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

ICES advice on fishing opportunities

ICES advises that according to the MSY approach the catch of salmon in the mixed-stock sea fisheries (both commercial and recreational) should be zero in 2022.

ICES advises that if spatial-temporal management can be implemented, some fishing opportunities would be possible. Coastal fisheries in the Åland Sea and Gulf of Bothnia (SD29N-31) catch only salmon from rivers in assessment units (AUs) 1–3. ICES considers that if sea fishing can be confined to existing coastal fisheries during the spawning migration (beginning of May to the end of August) in the Gulf of Bothnia and the Åland Sea, total sea catch (both commercial and recreational) in these areas of no more than 75 000 salmon could be taken while allowing all stocks in AUs 1–4 to reach the reference point R_{lim} and without affecting weak stocks in AU 5.

Stock development over time

Catches and harvest rates of salmon have generally declined since 1990 (Figures 1 and 2). The pre-fishery abundance (PFA) of SD 22–31 salmon has declined since 2012 (Figure 3). Despite the overall increase in wild smolt production, the decline in natural post-smolt survival from the late 1980s until the mid-2000s (Figure 5) has impacted fishing opportunities. Survival of wild post-smolts has improved slightly since the mid-2000s, but without an obvious trend in recent years. Survival of hatchery-reared post-smolts is generally lower than wild post-smolt survival.

Time-series of total smolt production by AU indicate that this has improved over time (Figure 4). Since the Salmon Action Plan (ICES, 2008a) was adopted in 1997, total wild smolt production has increased tenfold in AU 1 and is currently fluctuating between the aggregate median values of R_{MSY} and potential smolt production capacity (PSPC) for stocks belonging to this AU. A similar tenfold increase since 1997 has been seen for AU 2, but this increase has been followed by a decline since 2018 due to a river-specific disease problem. These two AUs are the largest contributors to the overall (AUs 1–5) wild smolt production. Smolt production in AU 3 has shown an increase from near zero for the first part of the time-series and has then remained rather stable; in AU 4 it has remained at around the same level since the 1990s. Total AU-specific smolt productions in AUs 2–4 are currently fluctuating around their corresponding aggregate AU-specific median values of R_{MSY}. The current smolt production among most of the AU 5 stocks is estimated to a few percent of their respective PSPC and well below R_{lim}, which indicates that their status is very poor. Within AU 5, only two river stocks (wild Salaca and mixed Nemunas) show somewhat higher levels of smolt production. Smolt production for the Salaca river in AU 5 has been fluctuating and low for many years (Figure 4). However, based on current parr densities, the wild smolt production for this river is predicted to increase in 2021 to about 70% of the river's PSPC (Figure 4).

The current status of the 29 river stocks assessed in subdivisions 22–31 is shown in Tables 1a and 1b. Among the 17 analytically assessed stocks in AUs 1–4, the probability that smolt production reached R_{lim} in 2020 is above 50% for 14 stocks. Eight river stocks have more than 50% probability of being above R_{MSY} in 2020 (Table 1a). While there is no analytical assessment of rivers in AU 5, the smolt production of most wild salmon rivers in AU 5 (Table 1b) is considered to be well below R_{lim}. The recent average smolt production for the river Salaca is, however, considered to correspond to R_{lim}.

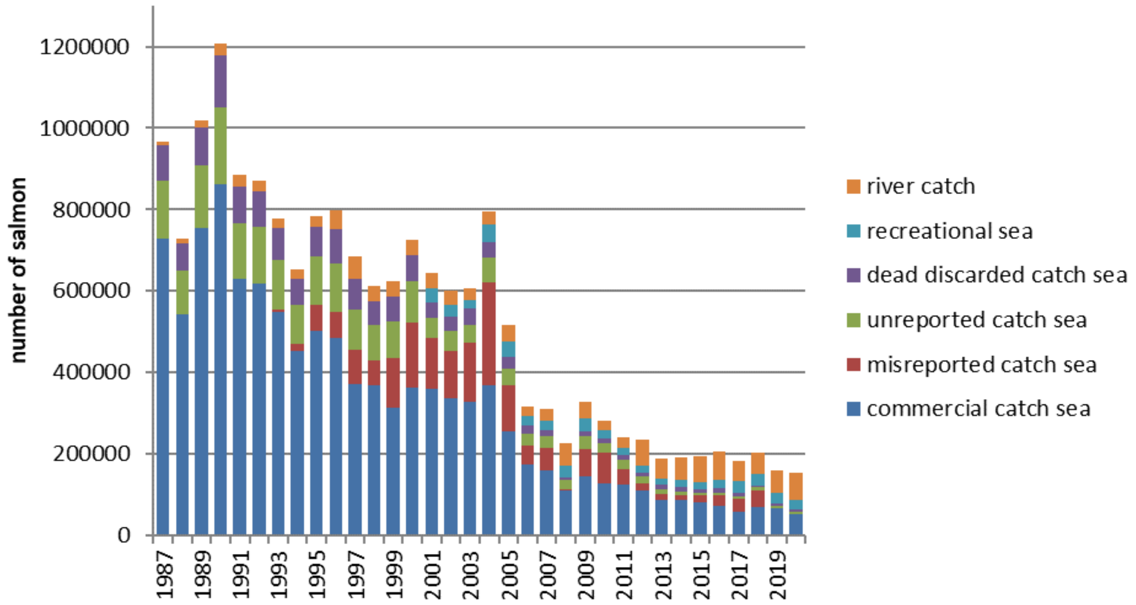

Figure 1 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Total number of removals (dead catch) in the years 1987–2020: river catches (mainly recreational, but also including some commercial fishing) and removals at sea (split into commercial and recreational nominal landings, unreported and misreported commercial landings, and dead discards). Note that commercial sea catch also includes recreational sea catch in the years 1987–2000.

Table 12 presents the total catch components based on the average proportion in all salmon fisheries in 2016–2020 in both the Main Basin and Gulf of Bothnia combined and the Gulf of Bothnia separately. Seal-damaged salmon are always dead, whereas some of the undersized salmon survive when discarded. River catches are calculated assuming a constant harvest rate in rivers on returning salmon, based on 2020 data.

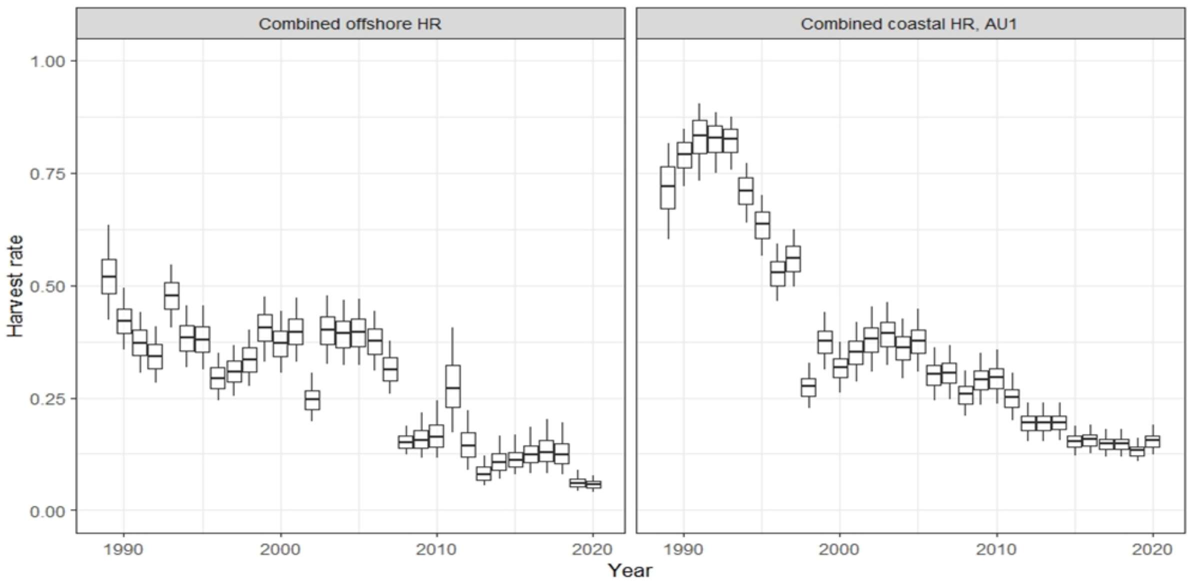

Figure 2 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Harvest rates (medians) in offshore (by fishing season; left panel) and coastal (by calendar year; right panel) fisheries for wild multi-sea-winter (MSW) salmon in 1989–2020 (all gears combined). The coastal harvest rate is displayed for salmon from AU 1 rivers (northeastern Bothnian Bay). Boxes and whiskers indicate 50% and 90% probability intervals, respectively.

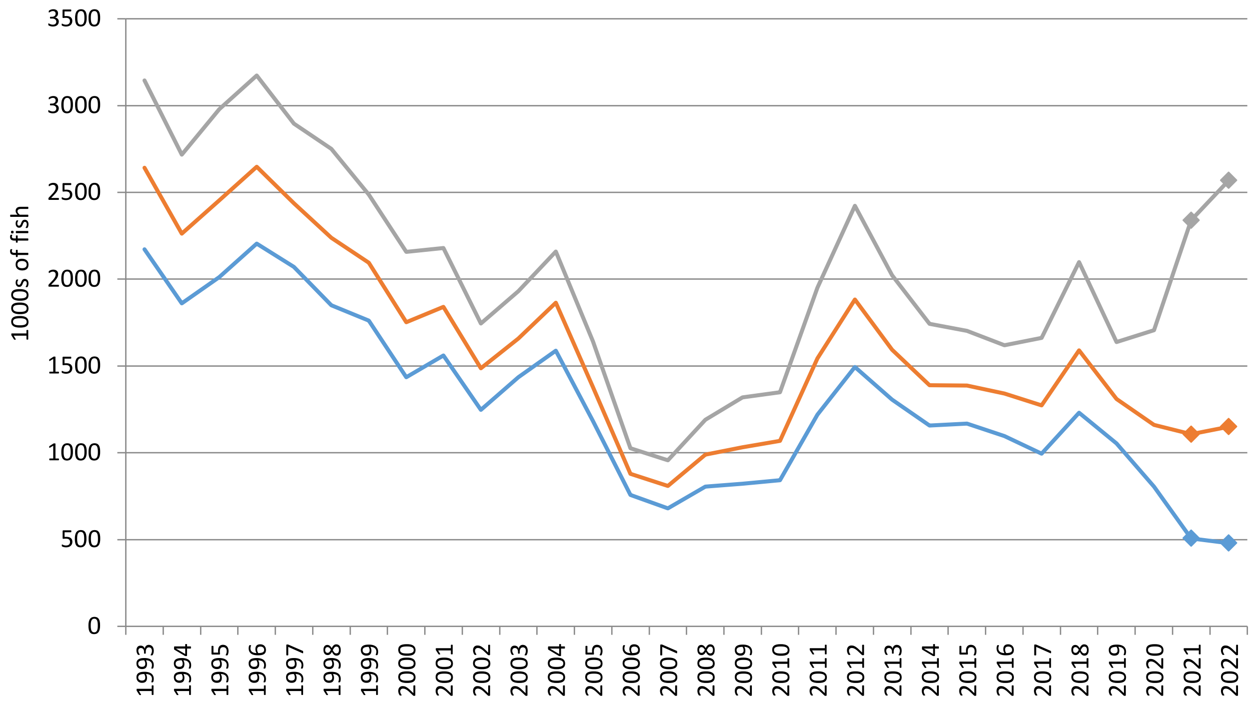

Figure 3 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Estimated pre-fishery abundance (PFA) in the sea, 1993–2022 (for wild and reared, one-sea-winter [1SW], and MSW combined). The median estimate and 90% probability intervals are plotted, with the diamond symbols indicating model projections (the 2021 projection uses the observed catch).

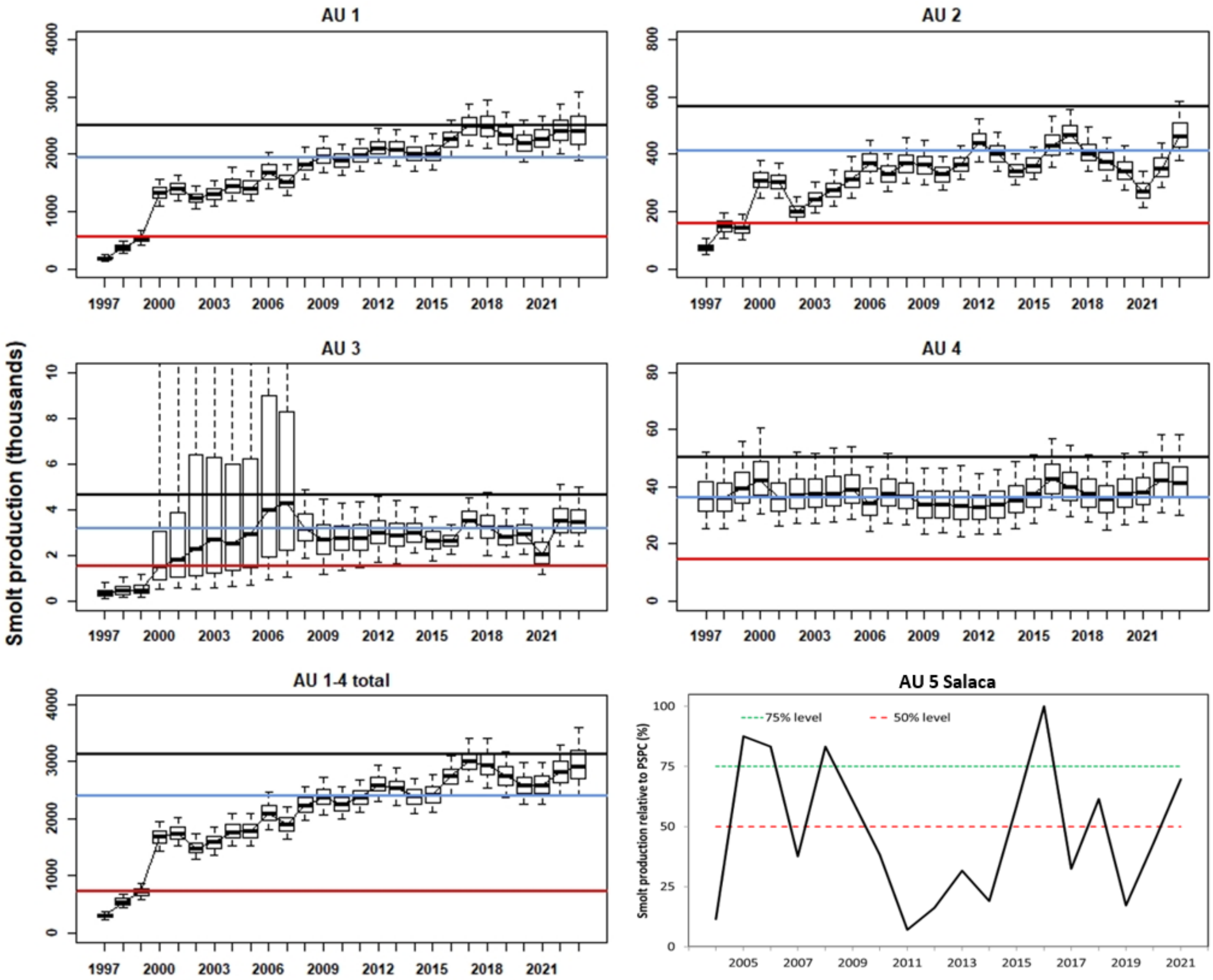

Figure 4 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Smolt production (median estimates - the boxes and whiskers indicate 50% and 90% probability intervals, respectively) relative posterior median for the unit-specific PSPC (black line), R_{MSY} (blue line), and R_{lim} (red line) in AUs 1–4. The smolt production estimates predicted for 2021–2023 are based on data collected until 2020. Bottom right panel: percentage of smolt production relative to PSPC in the Salaca river (AU 5), for which 50% (dashed red line) and 75% of PSPC (dashed green line) are shown as reference.

