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

3–12 April 2013

Tallinn, Estonia

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 Tallinn, Estonia, 3–12 April 2013. 14 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 2013. 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 ongoing work on Baltic Sea trout.

- The natural smolt production of salmon populations continued to increase until 2012 but is predicted to decline somewhat from 2013. An increase is then predicted for 2015, mainly as a result of the large spawning run in 2012. The current production is around 2.9 million wild smolts, which corresponds to about 65% of the overall natural potential smolt production capacity for salmon stocks.
- Post-smolt survival has declined from the late 1980s until the mid-2000s, but some indications of improvement have been noticed since then. Especially the post-smolt survival of the 2010 smolt cohort seems to have been higher than average in the last years, and the current survival is estimated to be about 15% for wild and 5% for reared post-smolts. The decline in survival has suppressed recovery of wild salmon stocks.
- The driftnet ban in 2008 resulted in a reduction in offshore salmon catches to the lowest level recorded, but subsequent increases in the longline fishery resulted in a harvest rate in 2010 that was as high as the combined harvest rate for longlines and driftnets was in the early and mid-2000s. Since then, the harvest rate in the offshore fishery has again declined and is now at an all-time low. The harvest rate in the coastal fishery shows an overall declining trend, reaching the lowest value in 2012.
- The group assessed the current status by evaluating the probability that individual salmon rivers have reached 50% and 75% of the potential smolt production. The large, northernmost stocks have likely or very likely reached the 50% objective, but only three rivers have likely reached the 75% objective. Southern stocks and a few small northern stocks have varying and on average much poorer status.
- Wild salmon stocks in Gulf of Finland show indications of some recovery. The smolt production has been below 50% of the potential in most years in two of the Estonian wild salmon rivers (Keila and Vasalemma), although a positive trend can be seen. In the third Estonian river (Kunda) smolt production has varied from 10% to almost 100% of the potential.

Sea trout populations are in a precarious state in the northern Gulf of Bothnia and in Gulf of Finland. Trout populations in the Main Basin area are in general in a better status, but there are indications of declining status in some areas.

1 Introduction

1.1 Terms of reference

2012/2/ACOM08 The **Baltic Salmon and Trout Assessment Working Group** (WGBAST), chaired by Tapani Pakarinen, Finland, will meet in Tallinn, Estonia, 3–12 April 2013 to:

a) Address generic ToRs for Regional and Species Working Groups (see table below);

b) Continue the work of improving sea trout assessment with the aim of compiling and using electrofishing data from all Baltic countries, and developing a method for assessing carrying capacity at electrofishing sites.

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 to the meeting must be available to the group no later than six weeks prior to the meeting.

WGBAST will report by 19 April 2013 for the attention of ACOM and PGCCDBS.

Fish Stock	Stock Name	Stock Coord.	Assess. Coord. 1	Assess. Coord. 2	Advice
sal-2431	Salmon in the Main Basin and Gulf of Bothnia (Salmon in Subdivisions 22–31)	Sweden	Finland	Finland	Update
sal-32	Salmon in Subdivision 32 (Gulf of Finland)	Estonia	Finland	Finland	Biennial
trt-bal	Sea trout in Subdivisions 22–32 (Baltic Sea)	Denmark	Poland	Sweden	Biennial

1.2 Participants

Janis Birzaks		Latvia
Johan Dannewitz	(part of meeting)	Sweden
Piotr Debowski		Poland
Stanislovas Jonusas	(observer, part of meeting)	European Commission
Martin Kesler		Estonia
Vytautas Kesminas	(part of meeting)	Lithuania
Tapani Pakarinen	(chair)	Finland
Stig Pedersen		Denmark
Wojciech Pelczarski		Poland
Jens Persson	(part of meeting)	Sweden
Henni Pulkkinen		Finland
Atso Romakkaniemi	(part of meeting)	Finland
Stefan Stridsman	(part of meeting)	Sweden

Serguei Titov	(part of meeting)	Russia
Simon Weltersbach	(part of meeting)	Germany

1.3 Response to last year's 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's 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.

General comments on the report

In terms of report structure, it would greatly facilitate the reviewers' task, as well as communication with the general public, if a Stock Annex could be provided (in line with the ICES procedure in other stock assessments WG) detailing the methodology used for conducting the stock assessments and projections. The RG understood that this will be achieved for AUs 1–5 as a consequence of the Inter-Benchmark Protocol that will take place this autumn and welcomes this development.

WG response. A stock annex has been produced during the inter benchmark protocol for Baltic salmon (ICES, 2012 IBP), and is attached as Annex 3 to the working group report. The stock annex describes the stock complex of salmon in the Baltic Sea, data collection and type of data used in the assessment, as well as the structure of the assessment model for salmon in all assessment units. However, sea trout is not part of the stock annex as this stock was not included in the inter benchmark protocol. The assessment of sea trout is instead described in the working group report (Section 5).

Section 5. Reference points and assessment of salmon in Main Basin and Gulf of Bothnia (Subdivisions 22–31)

- The chart in Section 5.3 indicates that models A–E are used to provide priors for subsequent use in the full life-history model. However, the RG is under the impression that some of the outputs from models A–E are used as observations (or, say, "pseudo-observations") rather than as priors in the full life-history model. Having this clarified and clearly explained in the Stock Annex (when this is produced later this year) would be very helpful.

  WG response. We have recently found out that a more technically correct term for "pseudo-observation" is likelihood approximation, and this term might be of better help in understanding the procedure.

  In practice what happens in the modelling is that the posterior distributions for stock specific wild smolt abundances obtained from the river model (model C) are fitted to the life cycle model by having the mean value of the posterior distribution as an observation of a distribution which has the model predicted value as its expected value, and the posterior distribution's variance as its "true" variance. The advantage of this procedure is that the weight of the information from the submodel is similar to the life cycle model as if the submodel was actually run inside the *life cycle model (as would be if we had unlimited computational power), whereas prior distributions tend to get updated easily if other, contradicting, data are included.*

Unfortunately this issue was forgotten when the Stock Annex was assembled, and thus it is not included and described there.

- There was a concern from the reviewers about the convergence problem and the long run times of the full life-history model used in this assessment. The very long run times makes the exploration of alternative assumptions and the analysis of their impact on model results an insightful exercise when conducting stock assessment, virtually impossible. In addition, in models with a very large number of parameters, some of them are often only weakly identifiable (in other words, the available data are not able to provide clear information to estimate them), resulting in likelihood functions and/or posterior distributions with strange shapes (e.g. ridges), which are difficult to analyse computationally and to interpret. As an example, the posterior distributions of PSPC's for some rivers are bimodal, suggesting two different PSPC levels which are both broadly in agreement with the available data. It is likely that the value in each of the two modes is, in turn, correlated with the values of some other model parameters (which may also have bimodal posterior distributions), although finding and understanding these correlations in such highly complex models is not easy. The RG encourages the WG to analyse the model in order to identify and reduce potential problems.

  WG response. The WG is aware about the problems connected to poor convergence, long run time and interpretation of the behaviour of the model. Although bimodality and some other 'strange shapes' may not necessary indicate that there is anything wrong in the model as such, these posteriors gain special attention from the WG. For, instance, bimodality of some PSPC estimates may indicate that there are several functional shapes which the stock–recruit dynamics might follow. Development work to resolve this kind of special research questions are mostly carried out outside the WG.

- A closely related issue to the previous point is that, in models of this level of complexity, it is not easy to understand what "goes on inside" or to evaluate model results against the signals in the input data. More exploratory analysis of input data (to identify and interpret signals in the data) and diagnostics of model outputs would be very useful.

  WG response. In last year report, model outputs on e.g. relative stock abundances at sea were compared to independent empirical information generated from mixed-stock analyses. The last few years, such comparisons have been conducted to verify that model outputs are realistic and in agreement with other information sources. Also, the various data from juvenile salmon abundance (electrofishing and smolt trapping data) and the outcomes of each step of analysing these data (mark-recapture model and river model) are annually reported by the WG, thus the consistency of the data and the outcomes of the analyses can be evaluated by a reader of the report. The result report of the WG is already now very comprehensive, and there are limited possibilities to include more analyses. Therefore, the view of the WG is that only those verification/illustration analyses that are linked to specific questions, which are handled by the WG at the moment, could be included in the report. In this year report, the association between winter temperatures and *spawning run strength has been analysed in more detail (Section 4.4). The use of an updated assessment model, where maturation rate is allowed to vary over time, has improved estimates of spawning run strength. Exploratory analyses comparing model outputs and independent information indicate that the model now is able to pick up climate induced variation in maturation rate, and also that predicted spawner abundances strongly correlates with spawner count information from rivers.*

- Assumptions used for conducting projections for the provision of catch advice should be clearly stated in the WG report (in full detail) and the draft advice document (in summary form). It was not clear to the RG how the post-smolt survival and M74 was dealt with in the stock projections. Clarifications in the report would be appreciated. A new updated version of the catch table is provided in Appendix 1. For this year the clarification of how the post-smolt survival and the M74 mortality were dealt with was provided during the RG meeting and the explanation was as follows:

  Post-smolt survival: The forward projection of post-smolt survival was conducted by assuming that the same autocorrelation structure as observed in the past will be maintained in future. Future survival was also assumed to gradually approach the median survival value estimated by the assessment model for 2009 (7.5% for wild salmon), which is the lowest value in the historical time-series. The first year with projected survival is 2011, i.e. 2010 is the last year for which the estimated value of survival was used. Because the survival estimate of 2010 is higher than that of 2009 and because of the relatively strong autocorrelation in the time-series, the first projected years have survival values which are closer to the 2010 estimate than the 2009 estimate (Figure 5.4.2.3). This implies that in short-term predictions, the choice of the value to which the future survival will return has minor effect. Further, this choice has virtually no effect at all on the catch options for 2013, because salmon fully recruited to the fishery in 2013 smoltified in 2011 and earlier. (Further comment from the RG: please clarify how the past autocorrelation structure was approximated and how exactly it was used in the forecast; e.g. was an AR(1) model or something else used for the forecast? what conditional variance was used in the forecast model? It would be helpful if a formula with the model used was provided in the Stock Annex, to be written later this year).

  M74 survival: To project future survival from M74, a similar method was used as that for projecting post-smolt survival. However, future survival was not assumed to approach a value of any specific year in the history, but instead the median value (92%) of M74 from all the rivers and all the years in the historical part was chosen. The first year with projected survival is 2012. As in the case of post-smolt survival, the relatively strong autocorrelation keeps projected values of M74 almost unchanged into the future. This is also partly due to the fact that the M74 prevalence in the last estimated year (2011) is close to the historical median value of M74 (Figure 5.4.2.3).

  An important aspect to clarify in the projections is the amount of reared fish that is assumed will be released in the projection years, given that this has a clear impact on the catch advice that can be provided.

  WG response. More detailed explanations for how the stock projections have been carried out, and what assumptions that are used, have been added in Section 4.3 *and Stock Annex. The WG hope that this information clarifies the issues mentioned above.*

- Even though additional explanation was provided during the RG meeting, it was still not possible for the RG to understand completely how the column corresponding to reported commercial catch in 2013 assuming no Polish misreporting had been computed (Table 5.4.3.1 in WG report). However, the WG checked the table in the WG report and it was realised that the projected Polish misreporting in the table are probably incorrect and should not be used. If similar results are presented in future WG reports, it is important that they are checked for correctness and that the method for their derivation is clearly explained.

  WG response. In this year, no attempts have been made to calculate the predicted reported commercial catch assuming no misreporting. Calculations of how the total catch is divided between reported landings, discard, unreporting and misreporting are based on the situation prevailed in 2012.

- The scenarios for the stock-projections were slightly different this year compared to last year. As a consequence there were some difficulties in comparing the two results. The RG therefore suggests for the future assessments that the WG include the scenario used for catch advice in the previous year, and this is especially important if the scenarios are modified in some way.

  WG response. The effort scenarios used as a basis for stock projections naturally change from year to year. The reason is that the reference scenario is meant to mirror the likely development in exploitation rate in case no additional changes will occur in fishing regulations etc. This scenario is based on expert judgements of the likely development in fisheries. To make it easier for a reader to compare and evaluate scenarios used in different years, the WG has now included (in Table 4.3.1.1) the effort figures for longlines and coastal trapnets on which the reference scenario is based on. In addition to carrying out year specific scenarios, the WG has started to consider including also some fixed scenario(s). However, the fishing pattern of salmon in the Baltic Sea is currently changing fast: offshore fishing is diminishing, coastal fishing seems to keep its volume but the regional allocation of it is changing and, finally, recreational fisheries is increasing. The changes in fishing pattern may result in major changes in AU specific harvest rates. Applying year after year any specific, fixed scenario with certain fishing pattern may be of little relevance in this situation.

5.2.1. Possibilities to keep estimates of the Potential Smolt Production Capacity (PSPC) constant over several years' period (ToR f)

- The WG analysed data on the PSPC and smolt production for some fixed years in the time-series and noted that when PSPC of a river was updated as more data were available, the annual smolt production estimates for the river were also updated in the same direction. The conclusion was that the updating did not change the river status much since the updating sequences for PSPC's and the smolt production values were positively correlated. In order to show more clearly what this means in terms of management, the sequence of ratios between the smolt production and the PSPC could be presented.

WG response. This year the WG did not have time to work on this issue. If time allows, the RG of 2013 would be provided with more illustrations about the correlated estimates. There are limited possibilities to analyse the management consequences of this phenomenon. The most important quality assurance when applying Bayesian framework as a basis of management recommendations is to fully take into account the correlations between estimates, thus any artificial 'fixing' of an estimate should be avoided.

Section 7. Sea trout

7.2.4. Assessment method

The RG appreciates the efforts made by the WG to initiate a model approach to be used in the assessment of the sea trout. At this first step of the model development, the model is focused on the recruitment in the rivers in order to produce "reference densities" to be compared with observed densities of parr from electro-fishing. The RG has a few questions regarding the model that could not be clarified during the RG-meeting:

- The regression model used for the assessment of sea trout parr needs to be checked for typos. The RG suspects that there should be a product sign instead of a plus sign prior to Wetted width:

Parr (log10) = 1,890-(1,153+Wetted width (log10))+(0,079*Aver. air temperature)

- Some concern from the RG was raised regarding how the assessment method had been applied. The predicted parr densities (or, rather, reference densities) are interpreted in the report as being a measure of the status of the stocks. However, if the stock–recruitment relationship is humped shaped (as in the Ricker function) a large spawner population may result in fewer offspring compared to the recruitment success from fewer adults, see e.g. Malcolm Elliott's work on sea trout. This problem potential problem is reduced when grouping the results into five year periods.
- Since this model was applied to the entire set of selected sea trout sites, there is some concern in the RG that variation among the habitat scores 1–3 differ between subdivisions and that this difference could lead to some bias in the status classification. It would therefore be desired to have a separate regression model for each habitat score. With a single regression model it will be difficult to separate between poor habitat quality and overfishing when the results indicate poor status. However, if the idea is to keep the selected sites and only use these in future assessment, the trend analyses should be reliable if all the sites are sampled repeatedly.
- The RG understood that the sites used to fit the regression model (which is subsequently used to predict abundance at all sites) were selected among those in the dataset based on having good habitat and water quality. However, the fishing exploitation status of sea trout stocks does not appear to have been taken into consideration for selecting these sites, as far as the RG could understand. Hence, if the relative recruitment status (observed/predicted parr abundance) of a given site is low, it is not clear whether the reason is poor habitat quality or too high fishing exploitation. Note that different management measures would likely be recommended

in those two situations. The RG would appreciate further clarification of these aspects by the WG.

- The method used for the trend analyses in the report was based on Pearson correlation coefficient, i.e. linear regression between the reference densities and the year. This method is not entirely reliable when there is autocorrelation in the time-series, and especially so when interpreting the significance of the trends. The RG suggest alternative methods for the trend analyses, e.g. ARIMA models in combination with year as a covariate. The ARIMA-model can deal with the autocorrelation and, moreover, the information about the autocorrelation structure can provide useful information about the occurrence of density-dependence in the parr populations.

  WG response. The assessment of status of sea trout populations has not been updated this year. The intention within the WG is to develop a more detailed assessment model within the near future, taking into account the above mentioned concerns amongst other things. However, there was not enough time to do this job before this year WG-meeting. Instead, the plan is to initiate the work to improve the assessment model for sea trout later this year. A more detailed description of how this work proceeds will be included in the WG report of 2014.

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 (Annex 3). 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 (Annex 3).

2.2 Catches

The catch tables cover 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 several of the catch tables. Estimation procedures for discards and unreported catches are described in the Stock Annex (Annex 3). More detailed information on discards and unreporting on a country-by-country level is given below (Section 2.3).

The catches in weight from 1972–2012 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 and 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 95% probability interval (PI). An overview of management areas and rivers is presented in the Stock Annex (Annex 3). 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 1139 tons in 2012.

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 was 0% in 2012. During the period, the proportion of the catch in trapnets has gradually increased and in 2012 it was 45% of the total nominal catches.

The non-commercial fishery is becoming a growing part of the total nominal catches. In 1994, non-commercial catches were 9.5% of the total nominal catches. In 2012 this share reached 33%. The percentage of the non-commercial parts 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 3000 individuals in 2012, 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, when the water temperature is below 10˚C, and the garfish are not active.

The catches in 2012, including the recreational fishery, were 118 tons (2011: 104 tons), and 23 175 individuals (2011: 21 064 individuals). The number of fish caught increased by 10% from 2011 to 2012. The prohibition of trade with salmon above 4.4/6.0 kilos, respectively, because of high dioxin levels has caused large decreases in the salmon catches in previous years.

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 2012 give a figure of 1387 salmon (615 in 2010), including 1225 salmon caught in competitions. In addition to that, 1000–2000 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: Recreational catch in rivers is allowed in rivers only and fishermen have legal right to fish with only one gillnet. A total of 922 kg salmon was caught in 2012 in that fishery. In 2012 the open sea catch was 1 t, which is similar to previous years. Coastal commercial catch was 8 t in 2012, which was slightly bigger than in 2011.

Finland: In 2012 Finnish fishermen caught 74 401 salmon (479 t) from the Baltic Sea, which was 42% more than in 2011. Commercial catch was 51 859 salmon (320 t) and recreational catch including river catches was 18 374 salmon (135 t). Increase in the catch occurred mainly in the coastal commercial fishery and in recreational fishery. Commercial offshore catch was 45% smaller than in previous year because of the restrictive national quota allocation set to the offshore fishery. Coastal catch increased about 45% with was possible as a result of the quota swapping with Latvia (10 410 salmon). A total of 19 vessels were engaged in the salmon longline fishery. Two of these vessels operated in the Main Basin and they fished also cod, whereas 17 vessels made only occasional attempts mostly inside the 4 nautical mile zone at the Finnish coast. The longline catch from the Main Basin comprised about 14% of the Finnish commercial catch. The major part (83%) of the commercial catch was taken by trapnets. Catch data from year 2012 is preliminary. River catches (recreational) almost doubled from 2011 and main increase took place in the River Tornionjoki. The estimates of recreational salmon catches in sea for years 2010 and 2012 are based on the results of a national survey in 2010 because the year 2012 results are not available yet. 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 9296 salmon (62 t) and recreational catch including river catches 950 salmon (6 t). Most of the commercial catch was caught at the coastal areas close to the river Kymijoki. Trapnets caught 89% the commercial salmon catch of the area. In all 34 fishermen fished salmon with 139 trapnets with the effort of 10 497 trapnet days (about the same as in 2011). There was little offshore fishery for salmon in the area (52 salmon, 200 kg).

Latvia: In 2012 the total catch was 1368 salmon (8,4 t), which was 20% more than catch in 2011. Coastal catches included 1013 salmon (4 t). In 2011 Latvian fishing vessels were not engaged in salmon offshore fisheries. About 6 tons of salmon were caught in commercial fisheries in the rivers, mainly in broodstock fisheries in the rivers Daugava and Venta.

Lithuania: In 2012 Lithuanian fishermen caught 537 salmon (2,3 t), which was more than in 2011. Out of this, 167 salmon were caught in coastal fishery, 370 salmon were caught in Curonian lagoon. Additionally, 31 salmon were caught in the rivers for artificial rearing.

Poland: Overall offshore and coastal catch was 5600 fish (28 t). Together with river catch of 84 fish (0,4 t) it gives a total catch of 5684 salmon, which is a 9% less compared to 2011. The reported river catch of 84 salmon originated mostly from Vistula River and Pomeranian rivers and was 15% lower than in 2011. Most of river catch was made for broodstock purposes.

Russia: In 2011 Russian fishermen caught 412 salmon (1,7 t) from the Baltic Sea. All those catches were spawners caught in the rivers in Subdivision 32 during broodstock fishing.

Sweden: Total weight of Swedish salmon catch increased from 480 tonnes in 2011 to 515 tonnes in 2012 (Table 1.0.1). The catch in coastal fisheries decreased from 174 tonnes to 168 tonnes, whereas the offshore catch in the Main Basin (ICES Subdivisions 22–29) decreased from 224 to 136 tonnes between 2011 and 2012. River catches increased from 82 tonnes in 2011 to 211 tonnes in 2012 (257%). Of total catches (in weight), the offshore catch constituted 28%, coastal catch 30% and river catch 42%.

No offshore catch was recorded since 2009 in Gulf of Bothnia, but the coastal catch decreased from 171 tonnes in 2011 to 163 tonnes in 2012.

Total river catches increased from 81 tonnes in 2011 to 209 tonnes in 2012. The 2012 river catch was 190% higher than the five-year-average (2006–2010) of 110 tonnes.

In three rivers commercial trapnet fishery occur inside the freshwater border and they made up 56 tonnes or 10 135 fish in 2012, compared to 19 tonnes and 3803 fish in 2011.

Recreational catches are not included in the Swedish TAC catch. The catch quota that should be included in the TAC is taken by licensed fishermen at sea or along the coast and it made up 38 148 individuals in 2012 as compared to 60 797 in 2011. Mainly because of a strong spawning migration and regulating national TAC in the commercial coastal and off shore fishery. Although the total number of caught salmon decreased, the total weight of salmon increased by 7.3 % due to an increasing catch of large salmon in rivers during 2012.

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 1993–2012 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 2.2.2.

In 2012, 90,5% of the TAC in Subdivision 22–31 was utilised (total TAC was 120 224 individuals). In the Gulf of Finland, 64,9% of the EC TAC of 15 419 individuals was utilised. The Russian catches of 470 salmon are not included. It should be noted, that there occasionally can be some exchange of TAC between countries, which may result in exceeded national TACs. In 2012 such an exchange took place in Finland, where 6000 salmon were exchanged from Latvia. The total TAC for salmon was allocated to countries and utilized in the following manner in 2012:

	SUBDIVISION 22–31			SUBDIVISION 32		
Contracting party	Quota (nos.)	Sea/Coast Catch (nos.)	Utilized (%)	Quota (nos.)	Catch (nos.)	Utilized (%)
Denmark	24 913	20 175	81	-	-	-
Estonia	2532	376	14,8	1581	717	45,4
Finland	31 065	42 563	137	13 838	9296	67,2
Germany	2772	272	9,8	-	-	-
Latvia	15 846	1056	6,7	-	-	-
Lithuania	1863	568	30,5	-	-	-
Poland	7558	5600	74,1	-	-	-
Sweden	33 675	38 148	113,3	-	-	-
Total EU	120 224	108 758	90,5	15 419	10 013	64,9
Russia [1)]	-	-		-		-
TOTAL	120 224	108 758	90,5	15 419	10 013	64,9

[1)] No international agreed quota between Russia and EC.

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 gives 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 2012 non-commercial catches (in numbers from coast, sea and river) constituted 33% of the total reported salmon catches.

2.3 Discards, misreporting and unreporting 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 (Annex 3). For years 2001–2012 the estimates for discards and unreporting were computed with a new method and updated expert evaluations that are described below.

Substantial misreporting of salmon as sea trout is considered to occur only in the Polish sea fisheries (ICES, 2012). Regarding the fishing year 2012 the calculation was made in a different method compared to earlier years. Reason for changing the method was that old method resulted higher number of salmon than the reported combined salmon and sea trout catch in the Polish offshore fishery. The new estimate was computed by assuming 95% for the proportion of salmon in the Polish offshore. This reference value was taken from logbook records of Swedish, Danish and Finnish vessels that had been fishing in the Polish zone in the last few years and recorded proportions of sea trout had been well below 5% in the offshore catches (ICES, 2012). In 2012 the reported Polish offshore catch was in total 22 950 fish (=4981 salmon + 17 609 sea trout). Assuming 95% salmon gave a catch estimate of 21 461 salmon in total and after subtracting the reported salmon the estimate for misreported catch was 16 480 salmon. Apart from offshore Poland reported 619 salmon (and 19 232 sea trout) in the coastal fishery. It was probable that misreporting occurred also in the coastal fisheries but working group was not able estimate misreporting there because of the lack of fishery-independent data on the species composition of catches in that fishery. Polish member of the working group disagreed with the estimation procedure (see minority statement below).

Regarding unreporting estimates the coefficient factors for unreporting and discarding by country and fisheries were updated for fishing years 2001–2012 during the IBPSalmon in autumn 2012 (ICES, 2012 IBP). Expert evaluations were given from Poland, Denmark, Sweden and Finland for all relevant fisheries of the country concerned. These countries cover the main fisheries in the Baltic Sea. 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. The average conversion factors were calculated separately for years 2001–2007 and 2008–2012 because of the change in relative weight between the fisheries in 2008 due to ban of driftnet fishing. Average values were used for those countries that have not given the expert evaluations for coefficient factors. For Poland, Denmark, Sweden and Finland the country specific coefficients were used. The transformation method of the parameters of the expert elicited triangular probability distributions to parameters of the lognormal distributions is presented in Annex 4. The model for computing the estimates of different catch components is presented in Annex 5.

Assumptions in estimation of unreported catch and discards:

- In the Polish fishery unreporting, discard and seal damage rates were based on the combined misreported and reported salmon catch.
- In all fisheries discard and seal damage rates were based on the combined reported and unreported catch.
- For the Finnish and Swedish reported seal damages, the same unreporting rate as for landings was assumed.
- For the other coastal gears, the same rate of seal damages was assumed as in trapnet fishery.

Estimated unreported catch and discarding are presented in Tables 2.2.1 and 2.2.2. Comparison of estimated unreporting and discard between the year period 1981–2000 and 2001–2012 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 of new computing method. Main part of the discards is seal damaged salmon and it occurs in the costal trapnet fishery but also in the offshore longline fishery (Table 2.3.2.) Also considerable amounts of undersized salmon are estimated to be discarded in the offshore longline fishery. 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.

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. The bycatch of salmon in other fisheries is believed to be at a quite low level. 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. There are no records of misreporting of salmon as other species (e.g. sea trout).

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 3833 salmon (22 t) salmon. This was about 45% more than in previous year. Seals caused severe damages to all fisheries mainly in Subdivisions 29–32 where seal damages comprised 8% of the total commercial catch in the region. Other discards were 334 salmon (1 t). Only in the Gulf of Finland discards of the seal damaged salmon were 1063 fish (7 t), being 10% of the total commercial catch in the area.

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 autumn 2005–2007 carried out in the lower part of the river Daugava. Seal caused salmon damages were not observed in the river. Latvia's salmon quota in 2012 was utilized only by about 6%, so unreporting of catches is probably not a problem.

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

In **Poland**, sampling made in 2012 in longline fisheries show that the discard can amount to about 2%. Young salmon (30–40 cm) can sometimes also be caught in bottom and pelagic trawling. Present use of longlines, which are highly unselective gear, increases the number of undersized salmon caught. Sampling in 2012 resulted in 2,1% of undersized fish caught. Many cases of damages by seals were observed in recent years in both offshore and coastal fisheries in Gulf of Gdańsk area (Subdivision 26). A recent assessment by NMFRI in 2011, based on voluntary reports from fishermen, indicated that within 16 fishing days, 375 fish (salmon and trout) were damaged by seals. In the coastal spring gillnet herring fishery from March–May in Subdivisions 25 and 26, recently released smolts can be caught (especially Carlin tagged ones, because these are more easily trapped in the meshes by their tag wire). There is no precise information on yearly discards and unreported catches. However, adding together sources of unreported and discarded salmon it can be assumed to be on a level of 5–7% of the reported number. In addition, possible misreporting of salmon as trout needs to be accounted for (Table 2.2.2).

In **Russia** information on discard, misreporting and unreporting is not available. However, unofficial information indicates presence of significant poaching.

In **Sweden** the proportion of seal damaged salmon captured in the offshore longline fishery has increased over time, and in 2012 it was reported by the fishermen to be 7.6%. 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. 12% of the total Swedish coastal salmon catch in 2011).

Explanations and comments provided by Poland on "Misreporting of salmon as trout in the offshore fishery"

In 2012 Poland and other Baltic countries was asked by ICES to provide for WGBAST data from controls in their salmonid fisheries and Poland provided such an official data, while other countries did not. Poland also passed to ICES other relevant data as requested. In comparison used by WGBAST to analyse the share of salmon in Polish and foreign catches, Denmark, Finland and Sweden presented only data based on logbooks or observers, not verified by inspectors, it means less trustworthy that of provided by Poland. That implies that foreign data could not be fully comparable and use of those data was not justified.

Moreover; analyses between individual Polish and foreign vessels fishing within that same ICES rectangle 1o x 30′ (area of several hundred sq nautical miles) could not be simply comparable due to different planning schedule of cruises and very much depends on conditions during catches: time, hydrology, bait used, fish distribution, gear technique, weather, experience of fisherman, which in turn, all together influences very much catchability of each of the vessels. Such a situation exists in all kind of world fisheries, including angling. Calculations made on the same conditions for every vessel have low practical probability and poor statistical logic; however, mathematically everything can be proven.

Poland has highest volume of yearly sea trout releases (1.2–15 million smolts and several millions of fry and alevins) among all Baltic countries and this process on massive scale started in 1996. Those releases have great positive impact on availability of sea trout in Polish EEZ, since those releases take place in rivers flowing to southern Baltic. It is proven by tagging that Polish sea trout is a species widely migrating and sea trout that migrate offshore are to a large extent taken as a bycatch in the offshore salmon fishery. This is reflected in high and almost constant sea trout catches since 1998 and explains to great extent high share (presence) of sea trout in Polish catches.

Poland again would like to emphasize that Polish salmon fleet, comparing to other fleets, has different characteristic of its activity which can cause higher share of sea trout in catches:

- operates exclusively within Polish EEZ, where sea trout is more abundant,
- consists of much greater number of vessels involved, comparing to other fleets.
- Total TAC for Poland in 2012 was 7558 salmon and was fished by 88 Polish coastal and offshore vessels with max. quota per vessel 400 salmon, while relevant quotas for other countries were:
    - Finland-4000 salmon for two offshore vessels and 27 65 for coastal fishery;
    - Sweden-14 000 salmon for 23 offshore vessels and 19 675 for coastal fishery;
    - Denmark-20 175 salmon for 16 offshore vessels and 3000 recreational.
- Low Polish quotas press skippers to fish on ground where sea trout is more abundant than salmon, also because the prices for salmon and sea trout in Poland are almost the same.

All above constraints give different from other fleets, pattern of Polish fleet activity based on different temporal and spatial coverage, thus possibility of different share of salmon in catch and lower cpue.

Data from controls conducted by OIRM Gdynia in previous years showed that share of salmon in Polish catch varies from 11% to 100% in catch (WGBAST Report 2012).

To fulfil requests from ICES for more controls, several missions of European Commission controllers were in 2012 in Poland, targeting mostly salmon fishery. Last one took place in 2012/2013. As a result, Poland in 2012 had the highest (45%) share of controlled landings among EU MS, but out of 2443 salmon controlled only 11% were mistakenly reported.

Based on controls made, the EC send to the Polish authorities an Audit Report (8 March, 2013), where it stated that probably Poland overfished its TAC in 130%, which in opinion of the Ministry responsible for fishery, is not fully true. Information on exceeded quota as an indicative value for assessments was given earlier to Chair and finally to WGBAST but it was not acknowledged.

In previous years' assessments, WGBAST has estimated Polish offshore salmon catches based on Polish LLD reported effort and catch per unit of effort (cpue) of other countries fishing with LLD in the same part of the Baltic Sea. To be able to fit the assessment model to fairly realistic offshore LLD catches of salmon, the WGBAST has agreed on an estimation procedure which is based on Polish reported (trout) LLD offshore effort times mean cpue of LLD salmon among Swedish, Finnish and Danish fishermen times a correction factor of 0.75. By applying a correction factor of 0.75, which in principle means that Polish fishermen are assumed to catch somewhat fewer salmon per unit of effort compared to other countries, the estimated Polish catch of salmon becomes close to the total number of salmon and trout reported by Poland for most years in the time-series. However, it was found that procedure had an error because did not recognize already reported salmon (WGBAST Report, Table 2.1.2), so WGBAST agreed to deduct the reported salmon from final results.

In 2012 Poland, however, presented a new correction factor, to be used in above estimation procedure. According to WGBAST recent data Polish cpue reached only 44% of mean cpue of foreign fleets and such a value was finally proposed to use instead of 0,75 in order to receive more realistic present amount of salmon.

Apparently, it did not fit to earlier assumed picture of salmon catch in Poland and majority of the Group accepted arbitrarily given fixed value of 95% salmon (16 500 fish in 2012) share in total offshore Polish catch to be used for further estimations, which Poland cannot accept. For such estimations must be used catch and effort of the only comparable gears i.e. longlines, because one cannot directly compare catchability and catch composition of LLD with GNS, pelagic trawls or other gears, which are in use by Polish offshore fleet and from were small amount of salmon is reported. Results from use of total offshore catch will give unproven and unrealistic high amount of salmon.

WGBAST response to explanations and comments provided by Poland

The working group would like to comment shortly on parts of the statement delivered by Poland.

- Only data from the Polish fishery that is available for working group are the official fisheries data up to date and inspection data from 1994–2011.

These data have been considered biased e.g. in the examination the working group made in 2012 (ICES, 2012).

- The referred EU Commission report was not available for the working group preventing evaluation of the procedures the Commission has carried out in the inspections and analysis.
- In Table 2.1.2 the estimate of additional Polish additional catch excludes the reported catch.
- The working group would need fishery-independent data or a study report on the species composition of catches in the Polish offshore and coastal fishery in order to evaluate the past estimates of misreporting and to estimate in future the Polish salmon and sea trout catches in a higher accuracy.
- Present estimates of the misreporting should be considered as magnitude of the catches. Shortcoming of data and information from the Polish sea fisheries makes it very difficult for the working group to infer the significance of the Poland's statement.

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 1987–2012. Cpue in trapnets on the Finnish coast of Gulf of Finland was 0.9 salmon in 2012, which is slightly bigger than in 2011 (0.7) and in 2010 (0,6) but less than 70% compared to 2009 (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) and is reported per half year (HYR). 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 SD30 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 SD30. 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 13 years in Subdivision 22–32 is presented in Table 2.4.2. Data are missing from Estonia, Lithuania and Russia, but as the catches by these countries are small, it seems unlikely that their vessels have been engaged more than occasionally in salmon fishery. Germany has no fishery targeting salmon directly, and is only catching salmon as a bycatch in other fisheries.

In 2012, 115 vessels were engaged in the offshore fishery and it was a decrease compared to the level in 2011 (169 vessels). In 2012, 98 vessels fished less than 20 days and only one vessel (FI) was fishing more than 40 days.

The total effort in the longline fishery in 2012 decreased by 45% to 1 144 000 hooks compared to 2 096 000 in 2011 (Figure 2.4.1). The effort in the trapnet fishery has remained on a stable level 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 (Annex 3). An overview of samples collected for biological sampling in 2012 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	464					464
Finland	1–4 and 9–12	Offshore	Longline	989					989
Finland	5–8	Coastal	Trapnet		475	435	908		1818
Finland	5–9	River	Trapnet				665		665
Latvia	1–12	River	Trapnet	852					852
Estonia	12-sty	Coastal	Gilnet+Trapnet					55	55
Lithuania	9–10	Coastal	Gillnet	109					109
Poland	2–12	Offshore	Longline	373					373
Russia	8–11	River	Trapnet					394	394
Russia	8–11	River	Gillnet						
Sweden	5–8	Coastal	Trapnet			158	243		401
Sweden	4–9	River	Varied	80		180	246		506
Sweden	1–3, 11–12	Offshore	Longline	376					376
Total				3243	475	773	2062	449	7002

Denmark: There were 464 scale samples collected from Danish landings in 2012.

Estonia: Starting in 2005 Estonia follows the EU sampling programme. Sampling takes place occasionally, carried out by fishermen with about 100 salmon per year from the coastal fishery. In addition 120–200 salmon have been sampled annually in the river broodstock fishery for some years. In 2012 55 samples were collected.

Finland: In 2012 catch sampling brought in 3472 salmon scale samples from the Finnish commercial salmon 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 (2208) also by DNA microsatellite techniques.

Germany: There is no information available on biological sampling in Germany.

Latvia: From 2008 Latvia's vessels were not engaged in salmon offshore fisheries. In coastal fisheries salmon biological sampling is carried out from June to November in two coastal locations: near the rivers Daugava (reared population) and Salaca (wild population) outlets. In total 852 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 2012 a total of 109 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 373 fish was sampled for age, length and weight in 2012. Age was estimated based on scale readings. Data collection was conducted in ICES Subdivisions 25 and 26 and covered longline fishery but also some pelagic trawl catches. Samples of salmon scales (over 300) were sent to RKTL, Helsinki for genetic analyses.

Russia: There is no biological sampling programme in Russia. However in 2012, 394 fish collected in the river broodstock (the rivers Neva, Narva and Luga) fishery are aged, and lengths and weights are recorded.

Sweden: Biological **s**almon 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. The relevant geographic area is the ICES Subareas IIIb, c and d. Swedish salmon fishery takes place in ICES Subdivisions 23–31 and it includes river, coastal and offshore fisheries.

The offshore longline fishery takes place mainly in the first and fourth quarter of the year. In 2012, 376 samples were collected from this fishery. As salmon from the offshore fishery is already gutted when landed, sex and gonad maturity-by-age is not available from offshore samples taken in ports. In addition to sampling in ports some sampling is carried out on board commercial vessels. Sex determination of fish is carried out in a proper manner by some coastal fishermen. The sampled fish are aged by scale reading, and at the same time it is also determined if the fish is of wild or reared origin. As a preparation for studies on stock proportions in catches, genetic samples were taken in the offshore, coastal fishery and river fishery in 2012.

The coastal trapnet salmon fishery covers second and third quarter of the year. In 2012, 401 samples were collected from this fishery. River samples The samples were taken by the Swedish University of Agricultural Sciences at three different locations in the Gulf of Bothnia (ICES Subdivision 30–31); Skellefteå, Skeppsmalen and in the archipelago of Haparanda. All data are stored in a database at the Institute of Freshwater Research.

2.6 Tagging data in the Baltic salmon stock assessment

Tagging data (Carlin tags) is 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). Table 2.6.1 gives an overview of the number of tagged hatchery-reared and wild salmon smolts released in rivers of assessment units 1, 2 or 3 and used as input data in the assessment. Tagging of wild salmon smolts has taken place only in assessment unit 1.

As tagging data used in the model is based on external tags, it is vital that fishermen find and report tags. However, earlier reports (summarized in e.g. ICES, 2012) indicate an obvious unreporting of tags. For various reasons, the number of tag returns has become very sparse in the last few years (Figure 2.6.1). 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 2010 WGBAST report (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.

The total number of Carlin tagged reared salmon released in the Baltic Sea in 2012 was 40 198 (Table 2.6.2), which was 15% less than in 2011. The share of tagged salmon in all releases (approximately 1,24%) was smaller than in 2010. The recapture rate shows a decreasing trend in Gulf of Bothnia and Gulf of Finland (Figures 2.6.2 and 2.6.3). The recapture rate of 1-y Carlin tagged salmon in the Gulf of Finland in Estonian experiments oscillated around 0.2% between 2000 and 2004 (Figure 2.6.4). There were no returns of tags in 2006, but next year the recapture rate exceeded 0.8%. The recapture rate of salmon released in 2007–2010 has not exceeded 0.3% (Figure 2.6.4). The recapture rate in the Baltic Main Basin varied between 0.4–1.2% (Figure 2.6.5).

The decline in recapture rate most likely has several explanations where decreasing exploitation reduced natural survival and possibly also 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. For more information see the Stock Annex (Annex 3).

2.7 Finclipping

Finclipping makes it possible to distinguish between reared and wild salmon. The information has been used to e.g. estimate proportion of wild and reared salmon in different mixed-stock fisheries, but is not directly included in the assessment model used by WGBAST. In 2012, the total number of finclipped salmon parr and smolt decreased by 13% compared to 2011 and was 2 156 375. Out of this, 185 094 were parr and 1 971 281 were smolt. Compared to 2011, the number of finclipped smolt decreased with about 16%. Number of finclipped parr increased with about 30%. In 2012, 52,5% of all reared salmon smolt were finclipped, which was 9% more than in 2011. Most finclippings (in numbers) were carried out in Subdivisions 30 and 31.

From 2005 it is mandatory in Sweden to finclip all salmon. All reared Estonian salmon smolts were finclipped in 2012. In Poland all salmon smolts (70 601) released into Subdivision 26 (rivers Drweca and Reda) were adipose finclipped. A majority of salmon smolts released in Russia, Finland, Lithuania and Latvia in 2012 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 has been used to estimate stock and stock group proportions of Atlantic salmon catches in the Baltic Sea since year 2000 with Bayesian method (Pella and Masuda, 2001; Koljonen, 2006). Data for several baseline stocks were updated in the 2013 analysis, and both 2011 and 2012 catches were analysed with this updated baseline stock set (Table 2.8.1). Fresh baseline samples were available for Simojoki (2010), Kalixälven (2012), Råneälven (2011), Öreälven (2012), Lögdeälven (2012), Daugava (2012), and Nemunas (2010). For Kalixälven the 2002 sample and for Daugava the 1996 sample data were omitted from the baseline, for all other stocks the fresh samples were added to the previous ones. In addition, the baseline was updated with three wild salmon stocks which have previously not been included in the baseline, the Swedish Piteälven (2012), Rickleån (2012), and Sävarån (2010, 2011) (Figure 2.8.1). After updating, the baseline includes information on 17

DNA microsatellite loci for 36 Baltic salmon stocks, and in all for 3842 individuals. In all 2208 DNA samples were analysed from the 2012 catches.

As in the previous years, the catch fish were divided in two classes according to their smolt age information: '1–2-year old smolts' and 'older smolts'. Salmon in the analysed catch samples with a smolt age older than two years are assumed to originate exclusively from any of the wild stocks (similarly as in the scale reading method), whereas individuals with a smolt age of one or two years may originate either from a wild or a hatchery stock. The smolt age distributions in the baseline for Tornionjoki wild, Kalixälven, Råneälven, Simojoki, were updated to correspond to smolt year classes from 2009 to 2011, of which a majority of catch fish originated from.

Results

In all three Baltic Sea areas, the proportion of wild salmon in catch samples from 2012 declined at least slightly from the 2011 estimates. The change was smallest in the Åland Sea, where the proportion of wild fish has traditionally been the highest, and clearest in the Main Basin catches, where feeding migrating fish are caught. The Åland Sea and Bothnian Sea catches are composed of maturing fish.

In Åland Sea, the salmon fishery has changed completely after 2008; since the driftnet fishery was not allowed anymore, the fishery has more or less collapsed. The currently analysed samples are mainly from longline and push-up trapnet fisheries. The proportion of wild fish in the catch from 2012 was high (90%), but slightly less than in 2011 (92%) (Table 2.8.2, Figure 2.8.2). The proportion of Finnish hatchery stocks had increased, from 4% to 7%.

The main stocks contributing to catches in the Åland Sea fishery over the years 2001–2012 (Table 2.8.3.) have been Tornionjoki wild and Kalixälven (combined estimate of 56%), Tornionjoki hatchery (8%) and Iijoki hatchery (6%). In 2012, the combined proportion of Tornionjoki wild and Kalixälven salmon (71%) was again high. In addition, wild salmon from the Swedish Vindelälven (5%) and Finnish Simojoki (5%) stocks contributed significantly to the 2012 catch in the Åland Sea. Åland Sea fishery is occurring in the very beginning of the fishing season, mainly in June, which may partly explain the generally high wild stock proportion.

In the Bothnian Bay, the samples analysed since 2006 represent evenly pooled Finnish and Swedish catches. There has been an increased share of wild fish in the pooled samples, from about 58% in 2006 to 85% and 84% in 2010 and 2011. However, in 2012 the proportion of wild fish has decreased to about 80%, mainly as result of the increased proportion of Finnish hatchery fish (from 12% to 17%). This was a result of increases in both Iijoki and Oulujoki proportions (Table 2.8.3). The proportion of Swedish hatchery stocks has remained low (3%). Swedish Byskeälven salmon makes a clear contribution (15%) to the wild component and now also the new baseline stock Piteälven could be detected for two year catches, with a 5% mean contribution. It has probably previously been included in the Kalixälven estimate. The other two new Swedish baseline stocks had each only about 1% proportion in the total Bothnian Bay catch.

The composition of Finnish and Swedish catch in the Bothnian Bay differed very markedly, and their main contribution comes from different stocks. Finnish catch sample is proportional to the total Finnish catch, but the Swedish sample could not be regarded as a representative sample of the fishery that occurs in the area. In 2012, more than half of the Finnish salmon catch originated from the wild Tornionjoki and Kalix stocks (58%), and 32% together from Iijoki and Oulujoki stocks. In the Swedish catch the majority came from Byskeälven (28%), and the other wild stocks Tornionjoki/Kalix (27%), Piteälven (12%), Åbyälven (9%), Vindelälven (6%) and Lögde (8%), were also abundant in the catches.

In the Main Basin over half of the pooled international catch sample has originated from the wild stocks since 2006 (62–74%) (Table 2.8.2). There is no clear trend in the overall share of wild fish in the Main Basin catches, but in years 2010 and 2011 the total proportion of wild salmon in the catch was the highest over 70% (71–74%). In 2012, however, the proportion of wild fish was only 63%. The share of Swedish hatchery stocks continued to be markedly higher (22%) than of the Finnish hatchery stocks (12%), although the abundance of Finnish hatchery stocks in the catches had increased from 6% in 2011 to 12% in 2012. There were increases in the proportion of the Tornionjoki hatchery and Oulujoki stocks (Table 2.8.3).

When analysing the total Main Basin catches from 2006–2012 divided into wild and reared salmon from different assessment units (Table 2.8.4, Figure 2.8.3), a notable change from 2011 to 2012 was the decrease in the proportion of wild salmon from AU1, the most northern wild stocks, from 57% to 47%. At the same time an increase was seen in the proportions of hatchery salmon from AU1, and wild and hatchery salmon from AU2. This may indicate increases in the abundance of salmon from AU2. The increase in the proportion of wild salmon from AU2 between 2011 and 2012 could not be a result of the inclusion of Piteälven into the baseline as this river stock was included in the 2011 estimate as well.

2.9 Management measures influencing the salmon fishery

Detailed information on international regulatory measures is presented in the Stock Annex (Annex 3). National regulatory measures are updated quite often, sometimes on a yearly basis, and are therefore presented below and not in the Stock Annex. Some of the management measures described below also refer to sea trout.

National regulatory measures

In **Denmark** 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.

The Danish quota was 24 913 salmon in 2012. The quota was divided into five time periods:

1) 25% January–March;

2) 15% April–June;

3) 5% July–15th. September;

4) 40% 16th September–15th November;

5) 15% 16th November–31st December.

In **Estonia** an all-year-round closed area of 1000 m from the mouths of the wild and potential salmon rivers Purtse, Kunda, Selja, Loobu, Valgejõgi, Jägala, Pirita, Keila and Vasalemma, and the sea trout rivers Punapea, Õngu and Pidula. From 2011, the closed area for fishing around the river mouth is extended from 1000 to 1500 m during the period from 1 September to 31 October for rivers Kunda, Selja, Loobu, Valgejõe, Pirita, Keila, Vääna, Vasalemma and Purtse. In rivers Selja, Valgejõgi, Pirita, Vääna and Purtse recreational fishery for salmon and sea trout is banned from 15 October to 15 November. In other important sea trout 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. For smaller sea trout spawning streams, an area of 200 m around the river mouths is closed from 1 September to 30 November. Apart from lamprey fishing no commercial fishery in salmon and sea trout 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 from the sport fishing closure are allowed by decree of the Minister of Environment in rivers with reared or mixed salmon stocks (rivers Purtse, Selja, Valgejõgi, Jägala, Pirita and Vääna). Below 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 new national regulations has been implemented in 2012. In the Gulf of Bothnia salmon fishing is forbidden from the beginning of April to the end of the 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. From the opening and three weeks ahead, five trapnets per fisherman are allowed. After this eight trapnets at maximum are allowed per fisherman for another three weeks. Non-professional fisherman may start fishing salmon two weeks after the opening of the fishery with 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 the fishing in 2012 started on June 25th. From 1 January 2013, the Finnish offshore fishery with longlines is closed.

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 October to 15 November. Salmon fishing in coastal waters has been restricted indirectly by limiting the number of gears.

In rivers with natural reproduction of salmon, all angling and fishing for salmon and sea trout is prohibited with the exception of licensed angling of sea trout and salmon in the rivers Salaca and Venta in spring season. Daily bag limit is one sea trout or salmon. From 2009, salmon angling and fishing has been allowed in the river Daugava too.

Since 2003, all fisheries by gillnets are prohibited all year-round in a 3 km zone around the River Salaca outlet. Fisheries restriction zones were enlarged from 1 to 2 km in 2004 around the rivers Gauja and Venta.

In **Lithuania** no new fisheries regulations were implemented in 2012. The commercial fishery is under regulation during the 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 1 September to 31 October, 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 15 September to 31 October, recreational 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.

During brown trout and sea trout spawning (from 1 October to 31 December) all fishing is prohibited in 161 streams. In larger rivers such as Neris and Šventoji (twelve rivers in total) special protection zones are selected where schooling of salmon and sea trout occurs. In these selected places only licensed fishing is permitted from 16 September to 15 October. From 16 October to 31 December all fishing is prohibited in these areas. From 1 January licensed salmon and sea trout kelt fishing is permitted in Minija, Veiviržas, Skirvytė, Jūra, Atmata, Nemunas, Neris, Dubysa, Siesartis and Šventoji rivers. The minimum size of salmon and sea trout for the commercial fishery is 60 cm.

All EC rules apply to **Polish** EEZ waters and some additional measures (seasonal closures and fixed protected areas) are in force within territorial waters. The TAC for Poland for 2012 was 7 704 fish. In 2012, individual salmon quota for Polish fishermen was given to 108 vessels and for year 2013 for 104 vessels, with similar system as in 2012. Maximal quota of salmon per vessel was ca. 400 fish in 2012, compared to 70 fish/vessel in 2011. Such a system, together with an opportunity of exchange of individual quotas, enabled fishermen to conduct salmon fishing in more economical way.

In **Russia** no changes in the national regulations were implemented in 2012. The international fishery rules are extended to the coastline. In all rivers and within one nautical mile from their mouths, fishing and angling for salmon is prohibited during the whole year, except fishing for breeding purposes for hatcheries.

In **Sweden** there were several changes of the regulations for salmon fisheries in 2012. The total Swedish salmon quota for 2012 (34 327 individuals) was divided between off shore longline and coastal trapnet fishery according to the relation of 40/60. Offshore longline fishery was stopped at the beginning of March when the quota was filled. Longlines are not allowed to use from 1 January 2013 and onwards.

Quota for the coastal trapnet fishery was divided by two areas where two thirds were allowed to be caught north and one third south of latitude 62º55′N. Coastal fishery south of this latitude was allowed from the start of the fishing season. North of this latitude to the border between county of Västernorrland and Västerbotten, salmon fishing was allowed to start on 11 June. North of this border, fishing was allowed to start on 19 June. Before the start of the coastal fishery, no gillnets with mesh size above 120 mm were allowed. The county administrations were allowed to give exemptions from the regulations mentioned above under certain circumstances.

Since 1997 fishing regulations in the border part of the river Torneälven have been decided upon by the Swedish Ministry of Agriculture (now Ministry of Rural Affairs) and the Finnish Ministry of Agriculture and Forestry. These regulations include e.g. agreements between the countries about start date for the trapnet fishery in the area outside the river mouth. Agreements between the countries also regulate fishing in the river with traditional driftnets.

In order to improve the situation for the poor sea trout stocks in subdivision 31 a number of changes were implemented from 1 July 2006. The minimum size for sea trout was raised from 40 to 50 cm in the sea. Furthermore a ban of fishing with nets was implemented in areas with a depth of less than 3 meters during the period 1 April–10 June and 1 October–31 December in order to decrease the bycatch of trout in fisheries targeting other species. In the period 1–31 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) will be implemented in 2013 to further strengthen the protection of sea trout. These include shortening of the autumn period for fishing with two weeks, resulting in a fishing ban from 1 September to 14 October, and restrictions of catch size (minimum 50 cm or window size 30–45 cm). The size restrictions will differ between rivers. The new regulations also include a bag limit of one trout per fisherman and day.

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 is provided in ICES (2007). There is no longer a minimum hook size for longlining in EC waters. 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 the 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 the longline fishery are small and they do not have capacity to use more than 2000 hooks.

TAC

A description of the TAC regulation can be found in the Stock Annex (Annex 3).

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 Gdańsk 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, the proportion of undersized salmon was 4.5%. 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, there are good reasons to believe that the catch of undersized salmon in the present longline fishery may be reasonably high, 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 virtually unknown. 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 onboard sampling is important to obtain further data on discards of undersized salmon.

National regulatory measures

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.

2.9.2 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) are not permitted to be marketed within the EU. From 9 February, 2009 this size salmon may be sold to countries outside the EU. Salmon with a weight below 2 kg (gutted weight) can be marketed without restrictions, while salmon with weight between 2 and 5.5 kg can be marketed only after deep skinning and trimming. By this process the more fatty parts of the salmon are removed. From the 9th February, 2009 the regulation has been changed, and from that date it has been allowed to land and sell (to countries outside the EU) all size groups of salmon.

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.

For the Baltic Sea area as such it seems to be only in Denmark that the possibilities for marketing are affected by dioxin levels and rules, probably influencing incitement to fish salmon.

Size (weight) distributions of catches

The weight limits for marketable salmon strongly affects the fishing practice and possibilities in future. It is likely that, if possible, specific marketable sizes will be targeted by the fishery.

Size limits may also affect the reported size distribution of catches. Weight distribution of sampled Polish (years 2005–2012) and Danish (years 2003–2012) are presented in Figures 2.10.1—2.10.2. In Poland there are no special marketing restrictions concerning weight level, while in Denmark there are.

In Poland, on average 84.5% of the catches had weights below 7 kg for the period 2005–2009. In 2010 the proportion of smaller fish increased in Poland and salmon with a weight below 7 kg was 99.8%. In 2011 and 2012 it again dropped to 72–75%. In Denmark the average catch of salmon with weight <7 kg for the period 2003–2008 was 91%, rising from 83 % in 2005 to more than 99% in 2007. In 2008 it was 98% and in 2009 it dropped again to just over 91%. And since that time it has remained stable between 90 and 95%. During the last three years the proportion of salmon with 3–4 kg weight has increased substantially.

Fisheries economics

Figure 2.10.3 presents the monthly salmon price per kilogramme paid to the fishermen in Bornholm 1998–2012. During the period 1998–2004 prices were relatively stable. During the winter 2003–2004 catches of salmon were very high in the sea close to Bornholm. Later in 2004 dioxin levels in Danish samples were found to be above levels set by EU authorities, resulting in a closure of the fishery for part of the year 2004. This meant that the market situation for the salmon fishermen was very uncertain and the changes in the prices in 2004 are most likely a result of these facts.

In Denmark the price of salmon has increased gradually from 2005 through 2008, when it on average was around 5.6 €/kg. This could be due to the increase in salmon world market prices and decrease in landings. In 2009 prices dropped again to below 5 €/kg, and in 2010 prices dropped even further to under 4 €/kg during winter when catches were largest. In December 2012 there was a sudden drop in prices; the reason for this is unknown. (Figure 10.2.3).

In Poland the salmon prices in 2010 were similar to Danish prices in 2010. To conclude, it seems that increasing salmon prices are not likely to result in a larger fishery for salmon.

The salmon import from Norway to Denmark has levelled out since 2006, but still constitutes by far the largest share of salmon on the market (Figure 2.10.4), and this is also the case in Poland. In both countries the market is completely dominated by farmed salmon. The price for farmed salmon was in Poland between 3 and 4.5 €/kg in 2009.

The salmon price in Finland has not been available for 2009. In 2008 it varied between 3.3 and 7.5 €/kg (average in 2007: 4.75 €/kg, 2006: 4.80 €/kg). In Sweden, the annual average salmon price in 2009 was 3.9 €/kg (2006: 3.29 €/kg, 2007 4.25 €/kg, 2008: 3.2 €/kg). In Poland the price in 2009 was approximately 6 €/kg (2008 around 5 €/kg). Swedish and Polish prices are subject to changes due to variable exchange rates.

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 1972–2012 in Subdivision 22–32. The estimation method for discards and unreported catches are different for years 1981–2000 and 2001–2012. (95% PI = probability interval).

Year	Reported catches by country										Reported catches	Non commercial catch.	Discard		Total unreported catches[3]		Total catches	
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland[1]	Russia	Sweden	USSR	total	included in tot. catch.	median	95% PI	median	95% PI	median	95% 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
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	606	39	136	4	180	37	616		2077	339	156	108-293	988	775-1721	3128	2899-3877
2002	334	16	509	29	108	11	197	66	572		1841	246	139	97-264	916	714-1607	2810	2594-3512
2003	454	10	410	29	47	3	198	22	454		1627	207	144	96-291	1020	830-1813	2690	2482-3500
2004	370	7	654	35	34	3	88	16	879		2087	349	160	111-389	1758	1446-2953	3910	3581-5140
2005	214	8	616	24	23	3	114	15	719		1736	359	121	89-232	885	682-1514	2665	2453-3302
2006	178	8	370	18	14	2	117	5	497		1208	207	95	72-158	440	315-790	1679	1548-2034
2007	79	7	408	15	26	2	95	6	484		1123	232	76	59-137	483	356-842	1626	1496-1991
2008	34	9	451	25	9	2	44	6	460		1039	365	46	38-75	182	82-483	1232	1131-1536
2009	78	7	422	9	15	1	51	2	507		1091	312	57	41-127	529	390-919	1645	1501-2039
2010	145	6	267	3	10	1	29	2	418		881	195	55	34-135	561	442-936	1471	1345-1853
2011	104	6	289	2	7	2	31	2	481		924	213	60	42-114	400	289-685	1343	1228-1633
2012	118	8	455	1	8	3	28	2	515		1139	373	56	40-95	279	161-622	1437	1316-1783

All data from 1972-1994 includes sub-divisions 24-32, while it is more uncertain in which years sub-divisions 22-23 are included. The catches in sub-divisions 22-23 are normally less than one ton. From 1995 data includes sub-divisions 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 Sub-division 25 has from 1993 been included in the Swedish statistics.
Danish coastal catches are non-profesional 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 1993–2012. Subdivisions 22–32. The estimation method for discards and unreported catches are different for years 1993–2000 and 2001–2012. (95% PI = probability interval).

Year	Country									reported	Discard		Estimated Polish	Total unreported catches 2)		Total catches	
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	total	median	95% PI	misreported catch	median	95% PI	median	95% 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	115756	7717	29002	1205	35606	7392	149391	439742	30620	20980-57970	126060	202900	157100-353500	655200	606300-807700
2002	76122	3247	104641.448	5762	21808	3351	39374	13230	138255	405790	29060	20020-54850	114964	188800	145100-329000	607100	560500-749900
2003	108845	2055	99174	5766	11339	1040	40870	4413	115347	388849	31890	21020-63110	143146	212400	169500-373400	610900	563700-775500
2004	81425	1452	132105	7087	7700	704	17650	5480	192856	446459	31030	20920-77150	254267	356000	290900-597500	816000	747700-1063000
2005	42491	1618	115068	4799	5629	698	22896	3069	144584	340852	23650	17310-45770	110816	176100	136200-302000	525200	483100-652400
2006	33723	1516	64501	3551	3195	488	22207	1002	97285	227468	17740	13310-29840	46899	86530	62460-155400	319900	294700-389100
2007	16145	1378	75092	3086	5318	537	18988	1408	95241	217193	14980	11610-27310	54309	95110	70490-166400	316600	291300-389000
2008	7363	1890	80735	4944	2016	539	8650	1382	90584	198103	9153	7537-14810	3295	35110	16160-93110	235400	216200-294000
2009	16072	2209	77897	1858	2741	519	10085	584	104918	216883	11930	8486-25770	60177	106100	78150-185100	327800	298800-407900
2010	29637	1756	44673	606	1534	427	5774	491	77787	162685	11150	6944-27140	73506	109600	87120-183000	278200	254300-352900
2011	21064	1845	49717	370	1271	546	6204	470	86305	167792	11590	8017-22230	43509	76790	56590-130000	248800	227600-302800
2012	23175	1093	70234	272	1056	568	5684	412	84332	186826	10240	7202-17460	16500	48460	29430-104300	239300	219500-295500

All data from 1993-1994, includes sub-divisions 24-32, while it is more uncertain in which years sub-divisions 22-23 are included.
The catches in sub-divisions 22-23 are normally less than one tonnes.
From 1995 data includes sub-divisions 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 1972–2012. S=sea, C=coast, R=river.

Year	Main Basin (Sub-divisions 22-29)										
	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

Year	Main Basin (Sub-divisions 22-29)																								
	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
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	1181.5	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	1020.6	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	618	66	7	691
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	25	0	5	4	0	2	30	8	6	4	0	88	5	2	212	61	11	284
2009	63	15	0	2	38	24	1	10	0	10	5	0	1	40	9	2	0	0	120	2	1	270	64	8	342
2010	130	15	0	1	36	20	1	2	0	4	6	0	1	23	5	0	0	0	163	3	1	354	49	8	411
2011	89	15	0	2	0	38	27	1	2	0	4	4	0	2	0	20	10	0	224	3	1	331	58	52	443
2012	103	15	0	3	22	36	0	1	0	2	6	0	2	25	3	0	0	0	136	5	2	288	66	9	363

Table 2.2.3. Continued.

Year	Gulf of Bothnia (Sub-divisions 30-31)											Main Basin+Gulf of Bothnia (Sub-divs. 22-31) Total		
	Denmark	Finland			Sweden			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

Year	Gulf of Bothnia (Sub-divisions 30-31)										Main Basin + Gulf of Bothnia (Sub-divisions 22-31) Total			
	Finland			Sweden			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
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	1122
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	212	459	256	927
2009	1	228	43	0	256	127	1	484	170	655	271	548	178	997
2010	0	142	32	0	182	69	0	324	101	425	354	373	109	836
2011	0	140	37	0	171	81	0	311	118	429	331	369	170	871
2012	0	218	111	0	163	209	0	381	320	701	288	447	329	1063

Table 2.2.3. Continued.

Year	Gulf of Finland (Sub-division 32)					Sub-division 22-32		
	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

Year	Gulf of Finland (Sub-division 32)												Sub-division 22-32			
	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	1211	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	1208
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	214	559	267	1039
2009	0	5	0	1	74	11	1	2	1	80	13	94	272	628	191	1091
2010	0	5	0	0	34	2	0	2	0	39	4	44	354	412	114	880
2011	0	4	0	0	44	3	0	2	0	48	5	53	332	417	175	924
2012	0	5	0	0	64	4	0	2	0	69	6	75	288	517	334	1139

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

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 hole 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 Sub-division 32 in 1986-1991 include a small quantity of coastal catches.

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

Danish coast catches are non-profesional 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 1996–2012. S=sea, C=coast, R=river.

Year	Main Basin (Sub-divisions 22-29)																									
	Denmark		Estonia		Finland			Germany	Latvia			Lithuania			Poland			Russia	Sweden			Main Basin (sub-divisions 22-29) Total			
	S	C	S	C	S	C	R	S	S	C	R	S	C	R	S	C	R	S	S	C	R	SEA	COAST	RIVER	GT
1996	105934	0	263	528	58844	8337	200	2400	19400	10577	0	1485	1059		27479	222	0	5199	121631	1322	633	342635	22045	833	365513
1997	87746	0	205	1023	61469	7018	0	6840	20033	12095	0	214	665		24436	0	65	4098	68551	1415	810	273592	22216	875	296683
1998	90687	2000	0	770	60248	2368	0	8379	13605	8098	0	288	781		23305	1927	890	6522	99407	573	940	302441	16517	1830	320788
1999	73956	2000	28	741	45652	15007	0	5805	24309	9059	0	166	1132		24435	1835	860	4330	74192	408	876	252873	30182	1736	284791
2000	82938	2000	129	1190	56141	12747	0	8810	24735	9106	0	78	1382		25051	2679	1195	4648	107719	400	1005	310249	29504	2200	341954
2001	88388	2000	122	819	26616	10706	0	7717	18194	10808	0	152	1053		33017	1764	825	6584	78873	407	890	259663	27557	1715	288935
2002	73122	3000	0	1171	32870	9503	0	5762	11942	9781	85	363	2988		35636	1804	1934	12804	60242	462	699	232741	28709	2718	264168
2003	105845	3000	16	681	24975	6521	0	5766	8843	2496	0	74	966		30886	4282	5702	3982	54201	498	469	234588	18444	6171	259203
2004	78425	3000	na	594	35567	17824	50	7087	4984	2316	400	49	655		16539	na	1111	4983	99208	849	441	246842	25238	2002	274082
2005	39491	3000	na	286	36917	14736	25	4799	2787	2054	788	na	691	7	20869	1025	1002	2433	66527	698	337	173823	22490	2159	198472
2006	30723	3000	na	291	19958	4326	20	3551	1705	1490	0	9	474	5	20050	1274	883	552	45685	542	180	122233	11397	1088	134718
2007	13145	3000	na	325	30390	2742	20	3086	2960	1478	880	0	529	8	14984	3038	966	888	44844	576	243	110297	11688	2117	124102
2008	4363	3000	na	432	9277	3779	35	4944	0	1410	606	0	518	21	6074	1542	1034	697	17883	915	317	43238	11596	2013	56847
2009	13072	3000	na	739	7964	3965	109	1858	0	2549	192	0	519	0	7996	1783	306	0	24747	404	154	55637	12959	761	69357
2010	26637	3000	na	396	6948	3152	140	606	0	1092	442	1	407	19	4670	1048	56	0	32611	474	210	71473	9569	867	81909
2011	18064	3000	na	754	7168	3964	140	370	0	1013	258	0	523	23	4073	2033	98	0	43173	497	144	72848	11784	663	85295
2012	20175	3000	na	376	4020	5149	50	272	0	573	483	0	537	31	4981	619	84	0	23968	763	288	53416	11017	936	65369

Table 2.2.4. Continued.

Year	Gulf of Bothnia (Sub-divisions 30-31)										Main Basin + Gulf of Bothnia (Sub-divisions 22-31) Total			
	Finland			Sweden			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	366012	168224	35404	569640
1997	8205	76683	17000	251	49724	27159	8456	126407	44159	179022	282048	148623	45034	475705
1998	11105	46269	5100	329	41487	23438	11434	87756	28538	127728	313875	104273	30368	448516
1999	3529	35348	3100	89	38447	25546	3618	73795	28646	106059	256491	103977	30382	390850
2000	2423	37755	4150	13	32588	23291	2436	70343	27441	100219	312685	99847	29641	442173
2001	1904	49497	3750	122	44077	25022	2026	93574	28772	124373	261690	121131	30487	413308
2002	864	42433	3900	174	55261	21417	1038	97694	25317	124050	233779	126403	28035	388218
2003	166	51922	4500	293	43047	16839	459	94969	21339	116767	235047	113413	27510	375970
2004	604	60368	5900	0	75151	17207	604	135519	23107	159230	247446	160757	25109	433312
2005	1045	39983	6700	99	55174	21749	1144	95157	28449	124750	174967	117647	30608	323222
2006	162	24776	2620	1144	34544	15190	1306	59320	17810	78436	123539	70716	18898	213153
2007	600	25871	3570	195	31712	17671	795	57583	21241	79619	111092	69271	23358	203721
2008	11	39954	12030	0	40092	31377	11	80046	43407	123464	43249	91641	45420	180310
2009	140	43696	7825	0	56113	23500	140	99809	31325	131273	55777	112767	32086	200630
2010	1	24029	4770	2	32506	11984	3	56535	16754	73292	71476	66104	17621	155201
2011	22	25432	5335	0	28946	13545	23	54378	18880	73281	72871	66162	19543	158576
2012	5	36809	13955	0	23943	35370	5	60752	49325	110082	53421	71769	50261	175451

Year	Gulf of Finland (Sub-division 32)												Sub-divisions 22-32 Total			
	Estonia			Finland			Russia		Total							
	S	C	R	S	C	R	C [1)]	R	S	C	R	GT	SEA	COAST	RIVER	GT
1996	0	396	0	20664	55840	1500	1485	296	20664	57721	1796	80181	386676	225945	37200	649821
1997	0	819	0	19577	54493	1500	1023	0	19577	56335	1500	77412	301625	204958	46534	553117
1998	22	761	76	4210	23876	1500	65	650	4232	24702	2226	31160	318107	128975	32594	479676
1999	12	1904	132	6234	19306	1100	95	915	6246	21305	2147	29698	262737	125282	32529	420548
2000	79	2833	254	8105	21040	1900	79	835	8184	23952	2989	35124	320869	123799	32630	477297
2001	62	1965	317	3804	17578	1900	82	726	3866	19625	2943	26434	265556	140756	33430	439742
2002	108	1968	0	3652	8219	3200	18	408	3760	10205	3608	17573	237540	136608	31643	405790
2003	17	1341	0	553	8812	1700	75	356	570	10228	2056	12854	235617	123641	29566	388824
2004	36	822	0	480	9811	1500	183	314	516	10816	1814	13147	247962	171573	26923	446459
2005	34	1298	0	536	12326	2800	213	423	570	13837	3223	17630	175537	131484	33831	340852
2006	48	955	222	506	10433	1700	121	329	554	11509	2251	14315	124093	82225	21149	227468
2007	64	764	225	451	10033	1395	120	400	515	10917	2020	13452	111607	80188	25378	217173
2008	0	1114	344	392	14158	1100	220	465	392	15492	1909	17793	43641	107133	47329	198103
2009	0	1470	0	228	11908	2063	170	414	228	13548	2477	16253	56005	126315	34562	216883
2010	0	1360	0	81	5152	400	0	491	81	6512	891	7484	71557	72616	18512	162685
2011	0	1091	0	91	6964	600	0	470	91	8055	1070	9216	72962	74217	20613	167792
2012	0	717	0	52	9604	590	0	412	52	10321	1002	11375	53473	82090	51263	186826

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 2012. Subdivisions 22-32. S=sea, C=coast, R=river.

SD	Fishery		Country									Total
			DE	DK	EE	FI	LT	LV	PL	RU	SE	
22	S	W	0.3									0.3
		N	64									64
24	C	W							0.1			0.1
		N							25			25
	S	W	1.0	31.8					0.0		23.3	56.2
		N	208	6548					9		4498	11263
25	C	W		15.0					0.2		4.2	19.3
		N		3000					36		620	3656
	R	W							0.1		2.1	2.2
		N							31		288	319
	S	W		71.4		22.3			10.3		105.0	208.9
		N		13627		4020			2055		18580	38282
26	C	W					2.3	0.2	2.8			5.3
		N					537	62	558			1157
	R	W					0.3		0.3			0.6
		N					31		53			84
	S	W					0.0		14.6		1.0	15.6
		N					0		2917		172	3089
27	C	W									1.3	1.3
		N									143	143
	S	W									2.0	2.0
		N									270	270
28	C	W			1.8			1.9				3.6
		N			253			511				764
	R	W						6.4				6.4
		N						483				483
	S	W									0.3	0.3
		N									51	51
29	C	W			0.9	35.8						36.7
		N			123	5150						5273
	R	W				0.2						0.2
		N				50						50
	S	W									4.1	4.1
		N									397	397
30	C	W				59.0					39.5	98.5
		N				8944					5194	14138
	R	W				3.7					75.9	79.5
		N				100					13290	13390
	S	W				0.0						0.0
		N				5						5
31	C	W				160.4					123.2	283.6
		N				28099					18749	46848
	R	W				106.8					133.2	240.1
		N				13855					22080	35935
32	C	W			5.1	64.6						69.7
		N			717	9703						10420
	R	W				3.6				1.7		5.3
		N				590				412		1002
	S	W				0.2						0.2
		N				52						52
TOTAL 22-31	C	W	0.0	15.0	2.7	255.2	2.3	2.1	3.1	0.0	168.1	448.4
		N	0	3000	376	42193	537	573	619	0	24706	72004
	R	W	0.0	0.0	0.0	110.7	0.3	6.4	0.4	0.0	211.1	328.9
		N	0	0	0	14005	31	483	84	0	35658	50261
	S	W	1.4	103.2	0.0	22.4	0.0	0.0	24.9	0.0	135.8	287.6
		N	272	20175	0	4025	0	0	4981	0	23968	53421
TOTAL 22-31	C+R+S	W	1.4	118.2	2.7	388.2	2.5	8.4	28.4	0.0	515.1	1064.9
		N	272	23175	376	60223	568	1056	5684	0	84332	175686
TOTAL 32	C+R+S	W	0.0	0.0	5.1	68.4	0.0	0.0	0.0	1.7	0.0	75.2
		N	0	0	717	10345	0	0	0	412	0	11474
GRAND TOTAL	C	W	0.0	15.0	7.7	319.8	2.3	2.1	3.1	0.0	168.1	518.1
		N	0	3000	1093	51896	537	573	619	0	24706	82424
	R	W	0.0	0.0	0.0	114.3	0.3	6.4	0.4	1.7	211.1	334.2
		N	0	0	0	14595	31	483	84	412	35658	51263
	S	W	1.4	103.2	0.0	22.6	0.0	0.0	24.9	0.0	135.8	287.8
		N	272	20175	0	4077	0	0	4981	0	23968	53473
NATIONAL TOTAL	C+R+S	W	1.4	118.2	7.7	456.7	2.5	8.4	28.4	1.7	515.1	1140.1
		N	272	23175	1093	70568	568	1056	5684	412	84332	187160

Table 2.2.6. Non-commercial catches of Baltic Salmon in numbers from sea, coast and river by country in 1997–2012 in Subdivision 22–31 and Subdivision 32. (S = Sea, C = Coast).

Sub-divisions 22-31																			
Year	**Denmark**	**Estonia**		**Finland**		**Germany**	**Latvia**		**Lithuania**		**Poland**		**Russia**		**Sweden**		**S+C**	**River**	**Grand**
	S+C	S+C	River	S+C	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	0	na	na	na	na	na	0	na	na	na	0	na	17000	17000
1998	2000	na	na	na	5100	0	na	na	na	na	na	0	na	na	na	0	2000	5100	7100
1999	2000	0	132	5100	400	0	0	0	0	0	0	0	0	0	9350	0	16450	532	16982
2000	2000	0	0	11667	4150	0	0	0	0	0	0	0	0	0	na	0	13667	4150	17817
2001	2000	0	0	11667	3750	0	0	0	0	0	0	0	0	0	14443	22216	28110	25966	54076
2002	3000	0	0	3500	3900	0	0	85	0	0	0	0	0	0	17906	16945	24406	20930	45336
2003	3000	0	0	3500	4500	0	0	0	0	0	0	0	0	0	14889	13424	21389	17924	39313
2004	3000	0	0	17200	5950	0	0	0	0	0	0	0	0	0	22939	14687	43139	20637	63776
2005	3000	0	0	17200	6725	0	0	0	0	0	0	0	0	0	17931	15260	38131	21985	60116
2006	3000	0	0	6000	2640	0	0	0	0	0	0	0	0	0	12757	12229	21757	14869	36626
2007	3000	0	0	6000	3590	0	0	0	0	0	0	0	0	0	11928	14429	20928	18019	38947
2008	3000	136	0	8909	12065	0	0	157	0	0	0	0	0	0	13809	24501	25854	36723	62577
2009	3000	0	0	8909	7934	0	0	192	0	0	0	0	0	0	18248	18505	30157	26631	56788
2010	3000	0	0	3420	4910	0	0	22	0	0	0	0	0	0	12827	9325	19247	14257	33504
2011	3000	0	0	3420	5475	0	0	0	0	0	0	0	0	0	11819	9886	18239	15361	33600
2012	3000	0	0	3420	14005	0	0	0	0	0	0	0	0	0	10526	25523	16946	39528	56474

Table 2.2.6. Continued.

	Sub-division 32										Sub-division 22-32		
Year	**Estonia**		**Finland**		**Russia**		**S+C Total**	**River Total**	**Grand Total**	**S+C Total**	**River Total**	**GT**
	S+C	River	S+C	River	S+C	River						
1997	na	na	na	17000	na	na	na	17000	17000	na	34000	62034
1998	na	na	na	5100	na	na	na	5100	5100	2000	10200	12200
1999	0	132	10000	1100	0	0	10000	1232	11232	26450	1764	28214
2000	0	na	8300	1900	0	0	8300	1900	10200	21967	6050	28017
2001	0	na	8300	1900	0	0	8300	1900	10200	36410	27866	64276
2002	0	na	2500	3200	0	0	2500	3200	5700	26906	24130	51036
2003	0	na	2500	1700	0	0	2500	1700	4200	23889	19624	43513
2004	0	na	3400	1500	0	0	3400	1500	4900	46539	22137	68676
2005	206	na	3400	2800	0	0	3606	2800	6406	41737	24785	66522
2006	138	na	182	1700	0	0	320	1700	2020	22077	16569	38646
2007	0	na	182	1395	0	0	182	1395	1577	21110	19414	40524
2008	294	268	727	1100	0	0	1021	1368	2389	26875	38091	64966
2009	0	0	727	2063	0	0	727	2063	2790	30884	28693	59577
2010	0	0	360	400	0	0	360	400	760	19607	14657	34264
2011	0	0	360	600	0	0	360	600	960	18599	15961	34560
2012	0	0	360	590	0	0	360	590	950	17306	40118	57424

In 2012 data from Finland and Sweden are preliminary.

Table 2.2.7. Nominal catches (commercial) of Baltic Salmon in numbers from sea and coast, excluding river catches, by country in 1993–2012 and in comparison with TAC. Subdivisions 22–32. Years 1993–2000 include also sea catch of the recreational fishery in Sweden and Finland.

Year	Baltic Main Basin and Gulf of Bothnia (Sub-divisions 22-31)											
	Fishing Nation									Total	TOTAL TAC	Landing in % of TAC
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden			
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	109036	354711	450000	**79**
2002	73122	1171	82171	5762	21723	3351	37440	12804	98233	335777	450000	**75**
2003	105845	697	80084	5766	11339	1040	35168	3982	83150	327071	460000	**71**
2004	78425	594	97163	7087	7300	704	16539	4983	152269	365064	460000	**79**
2005	39491	286	75481	4799	4841	691	21894	2433	104567	254483	460000	**55**
2006	30723	291	43221	3551	3195	483	21324	552	69158	172498	460000	**37**
2007	13145	325	53622	3086	4438	529	18022	888	65399	159454	437437	**36**
2008	4363	296	44111	4944	1410	518	7616	697	45081	109036	371315	**29**
2009	13072	739	46855	1858	2549	519	9779		63016	138387	309733	**45**
2010	26637	396	30710	606	1092	408	5718		52766	118333	294246	**40**
2011	18064	754	33166	370	1013	523	6106		60797	122477	250109	**49**
2012	20175	376	42563	272	573	537	5600		38148	108244	122553	**88**

Table 2.2.7. Continued.

Year	Gulf of Finland (Sub-division 32)					
	Fishing Nation		Total	EC TAC	Landing % of TAC	Russia
	Estonia	Finland				
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	717	9296	10013	15419	**65**	

All data from 1993-1994, includes sub-divisions 24-32, while it is more uncertain in which years sub-divisions 22-23 are included
Russia are not included in the TAC in Sub-division 31.
The catches in sub-divisions 22-23 are normally less than one tonnes. From 1995 data includes sub-divisions 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 sub-division 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 salmons 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.

Parameter	Country	Years	Source	min	mode	max	mean	SD
Share of unreported catch in offshore fishery	DK	2001-2012	EE	0.00	0.01	0.10	0.04	0.02
	FI	2001-2012	EE	0.00	0.01	0.10	0.04	0.02
	PL	2001-2012	EE	0.00	0.25	0.40	0.22	0.08
	SE	2001-2012	EE	0.05	0.15	0.25	0.15	0.04
Average share of unreported catch in offshore fishery		2001-2007					0.15	0.15
		2008-2012					0.16	0.16
Share of unreported catch in coastal fishery	FI	2001-2012	EE	0.00	0.10	0.15	0.08	0.03
	PL	2001-2012	EE	0.00	0.10	0.20	0.10	0.04
	SE	2001-2012	EE	0.10	0.30	0.50	0.30	0.08
Average share of unreported catch in coastal fishery		2001-2007					0.21	0.18
		2008-2012					0.20	0.17
Share of unreported catch in river fishery	FI	2001-2012		0.05	0.20	0.35	0.20	0.06
	PL	2001-2009	EE	0.01	0.10	0.15	0.09	0.03
	PL	2010-2012	EE	0.50	0.80	1.00	0.77	0.10
	SE	2001-2012	EE	0.10	0.20	0.40	0.23	0.06
Average share of unreported catch in river fishery		2001-2007					0.22	0.19
		2008-2012					0.22	0.19
Share of discarded undersized salmon in longline fishery	DK	2001-2012	D, EE	0.10	0.15	0.20	0.15	0.02
	FI	2001-2012	D, EE	0.01	0.03	0.05	0.03	0.01
	PL	2001-2012	D	0.01	0.03	0.04	0.02	0.01
	SE	2001-2012	D, EE	0.01	0.02	0.03	0.02	0.00
Average share of discarded undersized salmon in longline fisher		2001-2007					0.06	0.06
		2008-2012					0.04	0.04
Mortality of discarded undersized salmon in longline fishery	DK	2001-2012	EE	0.75	0.80	0.85	0.80	0.02
	FI	2001-2012	EE	0.50	0.67	0.90	0.69	0.08
	SE	2001-2012	EE	0.75	0.85	0.95	0.85	0.04
Average mortality of discarded undersized salmon in longline fishery		2001-2012					0.77	0.12
Share of discarded undersized salmon in driftnet fishery	DK	2001-2007	EE, D	0.00	0.03	0.05	0.03	0.01
	FI	2001-2007	D	0.00	0.02	0.03	0.02	0.01
Average share of discarded undersized salmon in driftnet fishery		2001-2007					0.03	0.08
Mortality of discarded undersized salmon in driftnet fishery	DK	2001-2007	EE, D	0.60	0.65	0.70	0.65	0.02
	FI	2001-2007	EE	0.50	0.67	0.80	0.66	0.06
Average mortality of discarded undersized salmon in driftnet fishery		2001-2007					0.65	0.14
Share of discarded undersized salmon in trapnet fishery	FI	2001-2012	EE	0.01	0.03	0.05	0.03	0.01
	SE	2001-2012	EE, D	0.01	0.03	0.05	0.03	0.01
Average share of discarded undersized salmon in trapnet fishery		2001-2012					0.03	0.07
Mortality of discarded undersized salmon in trapnet fishery	FI	2001-2012	EE, D	0.10	0.20	0.50	0.27	0.08
	SE	2001-2012	EE, D	0.30	0.50	0.70	0.50	0.08
Average mortality of discarded undersized salmon in trapnet fishery		2001-2012					0.38	0.21
Share of discarded sealdamaged salmon in longline fishery	FI	2001-2007	D	0.00	0.00	0.02	0.01	0.00
	SE	2001-2012	EE, D	0.02	0.05	0.08	0.05	0.01
	DK	2011-2012	EE, D	0.00	0.05	0.10	0.05	0.02
	FI	2008-2012	D	0.00	0.03	0.06	0.03	0.01
Average share of discarded sealdamaged salmon in longline fish		2001-2007					0.02	0.05
		2008-2012					0.03	0.06
Share of discarded sealdamaged salmon in driftnet fishery	DK	2001-2007	EE, D	0.00	0.03	0.05	0.03	0.01
	FI	2001-2007	D	0.01	0.02	0.04	0.02	0.01
Average share of discarded sealdamaged salmon in driftnet fishery		2001-2007					0.02	0.06
Share of discarded sealdamaged salmon in trapnet fishery	FI	2001-2012	D	0.05	0.08	0.14	0.09	0.02
	SE	2004-2012	EE, D	0.01	0.02	0.04	0.02	0.01
Average share of discarded sealdamaged salmon in trapnet fishe		2001-2007					0.05	0.08
		2008-2012					0.06	0.08

Table 2.3.2. Estimated number of discarded undersized salmon and discarded seal damaged salmon by management unit in 2001–2012. Estimates of discarded undersized salmon are based on 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 estimated conversion factors and therefore 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
SD22-31	2001	1279	6810	559	355	6726	1233	7971	1339	26272
	2002	817	7264	794	374	5791	2171	8358	633	26202
	2003	843	9465	697	154	5490	1453	8503	1597	28202
	2004	1042	7033	944	314	6076	2201	8860	1399	27869
	2005	613	4490	449	172	6682	2515	6409	731	22060
	2006	354	3386	349	266	3564	2111	3372	1580	14983
	2007	386	1887	462	161	3161	1506	5419	534	13516
	2008	0	880	466	141	4	1372	5495	852	9210
	2009	0	2320	898	161	1	2661	5707	616	12363
	2010	0	3743	563	63	3	3097	3842	373	11684
	2011	0	2690	331	97	0	5187	3767	363	12434
	2012	0	2297	499	78	0	2406	5289	522	11091
SD32	2001	1	26	31	22	5	58	3160	714	4016
	2002	31	18	17	23	77	173	2884	354	3577
	2003	0	2	19	16	20	29	3536	240	3864
	2004	1	9	24	14	42	7	3761	264	4122
	2005	1	2	27	20	26	36	1932	226	2270
	2006	1	1	35	20	92	4	2088	970	3210
	2007	1	2	28	7	43	5	2113	54	2253
	2008	0	2	38	13	0	26	2552	299	2930
	2009	0	1	35	21	0	3	2066	296	2423
	2010	0	1	17	8	0	4	1096	82	1207
	2011	0	1	53	5	0	1	1153	77	1288
	2012	0	0	125	10	0	0	1367	206	1708

Table 2.4.1. Fishing efforts of Baltic salmon fisheries at sea and at the coast in 1987–2012 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) and are reported per half year (HYR). The coastal fishing effort on stocks of assessment unit 1 (AU1) 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 AU2 refers to the Finnish coastal fishing effort in SD30 and partly to the Swedish coastal fishing effort in SD31. The coastal fishing effort on stocks of AU3 refers to the Finnish and Swedish coastal fishing effort in SD30.

					AU 1		AU 2		AU 3	
Effort		Offshore driftnet	Offshore longline	Commecial coastal driftnet	Commercial coastal trapnet	Commercial coastal other gear	Commercial coastal trapnet	Commercial coastal other gear	Commercial coastal trapnet	Commercial coastal other gear
1987	I	1523587	1447789	233703	16317	99171	8908	67956	10233	88375
	II	2122115	2142495	95009	54865	164084	34785	175555	32471	437726
1988	I	1914340	1568397	240296	28546	126509	16144	127284	17959	423237
	II	1623306	1173796	16092	56417	118718	39515	132120	40881	374801
1989	I	1833110	1216741	320879	30632	197177	18238	132953	18619	154266
	II	1956293	829833	57311	37701	148415	23753	251729	21517	308801
1990	I	1487996	1517064	339960	51594	120228	30570	105160	29308	135350
	II	1515556	1050816	24366	59739	140541	40435	128380	38844	144260
1991	I	1763644	1138104	398447	41902	185839	27621	139274	34613	178861
	II	1397820	534334	32973	61175	275215	43358	221086	38565	225466
1992	I	1553470	1174250	448853	54507	179395	29544	135902	29500	191465
	II	1556474	555475	24726	61286	172123	38552	146772	32204	147919
1993	I	1649367	835887	595034	54492	162849	33313	61293	37439	70857
	II	774882	288516	26783	65005	125396	43085	100180	42472	144853
1994	I	1380558	753481	538689	31648	116753	17521	110042	19702	133865
	II	1363667	217771	42617	52288	77930	41967	100885	35554	71983
1995	I	1756044	633759	394522	21584	68728	12236	66889	13468	67961
	II	954980	78073	58336	49087	83800	32371	80370	28697	73944
1996	I	828908	854241	48742	9728	46687	7065	44996	5333	41991
	II	606402	314326	29944	48538	53723	34990	47610	23696	48254
1997	I	681679	937311	87216	10493	51848	8307	43644	6933	43555
	II	549884	516218	30991	52609	55584	36297	38279	27162	41084
1998	I	1173608	1054785	89338	6543	3636	3634	2123	4307	1974
	II	710037	182425	23055	22101	4755	16570	3327	11465	3247
1999	I	1026458	965912	101733	11198	4792	6387	2976	6037	2470
	II	629706	570516	24849	32141	4532	25459	2739	14852	2601
2000	I	1014465	1298280	85034	9436	3227	5552	1571	6192	1375
	II	1052352	721174	21974	25498	5096	17832	4016	14205	3996
2001	I	824956	1286600	98962	11460	2088	7024	1451	8020	1305
	II	887163	602809	3695	28539	1791	20263	1210	25623	1208
2002	I	930922	1208473	82572	14960	1330	9744	487	10683	440
	II	500824	967825	3785	31002	2448	23985	2764	20554	2712
2003	I	579069	860564	92732	15915	3612	11711	2916	6837	3746
	II	657034	604798	2290	31118	5181	14998	4332	26310	5850
2004	I	672460	841713	93460	12220	2155	7524	982	7847	1695
	II	608695	241929	10190	28809	2032	20033	756	14952	572
2005	I	735893	545005	77607	13654	2327	9187	1784	7752	1897
	II	555388	296051	6616	30764	2130	23784	4559	18957	3718
2006	I	823374	785538	73979	13005	3014	9577	3176	6077	4385
	II	381054	231680	3936	20271	927	14135	625	10710	1036
2007	I	796348	448410	41857	15494	3594	11272	2541	6577	3413
	II	413622	76175	3700	19443	677	12075	374	11654	1179
2008	I	0	527959	0	10067	4975	6160	2654	6268	2623
	II	0	337784	0	17383	4708	9925	1832	17056	3742
2009	I	0	1603530	0	11685	2481	8701	1331	5101	1617
	II	0	1005308	0	19887	4576	14121	3943	9029	4766
2010	I	0	1769191	0	9351	1954	6513	1540	4595	1524
	II	0	457989	0	21597	1794	15679	496	9370	3162
2011	I	0	2130741	0	9384	2510	6566	2422	4407	2544
	II	0	410477	0	16499	886	9281	381	7571	1826
2012	I	0	962112	0	8614	1988	5698	1513	5786	1585
	II	0	191429	0	11441	854	5632	16	4562	318

Table 2.4.2. Number of fishing vessels in the offshore fishery for salmon by country and area from 1999–2012. Number of fishing days divided in 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	Sub-divisions 22-31	Denmark	5	7	4	4	20
		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
	Sub-div. 32	Finland	2	3	3	39	47
	Sub-divs 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	Sub-divisions 22-31	Denmark	8	9	2	9	28
		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
	Sub-div. 32	Estonia	0	0	1	0	1
		Finland	3	6	7	20	36
	Sub-divs 22-32	Total	80	62	53	110	305

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	Sub-divisions 22-31	Denmark	3	2	4	2	2	9	22
		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
	Sub-div. 32	Finland	0	0	0	4	3	15	22
	Sub-divs 22-32	Total	16	14	29	43	34	97	233

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						
2002	Sub-divisions 22-31	Denmark	3	3	2	3	5	12	28
		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
	Sub-div. 32	Finland	0	0	0	5	5	19	29
	Sub-divs 22-32	Total	5	3	4	22	25	82	191

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	Sub-divisions 22-31	Denmark	1	2	8	2	6	11	30
		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
	Sub-div. 32	Estonia	0	0	0	0	1	0	1
		Finland	0	0	0	3	2	12	17
	Sub-divs 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	Sub-divisions 22-31	Denmark	0	0	1	9	1	16	27
		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
	Sub-div. 32	Estonia	0	0	0	0	0	1	1
		Finland	0	0	0	0	1	14	15
	Sub-divs 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	Sub-divisions 22-31	Denmark	0	0	3	2	5	6	16
		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
	Sub-div. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	0	2	6	8
	Sub-divs 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	Sub-divisions 22-31	Denmark	2	1	0	3	0	3	9
		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
	Sub-div. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	1	1	14	16
	Sub-divs 22-32	Total	6	12	5	20	15	40	98

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	Sub-divisions 22-31	Denmark	0	1	0	4	2	5	12
		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
	Sub-div. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	0	1	7	8
	Sub-divs 22-32	Total	4	7	7	14	12	33	77

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						
2008	Sub-divisions 22-31	Denmark	0	1	0	3	3	5	12
		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
	Sub-div. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	0	0	10	10
	Sub-divs 22-32	Total	0	3	7	10	12	57	89

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	Sub-divisions 22-31	Denmark	0	0	2	2	13	6	23
		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
	Sub-div. 32	Estonia	na	na	na	na	na	na	na
		Finland	0	0	0	0	0	9	9
	Sub-divs 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	Sub-divisions 22-31	Denmark	0	0	0	4	6	10	20
		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
	Sub-div. 32	Estonia	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	7	7
	Sub-divs 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	Sub-divisions 22-31	Denmark	0	0	0	2	6	7	15
		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
	Sub-div. 32	Estonia	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	9	9
	Sub-divs 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	Sub-divisions 22-31	Denmark	0	0	0	2	7	7	16
		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
	Sub-div. 32	Estonia	0	0	0	0	0	0	0
		Finland	0	0	0	1	0	6	7
	Sub-divs 22-32	Total	0	0	0	1	0	6	7

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 2012.

Fishing season	Denmark			
	Sub-divisions 22-25		Sub-divisions 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

Table 2.4.3. Continued.

