. 126 samples were collected from Estonian catches in the Gulf of Finland (Table 5.1.1.1).

5.2 Data collection and methods

5.2.1 Monitoring methods

Monitoring sea trout populations in the Baltic area is carried out in all countries around the Baltic Sea. The intensity and period during which monitoring has been going on, varies between countries (ICES, 2008c). Some countries started monitoring during recent years, while very long dataseries exist for a few streams (ICES, 2008c).

In all countries monitoring is carried out by surveying densities of parr in the nursery streams, however with varying intensity. In a couple of countries sampling of parr densities is used to calculate the smolt production by a relation of parr to smolt survival either developed in the same stream or in different streams (ICES, 2008). In most countries (not in Denmark, Germany or Poland) this is supplemented with monitoring of smolt escapement by trapping and counting smolt numbers in one or more streams. In total, smolt production estimates exist for twelve rivers in the entire Baltic area, but the time-series varies very much.

In only two rivers (Åvaån and Vindelven in Sweden) both the number of spawners and the smolt run is monitored. Adult counts are determined by trapping and inspection of the ascending sea trout or by an automatic counter (VAKI). In Lithuania, the spawning run is estimated by test fishing in a couple of rivers and count of redds. In 17 rivers (ten in Sweden, three in Poland, three in Germany and one in Estonia) the number of spawners is monitored by automatic fish counters or video systems. Determination of species is possible in these, but exact size, sex, etc. cannot always be determined. In three rivers the total run of salmonids is determined with an echosounder. This technique does not allow discrimination between sea trout and salmon.

An indication of spawning intensity by count of redds is collected from a number of streams in Poland, Lithuania, Germany and Denmark (ICES, 2008). In a couple of streams in Denmark the catch in sports fisheries has also been used to estimate the development in the spawning run. Catch numbers from the sports fishery in rivers are available from some Swedish rivers.

Tagging and marking are used as methods to obtain quantitative and qualitative information on trout populations.

An evaluation of status of rivers is done based on national expert opinions as well as on factors influencing status. This evaluation is updated irregularly.

5.2.2 Marking

In 2014, the total number of fin clipped sea trout was 800 651 smolts (2013 = 967 393), what comprises 24% of all released smolts, and 85 985 parr (2013 = 237 194) (Table 5.2.2.1). Most fin clippings of smolts (57 1314) were carried out in GoB, less in the Main Baltic (215 828) and in GoF (13 509). Finclipping of hatchery reared smolts is mandatory in Sweden and Estonia. The highest number of finclipped smolts was released in Sweden (700 thousands), and Finland (95 thousands). There was no stocking of finclipped sea trout smolts in Poland (due to veterinary objections), Denmark, Germany, Russia, Latvia and Lithuania.

5.2.3 External tagging

In 2014 the total number of Carlin tagged sea trout was 15 068 (in 2013: 16 663; 2012: 35 192) (Table 5.2.3.1) and 14 241 were tagged with T-bar (T-Anch) tags (Table 5.2.2.1). There were also 2000 smolts tagged in Sweden with PIT tags.

5.3 Data presentation

5.3.1 Trout in Subdivision 30 and 31–Gulf of Bothnia

Sea trout populations are found in a total of 56 rivers in the Gulf of Bothnia, of which 28 have wild and 28 have mixed populations (Table 5.3.1.1). Two Finnish rivers have changed status from wild to mixed since the last update.

The status of sea trout populations in Swedish rivers is uncertain in many cases, but low or very low in rivers for which information is available, especially in the northernmost rivers (Table 5.3.1.1). Populations are affected by human activities influencing freshwater habitats, mostly through damming, dredging, pollution and siltation of rivers (Table 5.3.1.2).

Average densities for rivers in the area are presented in Figure 5.3.1.1. For Swedish rivers, the densities presented in this figure are from sites in rivers were also salmon are found. These rivers are therefore less suited for sea trout and they all differ from rivers and sites used in the main assessment. In the Swedish sites, densities dropped after 2006 from 8–16 parr per 100 m^2 to 1–3 of 0+ parr per 100 m^2 and have remained stable at this low level since. This was due to reduced densities in two rivers (Lögdeälven and Kågeälven). From Finland, results include three rivers (Torne River with two tributaries, and Isojoki and Lestijoki). Densities have remained low in Isojoki and Lestijoki, while they have been variable in the tributaries to Torne River, resulting in an overall average of between two and six sea trout 0+ parr in recent years with increase over ten in 2014.

The number of sea trout spawners recorded by fish counters in some of the larger rivers is in general very low (Figure 5.3.1.2). The average number in River Kalixälven increased somewhat after 2006 from some 100 sea trout to 120–180, and a further increase in 2013 and 2014 to over 300 sea trout. In River Byske the number decreased after 2005 from approximately 100 sea trout to very low levels around with only approximately 25 sea trout per year. The river Vindelven has from 2001 shown a cyclic population size with between approx. 25 and 150 sea trout ascending. In 2013 a number of fish increased to about 250 but in 2014 dropped to a previous level. In river Pite a positive trend has been obvious with increasing run to over 700 in the last three years.

Catches of wild sea trout have declined considerably over a long time period, indicating a very large overall reduction in population size. As an example, Swedish catches in the rivers Torneälven and Kalixälven are presented in Figure 5.3.1.3. Catches of wild sea trout in the Swedish sports fishery for all subdivisions is presented in Figure 5.3.1.4. The total annual catch varies much between years. In Subdivision 31, results from 14 rivers are included. Among these, seven have in the time period 1999–2011 average annual catches below 100 sea trout, and none have average annual catches above 500 sea trout. Overall, there is increasing trend in development of catches for three years.

Returns from Carlin tagging releases show a continuous decrease in returns for more than 20 years. Since 2003 it has been below 1%, (Figure 5.3.1.5). In the Gulf of Bothnia, recapture rate in Sweden was similar to Finland in the period 1980–2002.

Carlin tagging results in the Gulf of Bothnia show a large and increasing proportion, often the majority, of the sea trout to be caught already during the first year in sea. Trout are caught as bycatch in the whitefish fishery by gillnets and fykenets. Based on tagging data, the proportion of fish caught as undersized during the first sea year still is fluctuating around approximately 50%, even though the total effort of gillnet fishery by professional fishermen has not changed during the past ten years (Figures 5.3.1.6, and 5.3.1.7). The data have not been updated in 2014 since it is assumed that the proportion of older recaptured Carlin tagged sea trout might not be representative.

According to tagging data, the survival of the released smolt is at present lower than a long-term average.

In Table 5.3.1.3 smolt numbers for the period 2002–2014 are presented. In addition, the exact number of counted individuals and details on methods and catchability coefficients of the different traps are given for 2014. In river Tornionjoki, smolt trapping during the migration period for sea trout has only been possible in some years, not in 2014. The smolt trap from river Sävarån has been moved in 2014 to the river Rickleån, with estimated smolt production of ca. 350 individuals.

A recent study on tagging results from releases in two Finnish rivers in SD 30 and 31 has been conducted. Preliminary results indicate high rates of total (summed over fisheries) annual instantaneous fishing mortality, with a decreasing pattern of fishing mortality over time. Annual total fishing mortality rate estimates ranged from between 1 to 3 in most years for both rivers for sea trout aged 3 and older, corresponding to harvest rates between 0.63 and 0.95. A decreasing pattern of survival in the first year at sea was estimated, although this may reflect a possible decrease in the tag reporting rate over time. These sustained high rates of fishing mortality have likely contributed to the poor stock status and limited reproduction of wild sea trout stocks in these rivers.

Even though the spawning run in R. Piteälv has improved significantly over the last decade, and also both R. Kalix and R. Vindelven showed a positive trend in 2013 the number of spawners observed entering rivers in northern Sweden is extremely low, taking into account the size of the rivers. This is likely due to both low recruitment and elevated mortalities at sea. Anglers catch, as a proxy for the sea trout run, does not suggest any progress in this area.

The results from Finnish tagging returns indicate a very high proportion of sea trout being caught as post-smolts long before the fish reach maturity. The larger part of the catch is taken in bottom gillnets, targeting other species (whitefish).

In the Gulf of Bothnia sea trout become mature mainly after three sea winters (SW) (L>55 cm). According to the tagging data less than 5% of the catch has been 3SW or older in the last 15 years, i.e. the vast majority are caught before they reach maturity.

Tagging data show that Finnish sea trout migrate partly to the Swedish side of the Gulf of Bothnia (ICES, 2009). Correspondingly, Swedish sea trout have been caught at the Finnish coast.

The early catch of sea trout constitutes a major problem, primarily to Finnish sea trout populations, but also to Swedish populations because these partly migrate to

Finnish waters. This is most likely an important reason why populations in this area have such a poor status and show a negative trend in Finland, and only slow recovery in Swedish rivers.

5.3.2 Trout in Subdivision 32 – Gulf of Finland

The number of streams with sea trout in Gulf of Finland was revised in 2007 for all countries and partially updated this year. It is now estimated that there are 101 rivers and brooks in this region (Tables 5.3.1.1 and 5.3.2.1); of these 85 have wild stocks. The rest have been supported by releases. From 2013 releases of trout were terminated in Estonia. Status of populations is uncertain in 30 rivers and very poor in 29 with smolt production below 5% of potential.

Sea trout populations are found in 45 Estonian rivers and brooks in the Gulf of Finland region of which 38 have wild populations (Table 5.3.1.1). Electrofishing data from Estonian rivers showed densities of up to 140 0+ parr per 100 m^2 in 1980s. In more recent years, densities have in general been below 40 0+ parr per 100 m^2. Average densities from 1992 and onwards are presented in Figure 5.3.2.1. Rivers with higher smolt production are situated in the central part of the North Estonian coast. Smolt run in River Pirita during the period 2006–2013 varied between 100 and 2300 smolts (Table 5.3.1.3). The estimated smolt production in the river Pirita was the lowest for seven years, reflecting very opposite trends in rivers of the same SD 32.

Parr density of sea trout in the Finnish River Ingarskilanjoki in the Gulf of Finland has been highly variable with densities varying between 0 and 82.2) 0+ parr per 100 m^2 for the period 2001–2014 (Figure 5.3.2.1). This is the only Finnish river presented in this figure.

The recapture rate of Carlin tagged sea trout shows a continued decreasing trend for more than 20 years also in Gulf of Finland being 0 in later years (Figure 5.3.1.5). Finnish tagging results have shown that in general about 5–10% of the tag recoveries are from Estonia and some also from Russia. Correspondingly, Estonian tagged sea trout were partly recaptured at the Finnish coast. This has recently been confirmed in a genetic mixed stock analysis (Koljonen *et al*., 2014).

In Russia, wild sea trout populations are found in at least 40 rivers or streams (Tables 5.3.1.1 and 5.3.2.1). The majority are situated in the north coast of Gulf of Finland, but rivers with the highest smolt production are in the southern area. Average densities were in general below 10 0+ parr per 100 m^2 for several years but increased to about 20 in 2014. The total smolt production has been estimated to be at least 10 000–15 000 smolts. Smolt trapping shows that between 2000 and 8000 sea trout smolts of natural origin annually migrates to the sea from the largest Russian trout river Luga but with relatively low numbers in recent years (Table 5.3.1.3). Genetic studies showed that 6–9% of the catch along the southern Finnish coast is of Russian origin.

5.3.3 Trout in Subdivisions 22–29

In the Main Basin there is now 472 rivers streams and with sea trout populations and of these 395 are wild. The status of sea trout populations in this area was partially revised in 2014 and is uncertain in 218 rivers with wild populations (Tables 5.3.1.1 and 5.3.2.1). Status of 26 (wild and mixed including tributaries in large systems) populations are poor (estimated production <5%), mainly due to habitat degradation, dam building and overexploitation (Tables 5.3.1.2 and 5.3.3.1).

This does not include Germany where the actual number has not yet been evaluated, but it is estimated that the number of sea trout rivers could be approximately 70.

5.3.4 Trout in Subdivision 26–29–Eastern Main Basin

In Estonia, sea trout occurs in 35 rivers and brooks discharging into the Main Basin. All of them are small and have wild populations (Table 5.3.1.1). Average densities have in recent years been up to approximately up to 30 sea trout parr per 100 m^2 with an up-going trend (Figure 5.3.3.1). Densities tend to vary much between years, partly because of varying water flow.

In Latvia, sea trout populations are found in 28 rivers, about half of them wild (Table 5.3.1.1). Average densities of 0+ parr were between 4 and 12 0+ parr per 100 m^2 (Figure 5.3.3.1). The Salaca, Gauja and Venta rivers have the highest wild smolt production in Latvia. Estimated production in all Latvian rivers was about 43 000 smolts in 2014 (51 000 in 2013, 52 500 smolts in 2012, 55 000 in 2011, 65 000 in 2010). In R. Salaca smolt number varied between 2500 and 19 000 in the period 2002–2014 (Table 5.3.1.3). The smolt production in river Salaca has been reduced to 1/3rd compared to 2013 being only 3100.

In Sweden 207 sea trout rivers are found in the entire Main Basin. Out of them 200 have wild sea trout populations, and seven are supported by releases. Densities of trout are presented for Emån in Figure 5.3.3.1, showing very low values. Since the mid-1990s it has varied between 0.2 and 11 0+ parr pr 100 m^2. Catch in Emån is presented in Figure 5.3.1.4 (SD 27). Sport fishing harvest has been declining and has in recent years been only between 20 and 40 sea trout annually i.e. not including catch and release. Consequently, the number does not reflect the total run of sea trout.

In Lithuania sea trout are found in 16 river basins, six of them belong to the Nemunas drainage basin. In four rivers there are wild populations, while the rest are supported by releases. Average parr densities for 0+ trout have been around 6–10 0+ parr per 100 m^2 during the last few years (Figure 5.3.3.1). The total natural smolt production was in 2014 is estimated to be about 45 000 (34 200 in 2013, 44 900 in 2012). The estimated overall number of spawners has for a number of years been relatively stable (Kesminas and Kontautas in Pedersen *et al.*, 2012) varying between 5500 and 8000. The total area of spawning nests in the western part of the country did not increase from 2013, after increasing from 2011 to 2013.

In Poland the number of populations was revised in 2013. Sea trout are found in 25 rivers (whole country, twelve of them in SD 26), mainly in Pomerania (ten) but also in Vistula R. (six) and Odra R. (six) systems (including the main river systems). All are mixed due to stocking for many years. The density of parr has been highly variable with densities up to more than 90 0+ parr pr 100 m^2) (Figure 5.3.3.1). A very low density observed in 2007 was based on data from one site only.

The number of counted spawners in a fish counter in river Slupia in 2014 the count of sea trout was 2300 which is a decreased to less than half of that in 2013 (SD 25). In river Ina (SD 24) 2200 was counted which is an increase of approximately 25% compared to 2013. Both rivers have both wild and reared sea trout (Figure 5.3.3.2).

There is a dermatological disease of spawners in most of Polish Pomeranian rivers. Infected fish develop severe lesions on the skin which penetrate into the skeletal muscle. In fresh water the lesions become additionally infected with *Saprolegnia* fungus (Johansson *et al.*, 1982). The infected ascending adults are frequently reported to die before spawning, thus reducing the size of the reproducing population. It has been observed in a varying intensity in the last few years in the Polish rivers Słupia, Parsęta, Rega, Łupawa and Wieprza, and in kelts in the Gulf of Gdansk. This resulted in death of more than half of spawners caught for stripping. In 2008 the situation was similar in Slupia and also in other rivers. In 2011 the intensity was similar to 2010 and lower in comparison with the earlier years. In 2013 the problem was especially severe in R Slupia, where artificial breeding had to be given up. In 2014 the frequency of fish with infection decreased slightly. In spite of several attempts to identify the cause the reason is still unknown.

The situation of the sea trout populations from German Baltic Sea rivers and streams has started being investigated in the two Federal States Schleswig-Holstein (SH; SD 22) and Mecklenburg Western-Pomerania (MV; SDs 22/24). There is only preliminary information available concerning the number of rivers/streams with wild sea trout populations in SH. However, fry and smolts were released in 19 rivers/streams potentially leading to the development of reared/mixed populations, but a short-term, project-based monitoring programme based on results of a literature study (Petereit *et al*., 2013) exists in SH. In 27 out of 30 surveyed rivers and tributaries (123 stations / ~4 stations per system / 100 m sections) parr stages could be detected in 2013, indicating that in at least ten systems natural production is likely. The electrofishing survey for 0+ and 1+ parr stages based on the Trout Habitat Score Parr Index method (THS) was, showing similar correspondence between habitat quality and trout density as found in other countries. Average overall densities were 11.9 0+ sea trout per 100 m^2 (0–150) by one pass fishing without correction for catch efficiency (data not shown).

In MV nine rivers contain self-recruiting wild sea trout populations and four rivers have a mixed population. Sea trout were released in 33 rivers of MV between 2000 and 2010; presently releases are continued in 13 rivers. Some rivers initiated self-recruiting populations; some need still support and in the rest of the rivers poor survival of the released trout was observed. The stocking success monitoring will continue in MV, but from 2014 onwards including THS, following the good experiences made in SH, in order to have a common base with other Baltic countries.

In 2014 densities were determined in 26 streams (between one and 13 sites) with an average density of 77 0+ parr (SH and MV together) (Figure 5.3.4.1). These densities are not directly comparable to densities in 2013 due to the method of calculation, but there has without doubt been a significant increase in densities.

Spawner numbers have been collected by video counting in three streams with wild populations in SD 22 and SD 24 (Figure 5.3.3.2). In 2010/2011 the counts were incomplete due to flooding events. In the Peezer Bach (SD 24) the number of spawners was almost identical over the last three years (about 650). Hellbach (SD 22) had the highest count in 2013/2014 with 2300 adult trout whereas the count was 1030 in 2011/2012 and 855 in 2012/2013. In Tarnewitz (SD 22) counts were between 140 and 380 adults during the period 2011–2013.

Densities in the Swedish river Mörrumsån have since the mid-1990s been below 15 0+ parr per 100 m^2 (Figure 5.3.4.1). Smolt number from the upper part of river Mörrumån (approximately 15 km from outlet) has varied between 3500 and 10 200 during the last six years (Table 5.3.1.3). Sports fishing nominal catch in Mörrumsån is presented in Figure 5.3.1.4 where SD 25 is catch in Mörrum. The harvest has varied around 500 sea trout annually for several years, however declining during the last five years to 132 sea trout (not including catch and release).

Average densities of 0+ parr on spawning sites in five Polish rivers in SD 25 varied in recent years between 25 and 114 0+ parr pr 100 m² (Figure 5.3.4.1). Spawning run in R. Slupia was between 2300 and 7400 at Slupsk 30 km upstream from the outlet in the period 2006–2014. 2014 had the lowest run during this period.

It is estimated that the number of wild smolts produced in Danish rivers in SD 22–25 is presently approximately 290 000 smolts annually. Electrofishing data from Danish streams show average parr densities of between 50 and just under 200 parr per 100 m² since around 2000 (Figure 5.3.4.1). Smolt migration in one stream on Bornholm (Læså length 17 km, productive area 2.46 ha) was on average 6300 annually 2007–2013, however with very high variation (1687–16 138) due to varying water levels (Table 5.3.1.3). No estimate of smolt production is available from other rivers from SD 22–24.

The observed numbers of spawners in rivers in southern Baltic are much higher than in the large northern rivers even if some of them are very small and all have much smaller productive areas. The number of years with observations is in some of the rivers too short to evaluate on trends. However in the rivers with highest numbers there was a decrease in spawning run.

5.4 Reared smolt production

Total number of reared smolt released in 2014 in Sub-division 22–32 was 3 292 000, similar to the last year and the ten years average. Out of this, 1 951 000 smolts were released into the Main Basin, 1 076 000 into the Gulf of Bothnia and 265 000 into the Gulf of Finland (Table 5.4.1).

In Finland, smolt production is mainly based on reared brood stocks supplemented by spawners caught in rivers. Stocking with reared sea trout smolt varied around the ten years average 980 000 and reached 883 000 smolt in 2014 (Table 5.4.1), 64% into the Gulf of Bothnia. Swedish stocking of smolt was 739 000, close to the average level of last few years and the majority of the amount was released into Gulf of Bothnia (69%).

Estonia has released 7000 sea trout smolt into the Main Baltic and 6000 into the Gulf of Finland in 2014 (Table 5.4.1). In Poland juvenile fish are reared from spawners caught in each river separately; only a part of Vistula stocking is of reared brood stock origin. Almost 1.18 million smolt were released to Polish rivers in 2014, very close to the ten years average (Tables 5.4.1).

Denmark released 274 000 in 2014 and as part of a local promotion of fishing possibilities directed towards tourism additionally 420 000 smolt were released in river mouths on the island Fyn (SD 22). Latvian releases has decreased from 161 000 in 2013 to 123 000 one year old smolt in 2014 (Table 5.4.1). Russia released 74 000 smolts which was many more than in 2013 (Table 5.4.1). German stocking has been on level of 13–15 000 smolt since 2008.

In addition to direct smolt releases, trout are also released as eggs, alevins, fry and parr (Table 5.4.2). The calculated number of smolt originating from these is presented in Table 5.4.3. In 2014 the estimated number of smolt from these releases was around 279 000, mainly in the Main Baltic (above 229 000). The predictions for 2015 is approximately 244 000 smolt for the whole Baltic, of which 211 000 will migrate into the Main Basin (Table 5.4.3). Total number of smolt from enhancement releases in recent years is less than in the very beginning of the 21st century (Table 5.4.3).

5.5 Recent management changes and additional information

5.5.1 Management changes

In the Bothnian Bay (Subdivision 31), Bothnian Sea (Subdivision 30) and Gulf of Finland (Subdivision 32) fishing in the sea is still mainly directed towards other species using tackle that catches also young age groups of sea trout. The proportion of sea trout caught at a young age has continuously increased in part of the Bothnian Bay, and consequently a large part does not reach sexual maturity.

In order to improve the situation for the poor sea trout stocks in Subdivision 31 a number of changes were implemented in the Bothnian Bay from July 1, 2006 in both Sweden and Finland. The minimum size for sea trout was raised from 40 to 50 cm in the sea.

In the Finnish economic zone in the Gulf of Finland all reared sea trout must be adipose fin clipped. All caught sea trout that has adipose fin must be released back to sea. Minimum landing size (for finclipped sea trout) increased in 2014 to 60 cm and 65 cm in village owned waters in the Gulf of Finland. Minimum bar length in the gillnets that are intended to sea trout fishing is 80 mm (increased from 65 mm). In all bottom gillnets with less than 80 mm bar length only monofile nets are allowed and diameter of fibre must not exceed 0.20 mm.

In the river Torne harvest of sea trout is completely banned.

In Sweden, a ban of fishing with nets in areas with a depth of less than 3 meters during the period 1 April–10 June and 1 October–31 December was enforced in order to decrease the bycatch of trout in other fisheries. In the period 1 October–31 October, fishery with nets with a mesh size of less than 37 mm (knot to knot) is allowed.

