Atlantic salmon (*Salmo salar*) in subdivisions 22–31 (Baltic Sea, excluding the Gulf of Finland)

ICES advice on fishing opportunities

ICES advises that when the maximum sustainable yield (MSY) approach is applied, total commercial sea catch in 2020 should be no more than 116 000 salmon, assuming no change in recreational effort. Applying the same catch proportions estimated from observations in the 2018 fishery, the catch in 2020 would be split as follows: 103 400 wanted catch (89%; i.e. 52% reported, 5% unreported, and 32% misreported) and 12 600 unwanted catch (11%; previously referred to as discards). This would correspond to commercial landings (the reported wanted catch) of 59 800 salmon.

ICES advises that management of salmon fisheries should be based on the status of individual river stocks. Fisheries on mixed-stocks that encompass weak wild stocks present particular threats, and should not increase. Fisheries in open-sea areas or in coastal waters target mixed-stocks; they are thus more likely to pose a threat to depleted stocks than fisheries in estuaries and in healthy (at or above MSY) wild or reared salmon rivers.

The salmon stocks of rivers Rickleån, Sävarån, Öreälven, and Lögdeälven in the Gulf of Bothnia, Emån in southern Sweden, and all rivers in the southeastern Main Basin (AU 5) are particularly weak, and several have shown limited recovery to previous reductions in exploitation rates at sea. The offshore and coastal fisheries in the Main Basin includes catches from all of these weak salmon stocks on their feeding migration. The coastal fishery in the Åland Sea and Gulf of Bothnia catches salmon from weak stocks from northern rivers on their spawning migration. Weak stocks need longer term, stock-specific rebuilding measures, including fisheries restrictions in estuaries and rivers, habitat restoration, and the removal of physical barriers. In addition, exploitation should not increase along the salmon feeding and spawning migration routes at sea.

The increased mortality from disease, observed among spawners in rivers Vindelälven (AU 2) and Ljungan (AU 3) during the last few years, is anticipated to result in a significant decline in smolt production from 2019 and onwards. These stocks need additional fisheries restrictions to reduce total mortality among spawners, both when passing the estuaries and during upstream migration in the rivers.

Stock development over time

To evaluate the status of wild stocks, ICES uses smolt production relative to the potential smolt production capacity (PSPC) on a river-by-river basis. Time-series indicate that the status for most stocks has improved over time.

The 2019 assessment indicates that since the Salmon Action Plan (ICES, 2008a) was adopted in 1997, total wild smolt production has increased tenfold in assessment units (AUs) 1–2. These units are the largest contributors to the overall (AUs 1–5) smolt production (Figure 2a). Smolt production in AU 3, however, only shows a weak positive trend; in AU 4 it has remained at around the same level. Despite the overall increase in wild smolt production, the decline in post-smolt survival from the late 1980s until the mid-2000s (Figure 4) has impacted fishing opportunities. Post-smolt survival has improved slightly since 2005, without an obvious trend appearing in recent years.

Smolt production estimates for AU 5 rivers are mainly based on parr density data, in combination with expert judgement about parr-to-smolt mortality rates. Smolt production in AU 5 has been low for many years (Figure 2a), and large uncertainties make it difficult to assess trends. Based on current parr densities, the wild AU 5 smolt production is predicted to decrease to very low levels in 2019 (Figure 2a).

The harvest rate of salmon has decreased considerably since the beginning of the 1990s (Figure 2b). The overall trend of the pre-fishery stock abundance (PFA) is estimated to have remained largely unchanged over the last few years (Figure 2c).

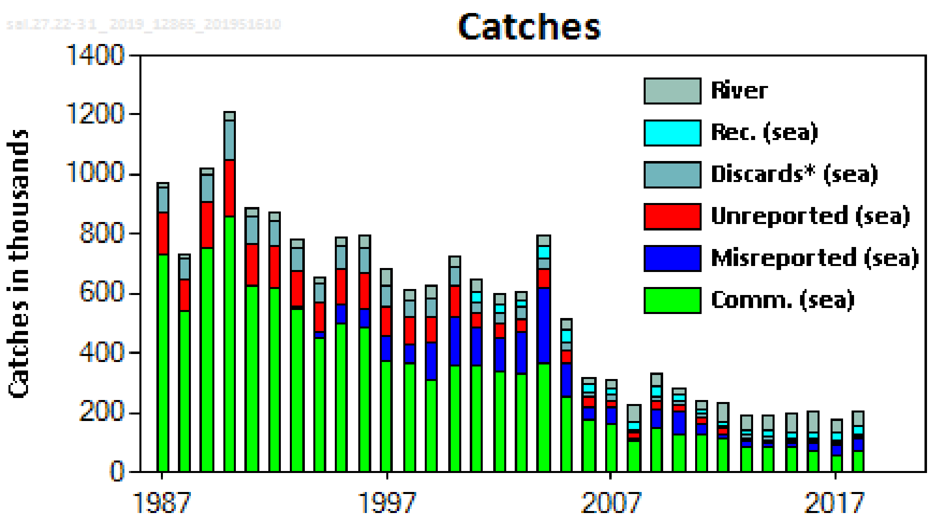

Figure 1 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Total number of removals (dead catch) in the years 1987–2018: river catches (mainly recreational, but also including some commercial fishing) and removals at sea (split into commercial and recreational nominal landings, unreported and misreported commercial landings, and dead discards). Note that commercial sea catch also includes recreational sea catch in the years 1987–2000. *Discards refer to dead discarded catch at sea.

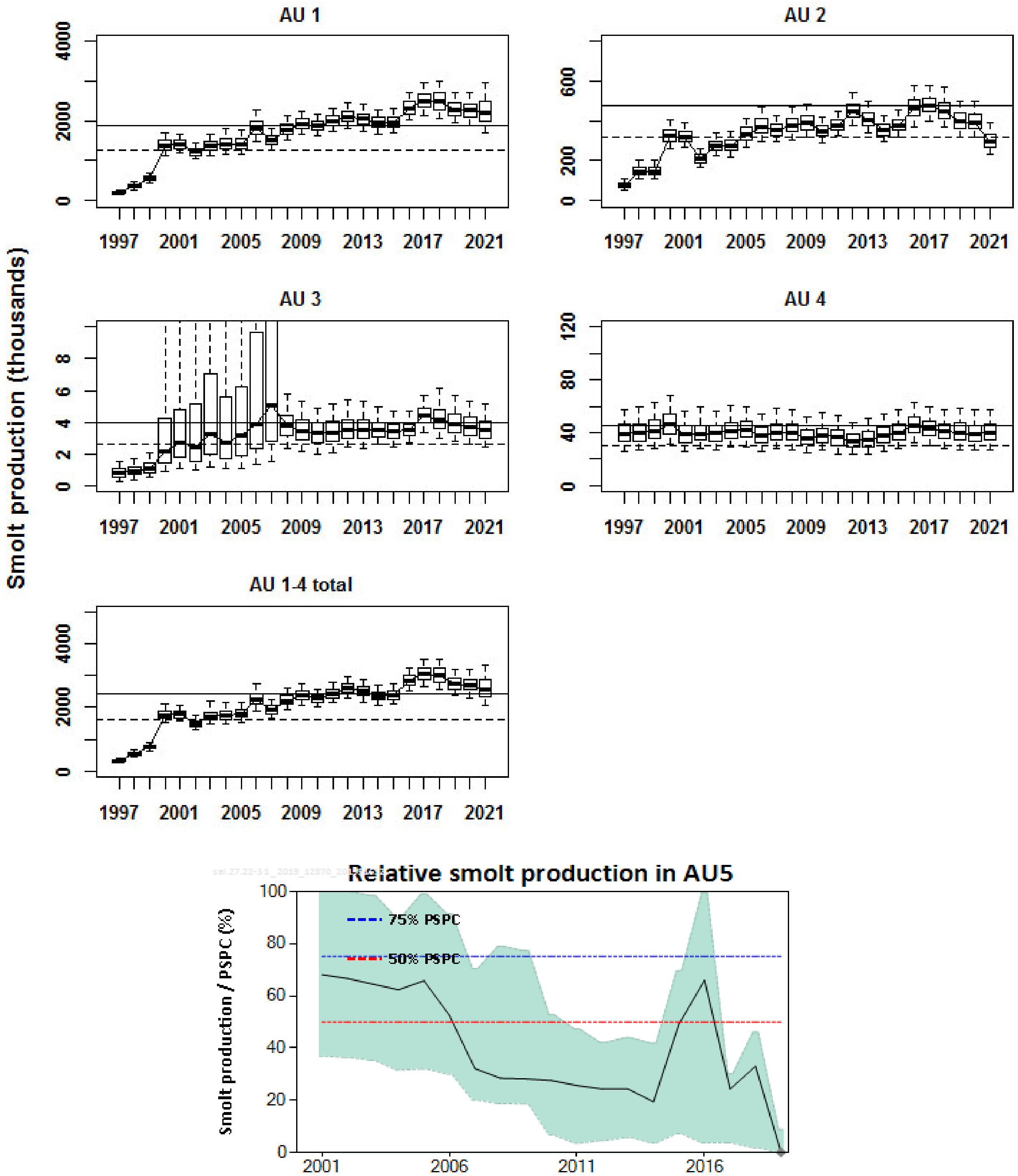

Figure 2a Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Top: Smolt production (median estimates - the boxes and whiskers indicate 50% and 90% probability intervals, respectively) relative to 50% (dashed line) and 75% of the potential smolt production capacity (PSPC - solid line) in AUs 1–4. The smolt production estimates predicted for 2019–2021 are based on data collected until 2018. Bottom: Percentage of smolt production relative to the PSPC in AU 5 (median estimate across wild rivers with 90% probability interval; diamond symbol represents prediction). Values of 50% PSPC (dashed line) and 75% PSPC (solid line) are shown as reference.

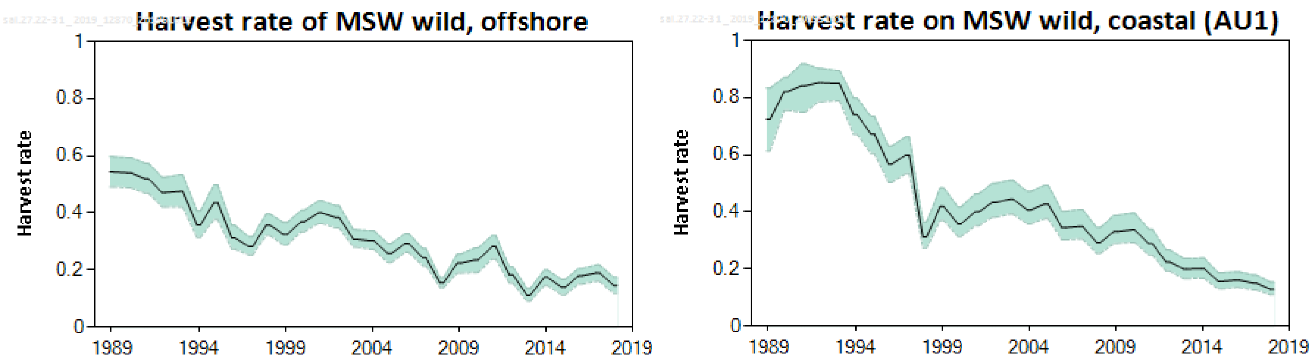

Figure 2b Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Harvest rates in offshore (by fishing season; left) and coastal (by calendar year; right) fisheries for wild multi-sea-winter (MSW) salmon in 1989–2018 (all gears combined). Coastal harvest rate is displayed for salmon from AU 1 rivers (northeastern Bothnian Bay). Median values with 90% probability interval.