Fishing season	Finland					
	Sub-divisions 22-29		Sub-divisions 30-31		Sub-division 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	14.6
2010	0.0	57.0	0.0	0.0	0	5
2011	0.0	51.5	0.0	0.0	0.0	0.0
2012	0.0	56.3	0.0	0.0	0.0	0.0

Table 2.4.3. Continued.

Fishing season	Estonia		Latvia		Russia		Sweden	
	Sub-divisions 28-29	Sub-divisions 32	Sub-divisions 26 and 28		Sub-division 26		Sub-divisions 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

All data from 1980/1981-1993/1994 includes sub-divisions 24-32, while it is more uncertain which years sub-divisions 22-23 are included. The catches in sub-division 22-23 are normally less than one ton. From 1995 data includes sub-divisions 22-32.
Estonian data from sub-div. 28-29 has earlier been given as sub-div. 24-29.
In 2011 data from Finland and Sweden are preliminary.

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 trapnetdays).

Year	Trapnet	
	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	11035	0.6
2012	10,497	0.9

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.

RELEASE YEAR	Reared salmon stocked in rivers without natural reproduction			Reared salmon stocked in rivers with natural reproduction			Wild salmon
	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 2012.

Country	24	25	26	27	28	29	30	31	32	Total
Denmark										
Estonia									3,783	3,783
Finland							1,999	7,394	1,000	10,393
Sweden							15,000	9,000		24,000
Poland			2,000							2,000
Russia									2,000	2,000
Lithuania			200							200
Latvia										
Total	0	0	2,000	0	0	0	16,999	16,394	6,783	42,176

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.

Year	Releases of adipose fin clipped salmon, Sub-divs. 24-32		Latvian offshore catches Sub-divs. 26 and 28	
	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	---	---

Table 2.7.2. Adipose finclipped salmon released in the Baltic Sea area in 2011.

Country	Species	Stock	Age	Number		River	Sub-division	Other tagging
				parr	smolt			
Estonia	salmon	Neva	2		8000	Narva	32	799 Carlin
	salmon	Neva	2		10000	Selja	32	600 Carlin
	salmon	Neva	2		10200	Loobu	32	598 Carlin
	salmon	Neva	2		10000	Valgejõgi	32	599 Carlin
	salmon	Neva	2		5000	Jägala	32	589 Carlin
	salmon	Neva	2		5600	Pirita	32	598 Carlin
Finland	salmon	Neva	2 yr		4497	Kiskonjoki-Perniönjoki	29	
	salmon	Neva	2 yr		10540	Paimionjoki	29	
	salmon	Simojoki	2 yr		13857	Karvianjoki	30	
	salmon	Neva	2 yr		4000	Kokemäenjoki	30	1000 T-anchor
	salmon	Tornionjoki	2 yr		24524	Kokemäenjoki	30	1000 T-anchor
	salmon	Iijoki	1yr parr	39974		Kiiminkijoki	31	
	salmon	Iijoki	2 yr		30000	Kiiminkijoki	31	
	salmon	Tornionjoki	2 yr		4437	Tornionjoki-Muonionjoki	31	
	salmon	Neva	2 yr		4227	Hounijoki	32	2000 T-anchor
	salmon	Neva	2 yr		8457	Koskenkylänjoki	32	
	salmon	Neva	2 yr		108979	Kymijoki	32	1000 Carlin + 1000 T-anchor
	salmon	Neva	2 yr		2662	Mäntsälänjoki	32	
	salmon	Neva	2 yr		5234	Porvoonjoki	32	
Latvia	salmon	Daugava	1 ur		2000	Daugava	28	2000 T-anchor
Sweden	salmon	Ångermanälv	2		136446	Ångermanälven	30	5000 Carlin
	salmon	Indalsälven	1	58820	332189	Indalsälven	30	
	salmon	Indalsälven	2		14634	Indalsälven	30	3000 Carlin
	salmon	Ljusnan	1	86300	179,736	Ljusnan	30	2000 Carlin
	salmon	Dalälven	1		199,317	Dalälven	30	
	salmon	Dalälven	2		15,374	Dalälven	30	4000 Carlin
	salmon	Skellefte älv	2		6,000	Gideälven	30	1000 Carlin
	salmon	Lule älv	1		80,493	Lule älv	31	
	salmon	Lule älv	2		480,526	Lule älv	31	5000 Carlin
	salmon	Skellefte älv	1		103134	Skellefte älv	31	
	salmon	Skellefte älv	2		28,149	Skellefte älv	31	2000 Carlin
	salmon	Ume älv	1		10,397	Ume älv	31	
	salmon	Ume älv	2		41,071	Ume älv	31	2000 Carlin
Poland	salmon	Dougava	1		71,601	Drwęca, Reda	26	
Total salmon				**185,094**	**1,971,281**			

Table 2.8.1. Updated Atlantic salmon baseline sample list. Updated stocks are shown as grey. For Kalixälven the sample from the year 2002 was replaced with the new 2012 sample, for Daugava the sample from 1996 was omitted, for all other stocks the new samples were added to the previous ones. The total number of baseline stocks increased to 36.

	Stock	Sampling year	Country	Propagation	N
1	Tornionjoki, W	2011	Finland, Sweden	Wild	200
2	Tornionjoki, H	2006	Finland	Hatchery	108
3	Simojoki	2006, 2009, 2010	-"-	Wild	174
4	Iijoki	2006	-"-	Hatchery	105
5	Oulujoki	2009	-"-	Hatchery	167
6	Kalixälven	2012	Sweden	Wild	200
7	Råneälven	2003, 2010, 2011	-"-	Wild	95
8	Luleälven	2006	-"-	Hatchery	120
9	Piteälven	2012	-"-	Wild	56
10	Åbyälven	2003, 2005	-"-	Wild	77
11	Byskeälven	2003	-"-	Wild	107
12	Skellefteälven	2006	-"-	Hatchery	120
13	Rickleån	2012	-"-	Wild	11
14	Sävarån	2010, 2011	-"-	Wild	78
15	Vindelälven	2003	-"-	Wild	150
16	Umeälven	2006	-"-	Hatchery	118
17	Öreälven	2003, 2012	-"-	Wild	55
18	Lögdeälven	1995, 2003, 2012	-"-	Wild	78
19	Ångermanälven	1995, 2006	-"-	Hatchery	120
20	Indalsälven	2006	-"-	Hatchery	120
21	Ljungan	1998, 2003	-"-	Wild	82
22	Ljusnan	2006	-"-	Hatchery	120
23	Dalälven	2006	-"-	Hatchery	119
24	Emån	1999, 2003	-"-	Wild	109
25	Mörrumsån	2003	-"-	Wild	136
26	Neva, Fi	2006	Russia	Hatchery	102
27	Neva, Rus	1995	-"-	Hatchery	50
28	Luga	2003, 2011	-"-	Wild, Hatchery	147
29	Narva	1999, 2001	Estonia, Russia	Hatchery	65
30	Kunda	1996	Estonia	Wild	60
31	Keila	1997	-"-	Wild	53
32	Salaca	2007, 2008	Latvia	Wild	46
33	Gauja	1998	-"-	Hatchery	70
34	Daugava, Lat	2011	-"-	Hatchery	192
35	Venta	1996	-"-	Wild	66
36	Nemunas	2002-2010	Lithaunia	Hatchery	166
	Total				3842

Table 2.8.2. Atlantic salmon stock group proportions in catches from Åland Sea, Bothnian Bay and Main Basin. Analyses are based on17-loci DNA microsatellite data and information on freshwater age. Also proportion of wild fish according to scale reading is indicated.

	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 %	Others / Eastern Main Basin	2.5 %	97.5 %	Sample size	*Scale reading - wild %*
1. Åland Sea																							
2000[F]	**23**	18	28	**37**	30	45	**39**	32	46	-			-			-			**1**	0	2	**412**	*22*
2002[F]	**65**	58	72	**23**	16	30	**10**	6	15	-			-			-			**2**	1	5	**218**	*58*
2003[F]	**70**	63	77	**24**	17	30	**6**	2	11	-			-			-			**0**	0	2	**209**	*64*
2004[F]	**73**	67	80	**15**	10	21	**11**	7	16	-			-			-			**0**	0	1	**258**	*65*
2005[F]	**69**	64	75	**24**	19	29	**6**	4	10	-			-			-			**0**	0	1	**315**	*64*
2006[F]	**80**	71	87	**13**	6	21	**6**	2	12	-			-			-			**1**	0	3	**133**	*68*
2007[F]	**80**	75	84	**14**	10	19	**6**	4	9	-			-			-			**0**	0	1	**398**	*78*
2008[F]	**63**	56	69	**14**	10	20	**22**	17	28	-			-			-			**1**	0	3	**252**	*56*
2009[F]	**79**	74	84	**13**	9	18	**7**	4	11	-			-			-			**0**	0	1	**271**	*69*
2010[F]	**90**	85	93	**7**	4	10	**3**	2	6	-			-			-			**0**	0	1	**416**	*80*
2011[F]	**92**	88	95	**4**	2	8	**3**	2	6	-			-			-			**0**	0	0.7	**282**	*90*
2012[F]	**90**	87	93	**7**	4	10	**3**	1	5	-			-			-			**0**	0	0.4	**468**	*82*
Mean	***73***	*67*	*78*	***16***	*11*	*22*	***10***	*7*	*15*	-			-			-			***0***	*0*	***2***		
2. Bothnian Bay																							
2006[FS]	**58**	52	63	**30**	25	35	**13**	10	16	-			-			-			**0**	0	1	**481**	*55*
2007[FS]	**66**	62	71	**15**	12	19	**18**	15	22	-			-			-			**0**	0	0	**629**	*66*
2008[FS]	**74**	70	78	**21**	17	25	**5**	3	7	-			-			-			**0**	0	1	**600**	*66*
2009[FS]	**76**	70	81	**16**	11	22	**8**	6	11	-			-			-			**0**	0	1	**510**	*67*
2010[FS]	**85**	81	89	**11**	8	15	**3**	1	6	-			-			-			**0**	0	0	**498**	*81*
2011[FS]	**85**	81	89	**12**	8	16	**3**	2	5	-			-			-			**0**	0	0.4	**444**	*76*
2012[FS]	**80**	76	84	**17**	13	21	**3**	1	5	-			-			-			0	0	0.4	**439**	*69-72*
Mean	***75***	*70*	*79*	***17***	*14*	*22*	***8***	*5*	*10*	-			-			-			***0***	*0*	*1*		
2012[F]	**62**	54	69	**36**	29	43	**2**	1	5	-			-			-			**0**	0	0.9	**212**	*54-55*
2012 [S]	**97**	93	99	**0**	0	1	**3**	1	7	-			-			-			**0**	0	0.9	**227**	*82-85*
3. Main Basin																							
2006[DFLPS]	**64**	59	69	**16**	12	20	**12**	9	15	**1**	0	3	**3**	2	4	**1**	0	2	**2**	1	4	**521**	*55-58*
2007[FPS]	**62**	57	66	**7**	4	10	**21**	17	25	**2**	1	4	**4**	3	6	**1**	0	2	**3**	2	5	**486**	*56-61*
2008[P]	**67**	61	72	**8**	5	12	**15**	11	19	**1**	0	2	**3**	2	5	**1**	0	3	**5**	3	8	**367**	*58-65*
2009[FP]	**60**	55	64	**13**	10	17	**20**	17	24	**0**	0	1	**3**	2	5	**1**	1	3	**2**	1	3	**618**	*49-57*
2010[DFPS]	**74**	69	79	**5**	2	9	**14**	11	17	**0**	0	0	**2**	1	4	**1**	0	2	**3**	2	5	**566**	*62-68*
2011[DFPS]	**71**	67	75	**6**	4	9	**18**	15	22	**0**	0	1	**0.2**	0	0.7	**1**	1	2	**2**	1	3.5	**830**	*66-67*
2012[DFPS]	**63**	60	66	**12**	9	14	**22**	19	24	**0**	0	1	**1**	0	1	**1**	1	2	**1**	1	2	**1301**	*55-57*
Mean	***66***	*61*	*70*	***10***	*7*	*13*	***17***	*14*	*21*	***1***	*0*	*2*	***2***	*1*	*4*	***1***	*1*	*2*	***3***	*2*	*4*		

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

Table 2.8.3. Medians of individual river-stock proportion estimates in Atlantic salmon catches from the Baltic Sea.

	Tornionj W & Kalix	Tornionj. Hatch.	Simojoki, W	Iijoki, H	Oulujoki, H	Råne, W	Luleälven, H	Piteälven, W	Åbyälven, W	Byskeälven, W	Skellefteälven, H	Rickleån, W	Sävarån, W	Vindelälven, W	Umeälven, H	Öreälven, W	Lögde, W	Ångermanälven, H	Indalsälven, H	Ljungan, W	Ljusnan, H	Dalälven, H	Neva-FI, H	Sample size
Åland Sea																								
2000	14	26	6	5	5	-	12		-	0	4			1	3	-	-	15	0	-	1	2	1	412
2002	65	10	-	8	2	-	5		-	-	-			4	-	-	1	-	-	-	5	-	5	218
2003	56	13	-	7	3	-	2		2	-	-			8	-	-	0	-	-	-	-	2	-	209
2004	55	5	7	10	-	-	5		-	5	-			5	-	-	-	1	2	-	-	1	-	258
2005	55	7	4	14	3	-	2		-	4	-			4	1	-	2	2	-	0	-	1	0	315
2006	53	4	8	6	1	2	2		3	6	-			4	-	1	-	-	-	-	1	2	1	133
2007	61	8	6	6	0	0	3		-	3	-			7	0	-	1	2	-	-	-	0	-	398
2008	48	9	0	3	1	0	11		3	6	-			3	-	-	0	4	4	0	-	2	1	252
2009	60	4	2	6	2	1	2		1	6	0			5	-	0	2	1	2	0	-	1	1	271
2010	70	3	5	3	0	0	0		-	6	0			4	1	-	1	1	1	3	-	0	0	416
2011	66	2	2	2	0	1	1	-	0	12	0	-	-	5	-	1	1	-	2	-	-	-	-	303
2012	71	3	5	3	-	1	-	-	2	4	0	1	-	5	0	0	1	1	-	-	-	0	0	468
Mean	*56*	*8*	*5*	*6*	*2*	*1*	*4*	*-*	*2*	*5*	*1*	*1*	*-*	*5*	*1*	*1*	*1*	*3*	*2*	*1*	*2*	*1*	*1*	
Bothnian Bay																								
2006[FS]	29	12	3	10	6	-	9		6	17	3			2	0	-	1	-	-	-	-	-	-	481
2007[FS]	33	8	5	2	3	0	10		6	11	5			4	1	2	4	2	1	0	-	-	2	629
2008[FS]	38	6	3	9	6	0	2		4	10	2			6	-	2	9	-	-	-	-	-	-	600
2009[FS]	40	3	2	7	5	-	2		4	20	3			3	1	1	4	1	0	0	0	-	-	510
2010[FS]	51	3	1	4	3	0	2		7	11	1			2	-	0	10	-	0	1	0	-	-	498
2011[FS]	48	3	2	3	6	-	-	4	5	16	2	2	1	2	-	1	4	1	-	-	0	-	-	444
2012[FS]	43	1	1	6	10	-	1	6	4	15	-	0	1	3	0	1	4	1	-	-	0	-	-	439
Mean	*41*	*5*	*3*	*6*	*6*	*0*	*4*	*5*	*5*	*14*	*3*	*1*	*1*	*3*	*1*	*1*	*5*	*1*	*0*	*0*	*0*	*0*	*2*	
2012[F]	58	3	2	12	20	-	2	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	212
2012[S]	27	-	-	-	-	-	-	12	9	28	-	2	1	6	1	2	8	1	-	-	0	-	-	227

Table 2.8.3. Continued.

	Tornionj W & Kalix	Tornionj. Hatch.	Simojoki, W	Iijoki, H	Oulujoki, H	Råne, W	Luleälven, H	Piteälven, W	Åbyälven, W	Byskeälven, W	Skellefteälven, H	Rickleån, 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	Neva-RU, H	Luga, W	Narva, H	Kunda, W	Keila, W	Salaca, W	Gauja, H	Daugava, H	Venta, W	Neumunas, H	Sample size
Main Basin																																				
2006[DFLPS]	47	11	3	4	1	1	4		-	3	-			5	-	0	1	3	3	4	1	1	-	1	3	-	1	-	-	-	-	2	-	-	0	521
2007[FPS]	44	4	4	2	0	0	10		3	2	1			6	-	-	1	3	5	-	0	-	-	1	4	-	2	-	-	-	-	1	1	-	1	486
2008[P]	54	6	2	0	1	1	5		1	4	2			4	1	-	-	2	4	-	-	1	-	1	3	-	1	-	-	-	-	3	1	-	1	367
2009[FP]	44	7	2	4	2	1	8		3	2	2			5	2	-	0	3	4	1	0	1	-	1	3	-	-	0	-	-	-	1	1	-	0	618
2010[DFPS]	60	4	3	1	1	-	4		1	3	1			5	-	-	-	3	4	2	-	2	-	1	2	-	-	-	-	-	2	0	-	-	1	566
2011[DFPS]	54	1	2	3	2	1	3	4	2	2	3	-	0	4	2	0	0	2	7	1	0	1	1	1	0	-	0	-	-	-	1	0	-	-	1	830
2012[DFPS]	44	5	2	2	4	1	13	2	0	4	0	0	0	7	0	0	1	1	6	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	1	1301
Mean	*50*	*6*	*3*	*2*	*2*	*1*	*7*	*3*	*2*	*3*	*2*	*0*	*0*	*5*	*1*	*0*	*1*	*2*	*5*	*2*	*0*	*1*	*0*	*1*	*2*	*-*	*1*	*0*	*-*	*-*	*1*	*1*	*1*	*-*	*1*	

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

Table 2.8.4. Proportion of wild and hatchery salmon from different assessment units in catches from the Main Basin.

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
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
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
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
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
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
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
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

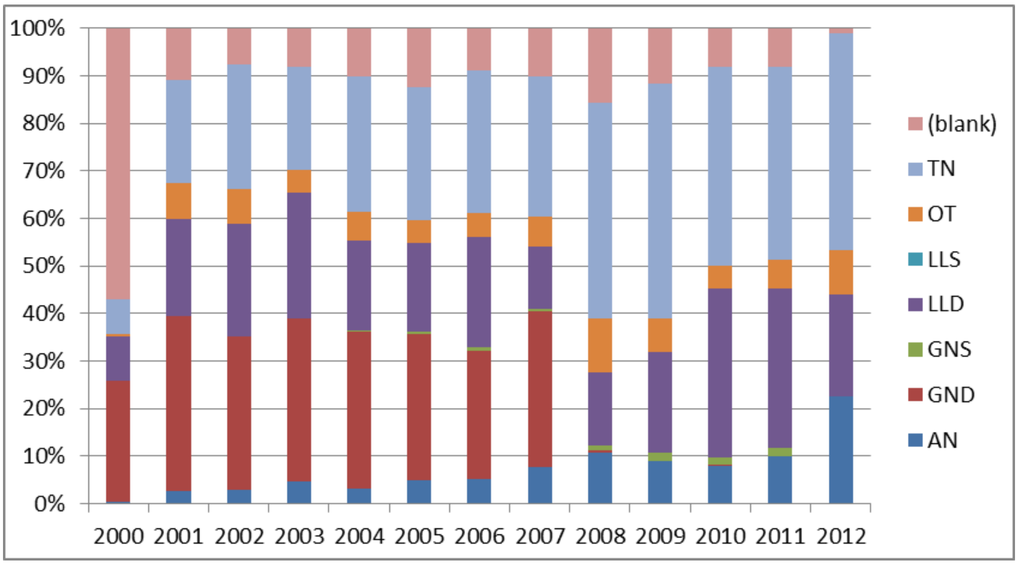


Figure 2.2.1. Proportion of catch of Baltic salmon by weight in different types of gear 2000–2012. Variables: GND=driftnet, AN=angling, GNS=gillnet, LLD=longline, OT=other, TN=trapnet. Blank=unidentified.

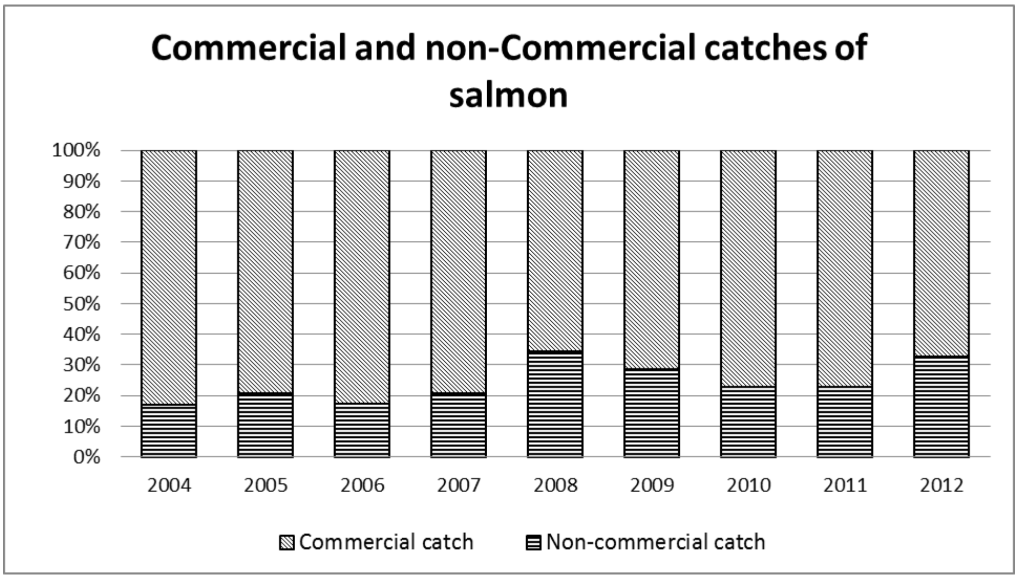


Figure 2.2.2. Commercial and non-commercial catches in percent (weight) in 2004–2012 in Subdivisions 22–32 from sea, coast and river.

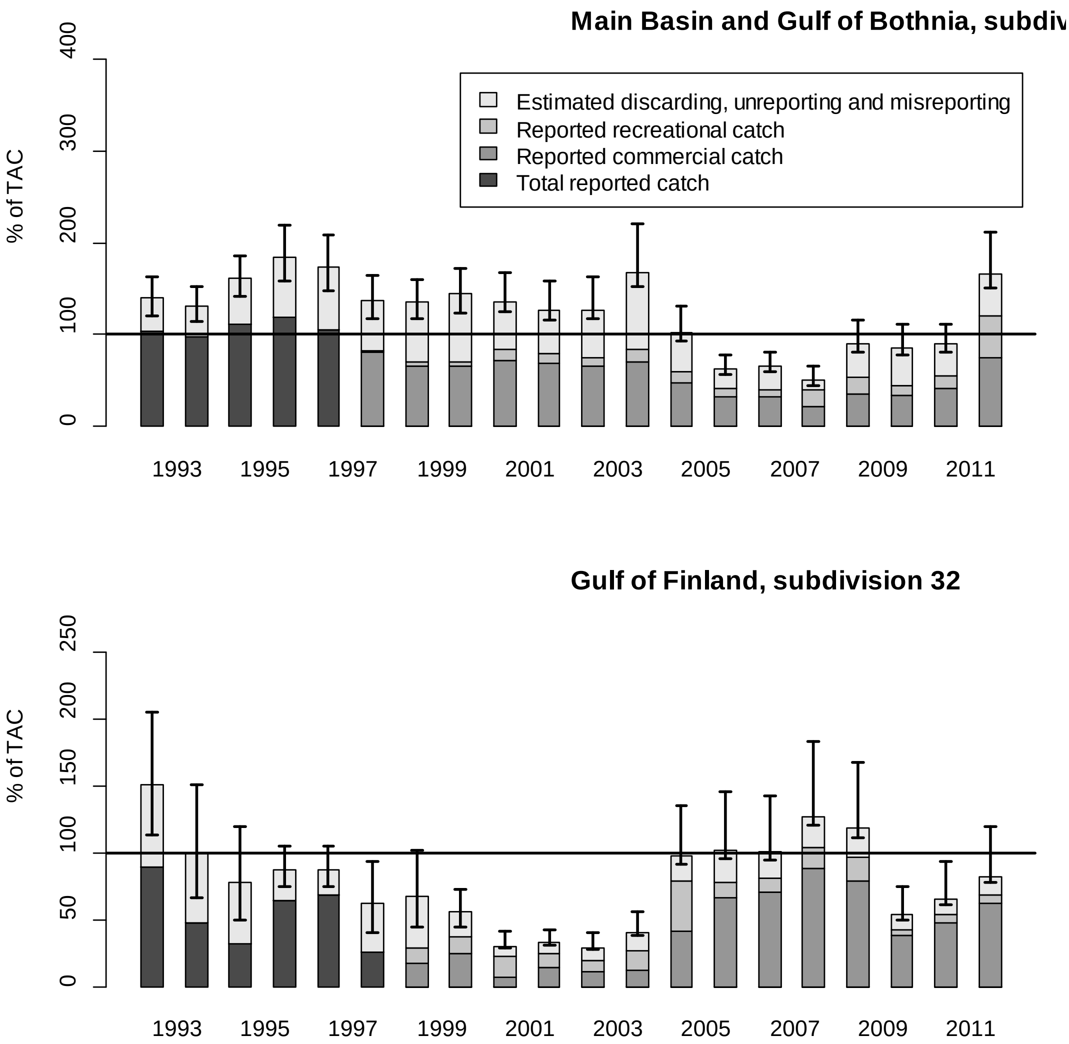


Figure 2.2.3. Catches of salmon in % of TAC. For years 1993–1997 (1993–1998 for Gulf of Finland) it is not possible to divide the total reported catch into commercial and recreational catches. Estimates of discards and unreported catches are presented separately in Table 2.2.2.

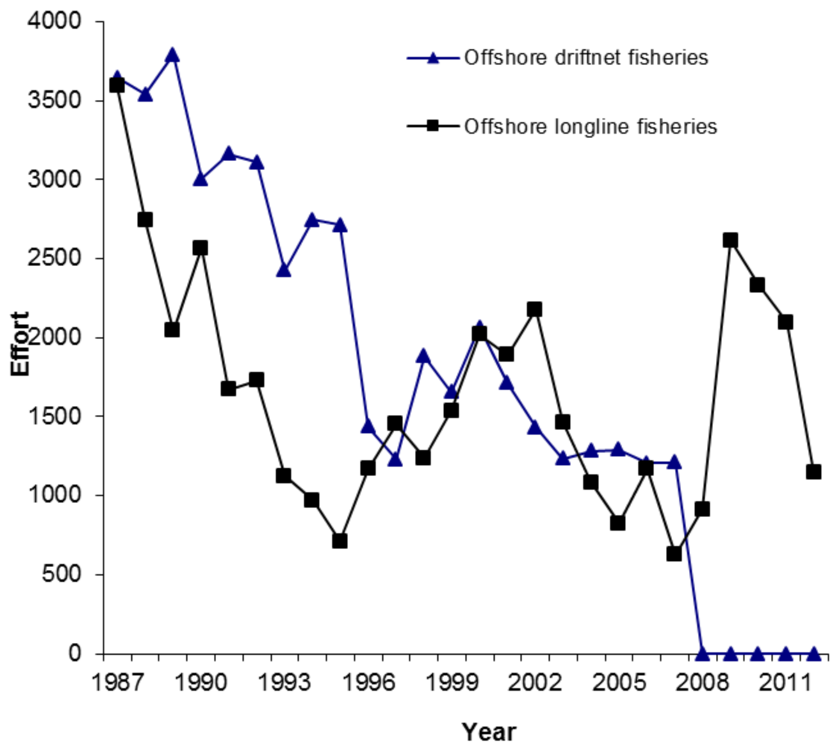


Figure 2.4.1. Fishing effort in Main Basin offshore fisheries (x 1000 geardays).

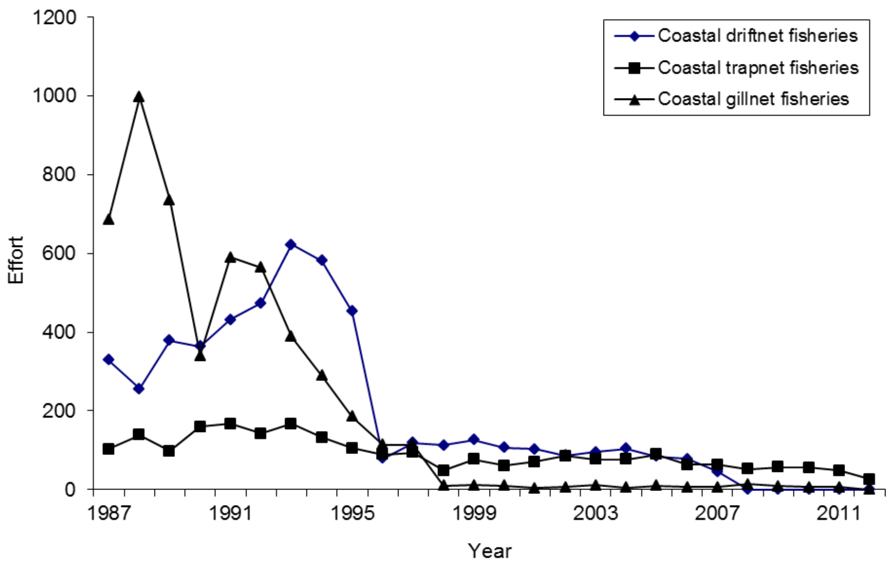


Figure 2.4.2. Effort in Main Basin and Gulf of Bothnia coastal fisheries (x 1000 geardays).

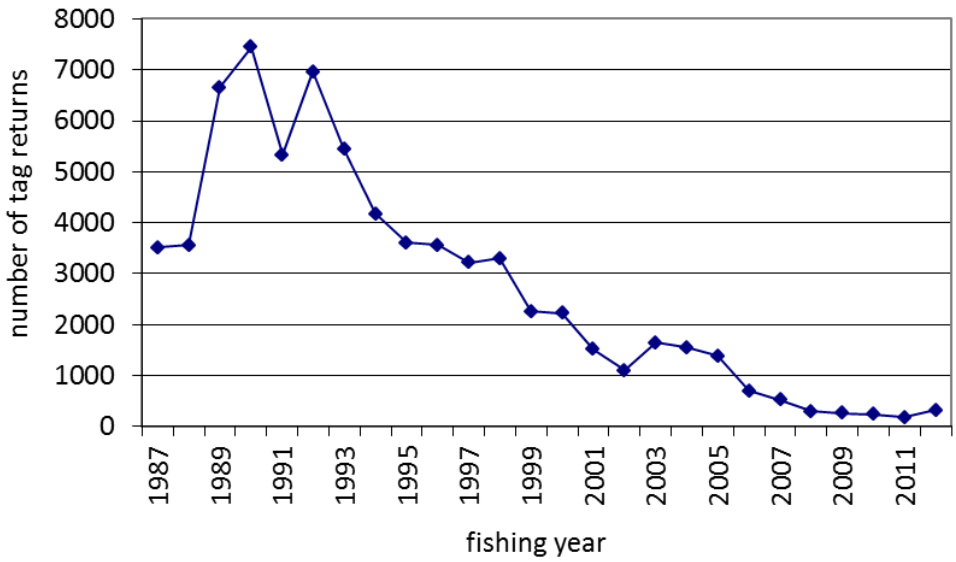


Figure 2.6.1. Number of tag returns available for the Baltic salmon stock assessment.

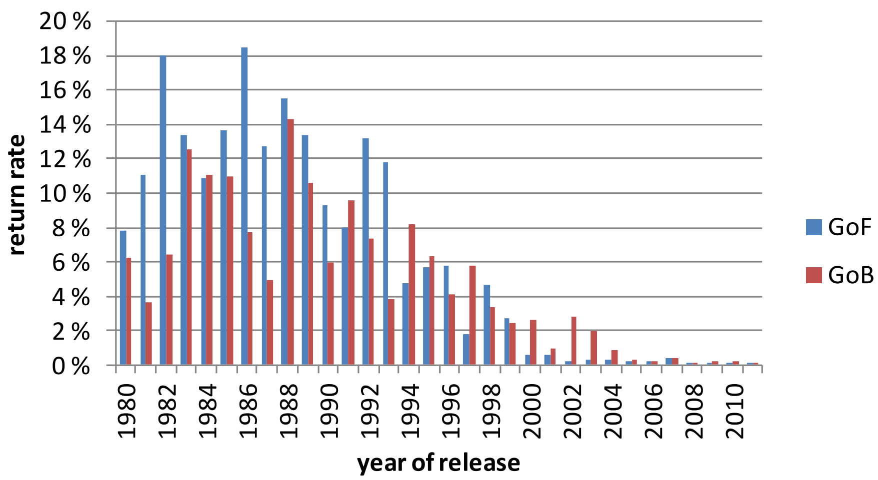


Figure 2.6.2. Return rates of Carling tagged salmon released in Gulf of Bothnia and Gulf of Finland in 1980–2012.

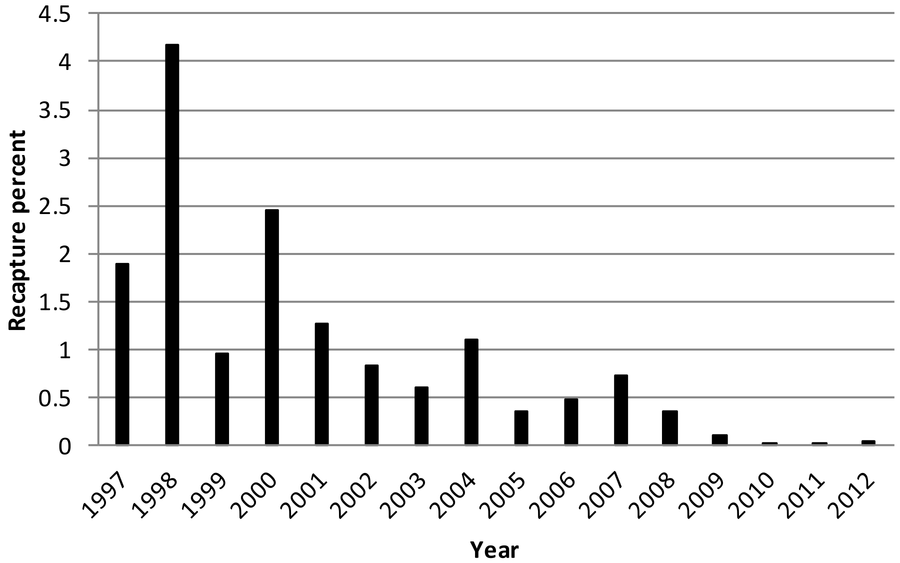


Figure 2.6.3. Recapture rate (in percent) of two-year-old Carlin tagged salmon in the Gulf of Finland.

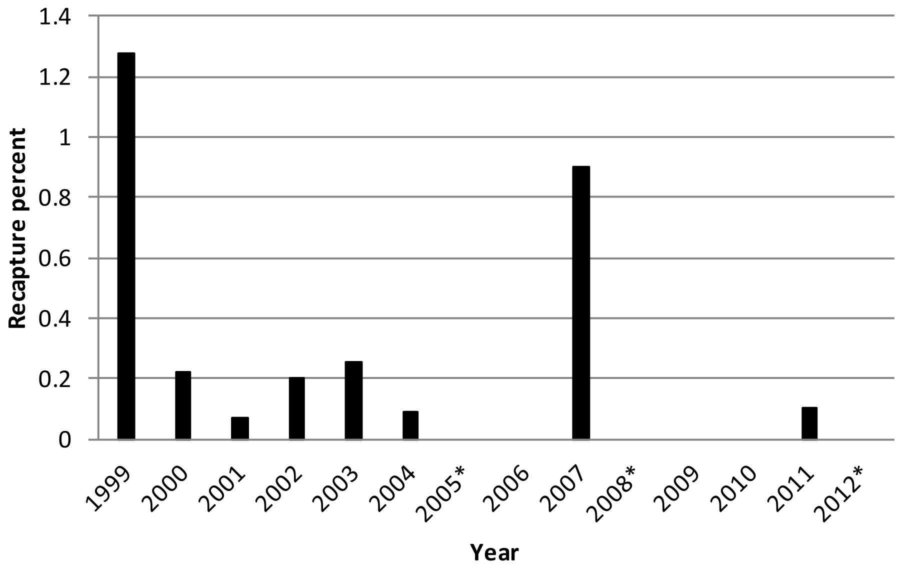


Figure 2.6.4. Recapture rate (in percent) of one-year-old Carlin tagged salmon in the Gulf of Finland (*-no fish were tagged in 2005 and 2008).

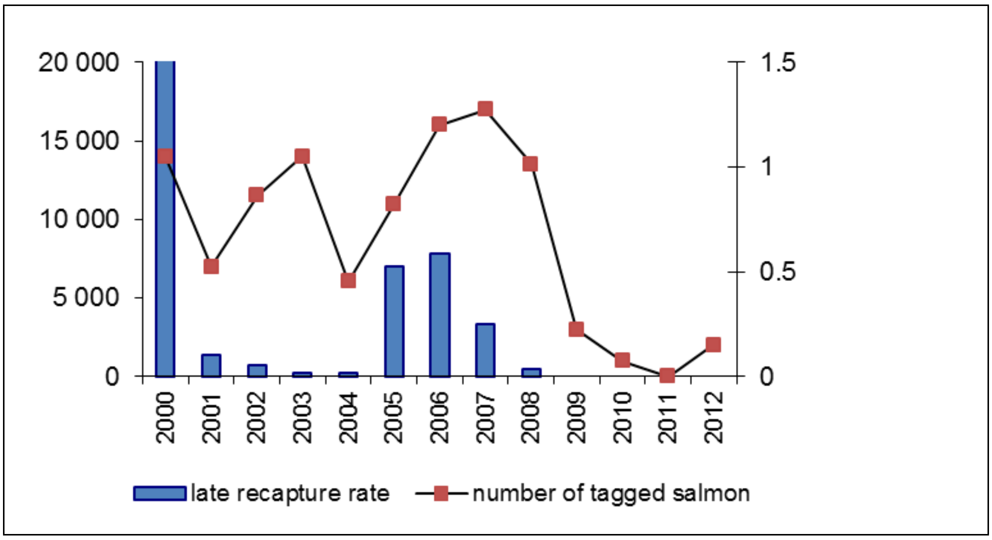


Figure 2.6.5. Return rates for salmon in 2000–2012 in Poland.

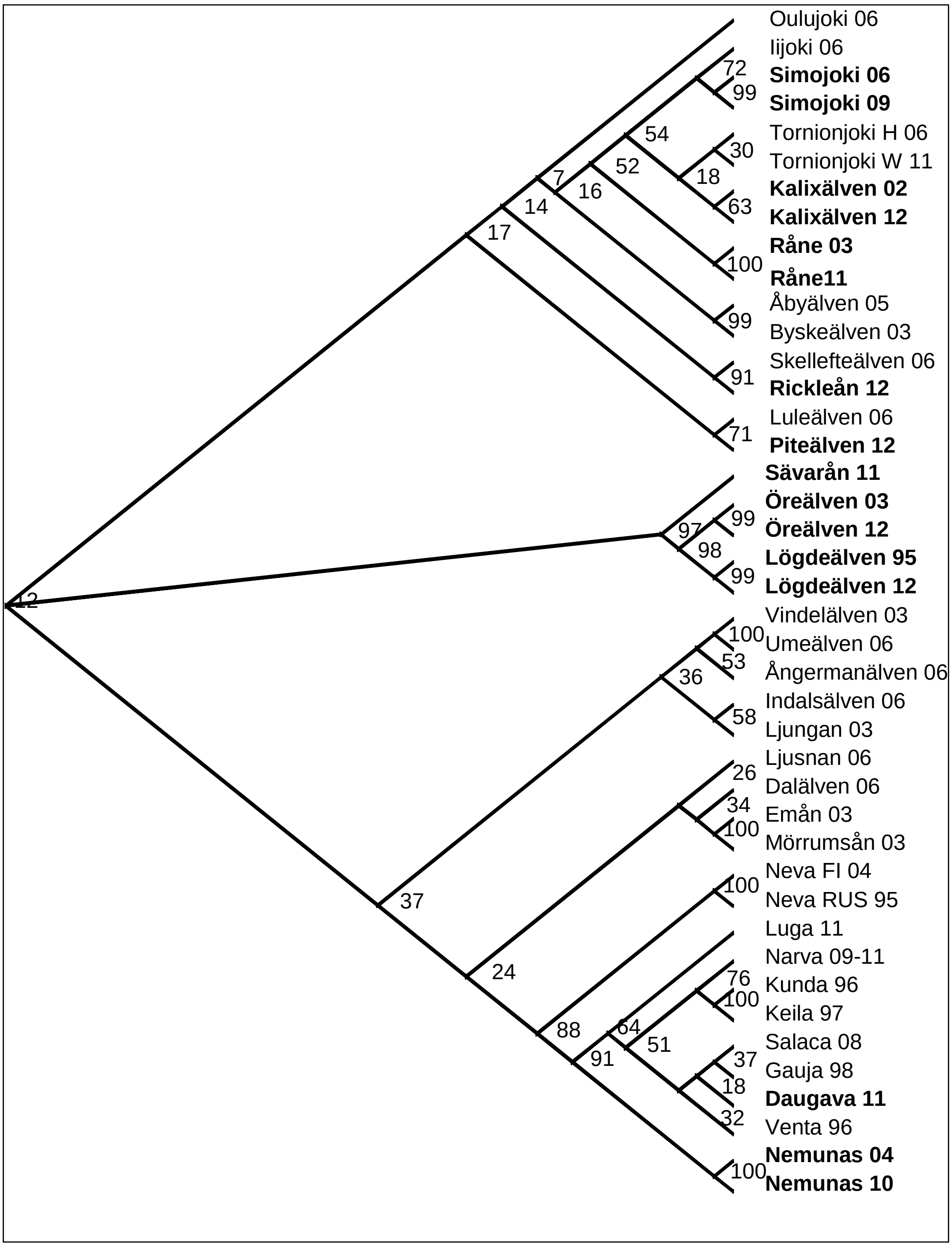


Figure 2.8.1. Dendrogram over stocks included in the baseline used for 2013 analyses of catch composition. Updated or new samples are indicated in bold text. See text for more information.

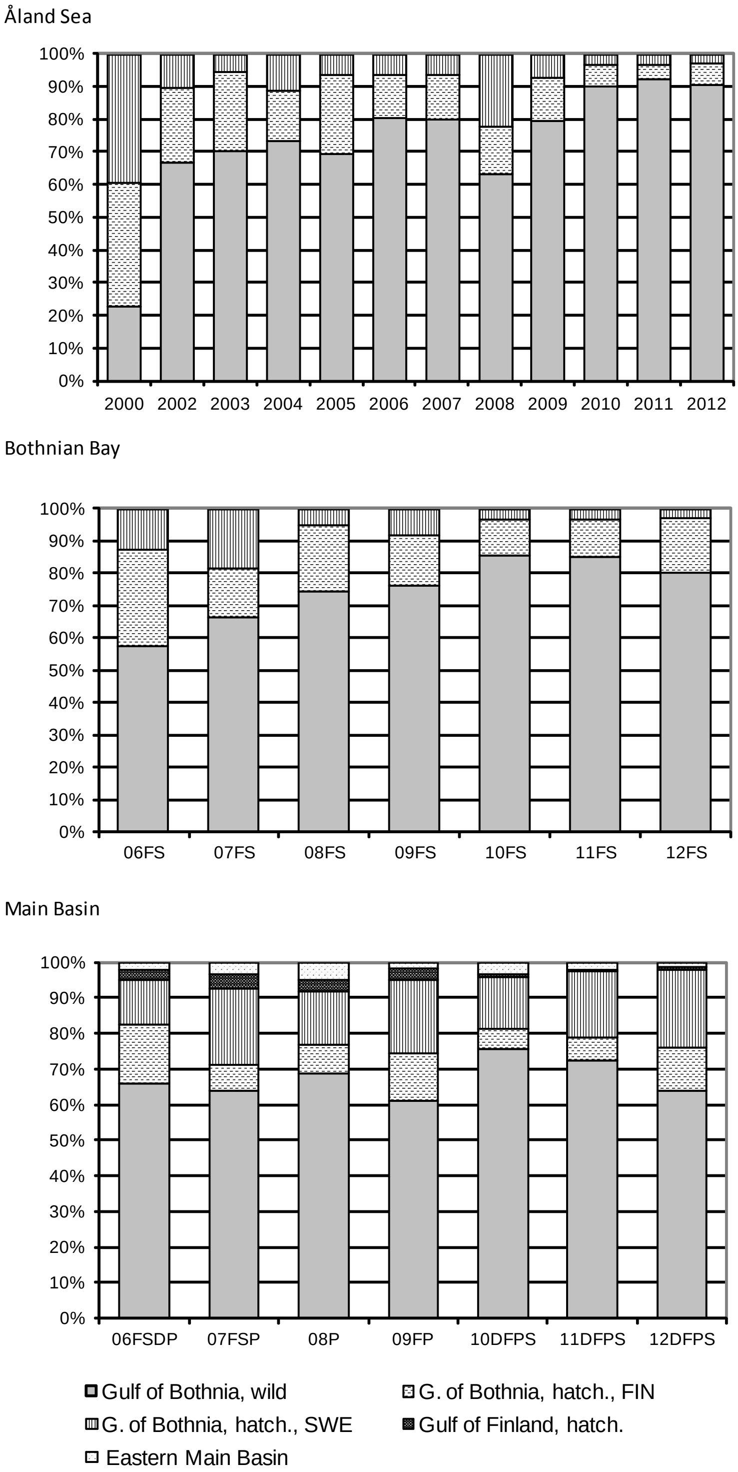


Figure 2.8.2. The proportion of Atlantic salmon stock groups in catches from three Baltic Sea areas.

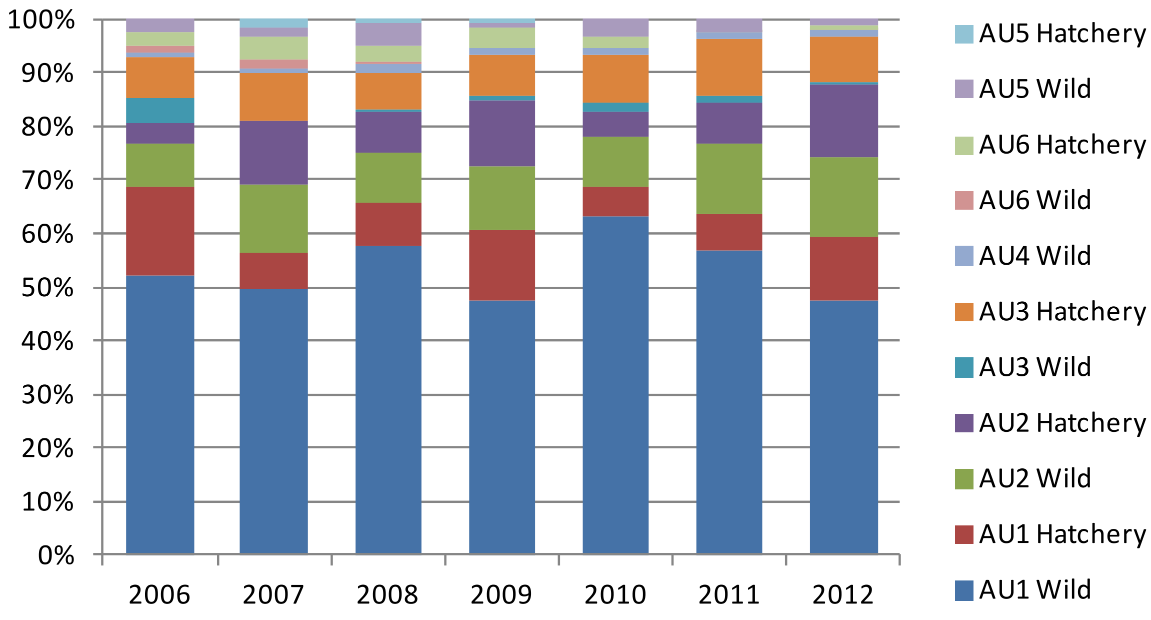


Figure 2.8.3. Proportion of wild and hatchery salmon from different assessment units in catches from the Main Basin.

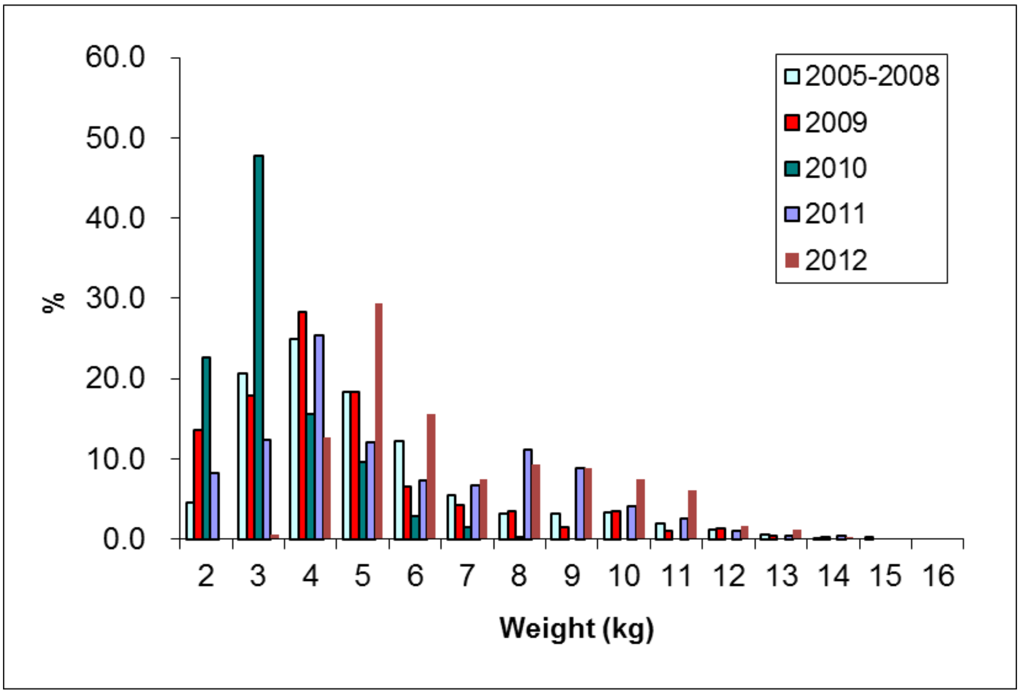


Figure 2.10.1. Weight distribution of sampled Polish catches of salmon 2005-2012.

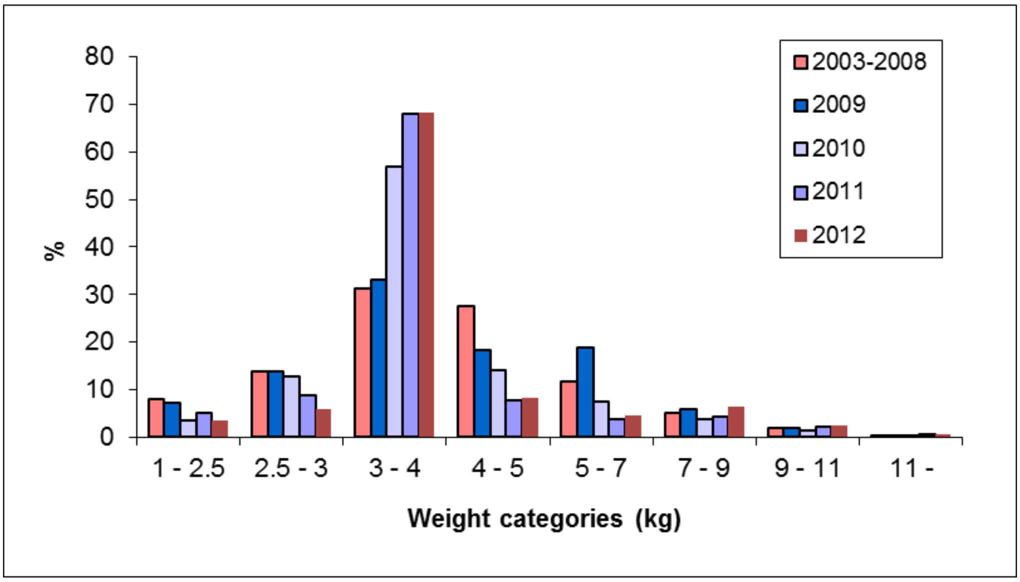


Figure 2.10.2. Weight distribution of sampled Danish salmon 2003–2012.

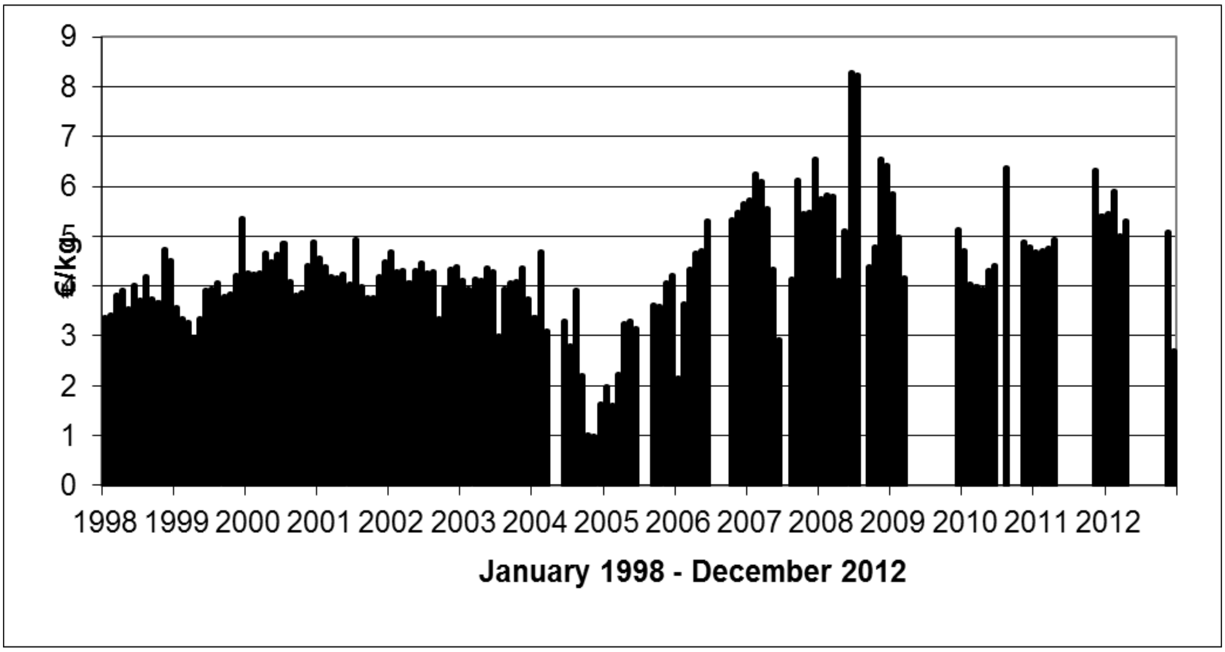


Figure 2.10.3. Monthly real salmon prices in Denmark. Empty spaces denotes months without landings in Denmark. Salmon prices (http://naturerhverv.fvm.dk) are converted to real values by using the Danish consumer price index (2000=100) (http://www.statistikbanken.dk). Value in DKK has been changed using the rate: 1 DKK=0.13457 EURO.

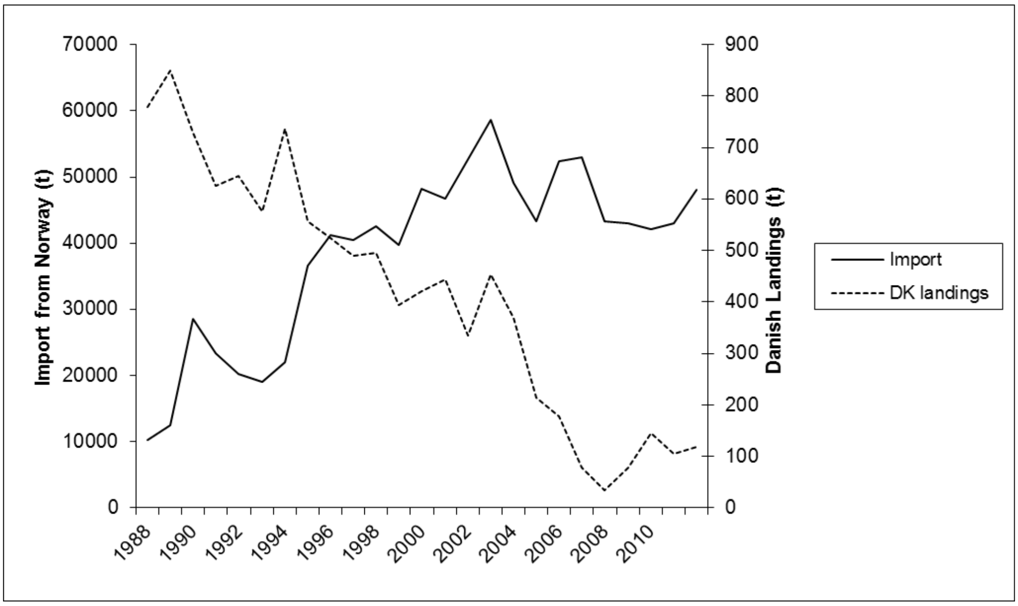


Figure 2.10.4. Danish landings of salmon (tons) and import to Denmark of farmed salmon from Norway (tons) during the period 1988–2012. Source: Statbank Denmark, http://www.statistikbanken.dk.

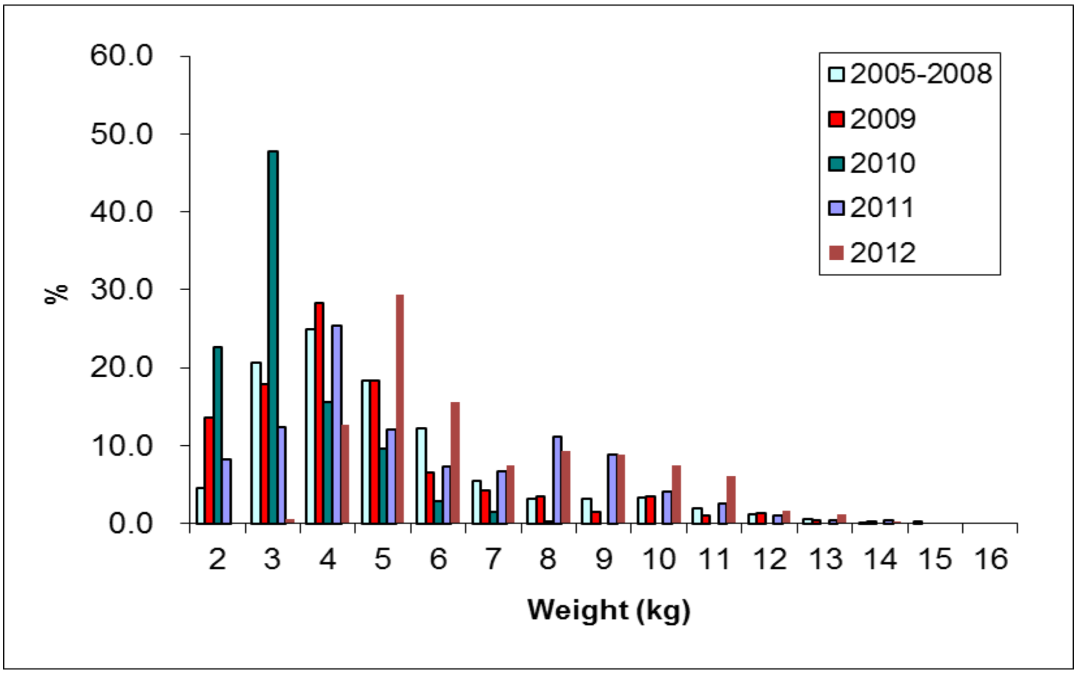


Figure 2.11.1. Weight distribution of sampled Polish catches of salmon 2005–2012.

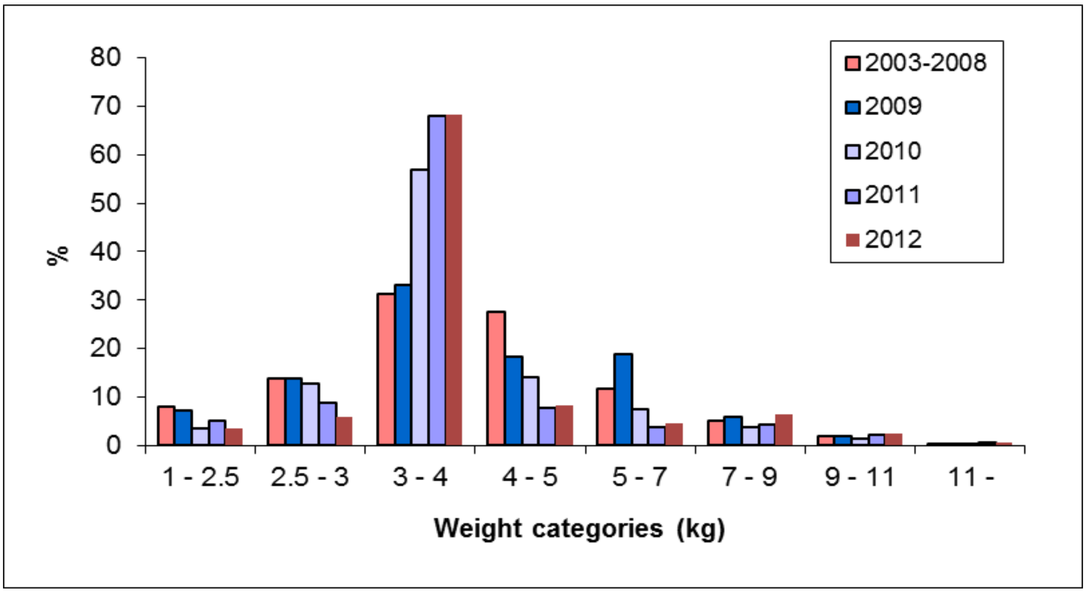


Figure 2.11.2. Weight distribution of sampled Danish salmon 2003–2012.

3 River data on salmon populations

The Baltic salmon (and sea trout) rivers may be divided into four main categories: **wild**, **mixed**, **reared** and **potential**. The list of wild rivers was updated and now includes also River Testeboån. The working group evaluated the reintroduction programme in the river and found that the river stock now fulfils the criteria for a wild river (for more information see section about potential rivers below). This change has not been included in the list of wild salmon rivers in the Stock Annex (Annex 3), which will be updated first during the next benchmark protocol.

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 the 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 the catch statistics from the **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, a clear increase in the river catches was observed. Salmon catches 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 was a new prominent rise in 2008. Exceptionally warm and low river water prevailed in these rivers during the summers of 2002, 2003 and 2006, which might have affected fishing success. Anyhow, exceptional circumstances cannot fully explain the reduced catches, but instead it is likely that the abundance of spawners was generally lower until 2008 (but see development in fishladder data from **Kalixälven**). In both **Tornionjoki** and **Kalixälven** the catch in 2008 was about double the catch in 2007 and 3–5 times higher than the catch in 2005. However, in 2009–2010 the catches dropped in all rivers. The catch in 2010 in Kalixälven was the lowest recorded since the beginning of the 1980s. After 2010, however, the catches (kg) in the Tornionjoki, Kalixälven and Simojoki started to increase again. In 2012, the catch in the Tornionjoki was three times higher than in 2011 and by far the highest in the records of the last decades, exceeding for the first time 100 tonnes (Table 3.1.1.1). Similar catch levels were observed in the early 20th century (Figure 3.1.1.1). Catches in 2012 did not rise in other rivers as much as in the Tornionjoki. The relatively low catch in Simojoki is partly due to the present low fishing effort.

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 ten to twenty-fold 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, when the total river catches were also peaking. In 2012 the cpue was 1253 grammes/day, which is the record of the whole time-series and which indicates a rapid increase of abundance. The 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 2007–2012. Every species passing both up- and downstream is distinguished with video recording. Totally six species (salmon, trout, whitefish, grayling, bream, and ide) where registered in 2007–2012. From the electronic registration 1999–2006, when species was not possible to distinguish, in total 100 fishes were every year reduced from the total count and classified as trout, the remaining were assumed to be salmon. The level of reduction is based on earlier number from the manual control and recorded catches of trout in the area closest to the fishladder.

The highest number of salmon that passed the ladder occurred in 2001 and 2002 when over 8000 salmon passed. 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 high level as in 2001 and 2002 however the number of multisea winter salmon was the highest recorded. (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). A comparative study was performed in 2008 using both a DIDSON (see below) and a split-beam sonar at the same site; the study provided information for adjusting the split-beam counts. According to the monitoring results, the spawning runs into Simojoki gradually increased from 2004 (680 upstream moving fish longer than 63 cm) to 2008–2009 (1000–1130 upstream moving fish longer than 63 cm). In 2010–2011 there was a drop to a level of 700–900 fish per year. In 2012 the number of ascending fish increased fourfold from the previous year to about 3600 (Table 3.1.1.2). 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. About 31 800, 17 200, 23 100 and 61 500 salmon passed the counting site in 2009, 2010, 2011 and 2012, respectively (Table 3.1.1.2). 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). This total number of ascending salmon into the river is calculated to be about 33 000–35 000, 19 000–21 000 and 254 000-27 000 and 67 000–77 000 fish in 2009, 2010, 2011 and 2012, respectively. By subtracting the river catch from these amounts, the spawning population in the Tornionjoki is estimated to be about 27 000–28 000, 15 000–17 000, 19 000–21 000 and 51 000–62 000 salmon in 2009, 2010, 2011 and 2012, respectively. Grilse account for a small minority (7–17%) of the annual spawning runs. The calculated harvest rate in river fishing has been varying around 20% with a gradually increasing tendency.

About 8800 catch samples have been collected mainly from the Finnish **Tornionjoki** fishery of salmon since the mid-1970s. Table 3.2.1.3 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. From mid-2000s, caught fish became gradually older until 2008, when the average sea age decreased and 2-sea-winter fish accounted for a large majority of spawners. This together with the parallel jump in the river catch (Table 3.1.1.1, Figure 3.1.1.1) indicate that salmon which smolted in 2006 constituted a very abundant cohort in **Tornionjoki**. The spawners from 2006 smolt cohort were relatively abundant even in 2010 (as 4-sea-winter fish). In 2011, 3SW salmon (smolted in 2008) constituted a larger-than average proportion in the spawning run. The proportion of grilse was very low in 2010 catch, as it was also in the DIDSON counts, but the proportion rose again in 2011 spawning run (Table 3.1.1.2).). In 2012, 3SW salmon constituted again a somewhat higher proportion in the catches-than on an average. The other age groups accounted for rather normal proportions of catch in 2012, thus it seems that the very strong spawning run into Tornionjoki in 2012 was a result of abundant fish from several smolt cohorts. The proportion of females was close to average level in 2011 catch. Few reared salmon were observed in the catch samples and they were probably strayers from the nearby Finnish compensatory releases (intact adipose fins).

Parr densities and smolt trapping

The lowest parr densities in the longest time-series of electrofishing were observed in the mid-1980s (Table 3.1.1.4, Figures 3.1.1.4 and 3.1.1.5). Since then, densities have 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 5–40 times higher than in the mid-1980s. Annual parr densities have varied 2–5 folds during this decade, but without any clear trend.

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 river and even the measurements of parr densities. In the summer 2006, circumstances for electrofishing were extraordinarily favourable because of the very low river water level, i.e. the circumstances were opposite to those prevailing in 2004–2005. These kinds of changes in conditions may affect the results of any monitored variable. Therefore, one must be somewhat cautious when interpreting the results.

The mean density of wild one-summer old parr about doubled from 2010 to 2011, but in 2012 it returned back to the 2010 level in River **Simojoki** (Table 3.1.1.4). The densities of older parr increased slightly in 2012 compared to 2010-2011 densities. In **Tornionjoki** the mean densities of one-summer old parr decreased only slightly from 2011 to 2012, but the decrease was marked among older parr. Parr densities in the River **Tornionjoki** started to increase again after the mid-2000s (Table 3.1.1.4). Densities of 0+ parr reached an all-time high level in 2008, but after 2008 the densities decreased in 2009–2010 by 25% both years. However, the densities of older parr have dropped only little. This together with the high densities observed in 2011–2012 in **Tornionjoki** indicate that the smolt production in the near future may stay at the current level or decrease only slightly.

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 century. Thus, run of wild smolt has followed the 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 the level of 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 2012, successful smolt trapping was carried out only in **Simojoki**. In **Tornionjoki**, a high and late flood peak postponed the start of the trapping and the development of water temperature and daily catches (once the trap was set up) indicated that smolt migration had already started before the trapping started. The estimated number of smolts decreased from previous year in **Simojoki** and was about 19 300 smolts. The 95% PI of the posterior distribution was 16 000–46 000. The river model with 2012 data updates the 2012 smolt run estimates for **Simojoki** to about 31 000 (20 000–49 000), and to 1.6 million (1.3–2.1 million) smolts for **Tornionjoki**. The river model predicts some increase in smolt abundance for **Simojoki** but a slight decrease for smolt abundance in **Tornionjoki** for the years 2013–2014, which naturally reflects the most recent parr densities observed in these rivers.

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

River catches and fishery

The catch in **Piteälven and Åbyälven** in 2012 stayed at the same low level as in 2011. Catches in **Byskeälven** have varied during the 1980s between 251–687 kg. At 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. The catches decreased in 2011 with 40% compared to 2010 to 870 kg and in 2012 the catch increased three times compared with catches 2011. In **Sävarån** the catches 2012 was at the same low level as in previous years, only 15 salmon were caught. The catches in **Ume/Vindelälven de**creased from 370 salmon in 2011 to 275 salmon in 2012. In 2012 the catch in **Öreälven** was the same, 75 salmon, as in 2011. In **Lögdeälven** the catches has decreased in the three latest years from 80 to 30 and down to 12 for 2012.

Spawning runs and their composition

In almost all rivers the upstream migration is counted by electronic, infrared fish counter, "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 is three times higher than the two latest years. (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 powerplant station (the only one in **Åbyälven**) with a fish-ladder 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 fishcounter with camera was installed for registration of species. Only salmon and trout were detected in 2009–2011 and from earlier manual control no other species have been registered. Based on the species distribution of salmon and trout, the number of salmon registered from 2000 has been reduced by 15%. The total run 2012 increased to 88 salmon compared with 36 salmon in 2011 (Table 3.1.1.2, Figure 3.1.1.3). Very low water level in the river can cause shut down of the power plant which makes it almost impossible for fish to enter the fish-ladder. In 2006 the power plant station was stopped for one month causing no passage of fish during that time. The water level 2012 was at mean level during the beginning and middle of the migration season causing no problem for fish to enter the ladder, but in the end of the season the water level increased and caused problems for fish to detect the ladder entrance. About eight salmon which is 10% of the total run died in the small pools that remain after shutting down the spill gates. The power company have fixed the small pits after the migration season so no fish will remain in the pits at any spill in the side channel.

In **Byskeälven** a new fishladder was built in 2000 on the opposite side to the old ladder. The waterfall is a partial obstacle for the 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. The run in the fishladder is part of the entire run. Low water level can increase the possibility for salmon to pass the natural waterfall while high water level decreases the possibility to force the waterfall. The total run has decreased yearly from 2004 to 2006, but in 2008 the number of salmon increased to 3409 which is the highest level since 1996. The run in 2009 decreased almost by half to 1976 salmon compared to the run 2008 and in 2010 the run was at the same level as in 2009. The run 2012 increased with 70% compared to 2011 and the total number of salmon was 2442 (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. Fishpassage is controlled with an electronic counter (Poro) 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 at 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 2009–2012 compared to five, seven, two and one salmon 2008, 2007, 2006 and 2005, respectively.

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 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, when the total run was divided into reared (absence of adipose fin) and wild salmon, the highest number of wild salmon occurred in 2002 when 6052 passed the ladder (6832 including reared). In 2012 the run of wild salmon increased to 8058 which is 65% higher compared to 2011 and the highest recorded. In addition to the wild salmon, 1651 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 two years and some modification was carried out last year in the entrance of the ladder which may have resulted in a positive effect for fish to detect the entrance.

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. During the time-series, the same group of people have made most of the electrofishing in Swedish rivers in assessment unit 1–4. At 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 have some possibility to catch parr. In 2003 and onward changes has been made in assessment unit 1 and 2 by reducing the size of the sites to about 300–500 m² due to the higher parr densities. In the summer 2006, 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, Subdivision 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 has 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 **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 2005 the densities of 0+ parr was 6.4/100 m² which is almost the same as the year before. In 2006 the densities reached the highest observed density 27.2 parr/100m². In 2012 the densities decreased with 50% compared to 2011. Densities of older parr in 2011 were the highest recorded; 14.7 parr/100 m² and stayed at the same level in 2012 (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. In 2006 the densities of 0+ parr decreased by half compared to 2005 when the density was 26.2 parr/100m². In 2007 the densities decreased to 6.8 parr/100 m² which is the lowest number since 1995. In 2012 the densities stayed at the same level as in 2010 (Table 3.1.2.1).

In **Rickleån**, the 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. In 2012 the densities increased compared to 2011 but stayed at low level (Table 3.1.2.1).

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 the highest densities occurred, 12.8 parr/100 m². Difficulties in the electrofishing with only some of the sites examined in 2000 might in part explain the very high number. No electrofishing was made in 2001 and 2004. The density in 2006 increased to 12.5 parr/100 m² which was the same level as in 2000. The mean of older parr (>0+) for the latest ten years is 5.3 parr/100 m². In 2011 the density stayed at the mean level for the last ten years. The densities in 2012 was the highest recorded both for 0+parr and older parr (Table 3.1.2.1).

In **Ume/Vindelälven**, the 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. The highest densities occurred in 1998 and 2003 when they were 21.6 and 24.0 parr/100 m², respectively. The densities of one year old parr stayed at the same level in 2010 as in 2009 but the densities of older parr increased and was the highest recorded. No surveys were carried out in 2011 due to high water level. In 2012 the densities of 0+ parr increased to the highest recorded level as in 2002 and 2003 (Table 3.1.2.1).

In **Öreälven**, the mean densities of 0+ parr in 1986–2000 have been very low: about 0.5 parr/100 m². In 2002 the densities increased to 6.7 parr/100 m². The density of 0+ parr in 2009 increased to 10.7 parr/100 m² which was the highest recorded so far. The density of 0+ parr in 2012 increased with 50% compared with the two earlier years. (Table 3.1.2.1).

In **Lögdeälven**, the 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, which is the highest recorded density. The density 2007 decreased to 2.9 parr/100 m² which is the lowest densities since 1997. In 2012 the densities decreased with 50% compared to the four latest years (Table 3.1.2.1).

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 and 28 wild salmon smolts were caught in 2005–2012, respectively. Fish were caught from mid-May to mid-June. The 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 number of recaptured tagged fish in the trap has varied between 4–23% during the trapping years, given rise to estimates of smolt run presented in Table 3.1.1.5.

In **Vindelälven** a smolt fykenet, of the same kind as used in Tornionjoki since the 1990s, has been used for catching smolts in 2009–2012. In Vindelälven, the entire smolt production area of the river is located upstream of the trapping site. In total, 2275, 1648, 2496 and 2628 salmon smolts were caught in 2009, 2010, 2011and 2012 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 caught during the whole time period with a peak in mid-June. In 2010 a pronounced spring flood caused problem to set up the fykenet trap and a considerable part of the smolt run was missed. Therefore, 2010 smolt counting could not be included in the assessment. 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, several episodes of high water flow resulted in repeated "breaks", and for this year it seems hard to even produce a crude guess of the proportion of the total smolt run that was missed.

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

River catches and fishery

In **Ljungan**, the salmon angling catch was 68 salmon in 2012 compared to 37, 40, 21, 35, 45and 30 in 2006–2011, respectively. The catches have slightly increased compared to the years 2000–2002 when 18, two, and one salmon, respectively, were caught by angling.

Parr densities

The densities in **Ljungan** of 0+ parr/100 m² in 1990–2005 have varied between 3.1 and 45.3, and the mean density has been 15.1 0+ parr/100 m² during the period (Table 3.1.3.1 and Figure 3.1.3.1). In 2005 the densities of 0+ parr/100 m² increased to 45.3 compared to 3.0 in 2004. One-summer old parr were observed in all of the study sites in 2005. No electrofishing was carried out in 2006 because of high water level in late autumn. The decrease in 2007 of the densities of 0+ parr could have been caused by the high water level during the surveys. In 2008 the density of 0+ parr increased to 19 parr/100 m² compared to 2007. Only three sites were possible to sample due to a high water level. During the last three previous years, no surveys have been carried out due to high water levels and in 2012 only one site were possible to survey due to high water level and the density was high 91 0+ parr/100 m²

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

River catches and fishery

In **Emån**, no salmon was reported as caught and retained in 2012 and 2011. The retained catches in 2005–2010 were 12, 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 could be an important reason for the decreasing catches.

In **Mörrumsån**, the retained salmon catches have varied during the latest five years between 149 and 536 salmon. In 2012 the catches (288 salmon) increased compared to 2011 (212 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 has increased. This could be one reason for decreasing catches in recent years.

Parr densities and smolt trapping

In **Emån**, the densities of parr in electrofishing surveys below the first partial obstacle in the river 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 is 43 parr/100 m². The highest densities of 0+ parr occurred in 1997. The density of 0+ parr was 47 parr/100 m² in 2012 which is 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 1992–2012 with a mean value of 3 parr/100 m² during the latest years.

The production estimates in River Emån have been a problem in the current assessment model used by WGBAST. According to the model the current production would be 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 smolt production in Emån river has not shown any positive signs after the 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 suggests that it is migration problems that have caused this lack of effects. Earlier work in WGBAST has estimated the spawning areas available for salmon in Emån but it is argued that very few salmon can migrate to these areas. Monitoring of salmon migration in one fishladder during 2001–2004 suggests that very few salmon could reach some of the upstream potential spawning areas.

In order to get a quantitative estimate of the smolt run in the river, smolt traps have been operating 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 of 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. The estimated salmon smolt run in 2008 was 3473 smolts (95% confidence interval 1536–5409 smolts). The trap efficiency was estimated to 6.1%.

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 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 since the mid-1990s. In 2012 the densities increased to 96 parr/100m². The probable reason for the lower density in both 2007 and 2011 was the high water level, as only part of the survey sites were possible to electrofish. In the 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 m^2 which is higher than in the three years before. The amount of hybrids has decreased in 2006–2011: only two 0+ hybrid parr/100 m^2 was caught in 2011, but in 2012 the hybrids increased slightly and the density of 0+ was 6 parr/100 m^2. In 2004 two new fishladders were built at the power plant station about 20 km from the river mouth which opens up about 9 km of suitable habitat for salmon including about 16–21 ha of production area.

In 2009–2012, a smolt trap wheel with leaders was operated in Mörrumsån 15 km upstream of the river mouth. Less than 50% of the production area for salmonids is located upstream this point. The main reason for choosing this location is that counting of ascending adults in a fishladder takes place close to the smolt trap site, which makes it possible to compare number of spawners and resulting smolt production in the upper part of the river.

In 2011 a total of 659 smolts were caught compared to 740, 512 and 138 smolts in 2011, 2010 and 2009, respectively. The efficiency was estimated to be 10.8% in 2012 10,3% in 2011, 13,3 % in 2010 and 5.8 % in 2009. Mörrumsån is located quite close to Emån in southern Sweden. 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.

In Mörrumsån the smolt production estimates for salmon has been much lower than expected in 2009–2012 (2000–7000). As a comparison, Lindroth (1977) performed smolt trapping in 1963–1965 close to the site chosen in 2009 and estimated the average yearly smolt production for salmon in the upper part of the river to 17 600 (range 12 400–25 000). Although releases of salmon fry occurred in Mörrumsån in the 1960s, which complicates any direct comparisons, the estimates for 2009–2012 appear low also in relation to the number of ascending spawners and to parr-densities observed at electrofishing during recent years. Further work will be needed to understand the apparently low smolt estimates from Mörrumsån and to resolve uncertainties, including a more refined habitat mapping and electrofishing at additional sites.

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 1996–2010. The number of parr/100m^2 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 2012 0+ parr occurred on the site but in low densities. In 2008 flood reduced the catchability. Part of a potential spawning area was cleaned from excessive vegetation in autumn 2004 and 2005 but parr density has not increased.

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:

6) Salmon monitoring carried out in 11 rivers (two river basin districts) with 48 electrofishing stations in total, smolt trapping in the river Salaca;

7) Fish background monitoring carried out in 28 rivers (four river basin districts) with 56 electrofishing stations in total.

In 2012 salmon monitoring was carried out in a reduced intensity. All together 41 sites in three (ten rivers) river basins were fished 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 all releases of artificially reared salmon in the river Salaca were stopped.

In 2012, ten sites were sampled in the river **Salaca** and its tributaries. All sites in the main river hold 0+ salmon parr. The 0+ salmon parr occurred in the Salaca tributaries **Jaunupe, Svētupe** and **Korģe**. Average density of 0+ salmon parr was 72 per 100/m^2. Density of 1+ and older salmon parr was 1.9 per 100/ m^2. Density of wild salmon parr in the river Salaca tributaries was 15.2 per 100/m^2.

Smolt trap in the river **Salaca** was in operation between 2nd of May and 28th May 2012. In total 385 salmon and 718 sea trout smolts were caught, 669 of them were marked using streamer tags for total smolt run estimation. The rate of catch efficiency was 8.4%. In total 4500 salmon and 8500 sea trout smolts was estimated to migrate from the river Salaca in 2012.

It is almost certain that the river **Salaca** monitoring data demonstrate that number of adult salmon probably is sufficient. It seems that fisheries management and effective fisheries control to 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 were found below the Rumba waterfall. In 2012 the number of 0+ parr increased compared to 2011 and parr were found on all sites. Older parr were found in low densities in 2012.

In the river **Gauja** wild salmon parr production in 2012 was lower in comparison with parr production in the tributary **Amata**.

Wild salmon were found in the river **Vitrupe**. Age structures testify that salmon reproduction occurred in the river at least in 2005, 2007, 2008 and 2009. The average 0+ parr density in 2012 was 5.7 per/100m^2.

Wild salmon parr has been caught with electrofishing in the rivers **Rīva** and **Saka**. Age structure of parr shows that salmon reproduction occurred in these rivers at least in 2005–2009. Wild salmon parr were also found in the river **Peterupe** (Saka system) and **Aģe** (small river in Gulf of Riga).

Lithuanian rivers

Lithuanian rivers are typical lowland ones and many of them are tributaries in Nemunas system. These are mainly the 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).

Electrofishing is the main monitoring method for evaluation of 0+ and older salmon abundance. Monitoring covers all main salmon rivers (including all potential rivers). In 2012 salmon parr were found in **Zeimena, Saria** (tributary of Žeimena) and **Neris.** No surveys were carried out in river Mera in 2012.

Abundance of salmon parr depends on hydrological conditions, spawning efficiency, protection of spawning grounds and migration ways. In 2021 the average density of salmon parr 0+ in the index river **Žeimena** decreased to 1.4 parr/100 m²; and >0+ were 0.6 parr/100 m². These values are at the mean value throughout the whole survey period. Salmon parr were caught in all five sites out of six. In 2012 the density increased in **Neris** River. In 2012, wild salmon parr were caught in seven sites out of nine in Neris River and the mean densities of 0+ parr increased to 3.3 ind./100 m²; and the densities of >0+ was 0.2 ind./100 m² (Table 3.1.5.2 and Figures 3.1.5.3 and 3.1.5.4).

Estimated salmon smolt production in 2012 in Lithuania increased to 33 300 compared with the last year (2011) when the production was 6656 smolt which gives an increased production within five times. Salmon smolt production increased significantly in all rivers; **Neris, Švenroji, Žeimena, Siesartis.** Only in **Vilnia** River smolt production remained at the same high level; 1597 ind., compared to multiannual average. In some other less important salmon rivers, smolt production increased notably, e.g. **Minija** River to 3117 ind., **Dubysa** River to 1232 ind. Smolt production decreased in **B. Šventoji** to 156 ind. Smolt production in small salmon rivers is significantly higher and reached 6400 individuals.

Salmon parr abundance increased in many sites of Neris River. Efforts to increase suitable areas for salmon in Lithuania were successful in Šventoji, Siesartis, Vilnia, Vokė, Dubysa rivers. Salmon is also present in many of the smaller rivers in the lower reaches of Mera, Kena, Musė, Širvinta, Virinta, Dūkšta, Žalesa, Saria. For the fourth time in recent years salmon parr has been recorded in western part of Lithuania - Minija basin. In Index River Žeimena there is only a natural population, no stocking has occurred. Due to successful stocking, salmon smolt production has increased in Siesartis River. Salmon stocking in Siesartis River was ceased two years ago. However, smolt production is still increasing indicating successful re-establishment.

Salmon restocking programme in Lithuania started in 1998 and there are lots of measures implemented every year to increase salmon population abundance, including artificial rearing, construction of fishladders, protection of spawning ground, stock monitoring, and scientific projects. Despite the measures taken, according to the data of salmon monitoring, smolt production in Nemunas basin increases very slowly. High increase in production was observed during the recent years. Smolt production increased substantially during 2007–2010, from 13 111 ind. to 47 843 ind. This could be due to good hydrological conditions and means directed towards protection of spawning grounds which were carried out for three subsequent years. Implementation of these measures helped to stabilize salmon population and prevented the risk for salmon extinction in Lithuania. Due to adverse ecological conditions, salmon parr density significantly decreased during 2010 in many important salmon rivers and in relation to this, smolt production decreased in 2011 down to 6656 smolt but in 2012 the production increased to 33 300 smolt.

All artificially reared smolts were not included in statistics. Salmon smolt production is affected by other factors as well. Water temperature in the Lithuanian rivers has been well above average during the last years and water levels were below normal. Also one of the main concerns in salmon rivers is the pollution problem. Another important factor is the fact that Lithuanian rivers are lowland type and there is a lack of habitats for salmon, only some river stretches are suitable for parr production. Quite high mortality rate caused by predators is another problem. The densities of predators are significantly higher in Lithuanian rivers compared with typical salmon rivers in the northern 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 low. 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, the natural reproduction is variable. Enhancement releases have been carried out in all of these rivers in 2000–2012 (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 has increased significantly since 2008 and in 2010 0+ parr density reached to highesest reported density (110.1 ind./100m^2). In 2011 the parr density decreased to approximately 25 ind./100m^2 which is still slightly above the long-term average and therefore it can be considered that the river Keila population is no longer in a critical state (Figure 3.2.6.1). The situation is more precarious in the rivers Kunda and Vasalemma where parr densities have remained at low levels. Despite of some strong year classes in these rivers no apparent increasing trend can be distinguished (Table 3.2.6.1).

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 small-scale wild reproduction has occurred in all of those rivers (Table 3.2.6.2). 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 3.2.6.2). In 2012 parr density increased considerably in all of them. In 2011 the parr density decreased in river Kymijoki and because of exceptional flow condition no parr density data are available from the year 2012.

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 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 in to 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 originate from spawners caught in the river Narva and Selja brood 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 are now replaced with 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 (79 100 smolts in 2011), however, still outnumber the natural smolt production (27 000 in 2011). 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 yr). 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 3.2.6.2). Lately, plans have emerged for building up fish passes and rebuilding salmon stock in river Kymijoki.

In the river Vantaanjoki, electrofishing surveys in 2010–2012 have shown only sporadic occurrence of salmon parr and only at a few sites.

In Russia the Luga and Gladyshevka River are the only rivers 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 in 2001–2012. 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 2012 the smolt trapping indicated some increase (6300 wild smolts) compared to previous year. 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.

Conclusions

The parr density in rivers Kunda and Vasalemma decreased slightly compared to 2011, but in the river Keila the density increased to a high level. The status of river Keila is no longer critical. However such improvement is less clear in Vasalemma and no clear trend can be seen in r. Kunda. Because of the high annual variation in Vasalmemma 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 2012 the parr density increased above long-term average in all of these rivers. Because of such high fluctuations in recruitment the status of these populations remains uncertain. To further safeguard these stocks additional regulatory measures were enforced in 2011 (see Chapter 2.9).

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.

Smolt production

Natural smolt production in Estonian, Finnish, and Russian rivers in the Gulf of Finland area was estimated to about 48 000 in 2012. The smolt releases in the period 2000–2012 has been on about the steady level. The exception was the year 2011 when releases were reduced to almost half (Table 3.4.1). The reduction in Russian smolt releases was caused by exceptionally warm climatic conditions in the summer 2010 causing high parr mortality in hatcheries and reared smolt production is planned to be kept at previous level.

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. Occurrence of wild-born salmon parr occurs in some potential rivers. For example, Kågeälven (au 2) and Testeboån (au 3) have had natural reproduction of salmon for a number of years. However, the Working Group has in previous reports pointed out that more information on the stock status is needed before any potential river could be transferred to the wild category. This year, an evaluation of the reintroduction programme in River Testeboån has been carried out, and the outcome of this evaluation was a decision that this river is now regarded as being a wild salmon river (see below for more information).

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 2012, 33 500 smolts and 40 000 one-year old parr of the river Iijoki origin were stocked in the Kiiminkijoki.

In the years 1999–2010 the average densities of wild (one-summer old) parr in the river **Kiiminkijok**i has have ranged between 0.7–8.2 ind./100 sq. m (Table 3.2.2.1). In the rivers Kuivajoki and Pyhäjoki, the corresponding densities have ranged from 0–3.2 and 0–1.9 ind./100 sq. m, 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 sq. m 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 was monitored until the spawning time. Also, downstream migration and survival of smolts through dams have been studied in these rivers.

Lithuania

In 2012, a total of 30 thousand salmon smolts were released into the four rivers **Neris**, **Šventoji** (Neris Basin), **Minija and Jūra**. Releases of 21 thousand salmon fry were carried out in **Vilnia, Muse, Vokė, Dūkšta** and **Kena** (Neris Basin). In total 14 thousand salmon fry were released in **Šventoji, Širvinta, Virinta** (Šventoji Basin). Five thousand salmon fry were released in **Dubysa** and **Lapiše** (Dubysa Basin). Five thousand salmon fry were released in **Minija, Žvelsa** (Minija Basin). 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 density was significantly lower in some larger tributaries of rivers **Neris** and **Šventoji**. The average salmon parr densities in **Šventoji** river basin were lower compared to the last year, the average densities decreased to 6/100 m^2 (0+4.0 and >0+1.5). In **Siesartis** river average density of salmon juveniles decreased to 3.7/100 m^2 (0+0.6 and >0+3.1). In **Vilnia** river density of juvenile salmonids decreased even more and the density were 0.5/100 m^2 (0+0 and >0+0.5). In rivers **B. Šventoji** the density was the same as the year before 3.0 ind/100 m^2 and **Dubysa** parr density increased to 1.6 ind/100 m^2. Salmon parr decreased in **Minija** river to 3.1 (0+1.4; >0+1.8) ind/100 m^2. In **Širvinta,** no electrofishing survey was carried out (Table 3.2.2.1).

Estonia

The rivers **Valgejõgi, Jägala** and **Vääna** were selected as potential rivers for Salmon Action Plan. Enhancement releases are carried out in river **Valgejõgi** and **Jägala**. In river **Vääna**, the most recent stocking occurred in 2005 (10 000 one year old smolts), stocking was then stopped due to the high risk of returning adults straying in to the neighbouring river Keila, which is considered to be a wild stock.

In the river **Valgejõgi** salmon 0+ parr have occurred regularly since 1999 (Table 3.2.2.1). There are three monitoring sites, but in 2007 0+ salmon parr were found only at the lowermost monitoring site at a density of 17.4 per/100 m^2 and more recently no wild parr was found in 2011. In 2012 the 0+ salmon parr were found in all monitoring sites and the average density was slightly above the long-term average (eleven per/100 m^2).

In the river **Vääna** low numbers of wild salmon parr have been found only in some years. Higher 0+ parr densities occurred in 2006 (17.6 parr/100m^2) and in 2008 (12.1 parr/100m^2) (Table 3.2.2.1). Wild parr were also found in 2009 (average density was9.0 parr/100m^2). No 0+ parr were caught in 2010 and 2011 and very low abundance (3.3 per/100 m^2) of 0+ were found in 2012.

In the river **Jägala** wild parr at low numbers was found in most of the years. No parr was found in 2011. In 2012 0+ parr abundance increased to 11.3 parr/100 m^2 (Table 3.2.6.2). The **Linnamäe** power plant is located about 1.5 km from river mouth and it was restored in 2002. During the restoration in 2002 and recently in 2011 large amount of soft sediments were released from water reservoir and spawning area below the dam. This had a strong negative effect on salmon spawning conditions however.

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 of successful re-establishment of self-sustaining salmon population (Table 3.2.2.1).

In 2011 the total number of released hatchery reared alevins was 50 000, fry 752 500, one-year-old parr 10 500, one-year-old smolt 274 700 and two-year-old smolt 30 500.

In 2011, spawners were observed in **Vistula** river system but there are no data on wild progeny. Totally 200 700 smolts and 261 200 fry and alevins were released into the river system (Subdivision 26).

Natural spawning was 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 37 000 of smolts and 153 000 younger fish (alevin, fry and parr) 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 2010 at a density of 9.0 0+ parr/100m^2. High water level made electrofishing on a monitoring site impossible in 2011. In 2011, a total of 305 200 smolts and 120 000 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 and alevins. It is interesting that 20 000 alevins released by World Wild Fund (WWF) into San, Vistula tributary, originated from the Swedish rivers Indalsälven and Ångermanälven.

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 2000 more than 100 000 young salmons have been released into the river. No releases were carried out in 2010. In 2012 about ten 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 m^2. In recent two years the density has decreased. In 2010, 0+ and older parr were detected during electrofishing, but the density was low and varied between 2 to 6 parr/100 m^2. The rapids of Gladyschevka have not been electrofished in 2011 and 2012 due to very high water level (Table 3.2.2.1).

Sweden

In Sweden, two salmon rivers, **Kågeälven** and **Testeboån**, have been selected nationally for reintroduction efforts, while several others, rivers **Moälven**, **Alsterån** and **Helgeån**, have restoration efforts on regional-local levels (Table 3.3.1.1). Densities of salmon parr have been quite high in rivers **Testeboån** and **Kågeälven** but they have decreased somewhat in recent years after the releases were stopped (Table 3.2.2.1). The last releases of newly hatched salmon fry in River Testeboån were made in 2006 and in Kågeälven in 2004. This means that parr found in electrofishing surveys now are the result of natural spawning.