New restrictions for the rivers in Bothnian Bay (Subdivision 31) were implemented in 2013 to further strengthen the protection of sea trout. This included shortening of the autumn period for fishing with two weeks, resulting in a fishing ban from 1 September to 31 December (in some rivers also between 1 May–18 June), and restrictions of catch size (minimum 50 cm in sea areas in Subdivision 30 and a slot limit between 30–45 cm in some rivers (30–40 cm in Subdivision 31). The size restrictions will differ between rivers. The new regulation also includes a bag limit of one trout per fisherman and day (See Section 2.9).

As a part of the bilateral agreement between Sweden and Finland on fishing in the River Torne (border river and area outside river mouth) a total ban on landing trout was decided and implemented in the spring 2013 and this was continued in 2014. From 2013 the Swedish offshore fishery targeting salmon and sea trout has been phased out.

In Estonia new restrictions established in 2011: 1) the closed area for fishing around the river mouth was extended from 1000 to 1500 m for time period 01.09–31.10 for river Kunda, Selja, Loobu, Valgejõe, Pirita, Keila, Vääna, Vasalemma and Purtse; and 2) In river Selja, Valgejõgi, Pirita, Vääna and Purtse recreational fishery for salmon and sea trout is banned from 15.10–15-11.

5.5.2 Additional information

In recent years predators such as cormorants (*Phalacrocorax carbo*) have increased dramatically in the Baltic area. Studies have shown that cormorants can have severe effects on fish stocks (Bzoma, 2004; Leopold *et al.*, 1998). Where large cormorant colonies occur in the vicinity of important salmonid rivers, there are good reasons to investigate whether cormorants have a significant negative impact on the stock.

For three years there has been practically no marking or tagging fish in Poland due to administrative decisions.

5.6 Assessment result

5.6.1 Model assessment method

The SGBALANST (ICES, 2008; 2009) screened available data on sea trout populations around the Baltic Sea, and proposed an assessment method for trout (ICES, 2011). The basic method, theory and development is fully described in (ICES, 2011 and ICES, 2012), and the slightly adjusted method applied in the assessment in 2012 is briefly summarized below, together with modifications applied in the present assessment.

Through screening of data availability (ICES, 2008; 2009; 2011) found that only data on abundance of trout from electrofishing were available from all countries. Together with habitat data trout densities are collected annually from specific sites every year in most countries. At the time of the screening the number of sites was highly variable between countries and mostly sparse in many parts of the Baltic. From a few countries directly useable data were not available, either because there was no fishing programme at all or because the information collected was not sufficiently detailed.

It was found that only little and scattered information on other life stages, sea migrations, abundance of spawners, smolt production and survival. Also information on human influence, such as sea and river catches (especially recreational catches) of sea trout was sparse.

An assessment model using electrofishing data together with habitat information collected at the same sites was proposed focusing on ***recruitment status*** as the basic assessment tool. Recruitment status was defined as the *observed recruitment* (observed densities) relative to the *potential maximal recruitment* (maximal densities that could be expected under the given habitat conditions, i.e. the predicted densities, see below) of the individual sea trout populations.

Due to the significant climatic (e.g. temperature and precipitation), and geological differences found across the Baltic area, as well as the huge variation in stream sizes the model proposed is constructed to take variables quantifying such differences into account.

Differences in habitat qualities (suitability for trout) influences trout abundance, given that stock status is below carrying capacity and that spawning success not is limited by environmental factors such as migration obstacles downstream to sites. To be able to compare trout abundances between sites with different habitat quality a submodel was proposed: i.e. the Trout Habitat Score (THS). The THS is calculated by first assigning values (scores) for relevant (and available) habitat parameter for 0+ trout: *average/dominating depth, water velocity, dominating substrate, stream wetted width, slope (where available) and shade*. Scores assigned were between 0 for sites with poor conditions and 2 for best conditions from suitability curves and in part by expert estimates (ICES, 2011). THS is then calculated by addition of score values resulting in a THS between 0 (very poor conditions) and 12 (10 if slope is omitted) for sites with very good conditions.

The THS values obtained were then further grouped in larger Classes between 0 (poorest) and 3 (best) (Table 5.6.1) (ICES, 2011).

In calculations parr abundance was transformed using Log10 (x+1) to minimize variation and improve a fit to normal distribution.

Sites judged to have (a prerequisite for trout to fulfil their life cycle) were selected.

The potential maximal recruitment for sites used in the assessment was at this first use of the assessment in 2012 due to a limited number of observations, calculated using all available datasets (fishing occasions) with good habitat (values 2 or 3) and good–intermediate water quality. Through a multiple linear regression analysis this on resulted in an equation correcting for Log10 (wetted width) and air temperature.

Recruitment trend over time was calculated for each site through linear regression over time (2000–2011) as Pearson r resulting in values from -1 to +1. Average values were calculated for larger assessment areas (5.6.2), ICES subdivisions, and, where more countries have streams in one subdivision (SD), for individual countries.

All results for individual sites were summarized for 1) assessment areas, 2) ICES subdivisions and 3) countries where more than one country had sites in streams with outlet to the sea inside one subdivision.

For the final assessment the outcome of this analysis was combined with additional information gathered, most markedly from fisheries and count of spawners, where available.

5.6.2 Model assessment modifications 2015

The assessment in 2015 was conducted along the same lines as in 2012, however with some differences:

a) In the multiple linear regressions used to calculate the predicted maximum densities for sites across the Baltic the variables entered were *stream wetted width, climate (average air temperature), latitude (proxy for productivity due to climate), longitude (proxy for the gradient from oceanic to continental climate) and the grouped trout habitat score (0-1-2-3 according to ICES, 2011)* with Log10 (0+ trout density + 1) as dependent variable. For this analysis sites with optimal densities are used. Since actual optimal densities (densities resulting from optimal recruitment) are not known, because it is not known if recruitment has actually been optimal on individual sites. Lacking this knowledge sites entered into the multiple regression analysis were selected from the dataset by 1) selecting sites in streams with 'good' river habitat and 'good' water quality, 2) from these only the three best years (highest density of trout) observed after year 2000 were selected, or, if less than five years of data were available we used only the best data, unless this was below ten trout per 100 m^2 for sites with a width <5 m or below five for a wider site; and one for sites where width was above 15 m. In this selection, sites where fish had been stocked are also included. In total this resulted in top values for the expected maximum density

b) Trend in density over time was calculated for the last five year period in order to illustrate the most recent development in change of status. Trend was calculated for the period 2010–2014 (for a limited number of sites where data from 2014 were not available data from the period 2009–2013 were used).

c) In the present assessment only 0+ trout were analyzed (contrary to 2012, where all age groups were included). The reason for this is the intention to focus on status for the most recent period. For this reason the assessment is also carried out on data from the period 2012–2014 (where up to eleven years were included in 2012).

5.6.3 Model assessment data availability

The total number of fishing occasions 2000–2014 was 2208 (including sites with stocked trout) distributed across the Baltic Sea. From these a subset of 110 fishing occasions with the highest densities was selected for multiple linear regression analysis to calculate expected maximal densities (Table 5.6.3.1; Figure 5.6.3.1).

The regression analysis found the variables *log (width), average annual air temperature, latitude, longitude and THS* to be significant when determining the optimal densities of 0+ trout, resulting in the relation:

Log10 (0+ density) = 0.963 - (0.906*logwidth) + (0.045*airtemp) - (0.037*longitude) + (0.027*latitude) + (THS*0.033); (r^2=0.5, Anova; $F_{2,254}$=51.8, p<0,001).

From the period 2012–2014 data for assessment analysis was available from 237 individual sites without stocking of trout and with intermediate, good water quality. From these sites 635 fishing occasions were available for the assessment (Table 5.6.3.2; Figure 5.6.3.2).

For trend analysis datasets were available from 100 sites (Table trend) with data from annual fishing on the same sites during the period 2010–2014 (a few sites with time--series 2009–2013 were included if data from 2014 were not available).

5.6.4 Data presentation

The recruitment status for the larger assessment areas (Table 5.6.4.1) is shown in Figure 5.6.4.1, recruitment status by subdivision in Figure 5.6.4.2, and in Figure 5.6.4.3 by country where several have sites in one SD.

Average trends in the development of 0+ trout densities over the last five years is presented in Figures 5.6.4.4, 5.6.4.5 and 5.6.4.6.

Only in the Gulf of Finland the average recruitment is 100% of expected, while the rest of the areas all are significantly lower. The lowest recruitment status is found in the eastern part of the Main Basin, with only 47% of the predicted. The highest average increase in trout density (positive trend) is also found in the Gulf of Finland, while the development is negative in the areas south and west. The assessment area east has a relatively poor recruitment status, seemingly stable over time, and the same is true for the Gulf of Bothnia.

In the southwest (SD 22, 23 and 24) the status is highly variable with a good status in SD 23 (however with a declining trend in densities) and relatively low in SD 22 (on average 57%, and also with declining trend), while it is on average somewhat better in SD 24 (average 72%), but also with declining trend. In SD 22, where Denmark and Germany both are represented, difference between the countries is considerable, with relatively good status in Denmark and only just over 50% in Germany. The negative trend in SD 22 is only for Danish sites, because there is not yet a sufficiently long time-series from Germany.

The average in SD 24 covers significant variations between the four countries represented. The poorest status is found in Germany (66%) and the highest in Sweden (>100%). The trend in development is positive in Denmark and negative in Sweden, while the time-series for both Germany and Poland are too short for trend analysis.

Further east in the Main Basin in SD 25 sites in both Sweden and Poland have a status of about 80%, both with slightly positive trends in population, however with continued observations of low densities in some rivers.

Further east in SD 26 the average status is just over 40%, due to low status on many sites in Lithuania. The time-series of these is too short for analysis of trend in development.

Further north in the Main Basin (SD 27 and 28) status is on average approximately 80%. SD 28 has three countries in the area, all with averages around 80%, but with a slightly positive trend in Estonia and vice versa in Sweden.

In the northern Main Basin (SD 29) with an average of just under 60%, large differences are found between the two countries. In Estonia only one site is found in the area having a status of over 100% while it on the three sites in Sweden is just below 50%. The time-series for trend analysis is not complete for the Estonian site, but was negative on the Swedish sites.

In the Bothnian Bay area (SD 30 and 31), where most sites are situated Sweden in a geographically limited area, status is slightly better in the southern part (SD 30), compared to the northern (SD 31). The situation is similar in both countries. The trend was slightly negative in SD 30, while there was no apparent development in SD 31. Looking at the two countries in SD 30 separately, a positive trend was observed in Finland (only one stream with averages from several sites), while it was slightly negative in Sweden. In SD 31 there was no apparent change in development. In this area results are available from only a few sites in larger (salmon) streams.

To improve the basis for assessment in SDs 30 and 31 results from more sites, especially from typical (smaller) trout streams, and from sites with a better geographical distribution are needed.

In SD 32 the status is not significantly different between the three countries with a status between approximately 80 and 100%. In all three countries the trend was positive, with the best development in Estonia and Russia.

5.6.5 Assessment result

In the **Gulf of Bothnia**, especially in the Bothnian Bay where spawning run is low and catch of immature sea trout as bycatch continues to be high sea trout are extremely stressed, with high sea mortality rates, low to moderate status and no overall positive trend in population densities. However, recently a slowly decreasing sea mortality and locally positive development has been observed. It is beyond doubt, that sea trout populations are seriously endangered. It is **recommended** that fishing pressure in the sea is reduced and that information from more sites with a better geographical coverage and from typical trout streams is provided, in order to improve the basis of monitoring.

Sea trout populations seem also particularly poor in part of the **Eastern** Baltic Sea, in particular in Lithuania, with poor status, low smolt numbers and low densities. The reason for this is not clear. Streams debouching into the Curonian Lagoon, and sea trout seems to a large extent to migrate from this into the Baltic Main Basin. In the narrow passage between the lagoon and the open sea fishing regulations are enforced to allow migration, but these could be insufficient. Because of lack of data from previous years it is unknown if this is the general situation. In the streams, where investigated, smolt numbers are also very low, but at least some spawning is observed, but trout spawning pits could be confused with salmon spawning. It is **recommended** that as much information as possible is gathered, especially in Lithuania on densities, smolt run, spawning run and fisheries catches in the sea and freshwater, in order to facilitate a better evaluation of the situation in future.

In the **southern** Baltic Sea the status is poor in particular in some German streams, where sea trout densities are very variable between streams. The reason for this is uncertain, but it is known that fishing is along the coast, invariably affecting trout populations. In Denmark and Sweden the trend is variable, but status of the populations is still good, while it is fair in Poland, with a positive trend. It is **recommended** that as much information as possible on densities, smolt run, spawning run and fisheries catches in the sea and freshwater is gathered, especially in Germany.

In the **western** Baltic Sea the status is in general fair, with exception of one stream in Sweden.

In the **Gulf of Finland** the situation has improved being best in Estonia and fair in Russia and Finland. A positive trend is observed in all three countries. Recent fishing regulations introduced in Finland are likely to have contributed positively to the improved status. In Russia poaching is locally still believed to be a problem to populations.

In **general** the information on recreational fisheries especially in sea fisheries is scarce. It is recommended that more detailed information is collected.

5.7 Future development of model and data improvement

It should be evaluated if existing information on the migration pattern of sea trout from tagging experiments can be combined with information on types and intensity of both local and distant fisheries to give a first indication on fishing mortality during sea migration.

It should be investigated if the present model could be expanded to include the distance from sea in order to take into account migration mortalities of both smolt and adults.

For comparison with model predicted densities expert opinions on the potential maximal densities of parr on individual sites should be collected.

Expert opinions should be collected on the fraction of trout migrating (sea trout) relative to the fraction not migrating (resident trout), and it should be evaluated if such information could be included in the model.

5.8 Compatibility of the DCF with the data needs for WGBAST

Table 5.7.1 provides an outline of the data requirements by the Working Group and to what extent such data are provided by the DCF. It also gives an overview of whether these data are used or not.

5.9 Recommendations

- A standardized minimum programme of sampling should exist in all countries.
- Data should be consistently collected on recreational sea trout catches taking into account the potentially high impact of recreational fisheries on sea trout stocks and the lack of these data in several countries.

- Data on the socio-economic value of recreational sea trout fishing should be collected and evaluated.
- Sufficient data coverage of sea trout parr densities from typical trout streams is needed from all countries. Continuing sampling for longer time periods is required.

5.10 Literature

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Table 5.1.1. Nominal catches (commercial + recreational) (in tonnes round fresh weight) of sea trout in the Baltic Sea in years 1979–2000. Commercial catches after 2000 are presented in Table 5.1.2 and recreacional catches after 2000 in Table 5.1.3. S=Sea, C=Coast and R=River.

Year	Main Basin																Total	Gulf of Bothnia						Total	Gulf of Finland				Total	Grand
	Denmark[1,4]	Estonia	Finland[2]			Germany[4]	Latvia		Lithuania		Poland			Sweden[4]			Main	Finland[2]			Sweden			Gulf of	Estonia	Finland[2]			Gulf of	Total
	S + C	C	S	S + C	R	C	S + C	R	C	R	S[9]	S + C	R	S[6]	C[6]	R	Basin	S	C	R	S[6]	C[6]	R	Bothnia	C	S	C	R	Finland	
1979	3	na		10		na	na		na		na	81[3]	24	na	na	3	121		6	na	na	na	na	6	na		73	0	73	200
1980	3	na		11		na	na		na		na	48[3]	26	na	na	3	91		87	na	na	na	na	87	na		75	0	75	253
1981	6	na		51		na	5		na		na	45[3]	21	na	na	3	131		131	na	na	na	na	131	2		128	0	130	392
1982	17	na		52		1	13		na		na	80	31	na	na	3	197		134	na	na	na	na	134	4		140	0	144	475
1983	19	na		50		na	14		na		na	108	25	na	na	3	219		134	na	na	na	na	134	3		148	0	151	504
1984	29	na		66		na	9		na		na	155	30	na	na	5	294		110	na	na	na	na	110	2		211	0	213	617
1985	40	na		62		na	9		na		na	140	26	na	na	13	290		103	na	na	na	na	103	3		203	0	206	599
1986	18	na		53		na	8		na		na	91	49	7	9	8	243		118	na	1	24	na	143	2		178	0	180	566
1987	31	na		66		na	2		na		na	163	37	6	9	5	319		123	na	1	26	na	150	na		184	0	184	653
1988	28	na		99		na	8		na		na	137	33	7	12	7	331		196	na	na	44	42	282	3		287	0	290	903
1989	39	na		156		18	10		na		na	149	35	30	17	6	460		215	na	1	78	37	331	3		295	0	298	1.089
1990	48[3]	na		189		21	7		na		na	388	100	15	15	10	793		318	na	na	71	43	432	4		334	0	338	1.563
1991	48[3]	1		185		7	6		na		na	272	37	26	24	7	613		349	na	na	60	54	463	2		295	0	297	1.373
1992	27[3]	1		173		na	6		na		na	221	60	103	26	1	618		350	na	na	71	48	469	8		314	0	322	1.409
1993	59[3]	1		386		14	17		na		na	202	70	125	21	2	897		160	na	na	47	43	250	14		704[7]	0	718	1.865
1994	33[8,3]	2		384		15[8]	18		+		na	152	70	76	16	3	769		124	na	na	24	42	190	6		642	0	648	1.607
1995	69[8,3]	1		226		13	13		3		na	187	75	44	5	11	647		162	na	na	33	32	227	5		114	0	119	993
1996	71[8,3]	2		76		6	10		2		na	150	90	93	2	9	511		151	25	na	20	42	238	14		78	3	95	844
1997	53[8,3]	2		44		+	7		2		na	200	80	72	7	7	474		156	12	na	16	54	238	8		82	3	93	805
1998	60	8		103		4	7		na		208	184	76	88	3	6	747		192	12	0	9	39	252	6		150	3	159	1.158
1999	110[8,3]	2		84		9	10		1		384	126	116	51	2	3	898		248	12	0	18	41	319	8		93	3	104	1.321
2000	58	4		64		9	14		1		443	299	70	42	4	3	1.011		197	12	0	14	36	259	10		56	3	69	1.339

[1]Additional sea trout catches are included in the salmon statistics for Denmark until 1982 (table 3.1.2).

[2]Finnish catches include about 70 % non-commercial catches in 1979 - 1995, 50 % in 1996-1997, 75% in 2000-2001.

[3]Rainbow trout included.

[4]Sea trout are also caught in the Western Baltic in Sub-divisions 22 and 23 by Denmark, Germany and Sweden.

[5] Preliminary data.

[6]Catches reported by licensed fishermen and from 1985 also catches in trapnets used by nonlicensed fishermen.

[7]Finnish catches include about 85 % non-commercial catches in 1993.

[8]ICES Sub-div. 22 and 24.

[9]Catches in 1979-1997 included sea and coastal catches,since 1998 costal (C) and sea (S) catches are registered separately

na=Data not available

\+ Catch less than 1 tonne.

Table 5.1.1.1. Biological samples 2014.

	Time period			Number of sampled fish by subdivision					
Country	**/ month number**	**Fisheries**	**Gear**	**22–28**	**29**	**30**	**31**	**32**	**Total**
Denmark[1]									0
Estonia	1–12	Coastal	Gillnet	7				126	133
Finland	4–9	Coastal	All gears		161		42	45	248
Latvia	3–11	Coastal, River	Gillnet, trapnet	311					311
Lithuania[1]	1–12	n.n.		9					9
Poland	1–12	Offshore,Coastal,	Longline, Gillnet/fykenet	188					188
Russia	9–11	River	Trapnet					72	72
Sweden	6–7	Coast	Trapnet			25	92		117
Sweden	4–7	River	Trap	108		41	71		220
Germany[1]									0
Total									>1298

Table 5.1.2. Nominal commercial catches (in tonnes round fresh weight) of sea trout in the Baltic Sea (2001–2014). S=Sea, C=Coast and R=River.

Year	Main Basin																	Total	Gulf of Bothnia				Total	Gulf of Finland				Total	Grand
	Denmark	Estonia	Finland		Germany	Latvia			Lithuania			Poland			Sweden			Main	Finland		Sweden		Gulf of	Estonia	Finland		Russia	Gulf of	Total
	S	C	S	C	S	S	C	R	S	C	R	S	C	R	S	C	R	Basin	S	C	C	R	Bothnia	C	S	C	R	Finland	
2001	54,4	2,0	5,0	14,1	10,0	0,5	11,3			2,2		485,8	219,3	10,8	23,4	2,2	2,7	843,8	1,7	54,0	15,8	44,0	115,5	8,0	0,2	16,9		25,1	984,4
2002	34,8	4,7	2,3	7,8	12,3	0,3	13,1			2,4		539,1	271,6	52,7	10,8	1,9		953,8	0,3	49,0	24,9		74,2	11,3	0,3	11,4		23,0	1050,9
2003	40,3	2,3	1,3	4,3	8,7	0,9	5,5					582,7	168,9	31,8	7,8	3,1		857,7	0,2	41,2	20,7	0,2	62,3	6,7	0,0	7,3		14,0	933,9
2004	46,0	3,1	0,8	5,3	11,7		7,0			0,5		606,3	121,9	36,0	9,1	2,8		850,5	0,8	38,9	20,6	0,3	60,6	7,1	0,0	7,3		14,4	925,5
2005	13,6	3,7	0,8	7,2	14,1		7,4	1,4		1,1	0,4	480,0	85,7	20,1	4,8	3,5		643,8	0,3	46,4	23,6	0,1	70,4	6,3	0,0	11,4		17,7	731,9
2006	44,1	10,0	1,0	9,6	11,8		7,1			0,6	0,3	414,4	98,2	17,3	6,1	2,4		622,8	0,8	40,5	20,2	0,0	61,4	9,3	0,1	13,3		22,7	706,9
2007	25,5	3,9	2,0	8,3	9,0		7,5			0,9	0,3	353,8	132,8	38,5	5,8	3,3		591,7	0,4	44,8	15,2	0,2	60,7	13,2		12,3		25,5	677,8
2008	18,3	3,6	1,0	10,5	13,1		7,5	0,4	0,0	1,9	0,2	33,9	90,1	48,1	3,9	3,1		235,8	0,3	47,3	18,5	0,5	66,6	8,2	0,0	17,8		26,0	328,4
2009	12,4	6,6	0,6	7,7	3,8		10,4	0,2	0,0	1,9		259,3	103,4	26,4	3,3	2,6		438,5	0,1	45,6	16,6	1,4	63,7	11,0		17,2		28,2	530,4
2010	8,0	4,8	0,1	6,4	2,8		5,4	0,4	0,0	1,7	0,3	343,2	80,5	30,0	2,4	2,6		488,5	0,0	36,9	20,4	1,0	58,3	11,2	0,0	10,3		21,5	568,3
2011	6,0	5,2	0,1	5,1	3,1			6,2	0,0	2,3	0,3	139,5	65,3	39,4	1,4	1,6		275,5	0,0	33,3	18,1	1,2	52,6	12,4		10,0		22,4	350,4
2012	10,6	8,2	0,0	5,5	17,7		4,4	0,5	0,0	3,3	0,3	37,4	73,5	26,1	0,3	3,2		191,1	0,0	40,8	18,4	1,6	60,8	13,6	0,0	15,6	0,2	29,4	281,3
2013	4,5	7,2	0,0	6,4	14,4		4,9	0,6	0,0	11,1	0,3	43,2	44,4	7,6	0,0	3,0		147,5	0,1	28,9	13,5	1,5	44,0	11,7		8,8	0,1	20,6	212,1
2014	10,2	4,8		5,8	14,3		5,1	0,8	0,0	5,5	0,3	44,5	48,2	27,9	0,2	2,7		170,3	0,0	21,5	10,8	0,3	32,6	9,8	0,0	6,5	0,1	16,4	219,2

Table 5.1.3. Nominal recreational catches (in tonnes round fresh weight) of sea trout in the Baltic Sea (2001–2013). S=Sea, C=Coast and R=River.