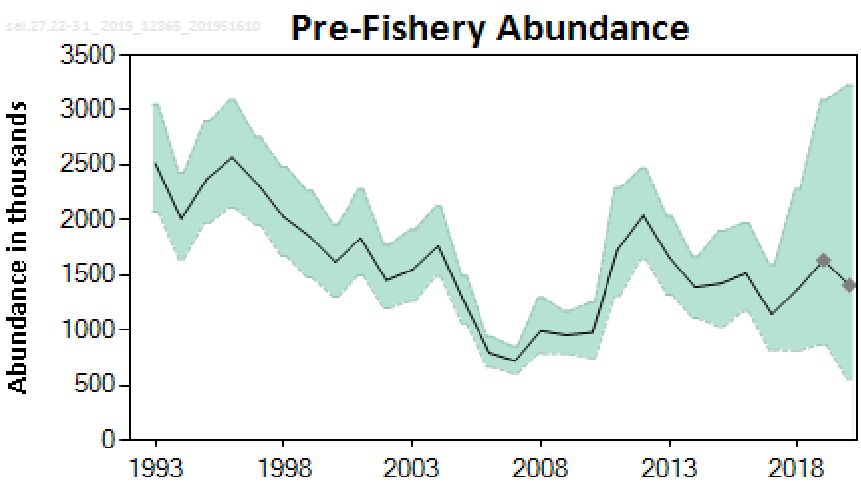

Figure 2c Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Estimated pre-fishery abundance in the sea, 1993–2020 (PFA; wild and reared, one-sea-winter [1SW] and MSW combined) for scenario 1 (Table 2). The median estimate and 90% probability intervals are plotted, with diamond symbols indicating model projections.

Stock and exploitation status

The current status of the 29 rivers assessed in subdivisions 22–31 is shown in Table 1. With a few exceptions, the status of rivers in the northern Baltic Sea (AUs 1 to 4) area is better. Among the 17 analytically assessed rivers in AUs 1–4, the probability that smolt production reached 75% of PSPC (the MSY proxy) in 2018 is above 50% for ten rivers and above 70% for seven rivers. The probability that smolt production reached 50% of PSPC is above 50% for 12 rivers and above 70% for 10 rivers. Five of the rivers in AUs 1–4 did not reach 50% of PSPC with 50% probability.

Table 1 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Overview of the status of the Gulf of Bothnia and Main Basin wild and mixed (shaded in grey) stocks in terms of their 2018 probability of having reached 50% and 75% (MSY reference point proxy) of the potential smolt production capacity. The probability values are classified into four groups: Above 90% (V.Likely), between 70% and 90% (Likely), between 30% and 70% (Uncert.), and below 30% (Unlikely). For stocks in AUs 1–4, the results are based on the assessment model run in 2019. The categorization of AU 5 stocks is based on expert judgments; for these rivers there are no defined 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

* Status uncertain and most likely overestimated, see text for more details.

Catch scenarios

Five fishing scenarios were considered, using estimates of pre-fishery abundance (PFA) at the beginning of 2019 (Table 2). Scenario 1 corresponds to the total commercial catch at sea advised by ICES for 2014–2019 (116 000 salmon per annum). Scenarios 2 and 3 represent, respectively, a 20% increase and a 20% decrease in catch, compared with scenario 1. Scenario 4 follows the EU Commission's proposal for a multiannual plan for Baltic salmon (EC, 2011), i.e. a harvest rule of F = 0.1 that covers the commercial catch at sea. Scenario 5 illustrates stock development under no fishing, either at sea or in rivers.

The outlook table for 2020 (Table 2) splits the total commercial catch at sea into similar components as in previous years. The proportions used are those estimated to have occurred in 2018: wanted catch reported (52%), wanted catch unreported (5%), wanted catch misreported (32%), and unwanted catch (11%; this is the catch that would be discarded if discarding was allowed). The 11% unwanted catch is the sum of 3% (undersized salmon) and 8% (seal-damaged salmon). Seal-damaged salmon are always dead, whereas some of the undersized salmon survive when discarded. All scenarios assume a fixed additional recreational fishing effort at sea, corresponding to annual catches of between 25 200 and 25 700 salmon. These are based on average catches in 2016–2018 and a constant harvest rate in rivers on returning salmon, based on the last year of data (2018). In Table 2, fishing mortality (F) is also indicated for all scenarios.

Table 2 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Assumptions made for the interim year and in the forecast.

Scenario	Commercial catch at sea in subdivisions 22–31 in 2020						
	Total commercial catch at sea	F of commercial catch	Wanted catch Reported	Unwanted catch		Wanted catch Unreported	Wanted catch Misreported
				Undersized (dead and alive)*	Seal Damaged (dead)		
1	116.0	0.09	59.8	3.7	8.9	6.3	37.3
2	139.3	0.10	71.8	4.4	10.7	7.6	44.8
3	92.8	0.07	47.8	3.0	7.1	5.0	29.9
4	134.0	0.10	69.0	4.3	10.3	7.3	43.1
5	0.0	0.00	0.0	0.0	0.0	0.0	0.0
Scenario	Total sea catch (comm. and recr.) 2020	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	

All values in the table are in thousands of fish.
Note: The figures in the table are rounded. Calculations were done with unrounded inputs and computed values may not match exactly when calculated using the rounded figures in the table.
* Survival of undersized discards are estimated, based on expert knowledge and relevant studies.

MSY approach

Figures 6a–d present, for the 17 wild rivers of AUs 1–4 included in the stock projections, the river-specific annual probabilities of meeting the MSY proxy (75% of the PSPC) under each scenario. Table 10 shows these probabilities for years 2025 (for stocks in AUs 1–3) and 2024 (for stocks in AU 4), which is approximately one full generation ahead from now. The results indicate relatively small differences between scenarios 1–4; only scenario 5 (zero fishing) is clearly different. There are, however, differences between rivers, with some having a much lower probability of reaching 75% of the PSPC. Rivers Rickleån, Sävarån, Öreälven, Lögdeälven (Gulf of Bothnia), and Emån (southern Sweden) have the lowest probabilities. All rivers in AUs 1–4 with low abundance show positive trends under virtually all scenarios. The predicted decline in status of Vindelälven is due to increased health-related mortality among spawners in recent years.

Figures 7a–d display estimated past and projected future smolt production and spawner abundance under scenarios 1, 4, and 5. For all rivers except Vindelälven, smolt production in 2024–2025 is expected to either remain around current levels or to increase under most scenarios.

Stock projections have not been conducted for stocks in AU 5. Although a few rivers in AU 5 have shown signs of recovery in 2015 and 2016, the smolt production was lower in 2017 and 2018 and is predicted to decrease further in 2019 (Figure 2a). A majority of these stocks are still regarded as weak. Mixed-stock fisheries pose a special problem in the fisheries management for these stocks. Effort in the fisheries has been reduced to low levels in recent years and should not increase. The reasons for the low productivity of southern stocks is not entirely clear but may, at least partly, be caused by conditions in the freshwater environment (ICES, 2014, 2015). Special actions (not only fishery-related) for these stocks are required in addition to the TAC.

The abundance of the mixed-stocks at sea, based on the PFA estimates (Figure 2c), have remained largely unchanged during the last few years with some annual variation. Until specific management objectives have been agreed and shown to be precautionary, the commercial catch at sea advised last year (scenario 1 in the catch scenarios) would allow the weakest stocks in AUs 1–4 to continue to improve (Figures 6a–e). This is considered to be consistent with exploitation under the MSY approach, and would imply a total commercial sea catch (including unreporting, misreporting, and dead discards) not exceeding 116 000 salmon in 2020.

It is likely that stocks in AU 5 will need additional fisheries restrictions in estuaries and rivers, and/or non fishery-related actions such as habitat restoration and removal of physical barriers, to allow for recovery.

Management plan

According to the management plan proposed by the EC "*the annual TAC for salmon stocks at sea shall not exceed the level corresponding to a fishing mortality rate of 0.1*". It is further stated that "*the TAC will only cover marine fisheries but will include masters of non-fishing vessels offering services for recreational fisheries*" (EC, 2011). The plan does not specify exactly how to interpret F = 0.1, or whether this value covers the total catch at sea or only the commercial part of this catch. Different fisheries vary in time and space, and many fisheries catch only maturing salmon. Any catch calculation based on F = 0.1 is, therefore, only approximate. ICES calculated the 2020 catch scenario by calculating the abundance at sea on 1 September for 1-sea-winter (1SW) fish and on 1 July for multi-sea-winter (MSW) fish, accounting for natural mortality from the start of the year. If F = 0.1 covers only the commercial catch at sea (scenario 4), this corresponds to a total commercial catch at sea not exceeding 134 000 salmon in 2020. Projections based on scenario 4 were found to be similar to those of scenarios 1–3 (Figures 6a–d and 7a–d).

ICES has not evaluated the proposed EC management plan for consistency with the precautionary approach and MSY.

Basis of the advice

Table 3 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). The basis of the advice.

Advice basis	MSY approach
Management plan	EC proposal for a multiannual plan (EC, 2011), not formally adopted.

Quality of the assessment

The latest benchmark for Baltic salmon (WKBaltSalmon; ICES, 2017) was held in 2016–2017, during which available data were evaluated and alternative parameterizations for the stock–recruitment function were explored. Some needs for improvement regarding data and methods identified during WKBaltSalmon were later taken into consideration in 2018 and incorporated in the assessment model (ICES, 2018a). Additional minor changes made between the 2018 and 2019 assessments include the following.

- The way semi-wild salmon (reared salmon stocked in Tornionjoki and Simojoki which later go on to spawn in these rivers) are treated in the model has been changed.
- Using spawner counting observations for Piteälven directly in the full life-history model instead of, as was done previously, using them to produce smolt production priors. This new way of using the data is 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.
- Adjustments to the spawner counting data for Ume/Vindelälven were made in 2019, as an interim solution to the problem of deviating ratios of grilse to MSW spawners observed in this river.

In addition, some input catch data were revised for 2009 onward.

There were difficulties in achieving full convergence for the full life-history model used for the assessment, but the results were considered to be adequate in forming the basis for advice. More details about how convergence issues were handled, as well as model updates and evaluations, can be found in the working group report (ICES, 2019).

There is considerable uncertainty about the amount of salmon discarded, and even greater uncertainty about the proportion that survives when discarded. Seal-damaged salmon are all dead, but there is also uncertainty about the amount of seal-damaged salmon. The values used in this advice represent the current available knowledge and are based on data from a variety of sources (such as logbooks, interviews with fishers, agreed sampling schemes with skippers, or Data Collection Framework [DCF] sampling data), but these data are generally sparse. Expert judgement has been applied when no data are available, or when there is a need to supplement sparse data. Due to this uncertainty, current estimates of discards should be considered as approximate rather than precise estimates.