There is a trap for ascending fish in river **Testeboån** but only a few salmon have normally been recorded every year. This seems to be due to the difficult conditions in the river mouth and around a hydroelectric power plant in the lower part of the river. Also, at higher flows, salmon can pass the dam beside the fish way where counting takes place, which means that the data on ascending spawners should be regarded as minimum values. In 2012 for example, only eleven salmon and 14 sea trout were counted in the fish way, which could be compared with the record year of 2008, when 31 salmon and 32 sea trout were counted in the fish way. However, high flow during a substantial part of the period for upstream migration in 2012 most likely resulted in that a majority of the fish passed the dam beside the fish way and were therefore not detected in the counting. Thus, more fish certainly entered the river in 2012. The same phenomenon has been observed, to a varying extent, also in previous years. Results from telemetry experiments for three years show high mortalities among emigrating smolts outside the river mouth. In high flow years the mortality appears to be lower than in low flow years. Migration problems for smolts may also partly explain the observed variation in number of returning adult salmon.

An evaluation of the reintroduction programme in River Testeboån was carried out in 2013 by the working group. The outcome of this evaluation was a decision by the group that River Testeboån should be regarded as a wild salmon river. It has therefore been moved from the list of potential rivers to the list of wild salmon rivers. The main arguments for classifying River Testeboån as a wild salmon river are the following:

- The last releases of reared salmon (fry) were made in 2006. Assuming a smolt age of two years (based on previous age analyses of smolts from the river), and that a majority of the returning spawners have spent two years at sea, 0+ parr observed in the electrofishing in 2012 were wild-born and mainly offspring of salmon which themselves also were wild-born. This suggests that the salmon have the possibility to fulfil the whole life cycle and are able to reproduce in the wild.
- A fairly stable level 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.
- The criteria for updating the status to "wild" presented by ICES (2008d, see also Stock Annex) are fulfilled. These criteria are less detailed as compared to the classification system presented by HELCOM (2011), but are not in conflict with either HELCOM's criteria nor the classification system presented in Commission's proposal for the establishment of a multiannual plan for the Baltic salmon stock (European Commission, 2011)(see table below).

Classification criteria for wild, mixed, reared and potential salmon rivers in the Baltic Sea according to ICES (2008d). Indicated in the table is also corresponding categories according to the classification systems adopted by HELCOM and EU Commission.

Category of salmon river	Management plan for salmon stock in the river	Releases	Criteria for wild smolt production	Corresponding categories according to Helcom's classification system	Commission's proposal of a multiannual plan for the Baltic salmon stock
Wild	Self-sustaining	No continuous releases	>90% of total smolt prod.	1–3	Wild salmon river
Mixed	Not self-sustaining at these production levels	Releases occur	10–90% of total smolt prod.	4	-
Reared	Not self-sustaining	Releases occur	<10% of total smolt prod.	5, 7	-
Potential leading to category wild	Lead to self-sustaining river stock	Releases occur during re-establishment	Long-term >90% wild smolt prod.	6	Potential salmon river
Potential leading to category mixed	Not self-sustaining river stock	Releases occur	Long-term 10–90% of total smolt prod.	-	-

Although River Testeboån now is included in the list of wild rivers, the inclusion of the river into the assessment model described in Section 4 will take time. There is a need to evaluate data needs to be able to carry out a reliable assessment of status of this river stock. The working group aims at performing at least a more simple assessment of stock status in 2014, but it will likely take additional time to include the river into the full assessment model. Necessary data to be able to carry out an assessment include e.g. prior probability distribution of the potential smolt production capacity (based on expert opinion ideally backed up with data). Also spawner count information should preferably be collected. Reliable spawner count data would improve estimation of stock–recruit parameters, especially when time-series of electrofishing data is short as is the case for River Testeboån. Also smolt counting would improve the assessment of status of the river stock.

In **Kågeälven** there is no trap for counting ascending spawners, but there is a successful angling in the river except for the latest years when only a few fish have been caught. The sportfishing in Kågeälven has successively become a catch and release fishing, and that could at least partly explain the low level of reported catches in recent years. The local administrator has recommended that salmon bigger than 80 cm should be released and from 2012 salmon are not allowed to be caught and retained. In the near future (potentially in 2014) also the reintroduction programme in River Kågeälven will be evaluated by the working group to investigate if the river could be classified as a wild river.

3.3 Reared salmon populations

The reared stocks in Sweden were severely affected by the M74-syndrome from spring of 1992 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 2012 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 are operated with equal intensity throughout the entire fishing season. This means that the catch in these traps can be considered as relative indices of escapement. In these rivers (Umeälven, Ljusnan and Dalälven) the catches in the five-year period 1995–1999 were considerably above the long-term average. This is to be expected because of the lower TAC and consequently a higher abundance of fish escaped from the sea to the rivers. The catches in 2000 in river Umeälven increased to the highest level since 1974. In 2001–2003 the catches decreased but in 2004 increased again almost to the level of year 2000 catches. In river Ljusnan the catches has been decreasing since 2001 and it was particularly low in 2003 when only eight salmon spawners were caught. The reason was uncertain but it is believed that seal predation may be a contributing factor to the low catch. In river Dalälven the catch in 2000 was about two times higher than the five-year-mean but decreased again in 2001 and has been since then at the average rates. In the river Skellefteälven the low numbers of salmon is at least partly due to inefficient function of both the catch gear in the broodstock fishery and the fishladder and the outlet passage in the weir in the lower part of the river. Catches in the coastal area and river mouth of this river indicate a similar abundance of salmon as in the other rivers. In total, the catches of spawners of the populations in Swedish rivers discharging into Subdivisions 30 and 31 decreased in 2004, but as discussed above the catch rates are often not a good indicator of the abundance of fish in the rivers.

The number of one-year-old salmon smolts has started to increase, especially in the most southern rivers. From 2008 to 2012 they made up of 34%, 40%, 45%, 50% and 59%, respectively, of the total 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 2013 indicates that the Swedish releases of salmon will be at the level of the water court decisions, approximately 1.8 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 three latest years the releases in Au 1 and 3 has been reduced to about 1.3 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 in 2012 they were 0.65 million.

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 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.

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 coastal fishery. However, no substantial surplus of fish has been observed in the rivers where compensatory releases have been carried out. Decrease in catches is considered to be based on reduced survival of salmon during the post-smolt phase. The tag return rate from year classes 1996 onwards has been substantially lower than long-term average levels. Return rates fluctuate in the same manner in different countries, indicating that long-term variation is partly caused by variation in the Baltic Sea ecosystem.

Wild smolt production has increased considerably since the mid-1990s, and wild salmon contribute significantly to catches. Catch samples from years 2000–2011 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 3.9 million and 0.6 million in assessment unit 6 (Subdivision 32) making a grand total of 4.5 million smolts in 2012 (Table 3.4.1).

Releases of younger life stages are presented in Table 3.4.2. 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 river 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

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

The proportion of females whose offspring suffered from M74 in 2012 was on average 1%, and below 5% in all cases, which is lower than ever since the beginning of the 1990s in the Gulf of Bothnia rivers (Table 3.5.1). Preliminary prognoses from River Dalälven and Luleälven of M74 occurrence among offspring that will hatch in spring 2013, which are based on subsamples of eggs which development have been forced by using warmer groundwater, indicate that the M74 frequency will be low in 2013. In addition, no signs of wobbling among mature fish were observed in autumn 2012, also indicating that the level of M74 mortalities will be very low among offspring that will hatch in 2013.

The M74 frequency in Table 3.4.1 has predominantly been given as the percentage of females whose offspring were affected by M74. In the Rivers Simojoki, Tornionjoki, and Kemijoki, mortality estimates are based on both the proportion of females affected 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). 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 part 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 suffer from M74 (Table 3.4.3).

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 1997 the M74 frequency, as a mean over monitored populations, has been below 40% in most cases and in recent years lower than that. 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 2011–2012 on the grounds of lower mortalities; in the year 2012 the incidence of M74 is by far weakest, practically non-significant, since the outburst of M74 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 3.4.1). 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 variation is very similar in the average data from Swedish and Finnish rivers but there appear to be some variation between rivers (Figure 3.4.1).

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). 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 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 grow less due to a lack of thiamine (Balk *et al.*, 2009). 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 and high condition factor 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), 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, and diminished body stores do not allow adequate deposition of thiamine into developing oocytes.

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, 2012c) the incidence of M74 has decreased during recent years almost disappearing in spring 2012.

In Section 5.3.6, 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 the 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 the substantial uncertainty in our knowledge of the M74 mortality in unmonitored stocks, but also 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.

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 and Keinänen *et al.*, 2008) but 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 1995, but no data for the years 2008–2012 exist because of problems in salmon collection for monitoring (Table 3.4.1). Thus the latest data from the R. Kymijoki are from spring 2007 (Table 3.4.1) 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). 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.

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, as compared to 2011, resulted in increased total river catches with 60–70% 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 2013 will stay at very low levels (Table 3.4.1).

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 negative trend over time (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. 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 and 2011 resulting in low densities of parr in 2009 and 2012 (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 the densities decreased to the lowest observed level since the mid-1990s, and the density in 2011 was also relatively low to again in 2012 reach the earlier higher densities. In the river **Gauja,** parr production level has been decreasing since 2004. It seems that in some of the small salmon rivers (**Barta**, **Saka**, **Peterupe** and **Vitrupe**) salmon reproduction occurs only occasionally.

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 different kinds of restoration and enhancement measures, which aim at stabilizing and improving natural reproduction. For instance, in the **Pärnu** river, cleaning of spawning grounds from extra vegetation and silt was carried out in 2004. In the river **Mörrumsån,** opening of new fishladders has increased the reproduction area accessible to salmon.

Table 3.1.1.1. 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 (au1) catch, kilo	Kalixälven (au1) catch, kilo	Byskeälven (au2) catch, kilo	Tornionjoki/ Torneälven (au 1) Finnish catch, kilo	Swedish catch, kilo	Total catch, kilo	CPUE 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
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

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 license.
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	Total	MSW	Total	MSW	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
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	
2011	791	1167	20326	23096	2202	2562	571	597	36	36	1187	1433	3992	1505	4886	
2012	2751	3630	50768	59533	7708	8162	1196	1418	74	88	2033	2442	5842	1765	8058	

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	2007	2008	2009	2010	2011	2012
N:o of samples	728	283	734	2114	2170	210	349	733	307	280	268	668
A1 (Grilse)	9%	53%	35%	7%	20%	6%	12%	8%	24%	3%	9%	9%
A2	60%	31%	38%	59%	50%	45%	34%	77%	59%	59%	42%	44%
A3	29%	13%	24%	28%	26%	40%	45%	10%	12%	25%	41%	40%
A4	2%	2%	3%	4%	3%	6%	7%	3%	3%	12%	7%	5%
>A4	0%	1%	<1 %	2%	2%	3%	2%	2%	2%	1%	1%	2%
Females, proportion of biomass	About 45 %	49%	75%	71%	65%	63%	70%	67%	62%	75%	63%	61%
Proportion of repeat spawners	2%	2%	2%	6%	6%	10%	10%	6%	9%	6%	9%	7%
Proportion of reared origin	7%	46 %*	18%	15%	9%	1%	2%	0.5%	1.3%	0.0%	0.0%	0.6%

* 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 was 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).

River	Number of parr/100 m² by age group						
year	0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
Simojoki							
1982	4.31			1.65	50%	14	No age data of older parr available
1983	0.83			2.86	57%	14	No age data of older parr available
1984	0.59			2.73	44%	16	No age data of older parr available
1985	0.11			1.08	8%	16	No age data of older parr available
1986	0.21			0.58	19%	16	No age data of older parr available
1987	0.82			0.81	27%	22	No age data of older parr available
1988	2.23	2.55	0.27	2.82	36%	22	
1989	2.57	1.27	0.38	1.65	41%	22	
1990	1.90	1.93	0.62	2.55	36%	25	
1991	4.05	1.92	0.71	2.63	32%	28	
1992						0	No sampling because of flood.
1993	0.09	0.38	0.95	1.33	19%	27	
1994	0.43	0.53	0.58	1.11	16%	32	
1995	0.73	0.35	0.14	0.49	31%	29	
1996	2.31			0.76	28%	29	No age data of older parr available
1997	12.12	1.53	0.32	1.85	72%	29	
1998	11.32	3.83	0.51	4.34	100%	17	Flood; only a part of sites were fished.
1999	23.11	11.5	2.66	14.16	93%	28	
2000	17.36	13.4	3.25	16.65	93%	27	
2001	9.74	7.9	3.58	11.48	72%	29	
2002	16.07	9.1	3.59	12.69	80%	30	
2003	21.89	5.85	1.56	7.41	90%	29	
2004	14.02	8.39	1.41	9.80	78%	18	Flood; only a part of sites were fished.
2005	20.35	8.22	2.08	10.30	82%	23	Flood; only a part of sites were fished.
2006	39.30	13.69	6.78	20.47	87%	31	
2007	4.95	2.88	1.34	4.22	43%	30	
2008	19.82	3.56	1.56	5.12	84%	31	
2009	28.56	13.41	2.17	15.58	76%	36	
2010	13.15	8.4	2.48	10.88	80%	35	
2011	29.00	7.35	2.66	10.01	83%	36	
2012	14.98	10.49	1.45	11.94	83%	36	

Table 3.1.1.4. Continued.

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	22.14	14.35	10.06	24.41	90%	78	
2012	19.81	7.57	5.40	12.97	92%	79	

Table 3.1.1.4. 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
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	
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	
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	
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	

Table 3.1.1.5. Estimated number of smolt by smolt trapping in the rivers Simojoki and Tornionjoki (assessment unit 1) and Sävarån (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. 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 (AU1)				Simojoki (AU1)				Sävarån (AU2)	
	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
1977					29,000					
1978					67,000					
1979					12,000					
1980					14,000					
1981					15,000					
1982										
1983										
1984					19,000					
1985					13,000					
1986					2,200					
1987	50,000 *)		1.11	32,129	1,800		1.78	14,800		
1988	66,000		0.37	11,300	1,500		3.73	14,700		
1989			1.22	1,829	12,000		0.66	52,841		
1990	63,000		0.20	85,545	12,000		1.41	26,100		
1991	87,000		0.54	40,344	7,000		1.69	60,916		
1992			0.47	15,000	17,000		0.86	4,389		
1993	123,000		0.27	29,342	9,000		1.22	5,087		
1994	199,000		0.16	17,317	12,400		1.09	14,862		
1995			0.38	61,986	1,400		7.79	68,580		
1996	71,000		0.60	39,858	1,300		28.5	140,153		
1997	50,000 **)			20,004	2,450		6.95	144,939		
1998	144,000		0.57	60,033	9,400		2.28	75,942		
1999	175,000	17%	0.67	60,771	8,960		0.75	66,815		
2000	500,000	39%	0.17	60,339	57,300		0.48	50,100		
2001	625,000	33%	0.09	4,000	47,300		0.15	49,111		
2002	550,000	12%	0.08	3,998	53,700		0.29	51,300		
2003	750,000	43%	0.06	4,032	63,700		0.26	18,912		
2004	900,000	33%	0.02	4,000	29,100		0.30	1,900		
2005	660,000	25%	0.00	4,000	17,500	28%	0.10	4,800	3,800	15%
2006	1,250,000	35%	0.00	3,814	29,400	35%	0.11	809	3,000	12%
2007	610,000	48%	0.00	8,458	23,200	20%	0.01	8,000	3,100	18%
2008	1,490,000	37%	0.00	6,442	42,800	29%	0.00	4,000	4,570	18%
2009	1,090,000	42%	0.00	4,490	22,700	29%	0.00	1,000	1,900	49%
2010	No estimate		0.00	4,965	29,700	28%	0.00	23,240	1,820	32%
2011	1,990,000	27%	0.00	3,048	36,700	13%	0.00	0	1,643	28%
2012	No estimate		0.00	4,437	19,300	37%	0.00	0	100	213%

*) trap was not in use the whole period; value has been adjusted according to assumed proportion of run outside trapping period

**) Most of the reared parr released in 1995 were non-adipose fin clipped and they left the river mainly in 1997. Because the wild and reared production has been distinguished on the basis of adipose fin, the wild production in 1997 is overestimated. This was considered when the production number used by WG was estimated.

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.

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
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.
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	
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	

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
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	
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	
Rickleån							
1988	0.00			0.23	0%	2	
1989	0.34			0.00	33%	6	
1990	0.69			0.24	29%	7	
1991	0.30			0.09	29%	7	
1992	0.22			0.05	43%	7	
1993	1.63			0.18	50%	8	
1994	0.63			1.18	38%	8	
1995	0.64			0.23	50%	8	
1996	0.00			0.10	0%	7	
1997	0.17			0.90	29%	7	
1998	2.56			0.99	86%	7	
1999	2.32			0.49	86%	7	
2000	3.41			4.04	100%	7	
2001						0	No sampling because of flood.
2002	2.42			2.58	43%	7	
2003	1.05			0.39	43%	7	
2004	1.13			3.24	43%	7	
2005	4.88			0.34	43%	7	
2006	3.88			5.70	86%	7	
2007	0.00			0.19	0%	7	
2008	4.16			2.16	43%	7	
2009	1.09			0.00	57%	7	
2010	3.73			6.23	100%	7	
2011	0.00			0.97	0%	7	
2012	0.91			1.96	86%	7	

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	
Ume/Vindelälven							
1989	1.57			1.97	67%	3	
1990	0.57			2.91	50%	12	
1991	2.28			1.11	50%	6	
1992							
1993	0.29			0.99	33%	6	
1994	0.51			1.10	24%	25	
1995	0.39			0.23	37%	19	
1996	0.30			0.95	14%	21	
1997	17.23			1.82	79%	19	
1998	21.59			11.12	100%	6	Flood; only a part of sites were fished.
1999	3.29			16.88	28%	18	
2000	4.53			3.99	75%	12	
2001	3.54			8.10	72%	18	
2002	21.95			18.21	89%	18	
2003	24.00			3.84	89%	18	
2004	12.09			10.36	83%	18	
2005	3.71			4.32	79%	19	
2006	16.44			9.52	63%	19	
2007	15.30			8.43	79%	19	
2008	8.46			5.55	79%	19	
2009	15.05			5.42	74%	19	
2010	12.60			18.48	100%	19	
2011							No sampling because of flood.
2012	21.15			11.65	95%	19	
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	
2012	7.35			4.32	80%	10	

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
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	

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

River	Number of parr/100 m² by age group					Number of	
					Sites with	sampling	
year	0+	1+	2+ & older	>0+	0+ parr (%)	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

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 0+	>0+	Number of sampling sites
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
2012	96	14	5

* Flood, only a part of sites were fished.

River year	Number of parr/100 m² by age group 0+	>0+	Number of sampling sites
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

* 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	Number of parr/100 m^2 by age group		Number of sampling
year	0+	>0+	sites
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	5.2	0	1
2010	0	0	1
2011	0	0	1
2012	2.4	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

Table 3.1.5.1. continued.

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
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
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

[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).

River year	Number of parr/100 m² by age group 0+	>0+	Number of sampling sites
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
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

Table 3.1.5.2. Continued.

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
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
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

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

River	Wild or mixed	Water quality[1)]	Flow m³/s		First obstacle km	Undetected parr cohorts 1997–2012	Production of >0+ parr 1997–2011
			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
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	1					

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	Jägala	1998	0.0	0.0	1
	2006	3.5	1.1	2		1999	1.3	0.0	1
	2007	12.5	0.2	3		2000	0.0	0.0	1
	2008	0.6	4.9	3		2001	18.9	0.0	1
	2009	1.8	4.1	3		2002	0.0	0.0	1
	2010	0.1	0.7	3		2003	0.0	0.1	1
	2011	0.0	2.1	3		2004	0.6	0.0	1
	2012	36.3	0.0	3		2005	4.4	0.0	1
						2006	0.0	0.2	1
Selja	1995	1.7	7.7	1		2007	0.0	0.0	1
	1996	0.0	0.5	1		2008	6.6	0.0	1
	1997	0.0	0.0	1		2009	0.4	0.9	1
	1998	0.0	0.0	1		2010	4.4	0.0	1
	1999	0.0	2.3	7		2011	0.0	0.0	1
	2000	1.5	0.3	3		2012	11.6	0.0	1
	2001	1.8	4.4	2					
	2002	0.0	0.0	2	Pirita	1992	2.4	0.8	1
	2003	0.0	0.1	3		1993	*	*	0
	2004	0.0	0.9	2		1994	0.0	0.0	1
	2005	5.2	2.1	4		1995	0.0	0.0	1
	2006	0.9	0.2	3		1996	0.0	0.1	1
	2007	0.3	0.1	4		1997	*	*	0
	2008	19.3	5.1	3		1998	0.0	0.0	6
	2009	19.8	4.9	4		1999	7.7	0.1	5
	2010	9.3	1.4	4		2000	0.0	0.6	4
	2011	1.9	1.0	4		2001	1.5	0.1	6
	2012	22.8	3.4	4		2002	0.0	0.3	6
						2003	0.0	2.8	6
Loobu	1994	1.5	3.3	2		2004	0.2	0.8	4
	1995	2.9	0.7	2		2005	24.0	8.7	4
	1996	0.0	1.9	3		2006	8.9	3.0	4
	1997	0.0	0.0	1		2007	3.2	3.4	4
	1998	0.2	0.0	2		2008	14.6	5.8	4
	1999	6.3	0.5	4		2009	23.1	6.5	7
	2000	0.5	0.7	4		2010	12.2	5.4	4
	2001	0.0	0.3	4		2011	0.6	1.8	4
	2002	0.2	0.1	3		2012	0.6	1.8	4
	2003	0.0	2.4	4					
	2004	1.5	4.2	4	Vääna	1998	0.0	0.1	5
	2005	3.0	7.8	5		1999	0.0	0.4	4
	2006	0.8	1.7	5		2000	0.1	0.0	4
	2007	3.1	0.0	5		2001	0.0	0.0	2
	2008	17.7	0.2	4		2002	0.0	0.2	4
	2009	26.8	15.0	4		2003	0.0	0.0	4
	2010	57.1	6.4	4		2004	0.0	0.0	2
	2011	0.4	5.1	4		2005	0.0	0.0	4
	2012	28.3	3.9	4		2006	17.6	0.0	4
						2007	0.0	0.6	3
Valgejõgi	1998	0.0	0.0	2		2008	12.1	0.0	3
	1999	1.7	0.9	6		2009	9.0	4.2	3
	2000	0.3	0.7	5		2010	0.0	1.1	3
	2001	2.4	0.7	4		2011	0.0	0.3	3
	2002	8.9	0.0	1		2012	3.3	0.0	3
	2003	0.1	0.3	3					
	2004	0.8	3.6	2					
	2005	7.4	3.3	3					
	2006	12.4	3.0	3					
	2007	8.8	6.7	3					
	2008	8.5	5.2	3					
	2009	20.2	5.7	3					
	2010	5.6	7.2	3					
	2011	0.0	3.6	3					
	2012	11.0	0.8	3					

*) = 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. Note that Testeboån is now classified as a wild river (see text).

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
Kåge älv	SE	31	yes	3,4	39	700-11600	yes	yes	c,f,j,n	1	Byskeälven	yes	yes	>0	>0
Moälven	SE	31	yes	3,4	7	2000	no	yes	c,l	2	Byskeälven	yes	yes	0	0
Testeboån	SE	30	yes	1,3	8	2100-4200	yes	yes	a,e,i	1	Dalälven	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. Note that Testeboån is now classified as a wild river (see text).

Contry	Assess-ment unit	Sub-div	River and year	Number of parr /100 m² 0+	>0+	Number of sampling sites
Sweden	2	31	**Kågeälven ***			
			1987	0	0	5
			1988	0	0	1
			1989	0	0	3
			1990	0	0	1
			1991	0.5	0	4
			1992	1.6	0.5*	2
			1993	0	1.1*	5
			1994	0	0.5*	5
			1995	n/a		
			1996	n/a		
			1997	n/a		
			1998	n/a		
			1999	19.7	14.1*	26
			2000	1.5	3.0*	10
			2001	9.5	7.0*	9
			2002	8.7	5.6*	26
			2003	8.3	1.2*	26
			2004	7.0	6.2*	25
			2005	14.0	1.5*	26
			2006	30.7	27.0*	17
			2007	4.1	6.2	25
			2008	2.5	7.1	14
			2009	8.2	2.9	13
			2010	5.8	2.7	13
			2011	2.8	2.1	13
			2012	18.1	10.3	13
Sweden	3	30	**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
			2011	11.1	2.4	11
			2012	10.2	6.0	11
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
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

table continues next page

* = 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.

Contry	Assess-ment unit	Sub-div	River and year	Number of parr /100 m² 0+	>0+	Number of sampling sites
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
			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			no sampling
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
Estonia	6	32	**Valgejõgi**			
			1999	2.2	0	3
			2000	0.4	1	3
			2001	4.4	1.6	4
			2002	7.1	1.6	1
			2003	0.2	0.8	3
			2004	0.5	3.7	2
			2005	0.5	2.8	3
			2006	8.2	2.6	3
			2007	6.7	5	3
			2008	4.9	3.4	3
			2009	18.0	4.9	3
			2010	4.8	5.4	3
			2011	0.0	3.6	3
			2012	11.0	0.8	3
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
Estonia	6	32	**Väänа jõgi**			
			1999	0	0	4
			2000	0.1	0	4
			2001	0	0	2
			2002	0	0	4
			2003	0	0	4
			2004	0	0	2
			2005	0	0	4
			2006	13.9	0	3
			2007	0	0.6	3
			2008	9.5	0	3
			2009	7.6	3.8	3
			2010	0	0.9	3
			2011	0	0.3	3
			2012	3.3	0	3
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

table continues next page

* 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.

Contry	Assess-ment unit	Sub-div	River year	Number of parr/100 m² by age group 0+	>0+	Number of sampling sites
Lithuani	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
Lithuani	5	26	**Siesartis**			
			2000	1.84	0.00	2
			2001	3.35	0.35	2
			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
Lithuani	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	n/a	n/a	
			2011	13.70	0.38	2
			2012	0.00	0.50	2
Lithuani	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	n/a	n/a	
			2011	4.70	0.30	2
			2012	0.00	0.00	2
Lithuani	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
			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
Lithuani	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	n/a	n/a	
			2011	3.80	0.00	2
			2012	5.20	0.80	2
Lithuani	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
Lithuani	5	26	**Dubysa**			
			2003	2.12	0.00	9
			2004	0.75	0.00	9
			2005	1.47	0.00	8
			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

Table 3.2.6.1. 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
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					

Table 3.2.6.2. 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
						2006	12.4	3.0	3
Selja	1995	1.7	7.7	1		2007	8.8	6.7	3
	1996	0.0	0.5	1		2008	8.5	5.2	3
	1997	0.0	0.0	1		2009	20.2	5.7	3
	1998	0.0	0.0	1		2010	5.6	7.2	3
	1999	0.0	2.3	7		2011	0.0	3.6	3
	2000	1.5	0.3	3		2012	11.0	0.8	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
	2011	1.9	1.0	4		2007	0.0	0.0	1
	2012	22.8	3.4	4		2008	6.6	0.0	1
						2009	0.4	0.9	1

Table 3.2.6.2. Continued.

Loobu	1994	1.5	3.3	2
	1995	2.9	0.7	2
	1996	0.0	1.9	3
	1997	0.0	0.0	1
	1998	0.2	0.0	2
	1999	6.3	0.5	4
	2000	0.5	0.7	4
	2001	0.0	0.3	4
	2002	0.2	0.1	3
	2003	0.0	2.4	4
	2004	1.5	4.2	4
	2005	3.0	7.8	5
	2006	0.8	1.7	5
	2007	3.1	0.0	5
	2008	17.7	0.2	4
	2009	26.8	15.0	4
	2010	57.1	6.4	4
	2011	0.4	5.1	4
	2012	28.3	3.9	4
Kymijoki	1991	4.1	NA	5
	1992	24.1	NA	5
	1993	5.8	NA	5
	1994	4.3	NA	5
	1995	24.8	NA	5
	1996	2.9	NA	5
	1997	4.0	NA	5
	1998	2.3	NA	5
	1999	18.0	NA	5
	2000	19.0	NA	5
	2001	29.7	NA	5
	2002	19.4	NA	5
	2003	9.1	NA	5
	2004	34.3	NA	5
	2005	59.5	NA	5
	2006	28.5	NA	5
	2007	17.5	NA	5
	2008	15.7	NA	5
	2009	36.6	NA	5
	2010	37.8	NA	5
	2011	13.0	NA	5
	2012	*	*	0
	2010	4.4	0.0	1
	2011	0.0	0.0	1
	2012	11.6	0.0	1
Pirita	1992	2.4	0.8	1
	1993	*	*	0
	1994	0.0	0.0	1
	1995	0.0	0.0	1
	1996	0.0	0.1	1
	1997	*	*	0
	1998	0.0	0.0	6
	1999	7.7	0.1	5
	2000	0.0	0.6	4
	2001	1.5	0.1	6
	2002	0.0	0.3	6
	2003	0.0	2.8	6
	2004	0.2	0.8	4
	2005	24.0	8.7	4
	2006	8.9	3.0	4
	2007	3.2	3.4	4
	2008	14.6	5.8	4
	2009	23.1	6.5	7
	2010	12.2	5.4	4
	2011	0.6	1.8	4
	2012	11.2	0.3	8
Vääna	1998	0.0	0.1	5
	1999	0.0	0.4	4
	2000	0.1	0.0	4
	2001	0.0	0.0	2
	2002	0.0	0.2	4
	2003	0.0	0.0	4
	2004	0.0	0.0	2
	2005	0.0	0.0	4
	2006	17.6	0.0	4
	2007	0.0	0.6	3
	2008	12.1	0.0	3
	2009	9.0	4.2	3
	2010	0.0	1.1	3
	2011	0.0	0.3	3
	2012	3.3	0.0	3

*) = no electrofishing

Table 3.3.1. Salmon smolt releases by country and assessment units in the Baltic Sea (x1000) in 1987–2012.

			year																									
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**
1	Finland	2yr	1301	1703	1377	1106	1163	1273	1222	1120	1440	1394	1433	1528	1542	1679	1630	1541	1361	1541	1205	1439	1406	1340	1182	1165	1189	1155
		3yr			21	5			0			1	1	1			1						1	1				
1 Total			1301	1703	1398	1111	1163	1273	1223	1120	1440	1395	1434	1529	1542	1679	1630	1541	1361	1541	1205	1439	1407	1340	1182	1165	1189	1155
2	Sweden	1yr	292			8					22						5							84	98	150	195	194
		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
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
3	Finland	1yr	3							73														0	67	2		
		2yr	435	454	313	277	175	178	135	201	235	257	125	188	202	189	235	211	155	163	252	239	237	250	266	196	117	188
		3yr	19																			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
		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
3 Total			1484	1437	1492	1261	1148	1242	1185	1083	794	1311	1257	1303	1104	1284	1215	1161	1218	1067	1414	1227	1122	1275	1322	1207	1078	1207
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						
		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
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
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
		2yr								2	107	77	30	80	175	60	24	86	53	58	69	79	98	30	32	41	31	11
	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
		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
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
Assessment units 1-5 Total			**5278**	**5429**	**5371**	**4350**	**4052**	**4300**	**4592**	**3950**	**4081**	**4369**	**4893**	**5158**	**4986**	**5215**	**4977**	**4713**	**4673**	**4460**	**4403**	**4750**	**4621**	**4862**	**4608**	**4399**	**3845**	**3954**
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
	Finland	1yr	156	26	23	30	67	26	120	66	63	45		15				65	80	58	84	13						
		2yr	429	415	372	363	349	315	190	198	284	346	222	253	326	362	400	338	266	275	325	276	222	337	266	271	146	218
		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
		2yr	3	2	2	30			9	22	18	18	6	12	12	41	135	1	107	85	81	33	55	1	31		1	586
6 Total			**686**	**556**	**478**	**524**	**518**	**354**	**470**	**398**	**489**	**542**	**449**	**507**	**597**	**584**	**801**	**681**	**644**	**817**	**865**	**742**	**635**	**778**	**700**	**617**	**366**	**586**
Grand Total			**6505**	**5986**	**5849**	**4874**	**4569**	**4654**	**5061**	**4347**	**4571**	**4911**	**5342**	**5665**	**5583**	**5799**	**5778**	**5394**	**5317**	**5277**	**5268**	**5492**	**5256**	**5639**	**5308**	**5016**	**4211**	**4540**

Table 3.3.2. Releases of salmon eggs, alevin, fry and parr to the Baltic Sea rivers (x1000) by assessment unit (x1000) in 1995–2012.

		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		
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	
	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		

Table 3.3.2. continued.

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		
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	
	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	

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 1985–2012. The data originate from hatcheries and from laboratory monitoring.

River	Sub-div.	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 (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*	
Tornionjoki(2)	31				5	6	1	29	70	76	89	76			*25*	*61*	34	41	*62*	0	*0*		*27*	9	*10*	4	*12*		*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	
Skellefteälven	31								40	49	69	49	77	16	5	42	12	17	19	7	0	2	3	13	0	0	5	3	3	
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	
Angermanälven	30								50	77	66	46	63	21	4	28	21	25	46	13	4	3	28	30	16	8	23	7	1	
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	
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	
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	
Mörrumsan	25	47	49	65	46	58	72	65	55	90	*80*	63	*56*	23																
Neva/Åland (2)	29									70	50																			
Neva/Kymijoki (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	8	3	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	
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**	

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 1986–2012), 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	
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	*16*	8	3	*12*	7	0	*6*	4
2011	3	NA	*6*	3	NA	*6*	0	NA	*6*
2012	*2*	*1*	NA	*0*	*0*	NA	*0*	*0*	NA

Table 3.4.3. Summary of M74 data for nine different Atlantic salmon stocks (hatching years 1985–2012), 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
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

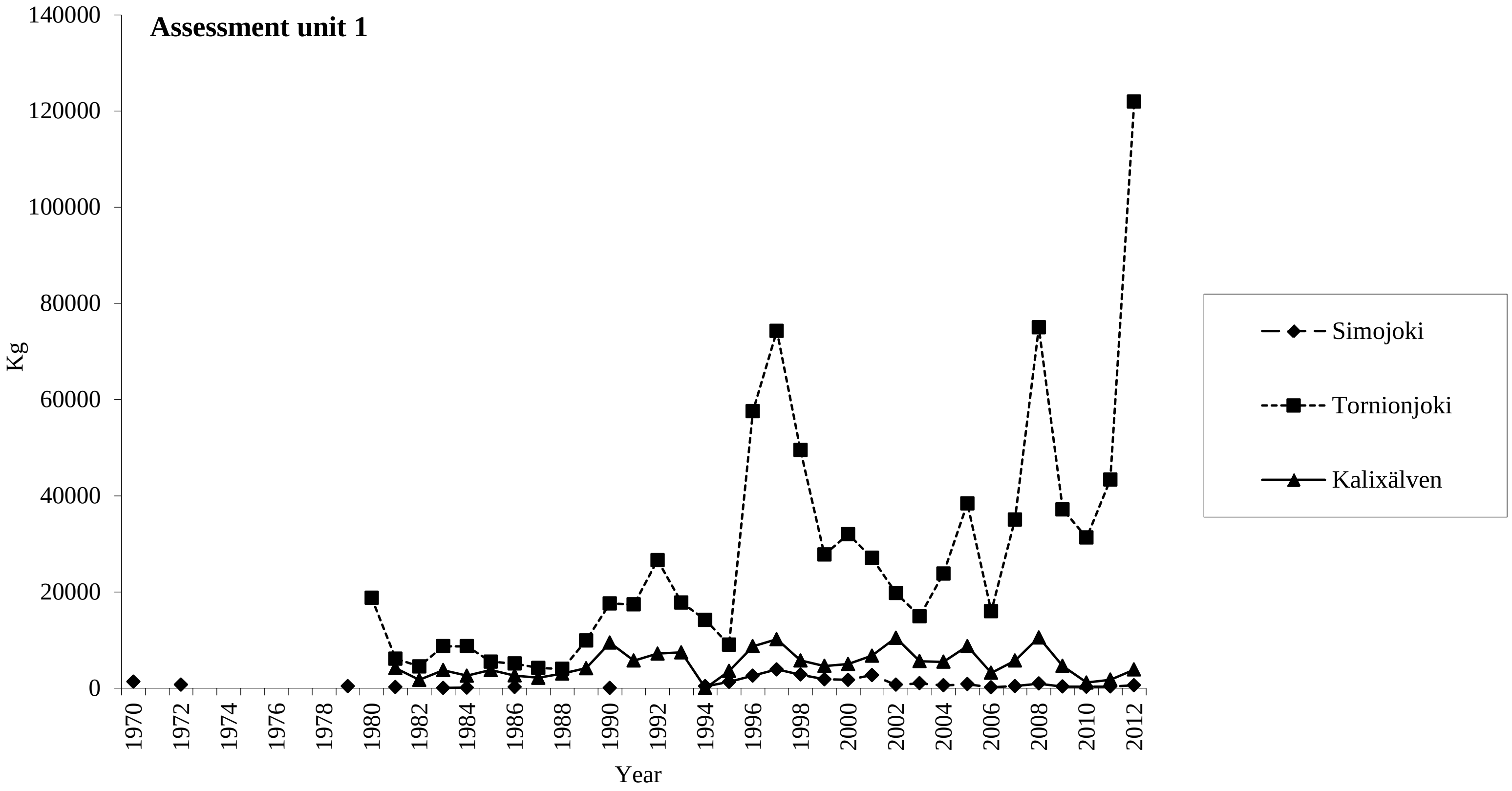


Figure 3.1.1.2 Salmon catch in the rivers Simojoki, Tornionjoki (finnish and swedish combined) and Kalixälven, Gulf of Bothnia, assessment unit 1.1970-2012. Ban of salmon fishing 1994 in the river Kalixälven.

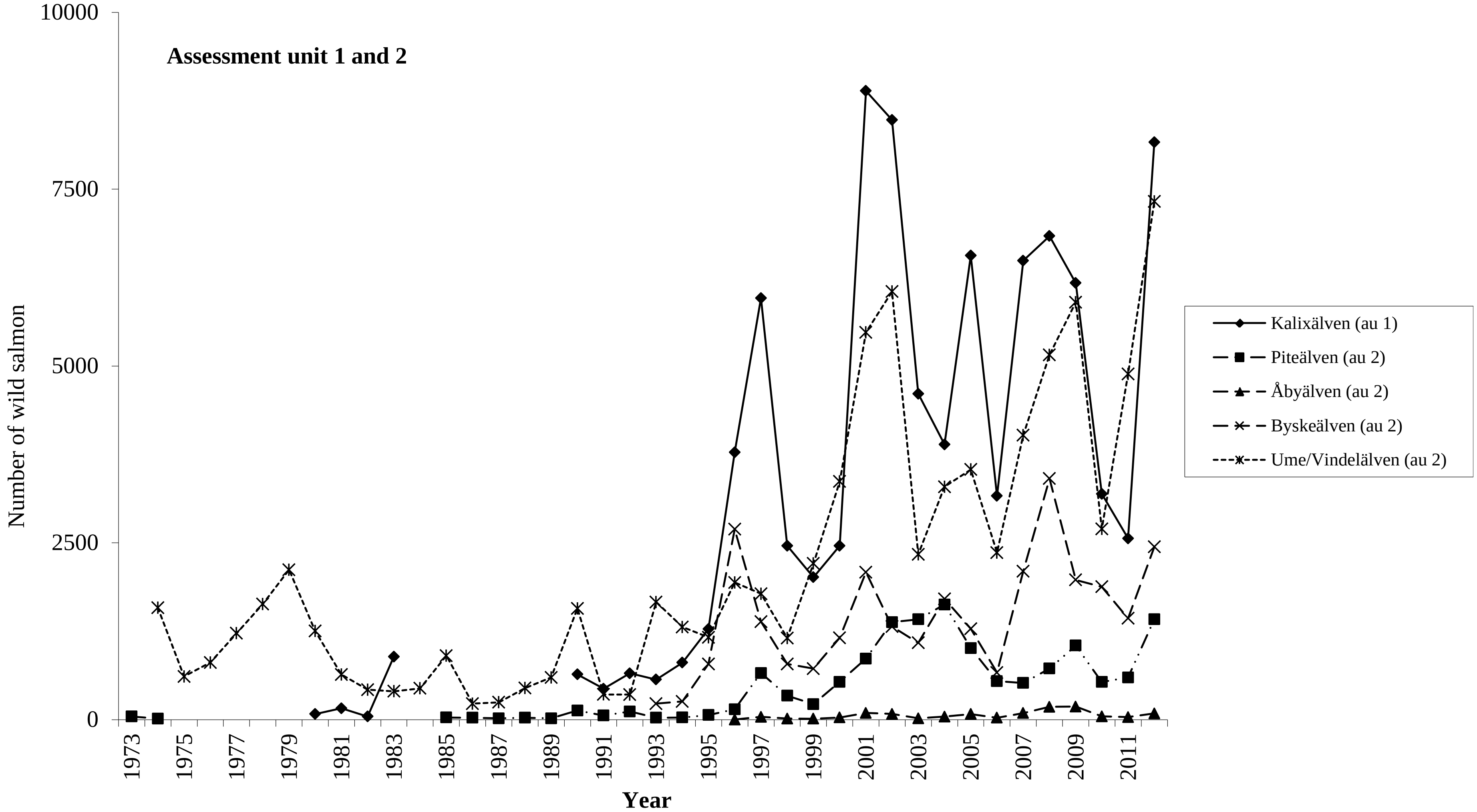


Figure 3.1.1.3. Total wild salmon run in fish ladders in rivers in assessment unit 1 and 2, in 1973-2012.

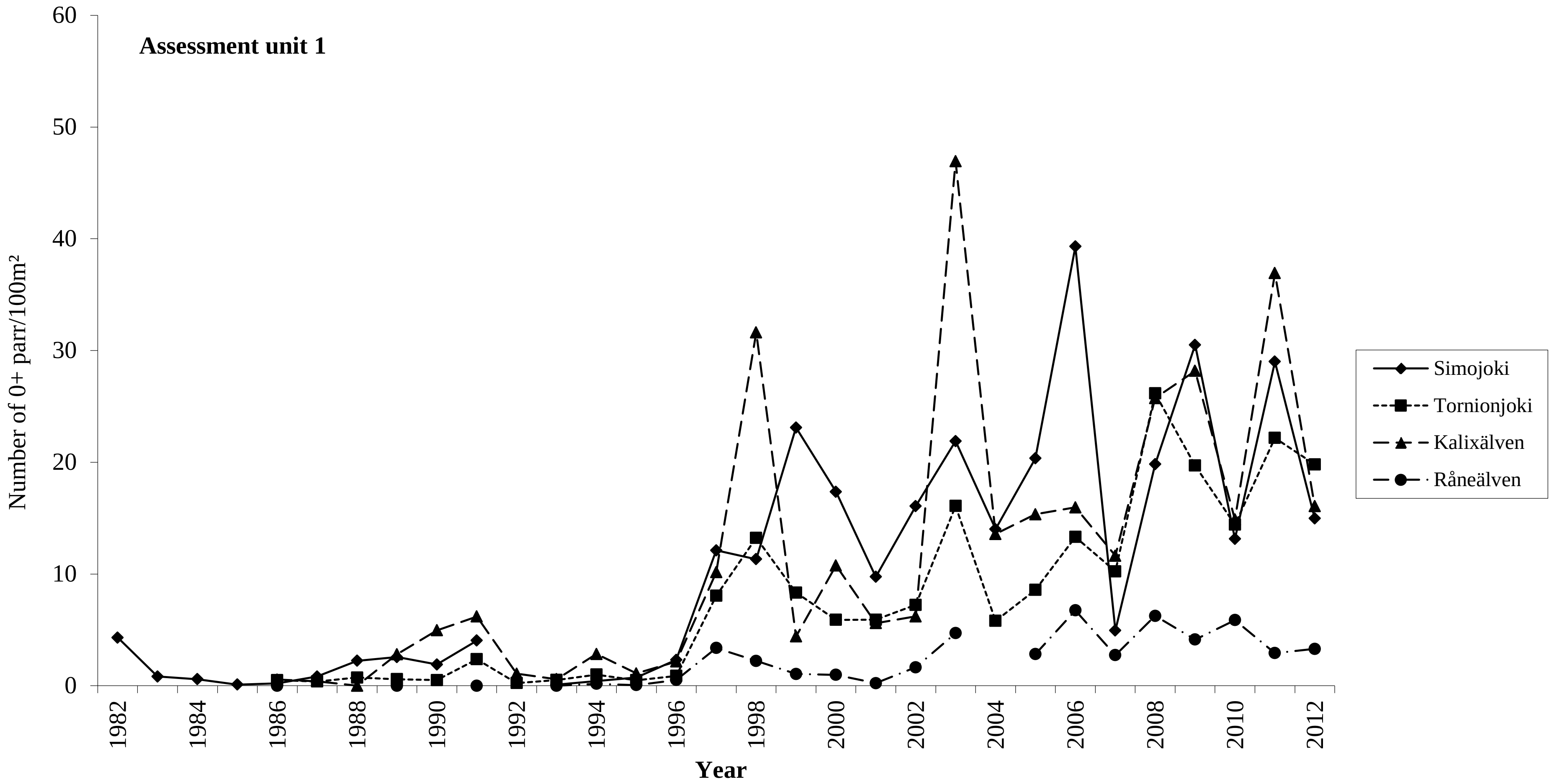


Figure 3.1.1.4 Densities of 0+ parr in rivers in Gulf of Bothnia (Sub-division 31), assessment unit 1, in 1982-2012.

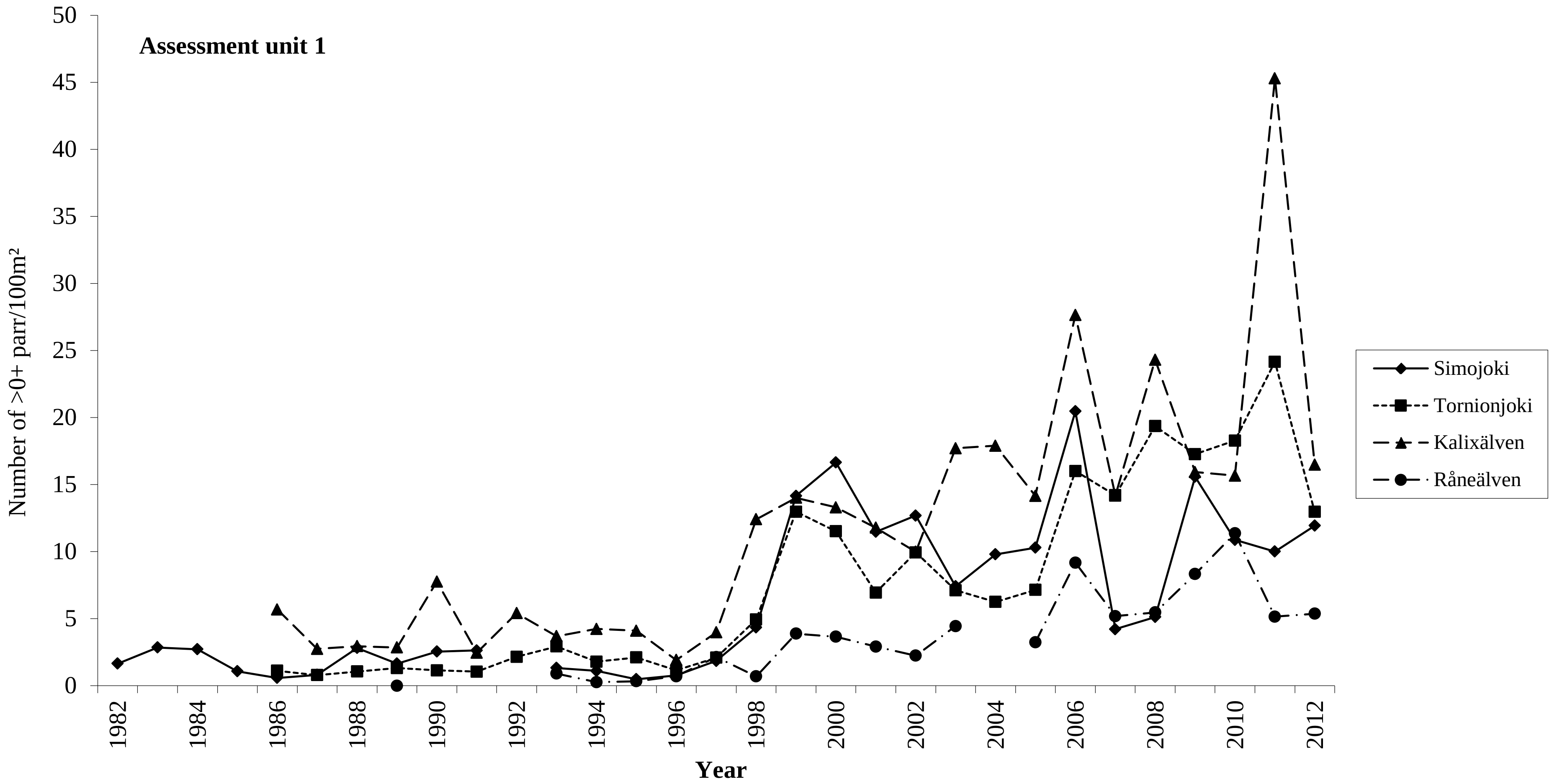


Figure 3.1.1.5 Densities of >0+ parr in rivers in Gulf of Bothnia (Sub-division 31), assessment unit 1, in 1982-2012.

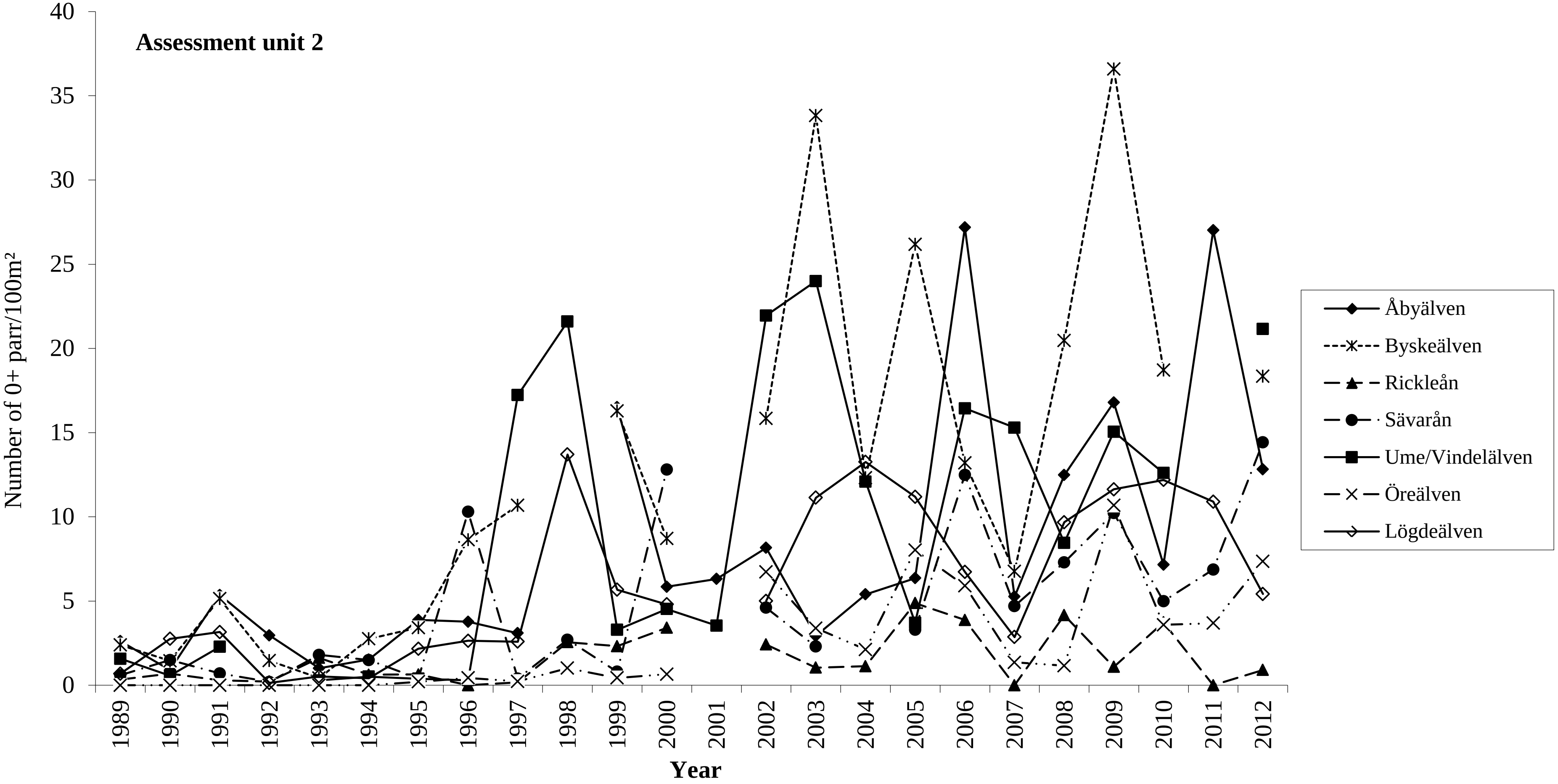


Figure 3.1.2.1 Densities of 0+ parr in rivers in Gulf of Bothnia (Sub-division 31), assessment unit 2, in 1989-2012.

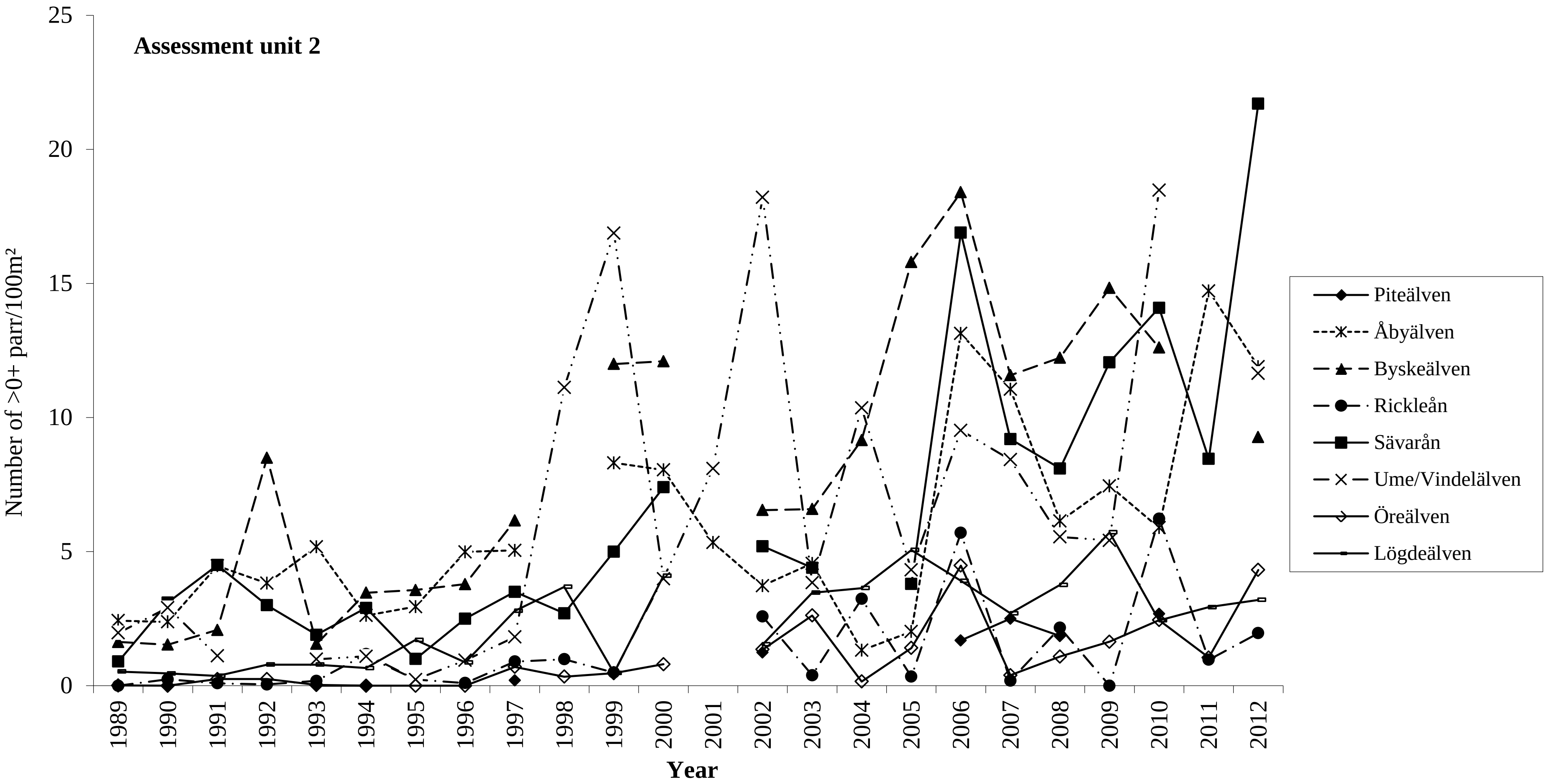


Figure 3.1.2.2 Densities of >0+ parr in riveres in Gulf of Bothnia (Sub-division 31), assessment unit 2, in 1989-2012.

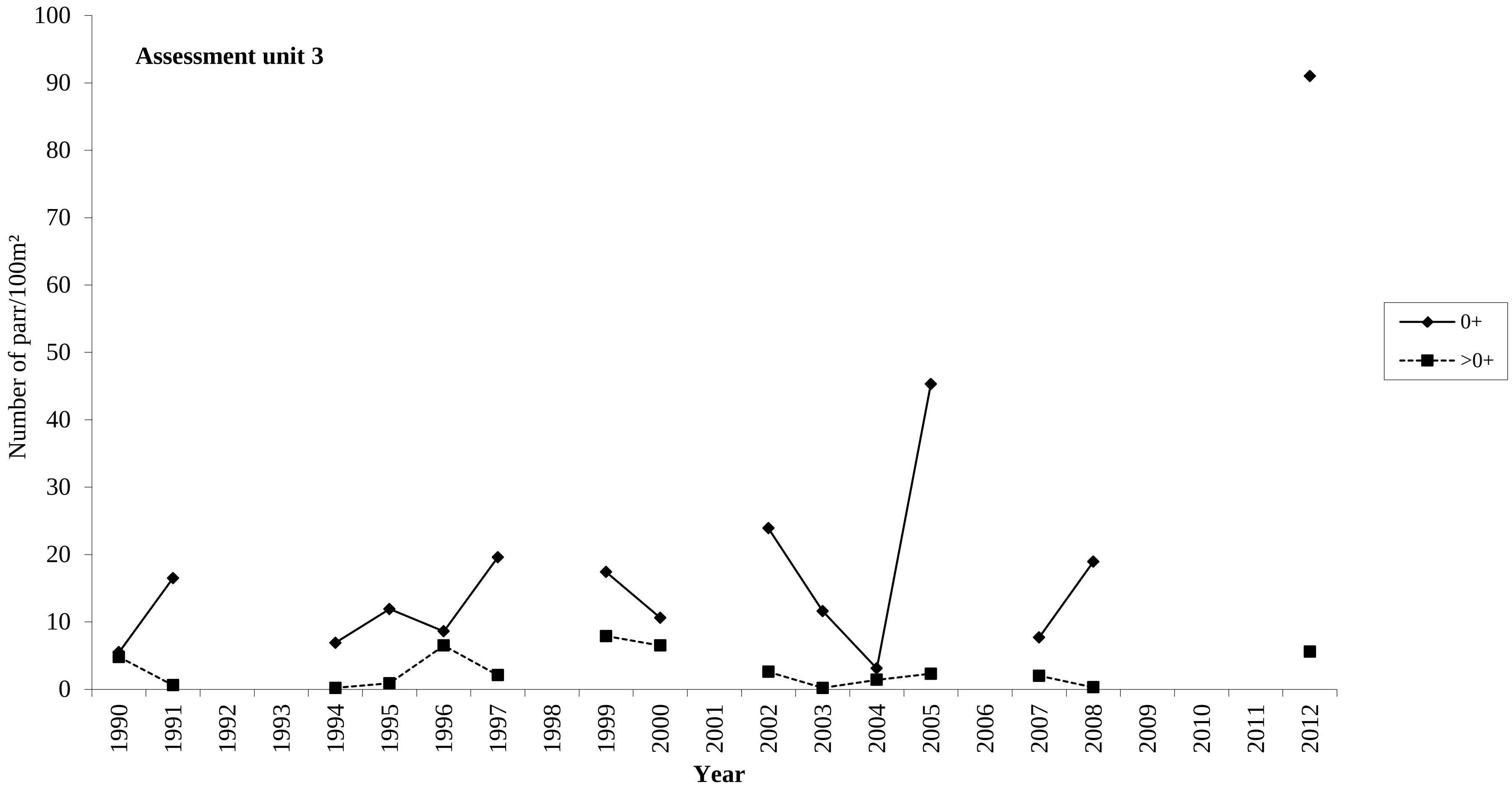


Figure 3.1.3.1 Densites of parr in Ljungan in the Gulf of Bothnia (Sub-division 30), assessment unit 3, in 1990-2012.

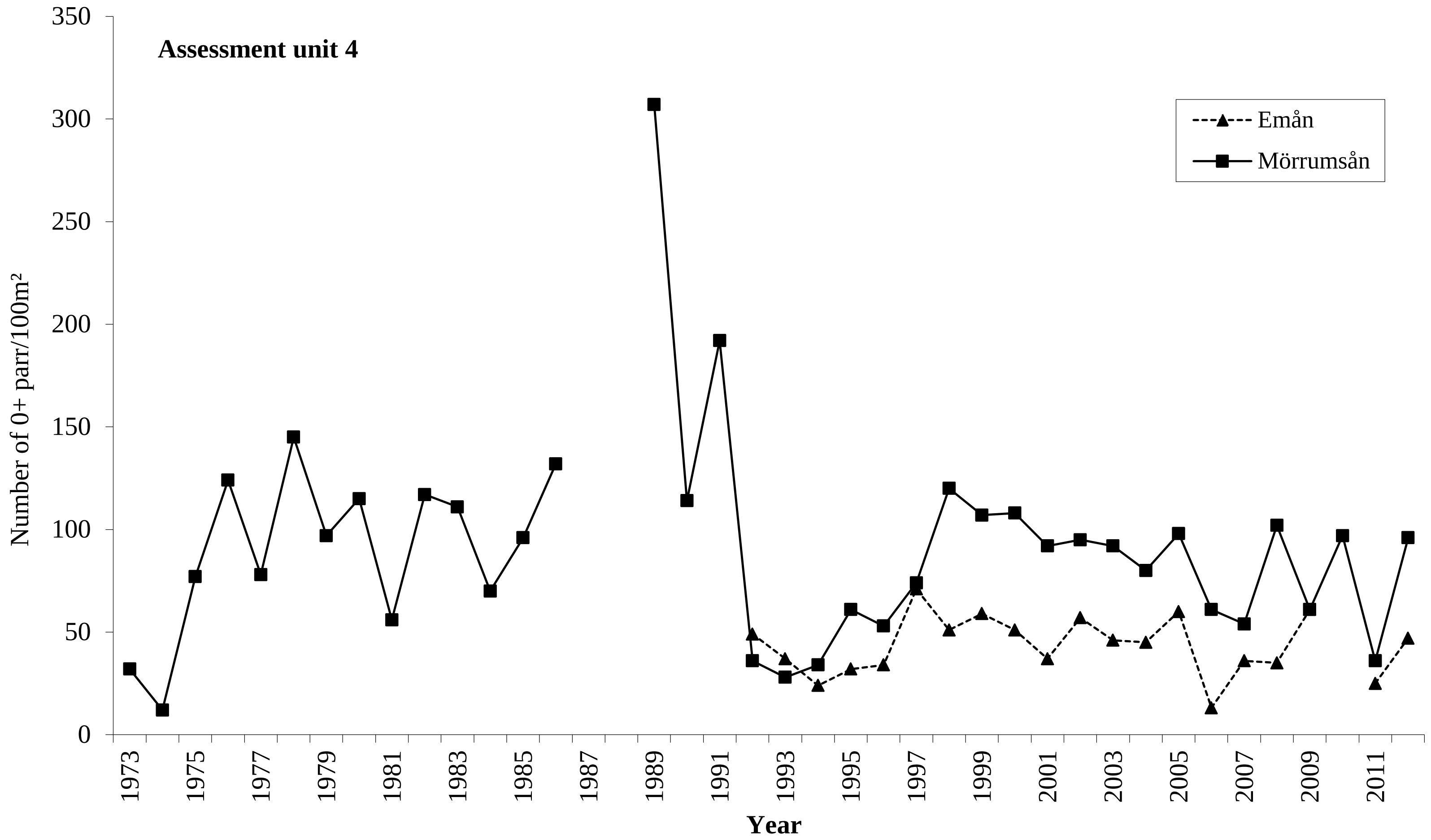


Figure 3.1.4.1 Densities of 0+ parr in rivers in the Main Basin (Sub-division 25-27), assessment unit 4, in 1973-2012.

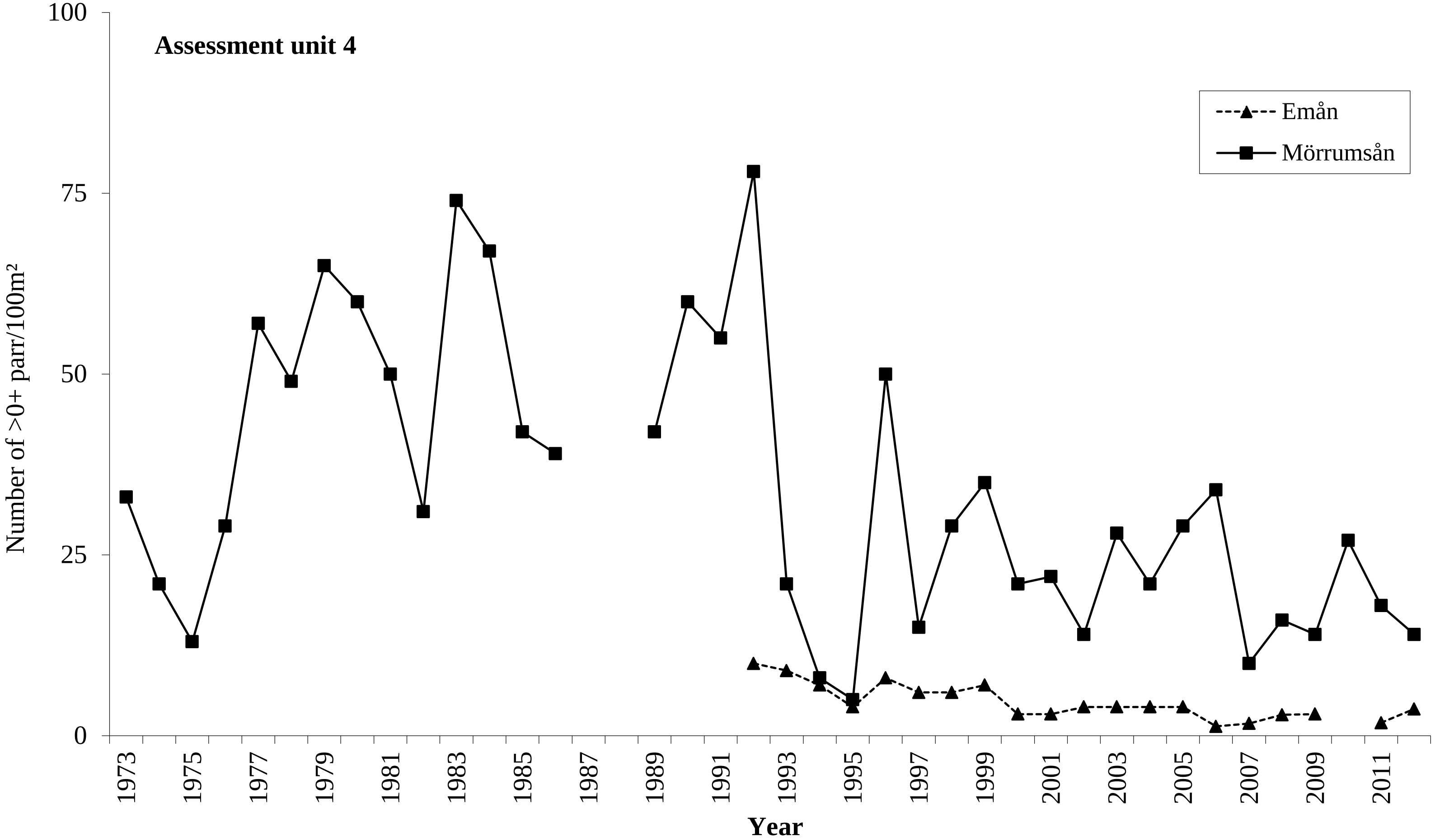


Figure 3.1.4.2 Densities of >0+ parr in riveres in the Main Basin (Sub-division 25-27), assessment unit 4, in 1973-2012.

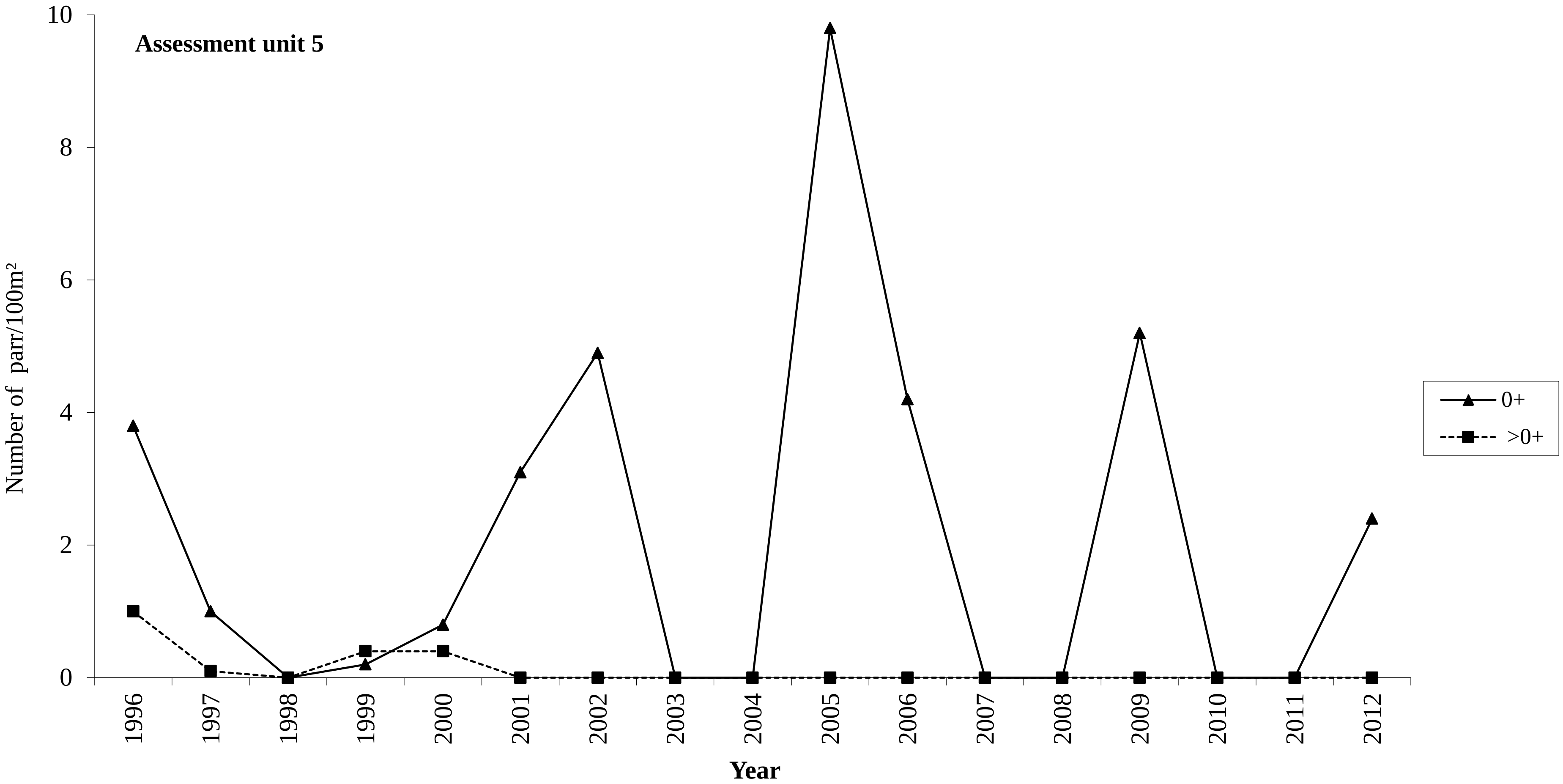


Figure 3.1.5.1 Densities of parr in the river **Pärnu** Main Basin (Sub-division 22-29) assessment unit 5, in 1996-2012.

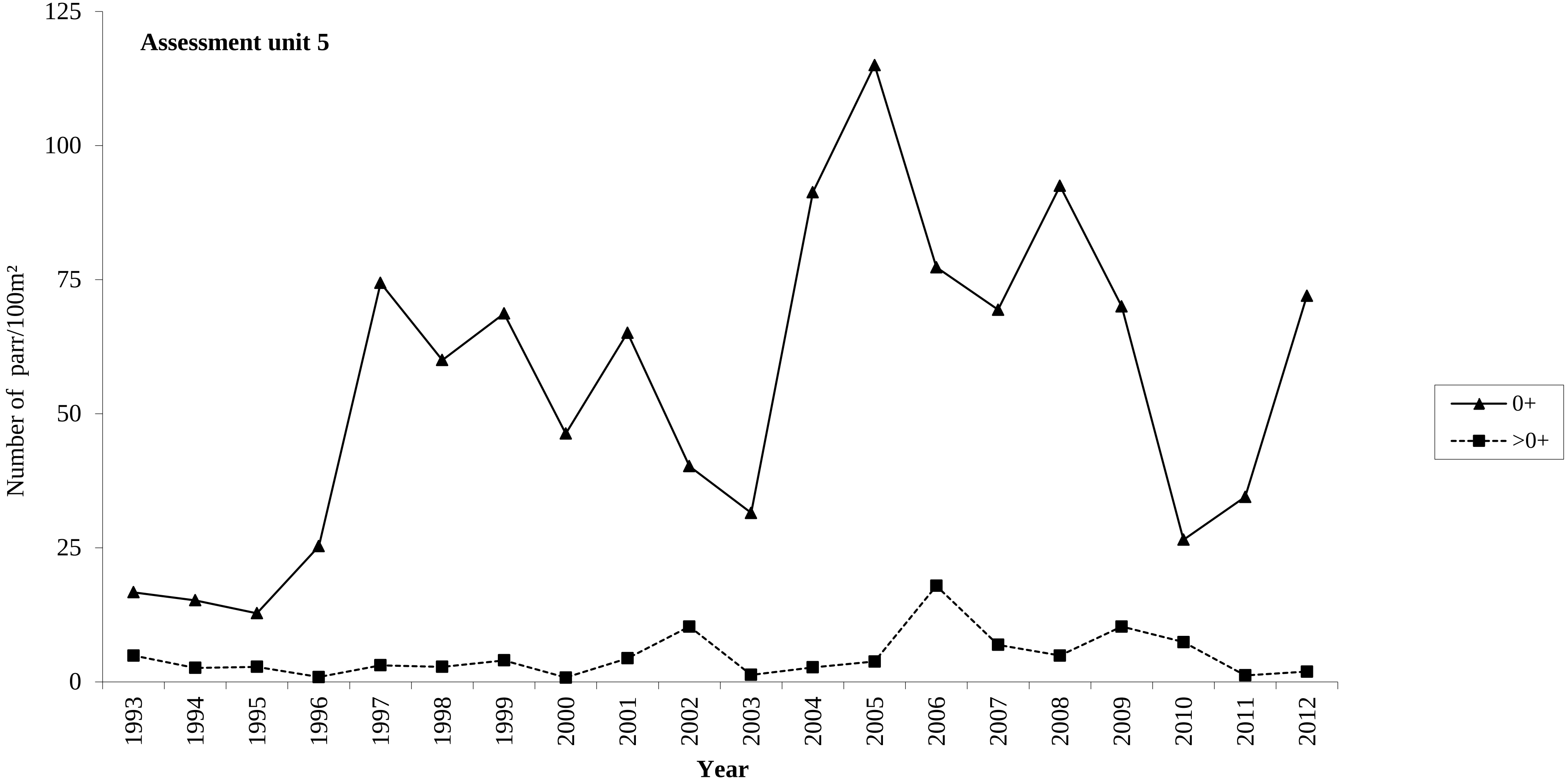


Figure 3.1.5.2 Densites of parr in the river Salaca Main Basin (Sub-division 22-29) assessment unit 5, in 1993-2012.

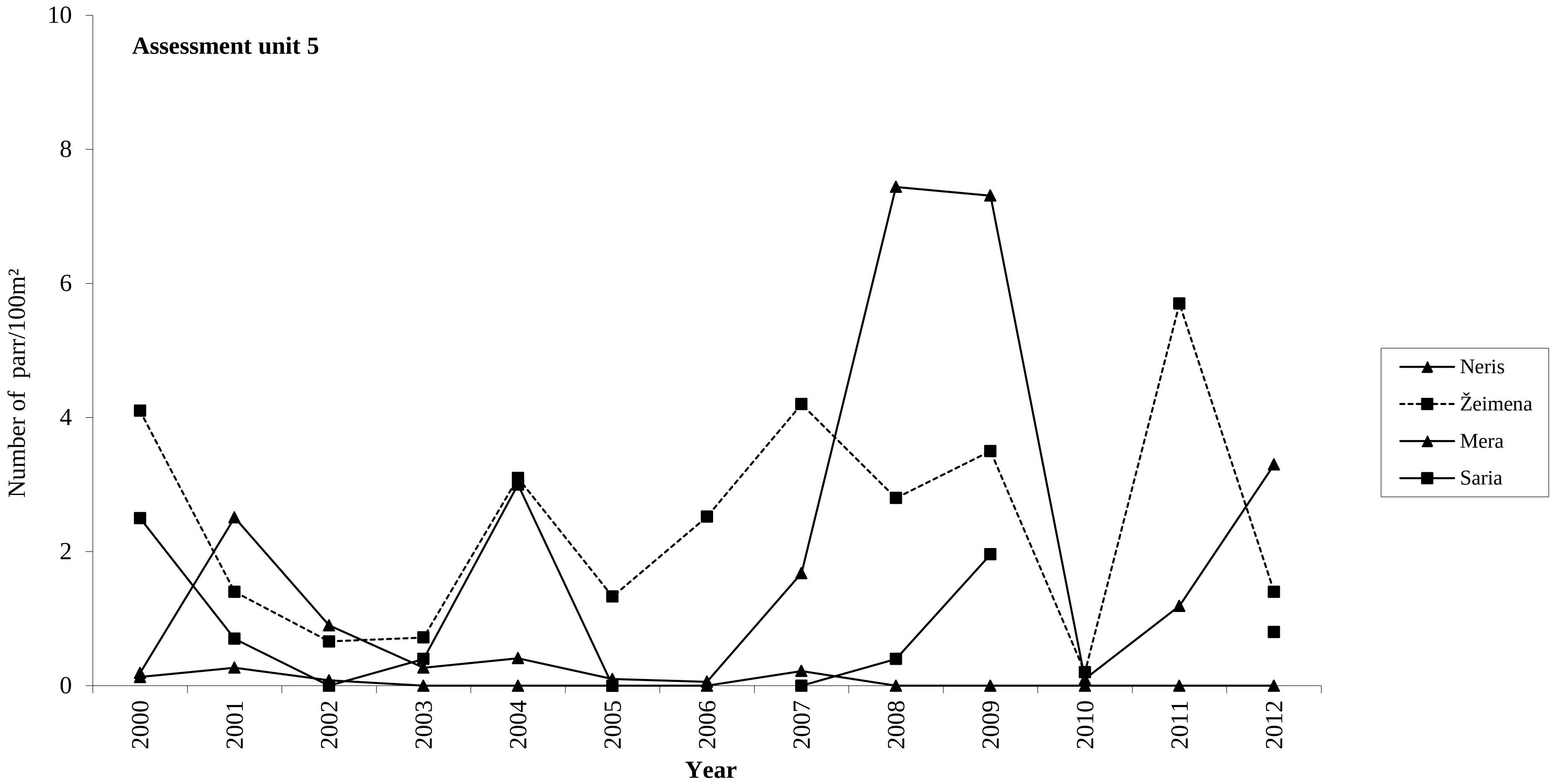


Figure 3.1.5.3 Densites of 0+ parr in Lithuanian rivers in Main Basin (Sub-division 22-29) assessment unit 5, in 2000-2012.

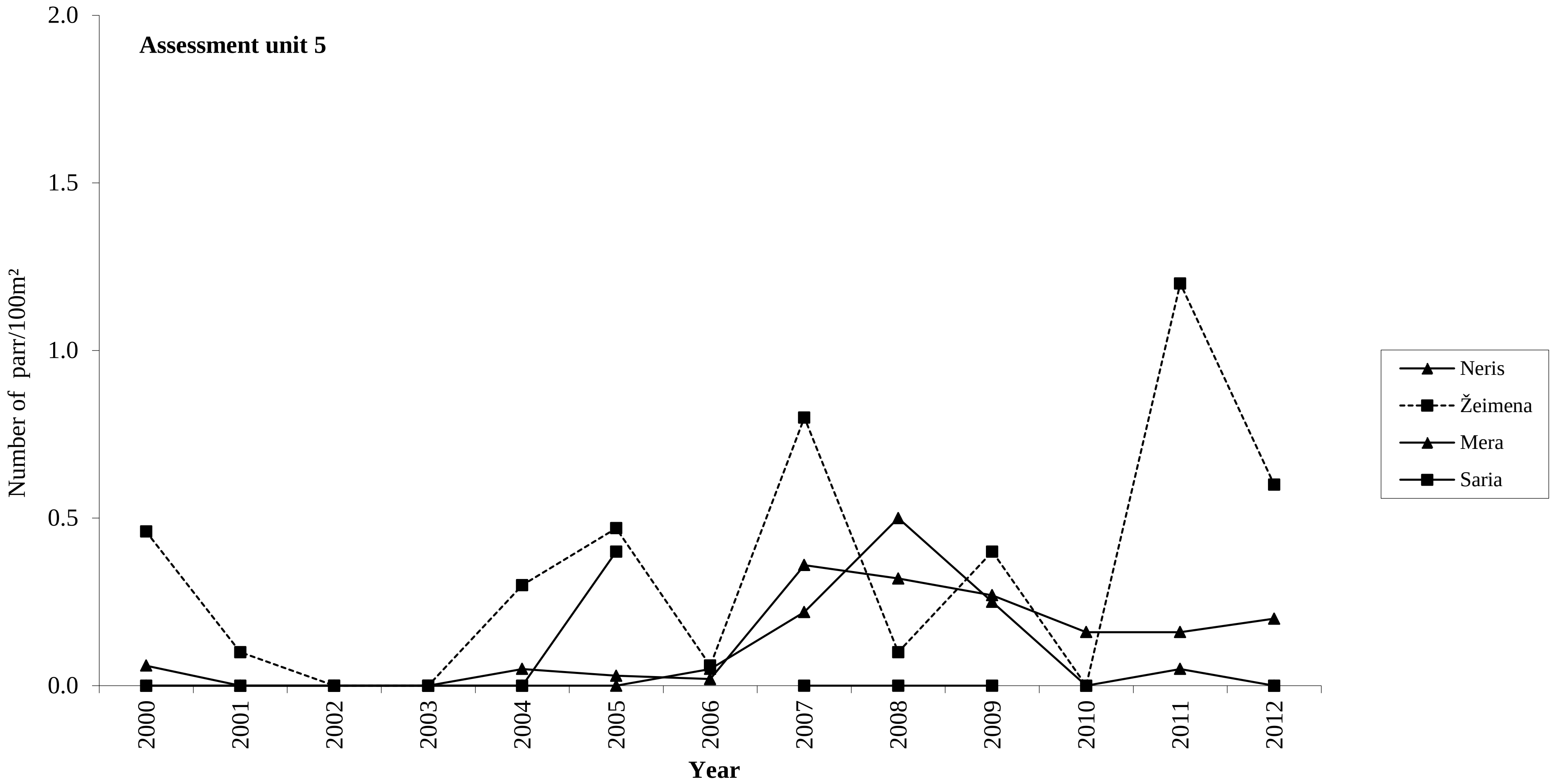


Figure 3.1.5.4 Densities of >0+parr in Lithuanian rivers in Main Basin (Sub-division 22-29) assessment unit 5, in 2000-2012.

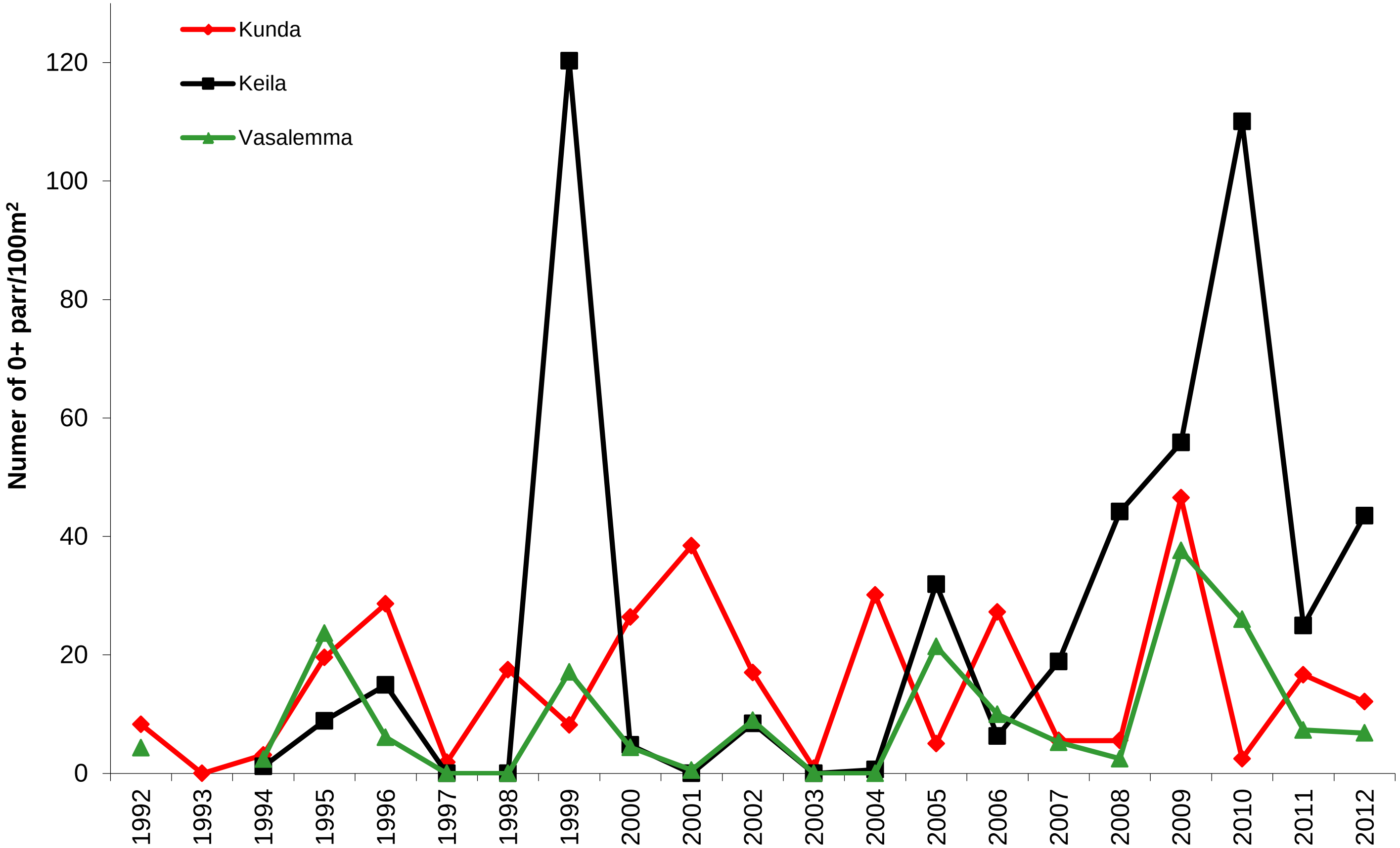


Figure 3.1.6.1. Densities of 0+ (one-summer old) salmon parr in the three wild Estonian salmon rivers.

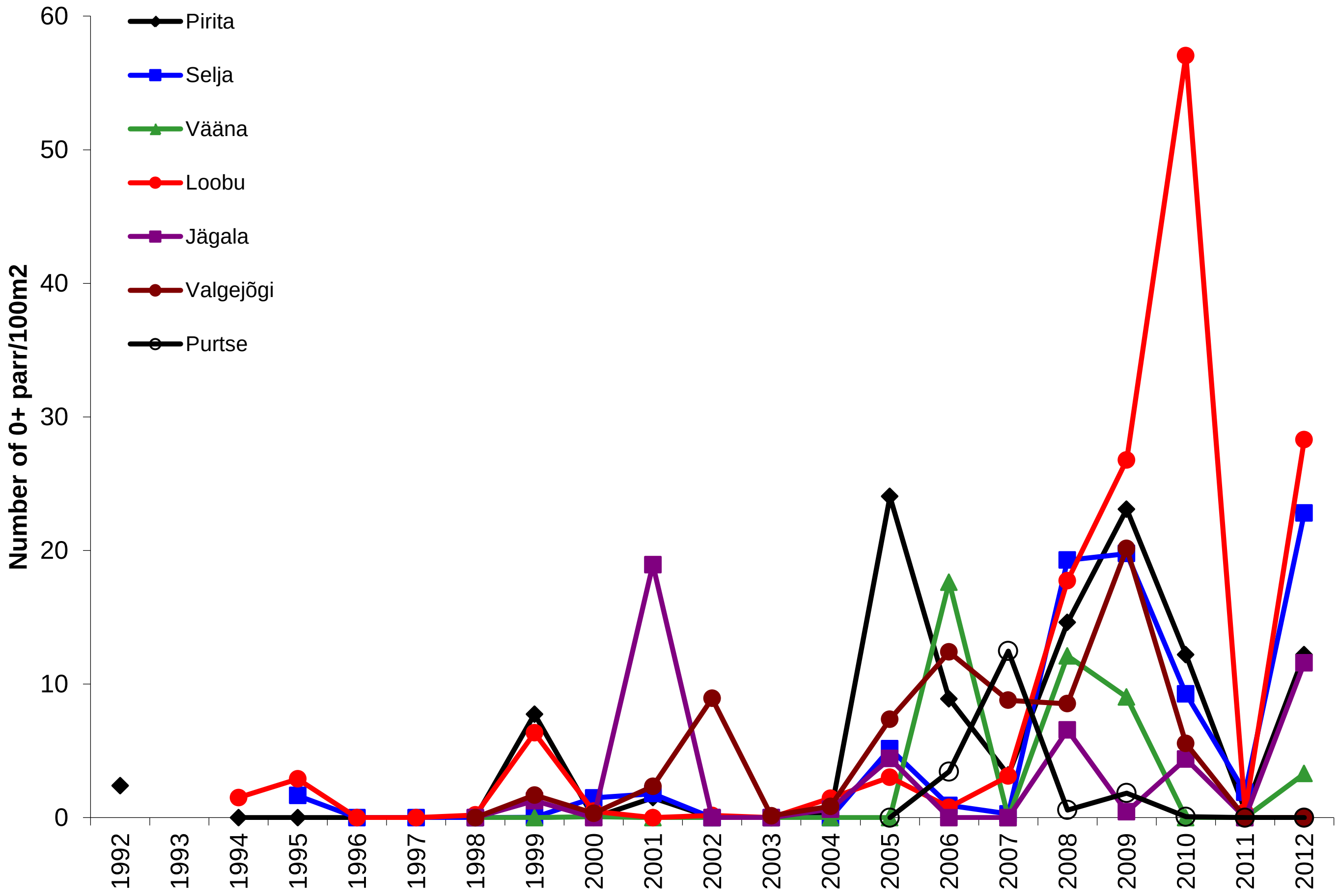


Figure 3.1.6.2. Densities of 0+ (one-summer old) wild salmon parr in the seven Estonian salmon rivers where supportive releases are carried out.

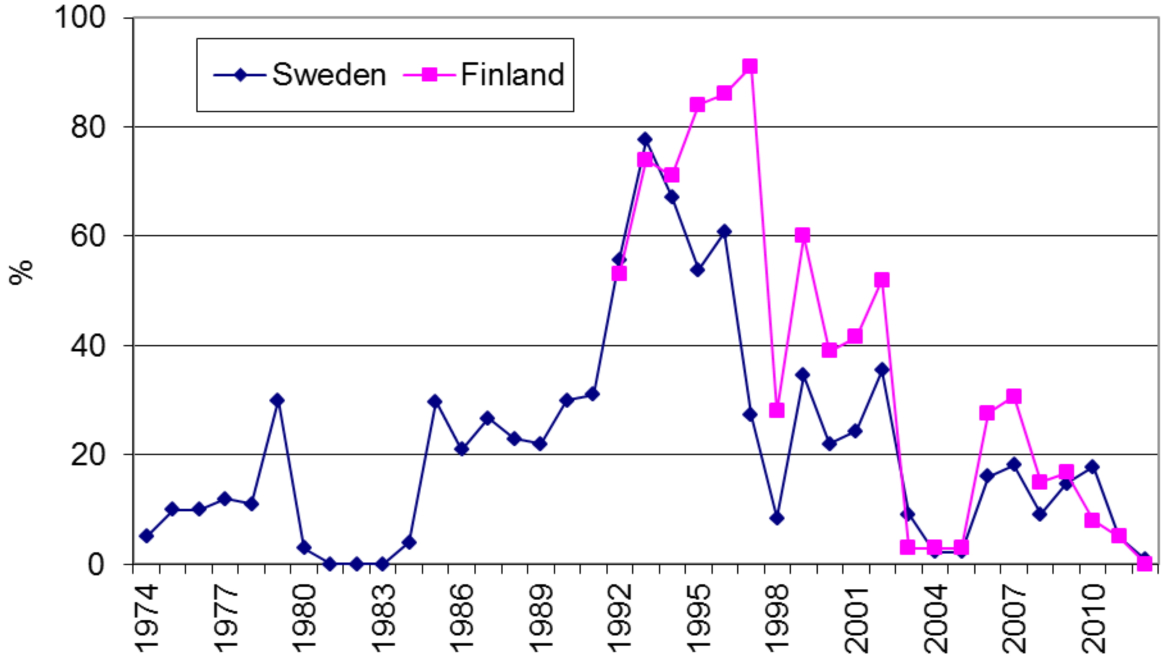


Figure 3.4.1. Proportion of M74 positive females in Swedish and Finnish hatcheries.

