BALTIC SALMON AND TROUT ASSESSMENT WORKING GROUP (WGBAST)

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i Executive summary

The Baltic Salmon and Trout Assessment Working Group [WGBAST] (Chair: Stefan Palm, Sweden) met in Saint Petersburg, Russia, 27 March–4 April 2019. A total of 26 experts from all nine Baltic Sea countries attended the meeting, whereof four via correspondence. The group was mandated to assess the status of salmon in Gulf of Bothnia and Main Basin (subdivisions 22–31), Gulf of Finland (subdivision 32) and sea trout in subdivisions 22–32, and to propose consequent management advices for fisheries in 2020. Salmon in subdivision 22–31 were assessed using Bayesian methodology with a stock projection model (data up to 2018) for evaluating impacts of different catch options on the wild river stocks.

Section 2 of the report covers catches and other data on salmon in the sea, and summarizes information affecting the fisheries and management of salmon. Section 3 reviews data from salmon spawning rivers, stocking statistics and health issues. Status of salmon stocks in the Baltic Sea is evaluated in Section 4. The same section also covers methodological issues of assessment as well as sampling protocols and data needs for assessment. Section 5 presents data and assessed stock status for sea trout.

- Total salmon catches have decreased continuously since the 1990s, although more slowly in recent years. The fishery related mortality for salmon in 2018 (including estimates of unreported, misreported and discarded catches and recently revised estimates for recreational trolling) increased compared to in 2017, but still remained on a historically low level. Reported efforts in commercial salmon fisheries have also remained historically low.
- Since 2014, the level of estimated misreporting has increased more than three times. The total misreporting of salmon as sea trout in 2018 was estimated to 42 600 salmon.
- The share of recreational catches of Baltic salmon in sea and rivers has increased over time, and at present they represent about half of the total fishing mortality. In particular, the offshore trolling fishery for salmon has developed rapidly since the 1990s and early 2000s. According to updated estimates, the total landed (retained) catch from recreational trolling has in recent years ranged from about 15 000 to 25 000 salmon per year.
- Since the 1990s, production of wild salmon smolts has gradually increased in the Gulf of Bothnia and Gulf of Finland. For most rivers in these areas, either increasing or stable smolt production is predicted also for 2019, as a result of generally good spawning runs in 2015–2016. In contrast, long-term trends for smolt production in southern Main Basin rivers have remained stable or slightly decreasing.
- The current (2018) total wild production in all Baltic Sea rivers is about 3.1 million smolts, corresponding to about 81% of overall potential smolt production capacity. In addition, about 4.4 million hatchery reared smolts were released into the Baltic Sea in 2018.
- Over time, an increasing proportion of the wild salmon stocks have reached the management target (75% of potential smolt production capacity) with high or very high certainty, especially in the northern Baltic Sea. Also in the Gulf of Finland, wild Estonian rivers show recovery. As assessed previously, most weak stocks are located in the Main Basin. Several of the rivers in this area are far below a good state and have showed a negative development in recent years.
- The exploitation rate of Baltic salmon in the commercial sea fisheries has been reduced to such a low level that most stocks (for which analytical projections are currently available) are predicted to maintain present status or recover at current levels of fishing pressure and natural mortality. However, due to local environmental issues, many weak stocks are not expected to recover without longer term stock-specific rebuilding measures, including fisheries restrictions in estuaries and rivers, habitat restoration and

removal of potential migration obstacles. In particular, nearly all Main Basin stocks require such measures.

- M74-related juvenile salmon mortality increased in hatching years 2016–2018, but is expected to again decrease somewhat in spring 2019. It is hard to predict future levels of M74. Recent disease outbreaks and fish with apparent lack of energy, resulting in large numbers of dead spawners and low parr densities in some wild rivers, is another future concern. Most alarming is the situation in Vindelälven and Ljungan where parr densities have collapsed. Despite ongoing research, the reason(s) behind the deteriorating salmon health remains largely unknown.
- Some positive development can be seen for sea trout in the Baltic Sea region, but many populations are still considered vulnerable. Stocks in the Gulf of Bothnia are particularly weak, although spawner numbers and parr densities show signs of improvement. Status for sea trout stocks is generally higher in most of the Main Basin and in southern Gulf of Finland. Populations in Lithuania and Germany are weak, however, probably in part due to natural causes, but they are also affected by coastal fishing.
- In general, exploitation rates in most fisheries that catch sea trout in the Baltic Sea area should be reduced. This also holds for fisheries of other species where sea trout is caught as bycatch. In regions where stock status is good, existing fishing restrictions should be maintained in order to retain the present situation.

ii Expert group information

Expert group name	Baltic Salmon and Trout Assessment Working Group (WGBAST)
Expert group cycle	Annual
Year cycle started	2019
Reporting year in cycle	1/1
Chair	Stefan Palm, Sweden
Meeting venue and dates	27 March–4 April 2019, St Petersburg, Russia (26 participants)

1 Introduction

1.1 Presentation of the working group and report

The Baltic Salmon and Trout Assessment Working Group within ICES (WGBAST) contains around 30 experts from all nine countries surrounding the Baltic Sea. The group is mandated to assess status and propose management advice for salmon in Baltic Main Basin and Gulf of Bothnia (ICES subdivisions 22–31), Gulf of Finland (subdivision 32) and sea trout in subdivisions 22–32. Compilation of data (biological and fisheries related) and stock assessment is performed annually in relation to a working group meeting. The working group report is externally reviewed before publication, and the status assessment constitutes the basis for ICES advice on fishing possibilities.

The present report contains updated data series and results from the last meeting in 2019. Section 1 contains background information and responses to last year's review comments, whereas section 2 of covers catches and other data on salmon in the sea, and summarizes information affecting the salmon fisheries and management. Section 3 reviews data from salmon spawning rivers, stocking statistics and health issues. Status of salmon stocks in the Baltic Sea is evaluated in Section 4. The same section also covers methodological issues of assessment as well as sampling protocols and data needs for assessment. Section 5 presents data and stock status for sea trout.

In addition to the above sections mainly focused on recent results and long-term trends, various important information of more static nature is presented in the so-called "Stock Annex" (Annex 2). The annex contains background descriptions of Baltic salmon biology, rivers and assessment units, fisheries, data collection, and estimation methods and models used for status assessment. The stock annex is only updated when needed, for example following larger changes to the assessment methodology that have been reviewed separately by external experts (during so-called "benchmarks").

1.2 Terms of reference

2018/2/ACOM10 The **Baltic Salmon and Trout Assessment Working Group** (WGBAST), chaired by Stefan Palm, Sweden, will meet in St. Petersburg, Russia, 27 March–4 April 2019 to:

a) Address relevant points in the Generic ToRs for Regional and Species Working Groups;
b) Prepare a draft plan for a scoping workshop on the management needs for Baltic salmon.
c) In relation to EU Member States and their obligations to collect data on salmon fisheries and stocks under the EU Data Collection Framework (DCF) and EU-MAP, and to address Commission and Regional Coordination Group (RCG) requirements ahead of June 2019:
   1. Comment on specific data needs of the WG from those specified in the DCF and recommend actions to improve data quality for the work of the WG and in the context of future usage of the RDBES database as the source of ICES data for analyses on salmon.
   2. Address the following recommendations from the RCG in 2018:
      (i) Explain and review the selection of national index rivers by the various Member States (noting that "rivers" in the Legal Text is interpreted to represent "waterbodies" (STECF 2017)), and comment on whether these selections are appropriate and sufficient for the WG to perform analyses and provide stock advice.

(ii) Identify the stocks from which salmon variables should be collected (for parr, smolts, and adults), and advise on sampling frequency and effort (sampling level) to collect these variables.

Material and data relevant for the meeting must be available to the group on the dates specified in the 2019 ICES data call. WGBAST will report by 11 April 2019 for the attention of ACOM.

Following correspondence with the ICES ACOM leadership, it was decided that specific ToR b) (planning of a scoping workshop) could be handled via correspondence later in 2019. In the report, generic ToRs for regional and species working groups are addressed primarily in Sections 4 (salmon) and 5 (sea trout). A short summary of the group's response to specific ToR c) on the EU Data Collection Framework and EU-MAP is provided in Appendix 1.

1.3 Participants

The following experts participated at WGBAST in 2019:

Janis Bajinskis		Latvia
Rafał Bernaś		Poland
Johan Dannewitz	(part of meeting)	Sweden
Piotr Debowski		Poland
Harry Hantke	(part of meeting)	Germany
Anders Kagervall	(by correspondence)	Sweden
Anastasiia Karpushevskaia		Russia
Martin Kesler		Estonia
Vytautas Kesminas	(part of meeting)	Lithuania
Marja-Liisa Koljonen	(by correspondence)	Finland
Antanas Kontautas	(part of meeting)	Lithuania
Adam Lejk		Poland
Katarina Magnusson	(part of meeting)	Sweden
Samu Mäntyniemi		Finland
Hans Jakob Olesen	(part of meeting)	Denmark
Tapani Pakarinen		Finland
Stefan Palm (chair)		Sweden
Stig Pedersen		Denmark
Atso Romakkaniemi	(part of meeting)	Finland
Stefan Stridsman		Sweden

Janis Bajinskis		Latvia
Oula Tolvanen	(participating remotely)	Finland
Susanne Tärnlund		Sweden
Sergey Titov		Russia
Didzis Ustups		Latvia
Rebecca Whitlock	(participating remotely)	Sweden
Ireneusz Wójcik	(part of meeting)	Poland

1.4 Code of Conduct

In 2018, ICES introduced a Code of Conduct that provides guidelines to its expert groups on identifying and handling actual, potential or perceived Conflicts of Interest. It further defines the standard for behaviours of experts contributing to ICES science. The aim is to safeguard the reputation of ICES as an impartial knowledge provider by ensuring the credibility, salience, legitimacy, transparency, and accountability in ICES work. Therefore, all contributors to ICES work are required to abide by the ICES Code of Conduct.

At the beginning of the 2019 WGBAST meeting, the chair raised the ICES Code of Conduct with all attending member experts. In particular, they were asked if they would identify and disclose an actual, potential or perceived Conflict of Interest as described in the Code of Conduct. After reflection, none of the members identified a conflict of interest that challenged the scientific independence, integrity, and impartiality of ICES.

1.5 Ecosystem considerations

1.5.1 Salmon and sea trout in the Baltic ecosystem

Salmon (*Salmo salar)* and sea trout (*Salmo trutta)* are among the top fish predators in the Baltic Sea. Together with European eel (*Anguilla anguilla*) and migratory whitefish (*Coregonus lavaretus*/*Coregonus maraena*) they form the group of keystone diadromous species in the Baltic Sea. Annex 2 contains background descriptions related to ecosystem aspects for Baltic salmon, including basic biology, ecological functioning, environmental pressures, disease outbreaks, effects of climate change, and fisheries impacts, whereof most are common for both species. At the beginning of Section 5, a short description is also given on how the life history and ecology of sea trout differs from that of salmon.

1.5.2 Data for HELCOM salmon and sea trout core indicators

The core indicator used by HELCOM for evaluation of salmon stock status is based on the comparison of assessed smolt production versus assessed potential smolt production capacity on the assessment unit (AU) level. To facilitate data transfer, AU-specific smolt production estimates needed for the HELCOM indicator are presented in Annex 4, where AU 1–2 have been combined to better match the division used for HELCOM assessment units. The indicator for evaluation of sea trout stock status is based on the comparison of observed to expected (potential) parr density in various habitats concerned. Assessment results presented in Section 5.5 support the HELCOM evaluation.

1.6 Response to last year's Technical Minutes

The aim of this section is to facilitate efficient use by the working group of constructive questions and comments 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. Below, specific comments from last year's review are repeated, with responses from the group *in italics*:

Overall

As suggested in the report, it will be valuable to update the Report Annex including changes to methods from the Benchmark Meeting and others that have occurred prior and subsequent to the meeting (e.g. new time-series for trolling). In addition, the Annex should document justification for those changes, and where possible, assess impacts of changes to assessed status. It becomes increasing difficult to review assessments where descriptions of methods are scattered among numerous documents.

The stock annex for Baltic salmon (Annex 2) has been updated and substantially revised. In particular, texts in the annex on analytical stock assessment (section C) now correspond with the last Benchmark (ICES, 2017c). In addition, several paragraphs with various background information of a more "static" nature (on ecosystem aspects, fisheries, M74, etc.) have been moved into the annex, to make the main WG report shorter and more focused on recent data, trends and assessment results.

The report identifies two potential salmon rivers in AU2 and 3 that were reclassified as wild after the 2011 assessment. The report further states that none of the other 22 potential rivers are close to achieving criteria for wild status, however, data to confirm this are not provided (only lists of rivers and restoration efforts in Table 3.2.1.1). The report also identifies one river currently classified as mixed, Nemunas (AU 5, Lithuania), that could possibly be re-classified as wild. Further evaluation of available data is required before reclassifying this river. Also, the report suggests increased proportion of reared (vs wild) salmon in one wild river, Pärnu (AU5 Estonia) should be evaluated, possibly resulting in reclassification of this river as mixed. Increases in releases have occurred in recent years in response to depleted status. Although the suggestions to evaluate Nemunas and Pärnu are reasonable, a thorough review of additional rivers in the EC Multiannual Plan is not possible without river-specific proportions of reared and wild smolt production.

Before the meeting, experts from all countries were asked to check and (if needed) add/change information in Table 3.2.1.1. In addition, a special session on potential salmon rivers was held during the meeting. Accordingly, texts and table on potential rivers (Sec 3) have been updated. The group agree that there is need to review the present criteria for wild, mixed, potential, and reared salmon rivers, but this has to be handled separately (see also comments in ICES, 2018b).

Section 2. Salmon Fisheries

2.1.2. Do regulations for recreational trolling prohibit barbs on hooks? This will affect post-release mortality rates. Because no estimates of post-release mortality from trolling are available for Atlantic or Baltic Salmon, estimate from Pacific salmon are used. However, several of the studies cited for Pacific salmon are quite dated (e.g. 1959, 1972…). Historically, barbed hooks were allowed for Pacific salmon trolling, which would overestimate post-release mortality, if barbed hooks are currently prohibited in the recreational fishery for Baltic salmon (as they currently are for Pacific salmon).

The use of barbed hooks in the recreational fishing for Baltic Salmon is currently allowed when fishing in the sea (e.g. trolling). Local rules can apply on the use of hook size and no barb when fishing in freshwater.

2.1.2. Clear documentation and justification for trolling catch estimates would help facilitate consistency in application of this expert driven approach among counties and over time. In particular, Swedish recreational fishery presumably represents a relatively large proportion of the total recreational fishery (Sweden represents a large proportion of total reported catch Table 2.2.1), yet there are very few data on those catch estimates. An upcoming Swedish study in 2019 may help inform these expert-derived time-series of troll fisheries for that country, and the study may also benefit from documentation from ICES (updated Annex) on how these are derived in other countries to facilitate consistencies in analyses were possible.

We agree that documentation and justification for any recreational catch data included should be available for each country. If estimates are based on expert opinions, the assumptions behind the estimate should be explained. When surveying the recreational fishery many different approaches can be chosen in terms of choice of survey and sampling design. This means that the data analysis can only potentially be standardized between countries using the exact same survey type and design. The choice of survey type is not necessarily following the guidelines of best practice (described in ICES WGRFS annual reports) and is often decided upon based on the financial situation.

2.2.2. The text states that no official statistics on bycatches are available for Russia, but it also states that no salmon were caught in offshore and coastal fisheries. These statements are inconsistent, since salmon could be caught as bycatch but not recorded/available.

The text on Russian fisheries has been clarified.

In **Table 2.2.3,** how is sea catch defined (compared with coastal and river catch), and how does it differ from offshore catch? (Only Poland and Denmark currently have offshore fisheries in Table 2.4.3, yet numerous countries have sea catch).

A description of how salmon catches are divided into fishing areas (formerly named fisheries) has been added in the updated stock annex (section A.2.1). Prior to WGBAST 2019, the four categories regarding fishing area were redefined. Moreover, a review of the applied fishing area categories in the reported catches by country and year was performed. As a result, currently only three main categories (out of four previous) are used: 1. River (R), 2. Coastal (C), 3. Open sea (O). A fourth category, 4. Sea (S), will only be used in cases when it is not possible to separate a catch between coast and off-shore.

2.3. Clear rationale for changes in coefficient factors from experts on discarding over time would be valuable. The changes in 2013 in this coefficient are due in part to updated expert opinions; exact reasons for these changes should be documented (in an Annex) to ensure consistency across experts/analysts with subsequent assessment for a single country, and among countries. For example, in Denmark the proportion of seal-damaged fish reported by harvesters is 40–50%, but data based on on-board inspectors are much lower (4%). Which types of data do experts consider and why?

We agree that changes made to coefficient factors should be documented, especially since experts involved and the data/information used changes over time. Regarding the example with Danish estimates of seal damaged salmon in the longline fishery, the previous contrasting high (40–50%) and low (4%) estimates came from "guestimates" and observer trips, respectively. For 2018, more reliable logbook data were available, and as a result the rate of seal damage in the DK LLD fishery was retrospectively revised also for years 2016-2017 with the same rate as assumed for 2018 (0.050; 0.20; 0.45). This update has been described in Section 2.3.

Given the relatively large proportion of reportedly salmon-damaged fish (e.g. in Finland, Latvia and Poland), it may be valuable to include time-series of seal abundances. The text describes increases in seal abundances, but have they increased at the same rate, timing, and location as reported increases in seal-damaged catch? This additional information might increase credibility in seal-damaged catch time-series (if time-series corroborate each other). I suggest that this issue be emphasized in Section 1.3 on Ecosystem Considerations given its significant impact in Gulf of Finland. Currently, that section simply states:

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

We have elaborated somewhat on the section about seal discarding, adding further information and references, and the text has been moved to the Stock Annex (Annex 2) together with other background information.

2.7 Are finclips used to assess proportion of reared salmon spawning in natural rivers? If monitoring "wild" rivers is key, then monitoring the proportion of wild-origin vs. reared fish on spawning grounds is critical, but this is only possible if smolts can be differentiated, such as with finclips. This is especially important given difficulties differentiating wild and reared fish genetically in some cases.

In some rivers the proportion of ascending fin-clipped (reared) adults is monitored, either from catch samples or using video cameras in fish-ways. At present, however, such information is only presented for River Tornionjoki (see Table 3.1.1.3). Note that also scale samples, external tags (although nowadays less used) and DNA (in some cases) can be used to identify hatchery reared strays. A comprehensive summary of all available information on straying in time and space of reared salmon into wild rivers would be valuable, when time allows.

2.9.3 The text states that the catch of undersized salmon in longline fishery may be noticeable; although data to evaluate this are not available, in part because survival rates of salmon released from hook are not known. Might survival rates of releases in longline fishery be similar to survival of trolling fish released from recreational fishery? Can the same assumptions be used here? (Section 2.1.2).

Post-release mortality will depend on several factors e.g. size of hook, depth of hooking, handling of the fish, water temperature, etc. The commercial longline fishery often takes place in the same areas and time of season as the recreational trolling fishery and hook sizes can be similar. Depth of hooking may be deeper in the commercial fishery but nonetheless it seems like a valid assumption to use the same post release mortality (25%) as long as no empirical data is available. At present, however, post release mortality for salmon below the minimum landing size (BMS) in the offshore driftnet fishery is currently not accounted for in the full life history model (FLHM). But since BMS catches are comparably small (see Table 2.3.2) this is not expected to affect the assessment result (estimates of F vs. M) more than marginally.

Section 3. River data on salmon populations

This section highlights the significant and often long-term use of rearing in many rivers. It's unclear to what extent the objectives of rearing are for conservation or to create fishing opportunities. If conservation is the goal, caution in the reliance on long-term rearing is warranted.

As inferred in the report, domestication can cause risks to mixed, potential, and wild populations, when reared fish spawn in the natural environment as they can outcompete natural spawners and are often less reproductively successful (i.e. produce fewer returning adult fish) than natural-origin fish. Indeed, Jones *et al*. (2008) demonstrated that for one depleted salmon stock, productivity increased after supplementation from a hatchery was stopped, allowing further recovery. Recent work by the US Hatchery Science Reform Group, HSRG (a decade long-process involving 100s of analysts to review, model, and develop recommendations for hatcheries), suggested developing clear, specific measureable goals for conservation-based hatchery/rearing programmes, with the goal of reducing rearing/hatcheries as habitat is recolonized (i.e. using rearing as *short-term* measure only). When supplementation is required (e.g. Pärnu), care must be taken to minimize genetic impacts from domestication.

Also, the thresholds specified in the Annex differentiating wild, mixed, and reared populations could perhaps be reconsidered. Recent work in Canada on Chinook Salmon (Withler *et al*., in press) has suggested that the degree of impact of reared fish on neighbouring wild populations is related to the proportion of out-of-basin strays to natural local-origin spawners. Modelling results indicate that fitness in the wild population may decline even when the proportion of out-of-basin strays is very low (<5%).

Recent progress in our understanding fitness impacts (genetic and epigenetic effects, etc.) from rearing on natural spawning may warrant revisiting use of rearing for conservation purposes and the classification systems for wild, mixed, and reared fish.

Also, is the management goal to recover "mixed" populations to "wild" status, or only "potential" rivers to "wild" status?

3.1. If one goal for "wild" rivers is to maintain "wild" status, I suggest including metrics of the impacts of rearing on these populations in the assessment (e.g. proportion of reared vs. natural-origin fish in rivers, or Proportionate Natural Influence, PNI, as used by US and Canada). This would require marking and monitoring of reared fish in rivers.

The group is generally aware that continuous stocking, including risks for elevated straying, may yield unwanted fitness consequences also when the used stocking material is of local origin. At the meeting a discussion was initialized on why stocking is still ongoing in so-called "mixed rivers", whether plans exist to evaluate and/or discontinue those releases, and on the distinction between mixed and potential rivers (see below). However, as a basis for formulating general recommendations from the group (directed to all countries around the Baltic) regarding stocking, a continued discussion is needed. In next year, if time allows, a specific session devoted to these topics would be valuable, preferably preceded by an updated review of relevant studies and recommendations. Similarly, as mentioned above, there is need for revising and possibly updating the presently used criteria for Baltic salmon rivers (i.e. wild, mixed, potential, reared).

3.2. Table 3.2.1.1 is a useful way of examining restoration measures for potential rivers across Assessment Units. Because long-term rearing practices may have negative genetic impacts on the naturally spawning fish (and possibly likelihood of recovering to "wild" status), I suggest including length of time that rearing has occurred in the table. As described in the text, restoration measures should address the numerous factors causing depleted status. However, this table highlights that this may not always be the case in practice. For example, in ten potential rivers, rearing is accompanied with only limited reduction in fishing pressure, failing to address habitat/pollution issues, possibly limiting recovery potential. Also, in the column on restoration measure, "l" and "m" are not defined.

We have revised and updated Table 3.2.1.1 on potential rivers. It now contains information on numbers of years with enhancement stocking. The previously missing definitions of letters "l" (fish ladder planned), "m" (fish ladder completed) and "n" (fish ladder not needed) have also been added. In addition, text in the corresponding section 3.2 has been updated according to new information from several countries.

3.4.3. Are there reports of disease in rearing facilities, in particular UDN-like diseases? The text states that disease has been documented in the returns of both wild rivers (Mörrumån) and reared (e.g. Indalsälven). Are there estimates of the proportion of diseased fish that die, directly and indirectly from the disease?

No reliable estimates of the total proportion fish affected do exist, neither from wild nor reared rivers. One main problem is that, although some fish have shown UDN-like symptoms, the reason(s) for deteriorating *health in (some) rivers is still unknown. Thus, there are so far no diagnostic methods available that e.g. could be used for analyzing a representative sample of a total spawning run.*

3.5. In AU5, the text suggests that "implementation measures have stabilized the salmon populations in Lithuanian rivers, and the production is increasing very slowly". However, Table 3.1.5.2 shows that density of >0+ parr was 0 for 2/4 rivers in AU5 for 2017 (Mera and Žeimena), and 0 for parr of all ages in 1 river (Mera). I suggest specifying that production may be increasing for one river in particular (Neris), not in the others.

We have modified the text in line with this comment, adding that tributary Mera is considered as a typical sea trout habitat which may explain the consistently low salmon parr densities.

For wild rivers of depleted status, a similar table as in 3.2.1.1 (for potential rivers) may be of value to document ongoing measures to rebuilding those stocks.

A good idea, but the group has not yet had time to implement it.

Section 4. Reference points and assessment of salmon

4.2.1. "New stock–recruitment parameters" Numerous changes to the Full Life-History Model (FLHM) have been implemented since the last successful run of the model. One of those changes was to include priors on maximum survival rates instead of eggs-per-recruit (EPR), as discussed at the 2017 Benchmarks Meeting. Since the Benchmark Meeting, the alpha prior was subsequently updated to resemble that of Pulkkinen and Mäntyniemi (2012). Were these updated to match the posterior predictive distribution for an unknown stock in Pulkkinen and Mäntyniemi (2012)? Based on the peak egg survival of that distribution at ~25, the 2017 priors look like they match better than the 2018 priors. It's not clear what other transformations have been made to derive the new prior. More explanation would be helpful. Ensuring the proper prior for this parameter is quite important, as it has a significant impact on assessments against PSPC and stock projections. Any changes should be well justified and clearly documented.

Yes, these priors were updated to match the posterior predictive distribution for an unknown stock in Pulkkinen and Mäntyniemi (2013). The new prior approximates the posterior predictive distribution for the maximum survival of eggs. It has a median at 0.058 (cf. 0.05 in Pulkkinen and Mäntyniemi (2013)), and 95% PI of 0.01–0.42 (cf. 0.01–0.51 in Pulkkinen and Mäntyniemi (2013)). The alpha prior in the FLHM is given by 1 divided by the prior for the maximum survival of eggs.

Figure 4.2.1.2. Shows prior and posteriors on R_0, but priors were implemented on K instead of R_0 in the new model formulation, according to the 2017 Benchmarks Report (and also mentioned in subsection "Effect of change son results and status evaluations" p. 4). I assume these priors were transformed for the purposes of this plot, although priors on K were used?

Yes, priors are now placed on K. What is plotted is the implicit prior on R0 (implied by priors on K and other parameters), obtained by running the model with no data. This will be stated in the report in future for clarity.

"Effects of changes on results and status evaluations". Given the numerous changes to the model formulation and platform (WinBUGS to JAGS), and the propensity for unintended bugs to crop up (e.g. as shown historically in "correction of errors" section), a more thorough evaluation of the revised FLHM model would be of value. Quantifying the effects of individual changes in the model on estimated stock status is difficult due to long computing time (i.e. model cannot be re-run for each individual proposed change). However, as suggested at the Benchmarks meeting, an alternative approach is to run the model under a set of assumptions to generate predicted model outputs, and then re-run it using those model outputs as inputs. The idea of this "simulation self-test" is to evaluate if any unintended biases crop up in parameter estimates. This type of analysis may not fit within the annual report, but could be included in a future benchmark meeting.

We also think that such an exercise would be of value in diagnosing potential biases, and as such could be considered as part of a future benchmark. However, it must be balanced against ongoing demands for model development and improvement.

4.2.3. Several parameters in the FLHM did not converge, notably the alpha parameter for the stock–recruitment model for three rivers (Torne, Simojoki, and Vindelälven). What is the impact on assessment results? Table 4.2.3.1 shows that the posterior of alpha parameter for Ume/Vindelälven is extremely low (lowest among all rivers), and extremely high for Simojoki (highest among all rivers), thereby projecting production from those stocks to be very high and low, respectively (alpha=1/max egg survival). Results for these rivers should be interpreted with caution (and/or the observed patterns should be more fully explained). Indeed, the probability of achieving 75% of PSPC varies over time significantly (jumping frequently between 20% and 80%) for these two populations, likely due to the large uncertainty in alpha parameter (Figure 4.2.3.7).

Because of the convergence issues experienced in last year, an appendix (Appendix 1) was later added to the report based on a converged (longer) run, with a series of comparisons of parameters estimated before and after adding more iterations. It was concluded that, despite significant updates for certain parameters, this did not affect the overall perception of stock status used as a basis for advice. Regarding alpha, it was found that those estimates barely changed when adding more iterations. Further, note that the commented year-to-year variation in the probability for stocks to reach 75% of PSPC seen last year in Figure 4.2.3.7 actually represents a combination of variation in 1) smolt production over time and 2) in R0 (PSPC) over time. This year we therefore added plots showing how river specific R0 fluctuates over time, to hopefully assist interpretations of temporal patterns (such as those in Figure 4.2.3.7 from last year).

Figure 4.2.3.3b. The large number of assumptions that are required for Piteälven are quite evident in the scatter of the poster distribution. The results for this river should also be interpreted with caution; small changes in those assumptions could have large impacts on the shape of the curve, especially at low abundances.

The temporary method for producing prior smolt estimates for Piteälven from last year has been replaced to be more consistent with how data are used elsewhere in the model. Now adult counts are added directly into the FLHM (details in Section 4.2.1).

Figure 4.2.3.9. How is the trend in increasing proportion wild (vs reared fish) in the offshore catch interpreted? Is this due to reduced adult survival of reared salmon, resulting in increased pressure on salmon from wild rivers? (As suggested for Estonian coastal catches, page 12, Section 4.2.5 and Figure 4.2.5.1).

In the assessment it is assumed that wild and reared salmon of the same AU have same migration routes and are therefore intercepted by the same fisheries (and their effort). Moreover, salmon of all units assessed are assumed to share the same feeding ground. Therefore, the proportion of wild vs. reared salmon in the offshore catches are considered to primarily reflect abundance of them once recruited (i.e. after the post-smolt stage) and the abundance would be mainly dictated by the amounts of wild production/stocking of smolts and the differences of their post-smolt survival. Research data exist to support this general assumption, e.g. fisheries recaptures from parallel tagging of wild and reared smolts of the same stock. However, there are also indications of minor tendencies for reared salmon to have a shorter sea migrations, both in terms of the geographic distance of migration as well as in terms of the time spent on feeding ground (e.g. Kallio-Nyberg et al., 2015). To accommodate such differences, the FLHM allows for different catchabilities and maturation rates for wild and reared salmon. Even the adult natural mortality is allowed to differ between the groups of origin (but no information exists about the values of adult M in the Baltic Sea). FLHM as a Bayesian analysis 'searches' for the most plausible value combinations of all these variables in the light of data. The posterior estimates support lower post-smolt survival, somewhat earlier maturation *(mainly grilsing) and higher overall adult M for reared than for wild salmon. However, offshore catchabilities (longlining) are almost exactly the same for wild and reared salmon, which does not support any relevant spatial segregation of salmon by origin. Catchabilities are assumed constant over time in the FLHM, which would effectively mask any possible changes in the targeting of fishing in this respect. This problem remains in the assessment and it needs further attention.*

4.2.4. The small increase in smolt production in 2017 in Pärnu is shown in 2017 in Table 4.2.3.3, but this increase is not visible in Figure 4.2.4.1. If this stock does "show small signs of improvement" (page 10 bottom, last paragraph of Section 4.2.3), this should be visible in the time-trend (but appears to be at 0% of PSPC in 2017).

The assumption of improvement was based on the increase of 0+ parr densities. The figure will be updated, but the improvement is still very small compared to PSPC.

4.2.4. The text states that the "status of Estonian wild and mixed stocks [in AU 6] has improved in the past few years (Figures 4.2.4.3 and 4.2.4.6)". However, the trends in mixed stocks show a steep drop in the last ~3 years. I suggest rewording to "status of Estonian wild and mixed stocks has shown improvements since 2005, followed by recent declines for mixed stocks since 2015" OR "followed by relatively low smolt production for mixed stocks 2016–2018". I suggest removing (or rewording) "This indicates that the total harvest rate in the sea fisheries in combination with established closed fishing area at the river mouth areas, can be considered sustainable, and that it may allow further recovery". All of the mixed-stock rivers in Estonia AU6 are below 50% PSPC (Figure 4.2.4.4), and could be considered depleted.

We kept this comment in mind when updating this year's report. Main reason for recent drops in smolt production was poor spawning success in autumn 2015 due to low water levels. Parr densities again increased in 2017 and in 2018.

4.4. If countries wish to target fishing mortality on salmon from particular rivers that are healthy, and avoid salmon from those that are depleted, a more through use of genetic mixed-stock analysis (MSA) data may be warranted, in order to understand which fish are being caught when and where. Although including those data quantitatively into the FLHM is listed on the work plan, I suggest moving to a higher priority if management intends to be more river-specific in future.

Work is ongoing on utilizing stock-specific harvest rate estimates for the coastal trap net fishery from genetic MSA in the FLHM. Some development of the MSA model (Whitlock et al., 2018) is first needed to ensure that data in the FLHM are not used twice: the current version of the MSA model uses posterior distributions for natural mortality and pre-season abundances from the FLHM. This work is viewed by the WG as a medium-term issue (2–3 years), since the inputs required for the FLHM do not yet exist in the format needed.

The FLHM is not well-suited to answering questions about which fish are being caught when and where, since it lacks spatial and sufficiently fine temporal structure. However, tools to answer such questions are being developed in parallel (addition of catches to a genetic MSA model and Bayesian decision analysis to evaluate spatio-temporal management actions for the coastal trap net fishery (Whitlock et al., in prep.)).

4.4.1. Is there evidence of compensation from M74 mortality, by reduced density-dependent mortality? Alternatively, could M74 (or other diseases) deplete components of the population in specific habitats, resulting in short-term relatively high density-dependence until those fish recolonize the newly available habitat? Without evidence either way, I suggest de-emphasizing the role of density-dependence reducing impacts of M74.

M74 mortality takes place at later yolk sac stage, i.e. before fry disperse, fight for territories and start feeding. Therefore we assume that M74 mortality decreases the density-dependent mortality and in the FLHM the dying fraction of M74 infected yolk sac fry are subtracted before density dependent processes *are allowed to occur (in practice the amount of laid eggs is reduced by the estimated amount of dying yolk sac fry). A short explanation on how/why M74 may affect populations having different status has been added to Section 4.4.1.*

There exist no information to support a hypothesis of different levels of M74 in different habitats within a river. However, it is a logical hypothesis to assume that spawners which have health problems (M74 or diseases) may not have resources to swim against current as well as healthy fish and therefore spawners with health problems may try to reproduce to larger extent on the lower than the upper parts of the rivers. In the assessment this hypothesis is, however, an extremely complicated issue to take into account.

4.5. (Relates to comment on Section 4.2.4 above.) Although wild stocks in AU6 have shown increases in recent years, the same is not true for mixed stocks. For the mixed rivers in AU6, and wild rivers in AU5, numerous additional factors are likely impacting recovery beyond fishing mortality (e.g. habitat, pollution, etc.).

Mixed rivers in AU 6 have higher variation, however there still seems to be a general trend.

Section 5. Sea Trout

I agree with the recommendation that more complex assessment methods which consider multiple sources of available data (like those for Baltic salmon) should be explored if possible.

In the event that this is not possible (e.g. due to limited resources and/or data), I recommend that current production potential estimates be revised with updated data. Results show that recruitment status is >100% of production potential in many rivers, which seems implausible. In addition, for Lithuanian Rivers, the long distance for river migration was cited as a reason for poor status, but this variable (distance to sea) could be included in the regression model predicting production potential (Section 5.3).

The reason why recruitment status in some sites/areas may exceed 100% is (1) that expected maximum densities were calculated on data available when the model was constructed in 2015. Since then, higher densities may have been observed in some sites/areas. Further, (2) the calculated maximum values used to calculate recruitment status represent average densities for several sites with a given habitat quality score (THS), i.e. individual observations may exceed the average values. In Section 5.3.1, there was already a short explanation on why assessed status occasionally may exceed 100%, and we have expanded that text somewhat.

The 'problem' with status estimates exceeding 100% could in part be dealt with by recalculating expecting maximum values, or by normalizing the calculated values. For the evaluation of population status, however, this is not considered to be a major problem, because specific reference points are not used. Distance to sea is currently not included in the model, but we plan to evaluate if this would contribute to the performance of the assessment model.

5.1. Catches include reported catches only. To what extent might unreporting, misreporting, and discarding of undersized or seal-damaged fish affect catch estimates?

While there is little or no doubt that all the elements mentioned exist and affect trout populations, there is currently no framework (expert-based approach) to include these elements in the assessment. However, this year previous misreporting of salmon as sea trout suspected to occur in the Polish sea fishery (Section see 2.3.2) has been accounted for when reporting sea trout catches.

Table 5.4.1.2 shows factors influencing status, presumably developed from expert opinion instead of quantitative analyses. Instead of individual factors, it is likely that the cumulative impacts drive status and that factors interact in often unpredictable ways (e.g. synergistically or antagonistically).

We agree that multiple factors affecting status may often interact. However, the information in this table is (based on previous expert evaluations) is intended to illustrate major elements affecting trout populations and is only used as background information in the assessment.

5.5.2. The trend in recruitment status is based on correlation coefficients over the last five years of recruitment status. However, uncertainty in those coefficients is not provided, making them difficult to interpret. I suggest including credible intervals (if Bayesian) or statistical significance, that reflect the large interannual variability of recruitment trends.

In line with this comment, confidence intervals to correlation coefficients have now been added. From those it is obvious that uncertainties are in most cases very high, and during the meeting alternative approaches to illustrate trends in status were discussed but not implemented (due to lack of time). The intention is to evaluate (and possibly implement) alternative approaches until next year's assessment.

Although the correlation coefficients are positive for SD 30 and 31 indicating recovery, other data suggest caution for these stocks. For example, survival rates from tagging studies have declined over time to low levels for Finnish populations (Figure 5.4.1.5), and a Bayesian mark–recapture model of two Finnish populations suggests high fishing mortality has resulted in poor status (5.4.1). These additional pieces of information are not considered in the current conclusions.

The declining number of tags returned is likely to reflect a combination of survival and return rates, and therefore difficult to interpret. In addition, the conclusions from the Bayesian model were based on older information (1987–2011); since then, fishing patterns and pressures may have changed considerably.

2 Salmon fisheries

2.1 Overview of Baltic salmon fisheries

The fishery for Baltic salmon is heterogeneous. Commercial and recreational fisheries occur in the sea (offshore and coast) and in rivers, using a variety of gears. Below follows a brief overview of the most important fisheries and gears. A more comprehensive description of various fisheries, gears and methods used to assess catches is given in the Stock Annex (Annex 2). Extensive descriptions of gears, as well as historical gear development in Baltic salmon fisheries, are also available in ICES (2003). Information on catches, effort, discards, unreporting, and misreporting is provided in Sections 2.2–2.4.

Commercial fisheries

Offshore commercial salmon fishing is mainly carried out in Southern Baltic Sea (Main Basin), although it has periodically occurred also in Southern Gulf of Bothnia. Today the commercial offshore fishery is limited to vessels from Denmark and Poland, whereas earlier several other countries were also involved. Historically, drift-nets was the most important gear, but after a driftnet ban enforced in 2008 commercial offshore fisheries consist mainly of longlining and to some extent anchored floating gillnets. The offshore fishery takes place mainly during the period November to March, and targets non-mature salmon in their feeding areas.

Coastal commercial fishing targeting salmon occurs mainly in Gulf of Bothnia and Gulf and Finland, along the coasts of Sweden and Finland, but to some extent also in Estonia and Latvia. Gears used include different types of trapnets. The fishery occurs during spring and summer and targets salmon on their spawning migration. Some commercial fisheries also exist in fresh water close to river mouths, such as in a few Swedish rivers with reared salmon and in River Daugava, Latvia.

Recreational fisheries

Recreational trolling is an increasingly common and popular fishing method to catch salmon in the Baltic Sea. So far, the trolling fishery is most developed in Sweden, Denmark and Germany. The trolling season varies between different sea areas and depends on the feeding and spawning migration of salmon and/or seasonal closures. In western Baltic and Main Basin, it typically starts in late fall and ends in the middle of May. In the Åland Sea and Gulf of Bothnia, the season starts in the end of May and continues until late summer. Over the past few decades, the trolling fishery has increased, whereas the commercial offshore catches have declined. Thus, the relative importance of the recreational fishery has increased over time.

The river fishing for salmon in the Baltic region has a very long history. Until the mid-1990s nets and weirs were used in many rivers throughout the Baltic region. Currently the river fishery for wild salmon is entirely recreational and to a major part restricted to angling (rod and reel fishing). The most productive wild Baltic salmon rivers are by far the Finnish and Swedish large rivers flowing into the northern Baltic Sea. The main fishing season is between May–September, during the spawning run. Rod fishing for salmon in these rivers is very popular, attracting several thousands of anglers every year. The recreational river fishing for salmon in other countries surrounding the Baltic Sea is more limited, although salmon, to some extent, is caught in Estonian, Lithuanian, Latvian and Polish rivers. Russia has no recreational salmon fishery in their rivers feeding into the Baltic Sea, and no Baltic salmon rivers exist in Denmark and Germany.

While the recreational salmon catch is largely dominated by angling (offshore trolling and rod fishing in rivers) there are other types of recreational fisheries carried out in some countries. To a smaller extent passive gears such as trapnets, gillnets or longlines are also being used for catching salmon, either as a target species or bycatch, in both coastal and riverine recreational fisheries. These catches are generally estimated to be of minor importance, in terms of impact on the stocks (i.e. removals).

Brood stock fisheries

Brood stock fisheries are aimed at collecting mature individuals for breeding purposes, either within sea-ranching programmes, where mature breeders are caught annually to produce salmon for stocking, or to renew closed brood stocks kept in captivity during the whole life cycle. Brood stock fisheries usually occur in rivers with reared salmon, but adult salmon are also caught for breeding purposes in some wild salmon rivers. Catches for breeding purposes are, however, rather limited and occur in Estonia, Finland, Latvia, Lithuania, Poland, Russia and Sweden.

2.2 Catches

This section contains information on commercial and recreational Baltic salmon catches from sea, coast and rivers in 2018 and over time. Commercial catch statistics provided for ICES WGBAST are based on EU logbooks, national reporting system for vessels not obliged carrying logbook, and/or sales notes. As described in more detail in the Stock Annex (Annex 2), non-commercial recreational catches are typically estimated by a combination of different types of national surveys targeting various recreational fisheries (e.g. using access-point surveys, questionnaires, camera surveillance, etc.) and expert evaluations or expert opinion 'guesstimates'. Further details on the collection of salmon catch data in the Baltic Sea (in total and by country) are given in Annex 2.

The following seven tables with nominal salmon catches divided in various ways (as described below) are annually updated and referred to in this report:

- Table 2.2.1.1: nominal reported and total salmon catches in *weight* by country for the years 2001–2018 (including discarded, unreported and misreported fish). Estimates of discards and unreported and misreported catches are presented separately.
- Table 2.2.1.2: corresponding annual catch data as in Table 2.2.1.1 in *numbers*.
- Table 2.2.1.3: nominal reported catches in *weight* from sea, coast and rivers divided by region (SD 22–29, 30–31 and 32) and country for the years 2001–2018.
- Table 2.2.1.4: corresponding annual catch data as in Table 2.2.1.3 in *numbers*.
- Table 2.2.1.5: nominal catches from last year (2018) in *weight* and *numbers* from sea, coast and river, divided by country and by SD.
- Table 2.2.1.6: nominal *commercial landings in numbers* (2001–2018) from sea and coast compared to TAC, divided by fishing nation and region (SD 22–31 and 32).
- Table 2.2.1.7: nominal *recreational (non-commercial) catches in numbers* from sea and coast (pooled) and rivers, divided by country and region (SD 22–31 and 32) in 2001–2018.

In addition to tables, a number of figures on salmon catch data are also presented that illustrate catch development over time.

The estimated discards, unreported and misreported catches are not included in the nominal reported catches, but presented separately. The estimated catches are calculated using conversion factors and reported in terms of the most likely value with a 90% probability interval (PI). More details on the estimating procedures are given in Section 2.3 (see also the Stock Annex,

Annex 2, Section B.1.3). In the Stock Annex, an overview of management areas (regions) and rivers is also presented.

Finally note that the WGBAST 2019 data call also requested for updated data from 2009–2017, in addition to asking for data from last year (2018). For this reason, there are in some case differences between the catches reported here and in earlier years. Further note that data for 2018 are in some cases still preliminary and future updates might thus occur.

2.2.1 Catch development over time

There has been a long-term decline of the total nominal catches in the Baltic Sea, starting from 5636 tonnes in 1990 down to just 900 tonnes in 2010. After that the catches have remained rather stable. In 2018, the total nominal catch was 921 tonnes (Table 2.2.1.1) or 148 160 salmon (Table 2.2.1.2), slightly higher than in the previous year.

After the driftnet ban was enforced in 2008, the percentage of the total commercial offshore catch by this gear has been zero. At the same time, commercial catches with trapnets along the coast have increased their share. Consequently, the proportion of the coastal catch has gradually increased over time, and in 2018, it was 56% out of the nominal total catch (in weight). In the same year, approximately 74% of all commercial catches (in weight) were taken in coastal trap (or fyke) nets.

Over the years, the total share represented by river catches has been fluctuating. However, in the latest years they have remained rather stable, being approximately 30% of the total (in weight). In Table 2.2.1.3 the distribution of total catches (in weight) from offshore, coastal and riverine fisheries are presented (see Table 2.2.1.4 for corresponding catches in numbers). The distribution of nominal catches in 2018 by country, per subdivision, offshore, coast and river is presented in Table 2.2.1.5.

A comparison of landings (coastal and offshore) per country compared to the EU TAC in 2018 is presented in Section 2.2.3. Compiled information on landings versus TAC is also presented in Table 2.2.1.6. Note that data presented in Section 2.2.3 are the latest available, while data in Table 2.2.1.6 are compiled from the (partly preliminary) data that were delivered in the WGBAST 2019 data call. Discards, unreported and misreported catches are not included in the utilisation of the TAC, but in Figure 2.2.1.1 total catches of salmon are presented (as a percentage of TAC) where such catches have been added.

A notable change in the catch distribution occurring in the past few decades is that the proportion of non-commercial catches has grown in relation to the commercial catches. The development for the proportion of non-commercial catches (including river catches and expert trolling estimates) from 2004 and onwards is illustrated in Figure 2.2.1.2. In 1994, non-commercial catches comprised just 10% of the total nominal catches (in weight), whereas since 2013 the share has fluctuated between 40 and 50%. Nominal recreational (non-commercial) catches in numbers from sea and coast (pooled) and rivers in 2001–2018, divided by country and regions (SD 22–31 and 32), are presented in Table 2.2.1.7.

In 2019, WGBAST continued the work initiated in 2017 to pay extra attention to the recreational salmon fisheries that are becoming proportionally more important. For the growing trolling fishery, a time-series of trolling catches from an expert elicitation initiated in 2017 (ICES, 2017a; 2017c) was updated (Figure 2.2.1.3). The estimates were partly updated until 2018, to take into account new information from earlier years received from new surveys. The update resulted in a slightly modified time-series compared to in previous years, with lower annual estimates for most years. The estimates are, however, still more than 20 000 salmon larger than previously assumed (i.e. for the 2010–2016 assessments). Trolling catches from the Main Basin (SD 22–28) are dominating, and are only to a lesser degree taken in SD 29–32. Catches in the Main Basin have been declining since 2015, but in 2018 a small increase was observed. The 2018 Main Basin estimate was about 14 500 salmon caught and retained, including estimated post-release mortality (Figure 2.2.1.3). In contrast to in 2017, when the assessment model for salmon in AU 1–4 did not perform, the new updated trolling catch estimates have been included in the 2018 and 2019 stock assessments (Section 4).

In subdivisions 22–31, the total recreational river catch in 2018 was similar to in 2017 with just under 30 000 salmon retained. In SD 32, the river catch in 2018 showed a further decline compared to in 2017 and 2016; the retained river catch (232 salmon) was the second lowest in the time-series that goes back to year 2000 (Figure 2.2.1.4). No further analysis of the recreational river catches have been made. In Section 3.1 details on specific river catches are presented.

2.2.2 Catches by country (2018)

Denmark: The Danish salmon fishery is an open sea fishery. The total commercial and recreational catch (including discards and seal damaged salmon estimates) in 2018 was 21 933 salmon. All catches, including the recreational ones, were caught in ICES SD 24–25. The commercial fishery uses longlines and it takes place from late autumn to spring (October–May). In 2018, the Danish fleet participating in the commercial fishery for salmon had decreased even further from the 12 vessels in 2017 to less than ten (majority <10 m long). It is likely that the effort in the commercial fishery has decreased in recent years due to the increasing number of seals in the waters close to the Island of Bornholm. Despite decrease of effort the commercial catch was 5993 salmon (31 tonnes), a noteworthy increase compared to 2017 (2988 salmon). The recreational fishery is mainly trolling, but some recreational passive gear fishing, i.e. longlining, also takes place in waters close to Bornholm. This fishery has according to local recreational fishers, in most recent years been effected in a negative way by the many seals around Bornholm, and the catches in 2018 are thought to be negligible. The estimate resulting from an Internet based recall survey in 2018 targeting annual licence holders yielded a result of 3790 salmon landed for trolling alone. From the same survey the estimated number of salmon caught and released in 2018 was 2376.

Estonia: There is no specific Estonian salmon fishery. In the coastal fishery, salmon is a bycatch and the main targeted species are sprat, flounder and perch. The share of salmon in the total coastal catch is less than 1%. In 2018, similar to in previous years the Estonian salmon sea catch was below 1 tonne. The coastal catch (commercial and recreational) was 9.6 tonnes, which is less than in last year. The vast majority of salmon is caught in the Gulf of Finland (SD 32). There are about 570 commercial fishermen in Gulf of Finland, and in addition up to 6433 monthly gillnet licences are distributed annually (standard length of a net is 70 meters). Commercial fishermen take 68% of the total catch. The vast majority of the salmon (88%) is caught in gillnets and the rest in trapnets. About 75% of the annual catch is taken in September, October and November. Nearly all caught salmon are spawners.

Finland: In 2018 Finnish fisherman caught a total of 50 044 salmon (365 tonnes) in the Baltic Sea, which was 2% more than in 2017. The landed commercial catch was 23 514 salmon (172 tonnes). The recreational catch (including river catches) was 24 687 salmon (182 tonnes). All commercial catch was taken in the coastal fishery, mainly by trapnets, and the catch decreased with about 7% compared to 2017. The latest catch estimate for the recreational fishery in the sea is for year 2016 and highly uncertain. River catch (all recreational) was 13 187 (86 tonnes) increasing 1% from 2017.

Finnish professional fishermen mainly use trapnets. In 2018, 157 coastal fishermen caught salmon with 392 trapnets, and total effort in the trapnet fishery was 11 391 gear days, being about 37% less than in previous year. There are strict regulations affecting fisheries season, effort and areas. Earlier, in terminal fishing areas the number of trapnets was unlimited, and only in the Kemi terminal area there was a closure in the early summer. Now the regulation for terminal areas is more similar to the rest of the region. In the Åland Islands, fishers have started to use anchored floating gillnets. In 2017, about 70% (about 800 salmon) of the catch in the Åland area was taken by these gillnets. About 12 fishermen participated in the fishery and it generated a total effort of 2000 netdays. The CPUE is about 0.5 salmon per net and day.

The official catch estimate of the recreational fishery is based on the National Survey. The last survey covers the year 2016 and was conducted in 2017. Note that in this national survey, salmon (and sea trout) catch estimates are highly uncertain because these fishers are so rare in the total population (just 17 salmon trollers among all respondents). National surveys are carried out every second year. For the missing 'odd' years, the same sea catch estimate as in the preceding year is assumed. The catch estimate in 2016 was 55–137 tonnes (7000–17 000 salmon). Results suggest that almost 90% of the catch was taken by trolling.

In 2017, the Finnish Federation for Recreational Fishing conducted a questionnaire among salmon trolling skippers (92 replies were received). The skippers are considered to represent the most active part of all trolling fishers. An expert estimate of the total number of active trolling boats in Finland is 300–400. In addition, about the same amount of less active boats exist that only go to sea 1–2 days per year (maybe not even for trolling). The responding skippers fished on average eight days in 2017 (range: 0–25 days) and the average catch was 0.2 salmon per fishing day in the Gulf of Finland and 0.4 salmon per fishing day at the Åland Islands and in Gulf of Bothnia. Extrapolation of these parameters to the estimated whole fleet suggests a total catch of about 300–1600 salmon in 2017.

In the Gulf of Finland, the Finnish commercial catch in 2018 was 5393 salmon (31 tonnes), and the recreational catch was 3232 salmon (21 tonnes). The river catch (all recreational) was 232 salmon (1 tonne) taken mainly from river Kymijoki. In 2016 (the latest survey year), approximately one third of the total recreational catch of all Finnish sea areas (35–145 tonnes) was taken from the Gulf of Finland (3000 ± 3000 salmon, 20 ± 19 tonnes, notice the high uncertainty).

Germany: The total reported commercial salmon catch in 2018 (SD 22–24) was 6.8 tonnes (795 individuals), which was 59% more compared to in 2017. In recent years, virtually no German commercial fishery has directly targeted salmon; hence, most of the salmon are caught as bycatch in other fisheries (mainly passive gear fisheries). Recreational salmon fishing in Germany occurs almost exclusively as trolling. The total number of landed salmon was estimated to be 5226 salmon. In addition, 923 salmon have been released, resulting in a release rate of 15%. There are no data available on freshwater salmon catches, but such commercial and recreational catches are most likely insignificant as there are no rivers with a significant salmon spawning along the German Baltic coast.

Latvia: Salmon is mostly caught as bycatch. The total reported salmon landings (commercial, recreational and brood stock) in 2018 were 3014 salmon (10.5 tonnes), but according to weight data there were likely a high percentage of misreported sea trout, both in commercial and recreational coastal fisheries. Taking that into account, total estimated salmon landings in 2018 were 1079 salmon (6.1 tonnes), which is 44% less than in 2017 (2435 salmon). A vast majority of the salmon was caught in SD 28. The commercial fisheries along the coast (fykenets and to a smaller extent gillnets) and in rivers (fykenets) caught about 30% (268 salmon, 1.8 tonnes) of the total salmon landings in 2018. About 82% of the total coastal salmon landings (commercial and recreational) were taken with gillnets. Two Latvian vessels have used longlines to catch salmon in open sea 2018 (total landings 141 salmon, 0.9 tonnes). The commercial Latvian river landings in 2018 consisted of 149 salmon (1 tonne), to compare with the remaining river catches where 98 salmon were taken by anglers and 282 salmon were caught for brood stock purposes (most of them in Daugava). There is new information on 10 active Latvian trolling boats that catch salmon, operating from January until end of July and from November until end of December. Total estimated landings are about 1 t of salmon.

Lithuania: There is no specialized salmon fishery carried out in Lithuanian waters. The largest share of salmon was caught in the coastal zone as bycatch. In 2018, Lithuanian commercial fishermen caught 731 salmon (3.1 tonnes), 4.2 times lower than in 2017. Part of the catch (239 salmon, 1 tonne) were caught in the open sea, whereas 143 (0.7 tonnes) were caught in coastal fisheries. The biggest share of the catch (349 salmon, 1.3 tonnes) were caught in the Curonian lagoon. In addition, 42 salmon individuals were caught in the Curonian lagoon for scientific purposes during the migration period, and 44 salmon individuals (0.3 tonnes) were caught in rivers for artificial reproduction (brood stock). The total recreational catch of salmon in 2018 was about 3268 salmon (14.5 tonnes) taken at trolling at sea (1238 salmon, 4.3 tonnes) and in rivers (2030 salmon, 10.2 tonnes).

Poland: The total offshore, coastal and river commercial salmon catch in 2018 was 8549 salmon (49.9 tonnes). This is 30% higher than in 2017, mainly due to additional quota exchanges with other countries. Most of the Polish salmon catch was taken from SD 26. Main gear in salmon fishery was longlines (56% of catch) and gillnets (27% of catch). In 2018, the Polish offshore and coastal longline fleet consisted of 145 vessels, mainly with a size >10 m. The share of longline offshore catch to total commercial catch in 2018 was 56% (4819 salmon). Pilot studies for estimation of Polish recreational catches were continued in 2018. A total of 136 trolling boats were inventoried in 2018. Trolling catch estimates for 2018 yielded 2 092 landed (retained) salmon and 84 released (below minimum landing size fish). A pilot study of Polish river recreational catches was initiated in 2017 and continued in 2018. Taking into consideration underestimation of registers, the recreational catch in Polish rivers can be roughly estimated to 40–80 salmon specimens yearly.

Russia: There is no specific Russian salmon fishery, but salmon (and sea trout) can be caught as bycatch in the coastal fishery (pelagic/demersal trawls, trapnets and gillnets) where the main targeted species are cod, flounder, herring, sprat, smelt, perch and pikeperch. No official statistics on bycatches are available, and accordingly no salmon were reported caught in offshore and coastal fisheries. In 2018, 458 spawners (1.65 tonnes) were caught in the rivers during brood stock fishing (172 in Neva River, 204 in Narva River and 82 in Luga River).

Sweden: The total salmon catch in 2018 was 56 732 salmon (324 tonnes) which is more than in 2017. The total coastal catch, mainly from commercial trapnetting in Gulf of Bothnia (SD 30–31), was 194 tonnes (27 678 salmon) taken with a total effort of 13 747 trapnet days. In addition, a total of 11 419 salmon (58 tonnes, preliminary data) were landed in commercial riverine trapnet fisheries in the reared salmon rivers Ångermanälven (SD 30) and Luleälven (SD 31). Last, in 2018, a total of 3806 adult salmon were caught for brood stock purposes.

In the Swedish recreational fisheries, a total of 17 635 salmon (73 tonnes) were landed in 2018, mainly in the wild and reared SD 30–31 rivers (14 662 salmon). Approximately 86% of the total estimated recreational salmon catches in numbers were riverine. The remaining 14% of the recreational catches, 2400 salmon, were taken offshore by trolling (main part in SD 25, a smaller fraction in SD 29). The estimated 2018 trolling catch is based on a survey conducted in 2015 with an additional expert evaluation. Since 2013 it is mandatory to release wild salmon (intact adipose fin) when trolling in Sweden. Both in rivers and at sea there is an increasing trend of catch and release, either voluntarily or due to regulatory measures. This may affects interpretations of catch numbers, as these consist only of landed salmon.

2.2.3 Landings by country compared with the EU TAC 2018

The total allowable catch (TAC) or fishing opportunity for Baltic salmon in 2018 was stated in COUNCIL REGULATION (EU) 2017/1970 of 27 October 2017. In SD 22–31, 75% of the original

TAC of 91 132 individuals was utilized and in SD 32, 74% of the original TAC of 10 003 individuals was utilized.

By fishing region and country, the 2018 original national quotas for Baltic salmon were allocated and utilized as follows:

Contracting party	SD 22–31			SD 32		
	Quota 2018	Catch 1)	Utilized	Quota 2018	Catch 1)	Utilized
	(No.)	(No.)	(%)	(No.)	(No.)	(%)
Denmark	18 885	5 993	32	-	-	-
Estonia	1 919	581	30	1026	1 043	102
Finland	23 548	23 514	100	8977	5 393	60
Germany	2 101	1 360	65	-	-	-
Latvia	12 012	260	2	-	-	-
Lithuania	1 412	367	26	-	-	-
Poland	5 729	8 545	149	-	-	-
Sweden	25 526	27 678	108	-	-	-
Total EU	91 132	68 298	75	10 003	6 436	64
Russia [2)]	-	-	-	-	-	-
TOTAL	91 132	68 298	75	10 003	6 436	64

[1)] N.B Data on landings presented here are the latest available, hence, they can have been updated since the WGBAST 2019 data call.

[2)] No international agreed quota between Russia and EC. No reported Russian commercial catches in the Baltic Sea.

As mentioned above, the national quotas presented are the original set ones. A country has the possibility to save a share of its quota from one year and transfer it to the next. Besides transferring quota shares between years, countries can also exchange (swop) quotas from different stocks between each other. Hence, in practice, less than 100% of the final national quotas were utilized in most countries. For example:

- Sweden had a final national quota of 31 041 salmon in 2018, out of which 90% was used. The final quota was obtained by a transfer of 2833 salmon from 2017 to 2018 and additionally, owing to two quota swops, Sweden obtained 200 salmon from Germany and 2482 salmon from Denmark.
- Poland had, after exchanges, a final quota of 16 098 salmon, resulting in a usage of 53%.

From 1993 and onwards the Baltic salmon TAC is given in numbers. Until 1992, it was given in tonnes. The coastal and offshore commercial official landings in numbers (excluding river catches) compared to the EU TAC 2018, by fishing nations and regions in 2001–2018, are presented in Table 2.2.1.6. See also Figure 2.2.1.1 where the total catch of salmon (including estimated discarding, unreporting and misreporting) are presented as a percentage of TAC.

Finally note that over time the proportion of the annual commercial sea catch (regulated by the TAC) out of the total catch has decreased, at the same time as the proportion of the recreational catch has increased (see Figure 2.2.1.2). Hence, the importance of TAC as a means of fishery control has decreased over time.

2.3 Discards, unreporting and misreporting of catches

Data on discards in the **commercial fisheries** are to some extent reported in the official statistics, and the latest country specific information on this is presented in Section 2.3.2. However, the quality of these data is very unsure. Therefore, additional estimates are made (see below). For obvious reasons, there are no official reports of unreported and misreported catches. However, for some countries information collected from diverse sources is still available. In Section 2.3.3 the issue of misreporting is elaborated on further.

Data for the period 1981–2000 on discards and unreporting of salmon from different commercial fisheries in the Baltic Sea are incomplete and fragmentary. For years 2001–2017 the estimates for discards and unreporting have been computed with a new method based on updated expert evaluations (adopted in WGBAST 2013). The resulting parameter values for the elicited priors and pooled (average) probability distributions for different conversion factors are given in Table 2.3.1. For detailed information about estimation procedures for these conversion factors, see Stock Annex (Annex 2, Section B.1.3).

The estimated unreported catch and discarding for the whole Baltic Sea are presented in Tables 2.2.1.1 (weight) and 2.2.1.2 (numbers). A comparison of estimated unreporting and discards between the periods 1981–2000 and 2001–2018 shows that the main difference is related to the estimates of discards. This is mainly because of updated expert opinions and partly the adoption of new computing model in 2013. A main part of discards is seal damaged salmon, which occurs in the coastal trapnet and gillnet fishery, but also in the offshore longline fishery (Table 2.3.2.). In the offshore fishery, it is small amounts of undersized salmon that are estimated to be discarded. Since 2015 there has been a landing obligation for the longline fishery; however, it has not been fully implemented since little reporting of such landings has occurred. Since 2018, the exemption in the landing obligation allows BMS salmon to be released back to sea in all fisheries. Estimates for discards, unreporting and misreporting by management area are presented in Table 2.3.3. The estimates are uncertain and should be considered mainly as an order of magnitude.

In the **recreational fisheries** on the other hand, almost no data on discarded (caught and released), unreported and misreported catch are collected and no estimates are currently made by WGBAST.

2.3.1 Estimated discards

In 2018, approximately 9900 salmon are estimated to have been discarded due to seal damages in the Baltic Sea (Table 2.3.2). More than half of these discards (6800 salmon) took place in the Danish and Polish longline fishery in the south Baltic Sea (i.e. Seal_LLD in Table 2.3.2). Estimates were based on the observed proportion of seal damaged catch in subsamples that has been extrapolated to the total catch. In this calculation, also potential misreporting and unreporting was included in the total catch. In WGBAST 2019, the Danish expert evaluation was updated retrospectively for years 2016 and 2017 using the same estimate as for 2018. Basis for the update was that there were no logbook data on discarded seal damaged salmon from Denmark in 2016–2017 and the previously estimated discard rate of 50% (5–65%) was based on sparse observer data in 2016 (i.e. no data in 2017). In 2018 logbooks records on seal damages were available, and these suggested an average discard rate of 20% (5%–45%) in the offshore longline fishery, which was approximately same order of discard rate as estimated in 2015 (Table 2.3.1). Consequently, in the Danish longline fishery in 2016–2018 approximately 20% (5–45%) of the catch was seal damaged. In the Polish longline fishery, sea damages fell mainly on SD 26 where about 35% (5%–65%) of catch was damaged. Representativeness of these estimates is unknown to the WG, but the amount of seal damaged catches in the Main Basin have undoubtedly increased gradually to significant rates starting around 2013, as a result of increase in grey seal population in the area. Monitoring will be needed to attain reliably estimates of the seal damages in the region.

In the northern Baltic Sea, seal damages started to escalate gradually from 1993, but since the introduction of 'seal safe' trapnets the catch losses in coastal fisheries have levelled off. In 2018, the total seal damaged discards was about 1730 salmon in the Gulf of Bothnia and 440 salmon in the Gulf of Finland. Most of the damages were reported from Finnish coastal trapnet fisheries. In Finland, data on seal damages are based on logbook records. In Sweden, the level of seal damages is estimated based on data from a voluntary logbook system and available data on seal interaction in the official statistics, for which an additional expert assessment has been made. The reported amounts of seal damaged salmon should, however, be regarded as a minimum estimate.

The reporting rate of the seal damaged catch is assumed to be the same as for the undamaged catch in the coastal fishery. For the time being, logbook based data on numbers of sea damaged salmon is available from Finland, Sweden and Latvia. In other countries, estimates are based on proportional damage rates derived from either logbook or expert evaluation. In 2018, seal damages in the Finnish trapnet fisheries comprised 8% (about 2200 salmon) of the total salmon catch. In Sweden 600 seal damaged salmon were discarded in 2018 (600 salmon). In Latvia, seal damage rated was estimated to be 7% and 12% in 2017 and 2018, respectively (about 30 salmon in 2018).

Dead discards of undersized salmon in 2018 were estimated to about 2400 salmon in the whole Baltic Sea (Table 2.3.2). Proportions of undersized salmon in the catches of different fisheries are mainly based on sampling data (Table 2.3.1) and are considered rather accurate. Mortality estimates of the discarded undersized salmon released back to the sea are based on expert opinions. Mortality of the undersized salmon released from longline hooks back to sea is currently assumed to be high (around 80%), but few studies have been carried out on this issue and the true rate is uncertain. In the trapnet fishery, post-release mortality is assumed to be lower (around 40%), but again the true rate is uncertain. Both the experimental design and the settings to study these mortalities are challenging, but such empirical studies are needed in order to get better estimates on the survival rate of salmon discarded.

Post-smolts and adult salmon are frequently caught as bycatch in pelagic commercial trawling for sprat (mostly for supplying fish for production of fishmeal and oil), but are probably often unreported in logbooks because the relative amount of salmon in these catches is low and can be identified only during unloading (ICES, 2011). Because of insufficient data, however, estimates of these potential removals are so uncertain that they are not taken into account in the present assessment. Besides, there is no estimate on the potential unreporting of bycatch of legally sized salmon in the pelagic trawl fishery. Only the reported catch from the trawls is accounted for in the catch data, although it has been very low over the years.

2.3.2 Reported information by country

Below follows country specific information on reported discards (seal damaged fish or fish allowed to discard), and for some countries short general information on seal interactions is also included. If available, any records on eventual unreporting and misreporting of catches are provided.

In **Denmark**, damages to caught salmon that were caused by seals have been reported by fishermen to reach a level of 40–50%. However, in two trips in December 2015 with observers on board, the proportion of seal-damaged salmon was approximately 4%, and in two other trips in February 2016, the proportion was 0.8%. Recently, seals have been observed to attack salmon being hooked in the recreational trolling fishery. Anglers have also observed seal-damaged salmon in their catches. There is no information in the Danish official statistics from which it is possible to estimate discard percentages in the commercial fisheries, even if this should be available from the DCF/EU-MAP data collection. Since the quota for salmon in recent years has not been fully utilized, it seems unlikely (however uncertain) that there are unreported catches in the commercial salmon fishery. The potential unreported landings would likely be any salmon with a weight above 7.9 kg, since it is not allowed landing these salmon for human consumption. The bycatch of salmon in other fisheries has been observed to be quite low. For example, in the winter 2017–2018 observers from DTU-Aqua participated in the Baltic herring and sprat fishery during 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 coastal gillnet fishery where salmon and sea trout are caught. Information from fishermen, shows that damages by seals have increased over time. A quantitative assessment of these damages is not available, as fishermen in most cases do not present claims for gear compensation. There are no available records of unreporting or misreporting.

In **Finland** logbook reported discards of seal damages were 1792 salmon (10 tonnes) in 2018, about 30% less than in 2017. However, seals caused severe harm for all fisheries in many coastal areas and comprised 8% of the total commercial removal. The compensation of seal damages is based on recorded catches (all species accounted), which is considered to improve the catch reporting. The rate of unreporting of catches is considered to have decrease to a very low magnitude as a consequence of the recent developments in the fishing regulations. In 2017, an individual quota system was initiated and since then also all landed salmon have had to carry a landing mark which probably steers to a careful catch reporting. There are no available records of misreporting.

In **Germany** there are no data available on seal fishery interactions. The current seal population in German Baltic waters is small. Concerning the current seal density and the low level of commercial catches, it seems unlikely that predation by seals is an important issue in the commercial fishery in German waters. However, German commercial fishers reported increased predation rates on salmon longline catches around the island of Bornholm in recent years, which led to the cessation of the directed salmon fishery by German vessels in 2016. Also in the recreational trolling fishery, anglers have started to report predation by seals during fish retrieval. Further, Germany has only scattered information on potential discards (BMS) in the commercial fishery in 2018. Concerning the low catches, it is unlikely that there is a discard problem in the commercial fishery, but there could be some unknown unreported salmon catches. Further, misreporting may be an issue concerning salmon catches, where salmon may be reported as sea trout. This could either occur deliberately, since sea trout catches are generally not limited by quota, or unintentionally through species misidentification. In 2013, the federal state authority of Mecklenburg-Western Pomerania initiated a pilot study to investigate the level of misreporting. Within the remits of this study fin samples were genetically analysed. Preliminary results show that misidentification occurred in 30–40% of the commercially landed salmon and sea trout, but that the misidentification was evenly distributed between the species, thus indicating no directed misreporting.

In **Latvia** the direct catch losses of salmon due to seal damages has increased significantly from 2003 and onwards. In the most affected area, the southern part of the Gulf of Riga, the percentage of salmon damaged by seal in the coastal fishery increased from 5% in 2002 to 40% in 2003 and to 60% in 2004. In recent years, the number of seals has continued to increase. Due to this, the salmon fisheries in late autumn in the coastal waters of Latvia have become economically unfavourable. This holds especially for the gillnet fishery. Experimental fishing with a 'seal-safe' gear (produced in Sweden) was unsuccessful. The gear was too fragile for fishing in the open Latvian coastal waters with a dominating SW–NW wind direction. There are no further records of discards and no available records of unreporting or misreporting.

In **Lithuania**, reported data of seal damages, discards, unreporting and misreporting are not available.

In **Poland**, a rapidly increasing amount of seal damages has been observed in recent years, both in offshore and coastal fisheries in SD 25–26 (Gulf of Gdańsk area). So far, no damages have been reported in SD 24. Preliminary data from 2013 indicate that the share of seal-damaged fish in separate catches was on average 25% (minimum 5%, maximum 65%). In 2018, losses of 201 salmon and 301 sea trout were recorded in logbooks. It is significantly less than in 2016 (721 salmon; 862 sea trout) and in 2017 (383 salmon; 498 sea trout). In addition, 1416 salmonids (both salmon and sea trout) have been reported to the Ministry of Maritime Economy and Inland Waterways in 2018 due to compensations for losses caused by birds and mammals in sea areas. It is a higher number than in 2017 (1300 fish, both salmon and sea trout). The seal colony at the Vistula River mouth has grown to 300 individuals that are hunting on neighbouring fishing grounds. For two years, the large amount of seals in the area has almost completely stopped the previous salmon and sea-trout fishery in the lowest few kilometres of the Vistula. In the last few years, no catch was reported, and in the autumn brood stock fisheries no spawners of sea trout or salmon could be collected in the Vistula river mouth due to seal attacks. In the past, Vistula used to be the best place for sea trout fishing and for collecting live spawners. Further, sampling of 2015–2017 longline catches resulted in a total of 2% undersized fish. No undersized salmon were reported in the gillnet fishery. There are no data available on unreported catches. Misreporting of salmon as sea trout in the Polish fisheries is treated below (Section 2.3.3).

In **Russia**, no information on seal damages, discard, unreporting and misreporting is available. However, unofficial information indicates presence of significant poaching of salmon and sea trout, both in the coastal area and in rivers.

In **Sweden**, in the official commercial catch statistics seal interaction on a fishing trip should be reported. Seal interaction includes seal-damaged gears and/or seal-damaged fish. These records form the basis for the system that handles seal damage compensation from the government to commercial fishermen. Discards should also be reported in the official statistics. Fish registered as discarded (but not seal damaged) include allowed discards. In 2018, a total of 601 seal-damaged salmon were reported as discarded (compared to 1120 in 2017 and 51 in 2016). In addition, 203 salmon were reported as discarded (compared to 1005 in 2017 and 1237 in 2016). In a fishery without an exemption from the landing obligation, all fish have to be landed. There are no available records of unreporting or misreporting.

2.3.3 Misreporting of salmon as sea trout

Misreporting of salmon as sea trout may occur in all countries, but apart from Poland, there is no indication in the data for a substantial misreporting. Through the years, Polish data on catches of salmon and sea trout have deviated markedly from corresponding data delivered by other countries fishing with the same gears in southern Main Basin open sea, 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 estimation procedures that have evolved over the years depending on availability of data. Misreporting estimates for earlier fishing years (1993–2008) were based on the assumption that catch per unit of effort in the Polish offshore fisheries (driftnet and longline) corresponded to 75% of the CPUE of other countries' fleets in the corresponding fishery and in the same area (see e.g. ICES, 2012).

In WGBAST 2014, the Polish misreporting was recomputed for years 2009–2013. This was because the WG received new data on the catch compositions in the Polish longline fishery. These data were collected by the (Polish) National Marine Fisheries Research Institute (MIR) in DCF sampling trips on the Polish longline vessels which operated offshore in SDs 25 and 26 in the years 2009–2013 (Table 2.3.3.1). These data are available in the ICES Regional Database Fish Frame (RDB). Since then these data have been available for the WGBAST until year 2017. In 2018, MIR could not perform the sampling due to refusal by fishers, resulting in that the observers could neither perform on-board nor harbour sampling.

According to Polish experts, the sampling in 2010 represented only 0.5% of the total number of days at sea, and the proportion of sampled trips has also been low in 2011–2017. Although there is a clear underrepresentation in the sampling of the total fishery, the observed proportion of salmon in the catches of the sampled trips is consistent and with little variation; none of the observations has indicated a substantial proportion of sea trout in the catch. These data suggest that the Polish longline fishery is an almost true salmon fishing with only few sea trout in the catches (approximately 0–3%; Table 2.3.3.1). These data correspond to catch compositions that have been observed in catches of other countries' vessels fishing in the same area (ICES, 2012).

Based on the given data, a 97% proportion of salmon was assumed in the total Polish longline catch for fishing years 2009–2017 and also for 2018, despite that sampling data are missing for this year. This is a conservative estimate, and it excludes potential misreporting in the Polish coastal fishery.

In WGBAST 2018, Polish catch data from 2006–2015 were revised further, because part of these catches (recorded as sea trout) taken with surface gillnets by large vessels (>=10 meters) had earlier been classified as coastal and consequently were ignored in calculations of misreporting by the group. This was done despite the fact that sorting of Polish catches in general is based on vessel categories so that catches of vessels larger than or equal to 10 m LOA are counted as open sea catches and those of vessels below 10 m LOA as coastal. Reason for this exception in sorting was that it was seen that anchored surface gillnets could not be used in deep and strong current areas in open sea. However, closer exploration of VMS data from 2016 revealed that surface gillnets had been used in the open sea. Therefore, surface gillnet catches of larger vessels have now been classified as open sea catches, and consequently the catches from years 2009–2015 have now been accounted for retrospectively in the calculation of misreporting. As a result, the estimates of misreporting in 2009–2015 increased substantially for most of these years, compared to earlier estimates. Misreporting estimates for years before 2009 were not revised, because earlier data on catch composition in Polish fisheries were not available for the WGBAST.

In WGBAST 2019, as a result of data call in late 2018 the Polish catch data updated slightly for years 2009–2017 and consequently also estimates of misreporting by the Polish fleet were updated. In the updated data, division of catches to open sea and coastal fisheries were based similarly on the vessel length 10 m LOA as earlier (>=10 m LOA = open sea; <10 m LOA = coastal). Otherwise, the estimates of misreported catches for years 2009–2018 were computed in the same way as in WGBAST 2018. Misreporting estimates for years before 2009 were not recomputed.

The total catch of the Polish offshore fishery decreased significantly until 2014, but have increased again after that, and in 2017 and 2018, it grew strongly. The total estimated misreporting in 2018 was 42 600 salmon, almost three times more than as estimated for 2014 (Table 2.2.1.2). This increase has mainly been due to an increase of effort, but partly also due to increase in CPUE in the offshore fishery. The Polish reported catch in the 2018 offshore fishery was 7012 salmon and 44 085 sea trout. Misreporting in the coastal gillnet fishery has not been estimated, although potential misreporting could take place there too. However, the Polish sampling data suggest very small proportions of salmon in coastal catches (annually maximum 5%).

The present misreporting estimates should be considered as rough order of magnitudes. The WGBAST would benefit from Polish contribution in providing more data or relevant reports that would support the estimation of misreporting rates in offshore and coastal salmon fisheries. Poland should make sure that the whole catch is sampled during each of the EU-MAP sampling trips, and that the planned number of trips will be carried out with an appropriate areal and temporal coverage and a statistical sound sampling scheme.

2.4 Fishing effort

In the **commercial fisheries**, data on effort are reported in the official catch statistics. The total fishing effort by gears in the Main Basin, and in the three main assessment areas for the coastal commercial salmon fishery (AU 1–3), excluding Gulf of Finland, is presented in Table 2.4.1. This table includes Baltic salmon fishery catches offshore and along the coasts in 1987–2018. The coastal fishing effort on AU 1 stocks refers to the total Finnish coastal fishing effort and partly to the Swedish effort in SD 31. The coastal fishing effort on AU 2 stocks refers to the Finnish coastal fishing effort in SD 30 and partly to the Swedish coastal fishing effort in SD 31. The coastal fishing effort on stocks of AU 3 refers to the Finnish and Swedish coastal fishing effort in SD 30. Because sea trout in Poland is targeted 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 per country engaged in the offshore fishery for salmon in SD 22–32 during the latest five years (2014–2018) is presented in Table 2.4.2. Catch per unit of effort (CPUE) by country is also presented in this table. For equivalent information for the years 1999–2013, see last year's WGBAST report (ICES, 2018a). In 2018, the total number of active vessels were about the same as in 2017 (approximately 100 vessels both years), though the Danish fleet had less vessels engaged in 2018 than in the year before However, the total effort decreased in 2018 to about two thirds of the effort in 2017 (details below). As in recent years, the Polish fleet is the one that is most active in the commercial offshore fisheries, followed by the Danish fleet. In 2018, also Lithuania, Finland and Latvia reported (minor) salmon catches from commercial longlining.

The development over time in fishing effort for the commercial offshore fishery is presented in Figure 2.4.1. When the driftnet fishery was closed 2008, the effort in the longline fishery consequently increased However, in later years the total effort in the longline fishery has levelled off. In 2018 the effort decreased to 1 047 168 hook-days (i.e. number of fishing days times number of hooks) from 1 090 305 in 2017, to be compared with 2 639 116 hook-days in 2010 (Figure 2.4.1 and Table 2.4.1).

Unit of effort in the coastal trapnet fisheries is gear-days (number of fishing days times the number of gears). Seen in a longer term perspective, effort in the coastal commercial fisheries has decreased markedly, although in more recent years the decrease has levelled off (Figure 2.4.2, Table 2.4.1). In 2018 the effort was 21 145 gear-days which is 20% lower than the effort reported in 2017 (33 965 gear-days).

Table 2.4.3 shows effort and CPUE (number of salmon caught per gear-day) over time (1988–2018) in the Finnish trapnet fishery in Subdivision 32. In 2018, CPUE in this fishery was higher (1.1. salmon per gear and day) than in the eight preceding years (average 0.68). Substantial differences can be seen when comparing CPUE in the Finnish and Swedish Gulf of Bothnia (SD 30–31) trapnet fisheries. Further analyses are needed to evaluate these differences and the quality of current and past effort data in Finnish and Swedish official catch statistics.

For **recreational fisheries** designated data collection of effort data are not yet implemented on any larger scale, and WGBAST is not currently analysing the sparse data available.

2.5 Biological sampling of salmon

General information on the structure of data collection in different fisheries, including length of time-series, is presented in the Stock Annex (Annex 2). The national work plans under the EU-MAP include data collected offshore, along the coasts and in rivers. Biological sampling is conducted both in commercial, recreational and brood stock fisheries. Biological sampling is also included in surveys targeting parr and smolts. General and future perspectives on sampling is further elaborated on in Section 4.7.

2.5.1 Age sampling by country (2018)

The table below gives an overview of EU-MAP age samples (biological sampling) collected in 2018. Information on Russian biological sampling in 2018 is also included (although not a member of the EU). In the biological sampling, a set of individual information (scales for age and/or genetic analysis, length, weight, sex and wild/reared origin) is typically collected.

Number of scale samples for ageing collected in 2018 by country and subdivision(s):

Country	Month (No.)	Fishery	Gear(s)	Number of sampled salmon by SD					
				22–28	**29**	**30**	**31**	**32**	**Total**
Denmark	2	Offshore	Longlines	350					**350**
Estonia	1–12	Coastal	Gillnets					134	**134**
Finland	5–9	Coastal	Trapnets & longlines				850		**1756**
	2–4	Offshore			291	306		309	
	5–8	River					501		**501**
Latvia	4–11	Coastal	Trapnets	128					**128**
Lithuania	8–10	Coastal	Gillnets	42					**42**
Sweden	4–7	River	Various	49		7	263		**319**
Russia	10–11	River	Gillnets					172	**172**
Total				**569**	**279**	**313**	**1614**	**615**	**3402**

Below follow short country-by-country summaries of biological sampling of salmon in 2018 with some comments:

Denmark: 350 scale samples were collected from the Danish salmon landings. All samples were age read.

Estonia: 134 age samples were collected. Sampling takes place occasionally and is carried out in cooperation with fishermen collecting the scales.

Finland: 1756 scale samples were collected from the Finnish commercial salmon fisheries, and 501 samples from the recreational river fisheries. The samples were distributed in terms of time and space. The whole pool of samples was resampled by stratification according to the total catches. The final amount of analysed samples was optimally adjusted to meet the quality criteria of EU-MAP. Finally, total numbers of samples were analysed by scale reading and part of these (600) were also analysed using DNA-markers (microsatellites).

Germany: No commercially caught salmon was sampled in 2018. Catch sampling of salmon from the commercial fishery is very challenging, as salmon is only bycaught. Further, the total catch is low and in most cases only very few individuals are caught per trip. Biological sampling of salmon in the recreational trolling fishery off the Island of Rügen is ongoing since 2016, but in 2018, no recreationally caught salmon were sampled.

Latvia: In the coastal and river trapnet fisheries, biological sampling was carried out from April to November in 2018. In total, 128 salmon were sampled in these two fisheries. None of Latvia's vessels have been engaged in salmon offshore fisheries since 2008. In general, sampling of salmon in the commercial fisheries is very challenging due to lack of a targeted Latvian salmon fishery and because salmon is taken as bycatch (with few individuals per fishing trip).

Lithuania: A total of 42 samples were collected in the Curonian lagoon (SD 28). No Lithuanian fishermen were engaged in a commercial fishery targeting salmon.

Poland: Neither commercial nor recreational caught salmon were sampled in 2018.

Russia: There is no ongoing biological sampling programme running in Russia. Despite this, 172 salmon were collected and sampled for age, length and weight in 2018. Since Russia is not an EU member state, the country is not obliged to follow EU regulations.

Sweden: Age sampling of smolts in rivers is included in the Swedish EU-MAP work plan. These data are needed in the WGBAST assessment modelling work; hence, the sampling is motivated on the ground of end-user needs. In 2018, a total of 319 smolts were scale sampled for ageing (49 in SD 25, 7 in SD 30 and 263 in SD 31). In the commercial coastal fishery, no biological sampling of salmon was carried out in 2018. An exemption for this mandatory sampling was applied in the Swedish national work plan, due to that these data are presently not used in the stock assessment. Occasionally, outside the EU-MAP, age samples are from time to time also collected from brood stock fisheries and from salmon caught by anglers.

2.5.2 Growth of salmon

Below a short summary of an ongoing study on growth of Baltic salmon in relation to composition of the overall fish community is presented.

The average weight of salmon by age group increased around year 1990, simultaneously with an increase in sprat abundance (Figure 2.5.2.1). Despite some annual variation, the level of growth has remained rather stable. In 2016–2018, catch samples indicate a slight increase in mean weights by age (particularly in the A.3 and A.4 groups) which is potentially a result of strong 2014 year classes of sprat and Baltic herring. Despite that salmon shares feeding areas with cod in the southern Baltic Main Basin, there is no clear reduction in the growth rate of salmon as has been observed for cod in the last few years. The estimated post-smolt survival decreased strongly from the mid-1990s until 2005 (Figure 4.2.3.1) but this cannot be recognised in the growth data. Mortality mechanisms seem to affect salmon populations in such a way that survived individuals grow approximately as large in periods of high mortality as in periods of low mortality.

2.6 Genetic composition of Baltic salmon catches

In this section, results from recent analyses of stock proportions in catches are presented. See the Stock Annex (Annex 2) for a general summary of used methods and applications.

Estimates of stock and stock group proportions in Baltic salmon catches in the Gulf of Finland and Gulf of Bothnia based on DNA and freshwater age in-formation

Combined DNA- and smolt age data have been used to estimate stock and stock group proportions of salmon catches in the Baltic Sea with a Bayesian method since year 2000 (Pella and Masuda, 2001; Koljonen, 2006; ICES, 2018a). In 2018, salmon catches both from the Gulf of Finland and Gulf of Bothnia were analysed. From the Gulf of Finland both Finnish (2018) and Estonian catches were available (2016, 2017 and 2018). In the Gulf of Bothnia, Finnish catches from the years 2017 and 2018 were analysed.

Methods

The same genotype baseline data were used for analysis of the 2009–2018 catch samples (Table 2.6.1, Figure 2.6.1). The current baseline stock dataset includes information on 17 DNA microsatellite loci assayed in samples from 39 Baltic salmon stocks from six countries, totalling 4453 individuals (Table 2.6.1).

The Gulf of Bothnia samples were from Finnish coastal catches in 2017 (N=397) and 2018 (N=235) from the same time period as in previous years. In addition, as the temporal fishing regulation has changed in Finland since 2017 (see Section 2.7.2), separate samples from early summer catches in 2017 (N=246) and 2018 (N=156) were also analysed.

In all, 576 samples from Gulf of Finland salmon catches were analysed, and from those 271 were from Estonian catches (2016–2018) and 305 from Finnish coastal catches (2018). This new data were pooled with the Finnish catches from the Gulf of Finland analysed in last year (years 2009, 2010, 2011, 2015 and 2017; ICES, 2018a). In addition, previously analysed data were available from the years 2002–2007 and 2014 (Koljonen, 2006; ICES, 2008a; ICES, 2015).

Estonian catches from 2016 (N=45) were from the Gulf of Eru (N=23), the coast near River Keila (N=11), Gulf of Kunda (N=5), Gulf of Mäda (N=3) and Gulf of Tallinn (N=2). Catches from the 2017 (N=135) were mainly from Juminda (N=97), and Gulf of Eru (N=23). Catches from the 2018 were all from Juminda (N=107). Finnish catches from the Gulf of Finland in 2018 (N=305) were from Kotka (N=114), Loviisa (N=73), Pyhtää (N=94) and Porvoo (N=7) areas.

Because smolt age information was used for stock proportion estimation, the fish in the catch samples were divided into two smolt age classes according to the smolt age information from scale reading: 1–2-year old smolts and 3–5 year old smolts. As all released hatchery smolts are younger than three years, salmon in catch samples with a smolt age of older than two years originated presumably, or *a priori*, from any of the wild stocks, whereas individuals with a smolt age of one or two years might have originated either from a wild or a reared stock. The same assumption is used in scale reading as well, when defining wild and reared fish. Correspondingly, smolt age distributions were needed for all baseline stocks in addition to genetic data (Table 2.6.4). Smolt age distributions of wild smolts in Tornionjoki, Kalixälven and Råneälven were updated to correspond to the mean distribution of smolt year classes from 2015 to 2017, of which the catches of adult salmon in 2018 were mainly composed. For the other stocks an average of smolt ages over the years was used (Table 2.6.4). For the 2017 catches, the genetic baseline used for last year’s analyses was used with the smolt age data for the year classes 2014–2016.

Results

In the Finnish **Gulf of Bothnia** catch samples from later part of the summer fishing season (comparable to time of sampling in years before 2017) the proportion of wild stocks was somewhat lower in 2017 and 2018 than in previous years; it was only about 60% in both later years, whereas it has been about 70% in 2015 and 2016 and even 80% in the maximum year of 2014 (70% on average in years 2009–2016). The proportion of released hatchery fish among smolts has been fairly constant over time, so likely the amount of wild salmon in the catches has been lower in later years. In contrast, during the early summer fishing season the proportion of wild fish was still high, about 80% (Table 2.6.2, Figure 2.6.2.). The decrease of wild stocks could also be seen in the individual stock composition results; as in the 2017 and 2018 catches from the late season there were higher proportions of hatchery stocks, especially from Tornionjoki (H) and Iijoki, than in previous years. The higher proportion of wild salmon during the early summer fishery mainly came from Kalixälven, followed by wild Tornionjoki and Simojoki (Table 2.6.3).

In the **Gulf of Finland,** the catch composition of Finnish and Estonian catches differed markedly. The major stock in the Finnish catches was the Finnish hatchery stock, the Finnish Neva salmon, which composed about half of all Finnish catches. The rest were coming from bypassing wild and reared Gulf of Bothnian salmon in the early summer (Table 2.6.2, Figure 2.6.2.).

Gulf of Bothnian salmon did nearly not occur at all in the Estonian catches, and also the proportions of reared Neva salmon (both Finnish and Russian) were very low in these catches (Table 2.6.3). The most common stock was River Kunda salmon, with an average of 40%, followed by Keila (17%) and the Narva hatchery stock (12%). Russian Luga salmon (which occurs both as wild and reared) comprised about 10% of the Estonian catch samples. Also, Estonian Kunda salmon exists as both wild and reared. Consequently, the total proportion of wild salmon in the Estonian catch samples is difficult to distinguish without additional information.

Finally note that in the stock group estimates (Table 2.6.2., Figure 2.6.2) the Gulf of Finland wild and hatchery stocks of Rivers Kunda (EST) and Luga (RUS) are both included into the Gulf of Finland wild group, as both rivers have both wild and hatchery production which cannot be distinguished with genetic methods. This affects the results from Estonian catches, and is expected to overestimate the wild production in those catches.

2.7 Management measures influencing the salmon fishery

2.7.1 International regulatory measures

Detailed information and evaluations of international regulatory measures are presented in the Stock Annex (Annex 2).

2.7.2 National regulatory measures

National regulatory measures are, unlike the international regulatory measures, updated more often, at times on a yearly basis, and therefore they are presented here and not in the Stock Annex. Effects of national regulatory measures on stock development are generally not evaluated by WGBAST.

In **Denmark**, no new national regulatory measures were implemented in 2018. For the commercial sea fishery, the following national regulations are applied in the period 2014–2020:

- all vessels targeting salmon should be registered as salmon fishing boats and have a specific permission for salmon fishery;
- vessels with a catch of ten or more salmon must notify the Fisheries Inspection before entering the harbour.

For recreational trolling fisheries no national legislation is in practice. However, voluntary restrictions are recommended by angler association(s).

Further restrictions: Throughout the year, all streams with outlets wider than 2 m are protected by closed areas within 500 m from the mouth. Otherwise, the closure period is four months at the time of spawning run. Estuaries are usually protected by an extended zone. Gillnetting is not permitted within 100 m of the low waterline. A closed period for salmon (and sea trout) has been established from November 16th to 15th January in freshwater. In the sea, this only applies for sexually mature fish in spawning dress (coloured). A maximum of three gillnets and three fykenets/sets of hooks are allowed per fisherman.

Around Bornholm, a maximum of six sets of gear (nets or hooks) are permitted per fisherman. Fishing with hooks is permitted only between 1 October – 1 May. For each set of hooks, a maximum of 100 hooks is allowed. Maximum length of the six nets allowed is 270 m in total. Between 16 September and the last day in February nets may be combined as follows, either: (A) up to six bottom gillnets, or (B) up to five bottom gillnets and one floating net (maximum 45 m length, maximum height 3 m, minimum mesh size (total) 157 mm (called *'Salmon nets'*) OR five bottom gillnets and one floating net 45 m length and height 12 m with minimum mesh size (total) 57 mm (called *'Bornholmer nets'*), or (C) up to four bottom gillnets and one floating gillnet maximum 45 length and 3 m height, and one 'salmon net'. Between 1 March and 15 September, maximum three of the six gillnets allowed can be floating (maximum length 135 m).
Further restrictions around Bornholm: On water with less than 30 m depth: a maximum of three gillnets is allowed (all year). Use of floating gillnets is prohibited from 16 September to the last day of February. Between 1 March and 30 April, maximum mesh size (total) is 60 mm in floating gillnets. All year, the use of both *'Bornholmer nets'* and *'Salmon nets'* is prohibited. On water with more than 30 m depth: use of *'Bornholmer nets'* is prohibited between 1 December and 31 May. All year only one *'Salmon net'* is permitted. Harvest of sea trout is limited to maximum three fish per man per day (and maximum three per boat per day). No mandatory bag limit exists for salmon, though local trolling fishers have agreed to harvest maximum two salmon per fisher per day, minimum length 75 cm and preferably retain only released (finclipped) salmon.

In **Estonia**, no new national regulatory measures were implemented in 2018. Since 2011, the following restrictions are in practice:

- no commercial fishery in salmon (and sea trout) spawning rivers is permitted, with the exception of lamprey fishing;
- only licensed angling is permitted.

Some specific management regulations are also in place on a river basis regarding closure periods for angling. A closed period for salmon (and sea trout) angling is established in rivers Narva, Purtse, Kunda, Selja Loobu, Valgejõgi, Jägala, Pirita, Keila, Vasalemma, and Pärnu from 1 September–30 November, and in other rivers from 1 September–31 October. Exceptions for these closures are allowed by decree of the Minister of Environment in rivers with a reared (Narva) or mixed salmon stock (Purtse, Selja, Valgejõgi, Jägala, Pirita and Vääna). Below of dams and waterfalls, all kind of fishing is prohibited at a distance of 100 m. In the River Pärnu, below Sindi dam, this distance is 500 m.

Furthermore, there is an all-year-round closed area of 1000 m radius at the river mouths of the present or potential salmon spawning rivers Purtse, Kunda, Selja, Loobu, Valgejõgi, Jägala, Pirita, Keila, and Vasalemma, and at the river mouths of the sea trout spawning rivers Punapea, Õngu, and Pidula. Since 2011, the closed area for fishing around the river mouth was extended from 1000–1500 m for the time period 1 September–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 the case of the most important Estonian sea trout spawning rivers (Pada, Toolse, Vainupea, Mustoja, Altja, Võsu, Pudisoo, Loo, Vääna, Vihterpadu, Nõva, Riguldi, Kolga, Rannametsa, Vanajõgi, Jämaja) a closed area of 500 m is established from 15th August to December 1st. In most of the salmon (and sea trout) rivers, angling with natural bait is prohibited.

In **Finland,** the national coastal salmon fishing regulation for the Gulf of Bothnia was latest renewed in 2017. Furthermore, an individual quota system was implemented in the commercial salmon fishery (and as well as in the Baltic herring and sprat fishery). In the Main Basin, offshore salmon fishery has been forbidden for Finnish vessels since year 2013.

In the Gulf of Bothnia, salmon fishing for commercial fishermen is allowed to start with one trapnet in the following dates in four zones: 1. Bothnian Sea (59°00′N–62°30′N) May 1st; 2. Quark (62°30′N–64°N) May 6th; 3. Southern Bothnian Bay (64°00′N–65°30′N) May 11th; and 4. Northern Bothnian Bay (65°30′N–>) May 16th.

An increased effort (one additional trapnet) is allowed from the following dates zone by zone: 1. Bothnian Sea - June 10th; 2. Quark - June 15th; 4. Southern Bothnian Bay - June 20th; and 4. Northern Bothnian Bay (65°30′N–>) June 25th.

After one week from the above dates, two more trapnets are allowed (i.e. maximum of four trapnets per fisher per year). In the recently initiated individual quota system, all salmon have to be marked with a coded landing mark. In the first period of the season (when only one trapnet is allowed) fishers are allowed to utilize up to 25% of their individual quota.

Also, in 'terminal fishing areas' outside reared rivers, the number of trapnets and fishing period was restricted. Earlier, the number of trapnets in terminal fishing areas was unlimited, and only in the Kemi terminal area there was a closure in the early summer. Now the regulation in terminal areas is more similar to the rest of the region. Fishing with one trapnet is allowed to start at the same time as outside these areas, but the number of trapnets can be raised up to three on June 17th and up to eight on June 25th (with up to two and four traps for fishers with a turnover of less than or equal to 10 000 €, respectively). In the coastal area outside River Simojoki, salmon fishing may start on July 16th, and outside the mouth of Tornionjoki on June 17th. Since 2015, recreational fishermen are not allowed to use larger fykenets (height limit 1.5 meters).

Salmon fishing with longlines and gillnets is forbidden in the Archipelago Sea and Gulf of Bothnia from April 1st to June 16th or June 21st or June 26th or July 1st depending on location (position). Finally, note that the above does not include the Åland Islands where a separate regulation is in place.

In **Germany,** no new national regulatory measures were implemented in 2018. There are two federal states bordering the Baltic coast: Schleswig-Holstein, (SH) and Mecklenburg-Western Pomerania (MV). Commercial (coastal) fishing and recreational fishing is under the jurisdiction of the German federal states. Consequently, marine coastal fishing is managed with different legislation. The fishing season is closed both for commercial and recreational fisheries during autumn, in SH October 1st–December 31th (only coloured fish) and in MV September 15th–December 14th. Closed areas in both federal states include protected spawning grounds in coastal waters, 300–400 m around spawning streams/rivers. For commercial fisheries there is also a 200 m gillnet ban in front of the coastline. In MV, trolling fisheries is permitted at a distance >1 km from the coastline between September 15th and March 15th and there is a rod limit of three rods per angler in place. In MV, there is also a bag limit in place allowing landing of three salmonids (sea trout or salmon) per day and angler. Recreational fishery for salmon (and sea trout) is allowed on a licence basis.

In **Latvia**, no new national regulatory measures were implemented in 2018. In summary, current national legislation in commercial offshore and in coastal waters includes the following restrictions:

- In the Gulf of Riga, salmon driftnet and longline fishing is not permitted;
- In coastal waters, salmon fishing is prohibited from October 1st–November 15th;
- Salmon fishing in coastal waters has been restricted indirectly, by limiting the number of gears in the fishing season.

In the recreational trolling fishery, one person is allowed to use three fishing rods in the waters of the Baltic Sea and the Gulf of Riga, if each gear has no more than three hooks of any type (including multi-grooves), and where more than one multi-hook hook is allowed only if it is free (moving) attached to one artificial bait. It is prohibited to use natural bait for salmon and trout. Daily bag limit is one salmon and one sea trout per person. Minimum size limit is 60 cm for salmon and 50 cm for sea trout.

In the rivers with natural reproduction of salmon, all angling and fishing for salmon and sea trout is prohibited with exception of licensed angling for sea trout and salmon during the spring season in the rivers Salaca and Venta. Daily bag limit is one sea trout or one salmon. Since 2013, all gillnetting is prohibited all year round in a 3 km zone around the River Salaca outlet. In 2004, the restriction zones were enlarged from 1 to 2 km for the rivers Gauja and Venta. In rivers Daugava and Bullupe (connects rivers Lielupe and Daugava) angling and commercial fishing of salmon is allowed since 2007. However, it is prohibited to use gillnets in these rivers.

In **Lithuania**, no new national regulatory measures were implemented in 2018. The commercial fishery is regulated during time of salmon (and sea trout) migration in the Klaipėda strait and the Curonian lagoon. Fishing is prohibited all year-round in a predefined part of the Klaipėda strait. From September 1st–October 31st, during the salmon (and sea trout) migration, fishing with nets is prohibited on the eastern stretch of the Curonian lagoon between Klaipėda and Skirvytė, at a 2 km distance from the eastern shore.

Recreational salmon (and sea trout) fisheries along the coast are regulated by one set of rules, whereas in inland waters another set of rules regulates the fisheries. For recreational fishing of salmon (and sea trout) in the Baltic Sea, one either needs to buy a fishing ticket or be entitled to special fishing rights to fish. In inland waters, you need a recreational fishing card for fishing. Both in the sea and in inland waters, there is a bag limit of one salmon or sea trout per angler and fishing day. In inland waters, the minimum size has been extended to 65 cm.

In the period September 15th–October 31st, recreational fishing is prohibited within a 0.5 km radius from the Šventoji and Rėkstyne river mouths, and from the southern and northern breakwaters of Klaipėda Strait. During the same period, commercial fishing is prohibited within a 0.5 km radius from Šventoji River mouth, and 3 km from the Curonian lagoon and Baltic Sea confluence. From October 1st to December 31st, all types of fishing are prohibited in 161 streams, because of brown trout and sea trout spawning.

In larger rivers, such as Neris and Šventoji (with twelve rivers/tributaries in total), specially protected zones have been selected where schooling of salmon and sea trout occurs. In these selected zones, licensed fishing is only permitted from September 16th until October 15th. Last year, the angling of salmon and sea trout in this selected river zones was limited by the 'catch and release' rule (from 1st until 15th October). From October 16th to December 31st any kind of fishing is prohibited in these areas. From January 1st, licensed salmon (and sea trout) kelt fishing is permitted in the Minija, Veiviržas, Skirvytė, Jūra, Atmata, Nemunas, Neris, Dubysa, Siesartis and Šventoji river. Fishing with a licence is allowed from January 1st to October 1st in designated stretches of the listed rivers. In the inland waters, regulation of fishing is more complex. In case of retaining a salmon (or sea trout), a specific part of the recreational fishing card must be removed not later than within five minutes. Such a marked recreational fishing card means that you are not allowed to continue fishing there and then.

In **Poland**, no new national regulatory measures were implemented in 2018. In addition to EC measures, seasonal closures and fixed protected areas are in force within territorial waters managed by Regional Fisheries Inspectorates. Fishing for salmon (and sea trout) in the sea is not allowed between September 15th and November 15th within a predefined belt along the coastal zone (< 4 Nm). A new law for recreational salmon fishing in Polish EEZ was introduced in 2015 including:

- catch quotas (per day/per angler);
- minimum size limits (TL.);
- periods and areas for protected fish species;
- minimum distance between anglers.

Rod fishing (coastal fishing, boat/belly boat fishing, and organized cruises on board fishing vessels) and spear fishing is allowed. Recreational fishing with nets is not allowed. A new system of obtaining fishing licences has been established. Currently, proof of a bank transfer with specified personal information is needed for legal fishing. The permit can be issued for a period of one week, one month or one year.

Since 2005, commercial fisheries for salmon (and sea trout) in rivers is based on new implemented rules. Fisheries opportunities were sold in 2005 by the state on a tender basis, where the bidder had to submit a fishing ten-year operational plan including restocking. Commercial river fisheries directed for sea trout and salmon already exist almost only in the Vistula River. However, salmon are rare. In Pomeranian rivers, some salmon are collected annually for brood stock during spawning run.

In the rivers, angling for salmon and sea trout is forbidden between 1 October and 31 December. A fishing licence and permit are needed for fishing in the rivers. Only rod fishing is allowed for fishing for salmon and sea trout in the rivers. In addition, in Rivers Ina, Rega, Parsęta and Słupia, anglers must release all salmon that have been caught.

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

In **Sweden**, no new national regulatory measures were implemented in 2018. As in recent years, the main bulk of the national quota in 2018 for the salmon commercial fishery was allocated to the coastal fishery, as the Swedish offshore longline fishery targeting salmon was phased out in 2012. National management measures for salmon include an early summer ban. The aim of the early summer ban in the coastal fishery is to ensure that a part of the spawning migrating population ascend rivers before the fishing season starts. Starting dates of the commercial coastal fishing season in 2018 were the same as in 2017 and 2016. North of latitude 62º55′N the fishing season started 17 June. Exemptions from this seasonal regulation of the salmon fishery were allowed by the local county board to professional fishermen in the area north of latitude 62º55′N up to the border between the counties Västerbotten and Norrbotten, so that a limited fishery could start on 12 June. South of latitude 62º55′N, commercial coastal fishing in 2017 was allowed from 1 April.

With the further aim of increase exploitation of reared salmon stocks and reducing exploitation of weak wild ones, the Swedish TAC is divided between three coastal regions SD 22–29, SD 30 and SD 31. In addition, the regional quota in SD 31 is divided between wild (not finclipped) and reared (finclipped) salmon. When the limit of non-finclipped salmon is reached, only fishing for finclipped salmon in terminal fishing areas outside reared rivers, and in the restriction area outside River Umeälven, is allowed. In SD 22–29 the regional quota is set to a low value (in 2018, 200 salmon), because of the higher expected proportion of salmon from weaker wild stocks in those catches. As compared to in SD 30, where the regional quota was 7500 salmon and in SD 31, where the quota was 12 000 non-finclipped (wild) salmon and 7000 finclipped salmon. To create a reserve for bycatches in fisheries targeting other species, a number of salmon is in each year not allocated to any specific coastal area. This reserve can also be used as buffer if catches in any of the areas would exceed the set regional quota.

Sweden has applied for and received a temporally exemption from the landing obligation for salmon and cod caught in traps (and a few other gears) in the Baltic, because the survival rate is expected to be high after release back into the sea. More information on this in given in the Stock Annex (Annex 2). In addition, Sweden has increased the Minimum Conservation Reference Sizes (MCRS) for salmon caught in SD 31 from the EU-regulated 50 cm to 60 cm.

Catches from commercial fisheries in reared rivers (freshwater) are not counted against the TAC, and therefore these fisheries can continue after the commercial coastal fishery is stopped.

Recreational fisheries in the sea and in rivers are also managed through national regulations. Recreational coastal fisheries with trapnets in the counties of Norrbotten, Västerbotten and part of Västernorrland were, as in the latest years, allowed from 1 July until the quota of salmon within the commercial fishery was fulfilled. In SD 31, the regional salmon quota was fulfilled already at the end of June resulting in that the salmon fishery was closed in 30 June. Hence, it was not possible to conduct recreational fishing with trapnets in SD 31 in 2018. Furthermore, according to information from the County Administrative Board, there are no active recreational trapnet fishermen in SD 30 despite the longer fishing season in this area. This could be due to the ban for recreational fishermen in the Baltic Sea to sell their catches. Hence, many recreational trapnet fishermen have applied for a commercial licence and therefore, their catches are now included in the quota.

National management measures for the Swedish recreational offshore trolling fishery (mainly in Main basin) have been in practice since 2013. Only salmon without an adipose fin (i.e. finclipped reared salmon) are allowed to retain.

In all rivers, there is a general bag limit of one salmon and one trout per fisherman and day. In addition, fishing periods are regulated on a national level. In Gulf of Bothnian wild rivers, for example, angling for salmon is forbidden from September 1st until December 31st, and in some rivers angling is also forbidden between May 1st and June 18th. In addition to national regulations, local fishing and management organizations may decide on more restrictive river-specific fishing regulations.

Management of salmon fisheries in Torneälven/Tornionjoki, including also the coastal area directly outside the river mouth, is handled through a Swedish-Finnish agreement. This agreement includes, for example, a specified time period within which the commercial coastal fishery in the river mouth is allowed to start. Regulations targeting the river fishery are also handled in the agreement. Deviations from the agreed fishing regulations are negotiated and decided upon on an annual basis by the Swedish Agency for Marine and Water Management (according to a Government commission from the Swedish Ministry of Enterprise and Innovation) and the Finnish Ministry of Agriculture and Forestry.

2.8 Other factors influencing the salmon fishery

The incitement to fish salmon compared with other species is likely to be influenced by a number of factors, such as the possibilities for selling the fish, the market price for salmon compared to other species, eventual opportunities to target and catch other species and problems with damages to the catches caused by seals and possibly birds.

Further, the possibilities for selling the fish is evidently affected by co-factors such as levels of contaminants, e.g. dioxin. Detailed information about dioxin contents in Baltic salmon, and how this affects the fishery, is presented in Stock Annex (Annex 2, Section A.2.6). Also, the overall health status of the fish is of importance. See Section 3.4.4 for a summary of disease problems seen in several rivers and areas in later years.

Table 2.2.1.1. Total catch: Nominal reported catches plus discards (incl. seal damaged salmon), unreported and misreported catches of Baltic Salmon in tonnes round fresh weight, from sea, coast and river by country in 2001–2018 in subdivisions 22–32. See ICES (2018) for catches before year 2001.

Year	Country									Reported total catch	Estimated misreported catch	Estimated unreported catch		Estimated discarded catch		Total catch	
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden			median	90% PI	median	90% PI	median	90% PI
2001	443	16	633	39	136	4	180	37	636	2124	630	277	215-373	207.5	190-230	3117	3051-3219
2002	334	16	510	29	108	11	197	66	580	1851	575	265	204-368	181.3	166-201	2769	2704-2876
2003	454	10	410	29	47	3	178	22	462	1615	716	219	167-306	193.7	175-218	2637	2580-2731
2004	370	7	655	35	34	3	88	16	894	2102	1271	316	236-458	221.5	201-251	3783	3699-3929
2005	214	9	617	24	23	3	114	15	731	1750	554	271	207-380	157.8	145-174	2629	2562-2741
2006	178	8	371	18	14	2	117	5	506	1219	234	196	150-274	120.3	112-131	1697	1650-1778
2007	79	7	409	15	26	2	95	6	492	1131	272	185	142-254	94.66	88-103	1605	1560-1675
2008	34	9	452	21	9	2	44	6	471	1048	16	199	149-285	53.27	50-58	1269	1219-1355
2009	82	7	423	14	15	2	49	2	508	1102	333	212	158-315	67.24	61-76	1695	1639-1800
2010	145	5	270	8	13	1	48	2	411	902	374	165	124-239	62.72	55-73	1485	1443-1560
2011	105	5	288	7	7	2	31	2	457	903	185	175	132-255	60.77	56-68	1320	1275-1401
2012	118	7	473	7	8	2	28	2	468	1113	87.5	215	165-299	56.71	52-64	1476	1425-1560
2013	138	9	373	6	12	1	24	2	398	964	75	168	126-234	70.44	60-81	1263	1220-1329
2014	143	7	453	6	11	2	15	2	372	1011	68	154	114-217	62.82	53-73	1295	1255-1357
2015	112	9	367	10	10	13	18	2	381	922	83	141	106-197	60.29	52-67	1169	1134-1225
2016	94	13	438	8	9	19	18	2	386	986	130	152	115-211	59.6	53-65	1290	1252-1349
2017	46	14	343	42	8	8	34	2	265	762	160	91	69-123	64.41	56-72	1030	1008-1063
2018	74	12	386	49	6	11	57	2	324	921	213	107	81-147	71.44	60-81	1238	1211-1279

Table 2.2.1.2. Total catch: Nominal reported catches plus discards (incl. seal damaged salmon), unreported and misreported catches of Baltic Salmon in numbers from sea, coast and river by country in 2001–2018 subdivisions 22–32. See ICES (2018) for catches before year 2001.

Year	Country									Reported total catch	Estimated misreported catch	Estimated unreported catch		Estimated discarded catch		Total catch	
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden			median	90% PI	median	90% PI	median	90% PI
2001	90388	3285	122419	7717	29002	1205	35606	7392	153197	450211	126100	61040	47090-82590	41280	37670-45760	658700	644000-681400
2002	76122	3247	104856	5762	21808	3351	39374	13230	140121	407871	115000	59200	45530-82030	38410	35090-42680	603400	588900-627200
2003	108845	2055	99364	5766	11339	1040	35800	4413	117456	386078	143100	52820	40230-73160	43480	39250-48800	603600	590000-625400
2004	81425	1452	130415	7087	7700	704	17650	5480	195662	447575	254300	67400	50360-97410	43760	39490-49690	790000	772100-820800
2005	42491	1721	113378	4799	5629	698	22896	3069	146581	341262	110800	53610	40920-75130	30880	28390-34080	518900	505700-541100
2006	33723	1628	64679	3551	3195	488	22207	1002	98663	229136	46900	36970	28270-51450	22720	21060-24870	323000	313900-338000
2007	16145	1315	75270	3086	5318	537	18988	1408	96605	218672	54310	35780	27470-49180	18740	17390-20460	315500	307000-329200
2008	7363	1890	80919	4151	2016	539	8650	1382	92533	199443	3295	37940	28370-54660	10190	9570-11050	243500	233900-260400
2009	17116	2064	77105	2799	3323	310	9873	584	111263	224437	66500	42790	31680-64420	13870	12570-15640	340600	329200-362500
2010	29714	1459	44981	1520	2307	243	9520	491	83318	173553	74800	30050	22670-43400	12480	11000-14560	283300	275700-296900
2011	21125	1332	49613	1483	1470	317	6149	470	90276	172235	37000	31310	23640-45160	11770	10770-13140	244200	236400-258300
2012	23180	1915	73450	1362	1371	355	5605	412	84331	191981	17500	34380	26490-47330	10250	9369-11520	247100	239200-260200
2013	25461	2426	56287	1210	2842	285	4808	387	62566	156272	15000	27080	20260-37730	13000	11090-14950	201000	194100-211800
2014	24596	2139	69132	1264	2650	388	2999	418	58056	161642	13600	22740	16940-31720	11090	9405-12740	200000	194200-209000
2015	19367	2597	62476	2009	2572	2580	3745	406	63309	159061	16600	22600	17070-31600	11060	9646-12280	200300	194700-209300
2016	17701	3180	62738	1623	2881	3803	3659	419	62549	158553	26000	23850	18140-32920	11380	10060-12300	210400	204600-219500
2017	9644	3005	52478	5632	2435	1702	7075	380	50770	133121	32000	16870	12770-23420	11360	9713-12650	184300	180100-190900
2018	14588	2534	53594	6586	804	2223	10641	458	56732	148160	42600	18490	13990-25820	12410	10290-13940	207400	202700-214800

Table 2.2.1.3. Nominal catches of Baltic Salmon in tonnes round fresh weight, from offshore, coast and river by country and region in 2001–2018. O=offshore, C=coast, R=river. See ICES (2018) for catches before year 2001.

	Main Basin (subdivisions 22–29)																										
Year	Denmark		Estonia		Finland			Germany	Latvia			Lithuania			Poland			Russia			Sweden			Total			
	O	C	O	C	O	C	R	O	O	C	R	O	C	R	O	C	R	O	C	R	O	C	R	O	C	R	GT
2001	433	10	0	4	135	64	0	39	66	71	0	1	4	0	165	9	6	33	0		313	2	7	1184	163	13	1361
2002	319	15	0	6	154	51	0	29	47	61	0	1	9	0	178	9	10	64	0		228	2	6	1021	153	16	1190
2003	439	15	0	3	115	33	0	29	33	14	0	0	3	0	154	22	3	20	0		210	3	3	999	94	5	1098
2004	355	15	0	3	169	74	0	35	19	13	2	0	2	0	83	0	5	14	0		433	5	3	1108	111	11	1230
2005	199	15	0	1	188	58	0	24	15	8	0	0	2	0	104	5	5	12	0		314	5	2	856	95	8	959
2006	163	15	0	1	105	22	0	18	9	5	0	0	2	0	100	12	6	3	0		220	3	1	617	60	7	684
2007	64	15	0	2	158	11	0	15	16	3	7	0	2	0	75	15	5	4	0		216	4	2	548	52	14	614
2008	19	15	0	2	46	16	0	21	0	5	4	0	2	0	30	8	6	4	0		88	6	2	207	55	11	273
2009	82	0	0	2	39	16	1	14	0	10	5	0	1	1	42	8	0	0	0		82	8	1	258	45	7	310
2010	145	0	0	1	36	11	1	8	0	4	10	0	1	1	40	7	0	0	0		128	5	1	357	28	12	398
2011	105	0	0	1	38	18	1	7	0	4	4	0	0	1	22	9	0	0	0		162	5	1	335	37	7	378
2012	118	0	0	2	23	27	0	7	0	2	6	0	1	1	25	3	0	0	0		88	6	2	261	40	10	312
2013	138	0	0	2	0	21	0	6	0	6	5	0	0	1	21	3	0	0	0		0	5	1	166	37	7	210
2014	143	0	0	2	1	29	0	6	0	5	5	0	1	1	13	3	0	0	0		0	6	1	163	46	8	216
2015	112	0	0	3	2	24	0	10	1	6	3	3	0	9	15	3	0	0	0		0	1	2	143	37	15	195
2016	94	0	0	3	1	24	0	8	0	7	1	8	0	11	15	3	0	0	0		0	3	1	126	41	13	180
2017	46	0	0	3	0	21	0	42	0	5	3	5	0	3	28	6	0	0	0		0	2	0	121	36	6	163
2018	74	0	0	3	0	26	0	49	2	1	3	6	1	4	52	5	0	0	0		0	2	0	182	38	7	227

Table 2.2.1.3. Continued.