Year	Main Basin								Total	Gulf of Bothnia				Total	Gulf of Finland			Total	Grand
	Denmark	Estonia	Finland		Latvia		Poland	Sweden	Main	Finland		Sweden		Gulf of	Estonia	Finland		Gulf of	Total
	C	C	C	R	C	R	R	R	Basin	C	R	C	R	Bothnia	C	C	R	Finland	
2001	n.a.		43,0						43,0	167,0	7,0			174,0		51,0	3,0	54,0	271,0
2002	n.a.		67,0	0,2				2,8	70,0	29,0	6,5		38,4	73,9		20,0	2,6	22,6	166,5
2003	n.a.		67,0	0,2				3,6	70,8	29,0	11,1		31,5	71,6		20,0	1,6	21,6	164,0
2004	n.a.		30,0	0,5				2,6	33,1	23,0	10,6		28,2	61,8		26,0	2,1	28,1	122,9
2005	n.a.		30,0	0,5				1,5	32,0	23,0	10,6		30,9	64,5		26,0	2,7	28,7	125,2
2006	n.a.		28,0	0,1				1,3	29,4	99,0	5,3		32,5	136,8		59,0	3,3	62,3	228,4
2007	n.a.		28,0	0,3				1,3	29,6	99,0	8,2		31,5	138,6		59,0	3,1	62,1	230,3
2008	n.a.		24,0	0,2				2,6	26,7	66,0	8,9		39,7	114,6		74,0	2,3	76,3	217,6
2009	n.a.		24,0	0,4				2,3	26,7	66,0	10,6		45,8	122,4		74,0	5,5	79,5	228,6
2010	346		10,0	0,4		0,1	1,6	3,3	361,3	44,0	7,3		39,1	90,4		2,0	1,2	3,2	454,9
2011	224		10,0	0,4			1,7	2,2	238,3	44,0	7,5	1,7	39,3	92,5		2,0	2,2	4,2	335,0
2012	260		19,0	0,3			2,4	2,2	283,9	67,0	10,6	2,5	38,9	118,9		23,0	3,8	26,8	429,6
2013	n.a.	1,4	19,0	0,2	3,0		n.a.	1,3	24,9	67,0	10,6	1,5	46,2	125,3	3,3	23,0	3,8	30,1	180,3
2014	n.a.	1,4	19,0	0,3	3,8		n.a.	0,7	25,2	67,0	5,2	1,4	43,0	116,6	3,4	23,0	2,2	28,6	170,5

Table 5.2.2.1. Adipose finclipped and tagged sea trout released in the Baltic Sea area in 2014.

Country	Sub-division	River	Age	Number		Tagging	Other Methods			
				parr	smolt	Carlin	T-Anch	PIT	ARS (2)	n.n
Estonia	32	Pühajõgi	1	7000						
Estonia	32	Pudisoo	2		5400	500				
Latvia	28	Gauja	1				6000			
Finland	32	at sea	2				1000			
Finland	32	Ingarskilajoki	2		8109		2790			
Finland	29	at sea	2			100	1077			
Finland	29	Aurajoki	2		28042		877			
Finland	30	at sea	2				1500			
Finland	30	Lapväärtinjoki	2		19251	1000				
Finland	30	Karvianjoki	1	12500						
Finland	30	Karvianjoki	2		5772	998				
Finland	31	Teuvanjoki	2		1321					
Finland	31	Lestijoki	1	10503						
Finland	31	Lestijoki	2		7639	2000				
Finland	31	Perhonjoki	1	10216						
Finland	31	Perhonjoki	2		7681					
Finland	31	Kiiminkijoki	2		17687					
Finland	31	Oulujoki	2			1000	997			
Finland	31	Iijoki	2			1000				
Finland	31	Kemijoki	2			1000				
Sweden	31	Luleälven	1		41251					
Sweden	31	Luleälven	2		60373	2000				
Sweden	31	Skellefteälven	1		31432					
Sweden	31	Skellefteälven	2		2607					
Sweden	31	Umeälven	1	12118						
Sweden	31	Umeälven	1		19431			1000		
Sweden	31	Umeälven	2		16868			1000		
Sweden	30	Gideälven	2		7050	500				
Sweden	30	Ångermanälven	2		54840	500				
Sweden	30	Ångermanälven	1	5000						
Sweden	30	Indalsälven	1		99009					
Sweden	30	Ljungan	2		44200	2000				
Sweden	30	Ljusnan	1	18583						
Sweden	30	Ljusnan	1		13190					
Sweden	30	Ljusnan	2		42253					
Sweden	31	Söderalaån	2		400					
Sweden	30	Gavleån	2		2500					
Sweden	30	Dalälven	1		14944					
Sweden	30	Dalälven	2		61615	1500				
Sweden	27	Åkersström	1		3200					
Sweden	27	Stockholms Ström	1		19800					
Sweden	27	Stockholms Ström	2		6000					
Sweden	27	Trosaån	1		3200					
Sweden	27	Other	1		39300					
Sweden	27	Nyköpingsån	2		7000					
Sweden	27	Marströmmen	2		700					
Sweden	27	Motala ström	2		13000					
Sweden	27	Coastal releases	1		77500	451				
Sweden	25	Lyckebyån	1	2478						
Sweden	25	Listerbyån	1		500					
Sweden	25	Bräkneån	1		2000					
Sweden	25	Mieån	1		1000					
Sweden	25	Mörrumsån	1	7587						
Sweden	25	Mörrumsån	1		14586					
Total sea trout				**85.985**	**800.651**	**14.549**	**14.241**	**2.000**	**0**	**0**

(2) ARS = Alizarin Red Staining

Table 5.2.3.1. Number of Carlin-tagged sea trout released into the Baltic Sea in 2014.

Country	22	24	25	26	27	28	29	30	31	32	Total
Estonia										500	500
Finland							100		7517		7617
Sweden					451			4500	2000		6951
Poland											0
Total	0	0	0	0	451	0	100	4500	9517	500	15068

Table 5.3.1.1. Status of wild and mixed sea trout populations. Partial update in 2014.

Area	Country	Potential smolt production	Smolt production (% of potential production)									
			<5 %		5-50 %		> 50 %		Uncertain		Total	
			wild	mixed	wild	mixed	wild	mixed	wild	mixed	wild	mixed
Gulf of Bothnia	Finland	< 1									0	0
		1-10	1	2	1						2	2
		11-100*			1						1	0
		> 100									0	0
		Uncertain									0	0
	Total		1	2	2	0	0	0	0	0	3	2
	Sweden**	< 1									0	0
		1-10									0	0
		11-100									0	0
		> 100									0	0
		Uncertain							25	26	25	26
	Total		0	0	0	0	0	0	25	26	25	26
Total			1	2	2	0	0	0	25	26	28	28
Gulf of Finland	Estonia	< 1	6		6		4	2	6		22	2
		1-10			5	3	9	2	1		15	5
		11-100			1						1	0
		> 100									0	0
		Uncertain									0	0
	Total		6	0	12	3	13	4	7	0	38	7
	Finland***	< 1	2	3							2	3
		1-10	4	3		1					4	4
		11-100	1			1					1	1
		> 100									0	0
		Uncertain									0	0
	Total		7	6	0	2	0	0	0	0	7	8
	Russia	< 1	1		3		2		2		8	0
		1-10	7		2				2		11	0
		11-100*	1	1	1						2	1
		> 100									0	0
		Uncertain							19		19	0
	Total		9	1	6	0	2	0	23	0	40	1
Total			22	7	18	5	15	4	30	0	85	16

Table 5.3.1.1. Continued.

Main Basin	Denmark	< 1	2	5	17	3	80	2			99	10
		1-10		1	5	9	34	9			39	19
		11-100			1	1		4			1	5
		> 100									0	0
		Uncertain									0	0
	Total		2	6	23	13	114	15	0	0	139	34
	Estonia	< 1	10		10		8		1		29	0
		1-10	2		2		3				7	0
		11-100									0	0
		> 100									0	0
		Uncertain									0	0
	Total		12	0	12	0	11	0	1	0	36	0
	Latvia	< 1							6		6	0
		1-10							8	5	8	5
		11-100			1					1	1	1
		> 100									0	0
		Uncertain								7	0	7
	Total		0	0	1	0	0	0	14	13	15	13
	Lithuania	< 1				3						3
		1-10		2		2	1				1	4
		11-100				1	1				1	1
		> 100*										0
		Uncertain										0
	Total		0	2	0	6	2	0	0	0	2	8
	Poland	< 1				2		2		1	0	5
		1-10						1			0	1
		11-100		3		4		1			0	8
		> 100		1							0	1
		Uncertain									0	0
	Total			4	0	6	0	4	0	1	0	15
	Russia	< 1									0	0
		1-10									0	0
		11-100									0	0
		> 100									0	0
		Uncertain							3		3	0
	Total		0	0	0	0	0	0	3	0	3	0
	Sweden**	< 1									0	0
		1-10									0	0
		11-100									0	0
		> 100									0	0
		Uncertain							200	7	200	7
	Total		0	0	0	0	0	0	200	7	200	7
Total			14	12	36	25	127	19	218	21	395	77
Grand total			37	21	56	30	142	23	273	47	508	121

* includes data from large river systems ** data from 2006

*** in 7 wild rivers it is not known if releases are carried out

Table 5.3.1.2. Factors influencing status of sea trout populations. Partial update in 2014.

Area	Country	Potential smolt production	Number of populations					
			Over exploitation	Habitat degradation	Dam building	Pollution	Other	Uncertain
Gulf of Bothnia*	Finland	< 1	0	0	0	0	0	0
		1-10	4	4	2	1	0	0
		11-100	1	1	0	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		5	5	2	1	0	0
Total			5	5	2	1	0	0
Gulf of Finland	Finland	< 1	4	4	4	0	0	0
		1-10	4	2	2	1	0	0
		11-100	2	2	1	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	1	1	0	0	0
	Total		10	9	8	1	0	0
	Russia	< 1	5	5	0	4	0	0
		1-10	11	9	2	7	0	0
		11-100	3	3	1	3	0	0
		> 100	0	0	0	0	0	0
		Uncertain	11	11	3	8	0	0
	Total		30	28	6	22	0	0
	Estonia	< 1	1	5	0	0	0	0
		1-10	6	3	1	4	0	0
		11-100	0	0	0	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		7	8	1	4	0	0
Total			47	45	15	27	0	0

Table 5.3.1.2. Continued.

Main Basin*	Estonia	< 1	29	29	0	0	0	0
		1-10	6	6	1	0	0	0
		11-100	0	0	0	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		35	35	1	0	0	0
	Latvia	< 1	0	1	0	0	0	0
		1-10	5	3	3	0	2	0
		11-100	0	0	1	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		5	4	4	0	2	0
	Lithuani	< 1	0	0	0	0	0	0
		1-10	0	4	5	2	0	0
		11-100	0	1	2	1	0	0
		> 100**	0	1	1	1	1	0
		Uncertain	0	0	0	0	0	0
	Total		0	5	8	4	1	0
	Poland	< 1	0	5	3	0		0
		1-10	1	1	1			
		11-100**	2	3	8	1		
		> 100	1	1	1	1		
		Uncertain						
	Total		4	10	13	2	0	0
	Russia	< 1	0	0	0	0	0	0
		1-10	0	0	0	0	0	0
		11-100	0	0	0	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	3	2	0	2	0	0
	Total		3	2	0	2	0	0
	Denmarl	< 1	0	51	62	0	0	0
		1-10	0	39	35	0	0	0
		11-100	0	0	0	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		0	90	97	0	0	0
Total			47	146	123	8	3	0
Grand total			99	196	140	36	3	0

* data from Sweden were unavaila** includes large river systems, see Table 7.2.1.6.

Table 5.3.1.3. Sea trout smolt estimates for the period 2002–2014.

SD	24	25	28	28	26	26	26	26	31	31	31	32	32	32	32
Country	DK	SE	LV	LV	LT	LT	LT	LT	SE	SE	FIN	RU	RU	EE	EE
River name	Læså	Mörrum	Salaca	Salaca	R. Mera	R. Mera	R. Siesartis	R. Siesartis	Säverån	Rickleån	Torne	Luga	Luga	Pirita	Pirita
Method	1)	2)	3)	4)	5)	6)	5)	6)	7)	8)	9)	10)	11)	12)	13)
2002			13100		12							8200			
2003			11000		11							2500			
2004			2500		11						12510	2500			
2005			7700		0		5					5000			
2006	4543		10400		3		8		510		12640	2800		349	
2007	2481		15200		32		104		1051			5000		100	
2008	16138		15800		170		95		2124		10810	2500		883,6	
2009	1687	6995	16900		11		163		1848			6900		2138,182	
2010	2920	3526	19400		3		73		1232			3300		2300,875	
2011	8409	5086	4900		584	n.d.	243	n.d.	637		19420	3100		832	
2012	8702	5517	11400		606	33	576	40	231			2000		1600	
2013	5326	10220	9600		422	0	186	2	1600			2100		1769	
2014	n.d.	6867	3100	265	344	98	559	6	n.d. trap moved	348	n.d.	6200	190	260	52

n.d. = no data

1) based on smoltrap - directly counted number of smolts, varying efficiency over years due to water level

2) Median values of Bayesian estimates are only for the upper part of the river!

3) estimated smolt output on the base of counted smolts and mean trap efficiency (8.5%)

4) directly counted number of smolts during trapping season

5) estimated output derived by electrofishing data. (assumed surval probabilities to smolts: 0+ --> 40%; >0+ --> 60%)

6) counted number of individuals smolts in trap. Assumed trap efficiency almost 100%

7) "simple" Peterson estimates - trap moved to river Rickleån in Year 2014

8) Trap located close to river mouth, so this is the total estimated production

9) estimated smolt output

10) estimated number of smolt output based on results of floating trap-netting- (3.1% trap efficiency known in 2014)

11) directly counted number of smolts in trap

12) estimated number of smoltoutput based on trap counts and efficiency (in 2014 20% trap efficiency)

13) counted number of individuals smolts in trap-experimentally derived catch efficiency in 2014 = 20%

Table 5.3.2.1. Status of wild and mixed sea trout populations in large river systems. Partial update in 2014.

Country	River (Area)	Potential smolt production	Smolt production (% of potential production) <5 % wild	<5 % mixed	5-50 % wild	5-50 % mixed	> 50 % wild	> 50 % mixed	Uncertain wild	Uncertain mixed	Total wild	Total mixed
Lithuania	Nemunas	< 1									0	0
	(Main	1-10									0	0
	Basin)	11-100	1		1	3		1			2	4
		> 100									0	0
		Uncertain									0	0
Total			1	0	1	3	0	1	0	0	2	4
Poland	Odra	< 1									0	0
	(Main	1-10				3					0	3
	Basin)	11-100		2							0	2
		> 100									0	0
		Uncertain									0	0
Total			0	2	0	3	0	0	0	0	0	5
Poland	Vistula	< 1									0	0
	(Main	1-10		1							0	1
	Basin)	11-100		3		1					0	4
		> 100									0	0
		Uncertain									0	0
Total			0	4	0	1	0	0	0	0	0	5
Russia	Luga	< 1	1		1						2	0
	(Gulf of	1-10	1		1						2	0
	Finland)	11-100	1			1					1	1
		> 100									0	0
		Uncertain							1		1	0
Total			3	0	2	1	0	0	1	0	6	1
Finland	Tornion-	< 1									0	0
	joki	1-10	1	4	2						3	4
	(Gulf of	11-100	1			1					1	1
	Bothnia)	> 100									0	0
		Uncertain									0	0
Total			2	4	2	1	0	0	0	0	4	5

Table 5.3.3.1. Factors influencing status of sea trout populations in large river systems. Partial update in 2014.

Country	River	Potential smolt production	Number of populations					
			Overexploitation	Habitat degradatio	Dam building	Pollution	Other	No influence
Lithuania	Nemunas (Main Basin)	< 1	0	0	0	0	0	0
		1-10	0	0	1	0	0	0
		11-100	0	2	4	1	1	0
		> 100	0	0	0	0	1	0
		Uncertain	0	0	0	0	0	0
Total			0	2	5	1	2	0
Poland	Odra (Main Basin)	< 1						0
		1-10	2	3	5			0
		11-100		1	1			0
		> 100						0
		Uncertain						0
Total			2	4	6	0	0	0
Poland	Vistula (Main Basin)	< 1						0
		1-10		1	1			0
		11-100	4	2	4	2		0
		> 100						0
		Uncertain						0
Total			4	3	5	2	0	0
Russia	Luga (Gulf of Finland)	< 1	2	1	0	0	0	0
		1-10	2	1	1	1	0	0
		11-100	2	2	0	2	0	0
		> 100	0	0	0	0	0	0
		Uncertain	1	0	0	0	0	0
Total			7	4	1	3	0	0
Finland	Tornion-joki (Gulf of Bothnia)	< 1	0	0	0	0	0	0
		1-10	7	6	0	0	0	0
		11-100	2	1	0	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
Total			9	7	0	0	0	0

Table 5.4.1. Sea trout smolt releases (x1000) to the Baltic Sea by country and subdivision in 1988–2014.

			year																										
	country	age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Main Basin 22-29	DE	1yr																					14	14	14	13		14	15
		2yr																									15		0
	DK	1yr	5	1	4	4	4	19	17	177	177	177	196	196	19	751	634	614	562	562	398	387	387	365	261	281	272	272	248
		2yr															30	30	30	30	21	9	9	2	2	2	2	2	0
	EE	1yr	50	5		5																	3						7
		2yr			5	6	10	10	16	28	30	32	30	32	30	32	30	23	25	2	21	20	17	21	26	21	1	20	0
	FI	1yr			11				1	0		4		26		28	1		15		35	52	45	52	18	115		40	5
		2yr		129	169	165	123	103	171	144	181	153	182	168	258	197	131	134	244	303	164	187	218	136	113	121	76	107	123
		3yr		35	16	0		26	1	8	0	13	17	25	35	34	24	9	16	16	15		8	14	4		0		0
	LT	1yr						5	5	4	4	10											23	58	45		11	10	26
		2yr								3														1					
	LV	1yr	1	1	6	26	44	26	24	20	1	1	7	25		114	160	170		74	91	113	63	50	153	236	270	161	115
		2yr	1	4	6	7	5	2					11	29		2	10	67		116	177	112	132	65					8
	PL	1yr	51	85	102	2	148	140	266	483	298	492	330	138	151	211	30	16	46	322	455	188	358	434	267	132	174	243	289
		2yr	857	847	498	248	376	845	523	642	821	1028	1001	924	845	733	739	804	765	843	968	1261	1021	834	1060	273	981	1046	888
	SE	1yr	13	9	8	19	41	18	6		4	23	19	90	7	10	108	10	116	11	131	15	76	180	129	170	118	138	207
		2yr	32	51	78	61	44	46	84	90	60	95	87	76	100	93	40	48	103	44	36	63	78	31	31	27	35	20	20
Main Basin Total			1010	1167	903	544	795	1239	1114	1600	1576	2029	1880	1730	1445	2204	1935	1925	1921	2322	2513	2406	2453	2255	2123	1389	1955	2073	1951
Gulf of Bothnia 30-31	FI	1yr			9							7		1		5						33						125	71
		2yr		358	579	700	716	527	525	510	663	639	483	540	462	478	503	451	305	358	477	541	608	676	426	519	472	503	493
		3yr		99	30	5	18	39	15	1	28	12	49	10	34	75	28	11	15	6	27	9	27	20	4	4	8	3	0
	SE	1yr			19	7				6			1										40	61	55	110	197	181	219
		2yr	445	392	406	406	413	376	460	642	554	429	407	372	405	424	380	428	361	413	569	530	410	428	400	420	395	311	293
Gulf of Bothnia Total			445	848	1042	1118	1147	942	1001	1159	1244	1087	939	923	901	982	911	890	681	776	1072	1113	1086	1184	885	1052	1071	1123	1076
Gulf of Finland 32	EE	2yr																14	6	8	9	12	10	6	6	15	13	8	5
	FI	1yr		5		22			4	5	15	12	13	5		38		4				11							18
		2yr		191	260	249	306	312	284	342	128	228	277	386	355	372	367	290	281	190	279	247	316	291	213	239	216	242	173
		3yr					24	6		1	33	92	40	7	24	18	6	16											0
	RU	1yr																4	3		13	95	25	10	3	7	64	44	74
		2yr																1		0								1	
Gulf of Finland Total				197	261	270	330	318	287	348	177	331	331	398	380	427	373	329	291	198	301	364	352	308	222	260	292	294	265
Grand Total			1455	2212	2205	1932	2272	2499	2402	3106	2997	3447	3150	3050	2726	3613	3219	3144	2893	3296	3886	3883	3890	3747	3230	2702	3318	3490	3292

Table 5.4.2. Release of sea trout eggs, alevins, fry and parr into Baltic rivers in 2014. The number of smolts is added to Table 5.4.3 as enhancement.