4 Reference points and assessment of salmon

4.1 Introduction

Under this chapter the results of the assessment model and alternative future projections of salmon stocks of the assessment units (AU) 1–4 are presented. Furthermore, the current status of salmon stocks of the 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 the stocks in the AUs 5–6 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 life cycle model by analysing all the juvenile surveys data from the rivers of the AUs 1–3. For the rivers of AU 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 for the last years of this decade (Table 4.2.1.1). The total smolt production is estimated to peak in 2012 and is predicted to slightly decrease in 2013–2014 because of the predicted decrease in the smolt production of Tornionjoki. The anticipated near-future decrease is, however, small. 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 for these rivers. Smolt abundance estimates for 2005–2012 in Sävarån and for 2009 in Ume/Vindelälven are more precisely estimated than in other years because during those years, smolt trapping data had been collected. These few years with smolt trapping result in an increased precision of the river-specific slope parameter. Thus, also the smolt estimates of the years without smolt trapping have become somewhat more precise in these rivers.

A **model for M74 mortality** provides input about mortality due to M74 into the life cycle model by analysing all the 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 very low level. These estimates can be compared against the data traditionally used to approximate M74 mortality, i.e. the percentage of females with offspring affected by M74 and the total average yolk-sac-fry mortality among offspring. 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. In addition, 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 represents the chance that the offspring of M74-affected females would die, this examination being available for Simojoki, Tornionjoki and an unsampled Atlantic stock.

4.2.2 Changes in the assessment methods

Carlin tag recaptures

Because of a sudden drop in the tag returns starting from 2010, it was decided that the tag–recapture data from calendar years 2010–2012 will be left out from the life cycle model. The original attempt was to leave out tagging data from years 2006–2012 but this lead to unexpected computational difficulties, and therefore the period without tagging data become shorter. The aim is to study in the future the possibilities of leaving out the tagging data also from 2006–2009. Figure 4.2.2.1 illustrates the impact of inclusion/exclusion of tagging data for 2010–2012 into post-smolt mortality estimates.

Figure 4.2.2.2 illustrates the problem of diminishing number of returned tags during 2005–2012. It is evident that decrease is a result of the change in the tag reporting rate, and not because of increased natural mortality. Reason for the decrease in the tag reporting activity is unknown and may vary between the countries. Potentially fishers don't find any more rewarding to return tags. In addition in some countries national fisheries laboratories don't campaign any more to motivate fishers 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 decreases the need to use tag–recapture data.

Yearly variation in maturation rates

Various observations support the hypothesis that the age-specific maturation rates of Baltic salmon are affected by the annually varying seawater temperature 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 this year, the maturation rate has been assumed to be fixed over time in the assessment model which makes the use of spawner counts in rivers rather critical for the estimation of salmon survival and abundance at sea. 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 this year's assessment the sea age group specific maturation rates are allowed to vary annually. The maturation rate of wild salmon of sea age j in calendar year i (Mat_{ij}^{W}) is assumed to be logit-normally distributed:

$$Mat_{ij}^{W} = logit(m_{ij}^{W})$$

$$m_{ij}^{W} \sim N(\mu_{ij}^{W}, \tau_j)$$

$$\mu_{ij}^{W} = c_i + b_j$$

where expected value μ_{ij}^{W} is assumed to depend on the age and calendar year specific components b_j and c_i and the precision term τ_j depends only on the age group. For reared salmon the maturation rate is modelled similarly, but in addition the expected value μ^{R}_{ij} is assumed to depend on age, year and on the age group specific reared term ρ_j:

$$\mu^{R}_{ij} = c_i + b_j + \rho_j$$

Furthermore, the variation in the maturation rates between different calendar years is assumed to follow normal distribution $c_i \sim N(\mu_L, \tau_L)$. Expert elicited prior distributions are given for parameters b_j, ρ_j, μ_L and τ_L. This procedure is illustrated in detail in the stock annex (Annex 3).

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 so far the removals are assumed to occur already in October (driftnetting) and December (longlining; Michielsens *et al.*, 2006).

In this year's assessment model the offshore fishing was moved so that driftnetting 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; the main effect is that in the updated model fish are subject to natural mortality 2–3 months longer before being harvested.

Estimate of number of misreported salmon by Polish offshore longline fishery

Polish salmon catch in 2012 was calculated for the purposes of the life cycle model similarly as previous years: by calculating half year specific cpues for combined Danish, Swedish and Finnish longline fisheries and multiplying this with Polish sea trout effort and by coefficient 0.75. This resulted in 36 960 salmon, and when Polish reported salmon catch (both offshore and coastal fisheries, all gears) of 5600 were substracted, estimate of 31 360 salmon remained for the number of misreported salmon by Poland. The full life-history model was then fitted to the total sea catch of 88 123 salmon, containing also both the reported and misreported share of Polish catches.

In the working group, however, Polish member argued that this estimated Polish salmon catch was too high, as it exceeded the total number of reported salmon and sea trout catches in the offshore. Thus, the working group decided to use another way on calculating the number of misreported salmon. In 2012 the group (ICES, 2012) explored the logbook records from Swedish, Danish and Finnish vessels that had been fishing in the Polish zone in the last few years and observed that proportion of sea trout had been well below 5% in the offshore catches. As there was available no other reliable data on the catch composition of Polish sea catches the group agreed (except Polish member) on using an estimate of 5% for the proportion of sea trout in the Polish offshore catch in 2012. Assuming that 95% of combined salmon and sea trout catch (in total 22 950 fish) in the offshore fishery was salmon, resulted 21 460 salmon in total for the offshore and after subtracting 4980 reported salmon the new estimate for misreported catch was 16 480 salmon (for more details, see Section 2.3). Apart from offshore catch Poland reported 619 from the coastal fishery. It was probable that misreporting occurred also in the coastal fisheries but working group was not able estimate misreporting there because of the lack of fishery-independent catch composition data from that fishery.

As the full life-history model takes several weeks to run, we did not have an opportunity to redo the run with this new estimate for misreporting. However, the group saw that this reduction of 17% in the total offshore catch ((31 360–16 480)/88 123=0.17) would have only a minor effect on the model results. Firstly, the slightly decreased fishing mortality would likely became compensated by a slightly lower post-smolt survival, as the abundances are ruled mostly by the number of smolts and spawners observed at rivers (total sea survival stays on the same level). In addition, there are underestimated catch components such as catches of recreational fishery and also discarding of undersized salmon and seal damaged salmon in the Main Basin (see Section 2); thus this extra salmon catch could be easily justified to be taken by some other type of fishery which is not so far fully taken into account in the assessment model.

Unreporting coefficients

The proportional correction factors of unreporting were used in order to derive estimates for the total catches in offshore, coastal and river fisheries. Discards and unreporting of recreational fisheries were not taken into account in the estimation of catches. Unreporting coefficients were updated for the years 2004–2012. For years 1987–2003 the same conversions factors were used as in previous years' assessments (Annex 3). The basis for the updated conversion factors was the expert opinions elicited in autumn 2012 during the process of IBPSalmon. The conversion factors were calculated separately for years 2004–2007 and 2008–2012 because of the change in relative weight between the fisheries in 2008 when the driftnet fishing was banned in the Baltic Sea. The combined estimates for different fisheries and year periods were computed from the country specific probability distributions by weighing by the country's contribution to catches in the fishery and year period concerned (same method as in Annex 3). The estimated conversion factors for unreporting in offshore, coastal and river fisheries in different year periods are presented in Table 2.3.1. (see average shares). There were only small differences in the conversion factors between the year periods. In the offshore fishery conversion factors were 0.18;0.15;0.16, coastal fishery 0.33;0.21;0.20 and river fishery 0.24;0.22;0.22 in year periods 1987–2003, 2004–2007 and 2008–2012 respectively. The point estimates of conversion factors were used still in this assessment to derive the total catch estimates, but in the future assessments the probability distributions of the different catch components including discards and potentially recreational fisheries will be used (see Section 2.3).

Evaluation of the current status of stocks in the assessment units 5–6

The current smolt production estimates (most likely values provided by experts) are displayed against the most likely values of 50% and 75% from the PSPC estimates provided by experts for the AU5–6 stocks. 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 the AU1–4 stocks. Due to the limited background data on the AU5–6 stocks the results must however be considered with caution.

Among AU 5–6 stocks, smolt production can be predicted only one year ahead (i.e. for the year of assessment), but not further. Thus, the consequences of future management options cannot be properly evaluated for these stocks. As the stocks of AU4 (Mörrumsån, Emån) are meeting a similar sea environment and are presumably harvested similarly as AU5 stocks, the results of the projection of AU4 stocks may be used as a proxy also for the AU5 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 MCMC sampling from the assessment model had reached the level needed to properly approximate posterior distributions, this being roughly 120 000 iterations after 20 000 burn-in. However, similar to last year a high autocorrelation was found in the MCMC samples of the PSPC estimates of Tornionjoki/Torneälven, Kalixälven and Ume/Vindelälven. Caution must therefore be taken in the interpretation of these results. The final sample was thinned with 120 to result with a sample of 1000 iterations for each parameter for which the results are based on.

The results indicate a decreasing long-term trend in the post-smolt survival and the lowest survival (about 10% among wild and a few percent among reared smolts) was estimated for salmon smolted in 2004–2006 (Figure 4.2.3.1). This year's assessment indicates some increase in survival since the mid-2000s; the most recent survival rates are about 15% level for wild smolts and to about 5% level for reared smolts. Survival improved especially among the salmon smolted in 2010. The current survival is on the same level as a decade ago, and about half of the survival level prevailing two decades ago.

The adult natural survival of wild salmon (median 83%, PI 81–90%) is estimated to be higher than that of adult natural survival of reared salmon (median 79%, PI 71–93%). The survival estimate of wild salmon is more precise than that of reared salmon, possibly due to fitting of model to spawner count data.

Maturation of grilse has in most years been 10–20% and 15–35% among wild and reared grilse, respectively (Figure 4.2.3.2). The model estimates much higher (up to about 50%) maturation rates for reared grilse for the period 2005–2010. Among 2-sea winter salmon maturation is estimated to have been mostly 25–35% and 40–60% for wild and reared salmon, respectively. Salmon of both origins have had rather similar maturation rate (60%) among 3-sea winter salmon. The estimates of maturation rate of 4-sea winter are on average lower but more uncertain than those of 3-sea winter salmon. This is against intuition and 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 full life-history model allows estimating the 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 the egg deposition and smolt abundance (the density of cloud indicates the amount of 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 the spawner and smolt abundance together with the latest changes in the model structure has resulted in some changes in the posterior probability distributions of the PSPCs compared to last year (Figure 4.2.3.4). Generally PCPS's are updated upward from the last year's assessment. The largest update is in the PSPC of Tornionjoki/Torneälven (over 50% increase) which, however, is dubious because in both 2012 and this year's assessments the MCMC sampling was inadequate for a proper approximation of this parameter (see above and ICES, 2012). Apart from Tornionjoki/Torneälven, PSPC estimates increased much also for Simojoki and Lögdeälven. The only apparent decrease is in the estimates of Kalixälven. The AU specific total PSPC estimate increased from the last year's assessment by 27% (about 0.7 million smolts) for AU1, while the updates in the other AUs were modest. The PSPC estimates of AUs 5 and 6 are not updated in this year's assessment. The total PSPC estimate of AU1–6 (median 4.43 million) is about 0.7 million smolts higher 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 nearly 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 AU1–2, the very fast recovery of smolt production indicates high productivity of these rivers. The only wild stock of AU3 (Ljungan) has also recovered, but the estimates of both the current and the potential smolt production of this river are highly uncertain. The development of AU4 stocks indicates no improvement. Instead, the production in these rivers is currently smaller than earlier in the time-series. This is the case also in AU5 stocks, but the stocks of AU6 show some improvements similar to the AU3 stock (see Section 4.2.4).

By comparing the posterior smolt production (Table 4.2.3.3) against the posterior PSPC it is possible to evaluate the current (year 2012) 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 AU5–6 stocks for which no posterior estimates have been analytically derived, but for which expert judgment is used to classify the current status. Overall, the perception about the status of stocks has changed only slightly compared to the last year's assessment. There are several changes in the status of AU1 stocks, the most pronounced of them being the decreased status of Tornionjoki/Torneälven stock (due to significant increase in the estimate of PSPC). Among AU2–4, only Piteälven and Mörrumsån have some updates in their status (both indicating higher probability to meet reference points). Some of the AU5 stocks are considered this year into a slightly better status than in the last year's assessment, in spite of the decreasing trend in the smolt production in most of them (see Section 4.2.4). In the AU6, two stocks are considered to be in good status in 2012, but the rest of the stocks are either unlikely or uncertain to have reached the reference points. Over two thirds of all the Baltic stocks are unlikely or uncertain to reach even the 50% target, and the majority of these stocks belong to AUs 5 and 6. Generally the probability to reach targets is the highest for the largest northern stocks. However, the probabilities vary widely among the northern stocks. While the most northern stocks show strong indication of recovery over the years, the stocks in AU4 have been unable to recover (Figure 4.2.3.7).

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 better than in the earlier years' assessments, although there is still some tendency for the older part of the time-series of the coastal catches to become overestimated and the most recent coastal catches to become underestimated. From the most recent years the model does not fully capture the year-to-year variation in river catches.

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

An increasing trend in number of spawners is seen in most of the rivers of AU1–4 (Figure 4.2.3.10). The model captures the trends seen in the fishladder counts and even the short-term variation in the rivers the data of which is not used for model fitting (see Åbyälven, Byskeälven). However, there are river-specific differences in this respect (see Piteälven). 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, 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 the Kalixälven, the development of spawner abundance estimated by the model is slightly 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. 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.

In spite of fluctuations, there was a long-term decreasing trend in the harvest rate of longlines until 2008 (Figure 4.2.3.11a). After that the harvest rate increased rapidly and reached the all-time high around 2010. In 2009–2011 the harvest rate of longlines was as high as the combined harvest rate of longlines and driftnets in 2003–2006. The harvest rate of coastal trapnetting dropped in the late 1990s. After 2010 the harvest rate has turned to decrease (Figure 4.2.3.11b). The further drop in 2012 is a result of closing the coastal fisheries in the middle of the fishing season due to filling up of quota. 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 Status of the assessment unit 5–6 stocks

Smolt production in relation to PSPC **in the AU5 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 2012 most rivers are estimated to produce about 20–40% 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 a positive development in AU5 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 relation to PSPC in the Nemunas is still far below 50% level. River Mörrumsån in AU4 and river Salaca in AU5 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 3.14 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 late 2000s.

Smolt production **in the AU6 stocks** shows a positive trend in most of the rivers but also a very large interannual variation, especially in the smallest rivers (Figures 4.2.4.3, 4.2.4.4 and 4.2.4.5). In spite of the positive trend, most of the rivers have stayed and are still (year 2012) below 50% of PSPC. In other words, they are either unlikely or uncertain to reach 50% of PSPC in 2012 (Table 4.2.3.4). Among the wild Estonian stocks (Figure 4.2.4.3), the increase in smolt production has been the highest in river Keila where parr densities have exceeded the previously estimated PSPC and for this reason the PSPC estimate is also revised and increased. No apparent trend in smolt production can be seen in river Kunda and 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 on 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. Since 2006 the conditions in the river have improved and smolt production also increased. The second low smolt production period occurred in 2009–2011 and this may be the result on low number of spawners originating from the weak year classes that occurred in 2003–2005. In the small Estonian mixed-stocks the trend is also positive in recent years (Figure 4.2.4.4). However the current PSPC in some of these rivers is severely limited by migration barriers and there is lots of annual variation in such small populations. In the mixed river Kymijoki no clear positive trend can be seen, but some stronger year classes occurred in 2007, 2010 and in 2012 (Figure 4.2.4.5). The smolt production has nevertheless remained below 50% level. In the river Luga wild smolt production is stable and has remained below 10% level despite large-scale annual releases.

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 catch samples has been collected from Finnish commercial fisheries. However, the last six years only samples from the coastal fishery in the eastern part of the area have been collected because offshore catches were simply too small to get a hold of them for sampling.

Catch samples were aged and wild/reared origin was determined by scale reading. Stock proportions were estimated by DNA-analysis (until 2007). The latest results from year 2007 suggested that the clearly largest contribution (61%) was made by locally released Neva salmon. The proportion of wild stocks originating from the Gulf of Bothnia was about 27% (ICES, 2008). The Estonian wild stocks were not recorded in these catch samples. The numbers of feeding wild salmon from Estonian rivers are low and the probability to observe them is minimal in the catch samples collected from different fisheries in the feeding area in the Gulf of Finland and Main Basin. According to the Carlin tag recaptures (smolt cohorts 2005–2010) from the releases made to the Estonian rivers flowing to the Gulf of Finland, only 19% of the stocked fish are harvested outside the Gulf of Finland area and 68% is 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 in the status of the gulfs wild stocks (see Chapter 3). The harvest rate in the Main Basin was estimated to be 20–30% in 1990s (ICES, 2008). 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 wild stocks, the closed area at the river mouth was extended 1500 m during the main spawning migration period (from 01.09 to 31.10) 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 should further ensure the lower harvest 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 the catch samples in the Gulf of Finland in 2003-2009, the exchange of recruits between the areas has been considered to be significant. The exchange of salmon between the areas has, however, not been quantified.

Status of Estonian wild salmon stocks has improved in the last years (Figures 4.2.4.3 and 4.2.4.4). 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 sustainable and allow the further recovery on 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.

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 2008–2011 (15%), 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 (95%). In addition, the forward projection for Mps is started from 2012 to replace the highly uncertain model estimate of the last year of the historical model. The starting point of M74 projections is 2013. Time-series for Mps and M74 survival are illustrated in Figure 4.3.2.3.

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. These time-series are presented in Figure 4.3.2.4.

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 2012 (Table 3.3.1).

Effort scenarios

The most likely (i.e. fixed) development of the fishing effort in the future years (scenario 1) is derived from each country as expert judgements. As a result, starting from the winter 2013/2014 the effort of Polish and Danish fisheries is expected to decrease roughly 10% compared to winter 2012/2013 level, whereas Finnish and Swedish longline fisheries is expected to remain absent. The coastal trapnet fishery by Finland and Sweden is expected to increase by approximately 20% starting from summer 2013 compared to summer 2012 level of effort.

In addition to with scenario 1, three alternative effort scenarios were considered with either 25% (scenario 2), 50% (scenario 3) or 100% (scenario 4) increase to the scenario 1 level. As the scenario 1 level of effort is very low (mainly because of the closures in Finnish and Swedish longline fisheries), no decreasing development compared to that scenario was considered. Figure 4.3.2.1 illustrates the levels of future fishing efforts in the scenarios.

4.3.2 Results

According to the projections, stock size on the feeding grounds will be about 1.4 (0.7–3.1) million salmon (wild and reared, 1SW and MSW fish in total) at the beginning of year 2014 (Figure 4.3.2.5). 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 0.84 (0.45–1.76) million salmon. These MSW fish will be fully recruited to both offshore and coastal fisheries in 2014. From the predicted amount of 1SW salmon (0.57 million, 0.21–1.50 million) at sea in spring 2014, a fraction (10–20% of wild and 15–35% of reared fish) will mature and become recruited to coastal and river fisheries.

The pre-fishery abundance of wild salmon has fluctuated in the past, and the highest abundance is now estimated to take place at the beginning of 2013 (Figure 4.3.2.5). However, this estimate is based on the assumptions of a high post-smolt survival in 2010, and on the low maturation rate for grilse in 2011. 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. Thus, it is important to note that the development in abundance depends very much on the development of post-smolt survival and 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. In near future, the pre-fishery abundance of reared salmon is expected to decrease further, mainly due to recent reductions in the amount of stocked smolts. Also the combined wild and reared pre-fishery abundance has declined substantially since the mid-1990s (Figure 4.3.2.5), but will likely be at the same level in the future as in 2006–2011 period. The rapid decline in combined wild and reared pre-fishery abundance, especially since 2004, has negatively affected possibilities for exploitation and is also the main reason for the significant reduction in advised catch levels from ICES (see for example advice table in ICES 2011c).

Table 4.3.2.1 illustrates the predicted total commercial sea catches (including unreported, misreported and discarded) of longline, trapnet and other commercial fisheries and the total numbers of catches and spawners in the rivers in 2014 with given effort scenarios. The amount of unreporting, misreporting and discarding in 2014 has been assumed based on the expert evaluated share of those catch components compared to the reported catches in 2012 fisheries. In 2012 the reported commercial catch accounted for about 65% from the corresponding estimated total removals, this percentage being substantially higher than the one estimated for 2011 (46%). Unreporting, misreporting and discarding are considered to take, respectively, about 20%, 10% and 5% share of the total removal. The share of the total catch by different fisheries (and by discards, unreporting and misreporting) for the period 2001–2012 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.

These predictions indicate that depending on the effort scenario, the commercial reported catch in year 2014 would be 61–104% compared to TAC of 2013 (Table 4.3.2.1). The highest median catch (totally 167 000 fish) would be caught by scenario 4 (100% increase compared to the most likely development of effort) and the lowest median catch (totally 66 000 fish) would be caught by scenario 1 (most likely development of effort). The amount of spawners would be about 45% higher in the scenario 1 than in the scenario 4. In addition, the harvest rule of $F_{0.1}$ falls close to scenario 3, indicating slightly higher removal. Total sea catch of 142 thousand is calculated by taking $F_{0.1}$ fraction of the median of the pre-fishery abundance in 2014. Figure 4.3.2.6 illustrates the longer term development of (reported) future catches given each scenario.

Figure 4.3.2.7a–c presents the river-specific annual probabilities to meet 65% of the PSPC under each scenario. Under these scenarios, different levels of fishing effort have an influence mostly on the level but not so much on the trend of the probability of meeting 65% over time. 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 65% target and of having a higher smolt production one generation ahead from 2012. Evidently, the probabilities are higher for effort scenarios with low exploitation, but differences between scenarios are quite small.

Figures 4.3.2.8a–h show longer term predictions in the river-specific smolt and spawner abundances for two scenarios (1=most likely development of effort and 4=100% increase to scenario 1). These two extreme scenarios illustrate the predicted effects of contrasting management decisions.

4.4 Additional information about the development in stock status

This section contains information on data and results currently not used in the stock assessment, but that give independent information about the status of the salmon stocks. Independent empirical information is also important to evaluate model predictions of important parameters. In last year's report, the relation between the relative spawning-run strength in rivers with fish counting was compared to average winter temperatures in the Southern Baltic Sea. The analysis was prompted by the fact that river counts of adult salmon were considerably lower in 2010 and 2011 than expected by the model. A clear positive relationship between annual spawning run strength and seawater temperatures in February was revealed, whereas (as expected) no such relationship existed between temperature and model predictions of run strength. It was concluded that maturation rates and/or sea survival was likely to be involved, and that further studies were needed (ICES, 2012).

More in-depth analyses of the association between winter temperatures, survival and maturation rate were performed during an inter-benchmark protocol (IBP) carried out in summer-autumn 2012. The results of these analyses showed that the association described above most likely is a result of variation in the maturation rate of salmon rather than elevated natural maturity (ICES, 2012 IBP). During the IBP, the assessment model was therefore updated by releasing the assumption of fixed maturation rates, thus allowing maturation rate to vary over time. Although it is too early to build an explanatory model for maturation with environmental covariates, there is plenty of information already included within the full life-history model about changes of maturation rates over time (due to e.g. variation in winter temperatures).

To study the behaviour of the updated assessment model, a time-series of maturation rate estimates derived from the model was compared to independent information on winter temperatures to investigate if these were correlated (as would be expected if winter temperature is one of the determining factors for maturation rate). The results of this exercise indicate a clear relationship between estimated maturation rate for 1SW and 2SW salmon and winter sea temperatures (Figure 4.4.1). Thus, the updated assessment model seems to reflect climate induced variation in maturation rate, even though no climatic data are fed to the model. Updated time-series on winter temperature and relative spawning run strength (empirical and model) are presented in Figure 4.4.2. Overall, the positive relationship for winter temperature and empirical fish counting data seen last year remains. However, in sharp contrast to last year results, there is also a positive relationship, although less clear, for winter temperature and model predictions of spawning run size, which mirrors the ability of the updated assessment model to account for climate induced variation in maturation rate. There is now also a strong correlation between the spawning run index derived from the model and the corresponding index derived from fish counting (Figure 4.4.3).

In the previous model version, in which climate induced variation in maturation rate was not accounted for (i.e. the maturation rate was fixed over time), the feeding of spawner count data from rivers into the model introduced a risk that salmon survival and abundance became underestimated in years following cold winters and vice versa. By using the updated assessment model, the risk of bias in post-smolt survival and abundance estimates is likely reduced considerably. Also, using the updated model it may be possible in the near future to take winter temperature in the interim year into account, thus increasing the precision in short-term projections of stock development under different fishing scenarios.

A trial scenario run was conducted by assuming a somewhat lower maturation of grilse and 2SW salmon in spring 2013, due to the cold winter 2012/2013. The maturation rates were picked up based on the observed correlation (Figure 4.4.1) and the fresh seawater temperature data from February, 2013. This exercise indicated that, for instance, the 2013 spawning run prediction into the river Tornionjoki/Torneälven would we about 7000 salmon smaller (the number of spawners decreased from about 63 000 to 56 000 salmon) if the maturation in 2013 was linked to the temperature data. The exercise also resulted in 27 000 salmon larger total PFA estimate for the beginning of 2014, because of the delayed maturation beyond 2013.

4.5 Conclusions

4.5.1 Development of fisheries and stock status

The salmon fishery has changed considerably since the beginning of the 1990s. Catches from offshore fishery (driftnets and longlines) dominated at the beginning of the period, but for various reasons the effort in the offshore fishery, and to a lesser extent also the coastal fishery, has decreased thereafter. Catches in the river fishery have been relatively stable during the period except for 2012 when the high number of ascending spawners resulted in substantial increases in river catches. Mainly because of a decreasing trend in 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 that year. However, a considerable effort increase in the longline fishery starting from year 2008 has counteracted the effects of the driftnet ban, and as a result the harvest rate of longlines in 2009–2011 was as high as the combined harvest rate for longlines and driftnets in the early and mid-2000s. In 2012, the longline effort decreased compared to previous years, and it is expected to decrease further in the near future 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 after the gradual reduction in effort from the mid-1990s to mid-2000s, and is predicted to stay at about the same level also in the near future. It is, however, important to note that future effort levels can be considerably affected by management measures.

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

Out of the 39 assessed stocks there are eleven stocks, mainly from northern rivers, which either likely or very likely reached 50% of the PSPC in 2012 (Table 4.2.3.4). For 14 stocks it is uncertain and for 14 stocks unlikely that they reached the 50% objective in 2012. Many of the stocks with weaker status are situated in the rivers of southern Baltic. Only five stocks likely or very likely reached 75% of the PSPC in 2012 and about 70% (28) of the stocks it is considered unlikely that they reached this higher reference point in 2012. For the wild salmon stocks of AU1–2, the very fast recovery with clear increases in smolt production indicates high productivity of these spawning rivers. Stocks which, according to the assessment, have not yet reached 50% of their estimated smolt production capacity and/or show clearly declining trends in smolt production are considered weak. It is notable that most of these stocks are found in relatively small rivers (in terms of discharge and available habitats). In the Gulf of Bothnia, such weak stocks are in the rivers Rickleån and Öreälven, and arguably also Råneälven, Sävarån and Lögdeälven. In southern Sweden, the stock in

Emån has a very low status whereas Mörrumsån shows declining trends in parr densities. In southeastern Baltic Sea (AU5) most wild stocks are considered weak and have not showed any signs of improvement during the last decade. Instead, in many of these rivers the production is currently smaller than earlier in the time-series. Even the clear drop in harvest rate in the sea fishery in 2007–2008 was not able to turn the negative trend observed for many of these stocks. The wild stocks in AUs 3 and 6 show some signs of improvements, but the between year fluctuations in densities of juveniles and smolt production is considerable, which tend to blur the picture.

The likely reasons for the low productivity of the southern stocks may lie either in the freshwater conditions of the spawning rivers, and/or in regional differences in conditions at sea (ICES, 2012). Various regional and river-specific information about the stocks and their habitat (data on river conditions, migration obstacles, tagging results etc.) support various hypotheses. Among the potential reasons are:

- A particular stock may be subject to overfishing (e.g. poaching) within or just outside the river.
- A particular stock may be subject to environmental problems such as local pollution and eutrophication which increases mortality among eggs and/or juveniles.
- Small rivers are more likely to be affected by environmental perturbations such as fluctuations in water flow and temperature. This, in turn, may result in juvenile fish mortality higher than that in larger and more stable habitats. For instance, some unusually warm summers (e.g. 2010) may have caused higher parr mortality in freshwater.
- Higher natural mortality among juveniles or outmigrating smolts and kelts than in other rivers may occur also due to turbine mortality (if applicable) or elevated predation in the river or at the river mouth.
- Migration obstacles (partial and/or total) limit spawning and rearing areas considerably in many southern rivers.
- Obstacles to upstream migration may furthermore result in estimates of potential smolt production that are too optimistic. The salmon stock in Emån, for example, serves as an example of a river with special problems in migration. In this river most of the production area is located above poorly functioning fish ladders, which is probably one reason why the stock in this river has been assessed to have such a poor status (ICES, 2008d). Any significant increase in salmon abundance necessitates the solving migration problems.
- Elevated levels of hybridization with sea trout in certain rivers could result in production levels that are lower than expected.
- Differences in migration time between rivers could result in higher fishing mortality for late migrating river stocks, if early season fishing restrictions are used to manage coastal and river mouth fisheries.

In small populations random demographic and environmental events are also expected to result in a slower population grow rate than in larger populations having the same demographic characteristics (e.g. Lande, 2002). At present, however, little is known to what extent certain Baltic salmon populations are expected to be affected by such stochastic processes. It should also be noted that salmon has a rather long generation interval, say 5–7 years, and it may thus take rather long time (in years) before weak populations show clear signs of improvement following reductions in, e.g. fishing mortality at sea.

Present estimates of stock–recruit (S/R) functions in the southern rivers display less steep increases than in most northern rivers (Table 4.2.3.1). A less steep S/R function indicates that the *per capita* survival among young fish is lower (e.g. due to factors listed above) due to within-river density-independent mortality (if assumed that the processes at freshwater stage of the life cycle is the underlying reason for differences in the steepness of S/R functions). Further, it indicates that a comparably higher number of adults (females) are needed to result in a given number of smolts, the surplus production available for harvesting is lower and, consequently, these weak stocks cannot support as high harvest rates as can the northern stocks. Likewise, other sources of mortality, such as increased post-smolt mortality, may affect populations with less steep S/R functions more severely. Conversely, the steeper rise of the S/R functions among northern stocks implies a higher potential for the recruitment to increase more rapidly when the number of spawners rise, whilst southern rivers may need longer time to recover. Also in the Atlantic Europe the recruitment per amount of egg deposited in salmon rivers has been assessed to increase towards northern latitudes (Prévost *et al.*, 2003).

It must be concluded that there are fewer sources of information to assess stocks in AU4–6, making our knowledge of the status and development of these stocks less reliable than those for AU1–3. Whatever is the underlying reason for the poor status and the lack of response to management measures, the overall lifetime survival of salmon from these weak stocks is lower compared to the survival of salmon from the other stocks. In order to recover weak river stocks, possibilities to reduce any type of mortality (whether it is related to fishery or not) at various life stages must therefore be considered.

4.5.2 Conclusions for future management

PFA is peaking in 2012–2013, but by 2014 it is expected to drop back to the level prevailing during the years before 2012. This is expected to decrease catches from 2012 to 2013 and later, depending on the assumed effort level (Figure 4.3.2.5) The drop in PFA is, however, almost fully dependent on the assumed postsmolt survival for salmon smolting in 2011 and later. The assumption about postsmolt survival is neither optimistic nor pessimistic (average from 2008–2011) because the decreasing trend in survival which was observed before is not obvious any longer (Figure 4.2.3.1). Given the 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 two scenarios with the lowest assumed fishing effort would in most rivers keep smolt production at that elevated level which is achieved by the recent peak in the number of spawners (spawning years 2012–2013) (Figures 4.3.2.6a–c and 4.3.2.7a–h). The other effort scenarios and also the F=0.1 scenario would generally result in some reduction from this peak, but the resulting smolt production would still likely increase from the 2012 level (Table 4.3.2.3). The weakest stocks included in the scenario runs (especially AU4 stocks) are rather non-responsive to further reduction in sea fisheries and some of them are likely to weaken further regardless of the level of fishing (Table 4.3.2.3). Consequently, the best management options would a mixture of setting the fishing pressure equivalent to the level indicated in the scenarios 1–2, together with special actions (also not fishery-related) directed to the weakest stocks. The surplus produced by the strongest stocks could be directed towards stock-specific fisheries. Also non-commercial fishing should be steered towards stock-specific harvesting.

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). Some of these issues have been evaluated in detail during the inter benchmark protocol for Baltic salmon carried out in summer-autumn 2012 (ICES, 2012 IBP).

- New method of fitting observed catches with the model. The current methodology with lognormal fitting makes it possible for model estimated catch to be lower than the observed (reported) and thus is considered unrealistic. Also the recent expert elicited information about unreporting and discarding could be used as distribution (and not just as median as the unreporting information is currently used) to estimate the total removal by the fisheries.
- New parameterization of stock–recruitment dynamics and new priors from hierarchical meta-analysis of Atlantic salmon stock–recruit data in the model. This would enable us to re-calculate MSY levels for different stocks.
- 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.
- Evaluation of inclusion/exclusion of tag–recapture data. This task involves evaluation of the tag–recapture data against the assumptions made about it (e.g. currently tag reporting rate is assumed fixed over time).
- Inclusion of data on composition of stocks at sea. The 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 is to include genetic information on proportions of fish from different AUs, separating also wild and reared salmon. Subsequently, information on the representation of single stocks may be included.
- Full inclusion of recreational sea fisheries (mainly trolling).
- Inclusion of AU5 and 6 stocks in the full life-history model. At present, these stocks are modelled separately from AU1–4 stocks. This will require updated information from AU5 and 6 stocks regarding e.g. smolt age distribution, 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.
- Continuing the work of including data from established index rivers. This includes e.g. fitting the model to smolt and spawner counts from River Mörrumsån.

4.7 Needs of 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 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 given preference 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 places.

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 index river are ongoing. The collection of data concerning parr densities, smolt counts and number of spawners has 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, but 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. Also catch data from recreational fisheries in rivers 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 (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 4.6.1.

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, 2012x). Data collection within index rivers is currently included in the national programmes of Estonia, Finland and Sweden.

Genetic data on catch composition have not been used so far in salmon stock assessment. However, there is a potential in the assessment model to incorporate also such data and the plan of the working group is to develop the model accordingly in the future. From an assessment perspective, the most important area for catch sampling is the Main Basin mixed-stock fishery (longline fishery in the offshore). Therefore it is important to ensure a catch sampling with a relevant spatial and temporal coverage in this area.

The renewed DCF gives obligation to sample catches to those countries where catches are landed. In the Main Basin, the main landings occur in Poland, Denmark and Sweden. The qualities of the collected data from the Main Basin offshore fisheries were evaluated by means of DNA analysis in WG 2010. The evaluation gave reason to amend the sampling scheme of the fishery in the area. According to evaluation results the optimal time for the sampling in Main Basin is the winter months from December to January. The main fishery has taken place in Subdivisions 25–26 in recent years and therefore the sampling shall aim at those areas. The sampling stratification (Table 4.6.2) is designed according to the approximate distribution of the catches in 2011 and 2012 in the area taking into account that Swedish and Finnish offshore fishery will not take place in the area in 2013 and onwards. All individual samples will be aged by scale reading and out of all these samples, 500 specimens will be selected for DNA analysis. The scale reading work is shared between Poland, Sweden and Finland. The DNA analysis will be carried out in Finland.

The evaluation in WG 2010 did not concern the sampling of coastal fisheries and river fisheries. Sweden has conducted an evaluation of their sampling of coastal fisheries, and this evaluation may result in changes in the sampling scheme in 2013 and onwards with respect to the time and place for sampling.

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 95% 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)																												Method of
	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	estimation
Assessment unit 1																													
1 Tornionjoki	69	80	72	78	86	91	131	204	135	103	98	124	209	608	839	640	619	658	662	708	758	1087	1244	1386	1556	1637	1559	1424	1,3,4
95% PI	40-121	48-131	41-125	51-121	57-130	55-147	86-192	136-312	83-222	69-153	61-150	86-180	154-281	458-802	649-1102	521-778	479-821	512-867	521-835	534-960	571-991	844-1431	985-1569	1106-1748	1258-1955	1312-2061	1198-2049	1038-2015	
2 Simojoki	2	2	10	10	8	13	11	10	2	2	3	8	12	41	53	50	47	34	26	34	33	38	22	36	39	33	44	43	1,3,4
95% PI	1-4	1-4	6-19	6-19	4-14	7-24	6-19	6-20	1-4	1-3	1-5	4-15	7-20	26-68	35-79	33-76	32-74	22-52	17-38	23-52	23-46	25-57	15-34	24-53	31-49	20-49	26-74	21-90	
3 Kalixälven	189	119	102	79	150	110	192	112	109	111	70	123	294	375	380	378	320	431	629	519	773	547	696	618	653	846	715	759	1,4
95% PI	40-1009	‘25-571	‘22-432	‘19-276	‘33-588	‘28-389	‘48-685	‘26-421	‘27-394	‘26-405	‘17-246	‘30-440	‘59-1282	‘98-1292	‘103-1293	‘102-1259	‘88-1064	‘115-1513	‘163-2285	‘138-1761	‘209-2632	‘149-1828	‘189-2322	‘169-2037	‘179-2126	‘225-2962	‘197-2367	‘202-2711	
4 Råneälven	28	19	19	10	10	9	8	7	2	2	3	8	14	22	25	19	14	22	33	29	37	41	34	45	52	44	41	35	1,4
95% PI	2-354	'1-212	'1-223	'0-145	'0-100	'1-85	'1-54	'1-44	'0-18	'0-14	'0-17	'1-31	'2-58	'5-85	'5-92	'4-78	'3-55	'4-82	'7-128	'6-119	'9-130	'10-148	'8-127	'11-156	'13-189	'11-160	'10-150	'8-138	
Total assessment unit 1	264	204	189	171	247	219	338	336	254	218	175	259	520	1037	1293	1076	1001	1139	1326	1282	1575	1700	1983	2063	2276	2542	2355	2273	
95% PI	106-1079	'98-661	'95-521	'99-372	'123-684	'121-498	'183-835	'208-656	'143-547	'121-515	'103-353	'151-576	'270-1509	'697-1968	'918-2227	'759-1975	'704-1763	'761-2230	'822-2997	'827-2546	'960-3441	'1188-3000	'1372-3639	'1485-3505	'1662-3789	'1791-4700	'1651-4064	'1516-4278	
Assessment unit 2																													
5 Piteälven	0	0	1	1	1	1	1	1	3	3	5	6	4	5	18	12	7	9	7	21	29	26	21	18	11	13	20	25	5
95% PI	0-7	0-6	0-2	0-2	0-2	0-2	0-2	0-2	1-7	1-7	2-12	3-14	2-10	2-12	9-43	6-28	3-17	4-21	4-18	13-37	16-66	13-52	10-41	9-36	6-23	6-25	10-40	12-49	
6 Åbyälven	3	3	2	2	3	3	6	8	3	4	6	7	5	9	13	9	6	6	4	4	11	17	13	11	13	15	20	19	1,4
95% PI	0-21	'0-18	'0-13	'0-12	'0-18	'0-18	'0-38	'1-39	'0-18	'0-18	'1-26	'1-29	'1-24	'1-43	'2-51	'1-39	'1-27	'1-28	'0-22	'0-19	'2-50	'3-67	'2-52	'2-42	'2-50	'3-60	'4-76	'4-77	
7 Byskeälven	22	18	16	12	16	17	44	23	24	23	24	43	61	80	90	70	61	63	90	100	136	108	97	106	118	118	99	108	1,4
95% PI	4-107	'3-77	'2-69	'2-48	'3-69	'3-66	'9-171	'4-95	'5-89	'5-86	'5-91	'9-168	'14-239	'21-277	'24-308	'18-244	'16-210	'16-222	'23-339	'28-335	'37-477	'30-355	'26-318	'29-364	'32-413	'33-407	'27-328	'28-402	
8 Rickleån	0.60	0.28	0.19	0.09	0.07	0.05	0.04	0.05	0.13	0.10	0.10	0.13	0.13	0.20	0.45	0.49	0.56	0.44	0.46	0.27	0.58	0.47	0.37	0.40	0.60	0.45	0.39	0.26	1
95% PI	0-15	'0-8	'0-6	'0-3	'0-3	'0-2	'0-2	'0-2	'0-3	'0-3	'0-3	'0-3	'0-3	'0-4	'0-7	'0-7	'0-8	'0-7	'0-6	'0-5	'0-8	'0-7	'0-6	'0-7	'0-8	'0-7	'0-6	'0-6	
9 Sävarån	1.8	1.3	1.1	0.8	0.8	1.0	0.7	0.4	0.6	0.4	0.4	1.3	0.9	1.3	1.4	1.7	1.7	2.1	3.8	3.0	3.2	4.6	2.6	2.3	2.1	2.2	4.1	4.8	1,3,4
95% PI	0-17	‘0-13	‘0-11	‘0-6	‘0-6	‘0-6	‘0-5	‘0-4	‘0-4	‘0-4	‘0-3	‘0-7	‘0-6	‘0-7	‘0-8	‘0-10	‘0-9	‘0-9	‘3-5	‘2-4	‘2-4	‘3-6	‘1-5	‘1-4	‘1-3	‘0-7	‘1-15	‘1-17	
10 Ume/Vindelälven	28	24	28	28	29	22	23	19	14	8	11	14	62	144	68	127	157	78	113	86	106	139	100	80	155	131	116	176	1,4
95% PI	6-125	'3-191	'3-212	'5-161	'7-105	'4-122	'3-156	'4-77	'3-45	'1-31	'2-41	'3-46	'9-252	'31-519	'18-249	'37-397	'42-537	'23-238	'38-321	'30-238	'33-302	'50-365	'49-205	'29-211	'59-404	'49-344	'35-344	'59-500	
11 Öreälven	2.5	1.2	0.8	0.4	0.3	0.4	0.4	0.2	0.2	0.2	0.2	0.8	0.8	1.2	1.3	1.4	2.0	3.3	2.7	2.9	4.3	3.4	2.8	2.7	3.8	3.3	4.2	4.6	1,4
95% PI	0-42	'0-22	'0-17	'0-10	'0-9	'0-8	'0-8	'0-6	'0-6	'0-7	'0-8	'0-12	'0-12	'0-16	'0-16	'0-19	'0-23	'0-28	'0-24	'0-26	'0-33	'0-28	'0-26	'0-23	'0-34	'0-29	'0-34	'0-40	
12 Lögdeälven	1.8	1.1	0.9	0.8	0.7	0.9	1.6	1.1	0.9	1.5	1.2	2.8	3.3	4.0	5.6	4.9	3.9	4.6	6.0	7.9	8.6	7.4	6.0	6.8	6.5	6.9	7.9	6.6	1,4
95% PI	0-18	'0-10	'0-8	'0-7	'0-6	'0-8	'0-11	'0-9	'0-8	'0-11	'0-9	'0-16	'0-18	'0-22	'1-27	'0-25	'0-23	'0-24	'1-29	'1-36	'1-38	'1-34	'1-29	'1-31	'1-31	'1-32	'1-36	'1-33	
Total assessment unit 2	65	31	45	39	53	45	78	82	72	65	74	91	162	339	253	282	296	224	305	280	361	376	301	301	410	376	346	417	
95% PI	48-485	35-431	31-433	27-305	32-241	28-237	42-323	24-195	28-174	25-161	30-175	26-249	32-502	118-904	94-625	95-724	84-842	86-531	116-725	114-638	141-859	156-836	133-640	122-692	164-935	150-866	135-812	153-1013	
Assessment unit 3																													
13 Lungan	0.86	0.73	0.63	0.93	1.19	0.68	0.89	0.60	0.23	0.40	0.92	0.84	1.43	1.83	1.70	1.37	0.76	0.76	0.76	0.56	1.60	0.99	0.60	1.25	0.73	0.68	0.87	1.87	1,4
95% PI	0-17	'0-12	'0-9	'0-10	'0-11	'0-8	'0-10	'0-8	'0-5	'0-6	'0-10	'0-9	'0-14	'0-15	'0-14	'0-11	'0-8	'0-8	'0-7	'0-6	'0-15	'0-10	'0-8	'0-14	'0-12	'0-12	'0-13	'0-23	
Total assessment unit 3	0.86	0.73	0.63	0.93	1.19	0.68	0.89	0.60	0.23	0.40	0.92	0.84	1.43	1.83	1.70	1.37	0.76	0.76	0.76	0.56	1.60	0.99	0.60	1.25	0.73	0.68	0.87	1.87	
95% PI	0-17	'0-12	'0-9	'0-10	'0-11	'0-8	'0-10	'0-8	'0-5	'0-6	'0-10	'0-9	'0-14	'0-15	'0-14	'0-11	'0-8	'0-8	'0-7	'0-6	'0-15	'0-10	'0-8	'0-14	'0-12	'0-12	'0-13	'0-23	
Assessment unit 4																													
14 Emån			5	5	5	15	5	5	3	3	4	4	4	5	3	3	3	3	3	3	1	2	3	2	2	2	2		4
95% PI			3.6-7	3.6-7	3.6-7	11-22	3.6-7	3.3-7	2.2-4	1.8-3.7	2.9-6	2.5-5	2.9-6	3.6-7	2.2-4	2.2-4	2.2-4	1.8-3.7	2.3-4	2.3-4	0.4-1.4	1-3.5	1.5-5.4	1-3	1-3	1-3	1-3		
15 Mörrumsån			120	120	120	100	90	60	30	35	60	60	76	98	70	68	55	76	50	65	87	38	44	63	63	64	35		4
95% PI			86-178	86-180	86-180	72-150	64-135	43-90	22-45	25-52	43-90	43-90	54-114	70-147	50-105	49-102	39-82	54-113	40-66	47-79	64-99	29-47	35-53	50-81	38-82	38-83	21-45		
Total assessment unit 4			125	125	125	116	95	65	33	38	64	64	80	103	73	71	58	78	53	68	62	40	48	64	64	66	36		
95% PI			91-185	91-185	91-185	86-165	69-140	47-95	24-48	28-55	47-94	46-93	58-118	75-152	53-108	51-104	42-85	57-116	42-69	50-83	44-91	32-50	39-60	52-83	52-83	47-100	26-54		

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 in spawning years 1985–2011.

	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
Simojoki	**2**	**2**	**1**	**2**	**7**	**2**	**49**	**64**	**53**	**64**	**53**	**55**	**8**	**44**	**27**	**27**	**23**	**0**	**2**	**1**	**4**	**13**	**7**	**5**	**3**	**2**	**0**
cv	1.03	1.04	1.05	1.05	0.59	0.85	0.16	0.14	0.17	0.10	0.16	0.14	0.29	0.11	0.21	0.23	0.23	0.61	0.62	0.91	0.49	0.29	0.47	0.48	0.65	0.70	2.23
Tornionjoki									**77**	**53**			**7**	**44**	**22**	**26**	**35**	**0**	**0**	**2**	**5**	**6**	**7**	**3**	**8**	**4**	**0**
cv									0.07	0.10			0.44	0.18	0.22	0.23	0.24	1.10	1.36	1.28	0.51	0.51	0.66	0.63	0.52	1.03	2.03
Kemijoki																						**22**	**13**	**12**	**5**	**3**	**0**
cv																						0.30	0.41	0.34	0.54	0.74	1.89
Luleälven								**56**	**56**	**38**	**36**	**28**	**2**	**27**	**14**	**21**	**25**	**1**	**1**	**1**	**5**	**11**	**7**	**8**	**21**	**1**	**1**
cv								0.16	0.06	0.13	0.19	0.16	0.34	0.12	0.16	0.14	0.20	0.60	0.43	0.67	0.40	0.23	0.24	0.25	0.20	0.41	0.59
Skellelteälven								**43**	**63**	**37**	**52**	**14**	**2**	**33**	**10**	**14**	**14**	**1**	**0**	**1**	**1**	**7**	**1**	**1**	**4**	**2**	**1**
cv								0.18	0.08	0.16	0.20	0.31	0.63	0.17	0.32	0.29	0.32	0.69	1.64	0.91	0.71	0.42	0.91	0.84	0.57	0.74	1.04
Ume/Vindelälven	**11**	**13**	**10**	**8**	**18**	**24**	**69**	**74**	**79**	**51**	**53**	**26**	**6**	**40**	**30**	**26**	**24**	**2**	**1**	**0**	**2**	**8**	**3**	**12**	**14**	**6**	**0**
cv	0.40	0.41	0.45	0.49	0.36	0.38	0.09	0.16	0.05	0.13	0.19	0.21	0.45	0.15	0.19	0.19	0.24	0.62	0.71	1.36	0.62	0.39	0.58	0.30	0.32	0.41	2.02
Angermanälven								**65**	**60**	**35**	**44**	**16**	**2**	**23**	**15**	**18**	**29**	**2**	**1**	**2**	**7**	**15**	**11**	**4**	**13**	**4**	**1**
cv								0.16	0.09	0.15	0.21	0.20	0.57	0.17	0.19	0.19	0.21	0.59	0.55	0.60	0.42	0.26	0.28	0.38	0.27	0.43	0.94
Indalsälven	**4**	**5**	**4**	**2**	**5**	**4**	**42**	**62**	**64**	**31**	**44**	**17**	**1**	**17**	**15**	**6**	**13**	**1**	**0**	**2**	**5**	**8**	**12**	**3**	**7**	**3**	**0**
cv	0.42	0.42	0.44	0.51	0.37	0.45	0.09	0.16	0.06	0.15	0.19	0.20	0.63	0.19	0.20	0.32	0.25	0.73	1.51	0.62	0.41	0.29	0.25	0.44	0.31	0.39	2.04
Ljungan								**71**	**52**	**41**	**25**	**22**	**4**	**23**	**12**	**9**	**30**	**1**	**1**								
cv								0.19	0.19	0.19	0.29	0.33	0.59	0.30	0.50	0.59	0.29	1.15	1.45								
Ljusnan	**1**	**1**	**1**	**1**	**1**	**9**	**32**	**64**	**58**	**41**	**49**	**17**	**3**	**32**	**18**	**31**	**24**	**2**	**0**	**1**	**7**	**8**	**6**	**8**	**6**	**2**	**0**
cv	1.08	1.02	1.08	1.02	0.88	0.43	0.15	0.16	0.07	0.14	0.20	0.21	0.45	0.18	0.21	0.15	0.24	0.59	1.54	1.39	0.44	0.36	0.35	0.31	0.34	0.52	1.93
Dalälven	**5**	**5**	**11**	**6**	**6**	**11**	**70**	**72**	**51**	**41**	**40**	**28**	**6**	**27**	**19**	**22**	**24**	**2**	**1**	**4**	**5**	**9**	**5**	**12**	**11**	**2**	**0**
cv	0.55	0.50	0.41	0.49	0.50	0.43	0.09	0.16	0.09	0.18	0.19	0.18	0.37	0.17	0.19	0.20	0.21	0.60	0.54	0.45	0.40	0.28	0.35	0.24	0.25	0.43	2.16
Mörrumsån	**25**	**32**	**23**	**29**	**41**	**32**	**50**	**75**	**66**	**46**	**39**	**19**	**4**														
cv	0.38	0.37	0.39	0.37	0.31	0.38	0.12	0.16	0.17	0.18	0.26	0.33	0.90														
Unsampled stock	**6**	**6**	**6**	**5**	**9**	**11**	**50**	**62**	**63**	**44**	**43**	**24**	**4**	**31**	**20**	**20**	**24**	**1**	**1**	**2**	**5**	**11**	**8**	**7**	**9**	**4**	**0**
cv	0.93	0.92	0.96	1.00	0.80	0.73	0.31	0.25	0.22	0.31	0.31	0.49	0.88	0.41	0.53	0.52	0.46	1.07	1.38	1.30	0.71	0.61	0.81	0.78	0.74	1.00	1.98

Table 4.2.3.1. Posterior probability distributions for the steepness and alpha and beta parameters of the Beverton–Holt stock–recruit relationship for different Baltic salmon stocks. The posterior distributions are described in terms of their mean and CV (%).

		Steepness		Alpha parameter		Beta parameter	
		Mean	cv	Mean	cv	Mean	cv
Assessment unit 1							
1	Tornionjoki	0.71	7	42	14	0.000	16
2	Simojoki	0.51	19	148	23	0.011	29
3	Kalixälven	0.82	9	17	37	0.001	24
4	Råneälven	0.71	13	39	36	0.014	44
Assessment unit 2							
5	Piteälven	0.84	8	14	38	0.045	17
6	Åbyälven	0.72	15	40	48	0.054	42
7	Byskeälven	0.78	12	26	51	0.006	34
8	Rickleån	0.63	16	71	36	0.204	167
9	Sävarån	0.73	15	40	58	0.182	50
10	Ume/Vindelälven	0.87	5	13	29	0.005	11
11	Öreälven	0.67	13	52	30	0.045	52
12	Lögdeälven	0.68	14	51	33	0.033	71
Assessment unit 3							
13	Ljungan	0.69	19	57	69	0.489	61
Assessment unit 4							
14	Emån	0.33	18	506	14	0.032	36
15	Mörrumsån	0.42	27	227	36	0.008	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 95% probability interval (PI), the method on how the posterior probability distribution has been obtained. These estimates serve as reference points to evaluate the status of the stock. For the updated estimates of AU1–4 rivers, medians as estimated by last year's 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	95% PI	estimation		
Assessment unit 1								
1	Tornionjoki	2357	2410	2453	1898-3249	1	1543	56%
2	Simojoki	60	67	72	42-133	1	50	34%
3	Kalixälven	735	770	788	456-1135	1	955	-19%
4	Råneälven	32	64	78	33-188	1	68	-6%
Total assessment unit 1		3251	3318	3390	2662-4285		2603	27%
Assessment unit 2								
5	Piteälven	20	21	22	16-31	1	20	5%
6	Åbyälven	17	19	19	8-32	1	16	17%
7	Byskeälven	117	148	164	86-319	1	149	-1%
8	Rickleån	6	10	12	1-34	1	11	-9%
9	Sävarån	3	5	7	3-16	1	5	0%
10	Ume/Vindelälven	189	192	197	158-259	1	158	21%
11	Öreälven	19	21	22	10-37	1	21	0%
12	Lögdeälven	23	34	41	10-112	1	25	38%
Total assessment unit 2		454	472	484	354-673		423	12%
Assessment unit 3								
13	Ljungan	0.7	1.9	3.5	1-19	1	2	-5%
Total assessment unit 3		0.7	1.9	3.5	1-19		2	-5%
Assessment unit 4								
14	Emån	14	15	15	11-21	1	15	-1%
15	Mörrumsån	81	84	85	61-117	1	81	4%
Total assessment unit 4		96	99	100	'75-133		96	3%
Total assessment units 1-4		**3840**	**3900**	**3978**	**3218-4888**			
Assessment unit 5								
16	Pärnu		4			2		
17	Salaca		30			3		
18	Vitrupe		4			3		
19	Peterupe		5			3		
20	Gauja		29			3		
21	Daugava		11			3		
22	Irbe		4			3		
23	Venta		15			3		
24	Saka		8			3		
25	Uzava		4			3		
26	Barta		4			3		
27	Nemunas river basin		164			3		
Total assessment unit 5			282					
Assessment unit 6								
28	Kymijoki		100			2		
29	Luga		100			4		
30	Purtse		8			2		
31	Kunda		2			2		
32	Selja		11			2		
33	Loobu		11			2		
34	Pirita		10			2		
35	Vasalemma		1			2		
36	Keila		5			2		
37	Valgejögi		2			2		
38	Jägala		0.3			2		
39	Väänа		2			2		
Total assessment unit 6			252					
Total assessment units 1-6			**4434**					

Methods of estimating potential production 1. Bayesian stock–recruit analysis 2. Accessible linear stream length and production capacity per area. 3. Expert opinion with 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 (95% 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.

Assessment unit, sub-division, country	Category	Reprod. area (ha, mode)	Potential (*1000)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Pred 2013	Pred 2014	Method of estimation: Pot. prod.	Method of estimation: Pres. prod.
Gulf of Bothnia, Sub-div. 30-31:																								
Finland																								
Simojoki	wild	254	67	3	6	8	11	26	46	50	52	43	32	37	34	41	35	42	40	33	33	21	1	1
95% PI		218-299	42-133	1-4	3-9	5-13	7-16	18-37	34-62	37-67	37-70	30-58	23-43	27-49	26-44	30-53	24-46	30-58	32-49	24-44	23-46	12-33		
Finland/Sweden																								
Tornionjoki;Torneälven	wild	4997	2409.5	104	78	129	200	534	737	640	679	680	656	861	820	1074	1140	1255	1421	1566	1475	1145	1	1
95% PI		3877-6695	1898-3249	72-147	54-110	95-173	153-258	418-672	589-908	529-770	541-842	539-855	529-810	684-1111	657-1010	867-1354	911-1402	1023-1507	1182-1720	1287-1915	1181-1848	719-1772		
Sweden																								
Kalixälven	wild	2570	770	129	113	210	270	776	631	632	613	620	587	752	659	661	685	612	674	730	713	676	1	1
95% PI		2062-3295	456-1135	54-271	50-231	106-401	143-478	511-1284	349-948	370-1037	372-990	361-1028	346-965	450-1204	395-1067	395-1042	386-1080	358-935	376-1083	413-1187	406-1149	367-1118		
Råneälven	wild	384	64	5	6	12	14	24	28	22	23	22	26	32	32	35	37	37	39	42	42	37	1	1
95% PI		325-462	33-188	1-17	1-15	4-26	5-31	11-44	14-52	10-42	11-41	10-40	13-46	18-55	18-55	19-61	20-64	20-65	21-69	23-76	22-77	19-72		
Assessment unit 1, total			**3318**	**244**	**204**	**364**	**498**	**1367**	**1452**	**1359**	**1375**	**1370**	**1299**	**1694**	**1553**	**1822**	**1910**	**1944**	**2187**	**2370**	**2290**	**1891**		
95% PI			2662-4285	166-386	136-331	247-563	362-738	1083-1885	1110-1806	1092-1764	1106-1743	1067-1792	1032-1653	1329-2175	1202-1982	1437-2323	1549-2376	1565-2378	1772-2719	1930-2929	1846-2836	1336-2620		
Piteälven	wild	425	21	3	4	5	5	8	16	14	13	14	13	18	20	21	20	19	16	17	20	19	1	1
95% PI		359-511	16-31	1-5	2-7	2-8	2-8	4-12	10-23	9-21	8-19	9-20	8-19	13-25	13-30	15-30	14-28	13-26	11-23	12-24	14-29	12-30		
Åbyälven	wild	84	19	3	3	5	6	10	13	11	10	9	9	10	11	12	12	12	12	13	13	11	1	1
95% PI		67-108	8-32	0-7	1-8	1-10	2-12	5-18	7-22	5-18	5-17	4-15	4-15	5-17	6-19	6-21	6-21	6-20	6-21	7-22	6-22	5-21		
Byskeälven	wild	560	148	27	26	44	58	86	99	92	88	89	95	111	108	117	117	114	119	125	121	115	1	1
95% PI		473-673	86-319	10-62	10-61	20-89	26-110	47-148	58-165	52-157	48-152	48-154	54-163	64-188	63-182	67-199	68-202	66-195	67-204	70-221	67-217	62-212		
Rickleån	wild	15	10	0.2	0.1	0.1	0.1	0.2	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.5	0.6	0.7	0.7	0.7	0.6	0.5	1	1
95% PI		9.2-29	1-34	0-0	0-0	0-0	0-0	0-0	0-1	0-1	0-0	0-0	0-0	0-0	0-0	0-1	0-1	0-1	0-1	0-1	0-1	0-1		
Sävarån	wild	21	5	1	1	2	2	2	3	2	2	2	3	3	3	4	3	3	3	4	4	3	1	1
95% PI		13-40	3-16	0-2	0-2	0-3	0-3	1-3	1-4	1-3	0-3	1-3	2-4	2-3	2-4	2-5	1-4	1-4	1-4	2-6	2-6	2-5		
Ume/Vindelälven	wild	1242	192	17	24	66	86	171	152	100	131	127	140	165	166	186	158	166	172	167	169	163	1	1
95% PI		917-1778	158-259	6-39	10-46	39-100	55-134	119-242	98-226	63-149	85-192	79-197	92-210	115-227	111-229	129-248	110-212	114-231	107-241	110-245	109-251	101-252		
Öreälven	wild	105	21	0.5	0.4	0.7	0.7	1	2	2	2	2	2	2	3	3	4	4	4	5	5	4	1	1
95% PI		84-135	10-37	0-1	0-1	0-1	0-1	0-3	0-5	0-3	0-3	0-3	0-4	1-5	1-6	1-7	1-8	1-8	1-9	2-11	2-11	1-10		
Lögdeälven	wild	104	34	1	1	2	3	4	6	5	4	4	5	7	7	8	8	8	9	11	11	10	1	1
95% PI		82-136	10-112	0-3	0-3	0-4	1-6	1-8	2-12	2-9	1-8	1-8	2-10	3-12	3-13	4-15	4-16	4-16	4-16	5-20	5-22	4-20		
Assessment unit 2, total			**472**	**55**	**62**	**127**	**165**	**289**	**295**	**231**	**255**	**250**	**273**	**321**	**320**	**355**	**329**	**331**	**342**	**350**	**353**	**334**		
95% PI			354-673	30-95	38-103	86-177	114-237	214-375	223-395	168-314	189-337	181-349	199-366	249-420	252-417	275-450	260-426	260-436	252-453	259-466	256-476	245-458		
Ljungan	mixed	17	2	0.29	0.59	0.72	0.97	1.24	1.30	1.12	1.11	1.03	0.93	1.19	1.14	1.22	1.23	1.23	1.22	1.20	1.26	1.12	1	1
95% PI		9.8-37	1-19	0-1	0-1	0-1	0-2	0-2	0-2	0-2	0-2	0-2	0-1	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2		
Assessment unit 3, total			2	**0.29**	**0.59**	**0.72**	**0.97**	**1.24**	**1.30**	**1.12**	**1.11**	**1.03**	**0.93**	**1.19**	**1.14**	**1.22**	**1.23**	**1.23**	**1.22**	**1.20**	**1.26**	**1.12**		
95% PI			1-19	0-1	0-1	0-1	0-2	0-2	0-2	0-2	0-2	0-2	0-1	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2		
Total Gulf of B., Sub-divs.30-31			**3801**	**348**	**341**	**560**	**752**	**1744**	**1826**	**1666**	**1690**	**1694**	**1643**	**2090**	**1967**	**2222**	**2286**	**2358**	**2604**	**2794**	**2691**	**2286**		
95% PI			3120-4774	256-493	256-470	429-774	590-1005	1466-2289	1480-2183	1381-2054	1395-2076	1385-2149	1363-2018	1708-2584	1583-2389	1810-2727	1913-2775	1921-2784	2151-3145	2339-3403	2210-3267	1718-3002		

Assessment unit, sub-division, country	Category	Reprod. area (ha, mode)	Potential (*1000)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Pred 2013	Pred 2014	Method of estimation: Pot. prod.	Method of estimation: Pres. prod.
Sweden																								
Emån	wild	21.7	15	2	4	4	4	6	3	3	3	3	3	3	1.4	2.2	2.7	2.0	2.1	1.8	1.4	1.5	1	1
95% PI			11-21	1-3	3-5	2-5	3-5	4-7	2-3	2-3	2-3	1-3	2-4	2-3	0-2	1-3	1-3	1-2	1-2	1-2	1-2	0-2		
Mörrumsån	wild	44	84	42	63	64	79	93	65	66	55	69	59	64	81	42	46	63	64	65	40	50	1	1
95% PI			61-117	30-57	47-83	48-85	59-104	69-123	48-86	49-86	40-72	51-91	44-77	48-84	68-95	35-49	39-53	52-74	50-81	51-82	31-51	30-80		

Table 4.2.3.3. continued.

Assessment unit 4, total			**99**	**45**	**68**	**68**	**83**	**98**	**68**	**69**	**57**	**72**	**62**	**66**	**82**	**44**	**49**	**64**	**66**	**67**	**42**	**52**		
95% PI			75-133	32-59	51-89	53-87	63-110	76-130	51-89	53-91	44-75	54-93	49-80	52-88	69-96	37-53	42-57	55-76	52-83	53-83	33-53	31-81		
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		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		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		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		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		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		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		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		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		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		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		3	5
Lithuania																								
Nemunas river basin	wild		164	10	10	10	2	2	5	8	4	2	6	7	5	13	42	48	7	33			3	3, 4
Assessment unit 5, total			285						**87**	**90**	**80**	**59**	**80**	**77**	**56**	**68**	**96**	**86**	**34**	**58**	**36**			
Total Main B., Sub-divs. 22-29			385						**156**	**158**	**137**	**130**	**143**	**143**	**138**	**112**	**145**	**151**	**100**	**125**	**78**	**52**		
95% PI			304-501						**138-176**	**143-181**	**124-155**	**113-152**	**129-160**	**129-165**	**125-152**	**105-121**	**138-153**	**141-162**	**86-117**	**111-141**	**69-89**	**31-81**		
Assessment unit, sub-division, country	**Category**	**Reprod. area (ha, mode)**	**Potential (*1000)**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Pred 2013**	**Pred 2014**	**Method of estimation**	
																							Pot. prod.	**Pres. prod.**
Finland:																								
Kymijoki	mixed	15[1)]+60[2)]	20[1)]+80[2)]					2	12	13	20	13	6	24	41	20	12	11	25	26	9		7	4
Russia:																								
Neva	mixed	0	0					7	6	6	6	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		7	2
95% PI			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			
Estonia:																								
Purtse	mixed	7.6	7.6													0.05	2.6	2.2	0.4	1.1	0.0		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		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		7	4
Loobu	mixed	9.9	10.5					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		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	0.2		7	2, 3
95% PI														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				
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		7	4
Keila	wild	3.5	6 (6,5)					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		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		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		7	4
Vääna	mixed	2.0	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		7	4
Assessment unit 6, total		**165**	**252**					**20**	**25**	**30**	**34**	**21**	**15**	**48**	**56**	**28**	**28**	**48**	**41**	**48**	**23**			
Gulf of B.+Main B.+ Gulf of F., Sub-divs. 22-32			**4436**	**348**	**341**	**560**	**752**	**1764**	**1938**	**1786**	**1805**	**1774**	**1738**	**2215**	**2080**	**2318**	**2410**	**2492**	**2679**	**2899**	**2750**	**2286**		
95% PI			3754-5424	256-493	256-470	429-774	590-1005	1486-2309	1592-2295	1500-2173	1509-2190	1464-2228	1458-2113	1833-2709	1695-2501	1906-2823	2037-2899	2055-2918	2226-3220	2444-3508	2268-3325	1718-3002		

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 2012. Stocks are considered very likely to reach this objective in case the probability is more than 90%. They are likely to reach the objective in case the probability is between 70 and 90% and unlikely in case the probability is less than 30%. When the probability of reaching the objective lies between 30 and 70%, it is considered uncertain the objective has been reached in 2012. For the AU1-4 stocks the results are based on the assessment model, whilst the categorization of AU5-6 stocks is based on expert judgments and there are no precise probabilities (column 'Prob') to present for these stocks.

	Prob to reach 50%					Prob to reach 75%				
	Prob	V.likely	Likely	Uncert.	Unlikely	Prob	V.likely	Likely	Uncert.	Unlikely
Unit 1										
Tornionjoki	0.93	X				0.20				X
Simojoki	0.47			X		0.07				X
Kalixälven	1.00	X				0.88		X		
Råneälven	0.74		X			0.34			X	
Unit 2										
Piteälven	0.99	X				0.68			X	
Åbyälven	0.87		X			0.49			X	
Byskeälven	0.95	X				0.69			X	
Rickleån	0.09				X	0.04				X
Sävarån	0.68			X		0.45			X	
Ume/Vindelälven	1.00	X				0.75		X		
Öreälven	0.08				X	0.01				X
Lögdeälven	0.29			X		0.10				X
Unit 3										
Ljungan	0.67			X		0.41			X	
Unit 4										
Emån	0.00				X	0.00				X
Mörrumsån	0.98	X				0.59			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
Väana	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	Fishing effort for year 2013 and onwards	Trapnet effort (trapdays)	Longline effort (hookdays)
1	The most likely development	41 000	600 000
2	25% increase compared to scenario 1		
3	50% increase compared to scenario 1		
4	100% increase compared to scenario 1		
	In all scenarios we assume 39% extra fishing mortality that covers discards, misreported, unreported, and recreational sea fisheries. (See text for details)		
Post-smolt survival of wild salmon			
Average survival between 2008-2011 (15%)			
Post-smolt survival of reared salmon			
Same relative difference to wild salmon as on average in history			
M74 survival			
Historical median (92%)			
Releases			
Same number of annual releases in the future as in 2012			
Maturation			
Age group specific average maturation rates over the time series, separately for wild and reared salmon			

Table 4.3.2.1. Estimates (in thousands of fish) of total removal in the commercial sea fisheries by scenario, and the corresponding reported commercial catch in total and divided between fisheries in 2014. Calculations about how the total catch is divided between reported commercial catch and misreporting are based on the situation prevailed in 2012 (see text). The table shows also the predicted total number of spawners in 2014 (in thousands). All values refer to medians unless stated otherwise.

	Commercial fisheries SD 22-31									
Effort	Total sea catch		Reported landing				Discarded		Unreported	Misreported
Scenario	Median	95%PI	Longline	Trapnet	Other gear	Total reported (% TAC 2013)	Undersized	Seal damaged		
1	97	(55,145)	26	37	3.2	66 (61 %)	2.1	3.2	17	10
2	116	(66,173)	31	45	3.8	81 (73 %)	2.6	3.8	20	12
3	134	(76,199)	36	52	4.4	92 (84 %)	3.0	4.4	24	13
4	167	(97,249)	44	64	5.5	113 (104 %)	3.7	5.5	29	16
F 0.1	142		37	55	4.7	97 (89 %)	3.1	4.7	25	14

Effort	No. spawners		River catch	
Scenario	Median	95%PI	Median	95%PI
1	115	(52,252)	40	(12,118)
2	102	(46,225)	36	(11,106)
3	91	(42,201)	32	(10,96)
4	73	(33,161)	27	(8,78)

Table 4.3.2.2. River-specific probabilities in different scenarios to: (1) meet 75% of PSPC in 2018/2019 (depending on the assessment unit) and (2) have a higher smolt production in 2018/2019 compared to smolt production 2012. Probabilities higher than 70% are presented in green.

River	Year of comparison	Probability to meet 75% of PSPC				Probability for increase in smolt production compared to 2012 level			
		Scenario				Scenario			
		1	2	3	4	1	2	3	4
Tornionjoki	2019	0.67	0.60	0.50	0.32	0.83	0.80	0.73	0.57
Simojoki	2019	0.14	0.09	0.06	0.02	0.55	0.43	0.31	0.14
Kalixälven	2019	0.96	0.95	0.92	0.89	0.58	0.56	0.53	0.47
Råneälven	2019	0.69	0.60	0.54	0.44	0.80	0.76	0.71	0.60
Piteälven	2019	0.95	0.94	0.95	0.91	0.81	0.81	0.79	0.76
Åbyälven	2019	0.77	0.73	0.68	0.57	0.72	0.71	0.65	0.54
Byskeälven	2019	0.88	0.85	0.83	0.77	0.66	0.66	0.64	0.55
Rickleån	2019	0.11	0.09	0.07	0.07	0.97	0.95	0.92	0.86
Sävarån	2019	0.64	0.61	0.58	0.52	0.75	0.73	0.69	0.58
Ume/Vindelälven	2019	0.95	0.95	0.94	0.92	0.69	0.71	0.68	0.66
Öreälven	2019	0.19	0.17	0.15	0.09	0.99	0.98	0.96	0.91
Lögdeälven	2019	0.35	0.32	0.27	0.21	0.94	0.90	0.88	0.81
Ljungan	2019	0.64	0.61	0.58	0.54	0.77	0.77	0.75	0.67
Mörrumsån	2018	0.46	0.43	0.41	0.37	0.40	0.34	0.32	0.26
Emån	2018	0.00	0.00	0.00	0.00	0.35	0.30	0.27	0.20

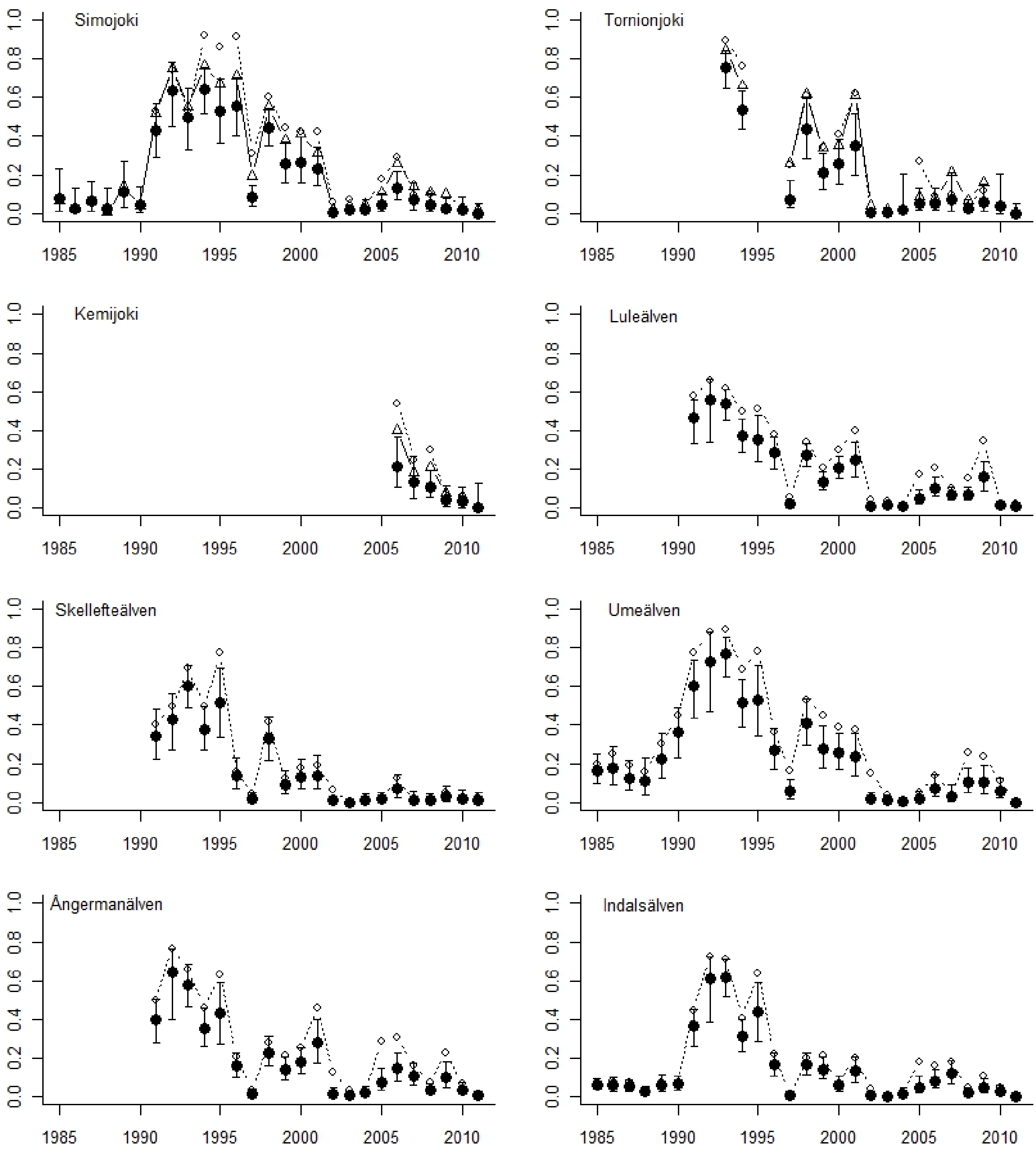
Table 4.7.1. Stock data problems relevant to data collection, WGBAST.

Stock name	Data problem identification	Description of data problem and recommend solution	Who should take care of the recommended solution and who should be notified on this data issue.
Baltic salmon	Misreporting	There is a suspected misreporting of salmon as sea-trout in the Polish sea fishery. Data (proportions of sea trout/salmon) from inspection campaigns coordinated by EU authorities should be made available to the working group to facilitate a more precise estimation of the level of misreporting. In addition Polish national institute should provide to the working group the catch sampling data collected under the DCF on the proportions of salmon and sea trout in the sea catches.	European Fisheries Control Agency, Polish national institute under DCF, WG
Baltic salmon	Amount of discards	The amount of undersized salmon in longline fisheries and in the catch of other fisheries (e.g. pelagic trawling and coastal trapnet fishing) should be evaluated. When salmon fishing is closed in the midstream of the fishing season as a result of quota fill up and fishing for the other species continues with salmon fishing gears, amounts of salmon that are released back to sea should be evaluated.	National institutes under DCF, RCM Baltic Sea
Baltic salmon	Survival of salmon released from salmon gears back to sea	The survival of salmon released from salmon gears back to sea should be evaluated.	WG
Baltic salmon	Age and stock composition of catches	Returns of the tagged salmon are low. Alternative tagging methods should be tested. Also a supplementary catch sampling is needed in each fishery. An evaluation of the associated data collected under DCF should to be evaluated.	WG
Baltic salmon	Stock–recruit data	It is important that index rivers are established in relevant assessment units to increase precision in assessment, such as estimates of sea survival.	National institutes under DCF, RCM Baltic Sea

Stock name	Data problem identification	Description of data problem and recommend solution	Who should take care of the recommended solution and who should be notified on this data issue.
Baltic salmon	Baseline genetic data	Baseline samples of the selected salmon stocks, particularly in AU 5 and AU 6, should be updated.	National institutes under DCF, RCM Baltic Sea
Baltic salmon	Migrations of salmon in the Gulf of Finland	All salmon tagging data from the area should be compiled and when necessary new taggings should be carried out in order to explore the migrations of salmon in Gulf of Finland. Also a literature study on the migrations should be carried out.	WG
Baltic salmon	Reporting rates of fisheries data and tag returns	Expert elicitation to monitor the reporting rates of catches and efforts and also tags recoveries shall be continued.	WG

Table 4.7.2. Number of salmon to be scale sampled in the longline fisheries by country in Subdivisions 25–26. Sample sizes were calculated based on the approximate distribution of catches in 2011 and 2012. In each sampling event/trip approximately 65 individual salmon scales will be collected.

	25		26		Total	Number of trips
	Nov–Dec	Jan–Feb	Nov–Dec	Jan–Feb		
POL	130	0	130	260	520	**8**
DEN	0	390	0	0	390	**6**
Total	130	390	130	260	910	14



Simojoki
Tornionjoki
Kemijoki
Luleälven
Skellefteälven
Umeälven
Ångermanälven
Indalsälven
0.0
0.2
0.4
0.6
0.8
1.0
1985
1990
1995
2000
2005
2010

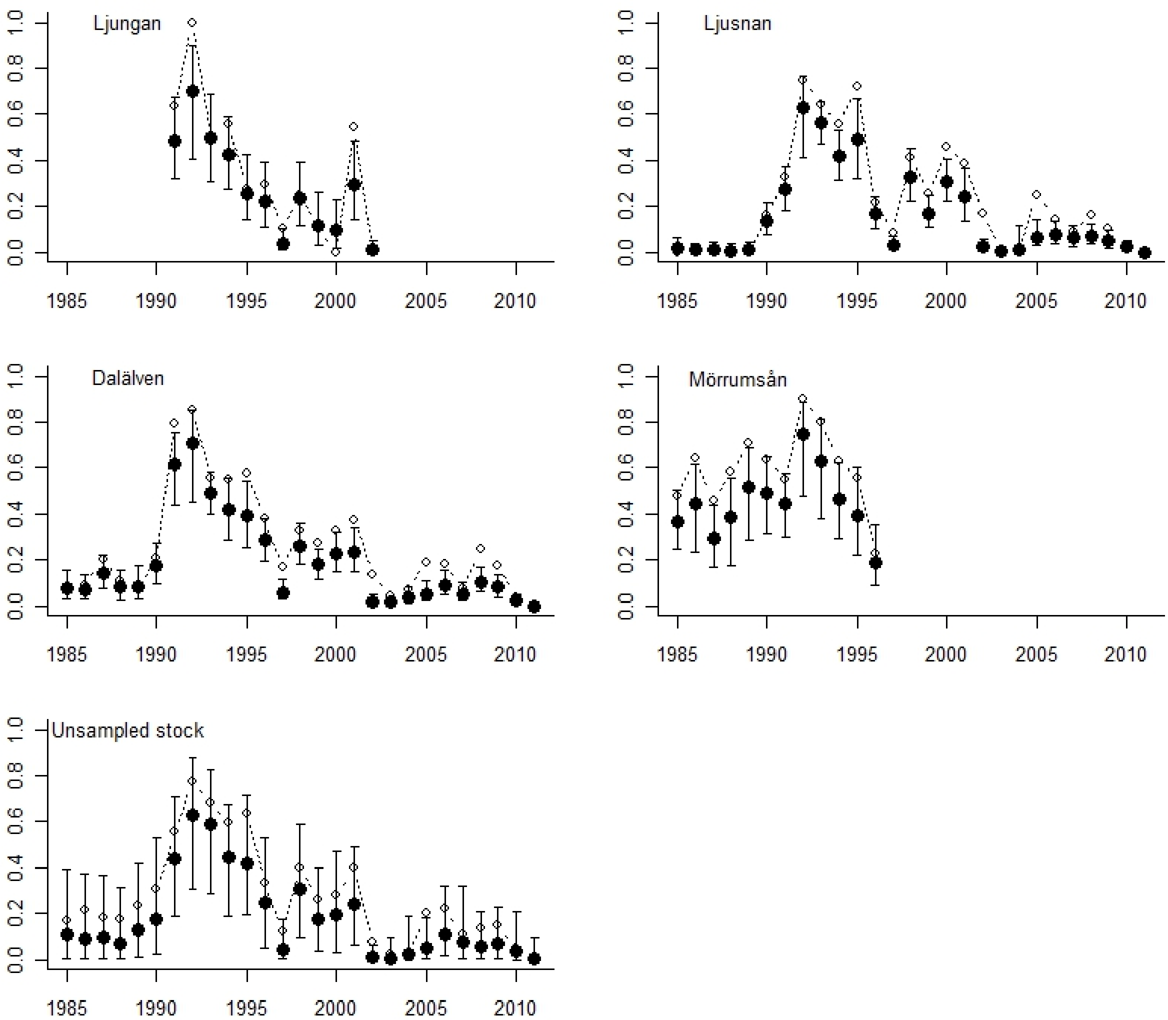


Figure 4.2.1.1. M74 mortality among Atlantic salmon stocks within the Baltic Sea by spawning year class. Solid circles and whiskers represent the medians and 95% probability intervals of the estimated M74 mortality. Open circles represent the proportion of females with offspring affected by M74 and triangles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

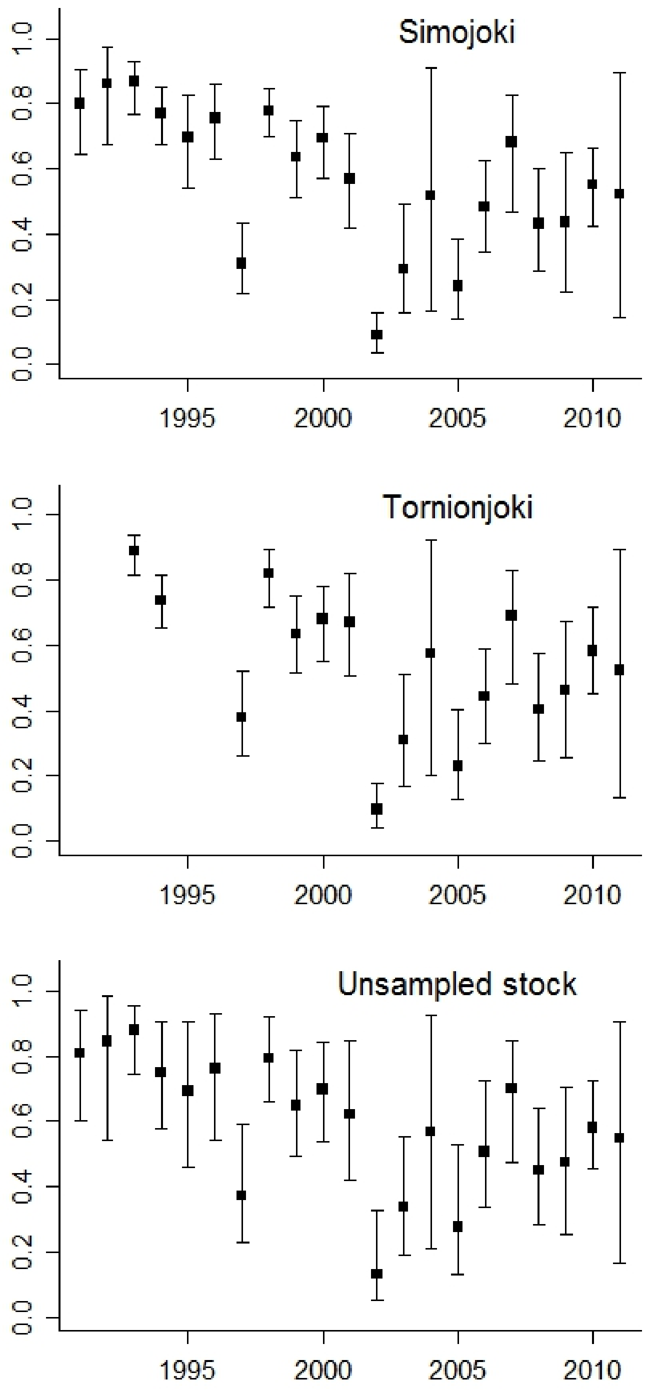


Figure 4.2.1.2. Estimated proportion of M74-affected offspring that die by spawning year class.

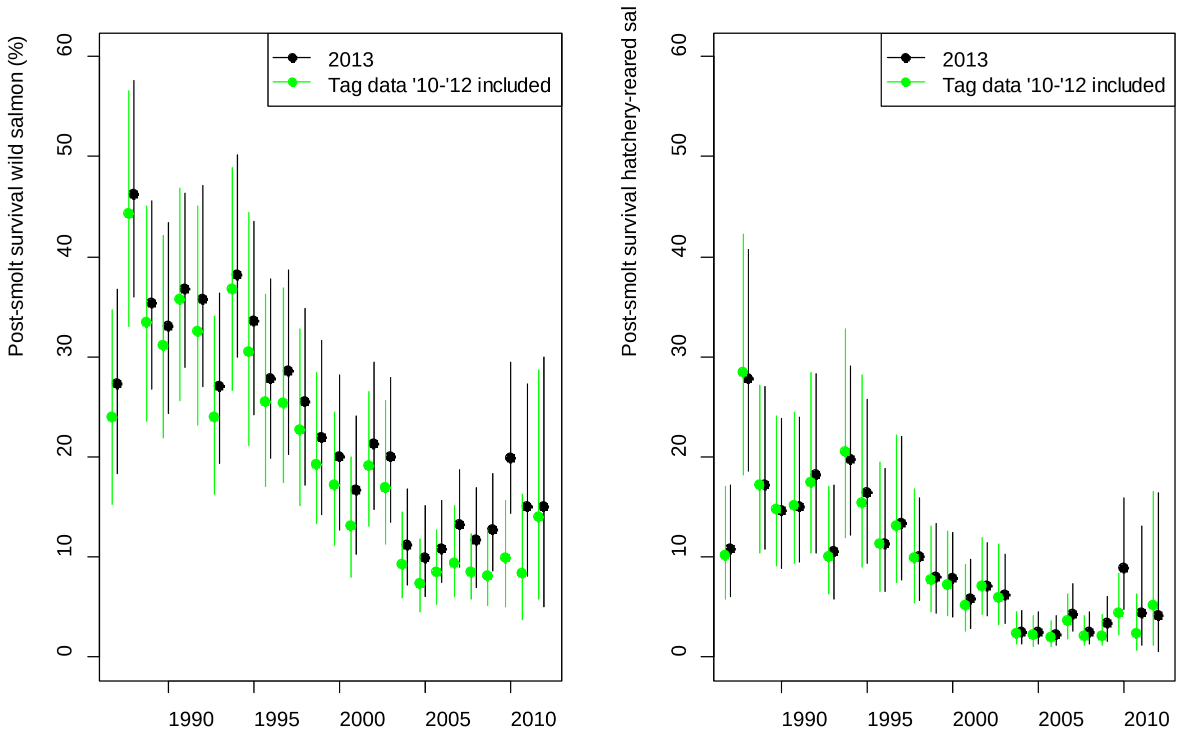


Figure 4.2.2.1. Impact of inclusion of tagging data from release years 2010–2012 in the wild and reared post-smolt survival estimates. Black estimates (2013) illustrate the model run that is used for the assessment (excluding tagging data for 2010–2012).

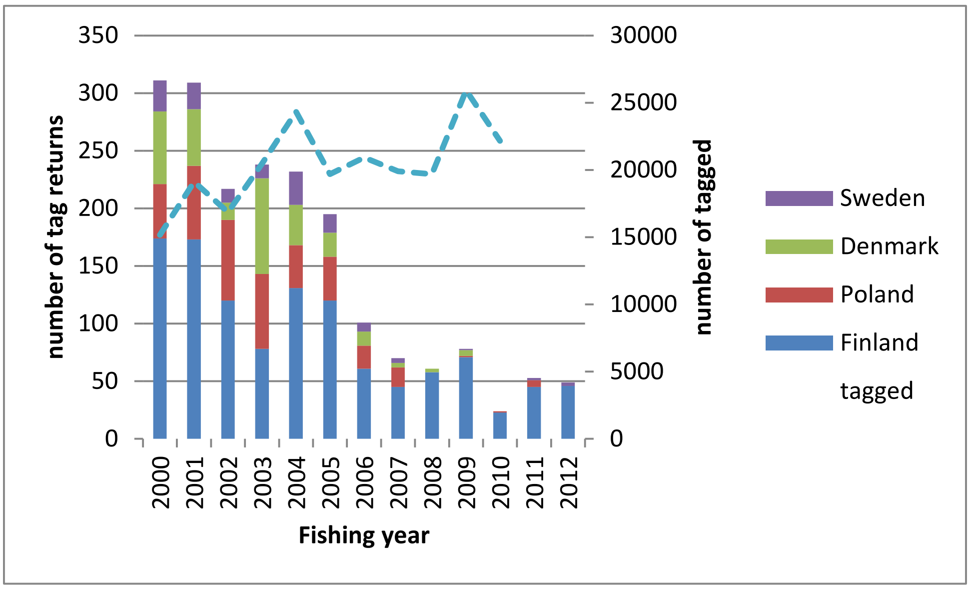


Figure 4.2.2.2. Number of returned tags by year and fishing country originating from the Finnish smolt releases in the Gulf of Bothnian rivers in 2000–2012. Number tagged fish has a two year lag i.e. the number of tagged smolts two years before the fishing year.

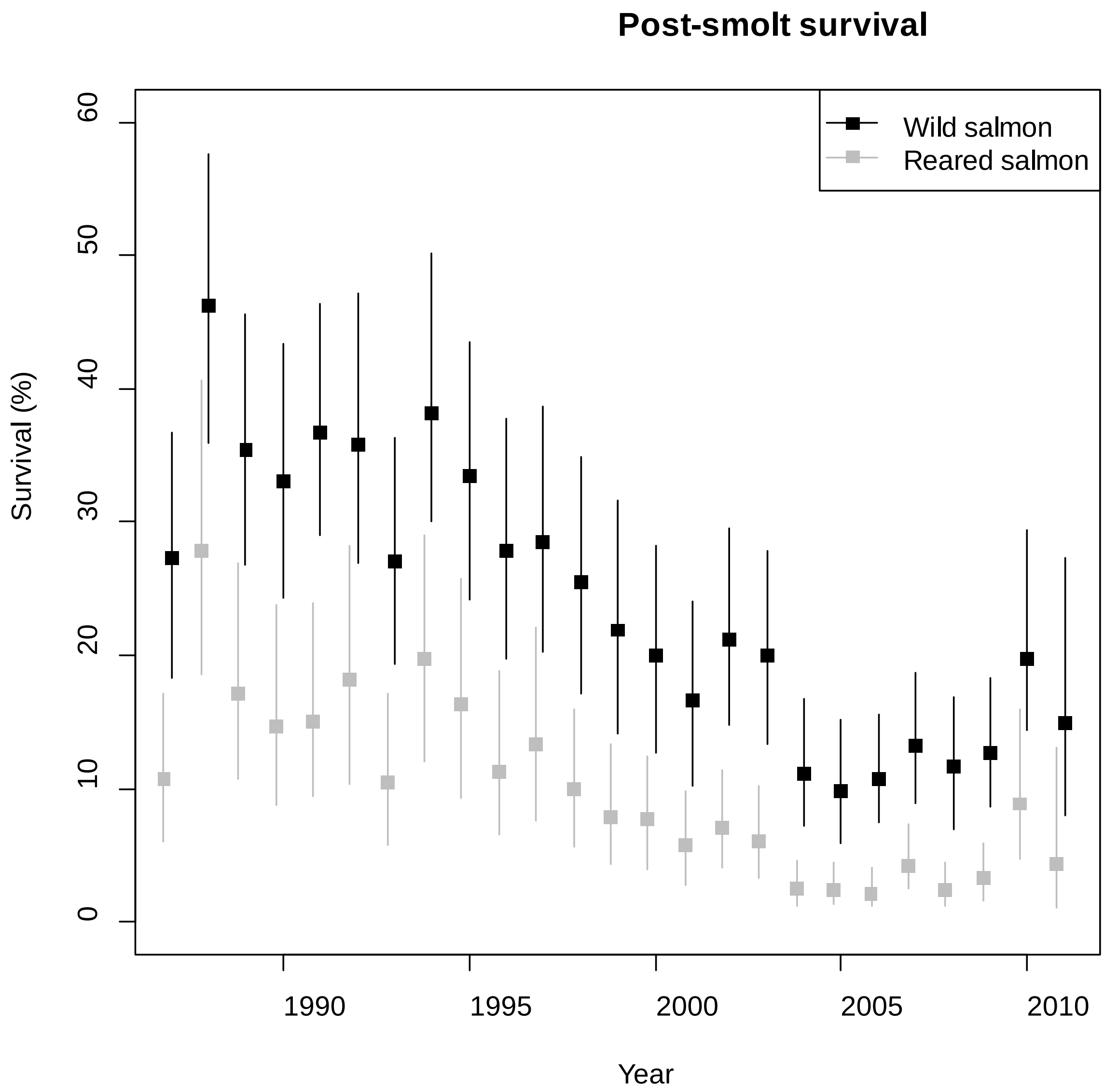


Figure 4.2.3.1. Post–smolt survival for wild and hatchery-reared salmon.