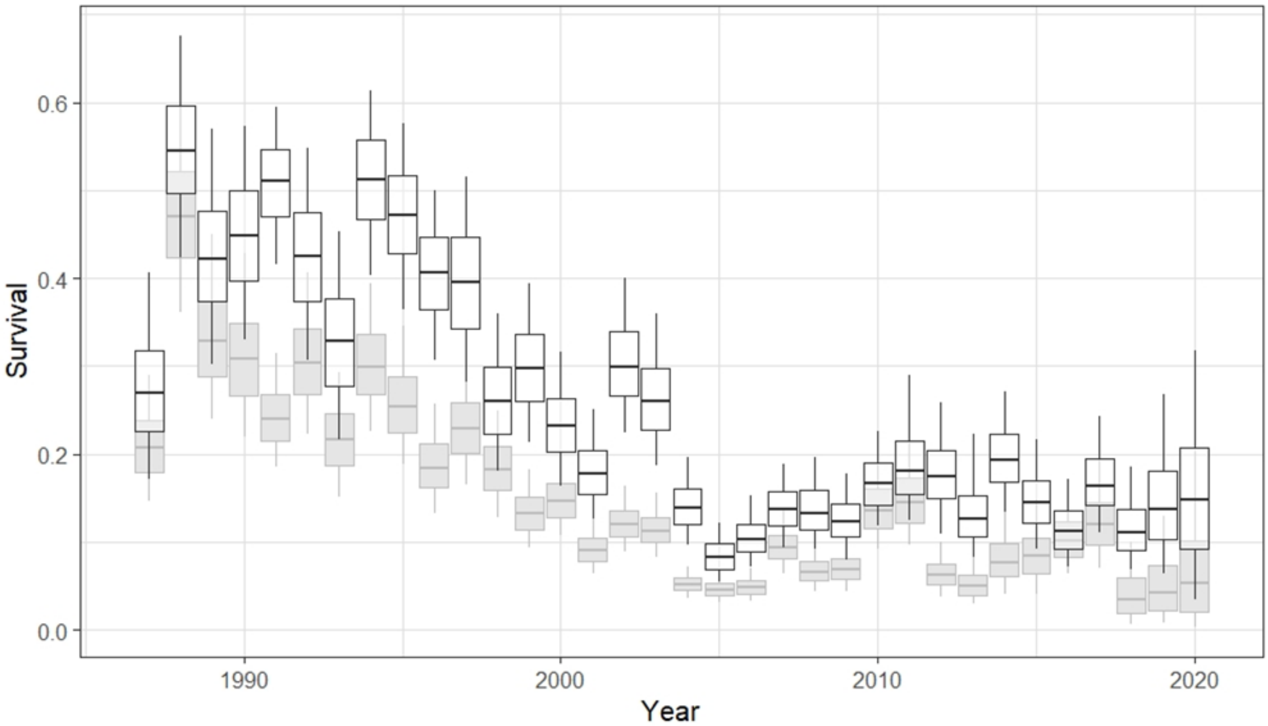

Figure 5 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Post-smolt survival (median) for wild (black boxplots) and hatchery-reared (grey boxplots) salmon per year of smoltification. Boxes and whiskers indicate 50% and 90% probability intervals, respectively.

Table 1a 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 stocks. AU 1–4 stocks are assessed in terms of the 2020 probability of having reached R_{MSY} and R_{lim}. The probability values have been classified into four groups: above 95%, between 70% and 95%, between 50% and 70%, and below 50%.

		R_{lim}					R_{msy}				
	Stock	Prob.	>95%	>70-95%	50-70%	<50%	Prob.	>95%	>70-95%	50-70%	<50%
AU 1	Tornionjoki	1.00	X				0.79		X		
	Simojoki	0.99	X				0.80		X		
	Kalixälven	1.00	X				0.68			X	
	Råneälven	0.99	X				0.60			X	
AU 2	Piteälven*	1.00	X				0.77		X		
	Åbyälven	0.88		X			0.44				X
	Byskeälven	1.00	X				0.74		X		
	Kågeälven	0.78		X			0.28				X
	Rickleån	0.65			X		0.09				X
	Sävarån	0.89		X			0.37				X
	Vindelälven	0.97	X				0.19				X
	Öreälven	0.62			X		0.17				X
	Lögdeälven	0.40				X	0.09				X
AU 3	Ljungan	0.38				X	0.21				X
	Testeboån*	0.99	X				0.75		X		
AU 4	Emån	0.28				X	0.09				X
	Mörrumsån	1.00	X				0.76		X		

* Status uncertain and most likely overestimated, see Section 4.4.2 in ICES (2021a) for additional information.

Table 1b 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 stocks. AU 5 stocks are assessed in terms of the year 2020 and the average smolt production in the years 2018–2020 in relation to PSPC.

	Stock	Category	Average smolt production (2018-2020) in relation to PSPC	Current smolt production (2020) in relation to PSPC
AU 5	Pärnu	mixed	< 1 %	3%
	Salaca	wild	40%	43%
	Vitrupe	wild	1%	1%
	Peterupe	wild	2%	< 1 %
	Gauja	mixed	4%	3%
	Daugava	mixed	< 1 %	NA
	Irbe	wild	3%	9%
	Venta	mixed	4%	5%
	Saka	wild	< 1 %	< 1 %
	Uzava	wild	< 1 %	3%
	Barta	wild	< 1 %	< 1 %
	Nemunas	mixed	21%	32%

Catch scenarios

Ten fishing scenarios were considered, using estimates of PFA at the beginning of 2022 (Table 2) and assuming full uptake of the TAC and similar recreational harvest in 2020. Scenario 1 illustrates stock development in the case that all fishing (both at sea and in rivers) is closed, whereas scenario 2 is similar but with the exception that only sea fisheries (both recreational and commercial) are closed but river fisheries continue (assumed constant effort). Scenarios 3–6 illustrate fishing scenarios with a differing degree of total catches at sea. Scenarios 7–10 assume that all coastal and offshore fisheries in subdivisions (SD) 22–28 and 29south are closed (both recreational and commercial), but coastal fisheries in the Gulf of Bothnia and the Åland Sea (in SDs 29north–31) would be allowed with various amounts of total catches. For management purposes, coastal salmon fisheries are those conducted between the beginning of May through the end of August within 4 nm of the shore.

In scenarios 2–10, in all rivers in AUs 1-4, fisheries are assumed to continue except in Kågeälven, Ljungan, Testeboån, and Emån according to current fishing regulations. ICES considers that scenario 2 corresponds to the MSY approach for the mixed-stock sea fishery.

The outlook table for 2022 (Table 2) presents the total sea catch and corresponding fishing mortality, the resulting river catch, the number of spawners, and the surplus of reared salmon.

Table 2 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Catch scenarios for 2022. All values in the table are in thousands of fish.***

Basis	Total commercial + recreational sea catch (2022)	F total sea catch (2022)	Projected total recreational catch (2022)	Projected total commercial catch (2022)	Projected river catch 2022	Spawners 2022*	% change in spawners ##	Projected reared surplus 2022**
ICES advice basis								
MSY approach#	0	0	0	0	52	156.4	−2	51.1
Other scenarios								
1	0	0	0	0	0	194.2	22	64.3
3	50	0.04	12.5	37.5	45.7	137.3	−14	44.9
4	100	0.09	25	75	40	119.4	−25	38.9
5	150	0.14	25	125	34.1	102.2	−36	33.2
6	200	0.19	25	175	28.5	84.6	−47	27.6
7	25	0.02	2	23	47.8	143.8	−10	46.7
8	50	0.04	4	46	43.5	130.9	−18	42.2
9	75	0.07	4	71	39.4	118.9	−25	38.0
10	100	0.09	4	96	35.1	106.3	−33	34.0

* Abundance at spawning time after fishing.
** Abundance after river fishing
*** The number of spawners and percentage of change according to scenarios are presented, but these are not used for assessment purposes in the absence of any spawner reference points.
# Scenario 2.
Spawners in 2022 relative to spawners in 2021 (159 000 fish).

In Figures 7a–d, the river-specific annual probabilities of meeting R_{MSY} under scenarios 1–6 are presented for the 17 wild rivers of AUs 1–4 included in the stock projections, whereas Figures 7e–h show the corresponding probabilities for scenarios 7–10. Tables 11a and 11b show the probabilities of meeting R_{lim} and R_{MSY}, respectively, in the smolt production of the years 2026 (stocks in AUs 1–3) and 2025 (stocks in AU 4) (year varies depending on smolt age), which reflect the direct, immediate effects of the 2022 fishing on future salmon smolt production (i.e. recruitment).

In scenarios 1–3 and 7–9, all the assessed river stocks (AU 1–4) have probabilities > 0.5 to meet R_{lim} in 2026/2025 . In scenarios 4–6 the stocks of Ljungan and Emån would fall below 0.5 probability to reach R_{lim}, while in scenario 10 only the stock of Ljungan would fall below this probability. There are no analytical assessment nor stock projections for the AU 5 river stocks. It is however considered that given their current low status, most river stocks in this unit would remain under

R_{lim} regardless of the chosen scenario. Scenarios 1, 2, and 7–10 (sea fisheries confined to the Gulf of Bothnia and Åland Sea) would reduce the exploitation rate of these AU 5 stocks and may increase their possibilities to recover.

The majority of the rivers in AUs 1–4 with a current low probability of reaching R_{MSY} in the years 2026 (stocks in AUs 1–3) and 2025 (stocks in AU 4) show positive trends under virtually all except the most extreme scenario (scenario 6, representing a clear increase in the exploitation rate [Figure 7]).

Scenarios 7–10 indicate very small differences between the exploitation rates and consequently between the probability of reaching R_{lim} in 2026/2025 in AUs 1–4 (Figures 7e–h). However, the probablity of reaching R_{lim} in 2026/2025 (Table 11a) is greater than 50% for scenarios 7–9. Under these scenarios, the weak stocks in AU 5 would not be affected by the sea fishery.

Compared to the current (2020) situation, the probabilities of meeting R_{lim} (and R_{MSY}) in 2026/2025 is higher for almost all river stocks with a current low status under these scenarios (Tables 11a and 11b), indicating a positive development for the weak AU 1–4 river stocks. For river stocks with a higher current status (probability of being at or above R_{MSY} > 0.5), the probabilities of fulfilling the targets in 2026/2025 will stay at approximately the same levels or increase compared to the current situation.

In the absence of assessment, the probabilities for AU 5 cannot be estimated; however, it is undoubtful that, in all scenarios, the status of the majority of rivers will remain weak, with some improvement for scenarios 1, 2, and 7–10.

Figures 8a–d display estimated past and projected future smolt production and spawner abundance under scenarios 1, 4, and 6. For scenarios 1 and 4, smolt production in 2026/2025 is expected to either remain around current levels or to increase, whereas for scenario 6 it is expected to decrease by a certain degree for some of the river stocks.

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 and recently withdrawn (EC, 2020).

There is no agreed multiannual management plan for Baltic salmon. Such a plan was proposed by the European Commission a decade ago (EC, 2011), and more recently managers from the Baltic Sea countries (BALTFISH) finalized an updated draft based on the original EC proposal. In a request from the EC, ICES was asked to evaluate parts of the new draft. A response to the request, where alternative management systems and objectives were evaluated and discussed, can be found in ICES (2020a, 2020b). In 2020, the EC decided to withdraw its proposed multiannual management plan for Baltic salmon (EC, 2020).

Quality of the assessment

Since the last full assessment in 2019, the following changes have been made:

- Smolt production at MSY (R_{MSY}) and limit smolt production (R_{lim}), calculated using river-specific stock–recruitment parameters and vital rates, are now used in evaluations of stock status instead of an MSY proxy (0.75 PSPC) used in earlier years.
- Offshore recreational trolling is now modelled as a separate fishery with annual variation in catchability in the full life-history model and scenarios.
- Annual variation in catchability was implemented for the longline and driftnet fisheries for grilse and MSW salmon.
- Maturation rates vary randomly only across years instead of across both years and age groups as before.
- Smolt trapping estimates for Åbyälven (2019–2020) were included in the river model.
- Recent changes in river regulations were taken into account in the projections.

The Baltic salmon assessment is comprehensive in the degree of uncertainty admitted. Uncertainties are accounted for in nearly all model parameters, as well as in many processes, including post-smolt survival, recruitment, maturation and catchabilities. While Baltic salmon in general is a data-rich system, there are large differences among stocks in the amount of data available. Expert knowledge together with hierarchical structures that allow flow of information between rivers are used to learn about data-limited salmon stocks. There is variation among stocks in the level of uncertainty, such that data-limited stocks can have a lower probability of reaching targets regardless of their true status.

Taken together, the changes to the assessment methods described above likely represent a slight increase in uncertainty relative to earlier years. A notable case of increased uncertainties is future harvest rates for fisheries that now have interannual variation in catchability (trolling and offshore longlining) and that are now much more uncertain than in previous years. For scenarios including these fisheries, uncertainty increases with the magnitude of the harvest rate.