Region	Egg	Alevin	Fry	Parr				Smolt			
				1-s old	1-y old	2-s old	3-s old	2015	2016	2017	Total
Sub-divs. 22-29	(1)	(1)	(4)	(6)	(9)	(10)	(10)				
Denmark	0	0	160100	78600	0	0	0	0	9519	0	9519
Estonia	0	0	0	0	0	0	0	0	0	0	0
Finland	0	180000	0	21900	0	96600	0	14490	3114	0	17604
Germany	0	0	1062000	0	0	0	0	0	31860	0	31860
Latvia	0	0	0	65500	64895	0	0	7787	3930	0	11717
Poland	0	2931000	3023394	0	1200	0	0	144	120012	0	120156
Sweden	0	0	25400	10100	0	0	0	0	1368	0	1368
Lituania	0	0	152000	0	0	0	0	0	4560	0	4560
Total	0	3111000	4422894	176100	66095	96600	0	22421	174363	0	196784
Sub-divs. 30-31	(2)	(3)	(5)	(7)	(8)	(8)	(10)				
Finland	512300	92600	0	10400	0	24200	0	0	2904	4575	7479
Sweden	0	0	336600	25000	160700	0	0	0	19284	8232	27516
Total	512300	92600	336600	35400	160700	24200	0	0	22188	12807	34995
Sub-div. 32	(1)	(1)	(4)	(6)	(9)	(10)	(10)				0
Estonia	0	0	0	9600	7000	0	0	840	576	0	1416
Finland	6000	0	0	0	0	0	0	0	60	0	60
Russia	0	0	0	0	0	0	0	0	0	0	0
Total	6000	0	0	9600	7000	0	0	840	636	0	1476
Grand total Sub-divs. 24-32	518300	3203600	4759494	221100	233795	120800	0	23261	197187	12807	233255

Table 5.4.3. Estimated number of sea trout smolts originating from eggs, alevins, fry and parr releases in 2000–2014.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sub-divs. 22-29																		
Denmark	30858	25555	45759	7912	17790	17508	13695	13695	13704	12540	12540	10737	9177	9606	9240	9246	9519	0
Estonia	0	0	2100	1200	400	1110	0	0	0	0	0	0	0	0	0	0	0	0
Finland	440	22670	33965	19550	18735	160	0	0	0	11445	13815	10350	8100	14375	16260	17787	3114	0
Germany	25500	24900	61200	72240	27240	36900	32550	38400	29640	29910	40800	34500	29400	34650	32700	32580	31860	0
Latvia	13815	8644	11007	960	5340	15227	6462	3189	19015	6840	17664	30595	5987	15300	28913	7787	3930	0
Poland	167496	148500	84240	68400	91000	63236	77690	61459	107686	84901	108422	114982	95939	103756	130787	133965	120012	0
Sweden	13129	39333	42690	5320	29335	2055	27700	4425	1623	2210	898	0	2385	1737	2940	3258	1368	0
Lituania	0	0	0	0	1670	2400	4350	7440	18180	12990	8040	6750	5370	10935	8580	6300	4560	0
Total	251238	269602	280961	175582	191510	138596	162447	128608	189847	160836	202179	207914	156358	190359	229420	210924	174363	0
Sub-divs. 30-31																0	0	0
Finland	54268	80662	26523	42828	36670	1890	31362	11787	22704	29892	32550	46753	39285	25881	22595	18782	12878	4575
Sweden	84237	78440	43614	24092	22921	36170	20207	22756	24561	16690	16497	12811	13026	5456	21906	9073	25850	8232
Total	138505	159102	70137	66920	59591	38060	51569	34543	47265	46582	49047	59564	52311	31337	44501	27855	38728	12807
Sub-div. 32																0	0	0
Estonia	0	0	0	2412	2532	4407	2100	420	0	0	1536	2098	6552	9486	3519	840	576	0
Finland	20910	5500	2049	419	340	3429	345	11574	8997	4353	5919	5233	291	1747	1632	1050	60	0
Russia	3882	3630	7800	200	1630	1281	6690	3924	0	312	9381	126	3441	1746	3	2910	0	0
Total	24792	9130	9849	3031	4502	9117	9135	15918	8997	4665	16836	7457	10284	12979	5154	4800	636	0
Grand total																0	0	0
Sub-divs. 24-32	414535	392476	360947	245533	255603	185773	223151	179069	246108	212083	268061	274935	218953	234675	279075	243578	213727	12807

Table 5.6.1. Habitat classes and corresponding Trout Habitat Scores.

Habitat Class	THS – including slope	THS omitting Slope
0	<6	<5
1	6–8	5–6
2	9–10	7–8
3	11–12	9–10

Table 5.6.2. Subdivisions combined in assessment areas for assessment of sea trout in the Baltic.

Assessment area	ICES Sub Divisions
Southern Baltic Sea	21–25
Eastern Baltic Sea	26 and 28
Western Baltic Sea	27 and 29
Gulf of Bothnia	30 and 31
Gulf of Finland	32

Table 5.6.3.1. Number of fishing occasions selected for multiple linear regression by subdivision.

Subdivision	N
21	1
22	2
24	1
25	8
26	29
27	2
28	17
29	3
30	2
31	3
32	42
Total	110

Table 5.6.3.2. Number of unique sites without stocking (total and by THS) and number of unique fishing occasions on sites with good–intermediate water quality 2012–2014.

	Number of sites THS					Fishing occasions
Subdivision	All	0	1	2	3	Total
21	3			1	2	6
22	38	1	8	17	12	58
23	5		1		4	8
24	23		5	10	8	53
25	23		3	16	4	62
26	57	7	19	22	9	199
27	12		2	5	5	33
28	15		1	2	12	39
29	5		1	3	1	14
30	8		2	5	1	22
31	11	1	5	3	2	28
32	37	1	13	8	15	93
Total	237	10	60	92	75	615

Table 5.6.4.1. Subdivisions combined in assessment areas for assessment of sea trout in the Baltic.

Assessment area	ICES Sub Divisions
Southern Baltic Sea	21–25
Eastern Baltic Sea	26 and 28
Western Baltic Sea	27 and 29
Gulf of Bothnia	30 and 31
Gulf of Finland	32

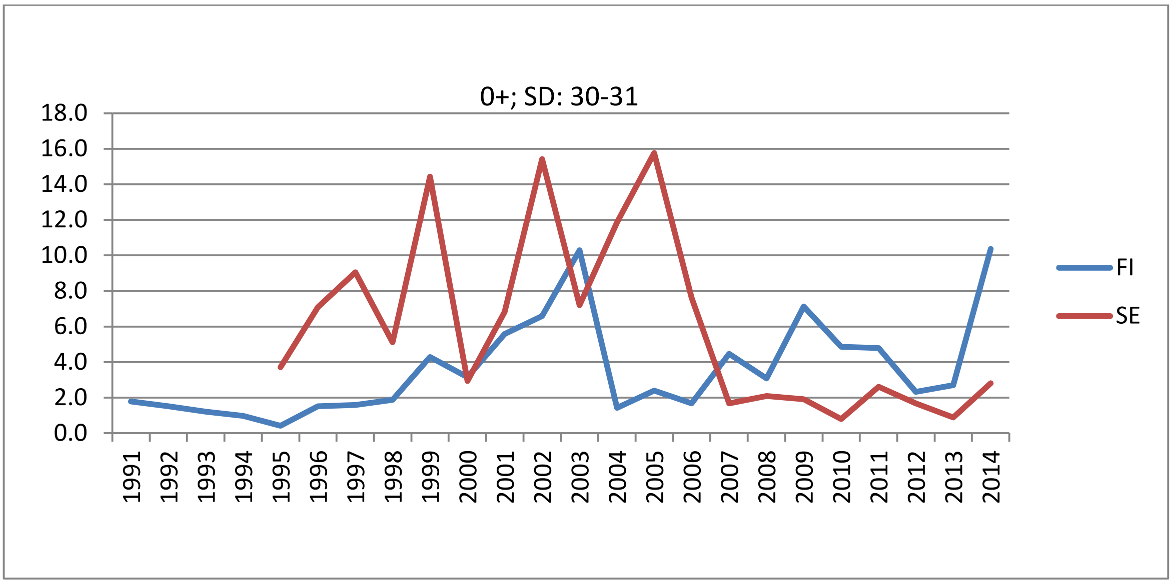

Figure 5.3.1.1. Average densities of 0+ trout in Finnish (FI) and Swedish (SE) rivers in ICES SD 30–31.

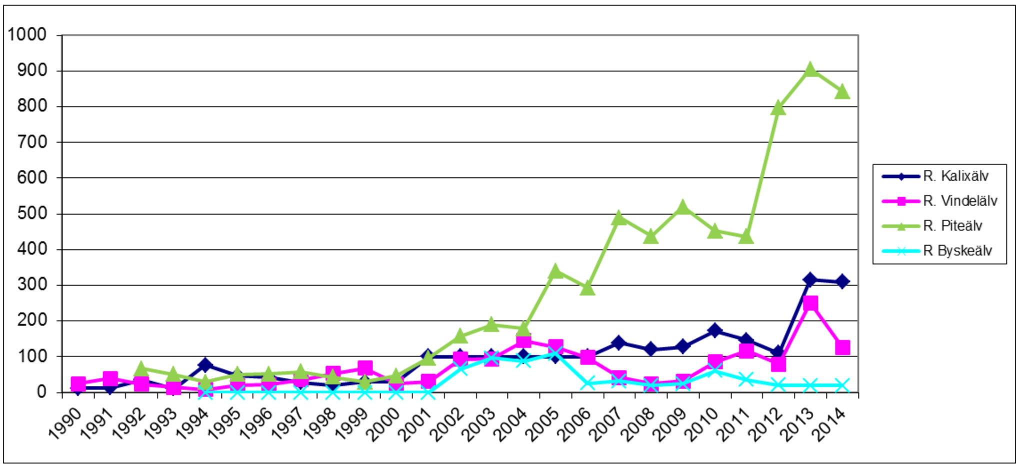

Figure 5.3.1.2. Number of ascending spawners in four rivers debouching in the Bothnian Bay.

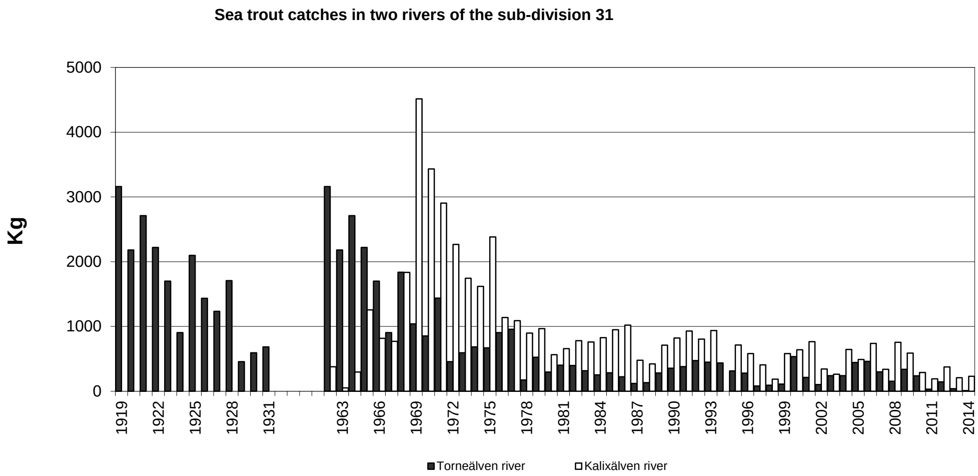

Figure 5.3.1.3. Swedish sea trout catches in two rivers of the Subdivision 31 between 1919–2014. (The Swedish Board of Fisheries, Fisheries Research Office in Lulea, unpub. data).

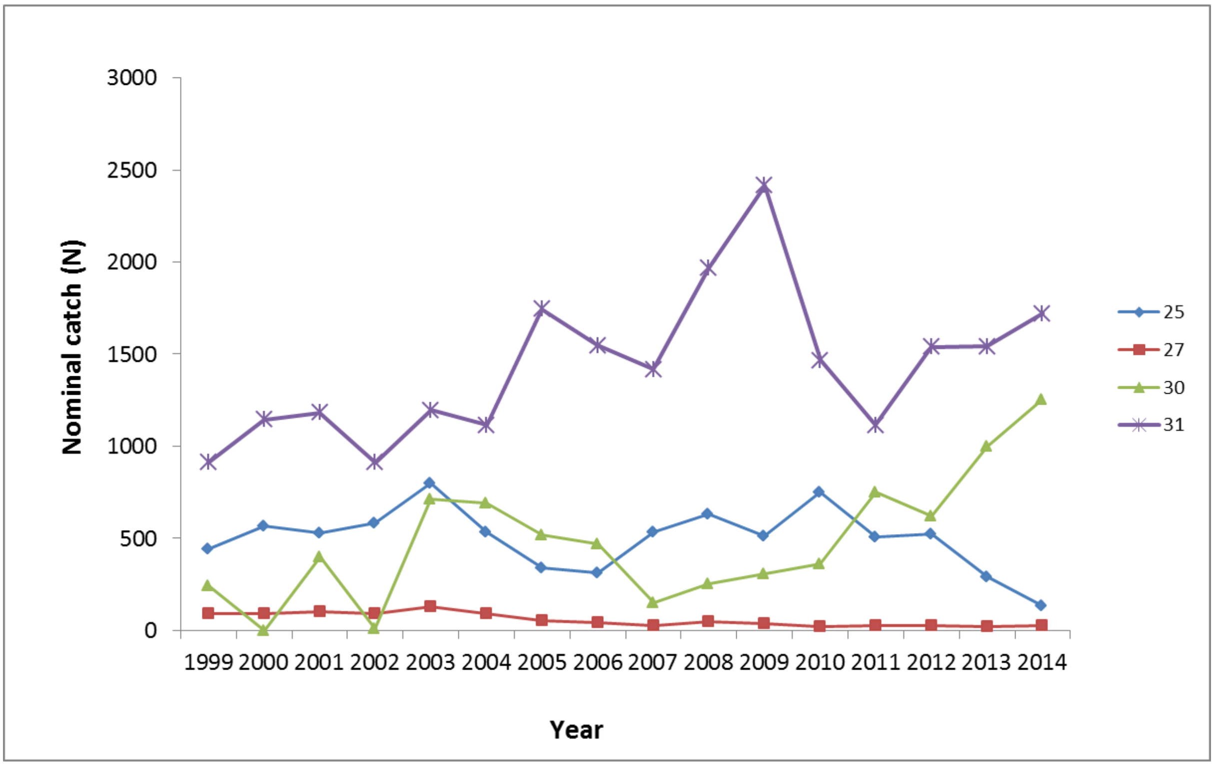

Figure 5.3.1.4. Anglers nominal catch (number) of sea trout (not including released fish) in Swedish wild rivers, ICES Subdivisions 25, 27, 30 and 31.

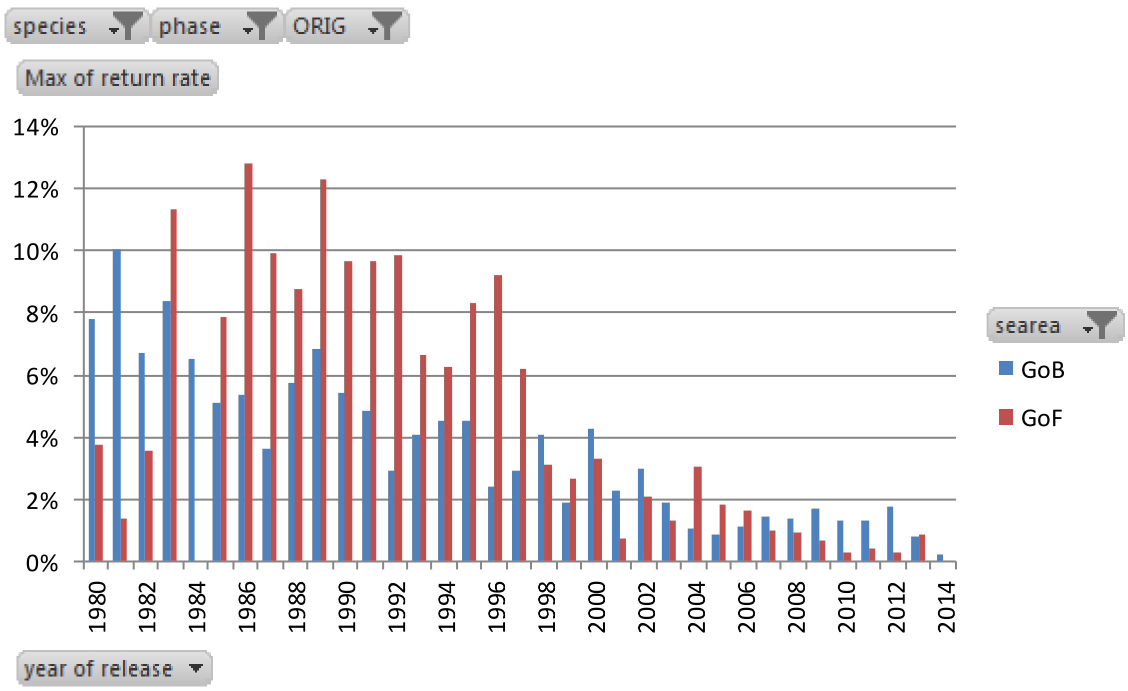

Figure 5.3.1.5. Return rates of Carling tagged sea trout released in Gulf of Bothnia and Gulf of Finland in 1980–2014.

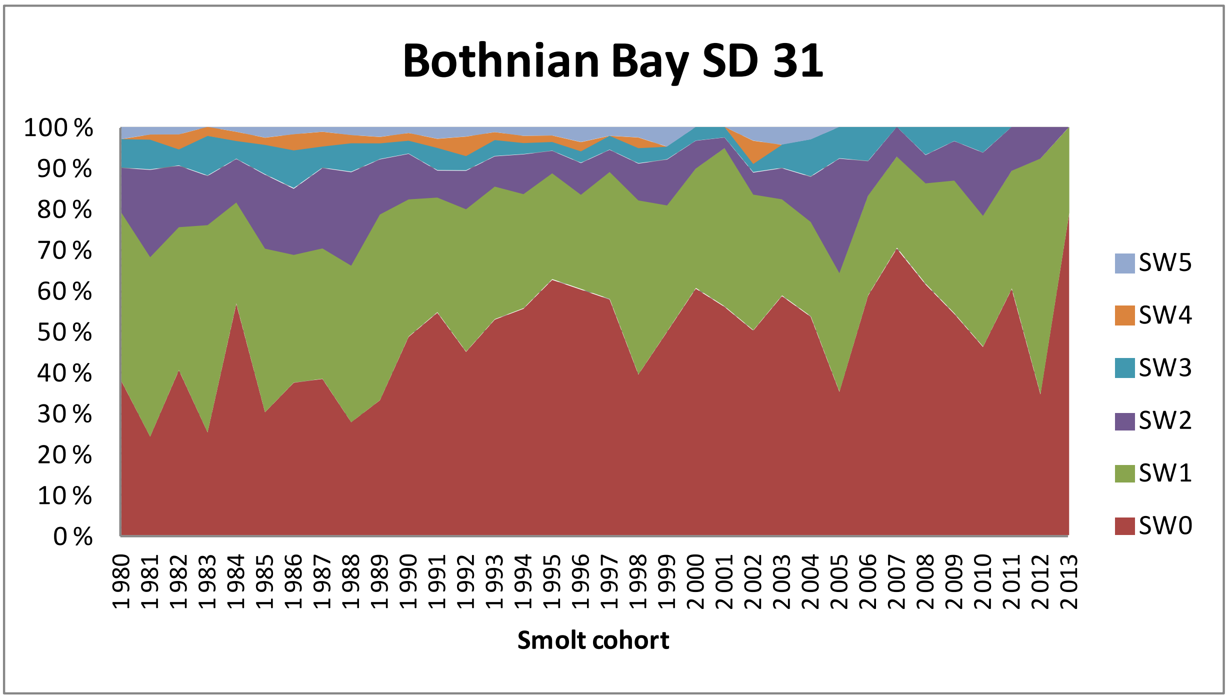

Figure 5.3.1.6. Age distribution of recaptured Carlin-tagged sea trout released in the Bothnian Bay (Subdivision 31) area in Finland in 1980–2013.

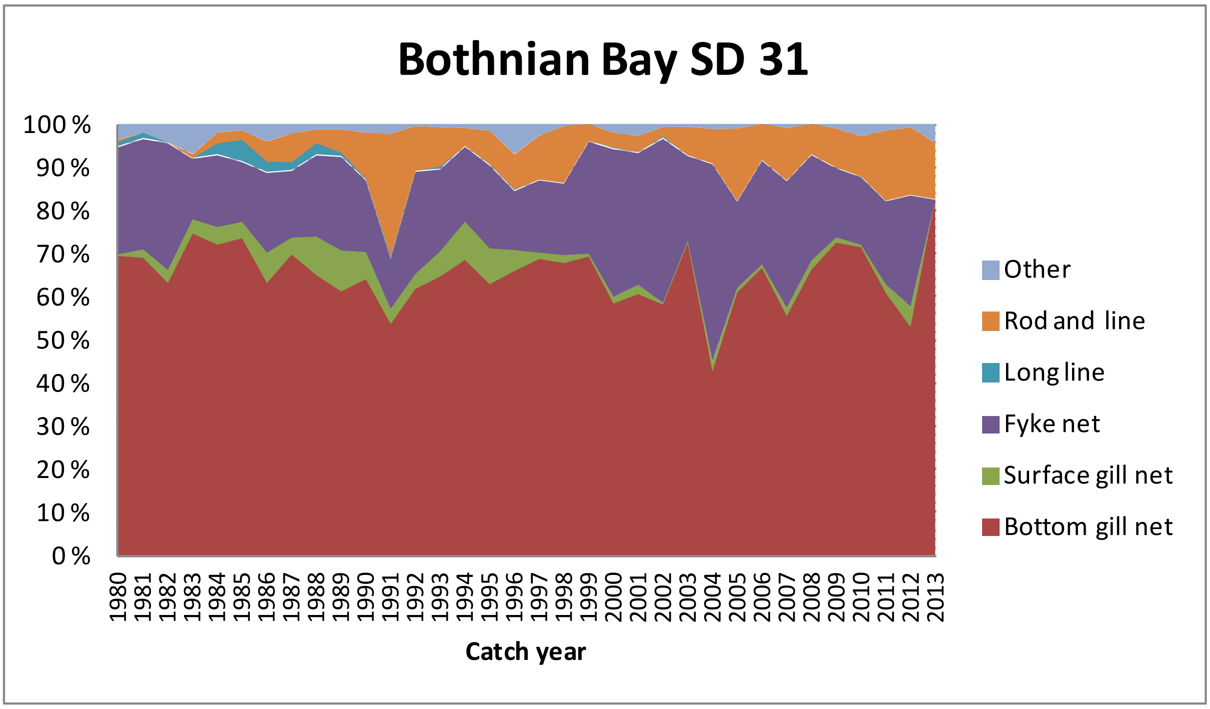

Figure 5.3.1.7. Distribution of fishing gear in recaptures of recaptured Carlin-tagged sea trout caught in the Bothnian Bay (Subdivision 31) area in Finland in 1980–2013.