The release of reared salmon (currently contributing up to 30% of the mixed-stock PFA in the Main Basin) is accounted for when assessing fishery opportunities.

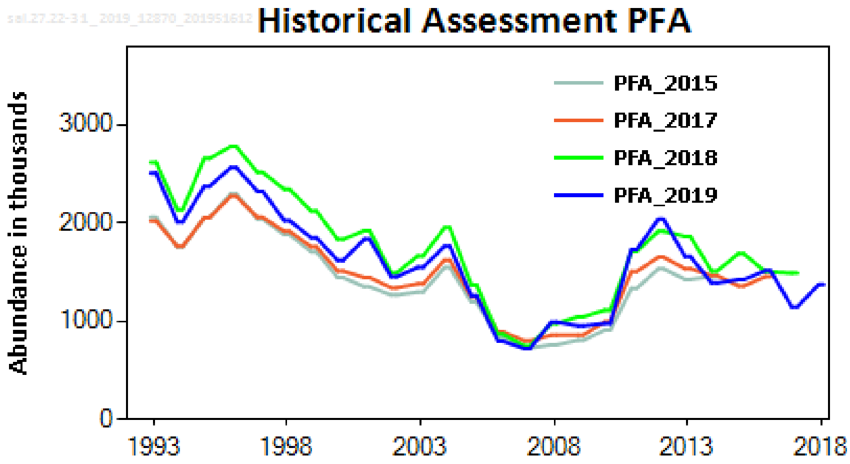

Figure 3 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Historical assessment results. Estimated pre-fishery abundance in the sea (PFA; wild and reared, 1SW and MSW fish in total) for scenario 1 from the assessments in 2015 and 2017–2019 (no analytical assessment was performed in 2016). Median estimates are plotted up to the last year with data. The stock was benchmarked prior to the 2018 assessment.

Issues relevant for the advice

With no EC management plan adopted, there are no guidelines for how quickly (within which time frames) weak salmon stocks should recover, what proportion should recover, and to what level. This means that under the current conditions, with one TAC for subdivisions 22–31 and many stocks with variable status, any catch advice for the mixed-stock sea fishery on Baltic salmon will be associated with trade-offs between exploitation possibilities, the time required to achieve management objectives, and conservation aspects. The current management system also includes trade-offs between commercial exploitation rates at sea (regulated by TAC), and fisheries in estuaries and rivers (regulated at national level).

The present salmon harvest rates are lower than in the past and as such so is fishing mortality, taken as a proportion of total mortality (Figure 2b). This implies that natural processes, mainly post-smolt and adult natural mortalities, currently have a higher relative impact than fishing mortality on the potential of reaching the 75% PSPC objective. This highlights the fact that fisheries regulations in the sea must be supplemented by additional actions in order to reach management targets. Weak stocks need longer term and stock-specific rebuilding measures, for example. These include fisheries restrictions in estuaries and rivers, habitat restoration, and the removal of physical barriers; exploitation should also not increase along their feeding and spawning migration routes at sea. As problems in the freshwater environment play a significant role in explaining the poor status of stocks in AU 5 (ICES, 2012a, 2014), additional work to improve river habitats and migration possibilities, as well as actions to reduce poaching, may be needed to increase the status of these weak stocks.

Fisheries on mixed-stocks that include reared salmon may present particular threats to wild stocks that do not have a healthy status. Fisheries in open-sea areas or coastal waters are more likely to pose a threat to depleted stocks than fisheries in estuaries of healthy wild and reared rivers.

Misreported catch as a proportion of the total estimated catch has continued to increase, from 16% in 2016 to 29% in 2017, and on to 32% in 2018 (ICES, 2019). This is caused by a large increase in the reported catch of sea trout with longlines in the Polish offshore fishery. The Polish reported catch in the 2018 offshore fishery was 7012 salmon and 44 085 sea trout. Based on observer data from 2009–2017 (no data available in 2018), Polish catches in the offshore fishery are almost entirely composed of salmon. The reported catch figures therefore suggest substantial misreporting of salmon as sea trout.

Exploitation in the Main Basin offshore fisheries affects possibilities for recovery of the Gulf of Finland salmon stocks, as some Gulf of Finland salmon are caught in the Main Basin.

As a result of disease outbreaks among spawners, the very low parr densities observed in Vindelälven (2016–2018) and Ljungan (2017–2018) are expected to result in a drastically reduced smolt production in 2019–2020 (ICES, 2019). It should be noted, however, that the effect of reduced parr densities in 2016–2018 is expected to only partly affect the estimated pre-fishery abundance of salmon from these rivers during the advice year (2020). The situation in the two rivers is still alarming, and local management actions aimed at protecting ascending spawners will be enforced in 2019. These national actions may need to be supplemented with additional measures in the near future, if the situation does not improve.

M74 mortality has been at relatively high levels in 2016–2018. The current advice is based on projections assuming historical levels of M74. The death of spawners from another unidentified disease has been observed in some rivers in the last few years, which may affect the projection. This extra mortality could reduce smolt production and PFA beyond the advice year; however, with the exception of the rivers Vindelälven and Ljungan, the likely impacts are uncertain. In those two rivers, substantial decreases in parr densities will negatively affect smolt production in the coming years (see above).

Recent efforts to re-establish self-sustaining salmon stocks in “potential” rivers, where salmon stocks have been extirpated in the past, present exceptional challenges to management. The numbers of spawners in the potential rivers are likely to be particularly low following initial reintroductions, and productivity is likely to be lower than average. The considerations presented in this advice for the existing weak salmon stocks (e.g. habitat restorations, fishery restrictions, etc.) also apply to re-established stocks.

Reference points

To evaluate the state of the stock, ICES uses the smolt production relative to 50% and 75% of the natural production capacity (potential smolt production capacity [PSPC]) on a river-by-river basis. The 75% of the PSPC reference is based on the MSY approach (ICES, 2008a, 2008b, 2018a). The 50% of the PSPC reference has no formal status as a reference point in ICES, but as it is widely considered an interim objective for weak stocks, it is also included as part of ICES stock status evaluation.

The PSPC is estimated based on a combination of expert knowledge and spawner/smolt estimates (based on river-specific stock–recruitment relationships) which are derived by fitting the assessment model to the data. The assessment model updates the estimates of smolt production historically as well as the PSPC for each river. The PSPC target varies with time, reflecting fluctuations in natural mortality (ICES, 2017); current and projected status is evaluated from estimates of smolt production relative to the “final year PSPC” (i.e. the PSPC corresponding to smolt production in the last year with data).

Basis of the assessment

ICES uses five assessment units for salmon in the Baltic Main Basin and the Gulf of Bothnia (Figure 8). The division of stocks into units is based on biological and genetic characteristics. Stocks of a particular unit are assumed to exhibit similar migration patterns. These stocks may, therefore, be assumed to be subject to the same fisheries, experience the same exploitation rates, and to respond equally to a similar use of management tools (e.g. using coastal management measures might improve the status of all stocks in a specific assessment unit). Even though the stocks of AUs 1–3 have the highest current smolt productions and thus have an important role in sustaining fisheries, the stocks in AUs 4 and 5 contain a relatively high proportion of the overall genetic variability of Baltic salmon stocks.

Table 4 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Assessment units.

Assessment unit	Name	Salmon rivers included
1	Northeastern Bothnian Bay stocks	On the Finnish–Swedish coast from Perhonjoki northward to the river Råneälven, including River Tornionjoki.
2	Western Bothnian Bay stocks	On the Swedish coast between Lögdeälven and Luleälven.
3	Bothnian Sea stocks	On the Swedish coast from Dalälven northward to Gideälven and on the Finnish coast from Paimionjoki northward to Kyrönjoki.
4	Western Main Basin stocks	Rivers on the Swedish coast in ICES subdivisions 25–29.
5	Eastern Main Basin stocks	Estonian, Latvian, Lithuanian, and Polish rivers.

Table 5 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). The basis of the assessment.

ICES stock data category	1 (ICES, 2018b).
Assessment type	Bayesian state–space model for wild rivers in AUs 1–4; assessment by expert judgement for AU 5. Uncertainties about estimated quantities from the Bayesian model are expressed as probability distributions.
Input data	Commercial removals (international landings and effort by fishery (1987–2018), wild and reared proportions, tag returns); recreational catch; estimated unreported and misreported catch; spawner counts in some rivers, parr densities from all rivers except one, smolt counts in some rivers.
Discards and bycatch	Included in the assessment (estimates based partly on data and partly on expert evaluation).
Indicators	None.
Other information	The assessment is based on the benchmark in 2012 (IBP Salmon; ICES, 2012b). The data and model options were re-examined in 2017 (WKBaltSalmon; ICES, 2017), and several minor improvements of the assessment model have been conducted in 2018 (ICES, 2018a) and 2019 (ICES, 2019).
Working group	Assessment Working Group on Baltic Salmon and Trout (WGBAST)

Information from stakeholders

There is no additional available information.

History of the advice, catch, and management

Table 6 Salmon in subdivisions (SDs) 22–31 (Main Basin and Gulf of Bothnia). ICES advice for salmon, landings, total catches, and agreed TACs; all numbers are in thousands of fish. Landings and total catch figures for 2018 are preliminary.