There is a lack of data about the amount of salmon discarded, and even less about the proportion of discarded salmon that survive. There is also little information about the amount of seal-damaged (and assumed dead) salmon. The values used in this advice represent the current available knowledge and are based on data from a variety of sources. Expert judgement has been applied where data are unavailable or sparse. Current estimates of discards are therefore uncertain and should be considered approximate.

Independent information indicates that the assessment model likely overestimates the status of Testeboån and Piteälven and underestimates the smolt production in Ljungan (see Section 4.2.2 in ICES [2021a]). The exact reason for this is unknown.

There are also substantial uncertainties regarding the level of bycatch of salmon in fisheries targeting other species, such as the pelagic trawl fishery for herring and sprat and the coastal fishery for e.g. whitefish (ICES, 2021a).

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.

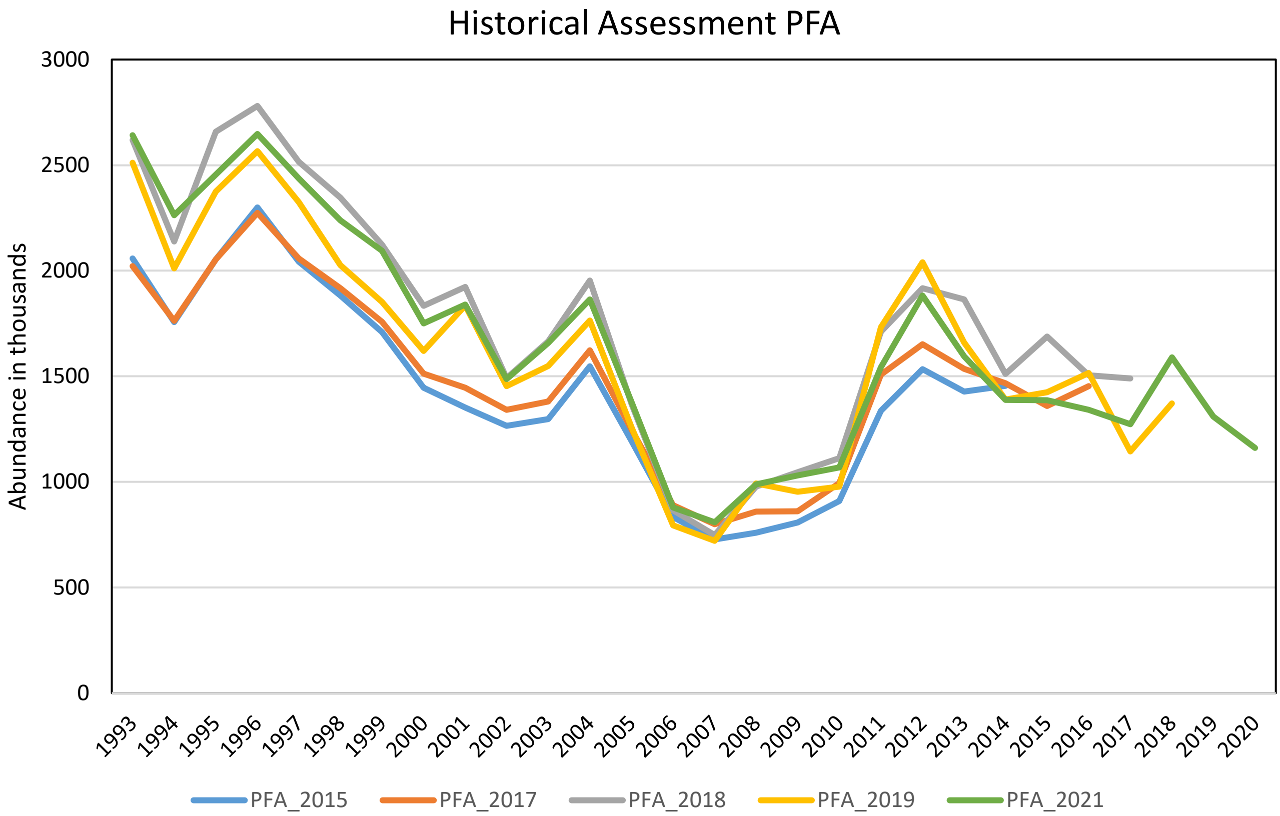

Figure 6 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Historical assessment results. Estimated pre-fishery abundance (PFA) in the sea (for wild and reared, 1SW, and MSW combined) until the assessment-specific advice year from the assessments in 2015 and 2017, 2018, 2019, and 2021 (no analytical assessment was performed in 2016 or 2020). 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

ICES notes that this advice, as requested by EC, only applies to the mixed-stock sea fisheries while taking into account the river catches. A large part of Baltic salmon fishing at sea is mixed-stock fisheries; this presents a particular management challenge as these fisheries are more likely to pose a threat to depleted stocks than fisheries on healthy (at or above MSY) wild or reared stocks in rivers as well as in estuaries or coastal areas (e.g. < 4 nm) where healthy single-river stocks dominate. Mixed-stock fisheries that catch weak wild stocks should be avoided. Ideally, management of salmon fisheries should be based on the status of individual river stocks.

The advice for 2022 represents a significant change compared to ICES advice provided in previous years. In 2020, ICES concluded (ICES, 2020a, 2020b) that under current conditions with a single TAC for SDs 22–31 and many stocks with variable status, any non-zero 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 protection of weak stocks. The advice on fishing opportunities for commercial sea fisheries provided previously has been a compromise between protecting weak stocks (via expected gradual improvement) and still allowing some exploitation of salmon by commercial sea fisheries. The 2020 Special Request Advice (ICES, 2020c) indicated that maintaining the mixed-stock sea fishery will negatively affect the recovery of the weak stocks and particularly the weakest river stocks from AU 5 that are found in the waters of the Main Basin when at sea. Most of these weak stocks from AU 5 are considered to be currently well below their respective limit reference point R_{lim} (ICES, 2021a). Therefore, to be consistent with the ICES MSY approach of maximizing yield while simultaneously sustaining all river stocks above R_{lim}, there is no scope for catches in the existing SD 22–31 mixed-fisheries as they exploit these weak stocks.

However, genetic analyses of catch samples from Sweden and Finland show that salmon from AUs 4–6 do not occur in catches during the spawning migration (May to August) in the Gulf of Bothnia or the Åland Sea [ICES, 2021a]). If the sea fishery is limited to that area and time, stock projections indicate that up to 75 000 salmon could be harvested while allowing all stocks in AUs 1–4 to be above R_{lim} (Table 11a) while not affecting the weakest AU 5 stocks.

Several of the weak river stocks in AU 5 have shown limited recovery to previous reductions in exploitation rates at sea, indicating the need for longer term stock-specific rebuilding measures. Besides reduced exploitation rates in offshore and coastal fisheries, additional measures focusing on freshwater fishing, such as fisheries regulations in estuaries and rivers and actions to reduce poaching where necessary, are likely necessary for these stocks to recover. Also, non-fishery-related actions, including habitat restoration and removal of physical barriers, may be necessary (ICES, 2020c).

In some recreational trolling fisheries there is compulsory releasing of wild salmon. However, given the estimate of post-release mortality (25%) currently used in the assessment, ICES considers that this measure is not sufficient to protect the weak wild salmon stocks.

The increased disease-related mortality observed among spawners in rivers Vindelälven (AU 2) and Ljungan (AU 3) during the last few years is anticipated to result in a successive reduction in smolt production from 2019 for a few years onwards in these rivers. More restrictive local regulations of fisheries have been applied since 2019 in both Vindelälven and Ljungan to reduce exploitation rates on migrating spawners, both when they pass the estuaries and during their upstream migration in the rivers. The development of the stocks and the effects of introduced regulations should be carefully monitored.

Reference points

From 2008 to 2020, ICES used 75% of the unfished equilibrium smolt production (PSPC) as a proxy for MSY for each river stock (ICES, 2008a, 2008b, 2020b). In 2020, ICES advised (ICES, 2020c) that the 75% PSPC proxy deviates from the objective of achieving maximum yield for several of the river stocks and defined reference points (R_{MSY} and R_{lim}) that are consistent with MSY on a river stock and AU basis.

R_{MSY} is defined as the smolt production required to produce the maximum sustainable yield (MSY).

R_{lim} is defined as the lowest level of smolt production from which a stock is expected to recover to R_{MSY} in one salmon generation (i.e. six–seven years) if all fishing is closed.

ICES considers that R_{lim} should be avoided in the short term with at least 50 % probability.

Both R_{MSY} and R_{lim} are calculated using stock–recruitment parameters and equilibrium vital rates for each stock.

Since salmon in AU 5 are yet to have an analytical assessment, it has not been possible to evaluate the. R_{lim} and R_{MSY} reference points. Therefore, the status of the AU is evaluated against previous proxy reference points related to PSPC (50% and 75% of PSPC). Estimates of smolt production for AU 5 river stocks are mainly based on parr density data in combination with expert judgement about parr-to-smolt mortality rates. ICES notes that 20–40% of PSPC roughly corresponds to R_{lim} estimates for AU 1–4 stocks (ICES, 2021a).

Table 4 Summary statistics for probability distributions of smolt production at maximum sustainable yield (MSY; in thousands), smolt production corresponding to recovery to MSY level in one generation's time (limit smolt production; in thousands), and long-term equilibrium unfished smolt production (R_0; in thousands) in AU 1–4 rivers. These estimates serve as reference points to evaluate the status of the stocks (Tables 1a and 1b). The posterior distributions are summarized in terms of their median, mean, and 90% probability interval (PI).

		MSY smolt production			Limit smolt production			Equilibrium smolt production		
		Median	Mean	90% PI	Median	Mean	90% PI	Median	Mean	90% PI
Assessment Unit (AU) 1										
1	Tornionjoki	1303	1317	1121–1564	403	405	314–509	1700	1722	1510–2047
2	Simojoki	32	32	23–45	16	17	12–25	48	49	37–67
3	Kalixälven	540	547	411–707	123	123	71–175	660	670	522–849
4	Råneälven	46	50	28–82	15	17	9–29	61	67	39–108
Total		1937	1946	1651–2278	562	562	441–680	2493	2508	2206–2879
Assessment Unit (AU) 2										
5	Piteälven	22	22	19–27	4	4	2–6	26	26	23–31
6	Åbyälven	6	8	3–19	2	3	1–8	8	11	4–27
7	Byskeälven	102	109	66–178	29	31	17–49	131	140	89–223
8	Kågeälven	22	23	9–37	10	10	5–18	32	33	16–53
9	Rickleån	7	8	4–14	3	4	2–6	11	11	6–20
10	Sävarån	9	11	5–24	4	5	2–12	14	16	7–36
11	Ume/Vindelälven	159	160	126–200	68	69	53–90	227	229	189–282
12	Öreälven	29	37	10–89	12	14	4–35	41	51	14–122
13	Lögdeälven	31	39	12–91	15	19	5–44	46	58	17–135
Total		410	417	319–543	157	160	126–205	568	577	462–733
Assessment Unit (AU) 3										
14	Ljungan	0.9	1.5	0.4–4.7	0.6	1	0.1–3.3	1.5	2.5	0.5–7.8
15	Testeboån	2.1	2.2	1.5–3.1	0.8	0.8	0.4–1.5	2.8	3	2.1–4.4
Total		3.2	3.7	2.0–7.2	1.5	1.8	0.7–4.2	4.6	5.5	3.0–11.3
Assessment Unit (AU) 4										
16	Emån	8	9	3–17	5	6	2–10	13	14	5–27
17	Mörrumsån	28	28	20–36	9	9	2–16	36	37	30–47
Total		36	36	25–49	15	15	7–23	50	51	38–69
Total assessment units 1–4		2397	2403	2047–2772	738	739	613–867	3130	3142	2772–3558

Basis of the assessment

ICES uses five assessment units (AUs) for salmon in the Baltic Main Basin and the Gulf of Bothnia (Figure 9). 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. It is assumed, therefore, that these stocks are subject to the same fisheries, experience the same exploitation rates, and respond equally to a similar use of management tools (e.g. coastal management measures might improve the status of all stocks in a specific unit). Even though the stocks in AUs 1–3 have the highest current smolt productions and thus 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 5 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Assessment units.

Assessment unit (AU)	Name	Salmon rivers included
1	Northeastern Bothnian Bay stocks	On the Finnish–Swedish coast from Perhonjoki northwards 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 northwards 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 6 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). The basis of the assessment.

ICES stock data category	1 (ICES, 2021b)
Assessment type	Bayesian state–space model for all wild salmon 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 (ICES, 2021a).
Input data	Commercial removals (international landings and effort by fishery [1987–2020], 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 last benchmark was conducted in 2017 (WKBaltSalmon; ICES, 2017)
Working group	Assessment Working Group on Baltic Salmon and Trout (WGBAST)

History of the advice, catch, and management

Table 7 Salmon in subdivisions 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 2020 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

Year	ICES advice	Predicted catch corresponding to advice	TAC†	Commercial reported landings at sea††	Landings at sea^	Catch at sea^^	River catch^^^
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
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, and 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, and 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, and 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, and wanted and misreported, are given in brackets)	116 (9%, 68%, 7.0%, 16%)	91	69	94	157	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, and wanted and misreported, are given in brackets)	116 (10%, 55%, 6%, 29%)	91	65	94	106	54
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, and wanted and misreported, are given in brackets)	116 (11%, 52%, 5%, 32%)	87	52	77	88	66
2021	Precautionary approach	116 (9%, 83%, 7%, 1%)	94				
2022	MSY approach	0					

† 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, misreported catch, and unreported catch.
^^^ Estimated total catches including unreporting.
* Value corresponds to total commercial sea removals, including reported landings, unreported catches, misreported catches, and dead discards.

History of catch and landings

Table 8 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Catch distribution by category in 2020 as estimated by ICES (median values from probability distributions).

<table>
<tr><th>Catch (2020; dead catch, including recreational and river catches)</th><th colspan="2">Landings</th><th>Discards (dead)*</th></tr>
<tr><td rowspan="2">930 tonnes</td><td>Nominal landings
(commercial and recreational at sea and in rivers)
96.5%</td><td>Unreported and misreported
3.5%</td><td rowspan="2">32 tonnes</td></tr>
<tr><td colspan="2">898 tonnes</td></tr>
</table>

* Dead discards are from seal damage and the estimated mortality of small salmon that are discarded in the commercial fisheries. Estimates of unreported and misreported catch include both commercial and recreational fisheries.