	Gulf of Bothnia (subdivisions 30–31)										**Main Basin + Gulf of** Bothnia (subdivisions 22–31) Total			
Year		Finland			Sweden			Total						
	0	C	R	0	C	R	0	C	R	GT	0	C	R	GT
2001	9	234	26	1	195	117	10	430	143	583	1191	571	157	1919
2002	5	202	20	1	241	101	6	444	121	571	1027	597	137	1761
2003	1	176	25	2	172	73	2	347	98	447	1002	441	103	1546
2004	3	309	32	0	368	86	3	677	118	798	1111	788	129	2028
2005	6	239	37	1	286	123	6	525	160	691	862	621	167	1650
2006	1	148	17	6	204	71	7	352	88	448	624	412	96	1132
2007	3	134	27	1	168	101	4	302	128	434	552	354	142	1048
2008	0	209	78	0	208	167	0	417	245	662	207	472	256	935
2009	1	237	43	0	290	127	1	527	170	698	259	572	177	1008
2010	0	151	32	0	208	69	0	359	101	459	357	387	113	857
2011	0	148	37	0	208	81	0	356	118	474	335	393	125	853
2012	0	231	103	0	163	209	0	394	312	706	261	434	322	1018
2013	0	196	73	0	212	179	0	409	252	661	166	446	260	871
2014	0	207	138	0	200	165	0	406	303	710	163	453	311	926
2015	0	175	112	0	189	202	0	364	314	678	143	401	329	873
2016	0	201	149	0	193	190	0	394	339	734	126	436	352	914
2017	0	181	87	0	155	114	0	336	201	537	121	372	207	701
2018	0	146	85	0	194	134	0	340	219	559	182	378	227	787

Table 2.2.1.3. Continued.

	Gulf of Finland (Subdivision 32)												**subdivision 22–32**			
Year	Estonia			Finland			Russia		Total				Total			
	O	C	R	O	C	R	C	R	O	C	R	GT	O	C	R	GT
2001	0	10	2	14	139	11	0	3	14	150	16	180	1208	742	173	2076
2002	1	10	0	17	46	15	0	2	18	56	16	90	1044	653	154	1851
2003	0	7	0	3	50	8	0	1	3	57	9	70	1005	498	112	1615
2004	0	4	0	2	57	9	1	1	3	62	11	75	1114	850	140	2103
2005	0	6	1	3	72	15	1	2	3	79	18	100	865	700	185	1749
2006	0	5	2	3	65	10	1	2	3	70	13	87	627	482	109	1219
2007	0	4	1	3	64	9	0	1	3	69	11	83	555	423	153	1131
2008	0	6	2	2	94	7	1	2	2	100	10	112	209	571	267	1047
2009	0	4	1	1	74	11	1	2	1	79	14	94	260	650	191	1102
2010	0	2	1	1	36	2	0	2	1	39	5	45	358	426	118	902
2011	0	3	1	0	43	3	0	2	0	45	5	51	335	438	131	904
2012	0	4	1	0	85	4	0	2	0	89	6	96	262	523	328	1113
2013	0	7	0	0	78	5	0	2	0	84	7	92	166	530	267	963
2014	0	5	0	0	74	4	0	2	0	79	6	85	163	531	316	1011
2015	0	6	0	0	53	1	0	2	0	59	3	62	143	460	332	935
2016	0	7	2	0	62	1	0	2	0	69	5	74	127	505	357	988
2017	0	9	2	1	52	1	0	2	1	62	4	67	122	434	212	768
2018	0	8	1	1	51	1	0	2	1	59	5	64	183	437	231	851

Table 2.2.1.4. Nominal catches of Baltic Salmon in numbers, from offshore, coast and river by country and region in 2001–2018 O=offshore, C=coast, R=river. See ICES (2018) for catches before year 2001.

	Main Basin (subdivisions 22–29)																										
Year	Denmark		Estonia		Finland			Germany		Latvia			Lithuania			Poland			Russia		Sweden			Main Basin (subdivisions 22–29) Total			
	O	C	O	C	O	C	R	O	C	O	C	R	O	C	R	O	C	R	O	C	O	C	R	O	C	R	GT
2001	90388	0	12	819	2661	8706	0	771	0	1819	1080	0	152	105	0	3301	176	825	6584	0	7887	485	890	26166	2363	171	28701
2002	76122	0	0	117	3287	8003	25	576	0	1194	9781	85	363	298	0	3563	180	193	1280	0	6024	556	699	23574	2430	274	26278
2003	10884	0	16	681	2497	5021	25	576	0	8843	2496	0	74	966	0	3088	428	632	3982	0	5420	575	469	23758	1402	112	25273
2004	81425	0	0	594	3556	1102	50	708	0	4984	2316	400	49	655	0	1653	0	111	4983	0	9921	900	441	24984	1548	200	26733
2005	42491	0	0	286	3691	7936	25	479	0	2787	2054	788	0	691	0	2086	102	100	2433	0	6652	715	337	17682	1270	215	19168
2006	33723	0	0	291	1985	3152	20	355	0	1705	1490	0	9	474	0	1995	137	883	552	0	4568	546	180	12503	7324	108	13344
2007	16145	0	0	325	3039	1468	20	308	0	2960	1478	880	0	529	0	1492	309	966	888	0	4484	598	243	11323	7496	210	12284
2008	7363	0	0	432	9277	2324	35	415	0	0	1410	157	0	518	0	5933	168	103	697	0	1788	104	317	45304	7407	154	54254
2009	17116	0	0	740	8039	2435	10	279	0	0	2549	774	0	166	144	8301	157	0	0	0	2478	132	737	61035	8788	176	71587
2010	29714	0	0	538	6966	1587	14	152	0	0	1092	121	0	106	137	8029	149	0	0	0	3355	817	856	79786	5631	234	87765
2011	21125	0	0	414	7193	2340	14	148	0	0	1013	457	0	59	258	4429	172	0	0	0	4085	726	588	75087	6272	144	82802
2012	23180	0	0	713	4088	3560	50	136	0	0	576	795	0	142	213	5094	511	0	0	0	2449	862	998	58222	6364	205	66642
2013	25461	0	0	766	66	2699	30	121	0	0	2038	804	0	72	213	4215	593	0	0	0	8068	724	151	39020	6892	256	48473
2014	24596	0	0	891	108	3840	15	126	0	0	1884	766	0	101	287	2494	505	0	0	0	8013	826	593	36475	8047	166	46183
2015	19367	0	0	118	235	3081	8	200	0	137	1923	512	620	72	188	3180	565	0	0	0	8019	120	880	33567	6947	328	43802
2016	17701	0	0	115	152	3196	10	162	0	0	2728	153	151	97	219	3102	557	0	0	0	8009	440	519	32097	8176	287	43151
2017	9644	0	0	863	45	2933	10	641	0	0	1864	614	996	48	658	5909	116	0	0	0	8005	217	642	31013	7091	192	40028
2018	21624	0	0	104	25	3379	7	750	0	345	212	529	123	131	856	9751	976	3	0	0	8007	216	234	48497	5956	162	56082

Table 2.2.1.4. Continued.

	Gulf of Bothnia (subdivisions 30–31)										Main Basin + Gulf of Bothnia			
Year		Finland			Sweden			Total			(subdivisions 22–31) Total			
	O	C	R	O	C	R	O	C	R	GT	O	C	R	GT
2001	1904	53280	3750	122	47804	25022	2026	101084	28772	131883	263691	124719	30487	418897
2002	864	44073	3900	174	57033	21417	1038	101106	25317	127462	236779	125409	28060	390249
2003	166	53562	4500	297	45075	16839	463	98637	21339	120439	238051	112658	22465	373174
2004	604	65788	5900	0	77904	17207	604	143692	23107	167403	250448	159181	25109	434738
2005	1045	45403	6700	99	57154	21749	1144	102557	28449	132150	177967	115264	30601	323832
2006	162	26228	2620	1150	35912	15190	1312	62140	17810	81262	126349	69464	18893	214706
2007	604	27340	3570	195	33054	17671	799	60394	21241	82434	114036	67890	23350	205276
2008	11	41589	12030	0	41916	31377	11	83505	43407	126923	45315	90912	44950	181177
2009	129	45342	6848	0	62203	23592	129	107545	30440	138114	61164	116333	32204	209701
2010	0	25539	4744	2	37448	12116	2	62987	16860	79849	79788	68618	19208	167614
2011	13	26891	5381	0	35704	13603	13	62595	18984	81592	75100	68867	20427	164394
2012	0	38890	12925	0	24013	35677	0	62903	48602	111505	58222	69267	50658	178147
2013	0	30041	10605	0	31612	28089	0	61653	38694	100347	39020	68545	41255	148820
2014	0	34661	18865	0	31731	23940	0	66392	42805	109197	36475	74439	44466	155380
2015	9	35391	14412	0	28311	34454	9	63702	48866	112577	33576	70649	52154	156379
2016	79	29894	19880	0	28863	32900	79	58757	52780	111616	32176	66933	55658	154767
2017	33	27367	12883	0	23370	26226	33	50737	39109	89879	31046	57828	41033	129907
2018	0	20110	12948	0	27455	28077	0	47565	41025	88590	48497	53521	42654	144672

Table 2.2.1.4. Continued.

	Gulf of Finland (Subdivision 32)												subdivisions 22–32			
Year	Estonia			Finland			Russia		Total				Total			
	O	C	R	O	C	R	O [1)]	R	O	C	R	GT	O	C	R	GT
2001	62	1965	317	2804	23458	1900	82	726	2866	25505	2943	31314	266557	150224	33430	450211
2002	108	1968	0	3652	8269	3200	18	408	3760	10255	3608	17623	240540	135664	31668	407871
2003	17	1341	0	553	8862	1700	75	356	570	10278	2056	12904	238621	122936	24521	386078
2004	36	822	0	480	9501	1500	183	314	516	10506	1814	12837	250964	169687	26923	447575
2005	34	1298	103	536	12016	2800	213	423	570	13527	3326	17423	178537	128791	33927	341255
2006	48	955	334	506	10431	1700	121	329	554	11507	2363	14425	126903	80972	21256	229131
2007	64	764	162	451	10032	1395	120	400	515	10916	1957	13388	114551	78806	25307	218664
2008	0	1114	344	392	14161	1100	220	465	392	15495	1909	17796	45707	106407	46859	198973
2009	0	1067	257	228	11912	2063	170	414	228	13149	2734	16111	61392	129482	34938	225812
2010	0	736	185	129	5476	400	0	491	129	6212	1076	7417	79917	74830	20284	175031
2011	0	733	185	91	6964	600	0	470	91	7697	1255	9043	75191	76564	21682	173437
2012	0	990	212	62	13285	590	0	412	62	14275	1214	15551	58284	83542	51872	193698
2013	0	1619	41	37	11879	930	0	387	37	13498	1358	14893	39057	82043	42613	163713
2014	0	1185	63	89	11049	505	0	418	89	12234	986	13309	36564	86673	45452	168689
2015	0	1373	38	48	9134	158	46	360	48	10553	556	11157	33624	81202	52710	167536
2016	0	1629	393	51	9228	248	16	403	51	10873	1044	11968	32227	77806	56702	166735
2017	0	1842	300	216	8783	208	0	380	216	10625	888	11729	31262	68453	41921	141636
2018	0	1333	159	106	8287	232	0	458	106	9620	849	10575	48603	63141	43503	155247

Table 2.2.1.5. Nominal catches of Baltic salmon in tonnes round fresh weight and numbers from sea, coast and river, by country and subdivisions in 2018. Subdivisions 22–32. O=offshore, C=coast, R=river, W=weight (tonnes), N=number of fish.

SD	Fishery	-	DE	DK	EE	FI	LT	LV	PL	RU	SE	Grand Total
22	O	W	0									0
		N	46									46
	C	W										0
		N										0
23	O	W									0	0
		N									3	3
24	O	W	48	4					0		0	53
		N	7463	713					24		1	8201
	C	W							0			0
		N							23			23
25	O	W		27					17		0	44
		N		5280					3068		3	8351
	C	W							1		2	3
		N							186		216	402
	R	W							0			0
		N							1		215	216
24–25	O	W							23			23
		N							4483			4483
26	O	W					1	1	4			6
		N					382	138	767			1287
	C	W					1	0	0			1
		N					370	23	2			395
	R	W										0
		N										0
27	C	W										0
		N									19	19
28	O	W						1				1
		N						207				207
	C	W			2			1				3
		N			691			189				880
	R	W						3				3
		N						529				529
29	O	W				0						0
		N				25						25
	C	W			1	26						27
		N			351	3379						3730
	R	W				0						0

SD	Fishery	-	DE	DK	EE	FI	LT	LV	PL	RU	SE	Grand Total
		N				7						7
30	C	W				33					41	74
		N				4333					5558	9891
	R	W				1					30	31
		N				150					8251	8401
31	C	W				113					153	266
		N				15777					21897	37674
	R	W				84					104	188
		N				12798					19826	32624
32	O	W				1						1
		N				106						106
	C	W			8	51						59
		N			1333	8287						9620
	R	W			1	1				2		4
		N			159	232				458		849
200	C	W		43					12			55
		N		15631					2176		8000	25807
29–31	C	W				76						76
		N				8500						8500
Total 22–31	O+C+R	W	49	31	3	333	2	6	45	0	330	798
		N	7509	5993	1042	44969	752	1086	8554	0	55989	125894
Total 32	O+C+R	W	0	0	9	53	0	0	0	2	0	65
		N	0	0	1492	8625	0	0	0	458	0	10575
	O	W	49	31	0	1	1	2	44	0	0	127
		N	7509	5993	0	131	382	345	8342	0	7	22709
	C	W	0	43	11	299	1	1	13	0	195	563
Grand Total		N	0	15631	2375	40276	370	212	2387	0	35690	96941
	R	W	0	0	1	86	0	3	0	2	134	227
		N	0	0	159	13187	0	529	1	458	28292	42626
	O+C+R	W	49	74	12	386	2	6	57	2	330	917
		N	7509	21624	2534	53594	752	1086	10730	458	63989	162276

Table 2.2.1.6. Nominal catches (commercial) of Baltic Salmon in numbers from sea and coast, excluding river catches, by country in 2001–2018 and in comparison with TAC. Subdivisions 22–32. See ICES (2018) for catches before year 2001.

	Baltic Main Basin and Gulf of Bothnia (subdivisions 22–31)											
Year	Fishing Nation									Total	TOTAL	Landing of
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden		TAC	TAC (in %)
2001	88388	941	77057	7717	29002	1205	34781	6584	112842	358517	450000	80
2002	73122	1171	82171	5762	21723	3351	37440	12804	100099	337643	450000	75
2003	105845	697	80084	5766	11339	1040	35168	3982	85259	329180	460000	72
2004	78425	594	97163	7087	7300	704	16539	4983	155075	367870	460000	80
2005	39491	286	75481	4799	4841	691	21894	2433	106564	256480	460000	56
2006	30723	291	43221	3551	3195	483	21324	552	70536	173876	460000	38
2007	13145	325	53622	3086	4438	529	18022	888	66763	160818	437437	37
2008	4363	296	44111	4151	1410	518	7616	697	47030	110192	371315	30
2009	14116	740	46855	2799	2549	166	9873	0	68242	145340	309733	47
2010	26714	538	30822	1520	1092	106	9520	0	56778	127090	294246	43
2011	18125	414	33167	1483	1013	59	6149	0	65006	125416	250109	50
2012	20180	713	43448	1362	576	142	5605	0	38125	110151	122553	90
2013	21961	486	29716	1210	1280	72	4808	0	28288	87821	108762	81
2014	21096	563	30059	1264	1112	101	2999	0	28411	85605	106366	80
2015	15867	638	30166	2009	1327	72	3745	0	27907	81731	95928	85
2016	9701	726	24821	1623	1752	97	3659	0	29312	71691	95928	75
2017	3045	593	21878	1176	1210	48	7075	0	23592	58617	95928	61
2018	5993	581	23514	1360	260	367	8545	0	27678	68298	91132	75

Table 2.2.1.6. Continued.

	Gulf of Finland (Subdivision 32)					
Year	Fishing Nation		Total	EC	Landing of	Russia
	Estonia	Finland		TAC	TAC (in %)	
2001	2027	12082	14109	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	1067	11410	12477	15419	81	170
2010	736	5245	5981	15419	39	0
2011	733	6695	7428	15419	48	0
2012	990	9897	10887	15419	71	0
2013	1254	8466	9720	15419	63	0
2014	908	8408	9316	13106	71	0
2015	896	6452	7348	13106	56	46
2016	1028	6279	7307	13106	56	16
2017	1384	5999	7383	13106	56	0
2018	1043	5393	6436	10003	64	0

Table 2.2.1.7. Non-commercial (recreational) catches of Baltic Salmon in numbers from sea, coast and river by country in 2001–2018 in subdivisions 22–31 and Subdivision 32 (O = Off-shore, C = Coast, PI = probability interval). See ICES (2018) for catches before year 2001.

Subdivisions 22–31																			
Year	Denmark	Estonia		Finland		Germany	Latvia		Lithuania		Poland		Russia		Sweden		O+C	River	Grand
	O+C	O+C	River	O+C (95% PI)	River	O+C	O+C	River	O+C	River	O+C	River	O+C	River	O+C	River	Total	Total	Total
2001	2000	na	na	13450 (±5490)	3750	na	0	0	0	0	0	0	0	0	14443	22216	29893	25966	55859
2002	3000	na	na	3640 (±1070)	3925	na	0	85	0	0	0	0	0	0	17906	16945	24546	20955	45501
2003	3000	na	na	3640 (±1070)	4525	na	0	0	0	0	0	0	0	0	14889	13424	21529	17949	39478
2004	3000	na	na	15820 (±7300)	5950	na	0	0	0	0	0	0	0	0	22939	14687	41759	20637	62396
2005	3000	na	na	15820 (±7300)	6725	na	0	0	0	0	0	0	0	0	17931	15260	36751	21985	58736
2006	3000	na	na	6180 (±3710)	2640	na	0	0	0	0	0	0	0	0	12757	12229	21937	14869	36806
2007	3000	na	na	6180 (±3710)	3590	na	0	0	0	0	0	0	0	0	11928	14429	21108	18019	39127
2008	3000	136	na	9090 (±4380)	12065	na	0	157	0	0	0	0	0	0	13809	24501	26035	36723	62758
2009	3000	na	257	9090 (±4380)	9020	3000	0	192	0	0	0	0	0	0	19347	18505	34437	27974	62411
2010	3000	na	185	3270 (±3600)	5284	3000	0	22	0	0	0	0	0	0	14346	9325	23616	14816	38432
2011	3000	na	185	3270 (±3600)	6121	3000	0	0	0	0	0	0	0	0	11581	9886	20851	16192	37043
2012	3000	na	212	3090 (±2830)	13565	3000	0	0	0	0	0	0	0	0	10548	25523	19638	39300	58938
2013	3500	645	41	3090 (±2830)	11565	3500	758	0	0	0	0	0	0	0	6516	22057	18009	33663	51672
2014	3500	605	63	8550 (±5450)	19385	3500	772	0	0	0	0	0	0	0	6559	19265	23486	38713	62199
2015	3500	1025	38	8550 (±5450)	14578	3500	733	0	620	1749	0	0	0	0	2943	19261	20871	35626	56497
2016	8000	1033	393	8550 (±4000)	20138	8000	976	13	1510	2010	0	0	0	0	2400	18711	30469	41265	71734
2017	4456	728	300	8550 (±4000)	13101	6599	660	53	996	562	0	0	0	0	2400	16094	24389	30110	54499
2018	5226	751	159	8551 (±4000)	13187	8595	297	98	1000	600	2092	0	0	0	2400	15235	28912	29279	58191

Table 2.2.1.7. Continued.

Subdivision 32											**subdivision 22–32**		
Year	Estonia		Finland		Russia		O+C	River	Grand	O+C	River	GT
	O+C	River	O+C (95% PI)	River	O+C	River	Total	Total	Total	Total	Total	
2001	0	na	14180 (±5780)	1900	0	0	1418	1900	3318	31311	27866	59177
2002	0	na	2550 (±750)	3200	0	0	2550	3200	5750	27096	24155	51251
2003	0	na	2550 (±750)	1700	0	0	2550	1700	4250	24079	19649	43728
2004	0	na	3090 (±1430)	1500	0	0	3090	1500	4590	44849	22137	66986
2005	206	103	3090 (±1430)	2800	0	0	3296	2903	6199	40047	24888	64935
2006	138	112	180 (±110)	1700	0	0	318	1812	2130	22255	16681	38936
2007	0	162	180 (±110)	1395	0	0	180	1557	1737	21288	19576	40864
2008	294	268	730 (±350)	1100	0	0	1024	1368	2392	27059	38091	65150
2009	0	257	730 (±350)	2063	0	0	730	2320	3050	35167	30293	65460
2010	0	185	360 (±400)	400	0	0	360	585	945	23976	15401	39377
2011	0	185	360 (±400)	600	0	0	360	785	1145	21211	16977	38188
2012	0	212	3450 (±3170)	590	0	0	3450	802	4252	23088	40102	63190
2013	365	41	3450 (±3170)	930	0	0	3815	971	4786	21824	34634	56458
2014	277	63	2730 (±3270)	505	0	0	3007	568	3575	26493	39281	65774
2015	477	38	2730 (±3270)	158	0	0	3207	196	3403	24078	35822	59900
2016	601	393	3000 (±3270)	248	0	0	3601	641	4242	34070	41906	75976
2017	458	0	3000 (±3000)	208	0	0	3458	208	3666	27847	30318	58165
2018	0	0	3000 (±3000)	232	0	0	3000	232	3232	31912	29511	61423

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

Parameter	Country	Year	Source	min	mode	max	mean	SD
Share of unreported catch in offshore fishery	DK	2001-2018	EE	0.00	0.01	0.1	0.04	0.02
	FI	2001-2012	EE	0.00	0.01	0.1	0.04	0.02
	PL	2001-2013	EE	0.00	0.25	0.4	0.22	0.08
		2014	EE	0.01	0.02	0.1	0.04	0.02
		2015-2016	EE	0.01	0.02	0.0	0.04	0.01
		2017-2018	EE	0.00	0.01	0.0	0.02	0.01
	SE	2001-2012	EE	0.05	0.15	0.2	0.15	0.04
	Others	2001-2018					0.08	0.01
Share of unreported catch in coastal fishery	FI	2001-2014	EE	0.00	0.10	0.1	0.08	0.03
		2015-2018	EE	0.00	0.01	0.1	0.04	0.02
	PL	2001-2012	EE	0.00	0.10	0.2	0.10	0.04
		2013-2018	EE	0.00	0.05	0.1	0.05	0.02
	SE	2001-2012	EE	0.10	0.30	0.5	0.30	0.08
		2013-2014	EE	0.00	0.15	0.3	0.15	0.06
		2015-2018	EE	0.05	0.15	0.2	0.15	0.04
	Others	2001-2018					0.12	0.01
Share of unreported catch in river fishery	FI	2001-2016		0.05	0.20	0.3	0.20	0.06
		2017-2018	EE	0.05	0.15	0.2	0.15	0.04
	PL	2001-2009	EE	0.01	0.10	0.1	0.09	0.02
		2010-2017	EE	0.50	0.80	1.0	0.77	0.10
	SE	2001-2018	EE	0.10	0.20	0.4	0.23	0.06
Average share of unreported catch in river fishery	Others	2001-2018					0.29	0.02
Share of discarded undersized salmon in longline fishery	DK	2001-2007	D, EE	0.10	0.15	0.2	0.15	0.02
		2008-2018	D, EE	0.00	0.03	0.0	0.03	0.00
	FI	2001-2012	D, EE	0.01	0.03	0.0	0.03	0.00
	PL	2001-2012	D	0.01	0.03	0.0	0.03	0.00
		2013-2018	D	0.01	0.02	0.0	0.02	0.00
	SE	2001-2012	D, EE	0.00	0.02	0.0	0.02	0.00
Average share of discarded undersized salmon in longline	Others	2001-2018					0.05	0.00
Mortality of discarded undersized salmon in longline fishery	DK	2001-2018	EE	0.750	0.80	0.85	0.80	0.020
	FI	2001-2012	EE	0.50	0.67	0.9	0.69	0.08
	SE	2001-2012	EE	0.75	0.85	0.9	0.85	0.04
	PL	2001-2018	D, EE	0.60	0.72	0.9	0.74	0.06
Average mortality of discarded undersized salmon in longline fishery	Others	2001-2018					0.77	0.028

Parameter	Coun-try	Year	Sourc e	min	mod e	ma x	mea n	SD
Share of discarded undersized salmon in driftnet fishery	DK	2001-2007	EE, D	0.00	0.03	0.0	0.03	0.01
	FI	2001-2007	D	0.00	0.02	0.0	0.02	0.00
Average share of discarded undersized salmon in driftnet fishery	Others	2001-2007					0.02	0.00 6
Mortality of discarded undersized salmon in driftnet fishery	DK	2001-2007	EE, D	0.60 0	0.65	0.7 0	0.65	0.02 0
	FI	2001-2007	EE	0.50	0.67	0.8	0.66	0.06
Average mortality of discarded undersized salmon in drift-net fishery	Others	2001-2007					0.65	0.03 2
Share of undersized salmon in trapnet fishery (released back to sea)	FI	2001-2016	EE	0.01 0	0.03	0.0 5	0.03	0.00 8
		2017-2018	D	0.01	0.06	0.1	0.07	0.02
	SE	2001-2018	EE, D	0.01	0.03	0.0	0.03	0.00
Average share of discarded undersized salmon in trapnet fishery	Others	2001-2018					0.04	0.01 0
Mortality of discarded undersized salmon in trapnet fishery	FI	2001-2018	EE, D	0.10 0	0.20	0.5 0	0.27	0.08 5
	SE	2001-2017	EE, D	0.30	0.50	0.7	0.50	0.08
Average mortality of discarded undersized salmon in trap-net fishery	Others	2001-2018					0.38	0.05 9
Share of discarded seal-damaged salmon in longline fishery	FI	2001-2007	D	0.00	0.00	0.0	0.01	0.00
		2008-2012	D	0.00	0.03	0.0	0.03	0.01
	SE	2001-2012	EE, D	0.02	0.05	0.0	0.05	0.01
	DK	2001-2007	EE, D	0.00	0.03	0.0	0.03	0.01
		2008-2012	EE	0.00	0.05	0.1	0.05	0.02
		2013-2014	EE, D	0.05	0.15	0.3	0.17	0.05
		2015	EE	0.05	0.20	0.3	0.20	0.06
		2016-	D	0.05	0.20	0.4	0.33	0.10
	PL	2001-2012	D	0.00	0.01	0.0	0.01	0.00
		2013-2015	EE, D	0.05	0.25	0.6	0.32	0.12
		2016-2018	D	0.05	0.35	0.6	0.35	0.12
	Others	2001-2018					0.16	0.02
Share of discarded seal-damaged salmon in driftnet fishery and other open sea gillnet fishery (GNS in Poland)	DK	2001-2007	EE, D	0.00	0.03	0.0	0.03	0.01
	FI	2001-2007	D	0.01	0.02	0.0	0.02	0.00
	PL	2008-2012		0.00	0.01	0.0	0.01	0.00
		2013-2015	EE,D	0.05	0.25	0.6	0.32	0.12
		2016-2018	D	0.05	0.35	0.6	0.35	0.12
	Others	2001-2007					0.15	0.03
Share of discarded seal-damaged salmon in trapnet fishery	FI	2001-2018	D	0.05 0	0.09	0.1 5	0.10	0.02 1
	SE	2004-2017	EE, D	0.01	0.02	0.0	0.02	0.00
	Others	2001-2018					0.06	0.01

***) updated retrospectively for year 2016–2017 in WGBAST 2019.**

Table 2.3.2. Estimated number of discarded undersized salmon and discarded seal-damaged salmon by management unit in 2001–2018. Estimates of discarded undersized salmon are proportional to nominal catches by the conversion factors (see Table 2.3.1). Estimates of seal damages age-based partly on the logbook records (Finland and Sweden) and partly to the estimates proportional to nominal catches by conversion factors. Estimates should be considered as a magnitude of discards.

		Discard undersized (dead)				Discard seal damaged				
Management	Year	Driftnet	Longline	Trapnet	Other gears	Driftnet	Longline	Trapnet	Other gears	Total
		Disc_GND	Disc_LLD	Disc_TN	Disc_OT	Seal_GND	Seal_LLD	Seal_TN	Seal_OT	
SD22–31	2001	3129	11840	1148	578	8606	3323	5555	1034	35213
	2002	2213	12360	1231	577	6841	3804	5455	302	32783
	2003	2343	15720	1186	418	6954	4366	5233	1484	37703
	2004	2676	13400	1564	745	7621	4483	5529	1277	37295
	2005	1875	7862	1066	398	7648	3567	4166	560	27141
	2006	1235	5554	685	234	4472	2642	1997	1485	18304
	2007	1237	3487	701	205	3785	1854	3804	376	15449
	2008	13	814	982	308	0	1032	3178	559	6885
	2009	0	2768	1286	320	0	2938	2843	361	10515
	2010	0	3460	794	159	0	3764	2029	265	10470
	2011	0	2299	839	165	0	4349	1925	179	9756
	2012	0	1483	821	189	0	2495	2764	336	8088
	2013	0	972	729	176	0	6603	2781	227	11487
	2014	0	812	734	185	0	5586	2258	281	9856
	2015	0	752	709	206	0	5342	1530	488	9026
	2016	0	766	650	247	0	6297	1419	545	9923
	2017	0	730	890	285	0	5870	1640	271	9686
	2018	0	864	981	312	0	6844	1725	530	11255
SD32	2001	3	59	109	86	3	56	2696	657	3669
	2002	10	64	63	90	71	170	2611	292	3372
	2003	2	9	74	60	19	29	3219	198	3610
	2004	3	5	75	46	40	7	3430	226	3832
	2005	3	7	104	62	24	36	1492	173	1900
	2006	5	2	118	53	89	4	1579	912	2763
	2007	3	3	121	33	41	5	1594	43	1844
	2008	0	9	163	43	0	23	1850	264	2353
	2009	0	5	132	60	0	1	1495	229	1922
	2010	0	2	59	24	0	3	826	63	977
	2011	0	2	82	24	0	0	790	66	964
	2012	0	1	120	38	0	0	818	157	1134
	2013	0	1	106	38	0	2	500	43	690
	2014	0	2	102	33	0	0	586	19	743
	2015	0	1	76	30	0	0	1059	200	1365
	2016	0	1	75	30	0	0	594	82	783
	2017	0	5	169	39	0	0	742	55	1010
	2018	0	3	151	40	0	0	440	23	656

Table 2.3.3. Estimated number of seal-damaged salmon, dead discard of undersized salmon, unreported salmon in sea and river fisheries and misreported salmon by management unit in 2001–2018. Estimates should be considered as order of magnitude.

	Sea fisheries							River fisheries	
	Seal damage		Discards (dead)		Unreported catch		Misre-ported catch	Unreported catch	
	median	90% PI	median	90% PI	median	90% PI		median	90% PI
SD22–31									
2001	19900	17940-22600	17260	14540-20680	49910	37070-70910	126100	8626	5462-14860
2002	17640	16000-19940	16990	14410-20330	49020	36380-71050	115000	7662	4951-12990
2003	19250	17250-22110	20130	16770-24480	44880	32950-65170	143200	6297	4071-10520
2004	20290	18020-23730	19140	15930-23530	58560	42430-88170	254300	6908	4576-11190
2005	17270	15900-19220	11450	9631-13830	42680	31120-63430	110800	8530	5649-14000
2006	11530	10620-12790	8133	6903-9713	29700	21560-43950	46900	5251	3363-9021
2007	10640	9860-11760	6049	5137-7235	27320	19920-40140	54310	6492	4267-10820
2008	5248	5009-5606	2370	1945-2967	22560	15560-37360	3295	12540	8237-20590
2009	6705	6024-7787	5024	4103-6337	31030	21170-52050	66500	9228	6107-15100
2010	6513	5555-8104	4818	3886-6159	23520	16750-36940	74800	5351	3665-8389
2011	7195	6541-8251	3452	2831-4287	24110	17070-37930	37000	5803	3939-9235
2012	6125	5533-7189	2771	2298-3393	18130	13020-27530	17500	14220	9487-23100
2013	9921	8077-11730	2064	1651-2610	13780	9196-22250	15000	11470	7662-18500
2014	8400	6789-9992	1807	1425-2318	9241	6078-15280	13600	11910	8049-18760
2015	7913	6579-9006	1719	1362-2183	7528	5294-11160	16600	14260	9684-22610
2016	8807	7500-9577	1708	1358-2181	7770	5462-11490	26000	15110	10340-23640
2017	8326	6776-9074	1967	1440-2831	6107	4264-9134	32000	9893	6701-15990
2018	9398	7364-10350	2339	1712-3310	7115	4953-10710	42600	10530	7080-17130
SD32									
2001	3701	3564-3977	278	215.7-368.5	1095	682.5-1859		758	526.7-1185
2002	3411	3286-3662	267	217.2-334.7	820	529.1-1324		875	535.7-1576
2003	3758	3622-4037	148	109.9-206.6	688	422.9-1206		506	320.7-889.6
2004	4018	3869-4311	145	109.5-201.7	660	394.2-1173		446	283.3-774.4
2005	1872	1802-2006	178	128.9-260.2	905	536-1604		815	518.1-1427
2006	2804	2702-3015	189	132.9-280.7	977	568.7-1818		596	404.8-975

	Sea fisheries							River fisheries	
	Seal damage		Discards (dead)		Unreported catch		Misre-ported catch	Unreported catch	
	median	90% PI	median	90% PI	median	90% PI		median	90% PI
2007	1826	1760-1961	162	111.8-245.8	938	543.5-1735		495	334.4-802.9
2008	2318	2233-2488	216	146.5-332.2	1249	713.4-2320		507	364.3-759.9
2009	1872	1803-2010	199	137.7-301.2	1076	623.2-1974		694	467.3-1142
2010	967	931.8-1039	88	62.24-130.4	475	281-862.2		300	222.2-418.8
2011	928	893.9-997.5	143	107.5-200.5	627	361.9-1168		341	249.6-494.2
2012	1057	1018-1137	240	186.7-327.5	926	528-1730		330	242.1-473.3
2013	593	569.1-636.2	393	344.8-470.5	828	484.8-1504		352	239.3-560.2
2014	657	631.9-705.3	197	152.2-271.2	795	459.1-1469		265	189.5-393.4
2015	1300	1274-1366	118	85.51-171.6	298	156.7-637.3		156	113.1-225.4
2016	699	683.5-735.3	122	89.71-173	302	161.9-635.1		298	226.1-402.9
2017	824	805.3-866.4	245	156.6-430.3	326	182.6-642.4		237	181.4-317.8
2018	479	467.4-504.7	196	111.4-366.2	273	149.5-560.3		222	167.6-306.5

Table 2.3.3.1. Number salmon and sea trout in the catch of sampled Polish long-line vessels in 2009–2017 (SAL=salmon and TRS=sea trout). No sampling in 2018.

SamplingType	Year	Month	Trip_id	SAL	TRS	% SAL
Sea sampling	2009	1	146	34	2	94%
			304	141	3	98%
		2	148	264	2	99%
			150	114	7	94%
			305	149	2	99%
			306	92	4	96%
			307	94	3	97%
	2009 Total			888	23	97%
	2010	2	1059	174	1	99%
			1222	509	0	100%
			1228	341	0	100%
		3	1223	102	2	98%
			1224	48	0	100%
	2010 Total			1173	3	100%
	2011	2	1287	81	0	100%
			1288	43	2	96%
		3	1650	169	0	100%
		11	1515	51	1	98%
		12	1528	78	0	100%
			1529	265	0	100%
	2011 Total			687	3	100%
	2012	1	1566	107	0	100%
		3	1639	89	0	100%
		12	1823	128	3	98%
			1827	36	1	97%
	2012 Total			360	4	99%
	2013	1	1830	70	0	100%
		1	1844	21	0	100%
		1	1845	50	1	98%
		1	1846	55	0	100%
		1	1877	84	1	99%
		2	1879	104	2	98%
		1	1880	46	1	98%
		1	1881	122	0	100%
		12	2076	37	3	93%
	2013 Total			589	8	99%
	2014 Total	1-12		701	5	99%
	2015 Total	1-12		717	42	94%

SamplingType	Year	Month	Trip_id	SAL	TRS	% SAL
	2016 Total	1		132	2	99%
		2		589	1	100%
		3		209	0	100%
		10		1	0	100%
		12		12	0	100%
	2017 Total	1		240	1	100%
		2		33	0	100%
		3		188	2	99%
		4		67	0	100%
		12		63	3	95%
Sea sampling Total				6058	91	99%
Market sampling	2009	12	1034	35	1	97%
	2009 Total			35	1	97%
	2010	12	1271	20	0	100%
	2010 Total			20	0	100%
Market sampling Total				55	1	98%
Grand Total				3163	34	99%

Table 2.4.1. Fishing efforts in commercial Baltic salmon fisheries at sea and at the coast in 1987–2018 in subdivision 22–31 (excluding Gulf of Finland). The fishing efforts are expressed in number of gear days (number of fishing days times the number of gear) per year. The yearly reported total offshore effort refers to the sum of the effort in the second half of the given year and the first half of the next coming year (e.g. effort in second half of 1987 + effort in first half of 1988 = effort reported in 1987, etc.). The coastal fishing effort on stocks of assessment unit 1 (AU 1) refers to the total Finnish coastal fishing effort and partly to the Swedish effort in subdivision (SD) 31. The coastal fishing effort on stocks of AU 2 refers to the Finnish coastal fishing effort in SD 30, and partly to the Swedish coastal fishing effort in SD 31. The coastal fishing effort on stocks of AU 3 refers to the Finnish and Swedish coastal fishing effort in SD 30.

				AU 1		AU 2		AU 3	
Year	Offshore driftnet	Offshore longline	Commercial coastal driftnet	Commercial coastal trapnet	Commercial coastal other gear	Commercial coastal trapnet	Commercial coastal other gear	Commercial coastal trapnet	Commercial coastal other gear
1987	4036455	3710892	328711	71182	263256	43694	243511	42704	526101
1988	3456416	2390537	256387	84962	245228	55659	259404	58839	798038
1989	3444289	2346897	378190	68333	345592	41991	384683	40135	463067
1990	3279200	2188919	364326	111333	260768	71005	233540	68152	279610
1991	2951290	1708584	431420	103077	461053	70979	360360	73177	404327
1992	3205841	1391361	473579	115793	351518	68096	282674	61703	339384
1993	2155440	1041997	621817	119497	288245	76398	161474	79911	215710
1994	3119711	851530	581306	83936	194683	59488	210927	55256	205848
1995	1783889	932314	452858	70670	152529	44607	147259	42165	141905
1996	1288081	1251637	78686	58266	100409	42055	92606	29029	90245
1997	1723492	1571003	118207	63102	107432	44605	81923	34095	84639
1998	1736495	1148336	112393	28644	8391	20204	5449	15771	5221
1999	1644171	1868796	126582	43339	9325	31845	5715	20889	5071
2000	1877308	2007775	107008	34934	8324	23384	5587	20397	5371
2001	1818085	1811282	102657	40595	3879	23743	2661	34886	2514
2002	1079893	1828389	86357	46474	3778	30333	3251	31389	3153
2003	1329494	1439370	95022	47319	8903	27060	7138	37614	9984
2004	1344588	792737	103650	41570	4315	28219	1610	25828	2278
2005	1378762	1099118	84223	45002	5886	33683	4914	30075	5844
2006	1177402	695597	77915	33817	4196	24374	3546	19487	5486
2007	413622	639638	45557	35406	4298	23920	2888	21790	4602
2008	0	1980394	0	27736	10252	16434	3917	25959	5226

				AU 1		AU 2		AU 3	
Year	Offshore driftnet	Offshore longline	Commercial coastal driftnet	Commercial coastal trapnet	Commercial coastal other gear	Commercial coastal trapnet	Commercial coastal other gear	Commercial coastal trapnet	Commercial coastal other gear
2009	0	2135367	0	32676	7062	24174	5149	15718	5411
2010	0	2639116	0	34040	4192	25399	2393	17405	2487
2011	0	1441613	0	27927	3625	18347	2768	15788	3067
2012	0	667347	0	21309	2911	11714	1539	10355	1551
2013	0	1176124	0	20619	3177	13734	2488	11277	2478
2014	0	800824	0	20782	3608	16234	3121	9084	3135
2015	0	1262088	0	16463	3214	11279	2498	7820	2578
2016	0	1511207	0	15931	5701	9068	4154	8565	4813
2017	0	1090305	0	15068	5278	9498	4622	9399	4626
2018	0	1047168	0	10861	4964	8138	4627	8146	4615

Table 2.4.2. For the commercial out at sea longline salmon fisheries: Effort in hook days (number of hooks x number of days) 2014–2018. The yearly reported effort in longline salmon fisheries refers to the sum of the effort in the given year. And when available, effort in days per ship by country and area (subdivisions 22–31 and Subdivision 32). Where number of fishing days divided in five groups, 1–9 fishing days, 10–19 fishing days, 20–39 fishing days, 40–59 fishing days and 60–80 fishing days. CPUE expressed as number of salmon caught per 1000 hooks.

			Effort in hook days		**Effort in days per ship**					
Year	Area	Country		CPUE	60–79	40–59	20–39	10–19	1–9	Total
					Number of fishing vessels					
2014	subdivisions	Denmark	173 540	121.6	1	6	5	3	3	18
	22–31	Finland	8 213	13.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Germany	0	0	0	0	0	0	0	0
		Latvia	0	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0	0
		Poland	811 786	2.8	0	4	5	2	31	42
		Russia	0	0	0	0	0	0	0	0
		Sweden	0	0	0	0	0	0	0	0
	Subdiv. 32	Estonia	0	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	0	0	0
	subdivs 22–32	**Total**	993 539		1	10	10	5	34	60
2015	subdivisions	Denmark	132 860	119.1	3	4	1	3	7	18
	22–31	Finland	15 470	15.8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Germany	0	0	0	0	0	0	0	0
		Latvia	n.a.	n.a.	0	0	0	1	0	0
		Lithuania	0	0	0	0	0	0	0	0
		Poland	727 889	3.6	0	5	4	7	28	44
		Russia	0	0	0	0	0	0	0	0
		Sweden	0	0	0	0	0	0	0	0
	Subdiv. 32	Estonia	0	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	0	0	0
	subdivs 22–32	**Total**	876 219		3	9	5	11	35	62
2016	subdivisions	Denmark	151 860	63.9	1	1	2	2	7	13
	22–31	Finland	16 233	14.2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Germany	0	0	0	0	0	0	0	0
		Latvia	0	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0	0
		Poland	1 054 021	2.1	0	3	9	12	29	53
		Russia	0	0	0	0	0	0	0	0
		Sweden	0	0	0	0	0	0	0	0
	Subdiv. 32	Estonia	0	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	0	0	0
	subdivs 22–32	**Total**	1 222 114		1	4	11	14	36	66

			Effort in hook days		**Effort in days per ship**					
Year	Area	Country		CPUE	60–79	40–59	20–39	10–19	1–9	Total
					Number of fishing vessels					
2017	subdivisions	Denmark	90 320	33.6	1	0	3	0	8	12
	22–31	Finland	5 490	14.2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Germany	0	0	0	0	0	0	0	0
		Latvia	0	0	0	0	0	0	0	0
		Lithuania	0	0	0	0	0	0	0	0
		Poland	1 439 987	2.8	0	6	8	9	70	93
		Russia	0	0	0	0	0	0	0	0
		Sweden	0	0	0	0	0	0	0	0
	Subdiv. 32	Estonia	0	0	0	0	0	0	0	0
		Finland	0	0	0	0	0	0	0	0
	subdivs 22–32	**Total**	1 535 797		1	6	11	9	78	105
2018	subdivisions	Denmark	58 760	81.3	1	0	2	2	3	8
	22–31	Finland	1 470	17.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Germany	0	0	0	0	0	0	0	0
		Latvia	n.a.	n.a.	0	0	0	2	0	0
		Lithuania	14 000	16.9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Poland	879 619	3.4	0	3	15	18	56	92
		Russia	0	0	0	0	0	0	0	0
		Sweden	0	0	0	0	0	0	0	0
	Subdiv. 32	Estonia	0	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Finland	0	0	0	0	0	0	0	0
	subdivs 22–32	**Total**	953 849		1	3	17	22	59	100

Table 2.4.3. Trapnet effort and catch per unit of effort in number of salmon caught in trapnets in the Finnish fisheries in Subdivision 32 (CPUE in number of salmon per trapnetday) 1988–2018.

	Effort	CPUE
1988		0.70
1989		1.00
1990		1.60
1991		1.50
1992		1.50
1993		1.40
1994		0.90
1995		1.20
1996		1.30
1997		1.50
1998		1.30
1999		1.30
2000	12866	0.90
2001	9466	0.90
2002	5362	1.00
2003	8869	0.70
2004	7033	0.90
2005	7391	1.10
2006	7917	1.20
2007	9124	1.10
2008	9902	1.30
2009	9413	1.10
2010	9791	0.50
2011	10818	0.60
2012	11119	0.90
2013	12062	0.70
2014	11199	0.70
2015	9861	0.60
2016	9094	0.70
2017	7614	0.70
2018	4519	1.10

Table 2.6.1. List of Baltic salmon stocks included in the genetic baseline database (17 microsatellites) used to produce stock proportion estimation of catches.

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

	Stock	Sampling year	Propagation	N
39	Neumunas	2002–2010	Hatchery	166
	Total			4453

Table 2.6.2. Medians and probability intervals of stock group proportion estimates (%) in Finnish salmon catch samples from the Gulf of Bothnia (A) and in Finnish and Estonian catches from the Gulf of Finland (B) based on microsatellite (DNA) and smolt age classes. Samples from the "advanced fishing season" are indicated as F_A (see text for details).

A)

	Gulf of Bothnia, WILD	2.5 %	97.5 %	G. of Bothnia, HATC, FIN	2.5 %	97.5 %	G. of Bothnia, HATC, SWE	2.5 %	97.5 %	Others	2.5 %	97.5 %	Sample size	*Scale reading - wild %*
Gulf of Bothnia Finnish catch														
2018^{F_A}	**79**	71	86	**20**	13	29	**0**	0	1	**0**	0	1	**156**	-
2017^{F_A}	**83**	76	88	**17**	11	23	**0**	0	1	**0**	0	2	**246**	-
Mean	**81**	74	87	**18**	12	26	**0**	0	1	**0**	0	2	**402**	
2018^{F}	**66**	58	72	**27**	20	34	**7**	4	11	**0**	0	1	**235**	-
2017^{F}	**61**	55	66	**38**	33	44	**1**	0	3	**0**	0	0	**397**	-
2016^{F}	**70**	64	75	**26**	21	32	**4**	2	7	**0**	0	1	**307**	64
2015^{F}	**69**	62	76	**28**	21	35	**3**	1	6	**0**	0	1	**219**	*64*
2014^{F}	**82**	77	86	**18**	14	23	**0**	0	1	**0**	0	1	**319**	76-77
2013^{F}	**59**	52	66	**39**	33	46	**0**	0	3	**0**	0	2	**220**	*54-55*
2012^{F}	**62**	54	69	**36**	29	43	**2**	1	5	**0**	0	1	**212**	*54-55*
2011^{F}	**78**	71	83	**21**	16	28	**1**	0	2	**0**	0	1	**220**	*70*
2010^{F}	**76**	69	82	**23**	18	30	**0**	0	2	**0**	0	1	**215**	*68*
2009^{F}	**66**	58	73	**32**	25	39	**2**	1	5	**0**	0	1	**252**	*55*
Mean	***69***	*62*	*75*	***29***	*23*	*35*	***2***	*1*	*4*	***0***	*0*	*1*		

B)

	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 (hatchery)	2.5 %	97.5 %	Gulf of Finland, hatchery	2.5 %	97.5 %	Western Main B., wild, SWE	2.5 %	97.5 %	Eastern Main Basin	2.5 %	97.5 %	Sample size	Sampling date	*Scale reading - wild %*
Gulf of Finland																								
2018^{EST}	**2**	0	7	**4**	1	10	**2**	0	6	**41**	28	55	**27**	17	38	**0**	0	1	**22**	12	34	**101**	8.5. -30.8.	*20%*
2017^{EST}	**0**	0	2	**1**	0	4	**0**	0	1	**65**	55	75	**23**	14	32	**0**	0	0	**10**	5	17	**129**	13.3.-3.11.	-
2016^{EST}	**0**	0	5	**0**	0	2	**0**	0	3	**96**	87	100	**0**	*0*	3	**0**	0	1	**2**	0	10	**41**	1.5.-14.11.	-
Mean	***1***	***0***	***5***	***2***	***0***	***5***	***1***	***0***	***3***	***67***	***57***	***77***	***16***	***10***	***24***	***0***	***0***	***1***	***11***	***6***	***20***	***271***		
2018^{FIN}	**29**	24	35	**17**	12	22	**1**	0	3	**2**	1	5	**46**	40	52	**0**	0	1	**3**	2	6	**305**	21.5.-26.8	*38%*
2017^{FIN}	**14**	11	18	**16**	12	19	**3**	2	5	**0**	0	1	**66**	61	70	**0**	0	1	**0**	0	1	**411**	6.6.-31.8.	*30 %*
2015^{FIN}	**17**	10	26	**14**	6	23	**1**	0	5	**0**	0	1	**67**	57	76	**0**	0	1	**0**	0	1	**99**	29.5.-9.9.	*16-17%*
2014^{FIN}	**41**	33	48	**14**	9	20	**5**	3	9	**0**	0	1	**39**	33	46	**0**	0	0	**0**	0	2	**210**	3.5.-9.9.	*35 %*
2011^{FIN}	**51**	40	62	**8**	3	16	**1**	0	5	**0**	0	1	**38**	*29*	49	**0**	0	1	**0**	0	1	**97**	15.6.-16.9	*51 %*
2010^{FIN}	**43**	34	54	**9**	4	17	**1**	0	4	0	0	1	**46**	37	55	**0**	0	0	**0**	0	1	**102**	16.6.-1.8.	*41-42%*
2009^{FIN}	**39**	30	49	**13**	7	21	**3**	1	8	**0**	0	1,18	**43**	33	52	**0**	0	1	**1**	0	4	**102**	26.5.-29.7.	*37-38%*
Mean	***33***	*25*	*40*	***13***	*8*	*19*	***2***	*1*	*5*	***0***	*0*	*2*	***50***	*43*	*58*	***0***	*0*	*1*	***1***	*0*	*2*	***1326***		

EST=Estonia, FIN=Finland. The group Gulf of Finland wild includes wild and hatchery productions of Rivers Luga (RUS) and Kunda(EST).

Table 2.6.3. Medians of individual river-stock proportion estimates in Finnish salmon catches from the Gulf of Bothnian (A) catches from the advanced season separately, and Finnish and Estonian catches from the Gulf of Finland (B).

A)

	Tornionj.Wild	Tornionj. Hatch.	Simojoki, W	Iijoki, H	Oulujoki, H	Kalixälven, W	Råne, W	Luleälven, H	Piteälven, W	Åbyälven, W	Byskeälven, W	Kågeälven, W	Skellefteälven, H	Ricleå, W	Sävarån, W	Vindelälven, W	Sample size
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Gulf of Bothnia, Finnish catch																	
2018^{F_Advanced}	53	2	4	17	0	21	0	0	0	0	0	0	0	0	0	0	156
2017^{F_Advanced}	49	9	7	7	0	25	0	0	0	0	0	0	0	0	0	0	246
Mean advanced	**51**	5	5	**12**	0	**23**	0	0	0	0	0	0	0	0	0	0	
2018^{F}	54	8	1	15	3	9	0	7	0	0	0	0	0	0	0	0	235
2017^{F}	43	13	2	17	8	13	0	1	0	0	0	0	0	0	0	0	397
2016^{F}	55	0	2	9	17	8	0	3	1	0	0	2	0	0	0	0	307
2015^{F}	48	5	2	13	9	18	0	2	0	0	0	0	0	0	0	1	219
2014^{F}	45	0	3	7	11	30	0	0	0	0	0	3	0	0	0	0	319
2013^{F}	32	0	5	17	21	18	0	0	0	0	3	-	0	0	0	0	220
Mean	**46**	4	3	**13**	**11**	**16**	0	2	0	0	1	1	0	0	0	0	

B)

	Tornionj.Wild	Tornionj. Hatch.	Simojoki, W	Iijoki, H	Oulujoki, H	Kalixälven, W	Råne, W	Luleälven, H	Skellefteälven, H	Sävarån, W	Vindelälven, W	Umeälven, H	Lögde, W	Indalsälven, H	Ljungan, W	Dalälven, H	Emån, W	Neva-FI, H	Neva-RU, H	Luga, W and R	Narva, H	Kunda, W and R	Keila, W	Salaca, W	Daugava, H	Venta, W	Neumunas, H	Sample size
	1	2	3	4	5	6	7	8	13	15	16	17	19	21	22	25	26	28	29	30	31	32	33	35	37	38	39	
Gulf of Finland																												
Estonian catch																												
2018^{EST}	2	1	-	2	-	-	-	-	-	-	-	1	-	1	-	-	-	2	8	12	16	23	5	7	14	0	1	101
2017^{EST}	0	0	-	1	-	-	-	-	-	-	-	0	-	0	-	-	-	3	0	15	19	49	0	4	5	0	1	129
2016^{EST}	0	0	-	0	-	-	-	-	-	-	-	0	-	0	-	-	-	0	0	0	0	49	46	0	0	1	0	41
Mean	*1*	*1*	-	*1*	-	-	-	-	-	-	-	*0*	-	*0*	-	-	-	***2***	***3***	***9***	***12***	***40***	***17***	***3***	***6***	*0*	*0*	*271*
Finnish catch																												
2018^{FIN}	21	13	1	4	0	5	0	0	-	0	1	-	0	-	1	1	-	45	0	2	-	-	1	0	3	-	-	305
2017^{FIN}	10	15	0	1	0	3	-	2	1	0	0	-	-	0	0	0	0	64	1	0	-	0	0	-	0	-	0	411
2015^{FIN}	15	7	0	6	0	0	-	0	1	-	1	-	-	-	0	0	-	67	0	0	-	-	0	-	0	-	-	99
2014^{FIN}	27	10	2	2	2	10	-	2	2	-	1	-	-	0	0	0	-	39	0	0	-	-	0	-	0	-	-	210
2011^{FIN}	28	1	0	6	0	22	-	0	1	-	0	-	-	-	0	0	-	38	0	0	-	-	0	-	0	-	-	97
2010^{FIN}	12	7	0	2	0	31	-	0	0	-	0	-	-	-	0	0	-	46	0	0	-	-	0	-	0	-	-	102
2009^{FIN}	21	6	1	6	1	16	-	0	1	-	0	0	-	-	0	0	-	43	0	0	-	-	0	0	0	-	-	102
Mean	***19***	***8***	*0*	***4***	*0*	***12***	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***49***	*0*	*0*	-	*0*	*0*	*0*	*0*	-	*0*	*1021*

EST=Estonia, FIN=Finland.

Table 2.6.4. Prior proportion of 1–2 year old smolts in the baseline stocks used for Baltic salmon catch composition analysis in year 2019.

	River stock	Smolt age	2,50 %	Median	97,50%	Years
1	Tornionjoki, W	1-2 years	5,0	6,4	8,0	2015–2017
2	Tornionjoki, H	1-2 years	99,8	100,0	100,0	All
3	Simojoki	1-2 years	32,3	41,2	50,3	All
4	Iijoki	1-2 years	99,8	100,0	100,0	All
5	Oulujoki	1-2 years	99,8	100,0	100,0	All
6	Kalixälven	1-2 years	4,3	6,2	8,6	2015–2017
7	Råneälven	1-2 years	2,7	6,3	11,5	2015–2017
8	Luleälven	1-2 years	99,8	100,0	100,0	All
9	Piteälven	1-2 years	16,6	20,0	23,8	All
10	Åbyälven	1-2 years	22,0	30,2	40,0	All
11	Byskeälven	1-2 years	22,4	30,7	39,5	All
12	Kågeälven	1-2 years	21,8	30,3	39,8	All
13	Skellefteälven	1-2 years	99,8	100,0	100,0	All
14	Rickleå	1-2 years	19,7	25,2	31,8	All
15	Säverån	1-2 years	19,6	25,1	31,8	All
16	Vindelälven	1-2 years	30,7	37,0	43,6	All
17	Umeälven	1-2 years	99,8	100,0	100,0	All
18	Öreälven	1-2 years	14,4	21,6	29,4	All
19	Lögdeälven	1-2 years	21,2	29,4	38,4	All
20	Ångermanälven	1-2 years	99,8	100,0	100,0	All
21	Indalsälven	1-2 years	99,8	100,0	100,0	All
22	Ljungan	1-2 years	27,8	37,4	46,4	All
23	Ljusnan	1-2 years	99,8	100,0	100,0	All
24	Testeboån	1-2 years	28,8	37,1	46,4	All
25	Dalälven	1-2 years	99,8	100,0	100,0	All
26	Emån	1-2 years	92,8	97,1	99,3	All
27	Mörrumsån	1-2 years	92,9	97,0	99,3	All
28	Neva, Fi	1-2 years	99,8	100,0	100,0	All

29	Neva, Rus	1-2 years	85,9	90,0	93,3	All
30	Luga	1-2 years	92,8	96,1	98,1	All
31	Narva	1-2 years	99,8	100,0	100,0	All
32	Kunda	1-2 years	97,7	99,0	99,7	All
33	Keila	1-2 years	97,9	99,0	99,6	All
34	Vasalemma	1-2 years	97,8	99,0	99,6	All
35	Salaca	1-2 years	97,9	99,0	99,7	All
36	Gauja	1-2 years	99,8	100,0	100,0	All
37	Daugava	1-2 years	99,8	100,0	100,0	All
38	Venta	1-2 years	99,8	100,0	100,0	All
39	Neumunas	1-2 years	99,8	100,0	100,0	All

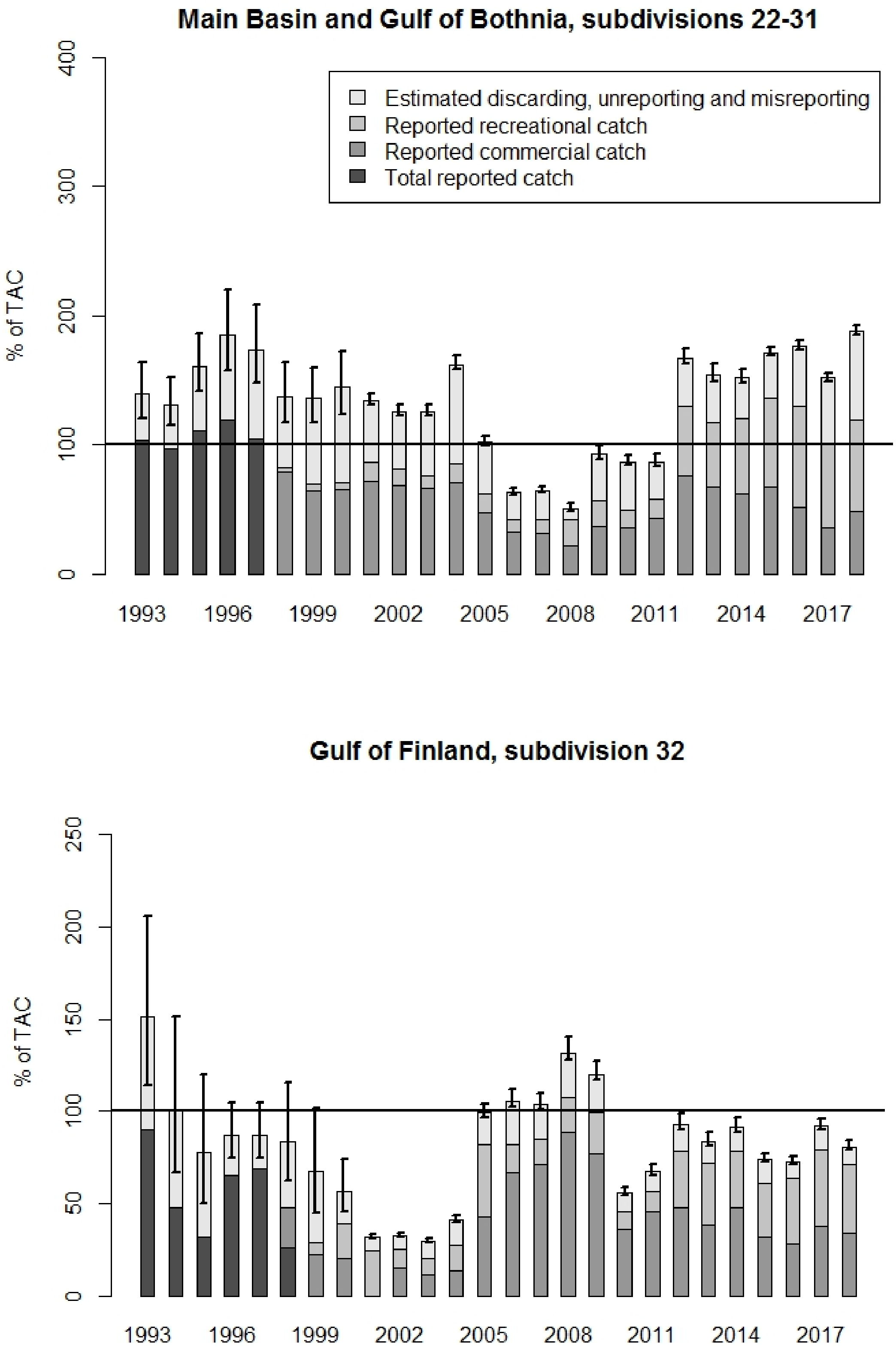


Figure 2.2.1.1. Total reported and estimated catches of salmon in % of TAC in 1993–2018. For years 1993–1997 (1993–1998 for Gulf of Finland) it is not possible to divide the total reported catch into commercial and recreational catches. Estimates of discards and unreported catches (in numbers) are presented separately in Table 2.2.1.2.

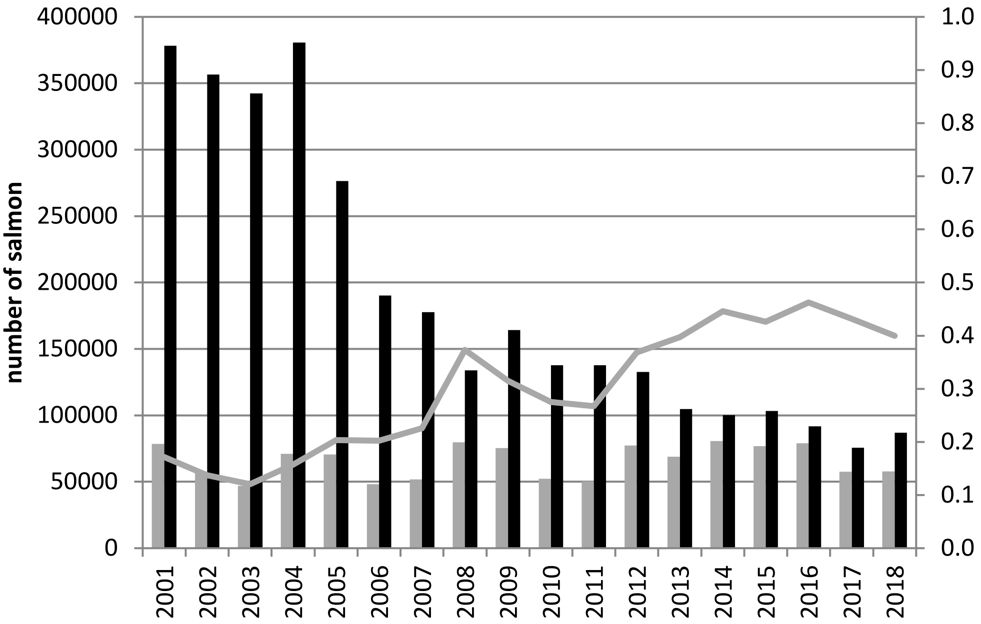
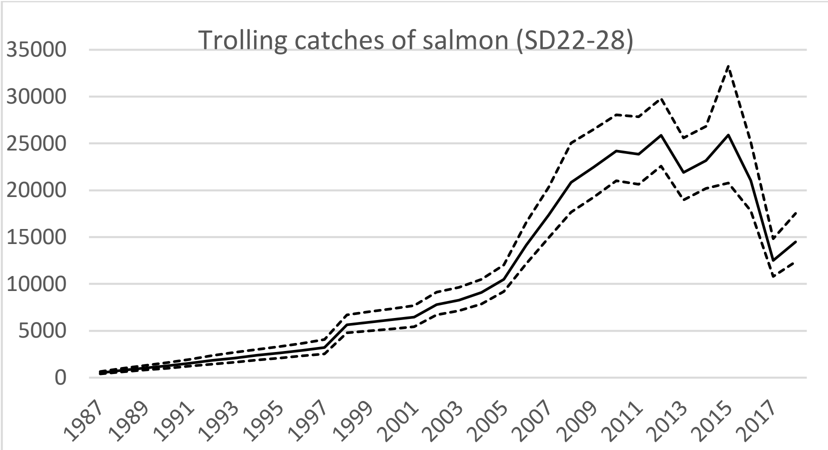
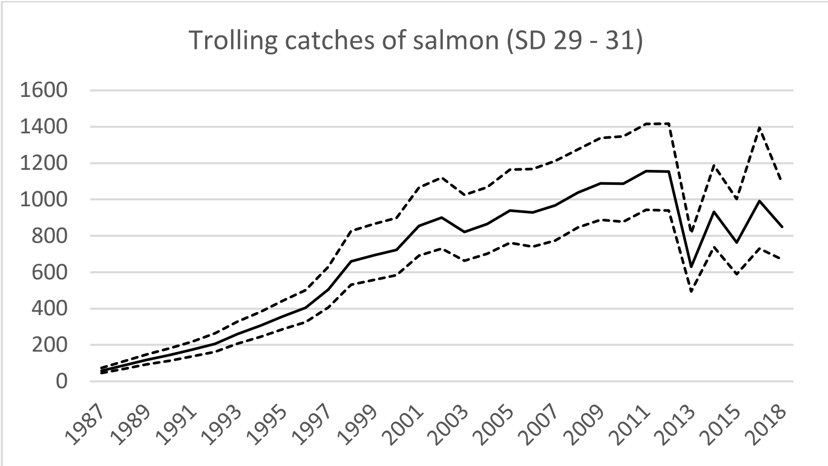


Figure 2.2.1.2. Commercial (black columns) and recreational (grey columns) catches of salmon in numbers in years 2000–2018 for subdivisions 22–32. The recreational catch proportion of the total catch (commercial and recreational) is shown for the same time period (grey line). The recreational catches include all components (river, coastal and sea), also the expert opinion trolling estimates depicted in Figure 2.2.1.3.





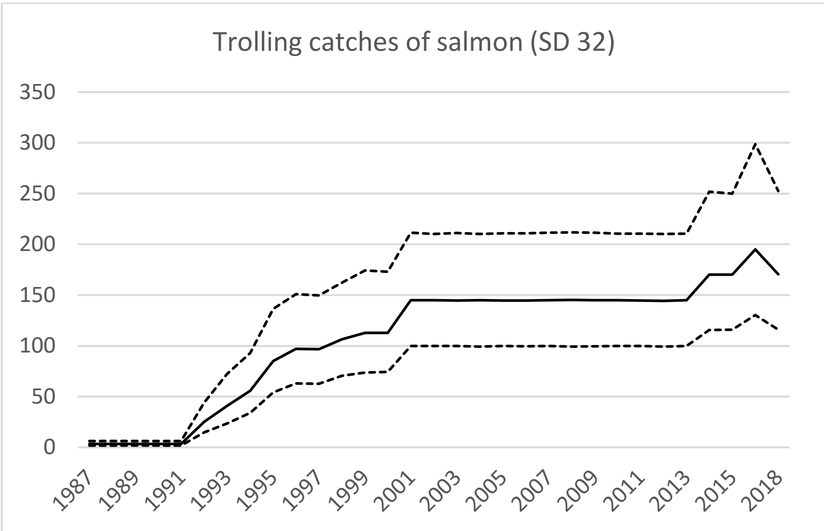
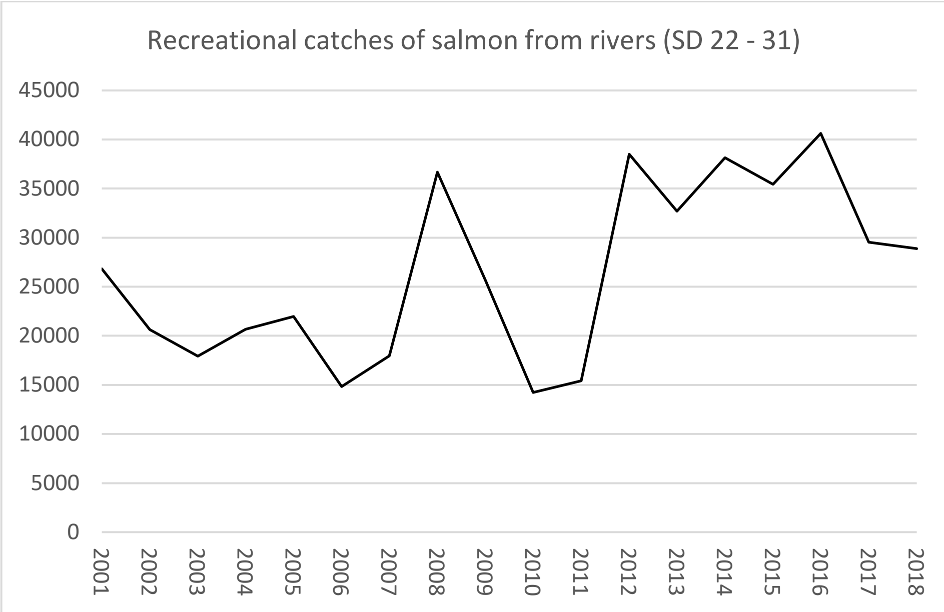


Figure 2.2.1.3. Combined expert estimates of total trolling catches in numbers (including retained fish and a 25% post-release mortality for released fish) for Baltic salmon, 1987–2018 (medians with 95% p.i.).



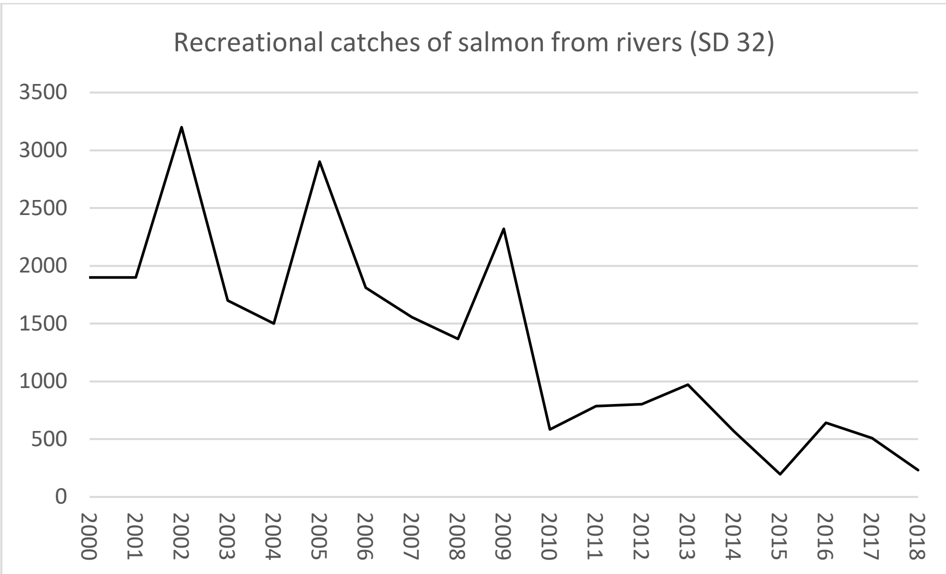


Figure 2.2.1.4. Recreational river catches for Baltic salmon, 2001–2018 (SD 22-31) and 2000–2018 (SD 32). Catch in numbers.

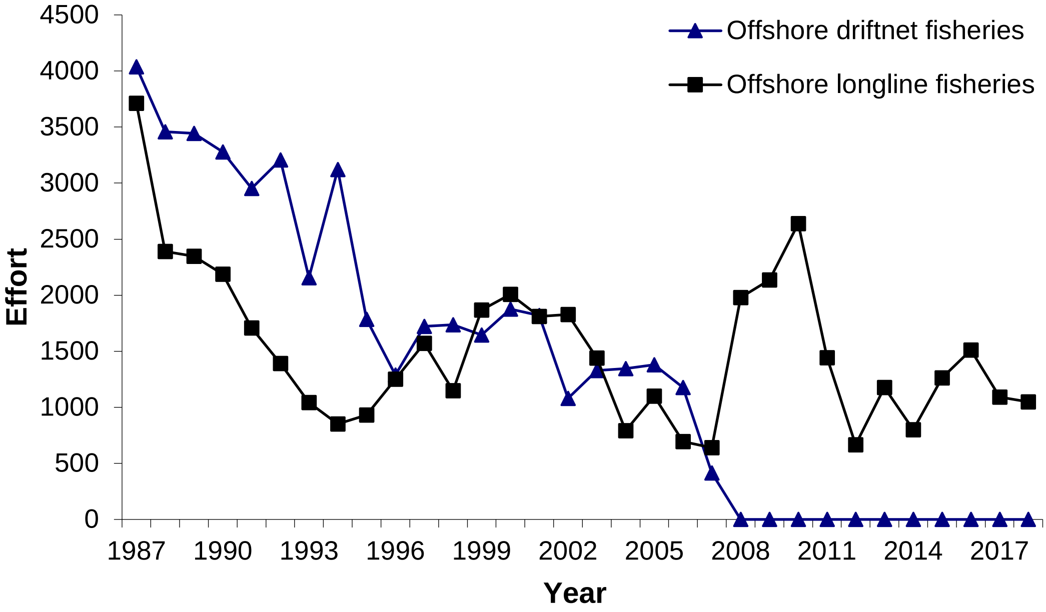


Figure 2.4.1. Fishing effort in Main Basin offshore fisheries (x 1000 geardays) in 1987–2018.

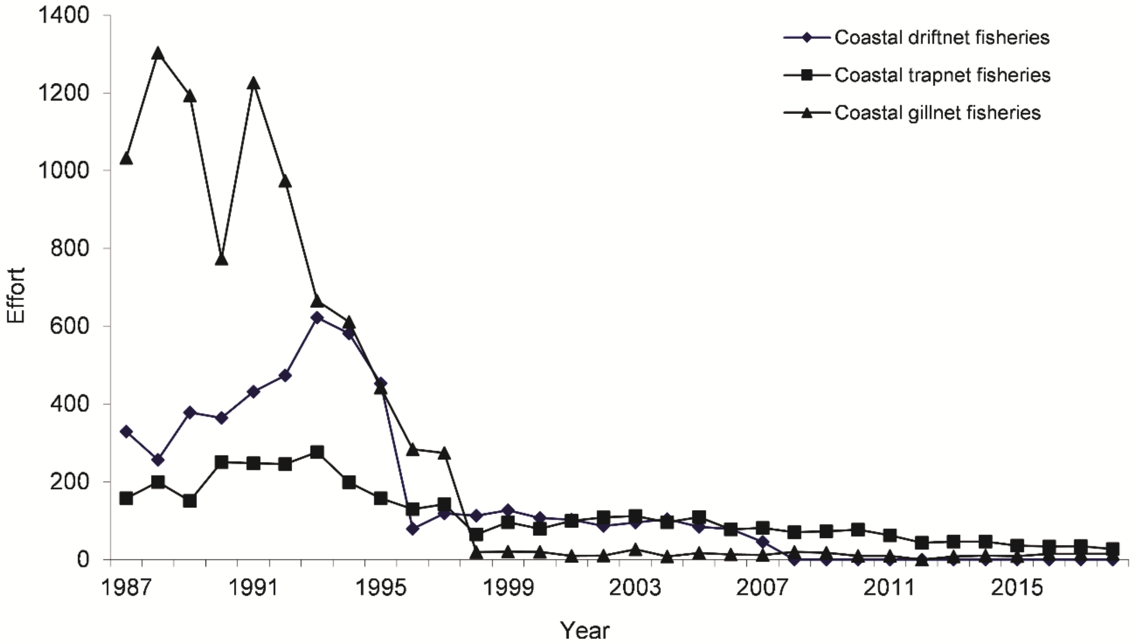


Figure 2.4.2. Effort in Main Basin and Gulf of Bothnia coastal fisheries (x 1000 geardays) in 1987–2018.

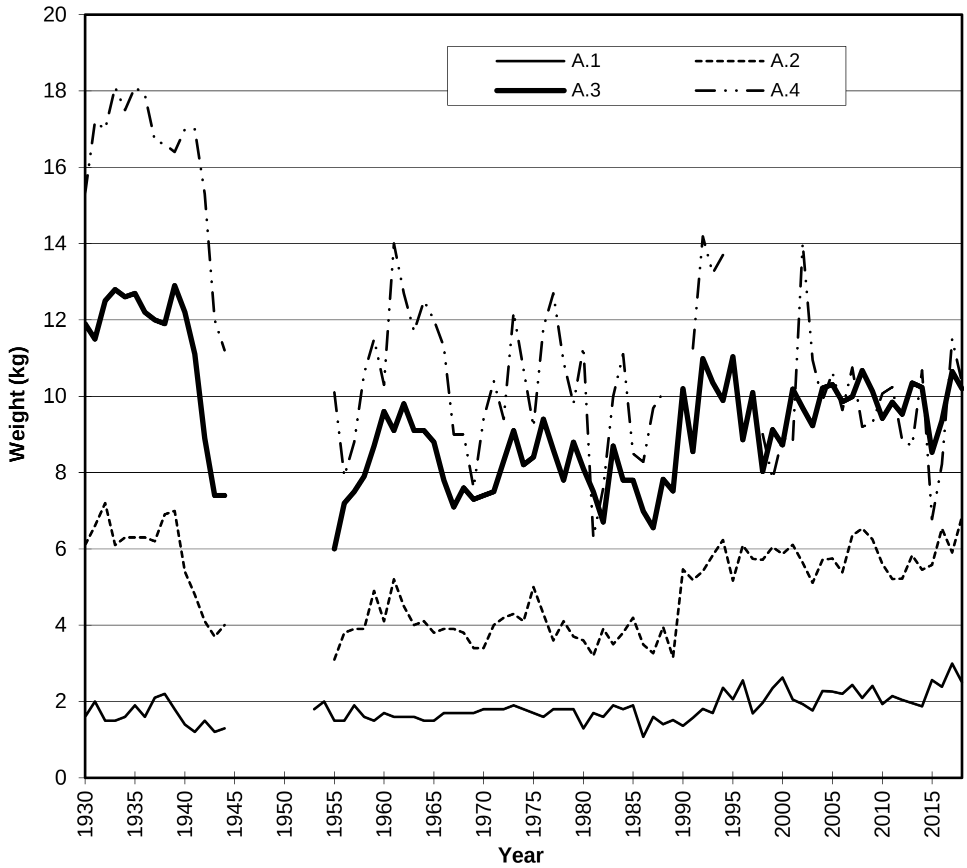
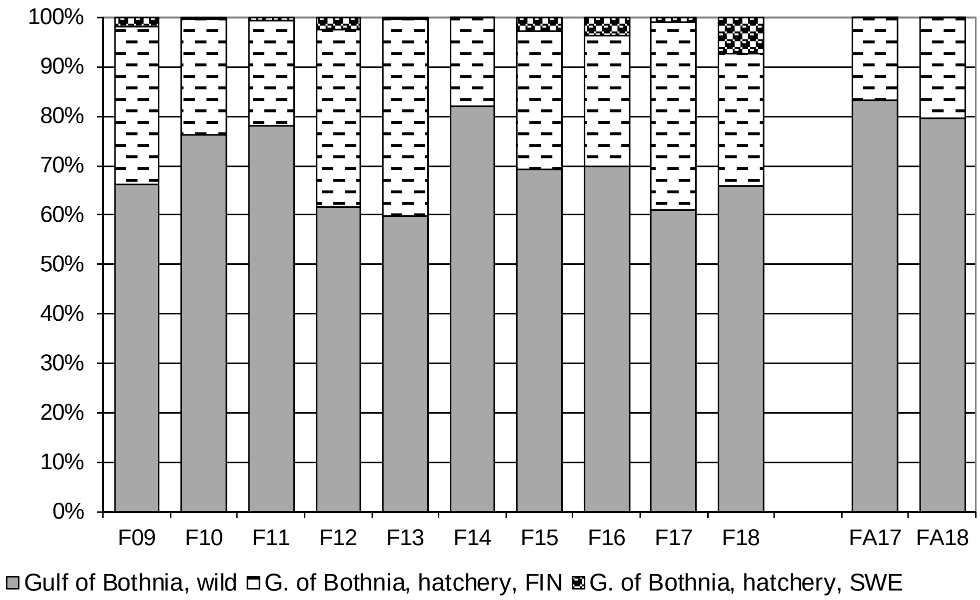


Figure 2.5.2.1. Mean weight of spawners in the Gulf of Bothnia by year. Values in 1930–1944 from catch statistics in the Rivers Oulu and Torne. Values in 1953–1985 are from Swedish tagging records and in 1986–2017 from the Finnish catch sampling data. Weights of A.4 salmon based on sampling performed 1953–2018 (where smaller sample sizes some of the years).

GENETIC DISTANCES BETWEEN SALMON BASELINE STOCK SAMPLES

Figure 2.6.1. Neighbour joining dendrogram (based on Nei's pairwise DA genetic distances) depicting genetic relationships among salmon baseline samples used for catch analysis. Numbers represent percentage support values based on 1000 bootstraps.

A)



B)

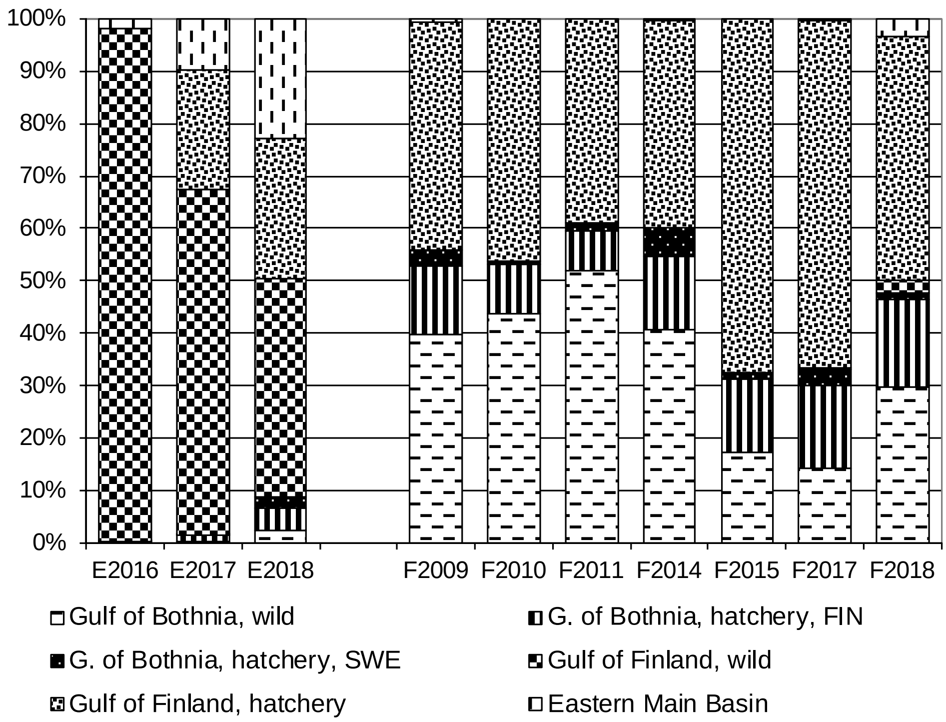


Figure 2.6.2. A) Proportions of salmon stock groups in Finnish salmon catches in the Gulf of Bothnia from 2009 to 2018. The catches from the advanced fishing season in 2017 and 2018 are analysed separately (FA2017 and FA2018). B) (Proportions of salmon stock groups in Finnish and Estonian salmon catches from the Gulf of Finland. Note that Gulf of Finland wild and hatchery stocks of Rivers Kunda and Luga are both included into the wild group, as they have both wild and hatchery production, which cannot be distinguished with genetic methods. This affects the results from Estonian catches, and overestimates the wild production in the catches.

3 River data on salmon populations

The Baltic salmon rivers are divided into four main categories: **wild**, **mixed**, **reared** and **potential**. Details on how rivers in countries and assessment units (AUs) are classified into these four river categories are given in the Stock Annex (Annex 2). At present there are 58 salmon rivers out of which 27, 14 and 17 are considered as wild, mixed (i.e. with both natural and reared production) and reared, respectively. In addition, it currently exist 21 potential salmon rivers in five countries (Section 3.2).

Over the years, some rivers have received altered status and further changes are likely to occur in the future. For example, in 2013 and 2014 the formerly potential salmon rivers **Testeboån** (AU 3) and **Kågeälven** (AU 2) in Sweden received status as wild, as they had fulfilled criteria previously set up by WGBAST (ICES, 2008c). Among the 14 rivers currently classified as mixed, the present level of salmon releases in Estonian rivers **Pirita** and **Väänä** (AU 6) are already close to the threshold of less than 10% reared smolt production adopted by WGBAST as a criteria for wild rivers (Annex 2, Table A.1.2.1). Hence, if stocking would be further reduced or stopped, these rivers could become candidates for receiving wild status by WGBAST. Conversely, the previously wild river **Pärnu** in Estonia (AU 5) was last year listed as mixed, because of an ongoing restoration programme that includes substantial annual releases of hatchery-reared juveniles (ICES, 2018a; 2018b). In the coming years, WGBAST plans to review its criteria and update the list of wild, mixed, and potential salmon rivers, according to river specific information, new studies and internationally recognized recommendations.

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 2).

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

River catches and fishery

In 2012, the catch in **Tornionjoki** was three times higher than in 2011 and for the first time since the beginning of the time-series with annual catch statistics, it exceeded 100 tonnes (Table 3.1.1.1). In 2014, the catch increased to 147 tonnes, and in 2016 it reached the present record of 161 tonnes (Table 3.1.1.1). In 2017 and 2018, however, the catch again declined to around 90 tonnes. Catch levels similar to those observed in 2012–2018 were observed in the early 20th century (Figure 3.1.1.1). Salmon catches in **Simojoki** did not rise much in 2012–2013, which is partly due to a low fishing effort. However, in 2014 and 2015 there was a clear increase in the catch and the rising trend continued until 2016, when the catch was 1.8 tonnes (Table 3.1.1.1). As in Tornionjoki, 2017–2018 catches dropped also in Simojoki, being about 0.75 tonnes in 2018. The catches in **Kalixälven** have decreased and in later years, they do not correspond to the registered number of salmon that have passed the fishway.

A special kind of fishing from boat (rod fishing by rowing) dominates the salmon fishing in **Tornionjoki.** This type of fishing also occurs in **Kalixälven,** but there it is not as dominating as in Tornionjoki. CPUE of this fishery in Tornionjoki has increased tens of times since the late 1980s (Table 3.1.1.1), apparently reflecting the parallel increase in the abundance of spawners in the river. The CPUE has been high (over 1000 grams/fishing day) in 1997, 2008 and 2012–2016, when the total river catches were also peaking. In 2017, CPUE dropped to 860 g/day but in 2018, it again increased to 1200 g/day. Annual changes in CPUE and in total river catch generally follow each other.

In **Råneälven** the local administration has since 2014 utilized a seasonal catch bag limit regulation of maximum of three salmon per person and season. Both obligatory tagging of killed fish (maximum of three tags per person and year) and a digital catch reporting system has been utilized to aid in enforcement. Most (80–90%) of the salmon caught with rod are released back; in 2017 a total of 56 salmon were caught, out of which 45 were released, whereas in 2018 only two salmon were caught and tagged (retained).

Spawning runs and their composition

In **Kalixälven** salmon are counted in the fishway at the waterfall in Jockfall about 100 km from the river mouth. From 2007 to 2012 the mean annual run was 5500 salmon. In 2013, the run increased to the highest observed when more than 15 000 salmon passed the fishway. The counted runs in 2014–2018 stayed at a lower level (between 5000–8000 salmon). No reared salmon (adipose fin clipped) has been registered in the counter since 2015.

A hydroacoustic split-beam technique was employed in 2003–2007 to count the spawning run in **Simojoki**. It seems evident that these counts covered only a fraction of the total run, as there are irregularities in the river bottom at the counting site, allowing salmon to pass without being recorded. Since 2008, the split-beam technique has been replaced by an echosounder called DIDSON (Dual frequency IDentification SONar). According to monitoring results, the seasonal run size has ranged from less than 1 000 up to more than 5000 fish (Table 3.1.1.2). Spawning runs gradually increased from 2004 to 2008–2009, but again dropped in 2010–2011. In 2012, the run increased fourfold from the previous year (to about 3000) and also the runs in 2013–2015 were about as abundant (3000–4000 salmon). The 2016 run was record-high with 5400 salmon counted. In 2017 the run dropped below 2000 salmon but increased in 2018 to about 4000 salmon (Table 3.1.1.2). A lot of back-and-forth movement of salmon has been detected in Simojoki, especially in 2018, which erodes the accuracy of the counts. There have also been problems connected to the separation of species.

The spawning runs into **Tornionjoki** have also been monitored using the DIDSON technique since 2009. The observed seasonal run size has ranged from 17 200 (year 2010) to 100 200 (year 2014) salmon (Table 3.1.1.2). Grilse account for a minority (7–24%) of the annual spawning runs. The run size in 2016 (98 300 salmon) was almost as high as in the record year 2014 (101 000 salmon), but as in the Simojoki, the run again dropped in 2017 (to about 41 000 salmon). In 2018 the counted amount increased only slightly (to 47 000 salmon).

The Tornionjoki counting site is located about 100 km upstream from the river mouth. Therefore, salmon which are either caught below the site or 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). Also, according to auxiliary studies, a small fraction of the spawners pass the counting site via the fast-flowing mid-channel without being detected by sonars. The 2018 count probably represents a smaller-than-normal proportion of the total run size into the river; observations were made of unusually high amounts of salmon staying on the lowermost river until autumn 2018. Moreover, the very low prevailing water level in 2018 probably allowed many spawners to pass the hydroacoustic counter via the deepest mid-channel where they may have remained undetected.

In 2014–2018 the spawning run in **Råneälven** has been monitored with an ultra-sound camera (SIMSONAR). The technique is similar to that used in Tornionjoki and Simojoki. The counting site is located about 35 km upstream from the river mouth, and the counts are expected to represent the total run as no salmon spawning areas exist downstream. The total counted salmon runs in the period 2014–2018 have been 3756, 1004, 1454, 1781 and 4184 individuals, respectively (Table 3.1.1.3).

Almost 13 000 catch samples have been collected from the **Tornionjoki** salmon fishery since the mid-1970s. Table 3.1.1.3 shows sample size, sea age composition, sex composition and proportion of reared fish (identified either by the absence of adipose fin or by scale reading) of the data for the given time periods. Caught fish have generally become older, and the proportion of repeat spawners has increased in parallel with a decreasing sea fishing pressure (see Section 4). The strong spawning runs into Tornionjoki in 2012–2016 were a result of fish from several smolt cohorts. In these years, the proportion of females has been fairly stable, about two thirds of total biomass, but in 2018 only 55% of the total biomass were females. The proportion of repeat spawners has generally been between 5–10% during the last decade. However, a record high proportion of repeat spawners (14%) was observed in 2014, and the proportion was high (12%) also in 2018. Very few salmon of reared origin (<1%) have been observed in the Tornionjoki catch samples in the last decade (Table 3.1.1.3).

Parr densities and smolt trapping

The lowest parr densities in AU 1 rivers were observed in the mid-1980s (Table 3.1.1.4, Figures 3.1.1.4 and 3.1.1.5). During the 1990s, densities increased in a cyclic pattern with two 'jumps'. The second, higher jump started in 1996–1997. Between these increases there was a collapse in densities around the mid-1990s, when also the highest M74 mortality was observed (see below). Average parr densities are nowadays 5–60 times higher than in the mid-1980s. Since the turn of the millennium, annual parr densities have varied 2–6 fold. In **Simojoki**, some years with higher-than-earlier densities of 0+ parr have been observed recently, but annual variation has been large and densities of older parr have often not increased in this river after years with high 0+ densities. In the other AU 1 rivers, however, parr densities have continued to increase rather steadily until in the mid-2010s.

In some years, like in 2003, high densities of parr hatched in **Simojoki, Tornionjoki** and **Kalixälven** despite relatively low preceding river catches (indicating low spawner abundance)**.** Similarly, high densities of 0+ parr were observed in **Tornionjoki** in 2008 and 2011, although river catches in the preceding years were not among the highest. Possible reasons for this inconsistency include exceptionally warm and low summer-time river water, which might have affected fishing success in the river and even measurements of parr densities. In years 2006, 2013, 2014 and 2018 conditions for electrofishing were favourable because of very low river water levels, whereas they were the opposite in 2004 and 2005. These kinds of changes in electrofishing conditions may have affected the results, and one must therefore be somewhat cautious when interpreting the data obtained.

In **Simojoki** the mean density of one-summer old parr increased by about 50% from 2015 to 2016 and it continued to increase in 2017 (Table 3.1.1.4). The 2017 density of 0+ parr (38.1 ind./100 sqm) is record high in the time-series, although most of the uppermost sites still lack 0+ parr. In 2018, the average 0+ parr density was also high (30.6 ind./100 sqm). The density of older parr doubled from 2015 to 2016 and again from 2016 to 2017. In 2018 the all-time high level of 42.0 older ind./100 sqm was observed. In **Tornionjoki** the densities of 0+ parr in 2014 and 2015 were clearly higher than in any earlier year in the time-series. In 2016, the average density of 0+ parr on the sampled sites was somewhat lower than in 2015. Several flood peaks due to heavy rains prevented electrofishing on the lower and on some of the middle and upper sections of the river system. In 2017, the average density of 0+ parr increased slightly from 2016 and was the third highest in the time-series (28.5 ind./100 sqm). However, in 2018 the mean 0+ parr density again dropped to only 18.3 ind./100 sqm. The average density of older parr in 2017 (17.2 ind./100 m^2) also dropped from the two earlier years and in 2018 a further decrease (to 16.2 ind./100 sqm) was observed. Thus, in Tornionjoki parr production has turned to decrease after the record years in the mid-2010s.

In **Kalixälven** the mean density of 0+ decreased in 2017 compared to 2016, but in 2018 the densities again increased 1.5 times. The density of older parr has been relative stable, varying between 12-20 ind./100 sqm during the five latest year. (Table 3.1.1.4). In **Råneälven** the density of 0+ parr has decreased with about 50% in the four latest years. In 2018, however, it stayed at the same (low) level as in 2017. The density of older parr also decreased compared to in the two preceding years.

Smolt production has been monitored in **Simojoki** and **Tornionjoki** by annual partial smolt trapping and mark–recapture experiments (see Annex 2 for methodology) since 1977 and 1987, respectively (Table 3.1.1.5). A so-called river model (also referred to as "hierarchical linear regression analysis") has been applied to combine information from electrofishing and smolt trapping results, to obtain updated estimates of wild smolt production in years when high water flow has prevented complete trapping, including also rivers without smolt trapping (Annex 2).

With a 1–3 year time-lag (needed for parr to transform to smolts) wild smolt runs have followed changes in wild parr densities. 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). The first increase in the production occurred in the early 1990s, and a second, higher jump occurred in the turn of the millennium. Since then, smolt runs have not increased in **Simojoki**, while in **Tornionjoki** the runs have continued to increase, especially during the last ten years. Since the turn of the millennium, annual estimated runs of wild smolt have exceeded 20 000 and 500 000 smolts with high certainty in **Simojoki** and **Tornionjoki,** respectively. Since 2008, estimates of wild smolt runs have exceeded one million smolts in the **Tornionjoki**.

Smolt trapping in 2018 was not successfully conducted in **Tornionjoki** because of a very high flood peak coinciding with rapid warming up of the water. The river model estimated the 2018 smolt run to be approximately 1.8 million smolts (median value, 90% PI's 1.4–2.4 million). The same model further predicts about 1.5 million smolts to leave the river in both 2019 and 2020.

Smolt trapping in **Simojoki** was conducted successfully in 2018, although a (minor) part of the early smolt run may have been missed due to the rapid warming up of the river. The mark–recapture experiment resulted in an estimate of 42 600 smolts (median value, 95% PI 33 000–63 000) (Table 3.1.1.5), whereas the river model with electrofishing and smolt trapping data up to 2018 updated the smolt run estimate to about 54 000 for 2018 (median value, 90% PI's 43 000–68 000 inds.). Moreover, the river model predicts an increase to approx. 90 000 smolts/year for both 2019 and 2020. Such high smolt runs have never been estimated for Simojoki earlier.

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

River catches and fishery

The 2018 catches in **Piteälven** and **Åbyälven** stayed at the same low level as in previous years. The retained catch in **Byskeälven** 2018 decreased to only nine salmon (32 released) or 58 kilos which is the smallest catch since the mid-1990s (Table 3.1.1.1). In **Kågeälven** (wild river since 2014) the sport fishery was regulated in 2012 by the local administration to become 100% catch and release, with all fish released to be registered in an obligatory reporting system. In the period 2015–2018 on average about 75 salmon per year (range: six to 92) have been caught and released in Kågeälven.

In **Rickleån** only two salmon were retained (18 released) in 2018, the same amount as in 2017. In the period 2008–2015 the retained catches varied between 10–20 salmon with releases ranging from 13 to 23.

In **Sävarån** the catches have been very low in recent years; in 2018 only five salmon were caught and released. In 2017 no salmon were caught, compared to in 2016 when 13 salmon were caught and released. The catch in **Ume/Vindelälven** decreased from 215 salmon (whereof 125 released) in 2016 to only 32 salmon (one released) in 2017. In 2018, a single salmon was retained (and 103 released). All reported caught salmon in the three latest year showed signs of disease. In **Öreälven** the catch in 2017 decreased to 95 salmon (whereof 60 released) compared to 600 (whereof 400 released) in 2016. No salmon was retained in 2018 (four released). In **Lögdeälven** the catch in 2017 was 143 salmon (whereof 61 released), compared to 135 (28 released) in 2016. The 2018 catch was 80 salmon (whereof 46 released).

Spawning runs and their composition

In the fishway in **Piteälven** the counted salmon run in 2018 was 1431, which is the same amount as in 2017. In 2016, the counted run was the highest ever recorded (1907 salmon) (Table 3.1.1.2, Figure 3.1.1.3).

In the fishway in **Åbyälven** the counted salmon run in 2018 was 113 which is at the same level as previous year (Table 3.1.1.2, Figure 3.1.1.3). In 2018, the hydropower station owner has sent in an application to the environmental court asking for reconstruction of the fishway to achieve a higher passage efficiency.

In the two fishways at Fällforsen in **Byskeälven** the counted salmon run in 2018 was 2168 salmon which is only half of the run in the previous year (Table 3.1.1.2, Figure 3.1.1.3). The counter in the fishway where a majority of the salmon run occurs, was broken at the end of July and wasn't repaired afterwards. The reason for not repairing or replacing the counter during the season was because the salmon run had already decreased due to an extremely low water level and high water temperatures.

In **Rickleån** a total of 36 salmon passed the fishways in 2018, which is the highest recorded number so far. In 2017, a total of 15 salmon passed the fishways, which is at the same level as in the two past years (Table 3.1.1.2).

In **Ume/Vindelälven** a total of 12 754 salmon passed the fishway in 2018, whereof a high portion were grilse (70%). In 2017, the run was only 4100 salmon (Table 3.1.1.2, Figure 3.1.1.3). Severe disease outbreaks have occurred in Ume/Vindelälven since 2015 and very few females passed the fishway in 2018 (see Section 3.4.4). In the beginning of the season, a large proportion of adult salmon suffered of some form of disease and died in the fishway or soon after having passed it. Out of 200 salmon tagged at the river mouth, despite no signs of poor condition, disease or visible injuries, only 12% passed the fishway. A new spilling regime into the old riverbed will be tested during 2019 that could more efficiency attract fish from the power plant tailrace into the old riverbed.

In **Öreälven** the control of ascending fish ended in 2000 (Table 3.1.1.2). The reason was high water levels that destroyed the part of the dam where the fish trap was located.

Parr densities and smolt trapping

Densities of salmon parr in electrofishing surveys in AU 2 rivers (Gulf of Bothnia, ICES SD 31) are shown in Table 3.1.2.1 and in Figures 3.1.2.1 and 3.1.2.2. In the summers of 2006, 2013 and 2014 conditions for electrofishing were extraordinary because of very low water levels, opposite to the conditions prevailing in 2004–2005. For the electrofishing carried out in 2009, 2010, 2012 and 2015, the water levels were normal, but in 2011 and 2016 high water levels due to rain prevented surveys in several rivers. In 2018, the water levels were extremely low from late summer into autumn.

Due to problems to electrofish large parts of **Piteälven**, only the number of ascending adults is used for indirectly estimating smolt abundance (details in Section 4.2.1). No consistent electrofishing surveys were made in the 1990s. The density of 0+ parr has been rather low in most of the years (Table 3.1.2.1). No surveys were done in 2011 and 2012 due to high water levels. In 2014 the densities of 0+ parr was the highest recorded (12 ind./100 sqm). In 2016, the average density increased compared to in the previous year. The density of older parr has also been low, varying between 4–9 ind./100 sqm the latest four years. No surveys were carried out in 2017 and 2018.

In **Åbyälven**, the mean densities of 0+ parr in 1989–1996 were about three ind./100 sqm. In 1999, the densities of 0+parr increased to 17 ind./100 sqm, about five times higher than earlier. In 2016, the average 0+ density increased to the so far highest recorded level (37 ind./100 sqm) and it stayed at about that level in 2017. In 2018 the densities decreased to 23 ind./100 sqm. The densities of older parr have been stable in the last seven years with a mean of 14 ind./100 sqm, and the densities 2017 were the highest observed so far and stayed at same level in 2018 (Table 3.1.2.1).

In **Byskeälven**, the mean densities of 0+ parr in 1989–1995 were about five ind./100 sqm. In 1996–1997 the densities increased to about 11 ind./100 sqm, and in 1999 and 2000 the 0+ parr densities increased further (they were about 70% higher than in 1996–1997). During the 2000s, the densities have been on rather high levels with a few exceptions, and in 2016 the 0+ density increased to the so far highest recorded level (43 ind./100 sqm) and it stayed at the same high level in 2017. In 2018, the densities decreased with half compared with the two previous years. The densities of older parr have remained rather stable during later years with a mean around 20 ind./100 sqm (Table 3.1.2.1).

In **Kågeälven**, the last releases of reared salmon parr were made in 2004, which means that the wild-born 0+ observed in 2013 were mainly offspring of spawners which themselves were wild-born. Stable occurrence of parr in recent years with means around 15 ind./100 sqm for both 0+ and older parr (Table 3.1.2.1) indicates that the population has become self-sustaining. Spawning also occurs along the whole river stretch available for salmon.

In **Rickleån**, the mean density of 0+ parr were only about 0.5 ind./100 sqm in 1988–1997, whereas since 1998 the mean density has been around 3.7 ind./100 sqm (Table 3.1.2.1). The mean 0+ density has decreased in every year since 2016, and in 2018 the densities were three ind./100 sqm. Older parr have remained at the same level in the last three years (around eight ind./100 sqm). In Table 3.1.2.1 also average densities from extended electrofishing surveys in Rickleån are presented, including sites in the upper part of the river that was recently colonized (for more details see Section 4.2.2 in ICES, 2015). Since some years, weighted mean densities including these extended electrofishing surveys have served as input in the river model used to calculate prior smolt abundances.

In 2014–2017, smolts of salmon and sea trout were counted during their downstream migration in Rickleån using a smolt wheel ('Rotary-Screw-trap') and mark–recapture experiments. The trap was positioned close to the river mouth. In 2014, a total of 434 salmon smolts were caught. The calculated recapture rate for tagged salmon was 20.3%, which was used to estimate a total smolt production of 2149 (Table 3.1.1.5). Because of many breaks when drifting the screw-trap in 2015, no reliable estimate of the smolt production could be obtained in that year. In 2016 and 2017, the estimated total run was about 4000 and 4800 salmon smolts, respectively (Table 3.1.1.5). No smolt trapping was performed in 2018 (the trap was moved to Råneälven).

In **Sävarån** the mean densities of 0+ parr in 1989–1995 were about 1.4 ind./100 sqm. In 1996, the average density increased to 10.3 ind./100 sqm, and in 2000 to 12.8 ind./100 sqm. No electrofishing was made in 2001 and 2004. The 0+ density in 2015 was the so far highest recorded (45 ind./100 sqm) followed by the highest for older parr in 2016 (34 ind./100 sqm). The densities of 0+ parr have decreased in the three lasts years, and in 2018 the density was 13 ind./100 sqm.

Also the density of older parr in 2018 decreased slightly compared to in previous years (Table 3.1.2.1).

From 2005 to 2013, smolts of salmon and sea trout were caught in Sävarån on their downstream migration from mid-May to mid-June using a smolt wheel (originally two parallel wheels were used). The trapping site was positioned 15 km from the river mouth. Estimates of total salmon smolt production are presented in Table 3.1.1.5. On average ca. 470 wild salmon smolts per year were caught. Smolts were measured for length and weight, with scale samples taken for age determination and genetic analyses. The dominating age group was three years. The proportion of recaptured tagged fish in the trap varied between 4–31 % corresponding to an average estimated annual smolt abundance close to 3000 (Table 3.1.1.5). No trapping of smolts has been carried out since 2014, as the smolt trap was moved and used in Rickleån during 2014–2017 (see above).

In **Ume/Vindelälven**, mean densities of 0+ parr in the 1990s were only about 0.8 ind./100 sqm. During the 2000s, densities have fluctuated within the range of 5–25 ind./100 sqm. No surveys were carried out in 2011 due to high water level. In 2014, the density of 0+ parr increased to the so far highest recorded (39 ind./100 sqm) followed by a decrease in 2015 with almost 50%. In years 2016-2018 the mean 0+ parr density has declined to very low values (<5 ind./100 sqm), levels not seen in the river since the peak years of M74 (fry mortality) in the early 1990s. In 2018, only two 0+ parr were caught across 27 electrofished sites. The reason for the very low density seems to be linked to the record small proportion of females passing the fish ladder in Stornorrfors in 2017 and also in 2015 and 2016 (Table 3.1.1.2; Figure 3.1.2.3) combined with a low survival rate after having passed the ladder. In recent years, a large proportion of the ascending spawning fish have suffered from (a still unknown) disease followed by secondary fungus (Section 3.4.4). The establishment of fungus has weakened the fish and resulted in high mortality, which has been observed in the fishway, at the intake grid to the hydropower station, and in the hatchery facilities where fish have died long before spawning time. In addition, the M74-frequency increased in the spawning years 2015–2017 (Section 3.4). These factors combined probably have led to a low egg deposition in autumns 2015, 2016 and 2017 and to the very low densities of 0+parr seen in 2016–2018.

In Table 3.1.2.1, average densities from extended electrofishing surveys in Vindelälven are also shown, including additional sites from upper parts in the river that recently have been colonized (see Section 4.2.2 in ICES, 2015). Since some years, weighted mean densities including these extended electrofishing surveys have served as input in the river model used to calculate prior smolt abundances.

A smolt fykenet for catching smolts, similar to the one used in Tornionjoki, was operated in Vindelälven between 2009 and 2015. The entire smolt production area is located upstream of the trapping site. On average around 2500 salmon smolts were caught, and the annual proportion of recaptured tagged fish varied between 2.2–3.6%. In 2009, the trap was operated from end of May to beginning of July, and smolts were likely caught during the whole time period with a peak in mid-June. In 2010, a pronounced spring flood caused problems to set up the fykenet and a considerable part of the smolt run was missed. In 2011, a period with very high water flow late during the season 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 'peak' that was likely missed. In 2012–2015, several episodes of high water flow again resulted in repeated breaks, and for those years, it was difficult to even produce crude guesses of the proportion of the total smolt run that was missed.

Due to the above mentioned interruptions in the function of the trap, direct smolt estimates from the mark–recapture experiments with the fykenet have not been possible to produce. However, estimates have still been obtained based on data for returning 1SW adults (grilse) that can be identified from their smaller body size even without age data. Since 2010, all captured smolts have been marked using PIT-tags. VAKI counters and PIT-antennas in the Ume/Vindelälven fishway record all marked and unmarked wild returning spawners. Assuming a common smolt-to-adult survival rate for marked and unmarked grilse, the size of a given smolt cohort has thus been possible to estimate indirectly (see Table 3.1.1.5) and used as prior information for the river model.

Since 2016, the Vindelälven smolt trapping has been moved to a newly built permanent smolt trap within the fishway at Stornorrfors (hydropower dam that must be passed by down-migrating smolts) just a few kilometres downstream the former trapping site. In 2016–2018, however, there have been technical problems with the new smolt trap, and as a consequence only few smolts were caught and marked.

In **Öreälven**, mean densities of 0+ parr in 1986–2000 were very low, just about 0.5 ind./100 sqm. The densities increased somewhat during the early 2000s, and then stayed around 3–10 ind./100 sqm until in 2015 when the density increased by three times compared with earlier to the highest value recorded so far (21.6 ind./100 sqm). In 2016 and 2017 the mean 0+ density showed a slight decrease compared to previous years, and in 2018 the mean density decreased to only 1.3 ind./100 sqm (Table 3.1.2.1). One-year old parr were only found in 44% of the electrofished sites. Densities of older parr has stayed at the same mean level (seven ind./100 sqm) during the four latest years. In Table 3.1.2.1, also average densities from extended electrofishing surveys in Öreälven are shown, including sites from upper parts of the river that recently have been colonized (see Section 4.4.2 in ICES, 2017a). Since the 2018 assessment, weighted mean densities including these extended electrofishing surveys have served as input in the river model used to calculate prior smolt abundances.

In **Lögdeälven**, mean densities of 0+ parr in 1990s were about 1.5 ind./100 sqm. Densities during the 2000s have fluctuated between three and almost 15 ind./100 sqm. In 2017, the mean 0+ density decreased with about 50% compared to in the three previous years, and in 2018 the densities decreased to a very low level (1.5 ind./100 sqm), similar to as in the 1990s (Table 3.1.2.1). The densities of older parr in 2018 stayed at same level as during the five latest years. In Table 3.1.2.1 also average densities from extended electrofishing surveys in Lögdeälven are shown, including sites from upper parts of the river that recently have been colonized (see Section 4.4.2 in ICES, 2017a). Since the 2018 assessment, weighted mean densities including these extended electrofishing surveys have served as input in the river model used to calculate prior smolt abundances.

In 2015–2016, a smolt wheel was operated in Lögdeälven, close to the river mouth. The number of caught salmon smolts were 299 (2015) and 463 (2016), with 11% and 10% of the marked smolts being recaptured. In 2015, the trap had to be closed before the migration was finished, and the total smolt run for this year was therefore likely underestimated. In 2016, however, the whole run was monitored, yielding an estimate of about 5200 smolts. No smolt trapping was done in 2017 and 2018 (Table 3.1.1.5).

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

Spawning runs and their composition

In **Testeboån**, an electronic fish counter was installed in late August 2015 in the new built fishway; a total of five salmon and 54 sea trout were counted in that incomplete season. In 2016, 2017 and 2018, a total of 73, 67 and 21 salmon were registered in the fishway, respectively. In 2016, salmon may have passed beside the counter in early June during high water flow, but on the other hand, salmon migration may not have started at that time of the year. In 2017 and 2018, in principle the entire run salmon passed through the fishway.

River catches and fishery

In **Ljungan**, the salmon angling catch in 2018 was 210 salmon (whereof 190 released) compared to an average annual total catch of 220 salmon in the period 2010–2016. In general, the catches have increased since the early 2000s, but in the last year, the catch decreased to a level similar to that in the early 2000s. As detailed below, Ljungan is one of the wild salmon rivers where considerable disease problems have occurred in recent years. In **Testeboån** (wild river since 2013) landing of salmon is not allowed.

Parr densities and smolt trapping

Parr densities from **Ljungan** are missing for several years, due to high water levels in late autumn making electrofishing impossible. For example, the relatively high value for 2012 only mirrors data from one electrofishing site (Table 3.1.3.1) as the other sites could not be fished due to high water levels. Recorded average densities of 0+ salmon varied markedly from three to 45 ind./100 sqm between 1990 and 2008, but without any clear trend (Table 3.1.3.1 and Figure 3.1.3.1). However, in 2012, 2014 and 2015 (especially) parr densities showed signs of increase. In 2017, the mean 0+ density in Ljungan dropped markedly to just 0.8 ind./100 sqm and in 2018, not a single 0+ parr was caught. The densities of older parr in 2018 was also very low (0.2 ind./100 sqm). This low density likely reflects that many adults died before spawning in the preceding autumn (Section 3.4.4).

Testeboån received status as a wild salmon river by WGBAST in 2013. The latest releases of reared salmon (fry) in the river occurred in 2006, which means that the wild-born 0+ parr observed at electrofishing from 2012 and onwards most likely were offspring to salmon which themselves were wild-born. Fairly stable levels of 0+ parr densities in recent years, except for in 2008 when 0+ parr were absent due to a very poor spawning run in 2007, indicates that the population is self-sustaining (Table 3.1.3.1). The mean density of 0+ parr decreased in 2014 compared to in the four previous years, but after that it increased, and in 2016 it was the so far highest recorded (about 28 ind./100 sqm). In 2017, the average 0+ density decreased to about the same level as in 2014 and it stayed at the same low mean density in 2018 (five ind./100 sqm; Table 3.1.3.1).

Smolt trapping using a smolt wheel has taken place in Testeboån since 2014. In 2015, the river was equipped with permanent facilities for counting of both smolts and ascending adults. Hence, since 2018 Testeboån represents a full index river. Annual estimates of the total smolt runs in 2014–2017 have varied in the range from about 2000 to 4300 smolts. In 2018, smolt trapping could not be carried out due to a high water level.

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

River catches and fishery

In **Emån**, anglers have increasingly applied catch and release over the past 10–15 years, and the river fishery is nowadays basically a 'no-kill fishing'. Therefore, the retained catches have decreased markedly, from more than 100 salmon fish per year in the early 2000s to nearly zero in recent years. In 2018, the total river catch was 19 salmon, out of which none was retained. In 2017, the total river catch was 83 salmon, out of which none was retained.

In **Mörrumsån** the salmon catch in 2018 was 215 (45 retained). Between 2010 and 2017 the total river catch has on average been 777 salmon, with large annual variation (range: 462–1511). Similar to in Emån, anglers have increasingly applied catch and release, which largely explains a decline in retained catches seen in recent years.

Parr densities and smolt trapping

Parr densities from electrofishing surveys in the two AU 4 rivers are displayed in Table 3.1.4.1, and in Figures 3.1.4.1 and 3.1.4.2.

For **Emån**, only densities of parr in electrofishing surveys below the first partial obstacle are displayed in the graphs referred to above. The densities of 0+ parr in the lowermost part of the river varied between 13–71 ind./100 sqm during 1992–2007, with a mean density of 43. The highest 0+ density so far occurred in 1997. The density of 0+ parr was 53 ind./100 sqm in 2016 and stayed at about the same level in 2017, which is just over the mean value for earlier years in the time-series. In 2018 the densities of 0+ parr decreased to the lowest, nine ind./100 sqm, recoded since electrofishing surveys started. The densities of older parr have varied from 1–10 ind./100 sqm during the period 1992–2018 with a mean value of five ind./100 sqm in recent years.

Table 3.1.4.1 also contains average densities calculated across all sections in Emån that are accessible for salmon, including sites above partial obstacles (dams with fish ladders) located in habitats that currently seem to be recolonized. For the present assessment, these weighted mean densities were used as input in the recently developed Southern river model (ICES, 2017c) to calculate prior AU 4 smolt abundances (Section 4).

The estimated smolt production in River Emån has appeared very low compared to the presumed production capacity. 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 fishways may give rise to low production of juveniles above the fishways. Electrofishing sites in these upstream areas do therefore normally show 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 has not shown signs of lesser abundance of either species. On the contrary, salmon seems to have increased in abundance.

Monitoring of salmon migration in one fishway during 2001–2004 also suggested that very few salmon could reach some of the upstream potential spawning areas. In 2006, the lowermost dam (at Emsfors) was opened permanently, and since then increased electrofishing densities for salmon have been recorded at the closest upstream electrofishing site. Activities are also ongoing to facilitate up- and downstream migration at the second dam counted from the sea, above which significant habitats regarded suitable for salmon reproduction are located.

In **Mörrumsån**, 0+ parr densities in the period 1973–2011 varied between 12–307 ind./100 sqm (Table 3.1.4.1, Figures 3.1.4.1 and 3.1.4.2). The by far highest average density so far was observed in 1989 (>300 ind./100 sqm). At that time, however, substantial supplementary hatchery releases based on smolts from returning spawners were ongoing, with aim to support the fishery.

In 2011, the average 0+ density decreased to 36 ind./100 sqm, the lowest value since the mid-1990s. One reason for the low density in 2011 could be high water level, as only part of the survey sites was possible to electrofish. However, it should be noted that the number of ascending salmon counted in the preceding autumn (2010) was also the lowest recorded at the Marieberg power plant, ca. 13 kilometres from the sea, since an electronic counter was installed in the fishway in 2002. A decision has been taken to remove the Marieberg dam, most likely in summer 2020. Important aims are to assist fish migration and to recreate spawning and nursery habitats for salmonids. As a consequence, new locations and methods for counting of adults and smolts in Mörrumsån are currently investigated.

Table 3.1.4.1 also contains average densities calculated across all sections in Mörrumsån (weighted according to relative habitat areas) that are currently accessible for salmon, including sites in upstream habitats that recently have been recolonized following the construction of two fishways in 2004 (see below). For the present assessment, these weighted mean densities have been used as input for the recently developed Southern river model (ICES, 2017c) to calculate prior AU 4 smolt abundances (Section 4).

Since 2015, the average parr densities in Mörrumsån has decreased, and in 2018, the 0+ density decreased more than half of the mean for the years 2012–2014. The recent decline may reflect current disease problems, with a large number of dead and affected salmon and sea trout in the river since 2014. Notably, however, this decrease cannot be seen in the average densities for all river sections (above). For several years, a slight decline in average parr densities could be seen in the downstream river sections, whereas the uppermost (most recently accessible) part seemed to be in a building-up phase with increasing densities. Therefore, two contrasting trends were partly counteracting each other in the weighted averages used for computing smolt prior estimates. Since the health problems accelerated in 2014, however, the most marked decreases in parr densities have be seen above the first migration obstacle (Marieberg dam), which may indicate that spawners in poor condition have not managed to migrate upstream.