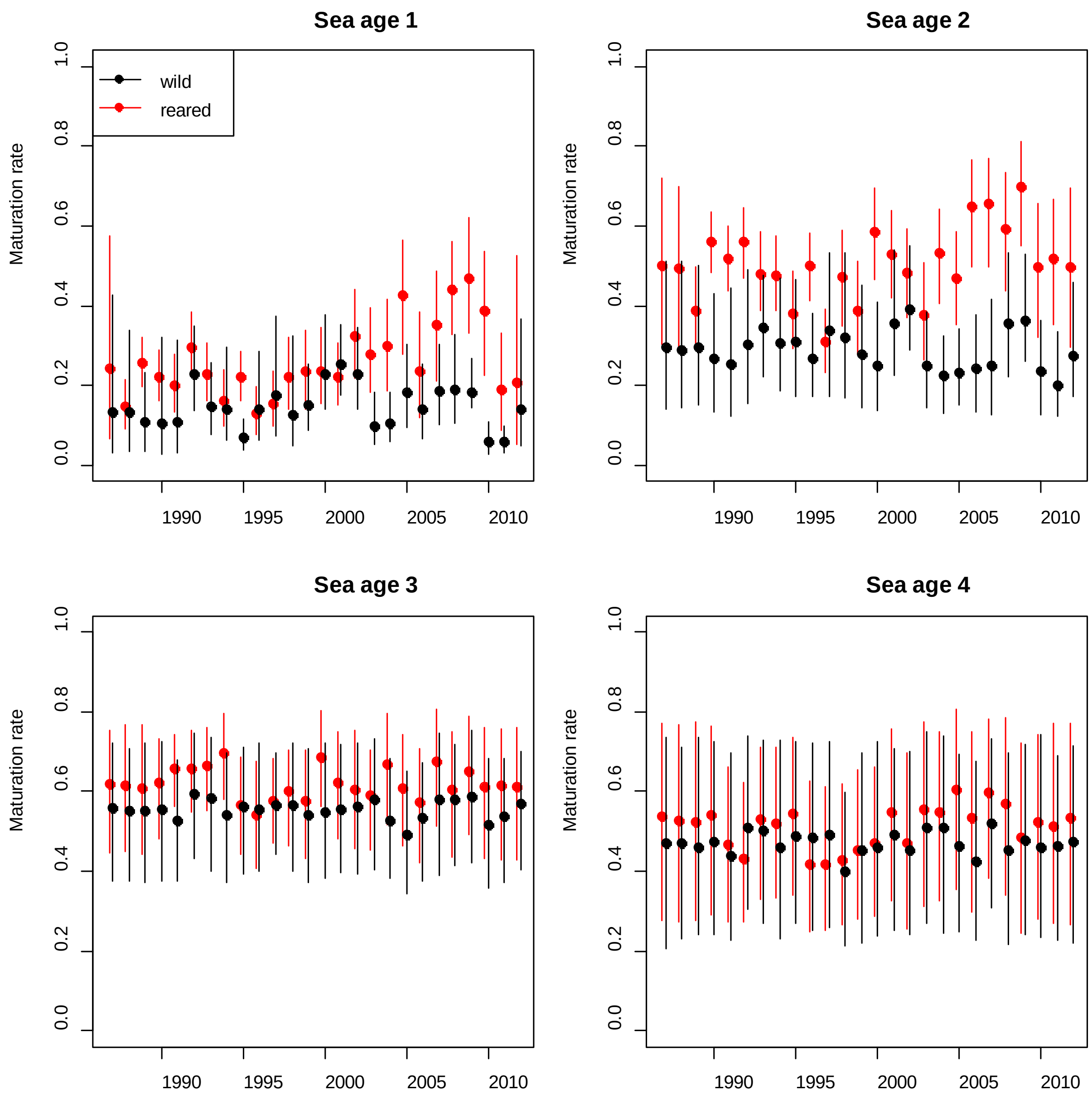
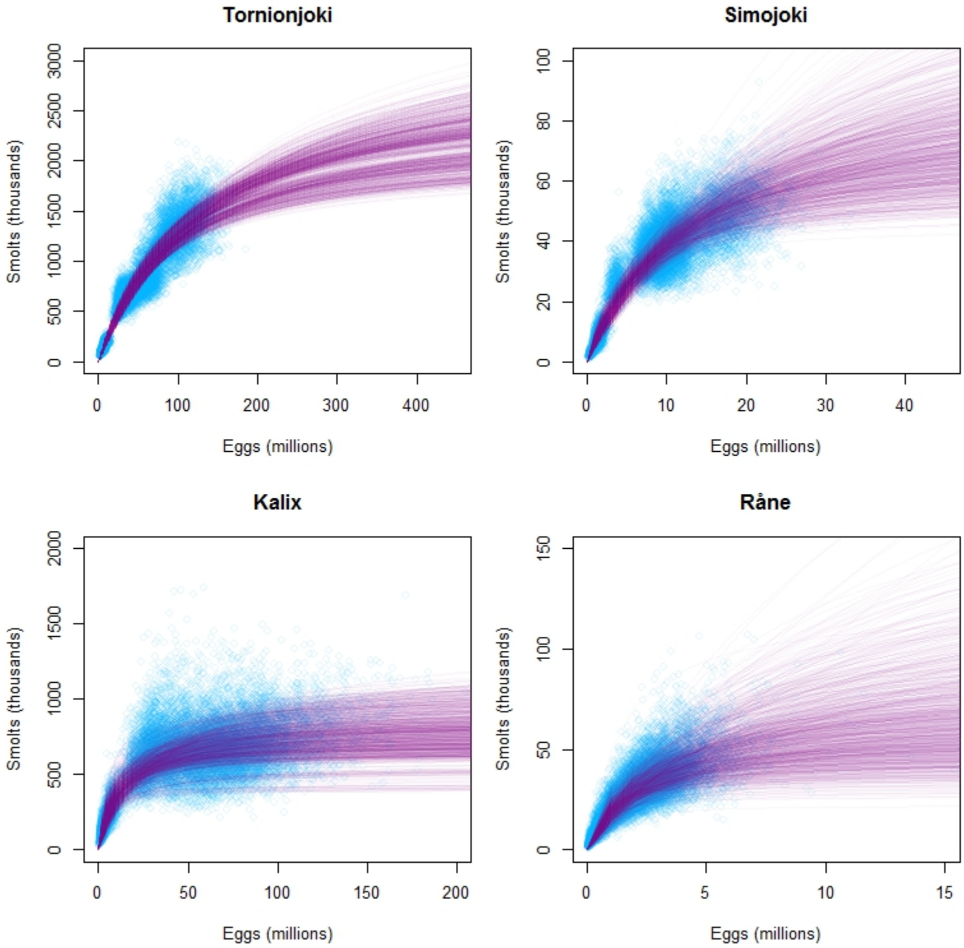
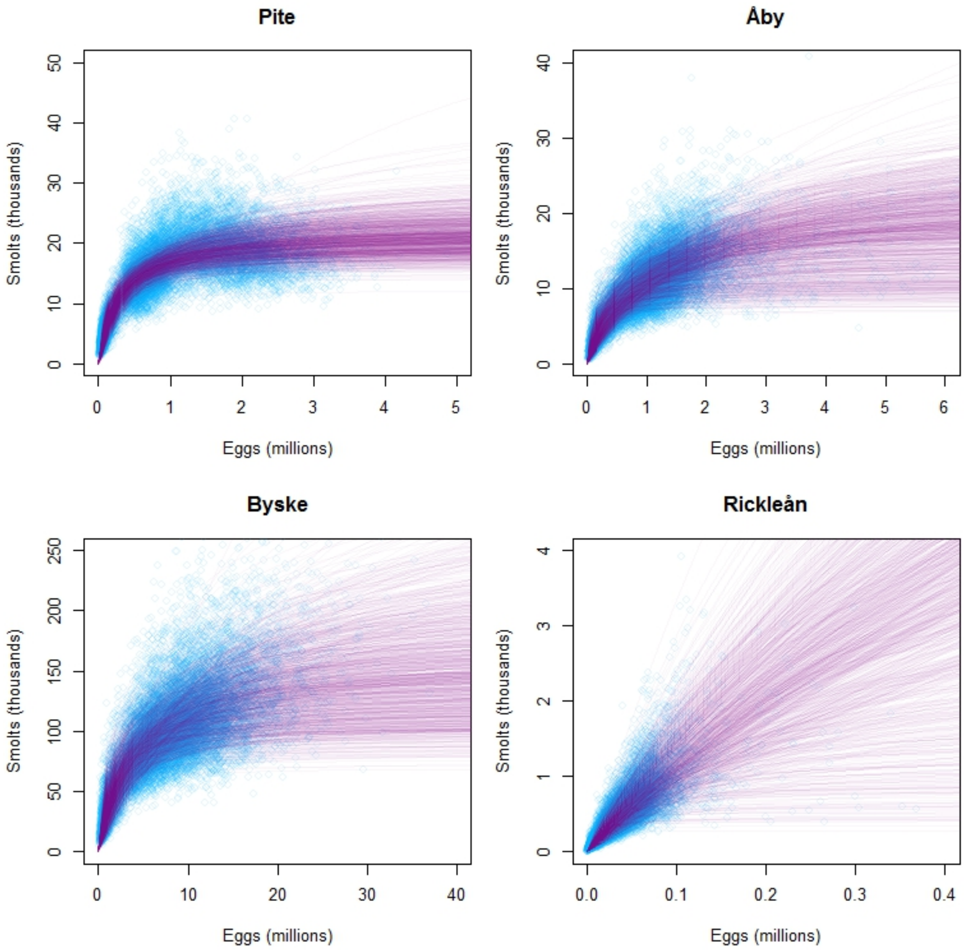
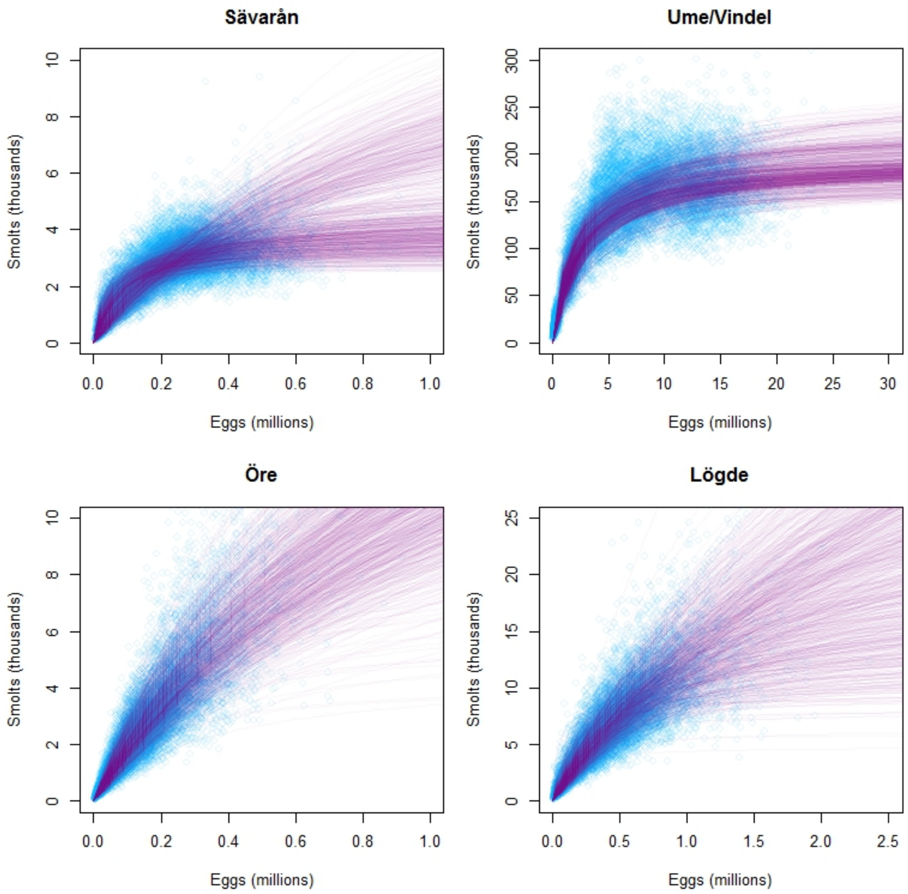


Figure 4.2.3.2. Proportion maturing per age group and per year for wild and reared salmon.


Tornionjoki
Smolts (thousands)
Eggs (millions)
Simojoki
Smolts (thousands)
Eggs (millions)
Kalix
Smolts (thousands)
Eggs (millions)
Råne
Smolts (thousands)
Eggs (millions)



Pite
Smolts (thousands)
Eggs (millions)
Åby
Smolts (thousands)
Eggs (millions)
Byske
Smolts (thousands)
Eggs (millions)
Rickleån
Smolts (thousands)
Eggs (millions)


Sävarån
Ume/Vindel
Öre
Lögde
Smolts (thousands)
Eggs (millions)

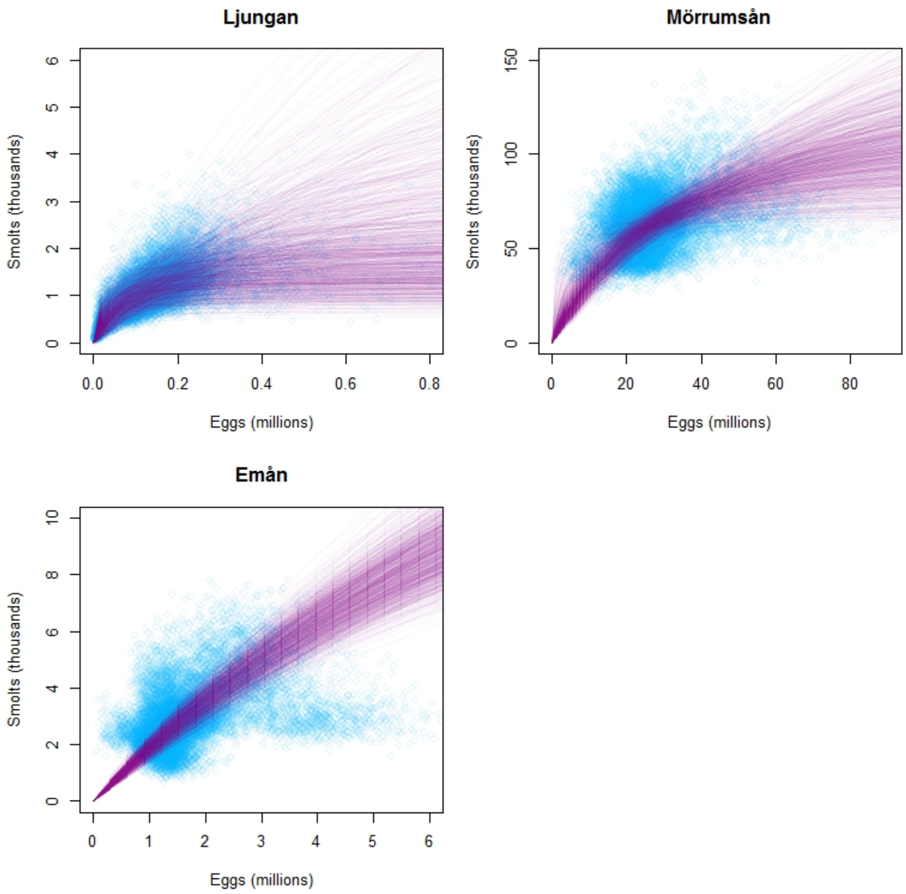
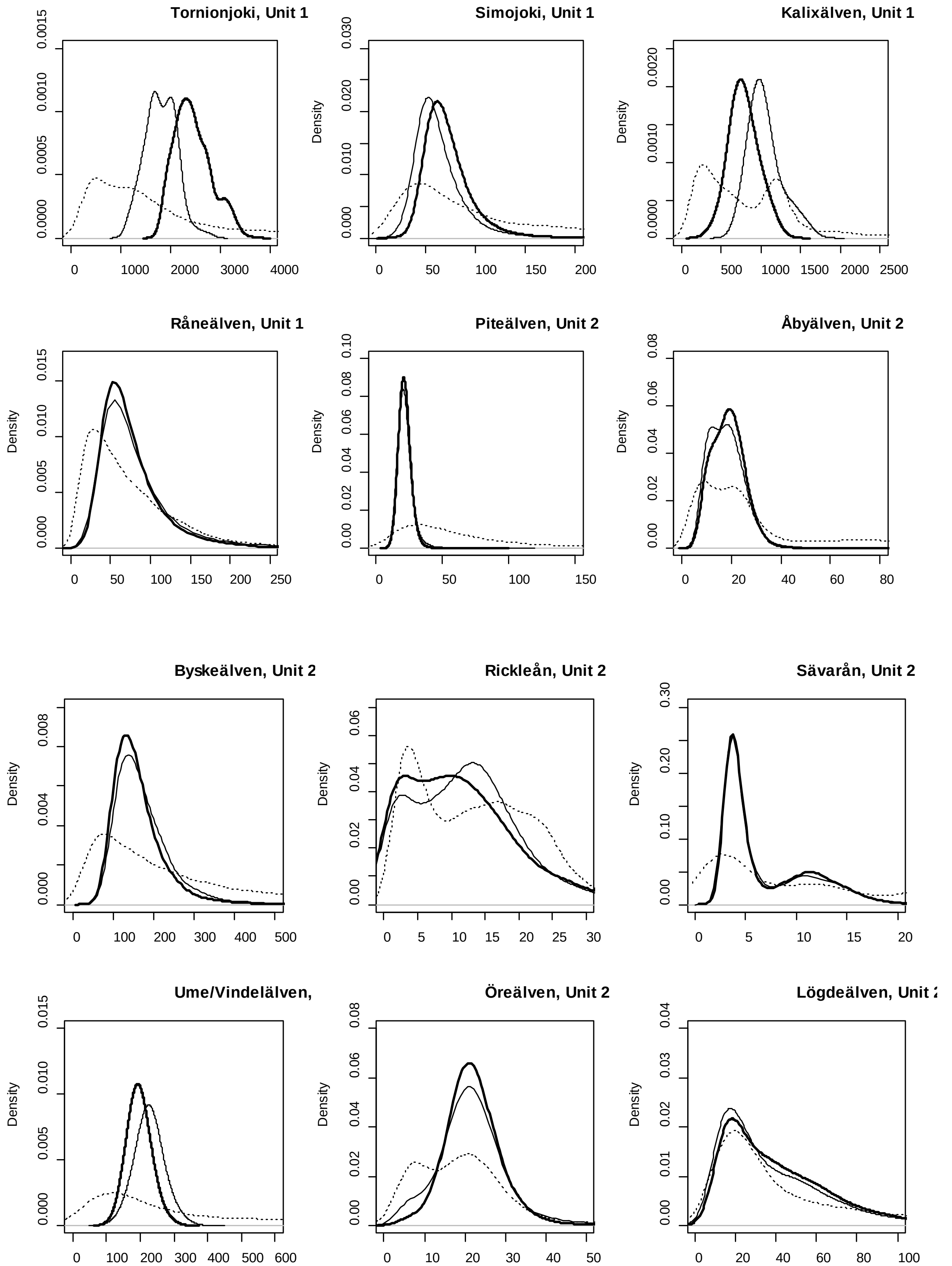


Figure 4.2.3.3. These graphs show the distributions for egg abundance (million), plotted against the smolt abundance (thousand) for stocks of assessment units 1, 2, 3 and 4. Blue dots present the posterior distributions of annual smolt and egg abundances, purple curves indicate the distributions of stock–recruit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



Tornionjoki, Unit 1
0.0000 0.0005 0.0010 0.0015
0 1000 2000 3000 4000
Simojoki, Unit 1
Density
0.000 0.010 0.020 0.030
0 50 100 150 200
Kalixälven, Unit 1
Density
0.0000 0.0010 0.0020
0 500 1000 1500 2000 2500
Råneälven, Unit 1
Density
0.000 0.005 0.010 0.015
0 50 100 150 200 250
Piteälven, Unit 2
Density
0.00 0.02 0.04 0.06 0.08 0.10
0 50 100 150
Åbyälven, Unit 2
Density
0.00 0.02 0.04 0.06 0.08
0 20 40 60 80
Byskeälven, Unit 2
Density
0.000 0.004 0.008
0 100 200 300 400 500
Rickleån, Unit 2
Density
0.00 0.02 0.04 0.06
0 5 10 15 20 25 30
Sävarån, Unit 2
Density
0.00 0.10 0.20 0.30
0 5 10 15 20
Ume/Vindelälven,
Density
0.000 0.005 0.010 0.015
0 100 200 300 400 500 600
Öreälven, Unit 2
Density
0.00 0.02 0.04 0.06 0.08
0 10 20 30 40 50
Lögdeälven, Unit 2
Density
0.00 0.01 0.02 0.03 0.04
0 20 40 60 80 100

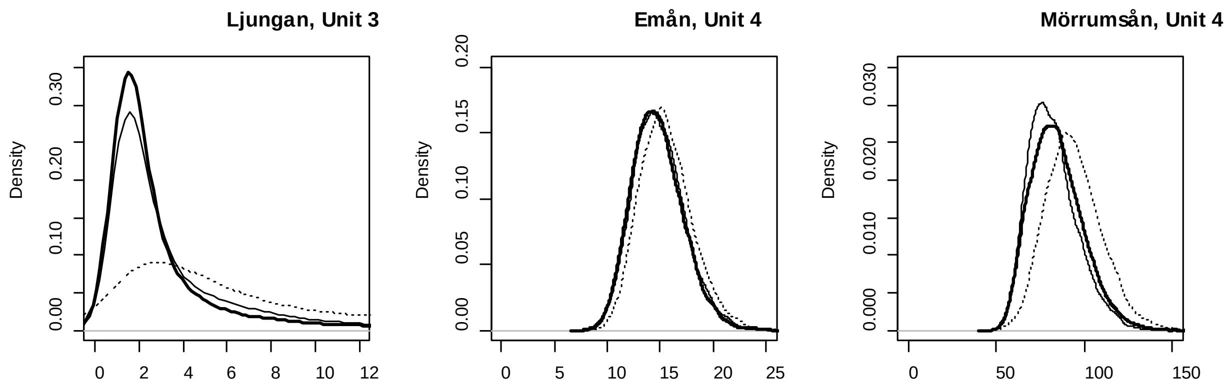


Figure 4.2.3.4. Prior probability distributions (dotted line) and posterior probability distributions of the potential smolt production capacity obtained in the assessment in 2012 (thin line) and 2013 (bold line).

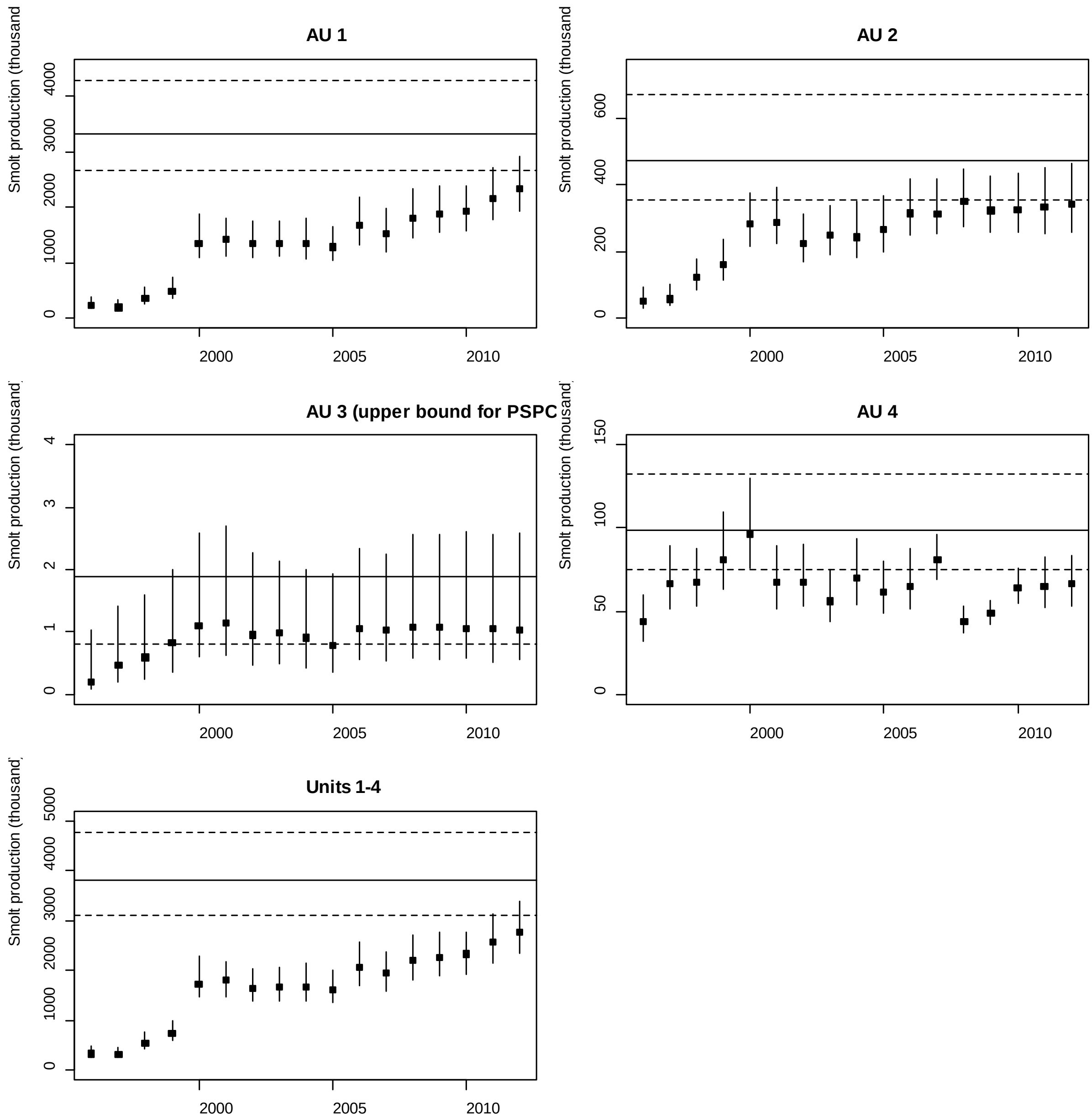


Figure 4.2.3.5. Posterior probability distribution (median and 95% PI) of the total smolt production within assessment units 1–4 and in total. Vertical lines show the median (solid line) and 95% PI (dashed lines) for potential smolt production capacity (PSPC).

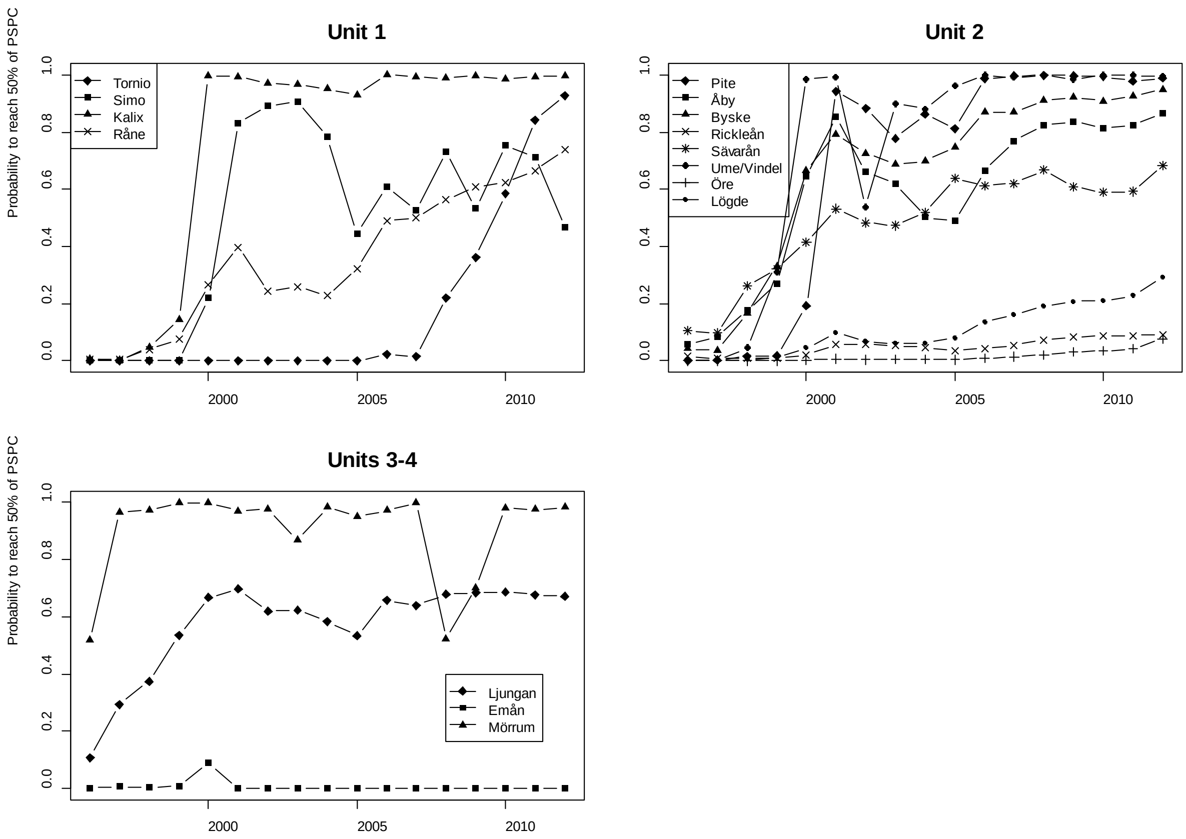


Figure 4.2.3.6. Probability of reaching 50% of the smolt production capacity for different stocks of assessment units 1–4.

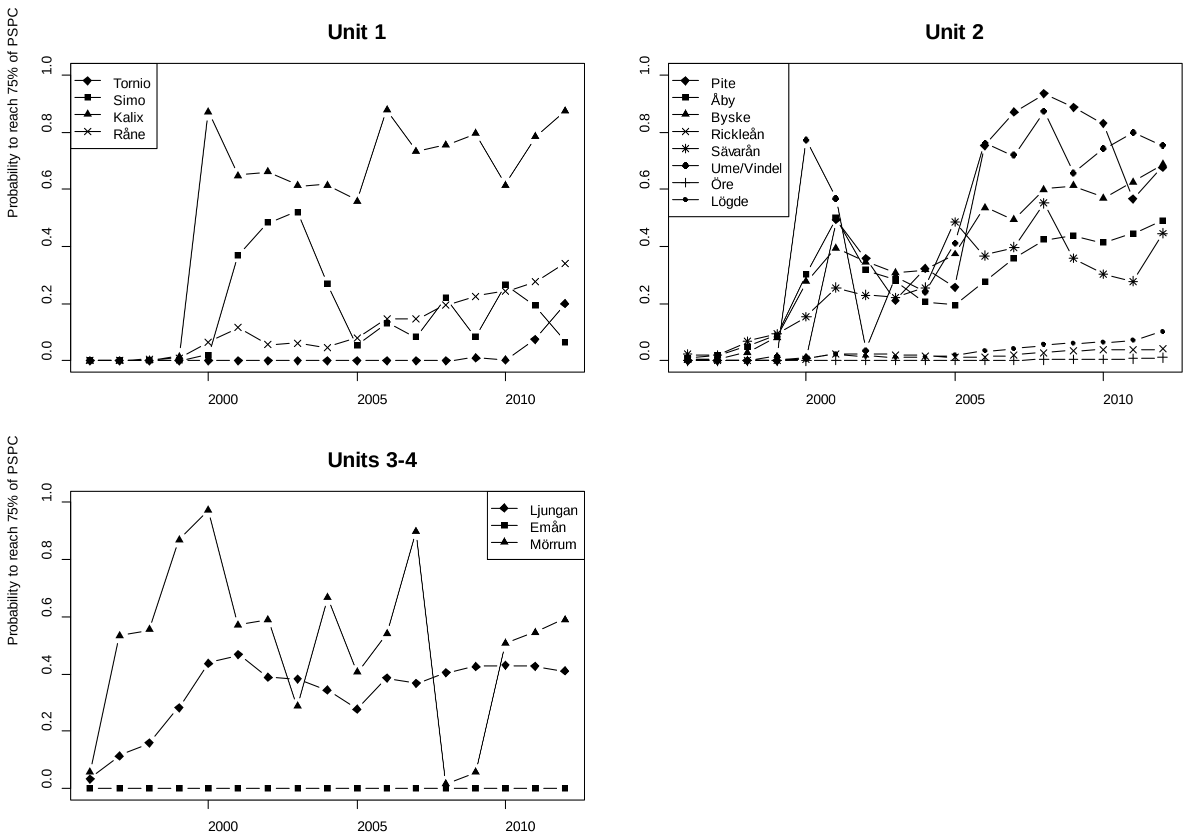


Figure 4.2.3.7. Probability of reaching 75% of the smolt production capacity for different stocks of assessment units 1–4.

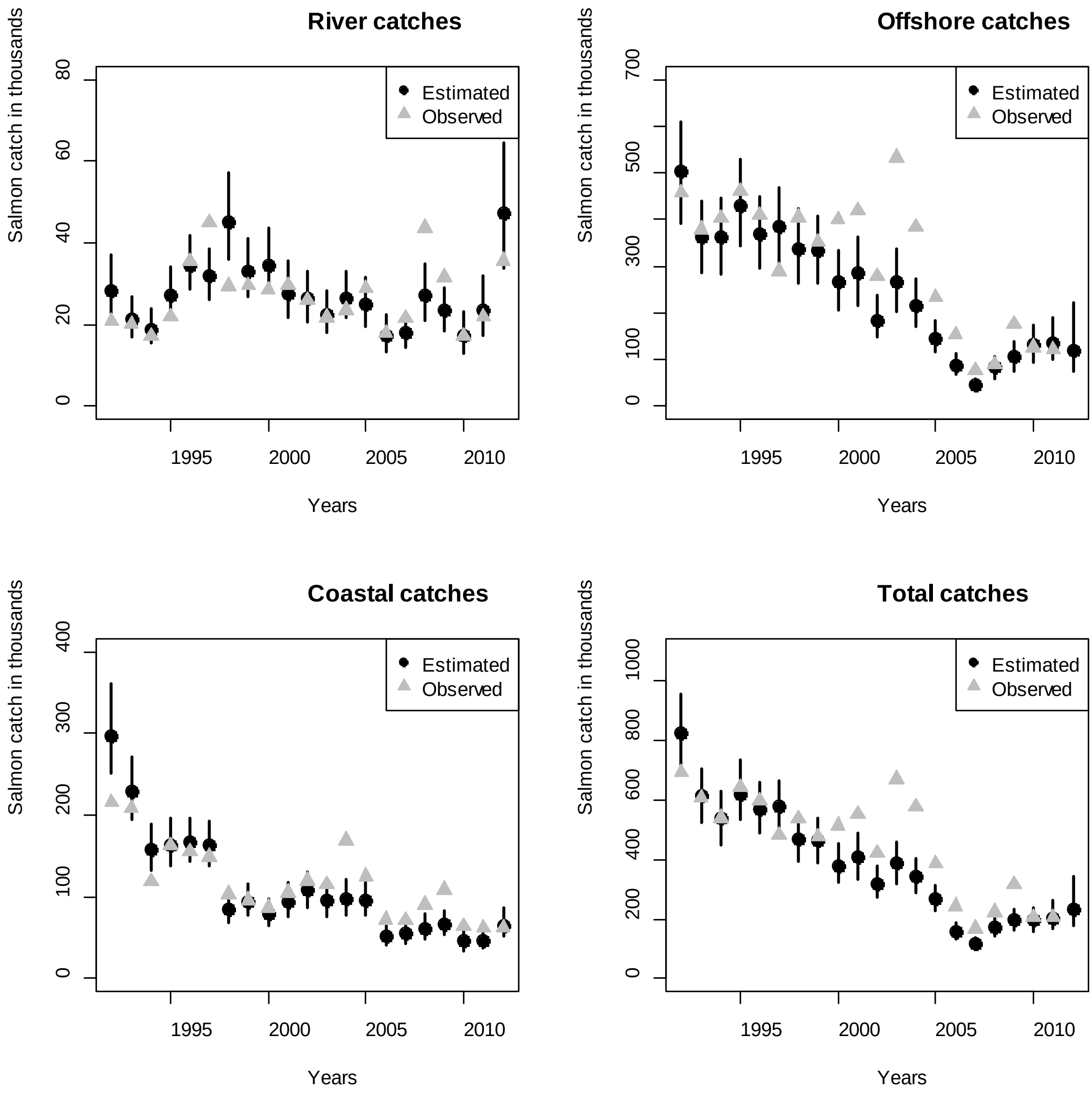


Figure 4.2.3.8. Estimated posterior distributions of catches in comparison to corresponding observed catches. Observed catches refer to reported commercial catches recalculated to take into account unreported catches in the longlining fishery.

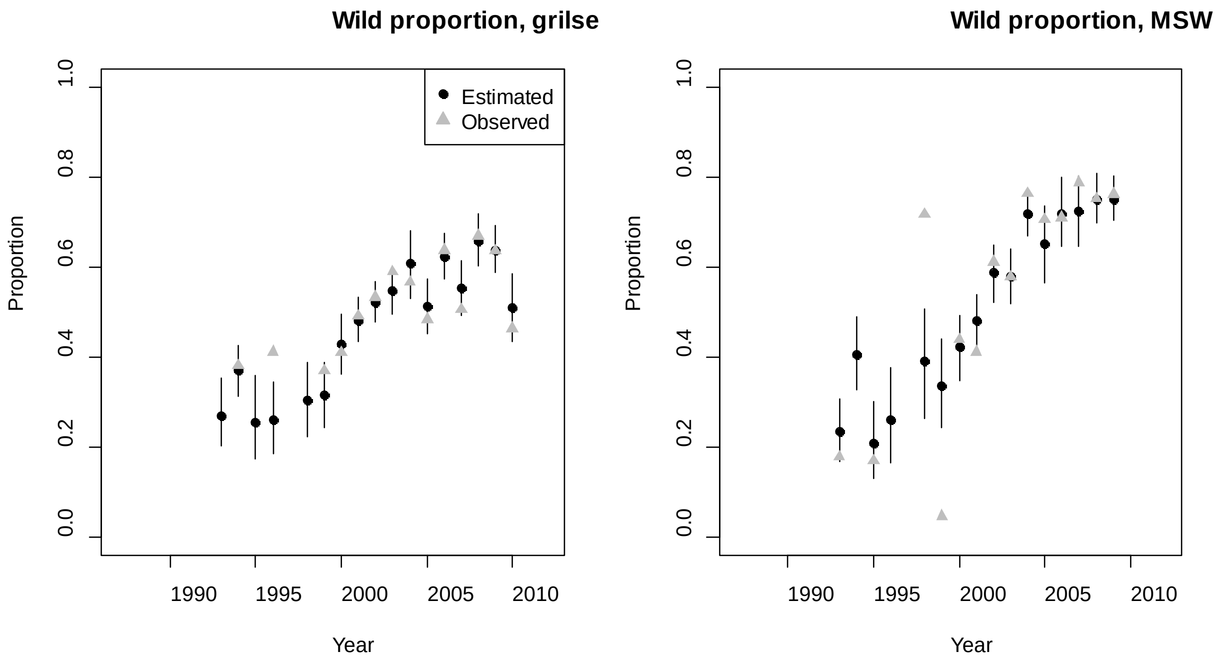


Figure 4.2.3.9. Estimated proportions of wild in offshore catches in comparison to wild proportions observed in the catch samples.

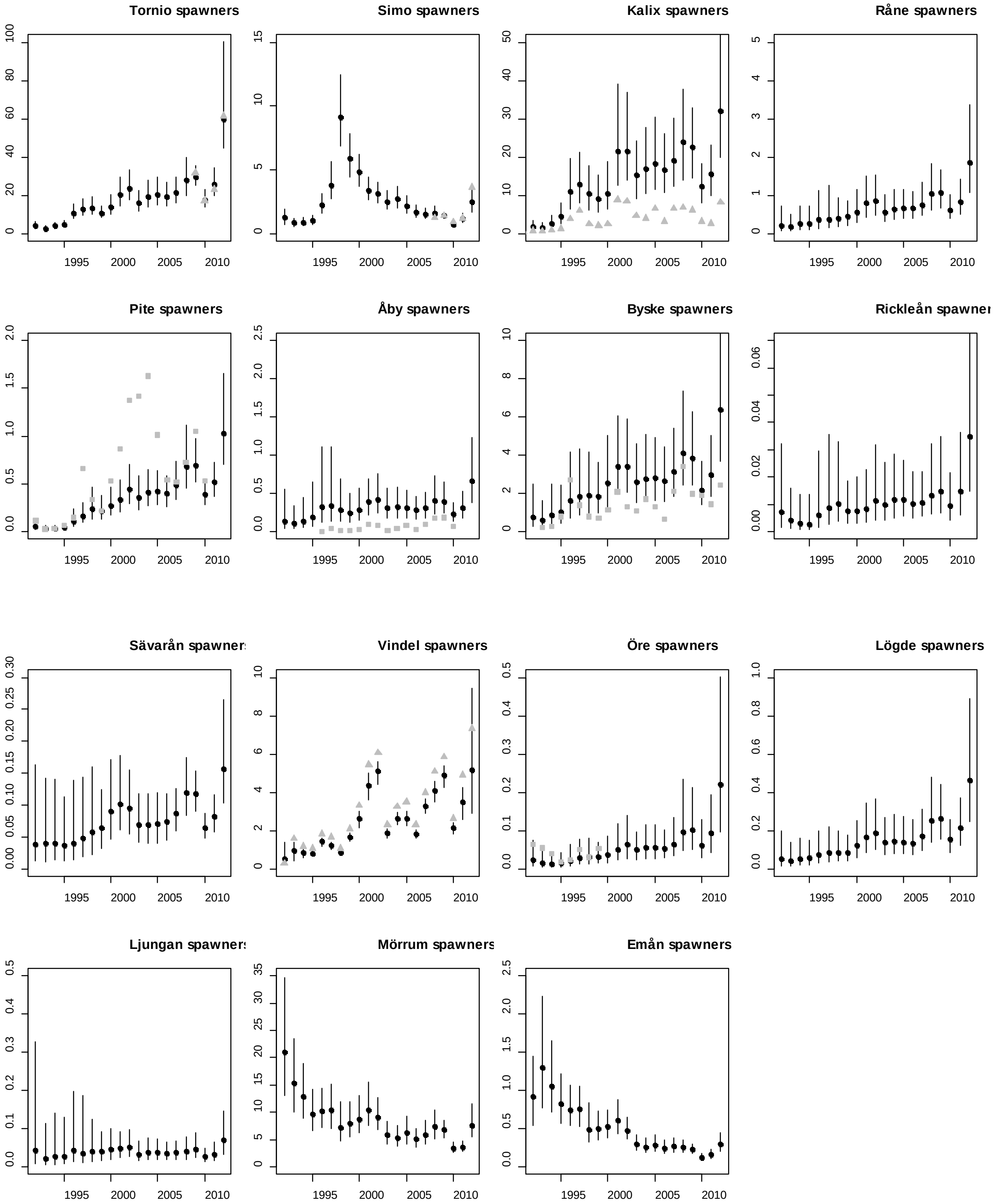


Figure 4.2.3.10. Estimated posterior distributions of the amount of spawners (in thousands) in each river vs. observed numbers of spawners in fish counters. River observed numbers indicated with triangles are used as input in the full life-history model.

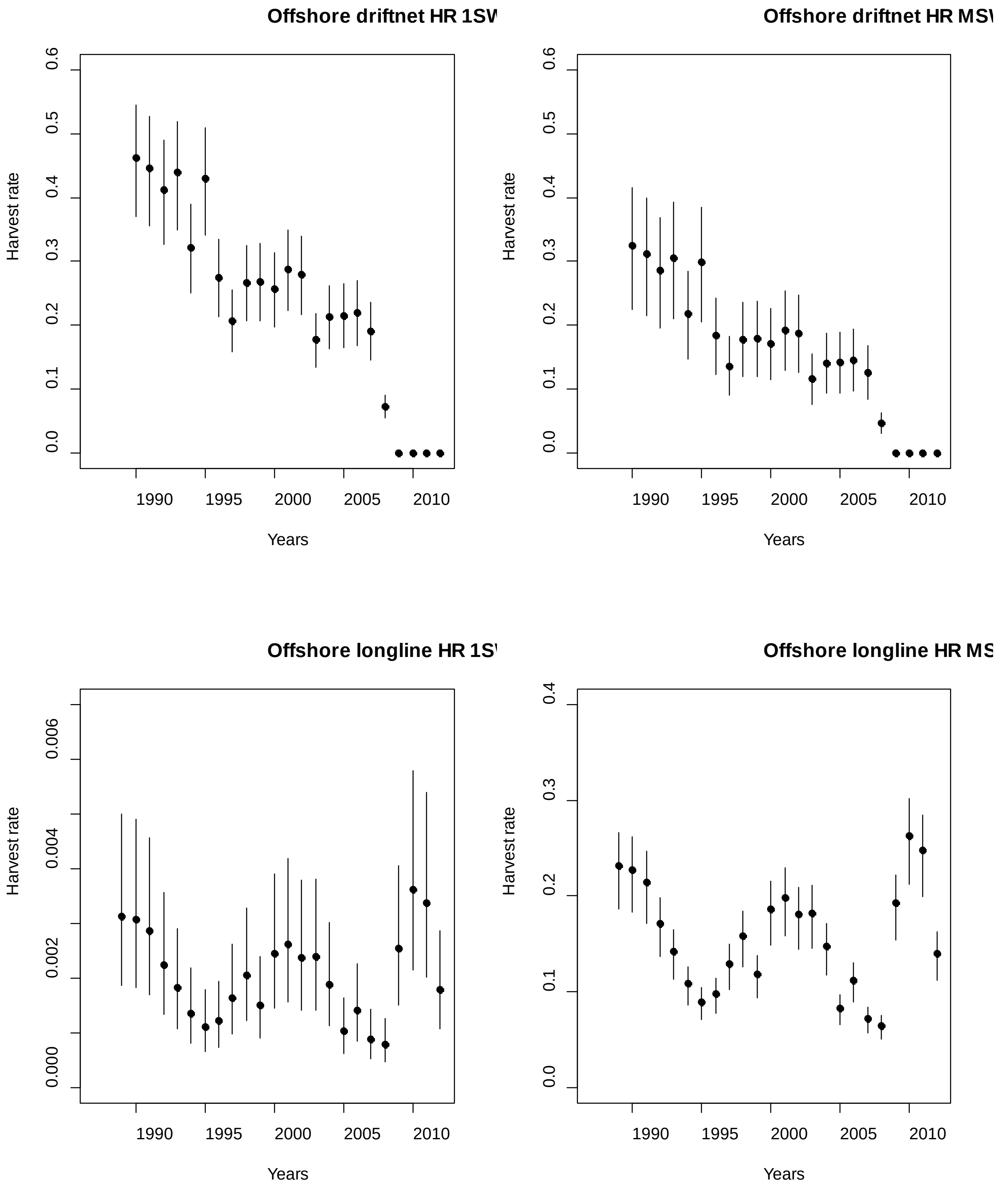


Figure 4.2.3.11a. Estimated posterior distributions of the harvest rates (harvested proportion of the available population) in offshore driftnet and offshore longline fisheries separately for one sea-winter and multi-sea-winter salmon. Note that the driftnet harvest rate in 2008 is not zero, since due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

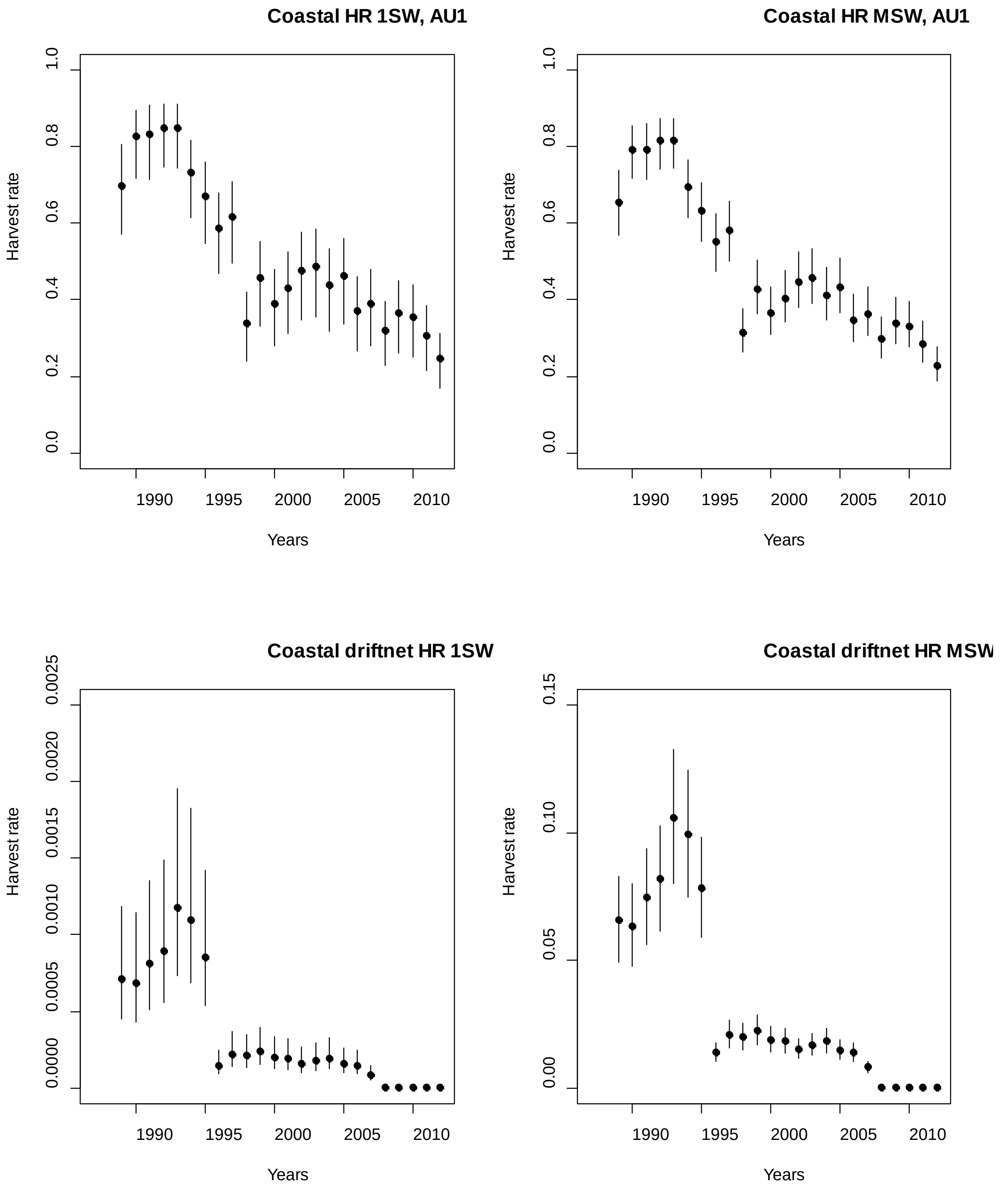


Figure 4.2.3.11b. Estimated posterior distributions of the harvest rates (harvested proportion of the available population) in other coastal fisheries than driftnetting in AU1 and in coastal driftnetting (all AUs together) separately for one sea-winter and multi-sea-winter salmon.

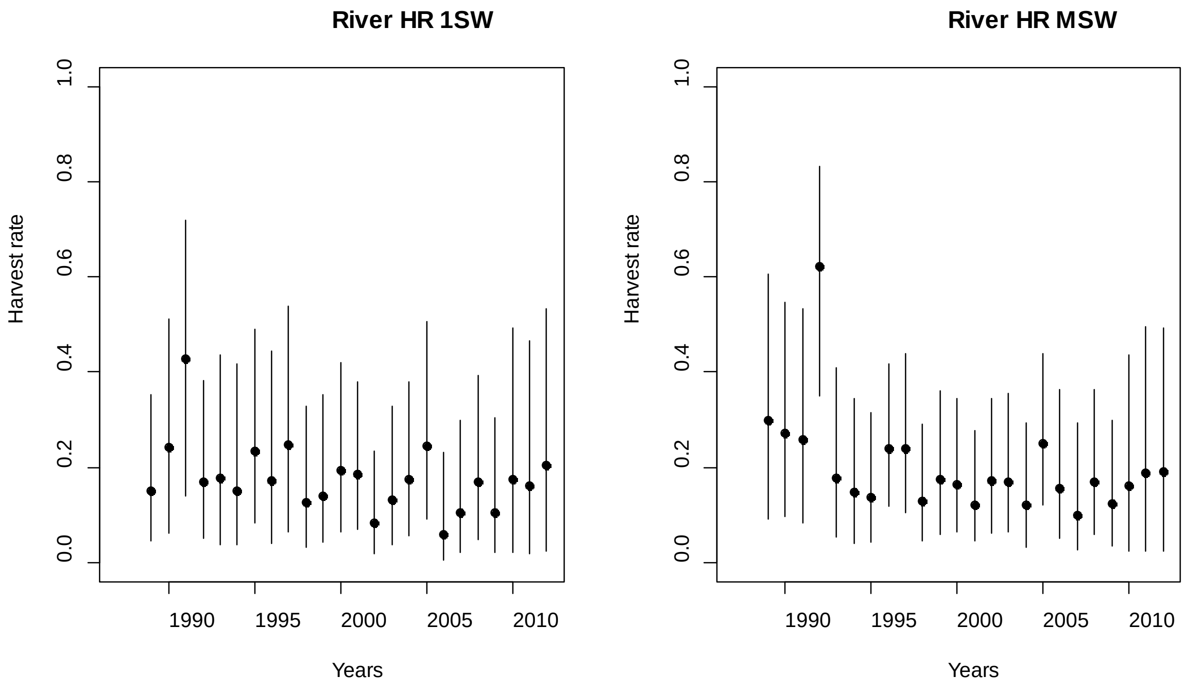


Figure 4.2.3.11c. Estimated posterior distributions of the harvest rates (harvested proportion of the available population) in the river fishery separately for one sea-winter and multi-sea-winter salmon.

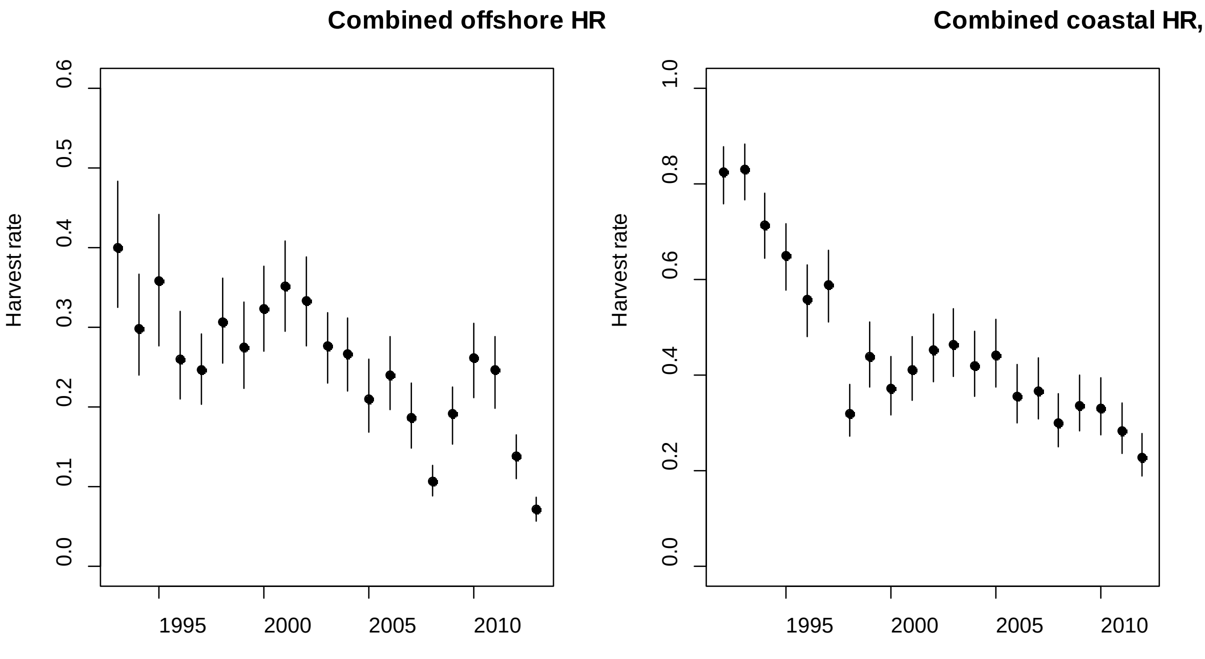


Figure 4.2.3.12. Combined harvest rates (harvested proportion of the available population) for offshore and coastal fisheries for MSW wild salmon in calendar years 1993–2012.

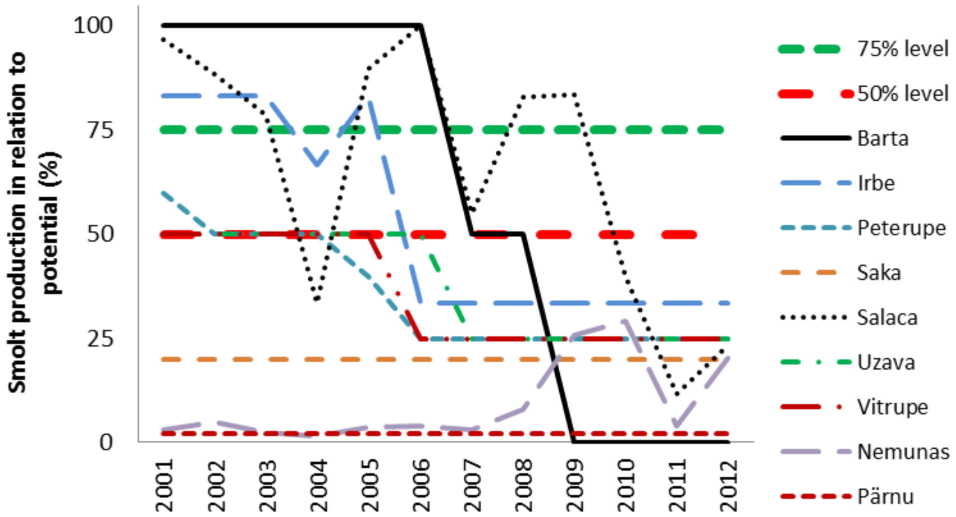


Figure 4.2.4.1. Smolt production in relation to PCPC in wild salmon rivers in AU5.

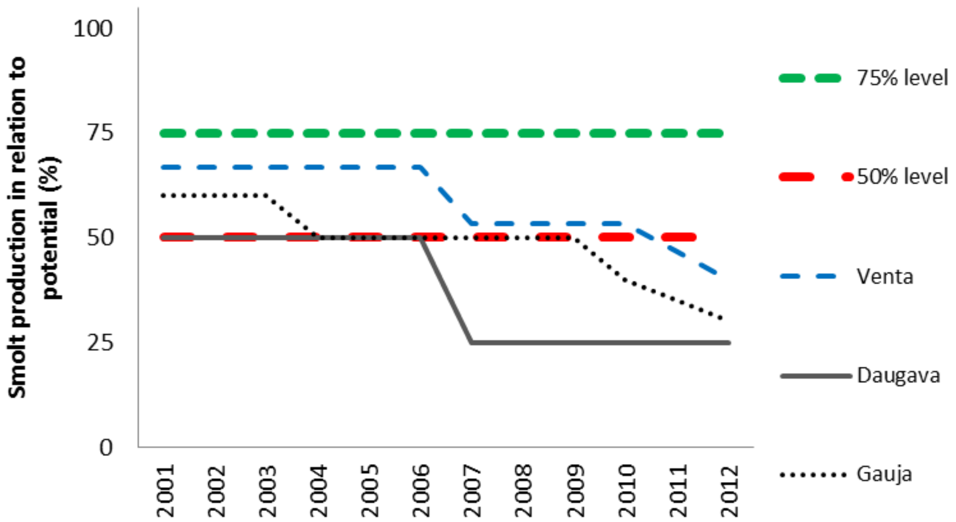


Figure 4.2.4.2. Wild smolt production in relation to PCPC in mixed salmon rivers in AU5.

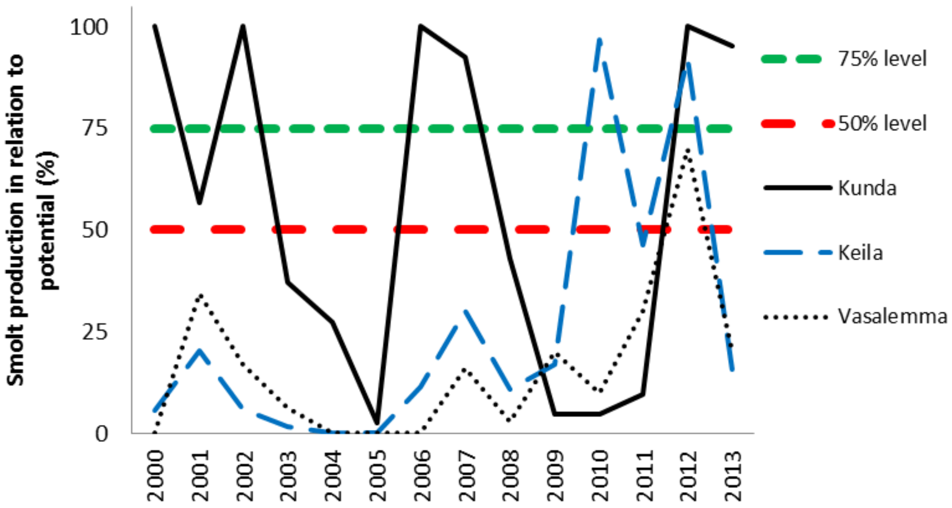


Figure 4.2.4.3. Wild smolt production in relation to PSPC in Estonian wild salmon rivers in AU6. Note that the PSPC is calculated only below the migration obstacle and these rivers would have considerably higher production capacity if there was access above the obstacle.

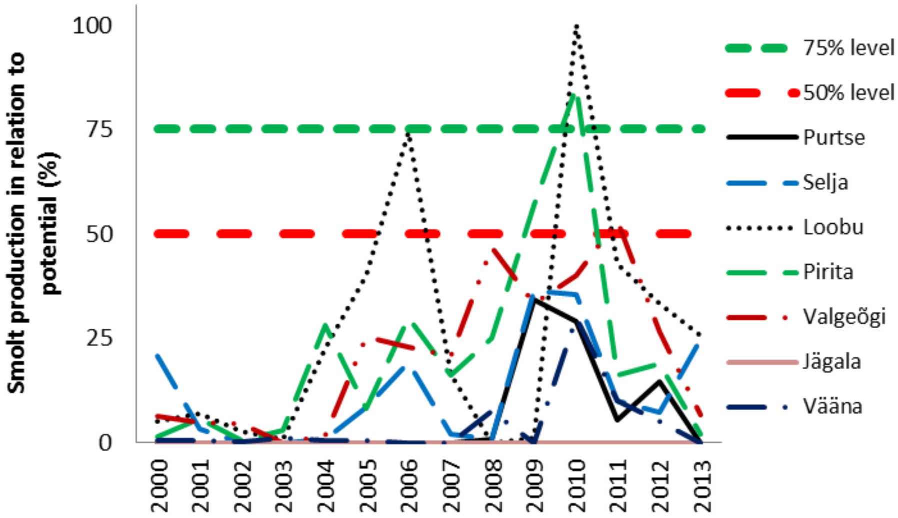


Figure 4.2.4.4. Wild smolt production in relation to PCPC in Estonian mixed salmon rivers in AU6. Note that the PSPC is calculated only below the migration obstacle and many of these rivers would have considerably higher production capacity if there was access above the obstacles.

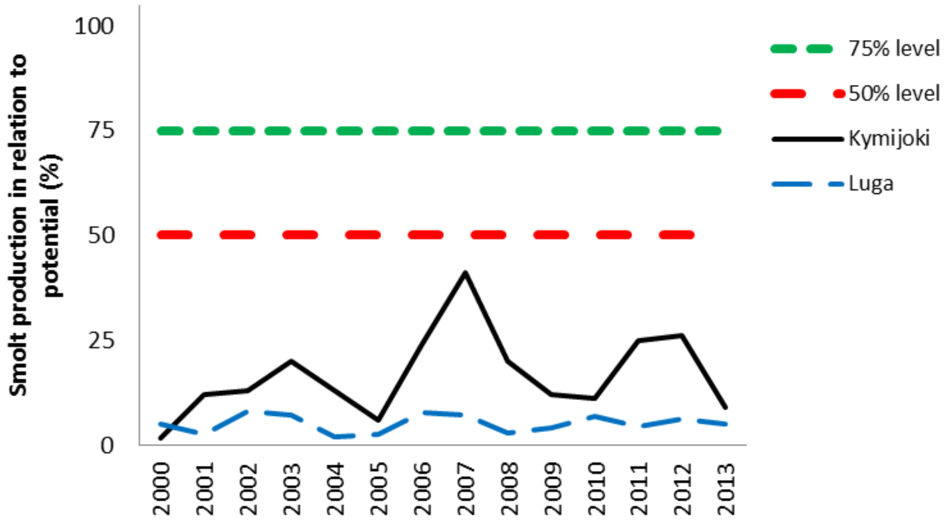
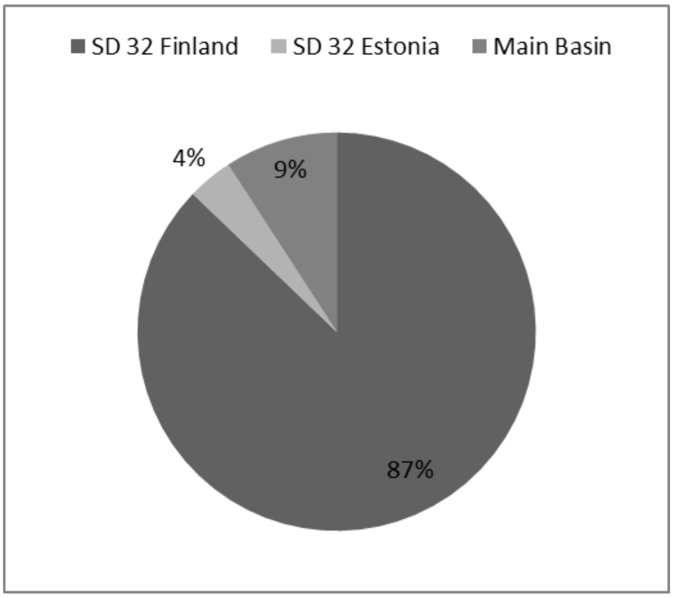


Figure 4.2.4.5. Wild smolt production in relation to PSPC in mixed salmon rivers Kymijoki (Finland) and Luga (Russia) in AU6.



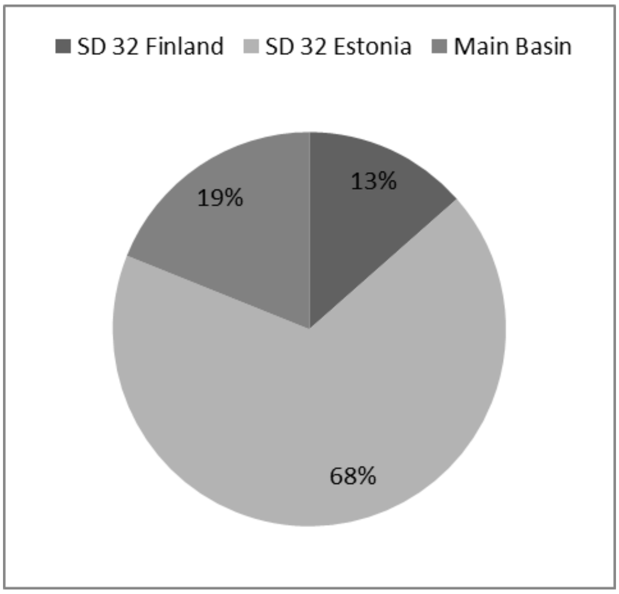


Figure 4.2.5.1. Regional distribution of Carlin tag recaptures of smolt cohorts 2005–2010 from the releases made to Kymijoki (left) and releases made to the Estonian rivers in the Gulf of Finland (right).

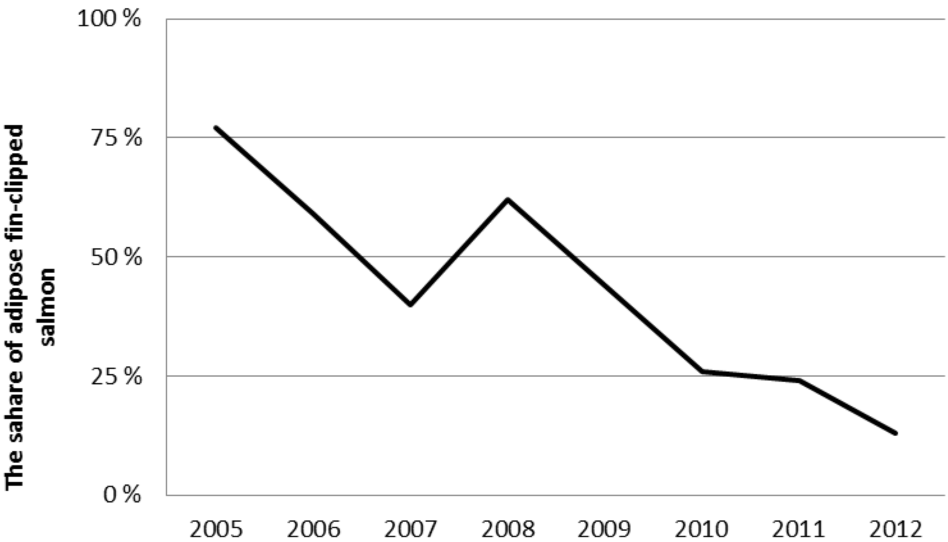


Figure 4.2.5.2. Share of adipose finclipped salmon in the catches at the south coast of the Gulf of Finland in 2005–2012.

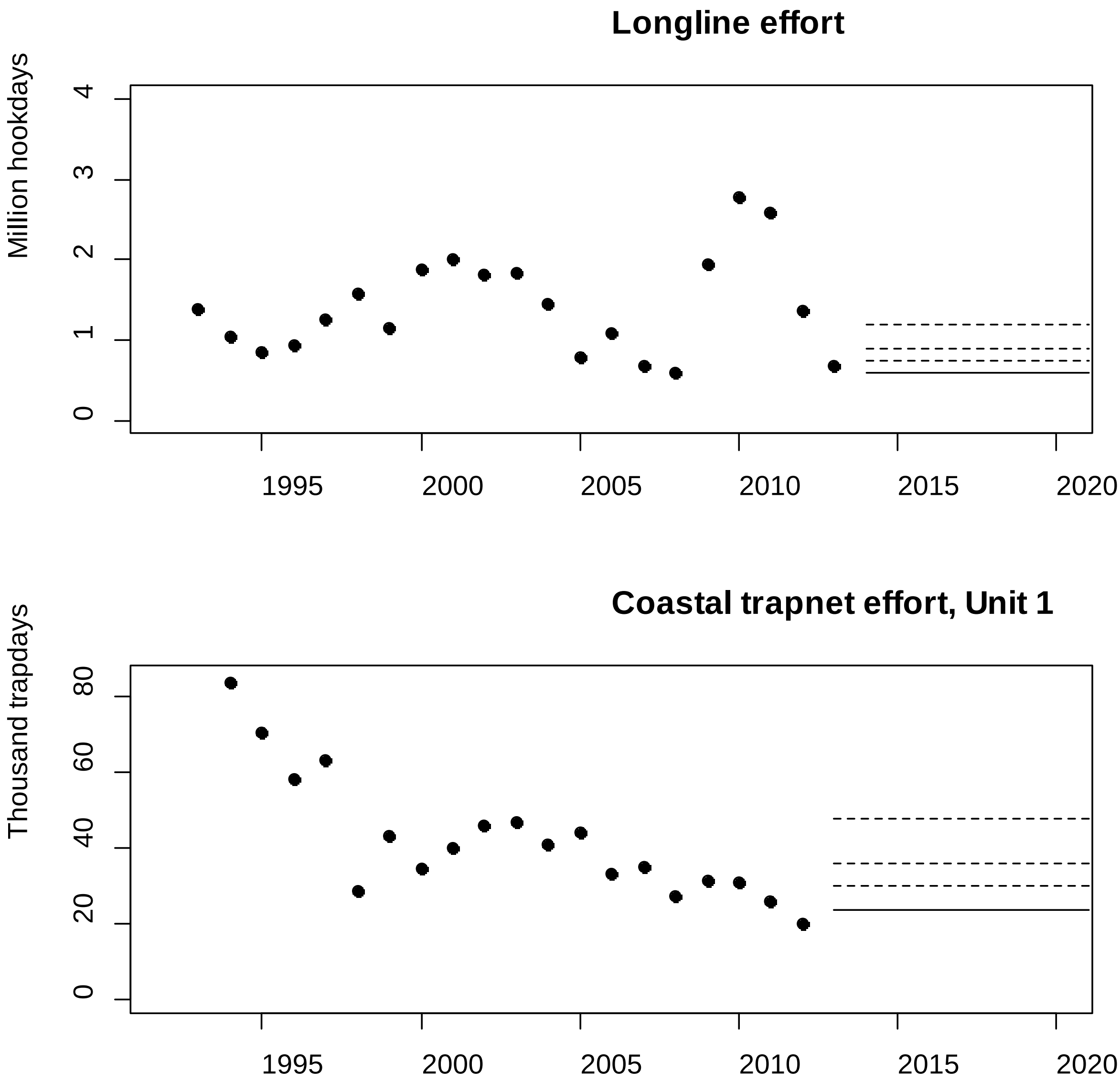


Figure 4.3.2.1. Illustration of fishing efforts for offshore longlines and coastal trapnets in historical years (1992–2012) and in future years (2013–2020) based on the following scenarios:

1) Most likely development of effort (solid line). 10% decrease in the longline effort levels for Poland and Denmark compared to 2012 level, no longline fishing for Sweden and Finland. 20% increase in the trapnet fisheries for Sweden and Finland.

2) +25%, (3) +50% and (4) +100% increase to scenario 1 (dashed lines).

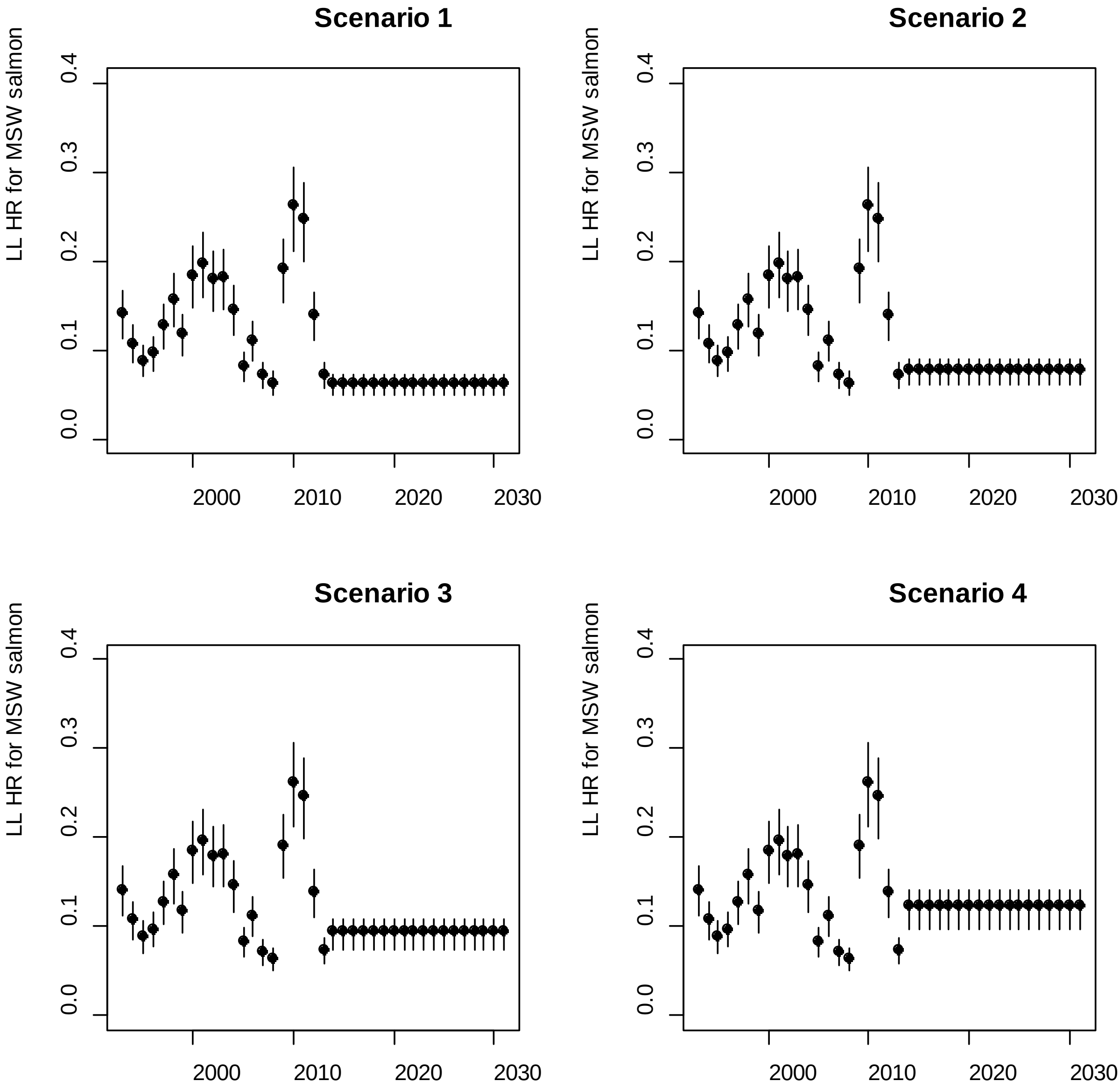


Figure 4.3.2.2a. Harvest rates (median values and 95% probability intervals) for multi-sea winter salmon in offshore longline fishery within different effort scenarios.

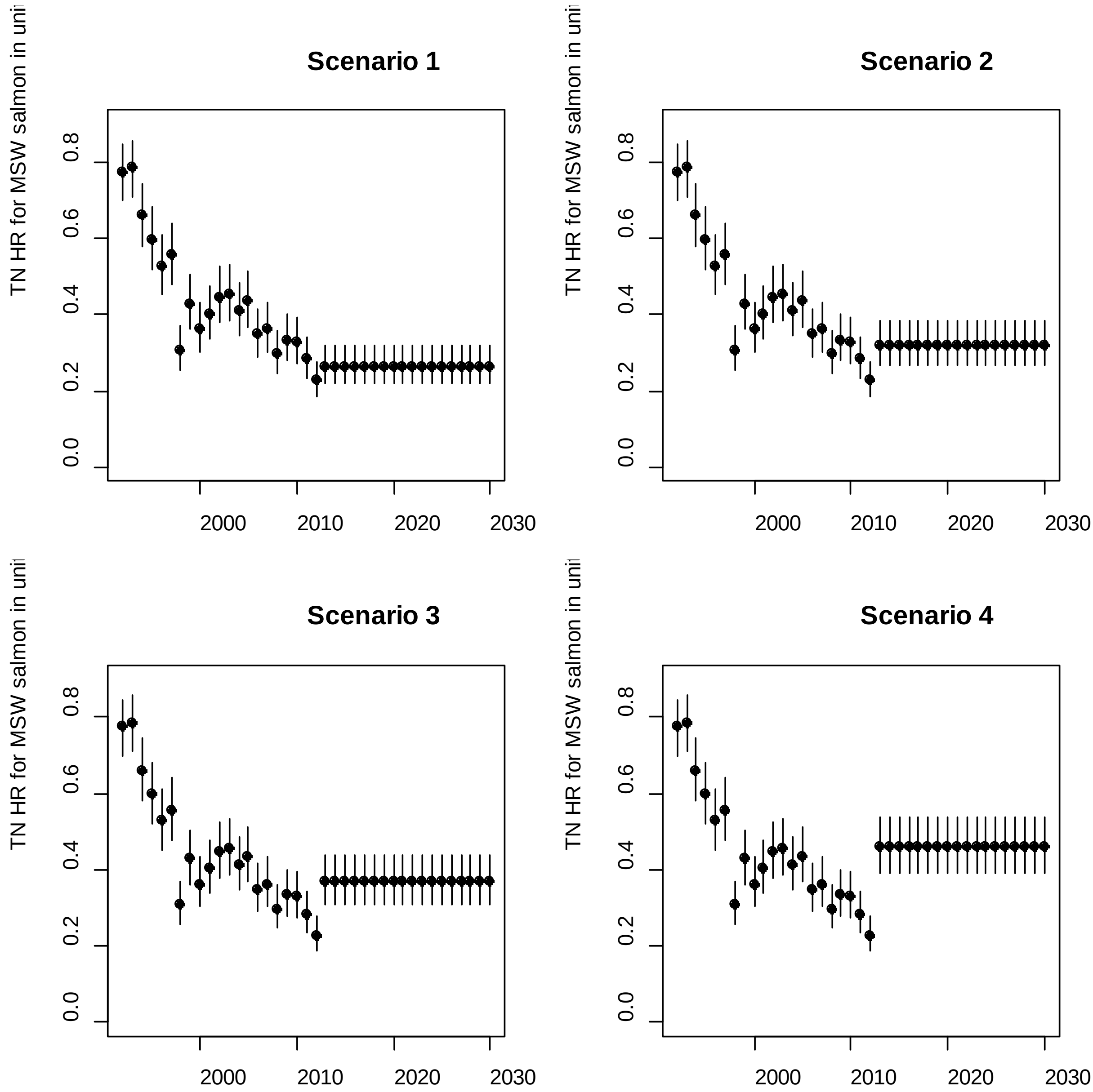


Figure 4.3.2.2b. Harvest rates (median values and 95% probability intervals) for multi-sea winter salmon in coastal trapnet fishery within different effort scenarios.

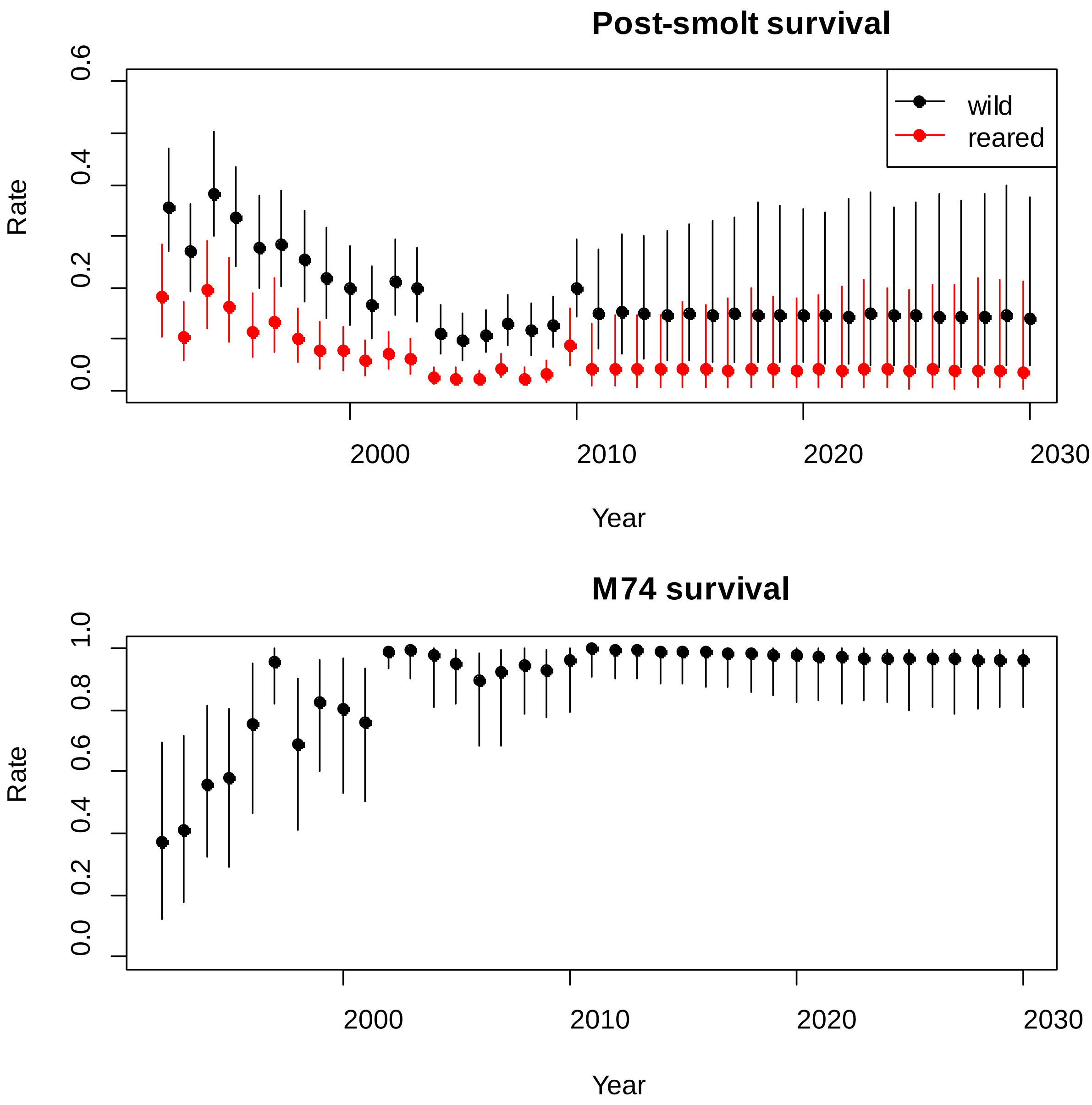


Figure 4.3.2.3. Median values and 95% probability intervals for post-smolt survival of wild and reared salmon and M74 survival assumed in all scenarios.

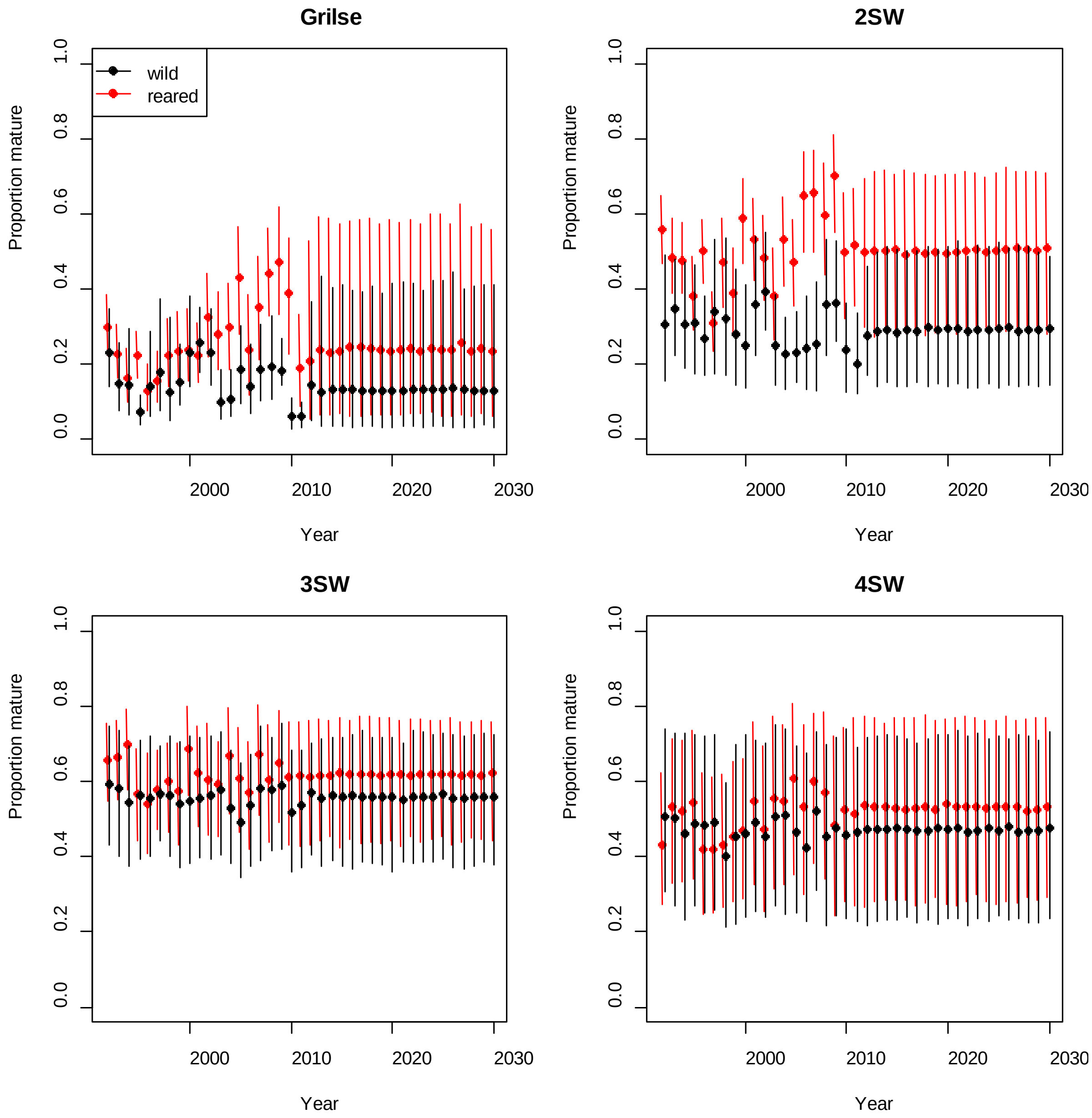


Figure 4.3.2.4. Median values and 95% probability intervals for annual proportions maturing per age group for wild and reared salmon in all scenarios.

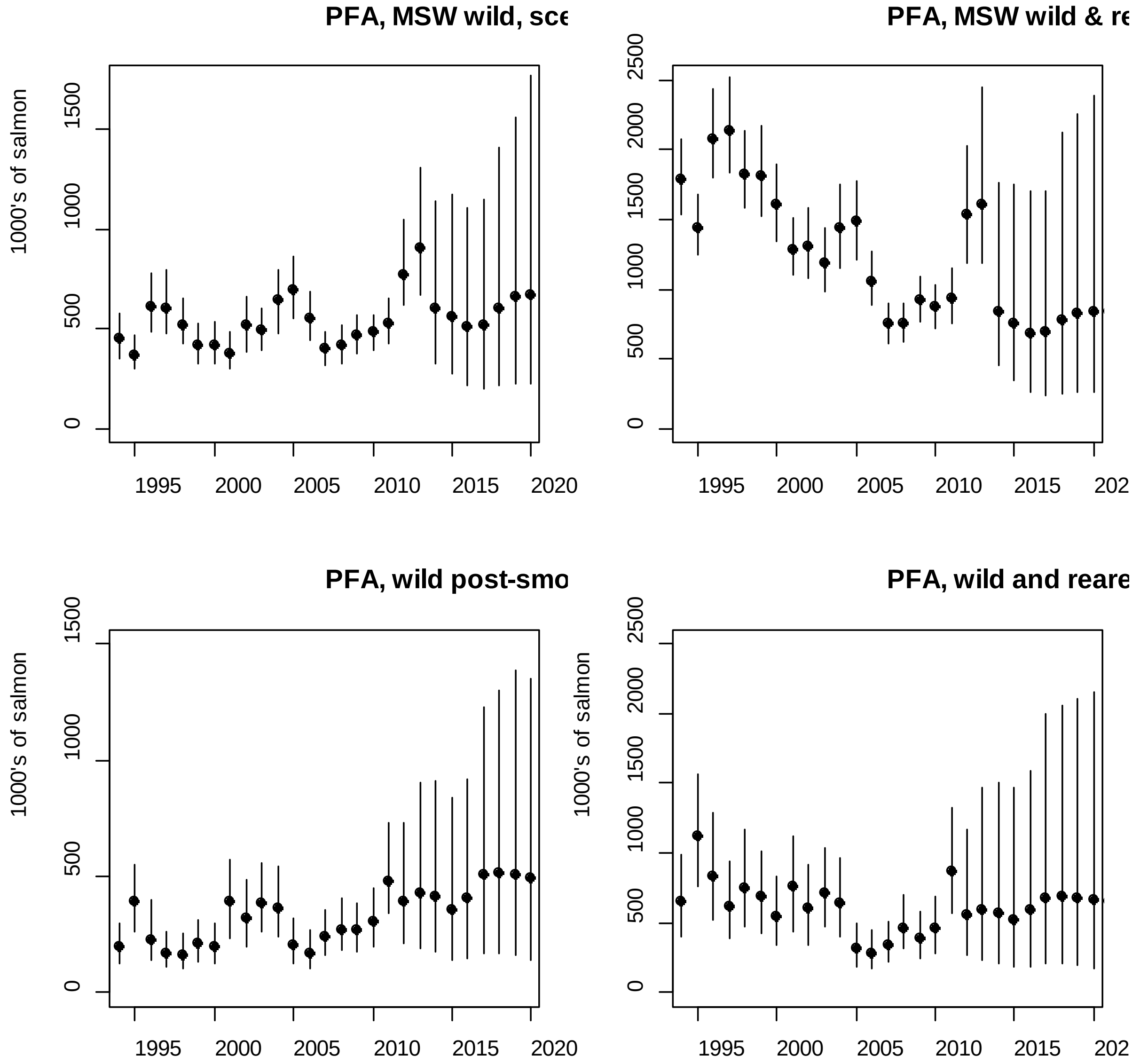


Figure 4.3.2.5a. Pre-fishery abundances of MSW and 1SW wild salmon and wild and reared salmon together based on scenario 1 (most likely development of effort). PFAs reflect the abundance that is available to the fisheries, in case of MSW salmon, at January 1st (before the winter fisheries take place in the model) and in case of post-smolts, at May 1st (before the summer fisheries). The PFA for post-smolts contains both the mature and immature salmon.