Table 9 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Nominal landings (reported; both commercial and recreational) of Baltic salmon in round fresh weight (in tonnes) and in thousands of fish: landings from rivers, coast, and offshore; total; commercial (in thousands) from coast and offshore combined; agreed TAC for subdivisions 22–31.

Year	Rivers		Coast		Offshore		Total		Coast and offshore*	TAC
	tonnes	thousands	tonnes	thousands	tonnes	thousands	tonnes	thousands	thousands	thousands
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	31	583	125	1201	267	1940	424	359	450
2002	137	28	582	125	1039	241	1758	394	338	450
2003	103	22	426	113	994	239	1523	374	329	460
2004	129	25	774	159	1103	252	2006	436	368	460
2005	167	31	606	115	854	179	1627	325	256	460
2006	95	19	397	69	617	128	1109	216	174	460
2007	142	23	339	68	539	115	1019	206	161	437
2008	256	45	456	91	194	46	906	182	110	371
2009	177	32	572	116	259	60	1008	208	145	310
2010	113	18	387	69	357	79	857	166	127	294
2011	125	20	393	69	335	74	852	163	125	250
2012	322	50	434	69	261	58	1017	176	110	123
2013	260	39	446	69	166	33	872	141	88	109
2014	312	43	452	74	163	31	927	148	86	106
2015	316	49	400	71	143	28	860	148	82	96
2016	350	53	436	67	126	27	912	147	72	96
2017	202	39	372	58	143	28	717	125	59	96
2018	227	42	419	60	190	36	836	138	69	91
2019	295	44	413	60	210	34	918	134	66	91
2020**	319	53	345	54	149	23	816	130	52	87

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

** Preliminary.

Table 10 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 of fish, 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 2020 are preliminary. Data for earlier years can be found in ICES (2018).

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	135714	7717	29002	1205	35606	7392	159480	469789	126100	61170	47380–83050	41110	37480–45670	17830	13360–25000
2002	76122	3247	116533	5762	21808	3351	39374	13230	146197	425624	115000	6774	6565–7073	41110	37480–45670	17100	12830–23720
2003	108845	2055	112662	5766	11339	1040	35800	4413	119820	401740	143200	61170	47380–83050	38060	34710–42180	19300	14360–27390
2004	81425	1452	143107	7087	7700	704	17650	5480	199335	463940	254300	59300	45650–81710	42840	38730–48060	658300	643600–681600
2005	42491	1721	124427	4799	5629	698	22896	3069	150174	355904	110800	52870	40430–73970	43480	39190–49310	603000	588500–626500
2006	33723	1628	73092	3551	3195	488	22207	1002	102339	241225	46900	67370	50670–97160	30370	27930–33530	603000	589200–625400
2007	16145	1315	83544	3086	5318	537	18988	1408	98076	228417	54310	53690	41130–75030	22470	20800–24550	789400	771100–819900
2008	7363	1890	86749	4151	2016	539	8650	1382	94066	206806	3295	37040	28280–51740	18350	17060–20010	518500	505200–540500
2009	17116	2064	82000	2799	3323	310	9873	584	112971	231040	66510	35710	27580–49130	9723	9200–10490	322700	313600–337900
2010	29714	1459	48281	1520	2307	243	9520	491	84774	178309	74810	37770	28350–54050	13450	12200–15200	315000	306600–328700
2011	21125	1332	52350	1483	1470	317	6149	470	93454	178150	37000	42860	31690–63940	12190	10710–14240	242800	233300–259200
2012	23180	1915	77434	1362	1371	355	5605	412	85834	197468	17500	29970	22690–43240	11490	10520–12830	340100	328600–361600
2013	25461	2426	59764	1210	2842	285	4808	387	62972	160155	15000	31360	23630–45310	9738	8939–10920	282900	275200–296600
2014	24596	2139	71906	1264	2650	388	2999	418	58488	164848	13600	34430	26410–47440	12540	10620–14430	243900	236000–258100
2015	19367	2597	65746	2009	2572	2580	3745	406	63361	162383	16600	22740	16990–32200	10640	8965–12260	246600	238500–259700
2016	17701	3180	65356	1623	2881	3803	3659	419	62549	161171	26000	22080	16390–31110	10640	9274–11810	196100	190300–205700
2017	9644	3005	55193	5632	2435	1702	10760	380	50771	139522	32000	21920	16450–30700	11010	9678–11890	198900	193200–208000
2018	14933	2569	50939	6613	1531	2223	12642	458	60330	144101	42600	22820	17140–32050	10640	9052–11520	199200	193700–208000
2019	15413	2775	58743	6502	4118	1836	12061	602	51361	153411	600	16240	12220–22790	5874	5446–6458	209000	203300–218300
2020	12517	2591	56411	1605	3366	2868	7820	752	57364	145294	200	17830	13360–25000	6989	6733–7366	186600	182500–193200

Summary of the assessment

Table 11a Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). River stock and AU specific probabilities of achieving R_{lim} in year 2026 (AUs 1–3) or 2025 (AU 4 [year depends on smolt age]) under different projection scenarios (ICES, 2021a). The probability values are indicated by the different colours: lower than 50% (red), between 50 and 70% (yellow), between 70 and 95% (light green) and above 95% (dark green). The current status values refer to level of smolt production in 2020 (the last available data year [Table 1]). The current status of Piteälven and Testeboån are likely overestimated (ICES, 2021a).

AU	River	Current status	Probability to meet R_{lim} Scenario 1	2	3	4	5	6	7	8	9	10
1	Tornionjoki	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Simojoki	0.99	0.99	0.97	0.97	0.95	0.93	0.88	0.97	0.96	0.95	0.94
	Kalixälven	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Råneälven	0.99	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00
2	Piteälven*	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Åbyälven	0.88	0.98	0.97	0.96	0.95	0.93	0.91	0.96	0.96	0.95	0.95
	Byskeälven	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Kågeälven	0.78	0.92	0.92	0.90	0.87	0.83	0.80	0.91	0.90	0.88	0.86
	Rickleån	0.65	0.95	0.91	0.89	0.86	0.81	0.75	0.90	0.89	0.87	0.84
	Sävarån	0.89	0.97	0.95	0.94	0.92	0.89	0.85	0.94	0.94	0.93	0.91
	Vindelälven	0.97	1.00	0.99	0.99	0.99	0.98	0.96	0.99	0.99	0.99	0.98
	Öreälven	0.62	0.95	0.91	0.89	0.87	0.84	0.80	0.90	0.89	0.87	0.86
	Lögdeälven	0.40	0.81	0.75	0.72	0.67	0.62	0.55	0.73	0.72	0.69	0.66
3	Ljungan	0.38	0.54	0.54	0.52	0.49	0.46	0.42	0.53	0.51	0.51	0.49
	Testeboån*	0.99	0.99	0.99	0.98	0.98	0.97	0.96	0.99	0.98	0.98	0.98
4	Emån	0.28	0.54	0.54	0.51	0.49	0.46	0.43	0.54	0.54	0.54	0.54
	Mörrumsån	1.00	1.00	0.99	0.99	0.99	0.99	0.98	0.99	0.99	0.99	0.99
5	Salaca		↗	↗					↗	↗	↗	↗
	Vitrupe		↗	↗					↗	↗	↗	↗
	Peterupe		↗	↗					↗	↗	↗	↗
	Irbe		↗	↗					↗	↗	↗	↗
	Saka		↗	↗					↗	↗	↗	↗
	Uzava		↗	↗					↗	↗	↗	↗
	Barta		↗	↗					↗	↗	↗	↗

* Status uncertain and most likely overestimated, see Section 4.4.2 in ICES (2021a) for additional information.

Table 11b Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). River stock and AU specific probabilities of achieving R_{MSY} in year 2026 (AUs 1–3) or 2025 (AU 4 [year depends on smolt age]) under different projection scenarios (ICES, 2021a). Current status refers to 2020 (last year with data). **T**he probability values are indicated by the different colours marking probabilities lower than 50% (red), between 50 and 70% (yellow) and between 70 and 95% (light green). The current status values refer to level of smolt production in 2020 (Table 1). The current status of Piteälven and Testeboån are likely overestimated (ICES, 2021a).

AU	River	Current status	Probability to meet R_{MSY} Scenario 1	2	3	4	5	6	7	8	9	10
1	Tornionjoki	0.79	0.86	0.81	0.78	0.73	0.69	0.62	0.79	0.77	0.74	0.71
	Simojoki	0.80	0.83	0.74	0.68	0.59	0.50	0.39	0.71	0.66	0.60	0.54
	Kalixälven	0.68	0.81	0.80	0.77	0.75	0.71	0.66	0.78	0.77	0.75	0.73
	Råneälven	0.60	0.83	0.77	0.73	0.68	0.61	0.53	0.75	0.72	0.69	0.64
2	Piteälven*	0.77	0.76	0.74	0.73	0.71	0.70	0.68	0.74	0.73	0.72	0.71
	Åbyälven	0.44	0.73	0.65	0.62	0.57	0.52	0.45	0.64	0.61	0.59	0.56
	Byskeälven	0.74	0.83	0.80	0.79	0.76	0.72	0.67	0.79	0.78	0.77	0.75
	Kågeälven	0.28	0.62	0.62	0.58	0.52	0.46	0.38	0.60	0.58	0.54	0.51
	Rickleån	0.09	0.48	0.37	0.32	0.27	0.22	0.16	0.35	0.32	0.29	0.26
	Sävarån	0.37	0.68	0.58	0.53	0.48	0.41	0.33	0.56	0.52	0.49	0.45
	Vindelälven	0.19	0.77	0.67	0.63	0.57	0.49	0.40	0.65	0.62	0.59	0.55
	Öreälven	0.17	0.50	0.41	0.38	0.32	0.27	0.23	0.39	0.37	0.33	0.30
	Lögdeälven	0.09	0.36	0.27	0.24	0.20	0.17	0.13	0.26	0.23	0.21	0.19
3	Ljungan	0.21	0.38	0.38	0.35	0.32	0.28	0.24	0.36	0.35	0.33	0.31
	Testeboån*	0.75	0.80	0.80	0.78	0.76	0.72	0.66	0.80	0.78	0.77	0.75
4	Emån	0.09	0.28	0.28	0.26	0.24	0.22	0.20	0.28	0.28	0.28	0.28
	Mörrumsån	0.76	0.81	0.75	0.74	0.72	0.70	0.68	0.75	0.75	0.75	0.75
5	Salaca		↗	↗					↗	↗	↗	↗
	Vitrupe		↗	↗					↗	↗	↗	↗
	Peterupe		↗	↗					↗	↗	↗	↗
	Irbe		↗	↗					↗	↗	↗	↗
	Saka		↗	↗					↗	↗	↗	↗
	Uzava		↗	↗					↗	↗	↗	↗
	Barta		↗	↗					↗	↗	↗	↗

* Status uncertain and most likely overestimated, see Section 4.4.2 in ICES (2021a) for additional information.

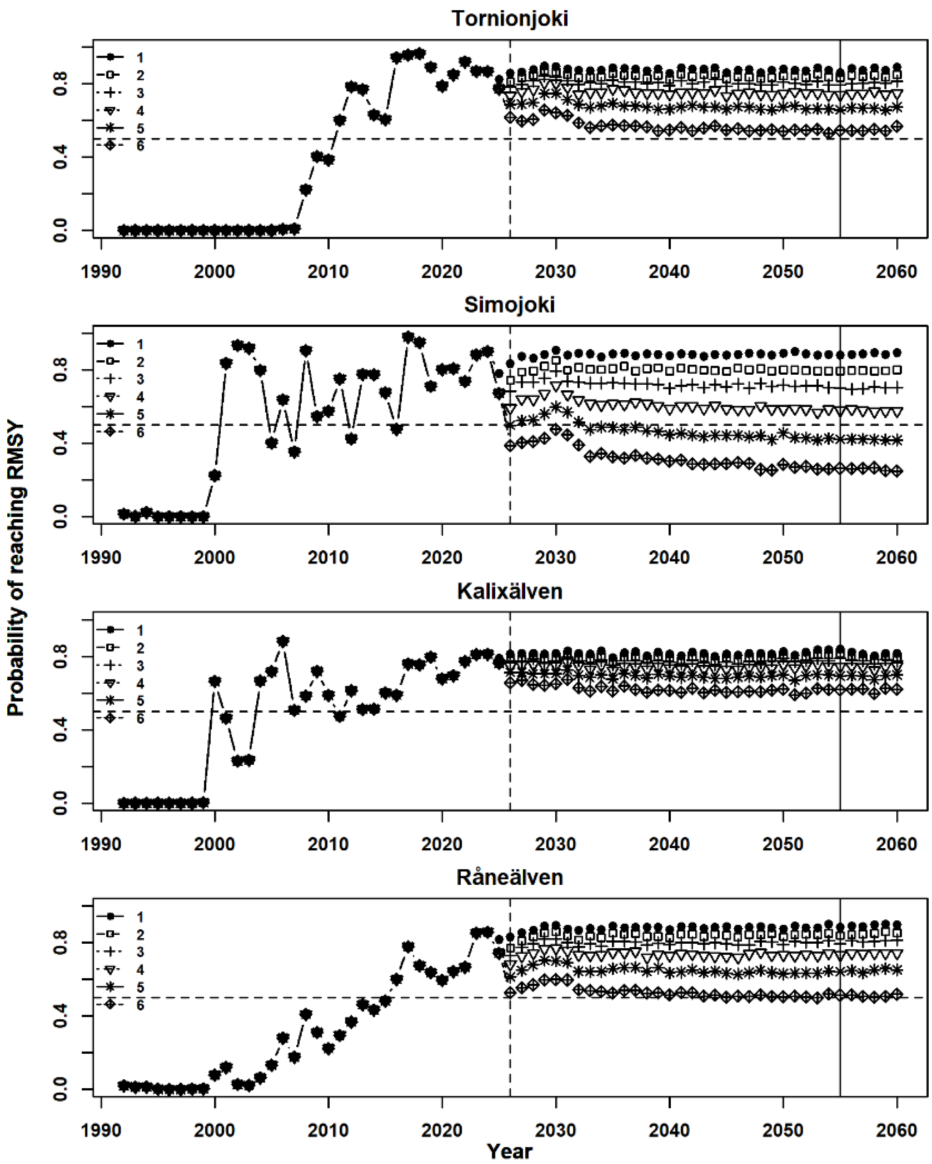

Figure 7a Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 1–6. Vertical lines mark predicted status in 2026 (AUs 1–3) or 2025 (AU 4) and approximately five salmon generations ahead (from 2020). Fishing in 2022 mainly affects smolt production in the years 2026/2025 (year depending on AU).