In Mörrumsån, hybrids between salmon and trout have been found during electrofishing since the early 1990s. In 1993–1994, at a period with high levels of M74-mortality and disease problems, the proportion of hybrids was high, up to over 50% in some sampling sites. After that, the occurrence of hybrids has varied. In 1995 and 1996, it was only some percent of the total catch. In 2005, the density of 0+ hybrids were 14 ind./100 sqm which is higher than in the three years before. The amount of hybrids has decreased during 2006–2018. In 2018, the densities of hybrids were 1.8 ind./100 sqm. Occasionally over the years, genetic markers have been used to evaluate identifications made in the field of salmon/trout hybrid parr; in a majority of those cases identifications were found to be correct.

In 2004, two new fishways were built at the power plant station about 20 km from the river mouth, which opened up about 9 km of suitable habitat for salmon, including about 16–21 ha of production area. In 2009–2017, a smolt wheel has been operated in Mörrumsån, ca. 12 km upstream from the river mouth. About 55% of the total production area for salmonids is located upstream the trap. A main reason for choosing this upstream, location was that ascending adults are counted in a nearby fishway close to the smolt trap site, which should allow comparisons among numbers of ascending spawners and smolts from the upper part of Mörrumsån. So far however, only preliminary numbers of ascending adult spawners exist; to obtain such reliable estimates, further work will be needed that accounts for (i) a relatively large share of missing or unclear species identifications (due to absent or low quality camera images from the fishway) and (ii) the fact that a rather large proportion of salmon–trout hybrids exists in the river (Palm *et al.*, 2013).

In 2009–2012, the estimated smolt production in the upstream parts of the river was lower than expected (ca. 2000–8000 per year). As a comparison, Lindroth (1977) performed smolt trapping in 1963–1965 at a site close to the one currently used, and estimated the average annual salmon smolt production to 17 600 (range 12 400–25 000). However, since 2013, the smolt production in the monitored upper reaches of Mörrumsån has increased. In 2013, it was estimated to ca. 15 000, and in 2014, it was estimated to be the highest recorded so far (ca. 21 400). In 2015, the estimated smolt production decreased to ca. 10 000, but in 2016, it again increased to ca. 18 000. In 2017, the smolt production decreased to 10 200 and in 2018 the smolt production decreased further to 7300.

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

Estonian rivers

The River **Pärnu** flows into the Gulf of Riga and is the only Estonian salmon river in the Main Basin. The first obstacle for salmon migrating in the river is the Sindi dam, located 14 km from the river mouth. The fish ladder at the dam has not been effective due to its small size and the location of the entrance. The quality of spawning areas above the dam is relatively good, and parr abundancy is associated with poor accessibility.

Electrofishing surveys on the spawning and nursery ground below the dam have been performed since 1996; the number of ind./100 sqm has been very low during the whole period (Table 3.1.5.1 and Figure 3.1.5.1). No salmon parr were found in 2003, 2004, 2007, 2008, 2010 and 2011. In 2018, the 0+ parr density below Sindi dam was 1.4 ind./100 sqm. The habitat quality below the dam is poor, and that is the main cause for the low parr density. Since 2013, electrofishing is also carried out upstream from the Sindi dam. Above the dam salmon parr have been found only in some years, and densities have been very low. In 2017, however, average 0+ parr density (four sites electrofished) was 26 parr/100 m^2. In 2018, 13 sites were electrofished upstream the dam; salmon parr were found at only two of these, with an average density of 0.1 parr/100 m^2.

In autumn 2018 removal of the Sindi dam started, and ascending salmon were able to pass the dam in November same year. As salmon now has free access to all spawning grounds, the population should be able to recover. A juvenile supplemental release programme was also initiated in 2012 aimed at assisting population recovery. The first juvenile salmon were released in 2013, and as pointed out initially in this section, under present conditions with large numbers of juveniles being stocked every year, Pärnu should be considered as a mixed river.

Latvian rivers

There are seven wild salmon rivers in Latvia, mainly flowing into the Gulf of Riga. Some rivers have been annually stocked with hatchery-reared parr and smolts, and salmon in these rivers thus consist of a mixture of wild and reared fish. In 2018, salmon parr were found at 31 sites (15 rivers) sampled by electrofishing. Parr densities are presented in Table 3.1.5.1 and Figure 3.1.5.2.

The wild salmon population in river **Salaca** has been monitored by smolt trapping since 1964 and by parr electrofishing since 1993. From 2000, no releases of artificially reared salmon have been carried out. In 2018, eleven sites were electrofished in the river and its tributaries. All sites in the main river held 0+ age salmon parr. Salmon 0+ parr also occurred in the tributaries Jaunupe, Svētupe and Korģe. The average density of 0+ salmon was 21.3 ind./100 sqm, whereas the density of 1+ and older parr was 8.2/100 m^2. The smolt trap in the river Salaca was in operation between April 24 and May 18, 2017. In total, 1825 salmon and 594 sea trout smolts were caught; 544 of them were marked using streamer tags for total smolt run estimation. The smolt trap catch efficiency was 9.9%. Thus, in total 18 400 salmon and 6000 sea trout smolts were estimated to have migrated from the Salaca in 2018.

In river **Venta**, wild salmon parr were found above the Rumba waterfall because of a high water level in the autumn of 2017. In 2018 only 0.8 ind./100 sqm 0+ were caught (no older parr) in river Venta. Average parr production has decreased due to high water temperatures and low water level in the summer of 2018.

In river **Gauja,** 2018 wild salmon 0+ parr production increased (5.2 ind./100 sqm) compared to in 2017 (4.4 ind./100 sqm). In **Amata,** which is a tributary to Gauja, salmon 0+ parr production was also significantly higher than in the previous three years (15 ind./100 sqm).

In 2018, wild salmon parr were also found in the small Gulf of the Riga rivers **Vitrupe, Aģe** and **Pēterupe**. Age structures of parr in these rivers testify that salmon reproduction does not occur in every year. Parr production in these rivers have increased compared to 2017.

Only 0+ parr in low densities were caught in the Main Basin river **Tebra** (Saka river system). No wild salmon parr were caught in **Irbe** and **Užava** in 2018.

In 2018, habitat mapping was initiated to re-evaluate productive habitat sizes in Latvian rivers. According to the first results from river **Bārta**, the total area of riffles suitable for salmon spawning and nursery constituted only 0.6 ha in the river section from the Latvian-Lithuanian border to Lake Liepājas, which is many times less than the 10 ha estimated earlier. None of the mapped riffles were evaluated to have high or good quality, 67% of the habitats had moderate quality, whereas the remaining ones had poor quality. Problems with habitat siltation and overgrowing are common in the river.

Next steps for season 2019 and 2020 were presented for working group; in those years the habitat mapping of Latvian salmon rivers is planned to be finished.

Lithuanian rivers

Lithuanian salmon rivers are listed in the Annex 2. Salmon inhabits 12 tributaries in the **Nemunas** river basin and river **B. Šventoji** that flows directly into the Baltic Sea. Purely natural salmon population inhabits only the Nemunas tributary **Žeimena** and its tributaries **Mera** and **Saria**. The index river Žeimena has never been stocked with artificially reared salmonids. Its tributary Mera is a typical sea trout river and therefore has the salmon production been very low all the time. Mixed populations are found in the **B. Šventoji** (river that flows directly in to the Baltic Sea) and the following tributaries of river Nemunas; **Neris**, **Šventoji**, **Vilnia**, **Dubysa**, **Siesartis**, **Širvinta**, **Virinta**, **Minija**, **Vokė**. Reared populations occur in the Nemunas tributary river **Jūra** and some smaller tributaries. In these rivers, salmon releases are been made regularly for several years.

Electrofishing is the main monitoring method for evaluation of occurrence and densities of 0+ and older salmon parr. Parr densities in Lithuanian rivers are presented in Table 3.1.5.2 and Figures 3.1.5.3 and 3.1.5.4. The abundance of salmon parr depends on hydrological conditions, spawning success, and protection of spawning grounds.

In 2018, the average density of salmon 0+ parr in the index river **Žeimena** increased to 6.3 ind./100 sqm and older parr density was 2.5 ind./100 sqm . The 2018 density is above the mean values for the whole survey period. Parr density in **Neris** in 2018 was also above long-term average. Average 0+ parr density was 3.46 ind./100 m^2 and older parr density was 0.7 ind./100 m^2 (Table 3.1.5.2).

The correlation between salmon juvenile density and water temperature during July, the warmest month of the year, has been investigated in two rivers characterized by different thermal regimes; Neris (r = -0,530, p =0,035) and Žeimena (r = -0,555, p =0,021). It was found that during a period of several years, water temperatures in July varied within a range of a few degrees (19.1°C on average). However, in 2010 the water temperature reached 22.6°C, which could have had a lethal impact on some of the weaker juveniles in the river. In that year, the parr density was also estimated to be the lowest in Žeimena recorded so far; only 0.2 ind./100 sqm. The average temperature during July in Neris is 20.9°C. Temperatures above the 'stress level' (>22°C) were seen seven times during a period of 17 years; in 2001, 2002, 2006, 2010, 2012, 2014 and 2018. These results illustrate that the thermal regime is a very important determinant for salmon production in Lithuanian rivers. Other concerns include pollution, and that rivers are of lowland type with scarce parr rearing habitats. Finally, quite high mortality rates are expected due to predation; densities of several predators are significantly higher than in more northern Baltic salmon rivers.

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

All three wild salmon populations in the Gulf of Finland area are located in Estonia: **Kunda**, **Keila** and **Vasalemma**. These rivers are small and their potential production is small. In addition, there is natural reproduction supported with regular releases in ten other rivers: **Kymijoki**, **Gladyshevka**, **Luga**, **Purtse**, **Selja**, **Loobu**, **Valgejõgi**, **Jägala**, **Pirita** and **Vääna**. In these mixed rivers, natural reproduction is variable, and enhancement releases have been carried out since year 2000. The salmon in rivers **Narva, Neva** and **Vantaanjoki** are of reared origin.

Status of wild and mixed AU 6 populations

Parr density in the wild river **Keila** started to increase significantly in 2005 and has increased furthermore since 2013. The parr density has remained on a high level in recent years. Therefore, it can be stated that the river Keila population is in a good and seemingly stable state (Figure 3.1.6.1). The parr densities in river **Kunda** have been varying and a positive trend is only evident in the past four years (Table 3.1.6.2). In comparison, the river **Vasalemma** is in a more precarious state, although some stronger year classes have occurred. The average 0+ density in 2017 increased to 52 ind./100 sqm but again decreased to 27.8 ind./100 sqm in 2018. In 2018, the Vanaveski dam in river Vasalemma was opened, and salmon gained access to all spawning and rearing areas. Previously only 2.4 ha of spawning areas below the dam were accessible, but now the total spawning area is at least 5 ha (the exact size of the added habitat area needs to be investigated).

The most important change in the 1990s was the occurrence of salmon spawning in the Estonian mixed rivers **Selja**, **Valgejõgi** and **Jägala**, after many years without natural reproduction. In 2006, wild salmon parr were also found in rivers **Purtse** and **Vääna**. Since then, a low and varying wild reproduction has occurred in all these mixed rivers (Table 3.1.6.3). In the period 2012–2015, parr densities increased to relatively high levels in these rivers. However, in 2016 parr densities were very low. In 2016, the Kotka dam in river **Valgejõgi** broke, and it will not be rebuilt. Thus, in autumn of 2016, salmon were able to ascend to potential spawning areas that before were not accessible, and a considerable increase in salmon abundance may be expected in coming years. So far, however, parr densities in upstream areas has remained very low. Salmon parr densities in 2017 and in 2018 were high in most Estonian mixed rivers. However, the density remained low in Jägala.

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

On the north side of AU 6, all wild salmon populations in Finland were lost in the 1950s due to gradual establishment of a paper mill industry and construction of hydroelectric dams. The geographically nearest available strain, Neva salmon, was imported from Russia in the late 1970s, and releases into rivers Kymijoki and Vantaanjoki started in 1980. The water quality in the mixed river **Kymijoki** has improved significantly since the early 1980s. Reproduction areas exist on the lowest 40 kilometres of the river. Water conditions in winter influence the hatching success in productions areas below the lowest dams. In general, parr densities have been on a moderate level, but some improvement have occurred over time (Table 3.1.6.3). In 2011 and 2012, parr densities were low because of exceptional flow conditions, whereas higher water levels in mild and rainy winters were followed by high parr densities in 2005 and 2015 (when the 0+ density increased to its long-term maximum of 113 ind./100 sqm). In 2016 and in 2017 the parr densities were low to again increase considerably in 2018.

Despite rainy autumns, most of the nursery areas in the lower part of Kymijoki dry out, because of water regulation between the power plants. Good quality habitats are located above the lowest power plants, but currently spawners can only access those areas via two river branches with dams equipped with fishways. The fish ladders in the Langinkoski branch do not function well, and salmon can ascend the dam only in rainy summers when the discharge is high. Because of higher outflow, usually most of the spawning salmon ascend to the Korkeakoski branch, where a fish pass at the hydropower station was finished in 2016. So far, the smolt production areas beyond the dams are only partially utilized. The new fish pass is expected to allow access of a much larger number of spawners to the better spawning and rearing habitats located upstream. If the fish pass will work well, it is anticipated to increase the natural smolt production of the river significantly. However, in autumns 2016–2018 only some tens of adult salmon passed the new fish pass, although a much larger number of spawners were observed below the dam.

Natural smolt production in Kymijoki has been estimated to vary between 7000 and 78 000 in the last fifteen years. Along with the gradual increase in natural production, smolt releases have been decreased in the last few years. The released number of smolts (on average 81 000 per year, 2014–2017) is, however, still clearly larger than the estimated natural production (on average 44 000 smolts per year, 2015–2018). The broodstock of salmon is held in hatcheries, and it has frequently been partially renewed by ascending spawners.

An inventory of 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 the river outlet). Out of this total, about 15 ha of the rapids are situated in the lower reaches with no obstacles for migration, whereas about 60 ha are located beyond dams. Potential smolt production has been assessed based on assumed parr density and smolt age distribution. The annual mean potential was calculated to 1.34 smolts per ha, yielding a total potential of the river of about 100 000 smolts per year. From this potential, annually about 20 000 smolts could be produced in the lower reaches and 80 000 in the upper reaches of the river (Table 4.2.3.3).

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

In Russia, **Luga** and **Gladyshevka** are the only rivers with natural Baltic salmon reproduction. In Luga the salmon population is supported by large and long-term releases. The released smolts are based on ascending Luga and Narva river spawners, as well as on a broodstock of mixed origin. In the mixed River Luga, a smolt trapping survey has been conducted since 2001. The natural production has been estimated to vary from about 2000 to 8000 smolts per year. In 2018, the estimated smolt number was 5800 which is close to the long-term average. The total potential smolt production of the river has been assessed to be about 100 000–150 000 smolts, and the current wild reproduction is thus very far from its expected maximum level. The main reason for this poor situation in believed to be intensive poaching in the river.

3.2 Potential salmon rivers

3.2.1 General

The definition of a potential salmon river is a river with potential for establishment of natural reproduction of salmon (ICES, 2000). For most potential rivers there exists documentation of historical salmon occurrence. The current status of restoration programmes in Baltic Sea potential salmon rivers is presented in Table 3.2.1.1. Releases of salmon fry, parr and smolt have resulted in natural reproduction in some rivers (see Table 3.2.2.1). Reproduction and occurrence of wild salmon parr has, in some potential rivers, occurred for at least one salmon generation. However, before any of these rivers may be transferred to the wild salmon river category, the Working

Group needs more information on river-specific stock status and rearing practices. Such evaluations were made in 2013 and 2014, when the formerly potential salmon rivers Kågeälven and Testeboån in Sweden were assessed as wild, as they had fulfilled the criteria for wild salmon rivers.

3.2.2 Potential rivers by country

Finland

Eight potential salmon rivers are listed in Table 3.2.1.1. Out of these three rivers **Kuivajoki**, **Kiiminkijoki** and **Pyhäjoki** were selected to be included in the Finnish Salmon Action Plan (SAP) programme. These SAP rivers are all located in AU 1 (Subdivision 31). Densities of wild salmon parr in electrofishing surveys in the SAP rivers are presented in Table 3.2.2.1.

Hatchery reared parr and smolts have been stocked annually 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 regular salmon releases only in Kiiminkijoki. In 2018, 20 500 smolts and 40 000 one-year old parr of the river Iijoki origin were stocked in the Kiiminkijoki.

Electrofishing is currently conducted irregularly in **Kiiminkijoki**. In 1999–2014 the average densities of wild 0+ (one-summer old) parr ranged between 0.7–8.2 individuals/100 m^2 (Table 3.2.2.1). There was no electrofishing in 2015–2017 due to high summer water levels in the river. In 2018, water levels allowed successful electrofishing, but the average 0+ parr density was low.

In rivers **Kuivajoki** and **Pyhäjoki**, the observed densities in 1999–2007 ranged from 0–3.2 and 0–1.9 parr/100 m^2, respectively. The poor success of stock rebuilding is probably due to a combination of fishing pressure, insufficient quality of water and physical habitat in rivers and their temporally low flow, which together keep the lifetime survival and reproductive success of salmon low.

Small-scale natural reproduction has also been observed in rivers Merikarvianjoki and Harjunpäänjoki (tributary of Kokemäenjoki at the Bothnian Sea, Subdivision 30), and in the Vantaanjoki at the Gulf of Finland (Subdivision 32).

Lately, plans have emerged for building up fish ladders 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. In the River Oulujoki a catching cage for spawners has been constructed in 2017 at the Montta hydro power station. From the cage spawners are trans-ported by a truck into two upstream tributaries. 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.

Sweden

Three potential Swedish salmon rivers are listed in Table 3.2.1.1: **Moälven**, **Alsterån** and **Helgeån**. Densities of wild salmon parr in electrofishing surveys in Alsterån are presented in Table 3.2.2.1.

Restoration efforts are ongoing at the regional–local level in several of the remaining potential Swedish salmon rivers. However, so far recent stocking activities and/or too low natural production have prevented them from having their status upgraded. Until next year (2020), the intention is to review and potentially update the list of Swedish potential salmon rivers.

Lithuania

Two potential Lithuanian salmon rivers, **Sventoji** and **Minija/Veivirzas**, are listed in Table 3.2.1.1.

In May 2018, 20 000 salmon smolts were released into five rivers: Neris, Šventoji (Neris basin), Dubysa, Minija, and Jūra. A total of 85 000 salmon fry were released divided as follows: 35 000 into Neris basin (Neris, Vilnia, Muse, Vokė, Dūkšta and Kena), 20 000 into Šventoji basin (Šventoji, Širvinta, Siesartis, Virinta), 10 000 to Dubysa basin, 10 000 to Minija basin and 10 000 to Jūra basin. When summarizing the results of restocking efficiency it is notable that this year was good, but the results depended on river size and ecological conditions. In medium sized rivers, restocking efficiency was very good in Siesartis, Vokė and Kena. It was concluded that restocking efficiency in smaller rivers was much greater than in larger ones. The survey indicates that in larger rivers mortality of juveniles is greater, although the estimation error is also expected to be higher.

Electrofishing densities of wild salmon parr in potential (mixed) Lithuanian rivers are presented in Table 3.2.2.1. In some larger tributaries of Neris and Šventoji, salmon densities in 2018 were relatively close to the long-term average. However, parr densities in Šventoji basin increased compared to in the previous year. Also, parr densities slightly decreased in all tributaries in the Šventoji river. In the Siesartis tributary, the average density of salmon juveniles in 2018 stayed at the same level as in the previous year. In Virinta the density of 0+ increased to 6.3/100 m^2 (>0+ 1.9/100 m^2).

In Vilnia and Vokė, the density of 0+ salmon decreased compared to the previous year and was considerably lower (two parr/100 m^2 in Vilnia and 0.5 parr/100 m^2 in Vokė). In western Lithuania, the potential salmon river B. Šventoji showed lower 0+ parr density compared to in the previous year (0.8parr/100 $m^{2.}$). In Dubysa and Minija the densities of 0+ parr decreased considerably to five parr/100 m^2 and 0.3 parr/100 m^2, respectively.

Poland

Restoration programmes for salmon in seven potential Polish rivers (Table 3.2.1.1) were started in 1994, based on releases of hatchery reared Daugava salmon. To date, however, there is no good evidence of a successful re-establishment of any self-sustaining salmon population.

In 2017, the total number of released hatchery reared fry was 72 000 (mainly in the **Słupia** and **Łeba** rivers, subdivision 25). In total, 42 600 smolts were released, almost all into the **Vistula** River (subdivision 26). Since at least 2011, salmon spawners have been observed in the **Vistula** river system, but there are still no data on wild progeny. Salmon spawning has been observed in the **Drawa** River (Odra R. system) for some years, but the number of redds has stayed on a low level (not higher than ten per year). Until present, there is only one piece of evidence of a few wild salmon progeny born in the river (result from spawning in 2013).

In almost all Pomeranian rivers, ascending and spent adult salmon have been observed and caught by anglers, but so far wild parr has only been found in the **Slupia** River. Due to high water level, no electrofishing surveys took place in 2017.

Russia

The **Gladyshevka** River was selected as a potential river for the Russian Salmon Action Plan and is listed in Table 3.2.1.1. Stocking of salmon with hatchery-reared (Neva origin) young salmon is ongoing in this river. Since 2001, a total of nearly 190 000 salmon parr and smolts has been released in the river. About 15 000 of one-year old salmon (including 2000 tagged by T-bar tags) were released in 2018.

Densities of wild salmon parr from electrofishing surveys in **Gladyshevka** are presented in Table 3.2.2.1. Since 2004, wild salmon parr have occurred in the river. In 2015, the average density increased to the highest observed so far: 24 parr/100 m². No electrofishing surveys were carried out in 2016 due to high water level. In 2017, the densities stayed at almost the same level as previous year 18.4 parr/100 m². No electrofishing surveys were carried out in 2018.

Estonia

No potential salmon rivers have been listed in Estonia.

Latvia

No potential salmon rivers have so far been listed in Latvia. However, rivers **Lielā Jugla** and **Mazā Jugla** in the lower part of the river Daugava system are regularly stocked by one summer salmon and sea trout parr. Electrofishing and habitat mapping is carried out, and the mapped potential reproduction areas in these rivers are 41 ha and 38 ha respectively.

Germany

No potential Baltic salmon rivers have been listed in Germany. So far, no rivers with outlet into the Baltic Sea exist with a known (former) wild salmon population. However, in 2015 and 2016, a few salmon were caught during spawning migration in the river Warnow (W. Loch, pers. comm.); those fish are most likely strayers. Nevertheless, there is no significant potential natural salmon smolt production in the German Baltic catchment area.

Denmark

No potential Baltic salmon rivers have been listed in Denmark.

3.3 Reared salmon populations

3.3.1 Releases

The total number of salmon smolts released in reared rivers around the Baltic Sea in 2018 is presented in Table 3.3.1.1 In AU 1–5 (subdivisions 22–31), about 3.7 million smolt were released, with an additional 0.6 million in AU 6 (Subdivision 32), making a grand total of 4.3 million smolts released in 2018.

Releases of younger life stages (eggs, alevins, fry, parr) are presented in Table 3.3.1.2. These releases have in many cases consisted of hatchery surplus, often carried out at areas with 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 potential, mixed or wild salmon rivers with good rearing habitats, they have had a true contribution to the smolt production. When comparing the total annual number of releases (of younger life stages) in the last two years, the number has stayed at the same level AU 1–3, whereas in AU 5–6, the releases has increases. In AU 4, there have been no releases since in 2012.

Seen from a longer perspective, releases of younger life stages have decreased in the majority of the assessment units, with exception of AU 5 where the observed trend is not as evident. Roughly, these releases are expected to produce less than 100 000 smolts in the next few years. However, the stocking statistics available to the working group do not allow distinction between single rivers and release categories (age stages), and therefore the corresponding number of smolts expected from releases of younger life stages has not been possible to estimate properly.

The yield from salmon smolt releases has decreased in the Baltic Sea during the last 10–15 years, according to results from ongoing national tagging studies (Figures 3.3.3.2–3.3.3.3). Possible explanations for lower catches include decreased offshore fishing and strong regulations in the coastal fishery. Initially, no substantial surplus of fish was observed in the rivers where compensatory releases were carried out, which most likely was due to decreased post-smolt survival. In recent years (2010–2018), however, the amount of salmon returning to reared rivers has increased, in some cases even considerably. In 2018, however, there was a decline in the amount of returning salmon to some Swedish rivers with compensatory releases that may partly be connected to the health issues described in Section 3.4.4.

In line with an increased wild smolt production since the mid-1990s, catch samples from the years 2000–2018 indicate that the proportion of reared salmon has decreased over time; currently reared salmon represents well below 50 percent of adults caught in most Baltic Sea fisheries (see Figure 4.2.3.9).

Releases country by country

Most releases in **Sweden** are regulated through water-court decisions. Since the reared (and wild) stocks were severely affected by the M74-syndrome in the early 1990s, the number of Swedish compensatory released salmon smolts in 1995 were only 60–70 percent of the intended amount. However, already in 1996 the releases increased to the levels set in the water-court decisions. From that year and onwards, the releases have been kept close to the intended level each year.

In 2018, a total of 1.57 million salmon smolts were released in Swedish AU 2, AU 3 and AU 4 rivers. The releases in AU 4 are minor and amounts to less than one percent of the total Swedish releases (Table 3.3.1.1). The number of one-year-old salmon smolts released in Sweden has increased over time, especially in the most southern rivers; in the period 2007–2018 the share of one-year old smolts has increased from 23% to 60% of the total releases. This development reflects a combination of high-energy feed (faster growth) and longer growth seasons due to early springs and warm and long autumns.

Many broodstock traps in Swedish reared rivers were previously operated with equal intensity throughout the fishing season. The catch could therefore be considered as a relative index of escapement. A reduced fishing intensity in most rivers with smolt releases reflects the increasing abundance of returning adults during the last ten years. Broodstock fishing at low intensity during the migrating season is nowadays sufficient to get the amount of spawners (eggs) needed to fulfil terms in court decisions, but the broodstock catches cannot be used as indices of spawning run strengths.

In **Finland**, the production of smolts is based on broodstocks reared from eggs and kept in hatcheries. The number of captive spawners is high enough to secure the whole smolt production. A partial renewal of the broodstocks has been regarded necessary in order to avoid inbreeding, and is consequently enforced occasionally by broodstock fishing in the specific river. In 2018, the total Finnish releases in AU 1 and AU 3 were 1.3 million smolts and in AU 6 it was 145 000 smolts (Table 3.3.1.1). When the Finnish compensatory release programmes were enforced in the early 1980s, the total annual salmon smolt releases were about 2 million in total, whereof 1.5 million released in AU 1 and AU 3, and 0.5 million in AU 6. In recent years, the releases have gradually been reduced. As in Sweden, the reared stocks in Finland have been affected by M74 over the years.

In **Russia** there are annual releases in AU 6; in 2018 a total of 373 000 reared smolts were stocked. In **Estonia** a rearing programme using the Neva salmon stock was started in 1994. Eggs were collected from the reared Narva stock and the mixed Selja stock. In the late 1990s, eggs were also imported from Finland. A captive stock based on spawners from river Kunda was established in 2007. One hatchery is at present engaged in salmon rearing. In 2018, the total annual smolt production was 113 000 smolts released in AU 6 (Table 3.3.1.1).

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. In 2018, the annual smolt production in Latvian hatcheries was 570 000 (Table 3.3.1.1). This is below the average number of releases during the last decade. Earlier, from 1987 and onwards, the annual Latvian releases ranged up to 1.1 million smolts in several years. Occasionally, also **Lithuania** makes annual releases of a smaller number of smolts in AU 5; in 2018 a total of 20 000 smolts were released (Table 3.3.1.1).

In **Poland**, the last wild salmon population became extinct in the mid-1980s. A restoration programme was started in 1984, when eyed eggs of Daugava salmon were imported from Latvia. Import of eggs continued until 1990. In 1988–1995, eggs for rearing purposes were collected from a salmon broodstock kept in sea cages located in the Bay of Puck. In subsequent years, eggs have been collected from returning spawners caught in Polish rivers, besides 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 rivers Drweca, Parseta, Rega and Slupia. The yearly production amounts to 2.5–3.0 million eggs. Stocking material (smolts, one-year old parr and one-summer old parr) are reared in five hatcheries. In 2018, the total smolt production was 238 000 released in AU 5 (Table 3.3.1.1). Starting from 1994, the annual releases have fluctuated between 24 000 and 0.5 million smolts.

In **Germany**, no regular release programme for salmon exists in the Baltic region, as there are no known natural populations. Consequently, there were no official releases of salmon in rivers with outlet into the Baltic Sea in 2018. However, a few irregular releases have been reported recently and in the past (e.g. in rivers Trave and Warnow). There is a controversy regarding the potential historic existence of wild Baltic salmon populations in some German rivers.

Until 2005, a rearing programme was run in **Denmark** in a hatchery on the Island of Bornholm using the river Mörrumsån stock (AU 4). The last year releases occurred was 2005. No new releases have been planned.

3.3.2 Straying

Observations on straying rates of released salmon vary between areas. The level of straying is evidently dependent on several factors. For example, in Finland rearing of smolts is based on broodstocks kept in hatcheries, whereas in Sweden it is based on annual broodstock fishing (‘sea ranching’). These differences in rearing practices may also influence straying rates. Strayers are often observed in the lower stretches of the rivers into which they have strayed. This may indicate that not all strayers necessarily enter the spawning grounds and contribute to spawning, but instead that a proportion of them may only temporally visit the ‘wrong’ river. This also implies that the place and time of collecting observations about straying is expected to influence obtained estimates of straying rate. More information is needed to study these aspects of straying.

According to scale analysis of catch samples collected from the Tornionjoki river fishery in 2000–2011, only eight salmon out of a total of 4364 analysed were identified as potential strayers from releases in other Baltic rivers. This indicates that about 0.2% of the salmon run into Tornionjoki were from other (reared) rivers, which corresponds to about 100 strayers per year, if one assumes an average spawning run into Tornionjoki of about 50 000 salmon. Tag–recapture data of compensatory releases in the Finnish Bothnian Bay indicate that the straying rate of these reared fish to other rivers is 3–4%. From all these releases, however, 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, assuming no strayers from the Swedish releases, there would be annually about

200 strayers in the Tornionjoki spawning run (corresponding to 0.4% straying into the river, again assuming a spawning run of about 50 000 salmon).

In Sweden, tag recoveries indicate that the average straying rate of reared salmon into other rivers has been 3.5–4.0% on average, but for some releases, the straying rate has been as high as 10–30%. Highest straying rate of tagged salmon is often observed in reared rivers with annual releases, due to a high total exploitation rate from the commercial, recreational and broodstock collection, and probably also because broodstock fisheries are carried out close to river mouths.

3.3.3 Tagging data

Tagging data, mainly from external Carlin tags, have been used historically within the Baltic salmon assessment, to estimate population parameters as well as exploitation rates by different fisheries (see Annex 2 for further details). Both wild and reared salmon of different ages may be tagged, but a majority of the fish tagged over the years represent hatchery-reared smolts. For various reasons, the number of tag returns has become very sparse after 2009, and therefore, in later years, tag return data have not been used in the assessment. As the tagging used are from external tags, it is vital that fishermen find and report tags. However, earlier reports (summarised in e.g. ICES, 2014) indicate an obvious unreporting of tags.

As the tag return data influence e.g. the annual post-smolt survival estimates, which is a key parameter in the Baltic salmon assessment, there is a need to supplement or replace the sparse tagging data in the near future. The WGBAST 2010 (ICES, 2010) dealt with potential measures to improve and supplement the tagging data, including alternative tagging methods and supplementary catch sample data. In 2010, the WG also noted need for a comprehensive study to explore potential tagging systems, before a change to a new system in the Baltic Sea may be considered.

Since smolt abundance is included as a parameter in the EU-MAP, tagging has to be carried out as part of the data collection (for mark–recapture experiments) (Table 3.3.3.1). Furthermore, salmon smolts are tagged for other monitoring purposes. In 2018, the total number of Carlin tagged reared salmon released in the Baltic Sea was 6995 (Table 3.3.3.2), which was 22% less than in 2017 and 49% less than in 2016. Carlin tagged salmon smolts were released by Finland and Sweden. As alternative methods, T-bar anchor tags are also used for tagging of smolts in Finland, Estonia, Latvia and Russia (Finnish tags). Furthermore, in Sweden internal PIT-tags have also been used in several wild (index) rivers and also in reared rivers (Table 3.3.4.2) and for tagging adult fish e.g. in Poland. In addition, a batch marking method with calcein dye was used in Lithuania in 2018 for experimental marking of salmon fry (Table 3.3.4.2).

As mentioned above, tag return rates show decreasing trends, as illustrated in Figures 3.3.3.1 and 3.3.3.2 for salmon tagged and released in the Gulf of Bothnia and Gulf of Finland, respectively. Since 2015, the return rate of Finnish Carlin tagged reared salmon smolts released in the Gulf of Bothnia and Gulf of Finland was close to zero (Figure 3.3.3.1). The return rate of 1-year old Carlin tagged salmon smolts in the Gulf of Finland in Estonian experiments varied around 0.2% in years 2000–2004. There were no returns of tags in 2006, but in the following year, the recapture rate exceeded 0.8%. Because of the low recapture rate and changes in stocking practices, no 1-year-old salmon smolts have been Carlin tagged in Estonia since 2012. The mean recapture rate of 2-year-olds in Estonian experiments for years 2001–2008 was 0.7% and varied between 0.02–0.1% in years 2009–2014 (Figure 3.3.3.2). Since 2015, only T-bar anchor tags are used in Estonian experiments for tagging of salmon smolts. The recapture rate for fish from the 2015 cohort was around 0.27%. For fish from the 2016 cohort, the tag–recapture rate increased significantly compared to in the last years and was around 0.6%. But for fish from the 2017 cohort it again decreased to 0.1%. A similarly low recapture rate has been seen for Polish Carlin tags, where the reporting rate was around 1.5–2.0% in 2000-2008, whereas it decreased below 0.5% since 2009 (Figure 3.3.3.3). No salmon mass tagging with Carlin tags or other tagging methods was conducted in Poland in 2018, because of low recapture rates in previous years (only two returned tags in 2018).

3.3.4 Finclipping

Finclipping makes it possible to distinguish between reared and wild salmon in catches. Such information has been used, e.g. to estimate proportion of wild and reared salmon in different mixed-stock fisheries. However, since not all Baltic salmon smolts released are finclipped, this type of information is not directly utilised in the WGBAST assessment model.

Since 2005, it has been mandatory in Sweden to finclip all released salmon (and sea trout). All reared Estonian and Latvian salmon smolts released in 2018 were also finclipped. In Poland, all types of tagging were stopped in 2013 and 2014, because of national veterinarian's objections. In 2015, tagging was again permitted in Poland; however, since 2016 finclipping of smolts has not continued. From 2017 and onwards, all salmon released in Finland are finclipped (except releases for enhancement purposes, mostly parr). Salmon smolts released 2018 in Russia, Lithuania, Poland, Germany and Denmark were not finclipped.

In Table 3.3.4.1 information on the total number of released adipose finclipped young salmon in years 1987–2018 is presented together with data on the proportion of adipose finclipped adult salmon in Latvian offshore catches in the period 1984–2007. In 2018, the total number of finclipped young salmon released was 4 036 213, an increase of 3.6% compared to in 2017. Out of this total, 268 905 were parr and 3 767 308 smolts (Tables 3.3.4.1 and 3.3.4.2). Compared to 2017, the number of finclipped salmon smolts was similar and increased with about 1%, while the number of finclipped parr increased with about 61.6%. Most finclipping (in numbers) were carried out in SD 30–32, but part of the finclipped fish were also released in SD 27–29 (Table 3.3.4.2). In Finland, about 78% of the released 1-year old parr were finclipped in 2018. Additionally, in Sweden and Estonia a total of 125 467 parr and 1 687 351 smolts were finclipped and released in 2018 (Table 3.3.4.2).

3.4 M74, dioxin and disease outbreaks

In this section updated information is provided on monitoring of M74, dioxin and disease outbreaks. See Stock Annex (Annex 2) for further background information.

3.4.1 M74 in Gulf of Bothnia and Bothnian Sea

The thiamine deficiency syndrome M74 is a reproductive disorder, which causes mortality among yolk-sac fry of Baltic salmon. The development of M74 is caused by a deficiency of thiamine in the salmon eggs that, in turn, is suggested to be coupled to an abundant but unbalanced fish diet with too low concentration of thiamine in relation to fat and energy content (Keinänen *et al.*, 2012). More background information about the M74 syndrome can be found in Annex 2.

When calculated from all Swedish and Finnish data, the proportion of salmon females whose offspring displayed increased mortality in 2018 was on average 18%, compared to 34% in the preceding year (Table 3.4.1.1). Hence, the incidence of the M74 syndrome decreased, although still remaining at a higher level than in the years 2012–2015 when the incidence of M74 was practically nonsignificant (1–6%) for the first time since the start of the 1990s. The prognosis for the proportions of offspring groups in spring 2019 suffering from M74 mortality varies from 1–5% at minimum up to 1–16% at maximum, depending on the river (Table 3.4.1.1).

The thiamine (vitamin B1) concentration in unfertilized eggs in autumn 2018 (reproductive period 2018/2019) as a mean for females of the Finnish side Bothnian Bay rivers increased somewhat compared to that in the preceding year (Figure 3.4.1.1), but still remained lower than in the years (reproductive periods 2011/2012–2014/2015) when no M74-related mortality was observed in the Finnish M74 monitoring data (Table 3.4.1.2). Thus in spring 2019, M74 mortalities are expected only among some offspring groups. In Swedish rivers, the proportion of offspring groups with increased M74-like mortality varied from 11–25% in 2018, compared to 7–58% in 2017 (Table 3.4.1.3; SLU Aqua, 2018).

No 'wiggling' females (i.e. with an uncoordinated swimming behaviour) were detected in either Swedish or Finnish rivers in autumn 2018. The average free thiamine concentrations in unfertilized eggs of salmon from the Rivers Tornionjoki, Ume/Vindelälven and Dalälven in autumn 2018 also had increased compared to those in autumns 2015–2017, but the concentrations still remained lower than those found in salmon eggs from the R. Simojoki in autumn 2014 (Figure 3.4.1.2). In 2018, no eggs from Simojoki salmon could be included in the M74 monitoring due to a temporary regulation (river mouth was in 2018 located within an "IHN safety area"). The mean free thiamine concentration of eggs in autumn 2018 did not significantly differ between the monitored rivers, although it tended to be lowest in R. Dalälven salmon. Also in autumn 2017, thiamine concentrations were significantly lower in Dalälven than in eggs of R. Simojoki salmon (with a tendency to also be lower than in R. Tornionjoki and Umeälven).

The prognosis for incidence of M74 in offspring groups (females) is based on the concentration of free thiamine in eggs vs. yolk-sac fry mortality (%) relating to thiamine deficiency in female-specific laboratory incubations (in Finnish M74 monitoring data from the reproduction periods 1995/1996–2009/2010, n = 1009). The limit values of free thiamine used in prognosis are: for 100% mortality ≤0.2 nmol/g, for occurrence of M74 mortality ≤0.5 nmol/g and possible late M74 (M74?) ≤1.0 nmol/g.

The M74 frequencies in Table 3.4.1.1 predominantly represent the percentage of females in a hatchery with a recorded increase in offspring mortality. In the rivers Simojoki, Tornionjoki, Kemijoki and Iijoki, however, mortalities are reported for the proportion of females affected by M74 and the mean percentage yolk-sac fry mortality (Table 3.4.1.2). In Finnish data, annual M74 figures are based on female-specific experimental incubations in which M74 symptom-related mortality has been ascertained by observations of yolk-sac fry (until the reproductive period 2009/2010) and/or comparing mortalities with the thiamine concentration of eggs (from 1994/1995 and onwards) (Figure 3.4.1.1). Three figures are presented: (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 offspring have all died (Keinänen *et al*., 2000; 2008; 2014; 2018; Vuorinen *et al*., 2014). Mean annual yolk-sac fry mortalities and proportions of M74 females correlate significantly, but the M74 frequency has usually been somewhat higher than the offspring M74 mortality, especially in years when many offspring groups with mild M74 occur, i.e. when only a proportion of yolk-sac fry die. In 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). In contrast, Swedish data are based only on the proportion of females whose offspring display increased mortality regardless of the proportion dying (Table 3.4.1.3).

Currently (from 2011/2012 on), in Finnish M74 monitoring the incidence of M74 is principally based on the free thiamine concentration of unfertilized eggs, which has a strong correlation with M74-related mortality of yolk-sac fry (Vuorinen and Keinänen, 1999; Keinänen *et al*., 2014; 2018). However, control female-specific incubations are run at a hatchery (Vuorinen *et al*., 2014a).

In the hatching years 1992–1996, the M74 syndrome resulted in a high mortality of salmon yolk-sac fry with an M74 frequency (i.e. the proportion of the females whose offspring were affected) over 50% in most Swedish and Finnish rivers (Table 3.4.1.1). Since then the incidence of M74 has on average decreased. However, it has varied greatly even between successive years with elevated mortalities in some years (e.g. 1999, 2002, and 2006–2007) compared to others with low or non-existent mortalities (e.g. 1998, 2003–2005 and 2011–2015). In the reproductive period 2011/2012, the incidence of M74 could be considered as non-existent for the first time since the large outbreak in the 1990s. However, M74 returned in the reproductive period 2015/2016.

In years with a high M74 incidence, there has been a tendency that estimates of M74 mortality have been higher in Finland than in Sweden, but this difference seems to have disappeared in the years when the mortality has been low (Figure 3.4.1.3). The difference may be due to the fact that, in Finland all females caught for M74 monitoring have been included, whereas in Sweden females that have displayed uncoordinated swimming (wigglers) have been excluded from incubation.

Wiggling females are known to inevitably produce offspring that all die from M74. The proportion of wiggling females was high in the early and mid-1990s (Fiskhälsan, 2007). Trends and annual fluctuations in average proportions of M74-affected females have been very similar in Swedish and Finnish rivers (Figure 3.4.1.3). However, in some years M74 has been insignificant or absent in the Finnish M74 monitoring, whereas rather high M74 frequencies have been reported from some Swedish rivers. It seems that those Swedish results may rather result from technical failures or too high or variable water temperatures, as reported by Börjeson (2013).

In the Finnish M74 monitoring, but not in Sweden before 2015/2016, the mortality and female proportion figures for M74 incidence have been ascertained by measuring the thiamine concentration of eggs (Figure 3.4.1.1). In the Finnish M74 data, the annual M74 incidence among the monitored Bothnian Bay rivers has been very similar. Therefore, it is relevant to express the proportion of M74 females and annual M74 mortality as an average of all individual monitored salmon females (and respective offspring groups) that ascended those rivers (Keinänen *et al.*, 2014). However, there may be some differences between salmon populations from rivers in the Bothnian Bay and in the Bothnian Sea, if migration routes and feeding grounds during the whole feeding migration differ. This would also explain different mortalities, reported during the early 1990s (Table 3.4.1.1), among offspring of salmon from the River Mörrum in AU 4, from where smolts descend directly into the Baltic Proper.

Evidently, as a consequence of strengthening of the cod stock and flattening out of the sprat stock (ICES, 2012) the incidence of M74 decreased and was virtually non-existent in 2012–2015. However, M74 returned, apparently principally as a consequence of an exceptionally strong year class of sprat hatched in 2014 (ICES, 2017b). Young sprat were exceptionally numerous in the northern areas of the Baltic Proper and Gulf of Finland. Moreover, the year class of herring in 2014 was strong, e.g. in the Bothnian Sea (Raitaniemi, 2018). The thiamine concentrations in unfertilized eggs of salmon ascended the rivers of the Gulf of Bothnia decreased in autumn 2015 and were even lower in salmon ascended in autumn 2016. Thus, after several favourable years, M74 again impaired salmon yolk-sac fry survival in spring 2016. The M74 mortalities further increased in spring 2017 and prevailed in spring 2018. The western cod stock has strengthened in recent years, but the eastern cod stock appears not to be strong, although the estimates for it are not very reliable (Raitaniemi, 2018). However, the increased thiamine concentrations in eggs of salmon ascendants of autumn 2018 indicate that balance between fish stocks has again been changed.

In unfertilized eggs of salmon having ascended the Lithuanian River Neris in autumn 2017, the free thiamine concentrations were considerable higher compared to salmon of the Gulf of Bothnian rivers, and the incidence of M74 in spring 2018 evidently was low (or, based on a small number of sampled fish, almost insignificant). Apparently those salmon have been feeding in the southern Baltic Proper, where the presence of cod, contrary to the northern Baltic Sea, has reduced sprat from its exceptionally high year class 2014 (ICES, 2017b). Thus young sprat from the year 2014 have been less numerous in the southern Baltic Proper than in the northern areas of the Baltic Sea (Raitaniemi, 2018), and the herring biomass as food for salmon, e.g. in SD 25, has been higher than that of sprat (Jacobson *et al.*, 2018).

In the Stock Annex (Annex 2, Section C.1.6), a description is given of a Bayesian hierarchical model applied to the Gulf of Bothnian (GoB) monitoring data (Tables 3.4.1.2 and 3.4.1.3) of M74 occurrence from rivers in Finland and Sweden, to obtain annual estimates of the M74-derived yolk-sac fry mortality. This information is needed to fully assess the effects of M74 on the reproductive success of spawners. Besides annual estimates of M74 mortality in the rivers, where such has been recorded, the model provides annual estimates of the mortality for any GoB river, in which no monitoring has been carried out (Table 4.2.2.2, Figure 4.2.2.2). Most of the wild stocks, including all smaller wild rivers in the GoB, belong to this group. The results demonstrate that in some years, the actual M74 mortality among offspring has been lower than the proportion of M74 females indicated, which apparently is related (see above) to mildness of the syndrome, i.e. to partial mortalities in offspring groups.

3.4.2 M 74 in Gulf of Finland and Gulf of Riga

In the River Kymijoki in AU 6 (Gulf of Finland) the incidence of M74 has in many years been lower than in the northern AU 1 rivers Simojoki and Tornionjoki (Table 3.4.1.1; Keinänen *et al.*, 2008; 2014). However, in the reproductive period 1997/1998, for example, when M74 mortalities among salmon yolk-sac fry of the Gulf of Bothnia rivers were temporarily low, the situation was the opposite; evidently this reflected variation in sprat abundance between the main feeding areas, i.e. the Baltic Proper and the Gulf of Finland. The long-term tendency has however, been roughly similar. The River Kymijoki of the Gulf of Finland, with introduced salmon originating from the Neva stock, was included in the Finnish M74 monitoring programme from the year 1995, but no data for the years 2008–2013 and 2015-–2017 exist, because of problems in salmon collection for monitoring. Therefore, the latest mortality data from the R. Kymijoki are from spring 2007 (Table 3.4.1.1). However, in autumn 2013 a few Kymijoki salmon females were caught for renewing of the broodstock. Based on relatively high thiamine concentrations in unfertilized eggs (mean 3.2 ± 1.1 nmol/g, N = 5) of all five females, M74 mortalities in spring 2014 were unlikely. In Estonia, M74 has been observed in hatcheries in some years during the period 1997–2006, but the mortality has not exceeded 15%. A small number of spawners is collected for broodstock from river Kunda since 2013, and no fry mortality has been observed. However, in 2016 the eggs from one female (out of four) displayed mortality after hatching. This recent observation indicates that the incidence of M74 may increase also in the Gulf of Finland, apparently as a consequence of the exceptionally strong 2014 year class of sprat (ICES, 2017b). According to Raitaniemi (2018) sprat has in subsequent years been highly abundant and more numerous than herring in the northern Baltic Proper and Gulf of Finland.

There is no evidence to suggest that M74 occur in Latvian salmon populations. In the main hatchery Tome, the mortality from hatching until the start of feeding varied in the range of 2–10% in the years 1993–1999. In addition, parr densities in Latvian river Salaca did not decrease during the period in the 1990s when salmon reproduction in the Gulf of Bothnia was negatively influenced by M74 (Table 3.1.5.1). Before ascending the river, salmon from Daugava and Salaca feed in the Gulf of Riga, where the main prey species of salmon was herring during the years 1995–1997 (Karlsson *et al.*, 1999; Hansson *et al.*, 2001). Although sprat was the dominant prey species in the Baltic Proper during that time period, the salmon diet in the Gulf of Riga did not include sprat. Furthermore, in contrast to salmon feeding in the Baltic Proper or in the Bothnian Sea, the proportion of other prey species, such as sand eel (*Ammodytes* spp.), perch (*Perca fluviatilis*), smelt (*Osmerus eperlanus*) and cod (*Gadus morhua*), was considerable in the Gulf of Riga (Karlsson *et al.*, 1999; Hansson *et al.*, 2001). Salmon in River Daugava moreover ascended later than salmon in Gulf of Bothnia rivers (Karlsson *et al.*, 1999).

3.4.3 Dioxin

In **Sweden**, the National Food Agency is responsible for sampling, analysis and dietary recommendations regarding dioxin in fish. In their latest report, the results indicate elevated levels of dioxin in Baltic salmon caught along the coast (Fohgelberg and Wretling, 2015). The Swedish control programme is set up in accordance with EU regulation 589/2014. Limits are set out in EU Regulation 1881/2006 with updates in EU Regulation 1259/2011. Sweden has an exception to the limits of dioxin when it comes to salmon and a few other fish species in the Baltic Sea and in Lakes Vänern and Vättern. Also, **Finland** has an exemption to the EC regulation 1259/2011 which allows selling of Baltic salmon and sea trout in the domestic market. No export of wild-caught salmon or sea trout is allowed. According to the Finnish survey for EU reporting (Airaksinen *et al.*, 2018) the concentrations of dioxins in salmon had decreased approximately to half during the 2000s. However, dioxin concentrations in salmon sampled in 2016 still exceeded the maximum allowable value set by the EU (Airaksinen *et al.*, 2018).

In **Denmark,** the following restrictions for marketing of salmon (and sea trout) were enforced from December 5th, 2016: Salmon ≤5.5 kg gutted weight caught in ICES subdivisions 24–26 must be trimmed (deep-skinned) before marketing. In the same SDs salmon weighing >5.5 kg and <7.9 kg can be marketed, if trimmed and the ventral part of the fish is removed. Each batch of salmon >2.0 kg caught in ICES SD 27–32 must also be analysed for dioxin before marketing. Dioxin levels found in samples taken in 2006 and 2013 were comparable, while samples from 2011 contained slightly lower concentrations of dioxin.

3.4.4 Disease outbreaks

For the last 5–6 years, health issues for salmon related to specific rivers have been reported from several countries around the Baltic. There are similarities between these reports, but also differences, and there is a need for an evaluation of the status before any overall conclusions for the current health status of Baltic salmon can be drawn. Besides national sampling programmes, the ICES Working Group on Pathology and Diseases of Marine Organisms (WGPDMO) has Baltic salmon health issues listed in its ToRs for the period 2019–2021.

Since 2014, an increasing number of reports from fishermen and local administrators of dying or dead salmon have come from Swedish and Finnish salmon rivers, spanning from Tornionjoki to Mörrumsån. The affected salmon have displayed various degrees of skin damage, from milder erythemas and bleedings, to UDN-like (Ulcerative Dermal Necrosis) lesions and more severe ulcers and traumatic wounds that are typically followed by secondary fungal infections causing death (SVA, 2017). To some extent also other fish species, such as sea trout, whitefish and grayling have been reported with the same symptoms.

The disease prevalence has varied considerably between both rivers and years. In some rivers, there are so far no reports of elevated levels of elevated salmon death. The most severe disease outbreaks occurred in Tornionjoki (2014–2015), Kalixälven (2015), Ume/Vindelälven (2015–2018), Ljungan (2016, 2018) and Mörrumsån (2014–2018). In several cases, the number of dead salmon (and other species) has been considerable, although quantitative estimates of total death rates are missing. However, in e.g. Mörrumsån, it has been noted that following a year with disease very few overwintered spawners (kelts) appear to remain the following spring according to river catches.

The failing health of returning salmon in some Swedish rivers continued in 2018. The symptoms resembled those in previous years, again with large variation among rivers. The most severe problems with weak or dead wild salmon were reported from Mörrumsån, Ume/Vindelälven and Ljungan. In Ljungan very low 0+ densities have been observed in 2017–2018. Also in Vindelälven, very low levels of 0+ salmon were again registered in 2018; across 27 electrofishing sites only two 0+ parr were found in total, corresponding to an overall density in the whole river that was essentially zero. This alarming result is in line with a small number of ascending adults (especially females) in 2017 and an elevated level of M74-mortality in recent years (Sections 3.1.2 and 3.4) combined with an observed and presumed additional mortality of spawners after having passed the Norrfors fish ladder where the counting takes place.

Notably, only one out of 400 salmon (0.25%) tagged at the Ume/Vindelälven river mouth in 2017 managed to pass the counter in the Norrfors fishway. Most of these tagged salmon stayed further downstream for some time, without managing to migrate further upstream, before finally leaving the river (Kjell Leonardsson, SLU, pers. comm.). In 2018, the proportion of tagged salmon passing the counter was higher (15%), but still low compared to most previous years with tagging experiments. Finally it should be noted that in the past two decades the proportion of females in Ume/Vindelälven has decreased markedly over time; a development not yet seen in Torneälven/Tornionjoki (Figure 3.1.2.3) or from more scattered data in other rivers with less pronounced salmon health problems.

In 2015 and 2016, the Swedish National veterinary institute (SVA) and the Finnish food safety authority (Evira) conducted investigations aimed at identifying the cause of the salmon disease. Analyses of Tornionjoki salmon in 2015 showed that some of the sampled fish displayed UDN-like symptoms. Cultivation for virus and bacteria in 2016 did not provide conclusive answers, although in some cases bacteria associated with skin lesions were identified. Next generation sequencing indicated presence of herpes- and iridoviruses in individuals with erythemas. These viruses may cause skin lesions, but these findings need to be investigated further. Although it appears likely that the disease outbreaks in Swedish and Finnish salmon rivers during recent years have a common cause, likely linked to the Baltic Sea phase, this still remains to be proved.

In 2018, Swedish investigations on salmon from selected rivers continued (Axén *et al.*, 2019). Results from screening of various "biomarkers" did not indicate exposure to environmental contaminants to any larger extent. However, salmon from Torneälven/Tornionjoki demonstrated induced EROD activity and an elevated production of red blood cells, which warrants further investigations. In addition, a possible effect on the endocrine system was observed with elevated levels of glucose in fish from Umeälven, whereas altered levels of thyroid hormones were observed in salmon from Ume/Vindelälven and Torneälven/Tornionjoki.

During 2019, samples collected within the Swedish 2018 study (Axén *et al.*, 2019) will be analysed further. Markers of oxidative damage and enzymes involved in T3- and T4 metabolism will be studied, as well as possible correlations between biomarkers and a newly developed disease index. Physiological systems in affected salmon will be studied through metabolomics (SVA and the University of Gothenburg). Studies of possible effects on the immune system caused by a combination of deficiency of vitamins and exposure to environmental toxins (OH- BDE, OH-PCB and PFAS) will carried out at Stockholm university, whereas effects of environmental stress, diet and possible exposure to algal toxins will be studied at the Swedish University of Agricultural Sciences.

Late in 2017, pre-spawning mortality for sea trout and salmon was reported for the first time from river Gauja in Latvia. Similar to in Swedish rivers, the fish were described as apathetic; they showed slow response to irritants and were easily caught. There were also multiple observations of skin wounds with fungal infections. Sea trout and salmon from Gauja were examined for presence of viruses: IHNV (infectious hematopoietic necrosis virus), VHSV (viral hemorrhagic septicemia virus) and IPNV (infectious pancreatic necrosis virus) and bacteria: *Aeromonas salmonicida*, *Aeromonas hydrophila*, *Yersinia* spp., *Salmonella* spp., *Pseudomonas* spp. and *Plesiomonas* spp. In addition, search for parasites and histological examinations of wounds were carried out. The investigations showed that the above mentioned pathogens were not the cause for the observed disease and pre-spawning mortality in Latvia. No new reports on health related mortality in adult salmonids were received from Latvian anglers in 2018.

In 2018, elevated mortality among adult salmon (mainly) and sea trout was also reported from tributaries within the Neris catchment (Nemunas river system) in Lithuania. Fish were observed to die from skin infections of fungal and/or bacterial origin, possibly reflecting secondary infections associated with UDN (not confirmed). In some cases, the proportion of affected individuals during and after the spawning period exceeded 90%.

Severe disease problems have occurred in all Polish Pomeranian sea trout rivers since 2007. Similar to in northern salmon rivers, the disease problems in Poland have been variable over time with peaks and drops (Bartel *et al*., 2009). Further, the affected sea trout display UDN-like skin damages followed by fungal infections, high mortality and lack of kelts. Also, salmon and grayling with symptoms have been observed. Polish veterinary studies have been performed, but so far without any clear conclusions, any virus or other uncommon bacteria were detected. In 2017, sea trout with symptoms were again observed, not only in Pomerania but also in the Vistula River.

So far, there have been no reports of UDN-like disease problems in Estonian and Russian rivers. Since spawning season 2011, an increasing number of fungal infected sea trout have been reported from the Trave River, the largest Baltic Sea discharging river in German Schleswig-Holstein. As a consequence, project-based research (2017–2019) on the health status of sea trout in the Trave has been launched.

Potential consequences of health-related problems for the future development of wild salmon stocks, and how such extra mortality may be monitored and handled in stock assessment is briefly discussed in Section 4.4.1.

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 wild rivers flowing into the Gulf of Bothnia and the Main Basin (assessment units 1–5), smolt abundance is measured directly in the current index rivers **Simojoki** and **Tornionjoki/Torneälven** (AU 1), **Vindelälven** (AU 2), **Testeboån** (AU 3), **Mörrumsån** (AU 4) and in **Salaca** (AU 5). In addition, 1–2 years of smolt counting has also been performed in **Lögdeälven** (AU 2) and **Emån** (AU 4) (Sections 3.1.2–3.1.4) and counting in additional rivers (**Råneälven** and **Åbyälven**) was initiated in 2018. The river model (Annex 2), which utilises all available juvenile abundance data, is a rigorous tool for formal assessment of current smolt production.

Differences in the status of wild stocks are apparent, not only in terms of the level of smolt production in relation to potential production (section 4.2), but also in terms of trends for various abundance indices. Differences in trends are clear between regions: most Northern Gulf of Bothnia (AU 1–3) rivers have shown increases in abundance while many of the Southern Main Basin (AU 4–5) rivers have shown either decreasing or stable abundances, whereas the development in the AU 6 rivers generally falls between these two regions.

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 3.4.1.1 and Figure 3.4.1.1), 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).

Despite some reduction in parr densities during 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 showed a yearly increase in most of the rivers, but in 2007 the densities of one summer old parr again decreased. Despite the relative high spawning run in 2009 the densities of one summer old parr in 2010 decreased substantially in most 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 2011 spawning run. The increased spawning run in 2012 did not substantially increase the densities of one summer old parr in 2013, whereas the increased spawning runs in 2013 and 2014 resulted in elevated densities of one summer old parr. The reduced spawning run in 2017 resulted in decreased densities of one summer old parr in 2018.

Catch statistics and fishway counts also indicate some differences among rivers in the development in number of ascending spawners. To some extent, these differences may reflect problems with fish passages in certain rivers. For example, a survey in 2015 of the efficiency of the fishway in Piteälven indicated a large delay in the spawning run and loss of salmon and trout that didn't pass the fishway located below the spawning areas. Similar observations have also been identified in Åbyälven (Section 3.1.2).

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 fishways. Counted number of salmon in 2007 increased with about 50% compared to 2006. The additional increase in fishway counts in 2008 is in agreement with 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, 2013, 2014 and 2016, as compared to 2011, resulted in increased total river catches with 40–70% compared to the two previous years. The spawning run in 2018 was relatively weak in many rivers, and one reason could be prevailing low water levels and high water temperatures during the summer. Likely for the same reasons, most river catches decreased.

Most data from the Gulf of Bothnia rivers indicate an increasing trend in salmon production. Rivers in AU 1 have shown the most positive development, while stocks in the small rivers in AUs 2–3 have yet not shown as strong positive development. These small rivers are located on the Swedish coast close to the Quark area (northern Bothnian Sea, southern Bothnian Bay). The recent period with historically low M74-levels close to zero in spawning years 2010 to 2015 (Figure 3.4.1.3) most likely affected the wild production positively. After that, higher M74 frequencies have followed. Preliminary data from thiamine analyses of eggs from two Swedish and two Finnish stocks indicate that M74-mortality among offspring hatching in 2019 (from spawning

2018) will decrease somewhat; preliminary results from, Tornionjoki, Kemijoki, Ume/Vindelälven and Dalälven indicate that offspring mortality for those rivers may be around 5–15%. Disease outbreaks seen in recent years in several rivers is another mortality factor that may have a negative impact on future stock development (Sections 3.4 and 4.4.1).

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

The status of the Swedish AU 4 salmon populations in rivers **Mörrumsån** and **Emån** in the Main Basin differ, but they both show a similar slight negative trend in average parr densities (Table 3.1.4.1 and Figures 3.1.4.1 and 3.1.4.2). The outbreak of M74 mortality in the early 1990s might have decreased smolt production in mid-1990s, after reaching the historical highest parr densities in Mörrumsån at the turn of the 1980s and 1990s. In Emån, the smolt production has for long been far below the required level, which is most likely a result of insufficient numbers of spawners that so far have managed to find their way to reproduction areas further upstream in the river.

Updated production capacity priors for Mörrumsån and Emån (ICES, 2015) and smolt estimates from the river model tailored for southern rivers (ICES, 2017c) are now used in the full life-history model. The improvements allow more reliable status assessment of stocks in these rivers (Section 4.4). High disease related mortality among spawners in Mörrumsån (but not yet in Emån) in recent years is another factor that also may affect the future stock development (Sections 3.4 and 4.4.1). According to results from analytical assessment, present stock status is higher in Mörrumsån than in Emån (Section 4). Although average electrofishing densities have not increased since the mid-1990s in Mörrumsån, smolt trapping results for the production in the upper part of Mörrumsån showed a generally positive trend from 2009 and onwards. In 2018, however, the production decreased to the lowest observed during the five latest years (Section 3.1.4).

Among rivers in AU 5, the **Pärnu** river exhibit the most precarious state: no parr at all were found in the river in 2003–2004. In 2005–2006, the densities increased slightly, but in 2007, 2008, 2010 and 2011 again no parr were found. Reproduction occurred in 2008, 2011 and 2012 resulting in low densities of parr in 2009 and 2012–2016. Parr density was remarkably high in 2017 but again decreased in 2018 (Table 3.1.5.1, Figure 3.1.5.1). There has been very large annual variation in parr densities, both within and between rivers in AU 5. Since 1997, parr densities in the river **Salaca** in Latvia have been on relatively high levels (Table 3.1.5.1, Figure 3.1.5.2), but in 2010 and 2011 the densities decreased to the lowest observed level since the mid-1990s. In 2015 the density increased to the highest observed so far, and in 2017 the densities increased compared with previous year. However, in 2018 one summer parr densities dropped significantly, most likely due to high water temperatures and low water levels in summer. In river **Gauja**, parr density levels have been very low since 2004. In 2014, the 0+ parr density increased to a slightly higher level and it also increased in 2018. It seems that in some of the AU 5 salmon rivers (**Saka**, **Užava** and **Irbe**) reproduction occurs only occasionally, as the salmon 0+ parr densities in some years are close to zero or zero.

Although only relatively short time-series of parr and smolt abundances are available from Lithuanian salmon rivers, the latest monitoring results (Table 3.1.5.2) indicate somewhat similar variation in juvenile production as seen in Latvian rivers. 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 AU 5. These stocks might have a higher risk of extinction than any of the stocks in AU 1–3 (Gulf of Bothnia). In Lithuania, various measures have been carried out since 1998 to assist the salmon populations (Section 3.1.5). The implemented measures have stabilized the populations in Lithuanian rivers, but production in different rivers and years still show significant fluctuations. Variation in climatic and ecological factors are believed to influence salmon parr densities and levels of smolt production. Pollution also affects the salmon rivers. Another important factor in Lithuanian rivers, which are of lowland type, is lack of suitable habitats for salmon parr.

Besides regulation of fisheries, many of the salmon rivers in the Main Basin (AU 4–5) may need habitat restoration and re-established connectivity, to stabilize and improve natural reproduction. For instance, in the **Pärnu** River, the Sindi dam prevented access to over 90% of the potential reproduction areas until 2018. Now salmon has access to all spawning areas in the river. In **Mörrumsån** and **Emån,** new fish passes have significantly increased the available reproduction areas for salmon. A new decision has also been taken to remove the dam in Marieberg in Mörrumsån, most likely this will take place in summer 2020. Important aims are to assist fish migration and to recreate spawning and nursery habitats for salmonids in the river.

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

The 0+ parr densities in Estonian wild rivers **Kunda** and **Keila** were high in 2017 and 2018. In **Vasalemma,** the 0+ parr density was on an average level in 2018. The status of river Keila and Kunda is considered to be good, whereas improvement has been modest in river Vasalemma. Because of highly variable annual parr densities in Vasalemma and Kunda, the status of these wild populations must still be considered uncertain.

In the Estonian mixed rivers **Purtse**, **Selja**, **Loobu**, **Valgejõgi**, **Jägala**, **Pirita** and **Vääna**, wild parr densities mostly decreased in 2016. However, in the preceding three years (2012–2015) parr density stayed above the long-term average in all of these rivers. In 2017 and 2018, parr densities increased to very high levels. The clearest positive trend can be seen in Selja, Valgejõgi, Loobu and Pirita. However, because of the high fluctuations in recruitment, the status of these populations remains uncertain. To safeguard these stocks additional regulatory measures were enforced in 2011 (see Section 2.7.2) and positive effect of these measures can be seen as increases in wild parr densities and as a relatively satisfactory amount of ascending spawners to R. Pirita in recent years (2014–2018).

In Russia, wild salmon reproduction occurs in rivers **Luga** and **Gladyshevka**. The status of both these stocks is considered very uncertain. However, high densities of 0+ salmon parr occurred in Gladyshevka in 2015 and 2017, whereas there was no monitoring in 2018. Since 2003, there is no information that suggests natural salmon reproduction in river **Neva**.

In Finland, natural reproduction in the mixed river **Kymijoki** has increased during the last ten years. However, reproduction varies a lot between years and it mainly takes place on the lower part of the river, although possibilities for salmon to access above the first dams have been improved. Smolt production still remains well below the river's potential (Section 3.1.6).

Total natural smolt production in Estonian, Finnish, and Russian rivers in the Gulf of Finland area was estimated to about 102 000 in 2017. In 2018, the estimated wild AU 6 smolt production halved to about 52 600. It is estimated that the wild smolt production will remain on the same level in 2019. The AU 6 smolt releases since year 2000 have been on a stable level. The exception was year 2011, when releases were reduced with almost 50% (Table 3.3.1).

Table 3.1.1.1. Salmon catches (in kilos) in four rivers of the sub-division 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
2013	260	4570	1664	57990	14313	72303	1322
2014	1205	3652	1388	124025	22707	146732	2210
2015	1500	2809	1480	101713	29300	131013	1252
2016	1800	1523	1179	125980	34995	160975	1662
2017	600	200	171	71320	3080	74400	860
2018	750	542	58	74934	12511	87445	1200

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.
* preliminary

Table 3.1.1.2. Numbers of wild salmon (MSW=MultiSeaWinter) in fishways and hydroacoustic counting in the rivers of the assessment units 1, 2, 3 and 4 (subdivisions 30–31, Gulf of Bothnia) and (subdivisions 25 and 27, Western Main Basin).

Year	Number of salmon																		
	Simojoki (au 1)		Tornionjoki (au 1)		Kalixälven (au 1)		Råneälven (au 1)	Piteälven (au 2)		Åbyälven (au 2)		Byskeälven (au 2)		Rickleån (au 2)	Ume/Vindelälven (au 2)			Testeboån (au3)	Mörrumsån (au4)
	MSW	Total	MSW	Total	MSW	Total	Total	MSW	Total	MSW	Total	MSW	Total	Total	MSW	Females	Total	Total	Total
1973									45										110
1974									15							716	1583		129
1975																193	610		no control
1976																319	808		109
1977																456	1221		90
1978																700	1634		30
1979																643	2119		38
1980					62	80									842	449	1254		47
1981					79	161									293	196	638		115
1982					11	45									216	139	424		105
1983					132	890									199	141	401		288
1984					no control										222	177	443		247
1985					no control				30						569	330	904		190
1986					no control				28						175	128	227		262
1987					no control				18						193	87	246		404
1988					no control				28						367	256	446		502
1989					no control				19						296	191	597		1685
1990					139	639			130						767	491	1572		1450
1991					122	437			59						228	189	356		771
1992					288	656		57	115						317	258	354		no control
1993					158	567		14	27				227		921	573	1663		no control
1994					144	806		14	30				258		984	719	1309		no control
1995					736	1282		23	66			157	786		619	249	1164		no control
1996					2736	3781		89	146	1	1	2421	2691		1743	1271	1939		no control
1997					5184	5961		614	658	38	39	1025	1386		1602	1064	1780		no control
1998					1525	2459		147	338	12	15	707	786		447	233	1154		no control
1999					1515	2013		185	220	10	14	447	721		1614	802	2208		no control
2000					1398	2459		204	534	10	31	908	1157		946	601	3367		no control
2001					4239	8890		668	863	40	95	1435	2085		1373	951	5476		no control
2002					6190	8479		1243	1378	49	81	1079	1316	17	3182	2123	6052		902
2003	936	n/a			3792	4607		1305	1418	14	18	706	1086	0	1914	1136	2337		438
2004	680	n/a			3206	3891		1269	1628	23	43	1331	1707	2	1717	663	3292		497
2005	756	n/a			4450	6561		897	1012	16	80	900	1285	1	2464	1480	3537		557
2006	765	n/a			2125	3163		496	544	20	27	528	665	6	1733	1093	2362		392
2007	970	n/a			4295	6489		450	518	62	93	1208	2098	7	2636	1304	4023		923
2008	1004	1235			6165	6838		471	723	158	181	2714	3409	5	3217	2167	5157		968
2009	1133	1374	26 358	31 775	4756	6173		904	1048	180	185	1186	1976	0	3861	2584	5902		666
2010	699	888	16 039	17 221	2535	3192		473	532	47	47	1460	1879	0	2522	1279	2697		232
2011	791	1167	20,326	23,076	2202	2562		571	597	36	36	1187	1433	0	3992	1505	4886		547
2012	2751	3630	52,828	59,606	7708	8162		1196	1418	74	88	2033	2442	0	5842	1765	8058		1407
2013	2544	3121	46,580	52,268	12247	15039		1168	1343	92	113	3137	3761	0	10002	5058	13604		1762
2014	3322	3816	92,167	100,210	7343	7638	3756	1221	1339	94	94	5417	5888	27	7852	2633	10407		1185
2015	2549	2950	45,456	57,152	5221	8288	1004	1566	1907	78	80	4224	5311	13	2781	790	7521		1057
2016	5125	5435	91,137	98,338	6368	8439	1454	1609	2009	116	155	5533	7280	17	4238	2741	9134	73	712
2017	1642	1918	36,409	40,952	4687	5174	1781	1335	1455	108	108	3465	4125	15	2582	908	4100	67	980
2018	3231	4016	35,866	47,028	5409	7215	4184	1222	1431	113	113	1305	2168	36	2777	728	12754	21	183

Simojoki: Hydroacoustic counting near the river mouth, started 2003.
Tornionjoki: Hydroacoustic counting 100 km upstream from the sea, started 2009.
Kalixälven: Fishcounting in the fishway is a part of the run. No control during 1984 - 1989.
Råneälven: Hydroacoustic counting 40 km upstream from the sea, started 2014.
Piteälven: New fishway built 1992. Fishcounting is the entire run.
Åbyälven: New fishway built in 1995. Fishcounting is only part of the total run.
Byskeälven: New fishway built 2000. Fishcounting is part of the total run.
Rickleån: New fishways built 2002. Fishcounting is part of the total run.
Umeälven/Vindelälven: Fishcounting in the fishway is the entire run.
Öreälven: Fishcounting in the trap is part of the run. The trap was destroyed by high water levels in 2000.
Testeboån: Fishcounting sice 2015 in the fishway. The counted number represent majority of the run.
Mörrumsån: The fishcounting site is 12 km from rivermouth. Until 1991 the control was done manually. From 2002 fish are counted by electronic fishcounter.

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

	Year(s)									
	1974-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016	2017	2018
N:o of samples	728	283	734	2114	2170	1879	2988	849	432	413
A1 (Grilse)	9%	53%	35%	7%	20%	8%	10%	6%	11%	37%
A2	60%	31%	38%	59%	50%	53%	43%	76%	69%	30%
A3	29%	13%	24%	28%	26%	31%	38%	11%	18%	21%
A4	2%	2%	3%	4%	3%	6%	6%	5%	1%	10%
>A4	0%	1%	<1 %	2%	2%	2%	3%	1%	1%	2%
Females, proportion of biomass	About 45 %	49%	75%	71%	65%	67%	62%	67%	64%	55%
Proportion of repeat spawners	2%	2%	2%	6%	6%	8%	9%	8%	3%	12%
Proportion of reared origin	7%	46 %*	18%	15%	9%	1%	0.3%	0.3%	0.5%	0.2%

* 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 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
Simojoki							
1982	3.90			1.50	50%	14	No age data of older parr available
1983	0.75			2.20	57%	14	No age data of older parr available
1984	0.53			2.29	44%	16	No age data of older parr available
1985	0.10			0.98	8%	16	No age data of older parr available
1986	0.19			0.53	19%	16	No age data of older parr available
1987	0.74			0.71	27%	22	No age data of older parr available
1988	2.01	2.30	0.24	2.54	36%	22	
1989	2.32	1.15	0.34	1.49	41%	22	
1990	1.71	1.74	0.56	2.30	36%	25	
1991	3.67	1.74	0.65	2.38	32%	28	
1992						0	No sampling because of flood.
1993	0.08	0.35	0.86	1.21	19%	27	
1994	0.39	0.47	0.53	1.00	16%	32	
1995	0.66	0.32	0.13	0.45	31%	29	
1996	2.09			0.76	28%	29	No age data of older parr available
1997	10.98	1.39	0.28	1.67	72%	29	
1998	10.22	3.47	0.46	3.94	100%	17	Flood; only a part of sites were fished.
1999	20.77	10.39	2.41	12.80	93%	28	
2000	15.76	12.17	2.95	15.12	84%	30	
2001	9.03	7.38	3.29	10.67	67%	31	
2002	15.44	8.56	3.30	11.85	81%	31	
2003	19.97	5.38	1.44	6.82	84%	30	
2004	12.97	7.68	1.30	8.98	74%	19	Flood; only a part of sites were fished.
2005	18.49	7.46	1.89	9.35	70%	27	Flood; only a part of sites were fished.
2006	35.82	12.37	6.14	18.51	83%	36	
2007	4.47	2.61	1.21	3.82	37%	35	
2008	17.75	3.19	1.40	4.60	72%	36	
2009	28.56	13.14	2.15	15.29	76%	36	
2010	13.15	8.26	2.45	10.71	80%	35	
2011	27.93	6.87	2.58	9.45	83%	35	
2012	14.98	10.09	1.43	11.52	83%	36	
2013	11.32	10.60	3.64	14.24	78%	36	
2014	34.30	4.94	2.96	7.90	75%	36	
2015	18.55	5.70	0.80	6.50	86%	36	
2016	28.08	10.19	3.54	13.73	83%	35	
2017	38.06	19.07	8.68	28.38	86%	37	
2018	30.60	25.62	16.37	41.99	83%	36	
Tornionjoki							
1986	0.52	0.89	0.23	1.12		30	
1987	0.38	0.31	0.48	0.79		26	
1988	0.73	0.60	0.46	1.06	46%	44	
1989	0.58	0.68	0.64	1.32	47%	32	
1990	0.52	0.82	0.36	1.18	40%	68	
1991	2.35	0.63	0.48	1.12	69%	70	
1992	0.24	1.80	0.36	2.16	16%	37	Flood; only a part of sites were fished.
1993	0.52	0.44	2.49	2.94	44%	64	
1994	1.02	0.49	1.35	1.84	43%	92	
1995	0.49	1.45	0.65	2.10	48%	72	
1996	0.89	0.33	0.82	1.15	39%	73	
1997	8.05	1.35	0.74	2.09	78%	100	
1998	12.95	4.43	0.53	4.96	92%	84	
1999	8.37	8.83	4.23	13.06	85%	98	
2000	5.90	4.70	6.81	11.51	83%	100	
2001	5.91	3.13	3.82	6.94	78%	101	
2002	7.23	6.03	3.92	9.94	78%	101	
2003	16.09	4.19	2.93	7.12	81%	100	
2004	5.79	4.99	1.27	6.25	80%	60	Flood; only a part of sites were fished.
2005	8.60	2.86	4.28	7.15	81%	87	
2006	13.33	10.57	5.44	16.01	83%	80	
2007	10.33	8.62	5.61	14.23	75%	81	
2008	26.00	10.66	8.70	19.36	94%	81	
2009	19.71	11.65	5.63	17.27	96%	79	
2010	14.42	11.39	6.89	18.28	89%	81	
2011	22.18	14.35	10.06	24.41	90%	78	
2012	19.47	8.04	4.96	13.00	92%	79	
2013	24.13	11.04	6.14	17.18	95%	81	
2014	36.08	10.82	4.41	15.23	97%	75	
2015	40.61	16.96	5.29	22.25	99%	80	
2016	25.24	3.85	3.93	21.58	98%	61	Flood; only a part of sites were fished.
2017	28.52	9.59	7.58	17.18	99%	80	
2018	18.25	10.86	5.33	16.20	92%	80	

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Table 3.1.1.4. Continues.

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	
2013	29.51	15.45	11.95	27.40	100%	30	
2014	25.69	14.44	6.03	20.47	100%	30	
2015	48.84	15.27	5.87	21.14	93%	30	
2016	14.80	11.75	6.18	17.93	100%	30	
2017	17.21	5.88	5.72	11.60	97%	30	
2018	26.15	11.56	7.22	18.78	83%	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	
2013	8.19	4.15	7.76	11.91	79%	14	
2014	7.42	3.85	4.12	7.97	79%	14	
2015	9.61	5.47	4.02	9.49	79%	14	
2016	4.66	5.16	5.75	10.91	86%	14	
2017	3.41	2.64	4.86	7.50	100%	5	Flood; only a part of sites were fished.
2018	3.86	1.79	5.85	7.64	64%	14	

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

	Tornionjoki (AU 1)				Simojoki (AU 1)				Sävarån (AU 2)		Ume/Vindelälven (AU 2)		Rickleån (AU 2)		Lögdeälven (AU 2)	
	Smolt trapping, original estimate	CV of estimate	Ratio of smolts stocked as parr/wild smolts in catch	Number of stocked reared smolts (point estimate)	Smolt trapping, original estimate	CV of estimate	Ratio of smolts stocked as parr/wild smolts in catch	Number of stocked reared smolts (point estimate)	Smolt trapping, original estimate	CV of estimate	Smolt trapping, original estimate	CV of estimate	Smolt trapping, original estimate	CV of estimate	Smolt trapping, original estimate	CV of estimate
1977	n/a				29,000				n/a		n/a		n/a		n/a	
1978	n/a				67,000				n/a		n/a		n/a		n/a	
1979	n/a				12,000				n/a		n/a		n/a		n/a	
1980	n/a				14,000				n/a		n/a		n/a		n/a	
1981	n/a				15,000				n/a		n/a		n/a		n/a	
1982	n/a				n/a				n/a		n/a		n/a		n/a	
1983	n/a				n/a				n/a		n/a		n/a		n/a	
1984	n/a				19,000				n/a		n/a		n/a		n/a	
1985	n/a				13,000				n/a		n/a		n/a		n/a	
1986	n/a				2,200				n/a		n/a		n/a		n/a	
1987	50,000 *)		1.11	32,129	1,800		1.78	14,800	n/a		n/a		n/a		n/a	
1988	66,000		0.37	11,300	1,500		3.73	14,700	n/a		n/a		n/a		n/a	
1989	n/a		1.22	1,829	12,000		0.66	52,841	n/a		n/a		n/a		n/a	
1990	63,000		0.20	85,545	12,000		1.41	26,100	n/a		n/a		n/a		n/a	
1991	87,000		0.54	40,344	7,000		1.69	60,916	n/a		n/a		n/a		n/a	
1992	n/a		0.47	15,000	17,000		0.86	4,389	n/a		n/a		n/a		n/a	
1993	123,000		0.27	29,342	9,000		1.22	5,087	n/a		n/a		n/a		n/a	
1994	199,000		0.16	17,317	12,400		1.09	14,862	n/a		n/a		n/a		n/a	
1995	n/a		0.38	61,986	1,400		7.79	68,580	n/a		n/a		n/a		n/a	
1996	71,000		0.60	39,858	1,300		28.5	140,153	n/a		n/a		n/a		n/a	
1997	50,000 **)			20,004	2,450		6.95	144,939	n/a		n/a		n/a		n/a	
1998	144,000		0.57	60,033	9,400		2.28	75,942	n/a		n/a		n/a		n/a	
1999	175,000	17%	0.67	60,771	8,960		0.75	66,815	n/a		n/a		n/a		n/a	
2000	500,000	39%	0.17	60,339	57,300		0.48	50,100	n/a		n/a		n/a		n/a	
2001	625,000	33%	0.09	4,000	47,300		0.15	49,111	n/a		n/a		n/a		n/a	
2002	550,000	12%	0.08	3,998	53,700		0.29	51,300	n/a		n/a		n/a		n/a	
2003	750,000	43%	0.06	4,032	63,700		0.26	18,912	n/a		n/a		n/a		n/a	
2004	900,000	33%	0.02	4,000	29,100		0.30	1,900	n/a		n/a		n/a		n/a	
2005	660,000	25%	0.00	4,000	17,500	28%	0.10	4,800	3,800	15%	n/a		n/a		n/a	
2006	1,250,000	35%	0.00	3,814	29,400	35%	0.11	809	3,000	12%	n/a		n/a		n/a	
2007	610,000	48%	0.00	8,458	23,200	20%	0.01	8,000	3,100	18%	n/a		n/a		n/a	
2008	1,490,000	37%	0.00	6,442	42,800	29%	0.00	4,000	4,570	18%	n/a		n/a		n/a	
2009	1,090,000	42%	0.00	4,490	22,700	29%	0.00	1,000	1,900	49%	n/a		n/a		n/a	
2010	n/a		0.00	4,965	29,700	28%	0.00	23,240	1,820	32%	193,800	21%	n/a		n/a	
2011	1,990,000	27%	0.00	3,048	36,700	13%	0.00	0	1,643	28%	210,000	14%	n/a		n/a	
2012	n/a		0.00	4,437	19,300	37%	0.00	0	n/a		352,900	19%	n/a		n/a	
2013	n/a		0.00	5,300	37,000	11%	0.00	500	3,548	31%	302,600	25%	n/a		n/a	
2014	n/a		0.00	4,800	36,600	19%	0.00	0	n/a		180,600	13%	2,149	16%	n/a	
2015	2,032,000	47%	0.00	0	n/a		0.00	0	n/a		186,000	13%	n/a		n/a	
2016	2,914,000	27%	0.00	0	29,900	7%	0.00	0	n/a		n/a		3,961	15%	5,211	22%
2017	952,000	27%	0.00	0	n/a		0.00	0	n/a		n/a		4,794	22%	n/a	
2018	n/a		0.00	0	41,300	18%	0.00	0	n/a		n/a		n/a		n/a	

*) 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	Number of parr/100 m² by age group				Sites with	Number of	
year	0+	1+	2+ & older	>0+ (sum of two previous columns)	0+ parr (%)	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.
2013	6.56	6.55	2.08	8.63	100%	7	Varjisån included
2014	12.15	6.39	2.92	9.31	100%	5	
2015	4.87	3.57	0.69	4.26	100%	7	
2016	7.64	4.73	1.22	5.95	100%	4	
2017							No sampling
2018							No sampling
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	
2013	16.29	7.32	5.22	12.54	100%	10	
2014	28.73	6.73	5.67	12.40	100%	10	
2015	18.82	9.79	3.33	13.12	100%	10	
2016	37.04	8.33	6.18	14.51	100%	10	
2017	33.11	11.88	5.42	17.30	100%	10	
2018	22.96	7.43	10.21	17.64	100%	10	

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Table 3.1.2.1. Continues.

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	
2013	24.00	14.27	9.48	23.75	93%	15	
2014	37.78	6.79	6.19	12.98	100%	15	
2015	35.86	13.95	5.08	19.03	100%	15	
2016	43.11	14.58	6.76	21.34	100%	15	
2017	40.10	15.51	7.04	22.55	100%	15	
2018	24.10	13.10	9.54	22.64	100%	15	
Kågeälven							
1987	0.00			0.00	0%	5	
1988	0.00			0.00	0%	1	
1989	0.00			0.00	0%	3	
1990	0.00			0.00	0%	1	
1991	0.51			0.00	25%	4	
1992	1.62			0.54 α	50%	2	
1993	0.00			1.13 α	0%	5	
1994	0.00			0.46 α	0%	5	
1995						0	No sampling
1996						0	No sampling
1997						0	No sampling
1998						0	No sampling
1999	19.74			14.07 α	58%	26	
2000	1.46			3.02 α	30%	10	
2001	9.47			7.05 α	33%	9	
2002	8.73			5.64 α	54%	26	
2003	8.34			1.17 α	46%	26	
2004	7.00			6.17 α	44%	25	
2005	13.95			1.52 α	58%	26	
2006	30.65			27.03 α	82%	17	
2007	4.10			6.20	40%	25	
2008	2.49			7.07	29%	14	
2009	8.16			2.87	85%	12	
2010	5.81			2.69	69%	12	
2011	2.76			2.09	38%	12	
2012	18.10			10.34	69%	12	
2013	10.02			14.03	92%	12	
2014	26.35			9.78	100%	13	
2015	19.79			14.98	100%	13	
2016	8.09			4.25	90%	10	
2017	17.47			12.98	100%	7	
2018	13.40			18.38	90%	11	
Rickleån		* 0+	* >0+				
1988	0.00	0.00	0.11	0.23	0%	2	
1989	0.34	0.16	0.00	0.00	33%	6	
1990	0.69	0.32	0.11	0.24	29%	7	
1991	0.30	0.14	0.04	0.09	29%	7	
1992	0.22	0.10	0.02	0.05	43%	7	
1993	1.63	0.77	0.08	0.18	50%	8	
1994	0.63	0.30	0.56	1.18	38%	8	
1995	0.64	0.30	0.11	0.23	50%	8	
1996	0.00	0.00	0.05	0.10	0%	7	
1997	0.17	0.08	0.43	0.90	29%	7	
1998	2.56	1.21	0.47	0.99	86%	7	
1999	2.32	1.10	0.23	0.49	86%	7	
2000	3.41	1.61	1.90	4.04	100%	7	
2001						0	No sampling because of flood.
2002	2.42	1.14	1.22	2.58	43%	7	
2003	1.05	0.50	0.19	0.39	43%	7	
2004	1.13	0.53	1.53	3.24	43%	7	
2005	4.88	2.30	0.16	0.34	43%	7/*11	
2006	3.88	1.83	2.69	5.70	86%	7	
2007	0.00	0.00	0.09	0.19	0%	7/*11	
2008	4.16	1.96	1.02	2.16	43%	7/*11	
2009	1.09	0.51	0.00	0.00	57%	7	
2010	3.73	1.76	2.94	6.23	100%	7	
2011	0.00	0.00	0.46	0.97	0%	7	
2012	0.91	0.43	0.98	1.96	86%	7/*14	
2013	4.94	2.59	2.01	2.98	57%	7/*13	
2014	2.66	1.56	0.65	0.77	86%	7/*9	
2015	14.60	8.08	2.58	4.69	100%	7/*9	
2016	11.77	5.85	3.92	7.80	100%	7/*11	
2017	9.20	4.62	4.63	8.78	100%	7/*11	
2018	2.99	2.50	7.04	8.34	100%	7/*12	

*) Average densities from extended electrofishing surveys in Rickleån, also including areas and sites in the upper parts of the river which have recently been colonized by salmon (for more details se section 4.2.2). These average densities are used as input in the river model (see stock annex).

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

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Table 3.1.2.1. Continues.

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+ (sum of two previous columns)	Sites with 0+ parr (%)	Number of sampling sites	Notes
Sävarån							
1989	0.60			0.90	25%	4	
1990	1.50			3.10	56%	9	
1991	0.70			4.50	29%	7	
1992	0.20			3.00	43%	7	
1993	1.80			1.90	29%	7	
1994	1.50			2.90	33%	6	
1995	0.40			1.00	33%	9	
1996	10.30			2.50	44%	9	
1997	0.40			3.50	33%	9	
1998	2.70			2.70	63%	8	
1999	0.80			5.00	44%	9	
2000	12.80			7.40	100%	4	
2001						0	No sampling because of flood.
2002	4.60			5.20	63%	8	
2003	2,30			4.40	56%	9	
2004						0	No sampling because of flood.
2005	3.30			3.80	56%	9	
2006	12.49			16.89	67%	9	
2007	4.70			9.20	67%	9	
2008	7.30			8.10	78%	9	
2009	10.22			12.06	78%	9	
2010	4.99			14.09	67%	9	
2011	6.87			8.46	67%	9	
2012	14.43			21.70	89%	9	
2013	20.17			18.31	89%	9	
2014	11.49			10.58	78%	9	
2015	45.30			34.31	100%	9	
2016	32.18			38.61	100%	9	
2017	21.58			34.47	89%	9	
2018	12.59			27.19	86%	14	
Ume/Vindelälven		* 0+	* >0+				
1989	1.57	1.13	1.41	1.97	67%	3	
1990	0.57	0.41	2.09	2.91	50%	12	
1991	2.28	1.64	0.80	1.11	50%	6	
1992							
1993	0.29	0.21	0.71	0.99	33%	6	
1994	0.51	0.37	0.79	1.10	24%	25	
1995	0.39	0.28	0.17	0.23	37%	19	
1996	0.30	0.94	0.69	0.95	14%	21	
1997	17.23	12.40	1.31	1.82	79%	19	
1998	21.59	15.53	8.00	11.12	100%	6	Flood; only a part of sites were fished.
1999	3.29	2.36	12.14	16.88	28%	18	
2000	4.53	3.26	2.87	3.99	75%	12	
2001	3.54	2.54	5.83	8.10	72%	18	
2002	21.95	15.79	13.10	18.21	89%	18	
2003	24.00	17.27	2.76	3.84	89%	18	
2004	12.09	8.69	7.45	10.36	83%	18	
2005	3.71	2.67	3.11	4.32	79%	19	
2006	16.44	11.83	6.85	9.52	63%	19/*25	
2007	15.30	11.00	6.07	8.43	79%	19/*25	
2008	8.46	6.09	3.99	5.55	79%	19/*25	
2009	15.05	10.86	4.23	5.42	74%	19/*30	
2010	12.60	9.11	13.67	18.48	100%	19/*32	
2011							No sampling because of flood.
2012	21.15	15.25	8.71	11.65	95%	19/*25	
2013	15.78	11.35	12.83	17.83	95%	19/*26	
2014	39.35	30.76	9.34	11.82	100%	18/*34	
2015	20.47	16.18	10.99	10.62	95%	19/*31	
2016	1.05	0.75	3.76	3.77	47%	19/*29	
2017	4.24	3.05	3.91	3.92	78%	9/*15	Only 9 of 19 sites were fished because of flood
2018	0.16	0.11	1.57	1.96	10%	19/*27	
Öreälven		* 0+	* >0+				
1989	0	0.00	0.00	0.01	0%	14	
1990	0	0.00	0.00	0.00	0%	8	
1991	0	0.00	0.12	0.25	0%	8	
1992	0	0.00	0.12	0.25	0%	6	
1993	0	0.00	0.01	0.03	0%	13	
1994	0	0.00	0.00	0.00	0%	8	
1995	0.21	0.10	0.02	0.04	30%	10	
1996	0.44	0.22	0.00	0.00	30%	10	
1997	0.23	0.38	0.37	0.70	50%	10	
1998	1.02	1.03	0.21	0.34	75%	8	
1999	0.44	1.01	0.29	0.47	40%	10	
2000	0.60	1.35	0.48	0.80	67%	9	
2001						0	No sampling because of flood.
2002	6.73	4.92	0.79	1.35	60%	10	
2003	3.39	3.53	1.44	2.62	60%	10	
2004	2.12	3.16	0.24	0.16	56%	9	
2005	8.02	6.35	0.88	1.41	44%	9	
2006	5.91	5.98	2.14	4.84	60%	10	
2007	1.36	3.58	0.42	0.39	30%	10	
2008	1.16	3.74	0.78	1.09	40%	10	
2009	10.69	8.73	1.08	1.64	100%	10/*20	
2010	3.59	4.53	2.50	2.45	80%	10/*21	
2011	3.69	3.33	1.17	1.06	89%	9	
2012	7.35	3.90	2.14	4.32	80%	10/*15	
2013	3.96	3.06	1.13	1.89	56%	9/*13	
2014	6.04	6.25	1.59	2.05	100%	10/*14	
2015	21.64	20.97	4.46	7.35	100%	10/*13	
2016	17.50	12.90	5.79	9.13	80%	10/*13	
2017	15.29	11.27	4.87	7.67	80%	10/*13	
2018	1.29	1.16	4.90	6.01	44%	10/*16	

*) Average densities from extended electrofishing surveys in Vindelälven, Öreälven also including areas and sites in the upper parts of the river which have recently been colonized by salmon (for more details se section 4.2.2). These average densities are used as input in the river model (see stock annex).

table continues on next page

Table 3.1.2.1. Continues.

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		* 0+	* >0+				
1989	0.69	0.25	0.30	0.53	50%	8	
1990	2.76	1.00	0.26	0.46	44%	9	
1991	3.16	1.14	0.21	0.37	88%	8/*9	
1992	0.14	0.05	0.45	0.79	38%	8	
1993	0.53	0.19	0.45	0.79	38%	8	
1994	0.42	0.20	0.45	0.66	38%	8	
1995	2.17	1.05	1.16	1.71	88%	8	
1996	2.64	1.28	0.59	0.87	89%	9	
1997	2.59	1.42	1.96	2.79	88%	8	
1998	13.7	5.31	2.21	3.69	100%	6	
1999	5.67	3.25	1.97	0.48	100%	8	
2000	4.80	2.41	2.59	4.10	86%	7	
2001						0	No sampling because of flood.
2002	5.01	3.44	1.42	1.54	100%	7	
2003	11.14	5.23	2.40	3.47	100%	8	
2004	13.26	6.16	2.56	3.64	100%	8	
2005	11.19	7.61	3.31	5.06	100%	8	
2006	6.73	5.35	2.75	3.91	88%	8	
2007	2.86	3.42	2.15	2.70	63%	8	
2008	9.68	7.30	2.79	3.76	100%	8	
2009	11.63	8.53	3.92	5.72	100%	8/*12	
2010	12.19	10.85	3.15	2.44	100%	8/*18	
2011	10.9	9.44	3.53	2.93	88%	8	
2012	5.42	5.80	3.80	3.20	100%	8/*19	
2013	9.55	11.22	3.87	1.49	100%	8/*14	
2014	14.85	11.98	5.48	7.43	100%	8/*14	
2015	16.53	14.99	11.27	7.97	100%	8/*11	
2016	16.93	13.90	7.95	9.44	100%	8/*11	
2017	8.50	6.98	10.61	12.60	100%	8	
2018	7.87	9.70	9.25	8.54	100%	8/*13	

*) Average densities from extended electrofishing surveys in Lögdeälven also including areas
and sites in the upper parts of the river which have recently been colonized by salmon (for more details se section 4.2.2).
These average densities are used as input in the river model (see stock annex).

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

River year	Number of parr/100 m² by age group 0+	1+	2+ & older	>0+	Sites with 0+ parr (%)	Number of sampling sites	Notes
Ljungan							
1990	5.5			4.8	67%	3	
1991	16.5			0.6	100%	3	
1992							
1993							
1994	6.9			0.2	100%	3	
1995	11.9			0.9	100%	3	
1996	8.6			6.5	100%	3	
1997	19.6			2.1	100%	6	
1998						0	No sampling because of flood
1999	17.4			7.9	80%	5	
2000	10.6			6.5	86%	7	
2001						0	No sampling because of flood
2002	23.9			2.6	100%	8	
2003	11.6			0.2	100%	8	
2004	3.1			1.4	56%	9	
2005	45.3			2.3	100%	9	
2006						0	No sampling because of flood
2007	7.7			2.0	89%	9	
2008	18.9			0.3	100%	3	Flood; only a part of sites were fished.
2009						0	No sampling because of flood
2010						0	No sampling because of flood
2011						0	No sampling because of flood
2012	91			5.6		1	Only one site fished because of flood
2013							No sampling because of flood
2014	49			0.7	100%	6	
2015	107			12.2	100%	9	
2016	27			4.5	100%	9	
2017	0.8			2.3	20%	10	
2018	0.0			0.2	0%	6	
Testeboån							
2000	17.6			n/a		10	
2001	32.7			n/a		10	
2002	40.0			n/a		10	
2003	16.7			n/a		10	
2004	17.8			n/a		10	
2005	12.3			n/a		5	
2006	8.2			n/a		5	
2007	10.8			17.8		10	
2008	0.0			4.9		11	
2009	8.8			0.8		11	
2010	12.3			6.9		11	
2011	11.1			2.4		11	
2012	10.2			6.0		11	
2013	15.7			9.9		11	
2014	5.2			7.9		11	
2015	11.1			0.8	73%	11	
2016	27.8			6.0	73%	11	
2017	6.6			6.7	64%	11	
2018	4.9			5.7	73%	11	

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

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

River year	Number of parr/100 m² by age group		Number of sampling sites	Number of parr/100m² by age group from extended surveys		Number of sampling sites from extended surveys
	0+	>0+		α) 0+	α) >0+	
Mörrumsån						
1973	32	33				
1974	12	21				
1975	77	13				
1976	124	29				
1977	78	57				
1978	145	49				
1979	97	65				
1980	115	60				
1981	56	50				
1982	117	31				
1983	111	74				
1984	70	67				
1985	96	42		33	15	6
1986	132	39		53	14	5
1987				74	14	0
1988				95	14	0
1989	307	42	11	116	15	6
1990	114	60	11	61	18	6
1991	192	55	11	116	18	5
1992	36	78	11	24	26	5
1993	28	21	11	25	9	6
1994	34	8	11	23	5	6
1995	61	5	11	47	3	9
1996	53	50	11	37	18	9
1997	74	15	14	44	12	9
1998	120	29	9	63	16	10
1999	107	35	9	58	20	10
2000	108	21	9	55	12	10
2001	92	22	9	49	13	10
2002	95	14	9	49	9	10
2003	92	28	9	51	16	10
2004	80	21	7	51	16	6
2005	98	29	9	56	16	10
2006	61	34	9	36	19	10
2007*	54	10	4	48	14	0
2008	102	16	9	60	8	10
2009	61	14	8	48	7	10
2010	97	27	8	69	15	11
2011	36	18	5	27	9	8
2012	96	14	5	45	7	14
2013	99	30	7	64	16	18
2014	95	23	8	48	14	17
2015	81	31	8	56	25	14
2016	72	20	8	37	10	18
2017	58	14	9	40	12	18
2018	39	15	8	34	11	17

*) Flood, only a part of sites were fished.
α) Average densities from extended electrofishing surveys also including areas and sites in the upper parts of the river which have recently been colonized by salmon. These average densities are used as input in the river model (see stock annex)

Table 3.1.4.1. Continued.

River year	Number of parr/100 m² by age group		Number of sampling sites	Number of parr/100m² by age group from extended surveys		Number of sampling sites from extended surveys
	0+	>0+		α) 0+	α) >0+	
Emån						
1967	52	4.0				
1980-85	52	8.0				
1992	49	10.0				
1993	37	9.0	2	7	3	1
1994	24	7.0	2	3	1	3
1995	32	4.0	4	10	1	2
1996	34	8.0	4	13	2	2
1997	71	6.0	4	23	1	2
1998	51	6.0	2	34	3	3
1999	59	7.0	4	15	1	2
2000	51	3.0	4	8	0	5
2001	37	3.0	4	18	1	2
2002	57	4.0	4	21	1	4
2003	46	4.0	7	20	1	4
2004	45	4.0	6	22	2	4
2005	60	4.0	7	27	2	7
2006	13	1.3	7	9	1	8
2007	36	1.7	5	30	1	4
2008	35	2.9	6	28	3	7
2009	61	3.0	4	45	5	8
2010*				35	4	0
2011	25	1.8	6	26	3	7
2012	47	3.7	4	31	3	8
2013	30	9.9	4	23	8	8
2014	27	3.0	7	32	4	8
2015	25	5.0	7	32	7	8
2016	53	7.9	7	53	8	8
2017	48	7.3	7	48	7	8
2018	9.1	4.2	7	9	4	8

* 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. Subdivision 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	18.4	0	1
2010	0	0	1
2011	0	0	1
2012	1.7	0	1
2013	4.3 : 0.2	0 : 0.06	1 : 4**
2014	2.7 : 0	0 : 0.04	1 : 4**
2015	2.4 : 6	1.1 : 0	1 : 5**
2016	0.6 : 0	0.3 : 0.3	1 : 5**
2017	10.2 : 26	0.8 : 0	1 : 4**
2018	1.4 : 0.5	0.5 :0.1	1 : 13**
Salaca			
1993	16.7	4.9	5
1994	15.2	2.6	5
1995	12.8	2.8	5
1996	25.3	0.9	6
1997	74.4	3.1	5
1998	60	2.8	5
1999	68.7	4	5
2000	46.3	0.8	5
2001	65.1	4.4	5
2002	40.2	10.3	6
2003	31.5	1.3	5
2004	91.3	2.7	5
2005	115	3.8	7
2006	77.3	17.9	6
2007	69.4	6.9	10
2008	92.5	4.9	5
2009	70	10.3	5
2010	26.5	7.4	5
2011	34.5	1.2	5
2012	72	1.9	5
2013	43.4	10.4	5
2014	59.1	3.8	5
2015	137.6	5.7	5
2016	67.7	5.5	5
2017	87.9	7.7	5
2018	21.3	8.2	5

Table 3.1.5.1. Continued.

Gauja			
2003	<1	<1	5
2004	7.9	<1	7
2005	2.7	1.3	5
2006	<1	0	7
2007	<1	0	5
2008	0.1	0.1	5
2009	0.7	0.3	5
2010	0.1	0.9	5
2011	0.4	1.6	5
2012	0.8	0	5
2013	0.3	0.1	5
2014	3.9	0.1	4
2015	1.8	1.6	4
2016	0.3	0.1	5
2017	2	0.3	5
2018	5.2	0.1	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
2013	6	0.1	5
2014	10.9	0.4	5
2015	16.7	0.1	5
2016	3.8	0.1	5
2017	2.2	0.1	5
2018	0.8	0	5
Amata[2)]			
2003	0.0	<1	3
2004	7.9	3.4*	3
2005	2.7	1.3	3
2006	16.7	3.4	3
2007	0.0	5.8	3
2008	6.2	1.8	3
2009	8.5	6.3	3
2010	3.3	3.9	3
2011	1.2	0.5	3
2012	1.0	1.4	3
2013	4.6	2.1	3
2014	4.6	2.1	3
2015	12.1	1.2	3
2016	0.0	0.9	3
2017	1.6	0.6*	3
2018	15.0	1.3	3

[2)] tributaries to Gauja

*) reard fish

**) electrofishing site - below Sindi dam : upstrem Sindi dam

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 m^2 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
2013	0.56	0.02	10
2014	0.90	0.01	12
2015	4.60	0.15	11
2016	1.52	0.30	11
2017	3.00	0.20	11
2018	3.46	0.70	11
Žeimena			
2000	4.10	0.46	7
2001	1.40	0.10	7
2002	0.66	0.00	6
2003	0.72	0.00	6
2004	3.10	0.30	6
2005	1.33	0.47	5
2006	2.52	0.06	5
2007	4.20	0.80	5
2008	2.80	0.10	7
2009	3.50	0.40	7
2010	0.20	0.00	7
2011	5.70	1.20	5
2012	1.40	0.60	6
2013	2.37	0.30	6
2014	2.90	0.90	6
2015	9.20	0.00	6
2016	3.30	0.40	6
2017	2.80	0.00	6
2018	6.20	2.50	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
2013	0.08	0.00	3
2014	0.00	0.30	4
2015	0.00	0.00	3
2016	0.00	0.17	3
2017	0.00	0.00	4
2018	0.17	0.08	3
Saria			
2000	2.5	0.00	1
2001	0.7	0.00	1
2002	0.00	0.00	1
2003	0.4	0.00	1
2004	3.00	0.00	1
2005	0.00	0.4	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	0.8	0.00	2
2013	n/a	n/a	
2014	n/a	n/a	
2015	1.05	0.15	2
2016	n/a	n/a	
2017	n/a	n/a	
2018	0.55	0.55	1

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 1997-2018	Production of >0+ parr 1997-2018
			mean	min			
Purtse	mixed	IV	6.7	3.7	4.9	1 (since 2006)	0-8.4
Kunda	wild	III	4.3	0.8	2	1	0.4-49.3
Selja	mixed	V	2.4	0.8	42	6	0-7.7
Loobu	mixed	II	2.0	0.3	10	2	0-16.6
Valgejõgi	mixed	IV	3.4	0.6	85	2	0.8-7.2
Jagala	mixed	II	7.3	0.7	2	6	0-0.9
Pirita	mixed	V	6.8	0.4	70	4	0-8.8
Vaana	mixed	V	1.9	0.3	21	9	0-4.2
Keila	wild	V	6.2	0.5	2	3	0-48.9
Vasalemma	wild	II	3.5	0.2	34.8	3	0-8.9

[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/100 m^2 by age group 0+	>0+	Number of sampling sites
Kunda			
1992	8.3	7.7	1
1993	0.0	5.3	1
1994	3.1	0.0	1
1995	19.5	3.6	1
1996	28.6	16.2	1
1997	1.9	25.4	1
1998	17.5	1.0	1
1999	8.2	21.4	1
2000	26.4	8.9	1
2001	38.4	17.4	1
2002	17.0	5.9	1
2003	0.8	4.3	1
2004	30.1	0.4	1
2005	5.0	49.3	1
2006	27.2	14.6	3
2007	5.5	5.8	3
2008	5.5	0.4	1
2009	46.5	0.8	1
2010	2.5	1.2	1
2011	16.6	14.6	1
2012	12.1	13.8	1
2013	13.5	6.5	3
2014	29.0	8.9	1
2015	105.8	14.1	1
2016	177.2	25.5	1
2017	139.6	20.2	1
2018	268.5	29.9	1
Keila			
1994	1.2	1.1	1
1995	8.9	0.4	1
1996	14.9	1.3	1
1997	0.0	6.2	1
1998	0.0	6.6	1
1999	120.3	1.5	1
2000	4.8	5.4	1
2001	0.0	1.5	1
2002	8.4	0.4	1
2003	0.0	0.0	1
2004	0.6	0.0	1
2005	31.9	3.0	1
2006	6.3	8.0	1
2007	18.9	2.8	1
2008	44.2	4.3	1
2009	55.8	25.8	1
2010	110.1	12.3	1
2011	25.0	24.7	1
2012	43.5	3.9	3
2013	157.1	33.8	1
2014	82.2	48.9	1
2015	111.8	18.1	1
2016	107.6	25.8	1
2017	283.1	27.0	1
2018	179.5	40.6	1

Table 3.1.6.2. Continued.

Vasalemma			
1992	4.3	3.1	1
1993	*	*	0
1994	2.4	0.0	1
1995	23.7	0.5	1
1996	6.1	5.9	1
1997	0.0	1.8	1
1998	0.0	0.1	1
1999	17.1	0.0	1
2000	4.4	2.0	1
2001	0.5	1.0	1
2002	8.9	0.4	1
2003	0.0	0.0	1
2004	0.0	0.0	1
2005	21.4	0.0	1
2006	9.9	1.0	2
2007	5.2	0.3	2
2008	2.5	1.1	2
2009	37.6	0.0	2
2010	26.0	1.9	2
2011	7.3	4.1	2
2012	6.8	1.1	2
2013	39.8	3.5	2
2014	26.1	4.2	2
2015	2.1	6.4	2
2016	18.2	0.5	2
2017	52.4	4.4	2
2018	27.8	8.9	2

*) = no electrofishing

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

River year	Number of parr/100 m² by age group 0+	>0+	Number of sampling sites
Purtse			
2005	0.0	0.0	2
2006	3.5	1.1	2
2007	12.5	0.2	3
2008	0.6	4.9	3
2009	1.8	4.1	3
2010	0.1	0.7	3
2011	0.0	2.1	3
2012	36.3	0.0	3
2013	15.3	8.4	3
2014	36.6	5.7	3
2015	8.4	4.0	3
2016	3.7	2.5	3
2017	43.9	1.7	3
2018	76.2	7.5	3
Selja			
1995	1.7	7.7	1
1996	0.0	0.5	1
1997	0.0	0.0	1
1998	0.0	0.0	1
1999	0.0	2.3	7
2000	1.5	0.3	3
2001	1.8	4.4	2
2002	0.0	0.0	2
2003	0.0	0.1	3
2004	0.0	0.9	2
2005	5.2	2.1	4
2006	0.9	0.2	3
2007	0.3	0.1	4
2008	19.3	5.1	3
2009	19.8	4.9	4
2010	9.3	1.4	4
2011	1.9	1.0	4
2012	22.8	3.4	4
2013	38.2	4.0	4
2014	14.6	4.4	3
2015	37.8	0.7	3
2016	1.9	0.7	3
2017	131.2	0.5	3
2018	122.5	6	3

River year	Number of parr/100 m² by age group 0+	>0+	Number of sampling sites
Valgejõgi			
1998	0	0	2
1999	1.7	0.9	6
2000	0.3	0.7	5
2001	2.4	0.7	4
2002	8.9	0.0	1
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	3.6	3
2012	11	0.8	3
2013	19.2	3.5	3
2014	21.6	5.1	3
2015	16.8	6.8	3
2016	0.6	3	3
2017	15.2 :0	4.6 : 0	3 : 2*'
2018	25,8 : 0.1	4.2 : 0	3 : 5*'
Jägala			
1998	0.0	0.0	1
1999	1.3	0.0	1
2000	0.0	0.0	1
2001	18.9	0.0	1
2002	0.0	0.0	1
2003	0.0	0.1	1
2004	0.6	0.0	1
2005	4.4	0.0	1
2006	0.0	0.2	1
2007	0.0	0.0	1
2008	6.6	0.0	1
2009	0.4	0.9	1
2010	4.4	0.0	1
2011	0.0	0.0	1
2012	11.6	0.0	1
2013	0.3	0.0	1
2014	1.5	0.0	1
2015	0.0	0.0	1
2016	3.2	0.0	1
2017	1.3	1.3	1
2018	1.2	0.0	1

Table continue on next page

*) = no electrofishing

**) = el.sites below the remains of Kotka dam : el.sites above the dam

Table 3.1.6.3. Continued.

River	Number of parr/100 m² by age group		Number of sampling
year	0+	>0+	sites
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
2013	64.5	5.0	4
2014	1.8	16.6	4
2015	37.6	1.2	4
2016	4.3	9.0	4
2017	36.3	0.9	4
2018	64.0	10.2	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	12.7	NA	5
2013	23.1	NA	5
2014	54.0	NA	5
2015	112.7	NA	5
2016	33.7	NA	5
2017	11.0	NA	5
2018	95.2	NA	5

River	Number of parr/100 m² by age group		Number of sampling
year	0+	>0+	sites
Pirita			
1992	2.4	0.8	1
1993	*	*	0
1994	0.0	0.0	1
1995	0.0	0.0	1
1996	0	0.1	1
1997	*	*	0
1998	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
2013	38.3	8.1	4
2014	15.8	3.7	4
2015	49.3	2.3	4
2016	3.0	8.8	4
2017	81.4	1.9	4
2018	27.9	8.2	4
Väana			
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
2013	4.7	0.6	3
2014	12.1	1.5	3
2015	0.0	1.5	3
2016	0.0	0.2	3
2017	10.8	0.1	3
2018	12.2	1.8	3

*) = no electrofishing

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

River	Description of river						Restoration programme						Results of restoration			
	Country	ICES sub-division	Old salmon river	Cause of salmon population extinction	Potential production areas (ha)	Potential smolt production (num.)	Officially selected for reintroduction	Programme initiated	Measures	Releases	Years with releases	Origin of population	Parr and smolt production from releases	Spawners in the river	Wild parr production	Wild smolt production
Moälven	SE	31	yes	3,4	7	2000	no	yes	c,l	2	2	Byskeälven	yes	yes	>0	>0
Alsterån	SE	27	yes	2,3	4	4000	no	no	c,g,l	4	2	**	**	yes	>0	>0
Helgeån	SE	25	yes	2,3	7	3200	no	yes	c,e,m	2	3	Mörrumsån	yes	yes	>0	>0
Kuivajoki	FI	31	yes	1,2	58	17000	yes	yes	b,c,f	1, 4	4	Simojoki	yes	yes	yes	0
Kiiminkijoki	FI	31	yes	1,2	110	40000	yes	yes	b,c,d,f	2	5	Iijoki	yes	yes	yes	>0
Siikajoki	FI	31	yes	1,2,3	32	15000	no	yes	b,g,m	1, 4	4	Mixed	yes	*	0	0
Pyhäjoki	FI	31	yes	1,2,3	98	35000	yes	yes	b,c,d,f,m	1, 4	5	Tornionjoki/Oulujoki	yes	yes	yes	0
Kalajoki	FI	31	yes	1,2,3	33	13000	no	yes	b,e, m	1, 4	2		no	*	*	*
Perhonjoki	FI	31	yes	1,2,3	5	2000	no	yes	b,f	1, 4	4	Tornionjoki/Oulujoki	yes	*	*	*
Merikarvianjoki	FI	30	yes	1,2,3	8	2000	no	yes	b,c,e	1, 4	5	Neva	yes	yes	>0	*
Vantaanjoki	FI	32	no?	2	16	8000	no	yes	b,c,f,m	1, 4	5	Neva	yes	yes	0	0
Sventoji	LI	26	yes	2,3	7	15000	yes	yes	m,c	2	*	Nemunas	yes	yes	6020	2730
Minija/Veivirzas	LI	26	yes	*	6	30000	yes	yes	c	2	*	Nemunas	no	no	0	0
Wisla/Drweca	PL	26	yes	1,2,3,4	*	*	yes	yes	b,m	2	5	Daugava	yes	yes	*	*
Slupia	PL	25	yes	1,2,3,4	*	*	yes	yes	b,m	2	5	Daugava	yes	yes	yes	*
Wieprza	PL	25	yes	1,2,3,4	*	*	yes	yes	b,m	2	5	Daugava	yes	yes	*	*
Parseta	PL	25	yes	1,2,3,4	*	*	yes	yes	b,m	2	5	Daugava	yes	yes	*	*
Rega	PL	25	yes	1,2,3,4	*	*	yes	yes	b	2	5	Daugava	yes	yes	*	*
Odra/Notec/Drawa	PL	24	yes	1,2,3,4	*	*	yes	yes	b	2	5	Daugava	yes	yes	*	*
Reda	PL	24	yes?	1,2,3,4	*	*	yes	yes	b	2	5	Daugava	yes	yes	*	*
Gladyshevka	RU	32	yes	1,2,4	1.5	3000	no	yes	a,g,k,n	2	4	Neva	yes	yes	yes	>0

Cause of population extinction
1 Overexploitation
2 Habitat degradation
3 Dam building
4 Pollution

* No data
** Not applicable

Measures
Fisheries
a Total ban of salmon fishery in the river and river mouth
b Seasonal or areal regulation of salmon fishery
c Limited recreational salmon fishery in river mouth or river
d Professional salmon fishery allowed in river mouth or/and river

Habitat restoration	Dam removal	Fish ladder
e partial	i planned	l planned
f completed	j completed	m completed
g planned	k not needed	n not needed
h not needed		

Releases
1 Has been carried out, now finished
2 Going on
3 Planned
4 Not planned

Years with releases
1 Releses 0-5 years
2 Releses 6-10 years
3 Releses 11-15 years
4 Releses 16-20 years
5 Releses >20 years
*) add if not releases every year

Table 3.2.2.1. Densities of wild salmon parr in electrofishing surveys in potential rivers. Note that all the Lithuanian rivers listed are currently stocked (and therefore could be called 'mixed').