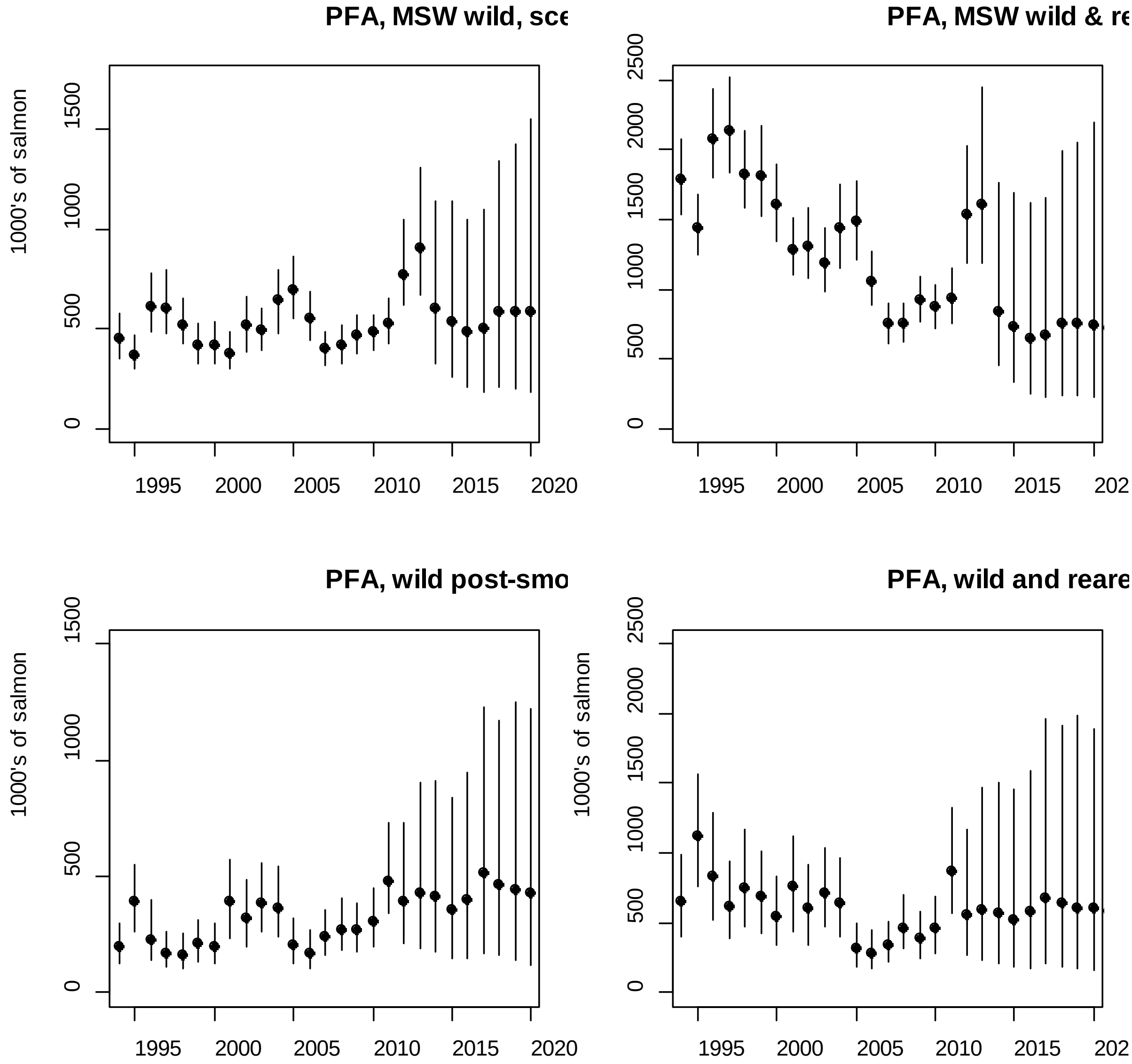


Figure 4.3.2.5b. Pre-fishery abundances of MSW and 1SW wild salmon and wild and reared salmon together based on scenario 4 (100% increase compared to effort of scenario 1). PFAs reflect the abundance that is available to the fisheries, in case of MSW salmon, at January 1st (before the winter fisheries take place in the model) and in case of post-smolts, at May 1st (before the summer fisheries). The PFA for post-smolts contains both the mature and immature salmon.

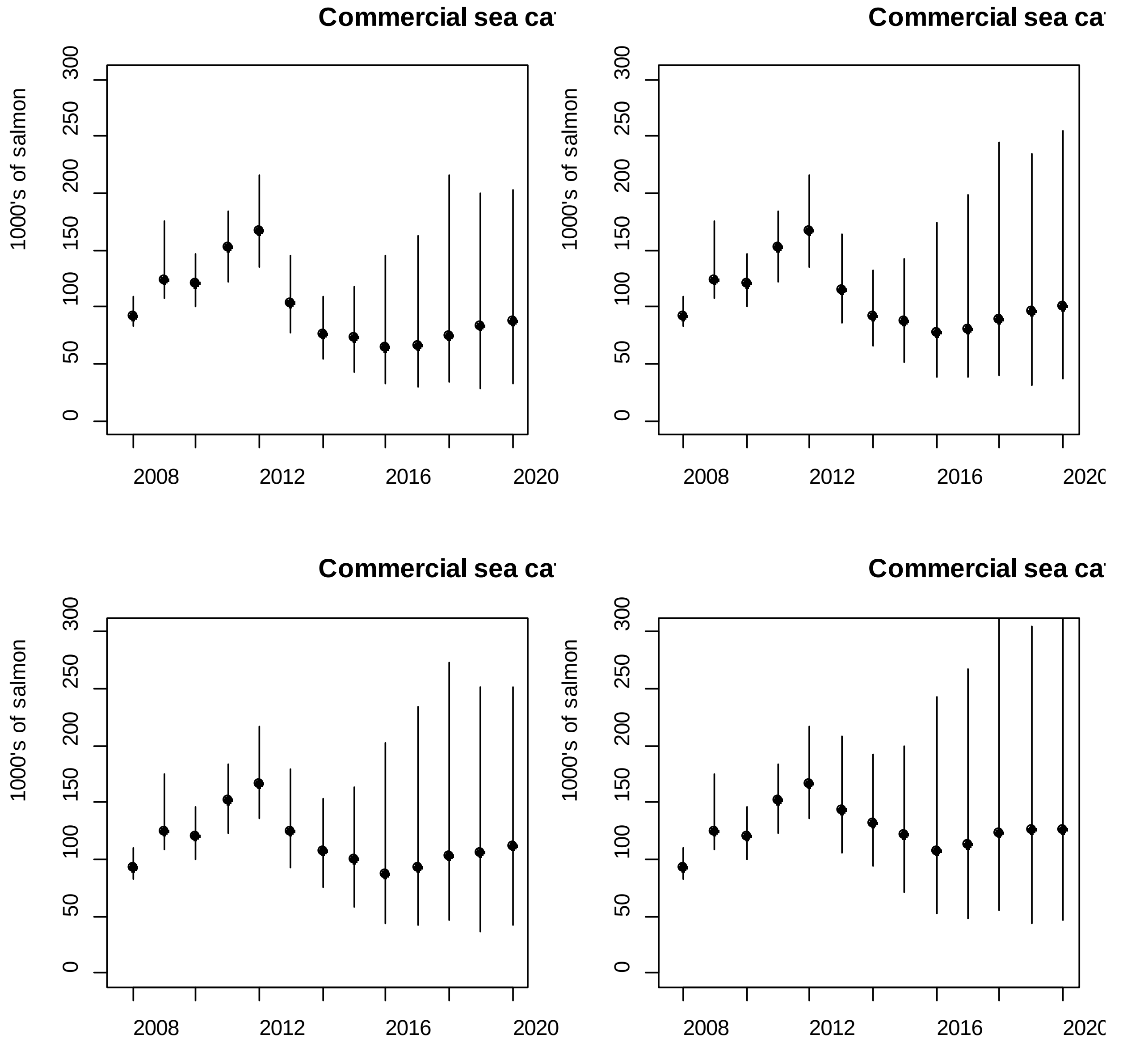


Figure 4.3.2.6. Estimates of reported commercial sea catches (all gears) based on different scenarios.

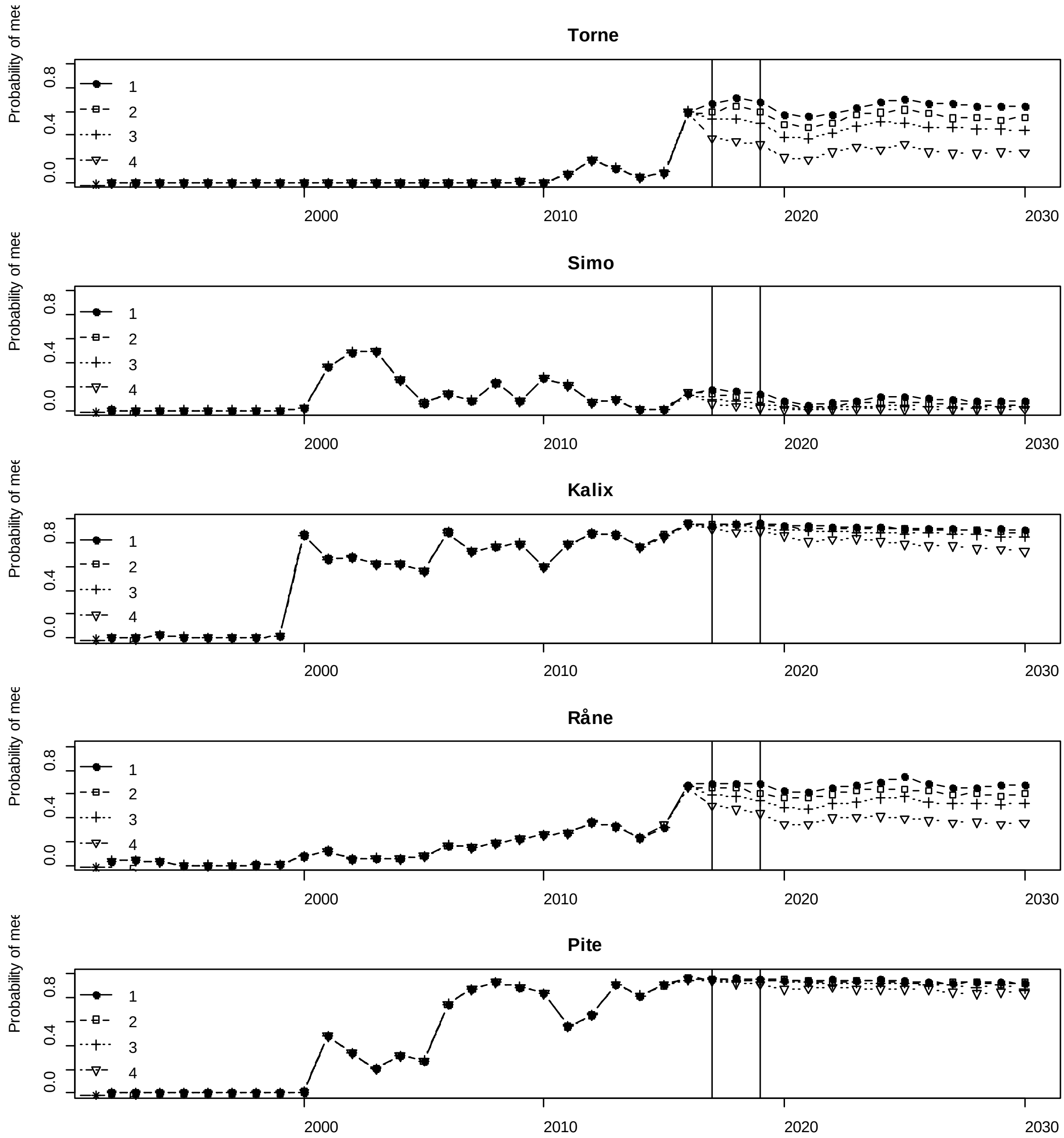


Figure 4.3.2.7a. Probabilities for different stocks for meeting an objective of 75% of potential smolt production capacity under different scenarios. Fishing in 2014 affects mostly years 2017–2019.

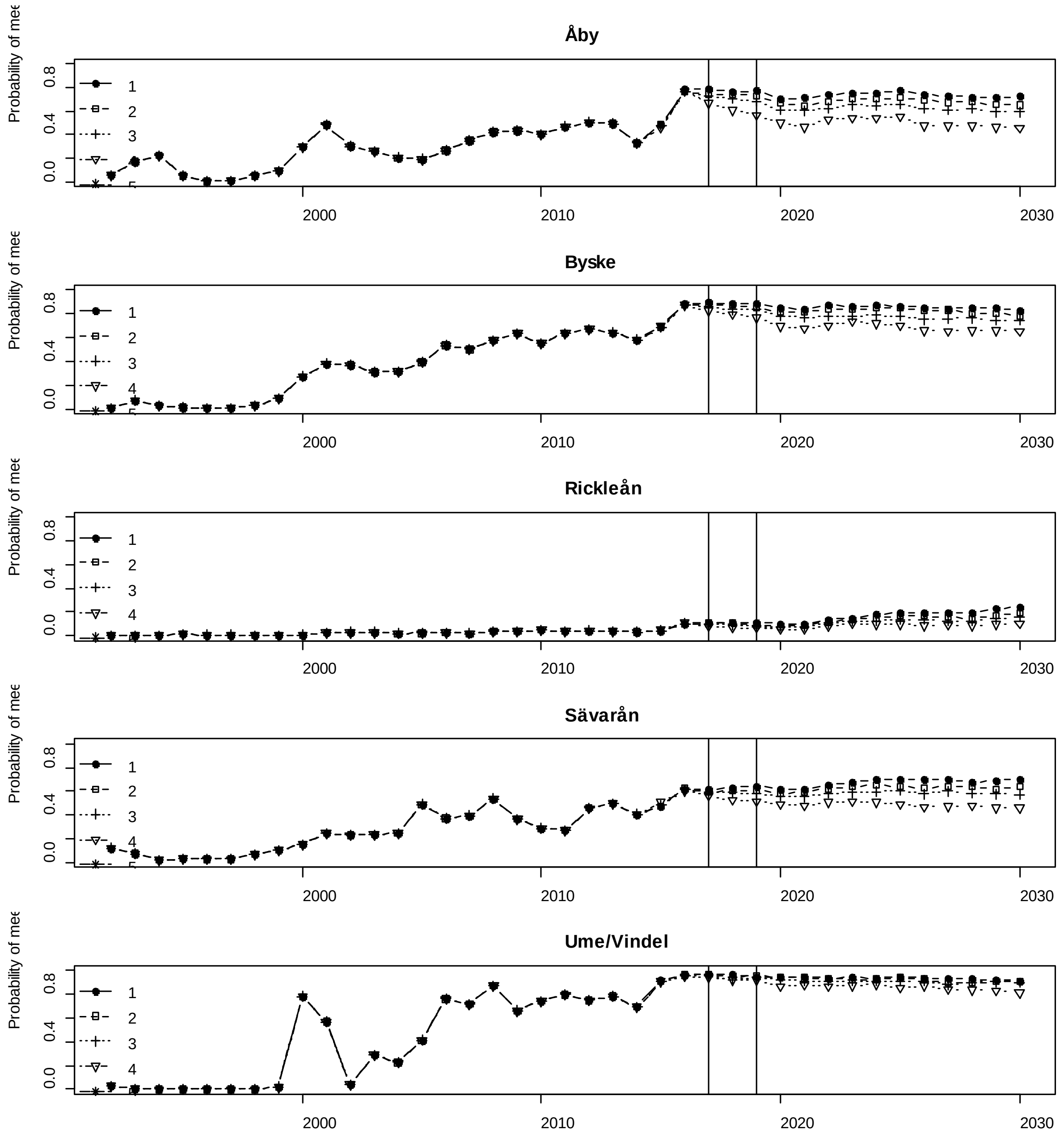


Figure 4.3.2.7b. Probabilities for different stocks for meeting an objective of 75% of potential smolt production capacity under different scenarios. Fishing in 2014 affects mostly years 2017–2019.

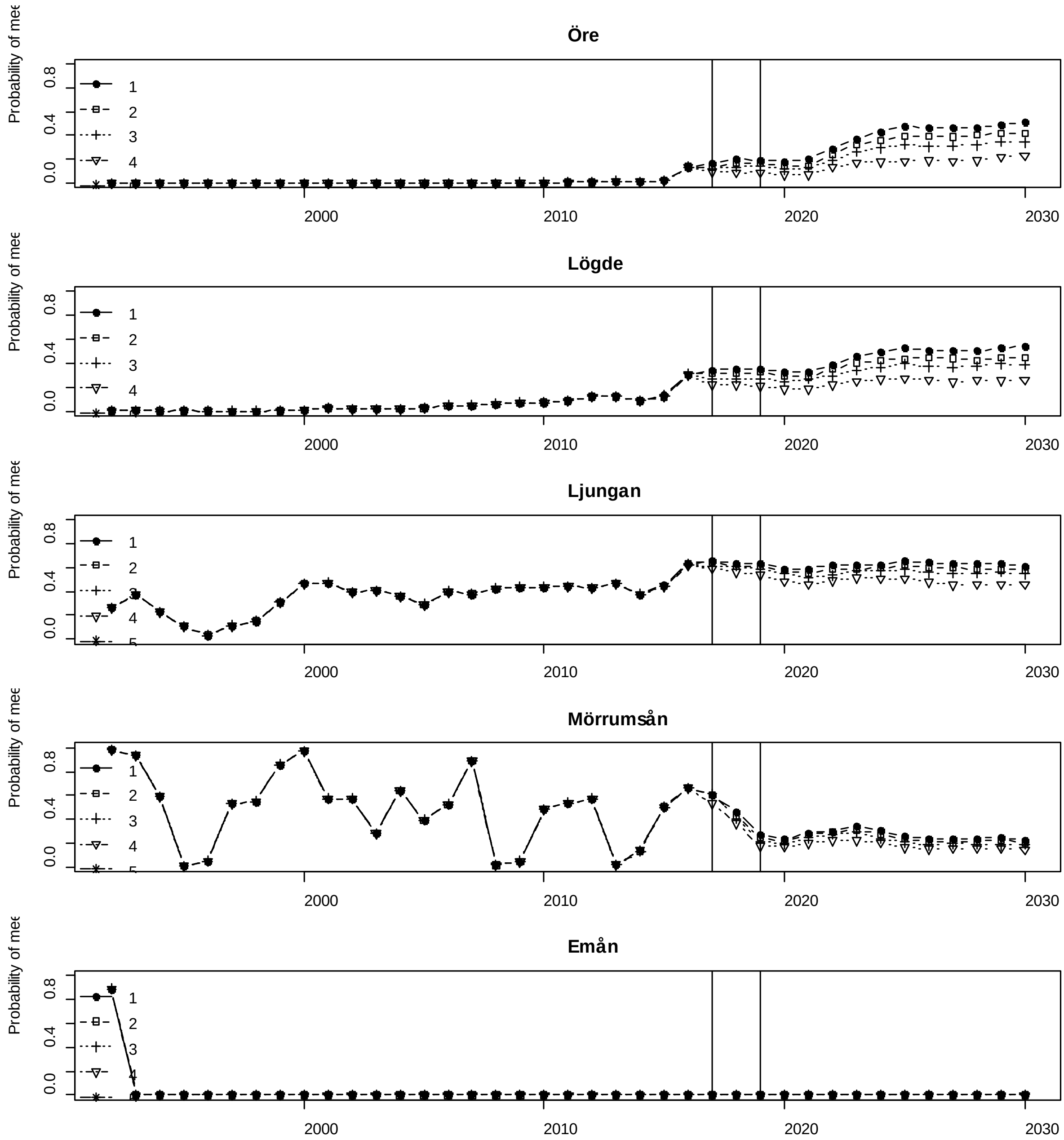


Figure 4.3.2.7c. Probabilities for different stocks for meeting an objective of 75% of potential smolt production capacity under different scenarios. Fishing in 2014 affects mostly years 2017–2019.

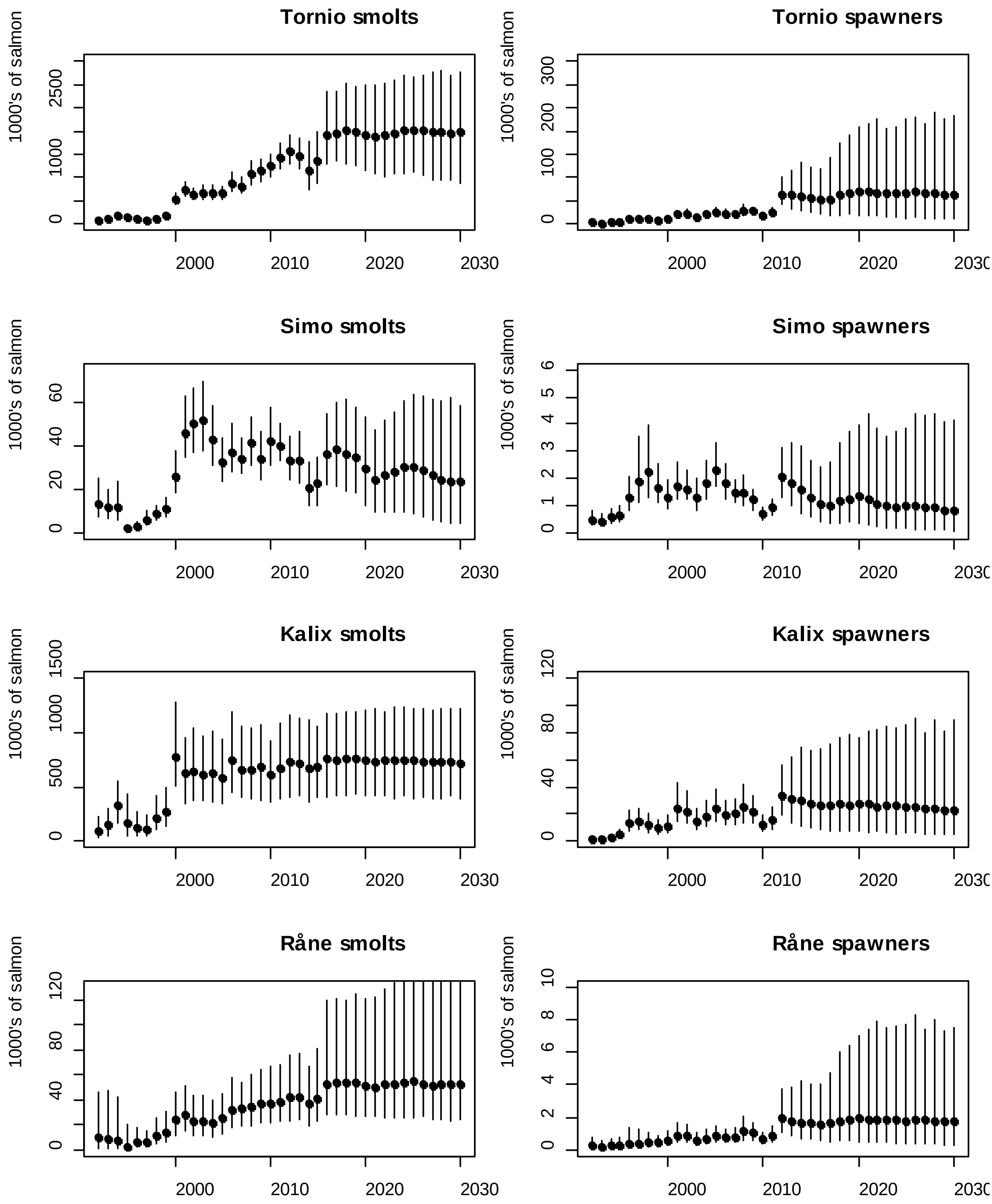


Figure 4.3.2.8a. Median values and 95% probability intervals for smolt and spawner abundances for rivers Tornionjoki, Simojoki, Kalixälven and Råneälven in scenario 1 (most likely development of effort).

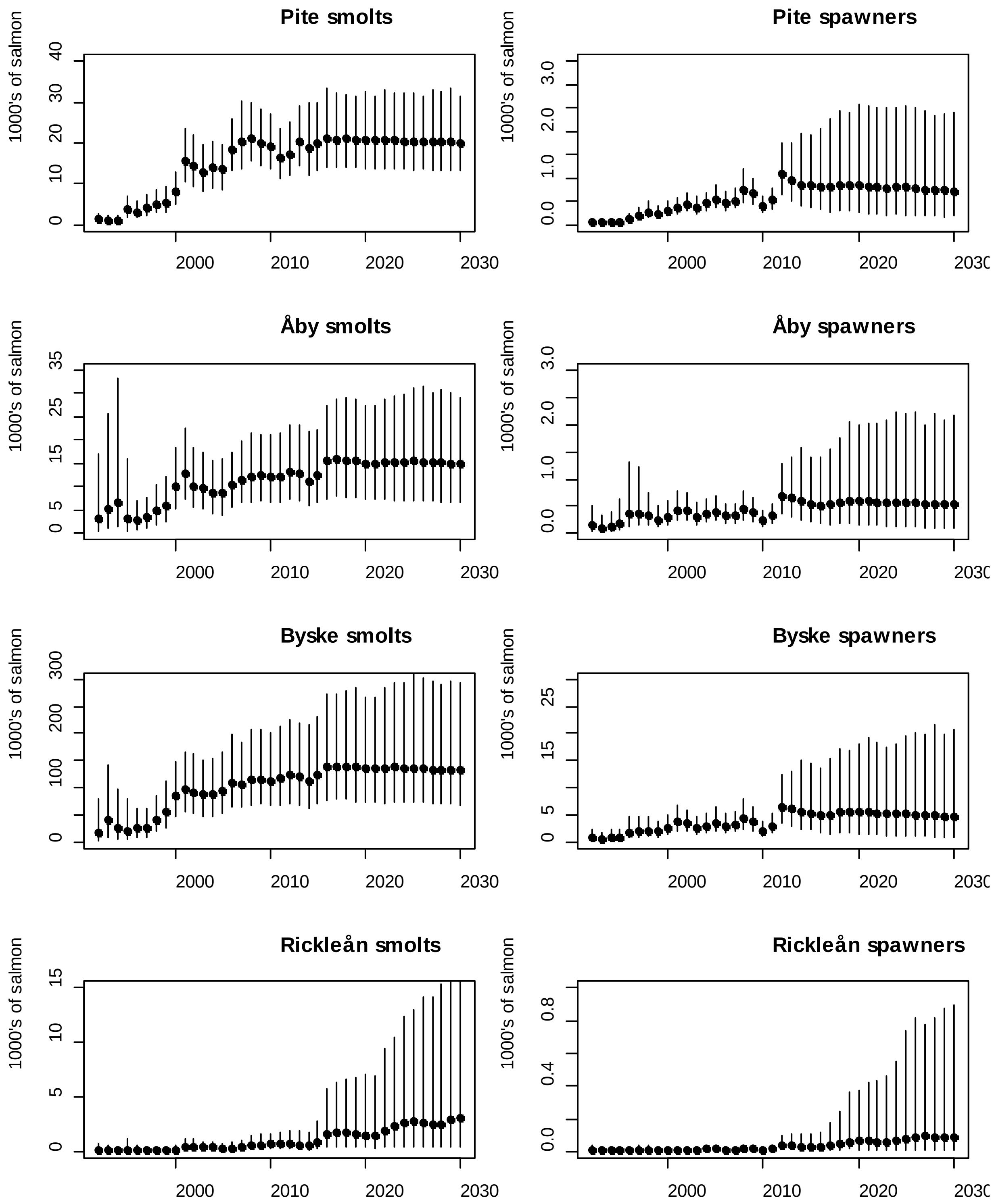


Figure 4.3.2.8b. Median values and 95% probability intervals for smolt and spawner abundances for rivers Piteälven, Åbyälven, Byskeälven and Rickleån in scenario 1 (most likely development of effort).

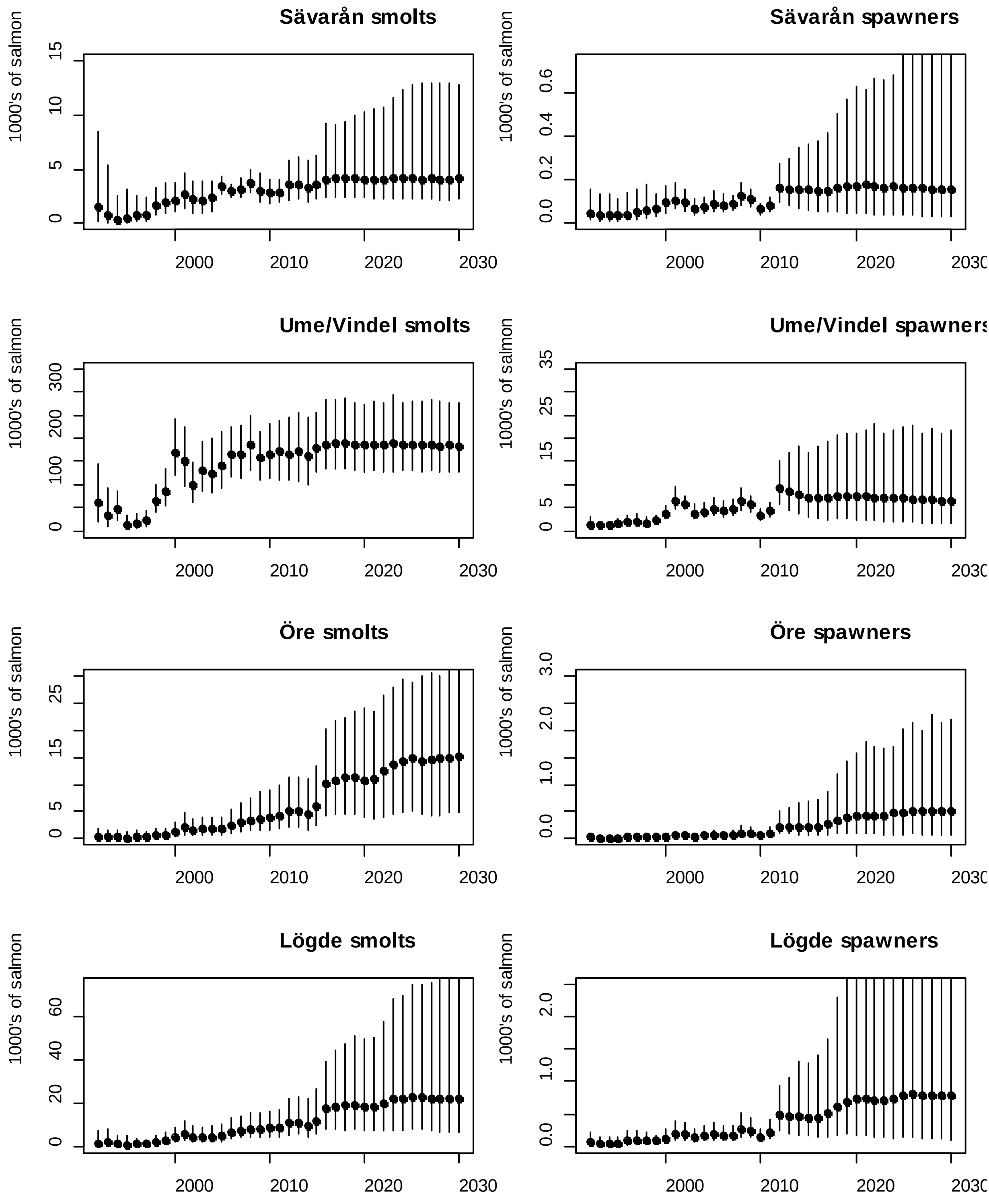


Figure 4.3.2.8c. Median values and 95% probability intervals for smolt and spawner abundances for rivers Sävarån, Ume/Vindelälven, Örealven and Lögdeälven in scenario 1 (most likely development of effort).

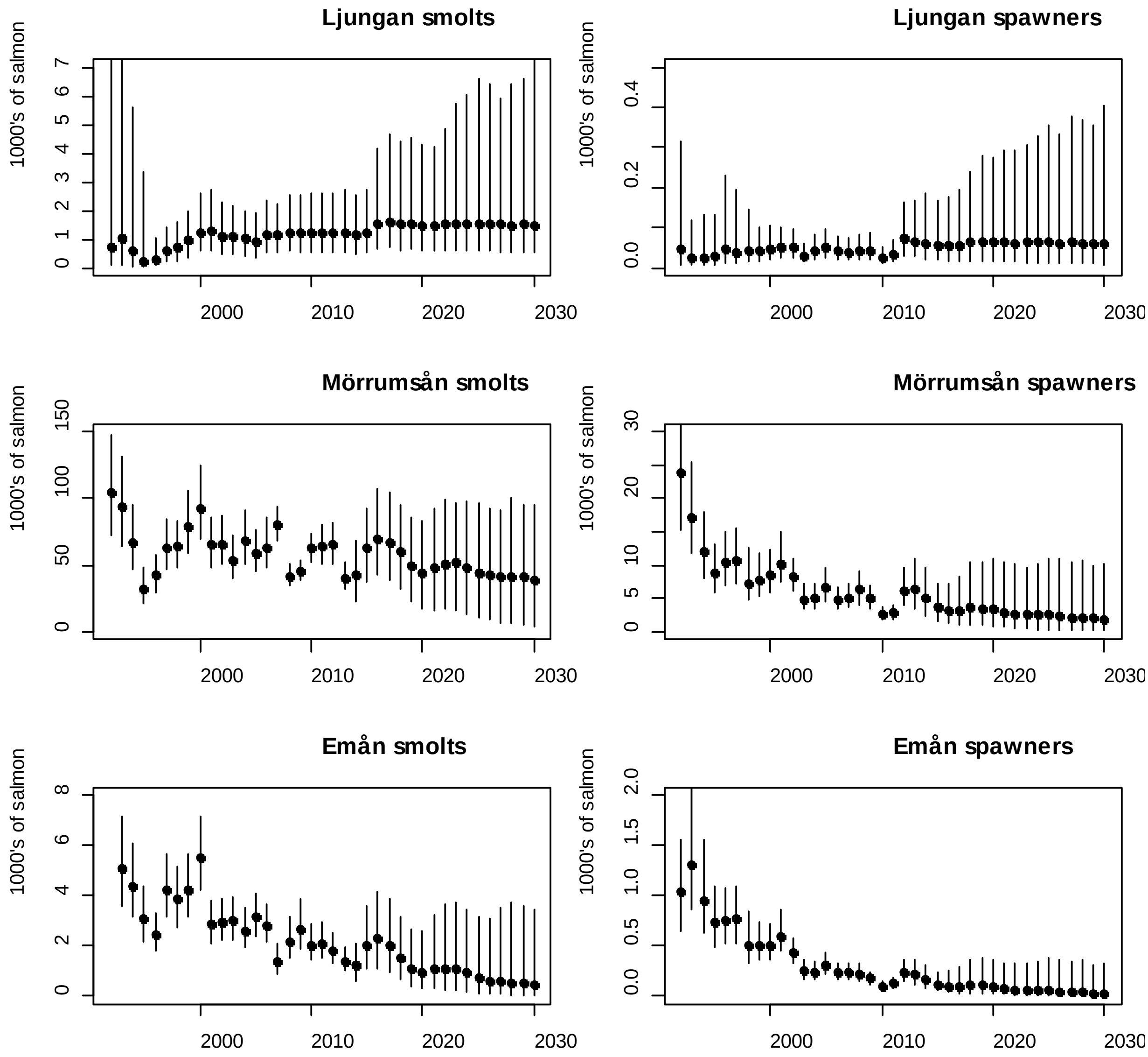


Figure 4.3.2.8d. Median values and 95% probability intervals for smolt and spawner abundances for rivers Ljungan, Mörrumsån and Emån in scenario 1 (most likely development of effort).

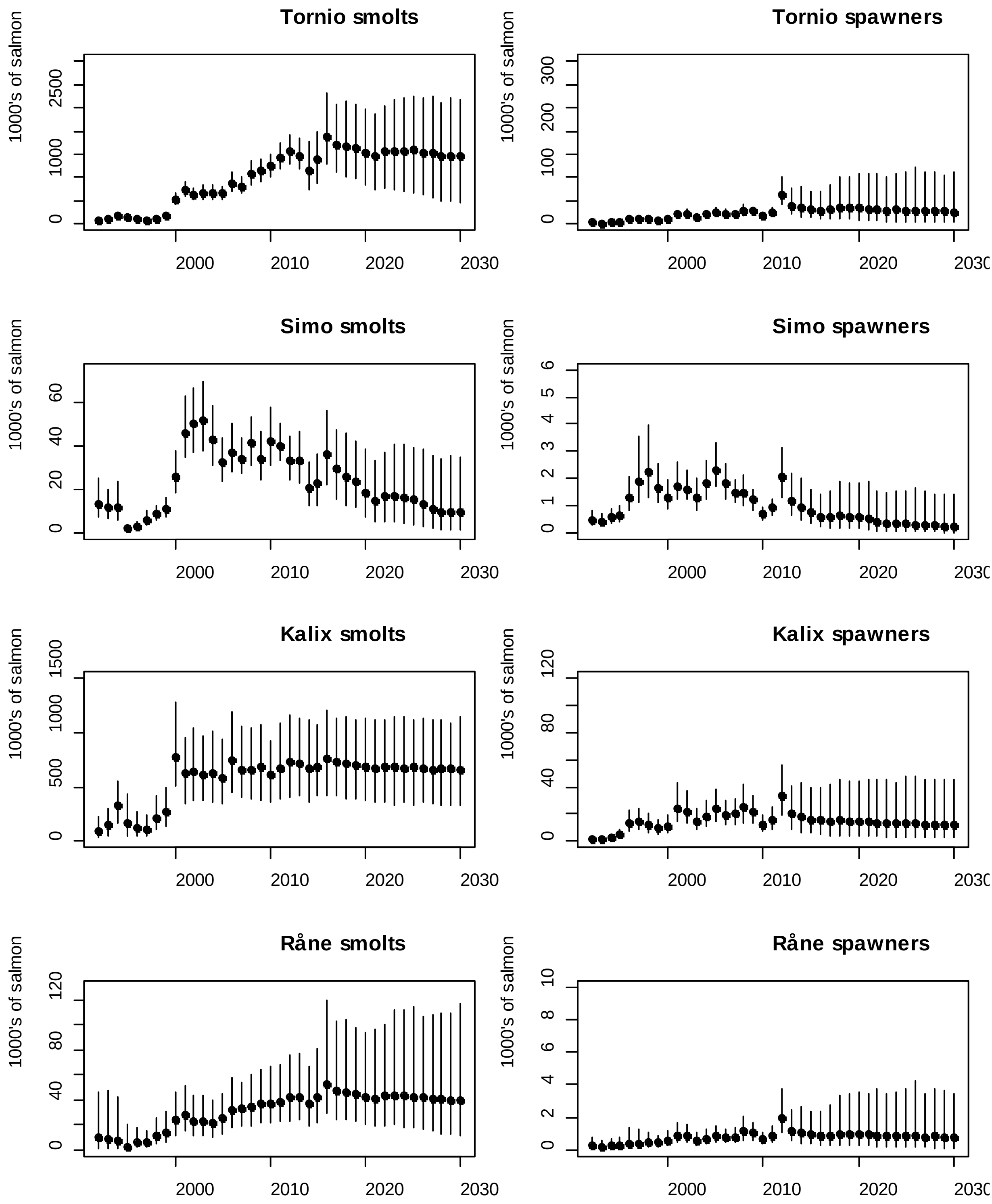


Figure 4.3.2.8e. Median values and 95% probability intervals for smolt and spawner abundances for rivers Tornionjoki, Simojoki, Kalixälven and Råneälven in scenario 4 (100% increase in effort compared to scenario 1).

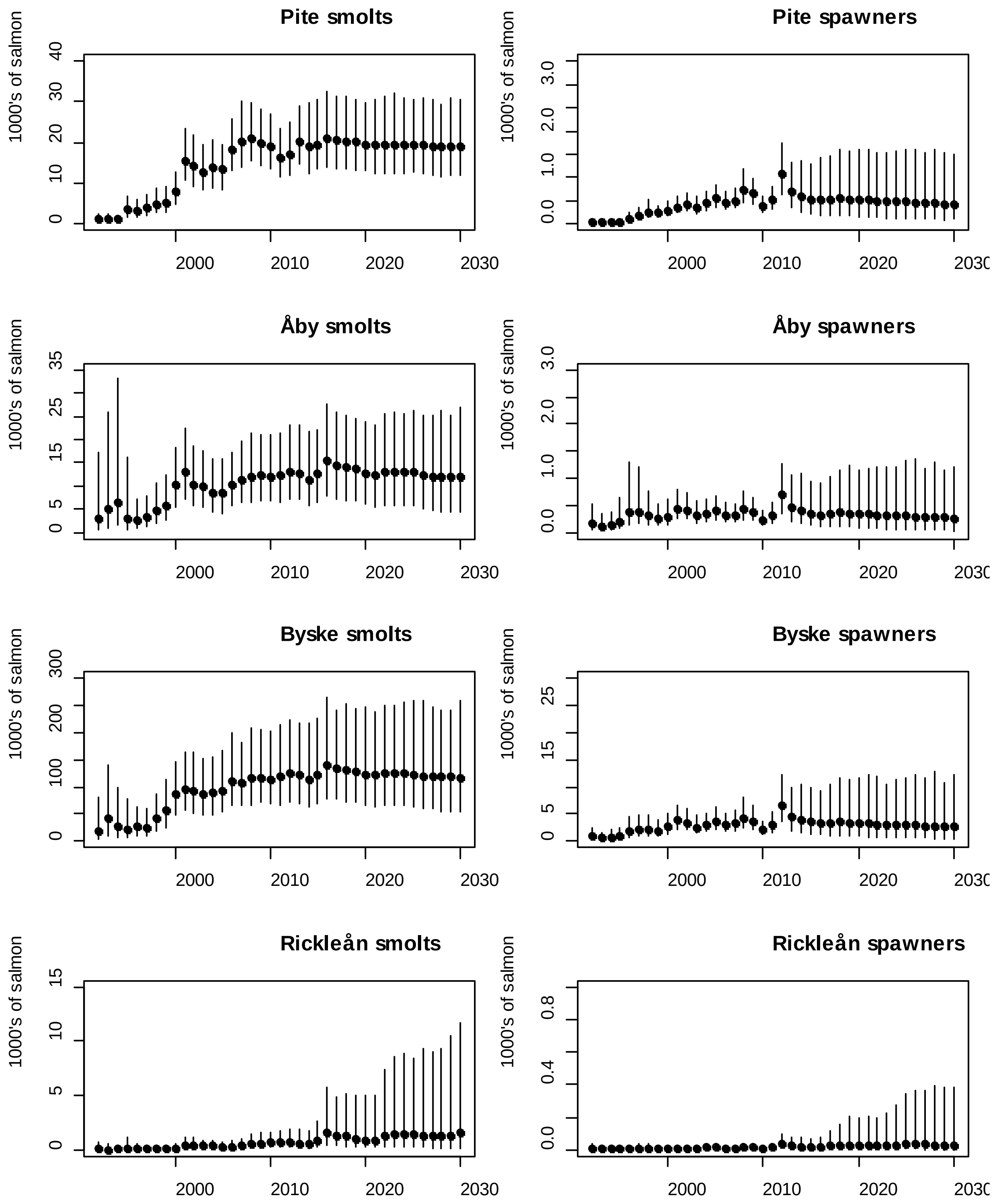


Figure 4.3.2.8f. Median values and 95% probability intervals for smolt and spawner abundances for rivers Piteälven, Åbyälven, Byskeälven and Rickleån in scenario 4 (100% increase in effort compared to scenario 1).

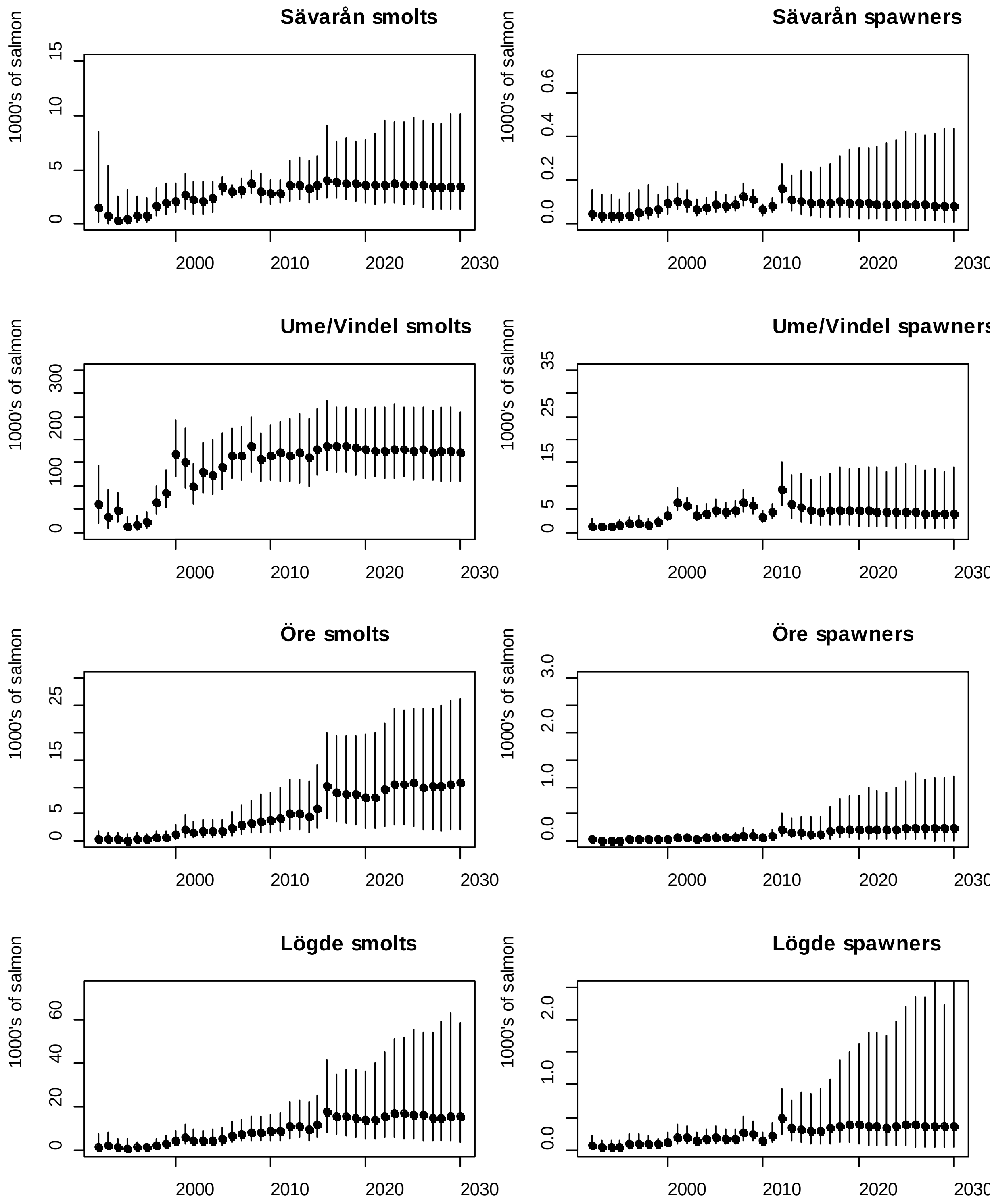


Figure 4.3.2.8g. Median values and 95% probability intervals for smolt and spawner abundances for rivers Sävarån, Ume/Vindelälven, Öreälven and Lögdeälven in scenario 4 (100% increase in effort compared to scenario 1).

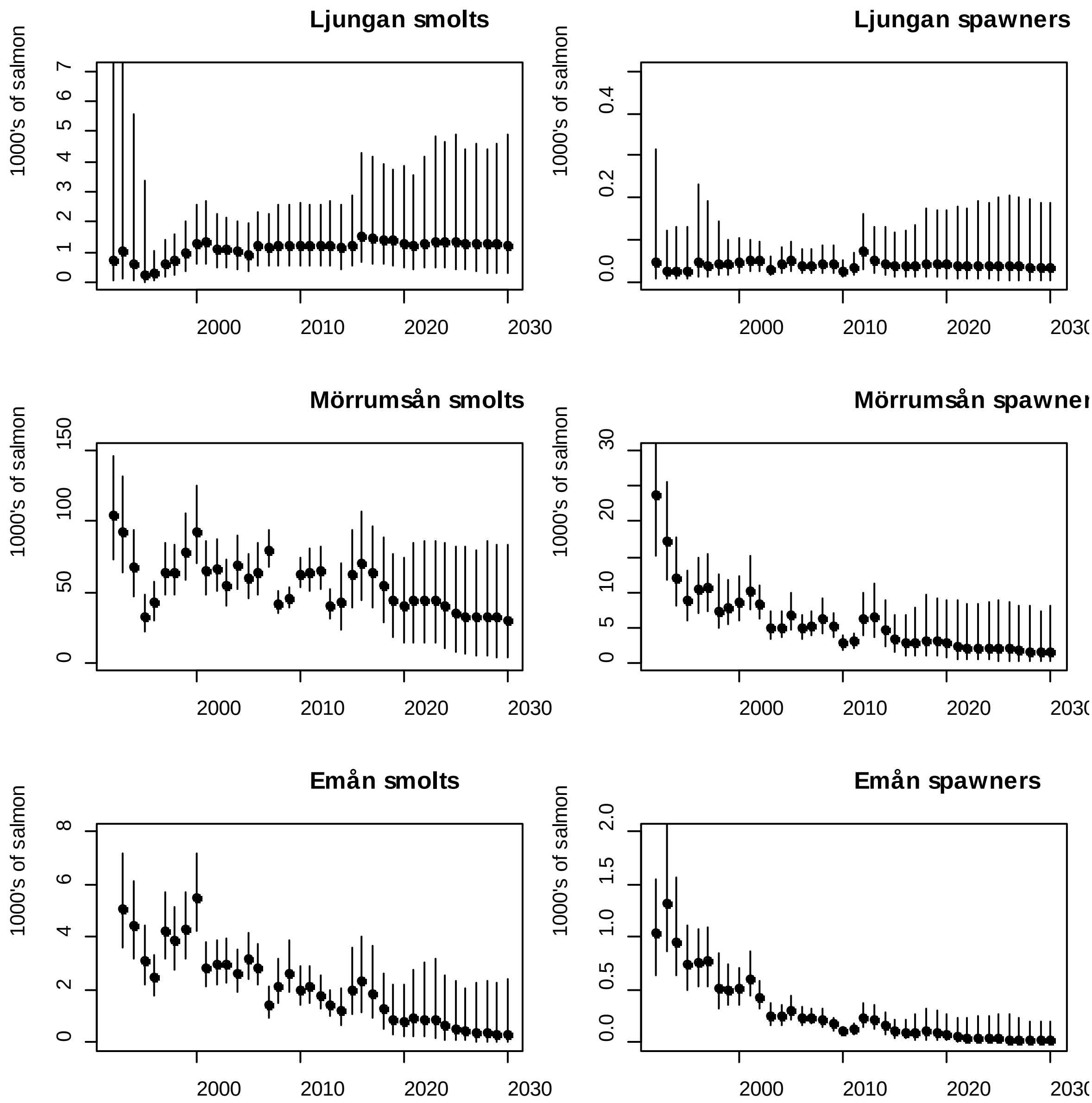


Figure 4.3.2.8h. Median values and 95% probability intervals for smolt and spawner abundances for rivers Ljungan, Mörrumsån and Emån in scenario 4 (100% increase in effort compared to scenario 1.

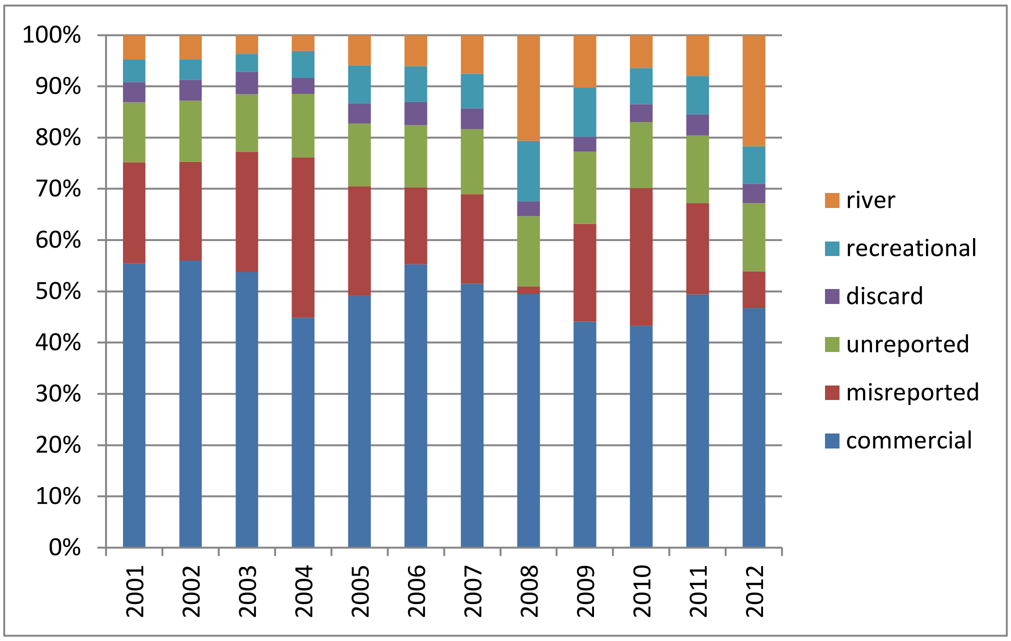


Figure 4.3.2.9. Share of commercial and recreational catches at sea, river catches (including also some commercial fishing), and discard/unreporting/misreporting of total catches in Subdivisions 22–31 in years 2001–2012.

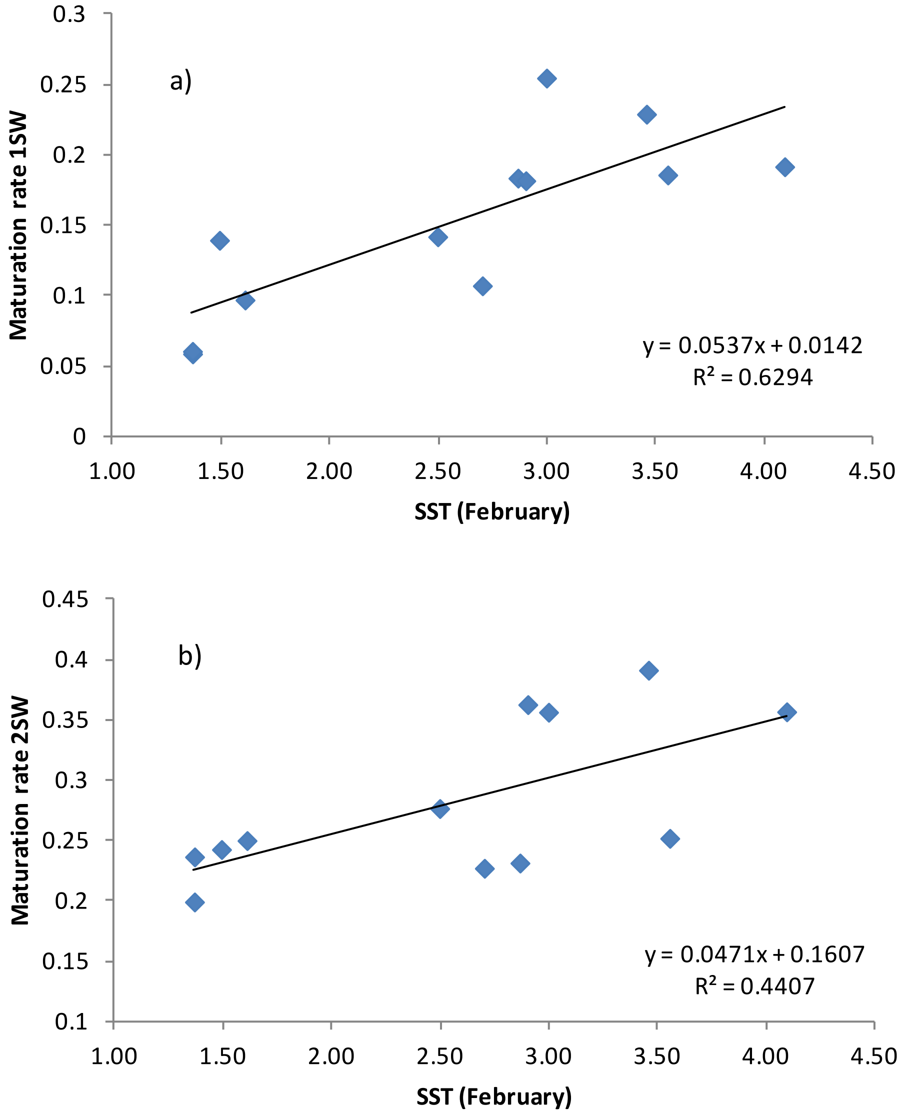


Figure 4.4.1. Correlations between sea surface temperatures in Main Basin during February and model estimates of maturation rate for a) 1SW and b) 2SW salmon. The positive correlations indicate that the updated assessment model is able to pick up climate induced variation in maturation rate (see text for more details).

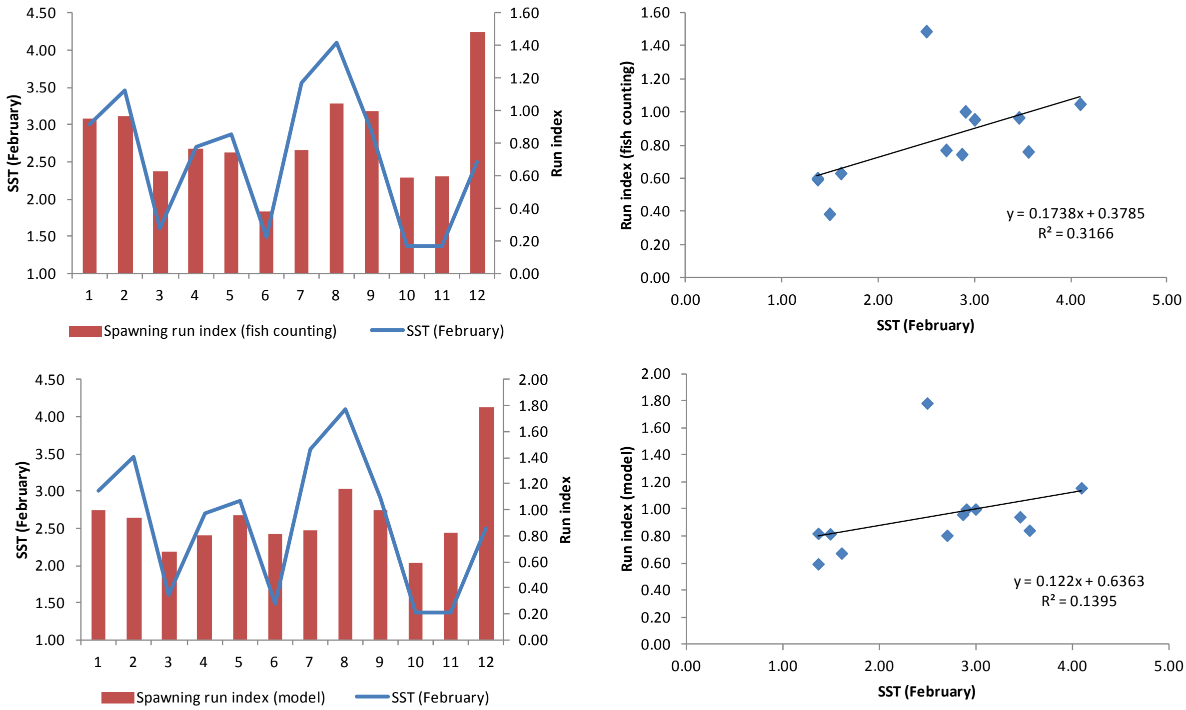


Figure 4.4.2. Correlation between relative spawning run strength (average for seven rivers, 2001–2011) and winter sea surface temperature (SST) in Main Basin (average for four to nine stations at 0–10 m depth in February-beginning of March) based on fish counting and model estimates (from 2013 assessment model), respectively.

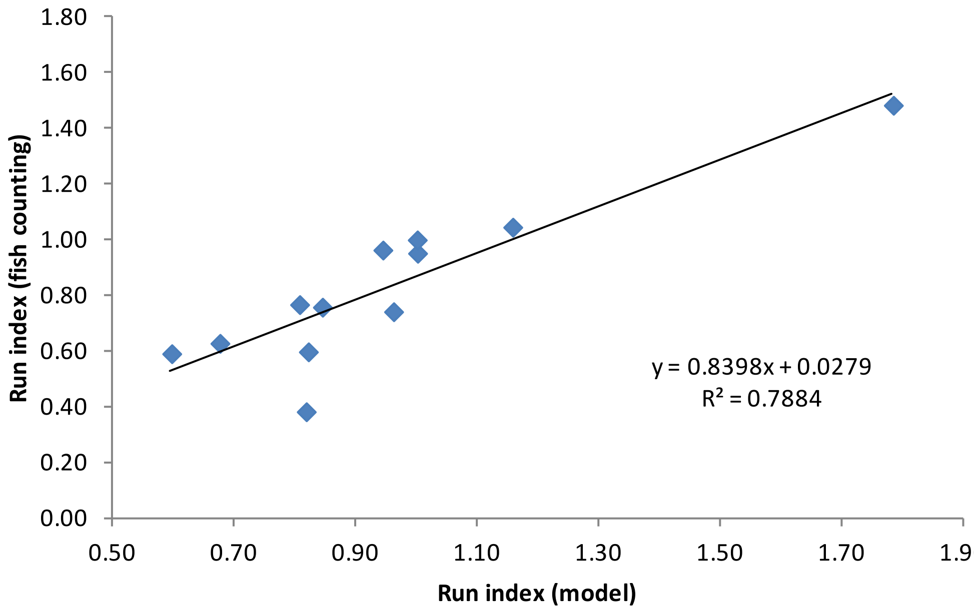


Figure 4.4.3. Correlation between spawning run index (average for seven rivers) derived from model predictions and counting of spawners. See text for more details.

5 Sea trout

Due to continuous concerns about the status and information available on sea trout in the Baltic Sea, a Study Group on Data Requirements and Assessment Needs for Baltic Sea Trout (SGBALANST) was established by ICES to work on a common classification system of habitats between countries (ICES, 2011b). A method of assessment was developed from this and carried out in 2012 (ICES, 2012). The results of the assessment are presented in this section (not updated this year). Also other information, such as tagging data, parr densities and information on spawner numbers, is used to determine status of sea trout populations in the Baltic Sea.

5.1 Nominal catch

The total reported sea trout catch in the Baltic Sea was 387 tonnes in 2012, which is 15% (69 tonnes) less compared to 2011 and 73% less than in 2000 when the catch begun to decrease (Tables 5.1.1 and 5.1.2).

The Main Basin is the most important area for sea trout catches; the catch in this area was more than 50% of the total catch in 2012. Total catches in the Main Basin have decreased from 1023 t in 2002 to 262 t in 2008. After two years of somewhat higher catches around 500 t, the catch again fell to 288 t in 2011 and reached a minimum of 202 t in 2012. Variation mainly reflects the changes in Polish offshore catch which decreased from 151 t in 2011 to 53 t in 2012. Catch in the Gulf of Bothnia was 152 t in 2012, close to the ten year average catch of 157 t. In the Gulf of Finland, catches were on the level of 85–105 t a few years before 2010 when it dropped to 25 t. Since 2010 catches has stayed on low levels and made up a total catch of 33 t in 2012. (Tables 5.1.1 and 5.1.2).

About 60% of the total Baltic catch was taken by the coastal fishery, mainly in the Gulf of Bothnia and slightly less in the Main Basin. About 15% was caught by the offshore fishery, almost exclusively by Polish vessels.

River catch was 84 t in 2012. The largest part (41 t) was reported from Swedish rivers flowing to the Gulf of Bothnia, mainly as anglers' catch, and from Polish rivers (26 t) partly as commercial catch in lower Vistula and partly as broodstock fishery in Vistula and Pomeranian rivers.

It is important to note that the actual catch of sea trout by Poland may be heavily overestimated due to possible misreporting of 16 500 (47.6 tonnes) salmon as trout. This is discussed in Section 2.3 in the present report.

Catches in the recreational fishery is known with little accuracy. Information has been gathered in both Sweden and Finland in recent years (Petersson *et al*., 2009; Jokikokko, 2003). The annual estimated catch for the Gulf of Bothnia could be as high as 400 to 500 t (ICES 2009) while catches in Finland in 2008 were 175 t (Subdivision 29–32) and the commercial catch 75 t. These figures may be compared to a registered catch in the commercial fishery of 1.5 t in Sweden in the offshore fishery and some 41 t in rivers. In spite of figures being incomplete the share caught in recreational fishery, according to the data available, constitute approximately 43% of total catches. There are at the moment no updated estimates of the recreational catch.

The total catch in the recreational fishery in Denmark was estimated in 2011 to be 175 t in 22 SD, 67 t in 23 SD and 80 t in SD 24–25 (Sparrevohn *et al*., 2011). These numbers were not included in the catch statistics since they were collected in a questionnaire.

Rough estimation of Polish anglers' catches in rivers made on the basis of questionnaires is around 4–6 t.

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 1400 sea trout were sampled. Most of them were sampled in the Main Baltic (SD 22–28) from Polish (634 individuals) and Swedish (235 individuals) catches. About 250 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 and a standardized minimum programme of sampling should exist in all countries. 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, 2008c). In most countries (not in Denmark 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 nine rivers in the entire Baltic area, but the time-series are not complete for all years.

In only one river (Åvaån in Sweden) the number of spawners is monitored by trapping and inspection of the ascending sea trout. In Lithuania, the spawning run is estimated by test fishing in a couple of rivers. In nine rivers (eight in Sweden, one in Poland) the number of spawners is monitored by automatic fish counters. 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 and Denmark (ICES, 2008c). 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.

5.2.2 Marking

In 2012, the total number of fin clipped sea trout was 1 044 645, smolts. What comprises one third of all released smolts, and 354 281 parr (Table 5.2.2.1). There is an increasing trend in number of fin clipped smolts since 2003. Most finclippings, of 620 thousand fish, were carried out in GoB, less in the Main Baltic (328 thousand) and in

GoF (96 thousand). Finclipping of hatchery reared smolts is mandatory in Sweden and Estonia. The highest number of finclipped smolts was released in Sweden, Poland (all smolts released to SD 25) and Finland. There was no stocking of finclipped sea trout smolts in Denmark, Russia, Latvia and Lithuania.

5.2.3 External tagging

In 2012 the total number of Carlin tagged sea trout was 35 192 (in 2011: 35 900) (Table 5.2.3.1) and 2000 were tagged with T-bar (T-Anch) tags (Table 5.2.2.1). There were also 3800 smolts tagged in Denmark with PIT tags released into streams in SD 22and 174 000 eggs and alevins coloured with alizarine and planted into Tornio R. (Table 5.2.2.1).

5.2.4 Assessment method

In 2011 the status of trout populations was analysed utilizing the method developed in (ICES, 2011). A full method description is found in ICES (2012).

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 30 have wild and 26 have mixed populations (Table 5.3.1.1). Five Finnish rivers have changed status from mixed to wild 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 occur. 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 to 1–3 of 0+ parr per 100 m^2. 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.

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 for the period 2001–2012 was 118 in River Kalixälven, 366 in River Piteälven and 81 in River Vindelälven. In River Piteälven the number gradually increases from less than 50 in 2000 to almost 800 in 2012. For some years there was also an increase in Kalixälven, Vindelälven and Byskeälven. However, the number of spawners ascending Kalixälven and Byskeälven again declined after 2010 and 2011.

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 no apparent trend in development of catches.

Returns from Carlin tagging releases show a continuous decrease in returns for more than 20 years. Since 2003 it has been below 2% (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 increasing (now 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).

According to tagging data, the survival of the released smolts is at present lower than a long-term average.

Finnish tagging data from the Gulf of Bothnia comparing performance of wild and reared fish has been evaluated. Survival of wild fish was 2–3 times higher than reared fish and they had a slightly later recapture time also indicating better survival.

Smolt production estimates exist for nine rivers in the entire Baltic area. In Table 5.3.1.3 smolt numbers for the period 2002–2011 is presented. In river Tornionjoki, smolt trapping during the migration period for sea trout has only been possible in some years. Wild trout production in the whole river system has been about 10 000–19 000 smolts in recent years. In Sävarån, smolt production has been between 800 and 1800 smolts 2009–2011.

5.3.2 Trout in Subdivision 32 Gulf of Finland

The situation for the sea trout populations in the Gulf of Finland resembles that in the Gulf of Bothnia. The number of streams with sea trout 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 (Table 5.3.1.1 and Table 5.3.2.1). Of these 85 have wild stocks. The rest have been supported by releases. From 2013 releases of trout will be 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 1988. In more recent years, densities have in general been below 40 0+ parr per 100 m^2. Average densities from 1992 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 2006–2012 varied between 100 and 2300 smolts (Table 5.3.1.3).

Parr density of sea trout in the Finnish River Ingarskilanjoki in the Gulf of Finland was on average 20.8 (0–82.2) 0+ parr per 100 m^2 for the period 2001–2012 (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 (Figure 5.3.1.5). Finnish tagging results shows that in general about 5–10% of the tag recoveries are from Estonia and some also from Russia. Correspondingly, Estonian tagged sea trout has partly been recaptured at the Finnish coast.

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 are in general below ten 0+ parr per 100 m^2. The total smolt production has been estimated to be at least 10 000–15 000 smolts. Smolt trap experiments indicate that between 2000 and 8000 sea trout smolts of natural origin annually migrates to the sea from the largest Russian trout river Luga (Table 5.3.1.3).

5.3.3 Trout in Subdivision 26–29 Main Basin

In the Main Basin (including SD 22–25) there are now 465 rivers and streams with sea trout populations and of these 382 are wild. The status of sea trout populations in this area was partially revised in 2012 and is known in 176 and unknown in 206 rivers with wild populations (Tables 5.3.1.1 and 5.3.2.1). Status of 40 (wild and mixed including tributaries in large systems) populations is poor, mainly due to habitat degradation, dam building and overexploitation (Tables 5.3.1.2 and 5.3.3.1).

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 varied between ten and 30 sea trout parr per 100 m^2 (Figure 5.3.3.1). Densities tend to vary much between years, partly because of varying water flow. In the 1980s densities were lower, partly because few sites were fished and some of these had low trout habitat quality.

In Latvia, sea trout populations are found in 20 rivers, most of them mixed, and in a few small rivers and brooks discharging into the Gulf of Riga and Baltic Main Basin (Table 5.3.1.1). Average densities of 0+ parr were between four and twelve 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 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 2002–2012 (Table 5.3.1.3).

In Sweden 207 sea trout rivers are found in the Main Basin. Out of them 200 have wild sea trout populations, and seven are supported by releases. Densities of trout are presented for Emån (Figure 5.3.3.1). Since the mid-1990s it has varied between 0.2 and 11 0+ parr per 100 m^2. Catch in Emån is presented in Figure 5.3.1.4 (SD 27). Sport fishing catch has been declining and has in recent years been only between 20 and 40 sea trout annually, 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. Parr densities for 0+ trout have been available for the last couple of years being around 6–8 0+ parr per 100 m^2 (Figure 5.3.3.1). The current total natural smolt production was estimated to be about 44 900 (42 000 in 2011, 41 000 in 2010). 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 increased considerably in 2012 after a decrease in 2011.

All Polish sea trout are of the widely migrating type. The number of populations was revised in 2010. Sea trout are found in 25 rivers (whole country, 12 of them in SD 26), mainly in Pomerania (10) but also in Vistula R. (6) and Odra R. (6) systems. All are mixed due to stocking for many years. The density of parr has been estimated in only one river (Reda, Figure 5.3.3.1) and has declined in the last three years. A very low density observed in 2007 was based on data from one site only.

5.3.4 Trout in Subdivision 21–25 Main Basin

In order to have a sufficient number of Danish sites fished every year, SD 21 was partly included.

Densities in R. Mörrumsån have since the mid-1990s been below 10 0+ parr per 100 m^2, except in 2007 when it was 13 0+ parr per 100 m^2. In 2012 it increased to 16.1 (Figure 5.3.4.1). Smolt number in the upper part of R. Mörrumån (approximately 15 km from outlet) has varied during the last four years between 4500 and 6500 (Table 5.3.1.3). Sportsfishing nominal catch in Mörrumsån is presented in Figure 7.3.1.4 where SD 25 is catch in Mörrum. The catch has varied around 500 sea trout annually for several years, 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 m^2 (Figure 5.3.4.1). Spawning run in R. Slupia was between 3500 and 7000 at Slupsk 30 km upstream from the outlet in the period 2006–2012. In 2012 it was approximately 4400.

It is estimated that the number of wild smolts produced in Danish rivers in SD 22–25 is presently approximately 332 000 smolts annually. Electrofishing data from Danish streams shows average parr densities of between 50 and just under 200 parr per 100 m^2 in recent years (Figure 5.3.4.1). Smolt migration in one stream on Bornholm (length 17 km, productive area 2.46 ha) was on average 6400 annually 2007–2012, however with very high variation (1687–16 138) due to varying water levels (Table 5.3.1.3).

Returns of tags from sea trout smolts released in Polish rivers are in general below 0.5% in recent years (Figure 5.3.4.2). However, the rate increased slightly to 0.65 for tagging in 2007 and to 1.55% for tagging in 2008.

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 freshwater 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, and Wieprza, and in kelts in the Gulf of Gdańsk. The highest frequency of infected fish was observed in 2007, especially in Slupia R. 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 2012 the problem still exists in the same rivers. In spite of several attempts to identify the cause the reason is still unknown.

5.4 Reared smolt production

Total number of reared smolts released in Subdivision 22–32 was in 2012 3 315 000, similar to the last two years. Out of this, 1 950 000 smolts were released into the Main Basin, 1 071 000 into the Gulf of Bothnia and 292 000 into the Gulf of Finland (Table

5.4.1). Latvian, Polish, Swedish and Danish releases of smolts were carried out in rivers and river mouths, while almost half of Finnish smolts were released directly into the sea.

In Finland, smolt production is mainly based on reared broodstocks supplemented by spawners caught in rivers. Stocking with reared sea trout smolts was increasing from 2006 to 2008 when it reached 1.22 million smolts. In 2012, the released number dropped below 800 000 mainly because of reduction of releases into Gulf of Finland (Table 5.4.1). Swedish stocking of smolts in this area was on average levels of about 400 000–600 000 smolts since the 1980s and increased lately to above 700 000 (Table 5.4.1). An increasing proportion of these are one year old, while previously it was almost exclusively two year old smolts. Estonia hasn't released sea trout smolts into Main Baltic in 2012 and the small releasing into Gulf of Finland will be stopped next year. (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 broodstock origin. Almost 7 million alevins and fry, and 1.15 million smolts were released to Polish rivers in 2012 (Tables 5.4.2, 5.4.3 and 5.4.1). Denmark and Sweden released 274 000 and 744 000 smolts, respectively, in 2012. Latvian releases has increased from 153 000 in 2010 to 271 000 one year old smolts in 2012 (Table 5.4.1).

Russia released 64 000 smolts which was the highest number so far (Table 5.4.1). German stocking has been on level of 13–15 000 smolts 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 smolts originating from these is presented in Table 5.4.3. In 2012 the estimated number of smolts from these releases was around 190 000, mainly in the Main Baltic (above 127 000). The predictions for 2013 is approximately 200 000 smolts for the whole Baltic, of which 156 000 will migrate into the Main Basin (Table 5.4.3). Total number of smolts from enhancement releases in recent years is less than in the very beginning of the 20th century (Table 5.4.3).

5.5 Status of stocks and recent management changes

5.5.1 Status of stocks

Assessment of sea trout populations was not updated for 2012. The results of last year's assessment were as follows.

Using the calculated relative recruitment, initial analysis showed that ICES Subdivision 32 had a lower than expected density of 0+ and older parr together (88%; Figure 5.5.1.1), in spite of stocking of trout in River Ingarskilanjoki. Also Subdivision 29 (average relative recruitment status 86%) and Subdivision 31 (average 86%) had low status, whereas Subdivision 30 had a higher status than expected (116%). In this subdivision, ten out of 14 sites (71%) had higher abundance than expected. It must be noted that the results are influenced from having a very low number of sites.

When combining subdivisions to larger units, and omitting the two streams with stocking of trout, the overall pattern was evident showing lower than expected parr abundance in the Gulf of Finland (average 88%). However, as the confidence interval crosses the 0-line the recruitment status was not significantly lower than expected (Figure 5.5.1.2). In Gulf of Bothnia, the large confidence interval around the mean reveals that the trend in ICES Subdivisions 30 and 31 differed.

Trends were calculated as the Pearson r correlation coefficient of parr abundance vs. years (2000–2011). The coefficients for individual sites were joined per subdivision.

Initial analysis showed significantly increasing trends in Subdivisions 30 and 32 (Figure 5.5.1.3). In Subdivision 25 (sites in Poland and southeastern Sweden), with many sites included (e.g. Table 5.5.1.1), the negative trend was significant. The remaining subdivisions all had trends with a confidence interval crossing the 0 line, i.e. no significant deviation from 0. The cause of this may be both few sites included, but also divergent development among sites.

A closer look at the results for larger areas (omitting sites with stocked trout) showed that the significant positive trend in Gulf of Bothnia and Gulf of Finland remained (Figure 5.5.1.4). The tendency for a declining trend in southern Baltic Sea was pronounced, but not significant.

Further analysis of SD 30–31 and 32, omitting results from rivers with stocking and discriminating between the countries, showed indications of a positive trend in densities (both 0+ and older) in Sweden (p=0.081) as opposed to Finland (p=0.496) (Figure 5.5.1.5). Looking only at 0+, the tendency was still the same, but none of the regressions were significant (Figure 5.5.1.7). Indication of a positive trend, only including 0+, was showed in Estonian rivers (p=0.05) while the trend was negative in Russian rivers (p=0.22) (Figure 5.5.1.6).

A positive trend in SD 30 and 32 was also apparent when discriminating between densities during the period 2000–2005 and 2006–2011 compared to the eleven year average between 2000 and 2011 (Figure 5.5.1.8).

5.5.2 Spawners

SD 30–31

Even though the spawning run in R. Piteälv has improved significantly over the last decade, 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, to some extent also indicating the number of spawners, does not suggest any progress in this area.

5.5.3 Tagging results

SD 30–31

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 shows that Finnish sea trout migrate partly to the Swedish side of the Gulf of Bothnia (ICES, 2009b). 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.

SD 22–25

Recent Polish and Danish tagging results have not been evaluated.

5.5.4 Management changes

In the Bothnian Bay (Subdivision 31), Bothnian Sea (Subdivision 30) and Gulf of Finland (Subdivision 32) the fishing is presently mainly directed towards other species using tackle that catches also young age groups of sea trout. The proportion of sea trout caught undersized has increased, i.e. a large portion 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 addition in the Finnish economic zone in the Gulf of Finland a new regulation was set to the state owned waters (outside the villages' waters) from the beginning of 2013. In that area all caught sea trout that has adipose fin must be released back to sea. Minimum landing size (for finclipped sea trout) was increased to 65 cm (from 50 cm). Minimum bar length in the bottom 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 single fibrenet is allowed and diameter of fibre must not exceed 0.20 mm.

Furthermore, 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) will be adapted in 2013 to further strengthen the protection of sea trout. This includes shortening of the autumn period for fishing with two weeks, resulting in a fishing ban from 1 September to 14 October, and restrictions of catch size (minimum 50 cm or window size 30–45 cm). 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 spring 2013. From 2013 the Swedish offshore fishery targeting salmon and sea trout is phased out.

A ban on marking and tagging fish in Poland was administratively decided in Poland early 2013 as a result of animal welfare considerations. This will impede practically all research seriously, by e.g. making it virtually impossible to distinguish between reared and wild fish. It will prevent the use of essential and irreplaceable methods in fisheries biology, otherwise providing information on vital aspects of salmon and trout life history.

5.5.5 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.

5.5.6 Assessment result

The present status of populations of sea trout is in some areas very alarming. Populations in especially SD 31 are considered to be at the risk of extinction, due to capture of post-smolts and young age classes of sea trout as bycatch in fisheries targeting other species. Also trout populations in SD 30 and 32 are in poor status due over exploitation. The situation is particularly severe in Finland. A positive tendency in parr densities is observed in Estonia (SD 32) and Sweden (SD 30), probably reflecting management changes in these countries. Also the continued increase in spawning run in river Piteälven (SD 31) is positive.

It is recommended that spatial and temporal fishing restrictions are maintained and enforced in SD 31, 30 and 32 to significantly decrease the fishing mortality of immature sea trout. It is recommended that closed areas around river mouths and fishing in rivers are restricted where this is not already enforced.

The poor and declining status in Russian populations, where trout are completely protected, is believed to be mainly due to illegal fishing in rivers (poaching). It is recommended that inspection is enforced.

Trout populations in the Main Basin area have in general a better status compared to the northern and eastern areas. In SD 25 a negative trend was observed for streams included in the assessment; however densities are still reasonable. The continued decline in densities in R. Mörrumsån is worrying. Temporal and catch restrictions in the sports fishery should be considered.

In the Main Basin area trout populations are reported to be limited from both poor habitat conditions and migration obstacles. Even if it is not evident from *average* densities of parr, that seem to be close to optimal, 299 trout populations were estimated to be below 50% of potential smolt production capacity in the Baltic (Helcom, 2011); 100 in Sweden, 50 in Estonia, 50 in Denmark and close to 50 in Russia.

5.6 Future development of model and data improvement

In 2013 it is planned that a further development of the trout assessment model will be initiated. With Sweden as a leading country it is planned to continue developing a trout model by use of Swedish electrofishing data and further proceed to also include data from other countries. The existing assessment model is based on comparing observed to expected 0+ densities, taking into account habitat quality. The plan is to develop a model adapted to maximum densities.

5.7 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.

Table 5.1.1. Nominal catches (in tonnes round fresh weight) of sea trout in the Baltic Sea by country in 1979–2012 in Subdivisions 22–32.

Year	Country								Total
	Denmark[1,4]	Estonia	Finland[2]	Germany[4]	Latvia	Lithuania	Poland [9]	Sweden	Total
1979	3	na	89	na	na	na	105[3]	3	200
1980	3	na	173	na	na	na	74[3]	3	253
1981	6	2	310	na	5	na	66[3]	3	392
1982	17	4	326	1	13	na	111	3	475
1983	19	3	332	na	14	na	133	3	504
1984	29	2	387	na	9	na	185	3	617
1985	40	3	368	na	9	na	166	13	599
1986	18	2	349	na	8	na	140	49	566
1987	31	na	373	na	2	na	200	47	653
1988	28	3	582	na	8	na	170	112	903
1989	39	3	666	18	10	na	184	169	1,089
1990	48[3]	4	841	21	7	na	488	154	1,563
1991	48[3]	3	829	7	6	na	309	171	1,373
1992	27[3]	9	837	na	6	na	281	249	1,409
1993	59[3]	15	1250[7]	14	17	na	272	138	1,865
1994	33[8,3]	8	1,150	15[8]	18	na	222	161	1,607
1995	69[8,3]	6	502	13	13	3	262	125	993
1996	71[8,3]	16	333	6	10	2	240	166	844
1997	53[8,3]	10	297	+	7	2	280	156	805
1998	60[8,3]	8	460	4	7	na	468	145	1,158
1999	110	10	440	9	10	1	626	115	1,321
2000	58	14	445		14	1	812	99	1,442
2001	54	10	363	10	12	2	716	85	1,252
2002	35	16	196	12	13	2	863	76	1,215
2003	40	9	183	9	6	na	823	65	1,136
2004	46	10	145	12	7	1	764	61	1,045
2005	14	11	159	14	9	2	586	61	855
2006	44	20	260	12	7	1	530	60	934
2007	26	17	265	9	8	1	525	55	906
2008	18	14	252	13	8	2	172	65	545
2009	12	18	252	4	11	2	389	70	757
2010	8	16	119	3	6	2	454	65	672
´2011	6	18	115	3	6	3	244	62	456
´2012[5]	11	21	125	18	5	4	137	67	387

[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
[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
\+ Catch less than 1 tonne.

Table 5.1.1.1. Overview of sea trout samples collected for biological sampling in 2012.

	Time period			Number of sampled fish by subdivision					
Country	/ month number	Fisheries	Gear	22–28	29	30	31	32	Total
Denmark[1]									
Estonia	1–12	Coastal	Gillnet					250	250
Finland	4–9	Coastal, River	All gears			x	x	x	>200
Latvia	1–12	Coast	Gillnet						
Lithuania[1]									
Poland	1–12	Offshore,Coastal	Longline, Gillnet	634					634
Russia	9–11	River	Trapnet						
Sweden	5–6	Coast	Trapnet				47		47
Sweden	6–7	River	Trap	235			4		239
Germany[1]									
Total									>1370

[1)] no sampling.

Table 5.1.2. Nominal catches (in tonnes round fresh weight) of sea trout in the Baltic Sea (1979–2012). 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		Lith.		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	3.0	na		10.0		na	na		na		na	81[3]	24.0	na	na	3.0	121.0		6.0	na	na	na	na	6.0	na		73.0	0.0	73.0	200.0
1980	3.0	na		11.0		na	na		na		na	48[3]	26.0	na	na	3.0	91.0		87.0	na	na	na	na	87.0	na		75.0	0.0	75.0	253.0
1981	6.0	na		51.0		na	5.0		na		na	45[3]	21.0	na	na	3.0	131.0		131.0	na	na	na	na	131.0	2.0		128.0	0.0	130.0	392.0
1982	17.0	na		52.0		1.0	13.0		na		na	80.0	31.0	na	na	3.0	197.0		134.0	na	na	na	na	134.0	4.0		140.0	0.0	144.0	475.0
1983	19.0	na		50.0		na	14.0		na		na	108.0	25.0	na	na	3.0	219.0		134.0	na	na	na	na	134.0	3.0		148.0	0.0	151.0	504.0
1984	29.0	na		66.0		na	9.0		na		na	155.0	30.0	na	na	5.0	294.0		110.0	na	na	na	na	110.0	2.0		211.0	0.0	213.0	617.0
1985	40.0	na		62.0		na	9.0		na		na	140.0	26.0	na	na	13.0	290.0		103.0	na	na	na	na	103.0	3.0		203.0	0.0	206.0	599.0
1986	18.0	na		53.0		na	8.0		na		na	91.0	49.0	7.0	9.0	8.0	243.0		118.0	na	1.0	24.0	na	143.0	2.0		178.0	0.0	180.0	566.0
1987	31.0	na		66.0		na	2.0		na		na	163.0	37.0	6.0	9.0	5.0	319.0		123.0	na	1.0	26.0	na	150.0	na		184.0	0.0	184.0	653.0
1988	28.0	na		99.0		na	8.0		na		na	137.0	33.0	7.0	12.0	7.0	331.0		196.0	na	na	44.0	42.0	282.0	3.0		287.0	0.0	290.0	903.0
1989	39.0	na		156.0		18.0	10.0		na		na	149.0	35.0	30.0	17.0	6.0	460.0		215.0	na	1.0	78.0	37.0	331.0	3.0		295.0	0.0	298.0	1,089.0
1990	48[3]	na		189.0		21.0	7.0		na		na	388.0	100.0	15.0	15.0	10.0	793.0		318.0	na	na	71.0	43.0	432.0	4.0		334.0	0.0	338.0	1,563.0
1991	48[3]	1.0		185.0		7.0	6.0		na		na	272.0	37.0	26.0	24.0	7.0	613.0		349.0	na	na	60.0	54.0	463.0	2.0		295.0	0.0	297.0	1,373.0
1992	27[3]	1.0		173.0		na	6.0		na		na	221.0	60.0	103.0	26.0	1.0	618.0		350.0	na	na	71.0	48.0	469.0	8.0		314.0	0.0	322.0	1,409.0
1993	59[3]	1.0		386.0		14.0	17.0		na		na	202.0	70.0	125.0	21.0	2.0	897.0		160.0	na	na	47.0	43.0	250.0	14.0		704[7]	0.0	718.0	1,865.0
1994	33[8,3]	2.0		384.0		15[8]	18.0		+		na	152.0	70.0	76.0	16.0	3.0	769.0		124.0	na	na	24.0	42.0	190.0	6.0		642.0	0.0	648.0	1,607.0
1995	69[8,3]	1.0		226.0		13.0	13.0		3.0		na	187.0	75.0	44.0	5.0	11.0	647.0		162.0	na	na	33.0	32.0	227.0	5.0		114.0	0.0	119.0	993.0
1996	71[8,3]	2.0		76.0		6.0	10.0		2.0		na	150.0	90.0	93.0	2.0	9.0	511.0		151.0	25.0	na	20.0	42.0	238.0	14.0		78.0	3.0	95.0	844.0
1997	53[8,3]	2.0		44.0		+	7.0		2.0		na	200.0	80.0	72.0	7.0	7.0	474.0		156.0	12.0	na	16.0	54.0	238.0	8.0		82.0	3.0	93.0	805.0
1998	60.0	8.0		103.0		4.0	7.0		na		208.0	184.0	76.0	88.0	3.0	6.0	747.0		192.0	12.0	0.0	9.0	39.0	252.0	6.0		150.0	3.0	159.0	1,158.0
1999	110[8,3]	2.0		84.2		9.0	10.0		1.0		384.0	126.0	116.0	51.0	2.0	3.0	898.0		248.3	12.0	0.0	18.0	41.0	319.3	8.0		93.0	3.0	104.0	1,321.3
2000	58.0	4.0		64.0		9.0	14.0		1.0		443.0	299.0	70.0	42.0	4.0	3.0	1,011.0		197.0	12.0	0.0	14.0	36.0	259.0	10.0		56.0	3.0	69.0	1,339.0
2001	54.4	2.0	5.0	57.1		10.0	12.0		1.0		485.8	219.3	10.8	23.2	1.1	2.7	884.5	1.7	221.0	7.0	0.0	14.2	44.0	287.9	8.0		67.9	3.0	78.9	1,251.2
2002	34.8	4.7	2.3	74.8	0.2	12.3	13.4		2.4		539.1	271.6	52.7	10.8	1.0	2.8	1,022.9	0.3	78.0	6.5	0.0	23.3	38.4	146.5	11.3		31.4	2.6	45.4	1,214.8
2003	40.3	2.3	1.3	71.3	0.2	8.7	6.4		+		582.7	168.9	71.8	3.4	1.1	0.0	958.4	0.2	70.2	11.1	0.0	19.2	31.7	132.4	6.7		27.3	1.6	35.6	1,126.4
2004	46.0	3.1	0.8	35.3	0.5	11.7	7.0		1.0		606.0	121.7	36.0	9.1	2.0	2.6	882.7	0.8	61.9	10.6	0.0	18.4	28.5	120.1	7.1	0.0	33.3	2.1	42.5	1,045.3
2005	13.6	3.7	0.6	37.0	0.5	15.1	7.4	1.4	1.1	0.4	480.0	85.7	20.1	4.7	2.1	1.5	675.0	0.3	69.4	10.6	0.0	21.6	31.0	132.9	6.3	0.0	37.4	2.7	46.4	854.4
2006	44.1	10.0	1.0	38.0	0.1	11.8	7.1		1.0	0.0	418.8	93.8	17.3	6.1	1.7	1.3	652.1	0.8	139.5	5.3	0.0	18.7	32.5	196.7	10.0	0.0	72.3	3.3	85.6	934.3
2007	25.5	3.9	2.1	36.3	0.3	9.0	7.5		0.9	0.3	356.9	129.7	38.5	5.8	2.1	1.3	620.1	0.4	143.8	8.2	0.0	13.9	31.7	197.9	13.2	0.0	71.3	3.1	87.6	905.6
2008	18.3	4.0	0.9	34.5	0.2	13.1	7.5	0.4	0.4	1.9	35.3	88.8	48.1	3.9	1.9	2.6	261.6	0.3	113.3	8.9	0.0	16.9	40.2	179.6	10.0	0.0	91.8	2.3	104.1	545.3
2009	12.4	7.0	0.6	32.0	0.4	3.8	10.4	0.2	0.0	1.9	271.1	91.5	26.4	3.3	1.4	2.3	464.7	0.1	111.6	10.6	0.0	15.4	47.1	184.9	11.0	0.0	91.2	5.5	107.7	757.2
2010	8.0	4.8	0.1	17.0	0.4	2.8	5.4	0.5	1.7	0.3	352.9	70.8	30.0	2.4	1.1	3.3	501.4	0.0	80.9	7.3	0.0	18.5	40.1	146.8	11.2	0.0	12.3	1.2	24.7	672.9
2011	6.0	5.2	0.1	15.1	0.4	3.1		6.2	2.3	0.3	151.3	53.5	39.4	1.4	1.0	2.2	287.5	0.0	77.3	7.5	0.0	16.5	40.6	141.9	12.4		12.0	2.2	26.5	455.8
2012[5]	10.6	8.1	0.0	14.1	0.3	17.7	4.4	0.5	3.3	0.3	52.8	57.7	26.1	0.3	3.2	2.2	201.8	0.0	80.2	10.6	0.0	20.9	40.5	152.1	13.3	0.0	15.9	3.8	33.0	386.9

[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 5.2.2.1. Adipose finclipped and tagged sea trout released in the Baltic Sea area in 2012.