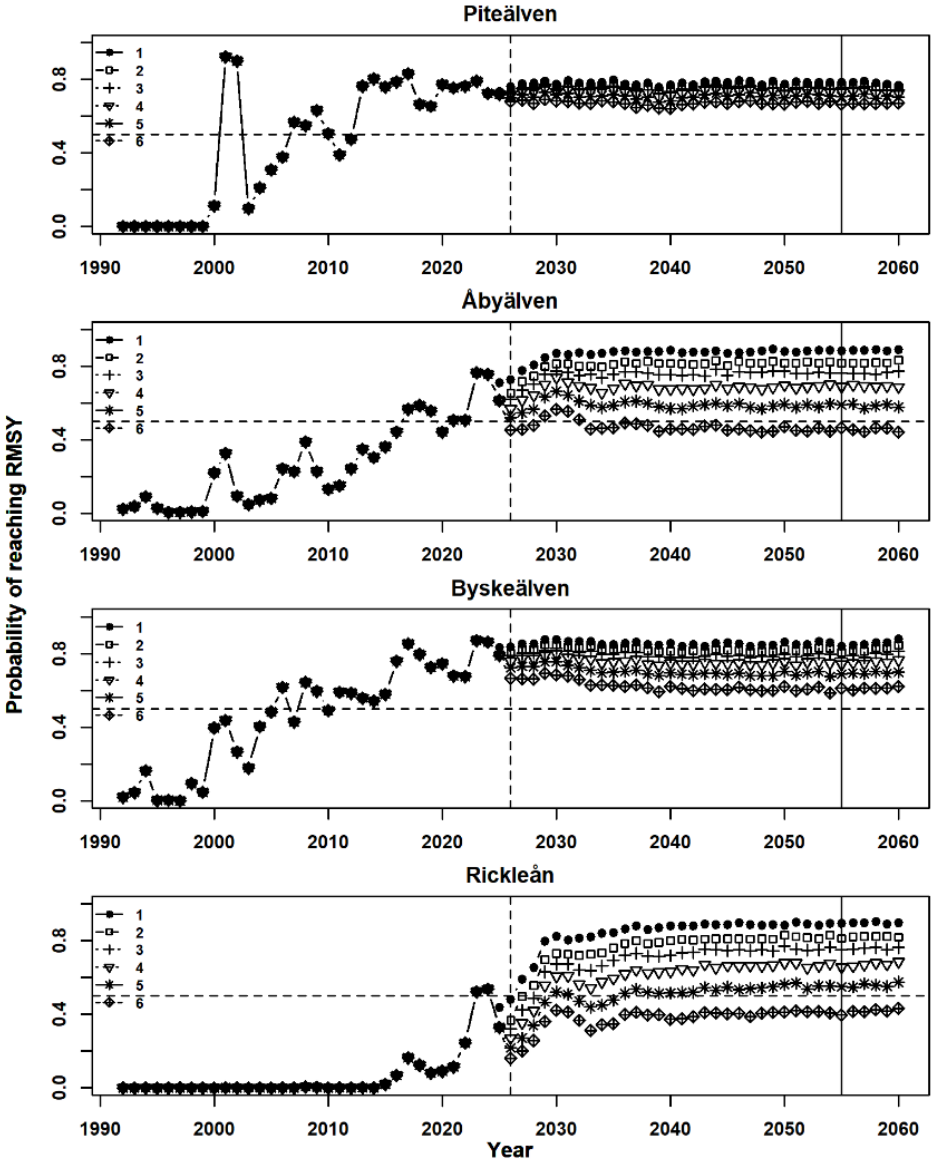

Figure 7b Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 1–6. Vertical lines mark predicted status in 2026 (AUs 1–3) or 2025 (AU 4) and approximately five salmon generations ahead (from 2020). Fishing in 2022 mainly affects smolt production in the years 2026/2025 (year depending on AU).

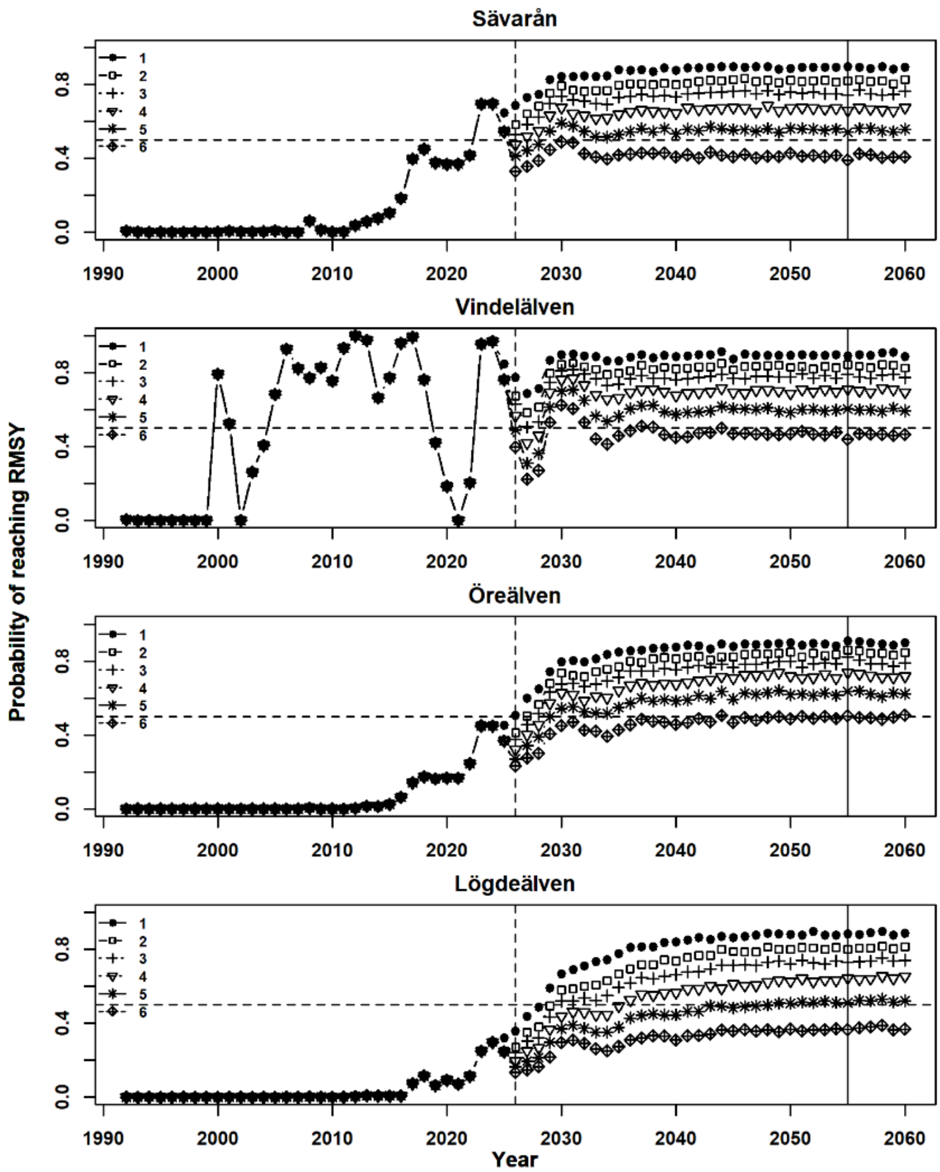

Figure 7c Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 1–6. Vertical lines mark predicted status in 2026 (AUs 1–3) or 2025 (AU 4) and approximately five salmon generations ahead (from 2020). Fishing in 2022 mainly affects smolt production in the years 2026/2025 (year depending on AU).

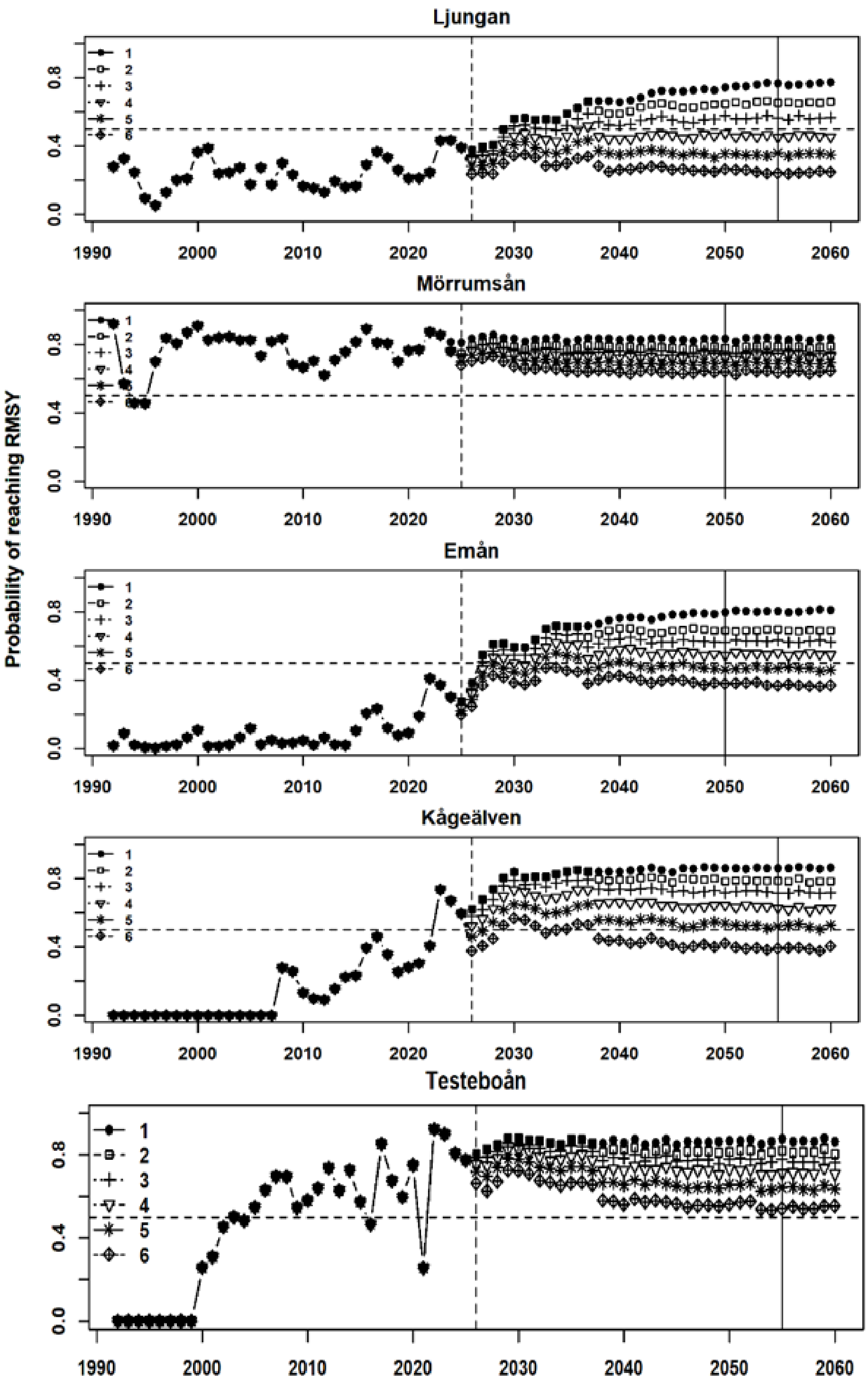

Figure 7d Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 1–6. Vertical lines mark predicted status in 2026 (AUs 1–3) or 2025 (AU 4) and approximately five salmon generations ahead (from 2020). Fishing in 2022 mainly affects smolt production in the years 2026/2025 (year depending on AU). In scenarios 7–9 the river fishery is closed in the Ljungan, Emån, Kågeälven, and Testeboån rivers in 2021–2033.

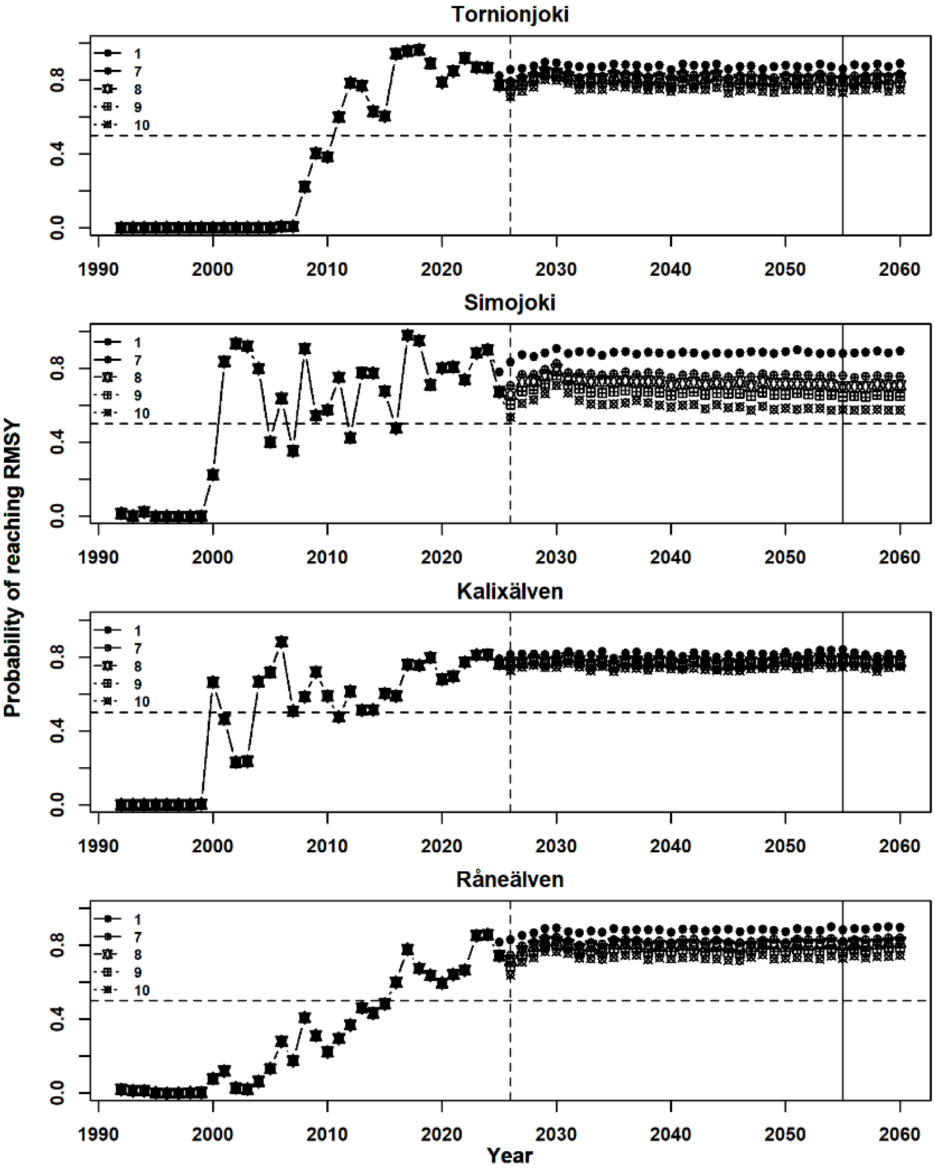

Figure 7e Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 7–9. For comparison with figures 5a–d, scenario 1 is also included. Vertical lines mark predicted status in year 2026 (AUs 1–3) or 2025 (AU 4) and approximately five salmon generations ahead (from 2020). Fishing in 2022 mainly affects smolt production in the years 2026/2025 (year depending on AU).