Year	ICES advice	Predicted catch corresponding to advice	TAC†	Commercial reported landings at sea††	Landings at sea^	Catch at sea^^	River catch^^^
1987	No increase in effort	-			729	957	11
1988	Reduce effort				543	716	13
1989	TAC	850			755	1001	18
1990	TAC				861	1179	28
1991	Lower TAC	-			630	857	27
1992	TAC	688			619	845	26
1993	TAC	500	650		549	753	25
1994	TAC	500	600		454	630	21
1995	Catch as low as possible in offshore and coastal fisheries	-	500		501	758	27
1996	Catch as low as possible in offshore and coastal fisheries	-	450		486	753	44
1997	Catch as low as possible in offshore and coastal fisheries	-	410		370	629	56
1998	Offshore and coastal fisheries should be closed	-	410		369	575	37
1999	Same TAC and other management measures as in 1998	410	410		313	588	37
2000	Same TAC and other management measures as in 1999	410	450		363	689	35
2001	Same TAC and other management measures as in 2000	410	450	359	388	602	39
2002	Same TAC and other management measures as in 2001	410	450	338	362	561	36
2003	Same TAC and other management measures as in 2002	410	460	329	351	578	29
2004	Same TAC and other management measures as in 2003	410	460	368	410	762	32
2005	Current exploitation pressure will not impair the possibilities of reaching the management objective for the stronger stocks.	-	460	256	293	475	39
2006	Current exploitation pressure will not impair the possibilities of reaching the management objective for the larger stocks. Long-term benefits for the smaller stocks are expected from a reduction of the fishing pressure, although it is uncertain whether this is sufficient to rebuild these stocks to the level indicated in the Salmon Action Plan.	-	460	174	196	292	24
2007	ICES recommends that catches should not increase.	324	437	161	182	280	30

Year	ICES advice	Predicted catch corresponding to advice	TAC†	Commercial reported landings at sea††	Landings at sea^	Catch at sea^^	River catch^^^
2008	ICES recommends that catches should be decreased in all fisheries.	-	371	110	136	170	57
2009	ICES recommends no increase in catches of any fisheries above the 2008 level for SDs 22–31.	-	310	145	177	287	41
2010	TAC for SDs 22–31	133	294	127	148	258	25
2011	TAC for SDs 22–31	120	250	125	144	216	26
2012	TAC for SDs 22–31	54	123	110	127	172	65
2013	TAC for SDs 22–31	54	109	88	108	148	53
2014	MSY approach. TAC for SDs 22–31, corresponding to reported commercial sea landings assuming discards, unreporting, and misreporting as in 2012 (corresponding total commercial sea removals are given in brackets)	78 (116*)	106	86	111	144	56
2015	MSY approach. Total commercial sea catch for SDs 22–31 (estimates of the split of the catch in 2013 into: unwanted, wanted and reported, wanted and unreported, wanted and misreported, are given in brackets).	116 (11%, 68%, 10%, 11%)	96	82	104	138	66
2016	MSY approach. Total commercial sea catch for SDs 22–31 (estimates of the split of the catch in 2014 into: unwanted, wanted and reported, wanted and unreported, wanted and misreported, are given in brackets).	116 (10%, 77%, 7%, 6%)	96	72	99	143	71
2017	MSY approach. Total commercial sea catch for SDs 22–31 (estimates of the split of the catch in 2014 into: unwanted, wanted and reported, wanted and unreported, wanted and misreported, are given in brackets).	116 (10%, 77%, 7%, 6%)	96	59	89	137	51
2018	MSY approach. Total commercial sea catch for SDs 22–31 (estimates of the split of the catch in 2016 into: unwanted, wanted and reported, wanted and unreported, wanted and misreported, are given in brackets).	116 (9%, 68%, 7.0%, 16%)	91	68	102	163	53

Year	ICES advice	Predicted catch corresponding to advice	TAC†	Commercial reported landings at sea††	Landings at sea^	Catch at sea^^	River catch^^^
2019	MSY approach. Total commercial sea catch for SDs 22–31 (estimates of the split of the catch in 2017 into: unwanted, wanted and reported, wanted and unreported, wanted and misreported, are given in brackets).	116 (10%, 55%, 6%, 29%)	91				
2020	MSY approach. Total commercial sea catch for SDs 22–31 (estimates of the split of the catch in 2018 into: unwanted, wanted and reported, wanted and unreported, wanted and misreported, are given in brackets).	116 (11%, 52%, 5%, 32%)					

† TAC applies to the commercial catch at sea.
†† Commercial reported landings at sea only, does not include misreported or unreported catch.
^ Total reported landings including recreational catches.
^^ Estimated total catches including discards, mis- and unreporting.
^^^ Estimated total catches including unreporting.
* Value corresponds to total commercial sea removals, including reported landings, unreporting, misreporting, and dead discards.

History of catch and landings

Table 7 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Catch distribution by category in 2018 as estimated by ICES (median values from probability distributions).

Catch (2018; dead catch, including non-commercial and river catches)	Landings		Discards (dead)*
1158 tonnes	Nominal landings (commercial and non-commercial at sea and in rivers) 77.5%	Unreported and misreported 22.5%	64 tonnes
	1093 tonnes		

* Dead discards are from seal damages and estimated mortality of small salmon that are discarded.

Table 8 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Nominal landings (reported) of Baltic salmon in round fresh weight and in numbers: landings from rivers, coast, and offshore; total; commercial (in numbers) from coast and offshore combined; agreed TAC for subdivisions 22–31.

Year	Rivers		Coast		Offshore		Total		Coast and offshore*	TAC
	tonnes	thousand fish	tonnes	thousand fish	tonnes	thousand fish	tonnes	thousand fish	thousand fish	thousand fish
1993	110		830		2570		350		676	650
1994	100		580		2250		2930		584	600
1995	120		670		1980		2770		553	500
1996	210	35	770	173	1730	361	2710	570	456	450
1997	280	45	800	153	1500	278	2580	476	396	410
1998	190	30	590	111	1520	307	2300	449	334	410
1999	170	30	590	108	1230	252	1990	391	286	410
2000	180	30	520	100	1450	315	2150	444	312	450
2001	157	30	571	125	1191	264	1919	419	359	450
2002	137	28	597	125	1027	237	1761	390	338	450
2003	103	22	441	113	1002	238	1546	373	329	460
2004	129	25	788	159	1111	250	2028	435	368	460
2005	167	31	621	115	862	178	1650	324	256	460
2006	96	19	412	69	624	126	1132	215	174	460
2007	142	23	354	68	552	114	1048	205	161	437
2008	256	45	472	91	207	45	935	181	110	371
2009	177	32	572	116	259	61	1008	210	145	310
2010	113	19	387	69	357	80	857	168	127	294
2011	125	20	393	69	335	75	853	164	125	250
2012	322	51	434	69	261	58	1018	178	110	123
2013	260	41	446	69	166	39	871	149	88	109
2014	311	44	453	74	163	36	926	155	86	106
2015	329	52	401	71	143	34	873	156	82	96
2016	352	56	436	67	126	32	914	155	72	96
2017	207	41	372	58	121	31	701	130	59	96
2018**	227	43	378	54	182	48	787	145	68	91

* For comparison with TAC (includes only commercial catches, except for the years 1993–2000 when recreational catches at sea are also included).

** Preliminary.

Table 9 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia) and Subdivision 32 (Gulf of Finland), pooled. The table shows total catches (from sea, coast, and river) of salmon, in numbers, in the entire Baltic (subdivisions 22–31 and 32 (Gulf of Finland)). These are split into: nominal reported catches by country and total, estimated misreported catch, estimated unreported catch (PI = probability interval = 90%), and estimated discard (including seal-damaged salmon) (PI = probability interval = 90%). Catches from the recreational fishery are included. Catch figures for 2018 are preliminary. Data for earlier years can be found in ICES (2018a).

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
200	90388	3285	12241	7717	2900	1205	3560	7392	15319	450211	126100	61040	47090–	41280	37670–	65870	644000–
200	76122	3247	10485	5762	2180	3351	3937	1323	14012	407871	115000	59200	45530–	38410	35090–	60340	588900–
200	10884	2055	99364	5766	1133	1040	3580	4413	11745	386078	143100	52820	40230–	43480	39250–	60360	590000–
200	81425	1452	13041	7087	7700	704	1765	5480	19566	447575	254300	67400	50360–	43760	39490–	79000	772100–
200	42491	1721	11337	4799	5629	698	2289	3069	14658	341262	110800	53610	40920–	30880	28390–	51890	505700–
200	33723	1628	64679	3551	3195	488	2220	1002	98663	229136	46900	36970	28270–	22720	21060–	32300	313900–
200	16145	1315	75270	3086	5318	537	1898	1408	96605	218672	54310	35780	27470–	18740	17390–	31550	307000–
200	7363	1890	80919	4151	2016	539	8650	1382	92533	199443	3295	37940	28370–	10190	9570–11050	24350	233900–
200	17116	2064	77105	2799	3323	310	9873	584	11126	224437	66500	42790	31680–	13870	12570–	34060	329200–
201	29714	1459	44981	1520	2307	243	9520	491	83318	173553	74800	30050	22670–	12480	11000–	28330	275700–
201	21125	1332	49613	1483	1470	317	6149	470	90276	172235	37000	31310	23640–	11770	10770–	24420	236400–
201	23180	1915	73450	1362	1371	355	5605	412	84331	191981	17500	34380	26490–	10250	9369–11520	24710	239200–
201	25461	2426	56287	1210	2842	285	4808	387	62566	156272	15000	27080	20260–	13000	11090–	20100	194100–
201	24596	2139	69132	1264	2650	388	2999	418	58056	161642	13600	22740	16940–	11090	9405–12740	20000	194200–
201	19367	2597	62476	2009	2572	2580	3745	406	63309	159061	16600	22600	17070–	11060	9646–12280	20030	194700–
201	17701	3180	62738	1623	2881	3803	3659	419	62549	158553	26000	23850	18140–	11380	10060–	21040	204600–
201	9644	3005	52478	5632	2435	1702	7075	380	50770	133121	32000	16870	12770–	11360	9713–12650	18430	180100–
201	14588	2534	53594	6586	804	2223	1064	458	56732	148160	42600	18490	13990–	12410	10290–	20740	202700–

Summary of the assessment

Table 10 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). River-specific probabilities of achieving 75% of the PSPC in 2024 or 2025 (depending on smolt age in different assessment units) under the projection scenarios from the 2019 assessment (ICES, 2019). Probabilities greater than 0.70 are shaded green.

River	Year of comparison	Scenario				
		1	2	3	4	5
Tornionjoki	2025	0.75	0.73	0.76	0.74	0.85
Simojoki	2025	0.43	0.40	0.46	0.40	0.68
Kalixälven	2025	0.81	0.80	0.82	0.80	0.87
Råneälven	2025	0.68	0.66	0.71	0.67	0.81
Piteälven	2025	0.84	0.82	0.84	0.83	0.88
Åbyälven	2025	0.61	0.60	0.62	0.60	0.72
Byskeälven	2025	0.77	0.76	0.79	0.76	0.86
Rickleån	2025	0.18	0.16	0.19	0.17	0.39
Sävåran	2025	0.29	0.26	0.31	0.27	0.51
Vindelälven	2025	0.50	0.47	0.53	0.48	0.78
Öreälven	2025	0.26	0.25	0.28	0.25	0.43
Lögdeälven	2025	0.14	0.13	0.15	0.13	0.27
Ljungan	2025	0.37	0.35	0.38	0.35	0.52
Mörrumsån	2024	0.66	0.65	0.68	0.65	0.79
Emån	2024	0.03	0.03	0.04	0.03	0.10
Kågeälven	2025	0.46	0.44	0.48	0.45	0.60
Testeboån	2025	0.59	0.58	0.60	0.58	0.72