Country	Assess-ment unit	Subdiv	River and year	Number of parr /100 m² 0+	>0+	Number of sampling sites
Sweden	4	27	**Alsterån**			
			1997	13.3	0	1
			1998	23.8	5.4	1
			1999	6.8	7	1
			2000	8	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	1
			2012	0	4.3	1
			2013	0	0	1
			2014	1.9	0	1
			2015	4.6	0	1
			2016-2018			no sampling
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
			2008-2018			no sampling
Finland	1	31	**Kiiminkijoki**			
			1999	1.8	n/a	
			2000	0.8	n/a	31
			2001	1.9	n/a	26
			2002	1.5	n/a	47
			2003	0.7	n/a	42
			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	n/a	19
			2011			no sampling
			2012	6.6	n/a	2
			2013	3	n/a	20
			2014	1.8	n/a	12
			2015			no sampling
			2016			no sampling
			2017			no sampling
			2018	1.2	3.8	15

table continues next page

* = stocked and wild parr. Not possible to distinguish stocked 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 continues…

Country	Assess-ment unit	Sub-div	River and year	Number of parr /100 m²		Number of sampling sites
				0+	>0+	
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	n/a	13
			2008			no sampling
			2009	0.2	0	6
			2010	0	0.4	6
			2011	0	0	4
			2012-2018			no sampling
Russia	6	32	**Gladyshevka**			
			2001	0	0	2
			2002	0	0	2
			2003	0	0	3
			2004	6	0	2
			2005	15.6	4.1	3
			2006	7.7	6.2	2
			2007	3.1	3.7	4
			2008	0	2	1
			2009	0.9	0.3	1
			2010	1.2	2	4
			2011			no sampling
			2012			no sampling
			2013	3	3	3
			2014	2	3	3
			2015	24.3	9.2	4
			2016			no sampling
			2017	12.5		4
			2018			no sampling

table continues next page

Table 3.2.2.1 continues…

Contry	Assess-ment unit	Sub-div	River year	Number of parr/100 m^2 by age group 0+	>0+	Number of sampling sites
Lithuania	5	26	**Šventoji**			
			2000	1.9	0	6
			2001	0.25	0	6
			2002	2	0.1	6
			2003	0.1	0	6
			2004	0.62	0.28	6
			2005	0.5	0.46	4
			2006	3.15	1.35	4
			2007	4.8	0.1	4
			2008	5.8	0.3	5
			2009	6.1	1.4	5
			2010	0.94	0.84	5
			2011	6.3	2.3	5
			2012	4	1.5	5
			2013	4.8	0.8	5
			2014	5.32	0.08	5
			2015	8.23	2.7	5
			2016	3.12	1.7	5
			2017	0.54	0.1	5
			2018	3.4	1.4	5
Lithuania	5	26	**Siesartis**			
			2000	1.84	0	2
			2001	3.35	0.35	2
			2002	2.5	0	2
			2003	0.45	0	2
			2004	3.4	0	3
			2005	7.3	3	2
			2006	0.27	0.94	2
			2007	6.3	1.2	2
			2008	18.9	17.5	2
			2009	44.1	4	2
			2010	0.15	3.4	2
			2011	6.8	1.9	3
			2012	0.6	3.1	3
			2013	5	1.3	3
			2014	11.95	5.1	4
			2015	6.2	2.3	4
			2016	5.9	3.2	4
			2017	3.1	1.8	4
			2018	2.9	3.8	4
Lithuania	5	26	**Virinta**			
			2003	0.95	0	2
			2004	0.17	0	2
			2005	0.55	0.49	2
			2006	0.14	0	2
			2007	0	0	2
			2008	0	0	2
			2009	6.8	3.6	2
			2010			no sampling
			2011	13.7	0.38	2
			2012	0	0.5	2
			2013	2.4	0	2
			2014	5	0	2
			2015	1.5	0.9	2
			2016	3.7	1.0	2
			2017	0.35	0	2
			2018	6.3	1.9	2

table continues next page

Table 3.2.2.1 continues…

Contry	Assess-ment unit	Sub-div	River year	Number of parr/100 m^2 by age group 0+	>0+	Number of sampling sites
Lithuania	5	26	**Širvinta**			
			2004	1	0	2
			2005	1	0	2
			2006	0	0	2
			2007	6.35	0.35	2
			2008	10.9	0	2
			2009	11.2	0	2
			2010			no sampling
			2011	4.7	0.3	2
			2012	0	0	2
			2013	0.8	0	2
			2014	2.7	0.15	2
			2015	1.6	0	1
			2016	1.6	0.4	1
			2017	4.5	0	2
			2018	5.3	0.4	4
Lithuania	5	26	**Vilnia**			
			2000	0	0	3
			2001	0.7	0	3
			2002	1.3	0	4
			2003	0	0	3
			2004	0.36	0.15	3
			2005	4.48	0.13	3
			2006	0.49	2.63	3
			2007	0.58	0	3
			2008	1.53	0.28	3
			2009	3.1	2.14	3
			2010	3.6	1	5
			2011	3.3	1.6	3
			2012	3.5	1	3
			2013	3.7	1.7	3
			2014	31.4	2.3	4
			2015	8.8	3.75	4
			2016	14.9	3.2	4
			2017	16.7	6.3	4
			2018	2.1	2.7	4
Lithuania	5	26	**Vokė**			
			2001	4.3	0	2
			2002	0.16	0	2
			2003	0	0	2
			2004	9.5	0	2
			2005	0.77	0	2
			2006	0	0.8	2
			2007	4.1	0	2
			2008	4.50	0	2
			2009	3.4	0.5	2
			2010			no sampling
			2011	3.8	0	2
			2012	5.2	0.8	2
			2013	3.4	0.7	2
			2014	9.5	3.8	2
			2015	2.2	1.45	2
			2016	1.6	2.85	2
			2017	6.8	1.7	2
			2018	0.5	6.7	2

table continues next page

Table 3.2.2.1 continues…

Contry	Assess-ment unit	Sub-div	River year	Number of parr/100 m^2 by age group 0+	>0+	Number of sampling sites
Lithuania	5	26	**B. Šventoji**			
			2003	1.12	0	8
			2004	2.52	0	8
			2005	0	0.22	9
			2006			no sampling
			2007	0.02	0	5
			2008	0.02	0	3
			2009	2.6	0	4
			2010	0.59	0	4
			2011	2.94	0.15	2
			2012	3	0	2
			2013	2.8	0.33	2
			2014	8	0.8	2
			2015	8.7	1.5	2
			2016	0.41	0	4
			2017	3.3	0.54	3
			2018	0.8	0.5	2
Lithuania	5	26	**Dubysa**			
			2003	2.12	0	9
			2004	0.75	0	9
			2005	1.47	0	8
			2006	0	0.06	9
			2007	0.02	0	8
			2008	0.53	0.09	10
			2009	0.79	0	7
			2010	2.79	0	5
			2011	0.52	0.29	3
			2012	1.1	0.5	2
			2013	3.7	1	3
			2014	9	0.3	8
			2015	5.1	0.8	7
			2016	0.22	0.53	10
			2017	10.2	0.74	4
			2018	5.23	2.18	6
Lithuania	5	26	**Minija**			
			2010	2.38	0	4
			2011	11.54	0.78	4
			2012	1.4	1.8	4
			2013	6.7	0	3
			2014	3.5	0.1	6
			2015	3.95	0.54	6
			2016	1.2	0.2	11
			2017	3.6	0.3	5
			2018	0.29	0.36	2

Table 3.3.1.1. Salmon smolt releases by country and assessment units in the Baltic Sea (x1000) in 1987–2018.

			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**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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	1164	1135	1082	1063	1302	1265
		3yr			21	5			0.3			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	1164	1135	1082	1063	1302	1265
2	Sweden	1yr	292			8					22						5							84	98	150	195	194	207	252	320	404	378	270
		2yr	976	901	771	813	809	816	901	804	675	711	786	803	784	693	795	802	758	748	779	685	780	784	698	680	648	550	502	530	405	454	355	437
2 Total			1267	901	771	821	809	816	901	804	698	711	786	803	784	693	800	802	758	748	779	685	780	867	795	830	843	744	709	782	725	859	733	707
3	Finland	1yr	3							73														0.2	67	2								11
		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	207	117	69	114	61	49
		3yr	19																			0.4												
	Sweden	1yr			10	12	11	41	10		103	43	69	43	38	35	47	84	162	96	273	268	391	564	628	688	711	847	795	818	869	887	860	822
		2yr	1026	983	1170	973	962	1024	1041	808	457	1011	1063	1072	864	1060	933	867	902	808	888	719	494	461	361	322	250	173	164	81	97	45	55	29
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	1166	1016	1034	1047	975	911
4	Denmark	1yr	62	60	46	60	13	64	80		70		103	30	35	72			14	13	16													
		2yr	8	10	10	12	11																											
	EU	1yr		25	107	60	109	40				7																						
		2yr		26	192	149	164	124	332	165	2	28																						
	Sweden	1yr	117	89	136	96	41	84	103	14	12	37	55	3		11		1				20							15	15	13	12	18	18
		2yr	129	113	18	58	69	25	33	68	3	4	9	2		1	9	5	5	6	7	8	31	8	17	20	11	9	3	3	3			
4 Total			317	323	509	435	407	337	548	246	87	76	167	35	35	84	9	7	19	19	23	28	31	8	17	20	11	9	18	18	16	12	18	18
5	Estonia	1yr			17	18	15	18	15																							11		
		2yr																														10	11	
	Poland	1yr		1						22	129	40	280	458	194	309	230	186	262	207	161	385	310	374	463	380	275	155	325	359	176	249	43	237
		2yr								2	107	77	30	80	175	60	24	86	53	58	69	79	98	30	32	41	31	11	55	12	12	10		1
	Latvia	1yr	686	1015	1145	668	479	580	634	616	793	699	932	902	1100	1060	1069	867	961	777	566	814	868	944	752	756	394	649	737	738	675	614	678	569
		2yr	224	49	39	36	31	34	86	58	33	60	8	49	41	46		64	34	38	175	61	5	23	7									
	Lithuania	1yr													11				9	4	11	30			38		25	25	10	20	23	21	22	20
5 Total			910	1065	1201	722	525	632	735	698	1062	876	1250	1489	1521	1475	1324	1203	1317	1084	983	1371	1281	1371	1292	1177	724	839	1127	1128	886	914	753	827
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**	**4184**	**4079**	**3743**	**3894**	**3780**	**3727**
6	Estonia	1yr							22	33		30	18	52	36	69	129	101	86	82	96	125	80	122	125	77	64				32	22	37	80
		2yr		1									29	90	58	35	34	40	35	46	46	48	0	49	45	33	26	53	32	35	42	27	32	33
	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	199	150	79	99	103	145
		3yr	12																						3									
	Russia	1yr	85	113	81	100	102	13	128	78	124	102	174	85	165	77	103	136	70	271	233	247	278	270	230	238	129	315	466	427	352	450	377	373
		2yr	3	2	2	30			9	22	18	18	6	12	12	41	135	1	107	85	81	33	55	1	31		1		1	0.4				
6 Total			**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**	**697**	**613**	**505**	**598**	**549**	**631**
Grand Total			**5964**	**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**	**4881**	**4692**	**4248**	**4492**	**4329**	**4358**

Table 3.3.1.2. Releases of salmon eggs, alevin, fry and parr to the Baltic Sea rivers by assessment unit in 1995–2018.

		age						
Assessment unit	year	eyed egg	alevin	fry	1s parr	1yr parr	2s parr	2yr parr
1	1996	73	278	92	338	685	15	
	1997		1033	459	321	834	14	
	1998		687	198	690	582		
	1999		1054	25	532	923	15	
	2000		835	27	402	935		
	2001				98	1079		
	2002			19	145	775	5	
	2003					395	10	
	2004				63	266		
	2005		98		96	451	15	21
	2006		330	11	14	896		
	2007		201	30	82	482		
	2008		89	220	19	489		
	2009		210			212		
	2010		354	1		172		
	2011	22	614			68		
	2012		556			64		
	2013		129		1	63	0.3	
	2015		296		10	67		
	2016					69		
	2017					50		
	2018		300			73		
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		
	2017	300						
	2018	300		1		118		
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		
	2013				216	79		
	2014			22	155	444		
	2015				133	6		
	2016			77		31		
	2017			5		16		
	2018			20		7		

Table 3.3.1.2. 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		
	2013			522	381	16		
	2014			354	282	62		
	2015		40	495	218	2		
	2016		10	159	148	5		
	2017			247		61		
	2018			519	237			
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	
	2013			99	112	95	7	28
	2014			98	22	15	24	
	2015			99	127	5	89	4
	2016				86	18		
	2017	56			55	120	21	
	2018			75	62	110	9	

Table 3.3.3.1. Number of tagged hatchery-reared and wild salmon smolts released in assessment units 1, 2 or 3 and used in the salmon assessment (data not updated since 2012).

RELEASE YEAR	Reared salmon stocked in 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 3.3.3.2. Number of Carlin-tagged salmon released into the Baltic Sea in 2018.

Country	24	25	26	27	28	29	30	31	32	Total
Denmark										0
Estonia										0
Finland								1,995		1,995
Sweden								5,000		5,000
Poland										0
Russia										0
Lithuania										0
Germany										0
Latvia										0
Total	0	0	0	0	0	0	0	6,995	0	6,995

Table 3.3.4.1. 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	---	---
2013	13,200	1,768,083	---	---
2014	119,670	2,038,400	---	---
2015	142,361	2,690,095	---	---
2016	93,113	2,777,782	---	---
2017	166,364	3,728,054	---	---
2018	268,905	3,767,308	---	---

Table 3.3.4.2. Adipose finclipped salmon released in the Baltic Sea area in 2018 (and clipped or unclipped tagged using other methods).

Country	Species	Stock	Age	Number parr	Number smolt	River	Sub-division	Other tagging
Estonia	salmon	Kunda	1 yr		19,900	Purtse	32	
	salmon	Kunda	2 yr		5,200	Purtse	32	500 T-bar
	salmon	Kunda	1 yr		14,700	Selja	32	
	salmon	Kunda	2 yr		5,200	Selja	32	500 T-bar
	salmon	Kunda	1 yr		15,100	Loobu	32	
	salmon	Kunda	2 yr		4,900	Loobu	32	500 T-bar
	salmon	Kunda	1 yr		29,800	Valgejõgi	32	
	salmon	Kunda	2 yr		7,500	Valgejõgi	32	500 T-bar
	salmon	Kunda	2 s	9,300		Valgejõgi	32	
	salmon	Kunda	2 yr		4,900	Jägala	32	500 T-bar
	salmon	Kunda	2 yr		5,100	Pirita	32	500 T-bar
Russia	salmon	Neva	1 yr			Gladyshevka	32	1992 T-bar (Finnish tags)
Finland	salmon	Tornionjoki	2 yr		3,646	Aurajoki	29	
	salmon	Simojoki	2 yr		4,878	Eurajoki	30	
	salmon	Tornionjoki	1 yr	10,938		Kokemäenjoki	30	
	salmon	Tornionjoki	2 yr		19,898	Kokemäenjoki	30	
	salmon	Simojoki	2 yr		8,000	Kokemäenjoki	30	
	salmon	Iijoki	1 yr	40,000		Kiiminkijoki	31	
	salmon	Iijoki	2 yr		20,468	Kiiminkijoki	31	
	salmon	Iijoki	2 yr		298,399	Iijoki	31	2000 T-bar
	salmon	Tornionjoki	2 yr		252,537	Kemijoki	31	1000 Carlin, 995 T-bar
	salmon	Iijoki	2 yr		385,284	Kemijoki	31	1000 Carlin, 982 T-bar
	salmon	Oulujoki	1 yr	32,500		Oulujoki	31	
	salmon	Oulujoki	2 yr		278,751	Oulujoki	31	1977 T-bar
	salmon	Oulujoki	2 yr		29,437	at sea	31	
	salmon	Neva	2 yr		2,765	Karvianjoki	30	
	salmon	Neva	2 yr		10,000	Kiskonjoki	29	
	salmon	Neva	1 yr	60,000		Kymijoki	32	
	salmon	Neva	2 yr		69,844	Kymijoki	32	3999 T-bar
	salmon	Neva	2 yr		11,746	Karjaanjoki	32	
	salmon	Neva	2 yr		63,338	at sea	32	
Sweden	salmon	Luleälven	1 yr	109,715	*	Luleälven	31	
	salmon	Luleälven	1 yr		109,715	Luleälven	31	
	salmon	Luleälven	2 yr		362,981	Luleälven	31	5000 Carlin
	salmon	Skellefteälven	1 yr		130,959	Skellefteälven	31	
	salmon	Skellefteälven	1 yr		6,150	Gideälven	30	
	salmon	Umeälven	1 yr		28,855	Umeälven	31	1000 PIT-tag
	salmon	Umeälven	2 yr		74,039	Umeälven	31	1000 PIT-tag
	salmon	Ångermanälven	1 yr		156,975	Ångermanälven	30	
	salmon	Ångermanälven	2 yr		28,749	Ångermanälven	30	
	salmon	Indalsälven	1 yr		305,066	Indalsälven	30	
	salmon	Ljusnan	1 yr		147,707	Ljusnan	30	
	salmon	Dalälven	1 yr	6,452		Dalälven	30	
	salmon	Dalälven	1 yr		206,355	Dalälven	30	3424 PIT-tag
	salmon	Dalälven	1 yr		5,500	Motala ström	27	
	salmon	Dalälven	1 yr		12,000	Stockholms ström	27	
Poland	salmon	Daugava strain	spawners			Parsęta	25	12 PIT-tag
Lithuania	salmon	Nemunas	fry			Minija	26	2000 Calcein dye
	salmon	Nemunas	fry			Musė	26	2000 Calcein dye
	salmon	Nemunas	fry			Dūkšta	26	2000 Calcein dye
Latvia	salmon	Daugava	1 yr		547,022	Daugava	28	
	salmon	Daugava	2 yr		2,760	Daugava	28	
	salmon	Gauja	1 yr		55,269	Gauja	28	2000 T-bar
	salmon	Gauja	1 yr		2,000	Brasla	28	2000 T-bar
	salmon	Venta	1 yr		13,915	Venta	28	
Total salmon				**268,905**	**3,767,308**			

***) Not considered to contribute to the smolt production in Luleälven**

Table 3.4.1.1. 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 sea-run female spawners, belonging to populations of Baltic salmon, in hatching years 1985–2018. The data originate from hatcheries and from laboratory monitoring. Prognosis (min–max) for 2019 is based on the free thiamine concentration in unfertilized eggs of autumn 2018 spawners and moreover, on the number of wiggling females (none in autumn 2018).

River	SD	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Simojoki (2)	31		*7*	3	7	*1*	*14*	4	53	74	*53*	92	*86*	91	31	60	44	42	42	6	7	3	*18*	29	10	10	3	3	*0*	*0*	*0*	0	4	33	16	
Tornionjoki(2)	31				5	6	1	29	70	76	89	76			*25*	*61*	34	41	*62*	0	*0*		*27*	9	*10*	4	10		*0*	0					16	1–1
Kemijoki	31																						38	*54*	*25*	30	7	*6*								5–9
Iijoki	31																									23								*41*		
Luleälven	31								58	66	62	50	52	38	6	34	21	29	37	4	4	1	18	21	10	16	34	2	2	1	2	2	11	25	20	
Skellefteälven	31								40	49	69	49	77	16	5	42	12	17	19	7	0	2	3	13	0	0	5	3	3	22	2	2	4	30	22	
Ume/Vindelälven	30	40	20	25	19	16	31	45	77	88	90	69	78	37	16	53	45	39	38	15	4	0	5	14	4	25	24	11	0	8	20	0	19	45	21	3–15
Angermanälven	30								50	77	66	46	63	21	4	28	21	25	46	13	4	3	28	30	16	8	23	7	1	4	4	0	24		11	
Indalsälven	30	4	7	8	7	3	8	7	45	72	68	41	64	22	1	20	22	6	20	4	0	3	18	16	18	14	11	5	0	0	4	3	15	7		
Ljungan	30								64	*96*	*50*	56	28	29	10	25	10	0	55	0																
Ljusnan	30							17	33	75	64	56	72	22	9	41	25	46	32	17	0	0	25	15	9	16	10	3	0	2	4	2	39	36	13	
Dalälven	30	28	8	9	20	11	9	21	79	85	56	55	57	38	17	33	20	33	37	13	4	7	15	18	7	24	18	4	0	3	13	7	34	58	25	4–16
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	7	3	0	0	0	0	4	33	16	
Mean River Luleälven, Indalsälven, Dalälven		16	8	9	14	7	9	14	61	74	62	49	58	33	8	29	21	23	31	7	3	4	17	18	12	18	21	4	1	1	6	4	20	30	23	
Mean total		**30**	**18**	**22**	**17**	**16**	**23**	**27**	**56**	**77**	**66**	**59**	**61**	**38**	**15**	**40**	**25**	**28**	**39**	**8**	**3**	**3**	**18**	**22**	**11**	**15**	**15**	**5**	**1**	**4**	**6**	**2**	**19**	**34**	**18**	

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

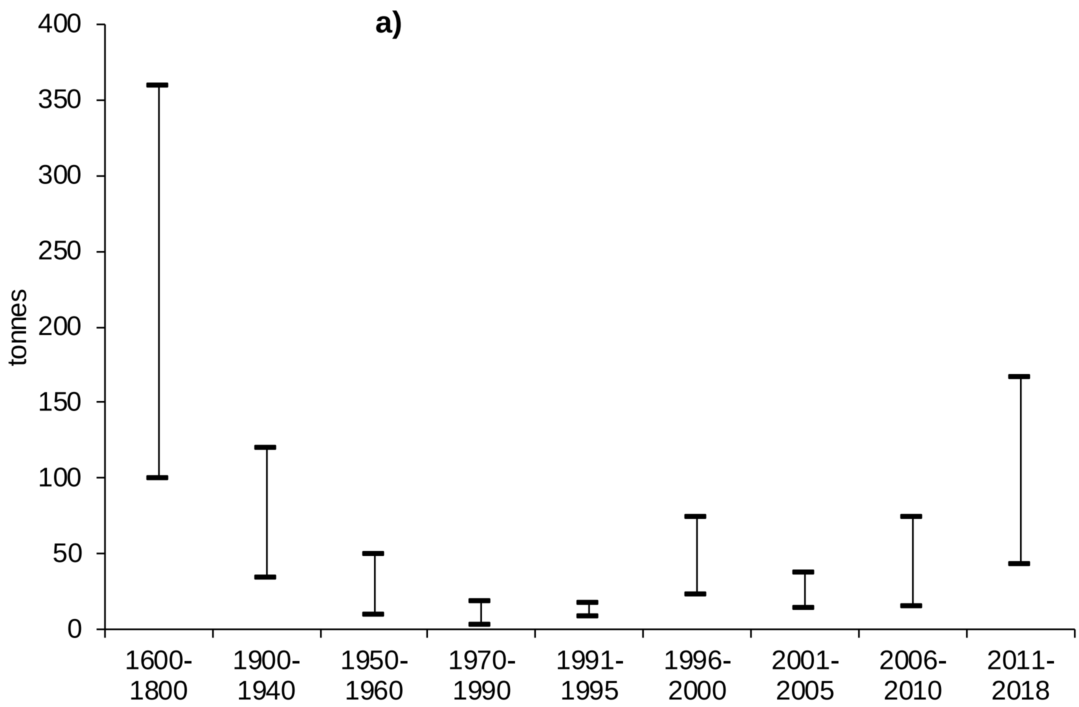
2) The estimates in the rivers Simojoki, Tornionjoki/Torne älv and Kymijoki are since 1992, 1994 and 1995, respectively, given as the proportion of females (%) with offspring affected by M74 and before that as the mean yolk-sac-fry mortality (%).

Table 3.4.1.2. Summary of M74 data for Atlantic salmon (*Salmo salar*) stocks of the Rivers Simojoki, Tornionjoki and Kemijoki or Iijoki (hatching years 1986–2018), indicating the total average yolk-sac fry mortality among offspring of sampled females (%), the percentage of sampled females with offspring that display M74 symptoms (%) 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/Iijoki	Simojoki	Tornionjoki	Kemijoki/Iijoki	Simojoki	Tornionjoki	Kemijoki/Iijoki
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	14	8	3	10	7	0	3	4
2011	3	NA	*6*	3	NA	*6*	0	NA	*6*
2012	*2*	*1*	NA	*0*	*0*	NA	*0*	*0*	NA
2103	*4*	*5*	NA	*0*	*0*	NA	*0*	*0*	NA
2014	6	NA	NA	0	NA	NA	0	NA	NA
2015	2	NA	NA	0	NA	NA	0	NA	NA
2016	7	NA	NA	4	NA	NA	4	NA	NA
2017	19	NA	*34*	33	NA	*41*	18	NA	*29*
2018	28	8	NA	16	16	NA	8	5	NA

Table 3.4.1.3. Summary of M74 data for nine different Atlantic salmon stocks (hatching years 1985–2018), 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
2013	2	220	10	45	5	60	2	80	0	120	NA	NA	2	92	3	121	NA	NA
2014	4	220	1	50	12	60	3	80	5	125	NA	NA	4	92	13	103	NA	NA
2015	5	202	1	50	0	60	0	80	3	120	NA	NA	2	92	6	85	NA	NA
2016	21	184	2	50	7	36	19	78	18	120	NA	NA	36	92	33	98	NA	NA
2017	51	206	15	50	10	22	NA	NA	8	120	NA	NA	31	85	41	92	NA	NA
2018	36	180	11	50	3	14	2	19	NA	NA	NA	NA	7	53	20	97	NA	NA



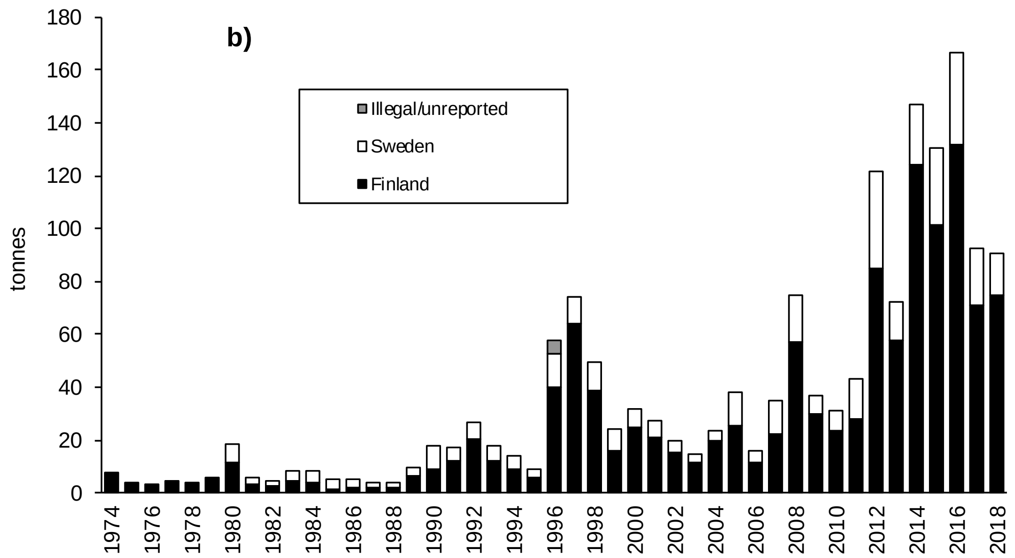


Figure 3.1.1.1. Total river catches in the River Tornionjoki (assessment unit 1). a) Comparison of the periods from 1600 to present (range of annual catches). b) from 1974 to present. Swedish catch estimates are provided from 1980 onwards.

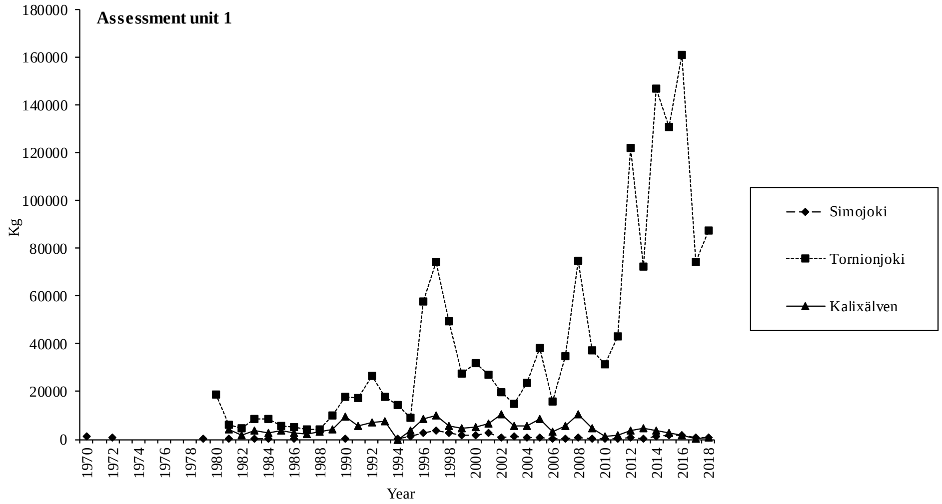


Figure 3.1.1.2 Salmon catch in the rivers Simojoki, Tornionjoki (finnish and swedish combined) and Kalixälven, Gulf of Bothnia, assessment unit 1, 1970-2018. Ban of salmon fishing 1994 in the river Kalixälven.

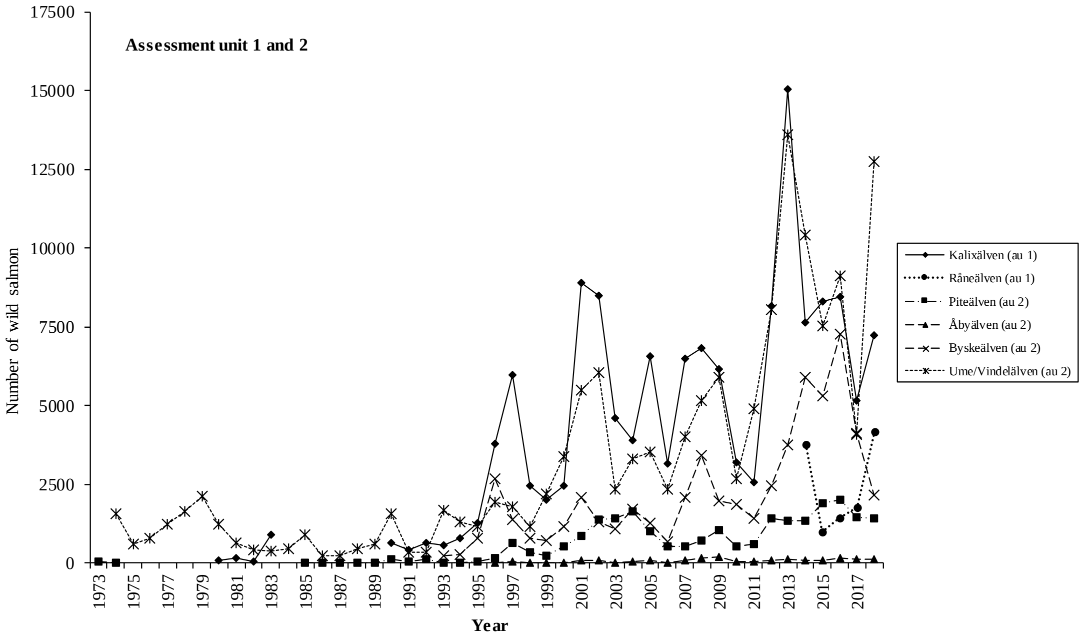


Figure 3.1.1.3. Total wild salmon run in fish way (ecosounder in Råneälven) in rivers in assessment unit 1 and 2, in 1973-2018.

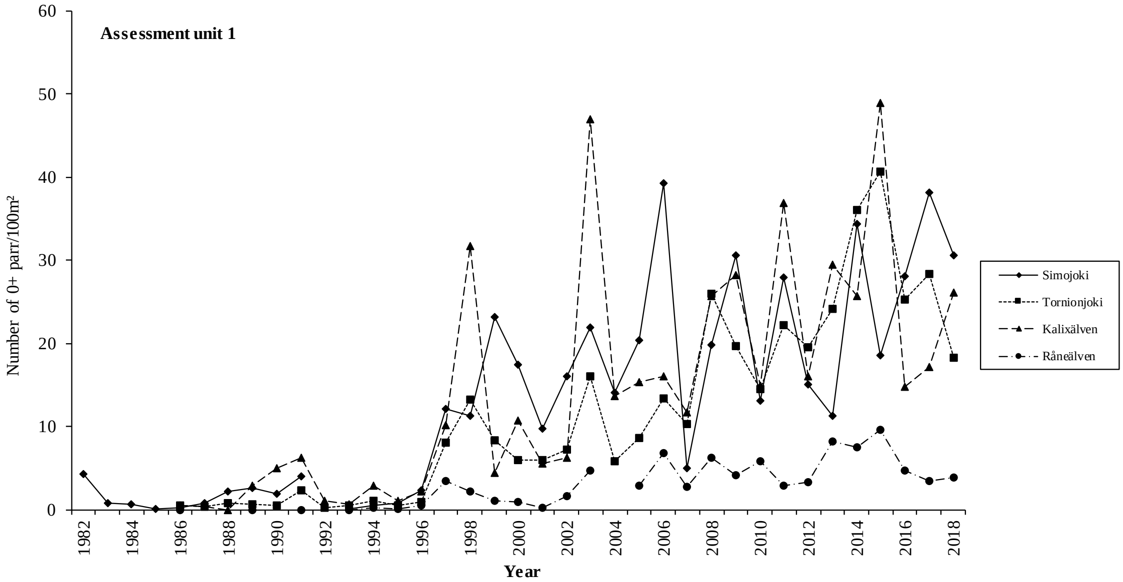


Figure 3.1.1.4 Densities of 0+ parr in rivers in Gulf of Bothnia (Sub-division 31), assessment unit 1, in 1982-2018.

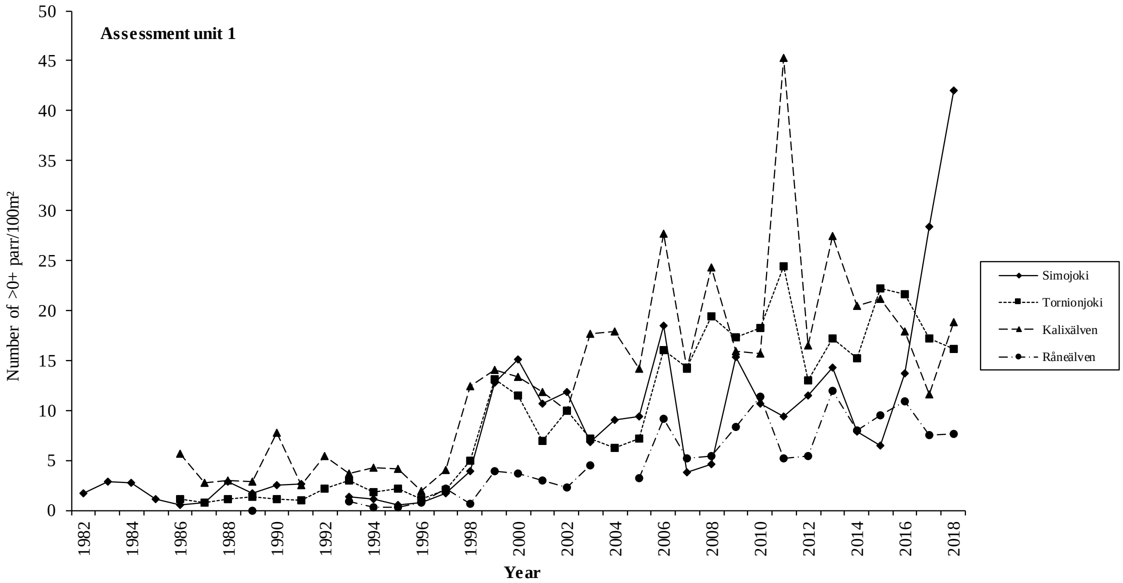


Figure 3.1.1.5 Densities of >0+ parr in rivers in Gulf of Bothnia (Sub-division 31), assessment unit 1, in 1982-2018.

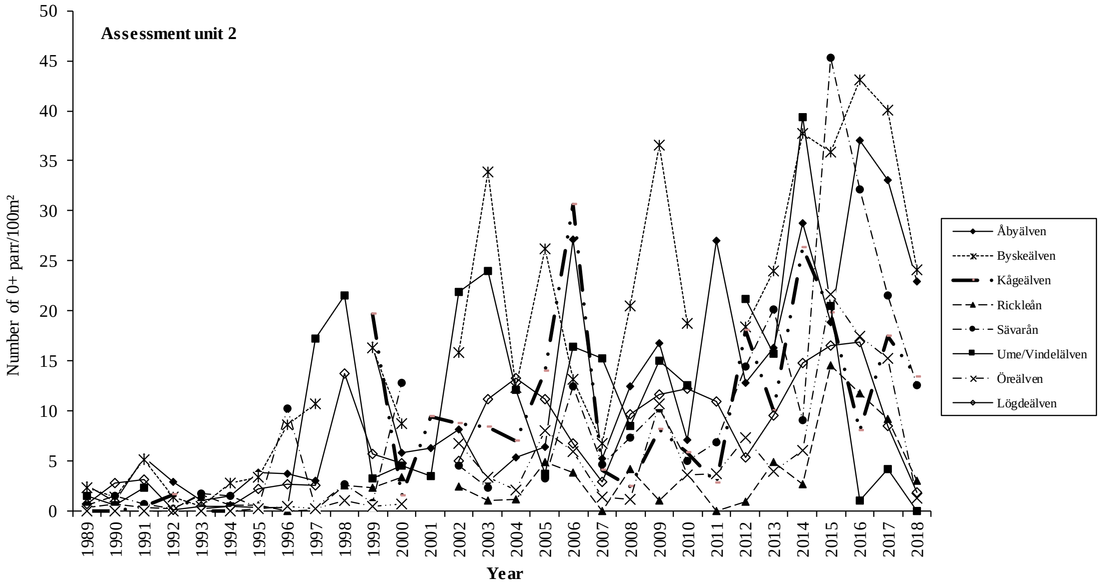


Figure 3.1.2.1 Densities of 0+ parr in rivers in Gulf of Bothnia (Sub-division 31), assessment unit 2, in 1989-2018.

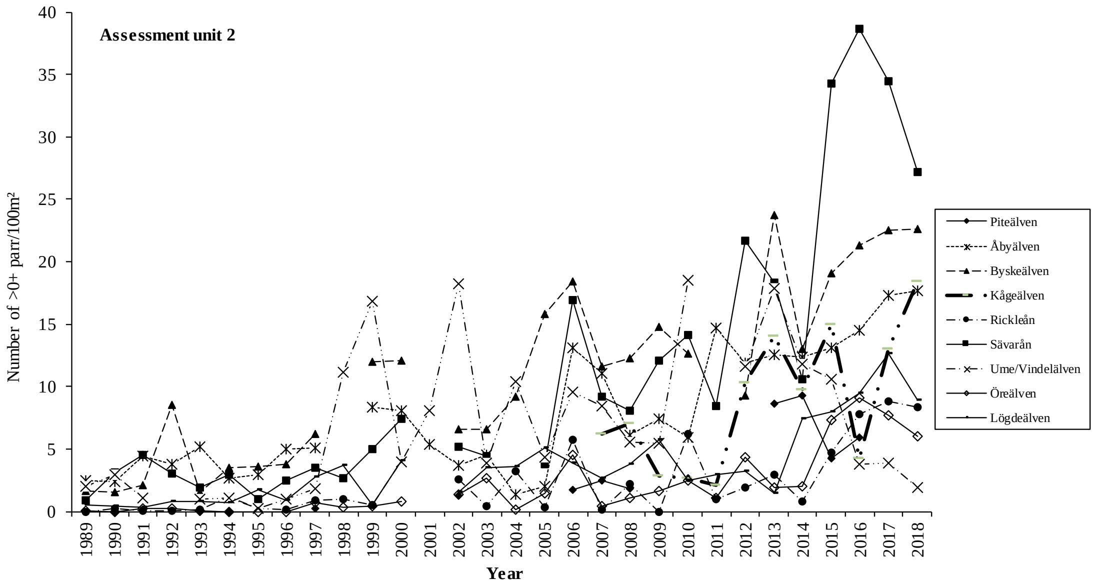


Figure 3.1.2.2 Densities of >0+ parr in riveres in Gulf of Bothnia (Sub-division 31), assessment unit 2, in 1989-2018.

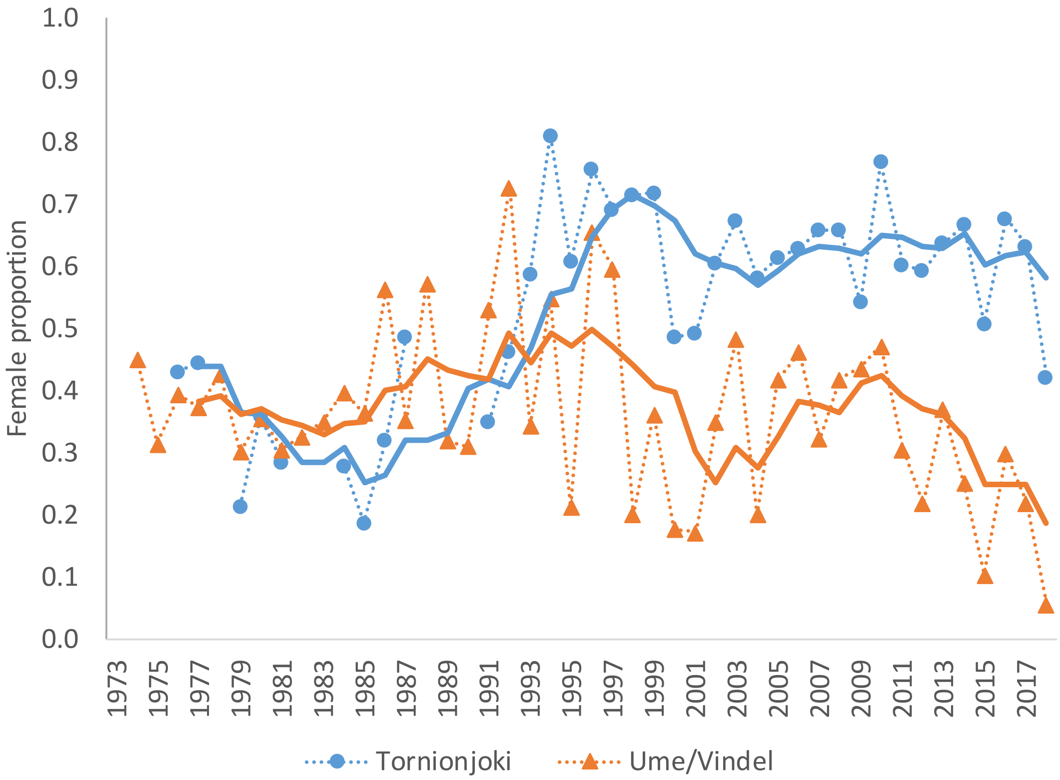


Figure 3.1.2.3. Observed female proportions in Tornionjoki (catch samples) and Ume/Vindelälven (fish ladder data) with moving 5 yr averages.

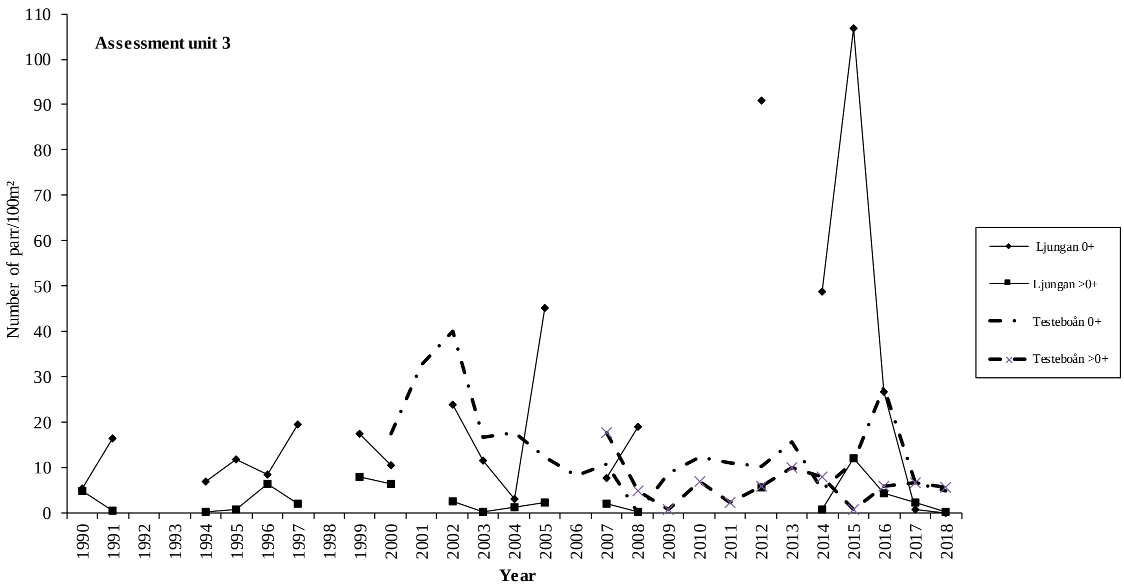


Figure 3.1.3.1 Densites of parr in Ljungan and Testeboån in the Gulf of Bothnia (Sub-division 30), assessment unit 3, in 1990-2018.

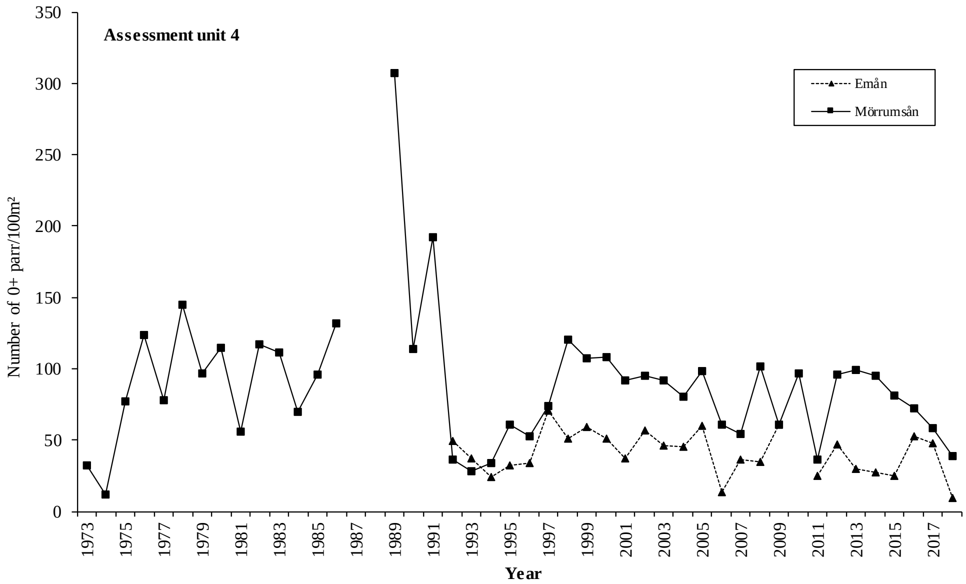


Figure 3.1.4.1 Densities of 0+ parr in rivers in the Main Basin (Sub-division 25-27), assessment unit 4, in 1973-2018.

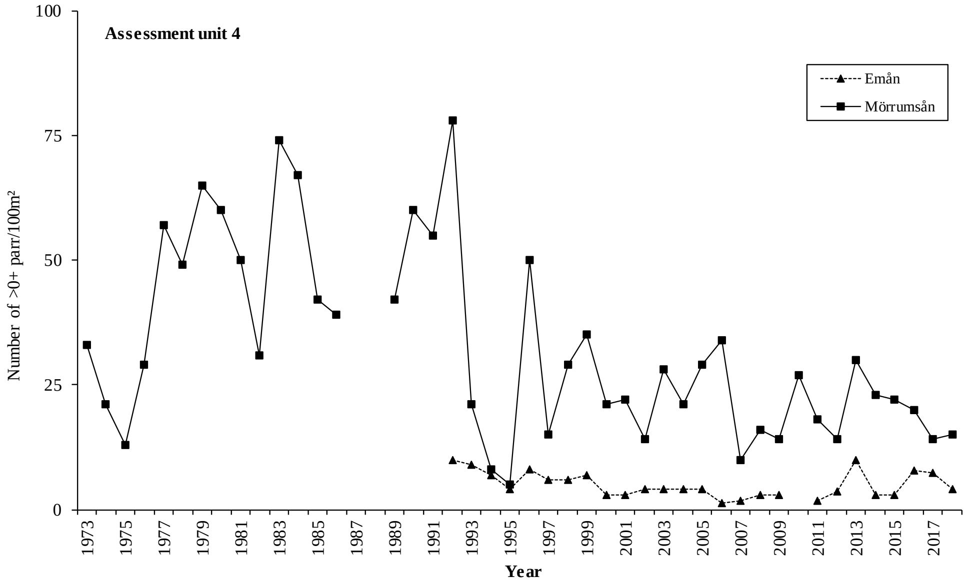


Figure 3.1.4.2 Densities of >0+ parr in rivers in the Main Basin (Sub-division 25-27), assessment unit 4, in 1973-2018.

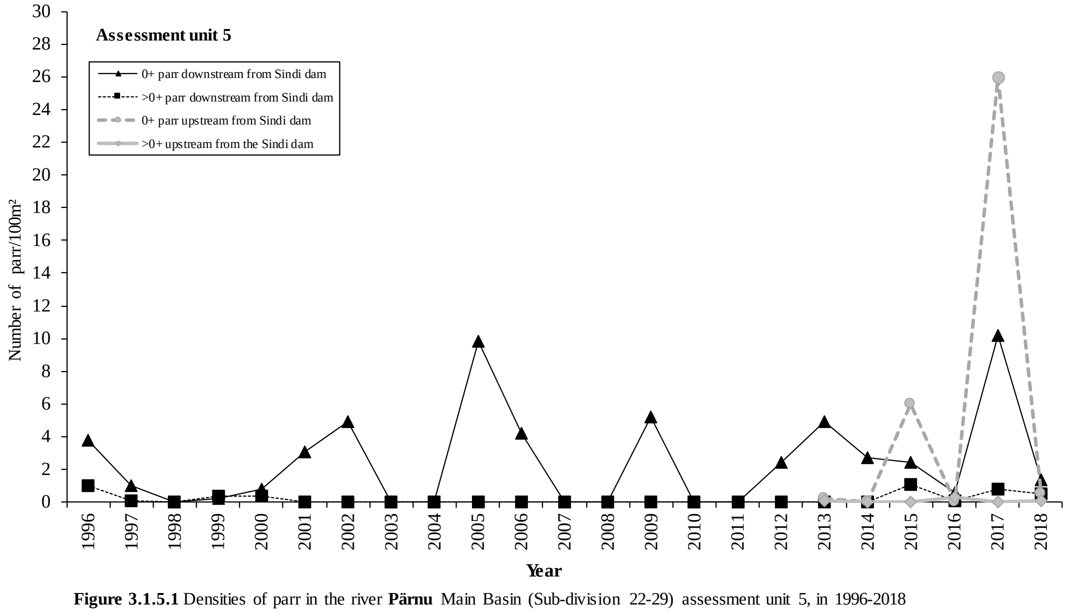


Figure 3.1.5.1 Densities of parr in the river **Pärnu** Main Basin (Sub-division 22-29) assessment unit 5, in 1996-2018

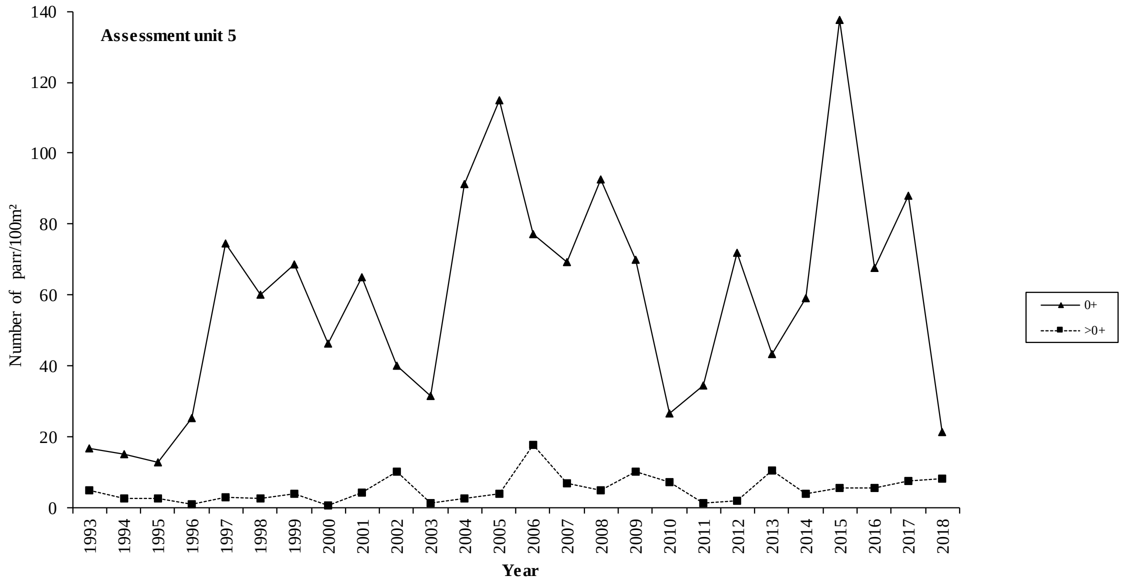


Figure 3.1.5.2 Densites of parr in the river Salaca Main Basin (Sub-division 22-29) assessment unit 5, in 1993-2018.

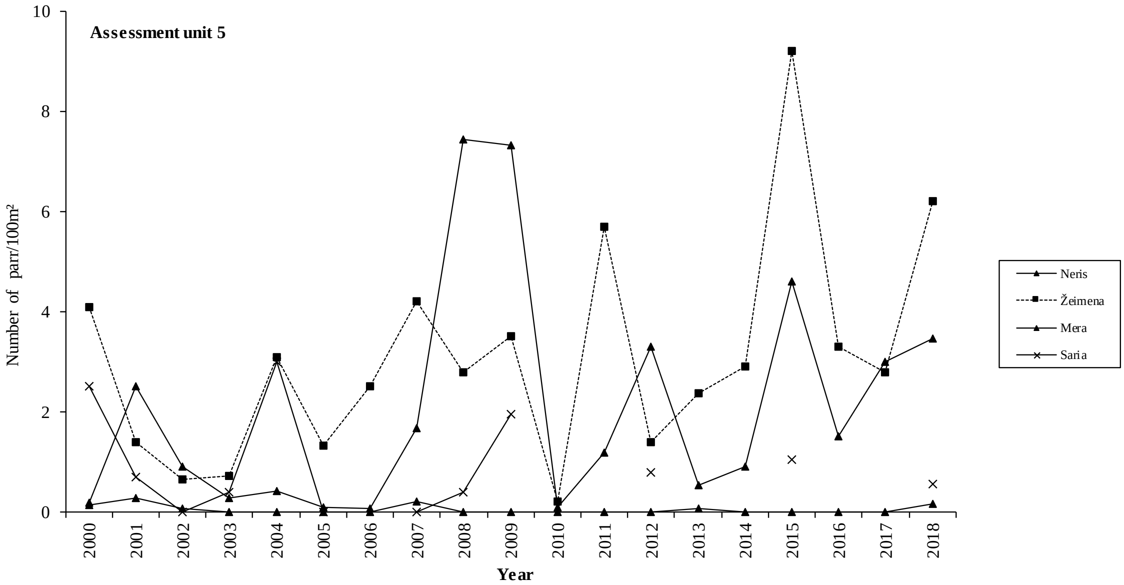


Figure 3.1.5.3 Densites of 0+ parr in Lithuanian rivers in Main Basin (Sub-division 22-29) assessment unit 5, in 2000-2018.

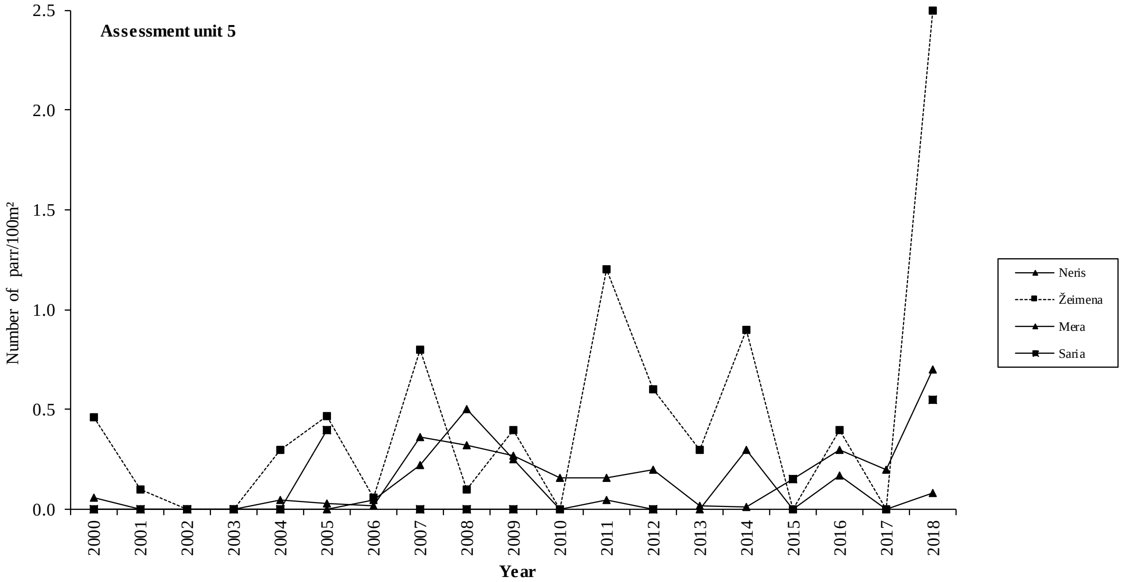


Figure 3.1.5.4 Densities of >0+parr in Lithuanian rivers in Main Basin (Sub-division 22-29) assessment unit 5, in 2000-2018.

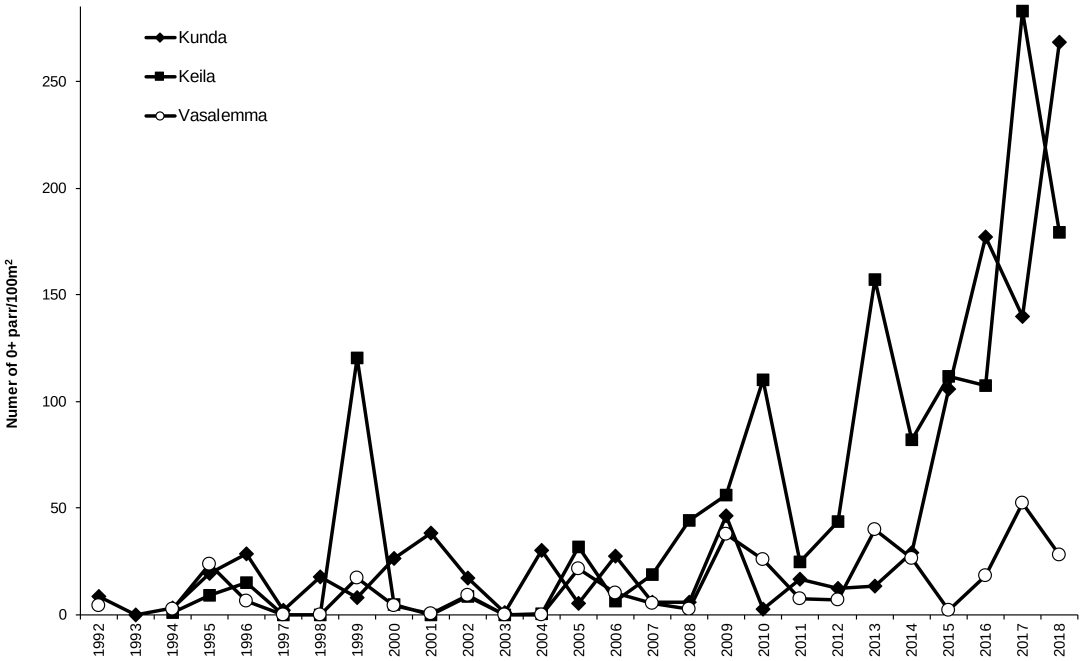


Figure 3.1.6.1. Densities of 0+ (one-summer old) salmon parr in the three wild Estonian salmon rivers

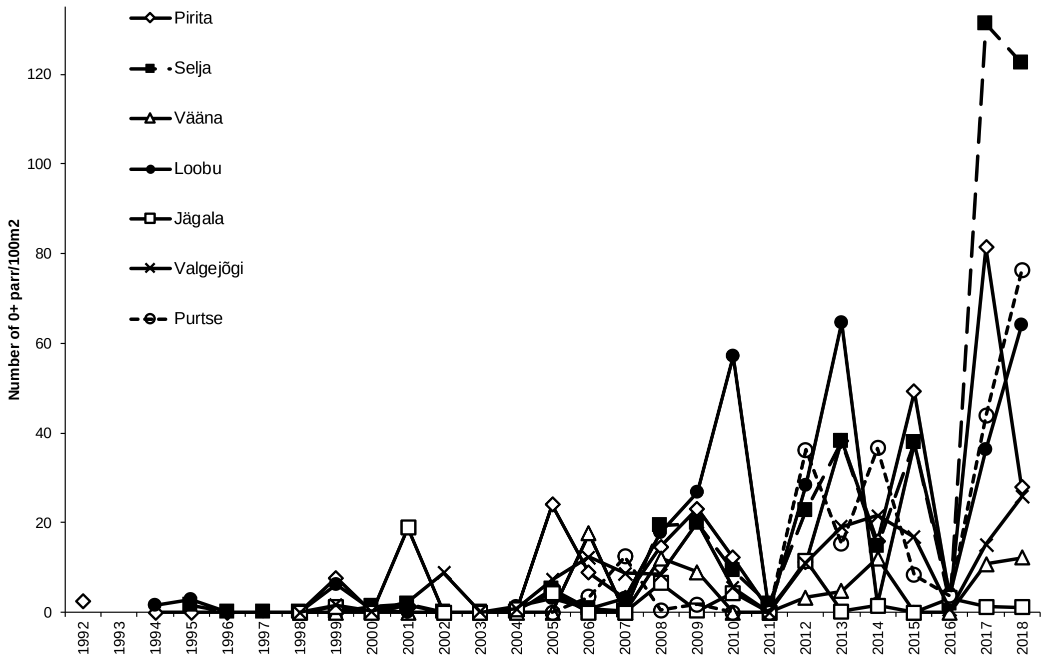


Figure 3.1.6.2. Densities of 0+ (one-summer old) salmon parr in seven Estonian salmon rivers were suportive releases are carried out.

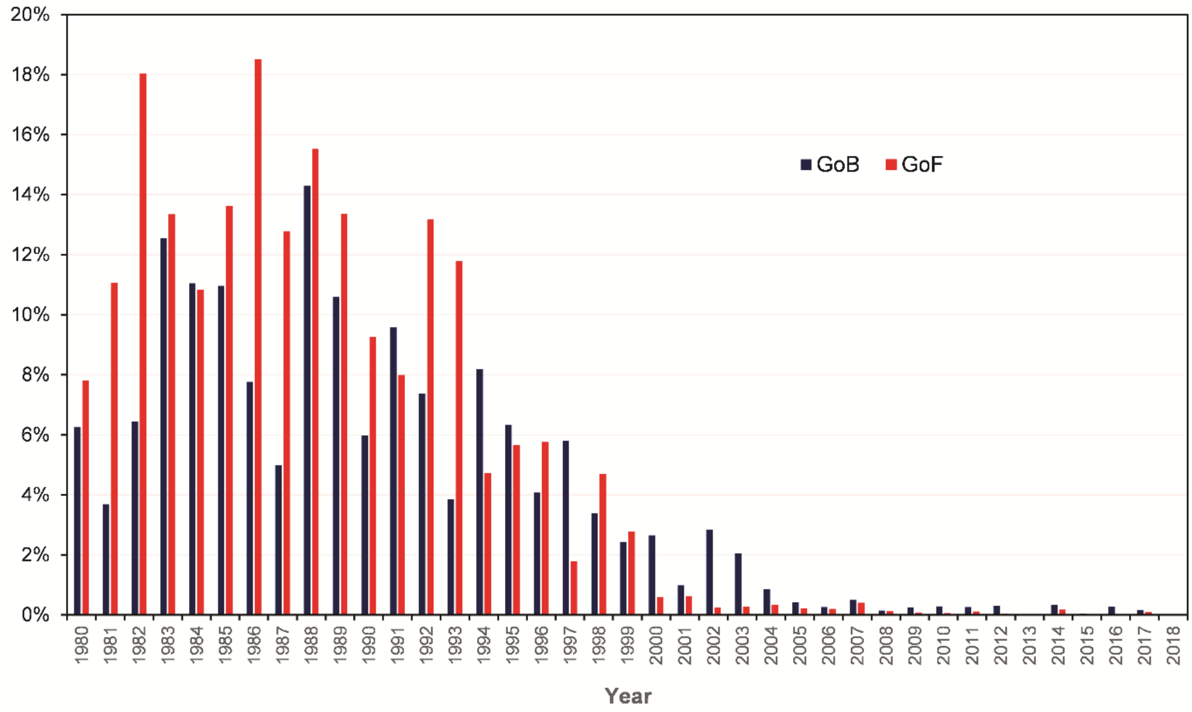


Figure 3.3.3.1. Return rates of Finnish Carlin tagged reared salmon released in Gulf of Bothnia and Gulf of Finland in 1980–2018 (updated in March 2019).

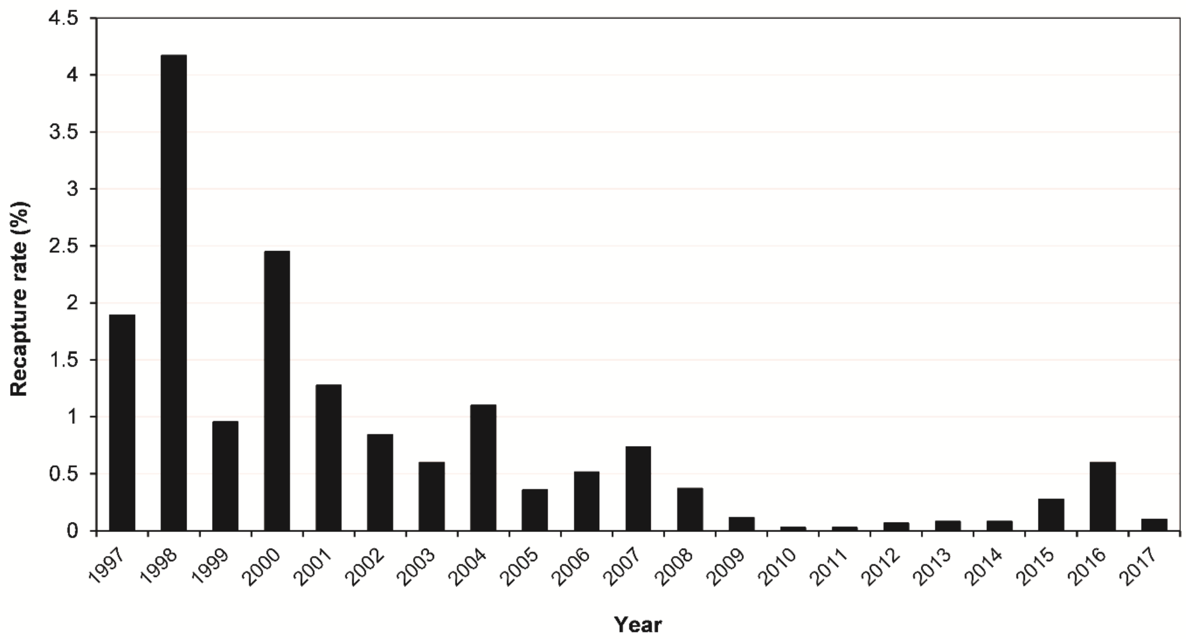


Figure 3.3.3.2. Recapture rate (%) of two-year-old Estonian Carlin tagged salmon in the Gulf of Finland. Carlin tagged from 1997–2014 and T-bar anchor tags since 2015 (updated in March 2019, no returns from 2018 cohort). Year on x-axis is a tagging year.

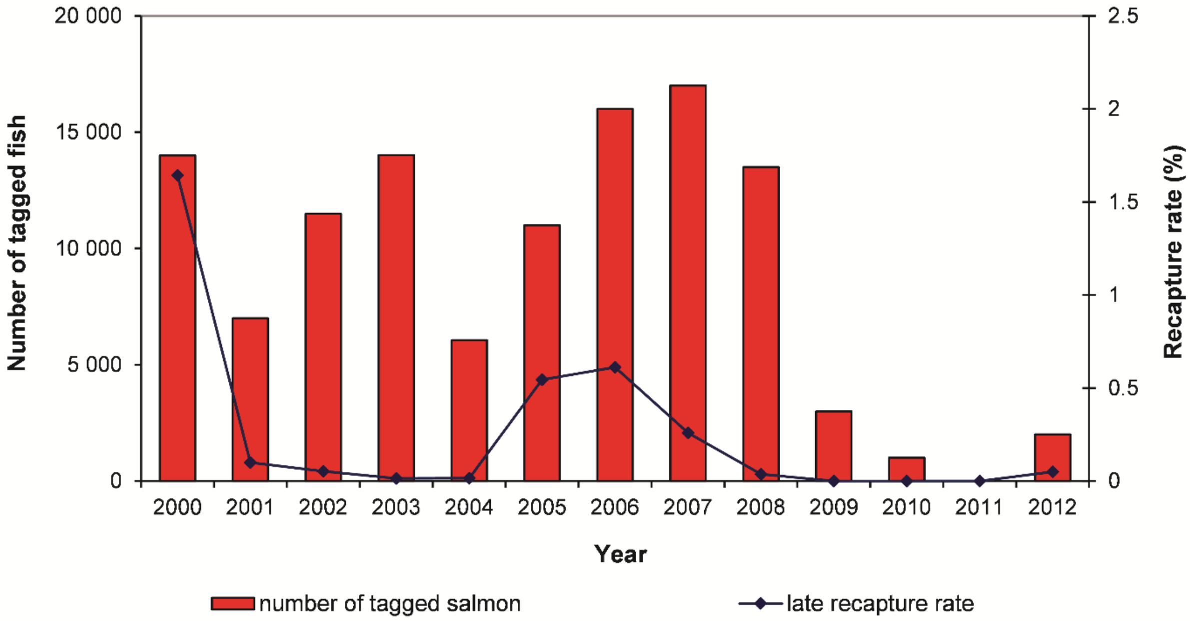


Figure 3.3.3.3. Number of Polish Carlin tagged salmon and return rate (%) for salmon in 2000–2012 (updated in March 2019; no tagging after 2012).

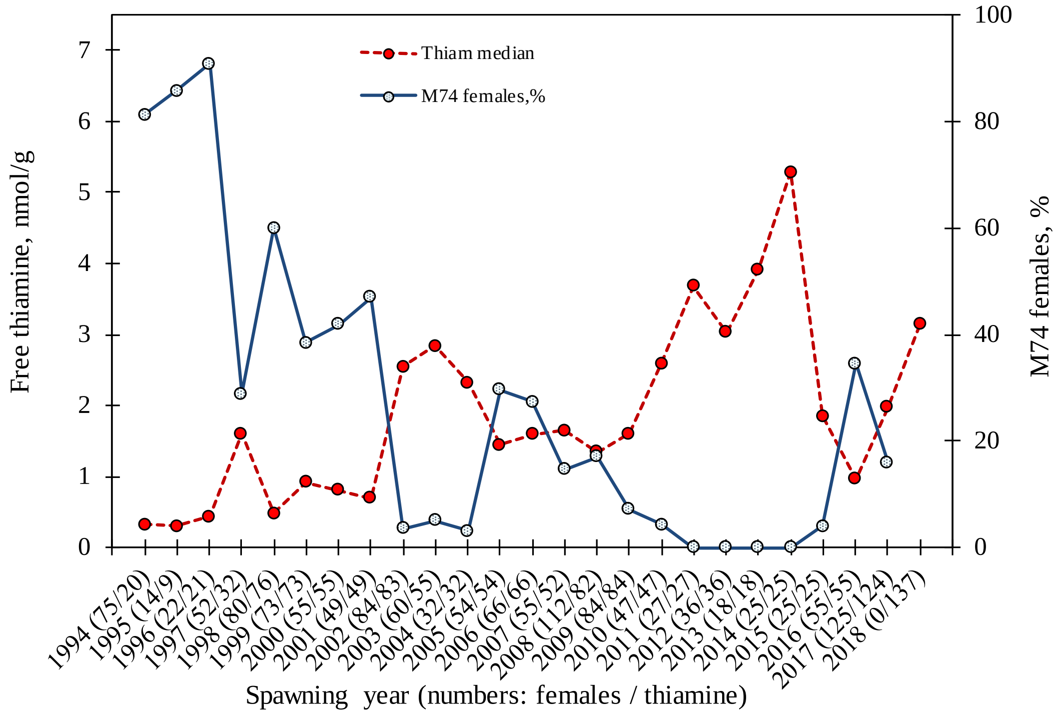


Figure 3.4.1.1. Relationship between the proportion of M74 females and the median concentration of free thiamine in unfertilized eggs of all M74-monitored salmon of the Rivers Simojoki, Torniojoki and Kemijoki (Vuorinen *et al.*, unpubl.).

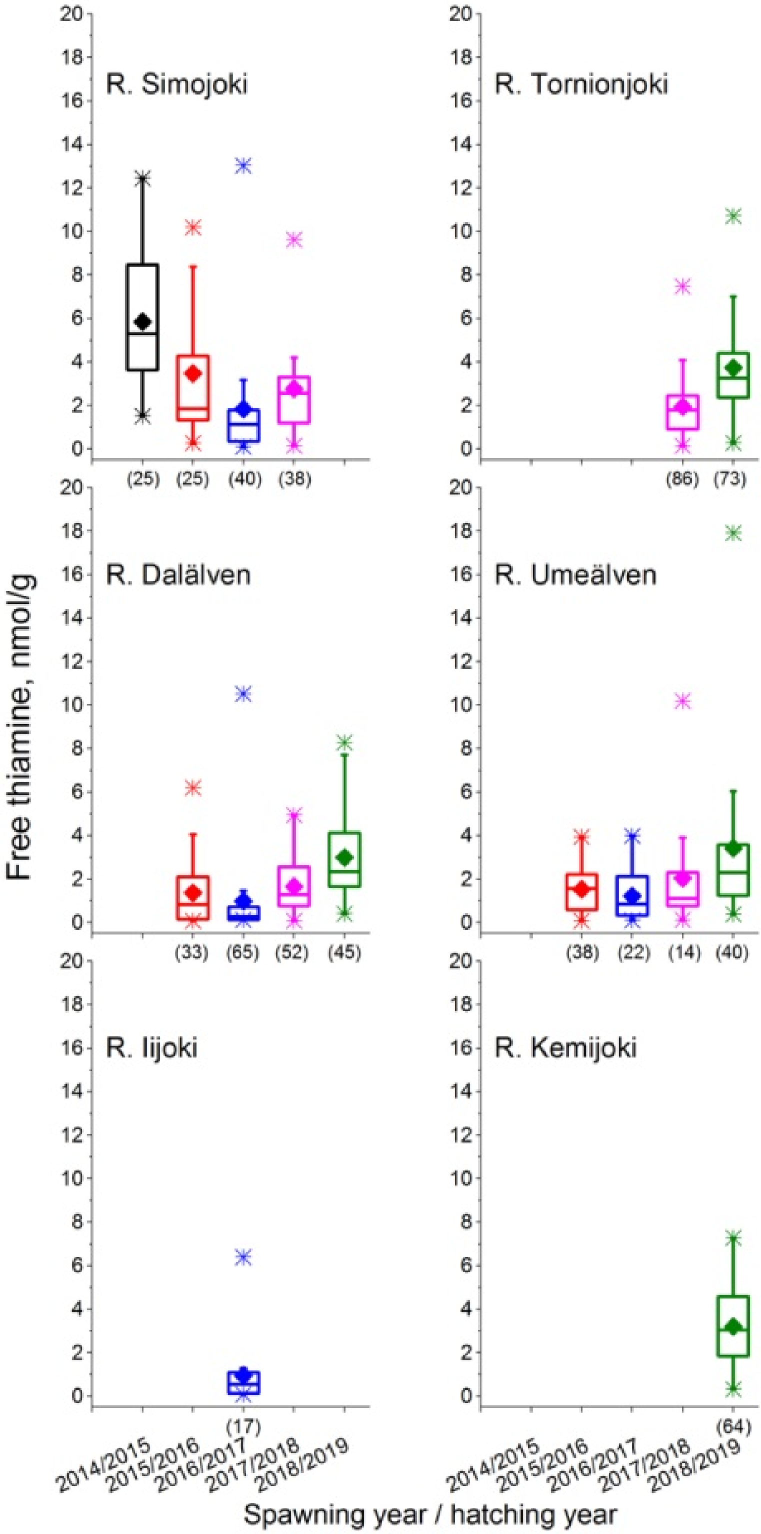


Figure 3.4.1.2. Concentration of free thiamine in the unfertilized eggs of salmon returned to the Rivers Simojoki, Tornionjoki, Dalälven, Ume/Vindelälven, Iijoki and Kemijoki in autumns 2014–2018. Data include female wigglers in autumn 2016 (one in R. Simojoki and 16 in Dalälven) and 2017 (one in R. Tornionjoki), for which an estimated thiamine concentration (0.130 nmol/g) was set. Box depicts the range of 25–75%, horizontal line the median, diamond the mean, whiskers the confidence level of 5–95% and stars the minimum and maximum observations. The reproductive period (spawning year / hatching year) and the number of females (in parentheses) are indicated below the x-axis.

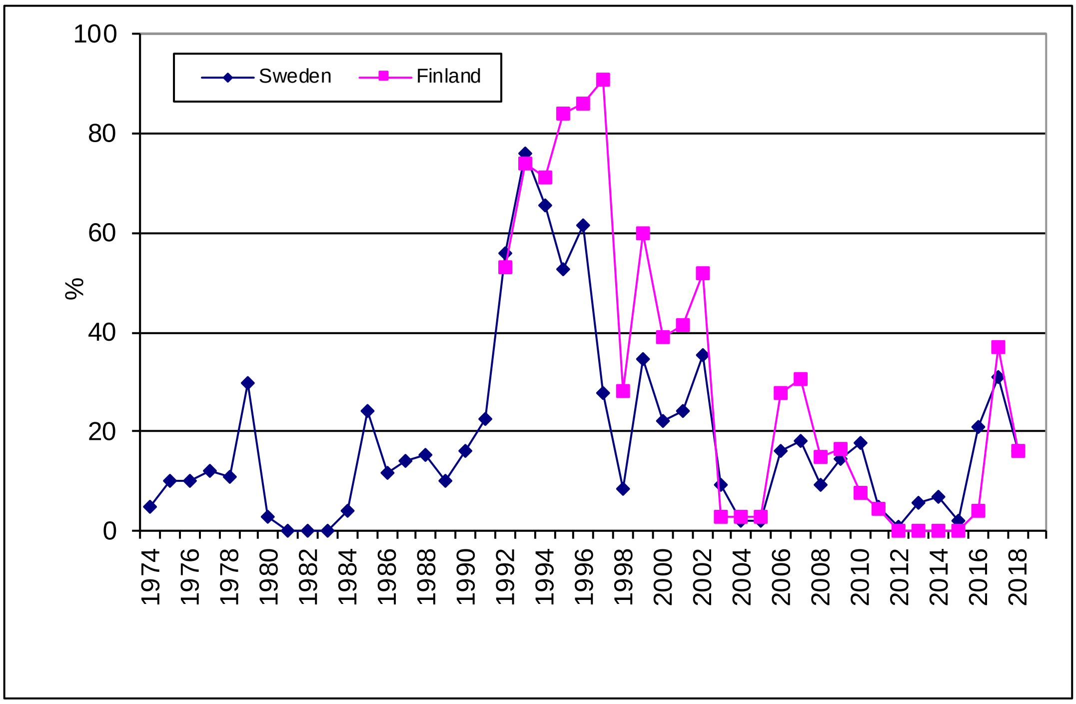


Figure 3.4.1.3. Proportion of M74 positive females in Swedish and Finnish hatcheries. The x-axis shows hatching year.

4 Reference points and assessment of salmon

4.1 Introduction

In this section results of the assessment model and alternative future projections of salmon stocks in assessment units (AU) 1–4 are presented. Furthermore, the current status of salmon stocks in AUs 5–6 is evaluated against the reference points. The methodological basis and details of the assessment model and stock projections are given in the Stock Annex (Annex 2). Here we describe only the methodological updates, which are new and applied for the first time.

Note that, as described below, the modelling results presented in this section are based on one MCMC chain (out of two) which had converged by the time of the working group meeting. An 'extended' (i.e. longer and more converged) run of the model, produced after the meeting, demonstrated that the results presented below approximate converged posterior distributions from two chains well for quantities and parameters used to estimate stock status (results not shown).

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

This section contains updated assessment results, including estimates of current stock status. It also contains information on smaller changes/corrections made since last year to the models.

4.2.1 Changes in the assessment methods

The last benchmark of Baltic salmon (WKBaltSalmon) took place in early 2017 (ICES, 2017c), during which alternative parameterizations for the stock–recruitment function were explored and reviewed. In the text that follows, R_0 and PSPC are used interchangeably to denote smolt production at the unfished demographic equilibrium. Since R_0 now varies by year, the R_0 corresponding to smolt production in 2018 is used below in status evaluations for AU 1-4 salmon. This means R_0 from 2014 for AU 1-3 stocks except Testeboån, where there is a four year delay from egg to smolt; and R_0 from 2015 for AU 4 stocks and Testeboån, where there is a three year delay from egg to smolt. Below, these are referred to as "final year PSPC" or "final year R_0". Figure 4.2.1.2 from ICES 2018a showing prior distributions for R_0 has now been replaced with new Figure 4.2.1.1, showing prior and posterior distributions for K (stock–recruitment carrying capacity) for different stocks.

Small changes to the model are also routinely made between stock assessments to reflect newly acquired knowledge, correct earlier errors etc. These small changes are generally not expected to make significant changes to estimated stock status. Changes made between the 2018 and 2019 assessments are detailed below.

Two changes were made to **the way in which semi-wild salmon** (reared salmon stocked in Tornionjoki and Simojoki which later go on to spawn in these rivers) **are treated** in the model. Firstly, releases of reared fish as parr are now added to the numbers of semi-wild salmon instead of wild salmon, since they are expected to follow the population dynamics of semi-wild salmon stocked as smolts more closely. Secondly, the river harvest rate for wild salmon (as opposed to reared salmon, as earlier) is now applied to semi-wild salmon, since they are thought to be exposed to fisheries in a similar way to wild salmon in the river.

Spawner counting observations for Piteälven are now used directly in the full life-history model (FLHM) instead of using them to produce smolt production priors as earlier. This new way of using the data avoids making assumptions about stock–recruitment parameters outside the model in converting from spawners to smolts, and is also more consistent with how data are used elsewhere in the model.

For **Ume/Vindelälven**, expert opinions on **spawner mortality** after counting were updated between the 2018 and 2019 assessments. Expert opinions on spawner mortality after counting are now given Beta prior distributions within the FLHM, instead of multiplying the annual proportion of females among spawners by the modal proportion that survives after counting, as in last year's assessment. Expert opinions on handling-related reduction in migration success among tagged fish were also updated between 2018 and 2019. These priors are used in the hierarchical Bayesian mark–recapture sub-model for the annual proportion of salmon that finds the fish ladder in Ume/Vindelälven (Figure 4.2.1.2). The sample size of the Binomial observation model for the number of salmon counted in the ladder then becomes the number of tagged fish that continue their migration, rather than the total number of tagged fish.

Ad hoc adjustments to the spawner counting data for **Ume/Vindelälven** were made in 2019 as an interim solution to a problem identified with the **ratio of grilse to MSW spawners** in this river. In recent years, Ume/Vindelälven has had a much higher proportion of grilse relative to multi-sea winter salmon when compared with other rivers, and experts from Sweden and Finland were concerned about effects on parameter estimates (e.g. maturation rates) for other rivers. Therefore in the 2019 assessment, observations for the proportion of MSW salmon among spawners in the years 2015–2018 are not used, and spawner counts for Ume/Vindelälven in the years 2015–2018 are the counts of MSW salmon divided by one minus the average grilse proportion in Tornionjoki and Kalixälven for the year in question. This should maintain approximately correct numbers of model predicted MSW salmon in Ume/Vindelälven given the grilse/ MSW ratio for other rivers.

Effect of changes on results and status evaluations

A separate evaluation performed before the present assessment revealed that the two changes described above for semi-wild salmon in Tornionjoki and Simojoki were associated with increases in estimates of harvest rates of reared salmon in coastal trap net and gill net fisheries, as well as river fisheries. Estimates of post-smolt survival decreased slightly for reared salmon, and increased for wild salmon, leading to an increased ratio of the survival of wild salmon to reared salmon. These changes also appear to have been associated with an approximately 10% decrease in estimate final year PSPC (R_0) for Tornionjoki, and lower historical spawner abundances for the Simojoki stock between 1992 and 2002.

Changes made to Piteälven and Umeälven have affected primarily estimates for parameters and variables for the stock in question. For Piteälven, significant updates of estimated spawner and smolt abundances as well as stock–recruit parameters (higher stock–recruit steepness, lower PSPCs (R_0s) have occurred. This in turn has led to changes in status evaluation compared with the 2018 assessment (probability to reach 75% of final year PSPC, see below).

For Ume/Vindelälven, significant updates occurred for spawner estimates for the years 2014–2017. Smolt estimates were updated downwards, but in many years posterior distributions overlapped to a large extent with last year's estimates.

4.2.2 Submodel results

The **river model** (also called **hierarchical linear regression analysis** with its two versions, one of which is for the northern and the other for the southern rivers, see Stock Annex, Section C.1.5) provides input about smolt production as likelihood approximations (these are sometimes called also ‘pseudo observations’ in the literature, but for simplicity they are usually called ‘smolt priors’ in this report) into the life cycle model, by analysing all the juvenile survey data from the rivers in AUs 1–4. For rivers in AUs 5–6, other methods are used to estimate smolt production (see Stock Annex, Section C.1.5 and ICES, 2017c).

Results of the river model indicate a substantial increase in smolt abundance in AU 1–2 rivers since the late 1990s. Currently (2017–2019), smolt abundance is in its highest level in most of these rivers, but the abundance is predicted to mostly turn to decrease (or to level off) around 2019–2020 (Table 4.2.2.1). Simojoki is a clear exception, because increasing parr densities have been observed in this river even in the latest field season and therefore smolt abundance is predicted to substantially increase in this river also in the near future. The long-term increase in smolt production in AU 3 (Ljungan and Testeboån) is less apparent than in the AU 1–2 rivers, nevertheless smolt abundance is currently peaking also in this AU. However, no parr were observed in Ljungan during the 2018 electrofishing, therefore smolt abundance in this river is expected to collapse in a near future. For the rivers Tornionjoki, Simojoki, Ume/Vindelälven, Rickleån, Sävarån Lögdeälven, Testeboån and Mörrumsån the results of the river model are more informative than for the other rivers, because of the availability of smolt trapping data from one or several years. Also, smolt estimates of years without smolt trapping have become somewhat more precise in these rivers. Smolt trapping has been conducted only in one year in Lögdeälven and Emån, which increases the precision of smolt abundance mainly in that specific year.

A **model for M74 mortality** provides input about fry mortality due to M74 into the life cycle model by analysing all data on incidence of M74 in the stocks (see Stock Annex, Section C.1.6). Figure 4.2.2.1 shows the estimates for M74 mortality (median and 95% probability interval); within the last ten years, the mortality has decreased until the spawning years 2015–2016 when it increased to the level of magnitude of 5–20%. The results from the 2017 spawning (Figure 4.2.2.1) and the predictions made for 2018 spawning (Section 3.4) indicate a return to the low level prevailing before 2015. In general, the percentage of females with offspring affected by M74 overestimates the M74 mortality due to the fact that part of the offspring will die due to normal yolk-sac-fry mortality, unrelated to M74. Also, not all offspring necessarily die when affected by M74. Because of the decreasing trend in mortality among offspring of females affected by M74, the data on proportion of females affected by M74 especially overestimate 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 4.2.2.2 shows the actual values of the M74 mortality for the different salmon stocks. Figure 4.2.2.2 illustrates the probability that offspring of M74-affected females would die, which has been possible to calculate for Simojoki, Tornionjoki and an “unsampled salmon stock”.

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

The full life-history model (FLHM) was run with two chains for 540 000 iterations after an adaptive phase of 10 000 iterations. The first 190 000 iterations were discarded as burn-in and the chains were thinned with an interval of 350 to yield a final sample size of 2000 (1000 iterations from each of two chains). Inspection of traceplots and Gelman-Rubin diagnostics indicated poor convergence for many parameters. On closer inspection it became apparent that one of the chains (chain one) was getting stuck at implausible values for many variables. It was therefore decided to base results on only one chain for this year’s assessment. In order to ensure that the best chain was selected for each parameter and variable in the model, the means from each chain were compared to posterior means from a long converged run of the 2018 assessment model, and the chain with the closest mean was selected for that parameter/variable. Starting with chain 2 as the default, this resulted in 6951 parameter/variables being substituted in from chain one, out of a possible 20 598. Some caution must therefore be taken in the interpretation of results. In the text and figures that follow, medians and 90% probability intervals (PIs) are used where possible as statistics of posterior probability distributions.

The results indicate a decreasing long-term trend in the post-smolt survival until mid-2000, after which survival has generally somewhat improved (Figure 4.2.3.1). The lowest overall survival was estimated for salmon that smolted in years 2005–2006 (median estimate around 6–8% among wild and 5% among reared smolts). Low survivals were estimated for either wild or reared smolts also in some other years of the mid- and late 2010s. Moreover, low survival of reared post-smolts has frequently occurred also in the current decade. After the last decade the survival has increased to an average of 16% for wild smolts and to on average 10% for reared smolts (median estimates ranging from 9–21% and 5–19% among wild and reared post-smolts, respectively). Survival improved especially among salmon that smolted in 2010 and 2014–2015 (Figure 4.2.3.1). After the relatively poor survival among the smolts of 2016, survival is currently relatively high (2017 is the last smolting year with data to estimate).

The adult natural annual survival of wild salmon (median 91%, PI 88–96%) is estimated to be clearly higher than that of reared salmon (median 74%, PI 71–83%). Thus, the difference in total sea survival back to the spawning/stocking site for wild and reared salmon is large both because of the survival difference both at post-smolt and at later stages.

Maturation of 1-sea winter salmon (grilse) has in most years been around 10–25% and 20–50% among wild and reared individuals, respectively (Figure 4.2.3.2). Differences in maturation rates between wild and reared salmon are smaller among multi-sea winter salmon: generally 30–60%, 60–70% and 50–60% of 2SW, 3SW and 4SW feeding salmon have matured, respectively. The estimated maturation rates of 4-sea winter are on average lower than those of 3-sea winter salmon. This is against intuition but might be an artefact due to the inconsistency between current model assumptions (no repeat spawners, all fish mature at latest after five sea winters) and the biology of salmon (some repeat spawners exist and some salmon have a longer lifespan than five years at sea). The maturation rates were generally on low levels around 2010–2011.

The full life-history model allows estimation of steepness of the stock–recruit relationship (Table 4.2.3.1) annual PSPCs (i.e. R_0s) and the recruitment carrying capacity (i.e. K or “maximum smolt production”) (Table 4.2.3.2, Figures 4.2.1.1 and 4.2.3.3) for different salmon stocks. Figure 4.2.3.3 gives an indication of river-specific stock–recruit dynamics. The blue clouds in the figure panels indicate posterior probability distributions of all the historical estimates of yearly egg deposition and corresponding smolt abundance (the density of the cloud indicates the probability). Curves added in the figure panels are draws from the posterior distribution of the Beverton–Holt stock–recruit function.

The annual PSPC (R_0) estimates are generally in most rivers on the same level over the time-series (Figure 4.2.3.4). However, PSPCs were temporally somewhat lower around 2012–2015 in almost all rivers. This phenomenon reflects the fact that natural survival at sea was low in several years during the last decade and these smolt cohorts were also affected by a temporal low maturation rate around 2010 (Figure 4.2.3.2): these unfavourable natural consitions jointly decreased EPR to the extent that it influenced PSPC, especially in the rivers with low steepness of the S/R relationships. In Ume/Vindelälven the recent serious problems for spawners to ascend spawning areas and to stay alive until spawning have dramatically decreased PSPCs of the most recent years (which in the stock status evaluation will be compared against the smolt production in the coming few years). In other words, this stock cannot produce much smolts even in unfished conditions, if problems to access spawning grounds and the related health problems will persist to the same rate as in the last years’ spawning runs. In cases similar to Ume/Vindelälven the stock status should not only be evaluated against (declined) final PSPCs (R0s), although this comparison still reflects the possibilities for fisheries management to affect the stock status. Essentially, the decline in PSPC arising from river specific problems, such as seen in Ume/Vindelälven, may help to quantify these fisheries-unrelated problems, and to compare their severity to the effects of fishing.

Adding one year of information on spawner and smolt abundance together with the latest changes in the model structure has resulted in several changes in posterior probability distributions of the final year PSPC's, as compared with last year (Table 4.2.3.2). PSPCs of several rivers were significantly updated from last year's assessment. The largest updates in the PSPCs took place in Simojoki (AU 1, 33% increase in median), Piteälven (AU 2, -41% decrease), Sävarån (AU 2, 88% increase), Testeboån (AU 3, -71% decrease) and Mörrumsån (AU 4, 23% decrease). Other notable updates (>10% change in median) to the PSPC's are seen in Tornionjoki, Åbyälven, Rickleån and Ume/Vindelälven. As pointed out above, care should be taken in the interpretation of these results because of changes in the assessment methodology (which however are minor between the 2018 and 2019 assessments, see Section 4.2.1), and because changes partially arise from comparing PSPCs of different years in the Table 4.2.3.2 (as a result of the new stock–recruit parameterization; see Stock Annex, Section C.1.2).

The total combined AU-specific final year PSPC estimates changed from the last year's assessment only by a few percent in AU 2. However, as the combined PSPCs decreased in all the AUs 1–4 (by 4–57% depending on the AU), the total PSPC of all these AUs combined decreased by 9%. Expert based estimates were updated in two rivers of AU 5 (in Pärnu due to recent removal of a dam and in Barta due to new habitat inventory) and in two rivers also in the AU 6 (Vasalemma and Valgejogi due to removal of dams). These updates increased the combined PSPC estimates of both these AUs by 7%. The estimated grand total PSPC of AUs 1–6 (median 3.83 million) is 7% (283 000 smolts) smaller than the corresponding estimate from the last year's assessment.

Since the mid-1990s, the status of many wild salmon populations in the Baltic Sea has improved, and the total wild production has increased from less than 0.5 to about three million smolts (Figure 4.2.3.5, Table 4.2.3.3). There are significant regional differences in trends in smolt production. For the wild salmon stocks of AUs 1–2, the very fast recovery of smolt production indicates high steepness for stock–recruit relationships in these rivers. The recovery is most pronounced in the largest rivers, but recently also the salmon stocks spawning in the smaller 'forest rivers' of the region (Åbyälven, Rickleån, Sävarån, Öreälven, Lögdeälven) have speeded up their recovery. However, their stock status (current production level against the potential) is generally assessed to be lower than that of the larger salmon rivers, as discussed below. The two wild stocks in AU 3 have also recovered, but the estimates of both the current and the potential smolt production of these rivers are highly uncertain. In AU 4 the Mörrumsån stock has stayed relatively stable, while the abundance in Emån has been gradually increasing. In contrast, all AU 5 stocks except Nemunas and Pärnu are showing a decreasing trend in smolt abundance, which is currently alarmingly low in many AU 5 rivers (see more details in Section 4.2.4).

By comparing the final year (2018) posterior smolt production (Table 4.2.3.3) against the posterior PSPC for that smolt cohort (i.e. PSPC in 2014 spawning for AU 1–3 stocks and PSPC in 2015 spawning for AU 4 stocks) it is possible to evaluate the current status of the stocks in terms of their probability to reach 50% or 75% of PSPC (Figures 4.2.3.6 and 4.2.3.7, Table 4.2.3.4). Table 4.2.3.4 also contains wild and mixed AU 5–6 stocks, which are currently not included in the FLHM. These stocks have not been analytically derived, but expert judgments are used to classify their current status; see Section 4.2.4.

The perception about the overall status of stocks (amount of stocks in different status classes) has not changed much compared to the last year's assessment. All stocks in the AU 1 except Råneälven are estimated to have very likely reached 50% of their PSPCs, and two out of four stocks have likely or very likely also reached 75% of their PSPCs. The stock of Tornionjoki has very likely reached even 75% of its final year PSPC. The lowest status in the AU 1 has been assessed for Råneälven and Simojoki: it is uncertain if these stocks have reached 75% of their PSPC (Table 4.2.3.4). Four out of nine stocks in the AU 2 are likely or very likely to have reached 50% of their PSPCs, but only three have (likely) reached the 75% target. The stock of Lögdeälven has unlikely reached even the 50% target, and Kågeälven, Rickleån, Sävarån and Öreälven are uncertain to have reached this target. In AU 3, Ljungan is uncertain to have reached 50% and 75% of PSPC, whereas Testeboån is very likely and likely to have reached the respective targets. In AUs 4–5, only Mörrumsån has likely or very likely reached both of the targets, whereas all the remaining 13 stocks are uncertain or unlikely to have reached even the 50% target (Table 4.2.3.4).

The final year PSPC of Testeboån estimated by the FLHM is much smaller than the expert estimate used in the last year's assessment (Table 4.2.3.2), and as a consequence, the status of Testeboån is perceived as good. In Testeboån smolt production has not increased in spite of decreasing fishing pressure, which in the model can only arise from the river being close to PSPC (because the model does not take into account extra losses/mortalities like decreased migration success in this river). This bias is discussed in more detail in Section 4.4.2.

Out of the 41 assessed wild and mixed stocks in Table 4.2.3.4, 32% (13 stocks) are likely or very likely to have reached 50% of final year PSPC, and 24% (ten stocks) are likely or very likely to have reached 75% of final year PSPC. The corresponding proportions calculated only for the 27 wild stocks are 44% and 33%. Generally, the probability to reach targets is highest for stocks in the largest northern rivers.

A total of nine wild and 12 mixed-stocks are unlikely to have reached 50% of (final year for AUs 1–4) PSPC, i.e. they are considered to be weak. All except two of the weak stocks are located in AUs 5–6. While most of the AUs 1–2 stocks show strong indications of recovery over the years, the stocks in AUs 4–5 have mostly been unable to recover. Stocks in rivers situated between these areas (i.e. AU 3 and AU 6 stocks) have mostly shown modest indications of recovery (Figures 4.2.3.6, 4.2.3.7 and Section 4.2.4).

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

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

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

In Kalixälven, Åbyälven and Rickleån the development of spawner abundance estimated by the model appears more optimistic than the development observed in the fish ladder counts. In Kalixälven, the counter is located about 100 km from the river mouth with large spawning areas downstream. In Åbyälven and Rickleån fishladders were constructed around the turn of the millennium and salmon are gradually repopulating the upstream sections. Therefore, counts in these rivers account for a small fraction of the total spawner population and the counts may not well represent the actual development of the salmon stocks.

Unlike in the other AU 1–3 stocks, the amount of spawners has dramatically dropped in Ume/Vindelälven during the last five years. Fish ladder counts have not dropped as much as the model estimated numbers of spawners (Figure 4.2.3.10 vs. Table 3.1.1.2 and Figure 3.1.1.3). This is due to the need to accommodate Ume/Vindel stock dynamics in the FLHM to the extra losses among female salmon to reach spawning grounds in this river (see Section 4.2.1 and Stock Annex, Section C.1.9). The drop in spawner abundance in Ume/Vindelälven is expected to dramatically decrease smolt production in the near future (Table 4.2.3.3 and Figure 4.3.2.8c), which may push this stock into serious decline.

The general synchronous drops and increases in the observed spawner counts are well captured by the model, also the most recent drop observed from 2016 to 2017–2018. This is probably a consequence of fitting the model to spawner counts in combination with assuming annually varying maturation rates; maturation rates are estimated to be lower preceding poor spawning runs and higher preceding high spawning runs (Figure 4.2.3.2 vs. Figure 4.2.3.10). Also, the effect of annually varying post-smolt survival is visible in spawner counts and estimates, e.g. the survival of the 2016 smolt cohort contribute to the low spawner abundance especially in 2018. For 2019, the FLHM predicts increasing spawner abundance in all the rivers. This prediction must, however, be taken with caution, because the prediction is very uncertain and e.g. natural conditions at sea during the spring 2019 (not currently well known/predicted) are also modifying the spawning run strength via maturation rates and run timing.

Despite some fluctuations, there was a strong long-term decreasing trend in the harvest rate of driftnets until the total ban of this gear type in 2008 (Figure 4.2.3.11a). The harvest rate of longlining has been fluctuating a lot (between less than 0.1 to almost 0.3 among MSW salmon) without any trend, and after the peak in 2009–2011, this harvest rate has stayed on the level of magnitude of 0.1–0.2. The combined offshore harvest rate (driftnetting and longlining) shows a clearly decreasing trend from about 0.5 in the early 1990s to about 0.15 in the last years (Figure 4.2.3.12). However, trolling, which is mostly offshore fishing, has increased until mid-2010s (Section 2), and it currently accounts for about 20–30% of the of the total offshore catches (30–50% if estimated misreporting of salmon as trout is not accounted for). When considering also this fishery, the total offshore harvest rate has apparently not decreased as much as indicated by Figure 4.2.3.12. Since the early 2000s the coastal harvest rate, which is predominantly trapnet fishing, has decreased almost continuously (Figures 4.2.3.11b and 4.2.3.12). Estimates of harvest rates in the rivers are inaccurate and lack a clear trend in the last ten years (Figure 4.2.3.11c). River-specific data indicate that there can be substantial variation in the harvest rate between rivers (Section 3.1), which are currently 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 **AU 5 stocks** shows a negative trend in almost every wild and mixed river (Figures 4.2.4.1 and 4.2.4.2). During the last decade, smolt production dropped from 50% or higher to below 50% of PSPC. Thereafter smolt production has stayed on this low level except for in 2015–2016, when a sudden temporal increase was observed in most rivers (Figure 4.2.4.1). In 2017 and in 2018, most AU 5 rivers were estimated to produce just about

10–30% of their PSPCs and they are therefore unlikely to reach 50% (given the associated uncertainties in estimation; Table 4.2.3.4). In river Pärnu the smolt production has shown small signs of improvement. The second river in AU 5 which shows limited positive development is Nemunas. This is a large watercourse with several tributaries, and many of them have been subject to long-term restoration efforts (habitat restorations, stocking, etc. see Sections 3.1.5 and 3.2.2). Observed smolt production in the Nemunas in relation to PSPC has remained far below 50% level.

Rivers Salaca (AU 5) and Mörrumsån (AU 4) are both well-known salmon rivers with the most extensive and longest time-series of monitoring data in the Main Basin area (Sections 3.1.4 and 3.1.5). The developments of parr densities in these two rivers roughly resemble each other since the early 1990s; an increase in the densities from the early to the late 1990s and a subsequent decrease starting in the early 2000s. Smolt production in Salaca in 2017 and 2018 was below PSPC and a further decrease is predicted for 2019.

Smolt production in the **AU 6 stocks** shows positive trends in most rivers but also a large interannual variation, especially in the smallest rivers (Figures 4.2.4.3 to 4.2.4.5). Among wild (Figure 4.2.4.3) and mixed (Figure 4.2.4.5) Estonian stocks the clearest positive trend exists in two of the wild ones (Keila and Kunda) which have reached 75% of their PCPCs. Smolt production in wild Vasalemma has also increased in recent years, however it has remained below 50% of PSPC (Figure 4.2.4.3). In 2018, the Vanaveski dam was opened and salmon got access to additional spawning areas upstream. Therefore, PSPC in Vasalemma is now estimated to be higher than in previous years.

In the small Estonian mixed stocks the smolt production was mostly low in 2017–2018, but an increase is expected in 2019 (Figure 4.2.4.4). Current PSPC in some of these rivers is severely limited by migration barriers, and parr densities show a lot of interannual variation in these small populations. PSPC in mixed river Valgejõgi has increased since 2016 (from 1500 to 16 500 smolts) because salmon regained access to all potential historical spawning and rearing areas.

In the Finnish mixed river Kymijoki no clear positive trend can be seen, although occasional stronger year classes have occurred. The smolt production has nevertheless remained far below the 50% level. In Russian river Luga, wild smolt production is stable but low, and it has remained below 10% of PSPC despite large-scale annual smolt releases using salmon of local origin (Figure 4.2.4.5).

4.2.5 Harvest pattern of wild and reared salmon in AU 6

About 90% of the salmon catches in Gulf of Finland are taken from the northern coast by the Finnish commercial coastal fishery. Genetic analyses of the stock composition (see Section 2.6) of Finnish commercial catches show that the largest stock contribution (50%) was from locally released reared Neva salmon, whereas wild stocks originating from the Gulf of Bothnia contributed with 30% and released Gulf of Bothnia stocks with about 15%. The share of Eastern Main Basin stocks was less than 5%. It should be noted, however, that there were pronounced differences between sampling sites and sampling times between the years (Section 2.6). The share of Gulf of Bothnian salmon was clearly higher during the early fishing season (June), whereas the share of Gulf of Finland Neva salmon was high later in the season. The proportion of other Gulf of Finland stocks (Russian and Estonian) in the genetically analysed catch samples from the northern Gulf of Finland have been estimated to zero or close to zero (<0.5% Kunda in 2017, Table 2.6.3).

Stock composition of Estonian coastal catches from 2016–2018 was for the first time genetically studied in this year's report (Section 2.6). The catch composition differed substantially from the Finnish coastal catches from the northern Gulf of Finland. On average over 80% of the catches consisted of local wild and released stocks, whereas Eastern Main Basin stocks contributed with about 10% on average and Gulf of Bothnian stocks contributed with less than 5%.

These results suggest that the main salmon fishery in Gulf of Finland that takes place at the Finnish coast has little effect on the Estonian wild populations. In contrast, the small and geographically restricted Estonian coastal fishery mainly harvests Estonian wild stocks. The present harvest rate seems to be on a sustainable level, as the Kunda and Keila populations are estimated to have good status. An increase in smolt production has also occurred in river Vasalemma.

Salmon fishing in Russian coast is not allowed. Despite this, the river Luga stock has remained on a very low level over the years. Circumstantial data indicate a high level of poaching at the river mouth and in the river, which may be a main reason for the low stock status.

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 assumptions on which the stock projections are based. The basis has been kept as similar to the last full assessment (ICES, 2018a) as feasible, in order to allow for a review of how the new information is affecting projections.

Fishing scenarios

The base case scenario (scenario 1) for future fishing (2020 and onwards) equals to the commercial catch advised by ICES for 2019, i.e. the median commercial removal would equal to 116 000 salmon. Scenarios 2 and 3 correspond to a 20% increase and 20% decrease from the scenario 1, respectively. Scenario 4 equals to an F=0.1 harvest rule, applied for total commercial removals. Scenario 5 illustrates stock development in case all fishing (both at sea and in rivers) was closed. Scenario 6 illustrates how recreational fishing alone would affect stock development. Scenario 7 represents a situation where recreational sea fisheries and river fisheries where absent, and only commercial sea fishery would be operational with a removal of 116 000 salmon. Finally, scenario 8 represents a 100% increase in commercial removal compared to scenario 1.

Similar to in previous years, fisheries in the interim year (2019) follow the scenarios, except for longline fishing during the first months of the year, which is estimated based on the effort observed during the corresponding months of 2018.

Scenarios were computed by searching an effort that results in a median catch that corresponds to the desired total sea catch (depending on the scenario) in the advice year (2020). For example, in scenario 1, the total sea catch (141 500 salmon) consists of total commercial sea catch (116 000 salmon) and total recreational sea catch (25 500 salmon). The recreational sea catch in 2020 varies slightly between all scenarios (Table 4.3.2.1.) except in scenarios 5 and 7, which assume closure of all recreational fisheries. The variation is caused by the assumption that the recreational sea effort would stay the same over the scenarios while number of salmon available to recreational fishery varies according to commercial removal. Scenario 6 provides the baseline recreational catch of 26 900, against which the recreational effort is estimated and used in other scenarios. The recreational catch in 2020 consists of an estimated three year average (2016–2018) offshore trolling catch (17 600 salmon) and reported recreational catches other than offshore trolling in 2018 (9300 salmon). Because the current model framework does not allow inclusion of recreational fisheries as a separate fishery, it is technically included as a part of offshore longline fishery, as described in Section 4.6.1.

Because the scenarios are technically defined in terms of future fishing effort, the predicted catches have probability distributions according to the estimated population abundance, age-specific catchabilities and assumed fishing effort. Scenarios 1–4, 7 and 8 assume the same fishing pattern in commercial fisheries (division of effort between fishing grounds) as realized in 2018. Figures 4.3.2.1a–d show the harvest rates prevailing in the scenarios.

In all scenarios, it is also assumed that the commercial removal reported under the TAC covers 53% of the total commercial sea fishing mortality, whereas 47% of this mortality consists of discards, misreported, and unreported commercial removals. This corresponds to the situation assessed to prevail in 2018 (Figure 4.3.2.9).

Survival parameters

In both the M74 and the post-smolt mortality (Mps) projections, an 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 2014–2017 (14%), variance over the same time-series and the autocorrelation coefficient are taken from the historical analysis into the future projections. The method for M74 is similar, but the stable mean for the future is taken as the mean over the whole historical time-series (83%). In addition, the forward projection for Mps is started from 2017 to replace the highly uncertain model estimate of the last year of the historical model and the future uncertainty is adjusted to accommodate the range of historical variation in M74. The starting point of M74 projections is 2019. Time-series for Mps and M74 survival are illustrated in Figure 4.3.2.2.

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

Maturation

Annual sea-age group-specific maturation rates are given as the average level computed over the historical period, separately for wild and reared salmon. This projection starts from 2020, as the maturation rates of 2019 can be predicted based on sea surface temperature (SST) information from early 2019 (ICES, 2014, Annex 4). The time-series of maturation rates are presented in Figure 4.3.2.3.

Releases of reared salmon

The number of released reared salmon per assessment unit is assumed to remain at the same level in future as in 2018 (Table 3.3.1).

4.3.2 Results

According to the projections, stock size on the feeding grounds (pre-fishery abundance, PFA) will be about 1.4 (0.47–3.6) million salmon (wild and reared, 1SW and MSW fish in total) in 2020 (Figure 4.3.2.4a–b). 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 0.66 (0.25–1.62) million salmon. These MSW fish will be fully recruited to both offshore and coastal fisheries in 2020. From the predicted amount of 1SW salmon (0.71 million, 0.16–2.14 million) at sea in spring 2020, a fraction (most likely 20–40%) is expected to mature and become recruited to coastal and river fisheries, while the rest of the 1SW salmon will stay on the feeding grounds and will not become recruited to the fisheries until next winter.

The abundance of wild salmon at sea has fluctuated without any apparent trend until 2010. During the current decade the abundance has on average been higher than before, at or above one million (according to median values for 1SW and MSW wild salmon combined) (Figure 4.3.2.4 a–b). Except for the high fishing scenario (8), the abundance of wild salmon is predicted to stay with high probability on this elevated level in the future.

Because one of the simplifying assumptions of the modelled life cycle is that all salmon die after spawning, a lower maturation rate will increase the survival of the cohort to the next year compared to years with the same abundance but with average maturation. Similarly, a high maturation rate will decrease the abundance of MSW salmon in following years. Because of this feature, it is important to note that the predicted abundance may easily become over- or underestimated because of the (predicted) development of maturation rates.

In contrast to wild salmon, the abundance at sea of reared salmon strongly decreased from the mid-1990s to the late 2000s, mainly due to the decline in post-smolt survival. In some occasional years in the early 2010s, substantial amounts of reared salmon have been assessed to recruit to the fisheries (which may be an artefact due to the poor estimation of e.g. Mps in those years, see Section 4.2.3), but thereafter the abundance has stayed on a rather low level, and it is predicted to stay low also during the coming years. The combined wild and reared abundance (PFA) also declined substantially from mid-1990s until late 2000s, but thereafter the total abundance has increased and is (except in scenario 8) expected to stay on this elevated level in future (Figure 4.3.2.4a–b).

Table 4.3.2.1 shows the predicted total catch by scenario for year 2020, divided into the following components:

- commercial wanted sea catch, consisting of reported, unreported and misreported;
- commercial unwanted sea catch, consisting of discarded undersized and seal damaged salmon;
- recreational sea catch; and
- catch in the rivers.

The table also shows the predicted fishing mortality (separate F of commercial fishing and F of all sea fisheries) as well as the predicted number of spawners in 2020 for the given fishing scenarios.

The amount of unreporting, misreporting and discarding in 2020 is based on the expert evaluated share of those catch components compared to the reported catches in 2018 fisheries. In 2018, the wanted catch reported (commercial) accounted for about 53% from the corresponding estimated total commercial sea catch (i.e. total fishery related mortality). Unreporting, misreporting and discarding in 2018 are considered to take about 5%, 31% and 11% shares of the total commercial sea catch, respectively. The share of the total catch by its components for the period 1987–2018 is illustrated in Figure 4.3.2.9. It is important to keep in mind that future changes in either fishing pattern or in fisheries control may easily lead to changes in the share of catch caught under the quota regulation.

Within scenarios 1–4 the predictions indicate that the wanted catch reported (commercial) in year 2020 would be 55–82% (50 000–75 000 salmon) compared to the TAC of 2019 (Table 4.3.2.1).

The corresponding total sea removal (including recreational fishing) would range from 119 700–166 100 salmon. The harvest rule of $F_{0.1}$ for commercial catch (scenario 4) results in a wanted catch reported of 72 200 salmon and an about 4% smaller spawning stock than under Scenario 1. The amount of spawners would be about 4% higher in Scenario 3 than in Scenario 1, and the zero fishing scenario indicates about 55% increase in the number of spawners compared to the scenario 1. The scenario 'recreational fishing only' (6) illustrates the magnitude of the current level of the recreational fishing which is predominantly angling in rivers and trolling at sea: recreational fishing alone would decrease the number of spawners by 22% compared to the zero fishing scenario. Figure 4.3.2.5 illustrates the longer term development of (reported) future catches given each scenario.

Figure 4.3.2.6a–e presents the river-specific annual probabilities to meet 75% of the PSPC under each scenario. Under the scenarios 1–4, different amount of fishing has small influence on the level but not on the trend of the probability of meeting 75% over time. Scenarios with severely increased (8) or decreased fishing (5,6,7) diverge clearly. It is noteworthy that the status of Ume/Vindelälven is expected to decline even in the zero fishing scenario (5). The reason for this is the recent high mortality of spawners (especially females) entering the river (see Sections 3.1.2, 3.4.4 and 4.4.1).

As expected, changes in fishing have the smallest effect to those stocks that are close to their PSPC. Because the overall level of fishing effort is rather low in these scenarios compared to history, the examined range of fishing mortality within scenarios 1-4 only results in modest impacts on the chances of reaching the management objective. Table 4.3.2.2 compares the probabilities of reaching the 75% target around years 2024–2025, which are approximately one full generation ahead from now. Evidently, the probabilities are higher for effort scenarios with low exploitation, but differences between scenarios are small except for scenarios 5 to 8. Figure 4.3.2.7a–c illustrates by scenario the rate and the direction of change in smolt abundance in 2024/2025 compared to the smolt abundance in 2018. Future predictions about smolt abundance are naturally more uncertain than the estimated abundance in 2018. However, in those stocks that are close to their PSPC, also the predictions are rather certain, indicating that smolt abundance will stay close to PSPC in these rivers under different fishing scenarios.

Figures 4.3.2.8a–e show longer term predictions in the river-specific smolt and spawner abundances for three scenarios (1=removal which corresponds to ICES advice for 2019; 8=100% increase to ICES advice for 2019; and 5=zero fishing). The two most extreme scenarios, (5 and 8) illustrate the predicted effects of contrasting amounts of fishing.

4.4 Additional information affecting perception of stock status

This section focuses on auxiliary information of importance for a complete evaluation of the current stock status. In particular, we highlight information about diseases and other factors that may affect development in stock status, but which are not fully taken into consideration in the current modelling. Likewise, weaknesses in input data used in the assessment model might affect the precision of status evaluations, and in the worst case introduce biases. Such shortcomings in the current assessment model, when it comes to input data and ways of handling those, are also discussed under this section. An example is the ongoing work of updating prior information on production areas and potential smolt production levels in salmon rivers, which may affect status evaluations of individual stocks.

4.4.1 Potential effects of M74 and disease on stock development

If the higher levels of M74-mortality observed in 2016–2018 should last for several years, this may gradually result in decreased stock status and reduced fishing possibilities. Occurrence of M74 more than half a year ahead cannot currently be predicted (thiamine level in the spawned eggs indicates quite well M74 mortality among the hatching offspring, see Section 3.4), but many of the M74-fluctuations seen since the early 1990s have tended to last for some years before changing in direction (Figure 3.4.3). The latest thiamine analyses of eggs spawned in 2018 indicate that M74 mortality among offspring is predicted to be somewhat lower in 2019 as compared to 2018 and 2017, which may indicate a decreasing trend. The disease outbreaks reported in several rivers in recent years (Section 3.4.4) is also a concern for the future. In contrast to M74, the cause(s) of the disease is still unknown, and to accurately quantify the amount of affected or dead salmon in a river appears difficult, if at all possible.

The currently existing information indicates that health issues among Baltic salmon - such as M74 and diseases increasing mortality among spawners - only affect the number of eggs deposited or hatched or the number of dispersing fry. That is, losses take place before the offspring stages with highest density-dependent mortality. Therefore, a stock with high status is expected to show more resilience against various events that negatively affects early reproduction (i.e. from egg deposition to dispersal of fry), because these effects may partly be compensated by reduced density-dependent mortality among the offspring. In contrast, weaker populations are not expected to have similar 'buffers' against such losses.

Average salmon 0+ parr densities in 2017–2018 have decreased somewhat compared to the historically high densities observed in many rivers around year 2015. Part of this may be explained by generation effects, i.e. variation in year class strength among spawners, but increase in mortality due to M74 and/or other disease outbreaks could also be part of the explanation. Compared to other rivers, the recent negative development in parr densities in **Vindelälven** and **Ljungan** is exceptional**.** In **Vindelälven,** the average 0+ density dropped drastically, from ca. 40 parr/100 m^2 in 2015 to only ca. one parr/100 m^2 in 2016, and has remained at very low levels since then (Table 3.1.2.1). The decline likely reflects a combination of factors. In 2015, only 790 females were counted in the Norrfors fish ladder, which represented just 11% of the spawning run (18% among MSW salmon, if assuming 6% females among grilse). In 2016, the number of females counted was higher (2741), but a large proportion of the salmon passing the ladder had severe skin problems (fungus infections) and many died soon after having been counted (see Section 4.2.1. on how this additional mortality has been handled in the assessment). Since then, female numbers again decreased to 908 in 2017 and 728 in 2018, which represented only 32% and 26%, respectively, among MSW salmon. There are no observations of such skewed sex ratios in the sea or at the river mouth. Hence, the recent disease problems in Ume/Vindelälven may for some reason have prevented particularly females from reaching the fish ladder. Moreover, low levels of thiamine among spawners in recent years have resulted in increased M74-mortality among offspring hatched in 2016 and onwards (see Table 3.4.1 for information on proportion of females affected by M74).