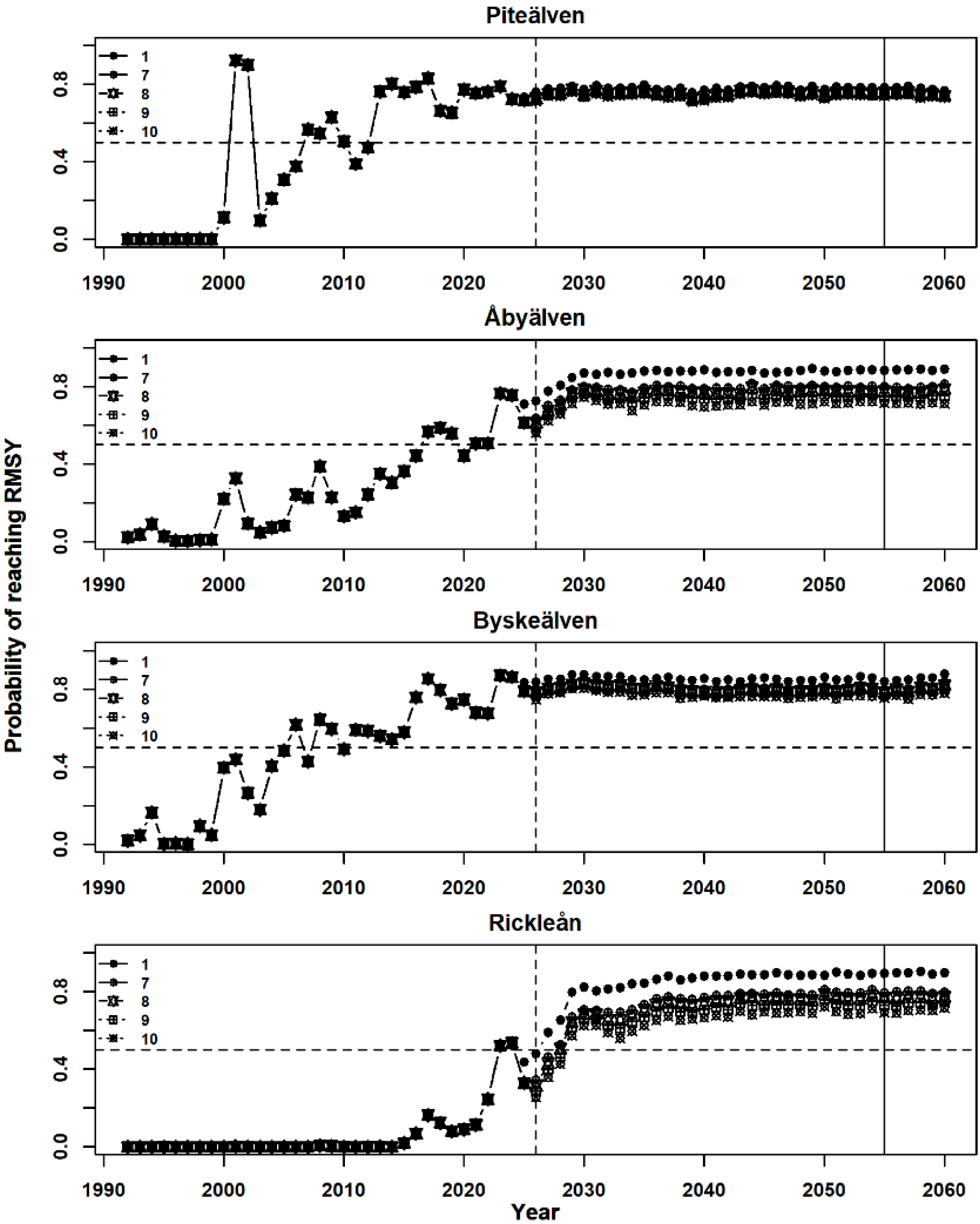

Figure 7f Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 7–9. For comparison with figures 5a–d, scenario 1 is also included. Vertical lines mark predicted status in year 2026 (AUs 1–3) or 2025 (AU 4) and approximately five salmon generations ahead (from 2020). Fishing in 2022 mainly affects smolt production in the years 2026/2025 (year depending on AU).

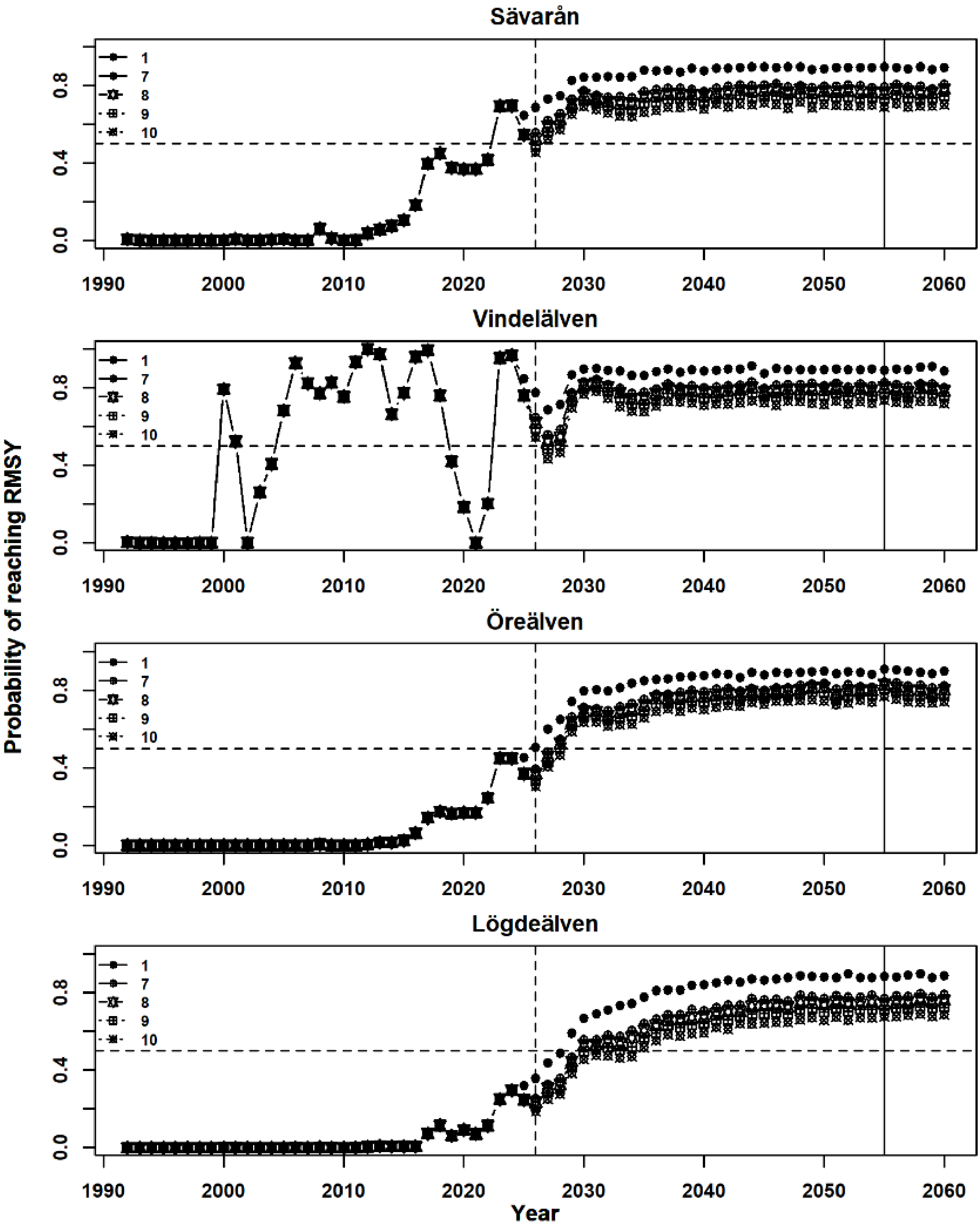

Figure 7g Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 7–9. For comparison with figures 5a–d, scenario 1 is also included. Vertical lines mark predicted status in year 2026 (AUs 1–3) or 2025 (AU 4) and approximately five salmon generations ahead (from 2020). Fishing in 2022 mainly affects smolt production in the years 2026/2025 (year depending on AU).

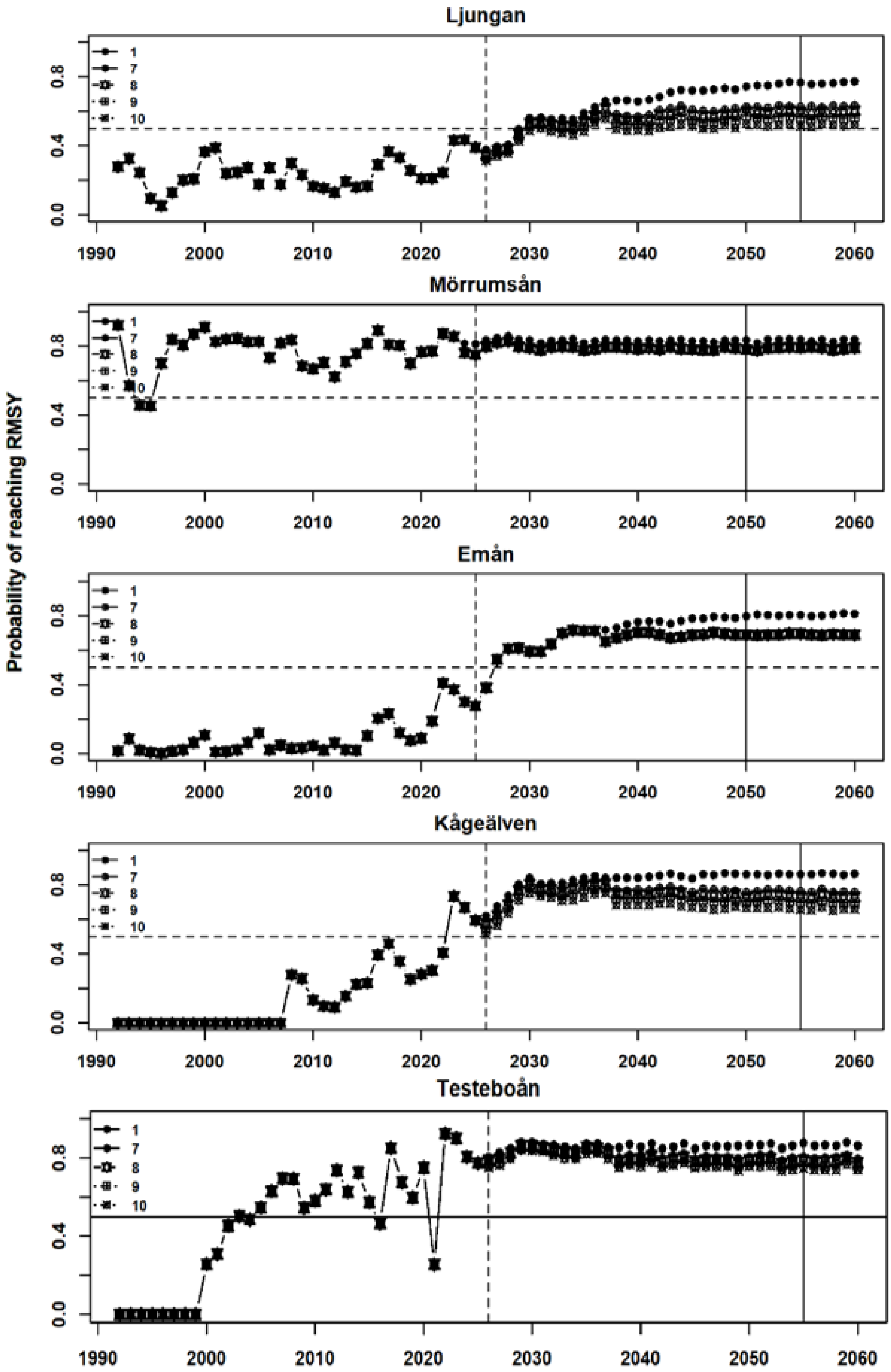

Figure 7h Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 7–9. For comparison with figures 5a–d, scenario 1 is also included. Vertical lines mark predicted status in year 2026 (AUs 1–3) or 2025 (AU 4) and approximately five salmon generations ahead (from 2020). Fishing in 2022 mainly affects smolt production in the years 2026/2025 (year depending on AU). In scenarios 7–9 the river fishery is closed in the Ljungan, Emån, Kågeälven and Testeboån rivers in 2021–2033.