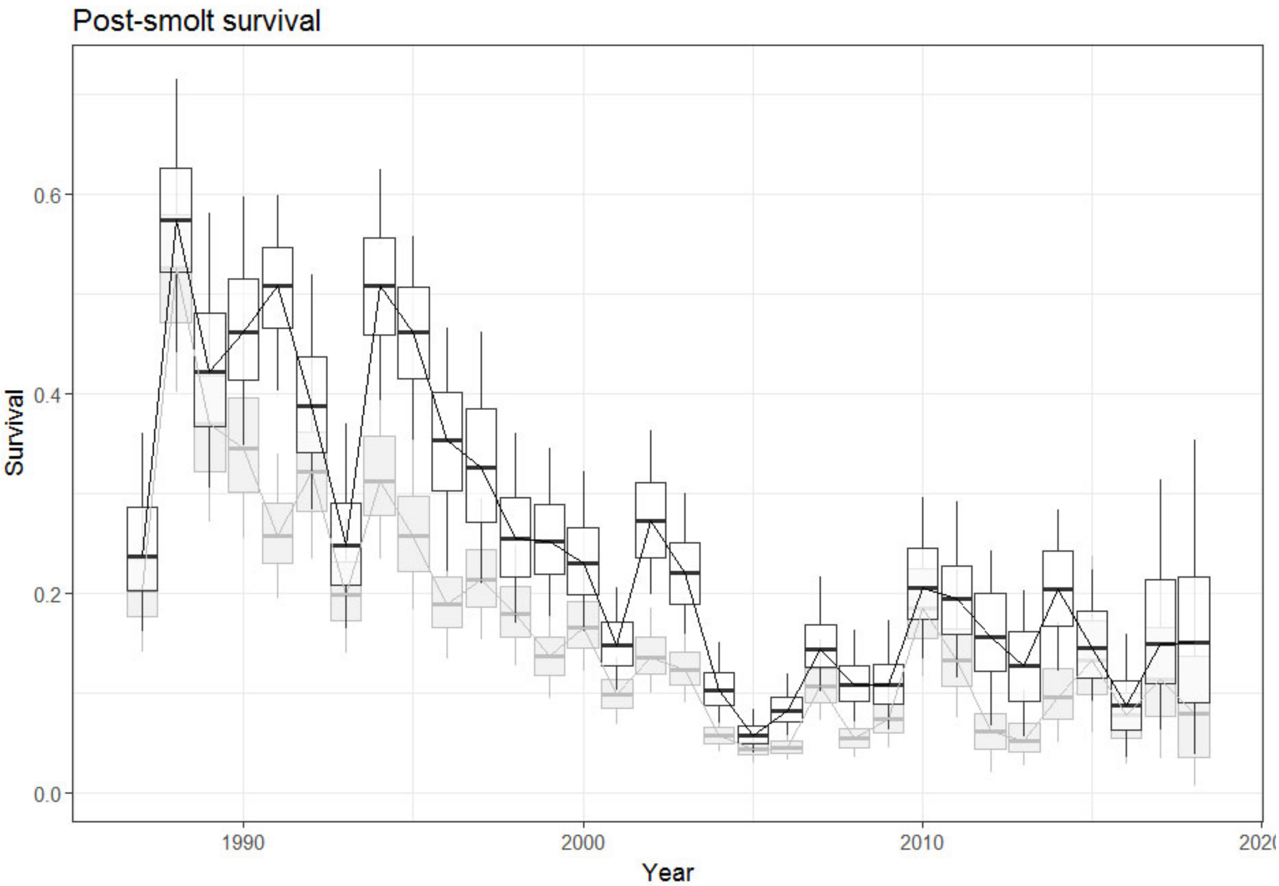

Figure 4 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Post-smolt survival (median) for wild (black boxplots) and hatchery-reared (grey boxplots) salmon. Boxes and whiskers indicate 50% and 90% probability intervals, respectively.

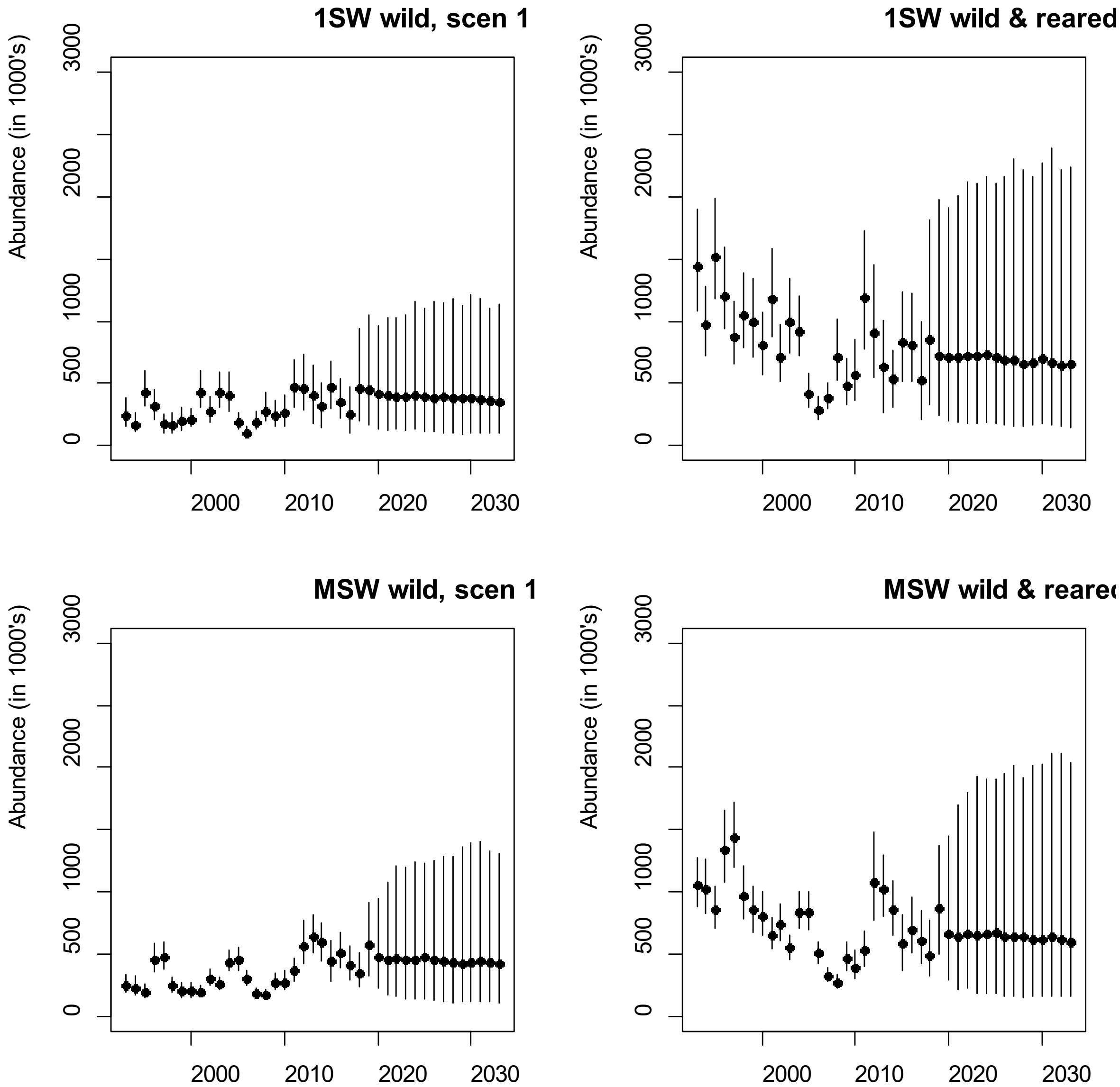

Figure 5 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Top panels: Annual abundances (medians with 90% probability intervals) of 1-sea-winter salmon (1SW) available to the fisheries. Four months of adult natural mortality are taken into account (from 1 May to 1 September) to cover natural mortality during the fishing season after the post-smolt mortality phase. Bottom panels: Annual abundances of multi-sea-winter salmon (MSW) available to the fisheries. Six months of adult natural mortality are taken into account (from 1 January to 1 July) to cover natural mortality during the fishing season. The left panels are for wild salmon, and the right panels for wild and reared salmon combined. The predicted future development (2019–2033) in abundance following projection scenario 1 is also indicated.

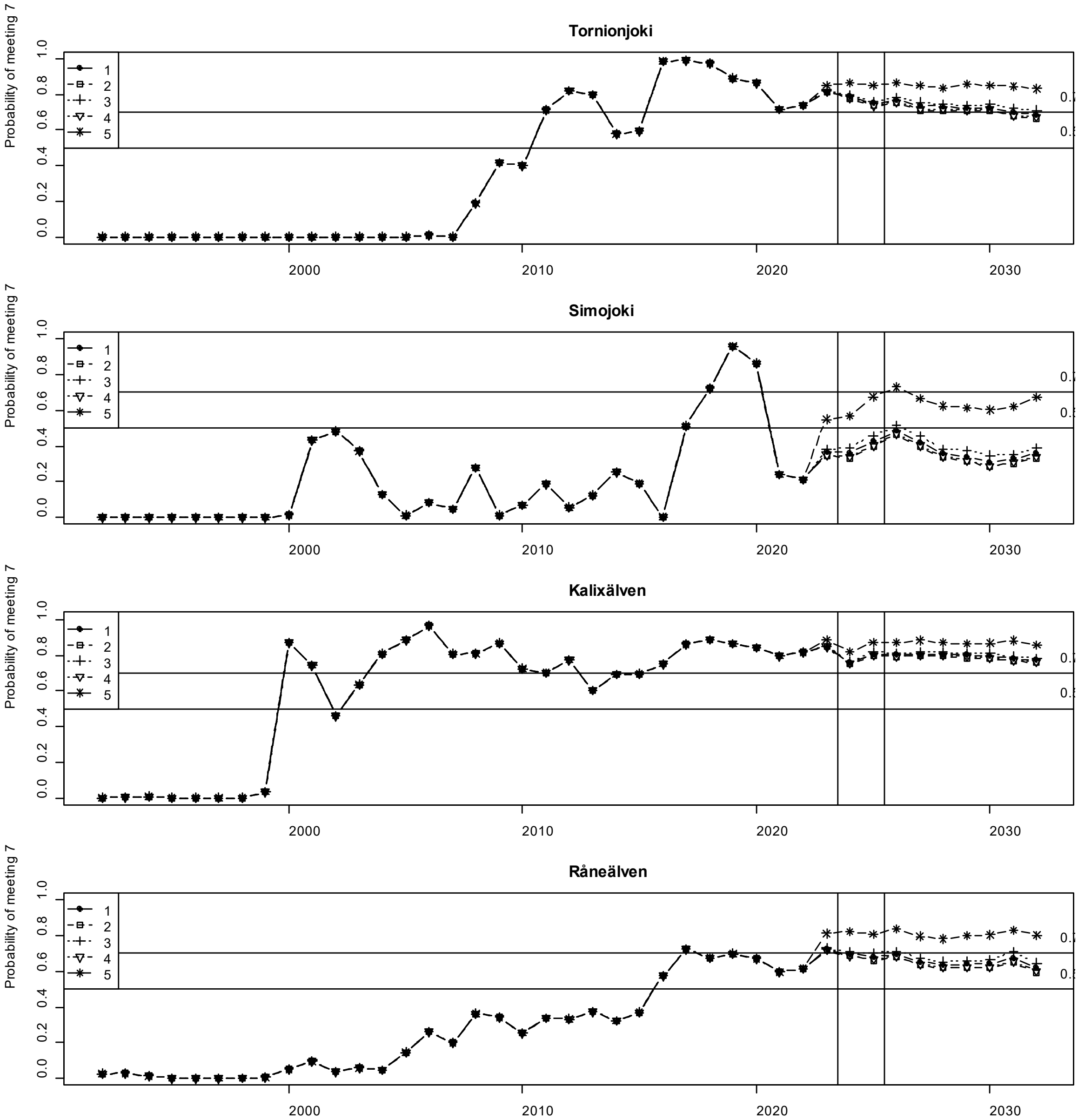

Figure 6a Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities for stocks to meet an objective of 75% of potential smolt production capacity (PSPC) under different projection scenarios. Horizontal lines represent the 50% and 70% probability of meeting 75% of PSPC. Fishing in 2020 mainly affects smolt production in the years 2024–2025 (between vertical lines).