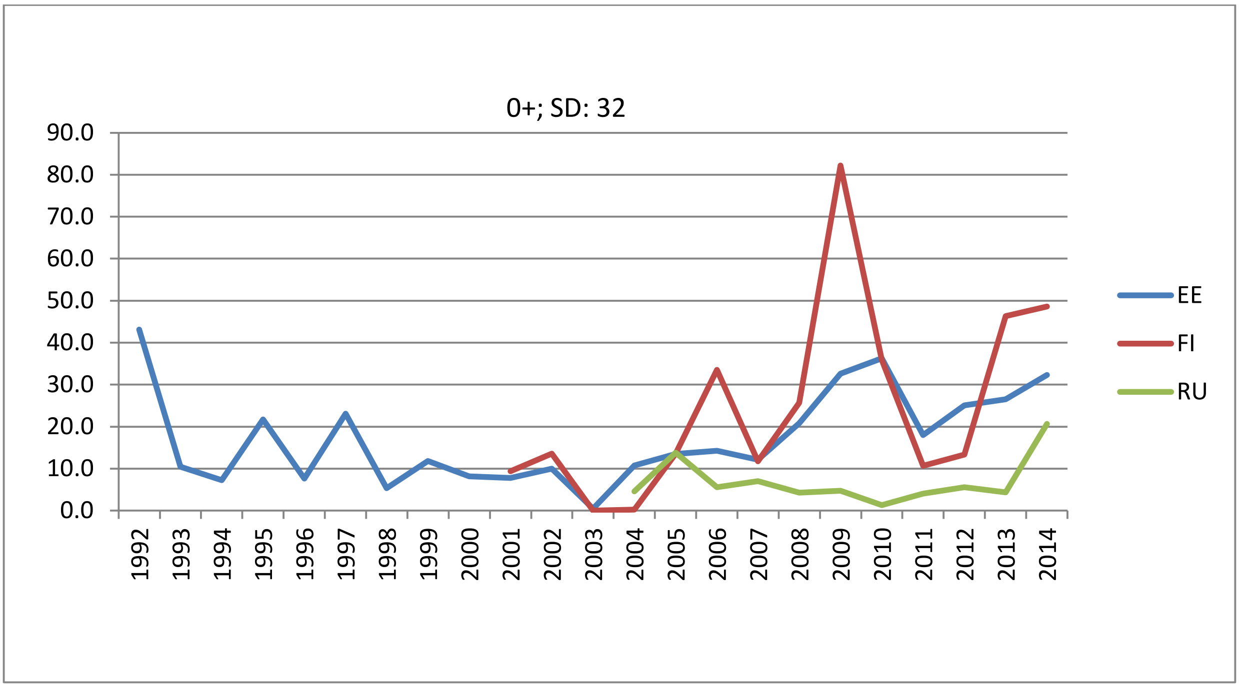

Figure 5.3.2.1. Average densities of 0+ trout in Estonian (EE) Finnish (FI) and Russian (RU) rivers in ICES SD 32.

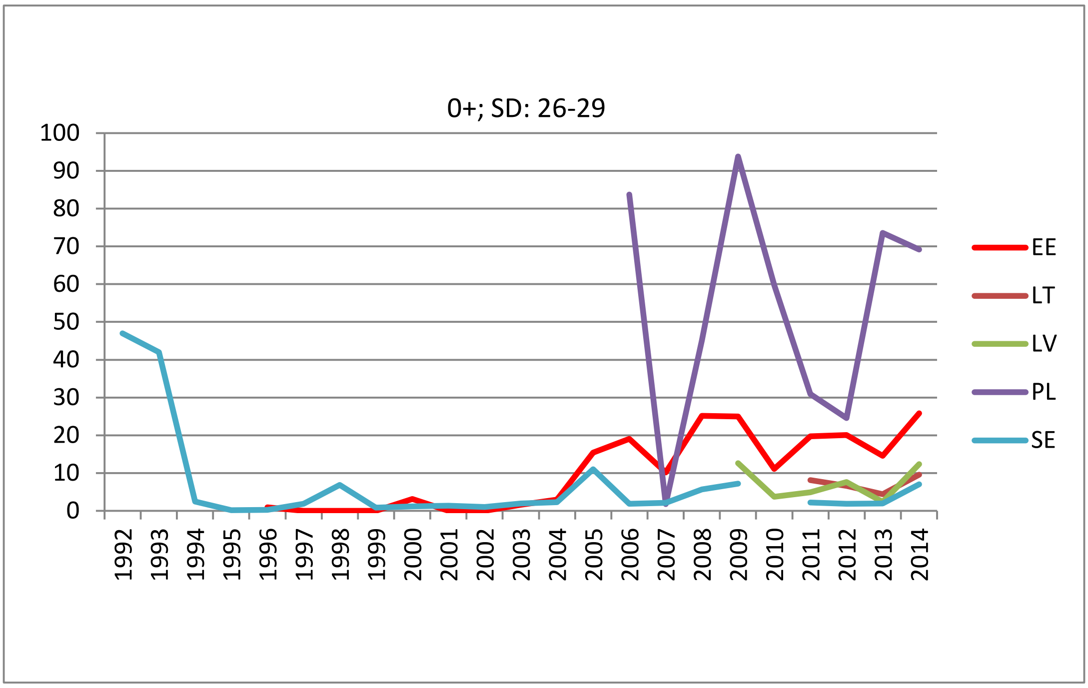

Figure 5.3.3.1. Average densities of 0+ trout in Estonian (EE), Lithuanian (LT), Latvian (LV) Polish (PL) and Swedish (SE) rivers in ICES SD 26–29.

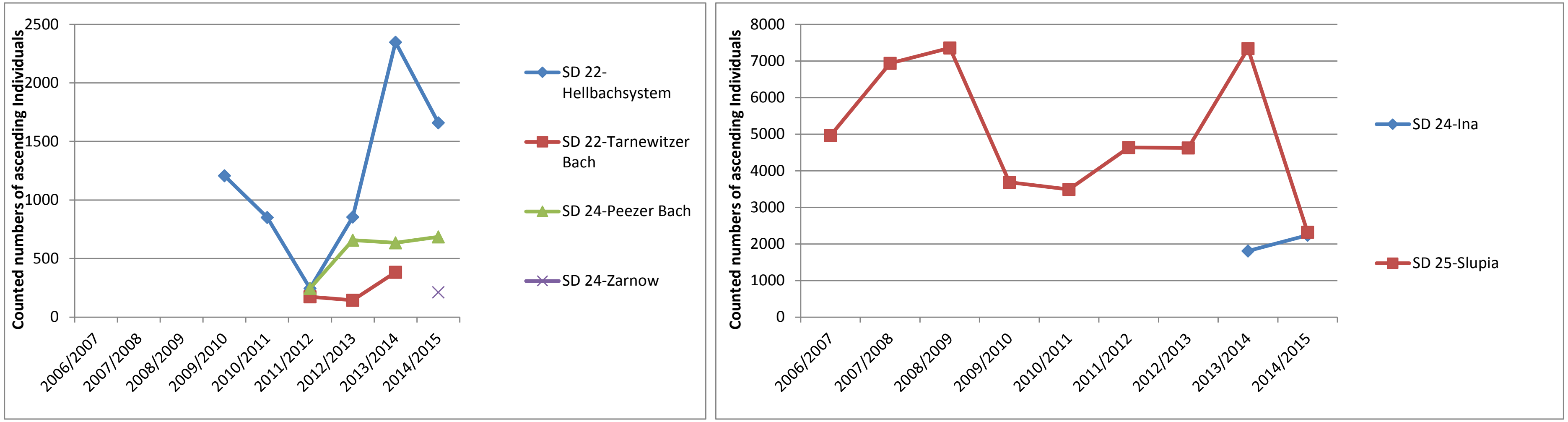

Figure 5.3.3.2. Video monitoring-based spawner counts in four German small river systems (SD 22+24) and Vaki counter numbers from Polish rivers (SD 24+25).

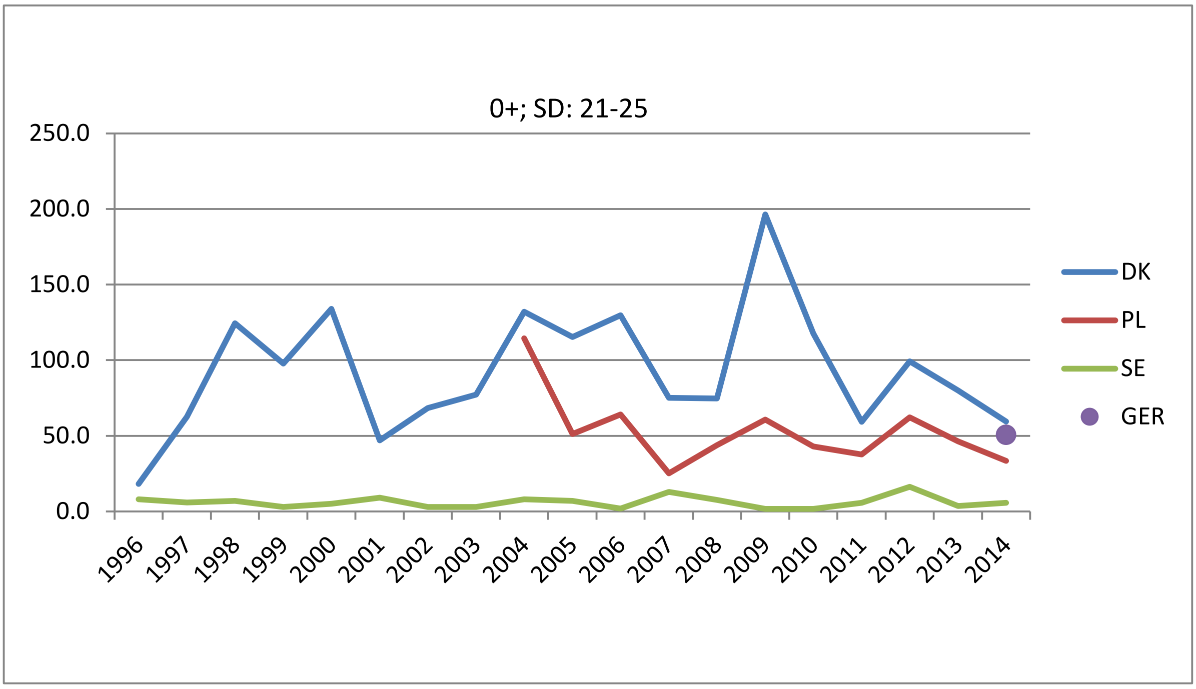

Figure 5.3.4.1. Average densities of 0+ trout in Danish (DK), Polish (PL), Swedish (SE) and German (GER) rivers in ICES SD 22–25.

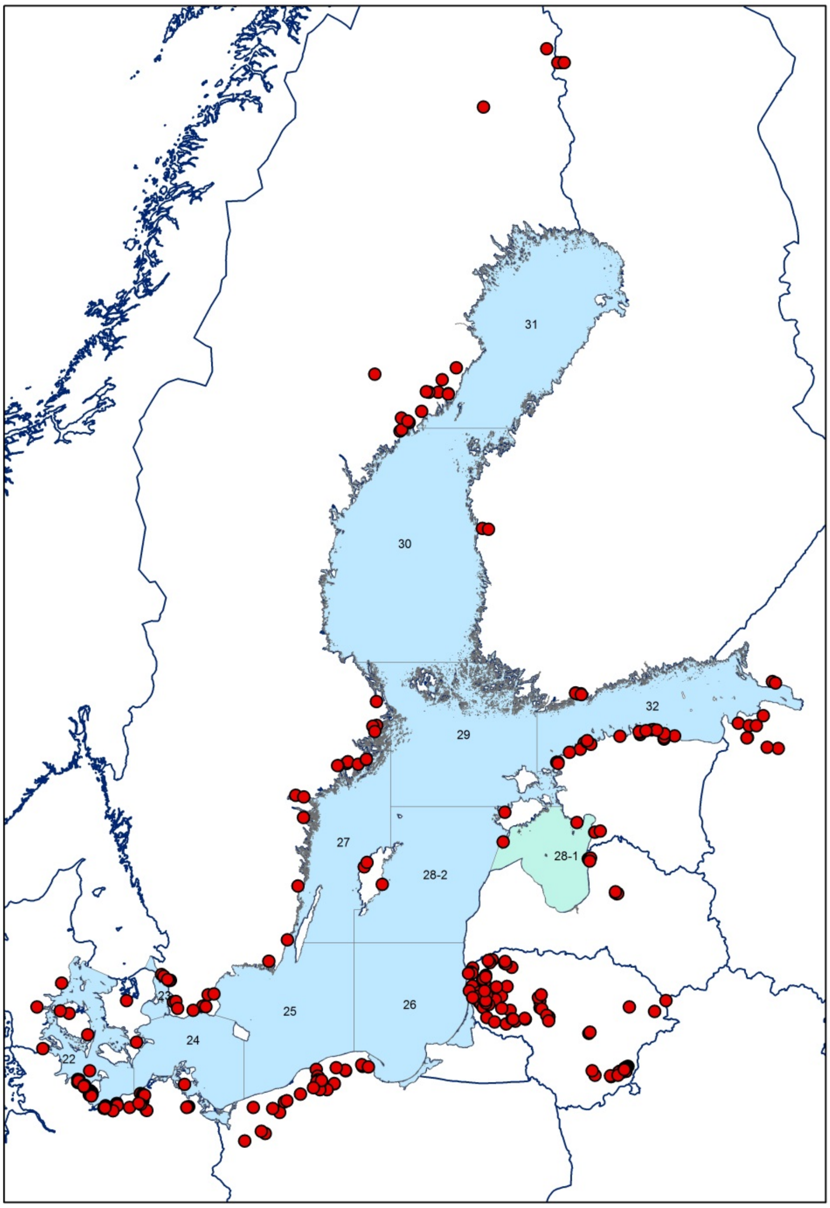

Figure 5.6.3.2. Electrofishing sites used for assessment 2015.

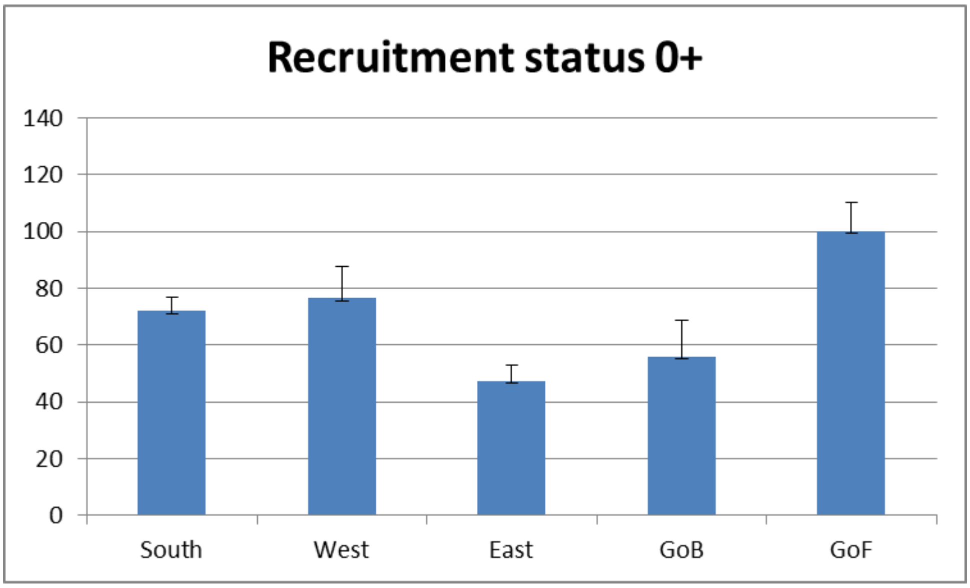

Figure 5.6.4.1. Recruitment status by Assessment Area Division for 0+ trout (95% CL).

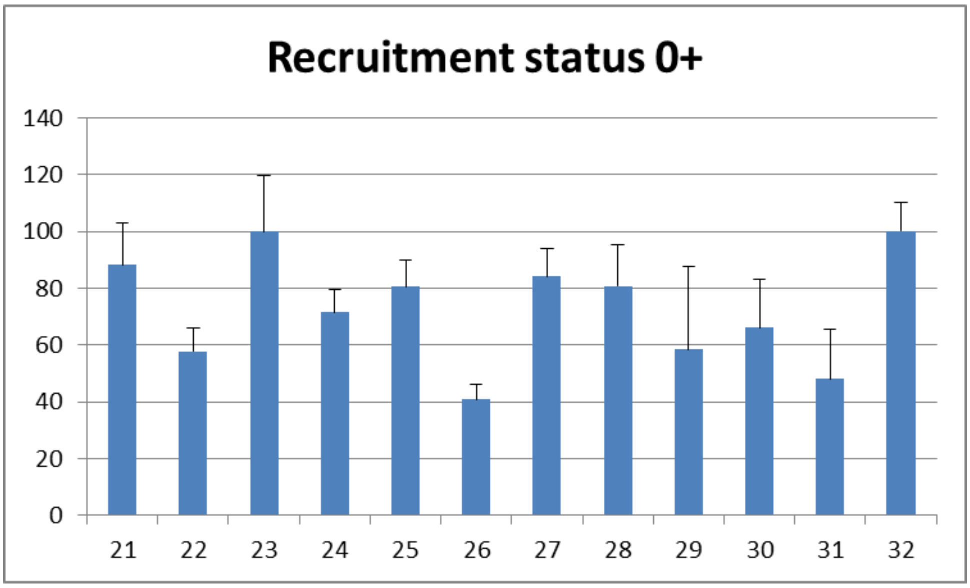

Figure 5.6.4.2. Recruitment status by subdivision for 0+ trout (95% CL).

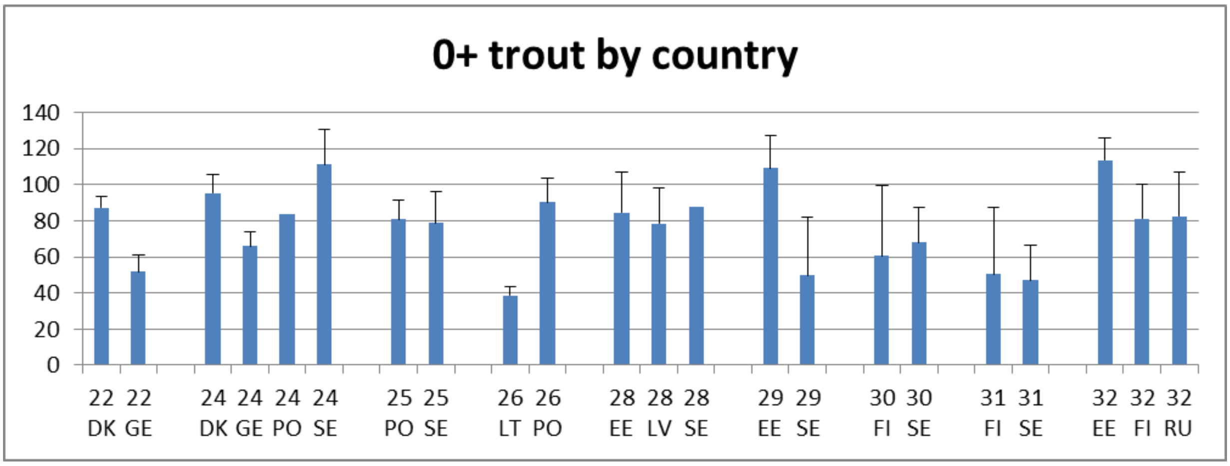

Figure 5.6.4.3. Recruitment status for individual countries by subdivision for xx trout (95% CL).

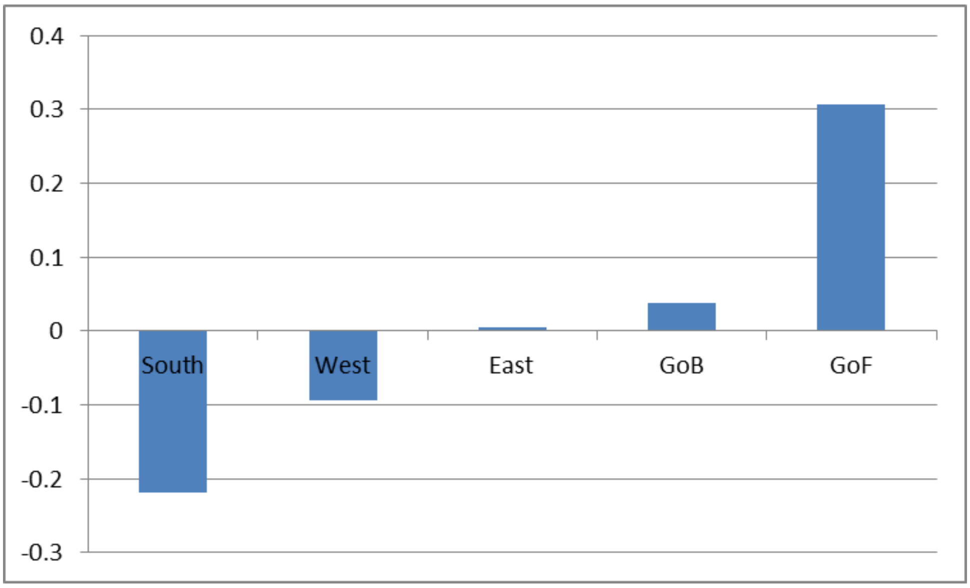

Figure 5.6.4.4. Average trend in 0+ trout densities over latest five years by sea area.

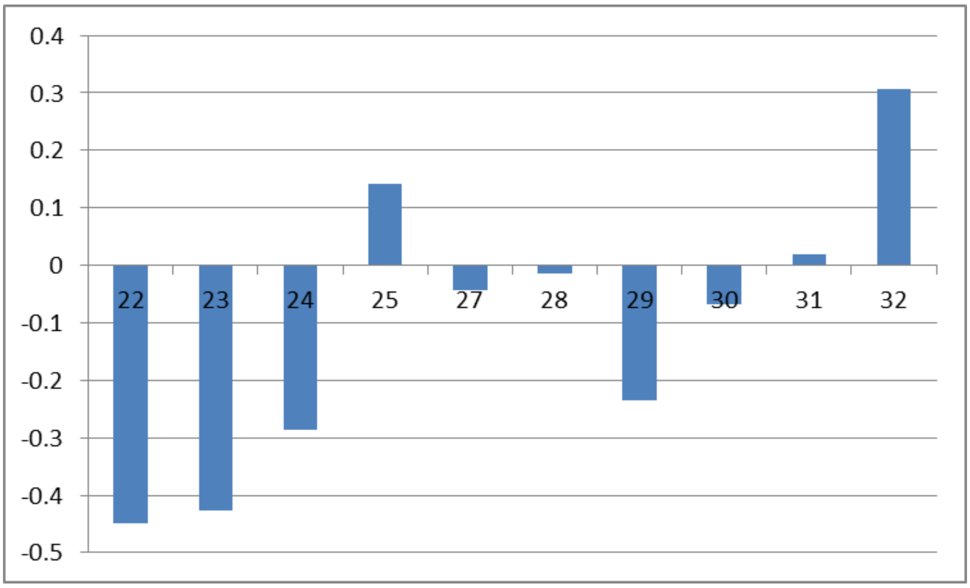

Figure 5.6.4.5. Average trend in 0+ trout densities over latest five years by subdivision.