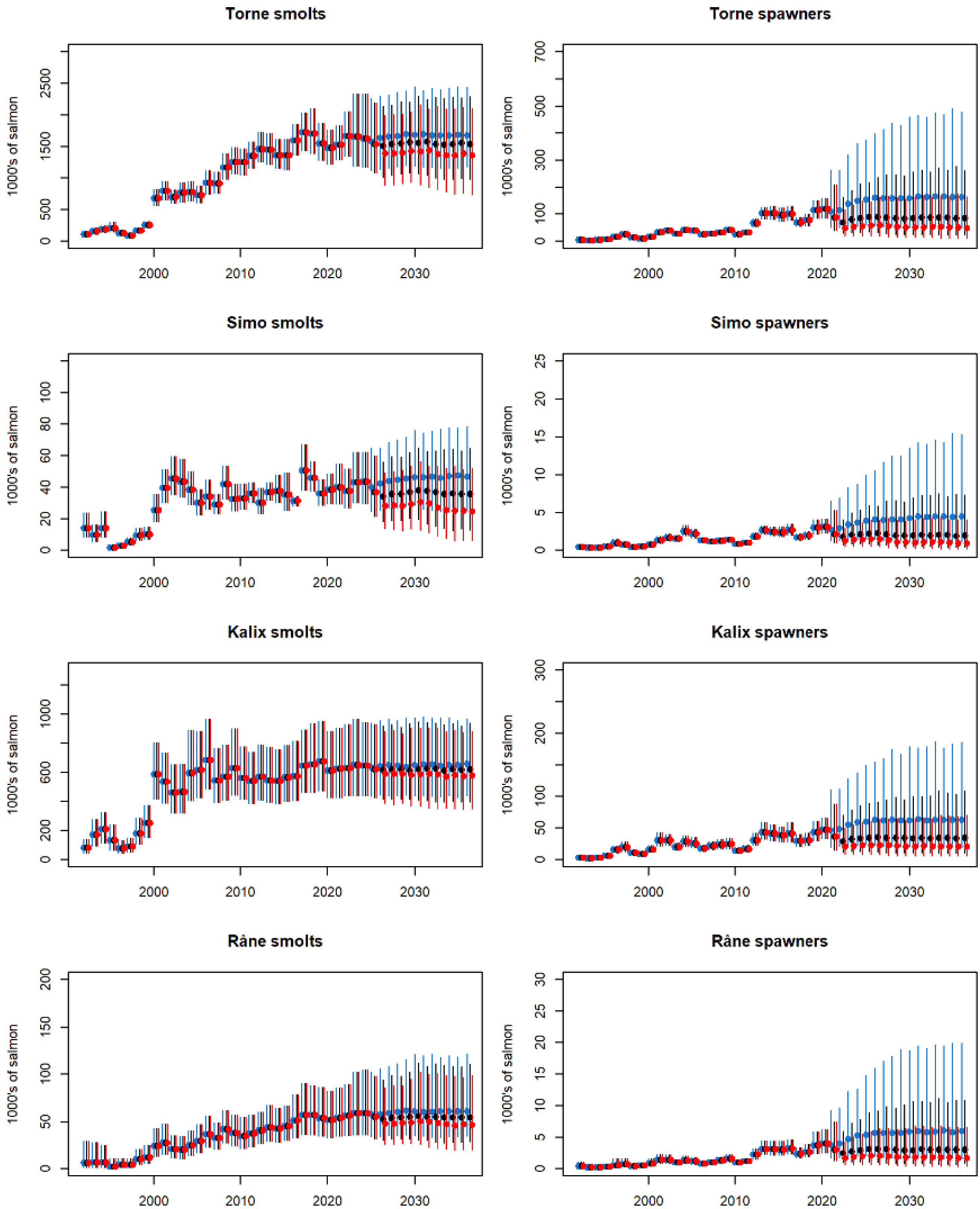

Figure 8a Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Long-term predictions of river-specific smolt and spawner abundances for three scenarios (medians with 90% probability intervals). Blue, scenario 1 (zero fishing); black, scenario 4 (100 000 sea catch); red, scenario 6 (200 000 sea catch). The two most extreme scenarios (1 and 6) illustrate the predicted effects of contrasting amounts of fishing. Fishing in 2022 mainly affects smolt production in the years 2026/2025.

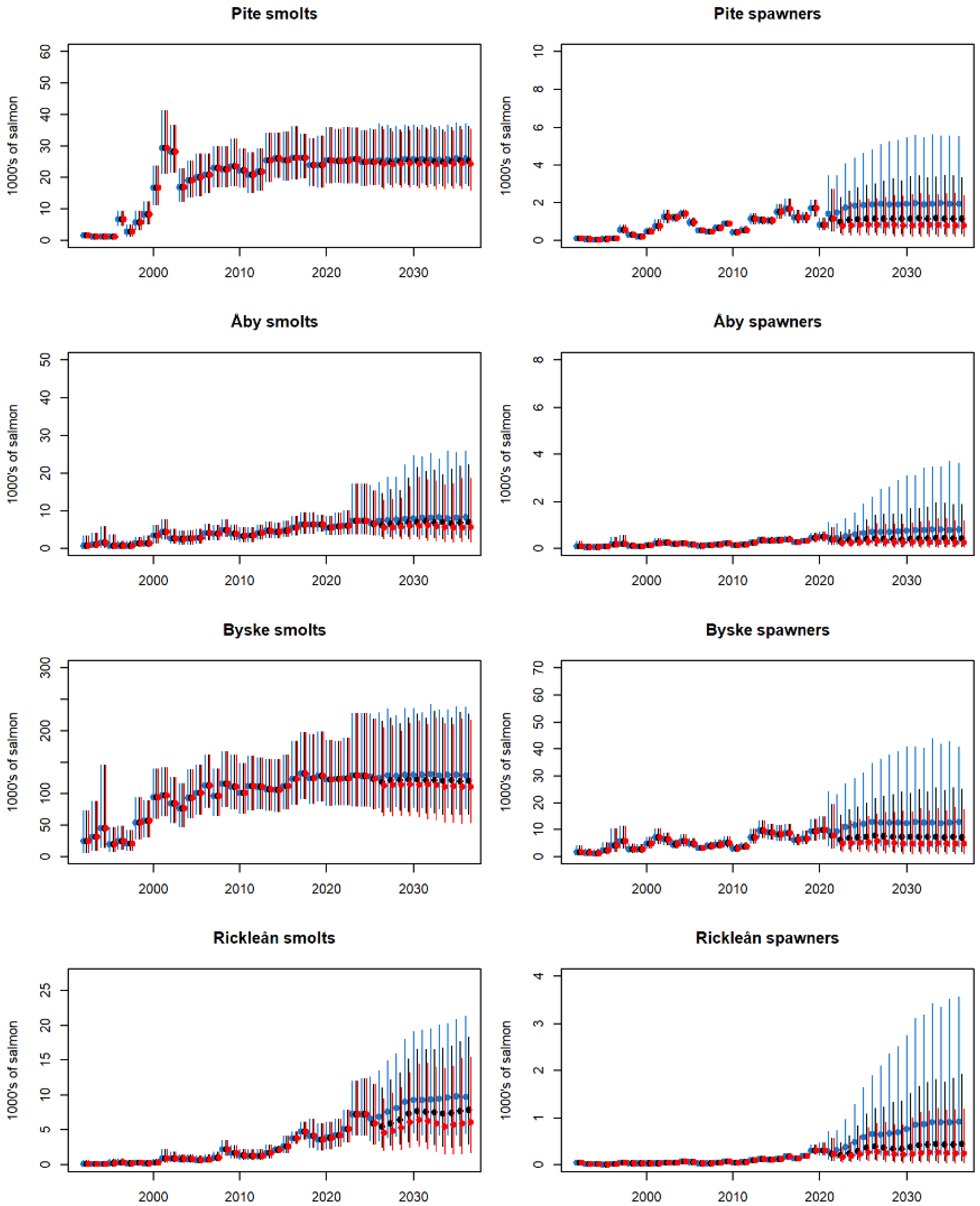

Figure 8b Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Long-term predictions of river-specific smolt and spawner abundances for three scenarios (medians with 90% probability intervals). Blue, scenario 1 (zero fishing); black, scenario 4 (100 000 sea catch); red, scenario 6 (200 000 sea catch). The two most extreme scenarios (1 and 6) illustrate the predicted effects of contrasting amounts of fishing. Fishing in 2022 mainly affects smolt production in the years 2026/2025.

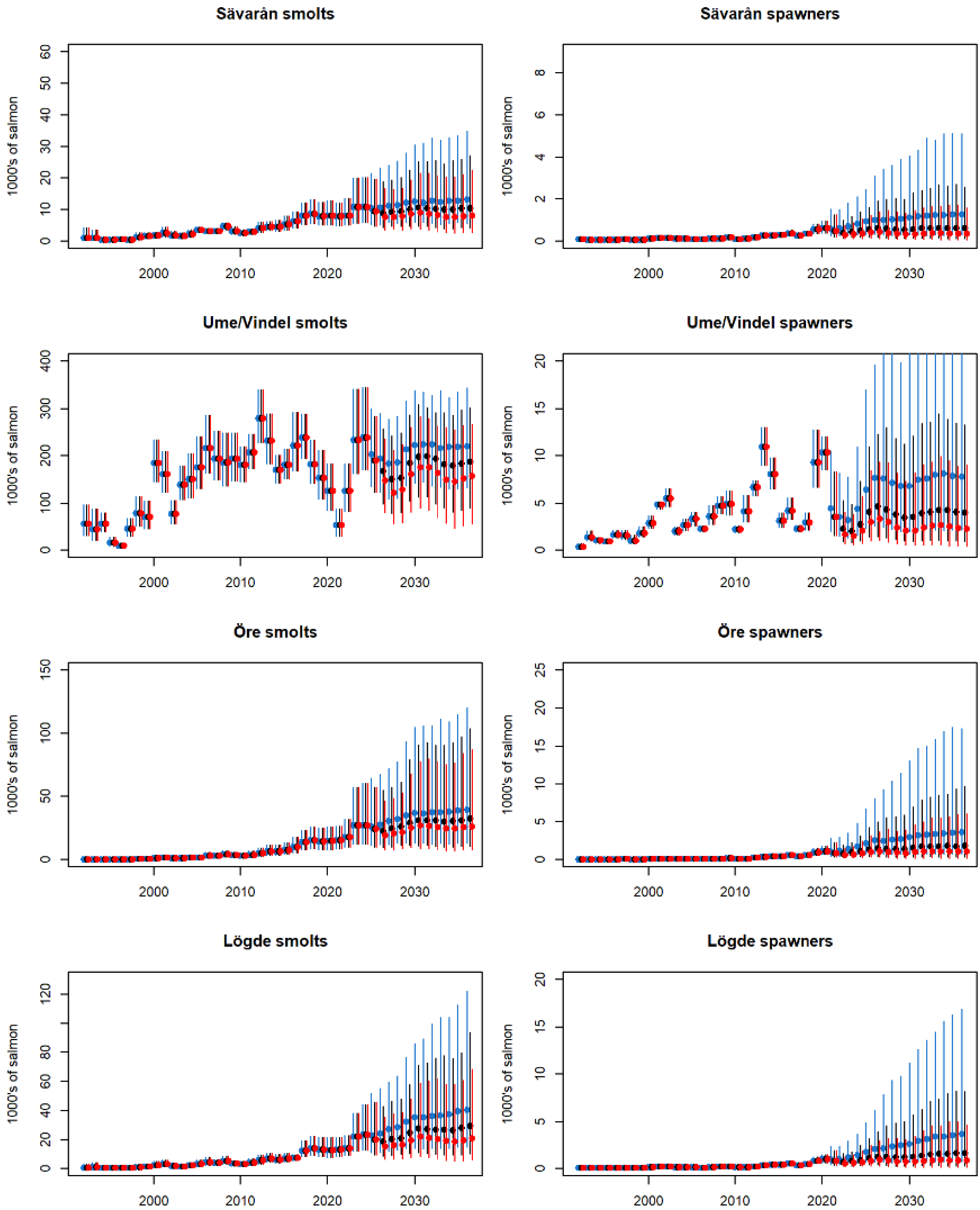

Figure 8c Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Long-term predictions of river-specific smolt and spawner abundances for three scenarios (medians with 90% probability intervals). Blue, scenario 1 (zero fishing); black, scenario 4 (100 000 sea catch); red, scenario 6 (200 000 sea catch). The two most extreme scenarios (1 and 6) illustrate the predicted effects of contrasting amounts of fishing. Fishing in 2022 mainly affects smolt production in the years 2026/2025.

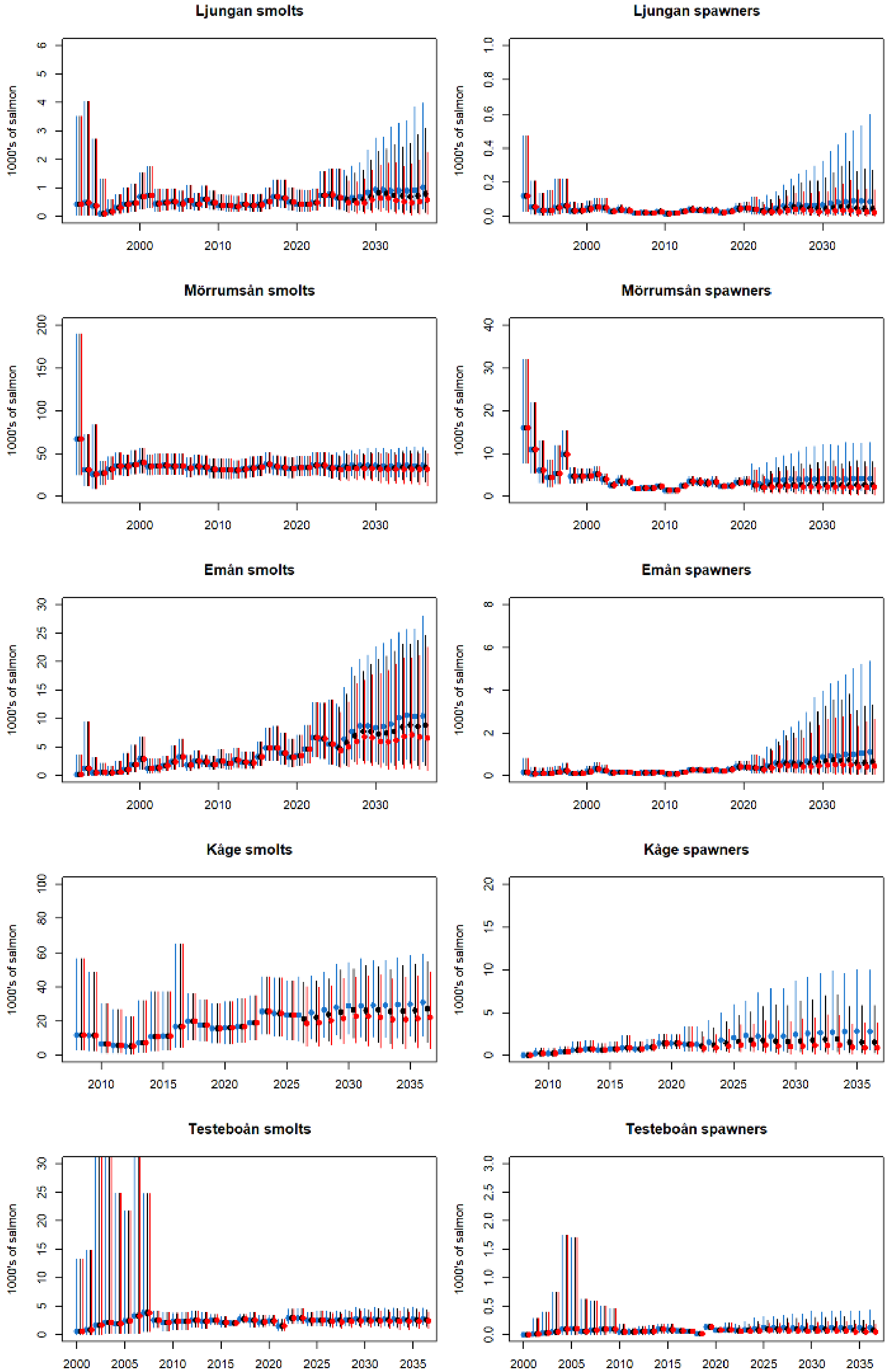

Figure 8d Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Long-term predictions of river-specific smolt and spawner abundances for three scenarios (medians with 90% probability intervals). Blue, scenario 1 (zero fishing); black, scenario 4 (100 000 sea catch); red, scenario 6 (200 000 sea catch). The two most extreme scenarios (1 and 6) illustrate the predicted effects of contrasting amounts of fishing. Fishing in 2022 mainly affects smolt production in the years 2026/2025.