Country	Sub-division	River	Age	Number parr	Number smolt	Other tagging
Estonia	32	Pudisoo	2		12,400	798 Carlin
	29	Coastal releases (Hiiumaa island)	2			1000 Carlin
Latvia	28	Daugava	2			1000 T-Anch
Finland	32	Vantaanjoki	1	3752		
	32	Porvoonjoki	2		3643	
	32	at sea	2		71656	
	32	Ingarskilajoki			8221	
	31	Lestijoki	1	5624		
	31	Lestijoki	2		1324	1000 Carlin
	31	Perhonjoki	2		1410	1000 Carlin
	31	Kiiminkijoki	1	22519		
	31	Kiiminkijoki	2		11446	
	31	Oulujoki	2			1000 Carlin, 1000 T-Anch
	31	Iijoki	2			1000 Carlin
	31	Kemijoki	2			2000 Carlin
	31	Tornionjoki	eyed egg			94300 Ars
	31	Tornionjoki	alevin			80000 Ars
	31	Tornionjoki	1	124040		
	31	Tornionjoki	1	47418		
	31	Tornionjoki	2		8932	
	31	Tornionjoki	3		2710	
	31	Tornionjoki	4		1306	
	30	Lapväärtinjoki	2		679	1000 Carlin
	30	Karvianjoki	2		740	1000 Carlin
Sweden	31	Luleälven	1		31936	
	31	Luleälven	2		94655	Carlin 2000
	31	Skellefteälven	1		20120	
	31	Skellefteälven	2		7934	Carlin 1000
	31	Umeälven	1		8037	
	31	Umeälven	2		4209	Carlin1000
	30	Gideälven	2		7000	Carlin 1000
	30	Ångermanälven	2		54032	Carlin 1000
	30	Indalsälven	1	79149		
	30	Indalsälven	1		101459	Carlin 1000
	30	Indalsälven	2		80073	Carlin 1000
	30	Ljungan	2		37200	Carlin 2000
	30	Harmångersån	2		3500	
	30	Norralaån	2		3000	
	30	Ljusnan	1	28118		
	30	Ljusnan	1		16221	
	30	Ljusnan	2		37712	Carlin 2000
	30	Gavleån	2		2499	
	30	Dalälven	1	43661		
	30	Dalälven	1		18790	
	30	Dalälven	2		63398	Carlin 2500
	27	Nyköpingsån	2		7000	
	27	Motala ström	2		18000	
	27	Coastal releases	2			Carlin 400
	25	Mörrumsån	2		14500	
Denmark	22	Island of Funen	1			3600 PIT
Poland	26	Vistula	2			7000 Carlin
	25	Łeba	1		35,894	
	25	Łeba	2		4,000	
	25	Słupia	1		13,200	
	25	Słupia	2		147,818	2000 Carlin
	25	Łupawa	2		17,576	994 Carlin
	25	Wieprza	2			2000 Carlin
	25	Parseta	1		29,101	
	25	Rega	2		41,314	1000 Carlin
Lithuania	26	Šašuola and Plaštaka	1			200 PIT
Total sea trout				**354,281**	**1,044,645**	

Table 5.2.3.1. Number of Carlin-tagged sea trout released into the Baltic Sea in 2012.

Country	22	24	25	26	27	28	29	30	31	32	Total
Estonia							1,000			798	1,798
Finland								2,000	6,000		8,000
Sweden					400			8,000	4,000		12,400
Poland			5,994	7,000							12,994
Total	0	0	5,994	7,000	400	0	1,000	10,000	10,000	798	35,192

Table 5.3.1.1. Status of wild and mixed sea trout populations in 2012.

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	3		1						4	0
		11-100*			1						1	0
		> 100									0	0
		Uncertain									0	0
	Total		3	0	2	0	0	0	0	0	5	0
	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			3	0	2	0	0	0	25	26	30	26
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 Basi	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		9		8		1		28	0
		1-10	2		2		3				7	0
		11-100									0	0
		> 100									0	0
		Uncertain									0	0
	Total		12	0	11	0	11	0	1	0	35	0
	Latvia	< 1									0	0
		1-10							2	11	2	11
		11-100			1					1	1	1
		> 100									0	0
		Uncertain								7	0	7
	Total		0	0	1	0	0	0	2	19	3	19
	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	35	25	127	19	206	27	382	83
Grand total			39	19	55	30	142	23	261	53	497	125

* 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 2012.

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	0	1	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	0	0	0	0	0	0
	Total		0	1	0	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
	Lithuania	< 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		
		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
	Denmark	< 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			12	112	122	8	3	0
Grand total			64	162	139	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 2002–2012.

SD	24	25	28	26	26	31	31	32	32
Country	DK	SE	LV	LT	LT	SE	FIN	RU	EE
River name	Læså	Mörrum	Salaca	R. Mera	R. Siesartis	Säverån	Torne	Luga	Pirita
2002			13100	12				8200	
2003			11000	11				2500	
2004			2500	11			12510	2500	
2005			7700	0	5			5000	
2006	4543		10400	3	8		12640	2800	349
2007	2481		15200	32	104			5000	100
2008	16138		15800	170	95		10810	2500	884
2009	1687	6734	16900	11	163	1848		6900	2138
2010	2920	4219	19400	3	73	1232		3300	2301
2011	8409	4543	4900			816	19420	3100	832
2012	8702	4996	11400	606	576	231		2000	1600

Table 5.3.2.1. Status of wild and mixed sea trout populations in large river systems. Partial update in 2012.

Country	River (Area)	Potential smolt production	Smolt production (% of potential production)									
			<5 %		5-50 %		> 50 %		Uncertain		Total	
			wild	mixed	wild	mixed	wild	mixed	wild	mixed	wild	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				4					0	4
	Basin)	11-100		1							0	1
		> 100									0	0
		Uncertain									0	0
Total			0	1	0	4	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	3	0	1	0	0	0	1	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.

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	0	0
		Uncertain	0	0	0	0	0	0
Total			0	2	5	1	1	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 1988–2012.

			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
Main Basin 22-29	DE	1yr																					14	14	14	13	
		2yr																									15
	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
		2yr															30	30	30	30	21	9	9	2	2	2	2
	EE	1yr	50	5		5																	3				
		2yr			5	6	10	10	16	28	30	32	30	32	30	32	30	23	25	2	21	20	17	21	26	21	
	FI	1yr			11				1	0		4		26		28	1		15		35	52	45	52	18	115	
		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
		3yr		35	16	0		26	1	8	0	13	17	25	35	34	24	9	16	16	15		8	14	4		
	LT	1yr						5	5	4	4	10											23	58	45		8
		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
		2yr	1	4	6	7	5	2					11	29		2	10	67		116	177	112	132	65			
	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
		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
	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
		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
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	1950
Gulf of Bothnia 30-31	FI	1yr			9							7		1		5						33					
		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
		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
	SE	1yr			19	7				6			1										40	61	55	110	197
		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
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
Gulf of Finland 32	EE	2yr																14	6	8	9	12	10	6	6	15	13
	FI	1yr		5		22			4	5	15	12	13	5		38		4				11					
		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
		3yr					24	6		1	33	92	40	7	24	18	6	16									
	RU	1yr																4	3		13	95	25	10	3	7	64
		2yr																1		0							
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
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	3312

Table 5.4.2. Release of sea trout eggs, alevins, fry and parr into Baltic rivers in 2012. 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	2013	2014	2015	Total
Sub-divs. 22-29	(1)	(1)	(4)	(6)	(9)	(10)	(10)				
Denmark		0	164,000	72,000	0	0		0	9240	0	9240
Estonia		0	0	0	0	0		0	0	0	0
Finland		0	0	52,000	0	66,000		9900	3120	0	13020
Germany		0	1,090,000	0	0	0		0	32700	0	32700
Latvia		0	0	20,000	55,000	0		6600	1200	0	7800
Poland		4,133,000	2,786,000	0	1,000	0		120	124910	0	125030
Sweden		0	98,000	0	0	0		0	2940	0	2940
Lituania		0	210,000	38,000	0	0		0	8580	0	8580
Total	0	4133000	4348000	182000	56000	66000	0	16620	182690	0	199310
Sub-divs. 30-31	(2)	(3)	(5)	(7)	(8)	(8)	(10)				
Finland	94,300	118,300	0	124,000	126,500			0	15180	9686	24866
Sweden	0	0	54,100	41,200	135,700			0	16284	3554	19838
Total	94300	118300	54100	165200	262200	0	0	0	31464	13240	44704
Sub-div. 32	(1)	(1)	(4)	(6)	(9)	(10)	(10)				0
Estonia	0	0	41,500	26,900	38,200	0		4584	2859	0	7443
Finland	100,700	1,300	0	0	5,100	0		612	1020	0	1632
Russia				50				0	3	0	3
Total	100700	1300	41500	26950	43300	0	0	5196	3882	0	9078
Grand total Sub-divs. 24-32	195000	4252600	4443600	374150	361500	66000	0	21816	218036	13240	253092

Table 5.4.3. Estimated number of sea trout smolts originating from eggs, alevins, fry and parr releases in 2000–2012.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Sub-divs. 22-29																
Denmark	30858	25555	45759	7912	17790	17508	13695	13695	13704	12540	12540	10737	9177	9606	9240	0
Estonia	0	0	2100	1200	400	1110	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	3120	0
Germany														0	32700	0
Latvia	13815	8644	11007	960	5340	15227	6462	3189	19015	6840	17664	30595	5987	15300	1200	0
Poland	167496	148500	84240	68400	91000	63236	77690	61459	107686	84901	108422	114982	95939	103756	124910	0
Sweden	13129	39333	42690	5320	29335	2055	27700	4425	1623	2210	898	0	2385	1737	2940	0
Lituania	0	0	0	0	1670	2400	4350	7440	18180	12990	8040	6750	5370	10935	8580	0
Total	225738	244702	219761	103342	164270	101696	129897	90208	160207	130926	161379	173414	126958	155709	182690	0
Sub-divs. 30-31																
Finland	54268	80662	26523	42828	36670	1890	31362	11787	22704	29892	32550	46753	39285	25881	22595	9686
Sweden	84237	78440	43614	24092	22921	36170	20207	22756	24561	16690	16497	12811	13026	5456	21906	3554
Total	138505	159102	70137	66920	59591	38060	51569	34543	47265	46582	49047	59564	52311	31337	44501	13240
Sub-div. 32																
Estonia	0	0	0	2412	2532	4407	2100	420	0	0	1536	2098	6552	9486	2859	0
Finland	20910	5500	2049	419	340	3429	345	11574	8997	4353	5919	5233	291	1747	1020	0
Russia	3882	3630	7800	200	1630	1281	6690	3924	0	312	9381	126	3441	1746	3	0
Total	24792	9130	9849	3031	4502	9117	9135	15918	8997	4665	16836	7457	10284	12979	3882	0
Grand total																
Sub-divs. 24-32	389035	367576	299747	173293	228363	148873	190601	140669	216468	182173	227261	240435	189553	200025	231073	13240

Table 5.5.1.1. Number of sites in each subdivision with a status below or above expected (100%).

ICES Subdivision	Below 100%	Above 100%	n
21	2	1	3
22	2	3	5
23	3	4	7
24	2	2	4
25	7	6	13
26	0	3	3
27	4	10	14
28	6	2	8
29	3	2	5
30	6	12	18
31	6	7	13
32	28	19	47

Table 5.7.1. Stock data problems relevant to data collection of Baltics WGBAST.

Stock name	Data problem identification	Description of data problem and recommend solution	Who should take care of the recommended solution and who should be notified on this data issue.
Baltic sea trout	Misreporting leading to overestimation of certain catches	There is a suspected substantial misreporting of salmon as sea-trout in the Polish sea fishery. Results (proportions of sea trout/salmon) from inspection campaigns coordinated by EU authorities should be made available to the working group to facilitate a more precise estimation of sea trout catches. In addition Polish national institute should provide to the working group the catch sampling data collected under the DCF on the proportions of salmon and sea trout in the sea catches.	European Fisheries Control Agency, Polish national institute under DCF, WG
Baltic sea trout	Missing catch data	Catch estimates of the recreational fisheries are defective or completely missing from part of the countries. Studies to estimate these catches should be carried out.	National institutes under DCF, RCM Baltic Sea
Baltic sea trout	Electro fishing data	Sufficient data coverage of parr densities is needed from all countries. Lack of data from typical trout streams. Continuing sampling for longer time periods is required.	National institutes under DCF, RCM Baltic Sea

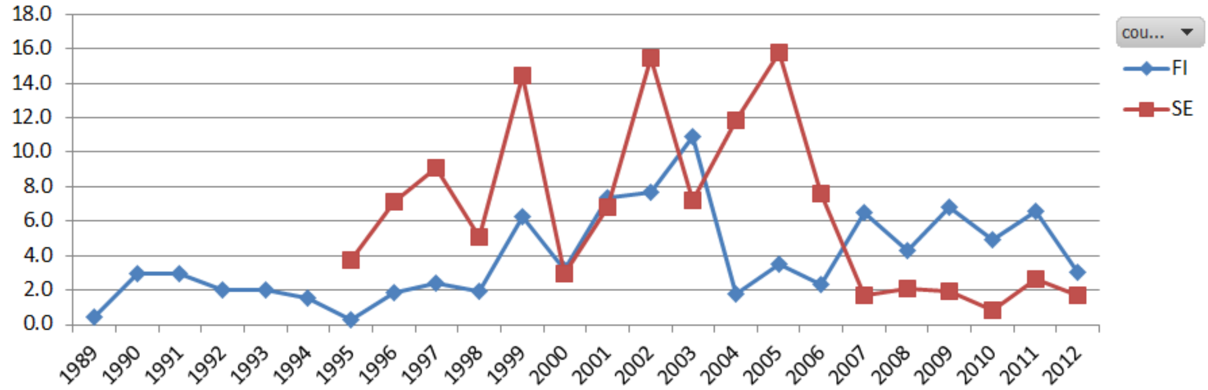


Figure 5.3.1.1. Average densities of 0+ trout in Finnish (FI) and Swedish (SE) rivers in ICES SD 30–31.

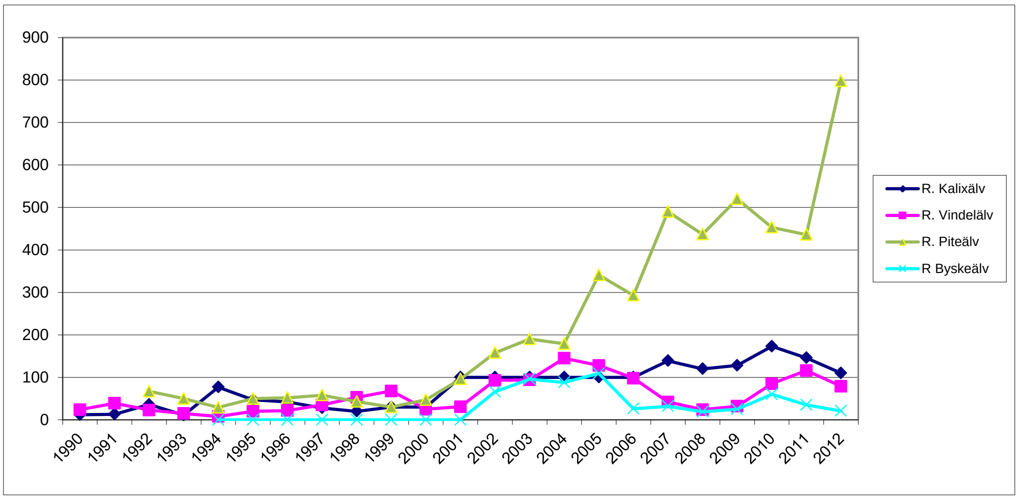


Figure 5.3.1.2. Number of ascending spawners in four rivers debouching in the Bothnian Bay.

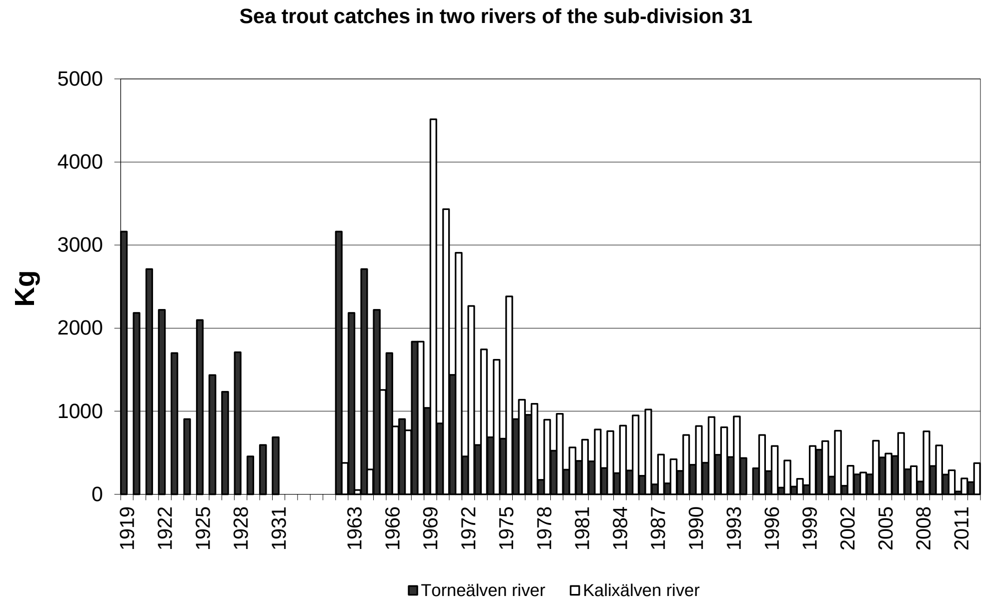


Figure 5.3.1.3. Swedish sea trout catches in two rivers of the Subdivision 31 between 1919–2012. (The Swedish Board of Fisheries, Fisheries Research Office in Lulea, unpub. data).

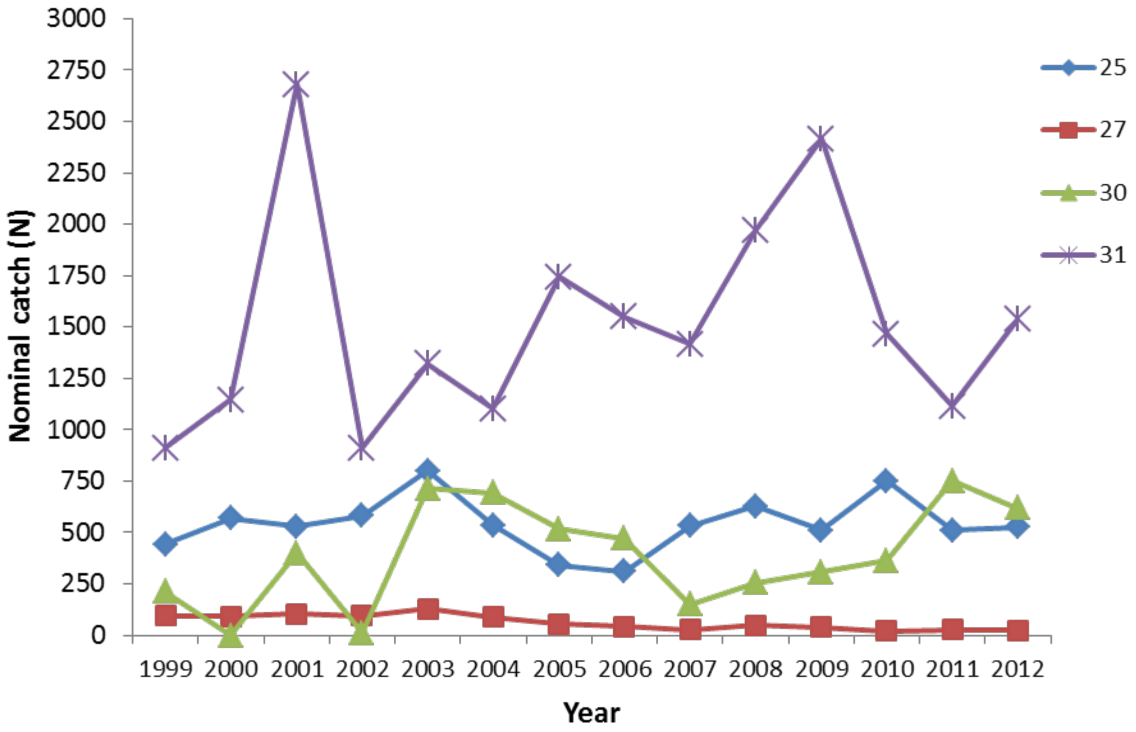


Figure 5.3.1.4. Anglers nominal catch (number) of sea trout (not including released fish) in Swedish wild rivers, ICES Subdivisions 25, 27, 30 and 31.

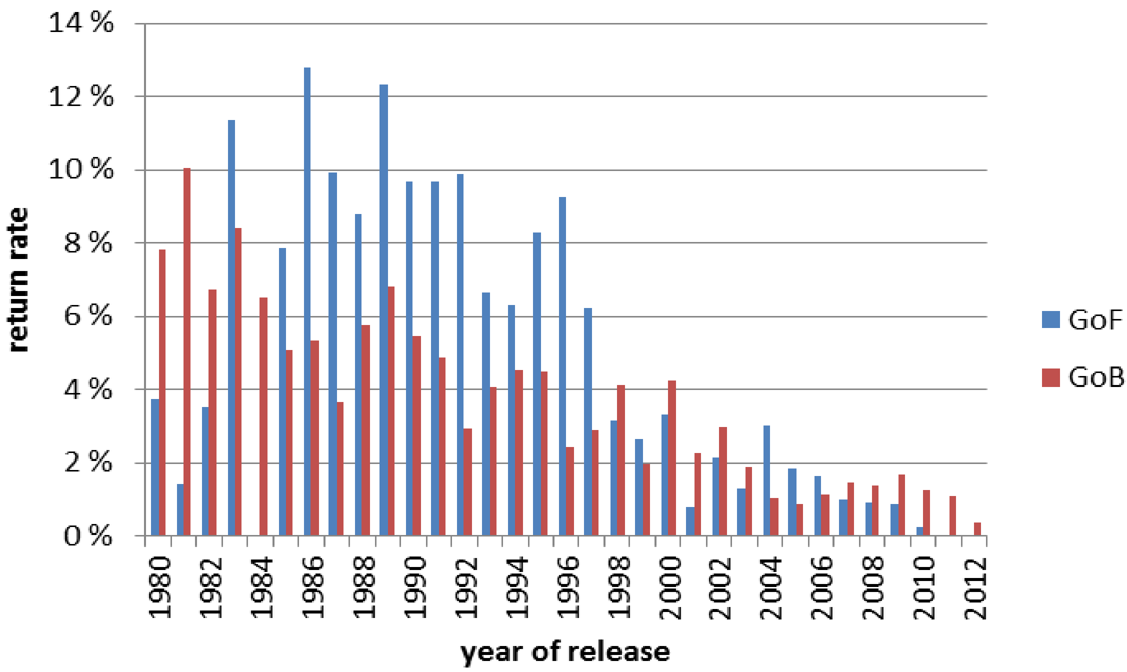


Figure 5.3.1.5. Return rates of Carling tagged sea trout released in Gulf of Bothnia and Gulf of Finland in 1980–2012.

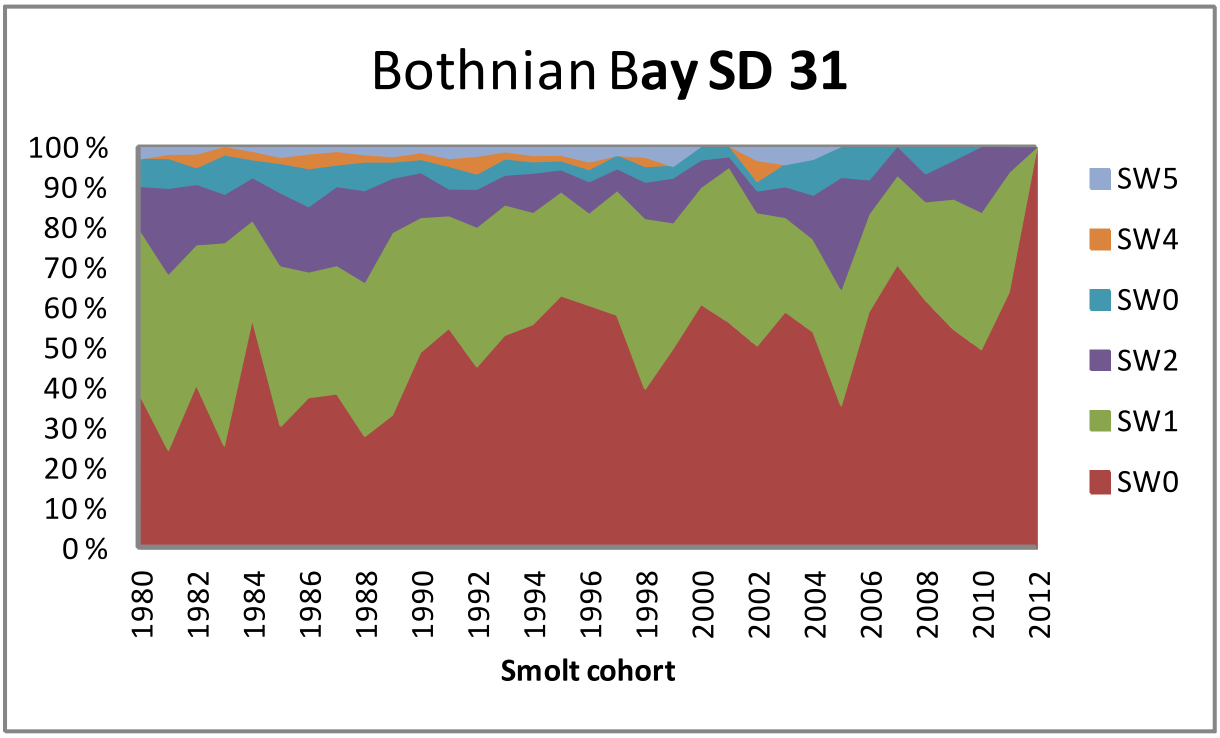


Figure 5.3.1.6. Age distribution of recaptured Carlin-tagged sea trout released in the Bothnian Bay (Subdivision 31) area in Finland in 1980–2012.

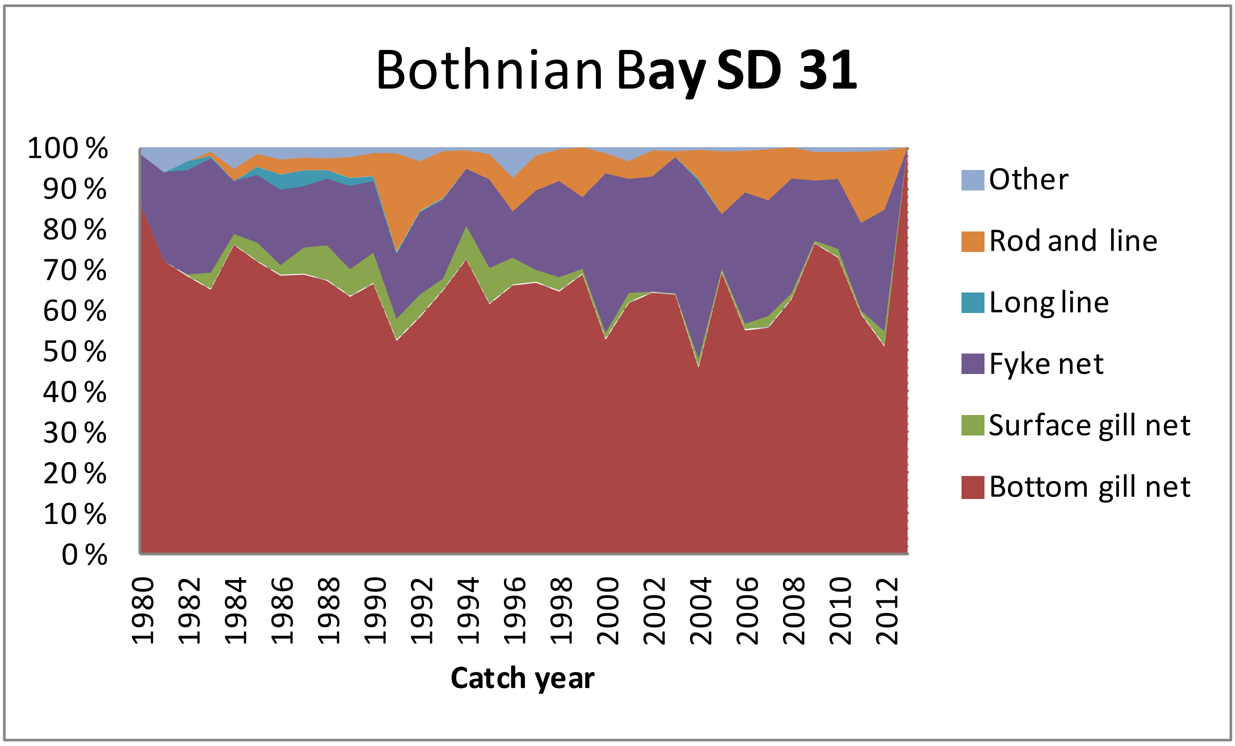


Figure 5.3.1.7. Distribution of fishing gear in recaptures of recaptured Carlin-tagged sea trout caught in the Bothnian Bay (Subdivision 31) area in Finland in 1980–2012.

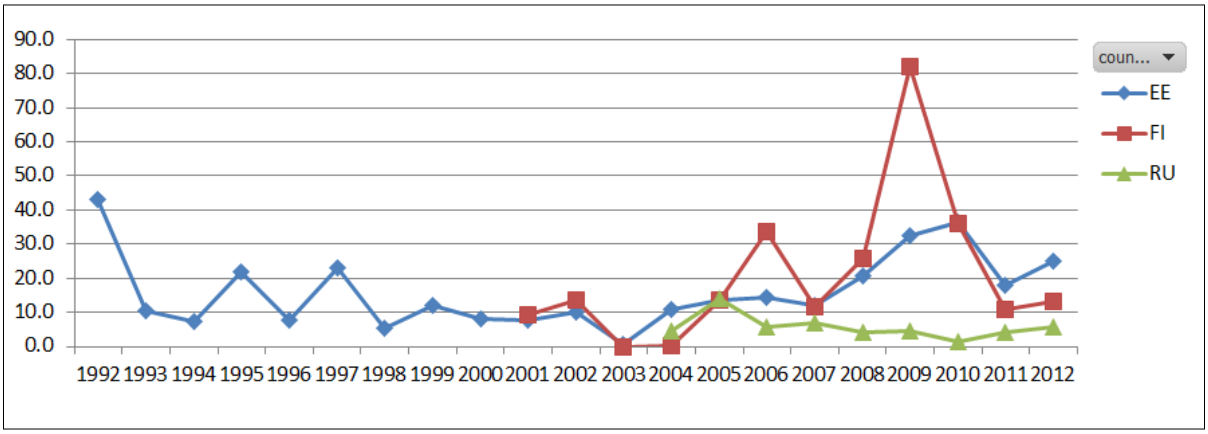


Figure 5.3.2.1. Average densities of 0+ trout in Estonian (EE) Finnish (FI) and Russian (RU) rivers in ICES SD 32.

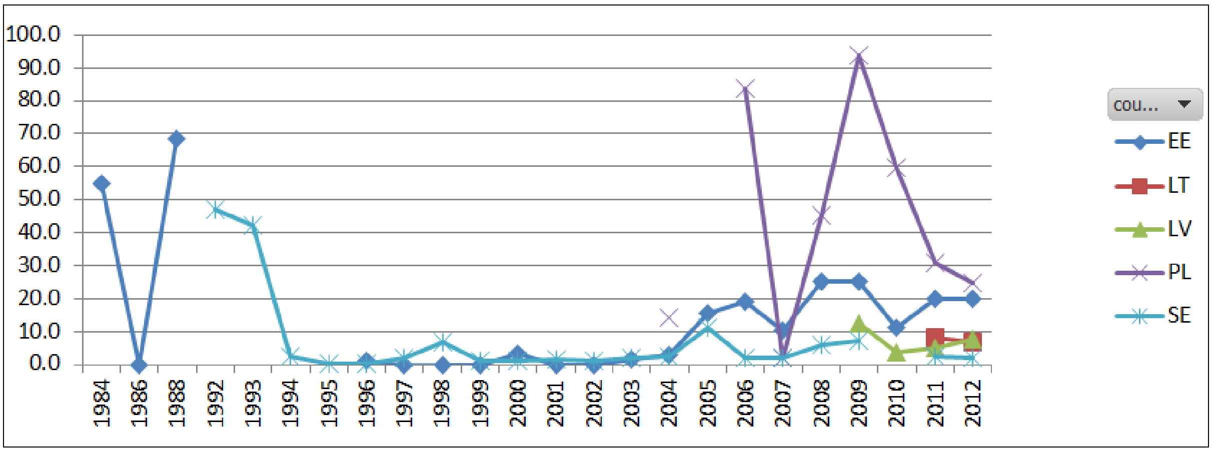


Figure 5.3.3.1. Average densities of 0+ trout in Estonian (EE), Lithuanian (LT), Latvian (LV) Polish (PL) and Swedish (SE) rivers in ICES SD 26–29.

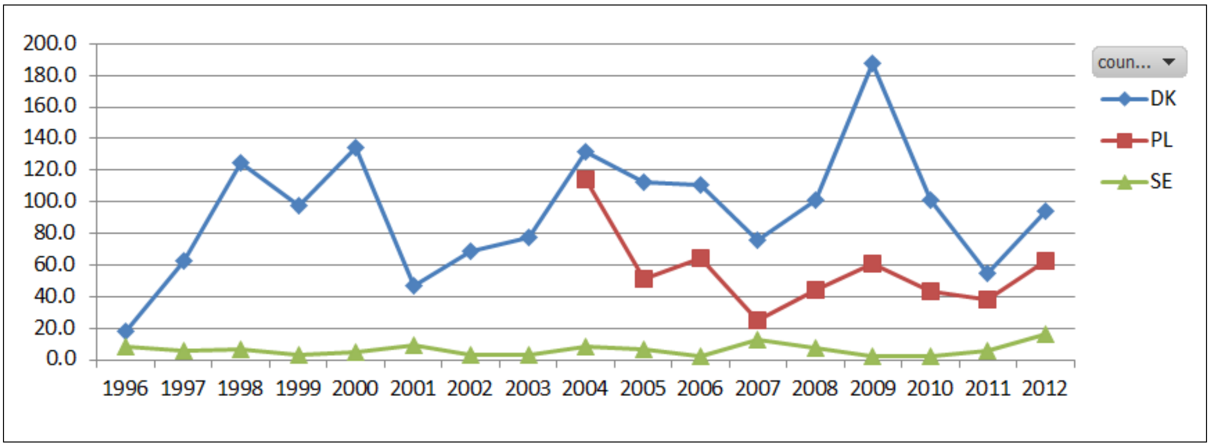


Figure 5.3.4.1. Average densities of 0+ trout in Danish (DK), Polish (PL) and Swedish (SE) rivers in ICES SD 21–25.

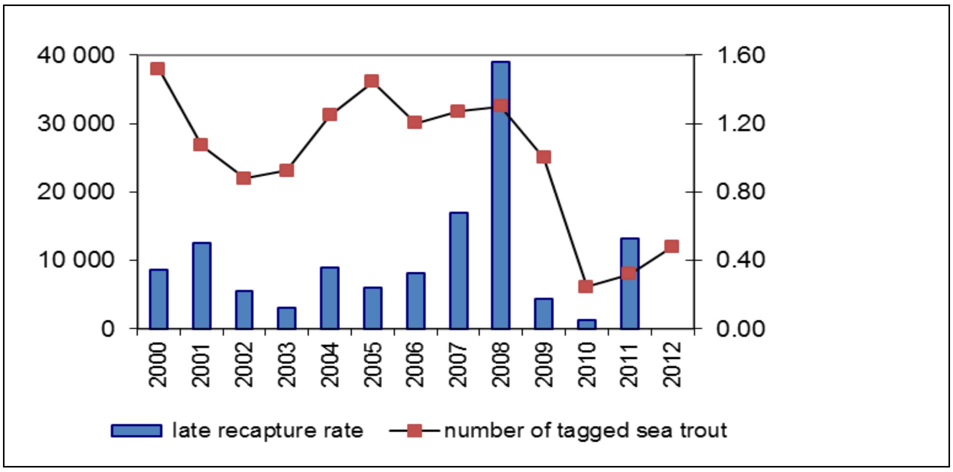


Figure 5.3.4.2. Reporting rates for sea trout in 2000–2012 in Poland. Only recaptures after the first summer are included in recapture rate.

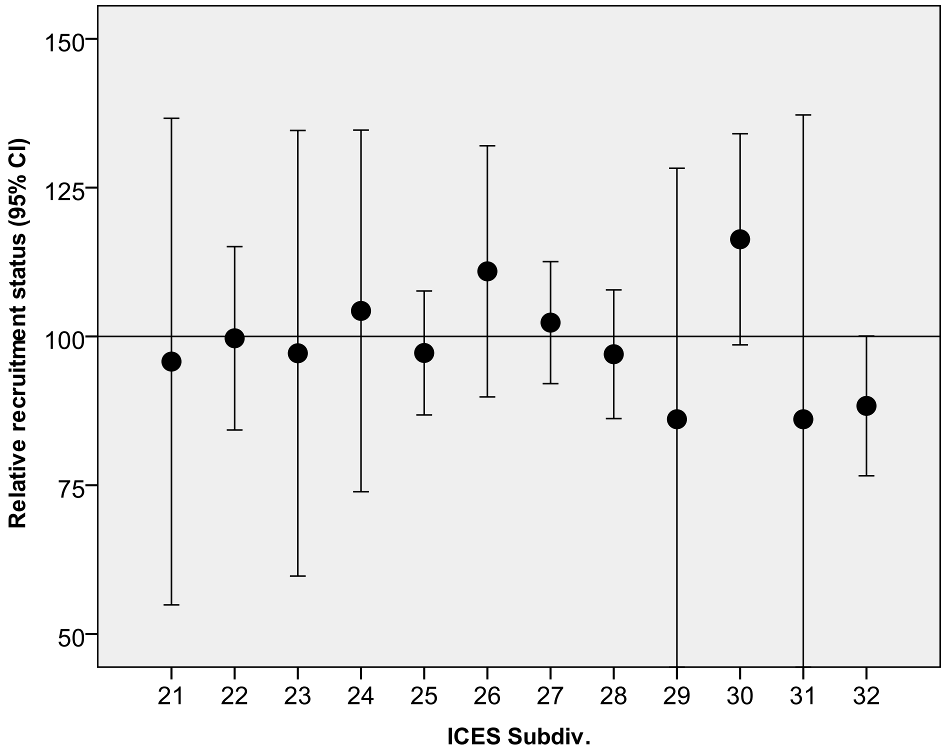


Figure 5.5.1.1. Average relative recruitment status ((observed parr abundance/predicted abundance)*100) for each ICES subdivision.

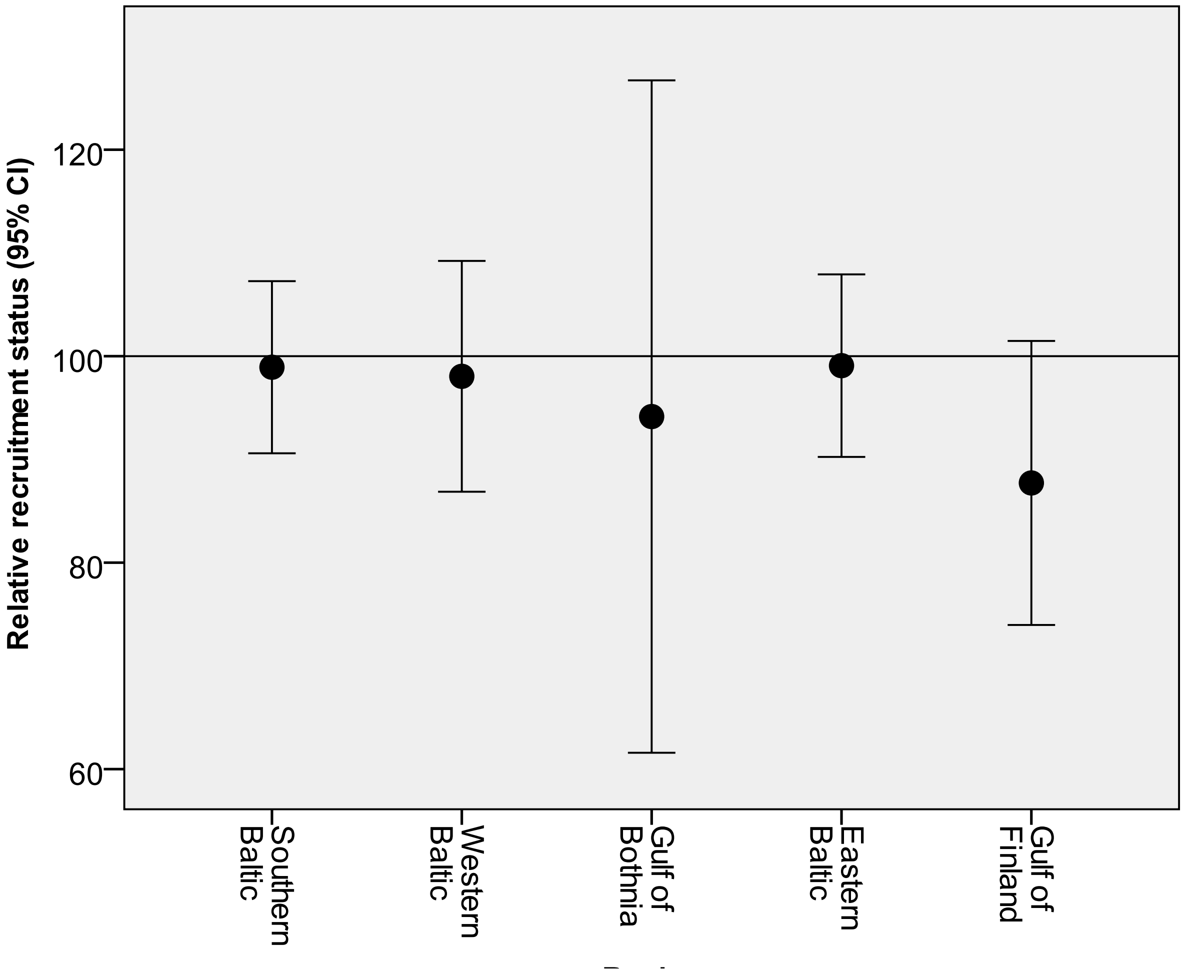


Figure 5.5.1.2. Average relative recruitment status ((observed parr abundance/predicted abundance)*100) for different parts of the Baltic Sea.

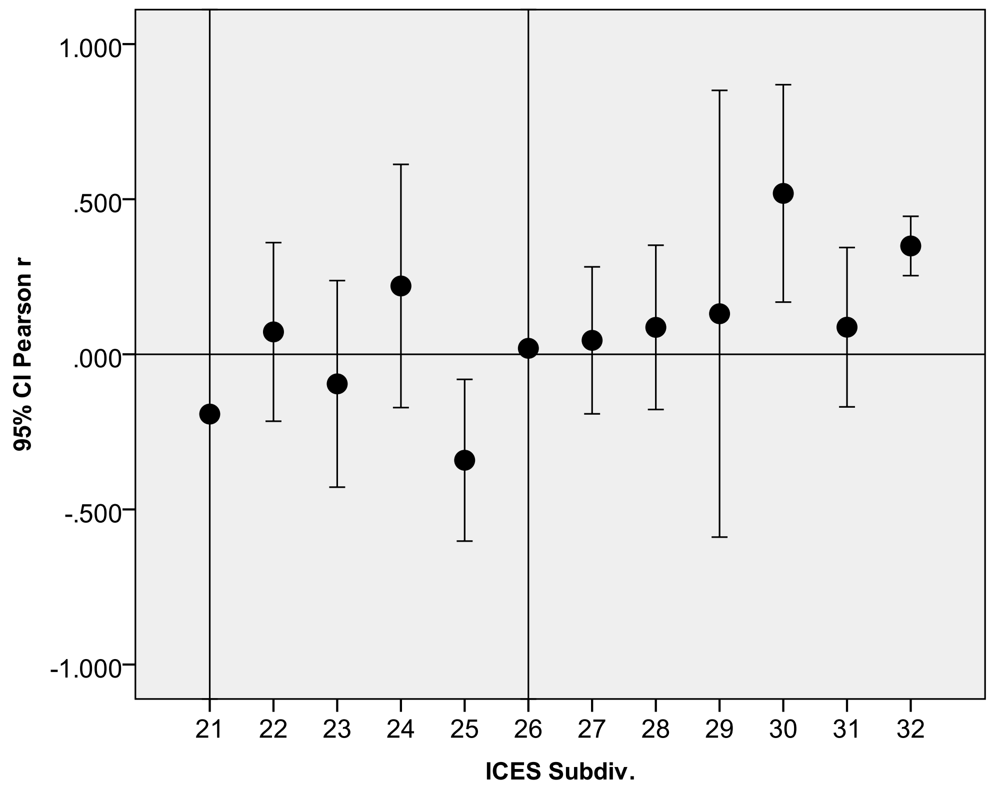


Figure 5.5.1.3. Average Pearson r (trend in parr abundance during 2000–2011) for each ICES subdivision.

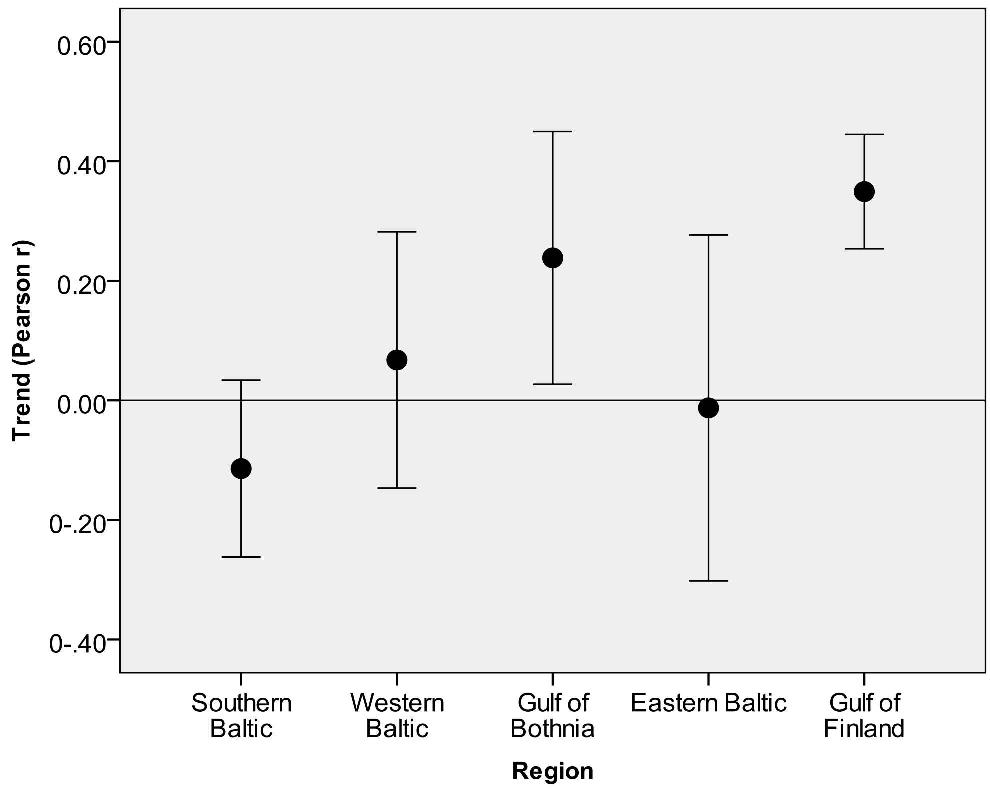


Figure 5.5.1.4. Average Pearson r (trend in parr abundance during 2000–2011) for different parts of the Baltic Sea.

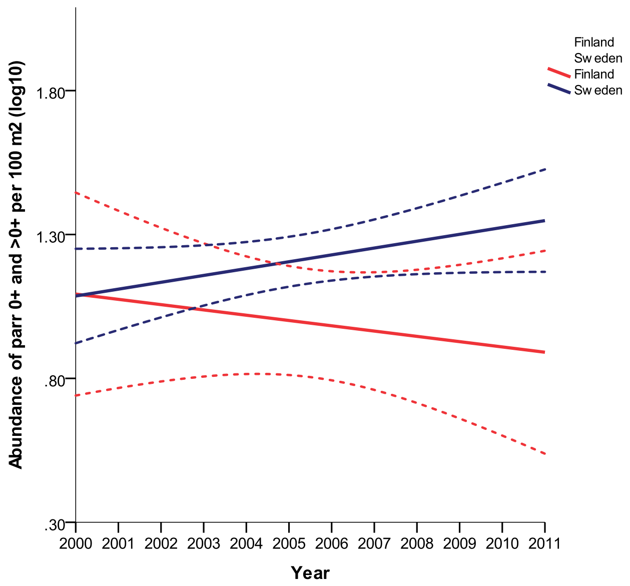


Figure 5.5.1.5. Trend in abundance (log10 per 100 m²) of parr 0+ and >0+ in Gulf of Bothnia (SD 30–31) separated into Swedish and Finnish sites (95% Cl of the mean). Figure only represent streams and sites included in the assessment (2000–2011). Regression Finland R^2 = 0.473, F=0.473 p= 0.496; SwedenR^2=0.017, F= 3.073, p=0.081.

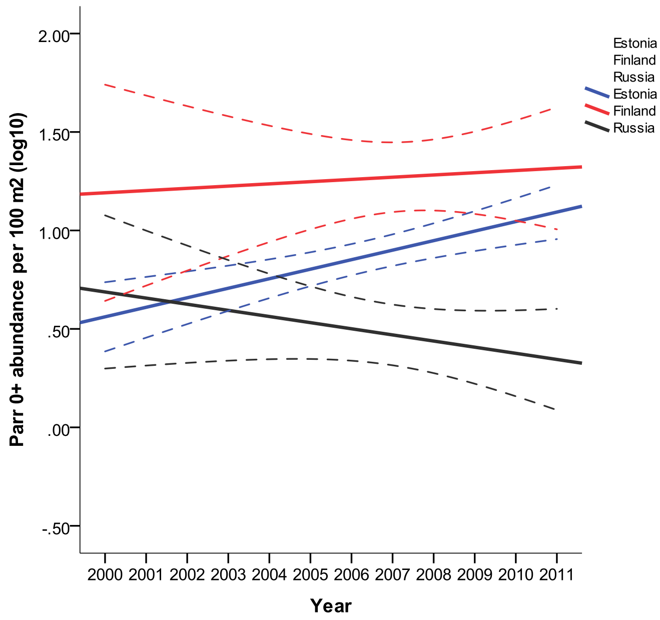


Figure 5.5.1.6. Trend in abundance (log10 per 100 m²) of parr 0+ in Gulf of Finland (SD 32) separated into Finnish, Estonian and Russian sites (95% Cl of the mean). Figure only represent streams and sites included in the assessment (2000–2011). Regression Estonia R^2=0.011, F=3.861, p=0.05; Finland R^2=0.002, F=0.104, p=0.748, Russia R^2=0.027, F=1.491, p=0.224.

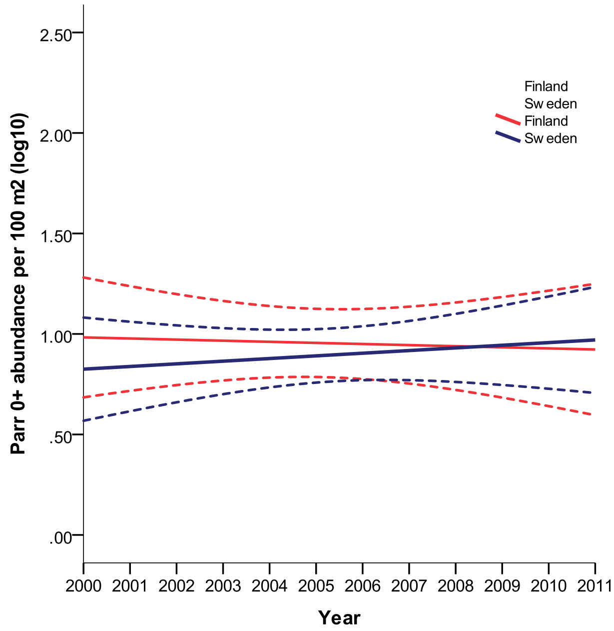


Figure 5.5.1.7. Trend in abundance (log10 per 100 m²) of parr 0+ in Gulf of Bothnia (SD 30–31) separated into Swedish and Finnish sites (95% Cl of the mean). Figure only represent streams and sites included in the assessment (2000–2011). Regression Finland R^2=0.003, F=0.058, p=0.813; Sweden R^2=0.003, F=0.410, p=0.523.

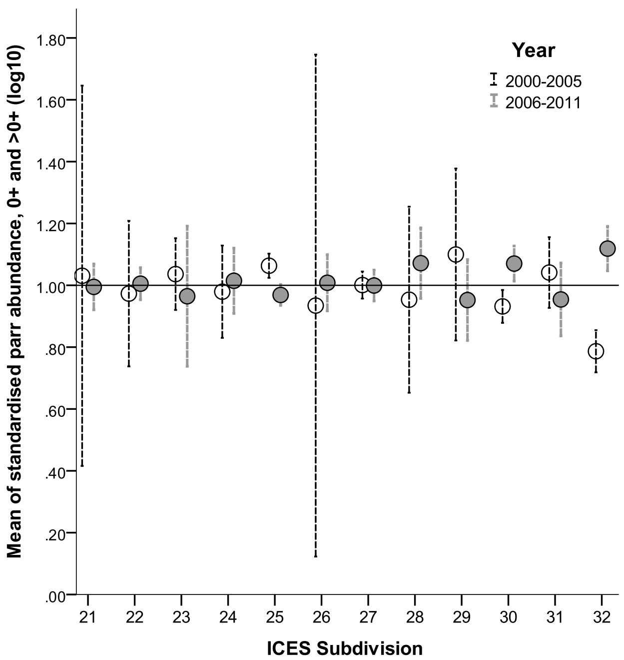


Figure 5.5.1.8. Mean (95% Cl) of standardized parr abundance (0+ and >0+) per 100 m² in 2001–2005 (white circles) and 2006–2011 (grey circles), in comparison to the eleven year average (2000–2011). Values close to one indicate no or little difference in abundance while positive or negative values respectively indicate positive or negative abundance in comparison to the eleven year average.

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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 defective or completely missing from part of the countries. Studies to estimate these catches should be carried out.	National institutes under DCF, RCM Baltic Sea
2. 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.	National institutes under DCF, RCM Baltic Sea
3. There is a suspected misreporting of salmon as sea-trout in the Polish sea fishery. Data (proportions of sea trout/salmon) from inspection campaigns coordinated by EU authorities should be made available 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 the catch sampling data collected under the DCF on the proportions of salmon and sea trout in the coastal and offshore catches separately.	European Fisheries Control Agency, European Commission, Polish national institute under DCF
4. The amount of undersized salmon in longline fisheries and in the catch of other fisheries (e.g. pelagic trawling and coastal trapnet fishing) should be evaluated. When the salmon fishing is closed in the midstream of the fishing season as a result of quota fill up and fishing for the other species continues with the same gears, amounts of salmon that are released back to sea should be evaluated.	National institutes under DCF, RCM Baltic Sea
5. Having considered the recent developments in the reform of the Common Fisheries Policy and in particular the possible obligation to land all catches in the Baltic sea, the Working Group recommends to exempt salmon and sea trout from such obligation, as a considerable proportion of salmon sea trout survive after releasing back to sea. The survival rate, however, is insufficiently known in different fisheries and furher studies on the subject are needed.	EU Commission; Baltic Sea countries
6. In order to reduce the potential of catching wild salmon in AU5-6, the Baltic Sea countries concerned should adopt additional measures and enforce them effectively.	Baltic Sea countries

Annex 3: Stock Annex for salmon in SD 22–32

Stock	Salmon in SD 22–31 (Main Basin and Gulf of Bothnia) and SD 32 (Gulf of Finland)
Working Group	WGBAST Baltic Salmon and Trout Assessment Working Group
Date	31 January 2013
Revised by	WGBAST during the IBPSalmon

A. General

A.1. Stock definition

The Baltic salmon is characterized by a marked population genetic structure. Previous studies indicate clear genetic differences both between salmon from different rivers located within restricted geographical areas and between groups of rivers on a larger geographical scale. According to the results of Säisä *et al*. (2005), there are three main groups of salmon populations in the Baltic Sea: 1) Gulf of Bothnia populations, 2) populations in southern Sweden, and 3) eastern populations (Gulf of Finland and eastern Main Basin). These groups or lineages are assumed to mirror three distinct post-glacial colonization events. About 5% of the total genetic diversity of the Baltic salmon is explained by differences between rivers within groups, whereas 6% is explained by differences between the lineages (Säisä *et al*., 2005).

Because of the pronounced population genetic structure, the Baltic salmon could not be regarded as one single assessment or management unit. Instead, the assessment is focused on restricted assessment units and rivers, and management objectives are evaluated both on an assessment unit level and on a river-by-river basis. Throughout this document, we are using the term "river stock" for salmon that belongs to a particular river. In most cases, river stocks most likely correspond to biological populations which lend support for this level of division from a conservation genetic perspective. However, it should be noted that some larger rivers may harbour several salmon subpopulations that are genetically separated spatially and/or temporally. There may also be cases where several smaller, closely situated rivers together constitute one single biological population because of significant gene flow.

A.1.1. Definition of assessment units within the Baltic Sea area

Within the Baltic Sea area, currently six different assessment units (AUs) have been established (Figure A.1.1.1). The grouping of rivers within an assessment unit is based on management objectives and biological and genetic characteristics of the river stocks contained in a unit. The partition of rivers into assessment units needs to make sense from a management perspective. River stocks of a particular unit are believed to exhibit similar migration patterns at sea. It can therefore be assumed that they are subjected to the same sea fisheries, experience the same exploitation rates and are affected by management of sea fisheries in the same way. In addition, the genetic variability between river stocks of an assessment unit is smaller than the genetic variability between river stocks of different units (see above). Although the rivers of assessment units 5 and 6 are relatively small in terms of their production capacity in comparison to rivers of the other assessment units, they are very important from a conservation perspective because of their unique genetic background.

The six assessment units in the Baltic Sea consist of:

1) Northeastern Bothnian Bay river stocks, starting at Perhonjoki up till the river Råneälven.
2) Western Bothnian Bay river stocks, starting at Lögdeälven up to Luleälven.
3) Bothnian Sea river stocks, from Dalälven up to Gideälven and from Paimionjoki up till Kyrönjoki.
4) Western Main Basin river stocks.
5) Eastern Main Basin river stocks, i.e. rivers in Estonia, Latvia and Lithuania.
6) Gulf of Finland river stocks.

Wild river stocks belonging to each assessment unit are listed in the next section.

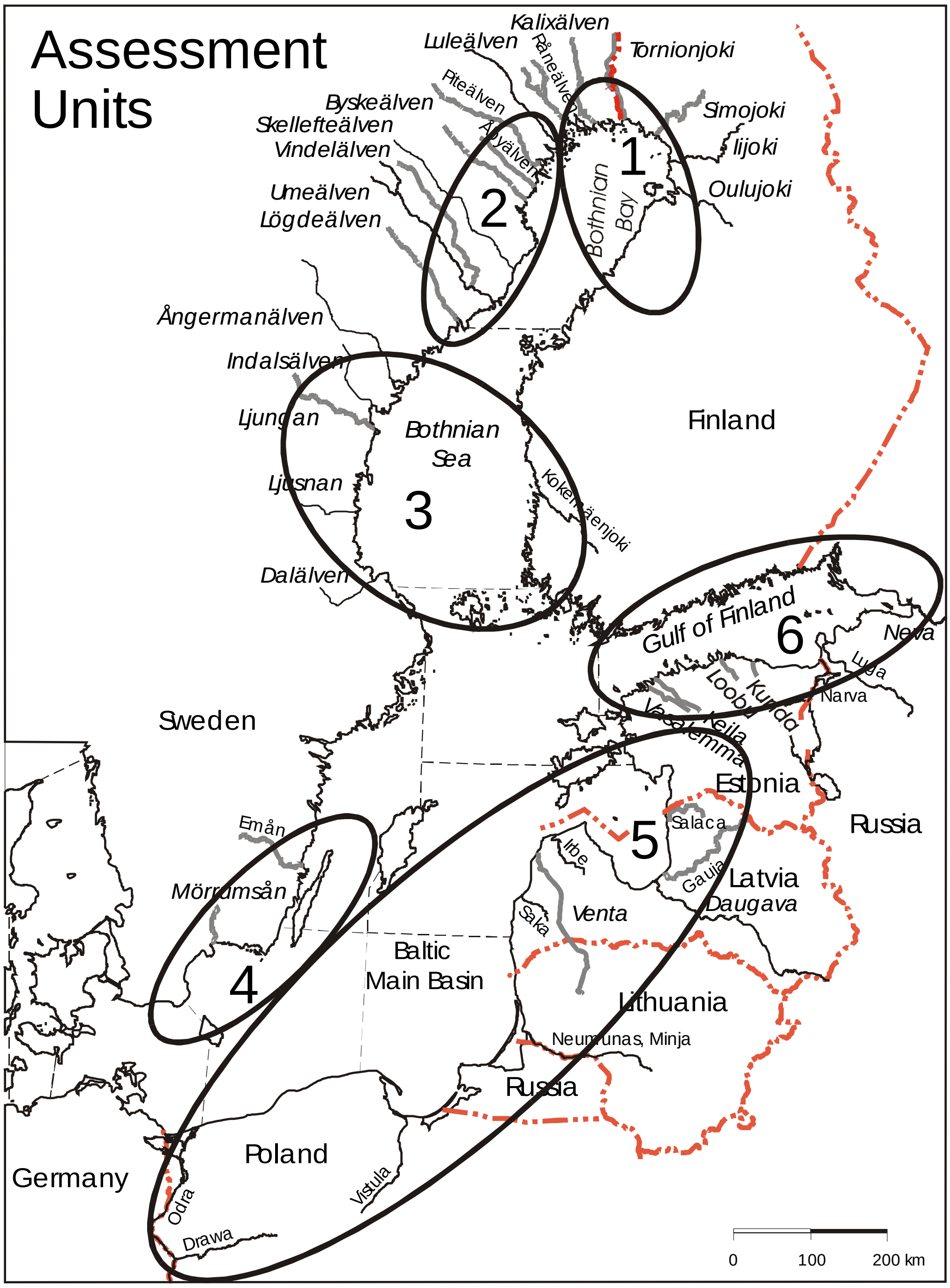

Figure A.1.1.1. Grouping of salmon river stocks in six assessment units in the Baltic Sea. The genetic variability between river stocks of an assessment unit is smaller than the genetic variability between river stocks of different units. In addition, the river stocks of a particular unit exhibit similar migration patterns. Note that not all rivers are indicated in the map.

A.1.2. Division of rivers into wild, mixed, reared and potential

The Baltic salmon rivers may be divided into four main categories: those holding either wild, mixed or reared river stocks and those owing potential to hold (but which currently do not hold) a wild or mixed river stock. This categorization scheme (see Table A.1.2.1) is used when discussing data from particular rivers, and it has been defined and discussed in earlier reports from ICES (e.g. ICES 2008b). The same scheme has also been used for determining which wild rivers should be included in the yearly assessments of stock status performed by the working group.

Briefly, wild salmon rivers (i.e. rivers holding wild river stocks) should be self-sustainable with no or very limited releases of reared fish; mixed rivers have some wild production but are subject to considerable stocking and it is often unclear if they could become self-sustainable (however, in some larger river systems regarded as mixed, individual tributaries like Zeimena in Nemunas river basin have self-sustainable wild populations); reared rivers currently have no possibility of holding self-sustaining river stocks and thus are entirely dependent on stocking; river stocks in potential rivers are currently not regarded as self-sustainable but are believed to have a fair chance of becoming so in future (Table A.1.2.1). It should be noted that during the re-establishment process, a potential river may first become a mixed river before it finally fulfils the criteria for becoming a wild river. In the total Baltic Sea (AU 1–6), there are currently 56 salmon rivers out of which 26, 12 and 18 are considered as wild, mixed and reared, respectively. In addition to these, a relatively large number of potential rivers (several with ongoing reintroduction programmes or occasional reproduction) exist.

Table A.1.2.1. Classification criteria for wild, mixed, reared and potential salmon rivers in the Baltic Sea.

Category of salmon river	Management plan for salmon stock in the river	Releases	Criteria for wild smolt production
Wild	Self-sustaining	No continuous releases	>90% of total smolt production
Mixed	Not self-sustaining at these production levels	Releases occur	10–90% of total smolt production
Reared	Not self-sustaining	Releases occur	<10% of total smolt production
Potential leading to category wild	Lead to self-sustaining river stock	Releases occur during re-establishment	Long-term >90% wild smolt production
Potential leading to category mixed	Not self-sustaining river stock	Releases occur	Long-term 10–90% of total smolt production

Wild and mixed salmon rivers in the Baltic Sea

Current wild salmon rivers in the Baltic Sea are listed below per country and assessment unit (AU). Several of the rivers were also listed in the former IBSFC Salmon Action Plan.

- Finland: Simojoki (AU 1)
- Finland/Sweden: Tornionjoki/Torneälven (AU 1)
- Sweden: Kalixälven (AU 1), Råneälven (AU 1), Piteälven (AU 2), Åbyälven (AU 2), Byskeälven (AU 2), Rickleån (AU 2), Sävarån (AU 2), Ume/Vindelälven (AU 2), Öreälven (AU 2), Lögdeälven (AU 2), Ljungan (AU 3), Emån (AU 4), Mörrumsån (AU 4)
- Estonia: Kunda (AU 6), Keila (AU 6),Vasalemma (AU 6), Pärnu (AU 5)
- Latvia: Salaca (AU 5), Vitrupe (AU 5), Peterupe (AU 5), Irbe (AU 5), Uzava(AU 5), Saka (AU 5)
- Latvia/Lithuania: Barta/Bartuva (AU 5)

Current mixed salmon rivers in the Baltic Sea are listed below per country and assessment unit (AU). Some of these may in future become wild rivers.

- Latvia: Gauja (AU 5), Daugava (AU 5), Venta (AU 5)
- Lithuania: Nemunas river basin (AU 5)
- Estonia: Purtse (AU 6), Selja (AU 6), Loobu (AU 6), Valgejõgi (AU 6), Jägala (AU 6), Pirita (AU 6), Vääna (AU 6)
- Russia: Luga (AU 6)
- Finland: Kymijoki (AU 6)

More information about wild, mixed and reared rivers could be found in Tables C.1.2.1, C.2.1 and C.3.1.

Potential rivers

Several countries have officially appointed potential salmon rivers as suggested in the former IBSFC Salmon Action Plan. Mostly, these rivers are old salmon rivers that have lost their salmon population. Restoration in potential salmon rivers was started in some countries in different ways and with varying efforts. The goal of the restoration is to re-establish natural reproduction of salmon.

Apparent increase in wild reproduction has been documented in at least one or two of the rivers in Gulf of Bothnia, but most of the potential rivers show only low and irregular wild reproduction despite even massive stocking programmes and other rebuilding efforts. Several problems in various phases of salmon's life cycle may adversely affect restoration measures, but their relative importance is difficult to assess. A more thorough analysis, e.g. comparing more and less successful cases of restoration is needed. The rivers Kågeälven and Testeboån show increasing densities of parr, indicating that self-sustainable river stocks may have been established in these rivers and both are under consideration by the working group to be included into the categorization of wild salmon rivers. More detailed information on the development and most updated status of salmon stocks in potential rivers could be found in the WGBAST report.

A.2. Fishery

A description of gears used in different fisheries, including extensive descriptions of gears in Sweden, Finland, Estonia, Latvia, Poland and Denmark, as well as historical gear development in the Baltic salmon fisheries, can be found in ICES 2003.

In the commercial offshore fishery, only longlines are used today for directed fishery on salmon. Driftnets, which were previously the most common gear in the Baltic fishery for salmon, were banned in the Baltic area 1 January 2008 according to Regulation (EC) 812/2004. From 1 January 2013, Sweden and Finland will phase out their longline fishery in the Main Basin. In the commercial coastal fishery, trapnets dominate today but also anchored floating gillnets are used to some extent (in Sweden anchored floating gillnets will be prohibited from 1 January 2013). The main fishing season for longlines is January and February, but some fishing takes place also during November, December, March and April. The main fishing season for the coastal fishery is June and July.

With continued problems from seals predating on salmon captured in fishing gears, the use of trapnets that protect the salmon from seal predation has increased. In Gulf of Bothnia and Gulf of Finland, trapnet fisheries have been developed using new netting material that the seal cannot bite through. Also fixed fences at the entrance of the traps, preventing the seal from entering the traps, has been developed. In Sweden a new type of trap has been developed in recent years, the so called 'push-up trap', with fixed walls that protect the catch from seals. An inventory of the number of both traditional and seal-safe traps was carried out in 2007. It showed that the total number of seal-safe traps in Gulf of Bothnia decreased from 703 in 2003 to 666 in 2007, being 35% of all trapnets. In Finland the government has been giving support to coastal fishermen to change from traditional traps to seal-safe traps, which currently constitute almost all traps.

Recreational fishing targeting salmon takes place in offshore, coastal and river areas. Landings from recreational fishing are not included in the TAC (see below) and no obligation to report catches exist. Catches are therefore estimated annually country by country through different surveys. Recreational fishing in offshore areas is practised by trolling, mainly located to the Main Basin. Studies to estimate catches outside Sweden has been performed in 2003, 2007 and 2011, and those are indicating an increase in both effort and total catch. In 2011, landings of salmon in Swedish trolling were estimated to be 21% of that in the Swedish longline fishery.

Recreational fishing along coastal areas mainly occurs in SD 30 and 31 by use of traditional trapnets. Inventories of non-commercial traps along the Swedish coast show continuous decreases in numbers from 264 to 102 between 1999 and 2011. Proportion of non-commercial traps in comparison to total numbers of traps in Sweden has decreased from 34% to 17% between 1999 and 2011.

Recreational river fisheries take place in wild, mixed and reared rivers, where angling by use of rod and line dominates. Traditional gears like seinenets, gillnets and trapnets are still used in some rivers. Due to stocking objectives, broodstock fishery occurs in some reared rivers. In these reared rivers broodstock fishery usually makes up a substantial part of the total catch.

International regulatory measures

The salmon fishery is regulated by both international and national management measures. International management measures adopted by IBSFC have regulated the salmon fishery in the convention area of IBSFC until the end of 2005. However, since the IBSFC was superseded by bilateral cooperation between the European Community and the Russian Federation new technical measures are developed for the Baltic salmon fishing by EU. These do not always follow strictly the recommendations made by the IBSFC but their purpose is rather to contribute to a comprehensive and consistent system of technical measures for Community waters, based on existing rules. Council Regulation (EC) No 2187/2005 laid down certain measures for the conservation of fishery resources in the waters of the Baltic Sea, the Belts and the Sound. Regulatory measures to be used in the Russian federation waters are not available.

TAC. IBSFC implemented a TAC system for Baltic salmon fishery management for the first time in 1993. There are two separate management areas; one consists of the Baltic Main Basin and Gulf of Bothnia (Subdivisions 22–31) and the second of Gulf of Finland (Subdivision 32). TACs have not been agreed between EC and Russian federation. The salmon TAC agreed for Main Basin and Gulf of Bothnia, and Gulf of Finland is divided between EC countries as indicated in Table A.2.1 (Council regulation (EC) 2010/0247 (NLE)). Catch quotas have not been regulating the fishing pressure before year 2012, because quotas have not been fulfilled. In early and mid-1990s, however, the quotas apparently decreased offshore fishing. This decrease together with strict national regulations set for the Gulf of Bothnian coastal fisheries was the impetus to the recovery of the northern Baltic salmon stocks (Romakkaniemi *et al*., 2003). The substantial decrease in the TAC for 2012 and consequent actions taken in the national regulations restricted salmon fishing in some countries in Subdivisions 22–31 in year 2012.

Table A.2.1. Allocation of TAC between EC countries.

COUNTRY	ALLOCATION KEY (%)
Management area: Main Basin and Gulf of Bothnia (Subdivisions 22–31):	
Estonia	2.0660
Denmark	20.3287
Finland	25.3485
Germany	2.2617
Latvia	12.9300
Lithuania	1.5200
Poland	6.1670
Sweden	27.4783
Russian Federation	1.9000
Total	100
Management area: Gulf of Finland (Subdivision 32):	
Estonia	9.3000
Finland	81.4000
Russian Federation*	9.3000
Total	100

***) No agreed TAC.**

Minimum landing size. Minimum landing size of salmon is 60 cm in Subdivisions 22–30 and 32, and 50 cm in Subdivision 31. Minimum landing size is restrictive and important in the offshore fishery, but a size limit is of little or no importance in river and coastal fishery as long as smolts are protected from being captured in rivers. On the contrary, in river and coastal fisheries, this measure may decrease exploitation of the least valuable parts of the stock.

Summer closure. In EC Community waters there are no longer gear based summer closures. They have been replaced by restrictions on fishing for salmon and sea trout (Article 17 of the Council Regulation (EC) No 2187/2005) and they are as follows;

- The retention on board of salmon (*Salmo salar*) or sea trout (*Salmo trutta*) shall be prohibited;
  - From 1 June to 15 September in waters of Subdivisions 22 to 31;
  - From 15 June to 30 September in waters of Subdivision 32.
- The area of prohibition during the closed season shall be beyond four nautical miles measured from the baselines.
- By way of derogation from paragraph 1, the retention on board of salmon (*Salmo salar*) or sea trout (*Salmo trutta*) caught with trapnets shall be permitted.

Driftnet ban. According to Council regulation (EC) No. 812/2004 of 26.4.2004 the use of driftnets in the fishery was banned from 1 January 2008. As a consequence, the harvest rate of feeding salmon decreased to about one third from 2007 to 2008. Since then the longline fishing has increased so that the harvest rate in offshore fishing in 2011 was probably as high as the combined harvest rate for driftnets and longlines in 2005. The share of discarded minimum size salmon is most likely higher in the present offshore longline fishery than in the past driftnet focused fishery.

The salmon fishery is also to a large extent regulated through national management measures. National regulatory measures and annual updates of these are described in detail in the WGBAST report. Also other factors influencing the salmon fishery, such as dioxin regulations, fishery economics and changes in natural mortality are described in the WGBAST report.

A.3. Ecosystem aspects

The salmon (*Salmo salar*) reproduce in rivers across the whole Baltic Sea, but the most productive rivers are found in the northern parts (Gulf of Bothnia). Juvenile salmon stay in freshwater for one to four years and then spend from one to several years at sea on a feeding migration before they return to spawn in the natal river. Salmon from different rivers (populations) are mixed in the southern Baltic during the feeding migration, but they become gradually segregated on their migration routes back to the home rivers. The Baltic salmon feed mainly on herring and sprat during the sea migration.

Environmental conditions in both the freshwater and marine ecosystem have a marked effect on the status of salmon stocks. In many rivers, hydropower exploitation has eradicated the wild salmon populations, and the production in many of these rivers is today maintained solely by breeding and releasing hatchery reared salmon. In many rivers in the southern Baltic, a range of problems in the freshwater environment may largely explain the current poor status of wild stocks. In many cases river damming and habitat deterioration have had devastating effects on freshwater environmental conditions.

The survival of Baltic salmon during the first year at sea (post-smolt stage) has decreased from around 30% in the mid-1990s to around 10% in recent years. The reasons for the decline in post-smolt survival are still unclear, but the post-smolt survival has been found to be negatively correlated with seal and smolt abundance, and positively correlated with herring recruitment in the Gulf of Bothnia (Mäntyniemi *et al*., 2012). The decline in survival seems also to be associated with changes in climatic conditions (ICES 2012b; cf Friedland *et al*., 2009).

The thiamine deficiency syndrome M74 is a reproductive disorder which causes mortality among yolk-sac fry of Baltic salmon. M74 related mortality among salmon fry was extremely high at the beginning of the 1990s (around 80%), but has thereafter declined to lower levels (5–15%) in recent years. The development of M74 is believed to be coupled to a diet which is characterized by an unbalanced composition between fatty acids (energy) and thiamine (Keinänen *et al*., 2012). Especially young sprat, which is a common prey for Baltic salmon, seems to provide low concentrations of thiamine in relation to the supply of unsaturated fatty acids (Keinänen *et al*., 2012).

Studies on Baltic salmon have found a correlation between spawning run size and spring sea surface temperatures in the Main Basin; following a cold winter and late spring, the salmon tend to arrive in smaller numbers and vice versa, a phenomena believed to be due to climate induced variation in maturation rate rather than climate effects on mortality (e.g. ICES 2012b). Cold winters have also been shown to delay the timing of the spawning run in the subsequent summer. Thus, climate variation has a rather strong impact on the population dynamics of the Baltic salmon.

The current salmon fishery in the Baltic Sea probably has no or minor influence on the marine ecosystem. However, the exploitation rate on salmon may affect the riverine ecosystem through changes in species compositions. There is limited knowledge of these effects and their magnitude.

Because the Baltic salmon is affected by both commercial and recreational fishing, as well as the marine ecosystem state, the Helsinki Commission (Helcom) has pointed out Baltic salmon as a candidate core indicator reflecting the status of the marine environment (Helcom 2012a,b). Suggested parameters of this core indicator include smolt production in rivers, post-smolt survival and trend in number of rivers with self-reproducing salmon populations.

B. Data

The main sources of information currently used for the assessment of the wild salmon stocks can be categorized into three groups according to the place where the actual data collection is carried out:

River surveys: parr density estimates, smolt trapping, monitoring of spawning runs and river catches;

Sea surveys: catch data, fishing effort data and catch composition estimates;

Joint river and sea surveys: tagging data (tagging in rivers, recaptures from sea and river fishery).

Section C gives an overview of all the riverine and tagging data collected and used for assessment on regular basis for the different river stocks within the Baltic Sea area.

B.1. Commercial and non-commercial catch

Description of basic collection of catch data

Countries participating in the Baltic salmon fishery are asked to deliver catch data of salmon and sea trout. Catches are given by economic zone, ICES subdivision, as well as type of fishery separated by offshore, coastal and river. Catches are further classified as commercial, recreational, discard, and seal damage. Catch per unit of effort is given as weight and number of caught individuals in different gears (longline, trapnet, non-commercial catches or other). Effort is given in terms of number of fishing days each gear was deployed.

Logbooks provide only preliminary information taken on board the vessels, where real count and weight estimates are normally difficult to obtain. The catch statistics in different countries are obtained by combination of data included in logbooks, landing declarations, first sales notes and fisheries companies catch reports. From 2005 EU type logbooks were implemented in the new member states Latvia, Estonia, Poland and Lithuania.

The catch statistics provided for WGBAST are mainly based on logbooks and/or sales notes (Table B.1.1). Non-commercial catches are mainly estimated by questionnaires or special issues. Area specific non-commercial catch estimates are, however, rather uncertain. In particular, estimates of catches and fishing efforts in (each) river are needed in order to better model the potential trends/changes in river fishing. In total, logbook information on catches represented approximately 67% of the total salmon catch (Table B.1.1). Extrapolated and estimated catch (partly based on solid information) provides approximately 32% of the total salmon catch.

Table B.1.1. Catch statistics provided for WGBAST.

Fishery type	Logbook [1)]	Extrapolated	Estimated	Guestimated	Total	%
Commercial	112 053	18 064	3116	1845	135 078	78.32
Discard	142				142	0.08
Non-commercial			34 560		34 560	20.04
Seal Damage	2696				2696	1.56
Total	114 891	18 064	37 676		172 476	100.0
%	66.61	10.47	21.85	1.07	100.0	

[1)] Includes all fisheries documentation, sales notes, logbooks, and landing declarations.

Catch tables presented in the annual WGBAST report are constructed by extracts from the resulting WGBAST salmon catch database. Because of a delay in the delivery of data from some countries, part of the catch information is preliminary. These data are corrected the following year. Effort data are calculated separately for stocks of assessment units 1–3. Basic data for these calculations are found in the catch database, but needs to be divided into assessment units before calculations are made.

Collection of catch statistics by country

Denmark: The catch statistics are based on official landing reports and logbooks, combined with additional information from logbooks (e.g. type of gear for all catches and from 2007 effort for 100% of the catches), and are collected in a database at DTU Aqua. From this total catches and effort is estimated. As no Danish salmon rivers discharge into the Baltic Sea, sports fishing for salmon is only possible by offshore trolling. The estimates of recreational catches are calculated by information from competitions, sports fishermen, and from boat rental companies.

Estonia: The catch statistics are based on logbooks from the offshore and coastal fisheries. Data on river catches are from broodstock fishery and anglers questionnaires.

Finland: Catch statistics in the commercial fishery has been collected in logbooks from the offshore and coastal fishery. Estimates of recreational salmon catches in sea are based on the results of the Finnish Recreational Fishing 2010 survey. Recreational river catches are estimated by annual surveys and by interviews and voluntary riverside catch statistics. To obtain more accurate estimates on catches in rivers Tornionjoki and Simojoki, extensive inquiries are conducted every year among fishermen who have bought a fishing licence.

Latvia: The Latvian salmon catch and landing statistics are based on the logbooks and landing declarations from the offshore and logbooks from coastal and inland fisheries. Catch data from a small-scale recreational fishing in the River Salaca and River Venta is based on questionnaires. These data are not included in catch statistics.

Lithuania: Catch statistics are based on logbook data. All data storing and processing are provided by the Fisheries Department of Ministry of Agriculture.

Poland: Commercial offshore and coastal catch statistics are based on logbooks of vessels over 8 m and on monthly reports of vessels smaller than 8 m. All raw data are sent through Regional Fisheries Inspectorates for input to the database, which is run by the VMS centre of the Ministry of Agriculture and Rural Development. Estimated catch data from rivers is obtained from Polish Anglers Union and cooperatives having rights to fish salmon in rivers.

Russia: The catch statistics are based on landing reports, logbooks and direct observation from the offshore and coastal commercial fisheries and broodstock fisheries in the rivers. Catches could be grossly underestimated.

Sweden: Swedish commercial catch data are mainly reported by logbooks from offshore fisheries and journals from coastal and river fisheries. Catches at sea are collected and stored by the Swedish Agency for Marine and Water Management while river catches are collected by responsible counties.

Recreational fishery takes place in offshore areas by trolling, in coastal areas by trapnets and in rivers by rod angling as well as use of nets, seine nets and other gears. As no obligations to report recreational catch exist, total recreational catch derives from estimates from different surveys.

Estimates of total trolling catch in offshore areas are based on surveys carried out in the Main Basin (SD 25–29) about every fourth year. Total nominal catch in the recreational trapnet fishery is estimated by comparing number of recreational gears to catches in the commercial trapnet fishery. An inventory of recreational trapnets distributed along the Swedish coast (SD 29–31) is carried out every fourth year. River catches are yearly collected from all Swedish salmon rivers through catch reports and questionnaires. Data quality highly depends on local interest, size of the river and on how the river fishery is organized.

Discards and unreporting

In general, data on discards, misreporting and unreporting of salmon from different fisheries in the Baltic Sea are incomplete and fragmentary. Main reasons for discard of salmon in the Baltic fisheries are seal damages on adults and bycatch of undersized young salmon. Salmon discard due to seal damages occurs predominantly in the northern part of Baltic Sea, in the main distribution area of the grey seal; Gulf of Riga, Gulf of Finland and Gulf of Bothnia. Bycatch of young salmon occurs in the whole Baltic Sea and in different types of fisheries, but probably mainly within pelagic sprat and herring trawling where it is likely to often remain unnoticed (e.g. ICES, 2011) and in longline salmon fisheries, in terms of mortality among undersized individuals that are released back into the sea.

To account for presence of unreported discarded catches, a conversion factor based on experts' opinions of these catches has been developed (ICES, 2003; ICES, 2004b). These opinions are based on the reported knowledge presented in this stock annex and in the WGBAST report, and other background information available for each country. Expert opinions were updated in 2012 (ICES, 2012b). The conversion factors are applied to obtain probabilistic estimates for the total number of salmon caught, including discarded catches. According to expert judgements the magnitude of discards has been 1.5% to 15% and reporting rate of catches 70% to 100% in the different fisheries in the last ten years. Conversion factors for catch, effort and discards are presented in the WGBAST report.

The magnitude of the present discard and unreported salmon catch is presumed to vary between regions and to generally account for 25–50% of the total commercial salmon catch in numbers. Some of these conversion factors may be too low, especially considering the high potential for bycatch of small salmon in the large-scale pelagic trawling fishery (ICES, 2011). So far, however, too little is known regarding the magnitude of that discard to motivate changes in the corresponding adjustment factors.

Unreporting of salmon catches is also expected to occur in many types of fisheries. One type of unreporting is associated with traditional small-scale commercial fisheries, where it may occur as self-consumption, traditional direct selling from the boat, unreported discards of dead fish, etc. Unreporting may also occur in offshore fisheries for salmon or other species, including bycatch of larger salmon in large-scale trawling fisheries.

Misreporting of salmon catches to varying extent probably occurs in all types of fisheries, fishery zones and countries. Typically salmon may be reported as sea trout, rainbow trout or even marine rainbow trout. Different reasons for misreporting salmon can be identified, including mistakes due, e.g. to difficulties to separate species, and deliberate actions aimed at obtaining a higher market price or to avoid fishery regulations (e.g. minimum landing size or TAC). Misreporting is included in the conversion factor for unreporting of catches. However, assumed misreporting in the Polish offshore salmon fishery is handled separately (see below), and estimates of the additional Polish salmon catch are included on top of the catch estimates generated by the general conversion factor for the offshore fishery.

In recent years' assessment, WGBAST has estimated Polish offshore salmon catches based on Polish reported effort and catch per unit of effort (cpue) of other countries fishing in the same part of the Baltic Sea. The reason behind the use of this estimation procedure is that reported Polish data on effort and catches of salmon and sea trout have deviated markedly from corresponding data delivered by other countries fishing with the same gears in the southern Main Basin, indicating that salmon have been misreported as sea trout in the Polish offshore fishery. To be able to fit the assessment model to fairly realistic offshore catches of salmon, the working group has agreed on an estimation procedure which is based on Polish reported (trout) offshore effort times cpue of salmon among Swedish, Finnish and Danish fishermen times a correction factor of 0.75. By applying a correction factor of 0.75, the estimated Polish catch of salmon becomes close to the total number of salmon and trout reported by Poland for most years in the time-series. This was considered realistic as offshore catches of other countries are strongly dominated by salmon and the proportion of sea trout usually falls well below 5%. This correction procedure has been applied for the fishing years 1992 to 2011 and updates the Polish salmon catches substantially; misreported catch has accounted for about 10% to 50% of the total salmon catch in the Main Basin. The misreporting is expected to decrease from 2012 because of the EFCA JDP campaigns that have included salmon fishing from autumn 2012.

More information on discards and unreporting on a country-by-country basis is presented in the WGBAST report.

B.2. Biological

Since 2004–2005, all EU Baltic sea countries follow the EU data collection framework (DCF) which includes collection of fishery associated data such as salmon age, length and weight composition in catches. Sampling of salmon catches under the DCF has been dealt with in the WGBAST 2005 report (ICES, 2005). The rationale of salmon sampling was described there and also in the various national programmes under the DCF. The national data collection programmes mostly include different fisheries regions (offshore, coastal, river), different fisheries (commercial, angling, broodstock), different origin (wild, reared) of fish. Only Russia provides data collection according to a state research programme.

The number of sampled and analysed fish varies between countries; mostly the national sampling programmes exceed the precision requirements of EC 1639/2001. Annually at least 3–4 thousand salmon are sampled from different fisheries. Available data on age, length and weight composition of salmon catches are presented in Table B.2.1.

Table B.2.1. Data on age, length and weight composition of salmon catches. Data available from the year indicated and onwards.

Country	Fisheries	Parameters			
		Length	Weight	Age	Sex
Denmark [1, 2]	Offshore	2002	1973	1973	-
Estonia	Coastal	2005	2005	2005	2005
Finland	Offshore [3]	1986	1986	1986	
	Coastal	1986	1986	1986	
	River	1974	1974	1974	1974
Latvia	Offshore [2]	1974	1974	1974	-
	Coastal	1978	1978	1978	1978
Lithuania	Coastal	1999	1999	1999	1999
Russia	River	Na	Na	Na	Na
Sweden [2]	Offshore [3]	2002	2002	2002	2006
	Coastal	1990	1990	1990	1990
	River	1991	1991	1991	1991
Poland	Offshore	2003	2003	2003	2003

1) no sampling in 2007.

2) no sampling in 2008.

3) no sampling from 2013 and onwards due to phasing out of the offshore fishery.

Also other data on salmon, besides fishery associated data, is collected within the DCF. This includes for example data collection in salmon index rivers. In 1999, in its 25th session, the former International Baltic Sea Fishery Commission (IBSFC) adopted a list of index rivers to be established as part of the IBSFC Salmon Action Plan. The status of wild salmon in these rivers would according to IBSFC be considered the basis for monitoring the status of wild salmon stocks. In total twelve index rivers were appointed, four in Gulf of Bothnia, five in the Main Basin and three in the Gulf of Finland. The monitoring in these rivers should consist of electrofishing, smolt trapping and counting of spawners (see Section B.3 for a description of these surveys). However, despite several attempts, in 2012 only four rivers (Simojoki, Tornionjoki, Vindelälven and Mörrumsån) with both smolt trapping and counting of spawners have so far been possible to establish.

The Working Group has repeatedly stressed the importance of establishment of index rivers in all parts (assessment units) of the Baltic as it is otherwise difficult to monitor the actual importance of the fishery for the future development of river stocks in these areas, estimate properly the at-sea survival, as well as create stock–recruit functions to be able to calculate the actual potential smolt production capacity of the rivers and estimate future development of the river stocks under different exploitation scenarios.

In the already established index rivers, electrofishing, smolt counting and counting of returning adults is carried out (see Section B.3 below). Part of these data is used in the assessment model (see Section C for more details), and the working group has the ambition to include additional data when it becomes available. Electrofishing data are also collected and used for assessment in all non-index rivers which are listed as wild. Table B.2.2 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.

The amount of information available from individual rivers differs significantly by river and assessment unit. Because of the discrepancies between the amounts of information available on wild salmon in different assessment units, the uncertainties in the assessment of stock status differ significantly between assessment units.

A detailed presentation, country by country, of the data collection during the last year can be found in the WGBAST report. Also updated schemes for data collection, and future needs of inclusion of additional data collection under the DCF, are presented in the annual WGBAST report.

Table B.2.2. Overview of the compatibility of data collected under the DCF with the data needed for stock assessment.

Type of data	Collected under DCF	Available to WG	Reviewed and evaluated by WG	Used in current assessment	Future plans	Notes
Fleet capacity	yes	yes	no	no	n	Incompatible with current assessment model
Fuel consumption	yes	no *)	no	no	n	Incompatible with current assessment model
Fishing effort	yes	yes	yes	yes	n	-
Landings	yes	yes	yes	yes	n	-
Discards	yes	yes	yes	yes	n	-
Recreational fisheries	yes	yes	yes	yes	n	-
CPUE data series	yes	yes	yes	yes	n	-
Age composition	yes	yes	yes	partly used	Increased use	Not incorporated in current assessment model, river samples used
Wild/reared origin (scale reading)	yes	yes	yes	partly used	Increased use	
Length & weight at age	yes	yes	yes	no	n	Not incorporated in current assessment model
Sex ratios	yes	yes	no	partly used	n	Not incorporated in current assessment model, river samples used
Maturity	yes***)	no ***)	no	no	n	
Economic data	yes	no *)	partly used	no	n	Incompatible with current assessment model
Data processing industry	yes	no *)	no	no	n	Incompatible with current assessment model
Electrofishing data	yes **)	yes	yes	yes	n	-
Smolt trapping data	yes **)	yes	yes	yes	n	-
Tagging data	no	yes	yes	yes	n	-
Fish ladder data	yes **)	yes	yes	yes****)	Increased use	-
Genetic data	yes **)	yes	yes	no	Will be used	Not incorporated in current assessment model

*) Not asked for by the working group.
**) Not mandatory under current DCR.
***) DCF requires collection but only a few of the countries are doing it.
****) Partial use.
n. No change.

B.3. Surveys

ICES salmon assessment is not based on sea surveys commonly used for other species. Instead, the assessment of salmon is based mainly on surveys in rivers (counting of spawners and smolts, and electrofishing surveys).

Monitoring of parr densities in rivers are carried out by standardized electrofishing surveys in all assessment units. Fish densities are estimated by using removal fishing. The electrofishing procedure is the same today as at the beginning of the time-series. The choice of electrofishing sites in almost all rivers was done at the beginning of the time-series (mostly during the 1980s) when densities of parr were extremely low. In order to have a reasonable possibility to detect salmon parr in those years, 'best' rapids and sites were often selected. When number of sites has increased to better cover whole river systems, the selection of sites has usually been made the same way as earlier. Because of this non-random selection of monitoring sites the calculated density estimates cannot be considered as fully representative and unbiased estimates of the average parr density in a river. Instead, the density estimates serve as relative abundance indices and the possibility that the relationship between density index and smolt production varies from river to river must be taken into account (see Section C.1.5).