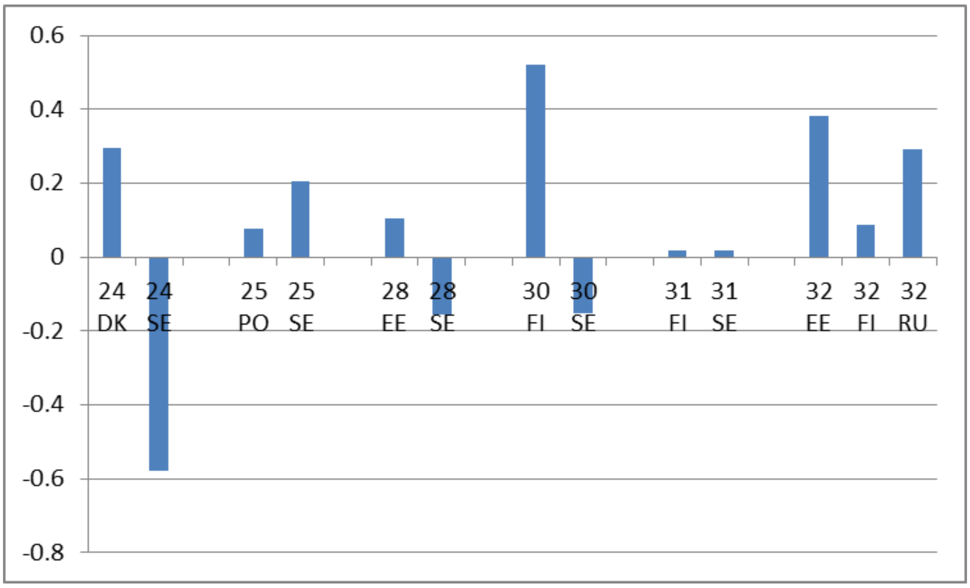

Figure 5.6.4.6. Average trend in 0+ trout densities over latest five years by subdivision and country for subdivisions shared by more countries.

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Annex 2: Recommendations

The Working Group recommends following actions in order to fulfil the shortcomings in the present data and knowledge regarding the Baltic Sea salmon and sea trout to further improve the stock assessment and also potentially support the management of Baltic salmon and sea trout.

Recommendation	Adressed to
1. Catch estimates of the recreational salmon and sea trout fisheries are uncertain and incomplete or totally missing for several coutries. Studies to estimate these catches should be carried out.	ICES Member States, RCM Baltic Sea
2. Sufficient data coverage of sea trout parr densities from typical trout streams is needed from Northern Sweden. Continuing sampling for longer time-series is required from all countries.	ICES Member States, RCM Baltic Sea
3. There is a suspected misreporting of salmon as sea-trout in the Polish sea fishery. Data on proportions of sea trout/salmon should be provided to the working group to facilitate a more precise estimation of the rate of misreporting. In addition Polish national institute should provide to the working group as representative catch sampling data as soon as possible on the proportions of salmon and sea trout in the coastal and offshore catches separately.	Poland
4. Unreporting of salmon in pelagic fishery for other species should be explored.	National institutes under DCF, RCM Baltic Sea
5. Sweden has implemented a fishing regulation in the coastal trapnet fishery where the quota is split into wild and reared salmon. As a consequence wild salmon are released back to sea during part of fishing season. The amounth of these discarded wild salmon as well as the survival rate of these fish should be evaluated.	Sweden
6. In order to reduce the potential of catching wild salmon (also in poaching) in AU5–6, the Baltic countries and Russia should adopt additional measures and enforce them effectively.	Lithuania, Latvia, Estonia and Russia
7. Inventories of the weak wild salmon rivers should be carried out in order to update the estimates of spawning and rearing habitat areas and consequently the potential smolt production capacities. Also investigations to reveal the factors that prevent the stock to improve should be carried out. Finally this information should be processed as stock specific rebuilding plans (habitat restoration, removal of potential migration obstacles, water quality issues, fishery regulation).	Countries with weak wild salmon stocks i.e. Finland, Sweden, Lithuania, Latvia, Estonia

Annex 3: Stock Annex for salmon in SD 22–32

The table below provides an overview of the WGBAST Stock Annex. Stock Annexes for other stocks are available on the ICES website Library under the Publication Type "Stock Annexes". Use the search facility to find a particular Stock Annex, refining your search in the left-hand column to include the *year*, *ecoregion*, *species*, and *acronym* of the relevant ICES expert group.

STOCK ID	STOCK NAME	LAST UPDATED	LINK
sal-2431+sal-32	Salmon in Subdivision 22–31 (Main Basin and Gulf of Bothnia) and Subdivision 32 (Gulf of Finland)	March 2014	Baltic salmon

Annex 4: Formulation of priors for potential smolt production capacity (PSPC) for Rivers Emån, Kågeälven, Mörrumsån, Rickleån and Vindelälven

Prior probability density functions (hereafter "priors") were formulated for five Swedish salmon rivers using expert opinions elicited from experts at the Swedish University of Agricultural Sciences. One of these rivers (Kågeälven) has only recently received its status as a wild salmon river, thus no PSPC prior existed formerly. Updating the PSPC priors for the four remaining rivers is justified on a variety of grounds, as new information has indicated that the existing priors may be too low (Vindelälven and Rickleån), too high (Mörrumsån) and/or too precise (Emån, Mörrumsån). Another river that recently gained the status of a wild salmon river, River Testeboån, was not included in this exercise as there is information missing for this river that prevents its inclusion in the assessment model. The plan is to estimate PSPC priors for Testeboån (and compile also other necessary information) and include this river in the assessment model in 2016.

Where available, the experts considered relevant data to help inform their opinion; they also consulted other experts when necessary. Experts were asked for summaries (mode, 0.025 and 0.975 quantiles) of distributions describing their knowledge and uncertainty about quantities of interest, following which parametric distributions were fitted, plotted and shown to experts for feedback and possible revision. This document is accompanied by a table of the priors elicited from experts and the final PSPC priors for each river. The table also lists the various sources of background information that were taken into consideration by the experts when specifying their priors.

General model structure

A simple model was developed to derive a distribution for PSPC as a function of several expert-elicited variables. These variables were smolt density (number of smolts produced per hectare or 100m^2); the area of habitat suitable for salmonid production; survival of natural mortality during the downstream smolt migration; passage efficiencies for any obstacles to downstream migration and, where applicable, mortality rates associated with passage of migration obstacles.

Habitat mappings (providing a qualitative measure of salmonid habitat quality as well as estimates of habitat area) have been performed for some rivers. Habitats have been classified as class 0 (unsuitable for salmonids); class 1 (poor quality); class 2 (fair to good quality); class 3 (very good quality). Where estimates of the area of salmonid habitat were available by habitat class, experts were asked to provide maximum smolt density estimates by habitat class for classes 1–3. For all rivers where habitat area was available by class, the proportions of the total area accounted for by different classes were assumed to follow a Dirichlet distribution (with parameters equal to 100 times the reported proportion of the total area accounted for by that habitat class).

In some cases, natural mortality during the downstream migration was calculated using a per kilometre mortality rate in combination with information on distances travelled by smolts originating from different sections of the river. For other rivers, a single mortality rate (for all smolts, independent of migration length) was used for downstream migration. Where a per kilometre mortality rate was applied, fish were assumed to be fairly evenly distributed throughout each section of the river, according to a Dirichlet distribution describing the distribution of smolts among 1 km long sections of river. The parameters of the Dirichlet distribution for each section of river were obtained as 1 divided by the length of that section in kilometres.

Example JAGS code for two of the rivers (R. Mörrumsån and Vindelälven) can be found in Appendix A.

River-specific details

Mörrumsån

Habitat areas were available by habitat class (0–3), and maximum smolt densities (per 100 m^2) were elicited by class (1 to 3). Values for the most likely density and a 95% probability interval (PI) were based on reported estimates of salmon or sea trout smolt production from other rivers, accounting for differences/ similarities to Mörrumsån in terms of physical characteristics and other factors. The total areas of suitable salmonid habitat in each of four main sections of the river (i.e. a reach of the river bounded by the sea or an obstacle to migration) were taken from a recent habitat mapping study (SLU, unpublished). Distributions for total habitat areas were specified with a positive skew for the downstream and upstream areas, to account for uncertainty arising from markedly lower estimates of total habitat area for these sections compared to an earlier study.

Losses were assumed to occur at each dam, according to the nature of the facility for fish to pass. Local actions that are taken annually to reduce downstream mortality (partial or full shutdown of turbines over a five week period) were also taken into consideration. For example, the number of smolts migrating downstream from the 4th section (counted from the sea) above both Hemsjö hydropower plants was reduced for passage of Hemsjö upper, Hemsjö lower and Marieberg power plant further downstream. The dams at Hemsjö were assumed to have the same passage efficiency, while a prior for passage efficiency with a somewhat lower mode was used for Marieberg to account for additional mortality (arising from predation) associated with passage of the large dam at that site. A prior for total downstream migration mortality was obtained using an estimated rate of per kilometre migration mortality based on a two-year telemetry study of wild salmon smolts in River Mörrumsån.

The final PSPC prior for Mörrumsån is shown in Figure 1. The clear reduction in the mode of the PSPC prior (from ca. 90 000 to ca. 60 000) most likely reflects primarily the fact that the total habitat available for salmonid production appears to be considerably lower than was previously recognized.

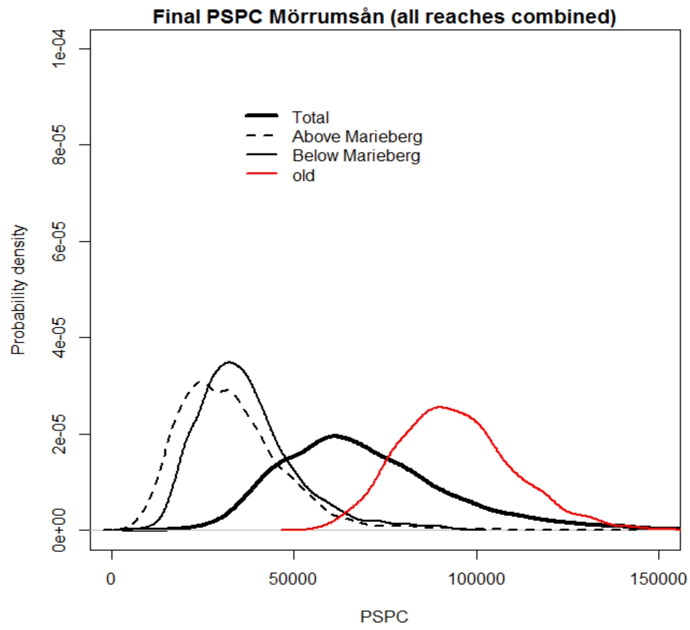

Figure 1. PSPC prior for Mörrumsån. Solid red line, old PSPC prior (from WGBAST 2014); thick solid black line, new PSPC prior; thin solid black line, PSPC below Marieberg; dashed black line, PSPC above Marieberg.

Emån

Habitat areas were available by habitat class, and smolt densities were elicited by class, accordingly. One of the experts expressed concern that the previously reported habitat areas might be overestimates of the true habitat area, based on observations from comparing habitat areas reported in the two different studies for River Mörrumsån mentioned above (estimates from a new and more detailed study were markedly lower than earlier ones obtained using same method as for Emån). The expert therefore requested that negatively skewed distributions be used. This was accommodated by the use of an inverted lognormal distribution for the total habitat area in each river section. Maximum smolt production rates for habitat classes 1–3 were assumed to be 80% of those in R Mörrumsån, to account for the fact that habitats in Emån may be overall somewhat less suitable for salmon (and better for sea trout).

In addition to natural mortality, assumed to be higher than in Mörrumsån due to higher predation pressure (e.g. due to European catfish), losses were assumed to occur at the fishways of the dams at Karlshammar (1st obstacle moving from the sea) and Finsjö (2nd obstacle, comprising two closely-located hydroelectric power plants with associated dams). The final PSPC prior for Emån is shown in Figure 2.

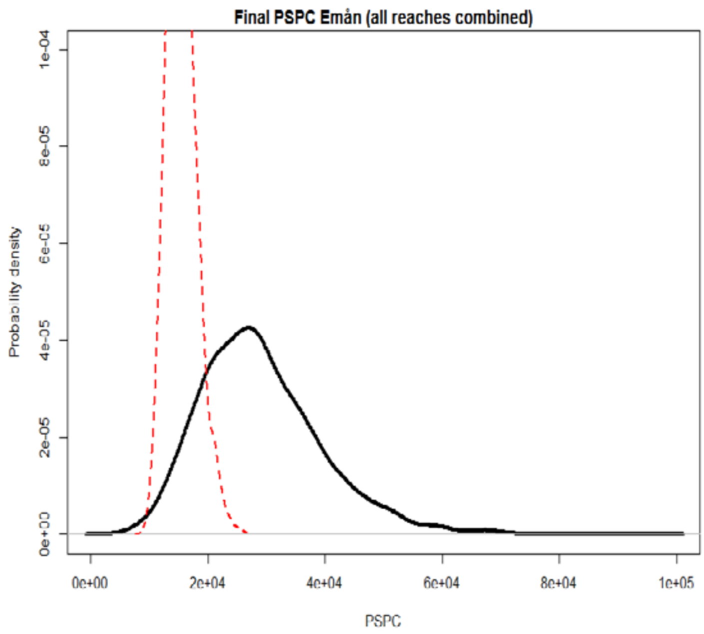

Figure 2. PSPC prior for Emån. Dashed red line, old PSPC prior (from WGBAST 2014); solid black line, new PSPC prior.

Kågeälven

Habitat areas were available by habitat class, and smolt densities (per hectare) were elicited by class, for classes 1 to 3. A total downstream migration mortality rate (natural causes) was applied, rather than a per kilometre rate. There are no obstacles to migration in the part of the river considered for this exercise (below Storfallet, a definite barrier to migration). The final PSPC prior for Kågeälven is shown in Figure 3.

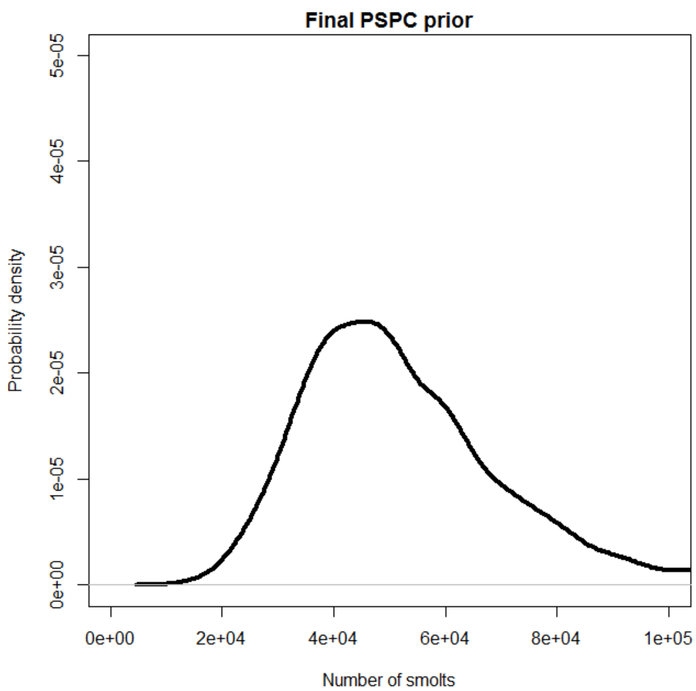

Figure 3. PSPC prior for Kågeälven.

Rickleån

Priors for smolt densities for Rickleån were provided per hectare, averaged over habitat classes. Priors were elicited to describe mortality arising from the passage of three closely located turbines at Robertsfors; the proportion of smolts that pass through each turbine and the proportion of smolts that are killed when passing a turbine. Mixing of smolts (that had taken different routes) was assumed to occur between turbines, and it was further assumed that passage of the different turbines was independent, i.e. a smolt that passed the first turbine and survived has the same probability to pass the second turbine as one that did not pass the first. The prior for the proportion of smolts that die passing a turbine was based on information from the literature. The final PSPC prior for Rickleån is shown in Figure 4.

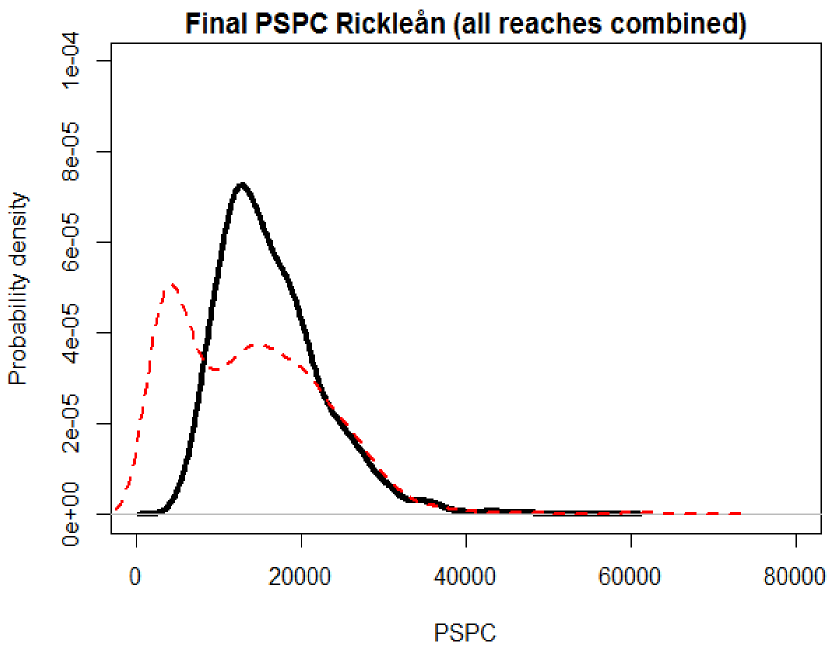

Figure 4. PSPC prior for Rickleån. Dashed red line, old PSPC prior (from WGBAST 2014); solid black line, new PSPC prior.

Vindelälven

Priors for smolt densities in Vindelälven were provided per hectare, averaged over habitat classes 1–3 and used in concert with a prior for total habitat area (all classes) to obtain a prior for smolt production. A total downstream migration mortality rate (natural causes) was applied, rather than a per kilometre rate. The whole production area in Vindelälven is above the Stornorrfors power plant, so that all smolts must pass a turbine (although a proportion may pass through the fish ladder or through the spillway at high flows). A prior was therefore elicited to describe the expert's knowledge about mortality resulting from passage of the turbine and associated tunnel. Priors that do and do not take this additional mortality into account are shown in Figure 5.

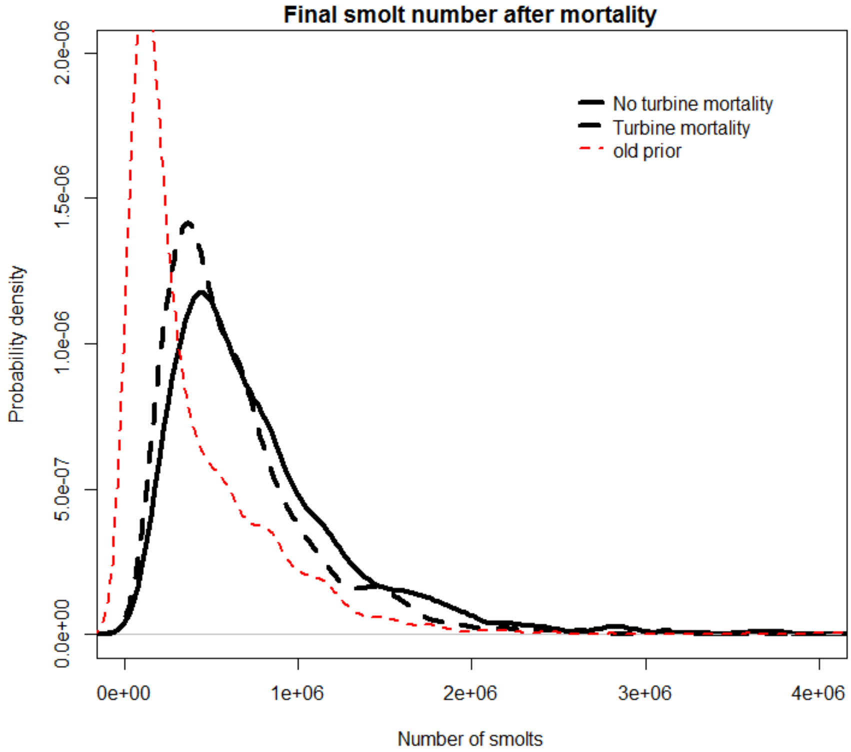

Figure 5. PSPC prior for Vindelälven. Dashed red line, old PSPC prior (from WGBAST 2014); solid black line, new PSPC prior without turbine mortality at Stornorrfors; dashed black line, new PSPC prior with turbine mortality at Stornorrfors.