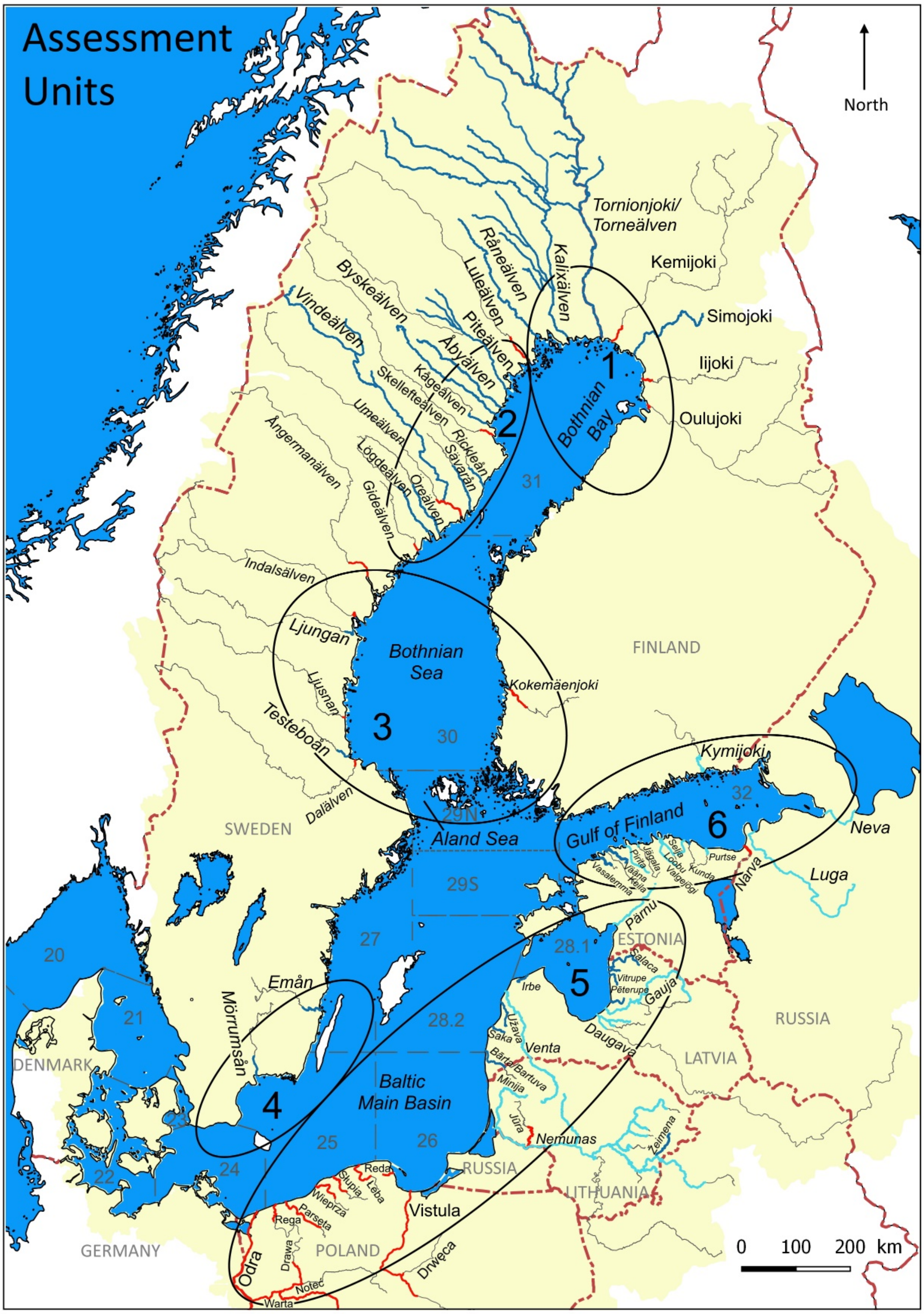

Figure 9 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Grouping of salmon stocks in six assessment units (AUs) in the Baltic Sea, including the Gulf of Finland. The genetic variability between stocks of an AU is smaller than the genetic variability between stocks of different AUs. In addition, the stocks of a particular unit exhibit similar migration patterns. Wild salmon rivers (dark blue), mixed salmon rivers (light blue), reared salmon rivers (red), river stretches not accessible for salmon (grey).

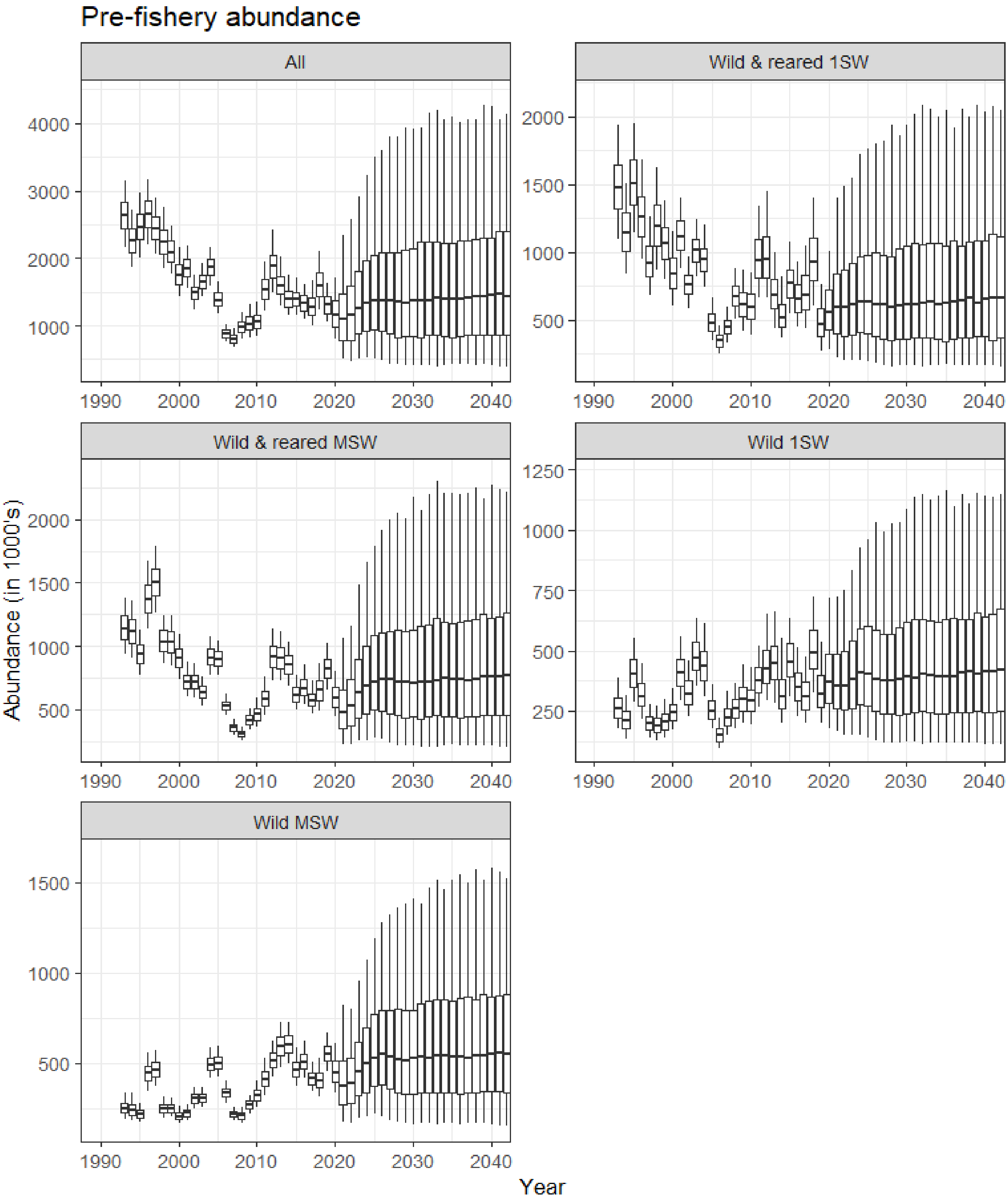

Figure 10 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Top left panel: total annual abundance (medians with 90% probability intervals) of salmon available to sea fisheries. Other panels: abundance divided on origin (wild or reared) for different sea ages. For one sea winter fish (1SW) 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, whereas six months of adult natural mortality (from 1 January to 1 July) are taken into account for multi-sea-winter salmon (MSW). The predicted future development (2021–2042) in abundance following projection scenario 9 is also indicated.

Table 12 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Catch components and their shares in 2016–2020 in the Main Basin and Gulf of Bothnia combined and separately in the Åland Sea and Gulf of Bothnia only.

Main Basin and Gulf of Bothnia (SD22-31)

Year	Commercial at sea						Recreational at sea	In river		% commercial at sea	% recreational at sea	% river
	Reported	Discarded BMS		Seal damaged	Unreported	Misreported		Reported	Unreported			
		alive	dead									
2016	71700	1293	1447	8803	6761	26000	21820	53201	14642	56.4 %	10.6 %	33.0 %
2017	58620	1674	1390	8329	5431	32000	27570	38942	9771	58.5 %	15.0 %	26.5 %
2018	69040	1904	1785	3551	6269	42600	27060	42296	10540	61.0 %	13.2 %	25.8 %
2019	65560	1573	929	5192	5530	600	28080	43355	10398	49.2 %	17.4 %	33.3 %
2020	52350	1426	633	5274	5031	200	24200	52637	12952	42.0 %	15.6 %	42.4 %
	Catches at sea only, shares							commercial				
2016	52.0 %	0.9 %	1.0 %	6.4 %	4.9 %	18.9 %	15.8 %	84.2 %				
2017	43.4 %	1.2 %	1.0 %	6.2 %	4.0 %	23.7 %	20.4 %	79.6 %				
2018	45.4 %	1.3 %	1.2 %	2.3 %	4.1 %	28.0 %	17.8 %	82.2 %				
2019	61.0 %	1.5 %	0.9 %	4.8 %	5.1 %	0.6 %	26.1 %	73.9 %				
2020	58.7 %	1.6 %	0.7 %	5.9 %	5.6 %	0.2 %	27.2 %	72.8 %				
	Commercial cathes at sea only, shares											
2016	61.8 %	1.1 %	1.2 %	7.6 %	5.8 %	22.4 %						
2017	54.6 %	1.6 %	1.3 %	7.8 %	5.1 %	29.8 %						
2018	55.2 %	1.5 %	1.4 %	2.8 %	5.0 %	34.0 %						
2019	82.6 %	2.0 %	1.2 %	6.5 %	7.0 %	0.8 %						
2020	80.6 %	2.2 %	1.0 %	8.1 %	7.8 %	0.3 %						

Åland Sea and Gulf of Bothnia (SD 29N-31)

Year	Commercial at sea						Recreational at sea	In river		% commercial at sea	% recreational at sea	% river
	Reported	Discarded BMS		Seal damaged	Unreported	Misreported		Reported	Unreported			
		alive	dead									
2016	54130	1035	525	2458	5779	0	8700	50730	13728	46.6 %	6.3 %	47.0 %
2017	45470	1410	528	2412	4724	0	8700	37670	9404	49.4 %	7.9 %	42.7 %
2018	51230	1558	634	2116	5454	0	5500	41190	10216	51.7 %	4.7 %	43.6 %
2019	48400	1477	626	2102	4847	0	5500	42550	10166	49.7 %	4.8 %	45.6 %
2020	43890	1363	485	2008	4603	0	5500	51050	12450	43.1 %	4.5 %	52.3 %
	Catches at sea only, shares							Total commercial				
2016	74.5 %	1.4 %	0.7 %	3.4 %	8.0 %	0%	12.0 %	88.0 %				
2017	71.9 %	2.2 %	0.8 %	3.8 %	7.5 %	0%	13.8 %	86.2 %				
2018	77.0 %	2.3 %	1.0 %	3.2 %	8.2 %	0%	8.3 %	91.7 %				
2019	76.9 %	2.3 %	1.0 %	3.3 %	7.7 %	0%	8.7 %	91.3 %				
2020	75.9 %	2.4 %	0.8 %	3.5 %	8.0 %	0%	9.5 %	90.5 %				
	Commercial cathes at sea only, shares											
2016	84.7 %	1.6 %	0.8 %	3.8 %	9.0 %	0%						
2017	83.4 %	2.6 %	1.0 %	4.4 %	8.7 %	0%						
2018	84.0 %	2.6 %	1.0 %	3.5 %	8.9 %	0%						
2019	84.2 %	2.6 %	1.1 %	3.7 %	8.4 %	0%						
2020	83.8 %	2.6 %	0.9 %	3.8 %	8.8 %	0%						

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