Also in **Ljungan** average 0+ salmon densities in 2017 and 2018 were exceptionally low (<1 parr/100 m^2) compared to in preceding years (average density of 61 in 2014–2016; Table 3.1.3.1). Notably, the collapsed parr density in 2017 followed after a year with many dead salmon observed in the river, combined with a high expected level of M74-mortality. The very low parr densities in **Vindelälven** (2016–2018) and **Ljungan** (2017–2018) are expected to result in a drastically reduced smolt production in 2019–2020. However, it should be noted that the estimated pre-fishery abundance of salmon from these two rivers exploited in the fishery during the advice year (2020) is only partly affected by the reduced parr densities in 2016–2018. Regardless, the situation for these two Swedish rivers is alarming. Therefore, local fishing restrictions, aimed at protecting ascending spawners in the river mouth area and during upstream migration, have been discussed and may be enforced in 2019.

Two more rivers, **Öreälven** and **Lögdeälven**, showed low levels of 0+ parr densities in 2018 (Table 3.1.2.1), but it is unclear whether this single year of comparably low parr densities is a result of the extraordinary warm summer in 2018 and/or mirrors elevated levels of mortality among spawners and fry due to health problems. The development of the salmon stocks in these two rivers should be carefully monitored in the coming years.

4.4.2 Revision of basic input data

Colonization of salmon to new areas further upstream and/or restoration efforts improving or increasing river habitats will increase the potential smolt production capacity (PSPC) of rivers. If such changes are not accounted for, the status assessment will likely become biased. WGBAST is continuously revising important input data, such as e.g. production areas, to avoid such biases in status assessment. Factors affecting the PSPC include river production area, smolt production potential per unit area and mortalities during downward smolt migration. In the analytical assessment of Baltic salmon, all these quantities are used to formulate river-specific prior probability density functions (hereafter called 'priors') for PSPC, which are updated by the model to posterior PSPCs when stock–recruit data are included. Status of individual stocks is evaluated by comparing posterior estimates of current smolt production levels with posteriors of PSPC.

For this year, there are no updates on figures on production areas and information on maximal smolt production per unit of area. I the last few years, updates have been made for the following rivers: Vindelälven, Rickleån, Piteälven, Lögdeälven and Öreälven. The updated information on production area and smolt production potential per unit area was used in combination with information on other important factors, such as mortality during smolt migration, to formulate new priors for PSPC (ICES, 2017a). These updated priors are used in the assessment model. For next year, the plan is to evaluate and update information about production areas, migration possibilities and potential smolt production capacity for Åbyälven.

Inclusion of Testeboån in the assessment model

Testeboån received status as a wild salmon river in 2013. In 2018, a PSPC prior for Testeboån was formulated using expert opinions about relevant variables. A simple model (the same model used in previous years for e.g. Öreälven and Lögdeälven, see Annex 4 in ICES, 2015 for more information) was used to derive a probability distribution for PSPC as a function of the expert-elicited variables. The derived median value for the PSPC prior was 8895 (90% PI: 3498–22 232).

To obtain smolt priors that allow for inclusion of Testeboån in the full life-history model (FLHM), the river has been included in the same river model as used to produce smolt prior estimates for Emån and Mörrumsån. For a detailed description of this 'Southern river model', see ICES, 2017c and the Stock Annex (Annex 2). Data from Testeboån comprise time-series of electrofishing data for the period 2007–2018 and smolt counting results from the years 2014–2017. Derived estimates of smolt priors for Testeboån are presented in Table 4.2.2.1.

This year, Testeboån was included in the FLHM for the first time. As described in Section 4.2.3, the PSPC posterior was heavily updated downwards, resulting in a seemingly too high status of this "new" wild salmon river (Section 3) that is perceived to be in a building-up phase. Most likely, the results mirror a bias which may be overcome by inclusion of spawner count data from the river. Therefore, the plan for 2020 is to include available data on spawner counts in the FLHM. Until then, results from the FLHM model regarding Testeboån must be viewed with caution.

4.5 Conclusions

For most rivers included in the FLHM (i.e. AU 1–4), the smolt production is expected to stay at relatively high levels in the coming years. Also, the pre-fishery abundance is expected to remain relatively unchanged in the near future, indicating possibilities for maintained exploitation levels during 2020. Results from the stock projections indicate that the current exploitation rate will result in either a maintained or positive trend in status for almost all AU 1–4 stocks (Section 4.3.2). However, there are a few exceptions. In particular, **Vindelälven** shows a clear negative trend because of disease problems (see below) under all fishing scenarios, also under the scenario with zero fishing. Also, **Ljungan** has been heavily affected by health problems in recent years which most likely will have negative effects on the development of this stock in the near future.

Projections indicate that changes in sea fishery removal of +/-20% have rather small effects on the expected status development of AU 1–4 stocks, further indicating that fishing mortality is currently at a fairly low level in comparison to other (natural) sources of mortality affecting the stock development. Obviously, probabilities to reach the smolt production targets are higher for scenarios with lower exploitation, but differences between scenarios are small except for the ones with a drastically reduced (‘zero fishing’, ‘recreational fishery only’ or ‘commercial fishery only’) or increased (‘100% increase to previous advice’) fishing.

Wild stocks in AU 6 have also shown a positive development in recent years, indicating that current exploitation level allows successive recovery of these stocks. There are, however, concerns for the development of several wild salmon stocks in almost all AUs. In particular, the majority of the AU 5 stocks have not responded positively to previous reductions in fisheries exploitation. These stocks are exploited in the Main Basin by offshore commercial and recreational fisheries and in rivers by angling. Many AU 5 stocks show a negative development in recent years and are far below a good state, indicating that current exploitation and natural mortality rates (at sea and/or in freshwater) do not allow for a recovery of these stocks. As detailed in Section 3, several environmental factors acting during the freshwater phase are also believed to affect development of these salmon stocks negatively.

Within the current management of Baltic salmon, there are no ‘rules’ or guidelines for how fast (within which time frames) weak salmon stocks should recover, or when a certain proportion of all stocks should have obtained their management goal. Therefore, under current conditions with only TAC regulated sea fisheries and many stocks with varying status, any catch advice for the mixed-stock fishery on Baltic salmon will be associated with some degree of subjective consideration of trade-offs. For some weak stocks, additional measures (on top of restrictions through the TAC system) also need to be implemented to increase number of spawners, for example by reducing fisheries on mixed-stocks in the Main Basin (to reduce the exploitation of weak AU 5 stocks) and on the spawning migration routes of weak stocks in areas where their share in catches becomes higher. Measures focused on the freshwater environment, such as work to improve river habitats and migration possibilities and actions to reduce potential poaching, are also necessary because these problems appear to be larger among the southern than among the northern stocks. Thus, special actions directed to the weakest stocks which are not only fishery-related ones are likely required at any advised TAC level, especially in AU 5 but also for a few weak rivers in other AUs, to enable these stocks to recover.

M74-mortality has been relatively high since 2016. In 2018, the mortality was lower compared to 2017, but still at higher levels than in years 2012–2015. In addition, deaths of spawners due to disease problems have been relatively common during the last few years in some rivers (Sections 3.4.4 and 4.4.1). If the higher M74 and/or other health related problems should prevail or increase further this may result in decreased status, particularly among weaker stocks, as well as reduced fishing possibilities, which may easily counteract any positive effects of e.g. good post-smolt survival. The two Swedish rivers **Vindelälven** and **Ljungan** have been particularly affected by disease problems, and the recruitment of parr has collapsed dramatically (see Section 4.4.1). More restrictive regulations of fisheries may be enforced locally in 2019, to reduce exploitation rates on migrating spawners in these two rivers and in coastal areas outside the river mouths. National and local management organizations of these two rivers should carefully monitor the development of the stocks and the effects of introduced regulations, and if necessary consider additional measures to increase number of spawners. Substantial disease problems (disease-affected and dead adults) have also been reported in **Mörrumsån** in recent years, but so far the parr densities have not decreased as dramatically as in the two rivers described above.

Several of the northern stocks are assessed to be close to or above the MSY-level (2018 smolt production; Table 4.2.3.4), and the surplus produced by these stronger stocks could in theory be directed towards stock-specific fisheries. However, the current management system, with a single TAC for SD 22–31 that is set at a relatively low level (from a historical perspective) to safeguard weaker salmon stocks, prevents this surplus to be fully utilised by the commercial sea fishery. In a similar way, the surplus of reared salmon cannot be fully utilised today because reared salmon is also included in the same TAC with wild salmon.

Baltic salmon fisheries management could be developed to become more "stock-specific", by implementing more flexible systems for regulation of commercial fisheries with the aim of steering exploitation towards harvesting of reared salmon and stronger wild stocks. This could be done by implementing e.g. area-specific quotas and/or exclusion of certain single-stock fisheries from the quota system (such as fisheries in estuaries of rivers with reared stocks). In contrast, the increasing recreational trolling in Main Basin is a true mixed-stock fishery where stock-specific harvesting is not possible. Regulations that only allow landing of finclipped (reared) salmon, such as has been implemented in Sweden since 2013, may reduce fishing mortality of wild stocks by trolling if the post-release mortality is relatively low. A higher degree of stock-specific exploitation will also be necessary in the future, if different management objectives should be decided upon for individual stocks (e.g. to allow for a larger number of spawners than needed to fulfil the MSY-level in certain wild rivers).

4.6 Ongoing and future development of the stock assessment

4.6.1 Road map for development of the assessment

The tasks listed below refer to ongoing, planned and potential updates of the assessment methodology.

Ongoing and short term

- *Inclusion of the recreational sea fishery (mainly trolling) as a separate fishery (part of WKBaltSalmon)*. At present, trolling catch estimates are added to the offshore commercial ones in the FLHM. Because of the increase in the recreational trolling fishery at sea, it would be desirable to model recreational trolling as a separate fishery. A model with recreational trolling at sea as a separate fishery has now been developed, and should be ready for use in the 2020 assessment.
- *Adding repeat spawners to the FLHM*. Salmon are currently assumed to die after first spawning in the FLHM. This assumption is known to be unrealistic (repeat spawners in some stocks now account for ~10% of all spawners). This is likely to cause bias in some parameter estimates e.g. stock–recruit parameters such as steepness, with implications

for management reference points. A version of the FLHM that accounts for repeat spawners has now been developed. The repeat spawning model uses observations on the proportions of maiden spawners by year and sea-winter to learn about the propensity for repeat spawning by sea-age. More work is needed on the description of population dynamics and fisheries for salmon after spawning. This work is expected to be completed by the 2020 or 2021 assessment.

- *Development of an analytical assessment of AU 6 stocks.* An assessment model for AU 6 has now been developed from most of its parts, but it requires evaluation and checking before it can be used (see details in Appendix 2). The AU 6 model will not be integrated to the AU 1–4 assessment in the first phase, but will be run as a separate unit of stocks. However, the model takes into account migrations of salmon between the assessment units, which will to some extent link the assessments of the AU 1–4 salmon and AU 6 salmon together. The aim is to run the analytical assessment for AU 6 stocks in WGBAST 2020.
- *Improvement of computation and model convergence*. Work is ongoing to improve convergence times for the JAGS model (e.g. by forcing JAGS to use block updating for correlated parameters) and test other softwares for inference. One promising candidate is the R package Nimble that allows compilation of the model in C++ for increased speed. A Nimble version of the FLHM has now been developed, but further work is needed get good mixing in MCMC simulations, or to utilise variants of importance sampling available in Nimble.

Medium-term, important issues planned to be dealt with in the next 2–3 years

- *Improved estimates of the exploitation of stocks in the coastal fishery*. There is a need to replace the crude assumptions about how the coastal fisheries affect development of the stocks with more precise stock-specific estimates as input in the assessment model. Stock-specific harvest rate estimates from a spatially and temporally-structured Bayesian mixed stock analysis (MSA)/population dynamics model for the coastal migration of spawning Baltic salmon (Whitlock *et al.*, 2018) are now available (Whitlock *et al.*, in prep). However, some development of the MSA model is first needed to ensure that data in the FLHM are not used twice: the current version of the MSA model uses posterior distributions for natural mortality and pre-season abundances from the FLHM.
- *Continuing the work of including data from established index rivers and expanding data collection in other rivers*. Some of the datasets collected in index rivers are still not used in the assessment model, such as e.g. spawner count data from River Mörrumsån. To improve precision in assessment results, there is also a need to increase collection of abundance data in non-index rivers. Therefore, a 'rolling' sampling programme that regularly collects smolt abundance data from rivers with limited data has been established in Sweden, starting in 2018.
- *Improving precision in short-term projections by including covariates for sea survival*. The potential for incorporating covariates such as herring recruitment strength and sea surface temperatures will be investigated as means to increase precision in short-term projections.
- *Inclusion of AU 5 stocks in the full life-history model*. At present, these stocks are treated separately from the AU 1–4 stocks. Inclusion in the full life-history model will require updated information regarding e.g. smolt age distributions, maturation rates, exploitation rates and post-smolt survival. In addition, increased amounts of basic biological data (e.g. smolt and spawner counts, additional electrofishing sites) may be needed for some rivers. The smolt production model ("river model") for southern stocks that has been developed could be used also for AU 5 stocks in future, to produce smolt production priors and estimates for the life-history model.

Long-term and/or less urgent issues, good to keep in mind

- *Refine the two river models to improve smolt priors used in the FLHM*. The present river models do not account for annual fluctuations in smolt age structure, which may result in biases. Development of the river models to account for fluctuations in parr growth rates and length-specific smoltification probabilities to improve estimates of smolt age structure would help solve this issue.
- *Allow for fluctuations in the stock–recruitment carrying capacity (K) over time in rivers*. Changes in physical river characteristics (e.g. habitat restoration and removal of obstacles to migration) have likely led to increases in K over the assessment period for some rivers. The current model version cannot handle this, which may lead to biases when using old stock–recruit data.
- *Inclusion of data on composition of stocks at sea*: The life-history model has already been fitted to information on proportions of wild and reared salmon in Main Basin as determined from scale readings. A next step would be to include genetic information on proportions of fish from different AUs, separating also wild and reared salmon from those areas. Subsequently, information on the representation of single stocks may be included. See more on future MSA in ICES (2015), Section 4.7.
- *Further use of scale-reading data*: In addition to wild/reared proportions, age data from catch samples could be used to get improved knowledge of year-class strength, maturation and natural mortality rates.

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

Because requirements for data will always exceed available resources, preferences must be given. The identification and prioritisation of new data collection is of importance with respect to the European data collection framework (EU-MAP). Modifications to ongoing monitoring work should be based on end-user needs, particularly those related to ICES assessment.

Over the years, WGBAST has repeatedly highlighted and discussed various needs for data collection (e.g. ICES, 2014; 2015; 2016). For example, the need for genetic analysis to study stock composition in catch samples (MSA) has been reviewed (ICES, 2015), with suggestions provided regarding future studies. Comments have also been given to a comprehensive list of proposals for Baltic salmon data collection produced at an earlier ICES workshop in 2012 (ICES, 2016). Further, the need for at least one wild index river per assessment unit has been highlighted, with suggestions given on potential candidates in AUs 5–6. As a part of the last benchmark for Baltic salmon (WKBALTSalmon, ICES, 2017c) all different types of information needed as input for the Baltic salmon stock assessment (fisheries statistics, biological data, etc.) were reviewed with respect to needs, availability and quality. Data issues and questions listed in that benchmark report are rather extensive and prioritizations will thus be needed before decisions on data collection included in EU-MAP.

In brief, WKBALTSalmon highlighted the below data needs and development areas. WGBAST encourage Member States to include these elements into their national data collection programmes.

River data

Biological monitoring

- Expansion of networks for electrofishing sites, to cover also recently populated river stretches;

- Updates of size estimates for river-specific reproduction areas using standardised methodology;
- Inventories of habitat quality, particularly in 'weak' salmon rivers (i.e. those with low stock status);
- Compilation of stocking data on young life stages combined with information that enables estimation of survival for these releases until the smolt stage;
- Counting data of ascending spawners from additional rivers. Guidelines to assure comparability of such data should also be compiled. In rivers where counting is ongoing but data are yet not used in the assessment, additional information may be needed (e.g. from tagging studies).

River fisheries

- The amount and quality of catch statistics varies considerably between rivers and countries. There is a general need for improvement and harmonisation of methods used for data collection, including estimates of unreporting;
- River-specific salmon catches should be included in InterCatch (ICES database);
- Available effort data from river fisheries should be evaluated.

Sea fisheries data

- The level of misreporting of salmon as sea trout in the Polish fisheries may still be underestimated. For the Polish coastal fishery, no misreporting is accounted so far, although it potentially may occur in substantial amounts there too. Data on proportions of sea trout and salmon in catches should be provided to the working group to facilitate estimation of the development of misreporting. In addition, Poland should provide catch composition data from coastal and offshore fisheries (as defined in the EU regulation) covering all main gears;
- Recreational trolling open sea catches have been estimated to be higher than previously recognised. Initiated work to improve methods and estimates should continue. Time-series of country specific catch estimates by three main fishing areas should be added into InterCatch;
- Also, estimates of other recreational salmon sea catches (i.e. from coastal fishing in Sweden and Finland) should be added into InterCatch;
- Unreporting of catches is challenging to estimate, and it is possible that higher than currently estimated unreporting takes place in some countries and fisheries. An expert elicitation covering all relevant fisheries is needed in order to update unreporting estimates. Also, discards (undersized and seal-damaged catch) may be substantially underestimated and studies on these (including post-release mortality following release of undersized salmon) are needed;
- Shortcomings in currently available fisheries data may cause bias in mortality estimates (F and M). At present, the possible magnitude of such bias, and consequently its potential impact on conclusions regarding stock status and catch advice, has not been evaluated. The present assessment model is assumed to estimate the magnitude of total mortality reasonably reliably. However, an exercise exploring extra uncertainties emerging from data deficiencies, currently not accounted for, and how these may influence the catch advices (both qualitatively and quantitatively) should be carried out.

Table 4.2.2.1. Likelihood approximations for the wild smolt production (*1000) in the Baltic salmon rivers included as "priors" in the Full Life-History Model (FLHM). The distributions are described in terms of their median, the 90% probability interval (PI) and the method on how these probability distributions have been obtained. Updated estimates ("posteriors") are presented 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	2015	2016	2017	2018	2019	2020	2021	estimation
Assessment unit 1																																				
1 Tornionjoki	71	80	74	80	87	92	135	207	139	106	101	127	217	625	847	642	621	657	664	701	773	1095	1258	1390	1560	1640	1565	1400	1438	1710	1903	1796	1515	1502	1284	1,2
90% PI	45-113	53-120	48-115	56-113	63-121	63-135	96-182	147-293	94-209	77-144	70-142	94-171	166-279	499-779	690-1056	543-757	506-774	534-819	544-801	556-901	616-962	892-1357	1045-1519	1158-1673	1311-1873	1374-1966	1274-1939	1152-1701	1194-1743	1447-2029	1563-2306	1385-2409	1217-1926	1169-1964	800-2363	
2 Simojoki	2	2	9	10	8	12	10	10	2	2	3	7	11	35	49	48	43	33	25	33	33	37	21	32	39	32	37	42	35	30	38	54	94	92	51	1,2
90% PI	1-3	1-3	5-14	6-15	4-11	7-19	6-16	6-17	1-3	0-2	1-4	4-12	7-16	25-51	36-66	35-66	31-59	23-45	18-33	23-44	25-42	27-51	15-29	23-43	32-47	22-42	32-43	32-51	23-51	26-33	26-53	42-67	71-123	60-139	23-119	
3 Kalixälven	182	113	97	76	135	104	176	108	105	97	67	111	258	347	363	343	290	389	562	491	695	505	631	558	591	746	651	729	668	688	706	545	560	607	457	1
90% PI	46-752	29-435	25-341	22-234	36-459	31-312	52-552	30-337	31-321	27-308	19-202	32-343	64-955	106-1040	113-1054	108-996	90-845	118-1184	168-1767	154-1436	215-2068	160-1455	200-1844	177-1601	188-1711	231-2282	206-1885	233-2120	214-1944	220-2000	226-2032	172-1582	178-1627	180-2010	114-1719	
4 Råneälven	30	19	18	9	9	8	7	7	3	2	3	8	13	22	25	21	15	21	32	30	38	42	37	45	55	47	46	47	51	60	72	67	51	43	41	1
90% PI	3-228	2-142	1-126	0-76	0-62	1-50	1-34	1-29	0-13	0-9	0-12	1-24	3-44	6-67	7-75	5-66	4-46	5-64	9-100	8-98	12-110	13-123	11-110	14-132	17-162	14-140	14-136	15-134	16-148	19-172	23-207	20-200	15-156	12-133	9-194	
Total assessment unit 1	**315.2**	**234.5**	**216.5**	**186.5**	**250.6**	**226.9**	**336.3**	**344.7**	**257.8**	**212.2**	**179.2**	**259.3**	**508.1**	**1050**	**1310**	**1067**	**988.3**	**1121**	**1301**	**1282**	**1558**	**1712**	**1979**	**2059**	**2284**	**2500**	**2342**	**2253**	**2231**	**2529**	**2770**	**2535**	**2276**	**2309**	**1971**	
90% PI	**143-963**	**123-607**	**119-507**	**115-372**	**139-586**	**138-448**	**199-716**	**231-591**	**160-482**	**131-426**	**116-318**	**167-496**	**297-1210**	**752-1762**	**80-2028**	**794-1734**	**733-1562**	**797-1931**	**870-2517**	**879-2254**	**030-2943**	**270-2702**	**457-3221**	**567-3149**	**756-3453**	**869-4077**	**754-3630**	**649-3672**	**660-3544**	**931-3872**	**2112-4154**	**884-3734**	**718-3416**	**685-3762**	**227-3758**	
Assessment unit 2																																				
5 Piteälven	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
90% PI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6 Åbyälven	3	3	2	2	3	3	6	8	4	4	5	7	5	9	13	10	6	6	4	4	11	17	13	10	12	15	18	19	17	20	23	26	30	26	18	1
90% PI	0-14	0-13	0-10	0-8	0-13	0-14	0-28	1-31	0-14	0-13	1-19	1-22	0-18	1-32	3-41	2-32	1-21	1-20	0-16	0-14	2-37	4-53	3-42	2-33	3-40	4-48	5-58	5-60	5-54	5-65	6-70	7-83	9-92	7-83	4-71	
7 Byskeälven	22	17	15	12	15	16	40	23	24	23	23	40	55	75	84	69	60	60	83	95	126	105	95	100	111	123	106	129	109	142	159	185	193	177	117	1
90% PI	5-83	4-60	3-52	3-40	3-53	4-52	11-130	5-75	6-76	6-69	6-70	11-129	16-179	24-221	27-243	21-199	19-176	19-178	25-259	31-269	41-375	35-296	31-271	32-293	36-332	40-357	35-306	42-376	36-311	46-420	53-463	62-539	66-551	58-515	30-398	
8 Kågeälven	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13	13	9	7	6	9	14	15	21	21	19	21	18	15	1
90% PI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2-49	2-48	1-37	1-27	1-24	1-34	3-53	3-55	5-76	5-73	4-70	5-76	4-70	2-68	
9 Rickleån	3	2	1	1	0	0	0	0	0	0	0	0	0	1	1	1	2	1	1	1	1	1	1	1	2	2	1	2	1	4	5	5	5	4	3	1,2
90% PI	0-23	0-12	0-8	0-5	0-3	0-2	0-2	0-2	0-2	0-2	0-2	0-3	0-3	0-4	0-6	0-7	0-7	0-6	0-6	0-4	0-6	0-5	0-5	0-5	0-7	0-7	0-6	1-2	0-6	3-5	3-6	1-15	1-16	0-14	0-16	
10 Sävarån	2	1	1	1	1	1	1	1	1	0	0	1	1	1	2	2	2	2	4	3	3	4	3	2	2	3	4	5	6	8	11	12	12	13	9	1,2
90% PI	0-12	0-8	0-6	0-3	0-3	0-3	0-3	0-2	0-2	0-2	0-2	0-4	0-3	0-4	0-5	0-5	0-5	0-6	2-4	2-3	2-4	3-5	1-4	1-3	1-3	1-8	2-6	2-11	2-13	3-15	5-22	5-24	5-23	5-25	3-20	
11 Ume/Vindelälven	55	37	39	48	50	36	29	27	21	11	12	17	72	182	173	143	136	118	169	168	141	127	142	155	187	268	229	165	167	215	226	155	80	36	27	1,2
90% PI	17-181	9-136	9-148	12-180	17-149	11-109	9-82	8-69	8-50	2-30	4-29	6-38	25-204	91-396	71-374	69-310	70-286	56-228	94-299	91-297	75-255	72-223	85-231	116-205	152-229	204-350	167-316	134-201	138-202	137-331	171-295	66-272	33-173	10-97	5-202	
12 Öreälven	3	1	1	0	0	0	0	0	0	0	0	1	1	1	2	2	3	4	4	4	6	5	5	5	7	7	7	6	5	9	14	15	15	9	6	1
90% PI	0-29	0-14	0-8	0-5	0-3	0-4	0-4	0-3	0-2	0-2	0-3	0-6	0-7	0-10	0-12	0-16	0-19	0-23	0-21	0-22	0-26	0-25	0-23	0-22	1-30	1-28	1-28	0-26	0-25	1-39	2-63	3-62	3-60	1-41	0-40	
13 Lögdeälven	1	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3	2	2	3	4	4	4	4	4	4	5	6	6	6	6	10	12	11	9	7	1,2
90% PI	0-5	0-4	0-1	0-1	0-1	0-1	0-2	0-2	0-2	0-3	0-2	0-4	0-5	0-7	0-8	0-8	0-7	0-7	0-8	1-10	1-11	1-11	1-10	1-10	1-11	1-13	2-14	1-14	2-15	4-8	4-22	4-27	4-26	3-22	1-22	
Total assessment unit 2	**119**	**82**	**77**	**81**	**87**	**73**	**93**	**73**	**61**	**46**	**50**	**78**	**167**	**326**	**332**	**276**	**255**	**232**	**319**	**326**	**340**	**307**	**306**	**317**	**371**	**489**	**432**	**374**	**356**	**465**	**511**	**470**	**392**	**306**	**233**	
90% PI	**42-283**	**27-201**	**22-202**	**20-226**	**29-200**	**25-160**	**37-203**	**30-146**	**26-121**	**19-98**	**22-102**	**35-171**	**65-355**	**149-590**	**141-590**	**128-491**	**122-444**	**109-392**	**160-521**	**165-529**	**174-595**	**164-513**	**168-490**	**195-493**	**239-572**	**310-694**	**266-621**	**236-603**	**231-540**	**266-750**	**320-799**	**247-832**	**203-768**	**150-656**	**93-635**	
Assessment unit 3																																				
14 Ljungan	1	1	1	1	1	1	1	1	0	0	1	1	1	2	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	3	2	1	0	0	1
90% PI	0-8	0-7	0-5	0-6	0-7	0-4	0-6	0-5	0-3	0-4	0-6	0-5	0-9	0-10	0-9	0-7	0-5	0-5	0-4	0-3	0-9	0-6	0-4	0-8	0-6	0-6	0-7	0-9	0-5	0-12	0-16	0-11	0-7	0-5	0-3	
15 Testeboån	3	3	2	1	1	0	0	0	0	0	0	0	1	1	1	1	1	2	2	3	3	3	1	1	2	2	3	3	2	2	3	3	2			
90% PI	0-39	0-36	0-19	0-11	0-8	0-9	0-10	0-8	0-7	0-11	0-8	0-7	0-7	0-10	0-10	0-10	0-13	0-14	0-16	0-22	0-16	0-14	0-6	0-8	0-9	0-10	0-12	1-5	1-3	1-2	2-3	0-14	0-11			
Total assessment unit 3	**4**	**4**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**4**	**4**	**4**	**2**	**2**	**3**	**3**	**4**	**4**	**4**	**5**	**5**	**5**	**3**			
90% PI	**0-46**	**0-42**	**0-26**	**0-19**	**0-13**	**0-15**	**0-15**	**0-11**	**0-11**	**0-18**	**0-14**	**0-16**	**0-18**	**0-19**	**0-17**	**0-15**	**0-18**	**0-19**	**0-20**	**0-32**	**0-22**	**0-19**	**0-15**	**0-15**	**0-15**	**0-18**	**0-22**	**1-11**	**1-15**	**1-18**	**2-15**	**0-22**	**0-16**			
Assessment unit 4																																				
16 Emån	3	3	1	0	0	0	1	1	1	1	1	2	2	1	1	1	2	2	2	2	1	2	3	5	3	3	4	3	4	5	6	5	2			1
90% PI	0-40	0-36	0-12	0-3	0-1	0-2	0-7	0-7	0-5	0-9	0-10	0-14	0-13	0-8	0-6	0-8	0-11	0-10	0-11	0-11	0-6	1-3	0-17	0-22	0-17	0-15	0-21	0-17	0-20	0-22	0-25	0-22	0-11			
17 Mörrumsån	9	9	49	66	54	70	37	22	16	32	36	35	47	46	40	35	36	39	39	45	35	28	26	27	36	19	30	49	37	45	29	28	29			1
90% PI	1-69	1-69	14-166	21-213	19-159	24-222	13-109	6-69	3-51	7-109	12-102	12-104	17-135	17-131	14-110	13-96	13-109	15-107	15-107	18-126	14-88	10-78	8-89	10-75	15-102	9-50	17-74	25-123	17-99	24-106	14-75	12-78	10-89			
Total assessment unit 4	**12**	**12**	**50**	**66**	**54**	**70**	**38**	**23**	**16**	**33**	**37**	**37**	**49**	**47**	**40**	**36**	**37**	**41**	**41**	**47**	**36**	**31**	**30**	**31**	**39**	**22**	**35**	**52**	**41**	**50**	**35**	**33**	**30.7**			
90% PI	**1-110**	**1-106**	**14-178**	**21-217**	**19-160**	**24-224**	**13-117**	**6-76**	**4-57**	**8-119**	**12-112**	**12-118**	**17-149**	**17-140**	**14-117**	**13-105**	**13-120**	**16-118**	**15-119**	**18-137**	**14-94**	**12-82**	**8-106**	**10-97**	**15-120**	**9-66**	**17-95**	**25-141**	**17-120**	**24-128**	**15-101**	**12-101**	**10-101**			

Method of estimation: 1. Bayesian linear regression model, i.e. the river model (see the Stock Annex) 2. Sampling of smolts and estimate of total smolt run size. 3. Inference of smolt production from data derived from similar rivers in the region.

Table 4.2.2.2. Median values and coefficients of variation of the estimated M74 mortality for different Atlantic salmon stocks (spawning years 1985–2017). The values in bold are based on observation data from hatchery or laboratory monitoring in the river and year concerned. Grey cells represent predictive estimates for years from which no monitoring data were available.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Simojoki	**8**	**3**	**6**	**3**	**11**	**4**	**42**	**64**	**50**	**64**	**52**	**54**	**8**	**44**	**25**	**27**	**23**
cv	0.61	0.89	0.53	0.96	0.51	0.70	0.17	0.14	0.16	0.10	0.16	0.14	0.30	0.11	0.21	0.23	0.23
Tornionjoki	11	9	**9**	**7**	**12**	**16**	**44**	**62**	**75**	**53**	**42**	**24**	**7**	**44**	**21**	**26**	**35**
cv	0.76	0.83	0.75	0.90	0.72	0.64	0.31	0.24	0.07	0.10	0.31	0.47	0.43	0.19	0.22	0.22	0.23
Kemijoki	11	9	9	7	12	16	43	62	60	43	42	24	4	31	17	19	24
cv	0.75	0.83	0.75	0.90	0.72	0.64	0.31	0.24	0.23	0.29	0.30	0.46	0.86	0.40	0.52	0.50	0.44
Iijoki	11	9	9	7	12	16	44	63	59	43	42	24	4	31	17	20	24
cv	0.76	0.83	0.75	0.91	0.72	0.64	0.31	0.24	0.23	0.29	0.31	0.46	0.86	0.40	0.52	0.50	0.44
Luleälven	11	9	9	7	12	16	**46**	**56**	**54**	**38**	**36**	**28**	**2**	**27**	**14**	**21**	**25**
cv	0.76	0.83	0.75	0.90	0.72	0.64	0.13	0.15	0.07	0.13	0.19	0.15	0.34	0.12	0.17	0.14	0.20
Skellelteälven	11	9	9	7	12	16	**34**	**44**	**60**	**37**	**52**	**14**	**2**	**33**	**9**	**13**	**14**
cv	0.75	0.83	0.75	0.90	0.73	0.64	0.20	0.18	0.10	0.16	0.19	0.30	0.61	0.18	0.33	0.29	0.32
Ume/Vindelälven	**16**	**18**	**12**	**11**	**22**	**33**	**60**	**74**	**77**	**51**	**53**	**27**	**6**	**40**	**28**	**26**	**24**
cv	0.23	0.31	0.30	0.42	0.27	0.28	0.14	0.16	0.07	0.13	0.19	0.20	0.45	0.15	0.20	0.19	0.25
Ångermanälven	11	9	9	7	12	16	**40**	**65**	**58**	**35**	**43**	**16**	**2**	**23**	**14**	**18**	**29**
cv	0.76	0.83	0.76	0.90	0.72	0.64	0.14	0.16	0.10	0.15	0.20	0.20	0.56	0.17	0.21	0.19	0.21
Indalsälven	**6**	**6**	**5**	**3**	**6**	**6**	**36**	**62**	**62**	**31**	**44**	**17**	**1**	**17**	**14**	**6**	**14**
cv	0.23	0.31	0.29	0.44	0.31	0.35	0.15	0.16	0.08	0.14	0.19	0.20	0.62	0.19	0.21	0.33	0.25
Ljungan	11	9	9	7	12	16	**48**	**70**	**51**	**42**	**26**	**22**	**4**	**24**	**12**	**10**	**29**
cv	0.75	0.83	0.75	0.90	0.72	0.64	0.19	0.19	0.19	0.19	0.29	0.32	0.60	0.29	0.48	0.56	0.30
Ljusnan	2	1	1	1	1	**13**	**28**	**64**	**56**	**42**	**49**	**17**	**3**	**33**	**17**	**31**	**24**
cv	0.84	0.92	0.83	0.99	0.81	0.34	0.18	0.16	0.09	0.14	0.19	0.21	0.44	0.18	0.21	0.16	0.24
Dalälven	**8**	**7**	**14**	**8**	**8**	**16**	**61**	**71**	**49**	**41**	**40**	**28**	**6**	**27**	**18**	**23**	**24**
cv	0.42	0.39	0.27	0.40	0.45	0.33	0.14	0.16	0.10	0.17	0.19	0.17	0.36	0.17	0.20	0.19	0.21
Mörrumsån	**36**	**43**	**28**	**39**	**50**	**45**	**44**	**75**	**63**	**46**	**39**	**19**	4	31	17	19	24
cv	0.17	0.26	0.23	0.26	0.22	0.27	0.16	0.16	0.17	0.18	0.24	0.33	0.86	0.40	0.52	0.50	0.44
Unsampled stock	11	9	9	7	12	16	43	62	60	43	42	24	4	31	17	20	24
cv	0.76	0.83	0.75	0.90	0.72	0.64	0.31	0.24	0.23	0.29	0.31	0.47	0.87	0.40	0.52	0.50	0.44

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Simojoki	**1**	**2**	**2**	**4**	**13**	**7**	**6**	**4**	**2**	**0**	**1**	**1**	**0**	**4**	**9**	**3**
cv	0.61	0.59	0.91	0.49	0.30	0.48	0.46	0.62	0.72	2.03	1.42	1.19	1.55	0.70	0.32	0.43
Tornionjoki	**0**	**0**	2	**5**	**6**	**7**	**4**	**7**	**4**	**0**	**0**	**3**	**1**	**10**	**12**	**3**
cv	1.05	1.46	1.30	0.49	0.49	0.63	0.62	0.47	0.98	2.03	1.44	1.09	1.44	0.74	0.60	0.37
Kemijoki	1	1	2	**10**	**21**	**13**	**14**	**6**	**3**	0	2	3	1	10	19	6
cv	1.10	1.39	1.29	0.32	0.30	0.41	0.31	0.53	0.70	1.90	1.36	1.10	1.45	0.74	0.43	0.44
Iijoki	1	1	2	5	11	8	**12**	9	4	0	2	3	1	10	**15**	**5**
cv	1.09	1.41	1.30	0.74	0.61	0.80	0.33	0.71	1.00	1.92	1.34	1.10	1.44	0.74	0.34	0.75
Luleälven	**1**	**1**	**1**	**5**	**10**	**7**	**9**	**21**	**1**	**1**	**1**	**1**	**1**	**7**	**12**	**3**
cv	0.61	0.42	0.65	0.39	0.24	0.24	0.21	0.20	0.43	0.59	0.76	0.59	0.57	0.40	0.44	0.53
Skellelteälven	**1**	**0**	**1**	**2**	**7**	**1**	**2**	**4**	**2**	**1**	**10**	**1**	**1**	**4**	**9**	**5**
cv	0.71	1.46	0.87	0.68	0.40	0.87	0.80	0.53	0.73	0.99	0.48	0.83	0.92	0.61	0.43	0.44
Ume/Vindelälven	**2**	**1**	**0**	**2**	**8**	**3**	**14**	**13**	**6**	**0**	**4**	**10**	**0**	**11**	**10**	**5**
cv	0.62	0.69	1.38	0.62	0.40	0.55	0.27	0.33	0.41	2.04	0.56	0.44	1.52	0.46	0.47	0.48
Ångermanälven	**2**	**1**	**2**	**7**	**15**	**11**	**5**	**13**	**4**	**1**	**1**	**2**	**0**	**14**	**14**	**5**
cv	0.59	0.55	0.59	0.42	0.26	0.28	0.38	0.27	0.42	1.00	0.75	0.63	1.53	0.39	0.47	0.58
Indalsälven	**1**	**0**	**2**	**5**	**8**	**12**	**3**	**7**	**3**	**0**	**0**	**2**	**1**	**9**	**12**	**5**
cv	0.69	1.53	0.59	0.42	0.29	0.25	0.40	0.30	0.39	1.92	1.44	0.55	0.67	0.41	0.60	0.75
Ljungan	**1**	1	2	5	11	8	8	9	4	0	2	3	1	10	12	5
cv	1.10	1.42	1.29	0.73	0.61	0.80	0.74	0.71	1.00	1.93	1.34	1.09	1.45	0.73	0.60	0.75
Ljusnan	**2**	**0**	**1**	**7**	**8**	**6**	**9**	**6**	**2**	**0**	**1**	**2**	**1**	**22**	**12**	**5**
cv	0.58	1.51	1.33	0.42	0.36	0.36	0.28	0.34	0.52	2.05	0.76	0.58	0.74	0.37	0.60	0.75
Dalälven	**2**	**1**	**4**	**5**	**9**	**5**	**13**	**11**	**2**	**0**	**1**	**7**	**4**	**19**	**12**	**5**
cv	0.57	0.51	0.45	0.40	0.29	0.35	0.21	0.25	0.42	2.01	0.67	0.44	0.53	0.37	0.60	0.75
Mörrumsån	1	1	2	5	11	8	8	9	4	0	2	3	1	10	12	5
cv	1.10	1.39	1.30	0.73	0.61	0.80	0.73	0.71	0.98	1.90	1.34	1.09	1.45	0.73	0.60	0.74
Unsampled stock	1	1	2	5	11	8	8	9	4	0	2	3	1	10	12	5
cv	1.09	1.41	1.29	0.72	0.61	0.80	0.73	0.71	0.99	1.88	1.35	1.09	1.45	0.73	0.60	0.74

Table 4.2.3.1. Posterior probability distributions for steepness, alpha, beta and K parameters of the Beverton–Holt stock–recruit relationship and the year 2018 eggs per recruit (EPR, millions) for Baltic salmon stocks included in FLHM. Posterior distributions are summarised in terms of their mean and CV (%).

		Steepness		Alpha parameter		Beta parameter		EPR 2018		K	
		Mean	cv	Mean	cv	Mean	cv	Mean	cv	Mean	cv
Assessment unit 1											
1	Tornionjoki	0.79	6%	47	25%	0.001	10%	741	21%	1823	10%
2	Simojoki	0.55	13%	149	25%	0.013	22%	741	21%	80	32%
3	Kalixälven	0.86	6%	29	37%	0.002	17%	741	21%	680	18%
4	Råneälven	0.74	11%	61	38%	0.014	33%	741	21%	78	43%
Assessment unit 2											
5	Piteälven	0.89	4%	17	34%	0.036	12%	594	20%	28	13%
6	Åbyälven	0.71	17%	76	53%	0.048	36%	741	21%	25	55%
7	Byskeälven	0.79	11%	47	52%	0.007	27%	741	21%	167	40%
8	Kågeälven	0.69	22%	97	85%	0.022	30%	741	21%	50	33%
9	Rickleån	0.57	12%	131	19%	0.082	38%	741	21%	14	38%
10	Sävarån	0.58	11%	121	18%	0.050	52%	741	21%	28	72%
11	Ume/Vindelälven	0.34	25%	18	26%	0.004	16%	42	27%	283	16%
12	Öreälven	0.63	11%	102	25%	0.023	62%	741	21%	64	71%
13	Lögdeälven	0.58	13%	128	19%	0.026	79%	741	21%	67	79%
Assessment unit 3											
14	Ljungan	0.61	28%	132	66%	0.464	55%	741	21%	4	124%
15	Testeboån	0.68	25%	98	83%	0.302	30%	741	21%	4	62%
Assessment unit 4											
16	Emån	0.42	17%	271	23%	0.045	42%	837	20%	26	40%
17	Mörrumsån	0.72	23%	89	82%	0.022	22%	837	20%	48	29%

Table 4.2.3.2. Posterior probability distributions (R0 of smolt year 2018) of the smolt production capacity (x 1000) in the AU 1-4 rivers and the corresponding point estimates in the AU 5-6 rivers. These estimates serve as reference points to evaluate the status of the stocks (Table 4.2.3.4). For the updated estimates of the AU 1-4 rivers, medians as estimated by last years stock assessment are also shown. This enables comparison of how much the estimated medians have changed compared to last year. Also long-term average estimates of R0 (1996 and onwards) are shown for the rivers included in the FLHM, enabling comparison of 2018 and long-term average PSPC's. The posterior distributions are described in terms of their mode or most likely value and the 90% probability interval (PI). Methods by which posterior probability distributions were obtained are also indicated.

		2018 PSPC (R0), thousand smolts				Method of estimation	Last year´s median	% change	Average PSPC (R0), thousand smolts			
		Mode	Median	Mean	90% PI				Mode	Median	Mean	90% PI
Assessment unit 1												
1	Tornionjoki	1686	1703	1745	1507-2044	1	1993	-15%	1622	1634	1665	1463-1908
2	Simojoki	61	65	69	50-98	1	49	33%	62	65	68	53-90
3	Kalixälven	622	641	663	504-865	1	684	-6%	637	649	665	536-826
4	Råneälven	57	67	74	42-125	1	67	-1%	57	64	70	44-110
Total assessment unit 1		2518	2536	2551	2235-2913		2824	-10%				
Assessment unit 2												
5	Piteälven	27	27	27	22-33	1	45	-41%	49	49	50	46-54
6	Åbyälven	16	20	23	12-46	1	17	15%	19	21	23	15-36
7	Byskeälven	129	146	158	102-246	1	137	7%	139	150	160	114-233
8	Kågeälven	40	44	46	27-72	1	44	0%	42	45	46	43-42
9	Rickleån	10	11	12	6-21	1	10	12%	11	12	12	8-18
10	Sävarån	13	19	24	9-58	1	10	88%	12	17	21	9-48
11	Ume/Vindelälven	231	236	241	194-304	1	275	-14%	271	274	278	239-328
12	Öreälven	32	47	58	18-128	1	50	-5%	40	51	60	28-115
13	Lögdeälven	28	46	59	13-155	1	44	5%	39	52	62	26-136
Total assessment unit 2		625	638	649	520-813		662	-4%				
Assessment unit 3												
14	Ljungan	0.9	1.9	3.1	1-8	1	2.2	-10%	2	3	4	2-7
15	Testeboån**)	2.4	2.9	3.2	2-5	1	10	-71%	4	4	4	3-5
Total assessment unit 3		3.9	5.2	6.3	4-12		12.2	-57%				
Assessment unit 4												
16	Emån	15	17	18	8-33	1	16	7%	19	20	20	13-28
17	Mörrumsån	40	42	43	33-56	1	54	-23%	45	46	47	40-56
Total assessment unit 4		58	60	61	47-81		71	-15%				
Total assessment units 1-4		**3238**	**3258**	**3268**	**2907-3656**		**3577**	-9%				

Table 4.2.3.2. Continued.

Assessment unit 5					
18	Pärnu	30*)	2	3	1000%
19	Salaca	30	3	30	0%
20	Vitrupe	4	3	4	0%
21	Peterupe	5	3	5	0%
22	Gauja	29	3	29	0%
23	Daugava	11	3	11	0%
24	Irbe	4	3	4	0%
25	Venta	15	3	15	0%
26	Saka	8	3	8	0%
27	Uzava	4	3	4	0%
28	Barta	0.2	3	4	-95%
29	Nemunas river basin	164	3	164	0%
	Total assessment unit 5	301		282	7%
Assessment unit 6					
30	Kymijoki	100	2	100	0%
31	Luga	100	4	100	0%
32	Purtse	8	2	8	0%
33	Kunda	2	2	2	0%
34	Selja	11	2	11	0%
35	Loobu	11	2	11	0%
36	Pirita	10	2	10	0%
37	Vasalemma	4*)	2	1	400%
38	Keila	5	2	5	0%
39	Valgejögi	16.5*)	2	2	870%
40	Jägala	0.3	2	0.3	0%
41	Vääna	2	2	2	0%
	Total assessment unit 6	269		252	7%
Total assessment units 1-6		**3828**		**4111**	-7%

*) Due to the removal of the lowermost dam, fish species are able to migrate much longer distance upstream the river than before 2018 (see details, Chapter 3).

**) PSPC in 2018 most likely heavily underestimated, for more information see Section 4.4.2.

Methods of estimating potential production

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

Table 4.2.3.3. Wild smolt production in Baltic rivers (year 2000 and onwards) with natural reproduction of salmon grouped by assessment units: posterior probability estimates derived from the Full Life History Model (FLHM) for the AU 1-4 rivers, and estimates derived by other means (inferred from parr densities, smolt trapping etc.) for the rest of the rivers. Median estimates (x 1000) of smolts with the associated uncertainty (90% Probability interval) are shown. Also the river specific reproductive areas and the potential smolt production capacities (PSPC's) are shown as medians and 90% PI's. Note that potential production capacity for Testeboån is likely heavily underestimated, see more information in Section 4.4.2.

Assessment unit, sub-division, country	Category	Reprod. area (ha, median)	Potential (x 1000)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Pred 2019	Pred 2020	Pred 2021	Method of estimation: Pot. prod.	Method of estimation: Pres. prod.
Gulf of Bothnia, Sub-div. 30-31:																											
Finland																											
Simojoki	wild	252	61	27	45	47	44	37	30	35	34	42	31	34	40	33	38	41	38	31	47	54	73	61	42	1	1
90% PI		222-285	50-98	20-36	35-56	36-58	34-55	29-46	23-37	26-44	28-41	32-52	23-38	27-44	33-46	25-42	32-43	33-49	27-50	27-34	36-61	43-65	56-93	45-81	29-59		
Finland/Sweden																											
Tornionjoki;Torneälven	wild	5409	1703	665	772	680	753	709	700	889	855	1117	1240	1228	1379	1458	1436	1322	1323	1665	1783	1716	1530	1520	1464	1	1
90% PI		4282-6835	1507-2044	544-800	642-923	590-793	627-902	583-862	586-830	728-1105	704-1026	933-1341	1059-1436	1054-1413	1184-1626	1235-1707	1200-1733	1125-1573	1125-1584	1425-1972	1497-2116	1358-2188	1255-1856	1227-1885	1041-2050		
Sweden																											
Kalixälven	wild	2604	641	660	546	468	539	644	644	826	581	576	608	568	531	564	510	533	538	564	606	631	608	608	644	1	1
90% PI		2124-3200	504-865	458-966	385-783	314-689	349-823	401-1007	435-991	553-1285	399-851	392-858	417-883	405-824	372-754	389-826	344-773	365-781	365-786	375-831	401-908	410-964	412-924	385-944	419-1049		
Råneälven	wild	386	67	24	30	22	24	25	31	39	35	43	42	37	41	43	45	42	45	54	59	60	56	55	54	1	1
90% PI		332-449	42-125	12-42	16-48	11-39	12-42	12-41	16-52	24-62	22-55	27-67	26-65	23-61	26-65	26-66	28-69	25-67	28-72	32-88	36-94	36-99	33-96	34-92	31-90		
Assessment unit 1, total			**2536**	**1389**	**1399**	**1222**	**1371**	**1422**	**1410**	**1805**	**1513**	**1792**	**1920**	**1881**	**1999**	**2116**	**2054**	**1948**	**1952**	**2330**	**2513**	**2501**	**2295**	**2268**	**2209**		
90% PI			2235-2913	**1140-1714**	**1190-1675**	**1040-1465**	**1136-1669**	**1149-1799**	**1160-1765**	**1489-2284**	**1268-1814**	**1524-2140**	**1654-2263**	**1623-2175**	**1747-2331**	**1815-2449**	**1730-2412**	**1671-2287**	**1694-2310**	**2016-2715**	**2139-2957**	**2052-3002**	**1947-2730**	**1897-2732**	**1720-2976**		
Piteälven	wild	441	27	15	34	26	16	18	20	19	24	23	23	24	20	22	25	26	26	27	25	27	26	26	25	1	1
90% PI		374-484	22-33	10-22	22-47	19-35	11-22	12-24	13-27	12-26	18-31	16-31	16-32	16-34	14-28	14-31	17-34	18-36	18-35	18-39	17-36	17-39	16-39	16-40	17-37		
Åbyälven	wild	86	20	12	15	11	11	10	11	12	13	15	15	12	13	13	14	14	14	17	18	18	18	18	16	1	1
90% PI		70-105	12-46	5-19	8-24	6-17	6-17	5-16	6-17	7-19	8-21	9-23	9-22	7-19	8-20	8-20	8-22	8-22	8-23	10-28	11-28	11-31	10-29	10-29	9-27		
Byskeälven	wild	563	146	94	96	91	82	99	103	123	93	122	120	106	111	114	110	106	115	134	135	139	136	133	124	1	1
90% PI		482-659	102-246	58-140	64-147	57-137	50-128	59-150	65-162	80-177	61-144	81-187	80-180	69-160	73-165	74-175	71-170	69-159	75-173	86-211	85-219	88-225	86-220	86-212	80-207		
Rickleån	wild	31	11	0.6	1.4	1.1	1.2	1.1	1.1	1.1	1.5	2.4	2.2	1.7	1.8	1.7	2.0	2.1	2.5	4.0	4.8	4.9	4.2	4.4	3.9	1	1
90% PI		22-44	6-21	0-1	0-2	0-2	0-2	0-2	0-2	0-2	0-2	1-3	1-3	0-2	1-2	0-2	1-3	1-2	1-4	3-4	3-6	2-7	2-6	2-6	2-6		
Sävarån	wild	22	19	1	3	2	2	2	4	3	3	4	3	3	3	4	4	5	5	7	8	10	9	9	8	1	1
90% PI		14-36	9-58	0-2	1-4	0-2	0-2	1-3	2-4	2-3	2-4	3-5	2-4	1-3	2-4	2-6	3-6	3-6	3-7	4-10	5-13	6-14	6-13	6-14	4-12		
Ume/Vindelälven	wild	1768	236	193	163	74	155	141	186	204	206	175	197	180	210	270	225	169	176	217	226	188	146	137	61	1	1
90% PI		1394-2246	194-304	149-259	120-219	52-101	114-204	100-193	134-251	152-275	161-264	127-239	148-258	143-224	178-246	217-338	176-289	139-198	150-209	160-293	178-278	133-264	103-209	91-199	27-107		
Öreälven	wild	107	47	2	3	2	2	2	2	4	4	6	5	4	5	6	7	7	9	13	15	17	16	17	15	1	1
90% PI		88-131	18-128	0-3	1-5	0-3	0-3	0-4	1-4	1-7	2-7	3-10	2-9	2-7	2-8	3-11	3-13	3-13	4-15	7-22	8-27	9-32	8-29	9-31	7-30		
Lögdeälven	wild	106	46	2	3	2	2	2	3	4	4	4	4	3	4	5	5	5	6	7	11	12	11	12	10		
90% PI		86-131	13-155	0-3	1-5	0-3	0-3	1-3	1-5	2-6	2-5	2-7	2-6	1-5	2-5	2-7	3-8	3-8	3-9	5-9	6-17	8-19	6-17	7-18	6-17		
Kågeälven	wild	96	44	na	na	na	na	na	na	na	na	14	14	8	6	6	9	14	15	22	26	26	23	27	25	1	1
90% PI		67-139	27-72	na	na	na	na	na	na	na	na	3-61	3-51	1-32	1-24	1-25	2-34	3-49	3-58	6-77	12-48	12-46	10-43	13-48	10-49		
Assessment unit 2, total			**638**	**323**	**322**	**210**	**275**	**279**	**335**	**373**	**352**	**377**	**394**	**348**	**380**	**448**	**409**	**354**	**376**	**462**	**478**	**451**	**401**	**393**	**300**		
90% PI			520-813	**261-404**	**268-394**	**166-265**	**222-342**	**216-351**	**267-416**	**298-471**	**296-431**	**304-468**	**317-482**	**293-422**	**324-453**	**380-542**	**341-499**	**300-426**	**321-455**	**371-578**	**396-577**	**369-571**	**319-502**	**316-497**	**231-389**		
Ljungan	wild	20	1.9	1.2	1.4	1.0	1.2	1.1	1.1	1.2	1.1	1.3	1.2	1.1	1.1	1.0	1.0	1.0	1.0	1.3	1.5	1.5	1.3	1.2	1.1	1	1
90% PI		11-35	1-8	0-2	0-2	0-1	0-1	0-1	0-1	0-2	0-1	0-2	0-2	0-1	0-1	0-1	0-1	0-1	0-1	0-2	0-2	0-2	0-2	0-2	0-2		
Testeboån	wild	10	2.9	0.64	1.00	1.23	1.94	1.54	1.92	2.50	3.80	2.49	2.13	2.17	2.24	2.52	2.43	2.51	2.32	2.10	2.82	2.58	2.53	2.42	2.31	1	1
90% PI		na	2-5	0-19	0-18	0-15	0-492	0-19	0-22	0-55	0-25	1-4	1-3	1-3	0-3	1-4	1-4	1-3	1-3	1-2	2-3	1-4	1-3	1-3	1-3		
Assessment unit 3, total			**5**	**2**	**3**	**2**	**3**	**3**	**3**	**4**	**5**	**4**	**3**	**3**	**3**	**4**	**4**	**4**	**3**	**3**	**4**	**4**	**4**	**4**	**4**		
95% PI			4-12	**'1-21**	**'1-19**	**'1-17**	**'1-494**	**'1-20**	**'1-23**	**'1-58**	**'2-27**	**'2-6**	**'2-5**	**'2-5**	**'2-5**	**'2-5**	**'2-5**	**'3-5**	**'2-5**	**'3-5**	**'3-6**	**'3-6**	**'3-6**	**'3-5**	**'2-5**		
Total Gulf of B., Sub-divs.30-31			**3193**	**1715**	**1727**	**1438**	**1644**	**1704**	**1753**	**2184**	**1873**	**2174**	**2327**	**2231**	**2385**	**2577**	**2468**	**2310**	**2331**	**2801**	**2995**	**2956**	**2692**	**2668**	**2513**		
90% PI			2847-3597	**1461-2057**	**1508-2013**	**1248-1688**	**1405-1959**	**1415-2091**	**1483-2117**	**1850-2668**	**1615-2180**	**1890-2553**	**2032-2691**	**1975-2536**	**2122-2735**	**2265-2910**	**2124-2835**	**2040-2660**	**2072-2700**	**2462-3214**	**2621-3456**	**2490-3497**	**2332-3153**	**2272-3150**	**2002-3289**		

Table 4.2.3.3. Continued.

Assessment unit, sub-division, country	Category	Reprod. area (ha, median)	Potential (x 1000)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Pred 2019	Pred 2020	Pred 2020	Method of estimation: Pot. prod.	Method of estimation: Pres. prod.
Sweden																											
Emån	wild	40	17	3	1	1	2	3	3	2	2.6	2.6	2.0	3.0	2.5	2.8	2.4	2.2	3.7	5.1	5.6	4.3	3.9	3.7	4.3	1	1
90% PI		30-49	8-33	1-6	0-3	0-2	0-3	1-5	1-6	1-4	1-4	1-3	1-3	1-5	1-4	1-5	1-4	1-4	1-7	2-9	2-10	2-8	1-8	1-8	1-9		
Mörrumsån	wild	56	42	43	37	38	38	38	39	35	37	37	34	35	33	31	32	35	36	40	37	36	36	35	35	1	1
90% PI		44-75	33-56	28-64	24-54	26-57	24-55	26-56	26-54	24-51	25-54	25-55	22-49	23-51	21-50	20-44	21-47	23-51	24-52	27-57	25-52	23-52	23-53	23-52	23-51		
Assessment unit 4, total			**60**	46	39	39	40	41	42	38	40	40	36	38	36	34	35	38	40	45	43	41	40	39	40		
90% PI			47-81	32-68	26-56	28-59	27-57	29-60	30-59	26-54	28-58	28-58	24-52	27-55	24-53	24-48	24-51	26-54	28-57	32-63	31-59	28-57	27-58	27-57	27-57		
Estonia																											
Pärnu	mixed	50***	30***	0.15	0.25	0.23	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.50	0.00			2	3, 4
Latvia																											
Salaca	wild	47	30	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	9.5	5.7	17.5	38.0	9.7	11	3			3	2
Vitrupe	wild	5	4	na	2.8	2.7	2.6	2.7	2.8	1.3	1.3	1.2	1.2	1.1	1.1	1.0	1.0	1.0	3.0	4.0	1.0	2.0	0.1			3	5
Peterupe	wild	5	5	na	2.8	2.7	2.7	2.7	2.7	2.7	1.3	1.2	1.2	1.1	1.1	1.0	1.0	1.0	3.0	3.4	1.0	1.7	0.3			3	2, 5
Gauja	mixed	50	29	14.3	13.7	13.8	13.6	11.6	11.6	11.6	11.4	10.7	10.5	8.4	7.4	6.0	8.0	4.0	10.0	8.0	4.0	4.0	0.8			3	2, 5
Daugava****	mixed	20	11	na	2.8	2.7	2.7	2.7	2.7	2.7	1.3	1.2	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	2.0	5.0	0.0			3	5, 6
Irbe	wild	10	4	na	6.8	6.7	6.5	5.4	6.7	2.9	3.0	2.4	2.3	2.3	2.3	2.0	2.0	2.0	2.0	1.5	1.0	0.7	0.0			3	5
Venta	mixed	30	15	na	12.1	11.9	11.9	11.9	11.9	11.8	9.7	8.7	8.7	8.6	7.6	6.0	8.0	5.0	8.0	10.0	3.0	5.0	0.1			3	2, 5
Saka	wild	20	8	na	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.4	1.4	2.1	2.1	2.1	2.0	1.0	2.0	1.0	1.0	0.5	0.0			3	5
Uzava	wild	5	4	na	2.8	2.8	2.7	2.7	2.7	2.7	1.3	1.2	1.2	1.1	1.1	1.0	1.0	1.0	2.0	3.0	1.0	1.5	0.0			3	5
Barta	wild	0.6	0.2	na	2.7	2.7	2.6	2.7	1.7	1.5	0.8	1.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			3	5
Lithuania																											
Nemunas river basin	mixed	na	164	2	5	8	4	2	6	7	5	13	42	48	7	28	14	13	36	37	26	20	32			3	3, 4
Assessment unit 5, total			**301**		**87**	**90**	**80**	**59**	**80**	**77**	**56**	**68**	**96**	**86**	**34**	**53**	**48**	**35**	**85**	**107**	**52**	**53**	**36**				
Total Main B., Sub-divs. 22-29 (AU's 4-5)			**361**		126	129	120	100	123	115	97	108	133	124	71	86	82	72	125	152	95	94	76				
					113-143	118-149	107-137	88-119	110-140	103-131	84-115	96-126	121-149	113-142	58-87	76-100	72-99	60-89	113-141	139-170	82-111	81-110	64-94				

Assessment unit, sub-division, country	Category	Reprod. area (ha, median)	Potential (x 1000)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Pred 2019	Pred 2020	Pred 2021	Method of estimation: Pot. prod.	Method of estimation: Pres. prod.
Finland:																											
Kymijoki	mixed	15*+60**	20*+80**	2	12	13	20	13	6	24	41	20	12	11	25	26	9	29	16	37	78	23	8	66		2	4
Russia:																											
Neva	mixed	0	0	7	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0		2	7
Luga	mixed	40	100	5	2.5	8	7.2	2	2.6	7.8	7	3	4	6.7	4.3	6.3	5	6.6	7	5.3	2	6	6			4	2
SE			51-144	4.8-5.2	2.4-2.6	7.7-8.3	6.9-7.5	1.9-2.1	2.0-35	5.1-16.5	4-10	1.9-4.1	2.8-6.1	4.8-8.6	2.7-5.9	1.9-4.1	3.2-6.8	4.3-8.9	4.6-9.4	2.9-7.7	1.9-2.1	3.2-8.4					
Estonia:																											
Purtse	mixed	7.6	7.6	na	na	na	na	na	na	na	na	0.05	2.6	2.2	0.4	1.1	0.0	4.3	3.1	2.1	1.3	0.9	4			2	4
Kunda	wild	1.9	2,1(3,7)	2.8	1.2	2.3	0.8	0.6	0.1	2.2	1.9	0.9	0.1	0.1	0.2	2.1	2.0	1.0	1.3	2.1	3.7	3.0	3			2	3
Selja	mixed	11.3	11.0	2.3	0.3	0.0	0.0	0.1	0.9	2.1	0.2	0.1	4.0	3.9	1.1	0.8	2.7	3.1	3.4	0.6	0.5	0.0	5			2	4
Loobu	mixed	12	12.0	0.5	0.7	0.3	0.1	2.4	4.2	7.8	1.7	0.0	0.1	10.5	4.5	3.5	2.7	3.5	11.6	0.8	2.0	0.6	7			2	4
Pirita	mixed	10	12.0	0.1	0.6	0.1	0.3	2.8	0.8	3.2	0.7	3.6	5.4	7.8	1.0	1.9	5.6	5.5	5.0	10.3	1.4	11.3	6.6			2	2, 3
Vasalemma	wild	5***	4***	0.0	0.3	0.2	0.1	0.0	0.0	0.0	0.2	0.0	0.2	0.1	0.3	0.7	0.2	0.6	0.7	1.1	0 .1	0.7	2			2	4
Keila	wild	3.5	5,4 (12)	0.4	1.3	0.4	0.1	0.0	0.0	0.7	2.0	0.7	1.1	6.3	3.0	6.0	1.0	8.3	12.0	4.4	6.3	6.6	10			2	4
Valgejõgi	mixed	19***	16.5***	0.1	0.1	0.1	0.0	0.03	0.4	0.3	0.3	0.7	0.5	0.6	0.8	0.4	0.1	0.4	0.5	0.7	0.2	0.4	0			2	4
Jägala	mixed	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0			2	4
Vääna	mixed	2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.6	0.2	0.1	0.0	0.2	0.3	0.2	0.0	0.0	0			2	4
Assessment unit 6, total			**273**	**20**	**25**	**30**	**34**	**21**	**15**	**48**	**55**	**29**	**30**	**50**	**41**	**49**	**28**	**63**	**61**	**65**	**95**	**53**	**52**				
Gulf of B.+Main B.+ Gulf of F., Sub-divs. 22-32			**3832**	1789	1883	1602	1832	1830	1901	2359	2033	2314	2494	2411	2499	2716	2579	2447	2519	3019	3186	3111	2827				
90% PI				1527-2133	1663-2167	1416-1849	1593-2303	1542-2217	1625-2258	2028-2861	1774-2352	2035-2692	2200-2856	2150-2712	2241-2848	2403-3048	2241-2948	2175-2798	2264-2884	2679-3430	2816-3643	2652-3637	2463-3290				

* Below the lowest dams
** Above the lowest dams
*** Potential production changed due to
**** = Tributaries
na = No data available

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

Methods of estimating present production
1. Bayesian full life history model (section 6.3.9)
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
6. Count of spawners
7. Estimate inferred from stocking of reared fish in the river
8. Salmon catch, exploitation and survival estimate

Table 4.2.3.4. Overview of the status of the Baltic Sea wild and mixed-stocks in terms of their probability to reach 50 and 75% of the smolt production capacity in 2018 (compared to PSPC in that year). Stocks are considered very likely to have reached this objective in case the probability is higher than 90%. They are likely to have reached the objective if the probability is between 70 and 90%, uncertain when the probability is between 30 and 70 % and unlikely if the probability is less than 30%. For the AU 1–4 stocks, the results are based on the assessment model, whilst the categorization of AU 5–6 stocks is based on expert judgments - for those rivers there are no precise probabilities (column 'Prob').

			Prob to reach 50%					Prob to reach 75%				
	Stock	Category	Prob	V.likely	Likely	Uncert.	Unlikely	Prob	V.likely	Likely	Uncert.	Unlikely
Unit 1	Tornionjoki	wild	1.00	X				0.97	X			
	Simojoki	wild	0.96	X				0.63			X	
	Kalixälven	wild	1.00	X				0.87		X		
	Råneälven	wild	0.88		X			0.66			X	
Unit 2	Piteälven	wild	1.00	X				0.86		X		
	Åbyälven	wild	0.95	X				0.72		X		
	Byskeälven	wild	0.99	X				0.84		X		
	Kågeälven	wild	0.65			X		0.28				X
	Rickleån	wild	0.35			X		0.07				X
	Sävarån	wild	0.49			X		0.17				X
	Ume/Vindelälven	wild	0.98	X				0.60			X	
	Öreälven	wild	0.32			X		0.15				X
	Lögdeälven	wild	0.22				X	0.08				X
Unit 3	Ljungan	wild	0.69			X		0.48			X	
	Testeboån*	wild	0.93	X				0.71		X		
Unit 4	Emån	wild	0.10				X	0.02				X
	Mörrumsån	wild	0.97	X				0.70		X		
Unit 5	Pärnu	mixed	n.a.				X	n.a.				X
	Salaca	wild	n.a.			X		n.a.				X
	Vitrupe	wild	n.a.				X	n.a.				X
	Peterupe	wild	n.a.				X	n.a.				X
	Gauja	mixed	n.a.				X	n.a.				X
	Daugava	mixed	n.a.				X	n.a.				X
	Irbe	wild	n.a.				X	n.a.				X
	Venta	mixed	n.a.			X		n.a.				X
	Saka	wild	n.a.				X	n.a.				X
	Uzava	wild	n.a.				X	n.a.				X
	Barta	wild	n.a.				X	n.a.				X
	Nemunas	mixed	n.a.				X	n.a.				X
Unit 6	Kymijoki	mixed	n.a.				X	n.a.				X
	Luga	mixed	n.a.				X	n.a.				X
	Purtse	mixed	n.a.				X	n.a.				X
	Kunda	wild	n.a.	X				n.a.	X			
	Selja	mixed	n.a.				X	n.a.				X
	Loobu	mixed	n.a.				X	n.a.				X
	Pirita	mixed	n.a.	X				n.a.	X			
	Vasalemma	wild	n.a.				X	n.a.				X
	Keila	wild	n.a.	X				n.a.	X			
	Valgejõgi	mixed	n.a.				X	n.a.				X
	Jägala	mixed	n.a.				X	n.a.				X
	Vääna	mixed	n.a.				X	n.a.				X

* Status uncertain and most likely overestimated, see Section 4.4.2 for more information.

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

Scenario	Total commercial removal (dead catch) for year 2020
1	Removal that corresponds to ICES advice for fishing year 2019
2	20% increase to scenario 1
3	20% decrease to scenario 1
4	F0.1 approach (commercial removal)
5	zero fishing
6	recreational fishing only
7	No recreational fishing (no trolling, no river fishing). Commercial removal as in sc 1.
8	100% increase to scenario 1
	In all scenarios we assume that the commercial removal (wanted catch reported) covers 53% of the total commercial sea fishing mortality, whereas 47% of this mortality consists of discards, misreported and unreported.
	Recreational fisheries in 2020 are assumed to have a catch that corresponds to the average effort in these fisheries in 2016-2018 period, whereas in future years the effort component is the same for these fisheries but the catch varies according to abundance. (See text for
	Post-smolt survival of wild salmon
	Average survival between 2014-2017 (Figure 4.3.2.2)
	Post-smolt survival of reared salmon
	Same relative difference to wild salmon as on average in history
	M74 survival
	Historical median (Figure 4.3.2.2)
	Releases
	Same number of annual releases in the future as in 2018
	Maturation
	Age group specific maturation rates in 2019 are predicted using january-march 2019 SST data. For other years, average maturation rates over the time series are used, separately for wild and reared salmon. (Figure 4.3.2.3)
	Ume/Vindelälven
	Average proportions 2016-2018 (no. spawners passing ladder, MSW sex ratio passing ladder, extra mortality after ladder)

Table 4.3.2.1. Estimates (in thousands of fish) of total removal in the commercial fishery at sea by scenario, and the corresponding reported commercial catch in total and divided between these fisheries in 2020. Calculations about how the total catch is divided between reported commercial catch and discards/unreporting/misreporting are based on the situation prevailing in 2018 (see text). The table shows also the predicted total number of spawners in 2020 (in thousands). All values refer to medians unless stated otherwise.

			Commercial catches (thousands of fish) at sea in SD 22-31 in 2020					
			Wanted Catch Reported		Unwanted Catch (Dead+Alive)			
Scenario	Total commercial catch at sea	inst. F of comm. Catch	Total	% of 2019 TAC	Undersized	Seal damaged	Wanted Catch Unreported	Wanted Catch Misreported
1	116.0	0.09	59.8	66%	3.7	8.9	6.3	37.3
2	139.3	0.10	71.8	79%	4.4	10.7	7.6	44.8
3	92.8	0.07	47.8	52%	3.0	7.1	5.0	29.9
4	134.0	0.10	69.0	76%	4.3	10.3	7.3	43.1
5	0.0	0.00	0.0	0%	0.0	0.0	0.0	0.0
6	0.0	0.00	0.0	0%	0.0	0.0	0.0	0.0
7	116.0	0.09	59.8	66%	3.7	8.9	6.3	37.3
8	232.0	0.18	119.6	131%	7.4	17.8	14.0	83.0

Scenario	Total sea catch (comm. + recr.) 2020	inst. F of total catch at sea	Recreational catch at sea 2020	River catch 2020	Spawners 2020
1	141.5	0.11	25.5	57.0	170.0
2	164.4	0.12	25.2	55.7	162.0
3	118.5	0.09	25.7	60.1	177.0
4	159.2	0.12	25.2	56.2	164.0
5	0.0	0.00	0.0	0.0	265.0
6	26.9	0.02	26.9	70.9	206.0
7	116.0	0.09	0.0	0.0	218.0
8	257.7	0.20	23.9	46.3	133.9

Table 4.3.2.2. River-specific probabilities in different scenarios to meet 75% of PSPC in 2024/2025 (depending on the assessment unit) Probabilities higher than 70% are presented in green.

River	Year of comparison	Probability to meet 75% PSPC Scenario 1	2	3	4	5	6	7	8
Tornionjoki	2025	0.75	0.73	0.76	0.74	0.85	0.81	0.82	0.65
Simojoki	2025	0.43	0.40	0.46	0.40	0.68	0.55	0.56	0.29
Kalixälven	2025	0.81	0.80	0.82	0.80	0.87	0.85	0.85	0.75
Råneälven	2025	0.68	0.66	0.71	0.67	0.81	0.76	0.77	0.57
Piteälven	2025	0.84	0.82	0.84	0.83	0.88	0.86	0.89	0.79
Åbyälven	2025	0.61	0.60	0.62	0.60	0.72	0.67	0.69	0.54
Byskeälven	2025	0.77	0.76	0.79	0.76	0.86	0.81	0.82	0.69
Rickleån	2025	0.18	0.16	0.19	0.17	0.39	0.25	0.31	0.11
Sävåran	2025	0.29	0.26	0.31	0.27	0.51	0.38	0.40	0.18
Vindelälven	2025	0.50	0.47	0.53	0.48	0.78	0.63	0.66	0.35
Öreälven	2025	0.26	0.25	0.28	0.25	0.43	0.33	0.36	0.19
Lögdeälven	2025	0.14	0.13	0.15	0.13	0.27	0.20	0.21	0.08
Ljungan	2025	0.37	0.35	0.38	0.35	0.52	0.44	0.48	0.30
Mörrumsån	2024	0.66	0.65	0.68	0.65	0.79	0.72	0.75	0.59
Emån	2024	0.03	0.03	0.04	0.03	0.10	0.05	0.06	0.02
Kågeälven	2025	0.46	0.44	0.48	0.45	0.60	0.52	0.53	0.37
Testeboån	2025	0.59	0.58	0.60	0.58	0.72	0.64	0.69	0.51

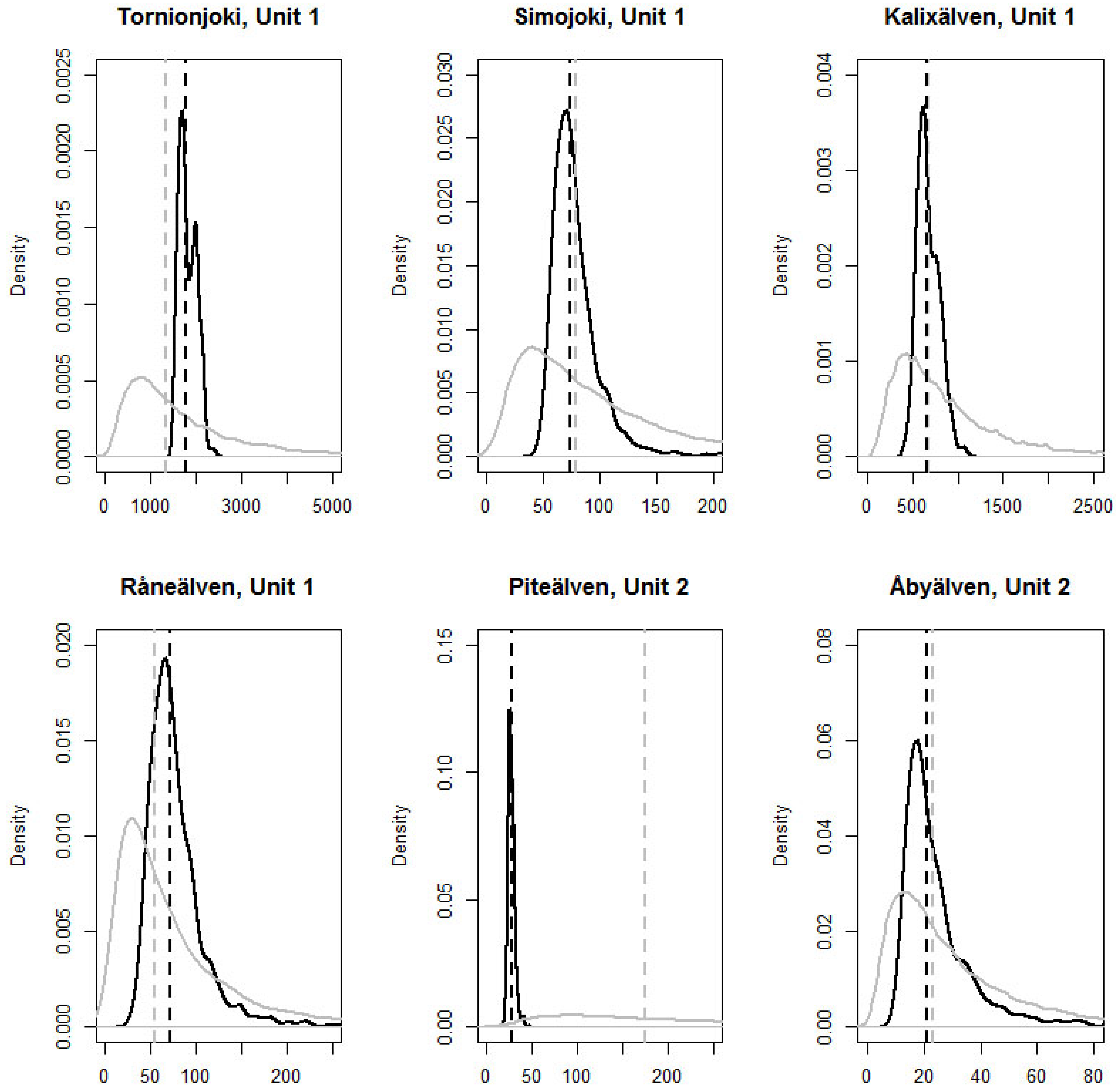


Figure 4.2.1.1a. Prior (grey line) and posterior (black line) distributions for K (maximum recruitment). Dashed vertical lines indicate prior medians (grey) and posterior medians (black).

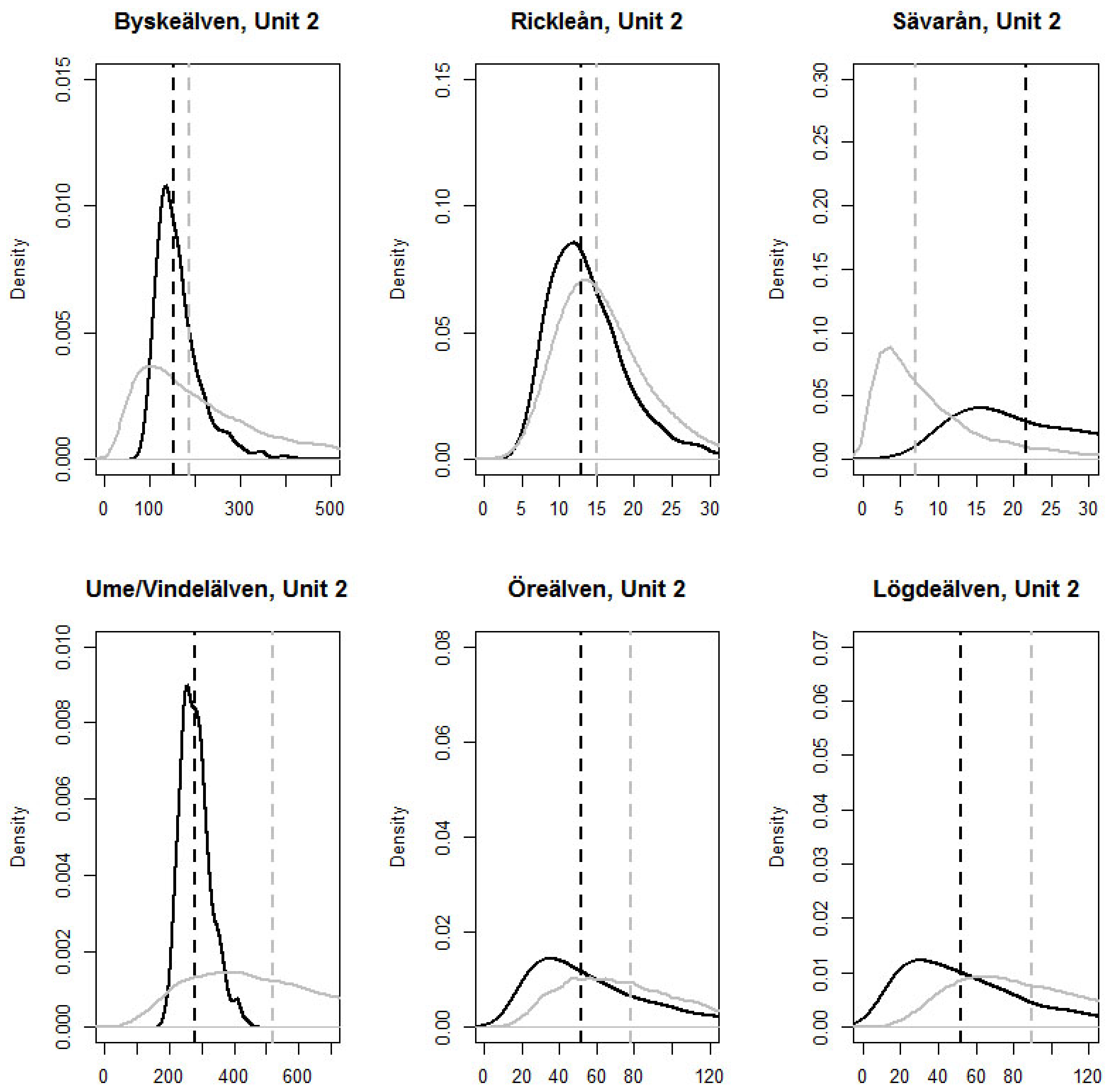


Figure 4.2.1.1b. Prior (grey line) and posterior (black line) distributions for K (maximum recruitment). Dashed vertical lines indicate prior medians (grey) and posterior medians (black).

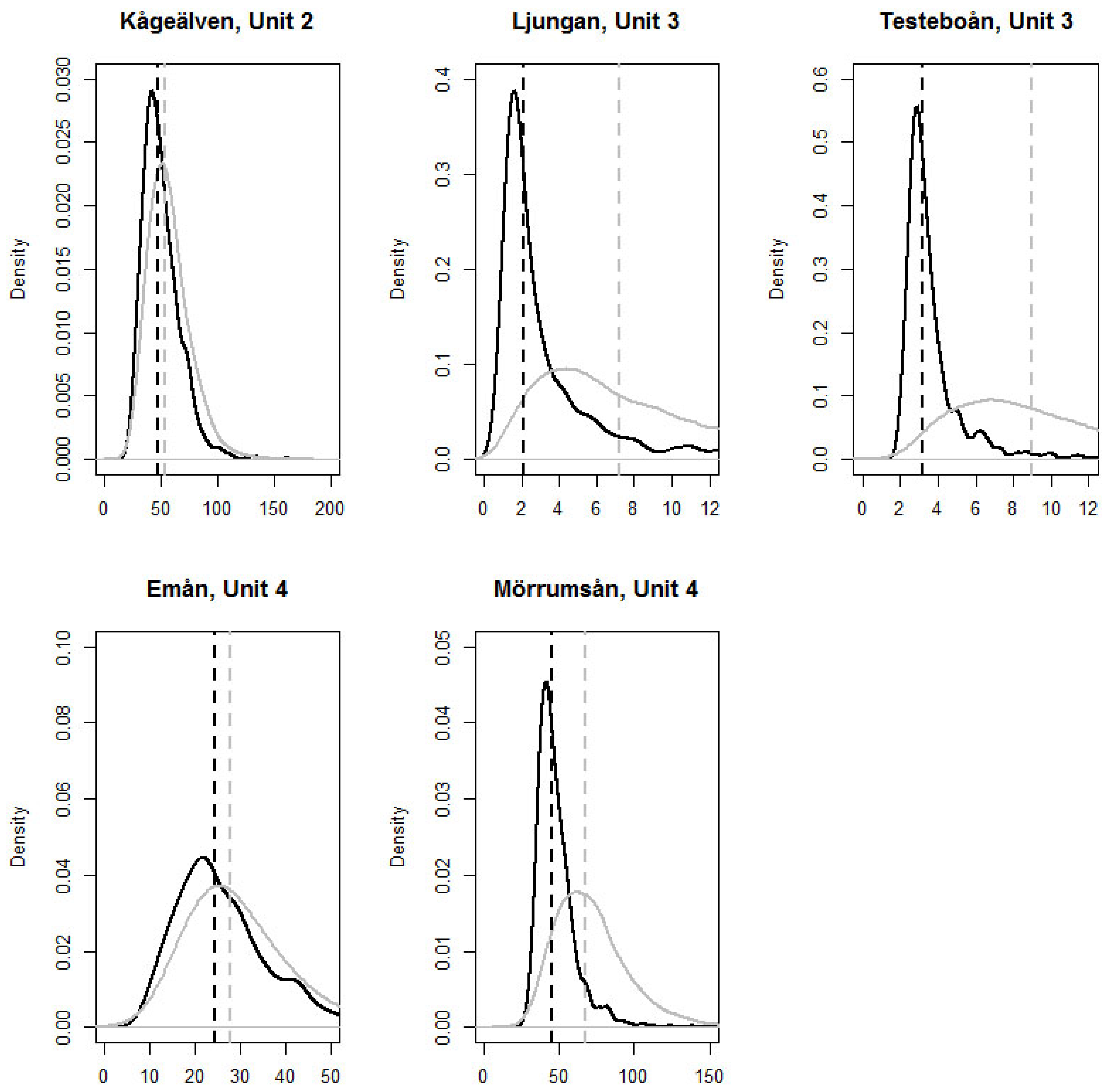


Figure 4.2.1.1c. Prior (grey line) and posterior (black line) distributions for K (maximum recruitment). Dashed vertical lines indicate prior medians (grey) and posterior medians (black).

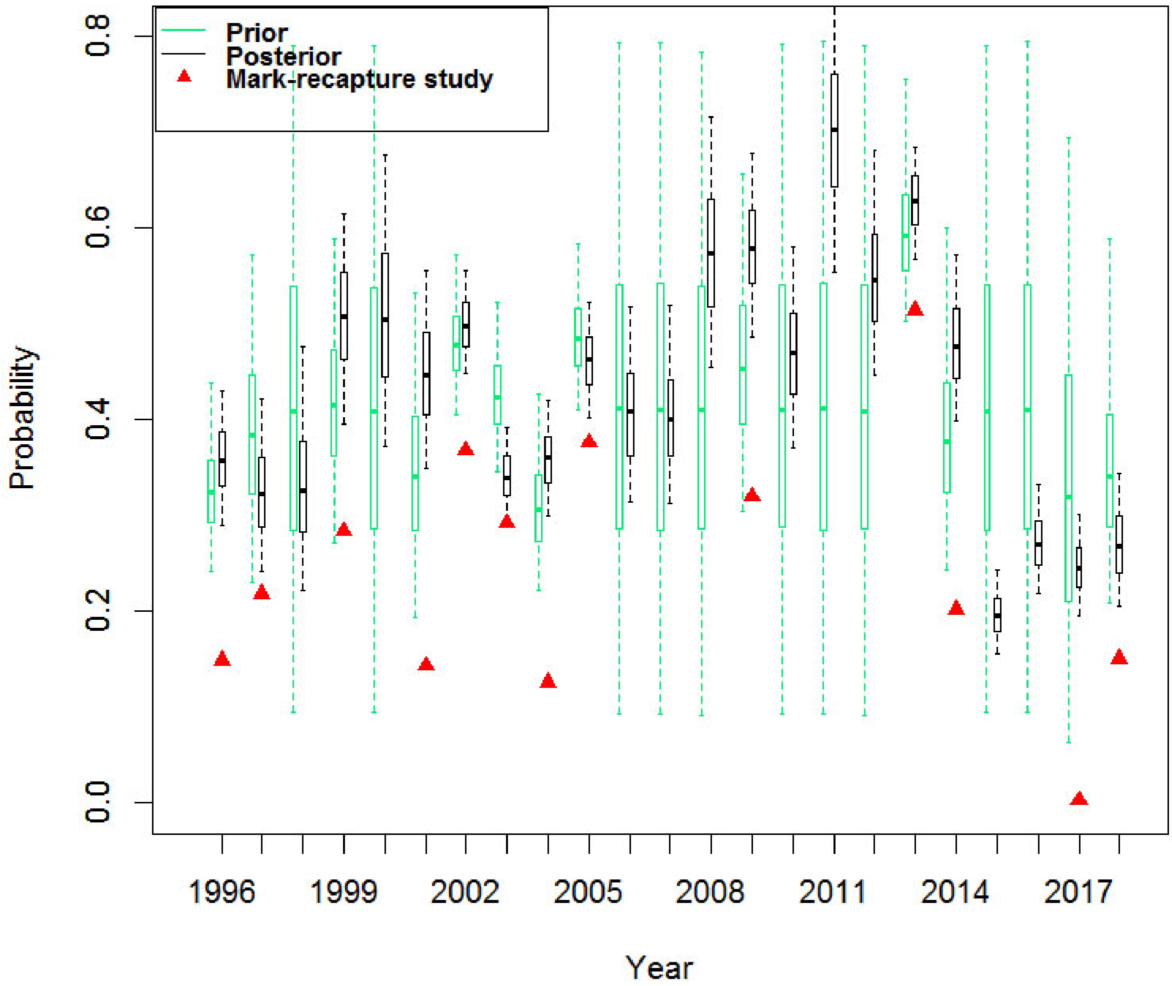


Figure 4.2.1.2. Probability that returning salmon find the fish ladder in river Ume/Vindel. For years in which mark–recapture experiments have not taken place, the prior distribution is the predictive distribution based on other years' mark–recapture studies.

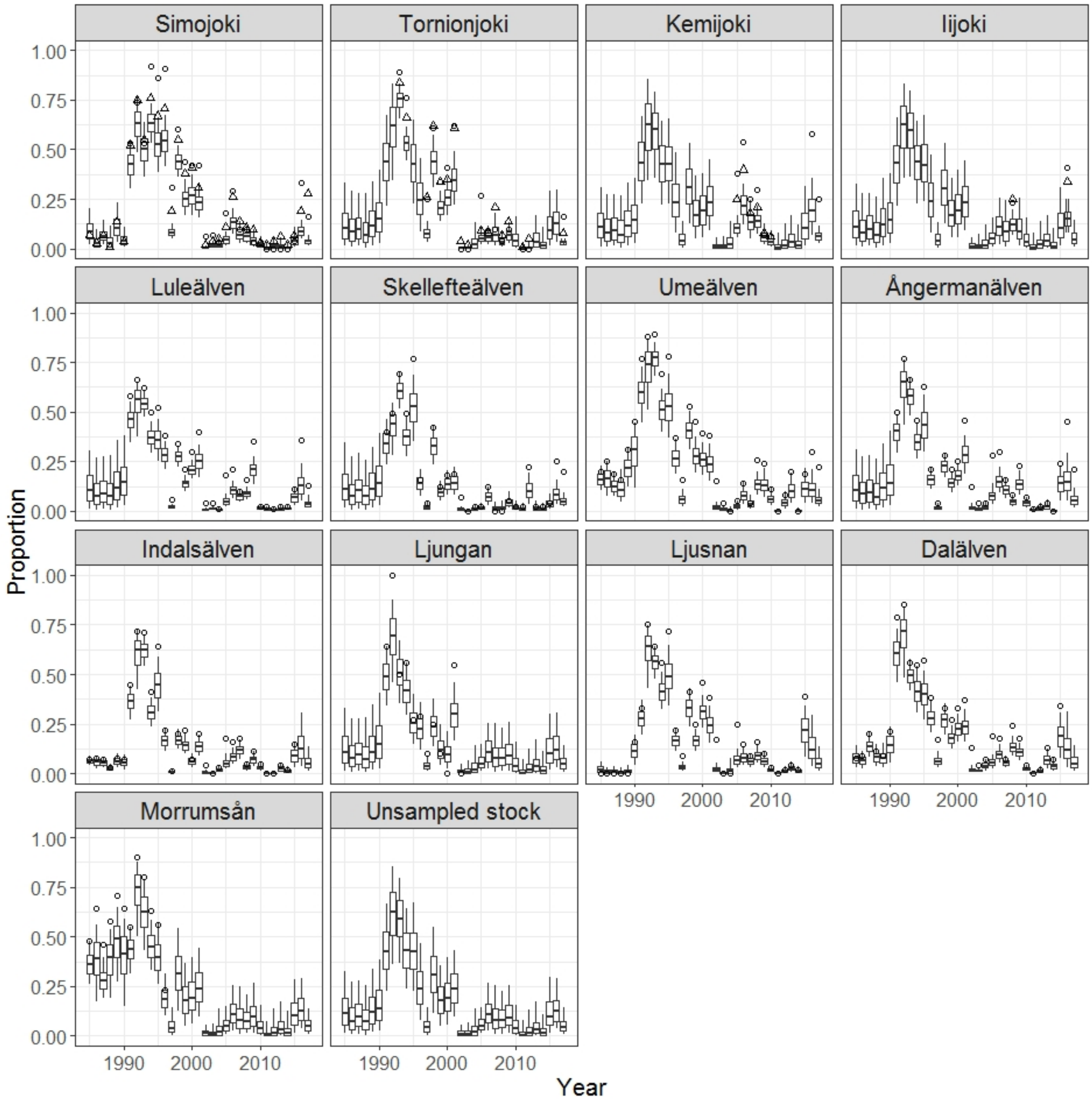


Figure 4.2.2.1. M74 mortality among Atlantic salmon stocks within the Baltic Sea by spawning year class in 1985–2017. Boxplots illustrate medians, 50% and 95% probability intervals of the estimated M74 mortality. Open circles illustrate the proportion of females with offspring affected by M74 and triangles the total average yolk-sac-fry mortality among offspring.

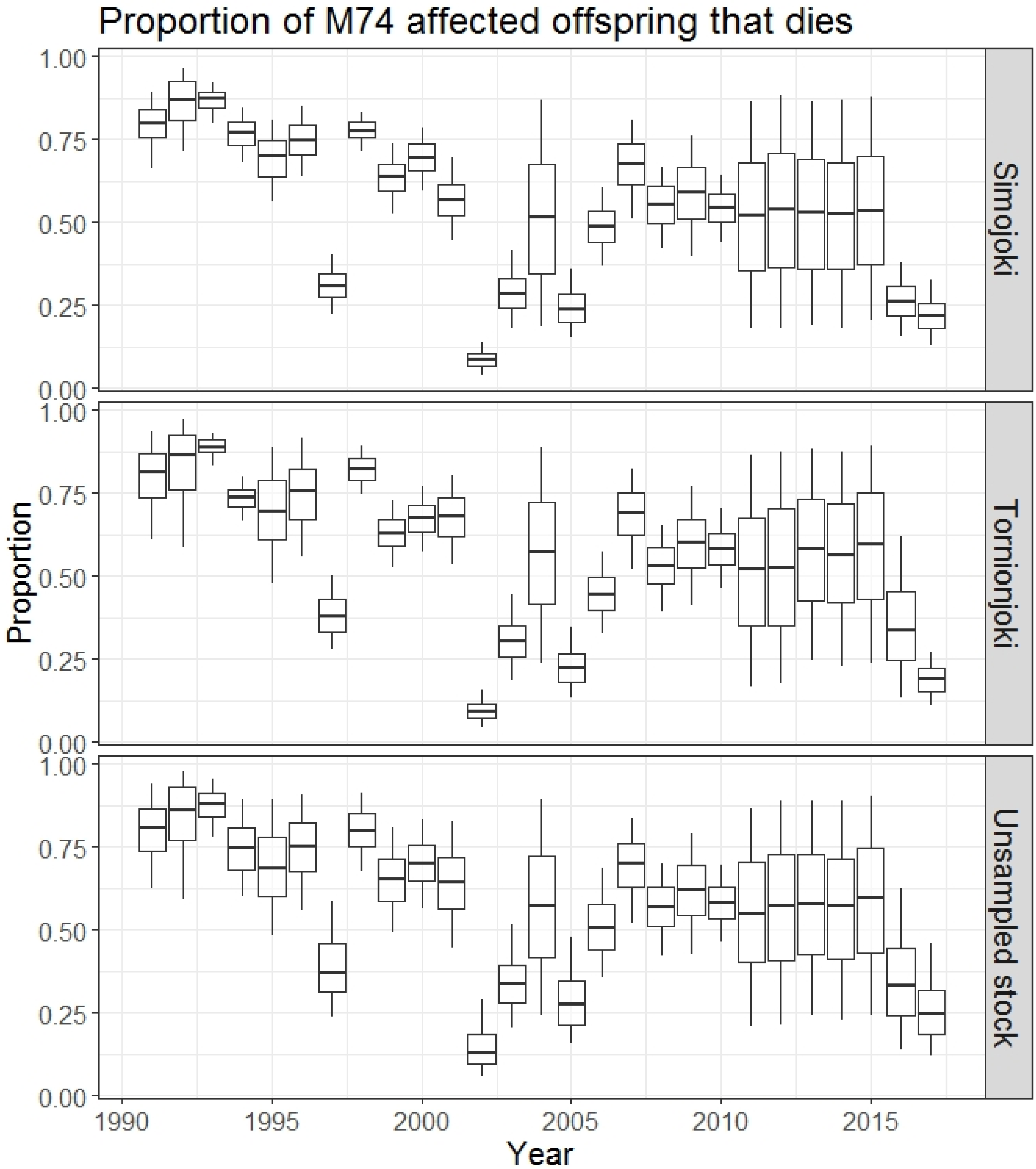


Figure 4.2.2.2. Estimated proportion of M74-affected offspring that die (i.e. mortality among those offspring that are from M74 affected females) by spawning year class in 1985–2017. Boxplots illustrate medians and 50% and 95% probability intervals.

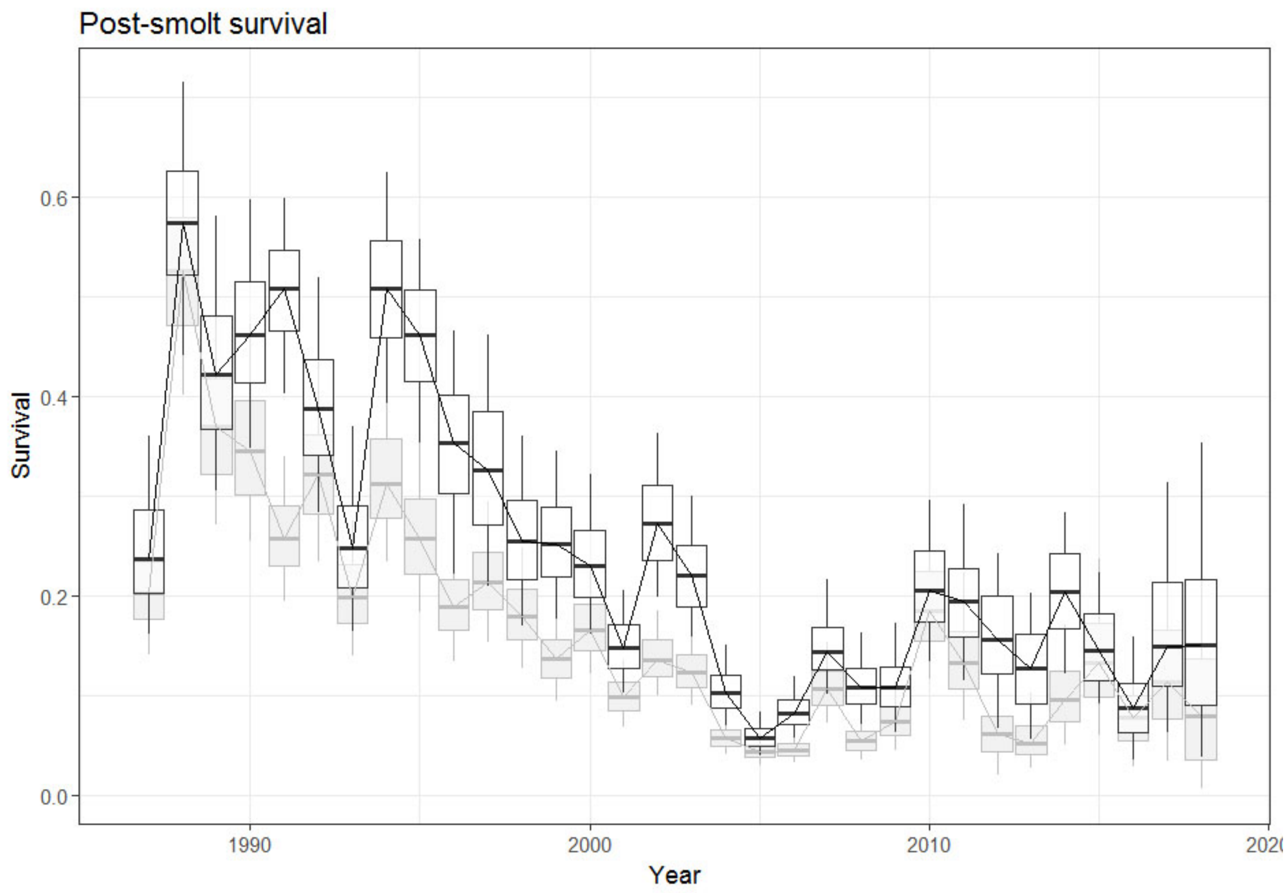


Figure 4.2.3.1 Post-smolt survival for wild (black) and hatchery-reared salmon (grey). Boxplots show medians with 5%, 25%, 75% and 95% quantiles.

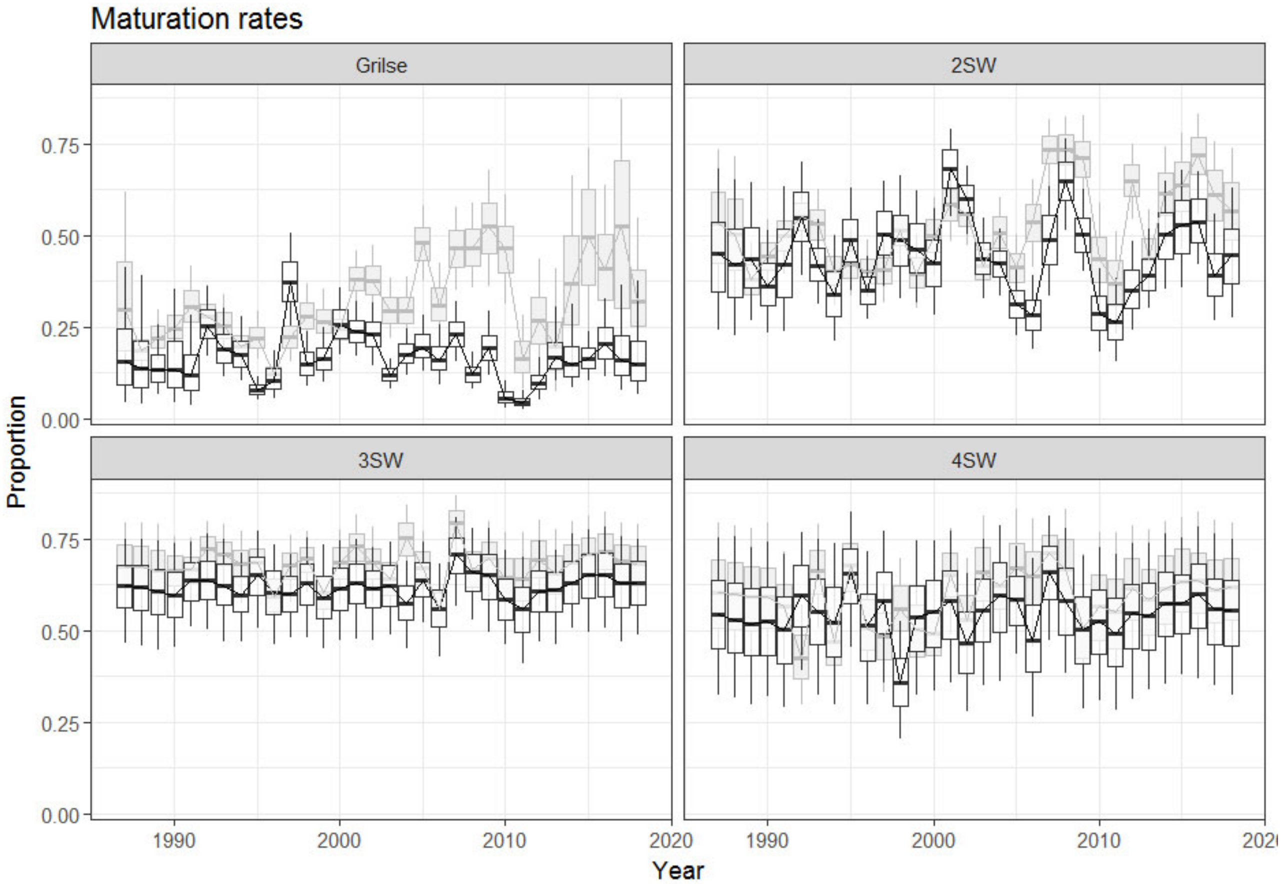


Figure 4.2.3.2. Proportion maturing per age group and per year for wild (black) and reared salmon (grey). Box-plots show medians with 5%, 25%, 75% and 95% quantiles.

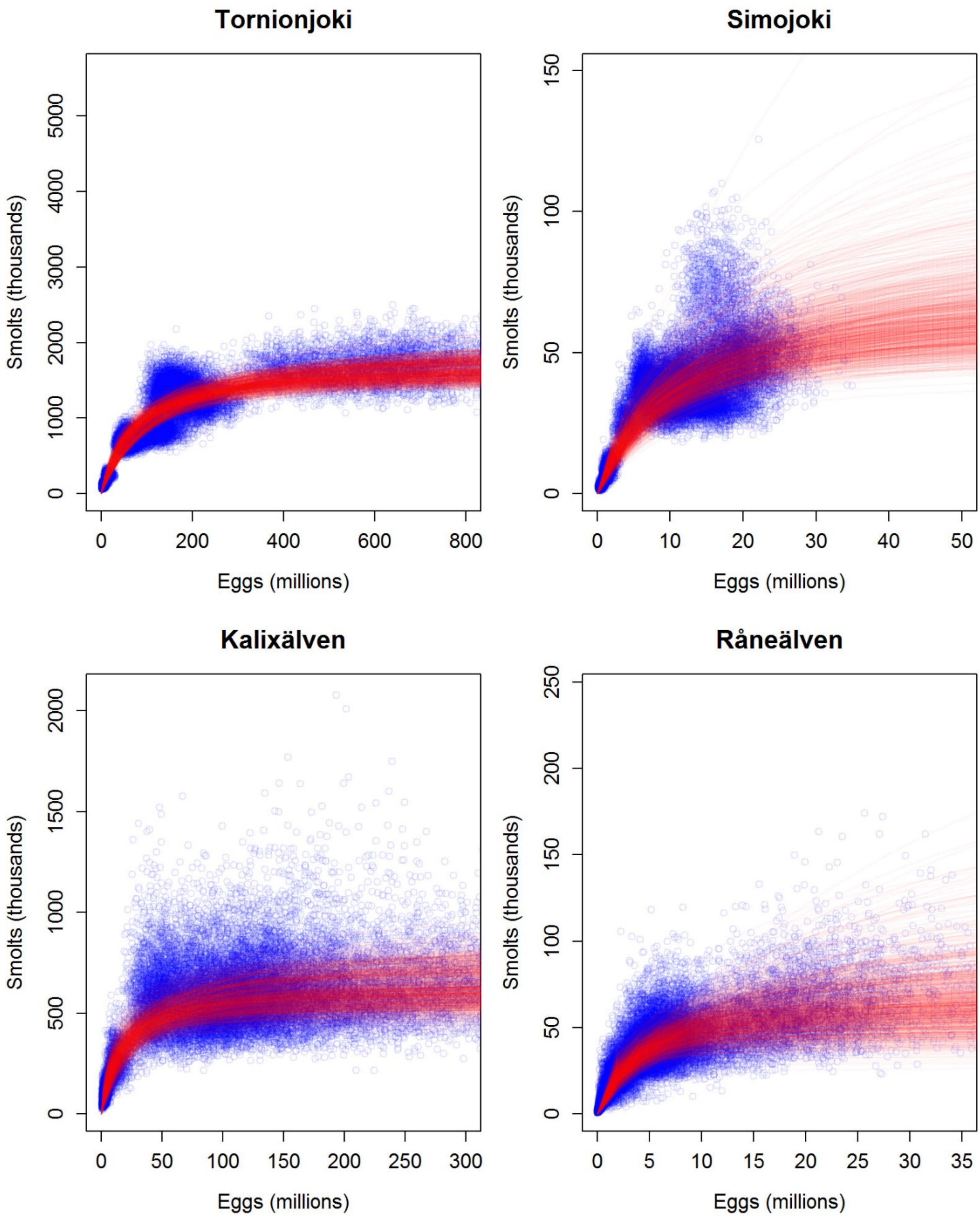


Figure 4.2.3.3a. Distributions for egg abundance (million), plotted against the smolt abundance (thousand) for stocks of assessment units 1–4. Blue dots present the posterior distributions of annual smolt and egg abundances, red curves indicate the distributions of stock–recruit relationship.

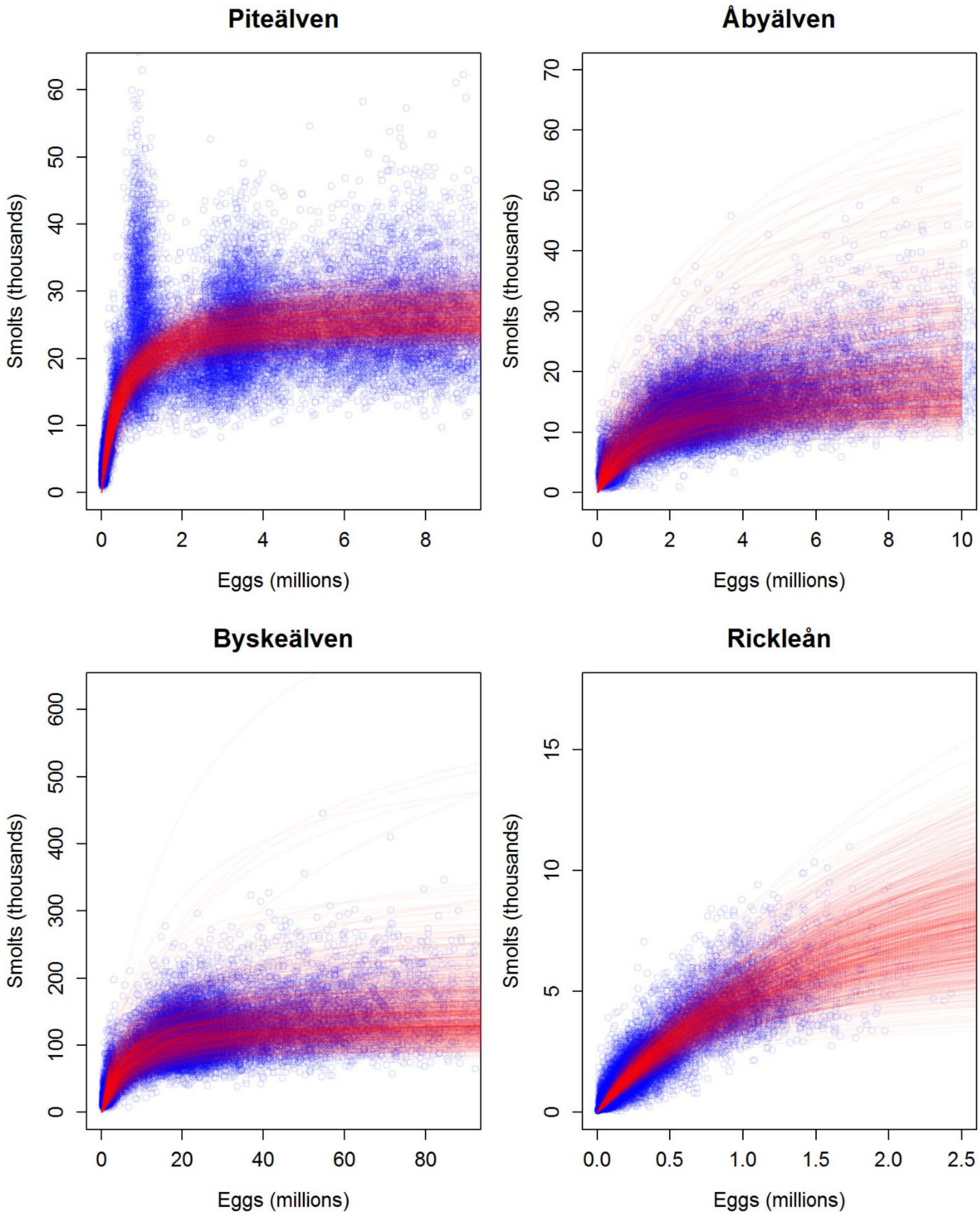


Figure 4.2.3.3b. Distributions for egg abundance (million), plotted against the smolt abundance (thousand) for stocks of assessment units 1–4. Blue dots present the posterior distributions of annual smolt and egg abundances, red curves indicate the distributions of stock–recruit relationship.

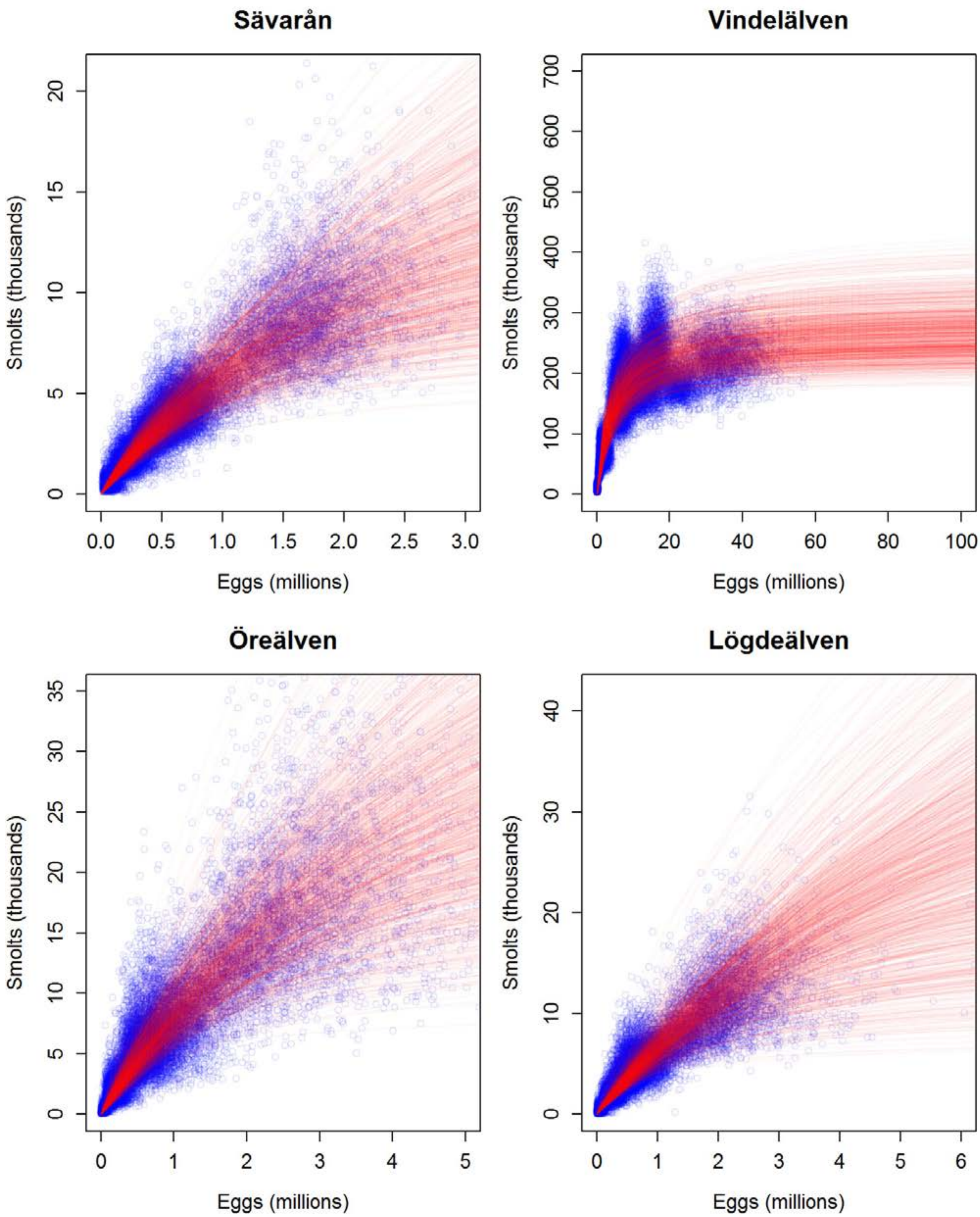


Figure 4.2.3.3c. Distributions for egg abundance (million), plotted against the smolt abundance (thousand) for stocks of assessment units 1–4. Blue dots present the posterior distributions of annual smolt and egg abundances, red curves indicate the distributions of stock–recruit relationship.