Appendix A. JAGS codes for the PSPC prior for Mörrumsån and Vindelälven

 # denotes a comment.

Mörrumsån

```
pspc_model<-"

model{

#Density priors, per 100m²
density[1]~dlnorm(2.43,8.16)      #Habitat class 1
density[2]~dlnorm(2.83,8.16)
density[3]~dlnorm(3.34,8.16)

#Total area (ha) in each of 4 river sections
#1 lower; 2 middle; 3 between Hemsjö dams; 4 upper

area[1]~dlnorm(3.04, 18.90)  #lower
```

```
area[2]~dlnorm(2.75, 25)
area[3]~dlnorm(1.14, 25)
area[4]~dlnorm(2.71, 4.53)  #upper

#Distribution of habitat classes by area

p.habitat[1:3,1]~ddirich(alpha[1,1:3])
p.habitat[1:3,2]~ddirich(alpha[2,1:3])
p.habitat[1:3,3]~ddirich(alpha[3,1:3])
p.habitat[1:3,4]~ddirich(alpha[4,1:3])

for(i in 1:reaches){
for(j in 1:classes){
area.h[i,j]<-area[i]*p.habitat[j,i]          #area of habitat in each river section
area.d[i,j]<-area.h[i,j]*density[j]          #abundance by habitat class and river section

}
reach.d[i]<-sum(area.d[i, ])*100      #total smolt abundance by section
mean.d[i]<-reach.d[i]/area[i]/100    #mean density by section
}
average.d<-sum(mean.d[])/4       #mean density all sections

#Downstream passage efficiencies through migration obstacles
p.pass[1]~dbeta(5.5,1.5)           #Marieberg mode 0.90 (to account for extra M due to dam)
  p.pass[2]~dbeta(5.75,1.25)   #Hemsjö mode is 0.95

#Downstream migration mortality
for(i in 1:4){
m_downstream[i]~dbeta(2.5,97.5)   #per km instantaneous natural mortality rate
}

for(i in 1:reaches){
p.km[1:(2*rlength[i]),i]~ddirich(alpha_r[i,1:(2*rlength[i])]) #probability for a fish to be in a given 1km long slice of river section i
```

```
  for(j in (rend[i]+1):14){
  m_km[i,j]<-0
  }

  for(j in 1:rend[i]){        #mortality for each 1km slice of section i
    m_km[i,j]<-p.km[j,i]*m_downstream[i]*(j-0.5)
  }
  mean_m[i]<-sum(m_km[i, ])  #average mortality for a fish in section i
}

#total migration mortality traversing several sections
mean_s[1]<-exp(-mean_m[1])
mean_s[2]<-exp(-mean_m[2])*exp(-mean_m[1])
mean_s[3]<-exp(-mean_m[3])*exp(-mean_m[2])*exp(-mean_m[1])
mean_s[4]<-exp(-mean_m[4])*exp(-mean_m[3])*exp(-mean_m[2])*exp(-mean_m[1])

#smolt numbers after passing obstacles and natural mortality
N.reach[1]<-reach.d[1]*mean_s[1]                  #downstream
N.reach[2]<-reach.d[2]*p.pass[1]*mean_s[2]
N.reach[3]<-reach.d[3]*p.pass[2]*p.pass[1]*mean_s[3]
N.reach[4]<-reach.d[4]*pow(p.pass[2],2)*p.pass[1]*mean_s[4]

N.total<-sum(N.reach[])     #total smolt abundance

N.above<-sum(N.reach[2:4])  #above Marieberg
pspc_old~dlnorm(4.53,35.1) #old PSPC prior
pspc_o<-pspc_old*1000

}"
```

Vindelälven

```
pspc_model<-"
model{
#Density priors: PER HECTARE averaged over habitat classes
```

```
density~dlnorm(6.19,2.74)
tot_area~dlnorm(7.48,48)
reach.d<-density*tot_area     #total smolt numbers per reach
#Turbine mortality at Stornorrfors
p.mort~dbeta(6.55,32.23)
p.pass<-1-p.mort
tot_migmort~dbeta(5.6,16.46)   #total migration mortality
mean_s<-1-tot_migmort                  #migration survival
N.total[1]<-reach.d*mean_s
N.total[2]<-reach.d*mean_s*p.pass #with turbine mortality
#old prior from Uusitalo expert model
expert~dcat(p[])
for(i in 1:5){
        p[i]<-1/5 # ...is uniform
}
for (r in 1:13){
        R[r]<- CC[r]/1000
        CC[r]<-exp(LCC[r]) # From log-scale to the original scale
        LCC[r]~dnorm(MM[r],tau[r]) # Normal distribution on log-scale
        MM[r]<-param[1,r,expert] # param[1,,]: Mean on the log scale
        tau[r]<-1/pow(param[2,r,expert],2) # param[2,,]: standard deviation on log
scale
}
}"
```

Annex 5: OpenBugs model

OpenBugs model for computing estimates for unreporting, discarding and total catch estimates for years 2001–2014. The probability distributions (pdfs) of different catch components are summed up by country, management unit and Baltic Sea level.

This model computes pdfs of discarding, unreporting and total catch for Tables 2.2.1 and 2.2.2 and also separate estimates for discarding in different fisheries in the Tables 2.3.2–2.3.3 and Figures 2.2.3 and 4.3.2.9. The catch data come from WGBAST database and conversion factors are presented in Table 2.3.1.

```
model{

for (i in 1:12){      # years 2001-2012 see year 2013 further down
  A_TotDis_BS[i]<-sum(Tdis[i,1:9,1:2])+sum(Tseal[i,1:9,1:2]) # for T2.2.1 and T2.2.2
  A_TotUnrep_BS[i]<-sum(Tunrep_T2[i,1:9,1:2]) # for T2.2.1 and T2.2.2
  A_TotCatch_BS[i]<-sum(Tcatch[i,1:9,1:2]) # for T2.2.1 and T2.2.2
  A_TotSeal_BS[i]<-sum(Tseal[i,1:9,1:2])

for(k in 1:2){                         # management units 1=SD22-31, 2=SD32

  B_TotUnrepDis_sea[i,k]<-sum(Tunrep_F2[i,1:9,k]) + sum(Tseal[i,1:9,k]) + sum(Tdis[i,1:9,k]) # Estimate of
  the total unrep, misrep and disdards for F2.2.3
  B_TotCatch_sea[i,k]<-sum(TcatchCom[i,1:9,k])+sum(TRecrSea[i,1:9,k])+B_TotUnrepDis_sea[i,k]  # for the
  F2.2.3

  B_TotRiver[i,k]<-sum(TRiver[i,1:9,k]) + sum(Runrep[i,1:9,k])  # for  F4.3.2.9 the river catch include also
  unreporting in river
  B_TotRecr_sea[i,k]<-sum(TRecrSea[i,1:9,k])        # Recr catch in the sea for the F4.3.2.9 and F2.2.3
  B_TotMisr_sea[i,k]<-sum(TMisr[i,1:9,k])                              # F4.3.2.9
  B_TotUnrep_sea[i,k]<-sum(Tunrep_F4[i,1:9,k])    # F4.3.2.9 misreporting excluded here
  B_TotCatchCom_sea[i,k]<-sum(TcatchCom[i,1:9,k])  # for the F2.2.3 & F4.3.2.9
  B_TotDisSeal_MU[i,k]<-sum(Tdis[i,1:9,k]) + sum(Tseal[i,1:9,k])          # F4.3.2.9
  B_TotUnrep_MU[i,k]<-sum(Tunrep_T2[i,1:9,k])
  B_TotCatch_MU[i,k]<-sum(Tcatch[i,1:9,k]) # All catches including unreporting and misreporting by MU


  B_TotDis[i,k]<-sum(Tdis[i,1:9,k])         # Total dead discards by MU
  B_TotSeal[i,k]<-sum(Tseal[i,1:9,k]) # Total seal damages by MU
  B_TotDNdis[i,k]<-sum(DNdis[i,1:9,k]) # dead discards by component and MU
  B_TotLLdis[i,k]<-sum(LLdis[i,1:9,k])
  B_TotTNdis[i,k]<-sum(TNdis[i,1:9,k])
  B_TotOTdis[i,k]<-sum(OTdis[i,1:9,k])
  B_TotDNseal[i,k]<-sum(DNseal[i,1:9,k]) # dead seal damages by component and MU
  B_TotLLseal[i,k]<-sum(LLseal[i,1:9,k])
  B_TotTNseal[i,k]<-sum(TNseal[i,1:9,k])
  B_TotOTseal[i,k]<-sum(OTseal[i,1:9,k])

  B_TotDis_alive[i,k]<-sum(Tdis_alive[i,1:9,k])       # Total alive discards by MU
  B_TotDNdis_alive[i,k]<-sum(DNdis_alive[i,1:9,k]) # alive discards by component and MU
  B_TotLLdis_alive[i,k]<-sum(LLdis_alive[i,1:9,k])
  B_TotTNdis_alive[i,k]<-sum(TNdis_alive[i,1:9,k])


  for(j in 1:9){        #  for countries 3=DK, 4=PL, 5=LV, 6=LT, 7=DE, 8=EE, 9=RU no reported discards
    Ounrep[i,j,k]<- (GND[i,j,k]+LLD[i,j,k]+Misr[i,j,k])* Oconv[i,j]/(1-Oconv[i,j])
    # unreported catch in off-shore fisheries
    Cunrep[i,j,k]<- (TN[i,j,k]+OT[i,j,k]) * Cconv[i,j]/(1-Cconv[i,j])           # coast
    Runrep[i,j,k]<- River[i,j,k] * Rconv[i,j] /(1-Rconv[i,j])          # river
    Sunrep[i,j,k]<- Ounrep[i,j,k] + Cunrep[i,j,k] # total unreporting in sea
```

```
   Tunrep_F2[i,j,k]<- Ounrep[i,j,k] + Cunrep[i,j,k] + Misr[i,j,k] # unreporting in river excluded from
unreporting in F2.2.3
   Tunrep_F4[i,j,k]<- Ounrep[i,j,k] + Cunrep[i,j,k]  # misreporting and unreporting in river are NOT in-
cluded to the total  unreporting in F4.3.2.9
   Tunrep_T2[i,j,k]<- Ounrep[i,j,k] + Cunrep[i,j,k] + Runrep[i,j,k] +Misr[i,j,k] # misreporting IS included to
the total unreporting in T2.2.1 and T2.2.2
   TRiver[i,j,k]<- River[i,j,k]*epsilon
   TRecrSea[i,j,k]<- Recr[i,j,k]*epsilon
   TMisr[i,j,k]<- Misr[i,j,k]*epsilon

   # Total unreported by year, country and management unit
   # input parameters
   # GND[,,]      LLD[,,]   TN[,,]    OT[,,]    Recr[,,]   Seal[,,]   Dis[,,]    River[,,]  Misr[,,]

   # Dead discards
   LLdis[i,j,k]<- (LLD[i,j,k] + Misr[i,j,k])*(1+Oconv[i,j]/(1-Oconv[i,j]))* DisLL[i,j]/(1-DisLL[i,j])*MDisLL
   # dead discards of LLD+Misreporting
   DNdis[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * DisDN[i,j]/(1-DisDN[i,j])*MDisDN         #
dead discards of DNS fishery; stopped in 2007
   TNdis[i,j,k]<- TN[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * DisC[i,j]/(1-DisC[i,j])*MDisC        # dead discards
of TN fishery; catches are corrected with relevant unreporting
   OTdis[i,j,k]<- OT[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * DisC[i,j]/(1-DisC[i,j])
   # disgards coastal fishery; same proportion of undersized as in TN fishery; all fish assumed to die

   # Alive discards; not added to the total catch
   LLdis_alive[i,j,k]<- (LLD[i,j,k] + Misr[i,j,k])*(1+Oconv[i,j]/(1-Oconv[i,j]))* DisLL[i,j]/(1-DisLL[i,j])*(1-
MDisLL)          # Alive discards of LLD+Misreporting
   DNdis_alive[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * DisDN[i,j]/(1-DisDN[i,j])*(1-MDisDN)
   # alive discards of DNS fishery; stopped in 2007
   TNdis_alive[i,j,k]<- TN[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * DisC[i,j]/(1-DisC[i,j])*(1-MDisC)         #
alive discards of TN fishery; catches are corrected with relevant unreporting
   Tdis_alive[i,j,k]<-  LLdis_alive[i,j,k] + DNdis_alive[i,j,k] + TNdis_alive[i,j,k]    #Total alive discards by
year, MU and country; same procedure for all countries


   Tcatch[i,j,k]<- GND[i,j,k] + LLD[i,j,k] + TN[i,j,k] + OT[i,j,k] +
                                          Recr[i,j,k] + River[i,j,k]  + Tunrep_T2[i,j,k] + Tdis[i,j,k]
   TcatchCom[i,j,k]<- (GND[i,j,k] + LLD[i,j,k] + TN[i,j,k] + OT[i,j,k])*epsilon

   # Total catch by year, country and management unit
}

for (j in 1:1){      #   country 1=FI, seal damages and other discards are given
   Tdis[i,j,k]<- LLdis[i,j,k] + DNdis[i,j,k] + TNdis[i,j,k] + OTdis[i,j,k] + Dis[i,j,k] * (1+Cconv[i,j]/(1-
Cconv[i,j]))        #Total discards by year FI; add Dis[,1,] manually to T2.3.2
   Tseal[i,j,k]<- Seal[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j]))
   #Reported seal damages are corrected with coastal unreporting because damages takes place there
   #DNseal[,,], LLseal[,,], TNseal[,,] and OTseal[,,] included in Seal[,1,]; add manually to relevant columns
in T2.3.2
   DNseal[i,j,k]<-0.00001
   LLseal[i,j,k]<-0.00001
   TNseal[i,j,k]<-0.00001
   OTseal[i,j,k]<-0.00001
}
for (j in 2:2){      # country 2=SE, seal damages in TN and LLD are given in Seal[,,] -parameter
   Tdis[i,j,k]<-  LLdis[i,j,k] + DNdis[i,j,k] + TNdis[i,j,k] + OTdis[i,j,k]    #Total discards by year SE
   #LLseal[i,j,k] and TNseal[i,j,k] included in Seal[,2,]; add manually to T2.3.2
   DNseal[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealDN[i,j]/(1-SealDN[i,j])        # Seal damage
DNS fishery; stopped in 2007
   OTseal[i,j,k]<- OT[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])
   # Seal damage in the coastal fishery by other gears
   LLseal[i,j,k]<-0.00001
   TNseal[i,j,k]<-0.00001
   Tseal[i,j,k] <- DNseal[i,j,k] + OTseal[i,j,k] + Seal[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j]))
```

```
    #Reported seal damages are corrected with off-shore unreporting, because majority in LLD fishery
  }
  for(j in 3:9){        # countries 3=DK, 4=PL, 5=LV, 6=LT, 7=DE, 8=EE, 9=RU no reported discards
    Tdis[i,j,k]<-  LLdis[i,j,k] + DNdis[i,j,k] + TNdis[i,j,k] + OTdis[i,j,k]     #Total discards by year
    Tseal[i,j,k]<- LLseal[i,j,k] + DNseal[i,j,k] + TNseal[i,j,k] + OTseal[i,j,k]              #Total seal damages by
  year
    LLseal[i,j,k]<- (LLD[i,j,k] + Misr[i,j,k])*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealLL[i,j]/(1-SealLL[i,j])
    # Seal damages LLD+Misreporting
    DNseal[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealDN[i,j]/(1-SealDN[i,j])         # Seal damage
  DNS fishery; stopped in 2007
    TNseal[i,j,k]<- TN[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])    # catches are corrected
  with relevant unreporting
    OTseal[i,j,k]<- OT[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])
    # Seal damage coastal fishery; mainly TN but all coastal caches included

  }
}
}
for (i in 13:14){       # year 2013-2014: only coastal fishery in FIN and SWE and  seal discards in POL off-
   shore fishery apply only for SD26 catch
  A_TotDis_BS[i]<-sum(Tdis[i,1:9,1:2])+sum(Tseal[i,1:9,1:2]) # for T2.2.1 and T2.2.2
  A_TotUnrep_BS[i]<-sum(Tunrep_T2[i,1:9,1:2]) # for T2.2.1 and T2.2.2
  A_TotCatch_BS[i]<-sum(Tcatch[i,1:9,1:2]) # for T2.2.1 and T2.2.2
  A_TotSeal_BS[i]<-sum(Tseal[i,1:9,1:2])

for(k in 1:2){                          # management units 1=SD22-31, 2=SD32

  B_TotUnrepDis_sea[i,k]<-sum(Tunrep_F2[i,1:9,k]) + sum(Tseal[i,1:9,k]) + sum(Tdis[i,1:9,k]) # Estimate of
  the total unrep, misrep and disdards for F2.2.3
  B_TotCatch_sea[i,k]<-sum(TcatchCom[i,1:9,k])+sum(TRecrSea[i,1:9,k])+B_TotUnrepDis_sea[i,k]  # for the
  F2.2.3

  B_TotRiver[i,k]<-sum(TRiver[i,1:9,k]) + sum(Runrep[i,1:9,k])  # for  F4.3.2.9 the river catch include also
  unreporting in river
  B_TotRecr_sea[i,k]<-sum(TRecrSea[i,1:9,k])         # Recr catch in the sea for the F4.3.2.9 and F2.2.3
  B_TotMisr_sea[i,k]<-sum(TMisr[i,1:9,k])                                 # F4.3.2.9
  B_TotUnrep_sea[i,k]<-sum(Tunrep_F4[i,1:9,k])    # F4.3.2.9 misreporting excluded here
  B_TotCatchCom_sea[i,k]<-sum(TcatchCom[i,1:9,k])  # for the F2.2.3 & F4.3.2.9
  B_TotDisSeal_MU[i,k]<-sum(Tdis[i,1:9,k]) + sum(Tseal[i,1:9,k])          # F4.3.2.9
  B_TotUnrep_MU[i,k]<-sum(Tunrep_T2[i,1:9,k])
  B_TotCatch_MU[i,k]<-sum(Tcatch[i,1:9,k]) # All catches including unreporting and misreporting by MU


  B_TotDis[i,k]<-sum(Tdis[i,1:9,k])          # Total dead discards by MU
  B_TotSeal[i,k]<-sum(Tseal[i,1:9,k]) # Total seal damages by MU
  B_TotDNdis[i,k]<-sum(DNdis[i,1:9,k]) # dead discards by component and MU
  B_TotLLdis[i,k]<-sum(LLdis[i,1:9,k])
  B_TotTNdis[i,k]<-sum(TNdis[i,1:9,k])
  B_TotOTdis[i,k]<-sum(OTdis[i,1:9,k])
  B_TotDNseal[i,k]<-sum(DNseal[i,1:9,k]) # dead seal damages by component and MU
  B_TotLLseal[i,k]<-sum(LLseal[i,1:9,k])
  B_TotTNseal[i,k]<-sum(TNseal[i,1:9,k])
  B_TotOTseal[i,k]<-sum(OTseal[i,1:9,k])

  B_TotDis_alive[i,k]<-sum(Tdis_alive[i,1:9,k])       # Total alive discards by MU
  B_TotDNdis_alive[i,k]<-sum(DNdis_alive[i,1:9,k]) # alive discards by component and MU
  B_TotLLdis_alive[i,k]<-sum(LLdis_alive[i,1:9,k])
  B_TotTNdis_alive[i,k]<-sum(TNdis_alive[i,1:9,k])

  for(j in 1:9){        #  for countries 3=DK, 4=PL, 5=LV, 6=LT, 7=DE, 8=EE, 9=RU no reported discards
    Ounrep[i,j,k]<- (GND[i,j,k]+LLD[i,j,k]+Misr[i,j,k])* Oconv[i,j]/(1-Oconv[i,j])
    # unreported catch in off-shore fisheries
    Cunrep[i,j,k]<- (TN[i,j,k]+OT[i,j,k]) * Cconv[i,j]/(1-Cconv[i,j])          # coast
    Runrep[i,j,k]<- River[i,j,k] * Rconv[i,j] /(1-Rconv[i,j])          # river
```

```
   Sunrep[i,j,k]<- Ounrep[i,j,k] + Cunrep[i,j,k] # total unreporting in sea
   Tunrep_F2[i,j,k]<- Ounrep[i,j,k] + Cunrep[i,j,k] + Misr[i,j,k] # unreporting in river excluded from
unreporting in F2.2.3
   Tunrep_F4[i,j,k]<- Ounrep[i,j,k] + Cunrep[i,j,k]  # misreporting and unreporting in river are NOT in-
cluded to the total  unreporting in F4.3.2.9
   Tunrep_T2[i,j,k]<- Ounrep[i,j,k] + Cunrep[i,j,k] + Runrep[i,j,k] +Misr[i,j,k] # misreporting IS included to
the total unreporting in T2.2.1 and T2.2.2
   TRiver[i,j,k]<- River[i,j,k]*epsilon
   TRecrSea[i,j,k]<- Recr[i,j,k]*epsilon
   TMisr[i,j,k]<- Misr[i,j,k]*epsilon

   # Total unreported by year, country and management unit

   # Dead discards
   LLdis[i,j,k]<- (LLD[i,j,k] + Misr[i,j,k])*(1+Oconv[i,j]/(1-Oconv[i,j]))* DisLL[i,j]/(1-DisLL[i,j])*MDisLL
   # dead discards of LLD+Misreporting
   DNdis[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * DisDN[i,j]/(1-DisDN[i,j])*MDisDN         #
dead discards of DNS fishery; stopped in 2007
   TNdis[i,j,k]<- TN[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * DisC[i,j]/(1-DisC[i,j])*MDisC         # dead discards
of TN fishery; catches are corrected with relevant unreporting
   OTdis[i,j,k]<- OT[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * DisC[i,j]/(1-DisC[i,j])
   # disgards coastal fishery; same proportion of undersized as in TN fishery; all fish assumed to die

   # Alive discards; not added to the total catch
   LLdis_alive[i,j,k]<- (LLD[i,j,k] + Misr[i,j,k])*(1+Oconv[i,j]/(1-Oconv[i,j]))* DisLL[i,j]/(1-DisLL[i,j])*(1-
MDisLL)         # Alive discards of LLD+Misreporting
   DNdis_alive[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * DisDN[i,j]/(1-DisDN[i,j])*(1-MDisDN)
   # alive discards of DNS fishery; stopped in 2007
   TNdis_alive[i,j,k]<- TN[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * DisC[i,j]/(1-DisC[i,j])*(1-MDisC)         #
alive discards of TN fishery; catches are corrected with relevant unreporting
   Tdis_alive[i,j,k]<-  LLdis_alive[i,j,k] + DNdis_alive[i,j,k] + TNdis_alive[i,j,k]    #Total alive discards by
year, MU and country; same procedure for all countries

   Tcatch[i,j,k]<- GND[i,j,k] + LLD[i,j,k] + TN[i,j,k] + OT[i,j,k] +
                                        Recr[i,j,k] + River[i,j,k]  + Tunrep_T2[i,j,k] + Tdis[i,j,k]
   TcatchCom[i,j,k]<- (GND[i,j,k] + LLD[i,j,k] + TN[i,j,k] + OT[i,j,k])*epsilon

   # Total catch by year, country and management unit
}

for (j in 1:1){       #   country 1=FI, seal damages and other discards are given
   Tdis[i,j,k]<- LLdis[i,j,k] + DNdis[i,j,k] + TNdis[i,j,k] + OTdis[i,j,k] + Dis[i,j,k] * (1+Cconv[i,j]/(1-
Cconv[i,j]))        #Total discards by year FI; add Dis[,,] manually to T2.3.2
   Tseal[i,j,k]<- Seal[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j]))
   #Reported seal damages are corrected with coastal unreporting because only coastal fishery occurred
   #DNseal[,,], LLseal[,,], TNseal[,,] and OTseal[,,] included in Seal[,1,]; add manually to relevant columns
in T2.3.2
   DNseal[i,j,k]<-0.00001
   LLseal[i,j,k]<-0.00001
   TNseal[i,j,k]<-0.00001
   OTseal[i,j,k]<-0.00001
}
for (j in 2:2){       # country 2=SE, seal damages in TN and LLD are given in Seal[,,] -parameter
   Tdis[i,j,k]<-  LLdis[i,j,k] + DNdis[i,j,k] + TNdis[i,j,k] + OTdis[i,j,k]    #Total discards by year SE
   #LLseal[i,j,k] and TNseal[i,j,k] included in Seal[,2,]; add manually to T2.3.2
   DNseal[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealDN[i,j]/(1-SealDN[i,j])        # Seal damage
DNS fishery; stopped in 2007
   OTseal[i,j,k]<- OT[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])
   # Seal damage in the coastal fishery by other gears
   LLseal[i,j,k]<-0.00001
   TNseal[i,j,k]<-0.00001
   Tseal[i,j,k] <- DNseal[i,j,k] + OTseal[i,j,k] + Seal[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j]))
   #Reported seal damages are corrected with coastal unreporting, because only coastal fishery occurred
}
```

```
for(j in 3:3){      # country 3=DK, no reported discards, expertevaluated rates for seal damages
  Tdis[i,j,k]<-  LLdis[i,j,k] + DNdis[i,j,k] + TNdis[i,j,k] + OTdis[i,j,k]    #Total discards by year
  LLseal[i,j,k]<- (LLD[i,j,k] + Misr[i,j,k])*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealLL[i,j]/(1-SealLL[i,j])
  # Seal damages LLD+Misreporting
  DNseal[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealDN[i,j]/(1-SealDN[i,j])       # Seal damage
DNS fishery; stopped in 2007
  TNseal[i,j,k]<- TN[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])   # catches are corrected
with relevant unreporting
  OTseal[i,j,k]<- OT[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])
  # Seal damage coastal fishery; mainly TN but all coastal caches included
  Tseal[i,j,k]<- LLseal[i,j,k] + DNseal[i,j,k] + TNseal[i,j,k] + OTseal[i,j,k]          #Total seal damages by
year
}
for(j in 4:4){      # country  4=PL,  no reported discards, expertevaluated rates for seal damages;
                                     # in 2013 55% of the LLD catch was taken from SD26, where
damage rate is high
  Tdis[i,j,k]<-  LLdis[i,j,k] + DNdis[i,j,k] + TNdis[i,j,k] + OTdis[i,j,k]    #Total discards by year
  LLseal[i,j,k]<- 0.55*(LLD[i,j,k] + Misr[i,j,k])*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealLL[i,j]/(1-SealLL[i,j])
  # Seal damages LLD+Misreporting year
  DNseal[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealDN[i,j]/(1-SealDN[i,j])       # Seal damage
DNS fishery; stopped in 2007
  TNseal[i,j,k]<- TN[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])   # catches are corrected
with relevant unreporting
  OTseal[i,j,k]<- OT[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])   # Seal damage coastal
fishery; mainly TN but all coastal caches included
  Tseal[i,j,k]<- LLseal[i,j,k] + DNseal[i,j,k] + TNseal[i,j,k] + OTseal[i,j,k]          #Total seal damages by
year

}
for(j in 5:9){      # countries 3=DK, 4=PL, 5=LV, 6=LT, 7=DE, 8=EE, 9=RU no reported discards
  Tdis[i,j,k]<-  LLdis[i,j,k] + DNdis[i,j,k] + TNdis[i,j,k] + OTdis[i,j,k]    #Total discards by year
  LLseal[i,j,k]<- (LLD[i,j,k] + Misr[i,j,k])*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealLL[i,j]/(1-SealLL[i,j])
  # Seal damages LLD+Misreporting
  DNseal[i,j,k]<- GND[i,j,k]*(1+Oconv[i,j]/(1-Oconv[i,j])) * SealDN[i,j]/(1-SealDN[i,j])       # Seal damage
DNS fishery; stopped in 2007
  TNseal[i,j,k]<- TN[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])   # catches are corrected
with relevant unreporting
  OTseal[i,j,k]<- OT[i,j,k]*(1+Cconv[i,j]/(1-Cconv[i,j])) * SealC[i,j]/(1-SealC[i,j])            # Seal damage
coastal fishery; mainly TN but all coastal caches included
  Tseal[i,j,k]<- LLseal[i,j,k] + DNseal[i,j,k] + TNseal[i,j,k] + OTseal[i,j,k]          #Total seal damages by
year
}
}
}

epsilon~dnorm(1,1000)I(0,)

# Mortalities of discarded
MDisLL~dlnorm(MLLM,MLLtau)I(0.5,1.1)
MDisDN~dlnorm(MDNM,MDNtau)I(0.4,1.1)
MDisC~dlnorm(MTNM,MTNtau)I(0.1,1.1)

MLLcv<-0.02822/0.7698              #Mortality of undersized discarded from longline
MLLM<-log(0.7698)-0.5/MLLtau
MLLtau<-1/log(MLLcv*MLLcv+1)

MDNcv<-0.03227/0.6535              #Mortality of undersized discarded from driftnet
MDNM<-log(0.6535)-0.5/MDNtau
MDNtau<-1/log(MDNcv*MDNcv+1)

MTNcv<-0.059/0.3832                #Mortality of undersized discarded from trapnet
MTNM<-log(0.3832)-0.5/MTNtau
MTNtau<-1/log(MTNcv*MTNcv+1)
```

```
# input parameters
# Omu[,,] Osd[,,]     Cmu[,,]    Csd[,,]     Rmu[,,]    Rsd[,,]     LLmu[,,]  LLsd[,,]    DNmu[,,] DNvar[,,]
     TNmu[,,]         TNsd[,,]   SLLDmu[,,]             SLLDsd[,,]             SGNDmu[,,]            SGNDsd[,,]
     STNmu[,,]        STNsd[,,]

# conversion factors are same for both management units
for (j in 1:9){         # countries 1=FI, 2=SE, 3=DK, 4=PL, 5=LV, 6=LT, 7=DE, 8=EE, 9=RU
for (i in 1:14){       # years 2001-2014

Oconv[i,j]~dlnorm(OM[i,j],Otau[i,j])I(0,0.6)
Cconv[i,j]~dlnorm(CM[i,j],Ctau[i,j])I(0,0.7)
Rconv[i,j]~dlnorm(RM[i,j],Rtau[i,j])I(0,0.7)

DisLL[i,j]~dlnorm(LLM[i,j],LLtau[i,j])I(0,0.3)
DisDN[i,j]~dlnorm(DNM[i,j],DNtau[i,j])I(0,0.2)
DisC[i,j]~dlnorm(TNM[i,j],TNtau[i,j])I(0,0.2)

SealLL[i,j]~dlnorm(SLLDM[i,j],SLLDtau[i,j])I(0,0.2)
SealDN[i,j]~dlnorm(SGNDM[i,j],SGNDtau[i,j])I(0,0.2)
SealC[i,j]~dlnorm(STNM[i,j],STNtau[i,j])I(0,0.35)

Ocv[i,j]<-Osd[i,j]/Omu[i,j]                  #Oconv, unreporting off-shore
OM[i,j]<-log(Omu[i,j])-0.5/Otau[i,j]
Otau[i,j]<-1/log(Ocv[i,j]*Ocv[i,j]+1)

Ccv[i,j]<-Csd[i,j]/Cmu[i,j]                  #Cconv, unreporting coast
CM[i,j]<-log(Cmu[i,j])-0.5/Ctau[i,j]
Ctau[i,j]<-1/log(Ccv[i,j]*Ccv[i,j]+1)

Rcv[i,j]<-Rsd[i,j]/Rmu[i,j]                  #Rconv, unreporting river
RM[i,j]<-log(Rmu[i,j])-0.5/Rtau[i,j]
Rtau[i,j]<-1/log(Rcv[i,j]*Rcv[i,j]+1)

LLcv[i,j]<-LLsd[i,j]/LLmu[i,j]               #LLdis, discarded undersized longline
LLM[i,j]<-log(LLmu[i,j])-0.5/LLtau[i,j]
LLtau[i,j]<-1/log(LLcv[i,j]*LLcv[i,j]+1)

DNcv[i,j]<-DNsd[i,j]/DNmu[i,j]                        #DNdis, discarded undersized driftnet
DNM[i,j]<-log(DNmu[i,j])-0.5/DNtau[i,j]
DNtau[i,j]<-1/log(DNcv[i,j]*DNcv[i,j]+1)

TNcv[i,j]<-TNsd[i,j]/TNmu[i,j]               #TNdis, discarded undersized trapnet
TNM[i,j]<-log(TNmu[i,j])-0.5/TNtau[i,j]
TNtau[i,j]<-1/log(TNcv[i,j]*TNcv[i,j]+1)

SLLDcv[i,j]<-SLLDsd[i,j]/SLLDmu[i,j]                  #Seal LLD, seal damages longline
SLLDM[i,j]<-log(SLLDmu[i,j])-0.5/SLLDtau[i,j]
SLLDtau[i,j]<-1/log(SLLDcv[i,j]*SLLDcv[i,j]+1)

SGNDcv[i,j]<-SGNDsd[i,j]/SGNDmu[i,j]                  #Seal GND, seal damages driftnet
SGNDM[i,j]<-log(SGNDmu[i,j])-0.5/SGNDtau[i,j]
SGNDtau[i,j]<-1/log(SGNDcv[i,j]*SGNDcv[i,j]+1)

STNcv[i,j]<-STNsd[i,j]/STNmu[i,j]                     #Seal TN, seal damages trapnet
STNM[i,j]<-log(STNmu[i,j])-0.5/STNtau[i,j]
STNtau[i,j]<-1/log(STNcv[i,j]*STNcv[i,j]+1)
}
}
}
```