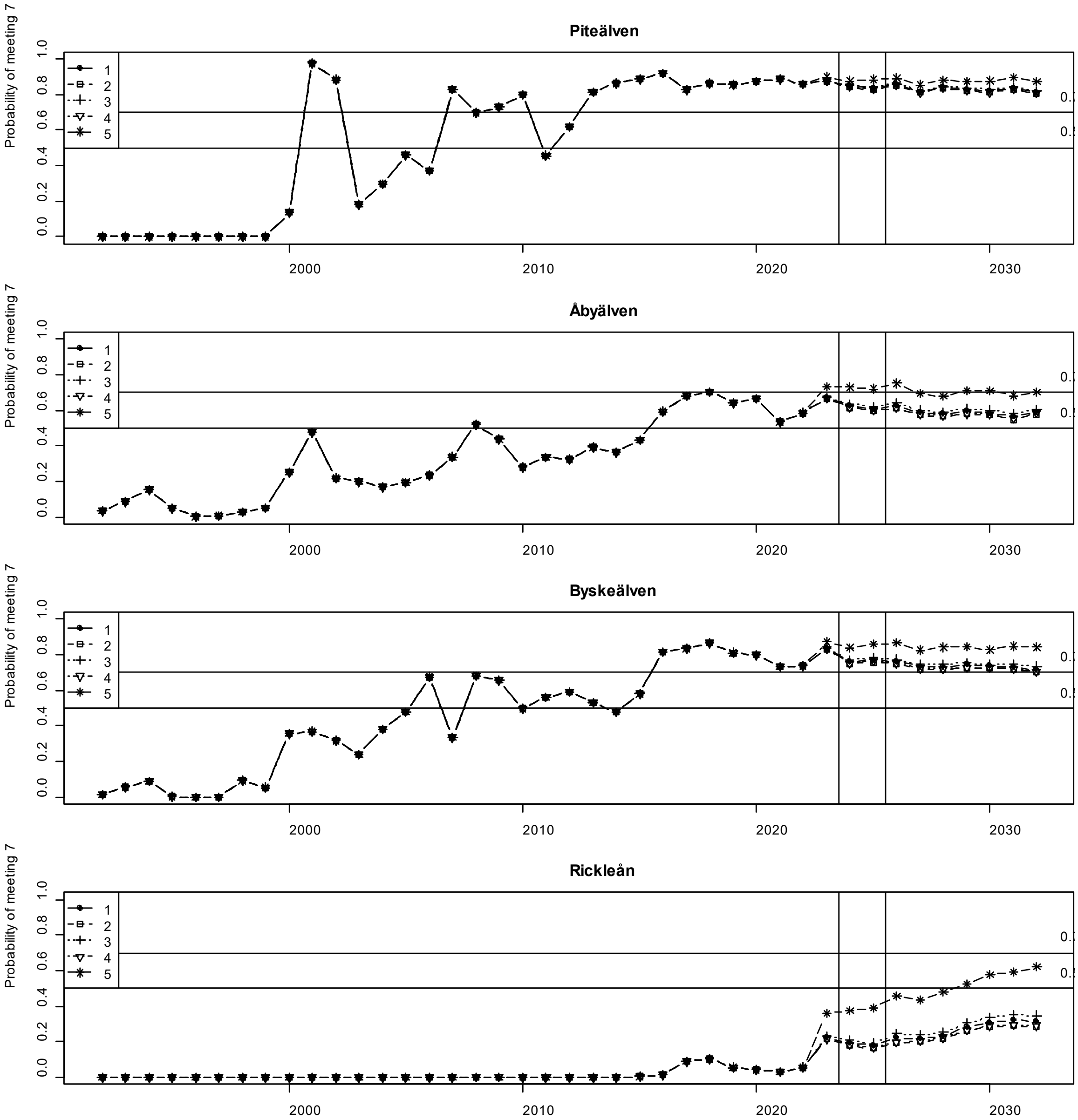

Figure 6b Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities for stocks to meet an objective of 75% of potential smolt production capacity (PSPC) under different projection scenarios. Horizontal lines represent the 50% and 70% probability of meeting 75% of PSPC. Fishing in 2020 mainly affects smolt production in the years 2024–2025 (between vertical lines).

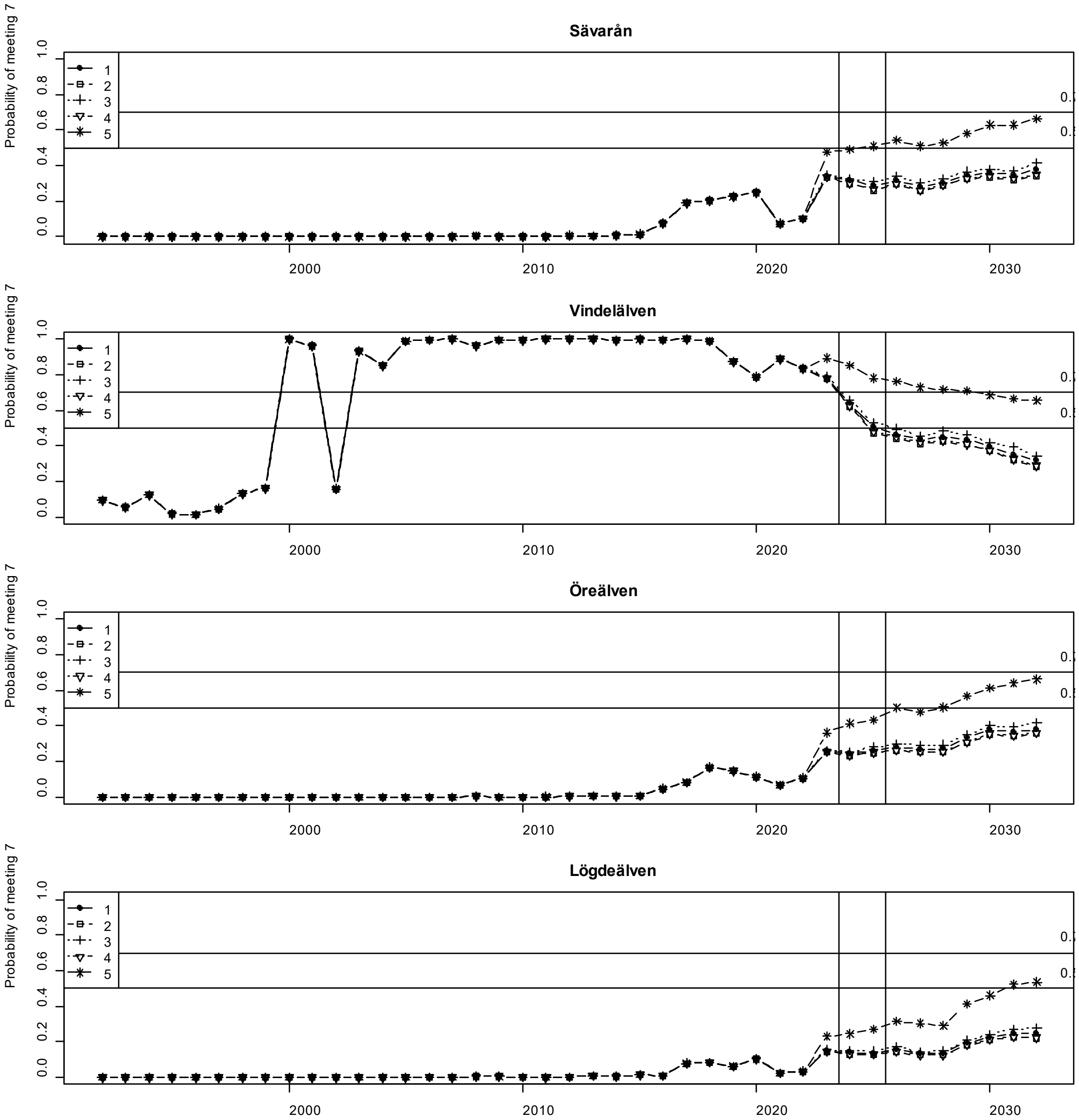

Figure 6c Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities for stocks to meet an objective of 75% of potential smolt production capacity (PSPC) under different projection scenarios. Horizontal lines represent the 50% and 70% probability of meeting 75% of PSPC. Fishing in 2020 mainly affects smolt production in the years 2024–2025 (between vertical lines).