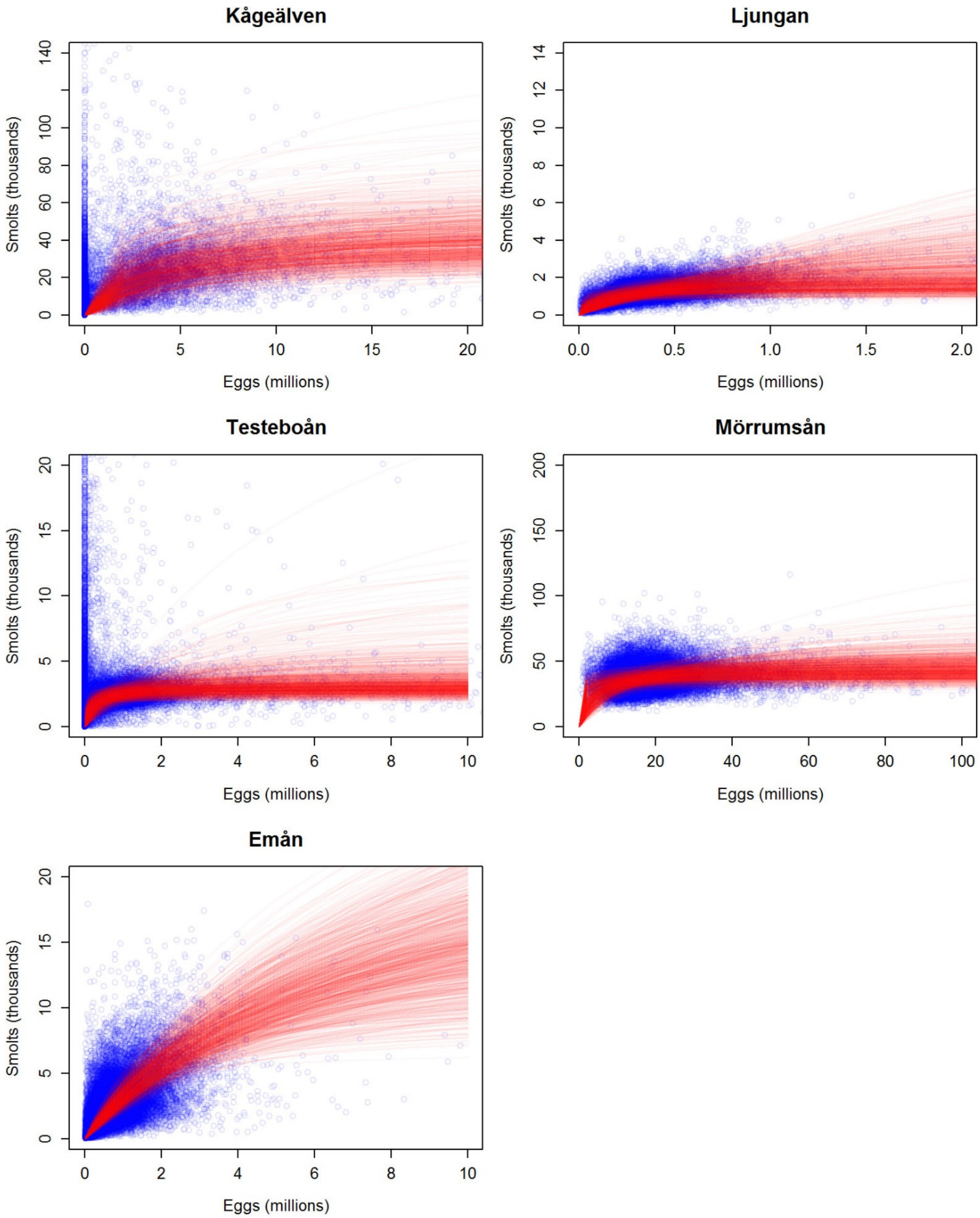


Figure 4.2.3.3d. Distributions for egg abundance (million), plotted against the smolt abundance (thousand) for stocks of assessment units 1–4. Blue dots present the posterior distributions of annual smolt and egg abundances, red curves indicate the distributions of stock–recruit relationship.

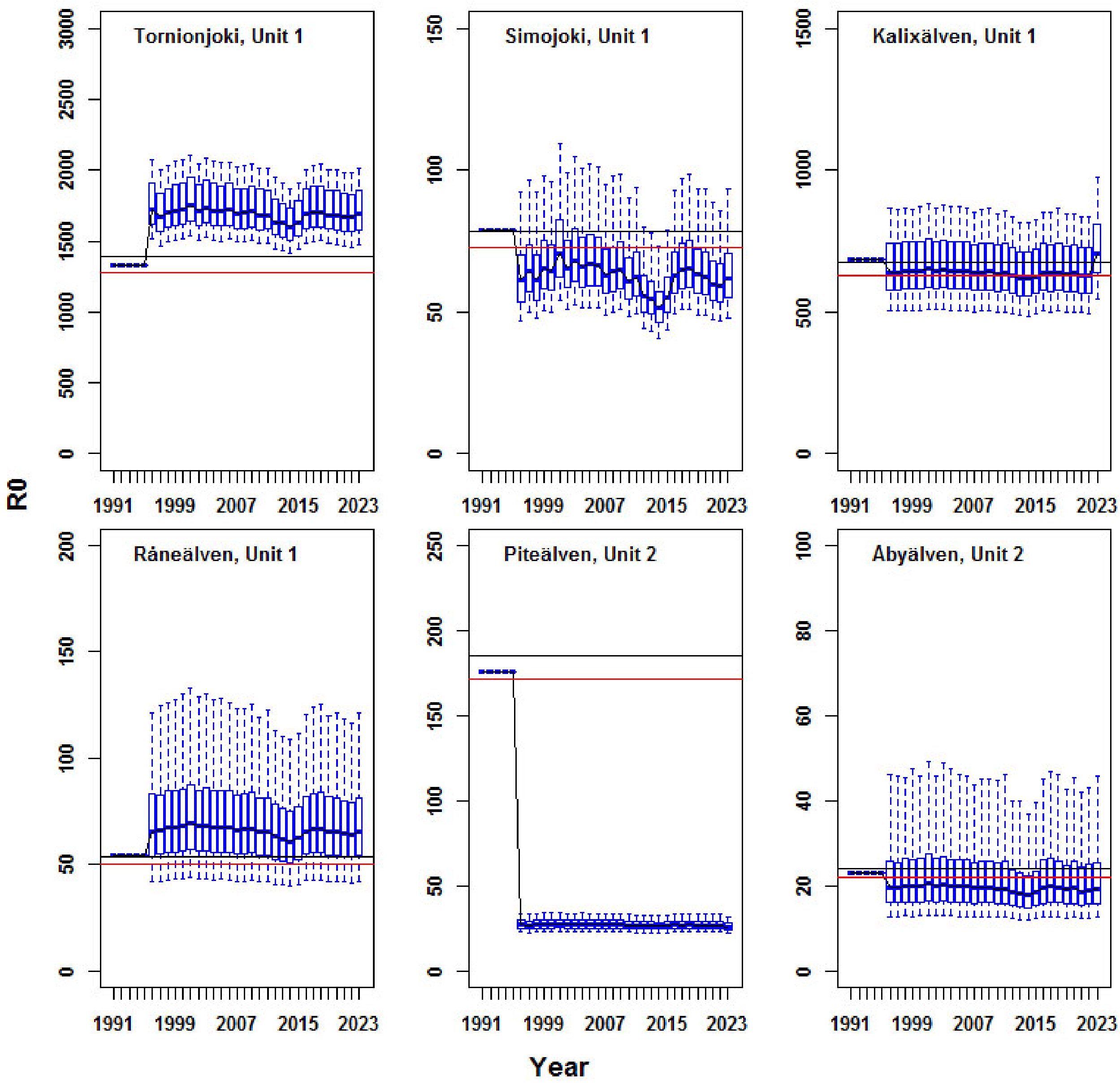


Figure 4.2.3.4a. Posterior probability distributions for potential smolt production capacity (R0 or PSPC, 1000s of smolts) by year obtained in 2019's assessment. Boxplots show medians with 5%, 25%, 75% and 95% quantiles. Horizontal lines indicate prior medians for K (black) and R0 in 2018 (red). Priors for R0 are indirect priors obtained by running the model with no data (i.e. implied by prior information about K, alpha and eggs per recruit.

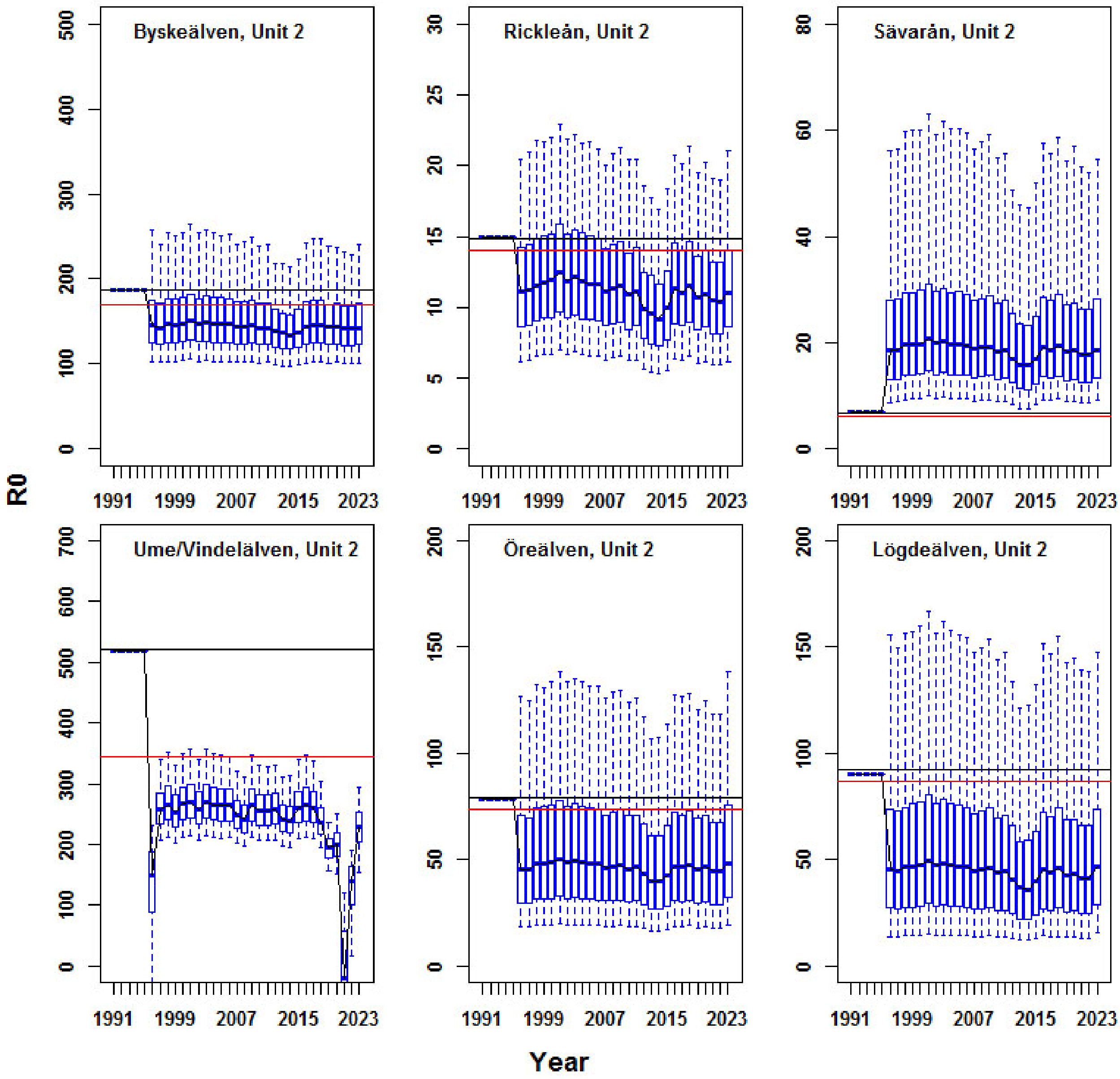


Figure 4.2.3.4b. Posterior probability distributions for potential smolt production capacity (R0 or PSPC, 1000s of smolts) by year obtained in 2019's assessment. Boxplots show medians with 5%, 25%, 75% and 95% quantiles. Horizontal lines indicate prior medians for K (black) and R0 in 2018 (red). Priors for R0 are indirect priors obtained by running the model with no data (i.e. implied by prior information about K, alpha and eggs per recruit.

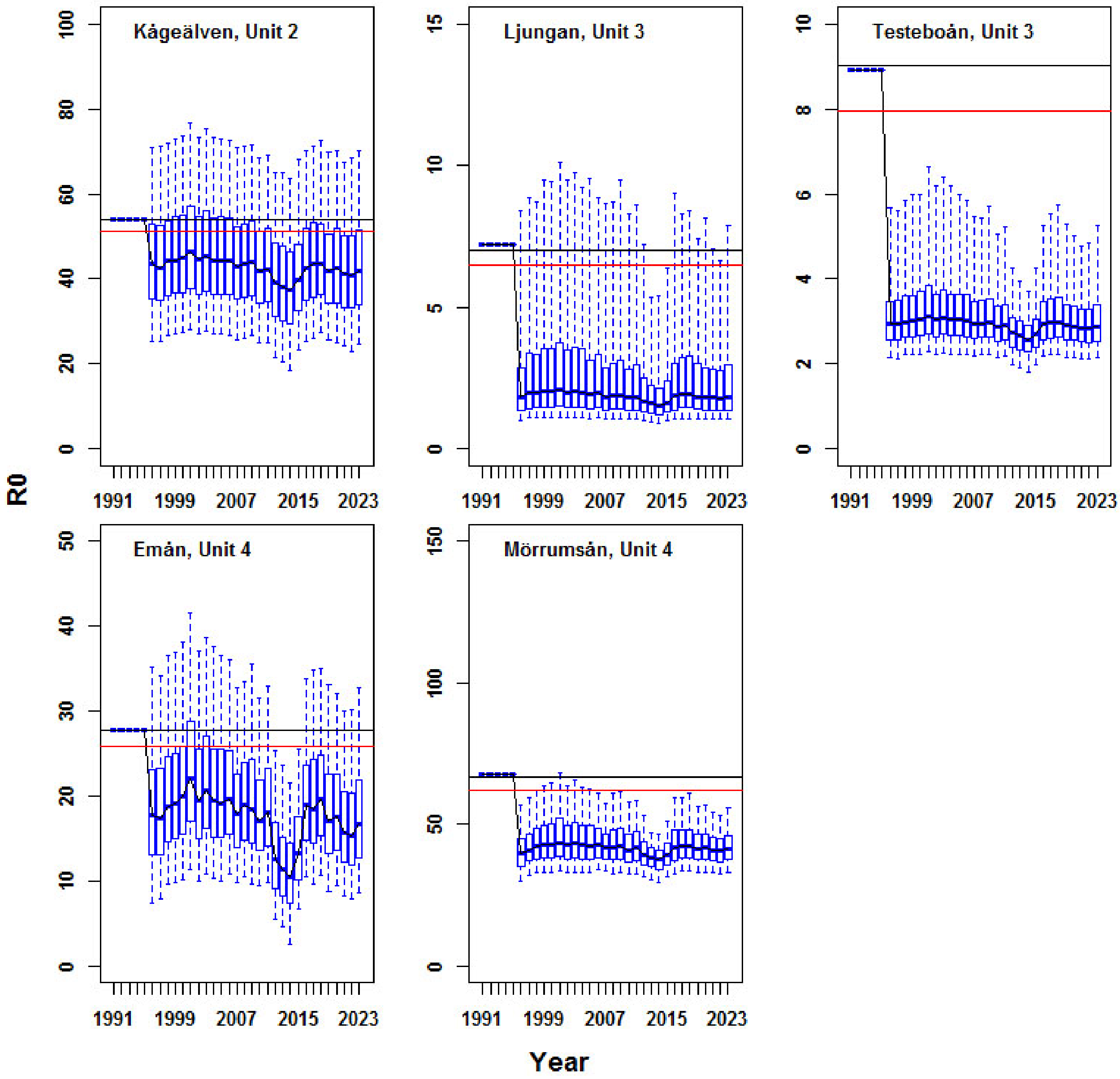


Figure 4.2.3.4c. Posterior probability distributions for potential smolt production capacity (R0 or PSPC, 1000s of smolts) by year obtained in 2019's assessment. Boxplots show medians with 5%, 25%, 75% and 95% quantiles. Horizontal lines indicate prior medians for K (black) and R0 in 2018 (red). Priors for R0 are indirect priors obtained by running the model with no data (i.e. implied by prior information about K, alpha and eggs per recruit.

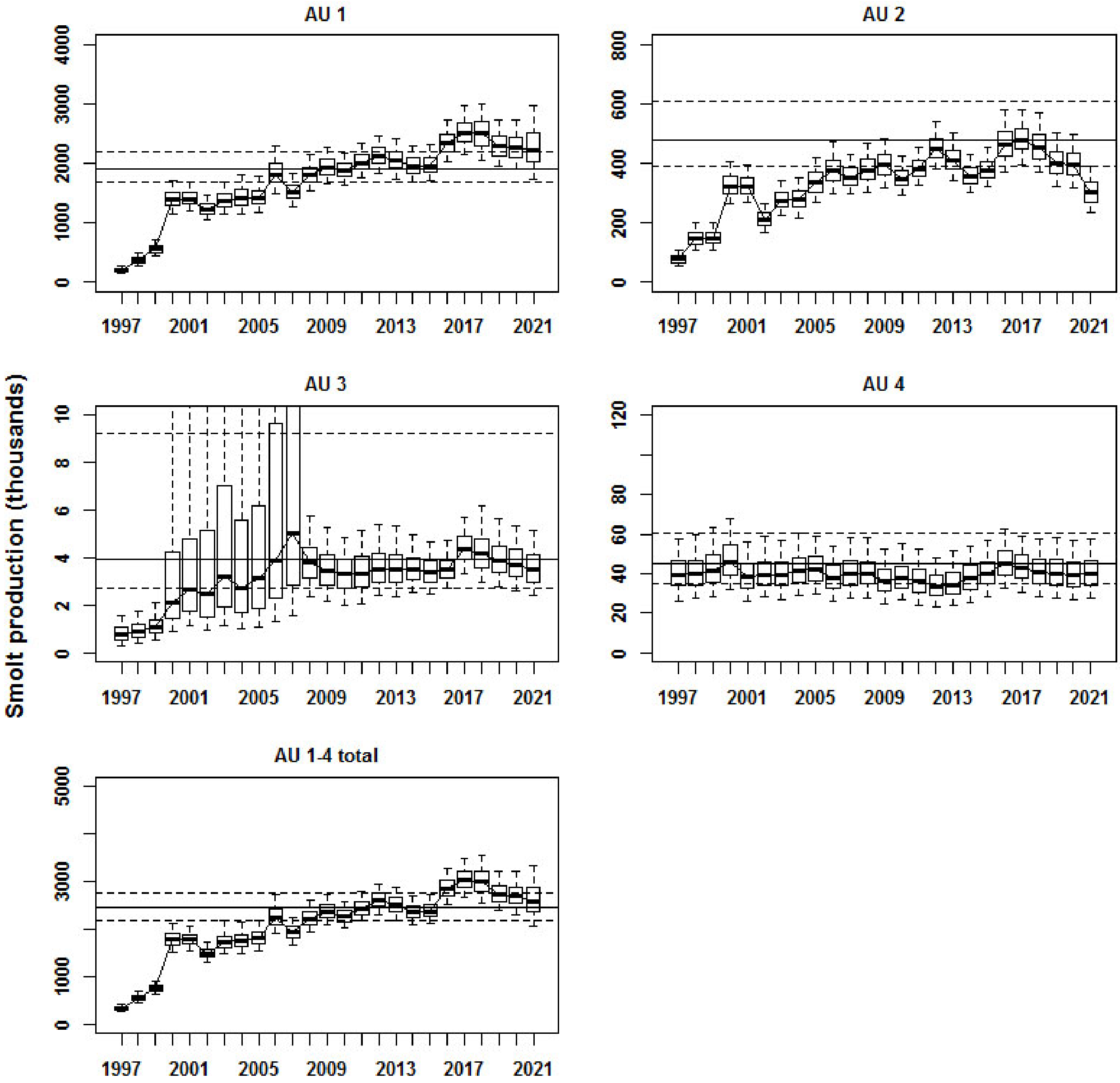


Figure 4.2.3.5. Posterior probability distributions for the total smolt production in assessment units (AU) 1 to 4 and all units combined. Horizontal lines within each box show the median (solid line); whiskers denote the 90% PI for smolt production. Solid horizontal lines denote the posterior median for the unit-specific potential smolt production capacity (R0 or PSPC) in 2018; dashed horizontal lines show the 90% posterior PI for unit-specific PSPC in 2018.

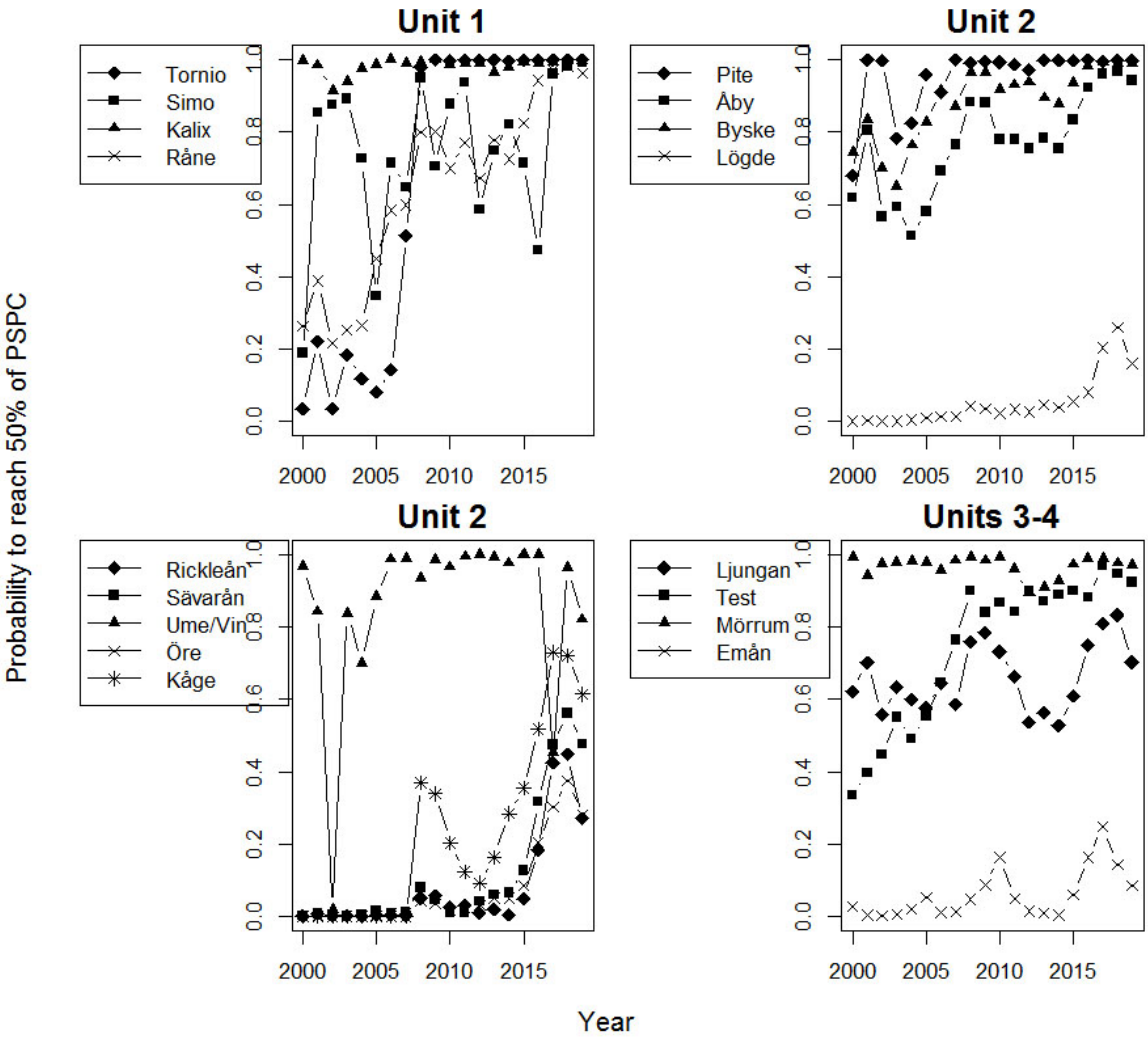


Figure 4.2.3.6. Probability of reaching 50% of the smolt production capacity for different stocks of assessment units 1-4.

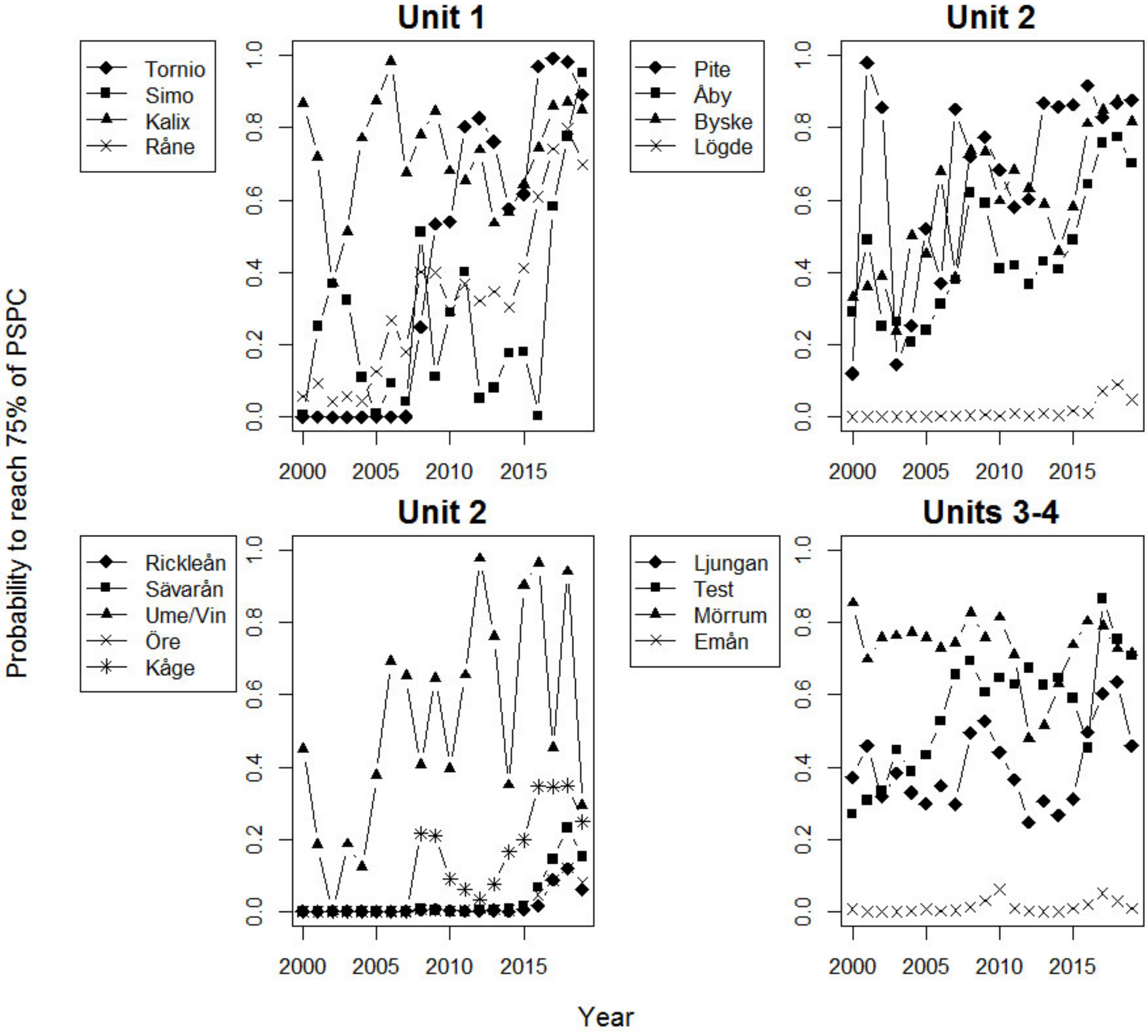


Figure 4.2.3.7. Probability of reaching 75% of the smolt production capacity for different stocks of assessment units 1-4.

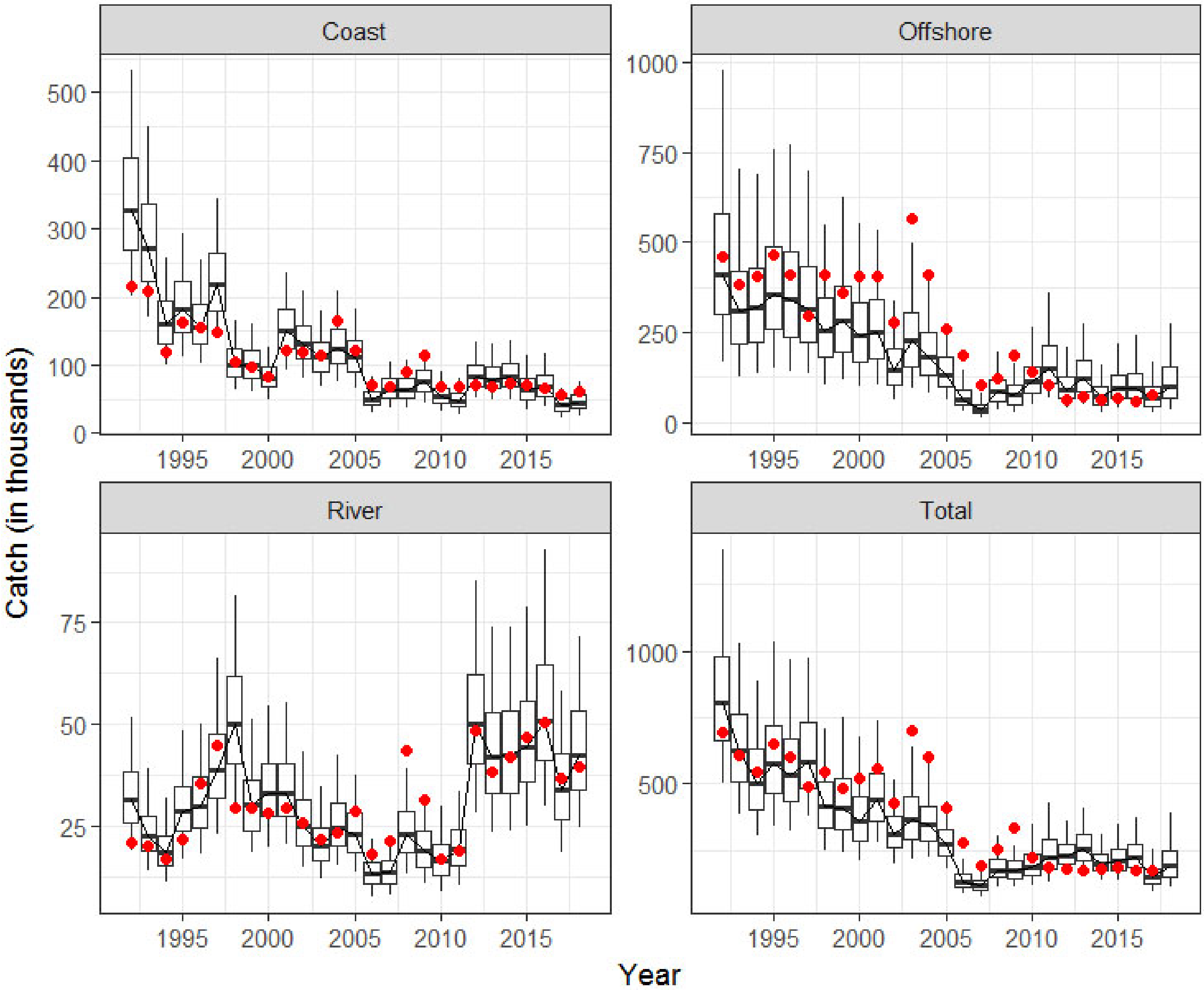


Figure 4.2.3.8. Estimated posterior distributions of catches compared with corresponding observed catches (boxplots with medians, 5%, 25%, 75% and 95% quantiles). Offshore catches cover both commercial fisheries and recreational trolling. Observed catches have been recalculated to account for unreporting.

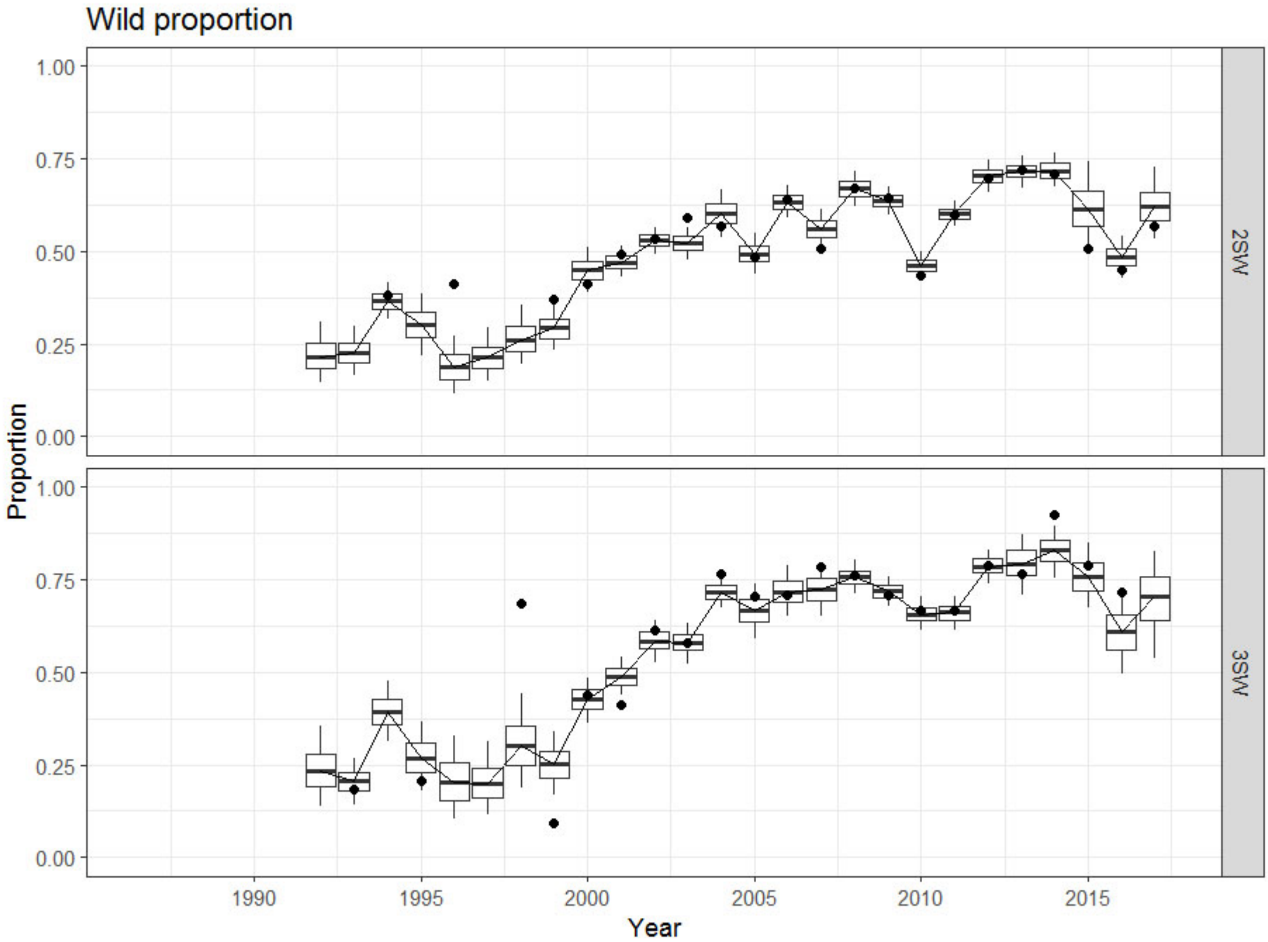


Figure 4.2.3.9. Estimated proportions of wild salmon in offshore catches in comparison to wild proportions observed in catch samples among 2SW and 3SW salmon. Boxplots show medians with 5%, 25%, 75% and 95% quantiles.

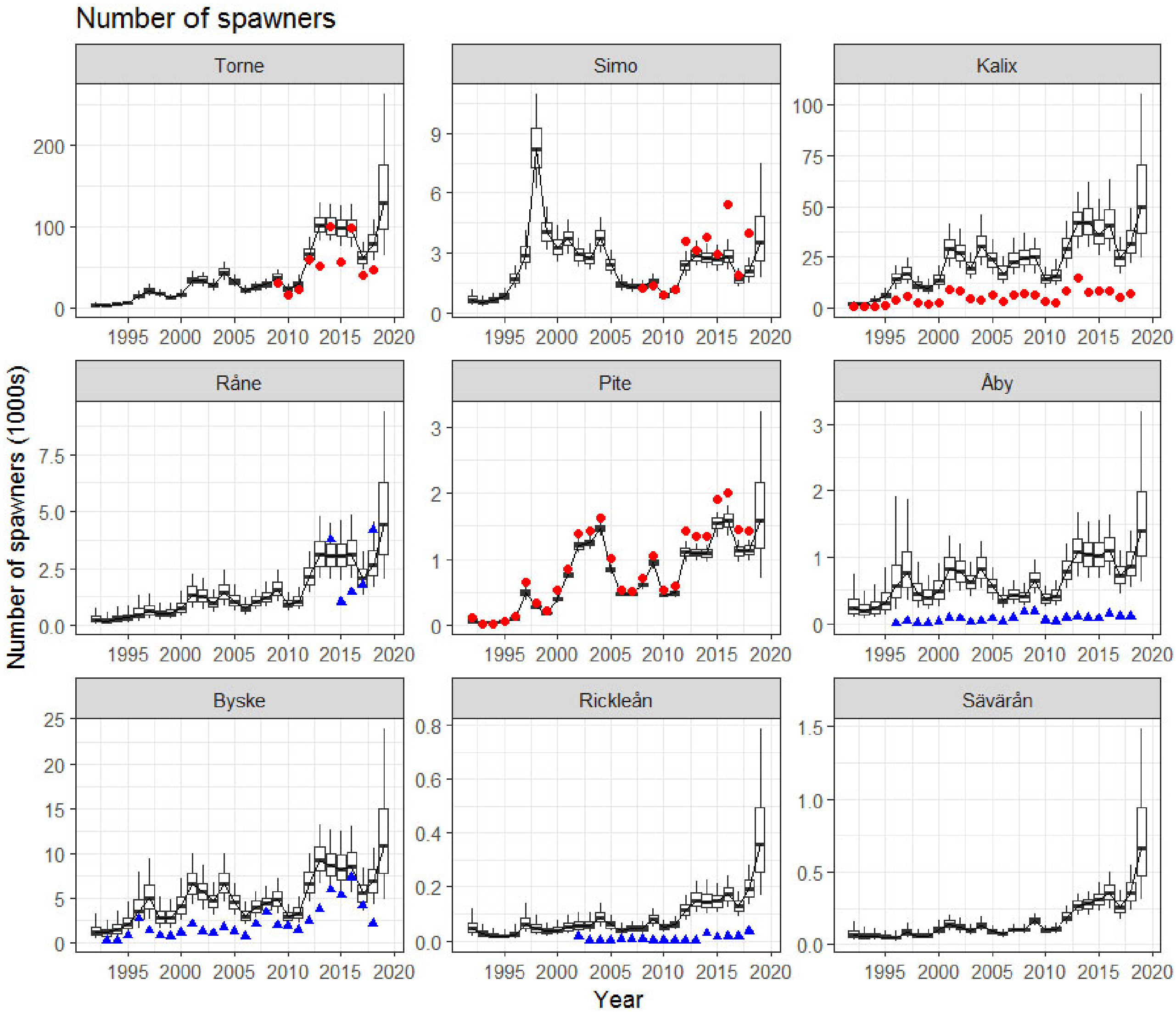


Figure 4.2.3.10a. Estimated posterior distributions of the number of spawners (in thousands) in each river versus numbers observed in fish counters. Observations indicated with dots are used as an input in the full life-history model whereas the ones indicated with triangles are so far not used as an input. Boxplots show medians with 5%, 25%, 75% and 95% quantiles.

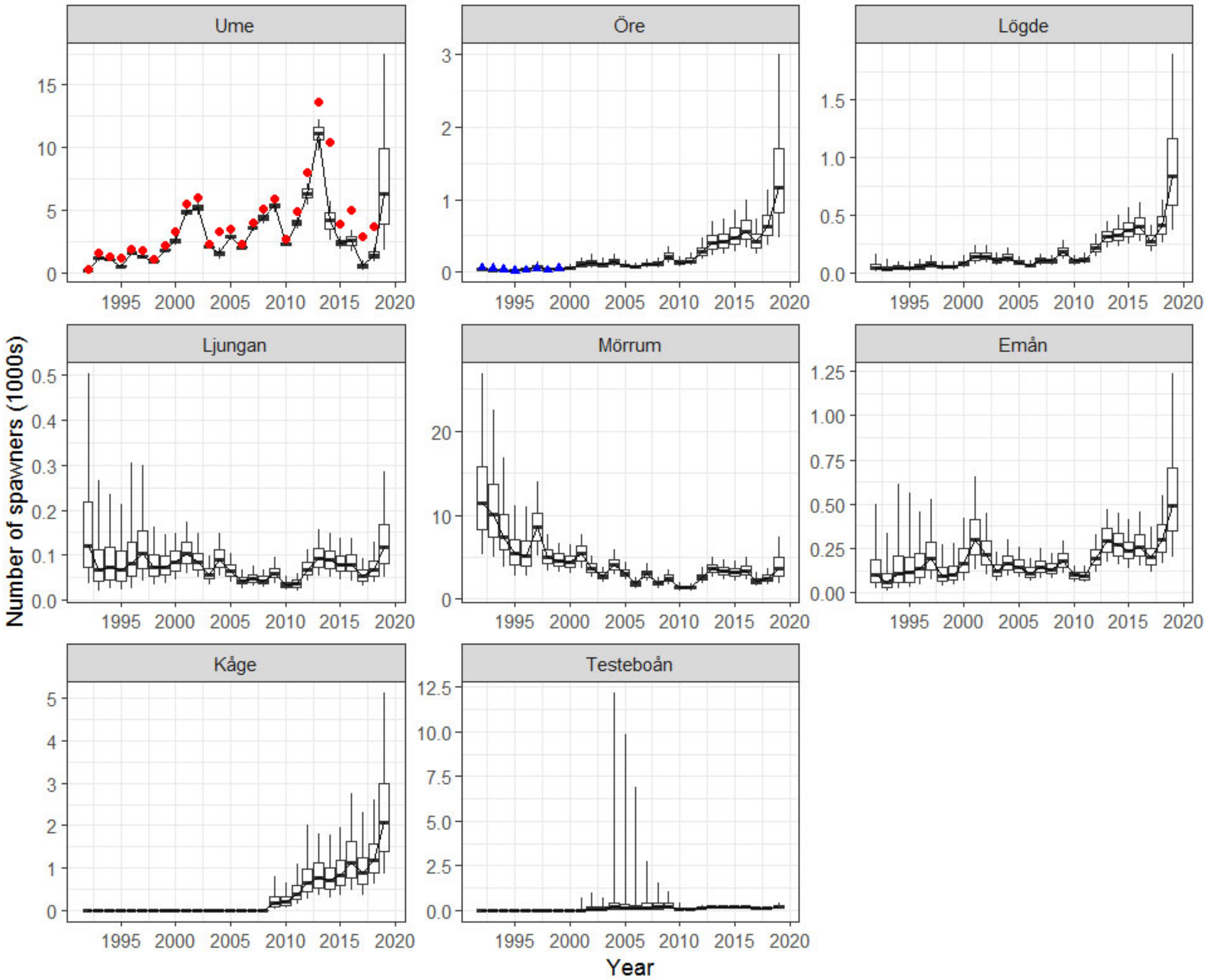


Figure 4.2.3.10b. Estimated posterior distributions of the number of spawners (in thousands) in each river versus number of observed in fish counters. Observations indicated with dots are used as an input in the full life-history model whereas the ones indicated with triangles are so far not used as an input. Boxplots show medians with 5%, 25%, 75% and 95% quantiles.

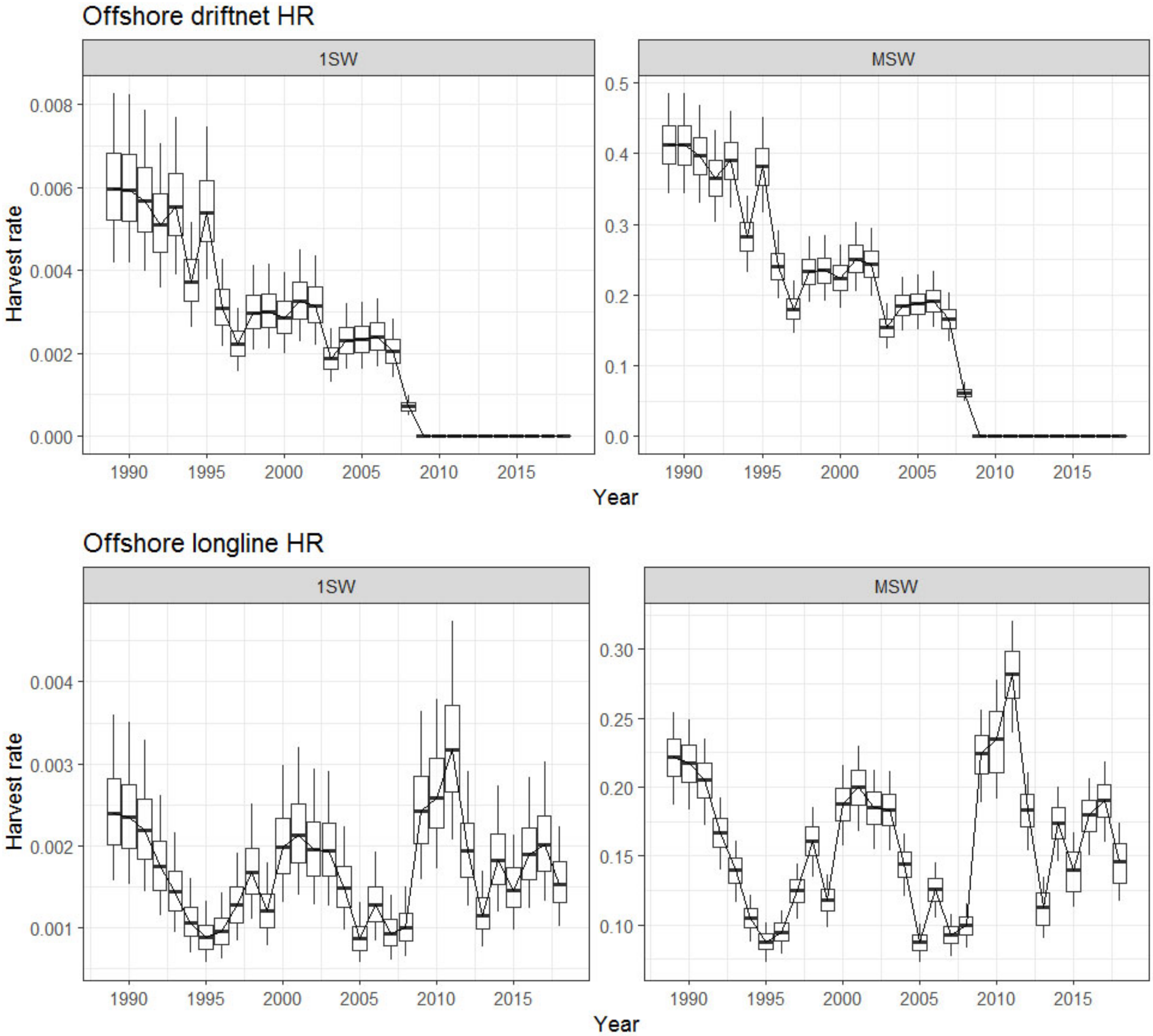


Figure 4.2.3.11a. Estimated posterior distributions of the harvest rates (harvested proportion of the available population) in offshore driftnet and offshore longline fisheries separately for one-sea-winter and multi-sea-winter salmon. The offshore longline fishery contains now also recreational trolling (see Section 4.2.1 for details). 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. Boxplots show medians with 5%, 25%, 75% and 95% quantiles.

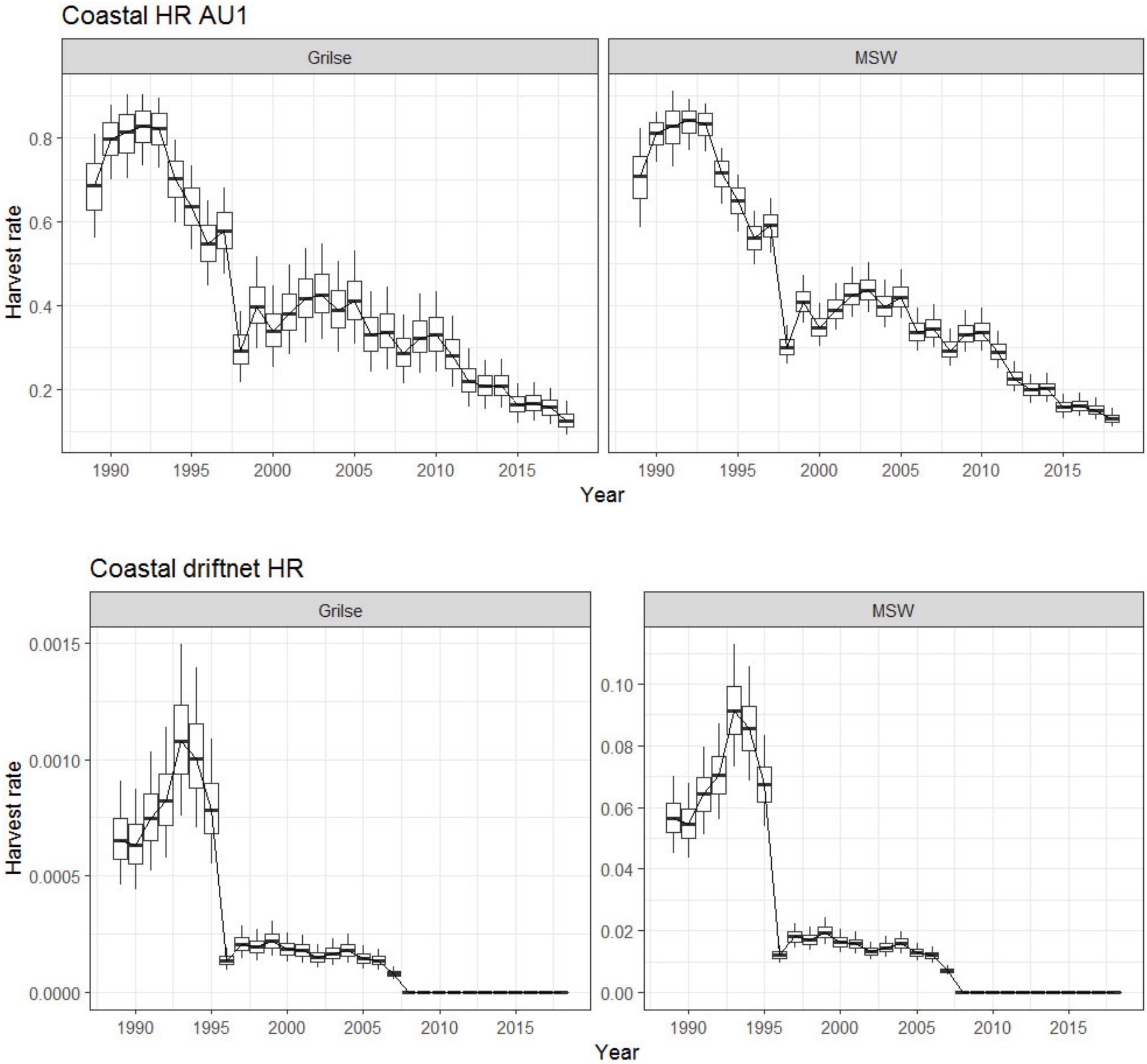


Figure 4.2.3.11b. Estimated posterior distributions of the harvest rates (harvested proportion of the available population) in other coastal fisheries than driftnetting in AU1 and in coastal driftnetting (all AU's together) separately for one-sea-winter and multi-sea-winter salmon. Boxplots show medians with 5%, 25%, 75% and 95% quantiles.

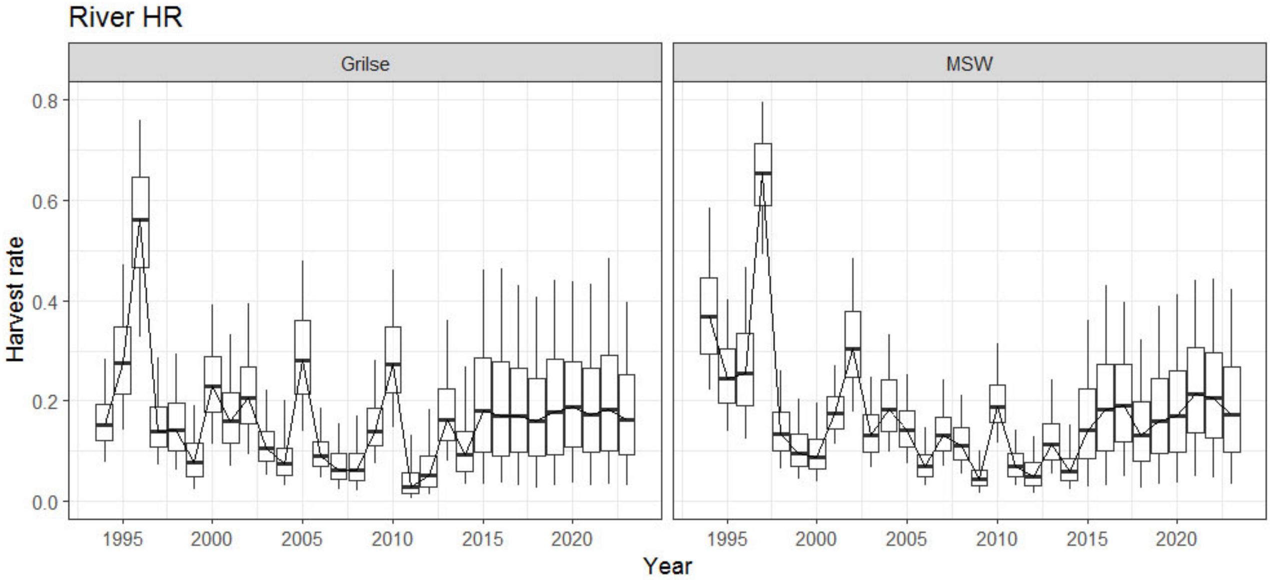
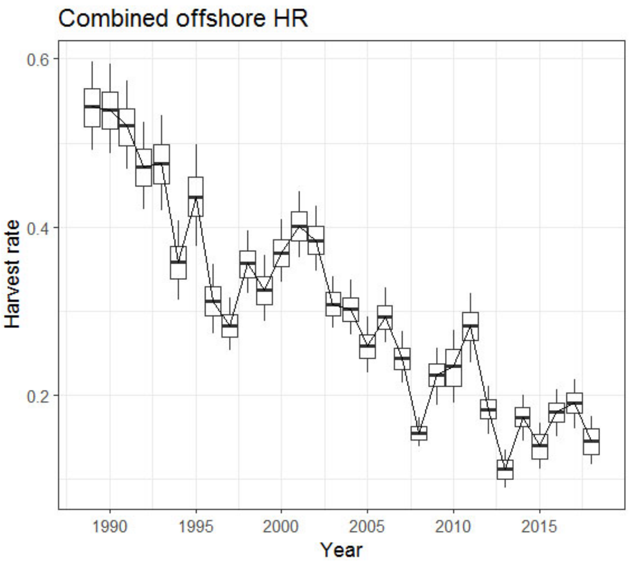


Figure 4.2.3.11c. Estimated posterior distributions of the harvest rates (harvested proportion of the available population) in the river fishery separately for one-sea-winter and multi-sea-winter salmon. Boxplots show medians with 5%, 25%, 75% and 95% quantiles.



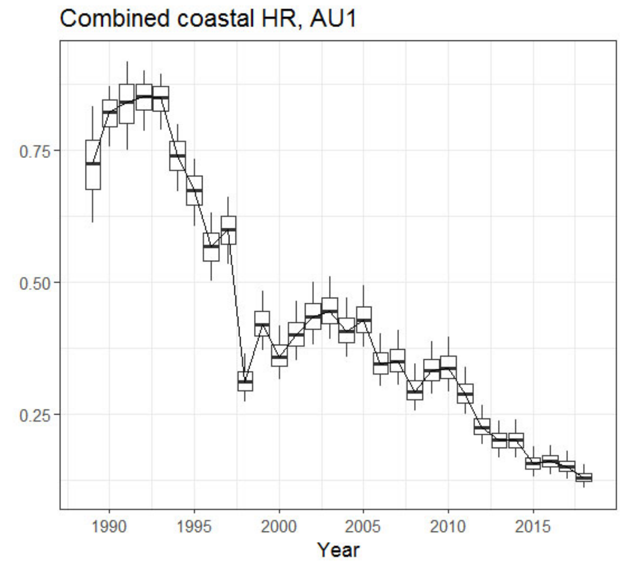


Figure 4.2.3.12. Combined harvest rates (harvested proportion of the available population) for offshore and coastal fisheries for MSW wild salmon in 1989–2018. Boxplots show medians with 5%, 25%, 75% and 95% quantiles.

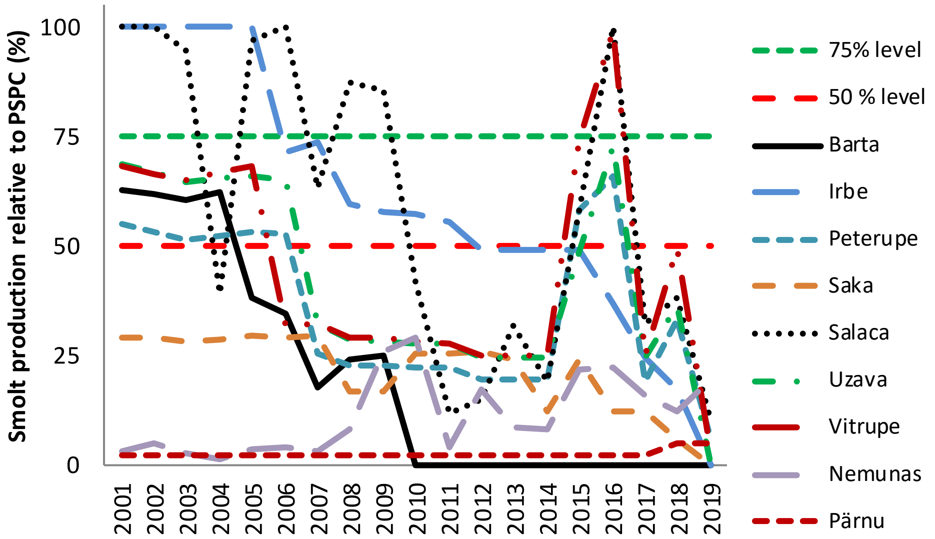


Figure 4.2.4.1. Wild smolt production level in relation to the potential in AU 5 wild salmon populations.

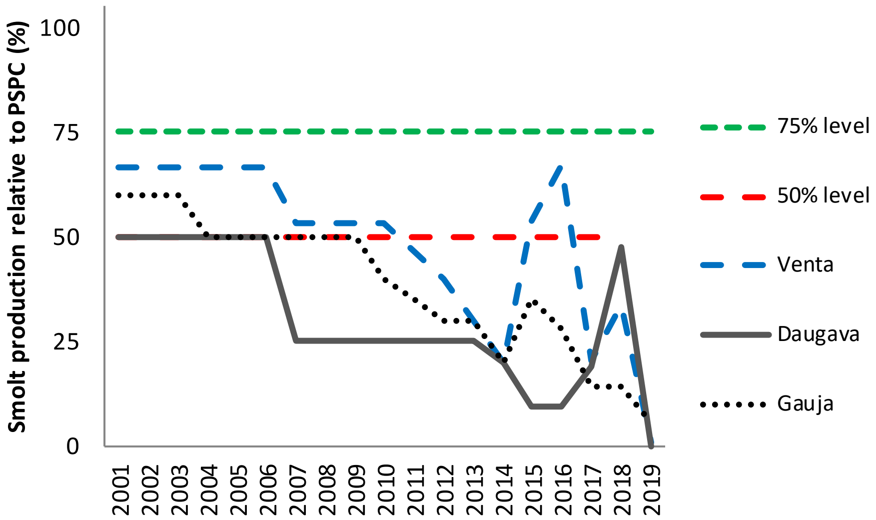


Figure 4.2.4.2. Wild smolt production level in relation to the potential in AU 5 mixed salmon populations.

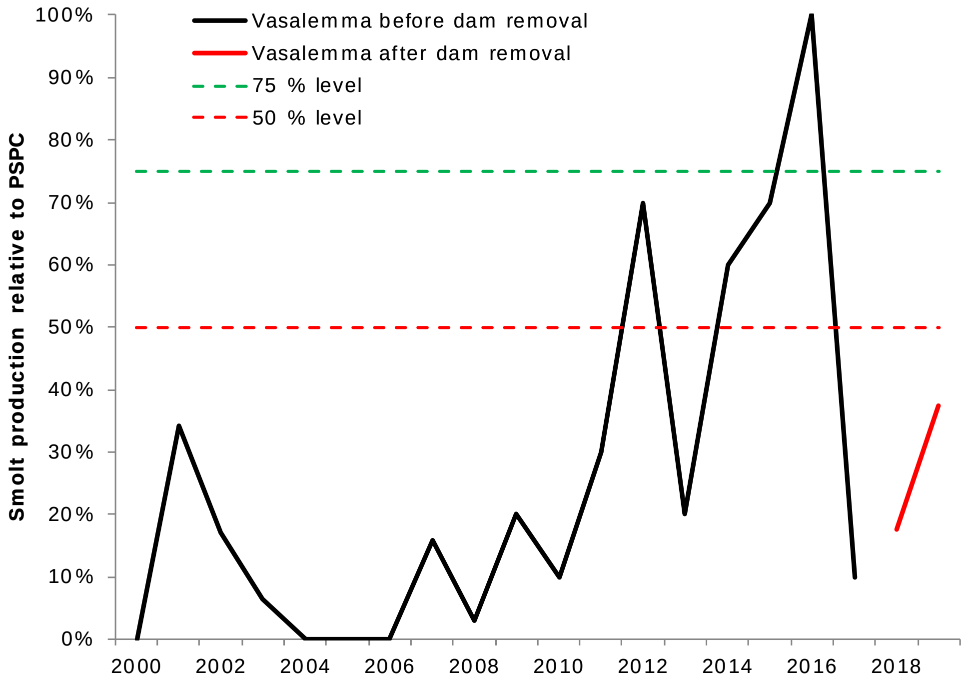


Figure 4.2.4.3. Smolt production level in relation to the potential in AU 6 wild salmon populations. Note that the PSPC is calculated only to the accessible rearing habitat; areas above migration obstacles are excluded. In 2018 a dam was removed in Vasalemma and the PSPC increased considerably. Therefore, the actual smolt production in relation to PCPS is low despite the increase in actual smolt production from 2018 onwards.

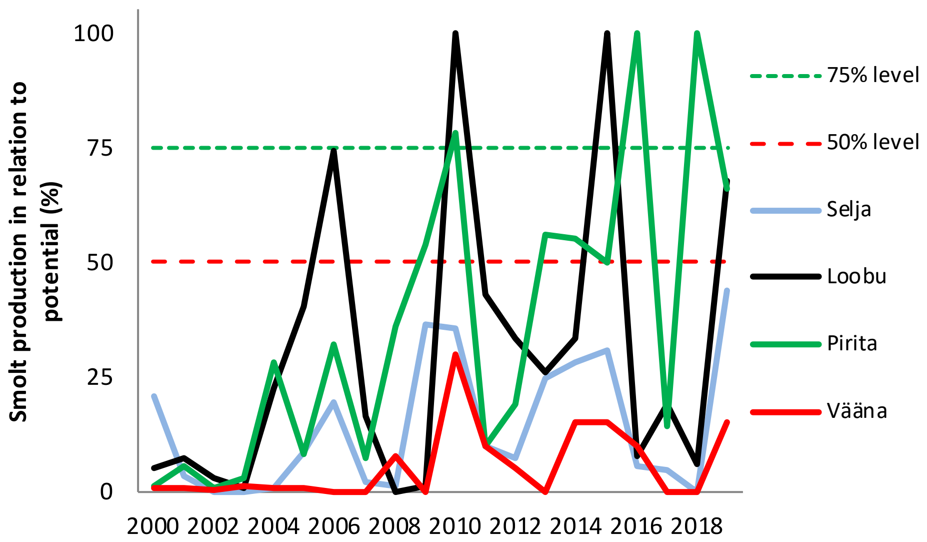


Figure 4.2.4.4. Smolt production level in relation to the potential in Estonian AU 6 mixed salmon populations. Note that the potential is calculated only up to the lowermost impassable migration obstacle and that many rivers have considerably higher total potential.

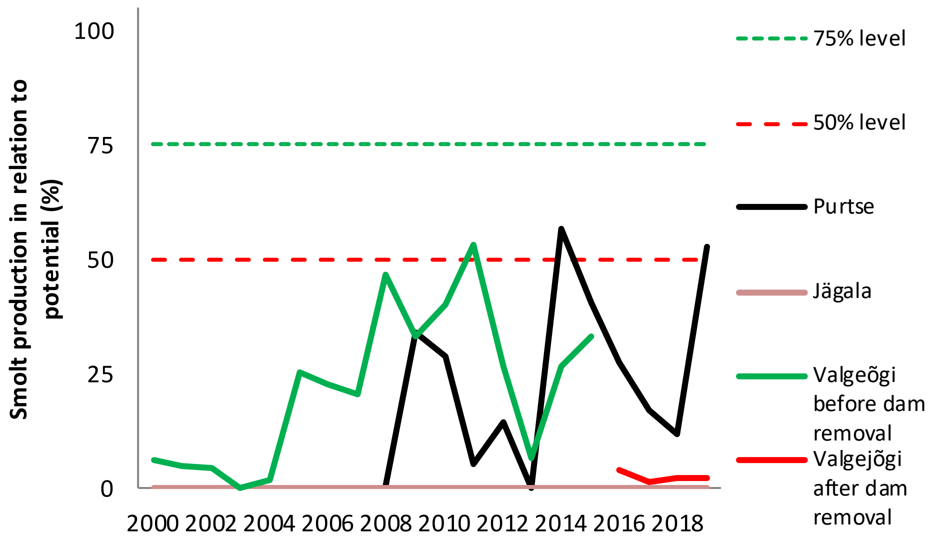


Figure 4.2.4.5. Wild smolt production level compared to potential in river Kymijoki (Finland) and in river Luga (Russia).

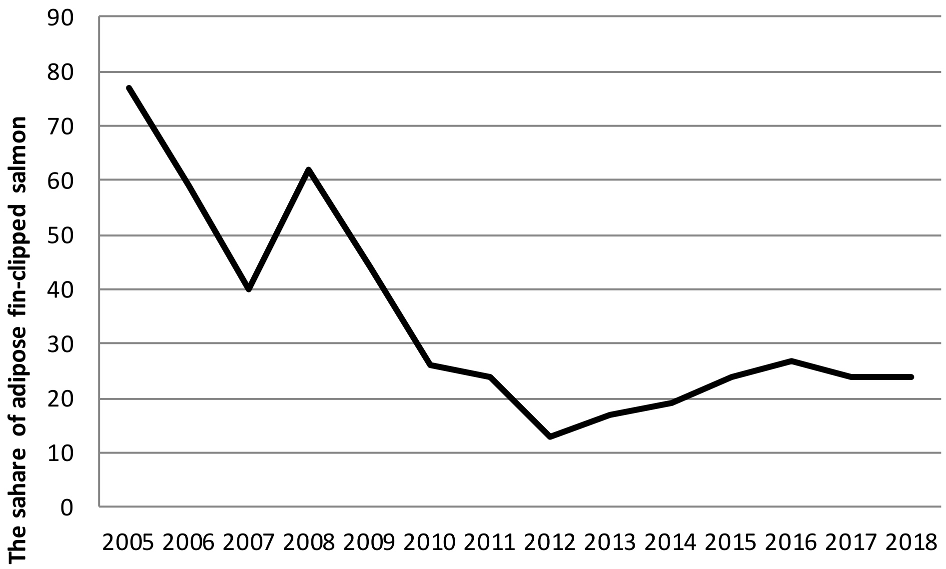


Figure 4.2.5.1. Share of adipose finclipped salmon caught on the southern coast of the Gulf of Finland.

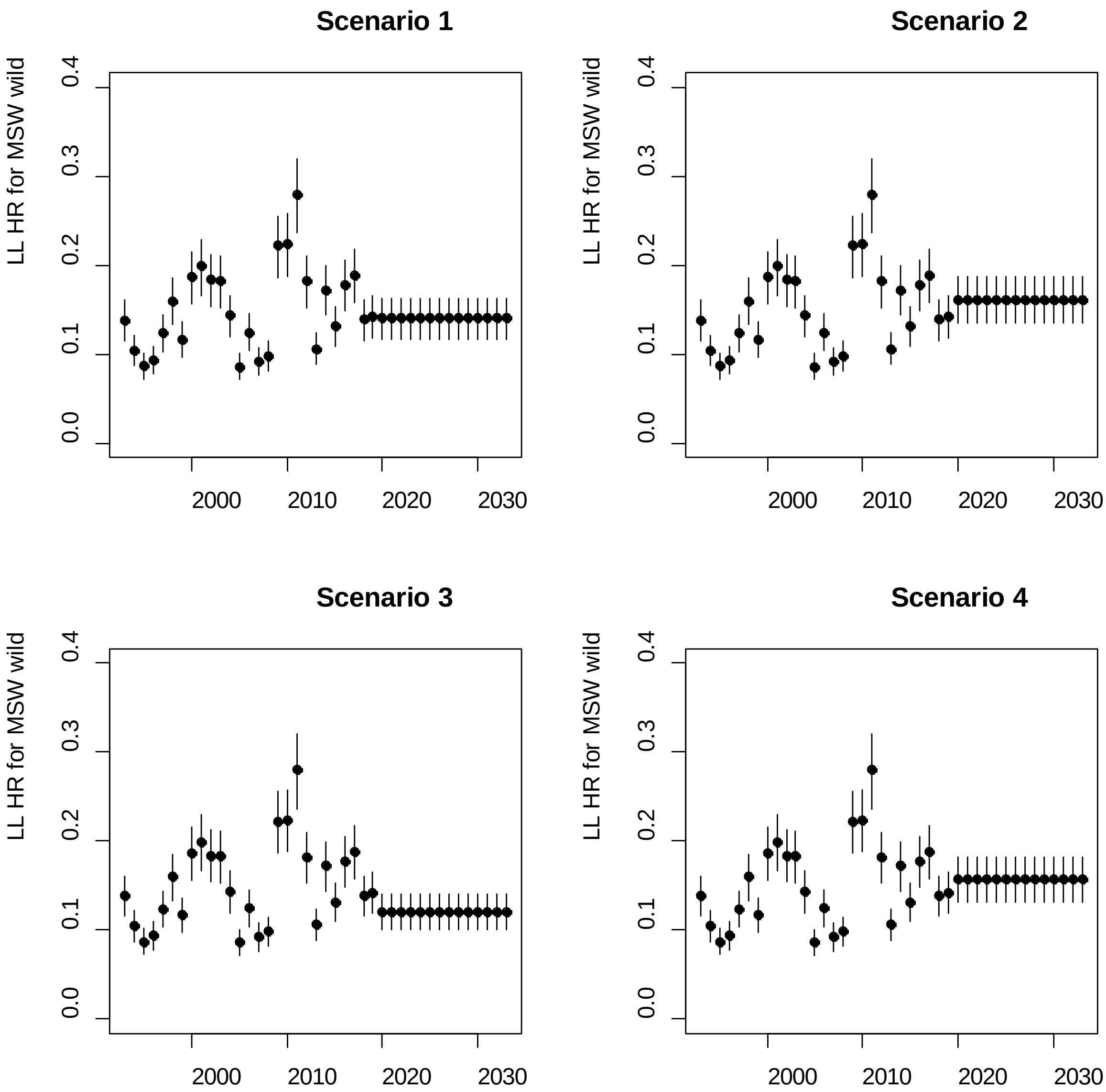


Figure 4.3.2.1a. Harvest rates (median values and 90% probability intervals) for wild multi-sea winter salmon in offshore longline fishery (including also recreational trolling, see Section 4.2.1 for details) within scenarios 1–4.

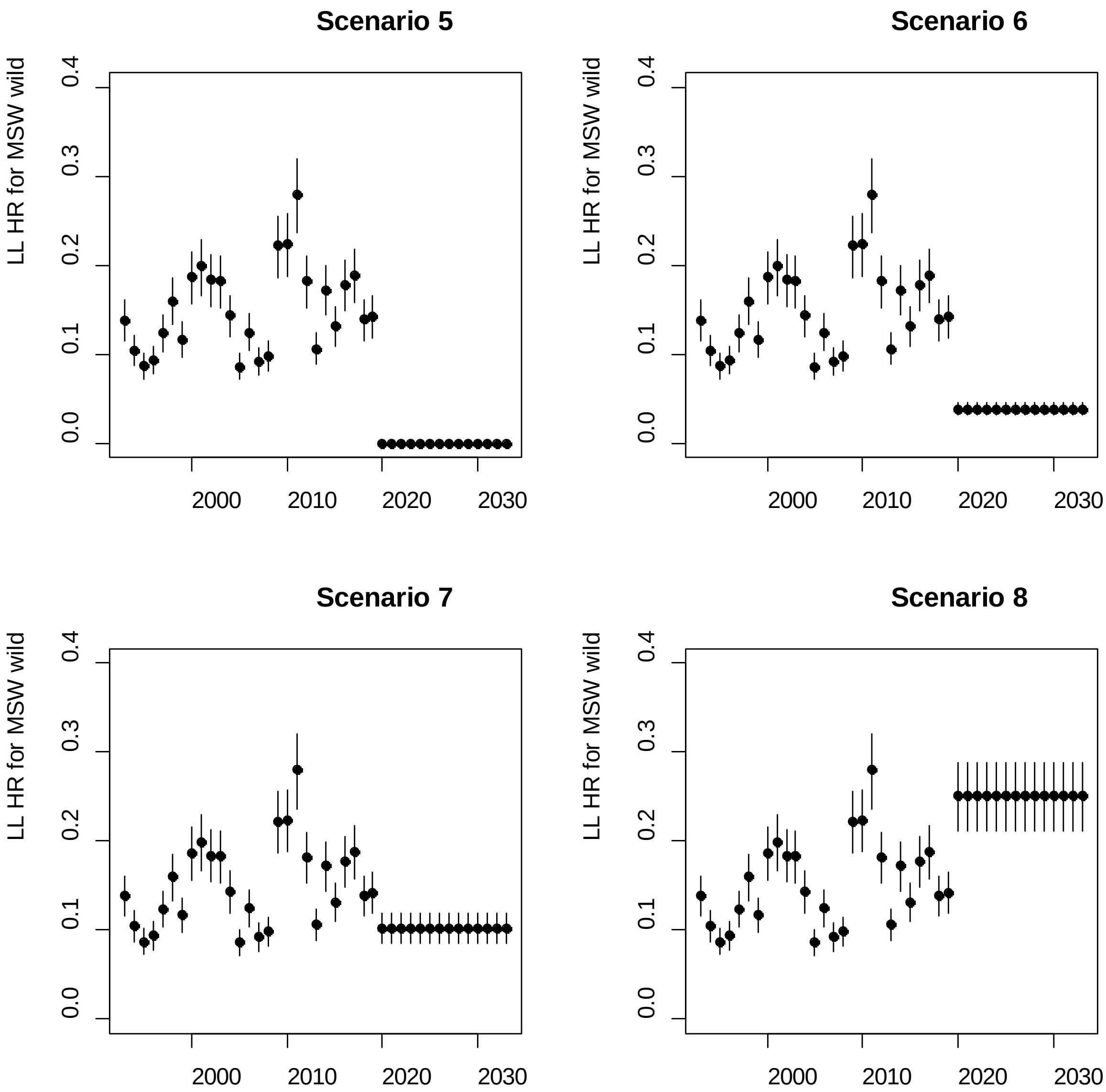


Figure 4.3.2.1b. Harvest rates (median values and 90% probability intervals) for wild multi-sea winter salmon in offshore longline fishery (including also recreational trolling, see Section 4.2.1 for details) within scenarios 5–8.

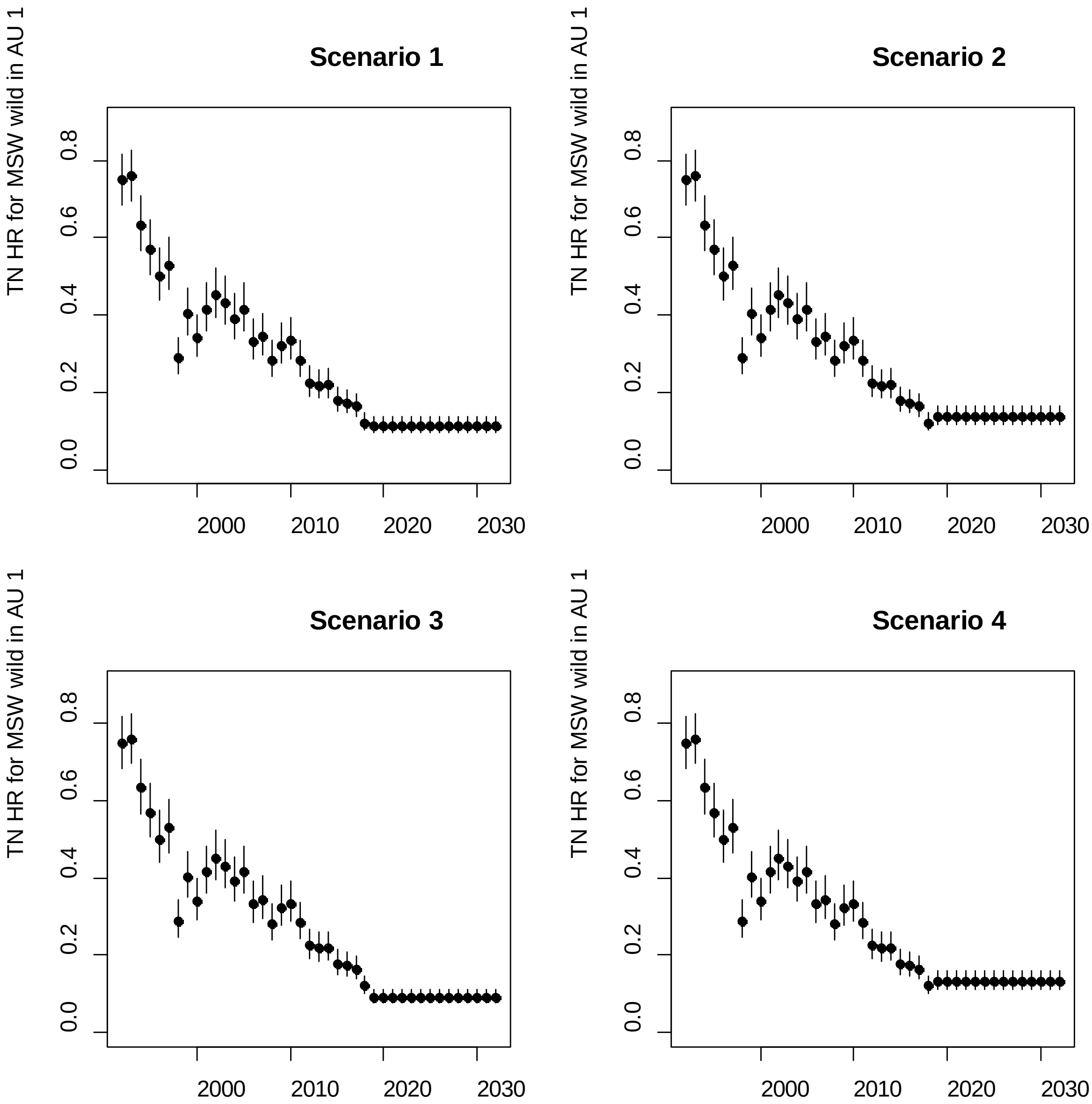


Figure 4.3.2.1c. Harvest rates (median values and 90% probability intervals) for wild multi-sea winter salmon in coastal trapnet fishery within scenarios 1–4.

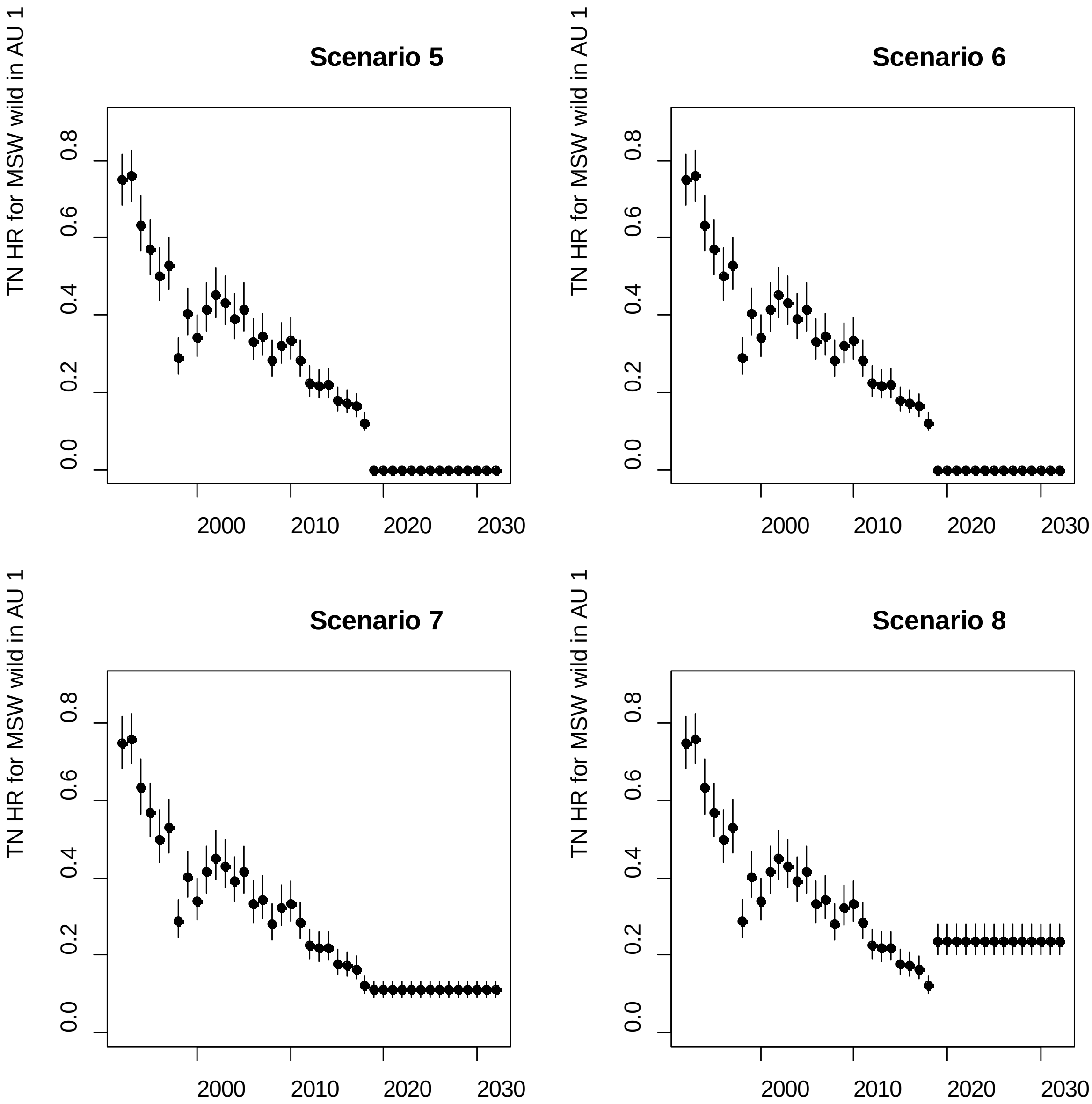
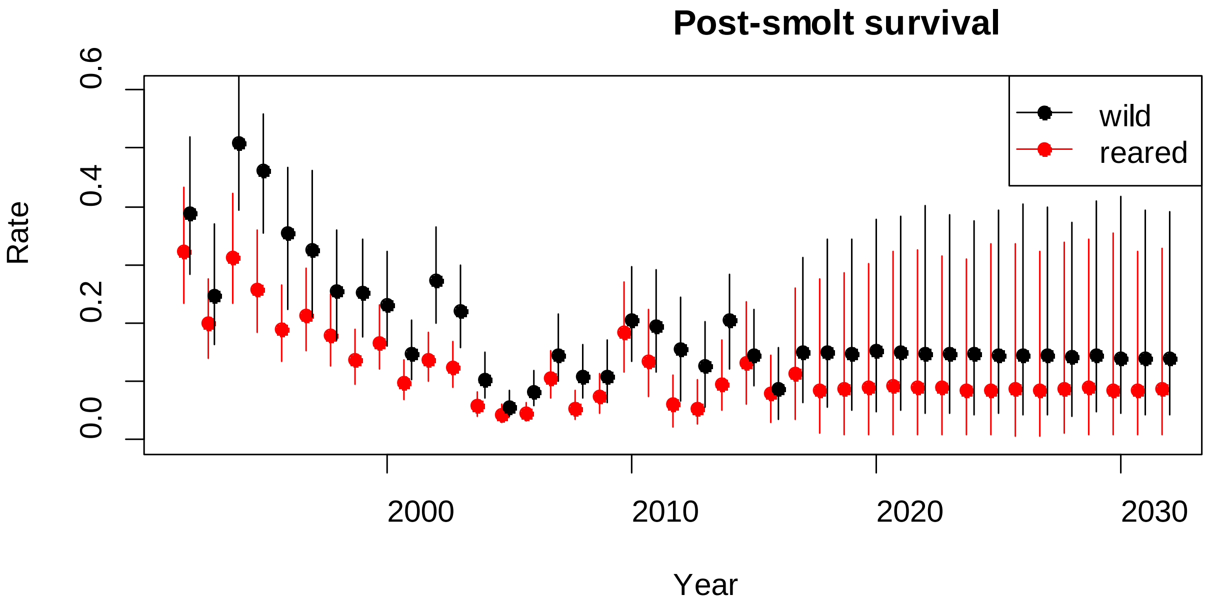


Figure 4.3.2.1d. Harvest rates (median values and 90% probability intervals) for wild multi-sea winter salmon in coastal trapnet fishery within scenarios 5–8.



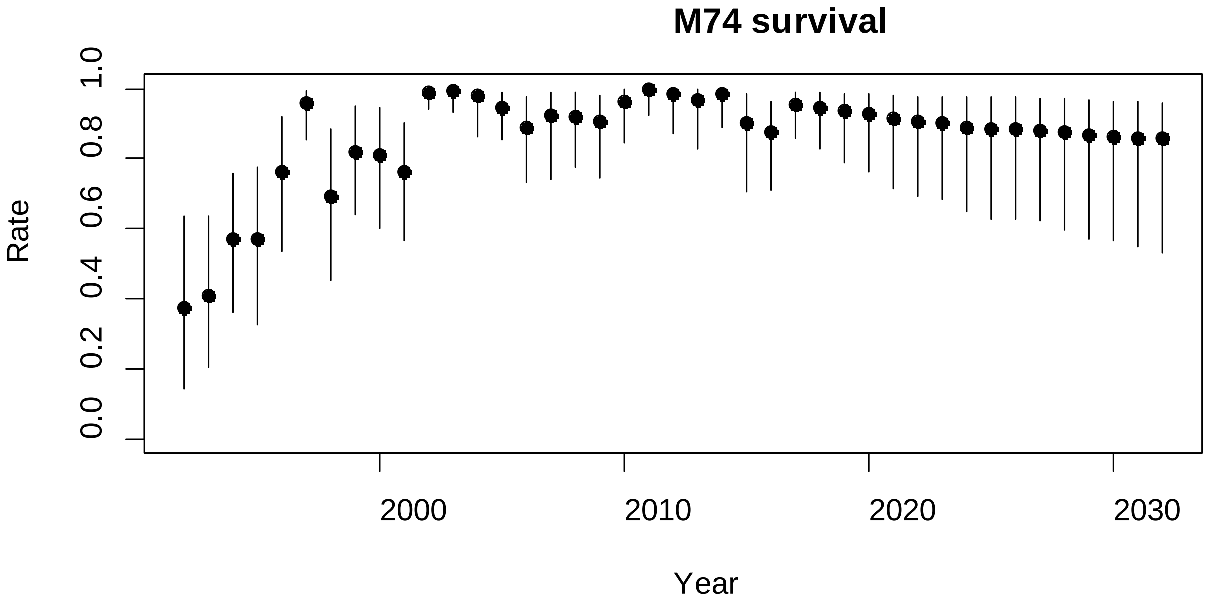


Figure 4.3.2.2. Median values and 90% probability intervals for post-smolt survival of wild and reared salmon and M74 survival assumed in all scenarios.

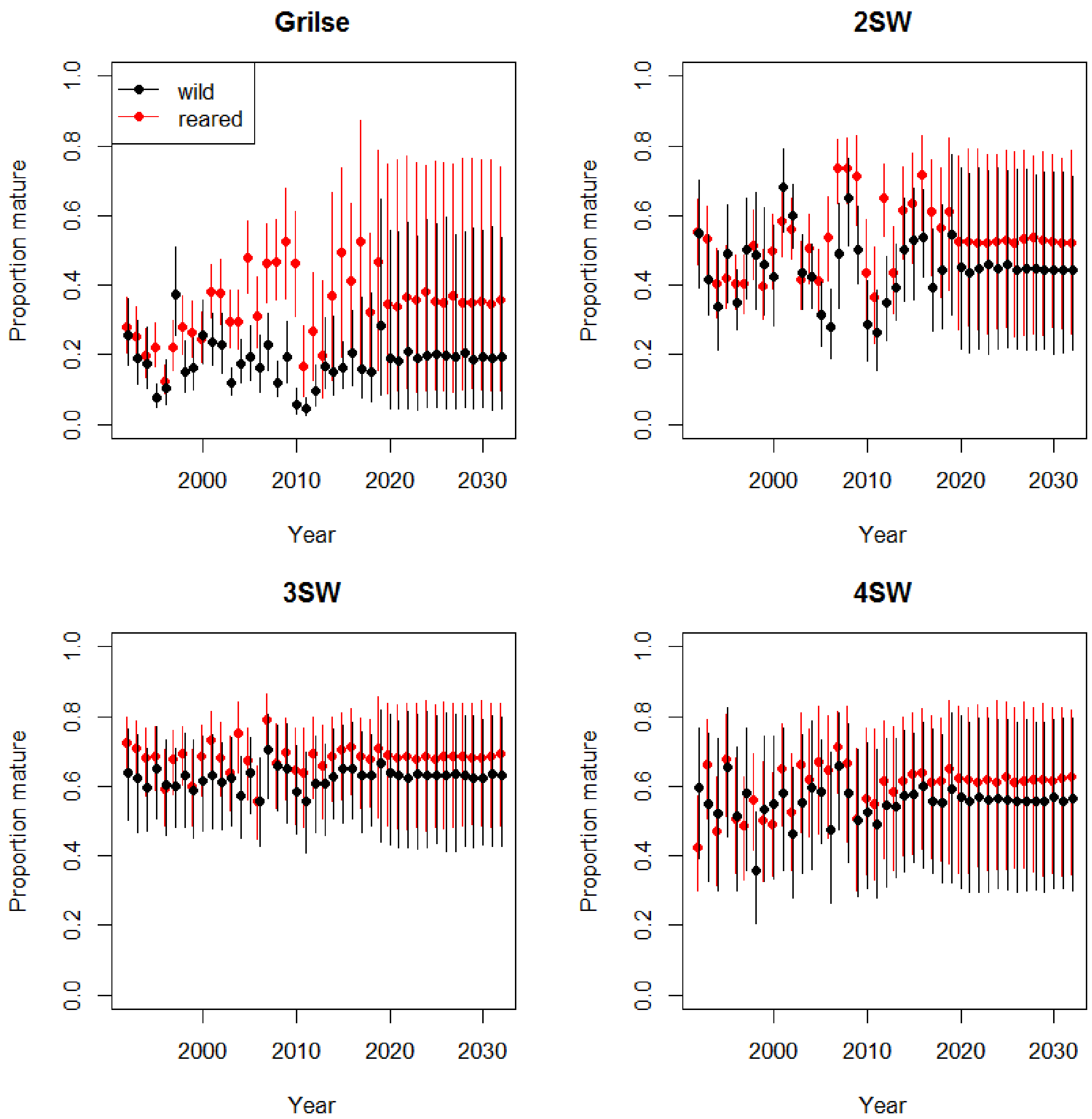


Figure 4.3.2.3. Median values and 90% probability intervals for annual proportions maturing per age group for wild and reared salmon in all scenarios.

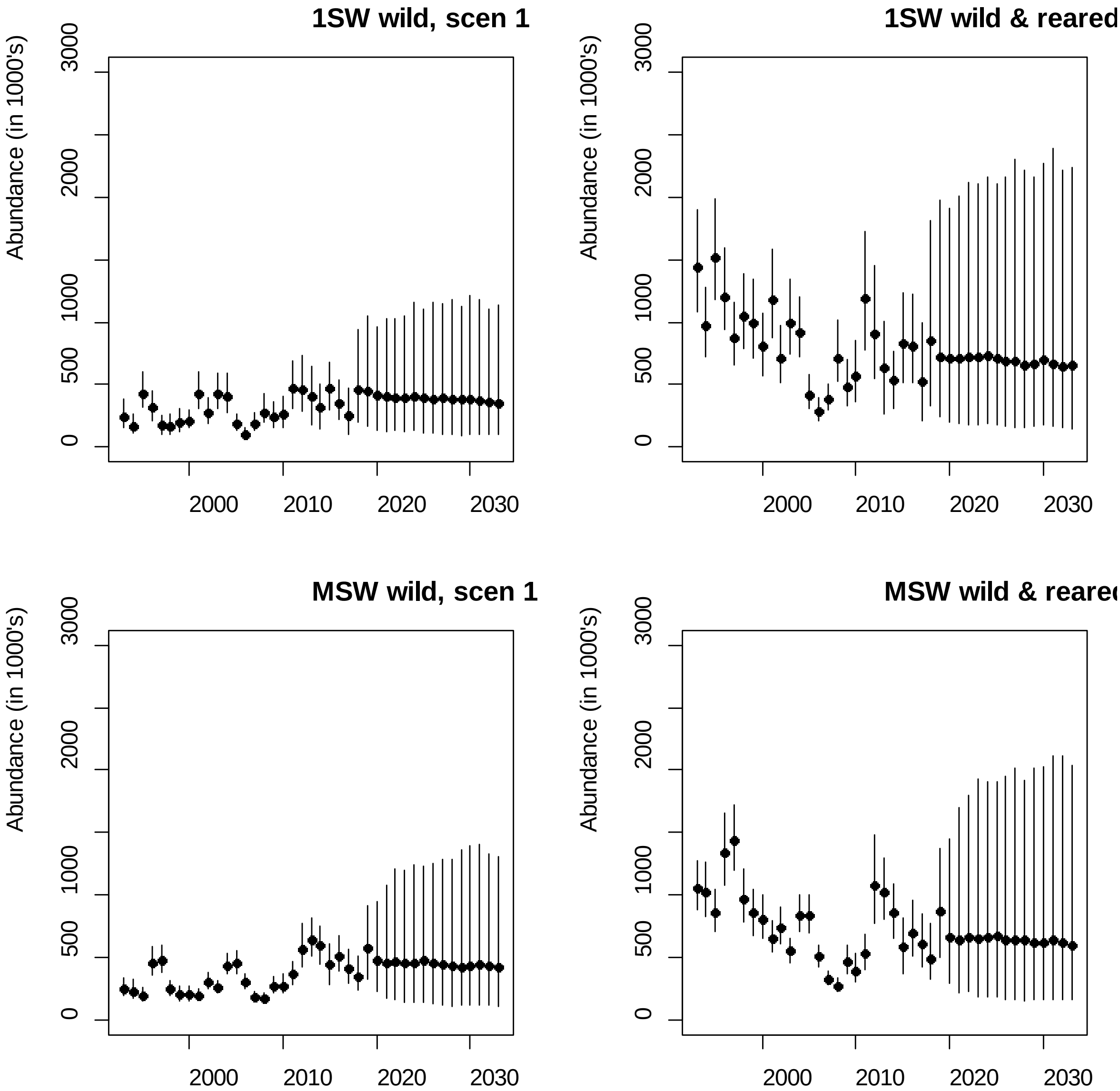


Figure 4.3.2.4a. Pre-fishery abundances of MSW and 1SW wild salmon and wild and reared salmon together based on scenario 1 (medians with 90% probability intervals). PFAs reflect the abundance that is available to the fisheries. In case of MSW salmon natural mortality is taken into account until end of June of the fishing year and in case of post-smolts, until end of August (four months after post-smolt mortality phase). See text for details.

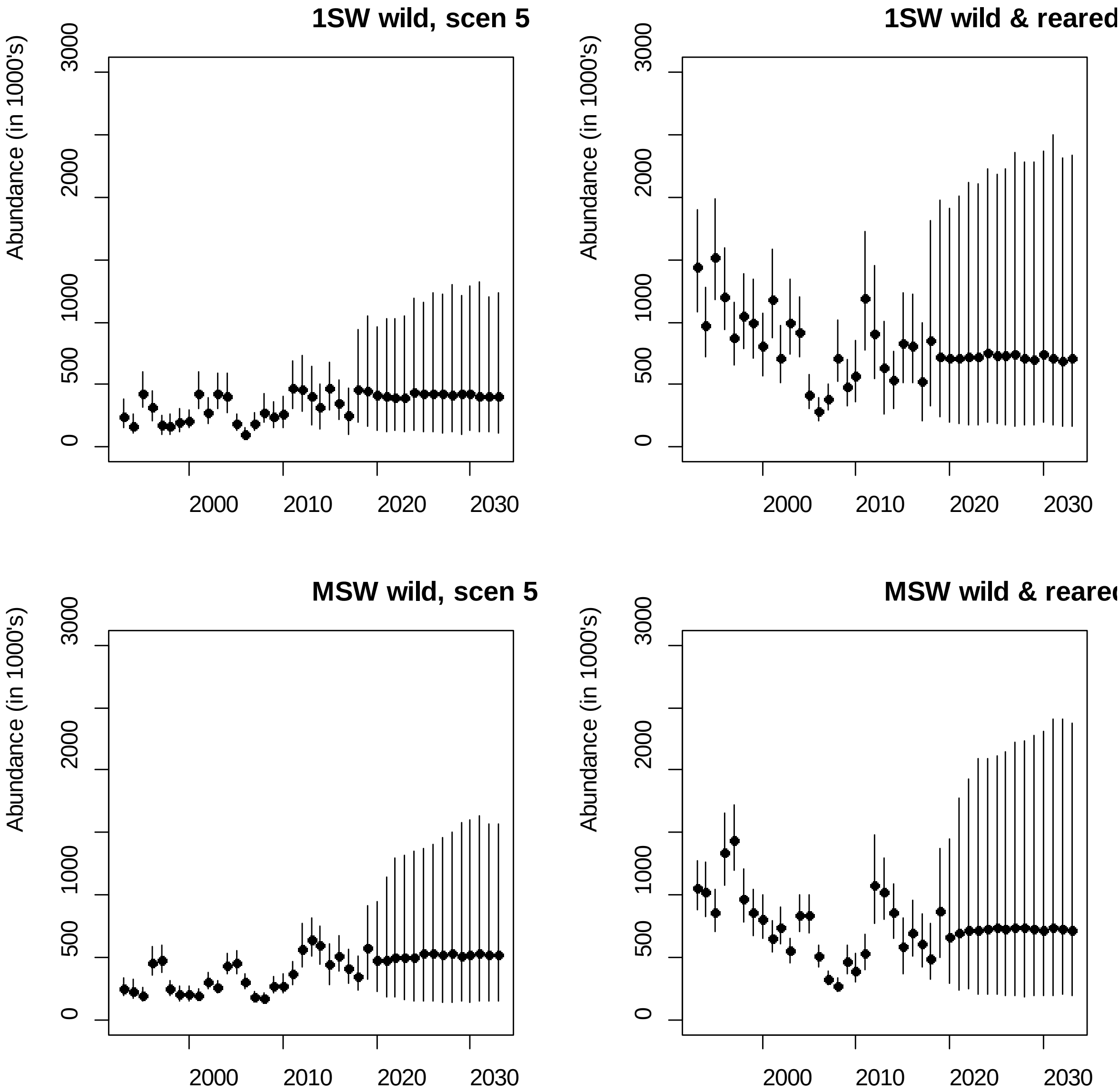


Figure 4.3.2.4b. Pre-fishery abundances of MSW and 1SW wild salmon and wild and reared salmon together based on scenario 5 (zero fishing) (medians with 90% probability intervals). PFAs reflect the abundance that is available to the fisheries. In case of MSW salmon natural mortality is taken into account until end of June of the fishing year and in case of post-smolts, until end of August (four months after post-smolt mortality phase). See text for details.

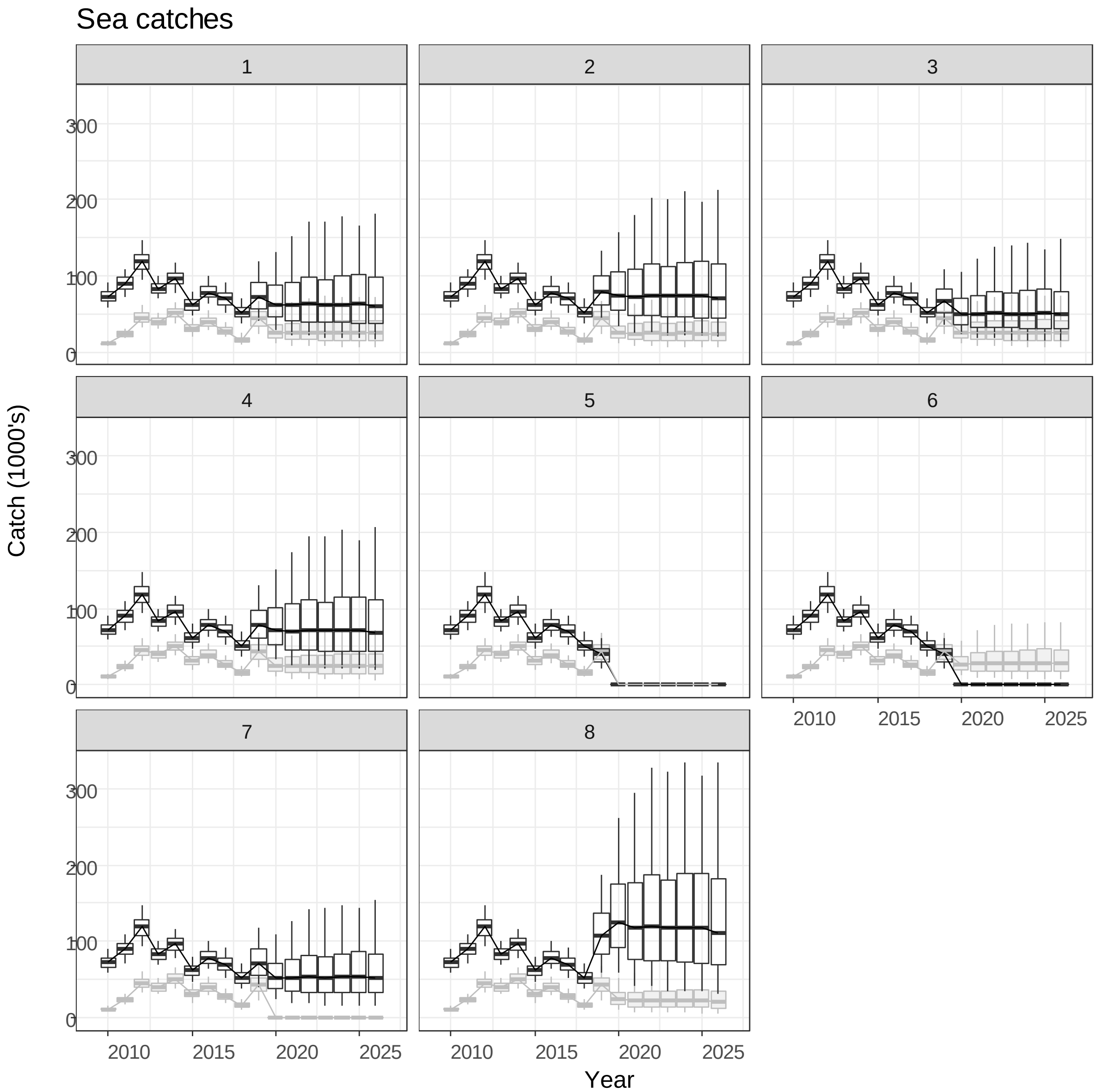


Figure 4.3.2.5. Estimates of reported commercial sea catches (all gears, black boxplots) and recreational sea catches (all gears, grey boxplots) based on scenarios 1–8. Boxplots show medians with 5%, 25%, 75% and 95% quantiles.

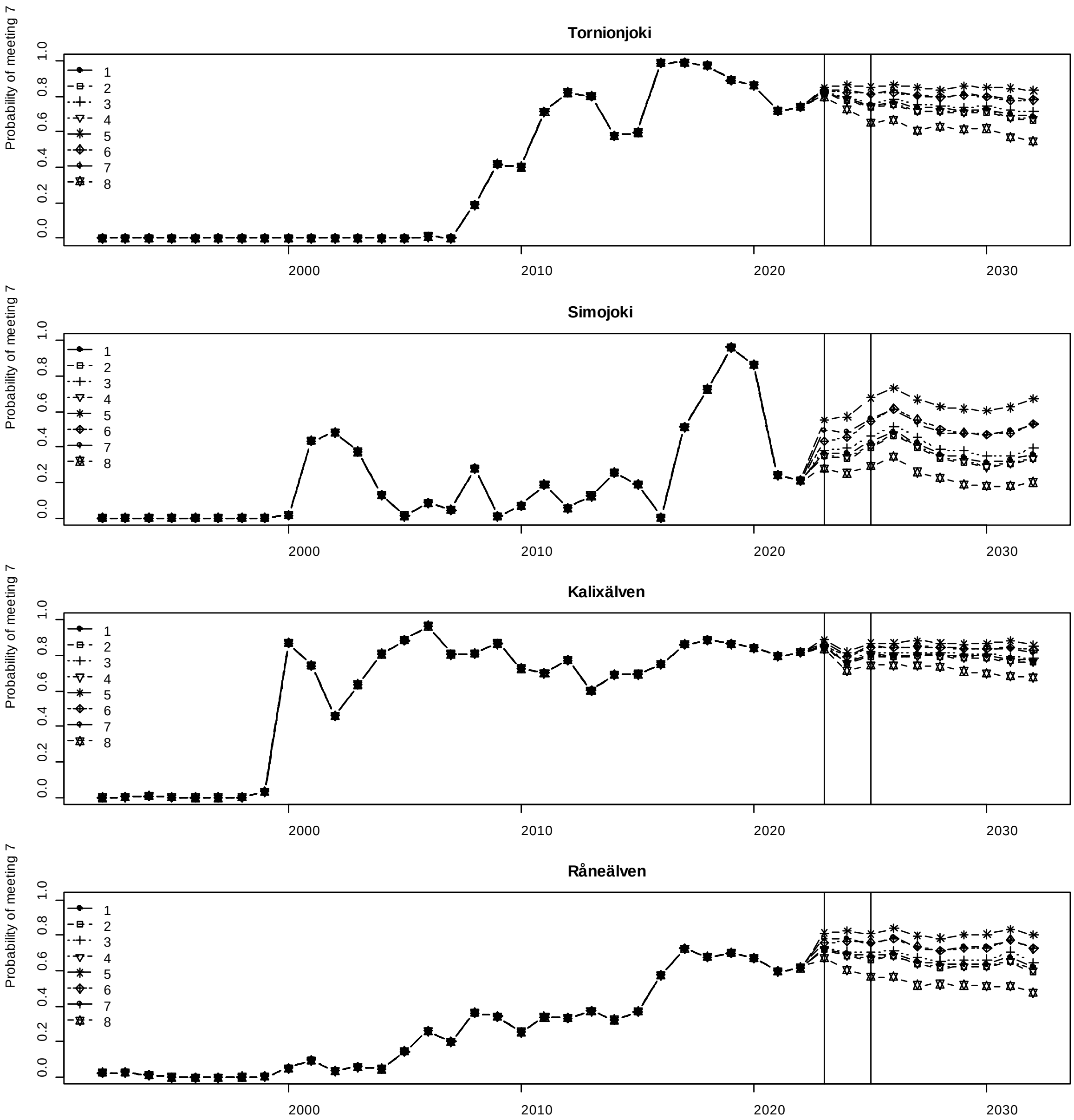


Figure 4.3.2.6a. Probabilities for different stocks to meet an objective of 75% of potential smolt production capacity under scenarios 1–8. Fishing in 2020 affects mostly years 2024–2025.

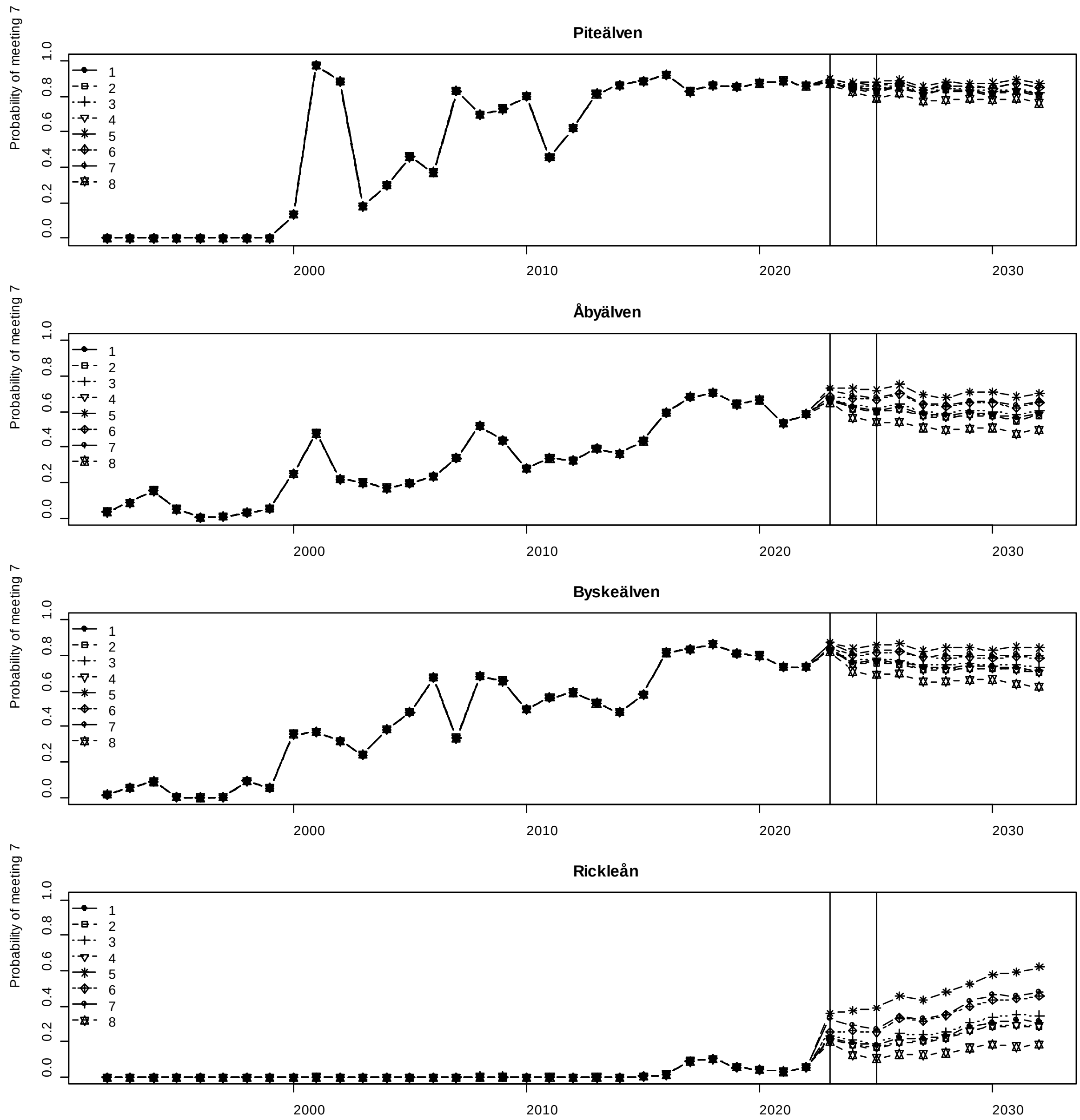


Figure 4.3.2.6b. Probabilities for different stocks to meet an objective of 75% of potential smolt production capacity under scenarios 1–8. Fishing in 2020 affects mostly years 2024–2025.

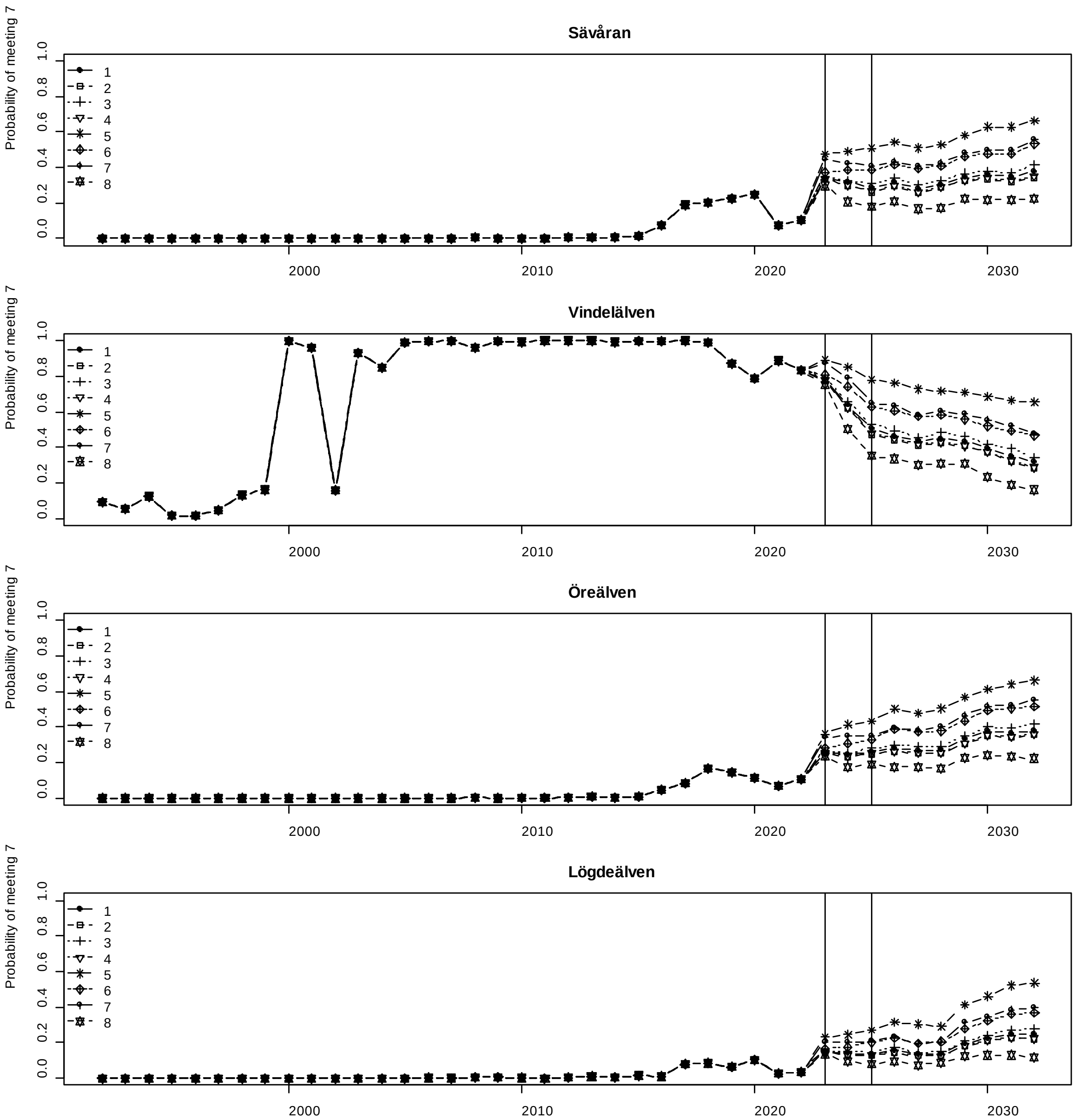


Figure 4.3.2.6c. Probabilities for different stocks to meet an objective of 75% of potential smolt production capacity under scenarios 1–8. Fishing in 2020 affects mostly years 2024–2025.

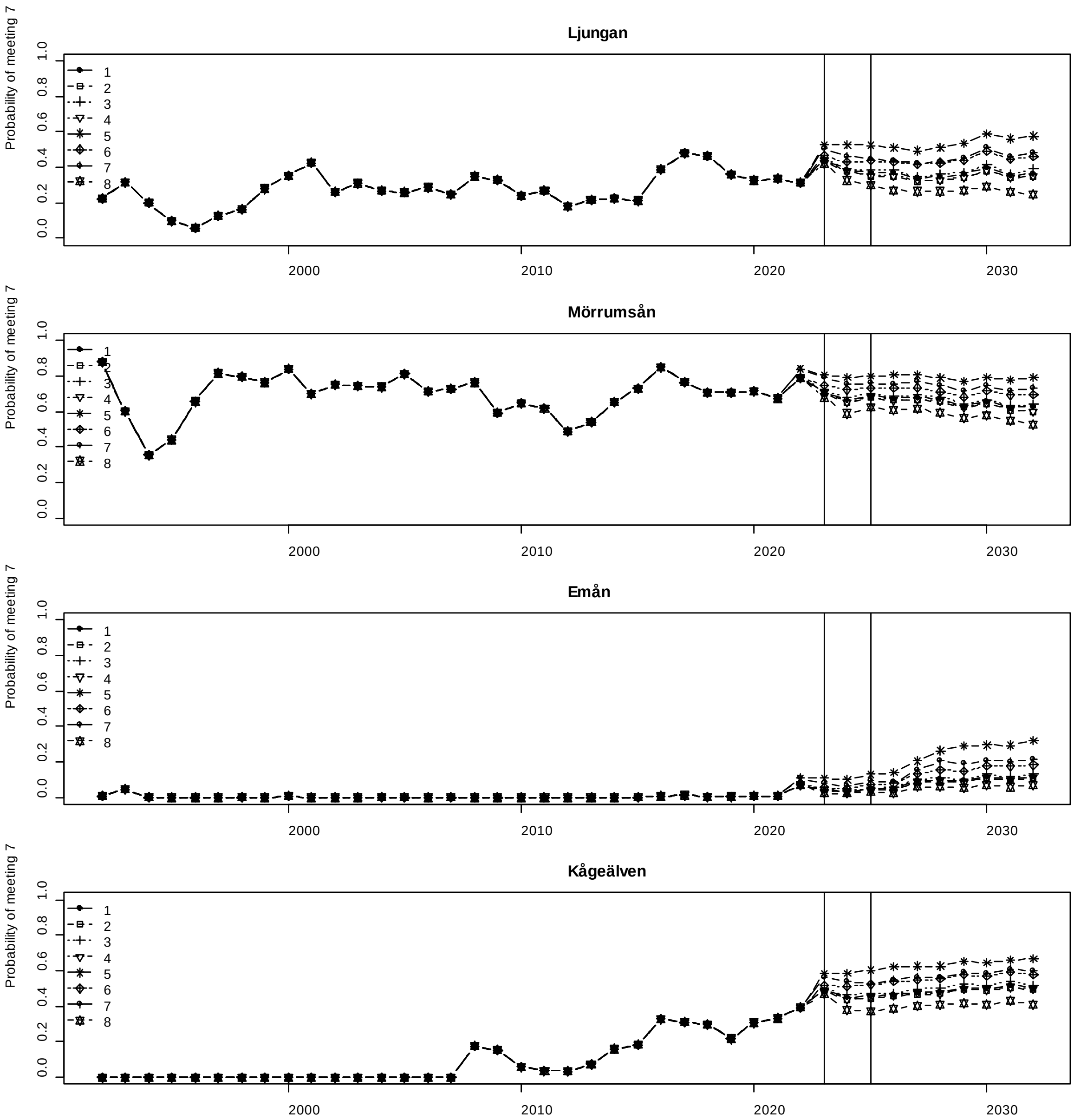


Figure 4.3.2.6d. Probabilities for different stocks to meet an objective of 75% of potential smolt production capacity under scenarios 1–8. Fishing in 2020 affects mostly years 2024–2025.