Salmon spawning runs into rivers are usually monitored in fishladders. The control of fish migration is carried out by electronic counters (usually an infrared fish counter, "Riverwatcher", Vaki Aquaculture System Ltd, Iceland), in combination with cameras which makes detection of individual species possible. DIDSON (Dual frequency IDentification SONar, http://www.soundmetrics.com/) is used in two rivers to monitor spawning run in natural river channels. DIDSON uses sound to produce video images of underwater areas. Identification of species is basically based on the length of the detected individuals and this sets certain limits to successful use of DIDSON to monitor salmon runs. In all fishladders and in one of the two DIDSON monitoring sites, the resulting count represents only a proportion of the total number of spawners ascending the river. This is because either the monitoring site is located in the middle- or upstream part of the river, or some fish may be able to pass the migration obstacle without using the fishladder (partial obstacle), or fish may not find the fishladder. One must take this into account when utilizing the data in the assessment (see Section C.1.9).

Smolt production is monitored by partial smolt trapping and mark–recapture experiments in 1–2 rivers per assessment unit. The traps are either specially designed fykenets or so-called rotatory screw traps (EG Solutions, Oregon, USA). A smolt trap is set up in a river as early as possible in spring and trapping continues to the end of the smolt migration season. In some years, high and late spring floods prevent early enough start of the surveys and the results from such years are not normally used in assessment. The smolt trap is emptied once or twice a day, a proportion of the catch is marked by an individual or group mark and the marked fish are then released some distance upstream the trap site. Recaptures of marked smolts are monitored at the trap. Catch and recapture data are stratified according to different time intervals, like days, or presented as annual totals. Daily water level and water temperature are also monitored as potential covariates affecting e.g. recapture rate of marked smolts. Based on this material, the catchability of the trap is estimated and the total run is assessed (see Section C.1.4).

B.4. Commercial cpue

In the same way as biological sampling of salmon, the EU member states fisheries data collection programmes include cpue data. The seasonal average cpue information has been collected since 1980/1981 for Danish, Finnish, Latvian and Swedish fisheries in various combinations of subdivisions in the Main Basin, the Gulf of Bothnia and the Gulf of Finland (Table B.4.1).

Table B.4.1. Available information on cpue for countries, fisheries and subdivisions (LL: longlines, DN: driftnets, GN: gillnets, TN: traps).

Country	Subdivision	Offshore fisheries, gear		Coastal fisheries, gear		Period from
		LL	DN (stopped in 2008)	GN/DN	TN	
Denmark	22–25; 26–29	X	X			1983
Estonia	28–29; 32		X			1980–1988
Finland	22–31; 32	X	X		X*	1980
Latvia	26, 28		X		X*	1980
Poland	24	X	X	X		2004
	25/26	X	X	X		2000
Russia	26		X			2000
Sweden	22–29	X	X			1985

*** Dataseries from 2000.**

The cpue is presented as number of salmon per 100 nets (driftnet), as number of salmon per 1000 hooks (longline) and number of salmon per trapnet day in coastal fisheries. From year 2000, all information available on cpue is obtained from the WGBAST salmon catch database (see Section B.1).

B.5. Other relevant data

Tagging data

Tagging data are currently used for many purposes by the Working Group. Carlin tagging data have been an important information source in the assessment models for the Main Basin and the Gulf of Bothnia. Tagging data in combination with tag reporting rate have been used within the assessment of Baltic salmon in order to estimate river stock parameters as well as the exploitation rates by different fisheries (see Section C for more information). Tagging data are almost exclusively from reared salmon. Tagging of wild salmon smolts has taken place only in assessment unit 1.

Swedish tagging data constituted a major part of the data when the initial models were established in the late 1990s, but since 2001 the power companies have been responsible for most Carlin tagging, and there have been periods when the data have not been available to the WGBAST. When the database finally became available from the power companies in 2007, it turned out that the database suffered from quality problems that had arisen in the period when it had been unavailable. The Swedish University of Agricultural Sciences has rectified the database, and the data are now again used in the assessment model.

The number of tag returns has become so sparse in the last few years that they update the catchability estimates little. There are various reasons for the drop in number of tag returns. Apart from the decrease in post-smolt survival during the last 20 years, reasons include also a decrease in recapture rate due to a decline in exploitation, and the reduction in number of tagged salmon in the last few years. Another factor is the reporting rate. Some studies to estimate the reporting rate have been carried out in the Baltic Sea and their results indicate an obvious unreporting. In the assessment model, a conversion factor (which is based on expert opinions and empirical information) is used to take into account unreporting of tags (see the WGBAST report for more information). A more problematic issue is the possible decline in reporting rate over time. Increasing evidence suggests that the tag reporting rate of Swedish fishermen has decreased considerably but to an uncertain extent in the last decade, also for tags from other countries. The reason for the decline is not clear.

The small number of tag returns is not highly critical so far in estimation of catchability values since the estimates are not year specific (each fishery based estimate covers the range of years 1987–2011). In addition the catchability of each fishery is assumed to stay rather stable through the years. However, the tag return data influence also to the annual post-smolt survival estimates, which is a key parameter in the Baltic salmon assessment framework. As the quality of the tagging data seems to have decreased considerably for the reasons mentioned above (a main problem being an assumed decline in reporting rate), development of an alternative tagging system that could replace the current Carlin tagging programme has been discussed (ICES 2010).

Analyses of catch samples

Combined DNA- and smolt-age-data has been used by the group to estimate river stock and stock group proportions in salmon catches in the Baltic Sea since year 2000. The baseline data currently includes data for 17 microsatellite loci for 33 river stocks. Catch samples are also analysed using scale reading, which gives direct information on the composition of wild vs. reared salmon. The relative abundance of wild vs. reared salmon in the Main Basin, as determined by scale reading, is used in the assessment model (see Section C). Genetic data on catch composition, on the other hand, has not been used so far in salmon stock assessment. However, information generated from genetic mixed-stock analyses has been used as independent information to evaluate model predictions on e.g. relative abundance-at-sea of salmon of different river origin. The scale reading work is shared between Poland, Sweden and Finland. The DNA analysis is carried out in Finland.

C. Assessment: data and method

Salmon populations in Gulf of Bothnia and southern Sweden (AUs 1–4), eastern Main Basin (AU5) and Gulf of Finland (AU6) are assessed separately following different methodologies which are described under different subheadings below.

C.1. Salmon in assessment units 1–4

Model used: A Bayesian state–space model fed by multiple Bayesian data analyses

Software used: WinBUGS (Bayesian inference using Gibbs sampling) software, versions 1.4 and newer (http://www.mrc-bsu.cam.ac.uk/bugs).

Model Options chosen: See later details

General introduction to Bayesian inference: description of the modelling approach

A Bayesian approach to statistical inference (Gelman *et al*., 1995) has been used for the assessment of Baltic salmon in assessment units (AUs) 1–4. This approach permits a probabilistic approach to fisheries stock assessment in which uncertainties about unobserved quantities are formulated as probability distributions (McAllister and Kirkwood, 1998). It also allows a diverse range of data and expertise to be incorporated probabilistically into the stock assessment and the input to be specified in a formal and probabilistic manner.

The key idea of the Bayesian approach is to express the prior knowledge of parameters of interest (population parameters, catchability, tag reporting rate, etc.) in the form of probability distributions, and then update the knowledge of the parameters by using empirical observations. The distribution which describes the degree of knowledge before obtaining empirical observations is called the prior (probability) distribution. The distribution updated by empirical observations is called the posterior (probability) distribution which is seen as a formal compromise between the prior knowledge and information contained in observations. Generally, small amounts of data result in small updates of the prior knowledge and large amounts of data results in more substantial updates of knowledge. Posterior distributions obtained from the analysis of one dataset can be used as prior distributions in the analysis of another dataset. This way the Bayesian approach serves as a formal tool for scientific learning as the information from multiple datasets accumulates to the posterior distribution.

The probability distributions are analysed using Monte Carlo simulation methods such as Markov Chain Monte Carlo (MCMC) methods and specialized software such as WinBUGS and Hugin have been used to calculate the probability distributions of interest based on the statistical models and prior probability distributions. The statistics most frequently used to describe a probability distribution (i.e. mode, median, mean, 95% probability interval) are illustrated by Figure C.1.1.

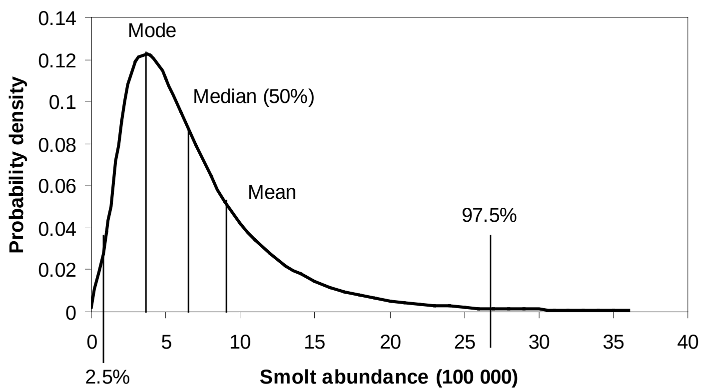

Figure C.1.1. Example of a posterior distribution for smolt abundance. The location of different statistics which are used to describe posterior distributions in the report are indicated by vertical lines in the figure. Most of the posterior distributions calculated by assessment models have shapes similar to the one presented here, which means that the order of mean, median and mode is the same as here: the median value lies between the most likely value (mode) and the expected value (mean).

C.1.2. Overview of the assessment method

An overview of the entire assessment model with the different submodels, data or information used within the submodels and their outputs, can be found in Figure C.1.2.1. The use of a Bayesian estimation procedure allows this type of systematic and integrative modelling approach which is able to utilize most of the information sources available.

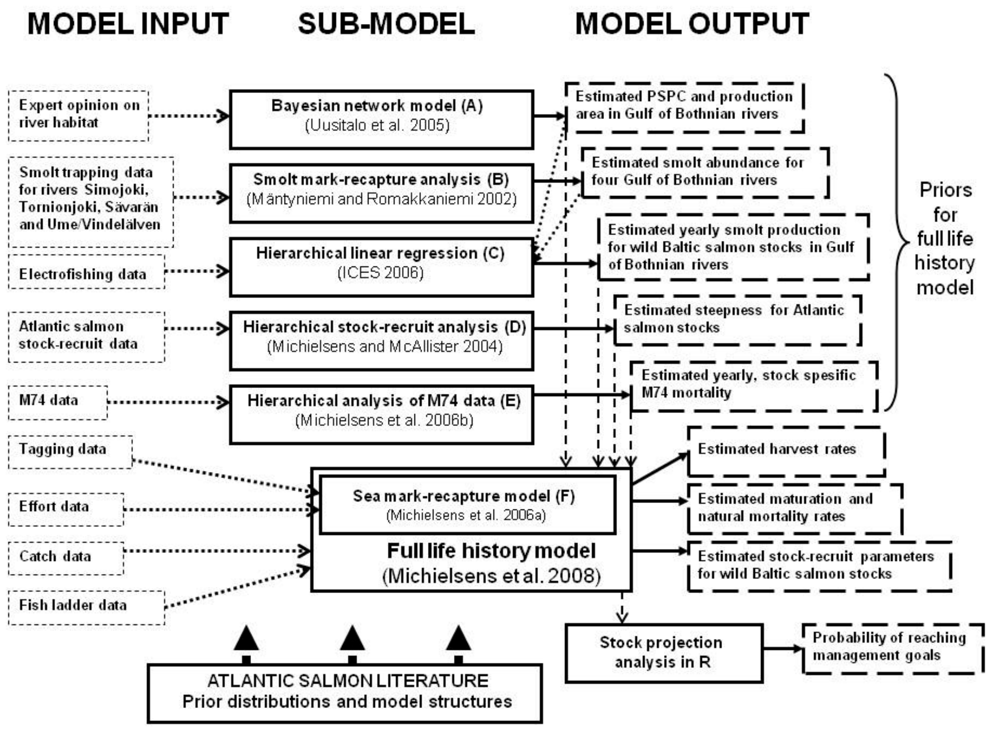

Figure C.1.2.1. Overview of the assessment methodology for Baltic salmon stocks. The results from five uppermost analyses provide informative prior probability distributions for the full life-history model. These priors become automatically updated by the information contained in the data and by the biological knowledge of the Baltic salmon life cycle used to build a full life-history model. PSPC=Potential Smolt Production Capacity.

In order to assess the status of the salmon stocks with respect to the reference points, the first requirement is to obtain estimates of the Potential Smolt Production Capacity (PSPC). A Bayesian network model (Uusitalo *et al.*, 2005) has been used to obtain the prior distribution for the PSPC of different Baltic salmon rivers. The model is based on expert opinions or judgements of the characteristics of the river environments and the corresponding salmon stocks. The resulting PSPC estimates are used as prior probability distributions when estimating the stock–recruit relationships.

In addition to the PSPC, the full life-history model also requires yearly smolt production estimates in order to assess the smolt production in relationship with the PSPC. For the rivers Tornionjoki/Torneälven, Simojoki, Ume/Vindelälven and Sävarån, smolt trapping data are available that can be analysed using a mark–recapture model in order to obtain yearly smolt production estimates for these four rivers (Mäntyniemi and Romakkaniemi, 2002). For most rivers, however, only electrofishing data are available. In order to be able to estimate the smolt production based on electrofishing data, the results for the rivers Tornionjoki/Torneälven, Simojoki, Ume/Vindelälven and Sävarån (for which both electrofishing and smolt trapping data are available), can be used within an hierarchical linear regression analysis to estimate the smolt abundance of different rivers based on parr density estimates obtained from electrofishing data (ICES 2004, Annex 2).

In order to be able to update the historic smolt abundance estimates and predict future smolt abundances, information regarding the relationship between the number of eggs and the resulting number of smolts is needed. Within the Baltic Sea, no stock–

recruit data (egg and smolt counts) as such are available. Therefore a hierarchical analysis of Atlantic salmon stock–recruit data has been undertaken in order to estimate the likely form and parameters of the stock–recruit function (Michielsens and McAllister, 2004).

In order to be able to use the stock–recruit function and predict future smolt abundances, a full life-history model is needed that can predict the number of spawners given a certain level of exploitation. A full life-history model requires the estimation of life-history parameters such as maturation rates, natural mortality rates and exploitation rates. In order to be able to estimate these parameters, tagging data are analysed using a mark–recapture model (Michielsens *et al.*, 2006). The results of this model are used together with the smolt abundance estimates and the priors for the stock–recruit function within a full life-history model of individual Baltic salmon stocks in order to be able to estimate the stock–recruit function parameters for individual salmon stocks, and update the smolt production and PSPC estimates of the individual salmon stocks (Michielsens *et al.*, 2008).

The results of the assessment models are used to calculate the probability that 50% or 75% of the PSPC will be exceeded in a given year and to assess future probabilities of reaching this objective under different assumptions about future exploitation and states of nature. The probabilistic projection of the stocks beyond 2010 has been executed using R.

An overview of the different types of data available for the different Baltic salmon stocks can be found in Table C.1.2.1. The table indicates for which rivers the current assessment methodology is able to predict future smolt abundance to be compared to the PSPC. This estimation is based on smolt abundance estimates, spawner abundance estimates and associated stock–recruit relationships.

The following subsections discuss more in detail each of the different submodels within the assessment methodology.

Table C.1.2.1. Overview of the different types of data available for the different Baltic salmon stocks. The table also indicates for which stocks the current assessment methodology is estimating smolt abundance, spawner abundance and associated stock–recruit function. River categories: W=wild, M=mixed, R=reared.

River identification				Data										Estimates		
River			Country	IBSFC index river	M74 data	Electrofishing survey	smolt trap data	tagging data	fish ladder/counter	broodstock fishery	river catches	age structure	Genetic baseline	smolt estimates	spawner estimates	S/R parameters
Assessment group 1: North-eastern Bothnian														x	x	x
Tornionjoki;Torneälven	31	W	FI/SE	x	x	x	x	x	x		x	x	x	x	x	x
Kalixälven	31	W	SE			x			x		x	x	x	x	x	x
Råneälven	31	W	SE			x							x	x	x	x
Simojoki	31	W	FI	x	x	x	x	x	x		x	x	x	x	x	x
Kemijoki	31	R	FI		x			x					x			
Iijoki	31	R	FI					x					x			
Oulujoki	31	R	FI					x					x			
Assessment group 2: North-western Bothn														x	x	x
Piteälven	31	W	SE			x			x					x	x	x
Åbyälven	31	W	SE			x			x			x	x	x	x	x
Byskeälven	31	W	SE			x			x		x		x	x	x	x
Rickleån	31	W	SE			x			x					x	x	x
Sävarån	31	W	SE	x		x	x				x	x		x	x	x
Ume/Vindelälven	31	W	SE	x	x	x	x	x	x	x	x	x	x	x	x	x
Öreälven	31	W	SE			x			x				x	x	x	x
Lögdeälven	31	W	SE			x							x	x	x	x
Luleälven	31	R	SE		x			x		x			x			
Skellefteälven	31	R	SE		x			x		x			x			
Assessment group 3: Bothnian Sea														x	x	x
Ljungan	30	W	SE		x	x		x					x	x	x	x
Gideälven	30	R	SE					x								
Ångermanälven	30	R	SE		x			x		x			x			
Indalsälven	30	R	SE		x			x		x			x			
Dalälven	30	R	SE		x			x		x			x			
Ljunsnan	30	R	SE		x			x		x			x			
Kokemäenjoki	30	R	FI					x								
Aurajoki	29	R	FI													
Paimionjoki	29	R	FI													
Assessment group 4: Western Main Basin														x	x	x
Emån	27	W	SE			x							x	x	x	x
Mörrumsån	25	W	SE	x	x	x	x				x	x	x	x	x	x

C.1.3. Prior probability distributions for Potential Smolt Production Capacity (PSPC)

A Bayesian network model (Jensen, 2001) is used for the construction of the prior distribution for the PSPC of each river. The idea is to express the knowledge of salmon scientists about the PSPC in the form of probability distribution. In particular, the knowledge of the PSPC before obtaining any recent smolt abundance data is intended to be expressed here. Each expert is asked to provide their knowledge of different factors affecting the PSPC, like area suitable for production, habitat quality and mortality of smolts during downstream migration. Prior probability distributions for the PSPC are then calculated as the product of all these factors. The final prior distributions are an average over priors of all experts, which means that the diversity of different expert opinions is taken into account. Detailed description of this method can be found from Uusitalo *et al*. (2005).

Data

No measurement data are directly used in this model. Experts are asked to not to take into account measurement data that will be used explicitly in the Bayesian stock assessment model. For example, experts are asked to ignore any smolt counts that will be used in the assessment, since these data will be used later to update the prior probability distribution for the PSPC. However, before giving their opinion the experts look at existing additional material from the different rivers that contain information useful for the evaluation of the river areas suitable for production, the habitat quality of each river and information on mortality of smolts during downstream migration.

The data have been obtained from five salmon experts (Lars Karlsson, Ingemar Perä, Ulf Carlsson, Eero Jutila and Atso Romakkaniemi) from the northern Baltic Sea area. The experts represented different views in the controversy over the smolt production capacity. Clemen and Winkler (1999) noted that experts who are very similar in philosophy and opinions tend to provide redundant information, and heterogeneity among experts is thus desirable. The marginal utility of information decreases as the number of experts increases, and using three to five experts is generally suggested (Makridakis and Winkler, 1983; Ferrell, 1985).

Eliciting the expert information has been done in three stages:

7) First the experts discussed the model structure and assumptions and any differences in definitions of the parameters were ironed out. Clemen and Winkler (1999) pointed out that great effort may be required to reach this goal. For successful combination of the estimates it is vital that experts agree on what is to be estimated and on the definitions regarding the model.

8) Secondly the experts conducted a ''warm up-exercise'', going through the estimation using as an example a southern Swedish salmon river not included in the analysis. This was intended to help the experts become familiar with the practice of probabilistic estimation in this specific context (Morgan and Henrion, 1990). The probability distributions and conditional distributions were also explained in detail to ensure that they were understood in the same way by all experts.

9) Finally, the experts estimated the probability distributions of the river-specific variables and conditional distributions that link these environmental factors to salmon reproduction. Each expert did this alone via a questionnaire form, with the possibility to hold discussions with the analyst, if desired. This arrangement was made to ensure that nobody's opinions and interpretations would affect the judgements of others, but that every expert would give the estimates in accordance with his own judgement. Hints also exist that interaction between experts at this stage may increase overconfidence and thus produce poorer results (Morgan and Henrion, 1990).

Methodology

The network model summarizes the current expert knowledge of PSPC of northern Baltic salmon rivers. The model was constructed in cooperation with salmon experts and aims to be compatible with experts' lines of reasoning rather than to describe the actual relationships of the nature in a detailed manner. Thus it describes a probabilistic justification for the expert views of salmon smolt production.

The model consists of ten variables (Figure C.1.3.1), five of which describe or reflect the external factors, physical and biological, to which salmon reproduction is exposed in the reproduction rivers (*chance of successful spawning*, *habitat quality of parr area*, *smoltification age*, *mortality during migration*, and *size of production areas*). Three variables (*parr density capacity*, *pre-smolt density capacity*, and *smolt production capacity*) describe the juvenile salmon stocks' response to the external factors. The remaining variables, *expert* and *river*, are auxiliary variables that enable handling of all the estimates in the same model. The first two variables have five discrete classes. The lowest class (i.e. very poor) is fixed to describe the situation in the poorest river in the northern Baltic Sea area, and the highest class (i.e. very good) the best salmon production river in the northern Baltic Sea. This relative scale is based on the fact that some part of the required knowledge is related to the intuitive understanding of experts who have spent most of their careers in studying these populations.

Current knowledge is based on several small pieces of information, and the model here permits the experts to quantify this knowledge as probabilities. The variable smoltification age does not aim to reflect a distribution for the smoltification age, i.e. the percentage of parr that smoltify at each age, but the modal smoltification age and uncertainty connected with it. The minimum age of wild smolts in the rivers concerned is two years, which means that all salmon juveniles contribute to the densities of older parr (age 1+ and older) prior to smoltification. Dependencies between the variables (Figure C.1.3.1) are described by conditional probabilities. For example, there is a table that contains the probability distribution of *parr density capacity* as a function of *chance of successful spawning*, *habitat quality of parr area*, and *expert*. It states the probability distribution, i.e. the probabilities of every possible value, of *parr density capacity*, given that e.g. the value of *chance of successful spawning* is ''very good'' and the value of *habitat quality of parr area* is ''good'' and *expert* is ''Expert 1''. A probability distribution exists stating the probabilities of different values of *parr density capacity* for every combination of values of the parent variables, in this case *chance of successful spawning*, *habitat quality of parr area*, and *expert*. Standard probability calculus has been used to obtain the probability distributions for carrying capacity, giving the results from the different experts an equal weight. Hugin-software package has been used for calculation of probabilities.

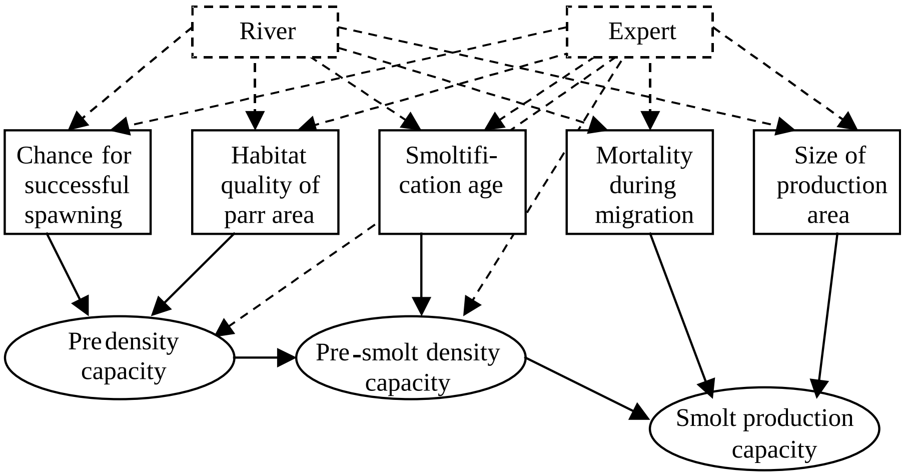

Figure C.1.3.1. Model structure. The solid rectangular nodes denote river-specific characteristics which are estimated for each river separately by each expert; the elliptical nodes denote conditional estimates on related input arcs, e.g. smolt production capacity depends on pre-smolt density capacity, mortality during migration, and the size of production area. The dashed nodes denote the auxiliary variables. The variables that are children of river are estimated separately for each river; the variables that are children of ''expert'' include separate estimates from each expert (Uusitalo *et al.*, 2005).

The model outputs are discrete prior distributions for the PSPC. Discrete distributions obtained directly from the model are difficult to use as such in further analysis. Therefore suitable continuous parametric distributions have been used to approximate the shape of the exact distributions obtained from this model. Lognormal distributions with median and coefficient of variation matching with the ones of exact distributions have been used for approximation. Multiple experts were used to come up with the priors for the set of rivers creates dependence between river-specific prior distributions. In other words, having new information about the PSPC in one river will also change the perception of the PSPC of other rivers. This can be also seen as automatic evaluation of experts: experts whose prior coincides well with the information implied by observations from a particular river will be given more weight in the prior distribution of other rivers. This inherent correlation between river-specific PSPC priors has been taken into account by approximating the prior distribution of each expert separately by a lognormal distribution. The resulting probability distributions for the PSPC can be found in Table C.1.3.1. PSPCs of the unit 4 rivers (Mörrumsån, Emån) are based on less structured expert judgements.

It is important to note that these probability distributions based on expert opinions only form the prior probability distributions for the PSPC. These priors will be updated when fitting stock–recruit models (C.1.7) to the available stock–recruit data (C.1.9), obtained by combining the smolt production estimates (C.1.4 and C.1.5) with the estimates of the marine survival (C.1.8). If the egg-to-smolt stock–recruit estimates for the Baltic salmon stocks appear to be informative, the probability density functions for the PSPC will then be substantially updated. Such an update can be expected in each assessment year as new data accumulates. The amount of annual change will depend on the amount of new data and the amount of information contained in the data.

Table C.1.3.1. Prior probability distributions for the smolt production capacity (* 1000) in different Baltic salmon rivers. The prior distributions are described in terms of their mode or most likely value, the 95% probability interval (PI) and the method on how this prior probability distribution has been obtained. These priors will be updated when fitting the Beverton–Holt stock–recruit function to the available stock–recruit data (Section C.1.9).

		Smolt production capacity (thousand)		Method of
		Mode	95% PI	estimation
Assessment unit 1				
1	Tornionjoki	690	246-6819	1
2	Simojoki	39	15-384	1
3	Kalixälven	240	143-2779	1
4	Råneälven	26	10-294	1
Total assessment unit 1		1598	589-8255	
Assessment unit 2				
5	Piteälven	30	7-369	3
6	Åbyälven	6	3-119	1
7	Byskeälven	75	31-879	1
8	Rickleån	3	1.0-31	1
9	Sävarån	2	0.6-30	1
10	Ume/Vindelälven	95	86-1330	2
11	Öreälven	5	4-160	1
12	Lögdeälven	17	7-289	1
Total assessment unit 2		492	238-2221	
Assessment unit 3				
13	Ljungan	2	0.8-27	1
Total assessment unit 3		2	0.8-27	
Assessment unit 4				
14	Emån	15	11-21.	3
15	Mörrumsån	90	66-128	3
Total assessment unit 4		105	79-145	

Method of estimation of smolt production capacity

1 Bayesian modelling of expert knowledge (Uusitalo et al. 2005)

2 Bayesian hierarchical stock-recruit analysis of Atlantic salmon stocks (Michielsens and McAllister 2004)

3 Expert opinion with associated uncertainty

C.1.4. Mark–recapture analysis of smolt trapping data

Mark–recapture experiments combined with smolt trapping have been used in four rivers (Tornionjoki, Simojoki, Ume/Vindelälven and Sävarån). Bayesian mark–recapture model proposed by Mäntyniemi and Romakkaniemi (2002) have been used to analyse the datasets. Simplified versions of the mark–recapture model (Bayesian Petersen method) are used in cases when data have not allowed incorporation of daily variation in parameters affecting trapping success.

Data

Mark–recapture data comprises of the number of untagged fish caught by the smolt trap, the number of tagged smolts released upstream from the trap, and the number of recaptured tagged smolts. These data are stratified according to different time intervals, like days, or presented as annual totals. Environmental covariates (daily water level and water temperature data) are also included into the analysis.

Methodology

The model structure is based on biological knowledge of the behaviour of salmon smolts during their migration. For example, their tendency to form shoals is taken into account by allowing catches to be more variable than in the case of independent behaviour. Knowledge of the sampling design is also utilized in the model structure. For example, the fact that it may take several days for a tagged smolt to pass the smolt trap again after the release is accounted for by modelling the mean and variance of the swimming speed of each marking group. A vague prior distribution is used for population size when analysing smolt trapping datasets. Posterior distributions for model parameters are calculated with the help of MCMC simulation.

Key assumptions behind the model structure:

- Smolts migrate in schools (shoals) rather than independently;
- Tagged and untagged smolts have equal capture probability when passing the smolt trap.

The output of the mark–recapture analysis is a posterior probability distribution, which formally includes all the information about the smolt abundance contained in the mark–recapture data. The smolt abundance estimates will be used in combination with parr density estimates in Section C.1.5.

C.1.5. Hierarchical linear regression analysis to estimate wild smolt production of different salmon stocks

A hierarchical Bayesian model is used to describe the relationship between relative densities of salmon parr and absolute abundance of salmon smolts. Parr populations are regularly monitored and a relative index of annual parr density has been calculated in most of the Baltic salmon rivers. For a few rivers (currently Tornionjoki, Simojoki, Ume/Vindelälven and Sävarån in the units 1–4) also smolt abundance estimates are available, which makes it possible for these rivers to look at and learn about the relationship between parr density and corresponding wild smolt production. By using a hierarchical structure based on assumed exchangeability of stock-specific parameters, the smolt abundance for stocks for which only parr density estimates are available is then estimated.

The core of the model is a latent dynamic linear regression model which connects relative densities of parr to smolt abundances. Information about parameter values between different rivers is transferred through hyperparameters, which are common to all rivers. Needed model inputs are prior distributions of model parameters and independent estimates of relative parr density and smolt abundance in a form of statistics of posterior distributions calculated separately from electrofishing and smolt trapping data.

Data

This model requires time-series of parr abundance indices for all rivers considered, and time-series of smolt abundance estimates for as many rivers as possible. More specifically, the annual number of sampling sites electrofished and the corresponding estimated density of age 0+, 1+ and >1+ parr are needed. The number of sampling sites is used as a measure of precision of the parr density. Medians of the posterior distributions from mark–recapture analysis for smolt abundance are used as observations, and CVs of the posteriors are used as their measurement errors. In order to be able to assume that the parameters of the linear model are exchangeable between rivers, the smolt abundance of each river must be scaled down by the assumed production area of the river. The prior distributions for the smolt production area of each river are obtained from the domain experts by using the network model provided by Uusitalo *et al*. (2005). Currently, parr density data from twelve rivers are used together with smolt abundance estimates from Simojoki, Tornionjoki, Ume/Vindelälven and Sävarån.

Methodology

It is assumed that a linear model can characterize the relationship between the parr density index and the smolt abundance based on the assumption that no density-dependent survival takes place in rivers of the Baltic Sea after the first summer (Figure C.1.5.1). The parameters of this linear relationship can be learned or estimated for rivers for which time-series of both parr abundance indices and smolt abundance estimates are available. It is assumed that the parameters of the linear model are not equal in all rivers, but instead they are assumed to be random draws from a distribution that characterizes the variation between rivers. In addition, mean discharge of the river is used as an explanatory variable for the slope of the linear model in each river. The residual variance can be learned from the variance of the parameters between rivers that have the necessary data. For rivers which have only parr abundance indices, the parameters of the linear model are given prior distributions which include the between river variability of the parameters and has the expected value predicted by the mean discharge of the river. This reflects the assumption that the parameters of the linear model are partially exchangeable between rivers. The model is described in detail in ICES (2004), Annex 2.

Key assumptions of the model:

- Parr density estimates are proportional to the true parr density.
- Survival and smoltification rates are not density-dependent after the fry stage.
- Relative selectivity of electrofishing is equal in all rivers.
- Knowing the name of the river would not help in the estimation of river-specific survival rate. This means that rivers cannot be ordered based on survival parameters by using prior information. This is the assumption of exchangeability which in turn leads to the assumption that river-specific parameters are random draws from a probability distribution describing the variation in survival between rivers.

This model produces posterior probability distributions for the annual smolt output of each river, as well as estimates of relative parr abundances, survival parameters and variation of survival parameters across rivers. The results of this analysis include all the information about smolt abundance contained in the electrofishing and smolt trapping data.

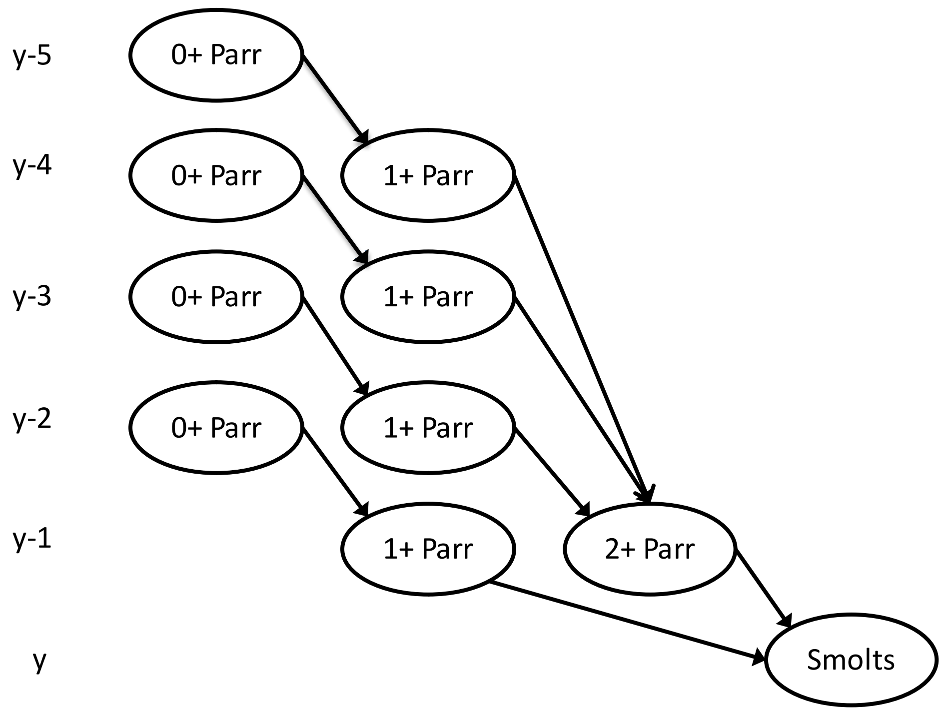

Figure C.1.5.1. A schematic diagramme illustrating the assumed dependencies when assessing the smolt abundance of year y (modified from ICES 2004).

Smolt production estimates in rivers not included in hierarchical linear regression analysis

For Piteälven, Emån and Mörrumsån, the smolt production estimates have been obtained differently. In Piteälven the number of eggs is estimated based on the number and size of the females passing the fishladder at the power plant station. Using an egg-to-smolt survival rate of 1%, it is possible to estimate the corresponding smolt production four and five years later:

Piteälven smolt forecast: = (0.01 * ((eggSY-4 * 0.62) + (eggSY-5*0.38)))

In Emån and Mörrumsån the smolt production is predicted using densities of 0+ and 1+ parr in combination with survival rates from one-summer old parr to two-summer old parr to smolts.

C.1.6. Estimating M74 mortality for different wild salmon stocks

Each year, the working group updates time-series on the percentage of females (at hatcheries) affected by M74 and the percentage of total yolk-sac-fry mortality. For assessment purposes, however, we need to know the percentage of annual mortality caused by M74 among the salmon offspring. These estimates allow us to integrate M74 mortality within the population dynamics of the stock.

Data

Two different datasets have been used to calculate the mortality among alevins due to M74 mortality. The first dataset consists of data for females from the river Simojoki, Kemijoki and Tornionjoki/Torneälven stocks. For each female it is indicated if the female suffered from the M74 syndrome and the percentage of yolk-sac-fry mortality by its offspring, calculated on the basis of the proportion of alevins from each female that die. A second dataset consists of M74 information for nine Swedish salmon stocks. The dataseries indicate the number of females sampled and the number of females affected by the M74 syndrome for each year and for each stock. Updated time-series on the data mentioned above can be found in the annual WGBAST report.

Methodology

The data are analysed using the same Bayesian hierarchical model as described by Michielsens *et al*., 2006b. The probability of eggs surviving the alevin stage depends on the probability of females being affected by M74. In case the females are not affected by M74, it is assumed that the probability of the eggs surviving the alevin stage depends on the 'normal' level of yolk-sac-fry mortality (M). If the females are affected by M74 then either all offspring die or only part of the offspring die (Figure C.1.6.1).

Because the degree of M74 mortality is assumed to differ across years and across stocks, the model calculates the average survival from M74 mortality for each stock for each year. By separating the M74 induced yolk-sac-fry mortality from the 'normal' yolk-sac-fry mortality (YSFM), the model also removes the effect of the rearing environment on the M74 mortality estimates. It is assumed that the 'normal' YSFM can differ between offspring from different females but that the variation between the 'normal' YSFM from offspring of females of the river Simojoki, Kemijoki and Tornionjoki is the same as the variation in 'normal' YSFM between different years and between different stocks. Based on this assumption it is possible to implement an hierarchical model structure and use the estimated mean 'normal' YSFM and the associated variance among females to predict the 'normal' YSFM for years and stocks for which no data exist which would allow to estimate the 'normal' YSFM. Similarly for the M74 mortality it is assumed that this mortality can differ for each female and that there is a mean M74 mortality across the different stocks for each year and a constant variation across stocks over the years. This assumption allows to use a hierarchical structure across stocks and to predict the M74 mortality for stocks for which there is no information on M74. Because the average M74 mortality across stocks is year-dependent, this methodology does not allow the prediction of future M74 mortalities.

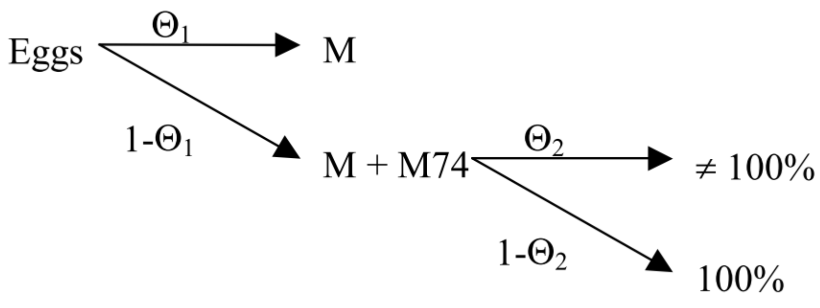

Figure C.1.6.1. Schematic illustration of the M74-model. M represents the normal yolk-sac-fry mortality (YSFM), M74 represents the mortality due to the occurrence of M74, Θ_1 is the probability that the offspring of a female will not show M74 related mortality and Θ_2 is the probability of a female of not having 100% mortality among its offspring.

C.1.7. Hierarchical analysis of Atlantic salmon stock–recruit data

A hierarchical analysis of Atlantic salmon stock–recruit data has been undertaken to come up with prior distributions for the steepness parameter of the stock–recruit function for Baltic salmon stocks (Michielsens and McAllister, 2004).

Data

Until year 2008 assessment, data from river Ume/Vindel was used in the hierarchical stock–recruit analysis together with the data from other Atlantic salmon stocks (ICES 2008). This reflected the idea that by incorporating the stock–recruit data of at least one Baltic salmon stock, the resulting probability distribution for steepness could be used for any unsampled stock, including Baltic salmon stocks which may in certain aspects differ from Atlantic salmon stocks from outside the Baltic Sea area. However, because of this the stock–recruit parameters of river Ume/Vindel were not updated in the full life-history model and it resulted in major problems with some posterior estimates of Ume/Vindel stock–recruit parameters. As a solution to this problem, Ume/Vindel was removed from the stock–recruit analysis and it was treated similarly in the full life-history model as all the other Baltic stocks.

Consequently, the stock–recruit analysis to obtain priors for the Baltic stocks is now based on data only from Atlantic salmon stocks outside the Baltic Sea. This is deemed justified since the stock–recruit parameter values of Ume/Vindel were not extreme compared to other Atlantic salmon stocks (ICES 2008). It is an indication that the range of values of stock–recruit parameters obtained from outside Baltic may well cover also the range of parameter values prevailing among Baltic stocks.

Methodology

A detailed description of the model used for the hierarchical analysis of stock–recruit data can be found in Michielsens and McAllister, 2004. Because the Beverton–Holt stock–recruit function has a much higher probability of being more suitable for Atlantic salmon than the Ricker function (Michielsens and McAllister, 2004), the current analysis will only be using this stock–recruit relationship.

The results for the steepness parameter are presented in Table C.1.7.1. For the Atlantic salmon stocks within the Northern Baltic Sea area (assessment units 1 to 3), it is assumed that the mean steepness across all Atlantic salmon stocks can be regarded as the prior distribution for the mean steepness and that the variance of the steepness among Atlantic salmon stocks can be used as the variance of the steepness of Northern Baltic salmon stocks. It is assumed that the mean steepness across the Southern Baltic salmon stocks (assessment unit 4) is lower than the mean steepness across the Northern Baltic salmon stocks but the variance in steepness across the southern stocks is given the same prior probability distribution as for the northern stocks (Prévost *et al*., 2003).

Table C.1.7.1. Mean and CV for the posterior probability distribution of the steepness for the Beverton–Holt stock–recruit function for Atlantic salmon. The posterior predictive distribution for an unsampled Atlantic salmon stock is used as a prior probability distribution for any unsampled Atlantic salmon stock in the Baltic Sea area.

	Posterior distributions	
Stock	mean	CV
Little Codroy river	0.79	0.13
Margaree river	0.66	0.19
Pollett river	0.74	0.14
Trinite river	0.79	0.13
Western Arm Brook	0.64	0.23
river Bush	0.70	0.19
river Ellidaar	0.72	0.19
river Oir	0.70	0.19
river Bec-Scie	0.67	0.19
Unknown Atlantic salmon river	0.71	0.20

C.1.8. Sea mark–recapture model for assessing the exploitation of Baltic salmon

Based on various data from fisheries and the sea and spawning migration of salmon it is possible to estimate population dynamics and harvesting of salmon from smolt to spawner. This is dealt with under this section.

Data

For the mark–recapture model, fishing effort data and tagging data have been used. The fishing effort data have been divided in separate coastal fishing efforts for stocks of assessment unit 1 to 3. The Swedish trapnet effort in Subdivision 31 has been divided between assessment units 1 and 2 with respective proportions of 45% and 55%. An overview of the number of tagged hatchery-reared and wild salmon released in rivers of assessment units 1, 2 and 3 can be found in the WGBAST report. Wild salmon have been tagged only in assessment unit 1.

For several of the parameters needed within the assessment model, basic data are fragmented and limited (e.g. tag reporting rates) or not simply not available (e.g. underreporting of catches). Instead of using the common approach of relying on expert opinions as such to extrapolate the data into parameter estimates, a more formalized approach has been used. For each parameter within the assessment model, twelve experts have been asked to provide a most likely value and a minimum and maximum value during a meeting at Bornholm in 2003 (ICES 2003). These expert opinions were based on data obtained from previous studies done, on literature, on the experts' experience or were subjective expert estimations in case no other information was available. Preliminary analyses, used for the formulation of prior probability distributions, included among others information from the broodstock fisheries, double tagging experiments, etc. Care has been taken to assure that the prior distributions were not based on data used within the mark–recapture model in order to avoid using the same data twice and thus rendering the results too informative. In general, these preliminary analyses gave often only a first indication of the model parameters but expert opinion needed to be used for example to extrapolate it to the entire Baltic Sea, or to other fisheries, etc.

The use of multiple experts resulted in multiple priors for the different model parameters. Model parameters such as the reporting rates of tags are dependent on the country. As such, the probabilities distributions for each country have been weighted by the country's contribution to catches of salmon and arithmetic pooling of the priors has been applied (Genest and Zidek, 1986; Spiegelhalter *et al.*, 2004). For other priors each expert is assumed to have equal expertise, arithmetic pooling without weighting of the priors has been applied. A description of the different model parameters and their prior probability distribution has been provided by ICES 2005.

The expert elicitation was carried out for the first time in 2003 (ICES 2003). At that time the elicited experts were mainly the members of the WGBAST. The resulting reporting rates have been used in the Baltic salmon assessments in years 2003–2012. However, because of the changes in the Baltic salmon fishery the WG saw appropriate to repeat the expert judgement in autumn 2012. The biological parameters were excluded and the focus was solely on tag reporting, unreporting of catch and effort and rate of discards in different fisheries. This time wider group of people including persons working with fisheries inspection and in fisheries statistics departments and also some fishermen were interviewed. The expert judgements from 2012 cover years 2004–2012 and resulting conversion factors replace the old estimates in 2013 assessment for the years concerned. The results from 2003 elicitation are used for years 1987–2003. Summary of the uncertainties associated to tag reporting and fishery can be found in the WGBAST report.

Methodology

The mark–recapture model is run within the full life-history model (Section C.1.9 below) and therefore separation of the descriptions of these two models is somewhat artificial. A state–space formulation is adopted to account for uncertainties in system dynamics and the observation process. The population dynamics model used within the mark–recapture analysis is age-structured and different fisheries are assumed to take place sequentially over time (Figure C.1.8.1). A detailed description of the model can be found in Michielsens *et al.*, 2006. The main difference between the model used by WGBAST and the one presented in this paper is that for the working group the model has been expanded to include assessment units 1 to 4 instead of only assessment unit 1. The main assumptions about the salmon stocks in the model are:

- The maturation rate for wild grilse is lower than that of the hatchery-reared grilse (Kallio-Nyberg and Koljonen, 1997; Jutila *et al.*, 2003).
- The post-smolt mortality rate of hatchery-reared fish is considered to be higher than that of wild fish (Olla *et al.*, 1998; Brown and Laland, 2001). The difference in post-smolt mortality rates between wild and reared salmon is modelled with an effect term which states that the instantaneous post-smolt mortality for reared salmon is the mortality of wild salmon times the effect term. The year specific effect terms are sampled from a distribution with common hyper parameters.
- The instantaneous natural mortality rate for adult salmon is allowed to differ between wild and reared salmon, but within both groups it is assumed to be constant over the years (except the mortality caused by seals along the coast, see below).
- On the coastal spawning migration of the Gulf of Bothnia seals are assumed to capture salmon at the entrance or outside the trapnets; this extra source of natural mortality is assumed to have increased proportionally to the increase of the Baltic seal population since 1989. This increase is incor-

porated by a coefficient which is given value=1 for year 1989 and which increases proportionally to the development of seal abundance.

- It is assumed that all adults die after spawning.

The main assumptions about the fishery in the mark–recapture model are:

- Stocks belonging to the same assessment unit experience the same harvest rates.
- Harvest rates between salmon stocks of assessment unit 1 to 4 mainly differ in the coastal fisheries and it is assumed that no coastal fishery exploits the salmon of assessment unit 4.
- The catchability coefficients for the different offshore and coastal fisheries are assumed constant over the years.

For each year, the model estimates different fishing mortality rates depending on the fishery (offshore driftnet, offshore longline, coastal driftnet, trapnet and gillnet and river fishery), depending on the age of the fish, and depending on whether it is a wild or hatchery-reared fish.

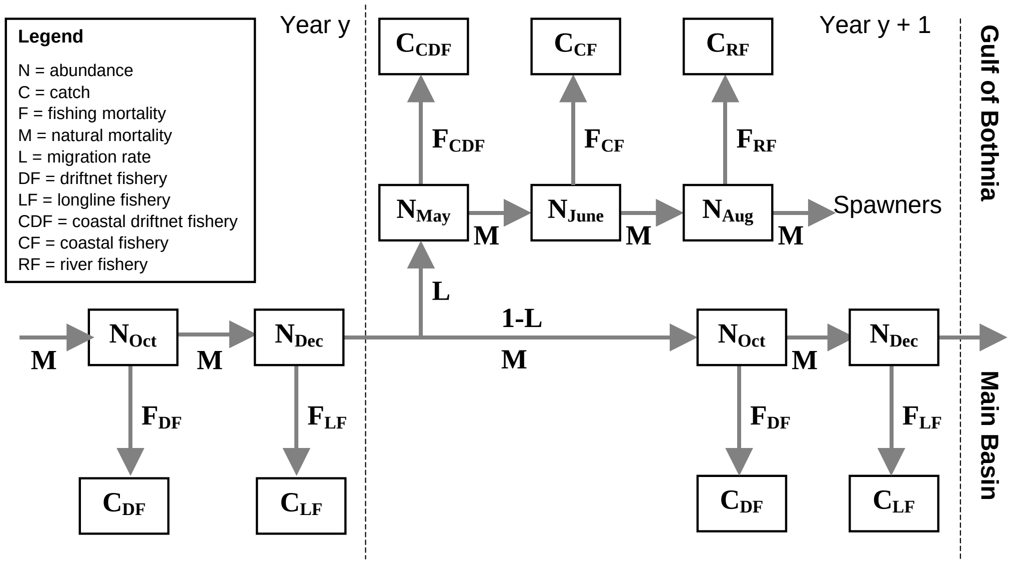

Figure C.1.8.1. Schematic presentation of the mark–recapture model for Baltic salmon. The offshore driftnet and longline fisheries in the Baltic Main Basin are assumed to take place in October and December, respectively. During the migration to the spawning grounds, the salmon can be intercepted by the coastal driftnet fishery in May, the trapnet and gillnet fisheries in June and the river fishery in August (Michielsens *et al.*, 2006).

C.1.9. Full life-history model of different wild Baltic salmon stocks

Spawner abundance estimates has been obtained by using the wild smolt abundance estimates of different rivers (Section C.1.5) with similar population dynamics as within the mark–recapture model (Section C.1.8; Michielsens *et al.*, 2006; Michielsens *et al.*, 2008). By linking the derived egg abundance estimates with the wild smolt abundance four years (in the case of Gulf of Bothnia stocks, assessment units 1–3) or three years (in case of assessment unit 4 stocks) later, it is possible to estimate stock–recruit parameters. The resulting stock–recruit function makes the loop between salmon generations and the estimates of abundance and survival parameters become updated across the time-series. The resulting posterior distributions are then used to assess the stock status and to predict abundance into the future.

Data

Both total number of wild smolts and number of released hatchery-reared smolts are used as inputs into the model. The model is also fitted to offshore, coastal and river catches. The Polish catch has been calculated by multiplying Polish effort with combined Danish, Finnish, Swedish and Latvian catch per unit of effort, assuming 75% of the fishing efficiency for Polish fishermen compared to others (see Section B). The Swedish trapnetting effort has been approximated by using Swedish catch data and Finnish catch per unit of effort for trapnetting, assuming 80% fishing efficiency for Swedish fishermen compared to the Finnish ones. Also, Swedish recreational trapnet fishery is assumed to have 80% of the efficiency of the Swedish commercial trapnet fishery. The number of salmon mauled by seals (discards) in coastal trapnets of the Gulf of Bothnia is calculated based on reports of Finnish fishermen.

Because assessment units 5 and 6 have not yet been included in the model, the catches have been raised by the proportions of smolts produced in these assessment units in comparison to the total smolt production of all units. In addition, the model also uses the data on the spawner counts in the rivers Ume/Vindelälven, Kalixälven, Tornionjoki/Torneälven, Simojoki, and the data on proportion of MSW (multi-sea-winter) spawners encountered in the rivers Tornionjoki, Kalixälven, Byskeälven, Ume/Vindelälven and Öreälven. The model also utilizes trap catches and the associated mark–recapture experiments of reared spawners in the rivers Dalälven in 2004–2011 and Luleälven in 1996, 1997 and 2001.

Data available about the relative occurrence of wild vs. reared salmon in catches is utilized from the river Tornionjoki (all years) and from offshore fishery (years 1996, 1998, 2001–). The data from the offshore fishery consists of the samples used for the genetic and scale reading analyses (see Section B), supplemented with some samples left outside the current genetic analyses.

By linking the wild spawner abundance produced from the yearly smolt production, with the smolt production four years (three years for AU4) after the year of spawning, it is possible to obtain stock–recruit information for wild salmon stocks. For each stock, the estimated abundances of spawners of different ages are multiplied with corresponding sex ratios and fecundity values (eggs/female) in order to estimate the total number of eggs deposited in each river in each year. The resulting number of eggs has been corrected for the effect of M74 by multiplying the estimated number of eggs with the percentage of yolk-sac-fry mortality due to the occurrence of M74 (Section C.1.6). In case no M74 data have been available for certain river stocks, the predictions of M74 related yolk-sac-fry mortality for unknown stocks are used.

Methodology

The population dynamics for the total abundance of salmon is expressed by similar equations as the population dynamics for the abundance of tagged salmon (Michielsens *et al.*, 2006). In order to estimate salmon catches, the tag reporting rates within the catch equation for tagged salmon have been replaced by the catch reporting rates. The main model outputs are the estimated stock–recruit parameters, i.e. the steepness parameter and the PSPCs.

The model simultaneously models the tagged salmon population and the total salmon population. For tagged salmon, the population equations account for tagging induced mortality, tag shedding and underreporting of tagged salmon catches. Based on the tagging data, the model is able to estimate maturation rates, natural mortality rates, and harvest rates. These estimates are then used to model the total salmon population based on the number of wild and released hatchery-reared salmon smolts. In order to estimate the coastal and river catches, the corresponding equations account for possible underreporting of the salmon catches. The probability distributions for the wild smolt abundance will be used as priors until the year 1992 for which the model is able to calculate the smolt abundance using the estimated number of spawners and the stock–recruit parameters. From that year onwards, the model can be fitted to the smolt abundance estimates instead of using them as priors. The entire model has thus been fitted to tagging data, catch data, catch composition data, data on the composition and counts of the spawning run, and data on smolt and parr abundance.

The prior probability distributions of the smolt production capacity for the different river stocks have been obtained by Uusitalo *et al.*, 2005 (Section C.1.3), based on expert opinions. The prior distribution for the steepness in each river has been derived by the hierarchical model described in Section C.1.7. These priors become updated by the full life-history model taking into account all available data.

Fishladder counts of spawners in rivers Kalixälven, Tornionjoki/Torneälven and Simojoki have been fitted with the amount of spawners ascending to the river. Probability for a spawner to be observed in the counter has been allowed to vary between years around a common mean. The model has been fitted also to the fishladder counts of spawners for river Ume/Vindelälven. Here, the ladder counts are assumed to indicate the maximum limit for the number of spawners in Ume/Vindelälven, because river fishing harvests salmon that pass the ladder. A separate parameter defines the success of ascending fish to find the fishladder. This parameter is given a prior distribution based on the results of tagging studies carried out in the river. The Ume/Vindelälven data are only used until 2009. A new fishladder in 2010 and a change in the flow regime in the fishladder area in 2011 makes older tagging studies less representative of the current situation.

In the river Luleälven, it is assumed that all salmon had reached the uppermost part of the river by the time of mark–recapture experiments. It is further assumed that the salmon are moving around randomly in the area and that all individuals have the same probability to enter the trap. However, the experiment period differs from year to year, and thus the data needs to be standardized with the period length (in days) since the possibility for a fish to enter the trap increases as the number of experiment days increases. A small observation model is fitted for the standardized mark–recapture experiment data to estimate the catchability of the trap. The data on total number of salmon caught by the trap is also standardized, and together with the mark–recapture data it provides an estimate of the total number of salmon surviving to the uppermost part of the river. This information is fitted with the model predicted abundances of reared fish in the Luleälven within the full life-history model.

Data on river Dalälven surviving salmon is modelled similarly as in Luleälven case, but in Dalälven there is no need to standardize the data with the number of experiment days. In the river Dalälven case, the prior distribution is given for the mean catchability of the trap and its variation over the years based on the information from continuous mark–recapture studies. This means that for river Dalälven, the original mark–recapture data are not included to the model (as is the case for Luleälven) since the prior distribution is informative enough in itself.

The model is fitted to time-series on the proportion of wild vs. hatchery-reared spawners in river catches from Tornionjoki/Torneälven. The model is also fitted to time-series of wild/reared proportions in catch samples from the offshore fishery. Because the offshore catch samples clearly consist of separate samples in time and space within each year, the wild/reared proportions were first analysed on annual basis using a hierarchical Bayesian model which allows estimation of true proportions from samples (Samu Mäntyniemi, unpublished). The results of this submodel were fed in the full life-history model as priors.

Estimation of post-smolt mortality. The first year at sea (post-smolt stage) is known to be critical for salmon because a large proportion of the marine mortality occurs within this period. Virtually no data exist about this stage of salmon's life, and therefore it is largely unknown what the exact processes are in this period and how they affect survival of salmon. Instead, data exist just before the period (smolt production estimates for wild salmon and stocking statistics for reared salmon) and also right after the period when salmon recruit to the fisheries and grilse mature. The post-smolt survival is year (i.e. smolt cohort) specific and the parameter aggregates all information about the total mortality within the post-smolt period. The parameter estimate is basically directly calculated from the difference in abundance estimates just before and right after the period. It should be noted that the abundance estimate after the post-smolt stage is derived from and strongly affected by all the accumulating information about the cohort specific abundance at later ages (as discussed above; catches, tag recaptures, spawner counts, etc.).

C.1.10. Uncertainties affecting the assessment results

Data deficiencies

The main information on the exploitation of wild salmon in the Baltic comes from mark–recapture data. The problem with these data is that they are geographically biased. All tag recapture data are representing salmon from AU 1–3, and wild salmon have been tagged only in AU1.

The fishing effort of the Swedish coastal fisheries by trapnet and other gears (predominantly gillnet fisheries) for the entire time-series have been based on the cpue of Finnish coastal fisheries. Also, the proportion salmon which is mauled by seals in the entire trapnet fishing is based on reports of the Finnish fishermen.

Uncertainties expressed by the prior probability distributions of the model parameters

For rivers with a lot of data such as Tornionjoki, the prior probability distributions for the smolt production capacity has been updated substantially, limiting the influence of the expert based prior probability distribution for the smolt production capacity. Other rivers such as the river Öreälven, for which not many data are available, the smolt production capacity is primarily updated due to the correlation between the smolt production capacity estimates of different rivers.

Prior probability distributions for the parameters of the sea mark–recapture model have been provided by twelve experts based on previous studies, on literature, on the experts' experience or were subjective expert estimations in case no other information was available. A table with all prior probability distributions are described in Michielsens *et al.*, 2006. With exception of the prior probability distributions of the catchability coefficients, the prior probability distributions for the model parameters have been given rather informative distributions. Sensitivity analyses have indicated, as could be expected, that results are to a large extent dependent on the prior probability distributions for the reporting rate and biological model parameters and to a very limited extent on the prior probability distributions for exploitation rates (Michielsens *et al*., 2006).

Uncertainties regarding the model assumptions and model structures of the estimation model

Given the large number of different methodologies used for the assessment of Baltic salmon stock, the model assumptions are described in the sections relating to the different methodologies.

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 still being used. This 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 structure of habitat use (Walters and Korman, 2001). If this phenomenon is valid for the Baltic salmon populations, our analysis of the recent stock–recruit information underestimates long-term (full) carrying capacity of the Baltic rivers.

Tag shedding and mortality

Possible sources of error in application of results from tagging experiments include the question of differential mortality between tagged and untagged fish and when this (possible) mortality occurs, also tag shedding (loss of tags) and whether this is related to the size of the fish. Possible difference in growth rate of tagged and untagged fish could be a problem. Reporting rate (proportion) of the tags caught in different fisheries are also important pieces of information to be able to use tagging data.

A considerable mix-up of these different factors is likely and in most cases it is difficult to keep the different factors apart.

It is vital for the tagging studies to have at least an overall estimate for tag shedding rate. Some information on salmon can be found in the data from Swedish broodstock fisheries in Gulf of Bothnia based on numbers of fish released in each year in 1987–1998 and the number of fish recovered in year 1990–1999. It is assumed that all tags in these fisheries are reported and therefore they can be used to elucidate the combined effect of tag shedding and difference in mortality between tagged and untagged. If the recovery rate in broodstock fisheries is compared with tag recoveries in rivers and river mouth areas, data on reporting rates can be calculated.

It is assumed that the best dataset is available from River Dalälven, which has a meticulous control of the number of the fish caught in the broodstock fishery. There is also a very good organization of the angling in this river and the catch statistics in this river is therefore assumed to be of particularly high class. The data from this river suggests that the tag shedding/mortality remove about 30% of the number of tags.

Comparison between model predictions and results from mixed-stock analyses

Previous comparisons between stock proportion estimates in catches (based on mixed-stock analyses) and model predictions of the stock composition in the Main Basin indicate that there is a good overall agreement between the two methods in the proportion of both wild and reared salmon. Not only the overall proportions of wild and reared salmon are in agreement, but also AU specific and even stock-specific catch proportions are in fair agreement between the model results and the results of genetic analyses of catches. Apparently, previous changes in the model structure and the expanded use of available data (fitting the model to proportion of wild vs. reared salmon in catch samples from offshore fishing, and to spawner counts in Dalälven, Luleälven, Tornionjoki/Torneälven and Simojoki) has greatly improved the performance of the model.

Nevertheless, there is a possibility that the present offshore fishing occur in areas where some stocks may be partly missing. For example the reared Daugava salmon has been observed in unexpected small proportions in the offshore catch samples which are taken from the Subdivisions 25 and 26 in the southern Main Basin. Neva salmon has been stocked in the Finnish Bothnian Sea; salmon of this strain has been shown to migrate shorter distances at sea than the strains of the Gulf of Bothnia salmon. Moreover, reared large smolts stocked in the Gulf of Bothnia are shown to stay on more northern feeding areas than smaller smolts. This together with the most recent spatial aggregation of offshore fishing to the southwesternmost part of the Baltic Sea may lead to stock/origin/strain specific differences in the offshore harvesting, which is not taken into account in the current model assumptions. Therefore it would also be important to further explore the distribution pattern of the feeding salmon vs. the distribution of the fishery.

Misreporting in the Polish longline fishery

Polish salmon catches has been corrected for the fact that a large proportion of the catches is misreported as being trout. The Polish longline catch of salmon was calculated from data on Polish effort and combined Finnish, Swedish and Danish cpue times a correction factor of 0,75. High-quality inspections are needed to give a reasonably precise estimate of the salmon catch in the Polish longline fishery, and to evaluate if the deviations from the corrected values are large enough to affect the assessment results. In 2012 European Fisheries Control Agency (EFCA) has included Baltic salmon fishery in the Joint Deployment Plan (JDP), which probably will gradually diminish the occurrence of misreporting. This would decrease the uncertainties of assessment result that are caused by this inaccessible catch component.

C.2. Assessment of salmon in eastern Main Basin (AU 5)

An overview of the different types of data available for salmon in AU 5 can be found in Table C.2.1.

Table C.2.1. Overview of the different types of data available for salmon in AU 5. The table also indicates for which stocks the current assessment methodology is estimating smolt abundance, spawner abundance and associated stock–recruit function. River categories: W=wild, M=mixed, R=reared.

River identification					Data									Estimates		
River	ICES subdiv	Category	Country	IBSFC index river	M74 data	Electrofishing survey	smolt trapping	tagging data	fish ladder/counter data	broodstock fishery	river catches	age structure	Genetic baseline	smolt estimates	spawner estimates	S/R parameters
Assessment group 5: Eastern Main Basin														x	x	x
Pärnu	28	W	EE	x		x							x	x	x	x
Salaca	28	W	LV	x		x	x	x				x		x	x	x
Vitrupe	28	W	LV											x	x	x
Peterupe	28	W	LV			x								x	x	x
Irbe	28	W	LV											x	x	x
Uzava	28	W	LV											x	x	x
Saka	28	W	LV											x	x	x
Barta	28	W	LV/LT											x	x	x
Gauja	28	M	LV			x		x					x	x	x	x
Daugava	28	M	LV					x					x	x	x	x
Venta	28	M	LV			x							x	x	x	x
Nemunas	26	M	LT	x		x							x	x	x	x
Minija	26	R	LT	x												
Lielupe	28	R	LV					x								

For AU 5, the full life-history model described in Section C.1.9 is run separately from AU 1–4. The model relies on several simplifying assumptions about salmon in this area (see below), and is used to assess current population status by comparing smolt production to the 50% and 75% level of the estimated natural production capacity on a river-by-river basis. Because of the limited amount of data available from AU 5, the estimates obtained for these rivers are not as reliable as for the other AUs. The following input data are used in the model:

- Prior probability distributions for the smolt production capacity that are mainly based on expert opinions (Table C.2.2). These estimates are not based on the Bayesian modelling of expert knowledge applied for northern rivers and are therefore considered to be less reliable. There is a concern that the probability distributions provided by experts, and which describes the uncertainty about our knowledge of production capacity, may be unrealistically narrow.
- Smolt production estimates derived mainly from electrofishing data using various methods that are based on the relation between parr and smolt abundances in the same and/or other rivers. These estimates do not usually contain information about uncertainties. For some rivers, smolt production estimates are completely based on data derived from other (similar) rivers in the region.
- Estimates from the full life-history model on annual harvest rates for offshore fisheries (thus assuming the same at sea migration pattern as for Gulf of Bothnia salmon).
- Estimates from the full life-history model on adult natural mortality (fixed over time) and annual post-smolt mortalities (thus assuming the same at sea survival as for Gulf of Bothnia salmon).

Table C.2.2. Prior probability distributions for the smolt production capacity (* 1000) in Baltic salmon rivers in assessment unit 5. The prior distributions are described in terms of their mode or most likely value, the 95% probability interval (PI) and the method on how this prior probability distribution has been obtained. These priors will be updated when fitting the Beverton–Holt stock–recruit function to the available stock–recruit data (see text and Section C.1.9).

		Smolt production capacity (thousand)		Method of
		Mode	95% PI	estimation
Assessment unit 5				
16	Pärnu	3.5	2.2-6.2	1
17	Salaca	30	26-35	2
18	Vitrupe	4	2.6-7.2	2
19	Peterupe	5	3.2-9.	2
20	Gauja	28	18-51	2
21	Daugava	10	6.-18	2
22	Irbe	4	2.6-7.2	2
23	Venta	15	10.-27	2
24	Saka	8	5.-14	2
25	Uzava	4	2.6-7.2	2
26	Barta	4	2.6-7.2	2
27	Nemunas river basin	150	96-269	2
Total assessment unit 5		291	218-395	

Method of estimation of smolt production capacity

1 Accessible linear stream length and production capacity per area

2 Expert opinion with associated uncertainty

In a similar way as for salmon in AUs 1–4 (Section C.1.9), stock–recruit parameters for AU 5 rivers are estimated by linking the derived egg abundance estimates with the wild smolt abundance two years later. The resulting stock–recruit function makes the loop between salmon generations and the estimates of abundance and survival parameters become updated across the time-series. The resulting posterior distributions are then used to assess the stock status.

C.3. Assessment of salmon in Gulf of Finland (AU 6)

For AU 6 salmon, there is no analytical assessment model developed. The assessment of population status is based on a qualitative assessment taking into account trends in parr densities, smolt production and exploitation rates. Expert opinions on natural production capacities are available for AU6 rivers, but no analysis of the stock–recruit dynamics exist at the moment, precluding validation of these preliminary production values.

An overview of the different types of data available for salmon in AU 6 can be found in Table C.3.1.

Table C.3.1. Overview of the different types of data available for salmon in AU 6. As can be seen, there is no analytical assessment model developed which could estimate smolt and spawner abundances, and associated stock–recruit functions. River categories: W=wild, M=mixed, R=reared.

River identification					Data									Estimates		
River	ICES subdiv	Category	Country	IBSFC index river	M74 data	Electrofishing survey	smolt trapping	tagging data	fish ladder/counter data	broodstock fishery	river catches	age structure	Genetic baseline	smolt estimates	spawner estimates	S/R parameters
Assessment group 6: Gulf of Finland																
Kunda	32	W	EE	x		x							x			
Keila	32	W	EE	x		x							x			
Vasalemma	32	W	EE			x										
Purtse	32	M	EE			x					x					
Selja	32	M	EE			x					x					
Loobu	32	M	EE			x										
Valgejõgi	32	M	EE			x					x					
Jägala	32	M	EE			x					x					
Pirita	32	M	EE			x	x				x	x				
Vääna	32	M	EE			x					x					
Luga	32	M	RU	x			x						x			
Neva	32	R	RU		x								x			
Karjaanjoki	32	R	FI													
Narva	32	R	RU/EE										x			

D. Short-term and long-term projections

Salmon in AU 1–4

Model used: Simulations based on full life-history model

Software used: R

Initial stock size: Stock and year specific numbers of smolts. Stock and year-specific numbers of fish by sea age group at sea in the first of May. Uncertainty included.

Maturity: Age-specific maturation rates estimated by full life-history model. Uncertainty included.

F and M: M is divided between post-smolt stage and 'adult' ages. M for post-smolt stage ('Mps') is assumed to hold the autocorrelation structure observed in the past, and the median value of it is assumed to return to a chosen value in the long term. M for 'adult' ages is same as estimated by the full life-history model. M74 mortality is assumed to vary within the limits of the observed range of values, but assuming the same autocorrelation structure as observed in the past. Fishery specific F's are dependent on assumed future effort through catchabilities which are estimated in the full life-history model.

Weight-at-age in the stock: Not used.

Weight-at-age in the catch: Not used.

Exploitation pattern: Same as in the last observed year.

Intermediate year assumptions: Same exploitation pattern as in the last observed year. Offshore fishing effort in the first months of the year are assumed known (no uncertainty) based on observed effort in the last months of the last observed year and by assuming similar division of effort between winter as observed one year before. Coastal fishing effort is based on expert opinions (uncertainty included).

Stock–recruitment model used: Stock-specific Beverton–Holt models estimated by the full life-history model. Uncertainty included.

Procedures used for splitting projected catches: Projections provide predictions of total removals with a given effort level. Splitting catches is based on the last observed year. The relative proportions of reporting, unreporting and discarding are assumed to stay the same as in the last year with observations.

Salmon in AU 5–6

No stock projections are made.

D.1. Description of stock projections

Projections are carried out for all rivers in assessment units 1–4. Due to the length of the life cycle of salmon and the chosen reference points (see G) projections are extended to at least six years into the future. There are no separate short-, medium- and long-term projections with different approaches.

The effects of various TAC decisions are screened stepwise by decreasing/increasing the last observed effort and by applying these alternative effort levels into the future. The stock projections are also based on scenarios for future post-smolt survival and M74 mortality.

Methods

In order to make forward projections, the salmon life cycle with the most relevant life-history parameters are copied from the full life-history model into a separate calculation platform. Joint posterior distributions describing the latest knowledge of the number of smolts and population parameters are also derived from the full life-history model (see Section C.1.9) and stored in the form of indexed MCMC chains. The estimates are stored up to the last year with observations about the parameter in concern. Scenarios are run by using R software (R Development Core Team, 2009).

Assumptions regarding biological parameters

The population dynamics for the stock projection analysis is similar to the full life-history model but lacks the process errors in the different survival parameters. In addition, only average annual M74 mortality is included in the stock projections instead of river-specific mortalities.

The two annually varying key parameters determining the natural survival of the salmon, i.e. post-smolt survival (Mps) and survival from M74 mortality are assumed to vary within the limits of the observed range of values, but assuming the same autocorrelation structure as observed in the past. The forward projection for Mps begins already from the assessment year -1 because of the absence of data containing information about the survival in that year. For M74, the projections start from the assessment year. Simulations are typically run for only one scenario about Mps: the median of which is expected to return to the lowest value in the historic time-series. Alternative scenarios can be executed if e.g. there are reasons to believe that Mps may improve in future. Survival from M74 mortality is expected to return to the median survival observed in the historic time-series.

Assumptions regarding development of fisheries

Scenarios for fisheries are implemented by making different scenarios for future development in effort. As an example, the key assumptions underlying the stock projections used by WGBAST in 2012 (ICES 2012a):

Scenario	Fishing effort for year 2013 and onwards
1	2011 level excluding Swedish longlining
2	-20% from level in scenario 1
3	-40% from level in scenario 1
4	-60% from level in scenario 1
5	-80% from level in scenario 1
	Post-smolt survival of wild salmon
	Projection starts from the 2010 survival estimate and is expected to approach the 2009 survival (7.5%) in the long run
	Post-smolt survival of reared salmon
	Same relative difference to wild salmon as on average in history
	M74 survival
	Projection starts from the 2011 survival estimate and is expected to approach the historical median (92%) in the long run

Survival values shown in the table represent the medians to which Mps and M74 are expected to return as explained above. Decisions which change management between the historic and future time-series can be taken into account if made before assessment. In the above example, the decision to ban longlining from 2013 onwards was made in Sweden before the 2012 assessment. The other fisheries would fish equally to their 2011 effort (scenario 1), or there would be either a 20% (scenario 2), 40% (scenario 3), 60% (scenario 4), or 80% (scenario 5) reduction in their effort compared to scenario 1. Also expert opinions about the country-specific development of the effort (with uncertainty) can be derived and applied in an alternative scenario. Expert opinions about the development of effort are needed anyway for coastal fisheries in the interim year.

European Commission has proposed to set TAC based on harvest rule F=0.1 (European Commission 2011). TAC based on this harvest rule can in principle be calculated directly from the stock abundance estimate. However, guidelines would be required to specifying how uncertainties in estimates should be taken into account and what would need to be assumed about the development of fisheries which is not controlled by TAC.

Evaluation of management alternatives

The future development of smolt production under different scenarios is evaluated in two ways:

1) River-specific probabilities to meet the 75% target is calculated for each future year, with a special emphasis on the smolt production of the years mostly affected by management measures in the year the advice is given for.

2) Changes in the river-specific probabilities to meet the 75% target from the current situation compared to one full generation into the future. The length of a salmon generation is on average seven years for AU 1–3 and six years for AU 4 river stocks. By comparing the current status with the status one generation ahead, the effect of a cyclic fluctuation in population abundance can be removed and the effects of different effort scenarios on the future development of stocks can be better evaluated.

Uncertainties regarding the stock projections

There are two differences between assumptions of the full life-history model and the population dynamics model which is used in projections.

1) Process error is lacking in all other survival processes except in recruitment (S/R dynamics). Excluding process error from the predictive model leads to results that are less variable than they would be if process errors in survival were included. Deterministic survival process in forward projections may underestimate the variation in probabilities to reach management targets in predictions.
2) Average values for M74 are used in the projection model instead of river-specific values used in the estimation model. River-specific differences in M74 mortality are therefore lost, which may lead to generally more uncertain river-specific projections.

Assuming a known offshore fishing effort in the interim year underestimates the uncertainties in stock size at the beginning of the year for which advice is given.

G. Biological reference points

There are no objectives with corresponding reference points agreed for the current management of Baltic salmon.

The working group evaluate the probability to reach 50% and 75% of the **Potential Smolt Production Capacity** (PSPC) in each river. Reaching at least 50% of the PSPC by 2010 in each river has been the objective of the Salmon Action Plan (SAP), defined by the former IBSFC. Reaching at least 75% of the PSPC has been suggested by ICES if the plan is to recover salmon river stocks to the MSY level (ICES, 2008b; ICES, 2008c). The objective of reaching at least 75% of the PSPC is also adopted in the Commission's proposal for establishing a multiannual plan for the Baltic salmon stock (European Commission, 2011), and is also used as a basis for ICES advice on fishing possibilities. The PSPC estimates therefore form the basis of the current reference points for the assessment of the Baltic salmon stocks.

There is a considerable amount of uncertainty associated to these reference points. All the model parameters including PSPC are updated every year when new data become available, and comparisons of the assessment year and the previous year's PSPC estimates are provided in the annual WGBAST report.

For salmon in AU 6 (Gulf of Finland), no analytical assessment model has been developed (see Section C.3 above). Preliminary Potential Smolt Production Capacity (PSPC) values have been proposed based on expert opinions but no stock–recruit data exist at the moment, precluding validation of these preliminary PSPC values. Thus, it is currently not possible to evaluate the management objectives for rivers in AU 6. Determination of status of rivers in AU6 is instead based on a qualitative assessment taking into account trends in parr densities, smolt production and exploitation rates.

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Annex 4: Parameter transformation equations for Triangular and Lognormal distributions

Parameter transformation equations for Triangular and Lognormal distributions

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March 29, 2005

1 Triangular distribution

Parameters of the triangular distribution are usually

a the lower bound of the distribution

b the upper bound of the distribution

c the mode of the distribution

Given that a, b and c are known, the following statistics can be calculated

$$\mu = \frac{a+b+c}{3} \tag{1}$$

$$\sigma^2 = \frac{a^2+b^2+c^2-ac-ab-bc}{18} \tag{2}$$

$$Med = \begin{cases} \frac{2a+\sqrt{2a^2+2c(b-a)}}{2} & ,c \geq \mu \\ \frac{2b-\sqrt{2(b-a)(b-c)}}{2} & ,c < \mu \end{cases} \tag{3}$$

2 Lognormal distribution

Let x be a Lognormally distributed random variable. The usual parameterization of the Lognormal is to use the mean M and variance S^2 of $\log(x)$. Given that these are known, the following statistics of x can be calculated

$$\mu = e^{M+\frac{1}{2}S^2} \tag{4}$$

$$\sigma^2 = e^{2M+S^2}(e^{S^2}-1) \tag{5}$$

$$Med = e^M \tag{6}$$

$$Mo = e^{M-S^2} \tag{7}$$

$$CV = \sqrt{e^{S^2}-1} \tag{8}$$

The inverse transformation from the statistics of x to the statistics of $\log(x)$ is simply

$$M = \log(Med) \tag{9}$$
$$S^2 = \log((CV)^2 + 1) \tag{10}$$
$$\tag{11}$$

Relationships between statistics of x can be then derived, for example

$$\mu = Med \times \sqrt{(CV)^2 + 1} \tag{12}$$
$$Mo = \frac{Med}{(CV)^2 + 1} \tag{13}$$
$$\sigma^2 = (Med)^2 \times ((CV)^2 + 1) \times (CV)^2 \tag{14}$$
$$\mu = Mo \times ((CV)^2 + 1)^{\frac{3}{2}} \tag{15}$$
$$\sigma^2 = (Mo)^2 \times ((CV)^2 + 1)^3 \times (CV)^2 \tag{16}$$

Annex 5: OpenBugs model

OpenBugs model for computing estimates for unreporting, discarding and total catch estimates for years 2001–2012. Different catch components (pdfs) can be summed up by country, management unit and Baltic Sea level.

```
# * * *
# This model is computes pdfs of discarding, unreporting and total catch for T2.2.1 and T2.2.2 and also
separate estimates for discarding in different fisheries
# Data comes from WGBAST database.

model{

for (i in 1:12){      # years 2001–2012, the whole Baltic Sea
      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[i,1:9,1:2])+sum(TMisr[i,1:9,1:2]) # for T2.2.1 and T2.2.2
      A_TotCatch_BS[i]<-sum(Tcatch[i,1:9,1:2])
      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[i,k]<-B_TotSeal[i,k]+B_TotDis[i,k]+B_TotUnrep[i,k]  # Estimate of the total unrep,
            misrep and disdards for F2.2.3
      B_TotDisSeal[i,k]<-B_TotSeal[i,k]+B_TotDis[i,k] # Estimate of the total disdards for T2.2.1& T2.2.2

      B_TotRiver[i,k]<-sum(TRiver[i,1:9,k])  # for the F4.3.2.9
      B_TotRecr[i,k]<-sum(TRecr[i,1:9,k])
      B_TotMisr[i,k]<-sum(TMisr[i,1:9,k])
      B_TotCatchCom[i,k]<-sum(TcatchCom[i,1:9,k])

      B_TotSeal[i,k]<-sum(Tseal[i,1:9,k])
      B_TotDis[i,k]<-sum(Tdis[i,1:9,k])
      B_TotUnrep[i,k]<-sum(Tunrep[i,1:9,k])
      B_TotCatch[i,k]<-sum(Tcatch[i,1:9,k])
      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]) #doesn't include FI seal damages
      B_TotLLseal[i,k]<-sum(LLseal[i,1:9,k]) #doesn't include FI & SWE seal damages
      B_TotTNseal[i,k]<-sum(TNseal[i,1:9,k]) #doesn't include FI & SWE seal damages
      B_TotOTseal[i,k]<-sum(OTseal[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 offshore 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

      # Total unreported by year, country and management unit
      Tunrep[i,j,k]<- Ounrep[i,j,k] + Cunrep[i,j,k] + Runrep[i,j,k] +Misr[i,j,k] # misreporting included in to-
      tal unreporting

      TRiver[i,j,k]<- River[i,j,k]*epsilon # Total catch river, recreational sea and misreporting
      TRecr[i,j,k]<- Recr[i,j,k]*epsilon
      Misr[i,j,k]<- Misr[i,j,k]*epsilon

      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 #
                  discards 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         #
                  discards 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       # 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;
                   mainly TN but all coastal caches included

    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


    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[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] #Total discards by year FI
    Tseal[i,j,k] <- Seal[i,j,k] * (1 + Cconv[i,j]/(1-Cconv[i,j]))  #Total seal damages by year corrected with
                   coastal unreporting
    }
for (j in 2:2){     # country 2=SE, seal damages in TN and LLD 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] #Total discards by year SE
    Tseal[i,j,k] <- (Seal[i,j,k] + DNseal[i,j,k]) * (1 + Oconv[i,j]/(1-Oconv[i,j]))
    #Total seal damages by year corrected with offshore unreporting
    }
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
}
}
}

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<-sqrt(0.1246)/0.7716            #Mortality of undersized discarded from longline
MLLM<-log(0.7716)-0.5/MLLtau
MLLtau<-1/log(MLLcv*MLLcv+1)

MDNcv<-sqrt(0.1436)/0.6535            #Mortality of undersized discarded from driftnet
MDNM<-log(0.6535)-0.5/MDNtau
MDNtau<-1/log(MDNcv*MDNcv+1)

MTNcv<-sqrt(0.206)/0.3837             #Mortality of undersized discarded from trapnet
MTNM<-log(0.3837)-0.5/MTNtau
MTNtau<-1/log(MTNcv*MTNcv+1)

# input parameters
# Omu[,,] Ovar[,,] Cmu[,,] Cvar[,,] Rmu[,,] Rvar[,,] LLmu[,,] LLvar[,,] DNmu[,,] DNvar[,,]
          TNmu[,,] TNvar[,,] SLLDmu[,,]        SLLDvar[,,]        SGNDmu[,,]        SGNDvar[,,]
          STNmu[,,]          STNvar[,,]

# 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 1:12){    # years 2001-2012
```

```
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]<-sqrt(Ovar[i,j])/Omu[i,j]                #Oconv, unreporting offshore
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]<-sqrt(Cvar[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]<-sqrt(Rvar[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]<-sqrt(LLvar[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]<-sqrt(DNvar[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]<-sqrt(TNvar[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]<-sqrt(SLLDvar[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]<-sqrt(SGNDvar[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]<-sqrt(STNvar[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 year 2012, 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]
60313	15559	30552	2612	14443	1795	0	25912	0
31973	26355	38213	1692	17906	1638	0	22116	0
36408	11802	32358	2582	14889	1039	0	17308	0
55788	31371	56605	8505	22939	1926	0	17648	0
40562	19958	41305	2742	17931	2011	0	22086	0
27083	15177	25968	930	12757	1850	0	15370	0
26254	12859	25685	601	11928	986	0	17914	0
0	11855	32404	822	13809	564	0	31694	0
0	18161	43603	1252	18248	1586	0	23654	0
0	26756	25527	483	12827	1409	0	12194	0
0	35213	24945	639	11819	3057	0	13689	0
0	16338	21422	388	10526	1284	0	35658	0

Table A2. Example of input parameter values for the probability function of coefficient factors for different catch components (Finnish fisheries in SD22–31, years 2001–2012).

Omu[,1]	Ovar[,1]	Cmu[,1]	Cvar[,1]	Rmu[,1]	Rvar[,1]	LLmu[,1]	LLvar[,1]	DNmu[,1]	DNvar[,1]	TNmu[,1]	TNvar[,1]	SLLDmu[,1]	SLLDvar[,1]	SGNDmu[,1]	SGNDvar[,1]	STNmu[,1]	STNvar[,1]
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.008	0.0044	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.008	0.0044	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.008	0.0044	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.008	0.0044	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.008	0.0044	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.008	0.0044	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.008	0.0044	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.0301	0.0123	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.0301	0.0123	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.0301	0.0123	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.0301	0.0123	0.0234	0.0063	0.09	0.0188
0.03669	0.02259	0.0834	0.031	0.2	0.0614	0.0283	0.0082	0.016	0.0055	0.0301	0.0082	0.0301	0.0123	0.0234	0.0063	0.09	0.0188

Annex 6: Technical Minutes from the Baltic Salmon Review Group

- RGSalmon
- ICES HQ, Copenhagen, 22–25 April, 2013.
- Participants: Carmen Fernández (Chair), Kjell Leonardsson (reviewer), Tapani Pakarinen (WGBAST chair), Ian Russell (WGNAS chair), Henrik Sparholt (Secretariat), Jonathan White (reviewer).
- 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 WG has applied a state-of-the-art approach to their efforts to model and assess Baltic salmon stocks. The report also includes up to date data on sea trout populations; the assessment of the status of sea trout populations in the Baltic has not been updated by WGBAST this year.

Section 2 of the 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 implemented management measures. Section 3 explains and analyses river data relevant to the salmon assessment. Section 4 presents the salmon assessment, including the status of stocks in relation to reference point estimates and forecasting future development under five scenarios of varying fishing effort. Issues pertaining to sea trout are addressed in Section 5, including a summary of sea trout data needs in accordance with the DCF. During the Inter-Benchmark protocol for salmon in 2012, a Stock Annex detailing the main features and methodology of the salmon assessment was developed and this is now included in the WGBAST report.

As with the previous year, although for different reasons, the compiled report was achieved at a late date giving little time for review. This year this was largely due to the short time period between the WG and the RG/ADG. A fully compiled report draft for the reviewers in advance of the RG/ADG meeting (at least one week in advance) would facilitate the review and advice drafting process significantly. The Stock Annex should also be available to the reviewers (this was not the case this year).

The RG acknowledges the detailed response to the previous year's RG technical minutes and appreciates its insightfulness. The RG also acknowledges that a technical review of the salmon assessment has recently been conducted in the context of the Inter-Benchmark Protocol that took place in 2012. Given this, these minutes pertain to lesser issues noted in the report and analyses.

Technical comments

Section 2.3 – Discards, misreporting and unreporting of catches

As detailed in the WG report, there are issues surrounding unreporting and misreporting in catches. This needs some form of resolution to ensure the WG is operating with the most robust and realistic data possible, and efforts to this end should be made, in preference before the data compilation prior to the 2014 model runs, as the assessment runs take place before the WG meets. As a possible work around for this, options may include:

- Applying average splits of sea trout and salmon derived from national reported splits;
- Incorporating uncertainty around the splits for instance as minimum–maximum uniform distributions; triangular distributions with minimum, most likely, maximum ranges; binomial proportional splits based upon national estimates or average proportions or other more sophisticated approaches;

Section 4.2.2 – Changes in the assessment methods

Carlin tag recaptures

Tag recaptures from 2010–2012 were omitted from this year's assessment. The reason for this was cited as a strong drop in tag returns, considered to be most likely due to a change in the tag reporting rate and not to increased natural mortality. This is difficult to elucidate in the present form as:

- there appears to be no correction to the tag return figures for effort (in reporting tags);
- the recorded returns do decline notably in 2006, and then gradually to 2012, but this is not entirely outside a continuation in the decline between 2000 and 2005.

While the estimates of post-smolt survival with the 2010–2012 data included (Figure 4.2.2.1) are generally lower (especially for the years in question), they do not appear substantially lower. Removal of the tag data should warrant more detailed justification, either subjective or objective.

Application of a correction factor to account for diminishing effort in looking for and reporting tags should be investigated with the aim of finding a means to retain this (valuable) data stream into the modelling process rather than excluding part of it.

It is appreciated that other, fisheries-independent, sources of data are being sought, and tag return data may become less important. However, there also appear to be some discrepancies in these data streams, with observed and estimated spawner numbers not always agreeing (see comment on Section 4.2.3 and Figure 4.2.3.10 below).

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

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

- Are raising factors applied for fish being missed by counters?
- 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.

To make model deviations from observed data more transparent, it would be desirable to have Figure 4.2.3.10 showing the adjusted (i.e. model-estimated) values, in order to fit appropriate estimates to comparable raised counter estimates. (Examples of rivers for which this would be useful are, for example, the Kalix and the Byske rivers, in which the counters are placed upstream rather large spawning areas).

Section 4.3.2 – Results/Figures 4.3.2.7a–c

Please check, 3rd para, page 157 "Figure 4.3.2.7a–c presents the river-specific annual probabilities to meet 60% of the PSPC under each scenario". Should this read "…meet 75%". And twice more in the para: at the end of the 2nd sentence and with reference to Table 4.3.2.2.

There appears to be a lack of sensitivity of the model to the five projection scenarios investigated, with the probabilities of attaining 75% of PSPC being met differing only marginally between scenarios 1 and 2, even with scenario 2 representing a 25% increase in fishing effort with respect to scenario 1. As noted in the text, this may indicate that fishing effort is at such a low level that even with a sizable relative increase, little effect is observed, with natural mortality of post-smolts and adults instead presently the limiting factor. Could it however indicate some other issue? Relating to:

- the model structure and the implementation of estimated post-smolt and adult natural mortality;
- data pertaining to estimated mortality, priors and their estimated variance;
- other elements of the ecology.

A 17 year forecast (to 2030) seems a long time to be looking forward.

Further comments

- On graphs with incorporated errors, inclusion of 25th and 75th percentiles (in addition to 5th and 95th) (e.g. around smolt production estimates at unit level) would assist in indicating the frequency distributions around the graphed mid points.
- **Table 8.4.14.1** replaced in the Advice draft. Check that it is replaced in the final version of the WGBAST report as well.
- As the coastal fishery is expected to increase while the future offshore fishery is reduced due to Swedish and Finnish reallocation of their fisheries there is some concern that the future data requirements for the assessment model needs to be considered. The catches of the coastal fisheries may vary considerably in stock composition depending on where the coastal fishery takes place. Near the river mouths the specific river stock is likely to dominate, while a mixed-stock fishery is likely to prevail in the outer parts of the archipelagos or further away from the river mouths. The different timing of the return migration of various river stocks in combination with restricted fishing periods may however, produce biased samples if fish are collected for genetic sampling from the coastal catches. Thus it will be a challenge to obtain good measures on the harvest on different stocks. It might therefore be a good idea to try to locate strategic "sampling sites" and identify proper time schedules for sampling to allow maximum information of the sampled salmons.
- The assessment model assumes that fishing mortality is proportional to effort, with effort assumed known in each fishery, and with the catchability

assumed to be constant over the years for each sea age group and fishery. These both seem rather rigid assumptions (e.g. there may be errors in the effort data or catchability may change over time). Would it make sense to allow some extra flexibility here? Or would the model end up having too many parameters (too much flexibility, particularly now that the maturation rates are also annually varying), essentially making it impossible to obtain realistic fits?

- The lack of flexibility mentioned in the previous bullet points could, presumably, be part of the reason for some of the not-so-good fits to the catch data by fishery seen in Figure 4.2.3.8.
- Would it be possible to include more of the river returns data (Figure 4.2.3.10) in the assessment model?
- Harvest rates for different fisheries and groups of salmon (e.g. representing sea ages or returning salmon) are presented in figures, but it is not completely clear how they have been calculated. Please present a formula for how these harvest rates are exactly computed, also indicating to which fraction of the salmon population they refer, time point within the year, etc. Also please explain, and give a formula for, how harvest rates are combined (e.g. combined offshore HR, or combined coastal HR, in Figure 4.2.3.12).
- A clearer explanation of how the coastal effort of fisheries is allocated to different assessment units would be helpful.
- A clear and detailed explanation in the report for how the total catch is split into different components in the projection seems very relevant to the salmon stocks. The ADG this year tried to be as clear as possible about this in the outlook table of the advice sheet for salmon in Subdivisions 22–31. A precise and detailed description should be included in the WG report, so that the process of producing and understanding the outlook table becomes simpler for everyone.
- Most assessments conducted in ICES compare the results obtained in a year with those obtained in the assessment performed in the previous year. This is only done to a limited extent by WGBAST and more comparison would be useful. Obvious things to compare (from the two consecutive assessments) would be: the time-series of PFA, time-series of harvest rates, time-series of smolt production (and, possibly, time-series of {smolt production}/PSPC), time-series of post-smolt mortality and, possibly, time-series of maturation rates. The actual choices and details are better left to WGBAST, but the idea is to get quick visual comparisons to help understand what has changed between assessments (aiming, at the same time, to understand the reason for the changes).
- The procedure described in the Stock Annex for Assessment Unit 5 does not seem to have been followed by WGBAST this year. The RG supports the work done by WGBAST on AU5 this year, but it is important that any deviations from the Stock Annex are clearly noted in the WGBAST report, justifying the reason for them.
- The data used for the assessment and computer code should be available (e.g. in the WGBAST SharePoint), so that reviewers can look into it. Tables summarizing outputs (in addition to figures), e.g. median, 5 and 95 percentiles of quantities of interest (such as PFA), would also be useful.

Conclusions

A robust analysis and well-structured report has been produced by WGBAST, which is to their credit considering the data issues (some outlined above) and technical complexity of the modelling approach faced by the group. The RG looks forward to seeing developments and assessment of potential inclusion of environmental variables as covariates in the modelling, although there is lack of clarity of the mechanistic link of the effect of sea surface temperature on returning adults who will inhabit deeper waters. The RG appreciates the inclusion and noting of the 2012 sea trout assessment, and looks forward to developments in 2014 on this matter.

In terms of process, the short time-scale between the WG meeting and review this year should be avoided in the coming years, trying to ensure the WG and Chair have enough time to complete their work and the report, and that the reviewers also receive the report with enough time to be able to gain an understanding in advance of the RG/ADG meeting. Two working weeks between WG and RG/ADG would seem the minimum required to achieve this.