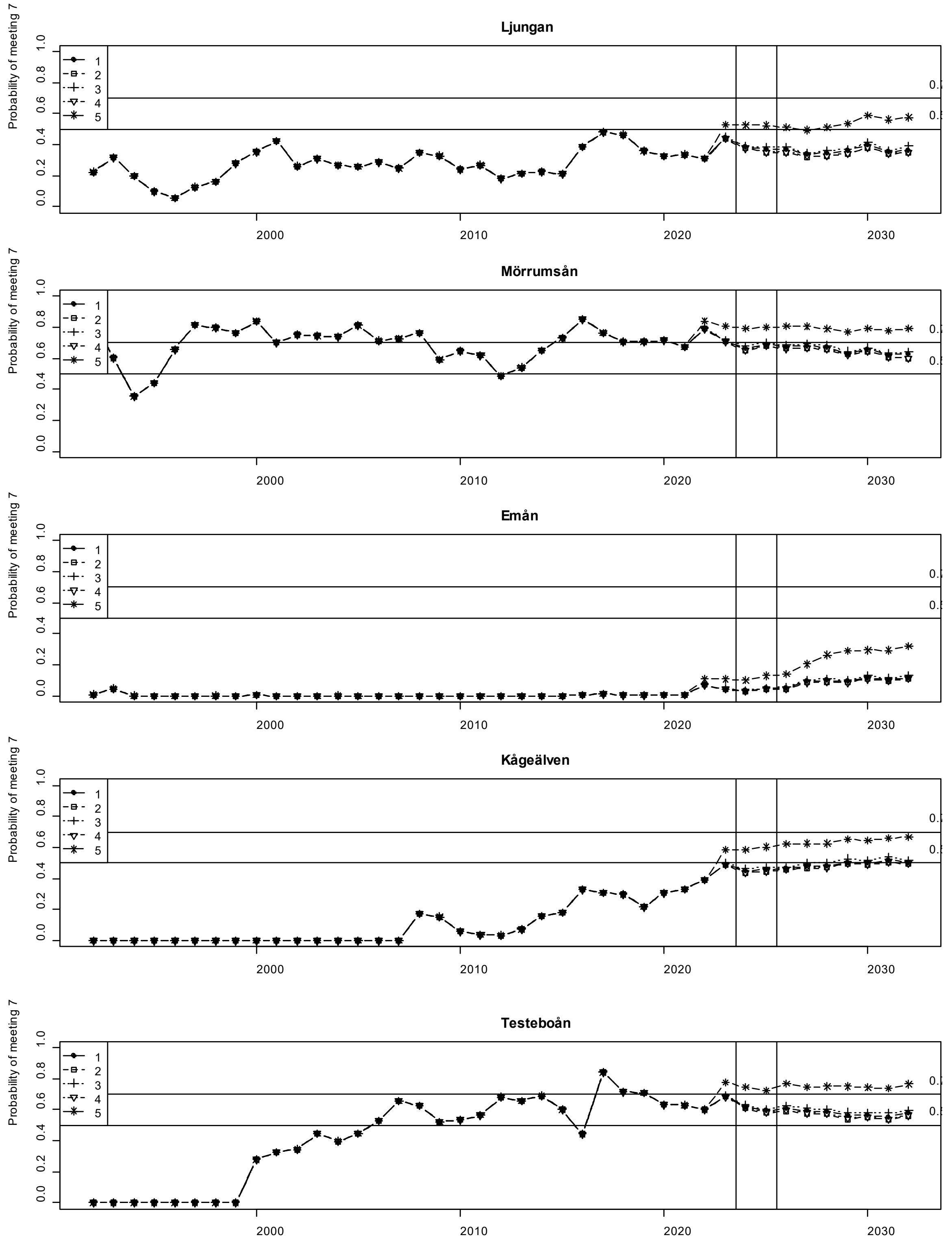

Figure 6d Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities for stocks to meet an objective of 75% of potential smolt production capacity (PSPC) under different projection scenarios. Horizontal lines represent the 50% and 70% probability of meeting 75% of PSPC. Fishing in 2020 mainly affects smolt production in the years 2024–2025 (between vertical lines).

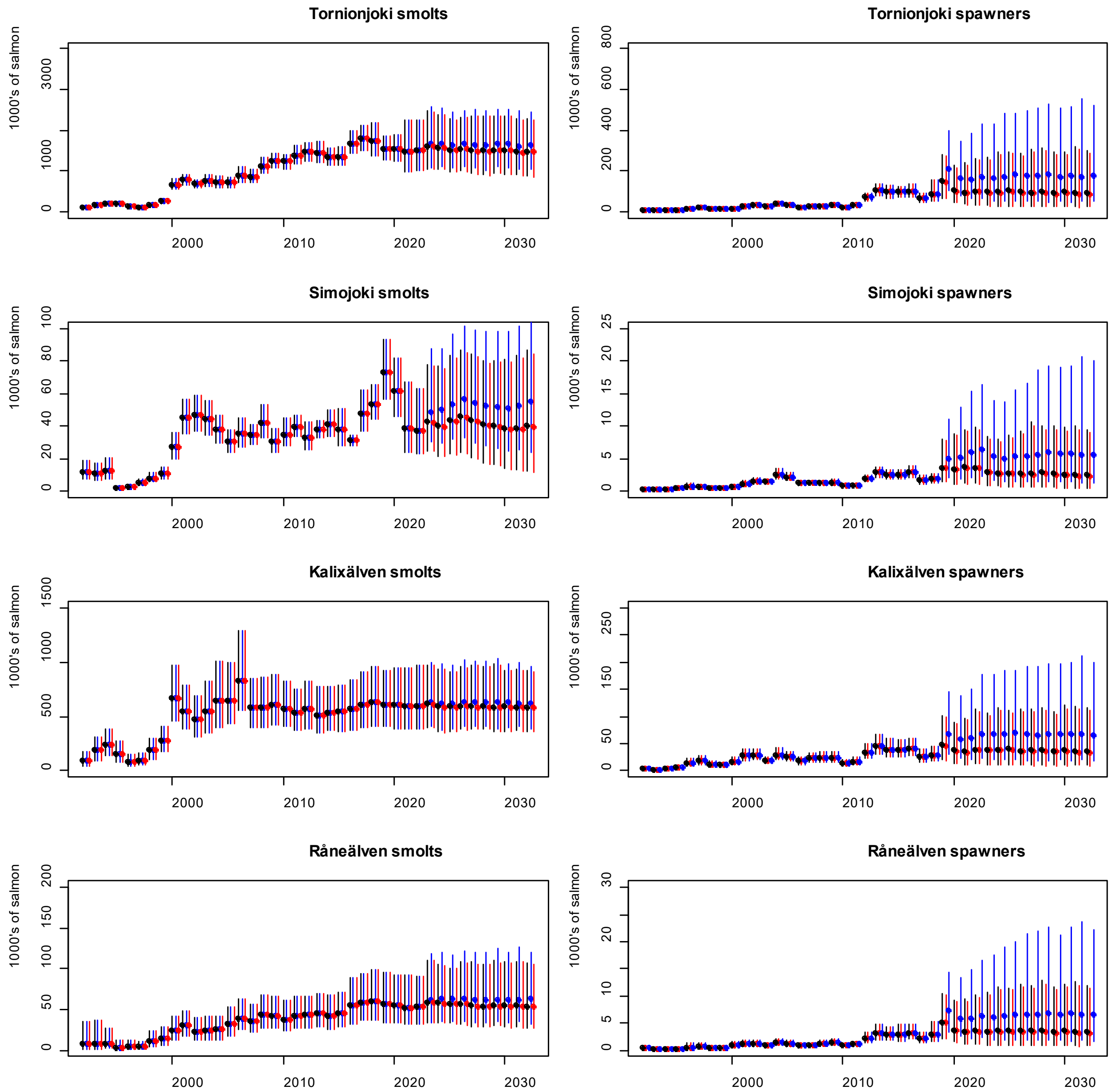

Figure 7a Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Median values and 90% probability intervals for smolt and spawner abundances in different rivers in projection scenarios 1 (black), 4 (red), and 5 (blue). Fishing in 2020 mainly affects smolt production in the years 2024–2025.

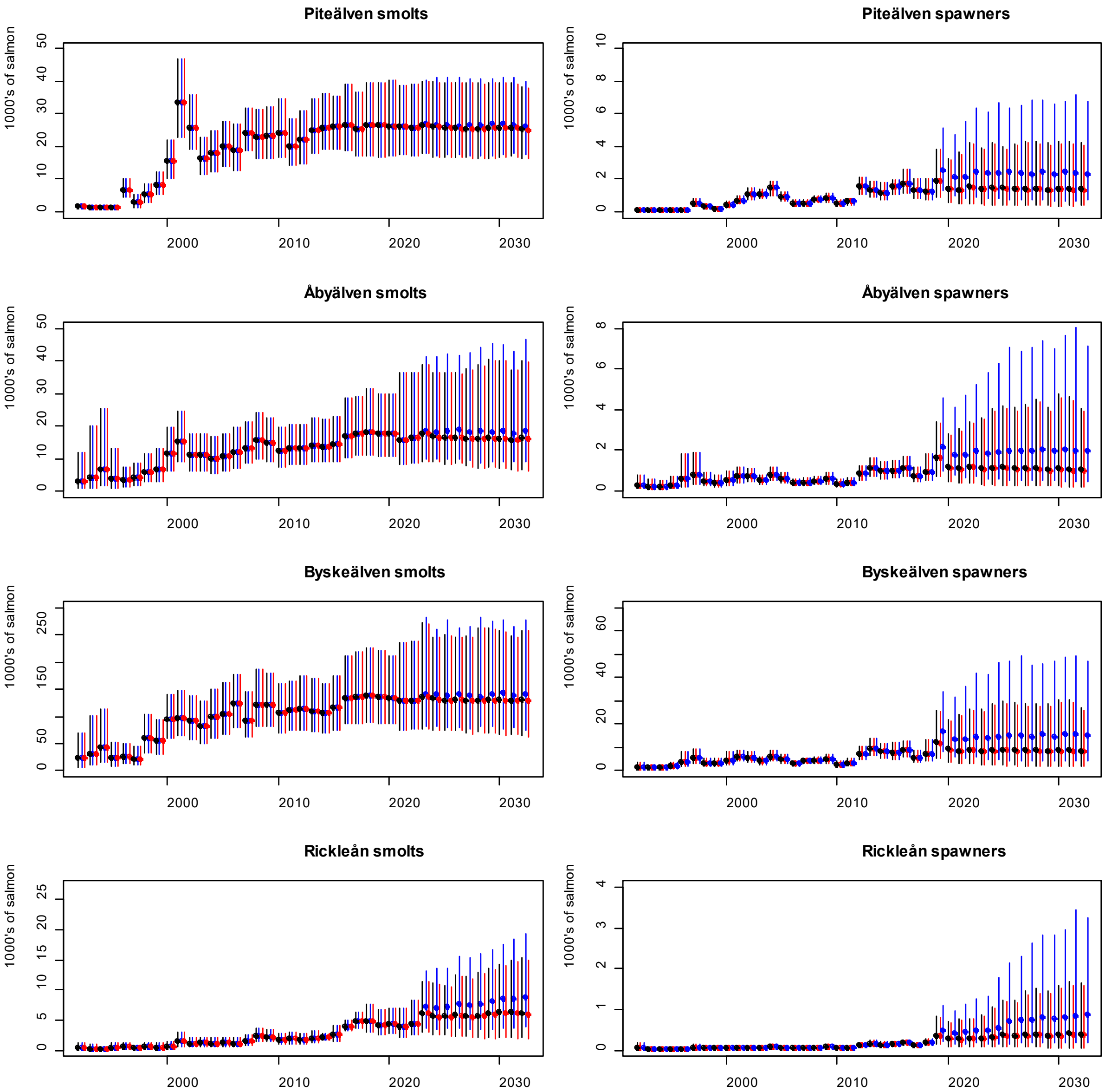

Figure 7b Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Median values and 90% probability intervals for smolt abundances in different rivers in projection scenarios 1 (black), 4 (red), and 5 (blue). Fishing in 2020 mainly affects smolt production in the years 2024–2025.