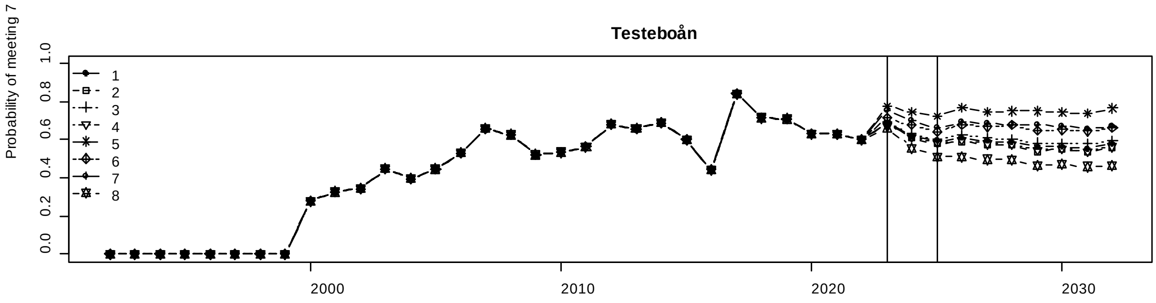


Figure 4.3.2.6e. Probabilities for different stocks to meet an objective of 75% of potential smolt production capacity under scenarios 1–8. Fishing in 2020 affects mostly years 2024–2025.

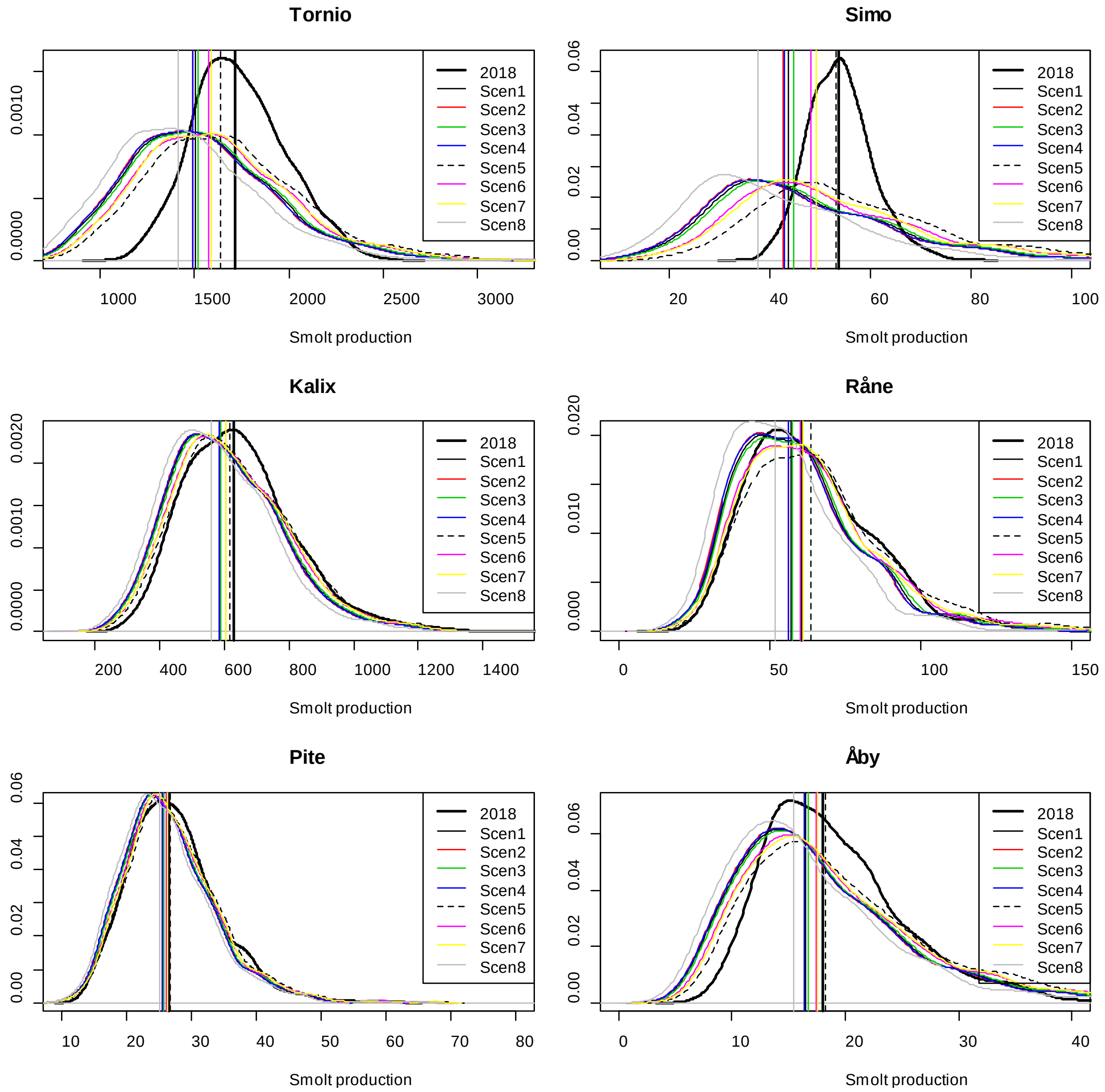


Figure 4.3.2.7.a. Predicted smolt production in 2025 (or 2024 for Emån and Mörrumsån) under fishing scenarios 1–8 (thin lines) compared to estimated production in 2018 (bold line). Vertical lines illustrate medians of the distributions.

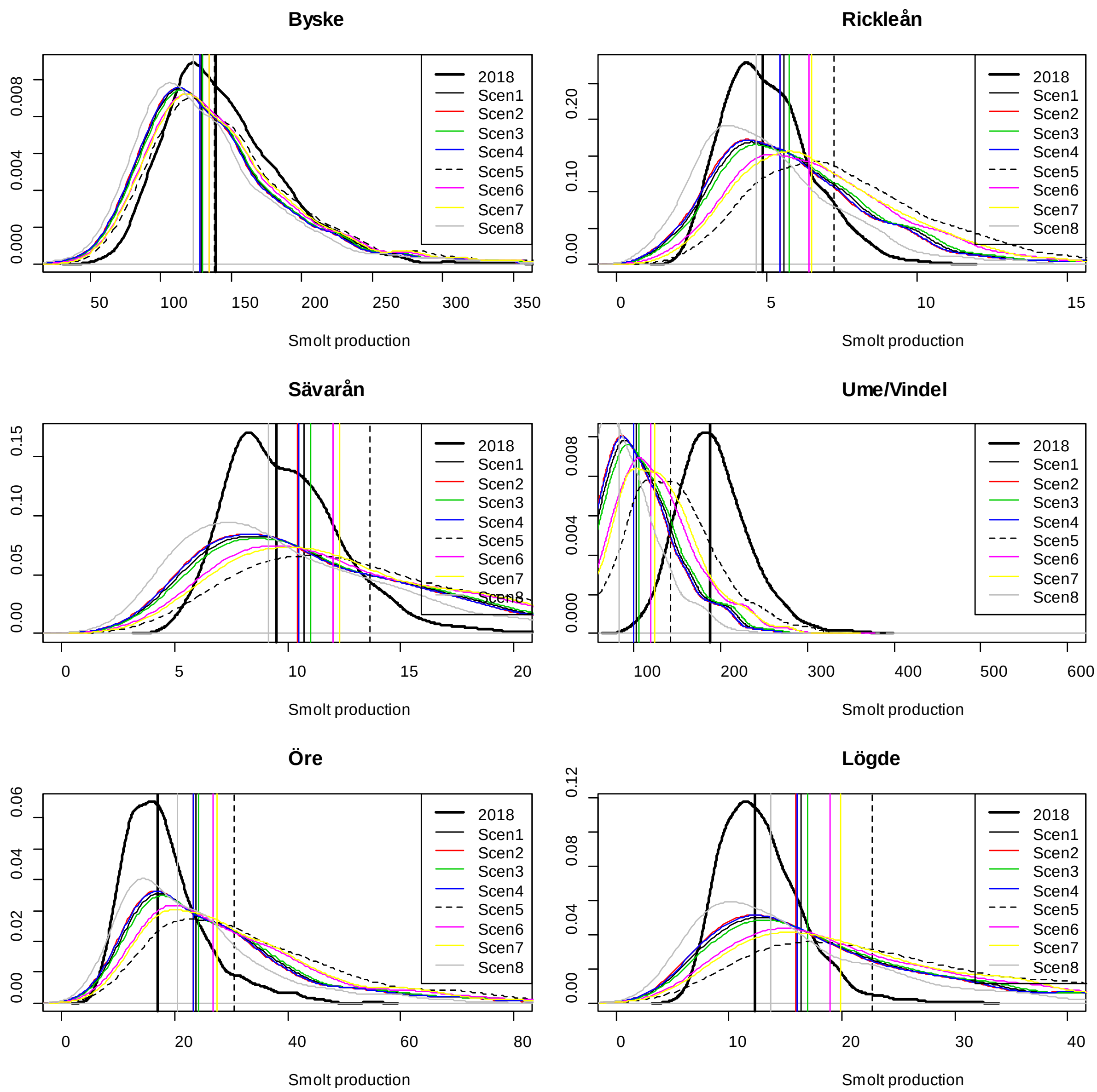


Figure 4.3.2.7.b. Predicted smolt production in 2025 (or 2024 for Emån and Mörrumsån) under fishing scenarios 1–8 (thin lines) compared to estimated production in 2018 (bold line). Vertical lines illustrate medians of the distributions.

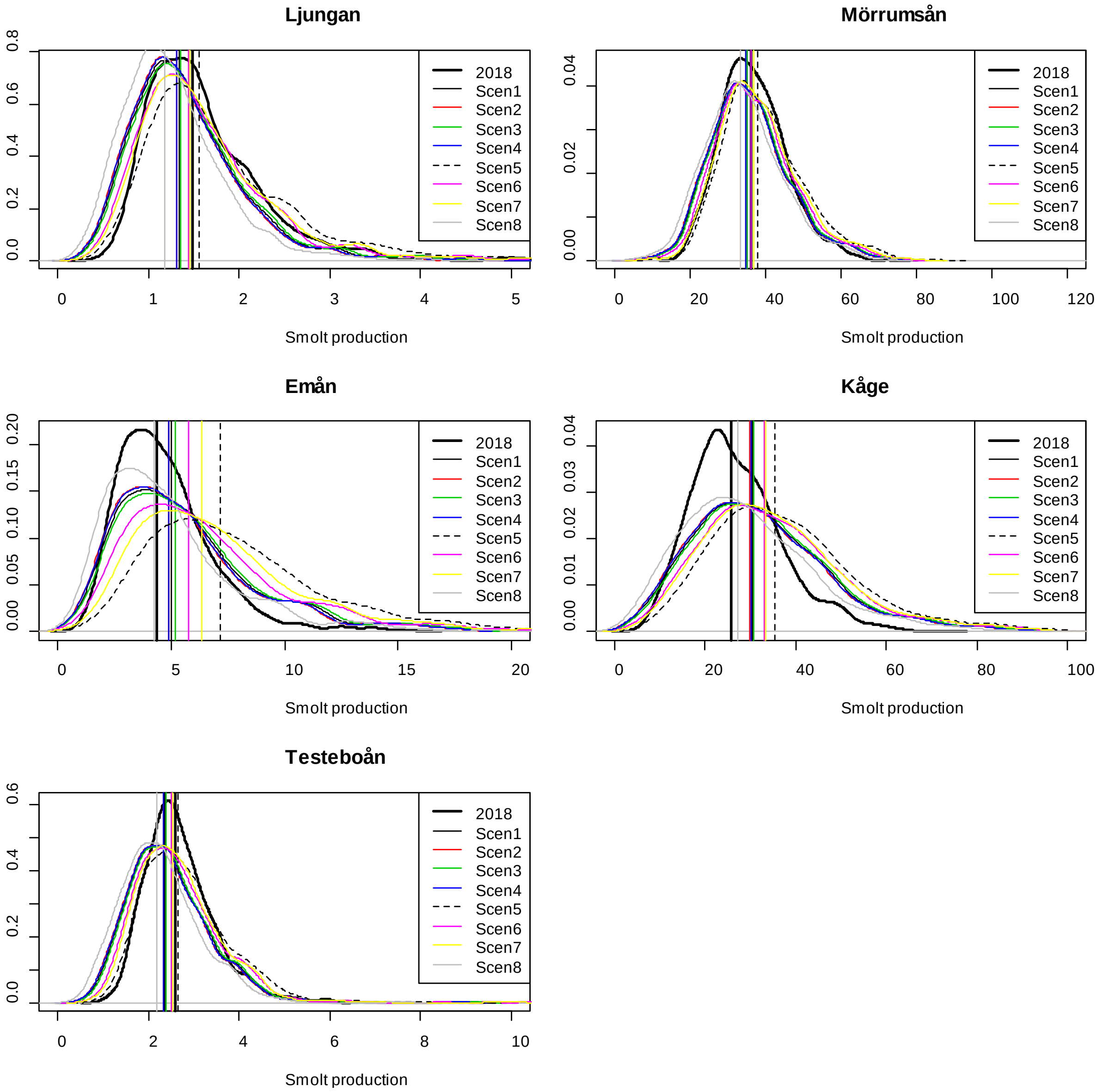


Figure 4.3.2.7.c. Predicted smolt production in 2025 (or 2024 for Emån and Mörrumsån) under fishing scenarios 1–8 (thin lines) compared to estimated production in 2018 (bold line). Vertical lines illustrate medians of the distributions.

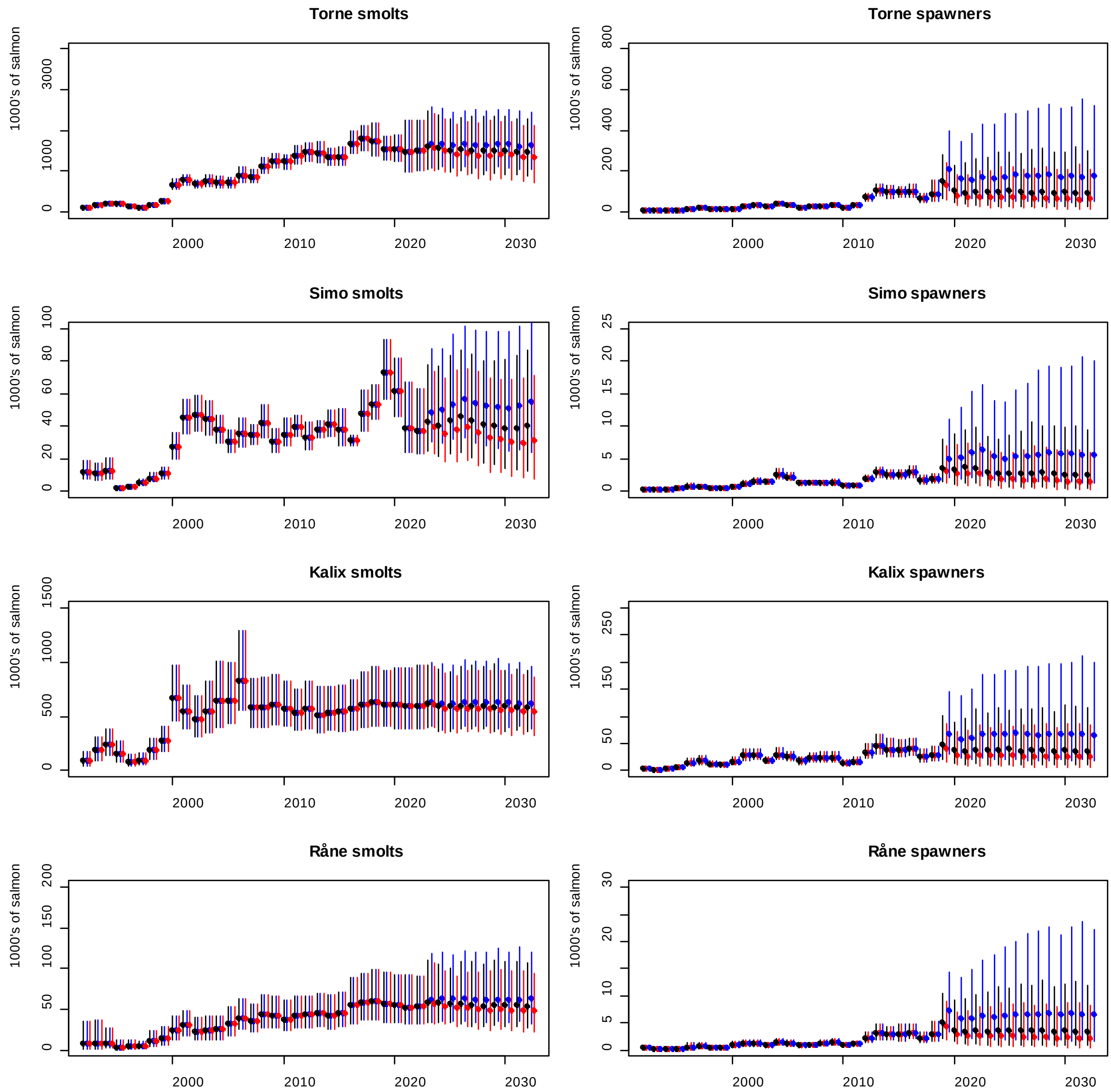


Figure 4.3.2.8a. Median values and 90% probability intervals for smolt and spawner abundances in scenarios 1 (black, previous advice), 8 (red, 100% increase to previous advice) and 5 (blue, no fishing).

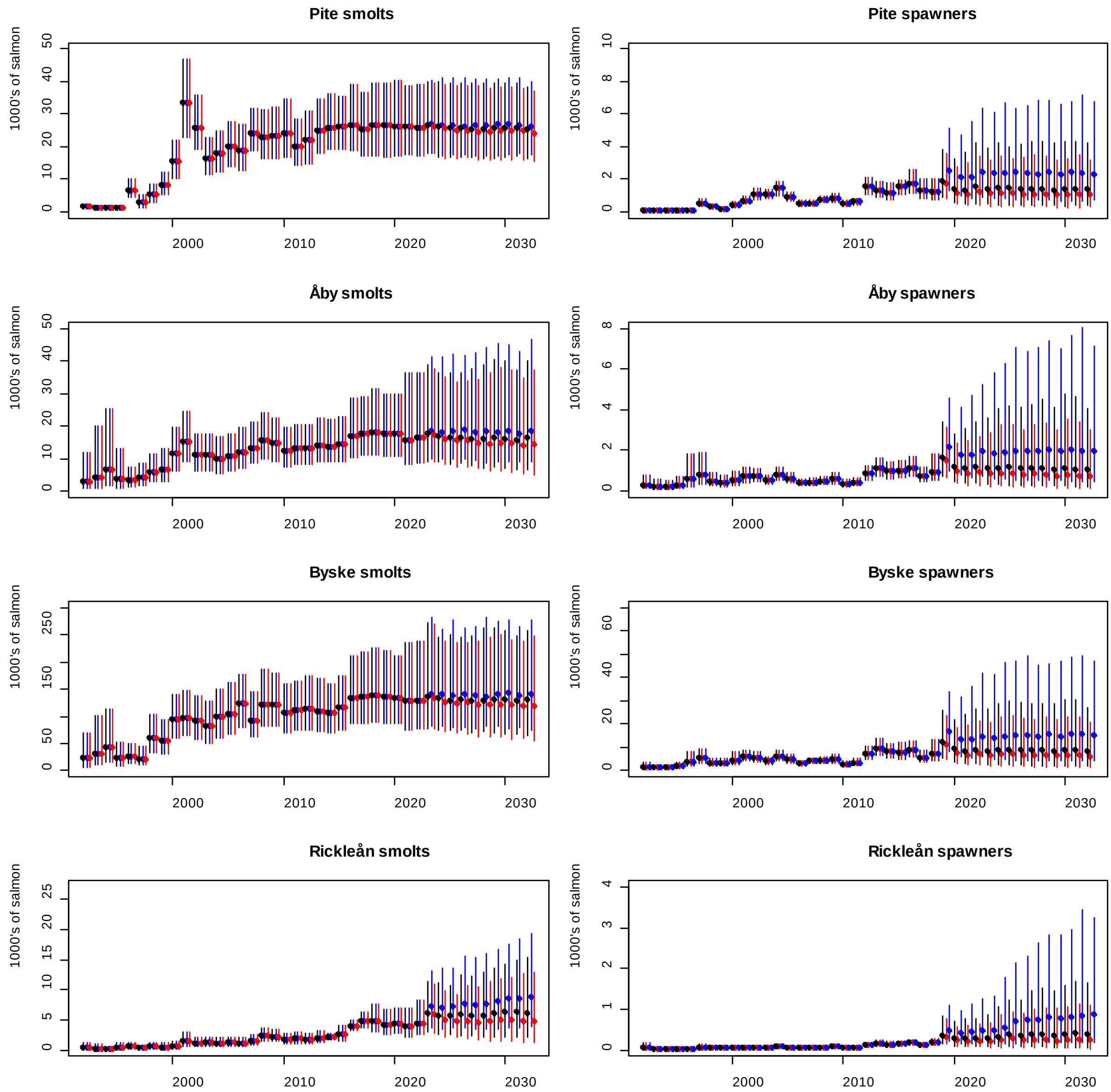


Figure 4.3.2.8b. Median values and 90% probability intervals for smolt and spawner abundances in scenarios 1 (black, previous advice), 8 (red, 100% increase to previous advice) and 5 (blue, no fishing).

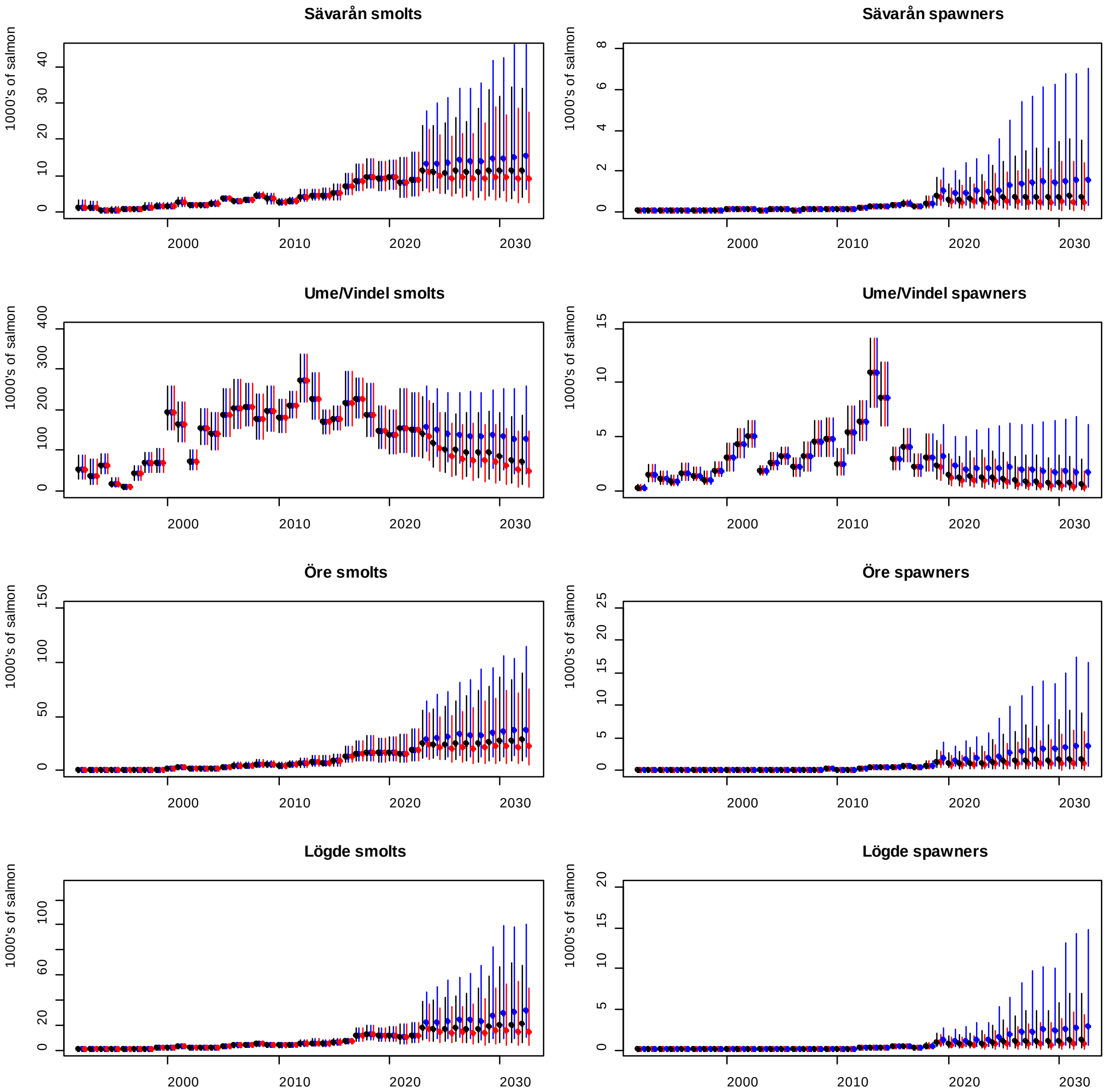


Figure 4.3.2.8c. Median values and 90% probability intervals for smolt and spawner abundances in scenarios 1 (black, previous advice), 8 (red, 100% increase to previous advice) and 5 (blue, no fishing).

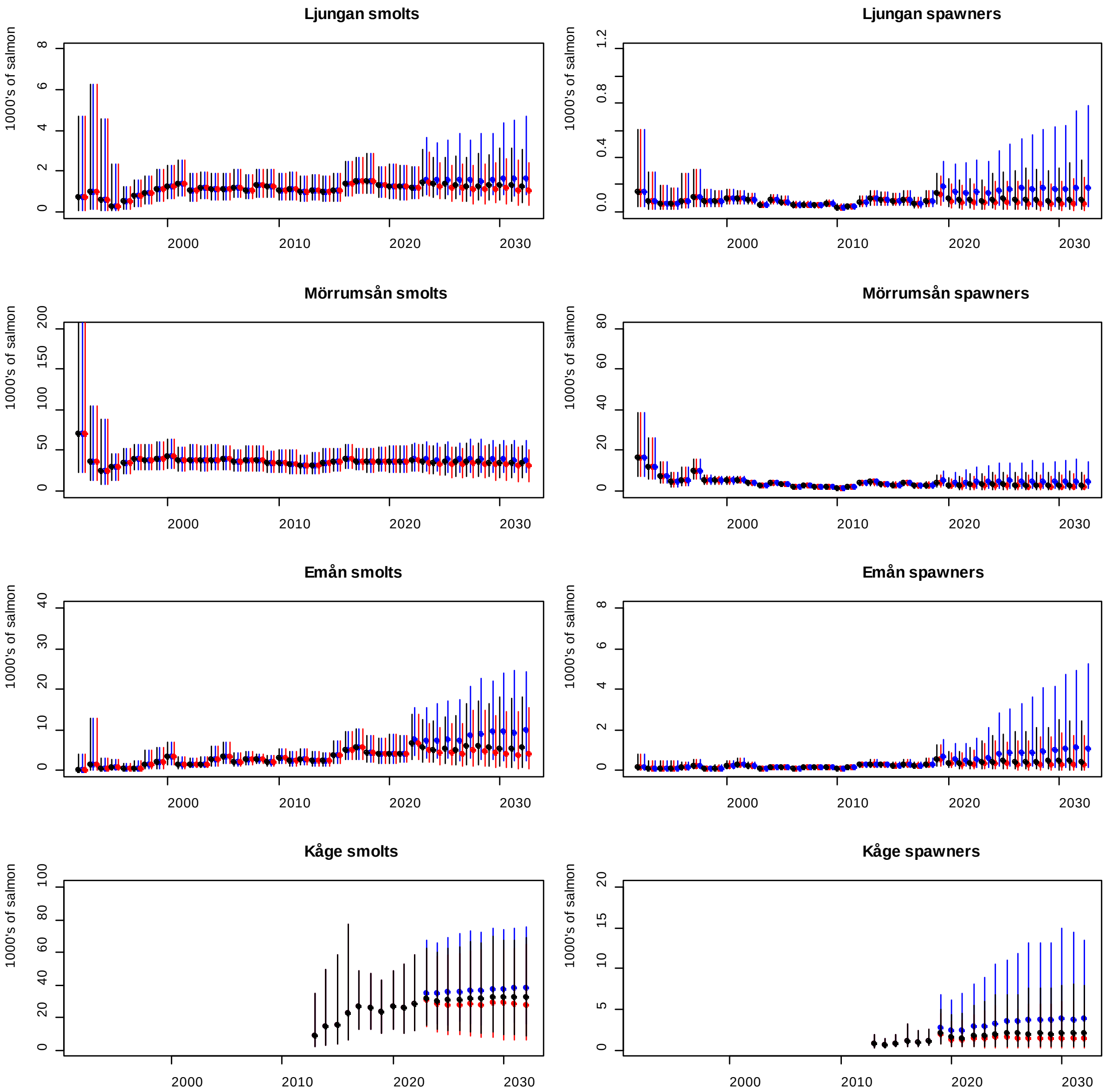


Figure 4.3.2.8d. Median values and 90% probability intervals for smolt and spawner abundances in scenarios 1 (black, previous advice), 8 (red, 100% increase to previous advice) and 5 (blue, no fishing).

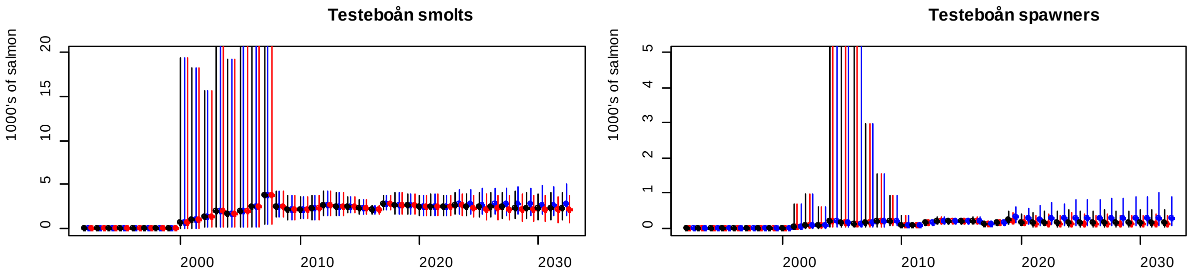


Figure 4.3.2.8e. Median values and 90% probability intervals for smolt and spawner abundances in scenarios 1 (black, previous advice), 8 (red, 100% increase to previous advice) and 5 (blue, no fishing).

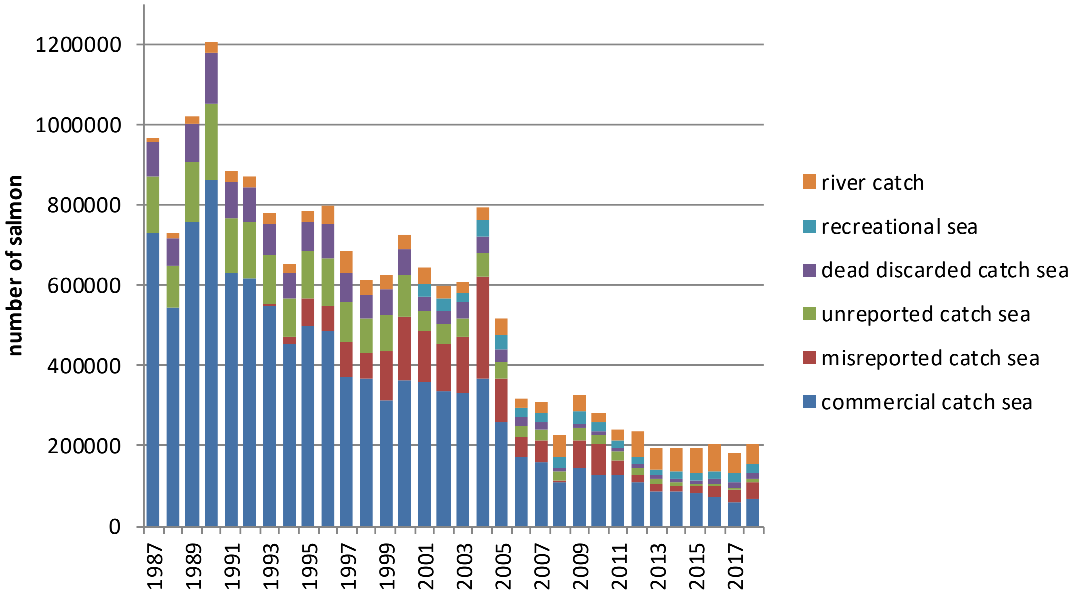


Figure 4.3.2.9. Share of commercial and recreational catches at sea, river catches (river catches include unreporting and also some commercial fishing), and discard/unreporting/misreporting of total sea catches in subdivisions 22–31 in years 1987–2018 (same data as in Table 2.2.2).

5 Sea trout

Sea trout basically has the same life cycle as salmon. The most important difference is that most strains do not migrate as far as the salmon. Instead, they spend the time in sea in coastal waters where the majority of sea trout from a specific strain stay within a few hundred kilometers from their home river. Some specimens, however, migrate further and in some strains in the Southern Baltic most sea trout seem to migrate longer distances into the open sea. Sea trout spawn and live during the first period of life in smaller streams than salmon. In the Baltic Sea area, sea trout are found in a much larger number of streams than salmon. Many of these streams are in lowland areas that are often strongly influenced by human activity.

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

Below follows sections on sea trout catches, fisheries, and biological monitoring data followed by descriptions of assessment methods and results.

5.1 Baltic Sea trout catches

5.1.1 Commercial fisheries

Nominal commercial catches of sea trout in the Baltic Sea are presented in Table 5.1.1.1. The total catch increased slightly, from 244 tonnes in 2017 to 312 tonnes in 2018. A majority (87%) of this catch was caught in the Main Basin.

In the Main Basin, the catch decreased from 954 tonnes in 2002 to 236 tonnes in 2008. After two years (2009–2010) of somewhat higher catches, around 450 tonnes, the total commercial catch again fell, reaching a minimum of 145 tonnes in 2015. In 2016, the total Main Basin commercial catch again increased somewhat to 184 tonnes (where it remained in 2017) and in 2018 it increased further to 274 tonnes. As in previous years, the majority of this catch was discounted by the Polish fishery (86%).

The total nominal commercial catch of trout in the Gulf of Bothnia was 22 tonnes in 2018, which is lower than in 2017 (41 tonnes) and below the ten year average catch (46 tonnes). All commercial catches in Gulf of Bothnia were from coastal fisheries. In the Gulf of Finland, the total commercial sea trout catch in 2018 was 16 tonnes (Table 5.1.1.1), which is below the average for the last ten years (21 tonnes).

5.1.2 Recreational fisheries

Recreational sea trout catches (landed) in the Baltic Sea are presented in Table 5.1.2.1. In 2018, the total catch slightly increased to 312 tonnes, from 262 tonnes in 2017. However, the catch was clearly lower than in 2016 when 592 tonnes were reported. It should be mentioned that data from 2018 are underestimated, because Danish catches are only for the first half year (second part of the year not yet estimated).

Recreational river catches in 2018 were 15.5 tonnes, and were taken mainly in Swedish Gulf of Bothnia rivers. This is a much smaller river catch than the ten years average (47 tonnes; Table

5.1.2.1). Most of the recreational catch in the coastal zones of the Gulf of Bothnia and the Gulf of Finland was taken by Finnish fishermen (232 tonnes), similar to in the last previous years.

Data on recreational coastal catches from the Main Basin in 2018 were available from Estonia, Latvia, Finland, Sweden and partially (only half year) from Denmark, amounting 55 tonnes (Table 5.1.2.1). From the last several years, results from questionnaires on Danish coastal recreational catches showed that; those catches increased from 224 tonnes in 2011 to 521 tonnes in 2014. Until 2016, they decreased to 323 tonnes, which constitutes about 55% of the total Baltic Sea recreational catch of sea trout.

5.1.3 Total nominal catches

The highest combined commercial and recreational nominal catches, above 1300 tonnes, were taken in the early and late 1990s (Table 5.1.3.1). Since 2001 they have been decreasing to the level of 700–800 tonnes in recent years, and even 506 tonnes in 2017 (but without data on Danish recreational catches in 2017) (Tables 5.1.1.1 and 5.1.2.1 combined). In 2018, the combined catches reached 625 tonnes, however Danish data were only partial and covered only half of the year. Note that when taking estimated levels of misreporting of salmon as sea trout in the Polish sea fishery into account (Section 2.3.3), the overall reported commercial sea trout catches have been much too high. A column with yearly estimates of salmon catches misreported as sea trout (in weight) in the last ten years were added to Table 5.1.1.1.

5.1.4 Biological catch sampling

Strategies for biological sampling of sea trout and procedures are very similar to those for salmon (Annex 2, Section 2.5). In total, 1393 sea trout were sampled in 2018, similar to in 2017 (Table 5.1.4.1). Most samples were collected from Latvian (n=459) and Swedish (n=454) catches. In addition, 124 samples were collected from Estonian catches in the Gulf of Finland (SD 32), and 128 from Finnish catches in SD 29–32. Polish samples originated from river catches (n=203) in two rivers: Vistula and Rega (Table 5.1.4.1).

5.2 Data collection and methods

5.2.1 Monitoring methods

Monitoring of sea trout populations is carried out in all Baltic Sea countries. The intensity and period during which monitoring has been going on varies (ICES, 2008c). Some countries started their monitoring in recent years, while very long data series exist for a few streams in others (ICES, 2008c). From 2016, a new European Union (EU) regulation (2016/1251) adopting a multiannual program for the collection, management and use of data in the fisheries and aquaculture, obligated EU countries to collect sea trout catch data.

Most monitoring of sea trout is carried out by surveying densities of trout parr in nursery streams by electrofishing. In Denmark, only a few sites in Baltic streams are monitored annually. In addition, a rolling scheme is used for electrofishing-monitoring of sea trout on the national level. Due to the large time lap between fishing separate rivers these are not directly useable for assessment, but the results are used as background information on the status of populations as such. In a couple of countries, sampling of parr densities are used to calculate smolt production by a relation of parr to smolt survival, either developed in the same stream or in some other (ICES, 2008a). In most countries (but not in Denmark and Poland) electrofishing is supplemented with annual monitoring of smolt escapement by trapping and counting in one or more streams.

In total, smolt production estimates exist for 12–13 rivers in the entire Baltic area, but the length of the time-series varies very much.

In only four streams/rivers (Mörrumsån, Åvaån, Testeboån in Sweden and Pirita in Estonia) both numbers of spawners and smolts are monitored. Adult counts are determined by trapping or recording of ascending sea trout using automatic counters. In 24 rivers (ten in Sweden, three in Poland, eight in Germany, two in Estonia and three in Finland) the numbers of spawners are monitored by automatic fish counters or video systems. In three rivers, the total run of salmonids is determined using echo sounder systems. However, this technique does not allow strict discrimination between sea trout and salmon (or other fish species of similar size).

An indication of the spawning intensity can also be obtained by counting of redds. Such information is collected from a number of sea trout streams in Poland, Lithuania and Germany (ICES, 2008a). In a couple of streams in Denmark, the catch in sport fisheries has been used to estimate the development of the spawning run. Catch numbers are also available from some Swedish rivers. Tagging and marking are furthermore used as methods to obtain quantitative and qualitative information on trout populations (see below). Evaluation of sea trout status in rivers is done based on national expert opinions, as well as on factors influencing status. Such evaluations are updated irregularly.

5.2.2 Assessment of recreational sea trout fisheries

There is a highly developed recreational fishery targeting sea trout in many countries. Angling (rod-and-line fishing) accounts for the majority of the catches. The most common methods are spin and fly fishing from the shore or in rivers, and trolling with small boats at sea (see Annex 2 for a general description of the trolling fishery). The shore-based fishery along coasts and in rivers is highly diffuse and variable with strong local and regional variations depending on weather conditions and season. In the southern Baltic Sea, recreational fishing on sea trout takes places during the whole year with distinct activity peaks in spring and autumn. Fishing times vary between seasons, but most anglers fish a few hours around dawn and dusk. In winter and early spring, there is also an activity peak during noontime due to higher water temperatures. Some night fishing occurs in summer.

While the recreational catches of sea trout are largely dominated by rod-and-line fisheries, there are other types of fisheries carried out in some countries. To a smaller extent passive gears such as trapnets, gillnets or longlines are being used for catching sea trout in the Baltic Sea, either as a target species or as bycatch in other coastal recreational fisheries. Except for in northern Gulf of Bothnia, the catches from this type of fishing is estimated to be of minor importance in terms of impact on the stocks, i.e. removals.

Monitoring of the recreational fisheries is carried out in different ways. Below follows a description of methods and activities in the Baltic countries.

Since 2009, recreational catches of sea trout in **Denmark** have been estimated based on an interview-based recall survey, which is conducted by DTU Aqua in cooperation with Statistics Denmark. In addition, during spring 2017, a project on the recreational sea trout coastal rod-and-line fishery was carried out on the island Funen in SD 22. Two different approaches were applied: 1) on-site interviews (rowing creel) collected information on i.a. catch, release rates and effort, and 2) by aerial survey, information on effort was obtained. Furthermore, information on motivation and satisfaction was collected.

In **Estonia**, catch reporting has been mandatory since 2005. The data are reported to and stored in the Estonian Fisheries Information System (EFIS) for passive gears (gillnets, longlines) and salmon and sea trout rod-and-line fishing in rivers. The latest recreational fishery survey was carried out in 2016, based on a phone call approach.

Since 2002, the official catch estimates of the recreational sea trout fishery in **Finland** is based on a national recreational fisheries survey. Biannual surveys are conducted to estimate participation, fishing effort and catches of the recreational fishery (http://stat.luke.fi/en/recreational-fishing). A stratified sample of about 7500 household-dwellings is contacted with response rates of around 40–45% after a maximum of three contacts. Afterwards, a telephone interview is done for a sample of the non-respondents. Harvested and released catch is measured separately by species. The last survey covering year 2016 was conducted in 2017.

In **Germany,** a nationwide telephone-diary survey with quarterly follow-ups was conducted in 2014/2015, contacting 50 000 German households to collect representative data on catch and effort, and social, economic and demographic parameters for the German marine recreational fishery, covering also the recreational sea trout fishery. However, to collect more detailed information on the recreational sea trout fishery an additional pilot study (diary recall survey) was conducted. During this study, a bus route intercept survey was used to recruit diarists, collect biological samples (length, weight, scales, and tissue samples), and socio-economic data. Ongoing analyses aim to combine both studies to provide a full picture of the recreational sea trout fishery in Germany. Anecdotal information showed that recreational sea trout catches in freshwater are small and probably insignificant compared to marine catches. However, a literature study including expert interviews will be conducted in 2018/2019 to gather more information on recreational sea trout fisheries in freshwater of the Baltic Sea catchment area.

In **Latvia**, a first attempt to estimate total sea trout catches from angling was done in 2018 using Internet questionnaires. The main aim was to get a general information about angling places, gears and efforts. In a second part of the questionnaire, information about sea trout, salmon, cod and eel catches were collected. The total estimate received of sea trout caught in the recreational fishery was deemed highly unrealistic, amounting to 51 978 individuals (156 tons), and should not be used in further analyses. Sea trout angling from coast is not popular in Latvia due to an unfavorable coastline (most of the coast consists of sandy beaches, no islands or archipelagos) and ice coverage in winter. However, all landings in the Latvian "self-consumption fishery" are reported in logbooks. According to this logbook information landings of seatrout in 2018 were 1957 individuals. Additionally, according to official reports from the licensed fishery, 103 sea trout were caught. This estimate does not include angling in Daugava river (no licensing, because Daugava stock consists mainly from reared salmon and sea trout) or angling from the coast.

In **Lithuania,** recreational sea trout fishing is mainly conducted in rivers. Since 2015 recreational (anglers) sea trout catches are estimated by an online survey, a face-to-face interview survey, and individual interviews and catch reporting with diaries of selected anglers and experts. CPUE data (ind/person/day) is estimated from survey data, and combined with number of licences sold to anglers to calculate the total catch. In 2015, the online survey, face-to-face interview survey, and individual angler interviews were conducted, whereas in 2016 and 2017 only online surveys were carried out.

A pilot study in **Poland** initiated in 2017, relating to marine salmon and sea trout recreational fisheries, was continued in 2018. Trolling boats have been observed in ten harbours with particular focus on the Hel, Gdynia, Gdańsk Górki Zachodnie and Kołobrzeg harbors. A total of 136 trolling boats were inventoried in 2018. Number of active trolling boats varied between the autumn/winter (76–89) and spring (55–101) seasons with a higher number of trolling boats in spring. At this time, there is no reliable information on how CPUE (expressed as a number of fish per boat per day) depends on season and total number of trolling operations (boat-days) per year. Trolling catch estimates for 2018 yielded 2092 landed (retained) and 84 released salmon (below minimum landing size fish). More detailed data will be provided in 2020, and it is planned to update catch data for 2017–2019 based on obtained results.

In 2017, a pilot study on river recreational catches in Poland was also initiated and it continued in 2018. According to preliminary results the average sea trout catch in years 2013–2016 was 132, 284 and 327 in the rivers Slupia, Rega and Ina, respectively, whereas 599 fish were caught 2017 in the river Parseta. The average catches of salmon were very low. Results from on-site surveys performed in 2017 and 2018 on Slupia, Rega, Ina and Parseta rivers, indicated that anglers reported a total of 774 sea trout; 519 in 2017 and 255 in 2018 for all monitored rivers. The average catch per angler in seasons 2017–2018 was 1.6 sea trout. There are 8–10 rivers with a similar intensity of sea trout/salmon fishing in Poland, so taking into consideration underestimation of registered catches, the total recreational catch in Polish rivers can be roughly estimated to 40–80 specimens of salmon and 5–10 tons of sea trout yearly.

In **Russia,** sea trout is a protected species in the Baltic Sea, and recreational fishers are not allowed to target sea trout in the sea nor in rivers.

In **Sweden,** recreational fishery for sea trout is very popular. Since there is no commercial fishing specifically targeting the species, commercial catches are low and most catches are from recreational fisheries. A major part of the Swedish recreational catch is taken along the Baltic coast (>2400 km, including islands of Öland and Gotland), in particular by angling from shore or small boats, and from use of gillnets. Offshore recreational fisheries are in most cases done by trolling targeting salmon, with sea trout caught only occasionally. However, trolling closer to the coast targeting sea trout is starting to be popular in some areas. Swedish data on recreational sea trout river catches are almost only collected in larger salmon rivers, and therefore river catch statistics are far from complete. However, as mentioned, the largest proportion of the catch is assumed to be taken in coastal waters where no surveys specifically targeting sea trout are in place so far. Currently the best source for catch statistics comes from an annual national mail survey conducted by the Swedish Agency for Marine and Water Management (SWaM), the authority responsible for fisheries management. The survey is sent to about 17 000 randomly selected persons each year, and it collects statistics on different aspects of recreational fishing (catches, expenditures, fishing days, etc.) for all species. However, this survey can neither estimate trout catches with good precision nor on the geographic scale needed for effective management. To obtain catch statistics with better precision and finer geographic resolution, a specific survey program needs to be developed.

5.2.3 Marking and tagging

The total number of finclipped sea trout released in 2018 in the Baltic Sea area was 1 718 891 smolts and 277 741 parr (Table 5.2.2.1). Finclipping of hatchery-reared smolts is mandatory in Sweden, Finland and Estonia. The largest number of finclipped smolts was released in Finland (705 404) followed by Sweden (687 745). All released sea trout smolts have been finclipped in the Gulf of Finland since 2014 and in the Gulf of Bothnia since 2016. In Latvia 325 742 smolts were finclipped and released in Subdivision 28. Finclipping was not performed in Poland in 2018, and there was also no stocking of finclipped sea trout smolts in Denmark, Germany, Russia, Estonia or Lithuania. In 2018, the total number of Carlin tagged sea trout was 4214, half of the amount in the year before. Most of the tagged trout were released in subdivisions 28 and 30–32 (Table 5.2.2.1). In addition, 9558 sea trout were tagged with T-bar (T-Anch) tags, mostly in Finland (7474). In Latvia, 2000 one-year old smolts were tagged with T-bars and released in the Brasla River. In addition, 84 tagged adults and kelts (post-spawners) were released in Poland (SD 25) (Table 5.2.2.1). Additionally 8882 sea trout were tagged internally with passive integrated transponders (PIT); the majority was tagged by Poland as reared smolts and released in Parsęta river (5000) in Subdivision 25. In subdivisions 31 and 30, smolts tagged with PITs were stocked in rivers Umeälven (2000) and Dalälven (1770) (Table 5.2.2.1). In Lithuania 6000 calcein dye solution (CAL) marked sea trout fry were released into the six rivers (Table 5.2.2.1).

5.3 Assessment of recruitment status

5.3.1 Methods

Recruitment status

The SGBALANST (ICES, 2008c; 2009b) screened available data on sea trout populations around the Baltic Sea, and proposed an assessment method (ICES, 2011). The basic method, theory and development is fully described in ICES (2011; 2012), and the slightly adjusted method applied since the assessment in 2012 is briefly summarized below, together with modifications applied in the present assessment.

Through screening of data availability, (ICES, 2008a; 2009a; 2011) it was found that only abundance of trout from electrofishing were available from all countries. Together with habitat data, trout densities are collected annually from specific sites every year in most countries. However, at the time of the screening, the number of sites was highly variable and mostly sparse in many parts of the Baltic. From a few countries, directly useable data were not available, either because there was no electrofishing programme at all, or because the information collected was not sufficiently detailed. It was also found that only little and scattered information existed on other life stages (sea migration, abundance of spawners, smolt production and survival). Likewise, information on human influence, such as sea and river catches (especially recreational ones), was sparse.

An assessment model using electrofishing data together with habitat information collected at the same sites was proposed focusing on *recruitment status* as the basic assessment tool (reference point). Recruitment status was defined as the *observed recruitment* (observed densities) relative to the *potential maximal recruitment* (maximal densities that could be expected under the given habitat conditions, i.e. the predicted densities, see below) of the individual sea trout populations.

Due to the significant climatic (e.g. temperature and precipitation) and geological differences found across the Baltic area, as well as the huge variation in stream sizes, the model proposed is constructed to take variables quantifying such differences into account. Differences in habitat qualities (suitability for trout) influence trout parr abundance, given that stock status is below carrying capacity and spawning success is not limited by environmental factors such as migration obstacles downstream to monitored sites.

To allow comparison of trout abundances between sites with different habitat quality, a submodel was used, i.e. the **Trout Habitat Score (THS)**. THS is calculated by first assigning values (scores) for the following relevant (and available) habitat parameters for 0+ trout: *average/dominating depth, water velocity, dominating substrate, stream wetted width, slope* (where available) and *shade*. Scores assigned range between 0 for sites with poor conditions and 2 for best conditions (assessed from suitability curves and in part by expert estimates; see details in ICES, 2011). THS is then calculated by addition of score values resulting in a total score that can vary between 0 (very poor conditions) and 12 (10 if *slope* is omitted) for sites with very good habitat conditions. Finally, the THS values obtained were grouped in four **Habitat Classes** ranging between 0 (poorest) and 3 (best) (Table 5.3.1.1) (ICES, 2011).

The potential maximum recruitment for sites with a given habitat quality used in this year's assessment was the same as in 2015 (ICES, 2015). In calculations, observed parr abundance was transformed using Log10 (x+1) to minimize variation and improve fit to a normal distribution.

Predicted maximum densities were determined by a multiple linear regression analysis based on select sites displaying expected "optimal densities" (see Section 5.6.2. in ICES, 2015). The analysis found the variables *log (width), average annual air temperature, latitude, longitude and THS* to be significant in determining optimal densities of 0+ trout (r^2=0.5, Anova; $F_{2,254}$=51.8, p<0.001) according to the following relation:

1) Log10 (*0+optimal density*) = 0.963 - (0.906**logwidth*) + (0.045**airtemp*) - (0.037**longitude*) + (0.027**latitude*) + (*THS**0.033).

This multiple regression relation 1) was used for calculating the potential maximal densities at the individual fishing occasions, with current **Recruitment Status** 2) calculated as:

2) Recruitment status = (Observed density / Predicted maximal density) * 100.

Note that for two reasons, it is possible that single observed densities can sometimes by higher than the predicted mean, resulting in a recruitment status somewhat above 100%. First, as described above, predicted maximal densities are calculated using multiple regression based on observations that show variation around the mean. The maximum values used to assess status thus represent average densities across several sites with a given habitat quality score (THS), and individual observations may occasionally exceed the predicted (average) maximum. Second, the calculation of predicted maximal densities have not been updated since the construction of the present model in 2015, taking more recent observations into account.

Mean recruitment status was calculated for each Assessment Area (see below and Fig-ure 5.3.2.1), each ICES subdivision (SD) and by SD and country combined. Recruitment status was calculated separately for 2018 and for the three last years (2016–2018). As-sessment Areas were defined according to the below table:

Assessment area	SD
Gulf of Bothnia (GoB)	30–31
Gulf of Finland (GoF)	32
Western Baltic Sea (West)	27 & 29
Eastern Baltic Sea (East)	26 & 28
Southern Baltic Sea (South)	22–25

Recruitment trends

An indicator of **Recruitment Trend** was calculated as the bivariate correlation between annual recruitment status (see above) and sampling year, illustrated using the slope from a linear regression with 95% CI. Recruitment over time was assessed for the last five year period (2014–2018) in order to illustrate the most recent development in change of status. Only sites where a calculated status was available for all years in the last five year period were used when trends were calculated (Figure 5.3.2.2).

Both recruitment status and trend were calculated as average values for each of the following units of analysis: **Assessment Area**, **ICES** s**ubdivision** (SDs) and, where more countries have streams in one SD, for **individual countries**.

For a final assessment, the results from the above status and trend analyses were combined with additional information gathered, most markedly from fisheries and count of spawners (where available).

5.3.2 Data availability for status assessment

Information on densities of 0+ trout from 479 fishing occasions in 2017, at sites with good or intermediate water quality and without stocking, was available for calculation of recruitment status. For the trend analysis, 169 sites that had been fished continuously in the latest five years period (2014–2018) were included (Table 5.3.2.1).

The geographical distribution of fishing occasions used for evaluation of status is shown in Figure 5.3.2.1, whereas the corresponding distribution of sites for trend analysis is shown in Figure 5.3.2.2. Note that new, previously not available electrofishing data have been included in the assessment over time. This is i.a. the case for Germany and Sweden, where many sites have now been included. In Russia, no data for 2016 were available, and only from a few sites in 2017 due to flow conditions.

5.4 Data presentation

5.4.1 Trout in Gulf of Bothnia (SD 30 and 31)

Sea trout populations are found in a total of 67 Gulf of Bothnia rivers, of which 32 have wild and 35 have mixed populations (Tables 5.4.1.1 and 5.4.2.1).

The status of sea trout populations in Swedish rivers is in general considered to be uncertain. Populations are affected by human activities influencing freshwater habitats, mostly through overexploitation, damming, dredging, pollution and siltation of rivers (Table 5.4.1.2).

Average 0+ parr densities for Swedish and Finnish rivers in the area are presented in Figure 5.4.1.1. For Sweden, the densities presented in this figure are mainly from sites chosen for salmon monitoring in larger rivers, and in many cases, trout is thus absent or found in low densities. The average densities dropped after 2005, from 8–16 to 1–4 0+ parr per 100 m^2, and they have remained stable at this low level since, although with a slight increase in 2015 followed by a decrease in the last three years (Figure 5.4.1.1). The SD 30–31 electrofishing results from Finland include three rivers (Lestijoki, Isojoki, and some tributaries of Tornionjoki). Densities of 0+ parr have remained low in Lestijoki, but increased after a few years drop in Isojoki and the Tornionjoki tributaries to above eight parr per 100 m^2 on average (Figure 5.4.1.1).

Sea trout smolt runs (trapped and estimated) in the period 2002–2018 are presented in Table 5.4.1.3. In river Tornionjoki (SD 31) smolt trapping during the whole migration period for sea trout has only been possible in some years, because the trout smolt run is earlier than for salmon, and in most years the trout smolt run is already ongoing when river conditions allow start smolt-trapping; the five annual estimates available for Tornionjoki range from about 11 000 to 19 000 sea trout smolts. Unfortunately, no estimate from Tornionjoki, was available in 2018 (Table 5.4.1.3). In the two smaller SD 31 rivers Sävarån and Rickleån, where trapping ended in 2013 and 2017, yearly production estimates have varied from ca. 200–2 100 and 300–600 smolts, respectively (Table 5.4.1.3).

The number of sea trout spawners recorded by fish counters is low in most larger ‘salmon rivers’ in Sweden (Figure 5.4.1.2). The average number of sea trout counted in River Kalixälven increased somewhat after 2006, from about 100 to about 200 with a maximum of 300 in 2013, 2014 and 2016, In River Byskeälven, the number decreased after 2005, from approximately 100 sea trout to very low levels (ca. 25 sea trout per year). In 2015–2016 the run again increasing in almost 300 fish followed by a decrease to 50 in 2018. From 2001, the annual number of ascending sea trout in River Vindelälven has varied within the range 25–150. However, the number increased considerably in 2015 to more than 500 fish, followed by a decrease to 200 fish in 2016 and 2017 and a new increase in 2018 to more than 400. In contrast, River Piteälven has showed a positive trend that has lasted since the beginning of the century, with 1600 sea trout spawners recorded in 2017, followed by a small decrease in 2018 (Figure 5.4.1.2).

Catches of wild sea trout in SD 30–31 have declined considerably over a long time period, possibly indicating large overall reductions in population sizes. Although catches since 2013 do not reflect actual runs, because of implemented restrictions (size and catch limits, in R. Torne a complete ban on harvest of sea trout, etc.) catches declined considerably after the late 1970s and have remained low until present. As an example, the catch in River Kalixälven dropped to zero in 2017 (Figure 5.4.1.3). In 2018, the overall catch of wild sea trout from sport fishing in Swedish SD 31 continued its decreasing trend, whereas it increased in SD 30 (Figure 5.4.1.4).

Returns from Carlin tagged sea trout have showed a rapid decrease since the 1990s, and after 2003, the average return rate has been below 1% (Figure 5.4.1.5). For trout tagged in Gulf of Bothnia rivers, a large and increasing proportion of the recaptures, often a majority, are caught already as post-smolts during their first year in sea. Sea trout are mainly bycatch in whitefish fisheries with gillnets and fykenets. Based on tagging data, the proportion of fish caught as undersized fish during the first sea year has been fluctuating around 50% in the last decades (Figure 5.4.1.6), and the proportional distribution of recaptures in different fishing gears has been relatively stable (Figure 5.4.1.7).

According to tagging results, the survival rate of released smolts is at present lower than the long-term average. Furthermore, tagging data show that Finnish sea trout migrate partly to the Swedish side of the Gulf of Bothnia (ICES, 2009a), whereas Swedish sea trout have been caught at the Finnish coast. There is no more recent information available.

A Bayesian mark–recapture analysis based on tagging data (Whitlock *et al*., 2017) has recently been conducted for reared sea trout in two Finnish rivers in SD 30 and 31 (Isojoki and Lestijoki, 1987–2011). The results of this study indicate substantial fishing mortality for sea trout aged three years and older from both stocks, but particularly in the case of Isojoki (Figure 5.4.1.8). Annual total fishing mortality rate estimates ranged from 1 to 3 in most years for sea trout aged 3 and older in both rivers, corresponding to harvest rates between 0.63 and 0.95. Total fishing mortality for the Isojoki stock showed a decreasing pattern over time, while the temporal pattern was fairly stable for Lestijoki sea trout. Fishing mortality was considerably higher for sea trout of age 3 compared with fish of age 2 in both stocks (Figure 5.4.1.8). A decreasing pattern of survival in the first year at sea was also estimated (results not shown). Sustained high rates of fishing mortality have likely contributed to the poor status and limited reproduction of wild sea-trout stocks in the Isojoki and Lestijoki rivers (Whitlock *et al*., 2017).

5.4.2 Trout in Gulf of Finland (SD 32)

The number of streams with sea trout in Gulf of Finland was partly updated in 2018. It is now estimated that there are 100 rivers and brooks with sea trout in this region; out of these 92 have wild stocks, the rest are supported by releases (Tables 5.4.1.1 and 5.4.2.1). The situation for populations is uncertain in 36 rivers and very poor in 20 (with current smolt production below 5% of the potential).

In Estonia, sea trout populations are found in 39 rivers and brooks in the Gulf of Finland region, of which 38 have wild populations (Table 5.4.1.1). Electrofishing data from Estonian rivers show densities of up to 140 0+ parr per 100 m^2 in the 1980s. In more recent years, densities have in general been below 40 0+ parr per 100 m^2 (Figure 5.4.2.1). Estonian rivers with higher smolt production are situated in the central part of the north coast. Smolt runs in River Pirita during the period 2006–2018 have varied between around 100 and 4000, and after a drastic drop in 2014, it attained its current record value in 2016 (Table 5.4.1.3). The number of spawners recorded by a fish counter in this river has varied between 26 and 125 fish during 2014–2018 (Figure 5.4.2.2).

Parr densities for sea trout in the Finnish rivers in the Gulf of Finland have been highly variable, with densities varying between 0 and 82 0+ parr per 100 m^2 in the period 2001–2018, as shown in Figure 5.4.2.1.

The recapture rate of Carlin tagged sea trout in Gulf of Finland shows a continued decreasing trend for more than 20 years; in recent years, it has been close to zero (Figure 5.4.1.5). Tagging results have shown that in Finnish catches in general, about 5–10% of the tag recoveries are from Estonia and some also from Russia. These migration patterns have been confirmed in a genetic mixed-stock analysis (Koljonen *et al.*, 2014).

In Russia, wild sea trout populations are found in at least 48 rivers and brooks, including main tributaries (Tables 5.4.1.1 and 5.4.2.1). A majority of these populations are situated in rivers or streams along the Russian northern Gulf of Finland coast, but the rivers with highest smolt production are located along the south coast. In most recent years, average 0+ parr densities have in general been below ten individuals per 100 m^2 (Figure 5.4.2.1). The highest Russian 0+ parr densities have been observed in a few small streams and two of the River Luga tributaries. In Solka (the second tributary of Luga River) numbers of 0+ parr per 100 m^2 was 245 in 2018.

The smolt run in River Luga during the period 2002–2014 varied between 2000 and 8000 wild trout smolts (Table 5.4.1.3). After increasing to a record level of 11 600 smolts in 2015, almost three times higher than the average for the total monitoring period (ca. 4000 smolts), it again decreased to 2600 in 2016, 3500 in 2017 and 5800 in 2018. Total production in the Russian part of Gulf of Finland has been estimated to about 15 000–20 000 smolts per year. Genetic studies have shown that 6–9% of the sea trout caught along the southern Finnish coast was of Russian origin (Koljonen *et al.*, 2014).

5.4.3 Trout in Main Basin (SD 22–29)

In the Main Basin, when including tributaries in larger water systems (Odra, Vistula and Nemunas), there are 396 rivers and streams with sea trout populations, out of which 321 are wild (Tables 5.4.1.1 and 5.4.2.1). However, these figures do not include Germany; the actual number of German sea trout streams/rivers has not yet been evaluated, although it has been estimated that it could be close to 90.

In Sweden, 207 sea trout rivers are found in the entire Main Basin. Out of these, 200 have wild sea trout populations whereas seven are supported by releases. In Denmark, 139 out of 173 trout rivers are wild, with a majority classified as being in good condition. In Poland, the number of populations was revised in 2018; sea trout are found in 26 rivers (whereof 12 in SD 26), mainly in Pomeranian rivers (eleven) but also in the Vistula (six) and Odra (six) systems (including the main rivers). All Polish sea trout populations but two are mixed due to supplemental stocking since many years. There are three Russian sea trout rivers flowing into the Main Basin (in the Kaliningrad Oblast). All are wild and their status is uncertain. In Lithuania, sea trout are found in 19 rivers, whereof eight belong to the Nemunas drainage basin. In eight Lithuanian rivers, there are wild populations, while the rest are supported by releases. In Latvia, sea trout populations are found in 28 rivers, about half of them wild. In Estonia, sea trout occurs in 36 rivers and brooks discharging into the Main Basin. All of them are small with wild populations.

The situation for sea trout populations in the Main Basin based on expert evaluation was partially revised in 2018, and it was found to be uncertain in 222 rivers with wild populations. Status of 25 populations (wild and mixed, including tributaries in large systems) are considered as poor with an estimated production <5% of the potential (Table 5.4.1.1 and 5.4.2.1), mainly due to habitat degradation, dam buildings and overexploitation (Tables 5.4.1.2 and 5.4.3.1).

Main Basin East (SD 26 and 28)

In Latvia, average densities of 0+ parr have varied from 4–12 per 100 m² (Figure 5.4.3.1). Rivers Salaca, Gauja and Venta show the highest estimated wild sea trout smolt production. In Salaca estimated smolt numbers from smolt-trapping have varied between 2500 and 19 000 in the period 2002–2016. In 2017 and 2018, it dropped to below 6000 (Table 5.4.1.3). Estimated smolt production in 2018 for all Latvian rivers combined was about 39 600 smolts, far below the last five-year average.

In Lithuania, average parr densities for 0+ trout have varied from 6–12 individuals per 100 m² during the past few years with a decrease to five in 2018 (Figure 5.4.3.1). The estimated total natural smolt production in 2018 was 43 755, a little more than in 2017.

In Poland, average densities of 0+ parr in SD 26 rivers have been generally high but variable, with densities of up to more than 90 individuals per 100 m² in some years. After four years (2013–2016) with high (70–90) and stable densities, the average 0+ density dropped to only 32 in 2017 followed by an increase to 52 in 2018 (Figure 5.4.3.1). Number of adult sea trout migrating upstream recorded by an electronic counter (VAKI) in a fish-pass at the Wloclawek dam in Vistula River decreased from 1554 in 2015 to only 173 in 2017, followed by an increase to 388 fish in 2018 (Figure 5.4.2.2).

Main Basin West (SD 27 and 29)

Average 0+ parr densities in eastern Estonian rivers (SD 29) have increased during the 20th century, from close to zero to almost 50 per 100 m² in 2018 (Figure 5.4.3.2). In Swedish river Emån, the average parr density also increased until 2016 followed by a decrease in the last two years to close to 1 0+ per 100 m² in 2018.

Nominal (landed) river catches of sea trout in Emån are presented in Figure 5.4.1.4. The sport fishing harvest of sea trout in Emån has been declining, and in 2018, it was only seven fish. However, since catch and release is not included, this does not give a correct picture of the total catch.

Main Basin South (SD 22–25)

Average parr densities in southern Swedish river Mörrumsån have been seven in average since the mid-1990s, although it increased to 20 in 2017. (Figure 5.4.3.4). Results from smolt trapping shows that the production in the upper half of the river (the smolt trap is located approximately 11 km from the outlet) has varied between 3200 and 10 200 smolts during the last ten years, with the smallest number seen in 2018 (Table 5.4.1.3). Number of spawners recorded in River Mörrumsån has been decreasing since 2012, when it was more than 1000; only 118 fish were counted in 2018, although the counter was not operated during the whole season (Figure 5.4.2.2). The sport fishing harvest of sea trout has declined markedly in the past decade, in 2018 it was 43 fish (Figure 5.4.1.4). However, since catch and release is not included, this does not give a correct picture of the total catch in Mörrumsån.

The total number of wild sea trout smolts produced in Danish rivers (SD 22–25) is at present estimated to around 290 000 per year. In most previous years, electrofishing data from Danish streams have showed average parr densities between 50 and just below 200 0+ per 100 m², but in 2018 the average decreased to 40 (Figure 5.4.3.4). Annual smolt migration in one stream on the

Island of Bornholm (Læså, length 17 km, productive area 2.46 ha) was on average 6300 individuals in the period 2007–2013; however, with very high variation among years (1687–16 138), probably due to varying water levels (Table 5.4.1.3). Smolt-trapping in Læså has not continued after 2013.

The average parr abundance in Germany has been decreasing from 68 in 2014 to 16 in 2018 (Figure 5.4.3.4), but the set of electrofished sites has been changed in every year. Spawner numbers in 2018 have been collected by video counting in eight German streams in SD 22 and 24 with wild populations. In four streams there were no or only a few fish. In both Peezer Bach (SD 24) and Hellbach (SD 22) the counted number of fish in 2018 was about 1000 (Figure 5.4.2.2). For Peezer Bach, it was a maximum count so far, whereas for Hellbach, it represented an increase after a four year decline following the record count of 2300 fish in 2013 (for both these streams fully reliable data for 2017 was not available). In Zarnow (SD 24), the counted 303 sea trout in 2018 was a maximum for the five years of monitoring, and in the first year of counting in Wallensteingraben 193 fish were recorded (Figure 5.4.2.2).

Average densities of 0+ parr on spawning sites in Polish rivers in SD 25 have shown a decreasing trend, from 114 in 2004 to 32 in 2018 (Figure 5.4.3.4). Spawning runs have been monitored by fish counting in the Slupia River since 2006; the number of migrants during last four years has decreased from more than 7000 to below 500 in 2017. In 2018, the number of spawners increased again to 1600 (Figure 5.4.2.2). A dermatological disease affecting sea trout spawners in most Polish Pomeranian rivers has continued (outbreak in 2007; Section 3.4.3).

In summary, parr densities in southwestern Baltic rivers (SD 22–25) demonstrate a decreasing trend during the last three years. Notably, the observed numbers of spawners in some southern Baltic rivers are higher than in larger northern ones, even if some of these southern rivers are very small. In most rivers with spawner counts, the time-series (number of years) still do not allow evaluations of long-term trends. However, in almost all monitored rivers spawner counts in 2018 were better than in 2017 (Figure 5.4.2.2).

5.5 Recruitment status and trends

Results from the updated analyses of recruitment status and trends for sea trout in rivers and streams around the Baltic Sea are shown in Figures 5.5.1 to 5.5.6.

5.5.1 Recruitment status

In the **Gulf of Bothnia** assessment area (SD 30–31) the recruitment status is on average just approx. 70% (Figures 5.5.1 to 5.5.3). Status in SD 30 is slightly better in Finland compared to in Sweden (Figure 5.5.3).

In the **Gulf of Finland** assessment area (SD 32) the overall status is good (Figure 5.5.1), almost equal in the three countries in the area. This is different compared to previous years, particularly in Russian streams. The change is in part due to a change in sites with available information from this country (Figure 5.5.3).

In assessment area **East** (SD 26 and 28; Figure 5.3.2.1) the overall status is low, but at the same time much higher in SD 28 compared to in SD 26. (Figures 5.5.1 to 5.5.3). In SD 26 the low status is due to a large number of sites with low status in Lithuania, while status in Polish rivers is considerably better. In SD 28 status is approximately equal in the three countries with streams in this SD (Estonia, Latvia, Sweden).

In assessment area **West** (SD 27 and 29; Figure 5.3.2.1) only Swedish sites were available this year (Figures 5.5.2 and 5.5.3). In this area, status is estimated as good.

In assessment area **South** (SD 22–25; Figure 5.3.2.1) overall status is low, however with large variations between both subdivisions and countries. Status is highest in SD 25, due to generally good status in Poland. In SD 24 the overall low status is mainly due to low status in Germany. In SD 23 (where only Swedish sites are available) status has declined further compared to assessed in previous years, now being on average less than 50%. In SD 22, status was low in both Denmark and Germany (Figure 5.5.3).

Recruitment status for year 2018 compared to an average computed for the three-year period 2016–2018 shows differences in some assessment units, indicating interannual variation. But in most comparisons, the overall situation has been relatively stable (Figures 5.5.1 to 5.5.3).

5.5.2 Recruitment trends

The trend in the development of recruitment status on sites being fished throughout the latest five years has been negative in all assessment areas, although with confidence intervals including values larger than zero in all areas except Gulf of Bothnia (Figure 5.5.4). Also on the level of subdivision, most estimated trends (linear slopes) were negative although uncertain (Figure 5.5.5).

On the level of individual countries by subdivision, the trends were more mixed (and uncertain). Positive trend estimates were obtained in Denmark on the one site included from SD 24, in Poland SD 25 and 26, and in Sweden SD 28 and 31 (Figure 5.5.6).

5.6 Reared smolt production

Total number of reared sea trout smolts released 2018 in the Baltic Sea (SD 22–32) was 3 356 000, which is little less than in last year (3 804 000) and equal to the last ten year average. Out of this total, 2 214 000 smolts were released into the Main Basin, 915 000 into the Gulf of Bothnia and 227 000 into the Gulf of Finland (Table 5.6.1).

- In Finland, trout smolt production is mainly based on reared broodstocks supplemented by spawners caught in rivers. In the past ten years, the average number of smolts released has been 841 000. In 2018, the number of smolts was 709 000, whereof 65% were stocked into the Gulf of Bothnia and 20% into the Gulf of Finland.
- In Sweden, the number of trout smolts stocked in 2018 was 641 800, close to the average level in the last few years. A majority of the Swedish smolts were released into Gulf of Bothnia (71%).
- Estonia has stopped all sea trout releases in 2018.
- In Poland, juvenile fish are reared from spawners caught in each river separately; only a part of the Vistula stocking is of reared broodstock origin. A total of 1 033 000 smolts were released into Polish rivers in 2018, below the ten years average of 1 400 000.
- Denmark released 550 000 smolts in 2018, little less than in 2017.
- Latvia released 309 000 smolts in 2018, somewhat less than in 2016 (391 000) but more than the last ten year average (224 000).
- Russia released 84 000 smolts in 2018 into the Gulf of Finland, similar to in 2016.
- The German level of stocking has been 13 000–15 000 smolts per year since 2008.

In addition to direct smolt releases, trout are also released as eggs, alevins, fry and parr (Table 5.6.2). The estimated number of smolts originating from these releases of younger life stages over time ('smolt equivalents', calculated as described in Table 5.6.2) is presented in Table 5.6.3. In 2018, the estimated smolt number expected from releases of younger life stages in previous years was around 213 000, mainly in Main Basin rivers. The prediction for 2019 is approximately

245 000 smolts for the whole Baltic, of which 217 000 will migrate into the Main Basin. Total number of smolt equivalents from enhancement releases in 2018 was very close to the last ten years average, but less than in the very beginning of the 20th century (Table 5.6.3).

5.7 Recent management changes and additional information

5.7.1 Management changes

No management changes for sea trout were implemented in 2018. Management changes from recent years are described in ICES (2017a, 2018a).

5.7.2 Additional information

Measures of stocking efficiency have been conducted in Poland, involving genetic parental assignment techniques. As target rivers Vistula and two Pomeranian rivers were chosen. In 2018, several hundreds of sea trout, returning to the Vistula River for reproduction, were collected and genotyped. Molecular analyses (microsatellite loci) of sea trout returning to the rivers in 2018 were used to identify descendants of fish used for artificial spawning in 2013. The genotypic parental database of spawners from 2013 included approximately 2000 broodstock fish. Genotyped farmed fish used for artificial spawning in 2013 were also a main part of the parental group in subsequent years (2014, 2015 and 2016). Analysis of parenthood, performed for fish caught in 2018 in the Vistula, indicated that 25–30% of the analysed fish originated from the broodstock spawners in 2013.

Trout parr otolith core strontium/calcium (Sr:Ca) ratios have been used to determine whether parr has an anadromous or resident maternal parent The study was carried out in some Estonian and Finnish short, coastal streams (ICES, 2018a).

In 2014/2015, a national probability-based telephone-diary survey was conducted aimed at providing information on the marine recreational fishery in Germany, covering also sea trout. To collect more detailed information on the recreational sea trout fishery, an additional pilot study (diary recall survey) was conducted. During this study a bus route intercept survey was used to recruit diarists, collect biological samples (length, weight, scales, and tissue samples), and socio-economic data. The ongoing analyses aim to combine both these studies to provide a full picture of the recreational sea trout fishery in Germany. The majority of research activities was, and still is, short- or medium-term projects, mostly funded on federal state authority level or externally through angling licence funds.

For the assessment in the coming years, there is concern about data availability from Schleswig-Holstein (S-H), Germany. In S-H, information has in recent years been provided from a time-limited project. The working group was informed that this project is likely to be discontinued, resulting in a regrettable lack of information on sea trout in western Germany. In contrast, it is very positive that a new initiative should be able to provide information in future years for sea trout in Mecklenburg-Vorpommern, Germany.

5.8 Assessment result

A positive development has been observed in more recent years (2015–2017) in many sea trout populations around most of the Baltic Sea, while a general decline in status was observed in 2018. The decline is reflected both in reductions in status in many areas, and in general a negative trend in status over the past five years. The negative trend appears stronger than what is displayed in the change of status. This is likely due to the fact that more sites (and to some extent also different sites) are available for status analysis, than are for the trend analysis. In general, it is believed that the 2018 decline is largely due to a warm and dry summer in that year. The overall final conclusion is that the change in status does not raise concern.

In spite of the overall improvement in recent years, populations in some areas are still considered to be fragile, and many uncertainties remain.

Sea trout in **Gulf of Bothnia** (SD 30 and 31) should still be considered vulnerable, and it is recommended to further reduce the fishing mortality in the fishery targeting other species, and to maintain the present restrictions. Spawner counts show a continued increase, especially in the river Pite, where it is believed to be partly a result of habitat improvements, whereas increases are modest in other rivers. However, absolute spawner numbers are still low considering the size of these northern rivers. Knowledge on parr densities is still quite limited, but in general, they seem to have improved during later years compared to earlier. However, in Swedish rivers in the latest three years average densities has diminished. Low values in 2018 are likely due to a warm summer with low water levels. Overall, in contrast to 2017, the recruitment status in 2018 was slightly reduced, and trends on sites electrofished during the last five years were negative (although positive in Sweden SD 31).

For 2018, there is no information on smolt numbers in Gulf of Bothnia rivers, but in the previous two years only a few hundred smolts migrated in Rickleån. Sea catches were still dominated by young trout, mostly caught in bottom gill nets, although a larger part of all catches in recent years were from angling.

The restrictions in the Swedish sea fishery (gillnetting ban in shallow waters), which has now been in effect for a number of years, and a more recent complete ban of harvest of wild (not finclipped) sea trout in Finnish waters, is expected to contribute to a positive future development in the Gulf of Bothnia. However, the continued fishery for other species (e.g. whitefish) with fine meshed gillnets that also catch post-smolts and young sea trout is still problematic and can be expected to either limit the level of wild sea trout populations in the area, or at least delay their recovery.

The relatively high recruitment status for sea trout in Finnish SD 30 is currently based on data from only one river (Isojoki). The expert opinion, based on local knowledge, is that the assessment model currently overestimates the actual status in Isojoki. Similar opinions have also been expressed regarding Swedish Gulf of Bothnia populations.

It is recommended that the model performance in northern Baltic Sea populations is evaluated. In particular, it is possible that the predicted maximum densities, used as reference when assessing sea trout status, are at present yielding a generally too optimistic view of the situation, and there is a particular need to update the underlying submodel (i.e. THS; ICES, 2015) with additional data from the northern Baltic Sea.

In the **Gulf of Finland**, a positive development has been observed in Estonia, where trout populations in general seem to be in a good shape, however with a relatively low, only slightly increasing smolt run in the Pirita. In Russia, average parr densities have improved and recruitment status was much higher in 2018 compared to in previous years. This is due to high parr densities at a couple of sites; the increase is due to improved habitat conditions after finished construction works in the river. In Luga, the smolt number in 2018 was much higher than in previous years, but the level of production is still very low taking the size of the river into consideration. The reason is most likely that most subpopulations in the tributaries are much below their potential levels. In Russia, illegal catch of sea trout may be one reason for the continued poor status for the populations in this area.

Recent catch restrictions for wild sea trout in Finland are expected to improve the sea survival of trout for all countries in the Gulf of Finland area. It is recommended to continue with the present management restrictions in both Finland and Estonia.

In the **Western Main Basin** (assessment area West, SD 27 and 29), data for calculation of recruitment status were only available from Sweden. In spite of low 2018 parr densities in Emån, likely due to a warm summer with low water levels, the recruitment status in Sweden (SD 27) was slightly higher in 2018 than in 2016 and 2017, being on the same level as in earlier years. The decreasing trend is a result of lower status in 2016 and 2017. Also in Estonian rivers (SD 29) densities have gradually increased, in spite of the warm and dry summer in 2018.

In the **Eastern Main Basin** (assessment area East, SD 26 and 28) both parr densities and status are rather good in Estonia, and presently the situation does not raise concern. While average densities and recruitment status in Latvian rivers is moderate, large variations were observed in 2018 between different parts of the country. The situation was worst in western Latvia, probably because of high temperatures. In the eastern part of the country, the situation was better. In this part of the country, however, populations are in some places limited by lack of suitable spawning places, in part because of siltation and overgrowth of the spawning gravel. The smolt run in Latvian river Salaca has in recent years been variable, but without signs of any significant change.

In Lithuania (SD 26) both average densities and recruitment status are low, and the five year trend in recruitment status is negative. Densities and status was lower in the eastern part of this country, compared to in the western part. It is believed that elevated summer temperatures is the main reason for this longitudinal difference. Smolt counts are low in most rivers with trapping (however increasing in R. Mera). A possible reason for the low recruitment status is believed to be low water flows during the spawning period in recent years. In addition, it is uncertain if there are sufficient spawning possibilities in all areas. The recruitment status could also be influenced by the long distance to the sea from most spawning areas.

In Eastern Poland (SD 26), the five year trend is positive and both densities and status are good. The situation does not raise concern in the smaller SD 26 rivers. In the river Vistula, however, in spite of heavy stocking, the number of spawners has been dramatically reduced in the last few years (Dębowski, 2018).

In the **Southern Baltic Sea** (SD 22, 23, 24 and 25) recruitment status in 2018 was lower than in 2017. The negative recruitment trend in Denmark (SD 22) is based on few sites, which only in part reflect the situation for sea trout, because the sites are situated partly in upstream areas. Danish sea trout populations are subject to a (mainly) recreational fishery, especially in the sea. In the streams, spawning possibilities are in many places still insufficient, in spite of significant restoration works in recent years. However, presently the situation does not raise concern.

No information was available from Schleswig-Holstein in Germany, where status in previous years was assessed as relatively good. In the German SD 22 streams, recruitment status in Mecklenburg-Western Pomerania is low. The main reason is believed to be high summer temperatures in 2018, and in 2017, the conditions for electrofishing were difficult. However, populations are also subject to fisheries both in the sea and in rivers.

Status in German populations further east (SD 24) is also low on average. This is thought to be the result of a combination of high temperatures and geomorphology, although trout in this area are also subject to angling and catches in fixed gears. River maintenance work has been carried out to improve habitat quality. In this area, beaver populations are presently increasing, creating migration barriers in the streams. In addition, some populations will have to pass narrow fjord-like waters, probably causing high mortalities due to predation on outward-migrating smolt.

In western Poland (SD 25) recruitment status is on average unchanged, and presently it does not raise concern. The continuous decrease in count of spawners in river Slupia, is believed to be related to the cessation of stocking of smolts some years ago, and problems with intensive UDN in several years (which concerns other Pomeranian rivers also).

In Sweden (SD 25) status in the streams included is on average low, and with a negative trend. In the River Mörrum the number of smolts counted (upper part of the river only) has decreased during the last few years, being lower than what could be expected considering the size of the river. In this river, part of the trout spawners (and salmon) have been observed to suffer from some kind of skin disease (similar to observations in Poland).

In SD 23, only Swedish sites are available for assessment, showing on average low status. The negative trend mainly reflects high recruitment status in 2014 together with a low recruitment status in 2018 (zero catches at two of six sites, of which one was reported to be affected by draught).

5.8.1 Future development of model and data improvement

In 2017, the ICES Working Group WGTRUTTA (Working Group with the Aim to Develop Assessment Models and Establish Biological Reference Points for Sea Trout (anadromous *Salmo trutta*) Populations) was established. The group will finalize its work this year, but is expected to apply for a continuation. In this group, one modelling approach for sea trout populations being evaluated, is similar to the one currently employed in WGBAST. Reference points for expected fry density may be estimated using breakpoints in cumulative distribution of 0+ trout, and used as a proxy for 'reference' 0+ density under the different THS scores and classes. It is expected that the outcome from this work can be used in future as a basis for development of the current sea trout assessment. However, the model is not yet ready for replacing the one currently used in the Baltic.

Since a new model that might be used for assessment in the Baltic is not expected in a near future, and because there is concern on the accuracy of the present model in the northern areas, it is planned to investigate if the current model for these areas should be adjusted, or possibly replaced by a submodel for these areas. Furthermore, since the present model was constructed, additional information has been collected for the sites used. The new information collected includes a.o. distance to sea and presence of downstream barriers. It is planned to investigate what effect distance to sea and possibly presence and nature of downstream barriers have for trout populations and how such effect might be included in the current model.

5.9 Compatibility of the EU-MAP with the data needs for WGBAST

A better geographical data coverage than hitherto is still needed, with a sufficient number of electrofishing sites from typical trout streams. In spite of inclusion of several new sites in the northern areas, it is still considered relevant to have more sites in the northern parts of the Baltic, preferably with good geographic coverage. This is relevant both for the actual assessment as such, and in order to evaluate how well the application of the assessment model work in these areas. Also, in the southwest Baltic (Denmark) there is currently a lack of sites being collected annually.

The concept of the current assessment model builds on a comparison of observed densities with estimated maximum densities at sites with good conditions, no migration obstacles and no or low impact from fishing. This is largely depending on expert judgment. If an array of trout index-rivers, with counts of both smolt and returning adults, was established, it would be possible to express recruitment as a proportion of maximum density, but also as a proportion of stock biomass and smolt production (thereby provide data for any future life-history models; such work has been initiated in WGTRUTTA).

5.10 Recommendations

- Sufficient data coverage of sea trout parr densities from typical trout streams should be collected in all countries. Continued (annual) sampling from these sites for longer time periods is required.
- Sea trout index-rivers should be established to fulfil assessment requirements with respect to geographical coverage and data collection needs.
- Data on recreational sea trout catches should be consistently collected, taking into account the potentially high impact of recreational fisheries on sea trout stocks and the lack of these data in several countries.
- The model used for assessment of recruitment status should be re-evaluated with the currently used and additional variables, both within the Baltic Sea and outside. This should also be done in separate geographical areas within the Baltic, to determine if the model adequately evaluates status also in e.g. northern areas where increasingly more data are becoming available.

Table 5.1.1.1. Nominal commercial catches (in tonnes round fresh weight) of sea trout in the Baltic Sea (2001–2017). S=Sea, C=Coast and R=River.

Year	Main Basin																Total	Gulf of Bothnia				Total	Gulf of Finland				Total	Grand	Estimated
	Denmark	Estonia	Finland		Germany	Latvia			Lithuania		Poland			Sweden			Main	Finland		Sweden		Gulf of	Estonia	Finland		Russia	Gulf of	Total	misreported catch*
	S	C	S	C	S C	S	C	R	S	R	S	C	R	S	C	R	Basin	S	C	C	R	Bothnia	C	S	C	R	Finland		
2001	54	2	5	14	10	1	11			2	486	219	11	23	2	3	844	2	54	16	44	115	8	0	17		25	984	
2002	35	5	2	8	12	0	13			2	539	272	53	11	2		954	0	49	25		74	11	0	11		23	1051	
2003	40	2	1	4	9	1	5				583	169	32	8	3		858	0	41	21	0	62	7	0	7		14	934	
2004	46	3	1	5	12		7			1	606	122	36	9	3		851	1	39	21	0	61	7	0	7		14	926	
2005	14	4	1	7	14		7	1		1	480	86	20	5	3		644	0	46	24	0	70	6	0	11		18	732	
2006	44	10	1	10	12		7			1	414	98	17	6	2		623	1	40	20	0	61	9	0	13		23	707	
2007	26	4	2	8	9		8			1	354	133	39	6	3		592	0	45	15	0	61	13		12		26	678	
2008	18	4	1	11	13		8	0	0	2	34	90	48	4	3		236	0	47	19	0	67	8	0	18		26	328	
2009	12	7	1	8	4		10	0	0	2	259	103	26	3	3		439	0	46	17	1	64	11		17		28	530	-266
2010	8	5	0	6	3		5	0	0	2	343	81	30	2	3		489	0	37	20	1	58	11	0	10		22	568	-299
2011	6	5	0	5	3			6	0	2	139	65	39	1	2		275	0	33	18	1	53	12		10		22	350	-148
2012	11	8	0	5	18		4	1	0	3	37	74	26	0	3		191	0	41	18	2	61	14	0	16	0	29	281	-70
2013	4	7	0	6	14		5	1	0	11	43	44	8	0	3		148	0	29	14	1	44	12		9	0	21	212	-60
2014	10	5	0	6	14		5	1	0	5	21	72	28	0	3		170	0	22	11	0	33	10	0	7	0	17	220	-54
2015	8	5	0	4	14		4	0	0	6	13	83	7	0	2		145	0	16	13	1	30	11		6	0	17	192	-66
2016	1	6	0	3	12		5	0	0	4	62	86	3	0	2		184	0	18	10	0	29	14		6	0	20	232	-104
2017	6	5	0	3	9		4	0		1	111	41	1	0	3		184		16	9	16	41	13		6	0	19	244	-128
2018	3	7		1	10	0	6	1	0	7	179	55	3	0	2	0	274		13	9	0	22	10		6	0	16	312	-170

* calculated from number of misreported salmon (cf. Section 2.3.3), to be substracted from the Main Basin total and Grand total.

Table 5.1.2.1. Nominal landed recreational catch (in tonnes round fresh weight) of sea trout in the Baltic Sea (2001–2017). S=Sea, C=Coast and R=River. N.a. data not available.

	Main Basin							Total	Gulf of Bothnia			Total	Gulf of Finland		Total	Whole of the Baltic	Grand
	Denmark	Estonia	Finland	Latvia		Poland	Sweden	Main	Finland	Sweden		Gulf of	Estonia	Finland	Gulf of	Finland	Total
Year	C+R	C	R	C	R	R	R	Basin	R	C	R	Bothnia	C	R	Finland	C	
2001	n.a.							0.0	7.0			7.0		3.0	3.0	324.0	334.0
2002	n.a.		0.2				2.8	3.0	6.5		38.4	44.9		2.6	2.6	116.0	166.5
2003	n.a.		0.2				3.6	3.8	11.1		31.5	42.6		1.6	1.6	116.0	164.0
2004	n.a.		0.5				2.6	3.1	10.6		28.2	38.8		2.1	2.1	80.0	123.9
2005	n.a.		0.5				1.5	2.0	10.6		30.9	41.5		2.7	2.7	80.0	126.2
2006	n.a.		0.1				1.3	1.4	5.3		32.5	37.8		3.3	3.3	187.0	229.4
2007	n.a.		0.3				1.3	1.6	8.2		31.5	39.6		3.1	3.1	187.0	231.3
2008	n.a.		0.2				2.6	2.7	8.9		39.7	48.6		2.3	2.3	163.0	216.6
2009	n.a.		0.4				2.3	2.7	10.6		45.8	56.4		5.5	5.5	163.0	227.6
2010	346.0		0.4		0.1	1.6	3.3	351.3	7.3		39.1	46.4		1.2	1.2	56.0	454.9
2011	224.0		0.4			1.7	2.2	228.3	7.5	1.7	39.3	48.5		2.2	2.2	56.0	335.0
2012	260.0		0.3			2.4	2.2	264.9	10.6	2.5	38.9	51.9		3.8	3.8	109.0	429.6
2013	301.0	1.4	0.2	3.0		n.a.	1.3	306.9	10.6	1.5	46.2	58.3	3.3	3.8	7.1	109.0	481.3
2014	521.0	1.5	0.3	3.8		n.a.	0.7	527.3	5.2	1.4	43.0	49.6	3.1	2.2	5.3	71.0	653.3
2015	395.7	1.7	0.3	2.9		n.a.	0.6	401.2	1.7		27.6	29.3	4.6	1.0	5.6	71.0	507.1
2016	323.1	2.3	0.2	5.0	0.1	n.a.	0.4	331.1	1.8		21.7	23.6	4.9	0.5	5.4	232.0	592.1
2017	n.a.	1.9	0.3	3.7		n.a.	0.1	6.0	3.9		15.5	19.4	4.3	0.3	4.6	232.0	262.0
2018	47.06*	0.0	0.0	7.7		n.a.	0.0	54.8	3.0		15.5	18.5	6.4	0.7	7.0	232.0	312.3

*only one halfyear 2018

Table 5.1.3.1. Nominal catches (commercial + recreational; in tonnes round fresh weight) of sea trout in the Baltic Sea in years 1979–2000. Commercial and recreational catches after year 2000 are presented in Tables 5.1.1.1 and 5.1.2.1. S=Sea, C=Coast and R=River.

Year	Main Basin																Total	Gulf of Bothnia						Total	Gulf of Finland				Total	Grand
	Denmark[1,4]	Estonia	Finland[2]			Germany[4]	Latvia		Lithuania		Poland			Sweden[4]			Main	Finland[2]			Sweden			Gulf of	Estonia	Finland[2]			Gulf of	Total
	S + C	C	S	S + C	R	C	S + C	R	C	R	S[9]	S + C	R	S[6]	C[6]	R	Basin	S	C	R	S[6]	C[6]	R	Bothnia	C	S	C	R	Finland	
1979	3	na		10		na	na		na		na	81[3]	24	na	na	3	121		6	na	na	na	na	6	na		73	0	73	200
1980	3	na		11		na	na		na		na	48[3]	26	na	na	3	91		87	na	na	na	na	87	na		75	0	75	253
1981	6	na		51		na	5		na		na	45[3]	21	na	na	3	131		131	na	na	na	na	131	2		128	0	130	392
1982	17	na		52		1	13		na		na	80	31	na	na	3	197		134	na	na	na	na	134	4		140	0	144	475
1983	19	na		50		na	14		na		na	108	25	na	na	3	219		134	na	na	na	na	134	3		148	0	151	504
1984	29	na		66		na	9		na		na	155	30	na	na	5	294		110	na	na	na	na	110	2		211	0	213	617
1985	40	na		62		na	9		na		na	140	26	na	na	13	290		103	na	na	na	na	103	3		203	0	206	599
1986	18	na		53		na	8		na		na	91	49	7	9	8	243		118	na	1	24	na	143	2		178	0	180	566
1987	31	na		66		na	2		na		na	163	37	6	9	5	319		123	na	1	26	na	150	na		184	0	184	653
1988	28	na		99		na	8		na		na	137	33	7	12	7	331		196	na	na	44	42	282	3		287	0	290	903
1989	39	na		156		18	10		na		na	149	35	30	17	6	460		215	na	1	78	37	331	3		295	0	298	1,089
1990	48[3]	na		189		21	7		na		na	388	100	15	15	10	793		318	na	na	71	43	432	4		334	0	338	1,563
1991	48[3]	1		185		7	6		na		na	272	37	26	24	7	613		349	na	na	60	54	463	2		295	0	297	1,373
1992	27[3]	1		173		na	6		na		na	221	60	103	26	1	618		350	na	na	71	48	469	8		314	0	322	1,409
1993	59[3]	1		386		14	17		na		na	202	70	125	21	2	897		160	na	na	47	43	250	14		704[7]	0	718	1,865
1994	33[8,3]	2		384		15[8]	18		+		na	152	70	76	16	3	769		124	na	na	24	42	190	6		642	0	648	1,607
1995	69[8,3]	1		226		13	13		3		na	187	75	44	5	11	647		162	na	na	33	32	227	5		114	0	119	993
1996	71[8,3]	2		76		6	10		2		na	150	90	93	2	9	511		151	25	na	20	42	238	14		78	3	95	844
1997	53[8,3]	2		44		+	7		2		na	200	80	72	7	7	474		156	12	na	16	54	238	8		82	3	93	805
1998	60	8		103		4	7		na		208	184	76	88	3	6	747		192	12	0	9	39	252	6		150	3	159	1,158
1999	110[8,3]	2		84		9	10		1		384	126	116	51	2	3	898		248	12	0	18	41	319	8		93	3	104	1,321
2000	58	4		64		9	14		1		443	299	70	42	4	3	1,011		197	12	0	14	36	259	10		56	3	69	1,339

[1]Additional sea trout catches are included in the salmon statistics for Denmark until 1982 (table 3.1.2).
[2]Finnish catches include about 70 % non-commercial catches in 1979 - 1995, 50 % in 1996-1997, 75% in 2000-2001.
[3]Rainbow trout included.
[4]Sea trout are also caught in the Western Baltic in Sub-divisions 22 and 23 by Denmark, Germany and Sweden.
[5] Preliminary data.
[6]Catches reported by licensed fishermen and from 1985 also catches in trapnets used by nonlicensed fishermen.
[7]Finnish catches include about 85 % non-commercial catches in 1993.
[8]ICES Sub-div. 22 and 24.
[9]Catches in 1979-1997 included sea and coastal catches,since 1998 costal (C) and sea (S) catches are registered separately
na=Data not available
\+ Catch less than 1 tonne.

Table 5.1.4.1. Biological sea trout samples collected in 2018.

				Number of sampled fish by subdivision					
Country	Month (number)	Fisheries	Gear	22–28	29	30	31	32	Total
Estonia	1–12	Coastal	Gillnet					124	124
Finland	4–9	Coastal	All gears		4	33	44	47	128
Latvia	3–11	Coastal, River	Gillnet, trapnet	459					459
Poland	1–12	River	All gears	203					203
Germany	1–12	Coastal	Rod	25					25
Sweden	6–9	River	All gears	33		244	177		454
Total									1393

Table 5.2.2.1. Adipose finclipped and tagged sea trout released in the Baltic Sea area in 2018.

Country	Sub-division	River	Age	Number fry	Number parr	Number smolt	Tagging Carlin	Other Methods T-bar Anch	Other Methods PIT	Other Methods ARS (1)	Other Methods CAL (2)
Poland	25	Leba	spawners					84			
Poland	25	Parseta	spawners						112		
Poland	25	Parseta	1yr						5 000		
Sweden	25	Listerbyån	1yr			500					
Sweden	25	Lyckebyån	1yr			700					
Sweden	25	Mörrumsån	1yr			14 400					
Lithuania	26	Minija, Neris	fry								6 000
Sweden	27	Stockholm, various places	1yr			125 700	476				
Sweden	27	Stockholm, various places	2yr			20 080					
Sweden	27	Trosaån	1yr			3 500					
Sweden	27	Nyköpingsån	2yr			7 000					
Sweden	27	Nyköpingsån	2yr			7 000					
Sweden	27	Motala ström	2yr			16 000					
Latvia	28	Venta	1yr			35 537					
Latvia	28	Gauja	1yr			173 000					
Latvia	28	Daugava	1yr			87 414					
Latvia	28	Salaca	1yr			17 791					
Latvia	28	Roja	1yr			7 000					
Latvia	28	Aģe, Pēterupe, Ķīšupe	1yr			5 000					
Latvia	28	Brasla	1yr					2 000			
Finland	29	at sea, Åland	1s parr		18 157						
Finland	29	at sea, Åland	2s parr		104 967						
Finland	29	at sea, Åland	1yr			15 210					
Finland	29	at sea, Åland	2yr			56 931					
Finland	29	at sea	2yr			33 706					
Finland	29	Mynäjoki	2yr			1 600					
Finland	30	at sea	2s parr		24 000						
Finland	30	at sea	2yr			26 300		4 000			
Finland	30	Eurajoki	1yr parr		12 000						
Finland	30	Eurajoki	2yr			4 000					
Finland	30	Karvianjoki/Merikarvianjoki	1yr parr		21 449						
Finland	30	Karvianjoki/Merikarvianjoki	2yr			9 148					
Finland	30	Kokemäenjoki	2yr			22 234					
Finland	30	Lapväärtinjoki/Isojoki	1yr parr		9 990						
Finland	30	Lapväärtinjoki/Isojoki	2yr			10 000					
Sweden	30	Gideälven	1yr			7 432					
Sweden	30	Ångermanälven	1yr			22 899					
Sweden	30	Ångermanälven	2yr			36 558					
Sweden	30	Indalsälven	1yr			101 046					
Sweden	30	Ljungan	2yr			32 611					
Sweden	30	Ljusnan	1yr		19 235	22 085					
Sweden	30	Ljusnan	2yr			44 508					
Sweden	30	Gavleån	2yr			200					
Sweden	30	Dalälven	1yr			32 195					
Sweden	30	Dalälven	2yr			65 791			1 770		
Finland	31	Iijoki	2yr		1 152	79 038		1 000			
Finland	31	Kemijoki	2yr		2 654	88 105	998				
Finland	31	Kiiminkijoki	2yr			20 000					
Finland	31	Lestijoki	1yr parr		29 134						
Finland	31	Lestijoki	2yr			7 606					
Finland	31	Olhavanjoki	1yr parr		3 000						
Finland	31	Oulujoki	2yr			39 688		1 974			
Finland	31	Perhonjoki	1yr parr		30 307						
Finland	31	Perhonjoki	2yr			18 732					
Finland	31	Siikajoki	2yr			1 000					
Finland	31	Tornionjoki	3yr			700					
Finland	31	Tornionjoki	wild smolts			240	240				
Finland	31	at sea	2yr			128 206					
Sweden	31	Luleälven	2			87 891	2 000				
Sweden	31	Skellefteälven	1yr			26 102					
Sweden	31	Ume/Vindelälven	1yr			8 776			1 000		
Sweden	31	Ume/Vindelälven	2yr			4 771			1 000		
Finland	32	at sea	2yr			116 299	500	500			
Finland	32	Kymijoki	2yr			13 943					
Finland	32	Vehkajoki	1yr parr		1 696						
Finland	32	Vehkajoki	4yr			280					
Finland	32	Ingarskilajoki	2yr			11 111					
Finland	32	Summajoki	2yr			1 327					
Total sea trout				**-**	**277 741**	**1 718 891**	**4 214**	**9 558**	**8 882**	**-**	**6 000**

(1) ARS = Alizarin Red Staining, *single marked, released as fry, (2) CAL = calcein dye

Table 5.3.2.1. Number of fishing occasions/sites in 2018 available for assessment of trout recruitment status, distributed on ICES sub divisions (SD), and number of sites available for trend analysis (sites fishes all years 2014–2018).

	Number fishing occasions	
ICES SD	**Recruitment**	**Trend**
22	74	5
23	6	6
24	96	1
25	35	17
26	109	44
27	13	11
28	36	13
29	4	4
30	28	19
31	26	6
32	52	43
Total	**479**	**169**

Table 5.4.1.1. Status of wild and mixed sea trout populations. Partial update in 2019.

Area	Country	Potential smolt production (x1000)	Smolt production (% of potential production)									
			<5 %		5-50 %		> 50 %		Uncertain		Total	
			wild	mixed	wild	mixed	wild	mixed	wild	mixed	wild	mixed
Gulf of Bothnia	Finland	< 1									0	0
		1-10	1	3	1						2	3
		11-100*			1						1	0
		> 100									0	0
		Uncertain									0	0
	Total		1	3	2	0	0	0	0	0	3	3
	Sweden	< 1									0	0
		1-10									0	0
		11-100									0	0
		> 100									0	0
		Uncertain							25	26	25	26
	Total		0	0	0	0	0	0	25	26	25	26
Total			1	3	2	0	0	0	25	26	28	29
Gulf of Finland	Estonia	< 1	1		2		4		12		19	0
		1-10			6	1	11				17	1
		11-100					2				2	0
		> 100									0	0
		Uncertain									0	0
	Total		1	0	8	1	17	0	12	0	38	1
	Finland**	< 1	1	1							1	1
		1-10	2	2	5	0					7	2
		11-100				2					0	2
		> 100									0	0
		Uncertain									0	0
	Total		3	3	5	2	0	0	0	0	8	5
	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			13	4	19	3	19	0	35	0	86	7

Table 5.4.1.1. Continued.

Main Basin	Denmark	< 1	2	5	17	3	80	2			99	10
		1-10		1	5	9	34	9			39	19
		11-100			1	1		4			1	5
		> 100									0	0
		Uncertain									0	0
	Total		2	6	23	13	114	15	0	0	139	34
	Finland	< 1									0	0
		1-10									0	0
		11-100	1								1	0
		> 100									0	0
		Uncertain									0	0
	Total		1	0	0	0	0	0	0	0	1	0
	Estonia	< 1	7		4		12		5		28	0
		1-10	1		4		3				8	0
		11-100									0	0
		> 100									0	0
		Uncertain									0	0
	Total		8	0	8	0	15	0	5	0	36	0
	Latvia	< 1							6		6	0
		1-10							8	5	8	5
		11-100			1					1	1	1
		> 100									0	0
		Uncertain								7	0	7
	Total		0	0	1	0	0	0	14	13	15	13
	Lithuania	< 1			2	2	1	1			3	3
		1-10				1	1	1			1	2
		11-100				1	1				1	1
		> 100*									0	0
		Uncertain									0	0
	Total		0	0	2	4	3	2	0	0	5	6
	Poland	< 1				3	1			1	1	4
		1-10			1			1			1	1
		11-100		3		4		1			0	8
		> 100		1							0	1
		Uncertain									0	0
	Total		0	4	1	7	1	2	0	1	2	14
	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			11	10	35	24	133	19	222	21	401	74
Grand total			25	17	56	27	152	19	282	47	515	110

* includes data from large river systems

** in 7 wild rivers it is not known if releases are carried out

Table 5.4.1.2. Factors influencing status of sea trout populations. Partial update in 2019.

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	5	5	4	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		6	6	4	1	0	0
Total			6	6	4	1	0	0
Gulf of Finland	Finland	< 1	2	2	1	0	0	0
		1-10	9	9	7	0	0	0
		11-100	2	2	1	1	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		13	13	9	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			50	49	16	27	0	0
Main Basin*	Finland	< 1	0	0	0	0	0	0
		1-10	0	0	0	0	2	0
		11-100	1	1	1	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		1	1	1	0	2	0
	Estonia	< 1	29	29	0	0	0	0
		1-10	6	6	1	0	0	0
		11-100	0	0	0	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		35	35	1	0	0	0
	Latvia	< 1	0	1	0	0	0	0
		1-10	5	3	3	0	2	0
		11-100	0	0	1	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		5	4	4	0	2	0
	Lithuani	< 1	0	0	0	0	0	0
		1-10	0	4	5	2	0	0
		11-100	0	1	2	1	0	0
		> 100	0	1	1	1	1	0
		Uncertain	0	0	0	0	0	0
	Total		0	6	8	4	1	0
	Poland	< 1	0	4	3	1	1	0
		1-10	0	1	2	0	0	0
		11-100	5	3	8	1	1	0
		> 100	1	1	1	1	1	0
		Uncertain	0	0	0	0	0	0
	Total		6	9	14	3	3	0
	Russia	< 1	0	0	0	0	0	0
		1-10	0	0	0	0	0	0
		11-100	0	0	0	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	3	2	0	2	0	0
	Total		3	2	0	2	0	0
	Denmarl	< 1	0	51	62	0	0	0
		1-10	0	39	35	0	0	0
		11-100	0	0	0	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
	Total		0	90	97	0	0	0
Total			50	147	125	9	8	0
Grand total			106	202	145	37	8	0

* data from Sweden were unavailable

Table 5.4.1.3. Sea trout smolt estimates for the period 2002–2018.

SD	24	25	26	26	26	26	28	28	31	31	31	32	32	32	32
Country	DK	SE	LT	LT	LT	LT	LV	LV	SE	SE	FIN	RU	RU	EE	EE
River name	Læså	Mörrum	R. Mera	R. Mera	R. Siesartis	R. Siesartis	R. Salaca	R. Salaca	Sävarån	Rickleån	Tornionjoki	Luga	Luga	Pirita	Pirita
Method	1	2	5	6	5	6	3	4	7	8	9	10	11	12	13
2002			12				13100					8200			
2003			11				11000					2500			
2004			11				2500				12510	2500			
2005			0		5		7700					5000			
2006	4543		3		8		10400		510		12640	2800			
2007	2481		32		104		15200		10851			5000			
2008	16138		170		95		15800		2124		10810	2500		884	772
2009	1687	6995	11		163		16900		1848			6900		2138	1945
2010	2920	3526	3		73		19400		1232			3300		2301	2198
2011	8409	5086	584	n.d.	243	n.d.	4900		637		19420	3100		832	153
2012	8702	5517	606	33	576	40	11400		231			2000		766	740
2013	5326	10220	422	0	186	2	9600		1600			2100		1769	1429
2014	n.d.	6867	344	98	559	6	3100	265		348	n.d.	6200	190	260	227
2015	n.d.	3612	0	226		23	12100	712		n.d.	n.d.	11600		1020	687

SD	**24**	**25**	**26**	**26**	**26**	**26**	**28**	**28**	**31**	**31**	**31**	**32**	**32**	**32**	**32**
Country	DK	SE	LT	LT	LT	LT	LV	LV	SE	SE	FIN	RU	RU	EE	EE
River name	Læså	Mörrum	R. Mera	R. Mera	R. Siesartis	R. Siesartis	R. Salaca	R. Salaca	Sävarån	Rickleån	Tornionjoki	Luga	Luga	Pirita	Pirita
Method	1	2	5	6	5	6	3	4	7	8	9	10	11	12	13
2016	n.d.	5298	768	306	537	95	17500	1369		604	17350	2600		3830	3771
2017	n.d.	3461	1866	91	676	8	5400	540		470	n.d.	3500		2241	1410
2018	n.d.	3173	n.d.	n.d.	0	n.d.	5999	594			n.d.	5800		3346	3783

n.d.= no data

1) based on smolt trap - directly counted number of smolts, varying efficiency over years due to water level (probability level data available)

2) Median values of Bayesian estimates are only for the upper part of the river!

3) estimated smolt output on the base of counted smolts and mean trap efficiency (2014=8.5%; 2015=5.9%; 2016=9.5)

4) directly counted number of smolts during trapping season

5) estimated output derived by electrofishing data. (assumed surval probabilities to smolts: 0+ --> 40%; >0+ --> 60%)

6) counted number of individuals smolts in trap. Assumed trap efficiency almost 100%

7) "simple" Peterson estimates - trap moved to river Ricklean in Year 2014

8) Trap located close to river mouth, so this is the total estimated production

9) estimated smolt output. Trap efficiency in 2016 from efficiency for salmon smolt

10) estimated number of smolt output based on results of floating trap-netting- 2.9% in 2016, due to high water only part of migration period covered

11) directly counted number of smolts in trap

12) Original estimates based on smolt trapping

13) Estimates based on a Bayesian model *) due to high water level counts individual numbers presumably too low.

Table 5.4.2.1. Status of wild and mixed sea trout populations in large river systems.

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				2	1	1			1	3
	(Main	1-10					1	1			1	1
	Basin)	11-100				1	1				1	1
		> 100									0	0
		Uncertain									0	0
Total			0	0	0	3	3	2	0	0	3	5
Poland	Odra	< 1									0	0
	(Main	1-10				3					0	3
	Basin)	11-100		1		1					0	2
		> 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	1		1						2	0
	joki	1-10		5	1						1	5
	(Gulf of	11-100		1	1						1	1
	Bothnia)	> 100									0	0
		Uncertain									0	0
Total			1	6	3	0	0	0	0	0	4	6

Table 5.4.3.1. Factors influencing status of sea trout populations in large river systems. Partial update in 2019.

Country	River	Potential smolt production	Number of populations					
			Overexploitation	Habitat degradation	Dam building	Pollution	Other	No influence
Lithuania	Nemunas (Main Basin)	< 1	0	3	4	2	0	0
		1-10	1	2	2	0	0	1
		11-100	0	1	1	1	1	0
		> 100	0	0	0	0	1	0
		Uncertain	0	0	0	0	0	0
Total			1	6	7	3	2	1
Poland	Odra (Main Basin)	< 1	0	0	0	0	0	0
		1-10	2	2	3	0	0	0
		11-100	3	1	2	0	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
Total			5	3	5	0	0	0
Poland	Vistula (Main Basin)	< 1	0	0	0	0	0	0
		1-10	0	1	1	0	0	0
		11-100	1	2	4	2	0	0
		> 100	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
Total			1	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	2	0	0	0	0	0
		1-10	6	5	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			10	6	0	0	0	0

Table 5.6.1. Sea trout smolt releases (x1000) into the Baltic Sea by country and subdivision in 1988–2018. Note that project based fisheries enhancement releases included.

			year																														
	country	age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Main Basin 22-29	DE	1yr																					14	14	14	13		14	15	14	15	14.8	
		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	272	333	313	930	591	550
		2yr															30	30	30	30	21	9	9	2	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	1	5					
	FI	1yr			11				1	0		4		26		28	1		15		35	52	45	52	18	115		40	5	30	14		15
		2yr		129	169	165	123	103	171	144	181	153	182	168	258	197	131	134	244	303	164	187	218	136	113	121	76	107	123	93	97	103	92
		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		11	10	23	29	32	32	31
		2yr								3														1									
	LV	1yr	1	1	6	26	44	26	24	20	1	1	7	25		114	160	170		74	91	113	63	50	153	236	270	161	115	98	308	224	296
		2yr	1	4	6	7	5	2					11	29		2	10	67		116	177	112	132	65					8	69			13
	PL	1yr	51	85	102	2	148	140	266	483	298	492	330	138	151	211	30	16	46	322	455	188	358	434	267	132	174	243	289	328	311	546	1024
		2yr	857	847	498	248	376	845	523	642	821	1028	1001	924	845	733	739	804	765	843	968	1261	1021	834	1060	936	981	1046	888	619	620	651	8
	SE	1yr	13	9	8	19	41	18	6		4	23	19	90	7	10	108	10	116	11	131	15	76	180	129	170	118	138	207	156	183	156	144
		2yr	32	51	78	61	44	46	84	90	60	95	87	76	100	93	40	48	103	44	36	63	78	31	31	27	35	20	20	30	17	33	40
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	2052	1955	2058	2026	1779	2527	2351	2214
Gulf of Bothnia 30-31	FI	1yr			9							7		1		5						33						125					
		2yr		358	579	700	716	527	525	510	663	639	483	540	462	478	503	451	305	358	477	541	608	676	426	519	472	503	493	473	405	417	458
		3yr		99	30	5	18	39	15	1	28	12	49	10	34	75	28	11	15	6	27	9	27	20	4	4	8	3		1	1	1	1
	SE	1yr			19	7				6			1										40	61	55	110	197	181	219	239	253	221	221
		2yr	445	392	406	406	413	376	460	642	554	429	407	372	405	424	380	428	361	413	569	530	410	428	400	420	395	311	293	230	190	276	236
Gulf of Bothnia Total			445	848	1042	1118	1147	942	1001	1159	1244	1087	939	923	901	982	911	890	681	776	1072	1113	1086	1184	885	1052	1071	1123	1005	943	849	915	915
Gulf of Finland 32	EE	2yr																14	6	8	9	12	10	6	6	15	13	8	5	6	3	2.5	
	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	242	173	132	194	178	143
		3yr					24	6		1	33	92	40	7	24	18	6	16														276	0
	RU	1yr																4	3		13	95	25	10	3	7	64	44	74	36	88	81.9	84
		2yr																1		0								1					
Gulf of Finland Total				197	261	270	330	318	287	348	177	331	331	398	380	427	373	329	291	198	301	364	352	308	222	260	292	294	252	173	285	538	227
Grand Total			1455	2212	2205	1932	2272	2499	2402	3106	2997	3447	3150	3050	2726	3613	3219	3144	2893	3296	3886	3883	3890	3747	3230	2702	3318	3475	3283	2895	3660	3804	3356

Table 5.6.2. Release of sea trout eggs, alevins, fry and parr into Baltic rivers in 2018. The number of smolts is added to Table 5.6.3 as enhancement.