Table A1. Example of catch components used in the computation of unreported catch and discards for the Tables 2.2.1 and 2.2.2. (Swedish fisheries, numbers of salmon in years 2001–2013, Subdivisions 22–31).

GND[,2,1]	LLD[,2,1]	TN[,2,1]	OT[,2,1]	RECR[,2,1]	SEAL[,2,1]	DIS[,2,1]	RIVER[,2,1]	MISR[,2,1]
60314	15559	34291	2678	14443	2483	0	25912	0
31973	26355	40012	1759	17906	2043	0	22116	0
36408	11802	34432	2617	14889	1230	0	17308	0
55788	31371	59406	8510	22939	2439	0	17648	0
40562	19958	43248	2796	17931	2159	0	22086	0
27083	15177	27322	954	12757	2042	0	15370	0
26254	12859	27039	611	11928	1052	0	17914	0
0	11855	34302	873	13809	814	0	31694	0
0	18161	45887	1291	18248	1708	0	23654	0
0	26756	28204	537	12827	1456	0	12194	0
0	35213	28548	709	11819	3178	0	13689	0
0	16338	21422	388	10526	1503	0	35658	0
0	0	27922	63	11335	406	0	27762	0
0	0	28187	29	11378	432	0	23086	0

Table A2. Example of input parameter values for the probability function of coefficient factors for different catch components (Finnish fisheries in SD 22–31, years 2001–2014).

OMU[,1]	OSD[,1]	CMU[,1]	CSD[,1]	RMU[,1]	RSD[,1]	LLMU[,1]	LLSD[,1]	DNMU[,1]	DNSD[,1]	TNMU[,1]	TNSD[,1]	SLLDMU[,1]	SLLDSD[,1]	SGNDMU[,1]	SGNDSD[,1]	STNMU[,1]	ST
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.007995	0.004262	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.007995	0.004262	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.007995	0.004262	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.007995	0.004262	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.007995	0.004262	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.007995	0.004262	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.007995	0.004262	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.03003	0.0123	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.03003	0.0123	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.03003	0.0123	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.03003	0.0123	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.03003	0.0123	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.03003	0.0123	0.02343	0.006259	0.09	0.0
0.03671	0.0226	0.08352	0.03105	0.1997	0.06085	0.02824	0.008152	0.01598	0.005471	0.03007	0.008207	0.03003	0.0123	0.02343	0.006259	0.09	0.0

Annex 6: Technical Minutes from the Baltic Salmon Review Group

- Salmon Review and Advice Drafting Group (RG/ADGSalmon).
- ICES HQ, Copenhagen, 20–23 April, 2015.
- Reviewer: Kjell Leonardsson
- Review of ICES Working Group on Baltic Salmon and Trout (WGBAST).

General comments on the report

The Review Group (RG) acknowledges the efforts expended by WGBAST in undertaking a substantial body of work and producing a thorough and informative report on the status and trends of salmon and trout in the Baltic Sea. The report was not fully compiled at the time of the Review meeting, with Section 1 missing. Consequently, Sections 2–5 were reviewed. The WG has applied a state-of-the-art approach to their efforts to model and assess Baltic salmon stocks (except for the stocks in the Gulf of Finland, where data are sparse and the assessment is based on much simpler models and expert judgement). The assessment of sea trout populations in the Baltic is based on a model developed by the Study Group on Data Requirements and Assessment Needs for Baltic Sea Trout (ICES, 2011), first implemented for the assessment in 2012 (ICES, 2012). The model is aimed at predicting the recruitment status in the rivers based on 0+ parr densities from electrofishing in rivers that are adjusted by using environmental data from the electrofishing sites. For the evaluation of the assessment results, basic observations such as tagging data, spawner counts and catch statistics are also taken into account.

The WGBAST report details salmon fishing gears, catches, discards, fishing effort, biological sampling, tagging and finclipping by countries, and estimates of stock groupings as assigned by DNA microsatellite samples, along with implanted management measures. River data used in forecast modelling are presented and tabulated followed by stock projections, assessments against reference point estimates and forecasting under five scenarios of various fishing effort. Issues pertaining to sea trout are then addressed: catches and biological sampling; data collection; reared smolt production; status of stocks and management changes; future development of the model employed in sea trout assessment and data improvements. The report concludes with a summary of sea trout data needs in accordance with the DCF.

Although this year's WGBAST report did not include a special section with detailed responses to last year's Technical Minutes, several of the questions raised last year by the RG have been incorporated in this year's report.

The ToR on F_{MSY} ranges was not dealt with in the WGBAST report nor in the RG meeting.

Technical Comments

Chapter 2: Salmon fisheries

Section 2.3: Discards, misreporting and unreporting of catches

As was the case last year, there is still an issue on misreporting and unreporting of catches, but it appears to be less of a problem than in previous years. The RG again points out this needs some form of resolution to ensure the WG can operate with the most robust and realistic data possible; efforts to this end should be made, preferably before the data compilation prior to the 2016 model runs, as these runs are conducted before the WG meet.

Chapter 4: Reference points and assessment of salmon

Section 4.2.1: Updated submodels

The river Kågeälven is now included in the river model, starting from year 2008.

Results of the river model indicate a substantial increase in smolt abundance of AUs 1–2 rivers since the late 1990s.

Section 4.2.2: Changes in the assessment methods

Extended time-series of smolt abundance estimates from river model

Previously, smolt abundance estimates obtained from the river model have been used two years into the future from the last year with data, although in AUs 1–3 it is possible to predict smolt abundances three years ahead (the most common smolt age is three years). In order to utilise the whole time-series of annual smolt abundance estimates in this year's assessment, the life-cycle model was extended by one extra year into the future. This was carried out by adding year/cohort indices into the model. This update to the life-cycle model is currently well motivated by the fact that the most recent parr year classes are offspring from the largest spawning stocks, hence, they are crucial in updating the knowledge about the stock–recruit dynamics.

RG comment: Although the river model accounts for a smolt reaction norm, with transition from the parr stage to smoltification at different ages with certain probabilities, this is not accounted for in the assessment model. In the assessment model the smolt age is fixed, which makes the prognoses of PFA and future spawner numbers more variable inter-annually than expected in reality, as well as less certain. For this reason, the WG should consider adding the river specific smolt reaction norm also to the assessment model.

Section 4.2.3: Status of the assessment unit 1–4 stocks and development of fisheries in the Gulf of Bothnia and the Main Basin / Figure 4.2.3.10

As noted last year by the RG, the estimated number of spawners in cases where observed returns (counter values) are available do not always agree very well (this applies to examples of both included and non-included counts in the model-fitting; clear differences can be seen in e.g. Kalix, Aby and Byske. This suggests a need to field check the counters:

- Are raising factors applied from fish being missed by counters?
- Are raising factors applied for counters positioned mid-way up a system?

It is understood that the modelling framework for the data included in the model-fitting takes account of the above facts, but some explanation of how this has been handled modelling-wise would help in the WGBAST report (to be transferred into the stock annex when this annex is next updated).

To make model deviations from observed data more transparent, it would be desirable to have an additional figure similar to Figure 4.2.3.10, showing the adjusted observed counts versus the model-fitted returns, to aid visual comparison. (Examples of rivers for which this would be useful are the Kalix and the Byske rivers, in which the counters are higher upstream than rather large spawning areas).

Figure 4.2.3.10: Check the scale in the graph with the Kåge spawners. Also note that the observed number of spawners is missing in the graph for Rickleån.

Section 4.6: Tasks for future development of the assessment

Development of a smolt production model for AU4 stocks. This development is strongly supported by the RG.

Inclusion of AU5 and 6 stocks in the full life-history model. At present, these stocks are treated separately from the AU1–4 stocks. Inclusion in the full life-history model will require updated information from these stocks regarding e.g. smolt age distributions, maturation rates, exploitation rates, post-smolt survival and information about exploitation of stocks from Gulf of Bothnia and Main Basin in the Gulf of Finland (and vice versa). In addition, increased amounts of basic biological data (e.g. smolt and spawner counts, additional electrofishing sites) may be needed for some rivers.

RG comment: There will probably be a need to consider the reared salmon in the stock–recruit function as spawners for AUs 5 and 6, since there might be a possibility for large reared smolt releases to reduce the production of wild salmon.

Repeat spawners: With increasing salmon stocks the number of repeat spawners increases, and these repeat spawners are not accounted for in the assessment model. For rivers without hydropower regulation, this may lead to considerable underestimation of the total expected number of eggs laid, since repeat spawners are larger in size than first time spawners. In addition, the eggs of the large repeat spawners are likely to be larger than the eggs of the first time spawners, and if there is a positive correlation between egg size and fry survival the influence of the repeat spawners on recruitment may be considerable. The proportion of repeat spawners may be as large as 10–20% of the spawning run. The RG therefore asks the WG to consider the possibility of including repeat spawners in the assessment model. It should be possible to gain information about repeat spawners from scale readings, as noted by the WG in the paragraph on "*Further use of scale-reading data*". A first step should preferably be to gather information on the repeat spawners in order to assess the potential influence of this stock component on number of spawners, stock–recruitment, and PFA.

April SST: The April SST was recently incorporated in the assessment model to account for inter-annually varying maturation rates. However, this also introduces some extra uncertainty since it needs to be estimated not only for the future projection but also for the same year in which the assessment is conducted. The question is therefore how much does the use of April SST improve the predictions compared to e.g. summing up the winter temperatures from November to March? Moreover, having an interannually varying maturation rate with the potential for early maturation due to warm winters increases the need to allow for repeat spawners in the model.

Constant catchability in the fishery: The model assumption about constant catchability in the fishery is problematic since it likely influences the results for other parameters, e.g. the post-smolt survival. The WG should consider the possibility of allowing for a varying catchability in the assessment model.

Section 4.7: Needs for improving the use and collection of data for assessment

The WG suggests that electrofishing surveys in non-index salmon rivers should be carried out, but notes that in the present assessment model it is not necessary to have annual surveys in every river. They could be carried out for instance every second or third year.

RG comment: The RG agree with this suggestion; it may be complemented by an argument that by not having annual electrofishing in non-index salmon rivers the saved resources could be better used by increasing the spatial sampling to cover, for example, twice as many sites every second year than can be covered by annual sampling. Today, several of the large non-index salmon rivers are electrofished annually at rather few sites in relation to the size of the rivers.

Tables and Figures of Section 4

Explanatory text is missing for several figures in Section 4.

A figure on smolt production relative to the PSPC (i.e. proportion, for all rivers combined) in a time-series graph for AU 5 is missing in this year's report. It was present last year.

Chapter 5: Sea trout

Section 5.5.1: Status of stocks

There was an update of the assessment of sea trout this year. As in the in 2012, the assessment model uses electrofishing data together with habitat information collected at the same sites, focusing on recruitment status as the basic assessment tool. Recruitment status was defined as the *observed recruitment* (observed densities) relative to the *potential maximal recruitment* of the individual sea trout populations. Due to the significant climatic (e.g. temperature and precipitation) and geological differences found across the Baltic area, as well as the huge variation in stream sizes, the model proposed is constructed to take variables quantifying such differences into account.

The assessment method was slightly changed in 2015 compared to in 2012: In the multiple linear regressions used to calculate the predicted maximum densities for sites across the Baltic the variables entered were stream-wetted width, climate (average air temperature), latitude (proxy for productivity due to climate), longitude (proxy for the gradient from oceanic to continental climate) and the grouped trout habitat score (0-1-2-3 according to ICES, 2011) with Log10 (0+ trout density + 1) as dependent variable. For this analysis sites with optimal densities were used. Actual optimal densities (densities resulting from optimal recruitment) are not known, because it is not known if recruitment has actually been optimal on individual sites. Lacking this knowledge, sites entered into the multiple regression analysis were selected from the dataset by 1) selecting sites in streams with 'good' river habitat and 'good' water quality, 2) from these only the three best years (highest density of trout) observed after year 2000 were selected, or, if less than five years of data were available, only the best data were used, unless this was below ten trout per 100 m^2 for sites with a width <5 m or below five for a wider site; and one for sites where width was above 15 m. In this selection, sites where fish had been stocked were also included. In total this resulted in top values for the expected maximum density.

RG comment: It is not possible from the description in the report to verify if this regression approach and treatment of the data is appropriate as a measure of recruitment success. To the review group, the method seems to require a large amount of expert judgement. For example, an optimal habitat is only expected to produce the maximum number of recruits when there are sufficient numbers of eggs laid there. Thus, the link between the optimal habitat and how many recruits it can sustain needs to be clarified in the method description. Furthermore, the concern raised by the RG in the last year's Technical Minutes, considering the problem in separating between sea-run and resident brown trout in 0+ fry during electrofishing, still remains. A considerable degree of expert knowledge is needed in order to perform the sea-trout assessment on the basis of parr densities; this causes concern to the RG.

RG comment: Another concern about choosing "optimal" habitats is if the sea trout are outcompeted at these sites by the increasing salmon population. The sea trout may expand into the tributaries to a larger extent when the salmon expands in the main stem of the rivers. For this reason, in combination with the problem of distinguishing between sea running and stationary brown trout during electrofishing, focusing on sea trout smolts and spawners should give more reliable figures on the status of the sea trout stocks than using electrofishing data, at least for the larger rivers in the northern Baltic.

Another issue with the maximum density model is how to use it in the assessment. When plenty of data are available, the predicted maximum densities will approach the true maximum densities and, therefore, the assessment will by definition provide results that are below the maximum. Therefore, a boundary needs to be introduced that separates between good and moderate status.

Stock Annex (see Annex 3)

Figure C.1.5.1 in the stock annex gives a schematic diagram of a smolt reaction norm. This figure seems to be somewhat misleading as it could be interpreted as if 1+ parr may become 2+ parr several years later.

Further comments

The RG asked about information on individual growth of salmon in the Main Basin as there are some concerns about reduced growth rate in cod due to changes in the spatial distribution of its food item sprat (lack of sprat in the area SD 22–26). As salmon are mainly feeding in the same area as cod and have sprat as a preferred food item, one would expect a reduced growth of salmon is also possible. The WGBAST did not look into this in 2014. The general impression was however, that growth has not been reduced in recent years. It would be useful if WGBAST could come up with growth data next year, or maybe even include this as a standard content of the WGBAST report. Most assessment working groups include growth data as a standard content of their report as this is an important metric for the general state of the stock.

Starting a few years ago, Sweden split the national quota into wild and reared salmon for the fishery that only takes place by means of trapnets and push-up traps along the coast. The wild quota is generally filled before the reared quota since the wild salmon returns earlier to the rivers; this means that there is a release of wild salmon after the wild quota is filled. It would be valuable to have a data on the amount of the wild salmon discarded, as well as a measure of the survival of these fish.

Conclusions

Robust analyses and a well-structured report, although not fully compiled at the review meeting, have been produced by the WG, which is to their credit considering the data issues and technical complexity of the modelling approach faced by the group.