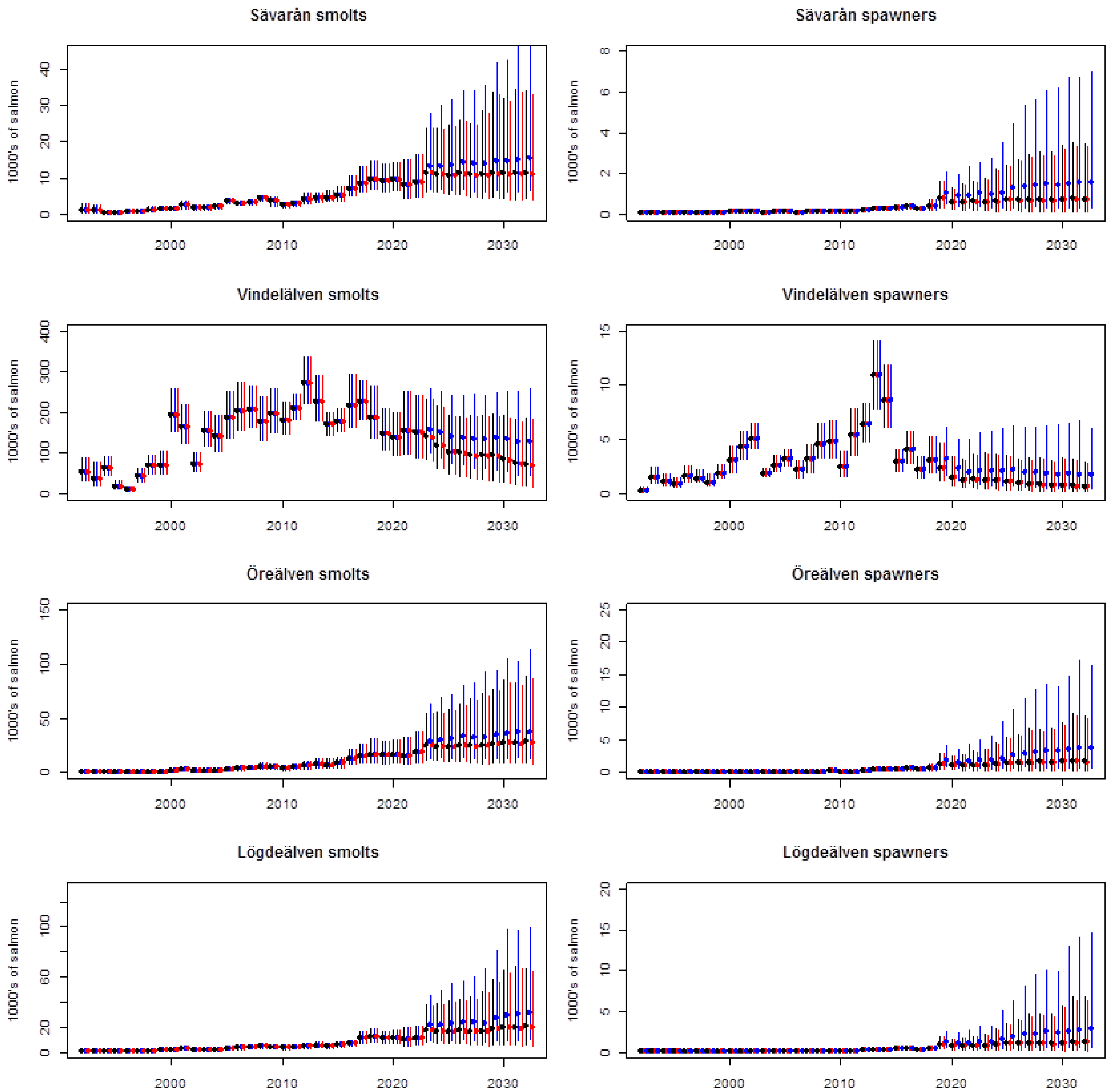

Figure 7c Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Median values and 90% probability intervals for smolt abundances in different rivers in projection scenarios 1 (black), 4 (red), and 5 (blue). Fishing in 2020 mainly affects smolt production in the years 2024–2025.

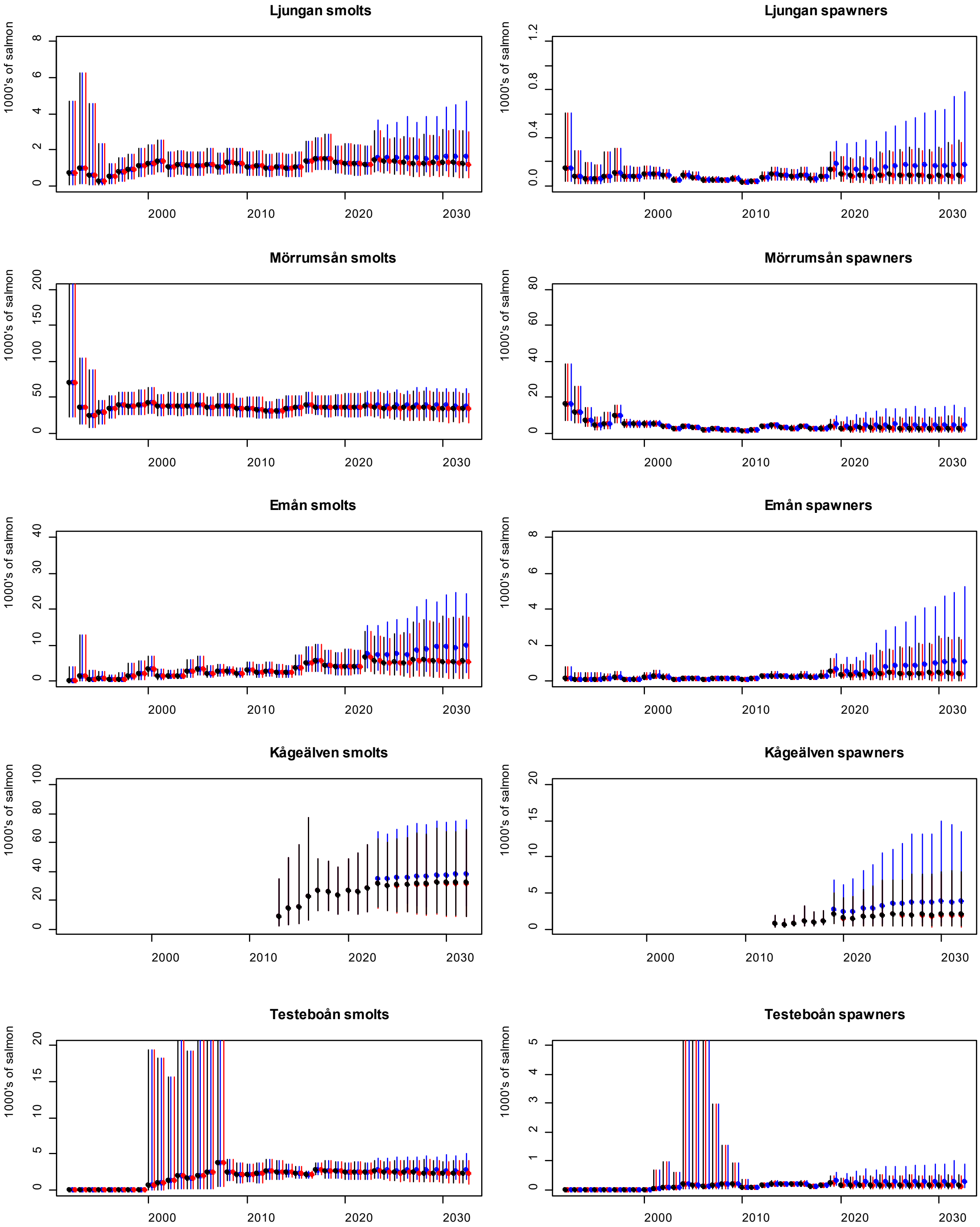

Figure 7d Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Median values and 90% probability intervals for smolt abundances in different rivers in projection scenarios 1 (black), 4 (red), and 5 (blue). Fishing in 2020 mainly affects smolt production in the years 2024–2025.

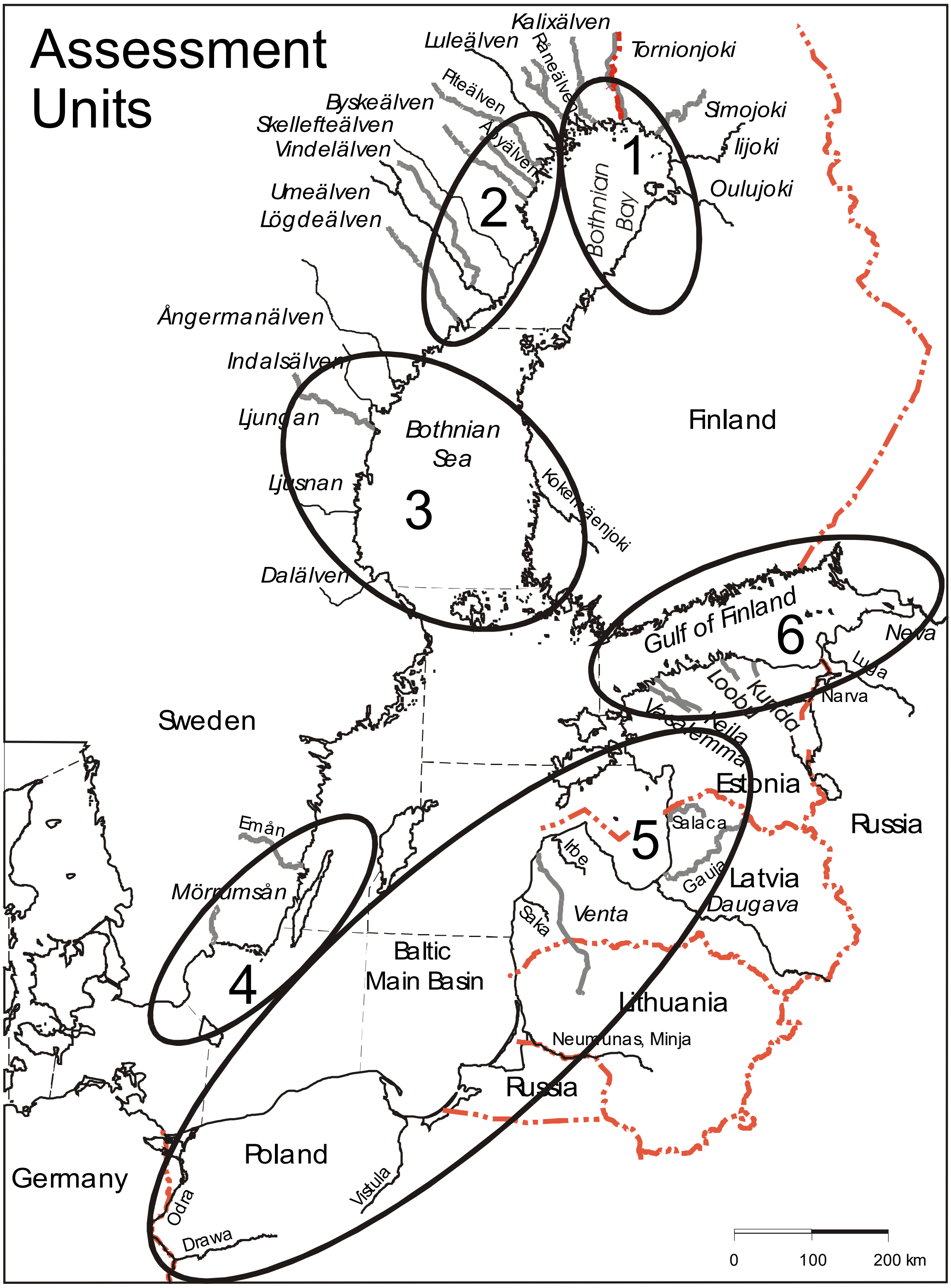

Figure 8 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Grouping of salmon stocks in six assessment units in the Baltic Sea, including the Gulf of Finland. The genetic variability between stocks of an assessment unit is smaller than the genetic variability between stocks of different units. In addition, the stocks of a particular unit exhibit similar migration patterns.

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