Region	Egg	Alevin	Fry	Parr				Smolt			
				1-s old	1-y old	2-s old	3-s old	2019	2020	2021	Total
Sub-divs. 22-29	(1)	(1)	(4)	(6)	(9)	(10)	(10)				
Denmark	-	-	900	7,100	-	-	-	-	453	-	453
Estonia	-	-	-	-	-	-	-	-	-	-	-
Finland	-	-	-	18,200	-	105,000	-	15,750	1,092	-	16,842
Germany	-	-	175,000	-	-	-	-	-	5,250	-	5,250
Latvia	-	-	-	140,000	-	-	-	-	8,400	-	8,400
Poland	-	310,000	2,819,760	-	-	-	-	-	87,693	-	87,693
Sweden	-	-	65,100	7,000	-	800	-	120	2,373	-	2,493
Lituania	-	-	94,000	-	-	-	-	-	2,820	-	2,820
Total	-	310,000	3,154,760	172,300	-	105,800	-	15,870	108,081	-	123,951
Sub-divs. 30-31	(2)	(3)	(5)	(7)	(8)	(8)	(10)				
Finland	-	173,000	-	-	105,800	24,000	-	-	15,576	2,595	18,171
Sweden	124,300	-	136,600	17,100	27,200	36,600	-	-	7,656	4,380	12,036
Total	124,300	173,000	136,600	17,100	133,000	60,600	-	-	23,232	6,975	30,207
Sub-div. 32	(1)	(1)	(4)	(6)	(9)	(10)	(10)				-
Estonia	-	-	-	-	-	-	-	-	-	-	-
Finland	294,200	-	6,500	-	1,700	-	-	204	3,137	-	3,341
Russia	-	-	-	-	-	-	-	-	-	-	-
Total	294,200	-	6,500	-	1,700	-	-	204	3,137	-	3,341
Grand total Sub-divs. 24-32	418,500	483,000	3,297,860	189,400	134,700	166,400	-	16,074	134,450	6,975	157,498

	Rate of survival to smolt	Time to smoltification		Rate of survival to smolt	Time to smoltification
(1)=	1.0%	2 years	(6)=	6.0%	2 years
(2)=	0.5%	3 years	(7)=	6.0%	3 years
(3)=	1.5%	3 years	(8)=	12.0%	2 years
(4)=	3.0%	2 years	(9)=	12.0%	1 year
(5)=	2.0%	3 years	(10)=	15.0%	1 year

Table 5.6.3. Estimated number of sea trout smolts originating from eggs, alevins, fry and parr releases in 2000–2018.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Sub-divs. 22-29																						
Denmark	30,858	25,555	45,759	7,912	17,790	17,508	13,695	13,695	13,704	12,540	12,540	10,737	9,177	9,606	9,240	9,246	9,519	518	518	518	453	0
Estonia	-	-	2,100	1,200	400	1,110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Finland	440	22,670	33,965	19,550	18,735	160	-	-	-	11,445	13,815	10,350	8,100	14,375	16,260	17,787	14,349	18,313	16,141	15,990	1,092	0
Germany	25,500	24,900	61,200	72,240	27,240	36,900	32,550	38,400	29,640	29,910	40,800	34,500	29,400	34,650	32,700	32,580	31,860	35,874	29,550	24,129	5,250	0
Latvia	13,815	8,644	11,007	960	5,340	15,227	6,462	3,189	19,015	6,840	17,664	30,595	5,987	15,300	28,913	7,787	11,621	6,000	6,828	-	8,400	0
Poland	167,496	148,500	84,240	68,400	91,000	63,236	77,690	61,459	107,686	84,901	108,422	114,982	95,939	103,756	130,787	133,965	120,012	143,635	127,479	167,504	87,693	0
Sweden	13,129	39,333	42,690	5,320	29,335	2,055	27,700	4,425	1,623	2,210	898	-	2,385	1,737	2,940	3,258	1,368	1,380	2,379	2,346	2,373	0
Lituania	-	-	-	-	1,670	2,400	4,350	7,440	18,180	12,990	8,040	6,750	5,370	10,935	8,580	6,300	4,560	4,680	3,840	6,120	2,820	0
Total	251,238	269,602	280,961	175,582	191,510	138,596	162,447	128,608	189,847	160,836	202,179	207,914	156,358	190,359	229,420	210,924	193,289	210,400	173,268	216,607	108,081	0
Sub-divs. 30-31																-	-	-				
Finland	54,268	80,662	26,523	42,828	36,670	1,890	31,362	11,787	22,704	29,892	32,550	46,753	39,285	25,881	22,595	18,782	12,878	12,879	21,328	16,284	15,761	2595
Sweden	84,237	78,440	43,614	24,092	22,921	36,170	20,207	22,756	24,561	16,690	16,497	12,811	13,026	5,456	21,906	9,073	25,850	12,996	17,203	11,003	14,220	4380
Total	138,505	159,102	70,137	66,920	59,591	38,060	51,569	34,543	47,265	46,582	49,047	59,564	52,311	31,337	44,501	27,855	38,728	25,875	38,531	27,287	29,981	6975
Sub-div. 32																-	-	-				
Estonia	-	-	-	2,412	2,532	4,407	2,100	420	-	-	1,536	2,098	6,552	9,486	3,519	840	1,020	618	-	-	-	0
Finland	20,910	5,500	2,049	419	340	3,429	345	11,574	8,997	4,353	5,919	5,233	291	1,747	1,632	1,050	7,716	2,409	2,722	1,384	3,137	0
Russia	3,882	3,630	7,800	200	1,630	1,281	6,690	3,924	-	312	9,381	126	3,441	1,746	3	2,910	-	-	-	-	-	0
Total	24,792	9,130	9,849	3,031	4,502	9,117	9,135	15,918	8,997	4,665	16,836	7,457	10,284	12,979	5,154	4,800	8,736	3,027	754	1,384	3,137	0
Grand total Sub-divs. 24-32	414,535	392,476	360,947	245,533	255,603	185,773	223,151	179,069	246,108	212,083	268,061	274,935	218,953	234,675	279,075	243,578	240,753	239,301	212,554	245,278	141,198	6975

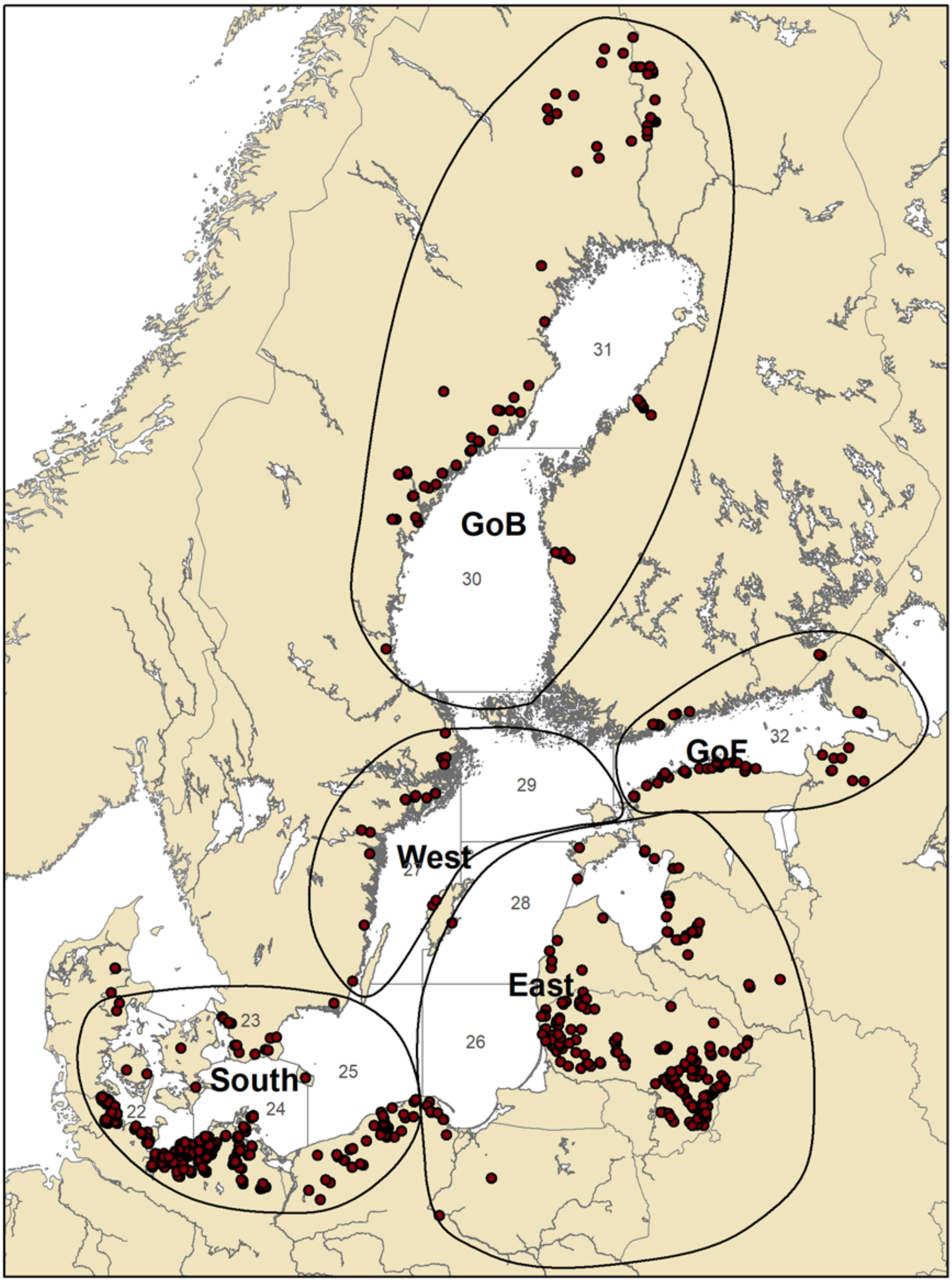


Figure 5.3.2.1. Electrofishing sites in subdivisions 22–32 used for assessment of sea trout recruitment status (2018).

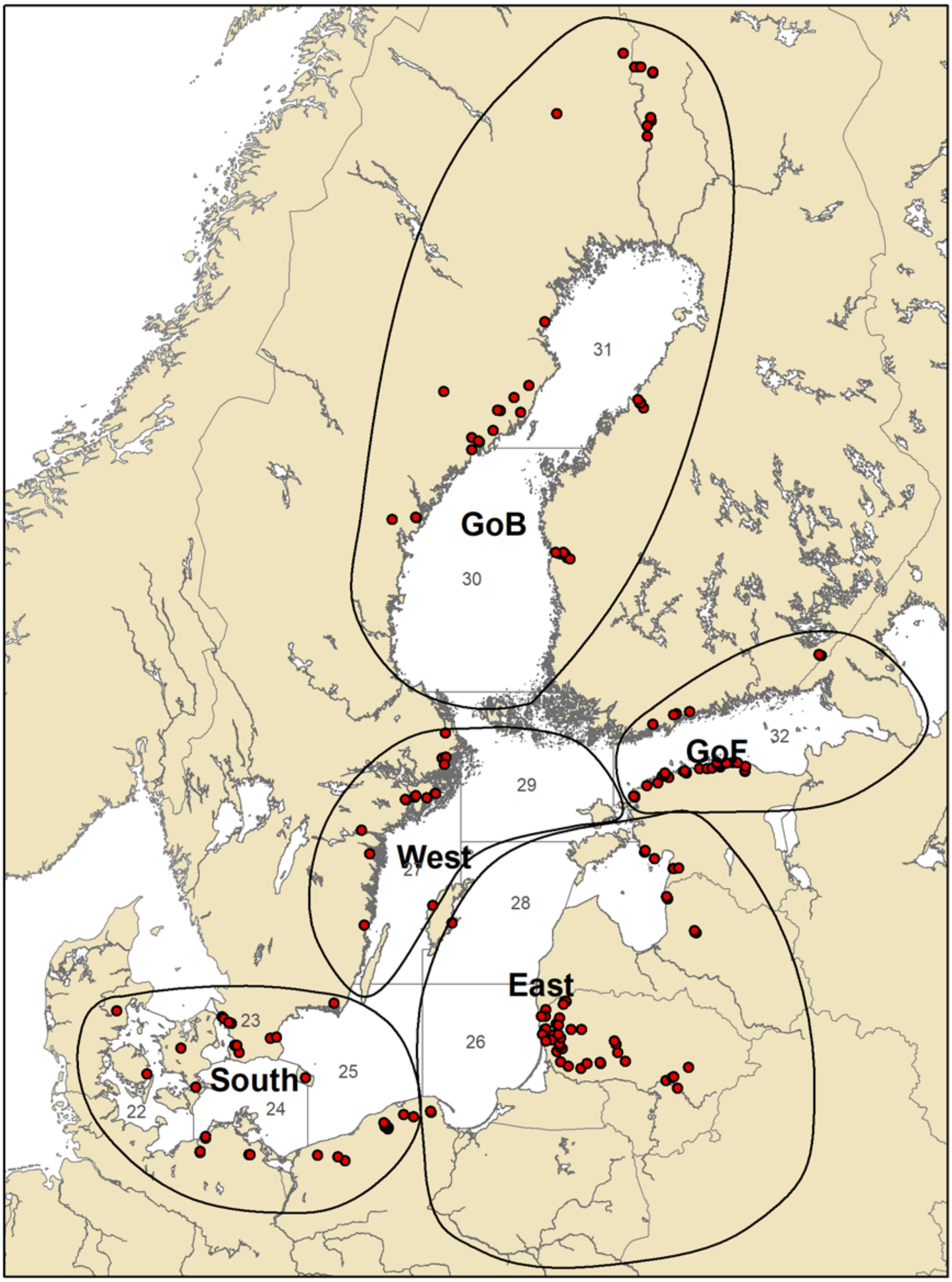


Figure 5.3.2.2. Electrofishing sites in subdivisions 22–32 used for trend analysis of sea trout recruitment status (2018).

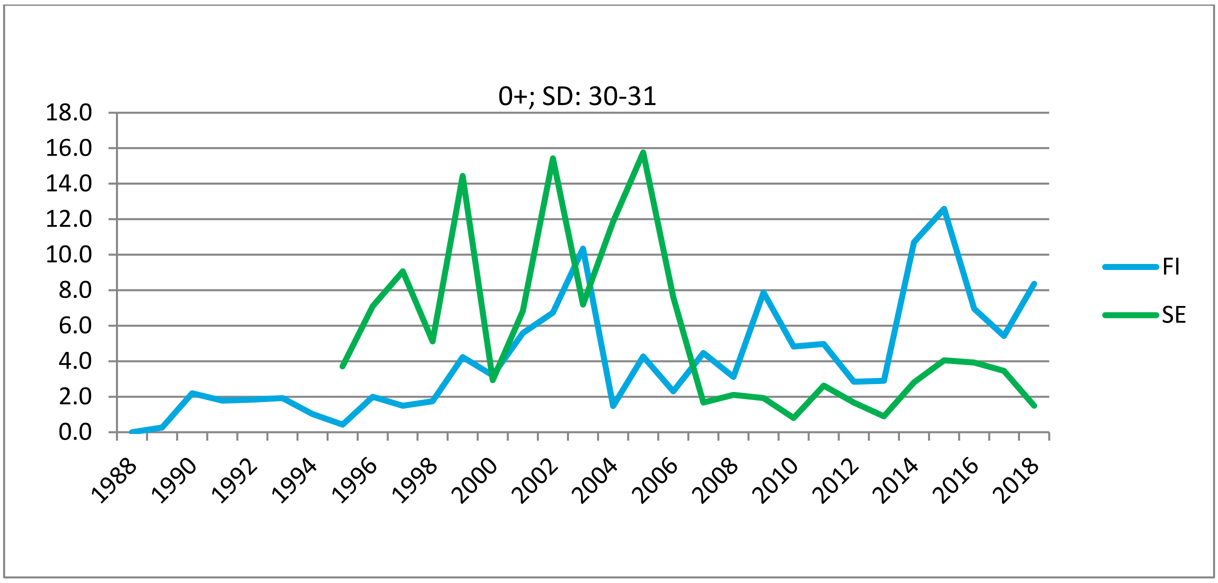


Figure 5.4.1.1. Average densities of 0+ trout in Finnish (FI) and Swedish (SE) rivers in ICES SD 30–31.

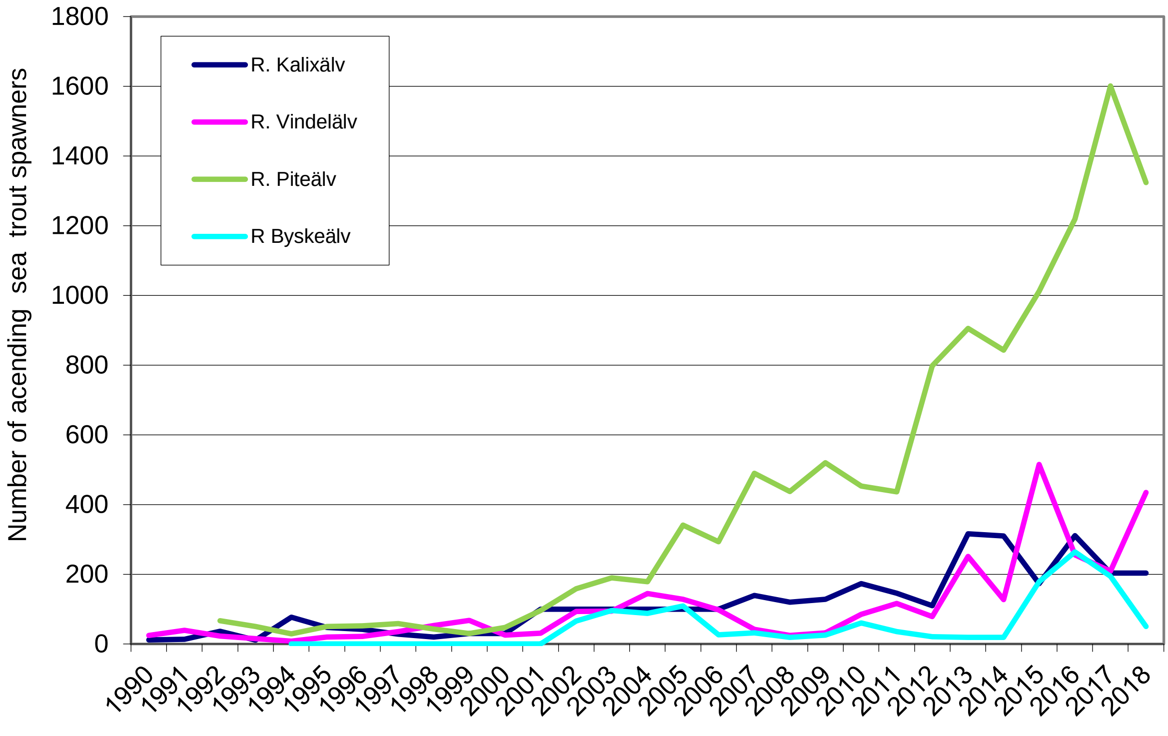


Figure 5.4.1.2. Number of ascending sea trout spawners from fish counters in four Swedish rivers debouching in the Bothnian Bay.

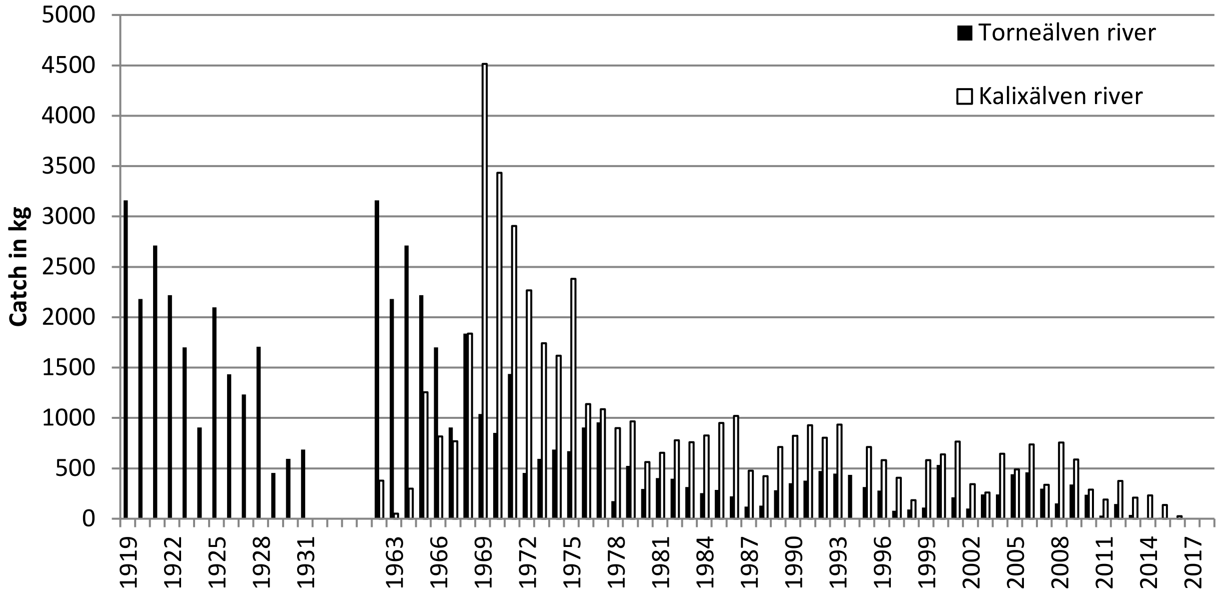


Figure 5.4.1.3. Swedish sea trout catches (landed, in kilos) in rivers Kalixälven and Torneälven (SD 31). Note that since 2013 there is a ban for landing of sea trout in Torneälven (updated for WGBAST 2019).

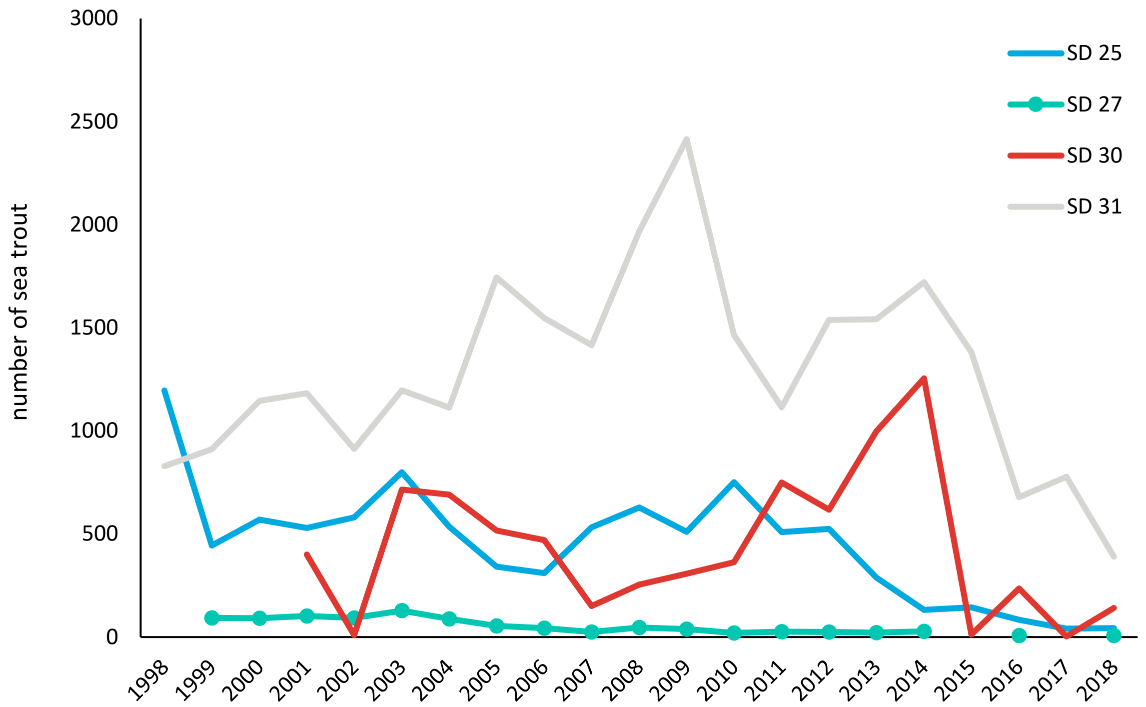


Figure 5.4.1.4. Nominal catches (in numbers) of sea trout in Swedish wild rivers (ICES SD 25, 27, 30 and 31). Only landed catches are included (no catch and release).

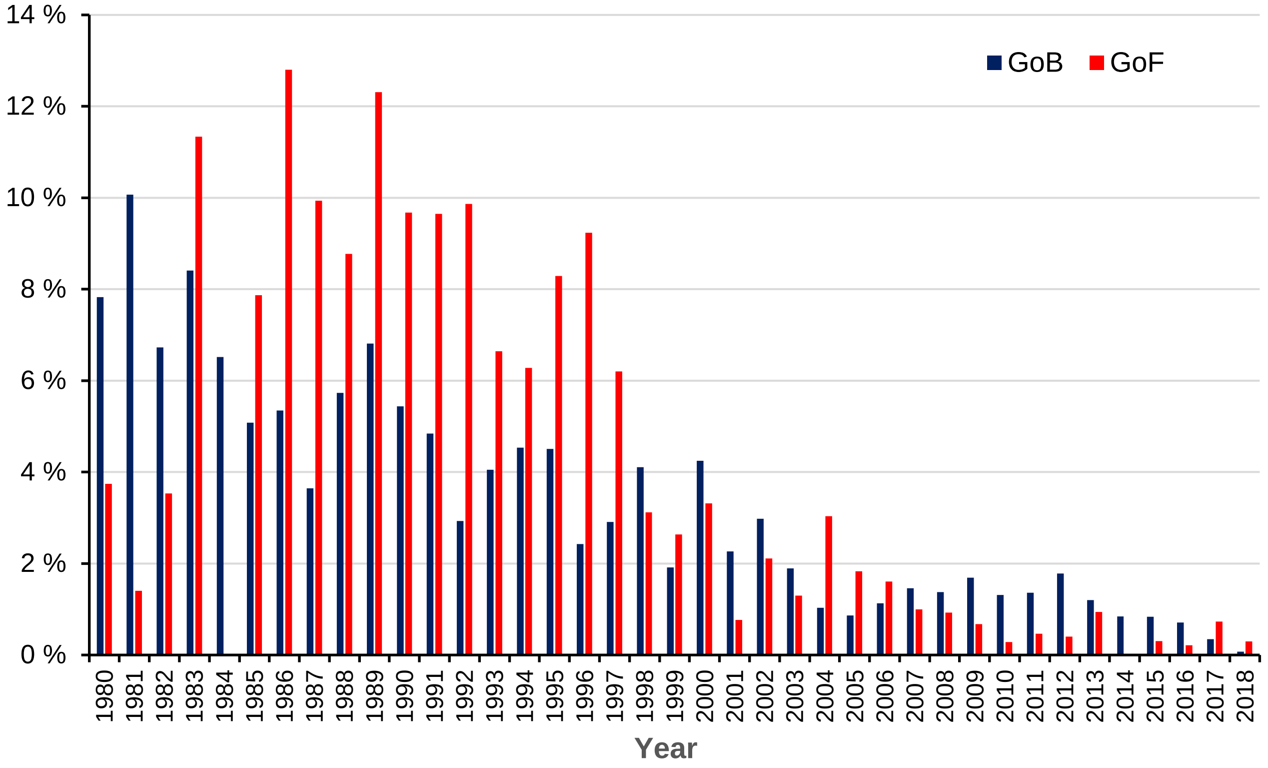


Figure 5.4.1.5. Return rates of Carlin tagged sea trout released in Gulf of Bothnia and Gulf of Finland in 1980–2018 (updated in March 2019).

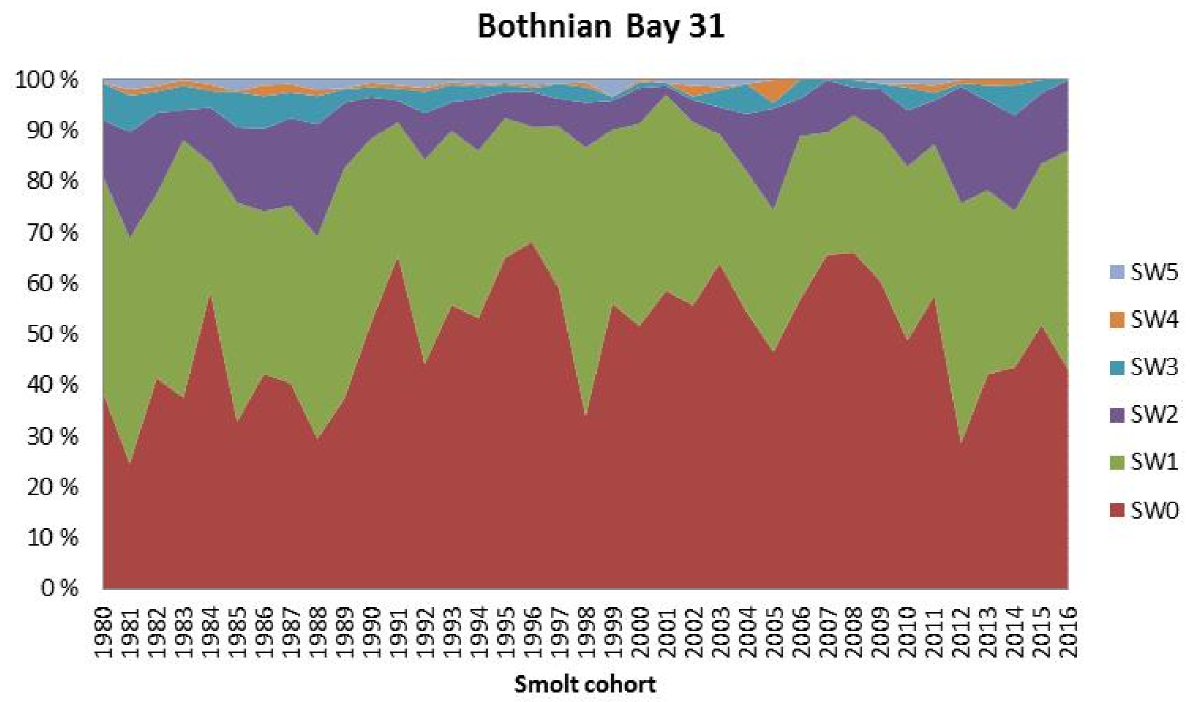


Figure 5.4.1.6. Age distribution of recaptured Carlin-tagged sea trout released in the Bothnian Bay (Subdivision 31) area in Finland, 1980–2015 (updated for ICES, WGBAST 2019).

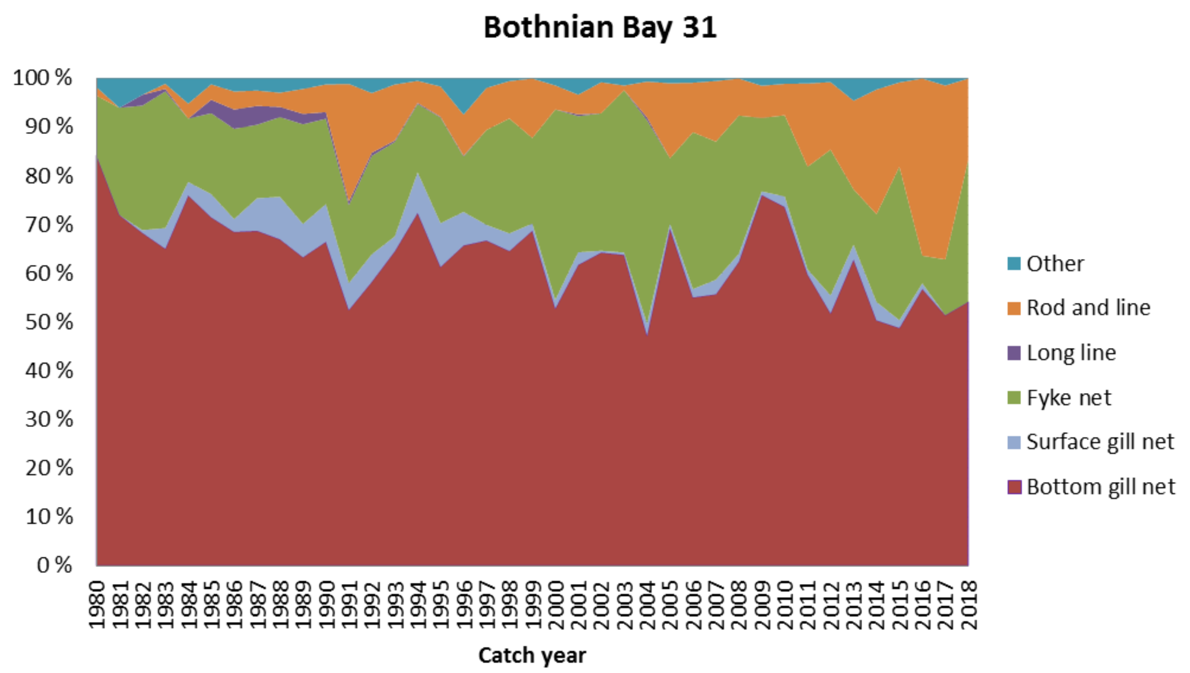


Figure 5.4.1.7. Distribution of fishing gear in recaptures of recaptured Carlin-tagged sea trout caught in the Bothnian Bay (Subdivision 31) area in Finland in 1980–2018. (updated for WGBAST 2019).

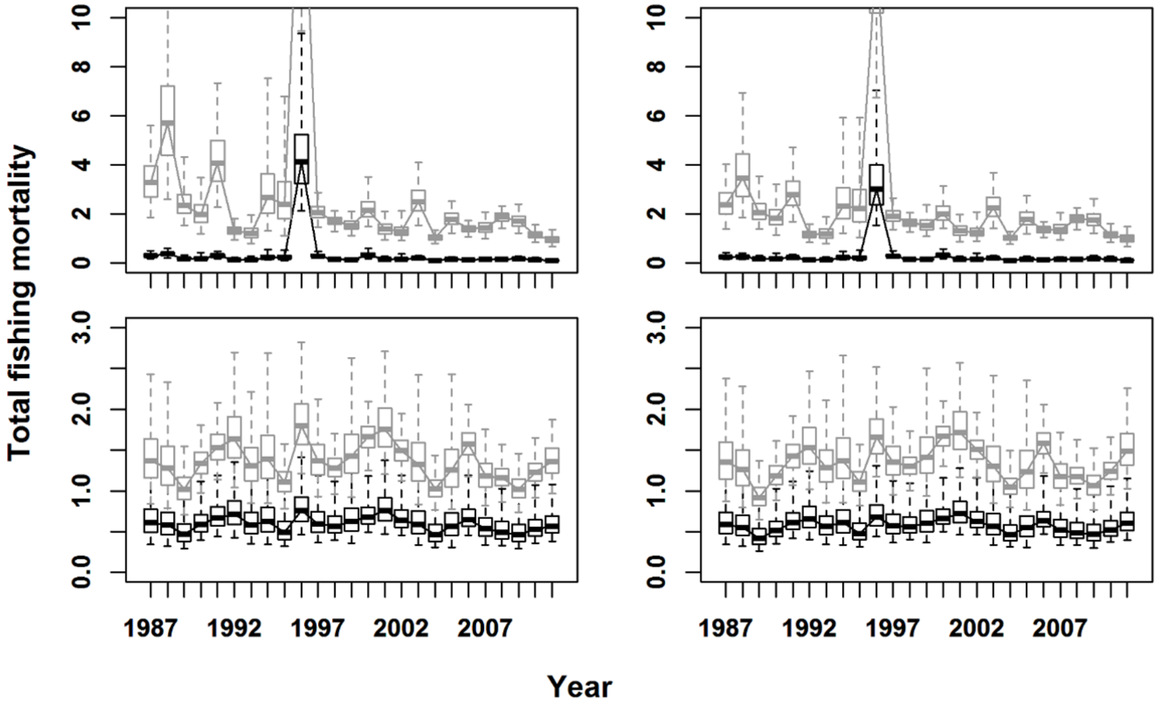


Figure 5.4.1.8. Posterior estimates of total annual instantaneous fishing mortality (F, summed over gear types/fleets) for sea trout from the Isojoki (top panels) and Lestijoki (lower panels) stocks with a time-invariant recreational tag reporting rate (left-hand panels) and time varying recreational tag reporting rate (right-hand panels). Survival from fishing =exp(-F) and harvest rate=1-exp(-F). Black boxes, age 2; grey boxes, ages 3+. The horizontal line in the center of each box denotes the median, the ends of the box denote the interquartile range and the whiskers extend to the 2.5th and 97.5th percentiles.

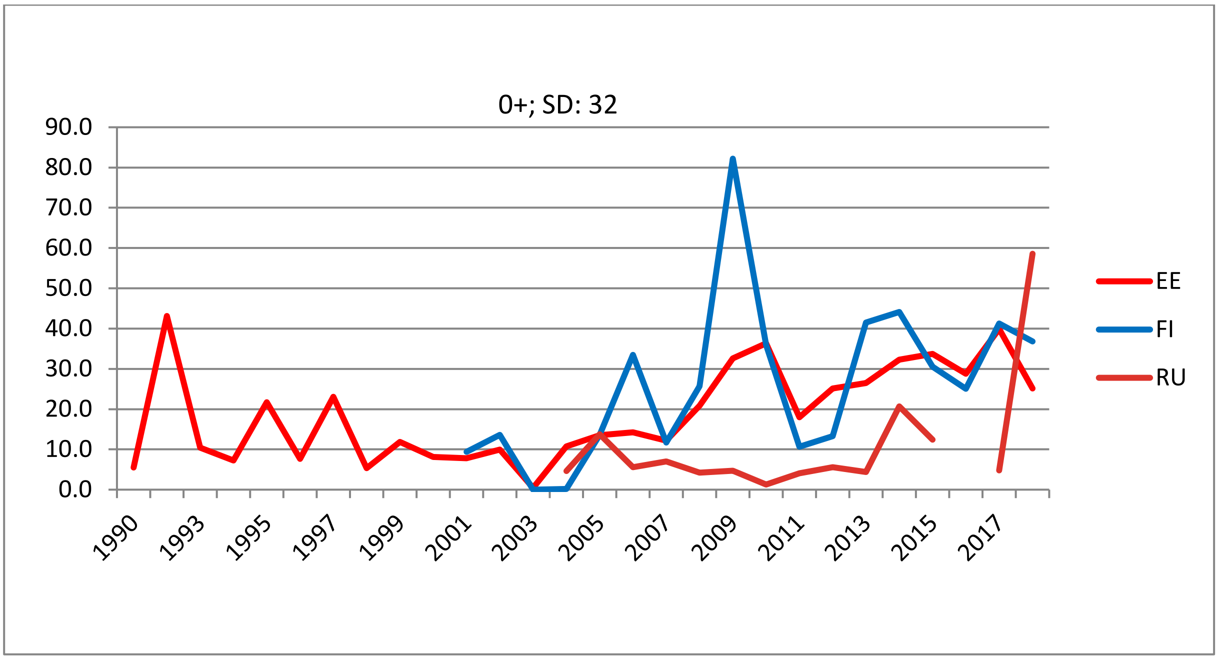


Figure 5.4.2.1. Average densities of 0+ trout in Estonian (EE), Finnish (FI) and Russian (RU) rivers in the Gulf of Finland (ICES SD 32).

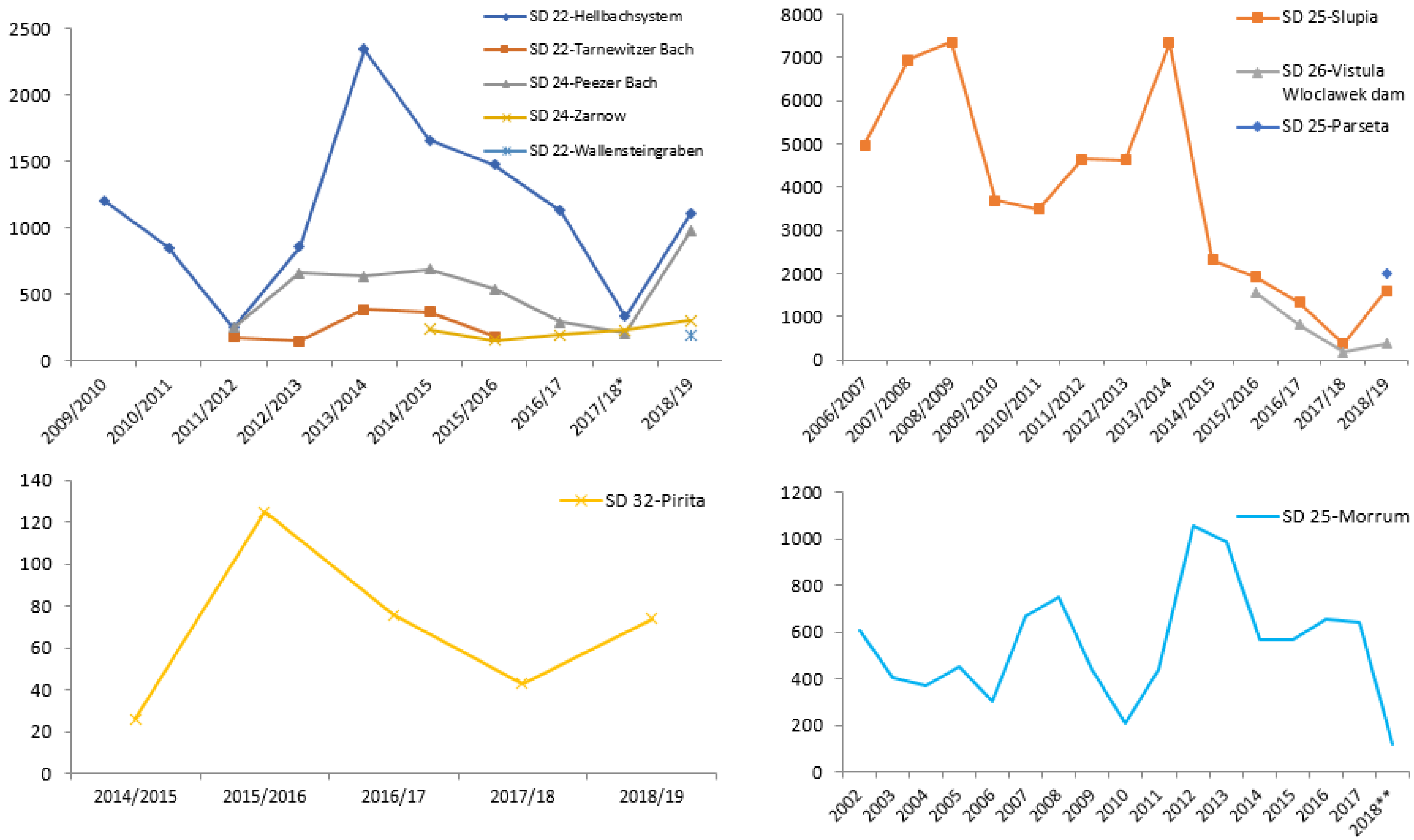


Figure 5.4.2.2. Video monitoring based on spawners counts in German small river systems (SD 22 and 24). Vaki counter numbers from Polish rivers (SD 25 and 26, right upper panel), Estonian Pirita River SD 32 and Morrum SD 25. *Data for German rivers are underestimated in 2017, **Data for Morrum River in 2018 are underestimated.

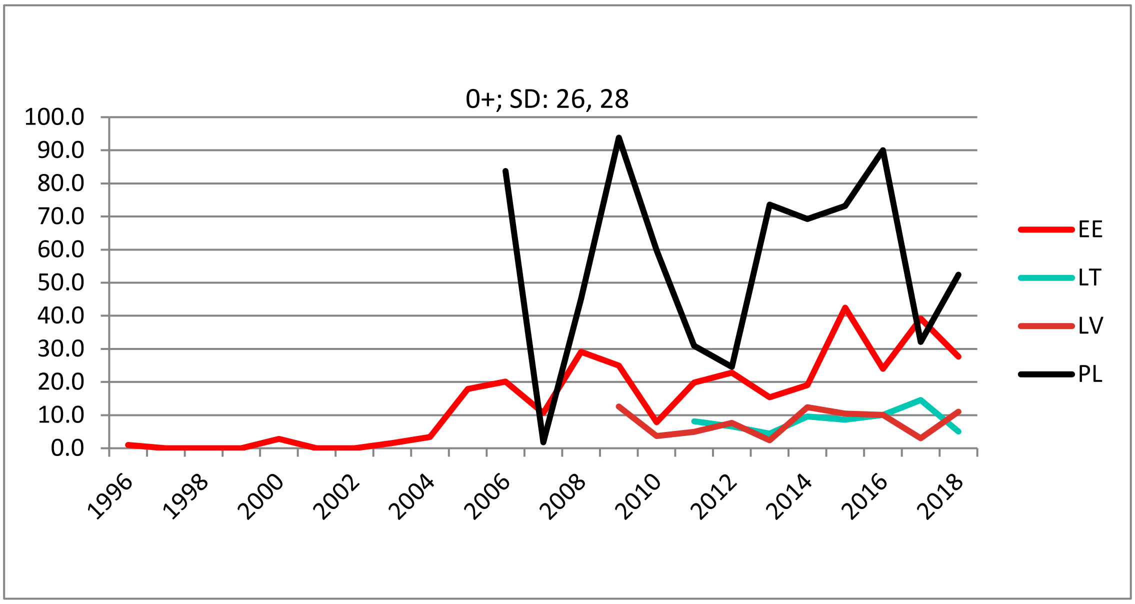


Figure 5.4.3.1. Average densities of 0+ trout in Estonian (EE), Lithuanian (LT), Latvian (LV) and Polish (PL) rivers in ICES SD 26 and 28.

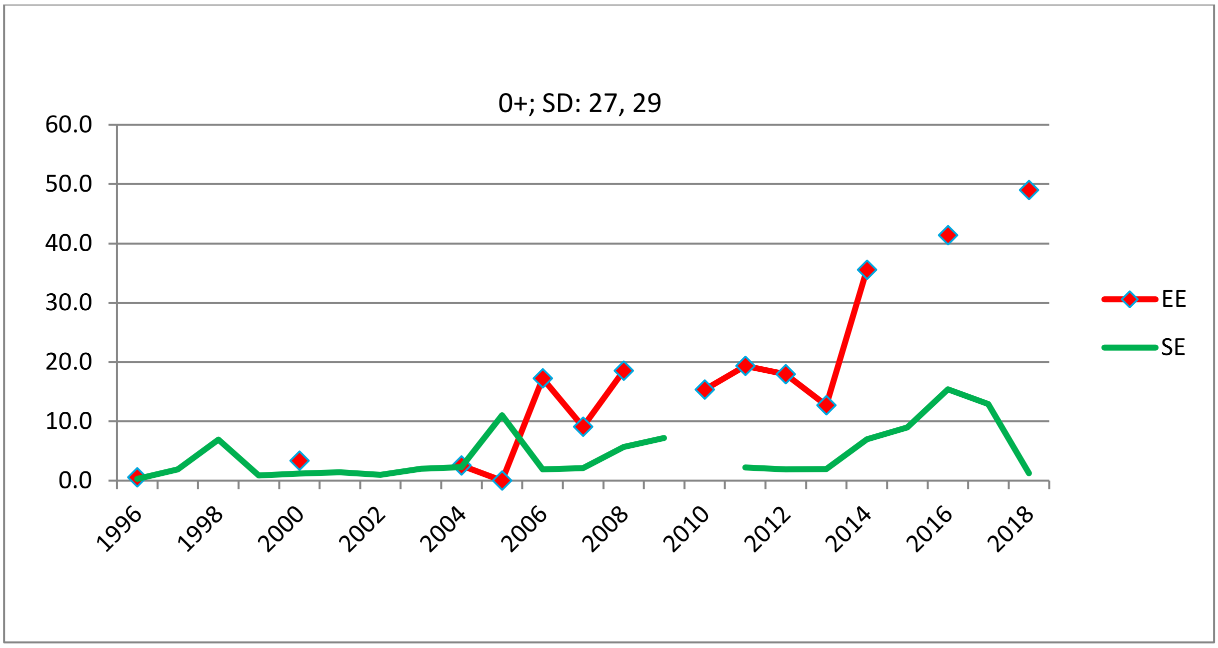


Figure 5.4.3.2. Average densities of 0+ trout in Estonian (EE) and Swedish (SE) rivers in ICES SD 27 and 29.

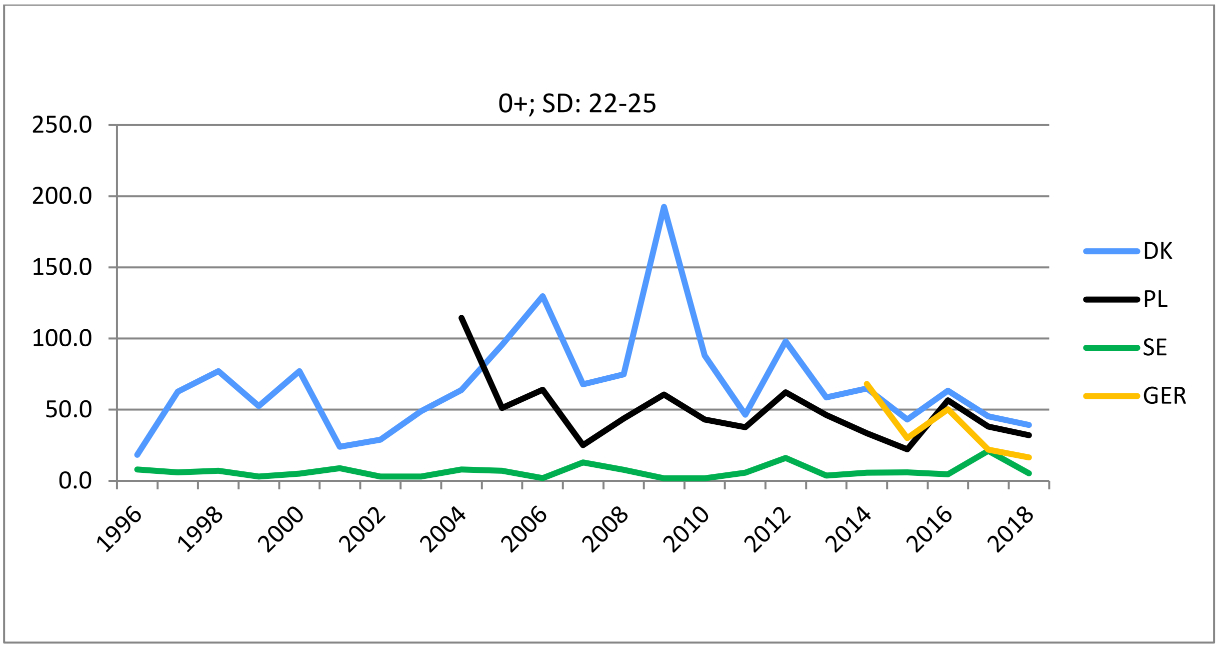


Figure 5.4.3.4. Average densities of 0+ trout in Danish (DK), Polish (PL), Swedish (SE) and German (GER) rivers in ICES SD 22–25.

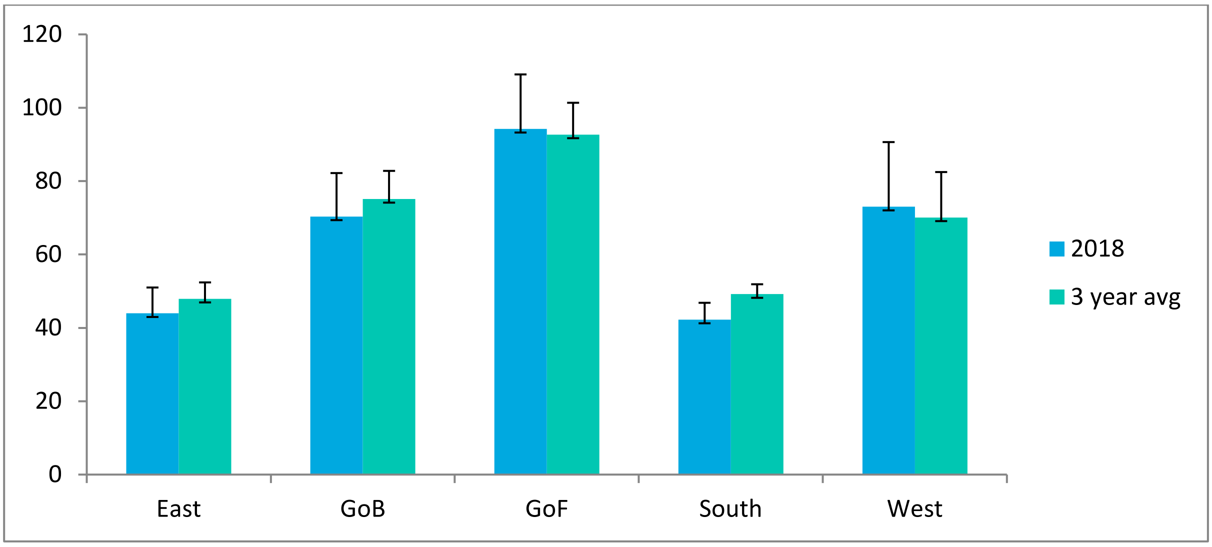


Figure 5.5.1. Recruitment status for 0+ trout by Assessment Area Division (95% CL, only positive value displayed) in 2018 and the last three years (2016–2018).

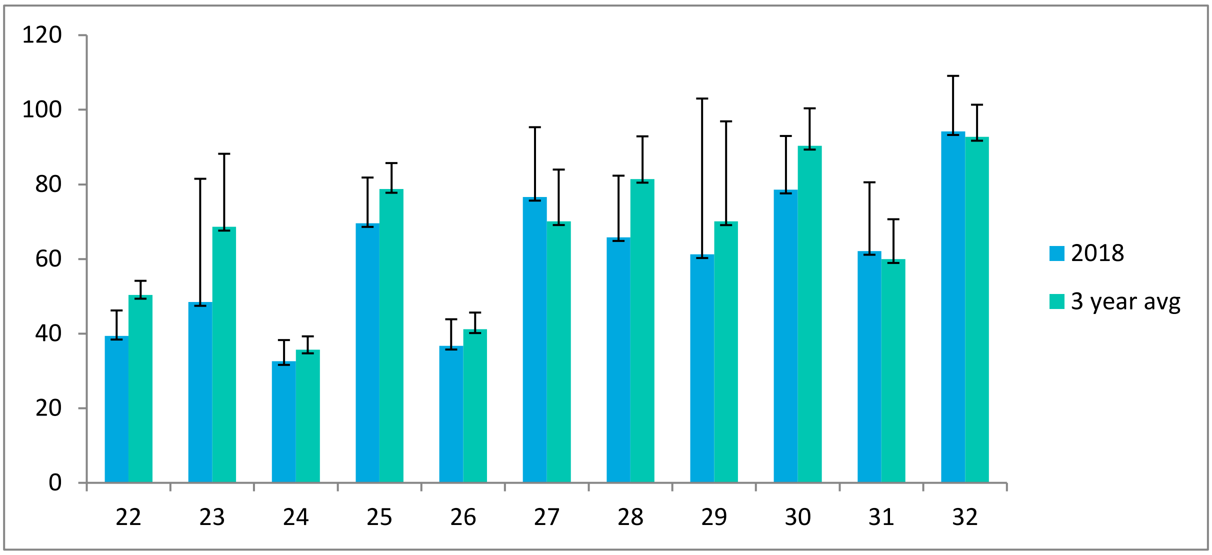


Figure 5.5.2. Recruitment status for 0+ trout by ICES SD (95% CL, only positive value displayed) in 2018 and the last three years (2016–2018).

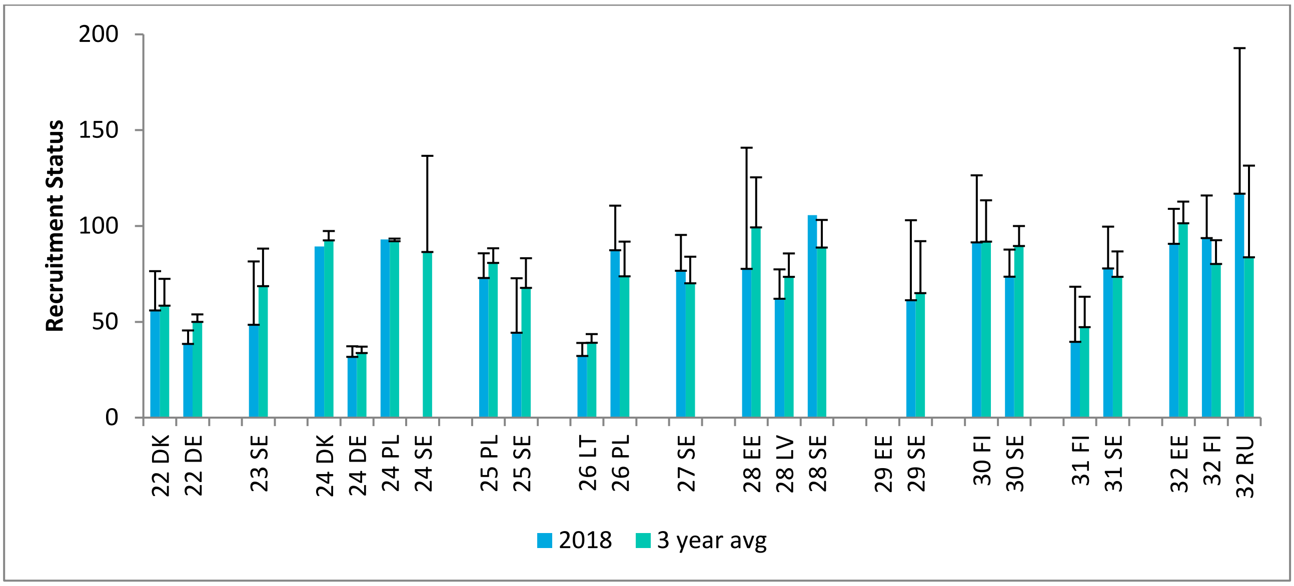


Figure 5.5.3. Recruitment status for 0+ trout by ICES SD and individual countries within SD (95% CL, only positive value displayed) in 2018 and the last three years (2016–2018). There are no CL bars year 2018 for 24 DK, PL and SE (n=1), and no data for 29 EE.

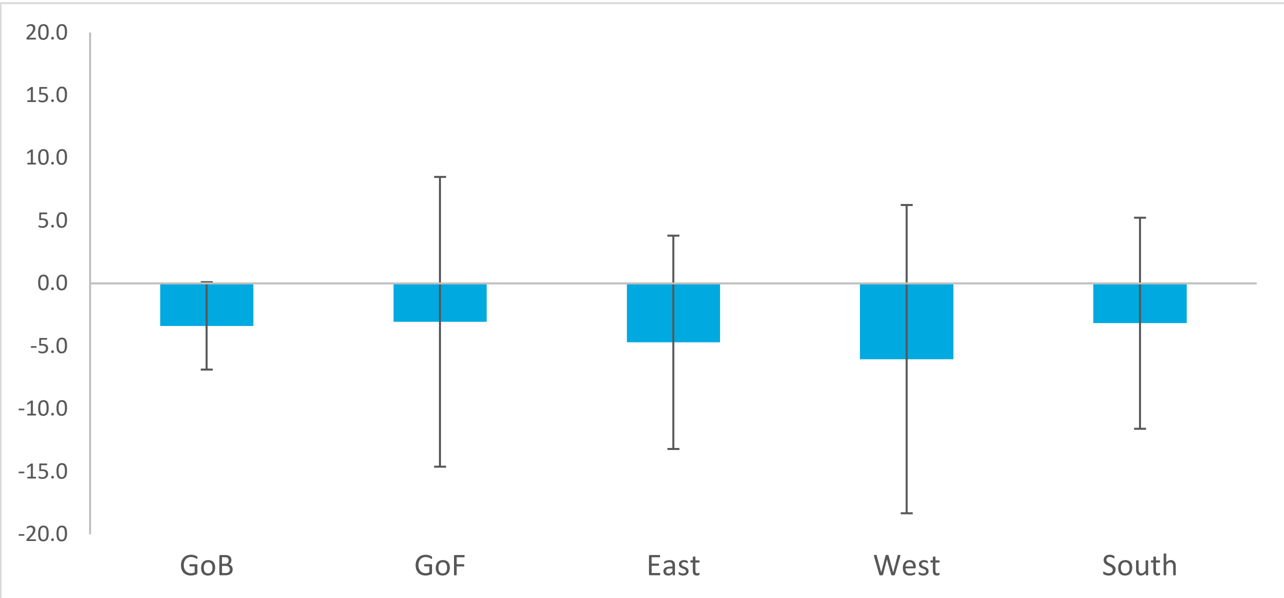


Figure 5.5.4. Average trend (linear regression slope with 95% CI) in 0+ trout recruitment status in the last five years by Assessment Area Division.

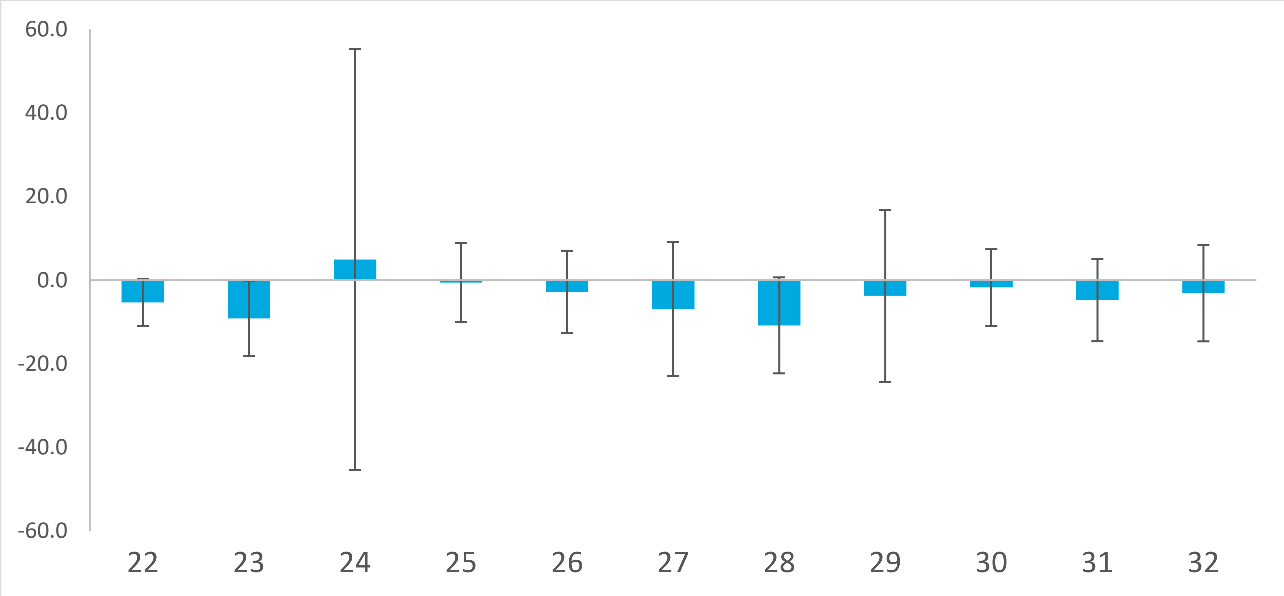


Figure 5.5.5. Average trend (linear regression slope with 95% CI) in 0+ trout recruitment status in the last five years by ICES SD.

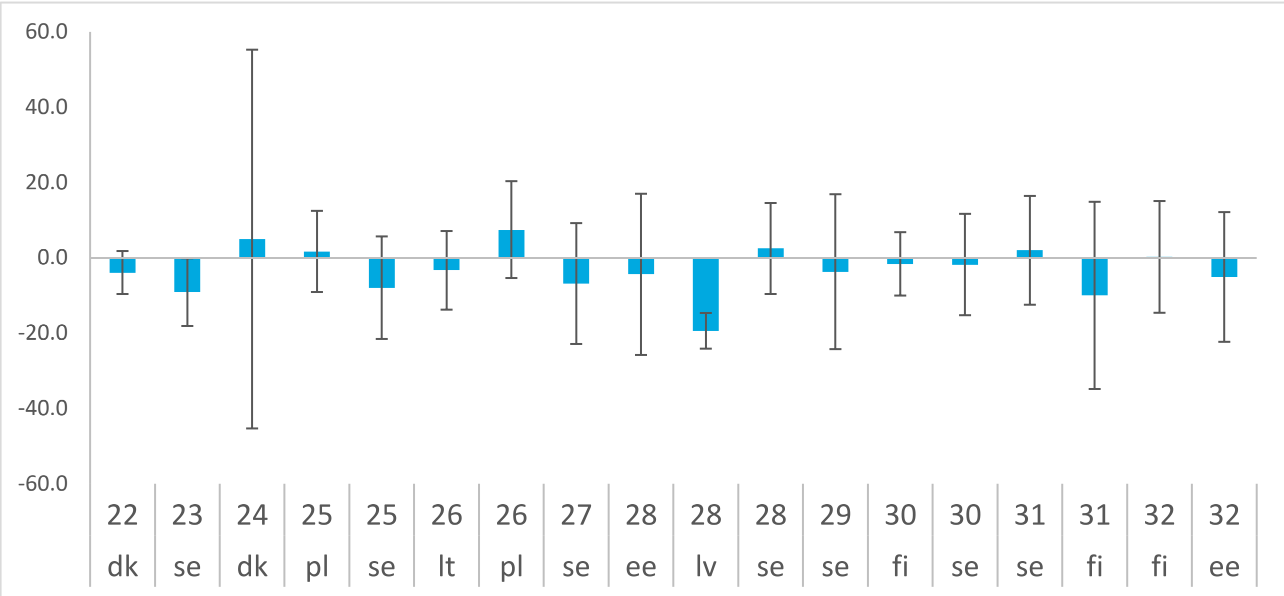


Figure 5.5.6. Average trend (linear regression slope with 95% CI) in 0+ trout recruitment status in the last five years by ICES SD and country (within SD:s shared by several countries).

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Annex 2: Stock Annex for Salmon (*Salmo salar*) in subdivisions 22–32 (Baltic Sea)

The table below provides an overview of the WGBAST Stock Annex. Stock Annexes for other stocks are available on the ICES website Library under the Publication Type "Stock Annexes". Use the search facility to find a particular Stock Annex, refining your search in the left-hand column to include the *year*, *ecoregion*, *species*, and *acronym* of the relevant ICES expert group.

STOCK ID	STOCK NAME	LAST UPDATED	LINK
sal.27.22–32	Salmon (*Salmo salar*) in subdivisions 22–32 (Baltic Sea and Gulf of Finland)	May 2019	Baltic salmon

Annex 3: 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 recreational salmon and sea trout fisheries are uncertain, incomplete or totally missing for several countries. Studies and methods to estimate these catches are needed.	ICES Baltic Sea Member States RCG Baltic Sea (DSG) ICES WGRFS
2. Sufficient data coverage of sea trout parr densities from typical trout streams is needed from all countries. Continuing sampling for longer time-series is required for assessment.	ICES Baltic Sea Member States RCG Baltic Sea (DSG)
3. It is unclear how the new EU regulation (2018/1628) will affect the spatial behaviour and catch reporting of the Polish fleet. Data on proportions of sea trout and salmon in catches should be provided to the working group to facilitate estimation of the development of misreporting. Poland should provide catch composition data from coastal and offshore fisheries (as defined in the EU regulation) covering all main gears.	RCG Baltic Sea (DSG), ICES PGDATA, Poland
4. Bycatch of salmon in the pelagic fishery for other species should be explored.	National institutes (EU-MAP) RCG Baltic Sea
5. In Sweden and Finland, in the coastal trapnet fishery, salmon are released back to sea during part of fishing season because of quota fulfillment or fishing regulations. Reported and non-reported amounts of these discarded salmon and their survival rate should be evaluated.	Sweden, Finland
6. Quality of data on amounts and areal distribution of seal damaged salmon and other dead discards by fisheries should be evaluated and improved in countries where these data are found to be defective.	ICES Baltic Sea Member States
7. Sea trout index rivers should be established to fullfil assessment requirements with respect to geographical coverage and data collection needs.	ICES Baltic Sea Member States
8. The cause(s) of the increasing disease affecting salmon and trout in recent years needs to be investigated further, including increased cooperation between veterinarian authorities in countries with affected rivers.	Sweden, Finland, Latvia, Poland, Germany ICES WGPDMO
9. Estimates of production areas are missing or uncertain for several salmon rivers in AU5. When reliable such estimates are available, it will be possible to apply the hierarchical smolt model that has recently been developed for southern rivers. Corresponding PSPC estimates are also needed for allowing future analytical stock assessment.	Latvia, Lithuania
10. Counting of ascending adults should be performed in all salmon index rivers.	ICES Baltic Sea Member States

Annex 4: Smolts and PSPC per AU for HELCOM salmon indicator

Table A4. The medians of total smolt production and potential smolt production capasity (PSPC) within assessment units 1–6 (AU1–2 combined) for the HELCOM salmon core indicator. In AU1–4 estimates are based on the analytical assessment whereas in AU5–AU6 smolt production estimates are derived from parr densities with country specific unharmonised mortality parameter values and PSPS estimates are based on the expert evaluation.

	Year	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	2015	2016	2017	2018	2019	2020	2021
AU1-2	Smolts	460	326	283	290	233	306	447	589	408	255	276	502	700	1714	1725	1437	1643	1703	1752	2184	1872	2173	2325	2230	2384	2576	2466	2308	2330	2800	2993	2955	2691	2668	2511
	Q5	237	188	184	203	179	223	330	459	297	192	216	407	573	1459	1507	1247	1405	1414	1482	1849	1614	1889	2031	1974	2121	2264	2122	2039	2071	2461	2619	2489	2331	2271	2001
	Q95	1247	656	464	416	309	416	601	755	554	342	355	639	863	2055	2012	1686	1958	2090	2115	2666	2179	2552	2690	2535	2734	2910	2834	2659	2699	3212	3454	3496	3152	3149	3287
	PSPC	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973	2973
	Q5	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622	2622
	Q95	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371	3371
AU3	Smolts	0.8	0.6	0.7	1.0	1.3	0.7	1.0	0.6	0.3	0.5	0.8	0.9	1.1	2.1	2.7	2.5	3.2	2.7	3.2	3.9	5.0	3.8	3.5	3.3	3.4	3.5	3.5	3.5	3.4	3.5	4.4	4.2	3.9	3.7	3.5
	Q5	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.0	0.1	0.3	0.4	0.5	0.9	1.1	1.0	1.1	1.0	1.1	1.3	1.6	2.4	2.2	2.0	2.0	2.4	2.4	2.6	2.5	2.7	3.3	3.0	2.8	2.6	2.4
	Q95	7.2	8.2	5.7	6.9	7.5	4.7	6.2	4.6	2.3	1.2	1.6	1.7	2.1	20.8	19.3	16.7	494.0	20.5	22.9	57.5	27.2	5.8	5.3	4.9	5.1	5.4	5.3	4.9	4.7	4.7	5.7	6.2	5.7	5.3	5.2
	PSPC	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
	Q5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	Q95	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
AU4	Smolts	15.9	15.0	51.7	64.6	58.0	71.5	40.0	25.7	29.9	35.4	39.4	39.9	41.6	46.1	38.8	39.5	39.5	41.2	42.4	37.9	40.1	39.7	36.2	37.9	36.5	33.7	34.5	37.7	40.2	45.2	43.0	41.0	40.1	39.3	40.2
	Q5	3.2	3.0	16.6	19.8	21.8	25.4	15.4	8.3	14.6	22.6	26.5	27.5	28.6	31.8	25.9	28.0	26.7	29.1	29.6	26.2	27.8	27.5	24.4	26.7	23.8	23.5	24.1	25.7	28.3	32.4	30.8	28.1	27.4	27.0	27.4
	Q95	82.9	76.3	167.7	211.6	159.3	233.6	108.3	88.6	47.2	53.7	57.8	59.7	63.1	67.9	55.8	59.2	56.8	60.2	59.2	53.9	58.2	57.9	52.1	55.1	52.6	47.7	51.4	54.0	57.0	62.9	59.1	57.2	58.0	56.9	57.4
	PSPC	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8
	Q5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5
	Q95	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2
AU5	Smolts															87.3	89.5	80.0	58.8	80.3	77.3	56.5	68.3	96.5	86.4	34.0	52.6	47.5	34.7	84.5	106.6	51.7	52.9	36.2		
	PSPC															301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301		
AU6	Smolts														19.9	25.0	30.3	34.5	20.9	15.0	48.2	55.0	29.2	30.0	49.8	40.8	48.9	28.3	62.5	60.9	64.6	95.4	52.6	51.6		
	PSPC														273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273		

Appendix 1: Response to specific ToR c)

Background

In the specific ToR c) RCG requires feedback from the working group (WG) regarding data needs for stock assessment, including a review of the current selection of index rivers and identification of river stocks from which salmon variables should be collected:

c) In relation to EU Member States and their obligations to collect data on salmon fisheries and stocks under the EU Data Collection Framework (DCF) and EU-MAP, and to address Commission and Regional Coordination Group (RCG) requirements ahead of June 2019:

1. Comment on specific data needs of the WG from those specified in the DCF and recommend actions to improve data quality for the work of the WG and in the context of future usage of the RDBES database as the source of ICES data for analyses on salmon.
2. Address the following recommendations from the RCG in 2018:
   (i) Explain and review the selection of national index rivers by the various Member States (noting that "rivers" in the Legal Text is interpreted to represent "water bodies" (STECF 2017)), and comment on whether these selections are appropriate and sufficient for the WG to perform analyses and provide stock advice.
   (ii) Identify the stocks from which salmon variables should be collected (for parr, smolts, and adults), and advise on sampling frequency and effort (sampling level) to collect these variables.

The WG discussed these requirements in plenum at the WG-meeting, and outcomes of these discussions are presented below.

Response from the WG

i. Data needs

Data needed for assessment of salmon in SD 22–31 and SD 32 are summarised in Table A1. In the table, it is indicated if specific data are 1) included in current assessment, 2) planned to be included in near future or 3) potentially useful.

Over the years, WGBAST has repeatedly highlighted and discussed various needs for data collection (e.g. ICES, 2014; 2015; 2016). For example, the need for genetic analysis to study stock composition in catch samples (MSA) has been reviewed (ICES, 2015), with suggestions provided regarding future studies. Comments have also been given to a comprehensive list of proposals for Baltic salmon data collection produced at an earlier ICES workshop in 2012 (ICES, 2016).

Quality of data

Regarding data on catches, quality issues concerns especially recreational catches in both marine and freshwater environments, which often have to be estimated based on limited information and are therefore uncertain. Data on commercial catches are generally of higher quality and are more precise. However, the level of unreporting and misreporting in the commercial fishery is of obvious reasons uncertain and in most cases based on expert elicitations. Quality aspects regarding biological monitoring/data collection concern for example electrofishing in rivers, where expansion of networks for electrofishing sites is needed in many rivers to cover also recently populated river stretches. Also, updates of estimates of river-specific reproduction areas using standardised methodology are needed in some rivers. A more detailed list of needs for improving the use and collection of data for assessment is presented in this report in Section 4.7.

Inclusion of data in RDBES

In the WGBAST 2019 data call for salmon and sea trout fisheries data, commercial landings and effort for years 2009–2018 were uploaded to InterCatch. Recreational catches from sea and river, however, were not uploaded to InterCatch, but were delivered separately. Recreational catch figures are often more or less uncertain estimates based on limited information, and questions remain how this type of data should be included in the database. When there is a system for uploading also different types of recreational catch estimates, WGBAST 2019 sees no obstacles to upload also these data in the ICES data portal system. Also discard data (e.g. seal damaged salmon and salmon below minimum size) should ideally be uploaded. However, discard data have so far not been uploaded to InterCatch, partly because data are considered to be of poor quality. Further discussions are needed on this issue.

Data that have been uploaded to InterCatch so far, i.e. landings and effort from the commercial fishery, will be uploaded to RDBES in the future when the Baltic salmon and sea trout stocks are included there. Further, data from commercial sampling of salmon fisheries collected under DCF (EU-MAP) will also be uploaded to RDBES. Currently these data are uploaded to RDB-FishFrame in conjunction with the annual RCG (EU-MAP) data call. Regarding data from biological monitoring (electrofishing data, smolt and adult counts etcetera), it is not clear whether these data will be possible to fit to RDBES structure in the future. Storing such data will require extensive developments of RDBES.

ii. Recommendations from RCG

1. The need for at least one wild index river per assessment unit (AU) has been highlighted in previous working group reports as a minimum requirement for assessment. The WG has agreed on appointing in total seven index rivers, of which five are located in AU 1–4, one in AU 5 and one in AU 6 (Table A2). The Bayesian stock assessment model developed for AU 1–4 river stocks is to a large extent dependent on input data from index rivers. For AU 6 river stocks, a Bayesian stock assessment model similar to the model used for AU 1–4 is under construction and will be used in near future to assess status of wild salmon populations in the Gulf of Finland. Data from the appointed index river in AU 6 are necessary for the completion and future use of this model. For AU 5 rivers, no analytical assessment has been developed, partly due to lack of data, which prevents e.g. evaluation of stock development under alternative fishing scenarios. The appointed index river in AU 5 will provide necessary data to increase information on abundance of salmon at all life stages once a technical solution for counting of adults has been developed.
2. Table A2 summarises the data collection of parr, smolts and adult salmon necessary for assessment of stock status and development. Data are collected annually for all variables.

References

ICES. 2014. Report of the Baltic Salmon and Trout Assessment Working Group (WGBAST), 26 March–2 April 2014, Aarhus, Denmark. ICES CM 2014/ACOM:08. 347 pp.

ICES. 2015. Report of the Baltic Salmon and Trout Assessment Working Group (WGBAST), 23–31 March 2015, Rostock, Germany. ICES CM 2015/ACOM:08. 362 pp.

ICES. 2016. Report of the Baltic Salmon and Trout Assessment Working Group (WGBAST), 30 March–6 April 2016, Klaipeda, Lithuania. ICES CM 2016/ACOM:09. 257 pp.

Table A1. Data requirements for assessment of Baltic salmon river stocks.

Data requirements for salmon stock assessment in the Baltic Sea		Assessment requirements			
Type of data	**Parameter**	**Currently used**	**Planned to be included in near future**	**Potentially useful**	**Comment**
Commercial Marine Fisheries data	Fishing effort	x			
	Landings	x			Reliable landing statistics from mixed salmon and sea trout fisheries are needed
	Discards (seal damage and release of wild fish)	x			
Recreational Marine Fisheries data	Fishing effort		x		
	Landings	x			
	Catch and release		x		Post-release mortality an issue that needs to be investigated in more detail before included in the assessment model
Freshwater Fisheries data	Fishing effort			x	
	Catches	x			
	Catch and release		x		Post-release mortality an issue that needs to be investigated in more detail before included in the assessment model
	Broodstock fishery	x			
Biological data	Scale sampling of fisheries to determine wild/reared proportions	x			
	Scale sampling of fisheries to determine year class strength (age-reading)			x	
	Genetic sampling of commercial mixed stock fisheries	x			Currently only used as independent information for comparisons, but will be included in assessment models in near future
	Estimates of river-specific production areas	x			Updates of production areas needed for some rivers
	Information on habitat quality	x			Partly used. Inventories needed in some rivers
	Parr densities by age group from wild and mixed rivers	x			Important data. The electrofishing program in some rivers needs to be extended to cover recently populated stretches
	Counts of ascending adults in selected rivers	x			
	Size and sea-age data of ascending adults in selected rivers	x			
	Parr size by age group			x	Could be used to develop the river model
	Stocking statistics	x			Currently used in assessment, but could also be used to develop the river model
	Smolt counts in selected rivers	x			
	Smolt size and age in selected rivers			x	Age used in current assessment. Size at age could be used to develop the river model
	M74 monitoring including thiamine analysis	x			
	Health status monitoring of wild fish			x	
Physical data	Sea Surface Temperature (SST)	x			

Table A2. Response to RCG (DSG) request (ToR c). Current data needs of WGBAST. Regarding sampling frequency, data collection indicated by "x" should take place on an annual basis. Indicated data should be viewed as a minimum level.

AU	River	Category	Data collection				
			Index	Parr	Smolt	Adults	Comment
Unit 1	Tornionjoki	wild	x	x	x	x	
	Simojoki	wild	x	x	x	x	
	Kalixälven	wild		x		x	
	Råneälven	wild		x	x*		
Unit 2	Piteälven	wild				x	
	Åbyälven	wild		x	x*		
	Byskeälven	wild		x			
	Kågeälven	wild		x			
	Rickleån	wild		x			
	Sävarån	wild		x			
	Ume/Vindelälven	wild	x	x	x	x	
	Öreälven	wild		x			
	Lögdeälven	wild		x			
Unit 3	Ljungan	wild		x			
	Testeboån	wild	x	x	x	x	
Unit 4	Emån	wild		x			
	Mörrumsån	wild	x	x	x	x	
Unit 5	Pärnu	mixed		x			
	Salaca	wild	x	x	x	(x)	Need of developing techniques to count adults
	Vitrupe	wild		x			
	Peterupe	wild		x			
	Gauja	mixed		x			
	Daugava	mixed		x			
	Irbe	wild		x			
	Venta	mixed		x			
	Saka	wild		x			
	Uzava	wild		x			
	Barta	wild		x			
	Nemunas	mixed		x			
	Baltic Sventoji	mixed		x			
Unit 6	Kymijoki	mixed		x			
	Luga	mixed		x	x		
	Purtse	mixed		x			
	Kunda	wild		x			
	Selja	mixed		x			
	Loobu	mixed		x			
	Pirita	mixed	x	x	x	x	Stocking is allowed for a limited time period to increase information of importance for development of AU6-modelling
	Vasalemma	wild		x			
	Keila	wild		x			
	Valgejögi	mixed		x			
	Jägala	mixed		x			
	Vääna	mixed		x			

*Smolt counting (temporary, 2-3 years per river) that will move between rivers

Appendix 2: Gulf of Finland assessment model-model description and current status of the work

Introduction

This annex describes the status of an ongoing project aimed at developing a Bayesian stock-assessment model for the Gulf of Finland salmon population. The work is unfinished and no stock-assessment results are presented in this chapter for the Gulf of Finland area. Project leaders are Atso Romakkaniemi (FI), Tapani Pakarinen (FI) and Henni Pulkkinen (FI). Oula Tolvanen (FI) has been in charge of developing and testing the JAGS-model code and supplementary R scripts.

Model description

Assessment groups

The modelled Gulf of Finland salmon population consists of eleven reproductive stocks from Estonia, Russia and Finland. The stocks are divided into three separate assessment groups A, B and C that correspond to each country's coastal waters.

In the model the as the salmon go through their life cycle they are thought to migrate several commercial fisheries, which are modelled as consecutive instantaneous fishing mortalities, starting from the offshore fishery, followed by the coastal and river fisheries.

Fish in all groups A, B and C are subjected to the mixed-stock offshore driftnet and longline fisheries. An unknown portion of population is thought to migrate out the Baltic Sea Main Basin, where they face a different fishing pressure than the salmon staying in the Gulf of Finland offshore area.

Salmon population in the Gulf of Finland

Group A consists of nine Estonian stocks: Kunda, Vasalemma, Keila, Loobu, Pirita jõgi, Purtse, Selja, Valgejõgi and Väänä. Kunda, Vasalemma and Keila are considered to be wild-only populations, with no reared fish spawning there. All other stocks are mixed populations with wild and reared fish spawning together. All reared-only salmon stocked in non-reproductive rivers are pooled together as group A reared fish. Salmon in this group subjected to the Estonian coastal gillnet and trapnet fishery and finally the Estonian river fishery.

Group B consists of only River Luga in Russia. The Luga population is a mix of wild and reared spawners. All reared salmon stocked in non-reproductive rivers are pooled together as group B reared fish. Salmon in this group are subjected to both the Estonian and the Russian coastal gillnet and trapnet fisheries, followed by the Russian river fishery.

Group C consists only of River Kymijoki and all reared salmon stocked in waters on the Finnish side of the Gulf of Finland. The Kymijoki population is a mix of wild and reared spawners. Salmon in this group are subjected to the Finnish coastal gillnet and trapnet fisheries, followed by the Finnish river fishery.

There is no coastal driftnet fishery in any of the modelled areas.

Information about the survial of the salmon is gained by fitting the model to observed annual tag-returns and the total catches at each stage. Figure 1 gives a schematic presentation of, how the salmon move through different fisheries and, how tag-returns and catches are observed during the course of the year.

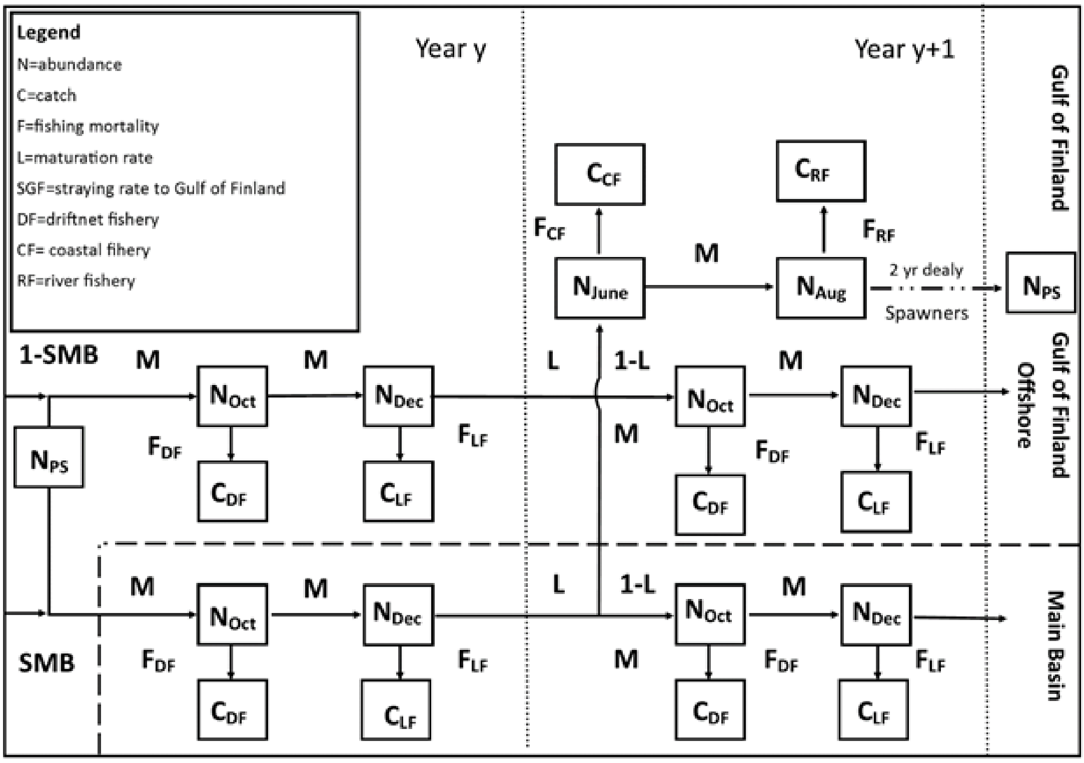

Figure 1. Schematic presentation of the mark–recapture model used in the Gulf of Finland salmon model. After the post-smolts leave the river in April/May, they move towards the offshore feeding area. SMB portion of the post-smolts migrate to the Baltic Sea Main Basin area and 1-SMB post-smolts will migrate to the Gulf of Finland offshore area. In both areas the fish can be intercepted in the offshore longline (October) and driftnet fisheries (December). Both areas are assigned with separate fishing efforts. The catchability in the Main Basin area is modelled separately using the posterior probability distributions from the Gulf of Bothnia salmon model. When the salmon in both offshore areas maturate they return to the Gulf of Finland coastal waters, where they can be intercepted in June, by the gillnet and trapnet fishery. When the fish ascend to the rivers they can be intercepted by the river fishery in August.

General model assumptions

The model follows the same structure as the Gulf of Bothnia – Main Basin full life-history model presented by Michielsens *et al*. (2008). In the model, a salmon cohort will complete its life cycle in seven years, two years in the river and a maximum of five winters in the sea. All salmon are assumed to perish after spawning.

The riverine part of the life cycle is modelled only as a two year delay between the eggs spawned and the smolts exiting the river (given as data). M74 syndrome is assumed to be negligible in the Gulf of Finland salmon rivers. Key differences between the two models are presented in **Table 1.**

Table 1. Comparison between the Gulf of Bothnia and Gulf of Finland salmon models' assumptions.

General structure	Gulf of Bothnia FLHM	Gulf of Finland FLHM
Timeline	1987–present	2000–present
N. of assessment units	4	3
Biology		
M74 mortality	Yes	No
Seal mortality	Affects 3/4 assessment units	Affects all areas
Smolt age	3–4 years	2 years
Straying behavior	No	Yes
Fishery		
Assessment units	4	3
Offshore driftnet	Main Basin	Gulf of Finland & Main Basin
Offshore longline	Main Basin	Gulf of Finland & Main Basin
Coastal driftnet	Yes	No
Coastal trapnet+gillnet	Yes	Yes
River fishery	Yes	Yes
Data		
DNA data	No	Yes
Mark–recapture data	Wild & reared salmon	Reared salmon only
Spawner counts	4 rivers	2 rivers

Data and submodels

Information about different model parameters are given as data inputs. Inputs include pure data sources such as reported catch and effort and likelihood approximations of probability distributions produced by various submodels. The connections between data sources, different submodels and the full life-history model are presented in **Figure 2**.

An overview of the available data and its status is presented in **Table 2**.

Expert interviews and PSPC estimation

Three experts were interviewed in February–March of 2019 about the salmon smolt production potentials (PSPCs) of each river. The interviewed experts were: Martin Kesler (Estonian rivers), Ari Saura (Kymijoki) and Janne Raunio (Kymijoki). River Luga estimate is based on HELCOM (2014) report about the river.

The experts gave minimum, maximum and best guess estimates for stock–recruitment parameter K. These estimates were then transformed into log.-normal probability distributions and used as model inputs.

During the interview with Martin Kesler, additional questions about things affecting the smolt production potential in each river were also asked. The additional information gathered includes:

- estimates for total area of suitable salmon habitat in each river;
- habitat quality in each area;
- distance to sea from each area;
- existence of migration barriers (past and present);
- existence of hydroelectric power plants;
- turbine type in each hydroelectric power plant.

The additional information is intended to be used in the future as inputs for the Bayesian network model (submodel A in **Figure 3**) developed by Uusitalo *et al*. (2005).

For River Kymijoki similar information is available in reports published previously by the National Resource Institute of Finland and other local operators.

Additional information gathered from the River Kymijoki experts included:

- smolt production potential per hectare per habitat quality class (Saura);
- percentage of total spawner abundance going up the fish ladders (Raunio).

An additional expert, Petri Karppinen, was also interviewed about the percentage spawners going up the fish ladders in River Kymijoki.

Annual smolt abundance

Annual smolt abundances are estimated using the hierarchical linear regression model developed by ICES (2006) (submodel C in **Figure 3**). The input data for the smolt estimation include electrofishing data from Kunda, Keila, Vasalemma, Pirita jõgi and Kymijoki and smolt trapping data from Pirita jõgi (analysed using submodel B). River Kymijoki smolt trapping data are not used for the time being, since the catchability of the smolts is assumed to very low due to geography of the river.

In order to add more information about the parr to smolt relationship, electrofishing and smolt trapping data from Testeboån (SWE) and Salaca (LV).

For future assessment purposes, the estimates need to be run again, and the model needs to be modified so that it is able to account for the shorter tw year river phase. Rebecca Whitlock (ICES, 2016, Section 4.4) has already done similar modification for assessing the AU 4 smolt run, but further modifications for maybe needed.

Coastal catch DNA composition data

The presence of salmon originating from outside the modelled stocks in coastal catches is taken into account using the DNA samples gathered from the Finnish and the Estonian coastal areas. Before the DNA data can be used, it is necessary to assess how well the DNA samples represent the composition of the actual catch in each coastal area? The sample size, sampling period and the catching locations of the sampled fish vary from year to year, and therefore a submodel needs to b4e developed, before the data can be used for assessment purposes. Tentative name for the model used in **Figure 3** is "Temporal sample overlap model".

Spawner counts

The annual Pirita jõgi VAKI count is thought to represent the entire spawning stock and the detection rate is thought be close 100%. The uncertainties concerning the correct determination the age, sex, species and the wild/reared origin of the observed salmon are not yet taken into account. A submodel or some other formal way of quantifying the uncertainty maybe needed in future.

The Kymijoki spawner count is produced by three different VAKI counters located approximately 6–9 km upstream from the river outlet. Two counters have been in use at the Koivukoski HEP since 2014, and the third one has been in use since 2016 when the Korkeakoski HEP's fish ladder was completed. Because of the special nature of the data collection process, the spawner count data require a separate submodel before it can be used in future assessments.

Two experts, Janne Raunio and Petri Karppinen, were interviewed about the percentage of spawners migrating through the three VAKI counters.

Their estimates varied between 10% and 35%. Both experts thought that the number of spawners going up the ladders will increase in future, as more and more salmon become marked with the spawning grounds above the ladders. They both agreed that the salmons' ability to go up the ladder depends on prevalent flow conditions during the spawning season.

Currently most of the salmon reproduction occurs beneath the ladders, where 14% of the estimated area suitable for salmon is located, but this is expected to change in the future. A task for the future is to develop a model for River Kymijoki that could address the following questions:

- How does discharge affect the distribution of salmon spawners underneath and above the fish ladders?
- How much does the ladder count in any given year depend on the ladder counts of previous years?
- To what extent is, the carrying capacity filled underneath and above the fish ladders?
- What portion of the annual spawning stock is observed in the fish ladders?

The model should include daily information on ladder counts and discharge in each outlet, observed densities of salmon parr underneath and above the ladders, smolt trapping estimates. Other possibly useful sources of information are the Didson sonar counts in Korkeakoski and telemetry studies conducted with ascending salmon. Tentative name for the model used in **Figure 3** is "Temporal auto-correlation model".

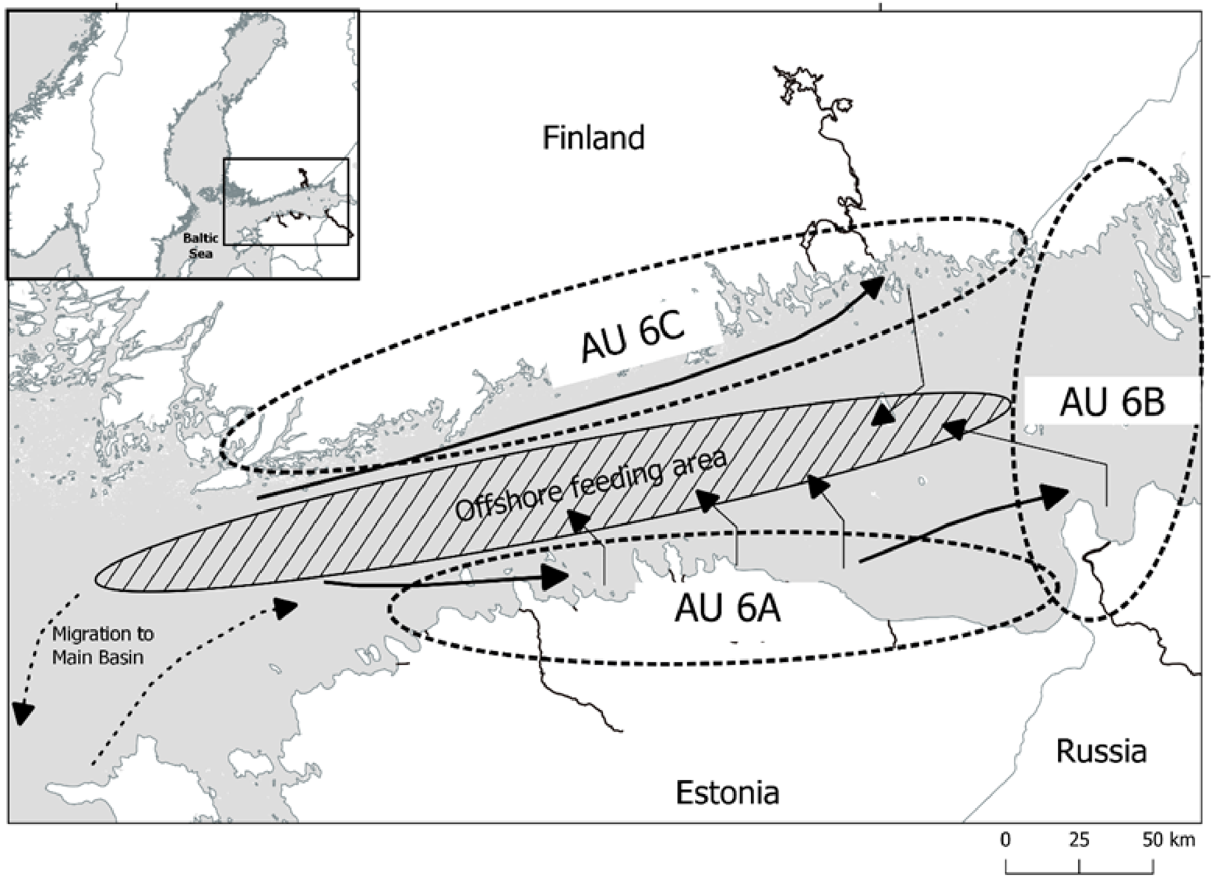

Figure 2. Map of the assumed migration routes of Atlantic salmon (*Salmo salar*) stock from the Rivers Kunda, Vasalemma, Keila, Loobu, Pirita jõgi, Purtse, Selja, Valgejõgi, Väänä Luga and Kymijoki. The hashed ellipse represents the Gulf of Finland offshore area, where the salmon are exposed to the mixed-stock longline and driftnet fisheries. Dashed ellipses represent the three different assessment groups, with separate coastal and river fisheries. Salmon in the River Luga stock are assumed to migrate through the Estonian (A) as well as the Russian (B) coastal fisheries.

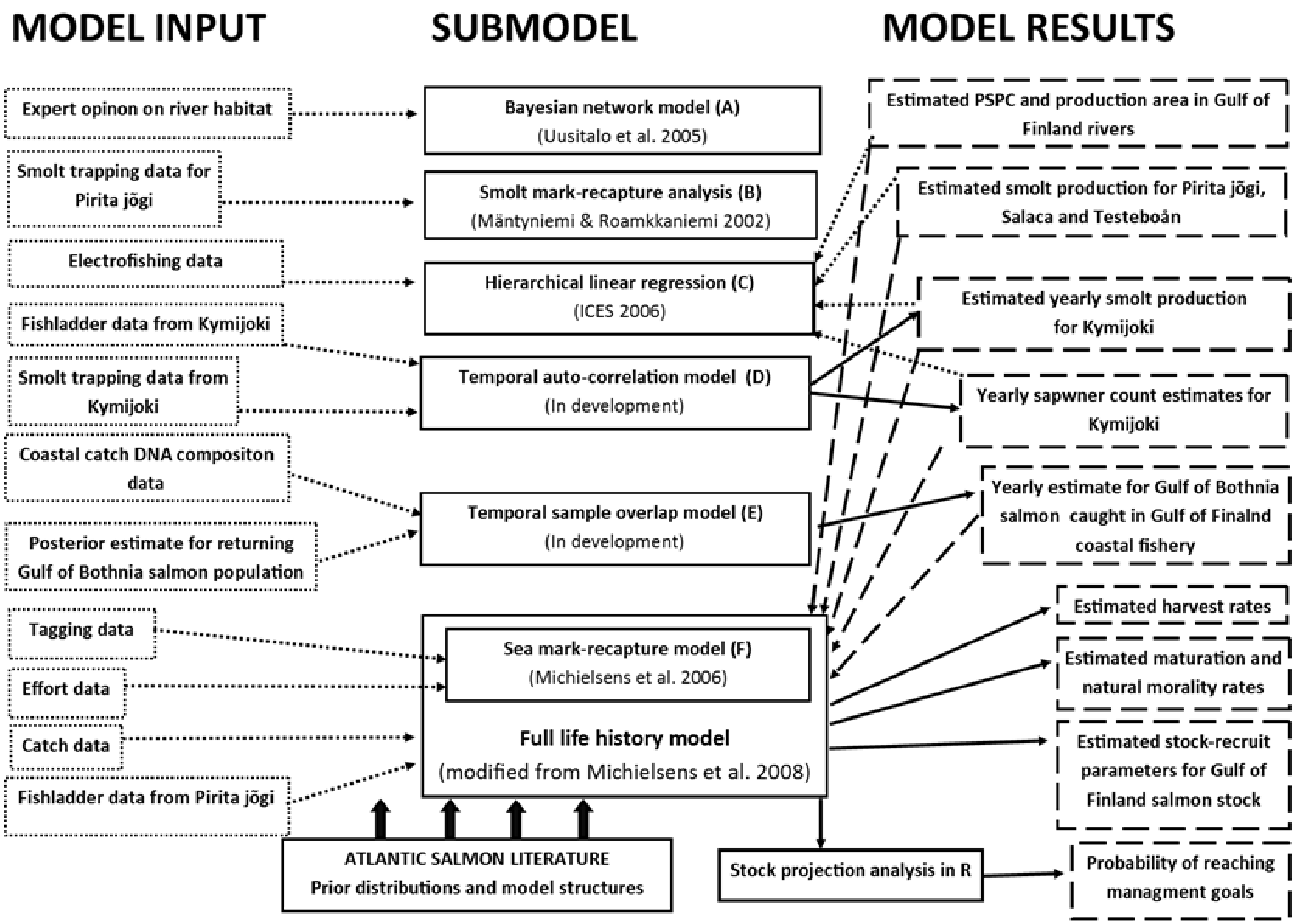

Figure 3. Overview of the connections of various data sources, submodels and the full life-history model used for Gulf of Finland salmon (*Salmo salar*) assessment.

Table 2. Overview of the data available for the Gulf of Finland salmon model.

Data	Availability	Status*
Tagging data	EE, RU & FI	Compiled
Stocking data	EE, RU & FI	Compiled
Catch data	EE, RU & FI	Compiled
Effort data	FI	Compiled for FI, CPUE based estimation for EE & RU
PSPC	EE, RU & FI	Informal elicitation for EE & FI, RU estimate based on HELCOM 2014 report**
Spawner counts	VAKI counters: Pirita jõgi & Kymijoki, 2014--> Didson: partial count in Kymijoki 2018 -->	Compiled, Kymijoki needs a submodel
MSW proportion data	VAKI counter data, 2014-->	Pirita jõgi compiled, Kymijoki uncompiled
Wild proportion	VAKI counter data EE & FI	Uncompiled, data accuracy uncertain
Electrofishing data	4 rivers in EE, 1 in FI, 0 in RU	Compiled
Smolt trapping data	Pirita jõgi 2006 --> Kymijoki 2008 -->	Pirita jõgi compiled Kymijoki data requires a submodel
DNA data	FI (2009–2011,2014,2015,2017,2018) EE (2016–2018)	Requires a submodel

*** compiled up until WGBAST 2018.**

**** HELCOM 2014, BASE project 2012–2014: ‘Support for development of a salmon management plan in the Luga River.’**

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Annex 5: Technical Minutes from the Salmon Review Group

- RGSalmon
- 23–26 April 2019 at ICES in Copenhagen, Denmark
- Participants: Alain Biseau (chair), Carrie Holt (Reviewer), Martha Robertson (WGNAS chair), Stefan Palm, (WGBAST chair) Ghislain Chouinard, Marie-Julie Roux, Henrik Mosegaard, Martin Kesler, Erkki Jokikokko, Didzis Ustups, Antanas Kontautas and Liese Carleton (ICES Secretariat)
- Working Group: WGBAST

Review of ICES WGBAST 2019 Report

Thank you for the opportunity to review this assessment. Large improvements have been made in the models, especially for Baltic salmon over the last few years, improving the quality of advice. In general, I support the conclusions of this report, and have provided some detailed comments on specific sections below. The remaining are more minor or editorial, and I can provide written clarifications at a later date if required.

Section 2 Salmon fisheries

2.3 Discards, unreporting, and misreporting of catches

By how much could the new exemption to for obligatory landing of salmon for BMS fish impact discarding rate? Is this accounted for in expert opinion estimate of discards, or where those estimates identified prior to 2018? Also, BMS is not defined in Section 2, other than "potential discard".

2.4 Fishing effort

Table 2.4.3 shows CPUE for Finnish trapnet fisheries. Do time-series of CPUE data exist for any other fisheries? The text states "Substantial differences can be seen when comparing CPUE in the Finnish and Swedish Gulf of Bothnia (SD 30–31) trapnet fisheries. Further analyses are needed to evaluate these differences and the quality of current and past effort data in Finnish and Swedish official catch statistics." Where are these shown (only effort is shown in previous figure/tables)? Might these differences be related to changes in spatial distribution of fish over time (changes in migration patterns) and/or spatial changes in marine mortality (e.g. seal predation) causing localized depletions?

Section 3 River data

3.1 Wild rivers

In AU1, is there evidence for density-dependent survival in Simojoki, such that increases in older par have not been observed despite increases in 0+ parr densities, or is this discrepancy due to observation errors? My understanding is that the hierarchical linear model assumes no density-dependence.

In AU4, to what extent will the removal of Marieberg dam affect the estimates of capacity (i.e. if fish can more easily access upper reaches)? Are there plans to update priors on capacity for this river? Failure to account for range expansion (and increases in reference points for assessment) may hide the negative impacts of diseases.

In AU5, the text notes that Pärnu is now considered a mixed river. ICES has explicit targets about abundances (0.5 or 0.75 R_0), but it's not clear if maintaining "wild" rivers is also a priority. If so, what are the measures taken to recover Pärnu to reduce reliance on hatchery supplementation? As, I mentioned last year, it would be helpful to expand Table 3.2.1.1 (on restoration programmes in potential rivers) to mixed and wild rivers, especially for cases like Pärnu to ensure that additional restoration programmes are in fact in place.

In AU6, the index river Pirita, is a mixed river, but the intention of index rivers is to inform "status of wild salmon". Was Pirita chosen because there were no suitable wild salmon rivers? Some justification, and implications of this choice, would be helpful. In particular, trends and status of Pirita may be more related to hatchery practices than natural survival or habitat suitability.

3.2 Potential rivers

3.2.1 General

The first paragraph states "However, before any of these rivers may be transferred to the wild river category, the Working Group needs more information on river-specific stock status". I suggest adding "and rearing practices". Presumably, a river that is continually stocked would become mixed before wild?

3.2.2 Potential rivers by country

<u>Potential rivers in Finland.</u> The relatively weak rebuilding of populations in the Kuivajoki and Pyhäjoki might also be due to reared salmon being poorly adapted to the natural environment. Although there is evidence for natural spawning in some rivers (in Finland and other countries), is there evidence of 2nd generation natural spawners, i.e. natural spawners with hatchery parents that complete an entire life cycle in the wild? Alternately, are all natural spawners first generation natural spawners who produce unfit progeny not adapted to the wild? This latter situation is the case for many Pacific salmon stocks on Vancouver Island (Chinook salmon), which results in the appearance of a healthy stocks that actually rely entirely on hatchery supplementation.

3.3 Reared rivers

In general, to what extent do rearing practices consider genetic consequences on natural spawners within mixed populations (and possible straying to other populations, see further comments on this below)? Are there minimum requirements for the proportion of natural-origin vs. reared salmon used a broodstock to minimize genetic impacts?

3.3.2 Straying

This section describes low stray rates into Tornionjoki, a river with very high wild production relative to the small number of strays. However, strays from large rearing facilities into small rivers may have much larger impacts. Indeed, stray rates of 3–4% (as estimated from tag–recapture data) may be have significant genetic impacts where rearing production is high and wild production is weak (and may contribute to a much larger percentage of spawning in depleted, wild rivers).

"Highest straying rate of tagged salmon is often observed in reared rivers and annual releases, due to high total exploitation rate from the commercial, recreational and broodstock collection, and probably also because broodstock fisheries are carried out close to the river mouths" **(p.22).**

Does this refer to observed estimates of straying, which may be biased by these factors, or direct impacts on straying? How do climate variables and diseases impact stray rates?

3.4 M74, dioxin, and disease outbreaks

3.4.1 M74 in Gulf of Bothnia and Bothnian Sea

Data on M74 are used in a Bayesian hierarchical model to predict M74 mortality in unsampled rivers, accounting for river-specific mortality rates informed by rearing environments. This model assumes the effect of M74 is similar across rivers. Although this was likely justified in the 2006 report when the model was developed, is this still the case? Have we learnt anything to improve the hierarchical model (possible covariates or grouping variables in hierarchical analyses) given the last 12 years of data?

3.5 Summary

In the last sentence, it might be more accurate to say “the development of AU6 rivers tend to be positive with high uncertainty and high interannual variability” than “the development of AU6 river generally falls between these two regions [AUs 1–3 and AUs 4–5].

Section 4 Reference points and assessment of salmon

4.2.1 Changes in assessment methods

The posterior distribution of K for Tornionjoki is bimodal (Figure 4.2.1.1a). Is this because of wild and semi-wild fish? This bimodal pattern was not evident in the posteriors for R_0 last year.

How are the dynamics of semi-wild fish different from wild fish? This information could be put in the Annex.

4.2.3 Status of AU 1–4

Drawing parameters from a combination of chain 1 and chain 2 means that correlations among parameters within chains are not preserved. Although on one hand this may be may result in more plausible values when compared with previous year values, it does result in stabilization of outputs from last year to this year. I suggest explicitly mentioning this stabilization. Why not just take only parameters from chain 2 to preserve these correlations? I assume the parameter closest to last year’s estimates was chosen? In which case a “default” is not necessary.

For Kågeälven and Testeboån, why are there high smolt abundances at zero egg abundances in **Figure 4.2.3.3**?

Figure 4.2.3.4 highlights the impacts of time-varying PSPC (R_0), especially for Ume/Vindelälven. In periods when marine survival is low, then PSPC is reduced and it is easier to achieve conservation objectives. This may be appropriate in most cases, except perhaps at extremes or where declines in survival are thought to be within management control. For example, is there a lower absolute limit for PSPC (e.g. below 1000 fish, an IUCN minimum abundance threshold) below which depensatory dynamics may occur? The upper limit would be bounded by K presumably. Also, if declines are due to, e.g. disease or freshwater mortality which may be at least in part under management control, then revising PSPC downward under periods of low survival may mask triggers for increased management intervention. The text suggests problems for these very low R_0 values for Ume/Vindelälven, where it recommends, “the stock status should not only be evaluated against (declined) final PSPC’s (R0’s)”. How else should stock status be evaluated?

I suggest adding units to y-axis of **Figure 4.2.3.4**, R_0, which are presumably 1000s of smolts?

Can the changes in PSPCs from 2017 to 2018 (**Table 4.2.3.2, Figure 4.2.3.4**) be explained by river-specific annual changes in vital rates (EPR_0)? [I see that justification for changes in PSPC for Testeboån is provided in the first paragraph of 7]. I assume this would have a stronger impact than model changes for most stocks, except perhaps for Tornionjoki, Simojoki, Piteälven, and Ume/Vindelälven where model changes were made. Note, the calculation of R_0 is not included in Annex, but would be helpful.

Table 4.2.3.3 describes the various methods used to derive present and potential production capacity. For AU5, the Annex describes how the full-life-history model is run separately for AU5 with some simplifying assumptions. However, this is not reflected in columns AB and AC, resulting in some confusion on how there were actually derived. The same discrepancy is in **Table 4.2.3.2**, column H.

4.3 Stock projections

Figure 4.3.2.7. I suggest only plotting two panels/page to increase resolution for individual curves. It is difficult to differentiate the scenarios, especially scenario 1.

4.5 Conclusion

I agree that river-specific exploitation rates should be included once spatial-temporal model completed, and that spatial management measures should be considered once the model is implemented. In addition, could the spatial distribution of discards from seal damage and/or natural morality from seals be included, given changes in spatial distribution of seals and increasing predation on salmon?

2nd paragraph: Although increasing fishing +/- 20% does not affect probability of recovery to 50% or 75% of PSPC for most AU 1–4 rivers, that is not necessarily the case for AU 5–6, though projections are not possible here. Also, for AU3, the favourable performance of Testoboån is in part due to underestimation of R_0 (Section 4.4.2, 4.2.3, and Table 4.2.3.2). I suggest mentioning these caveats. To what extent might this also be an issue for Piteälven (Table 4.2.3.2, where large decline in R_0 from 2017 to 2018).

4.6 Ongoing and future development

I agree that improvements in computation and model convergence is critical for a variety of reasons. For example, if multiple runs of the model were possible, simulation-evaluation could be used to evaluate benefits/shortcomings of changes in assessment and monitoring on achieving conservation objectives. The model could be run over various simulated data sets with known underlying biological trends and with different of simulated levels of assessments/monitoring to identify levels required to achieve objectives with a specified probability (as in Management Strategy Evaluation). This would help prioritize where to focus effort on new data collection (4.7). Also, does the work plan include comparison of results between platforms, if changed?

On the long-term list of items, bullet three states, "A next step would be to include genetic information on proportions of fish from different AUs, separating wild and reared salmon from those areas." However, the Annex states, "A spatially- and temporally-structured Bayesian population dynamics model that tracks the migration of Baltic salmon stocks from their feeding grounds in the Baltic Sea to their natal rivers has been developed (Ref Becky)." So, has this long-term next step already been implemented?

4.7 Needs for improving the use and collection of data

The text states that wild index rivers need to be established with potential candidates, but Annex states, "From 2018 and onwards, in total seven index rivers have been established; Tornionjoki and Simojoki (AU1), Vindelälven (AU2), Testeboån (AU3), Mörrumsån (AU4), Salaca (AU5) and Pirita (AU6)." Are these confirmed? However Pirita (AU6) is mixed, not wild.

Section 5 Sea Trout

5.1 Baltic sea trout catches

5.1.2 Recreational catches

First sentence of page 3, I think should read, "data on recreational coastal catches from the Main Basin in 2018 were available from…", not 2017.

5.2. Data collection and methods

5.2.2. Assessment of recreational sea trout fisheries

I suggest including a section in the Annex on sea trout, and moving much of the information to there (at least the components that do not vary annually). In addition, consider putting the summary of the ICES (2011; 2012) model there.

5.5 Recruitment status and trends

Figures 5.5.1–5.5.3 show recruitment status relative to recruitment potential with 95%CIs. How are 95%CIs calculated for each figure? For example, in Figure 5.5.1, are they the 95% CIs among rivers within an AU, or combined uncertainties from individual parr surveys, or otherwise? For a number of the AUs, the uncertainties at the aggregate level (Figure 5.5.1) are smaller than for the component SDs and countries (Figure 5.5.3), and I wonder if uncertainty is underestimated at the aggregate scale (e.g. if the 95% CIs represent variation among SDs within AUs) providing assessments that are overly confident.

For 3-year average assessments in Figures 5.5.1–5.5.3, are years of missing river assessment rivers infilled? For example, some rivers were not assessed this year, making it difficult to compare previous year's estimate to the current year. Similarly, averaging across years is only valid if missing years are infilled (e.g. with a mean value or other algorithm). Given challenges in comparing assessment across years that include different rivers, would it be useful to include a metric of proportion of rivers assessed each year (added to Figures), providing an indication of uncertainty in the estimate. For example in years where only a small portion of rivers are monitored, missing values could be infilled, but results de-emphasized given high uncertainties.

5.5.1 Recruitment status

"In assessment area **West** (SD 27 and 29; Figure 5.3.2.1) only sites in SD 28 were available this year, except one Swedish sites in 29 (Figure 5.5.2)" (p. 14). Is this a typo since SD28 is in the East assessment area? If there is only one river in SD 29 in 2018, why do 95% CIs differ for SD 29 in Figures 5.5.1 and 5.5.2 (blue bars)?

"Recruitment status for year 2018 compared to an average computed for the three-year period 2016–2018 show differences in some assessment units, indicating inter-annual variation" (p. 14). If missing rivers are not infilled, then high inter-annual variation may be due to differences in assessed rivers among years.

5.5.2 Recruitment trends

How are 95%CIs calculated for each level of aggregation (Figures 5.5.4, 5.5.5, and 5.5.6)? They are very large for most cases (spanning -1 to +1), but quite narrow for a few, which is not intuitive. For example, why are the 95%CIs relatively narrows for GoB, but very large for component SDs, 30 and 31? It looks like 95%CIs at the aggregate AU level account for variability in mean values among SDs, but not underlying uncertainty within SDs. If these 95%CIs can be justified, I suggest emphasizing these large uncertainties in trends in the section.

Instead of Pearson correlation coefficient, *r*, between recruitment and year, the average annual change in recruitment (the slope of linear regression) might be a more intuitive trend metric. The 95% CIs in the slope parameter would provide maximum and minimum annual changes, also more intuitive than 95%CIs in Pearson *r*. Linear trend lines could be added to the recruitment time-series plots with 95% confidence intervals in the slope showing the minimum and maximum average annual changes.

5.8 Assessment results

"A positive long-term development has in more recent years been observed in many sea trout populations around most of the Baltic Sea" (p. 19). This conclusion is not aligned with results in Section 5.5.2 and Figures 5.5.4–5.5.6) on recruitment trends. The discrepancy may be in the time period. Does this sentence refer to long-term (~5 year), recent trends (last year to this year) trends, or another time period?

Fish in numerous rivers have been negatively impacted by warm summer temperatures in recent years. What is the long-term prognosis for sea trout in the Baltic, given climate change projections of warmer temperatures in this region? Although formal projections are not possible here, is it possible to provide qualitative advice that survival is expected to decline over the next 50 years under expected climate projections? In the future if quantitative advice were possible, perhaps it could be included in forward projections?

5. 10 Recommendations

I agree with recommendations to increase data collection and improve modelling approaches to reduce uncertainties in assessments. However, this might only be necessary if harvest pressure remains a significant source of mortality. If increases in data collection and modelling are not possible in the short-medium term, the alternative is reductions in harvest pressure in depleted regions, such as Gulf of Bothnia, and possibly the Main Basin and southern Baltic (where uncertainties in assessments are very high). Given widespread declines (with high uncertainty), evidence that populations can sustain current harvest is weak for many of these rivers.

Annex 2: Stock Annex for salmon in SD 22–32

I suggest including a map with SDs 22–32.

A3.2. Effects of climate change

A more thorough, and annually updated evaluation of climate change impacts may be warranted. This could document ongoing research linking climatic, environmental or ecological variables to population dynamics, and current conditions affecting salmon and trout (e.g. documenting extreme events that have recently impacted populations). For example, for Fraser River sockeye salmon in Canada, we have both a quantitative pre-season forecast to inform management, and a paired qualitative forecast that includes comprehensive environmental indicators that may impact salmon survival, but are not yet included in the quantitative model (e.g. DFO, 2016).

DFO. 2016. Supplement to the pre-season run size forecasts for Fraser River Sockeye Salmon (*Oncorhynchus nerka*) in 2016. DFO Can. Sci. Advis. Sec. Sci. Resp. 2016/047.

C1 Salmon in assessment units 1–4

Figure C1.2.1 should be updated, preferably linking the submodels (boxes) with section labels (C1.2–C1.8).

I suggest including text and equations from the 2017 benchmarks report on the current parameterization of the stock–recruitment model to help explain the new priors described below Figure C1.2.1.

I assume Section C.1.7 will be replaced/revised, since priors on maximum egg survival instead of steepness?