Atlantic salmon (*Salmo salar*) in subdivisions 22–31 (Baltic Sea, excluding the Gulf of Finland). Replacing advice provided in May 2023

ICES advice on fishing opportunities

Please note: The present advice replaces the advice given in May 2023 for catches in 2024

ICES advises that according to the MSY approach the catch of salmon in the mixed-stock at sea fisheries (both commercial and recreational in the off-shore and coastal areas) should be zero in 2024.

ICES advises that there should be zero catch of wild salmon in weak rivers in AU 5 and in Ljungan in AU 3 in 2024.

ICES advises that if spatial-temporal management can be implemented, some fishing opportunities would be possible. 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 Bothnian Bay (SD 31)[*], total sea catch (both commercial and recreational) in this area of no more than 60 000 salmon could be taken.

ICES advice on conservation aspects

ICES advises that management measures should be implemented to reduce biological risks associated with straying of reared salmon into wild rivers. This is of particular importance in sea areas with closed salmon fisheries, where an increased surplus of returning hatchery reared salmon can be anticipated when the mixed-stock at-sea fishery is closed. Management measures could include increased fishing in rivers with only reared salmon and (or) reduced stocking of reared salmon smolts.

Based on ecosystem management considerations ICES advises that:

- all non-fisheries related anthropogenic mortalities should be minimized, and
- measures focused to improve river habitats and migration possibilities are important, especially in the spawning rivers of the weakest stocks, which typically suffer from reduced reproduction success due to freshwater habitat degradation;

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 (Figure 4), the decline in natural post-smolt survival (of both wild and hatchery reared) from the late 1980s until the mid-2000s (Figure 5) has reduced fishing opportunities. Survival of wild post-smolts has remained between 10% and 20% since the mid-2000s. Survival of hatchery-reared post-smolts is generally lower than wild post-smolt survival.

Time-series of total wild 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 has been above R_{MSY} since 2011. A similar tenfold increase since 1997 has been seen for AU 2, but with a temporal decline during 2018-2022 due to a river-specific disease problem. AU 2 is predicted to be above R_{MSY} in 2023. These two AUs are the largest contributors to the overall (AUs 1–5) wild smolt production. Wild 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 around R_{MSY}; in AU 4 it has remained at or above R_{MSY} since the 1990s. The current wild smolt production among most of the AU 5 stocks is estimated to a few percent of their respective PSPC and well below any potential value for R_{lim} (Table 1b). Only two AU 5 river stocks (Salaca and Vitrupe) show somewhat higher levels of wild smolt production that may roughly correspond to the interval for R_{lim} observed in AU 1-4 rivers, at least in some years. Wild smolt production in these two rivers (especially Vitrupe) has been fluctuating and low for many years (Figure 4). However, based on current parr densities, the wild smolt production in Salaca is predicted to increase to about 65% of the river's PSPC in 2023, whereas the wild smolt production in Vitrupe is predicted to decline to a low level (Figure 4).

[*] To add further clarity to the area referenced, "SD 31" was added here in reference to the Bothnian Bay.

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 wild stocks in AUs 1–4, the probability that smolt production be above R_{lim} in 2022 is above 50% for 16 stocks. Twelve river stocks have more than 50% probability of being at or above R_{MSY} in 2022 (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 wild smolt production for the rivers Salaca and Vitrupe is, however, considered to correspond to R_{lim}.

Table 12 presents the total catch components based on the average proportion in all salmon fisheries in 2019–2022 in both the Main Basin and Gulf of Bothnia combined and separately in the Åland Sea and Gulf of Bothnia, and in the Bothnian Bay only. Seal-damaged salmon are always dead, whereas some of the undersized salmon as well as most of the C&R salmon in recreational trolling survive when discarded.

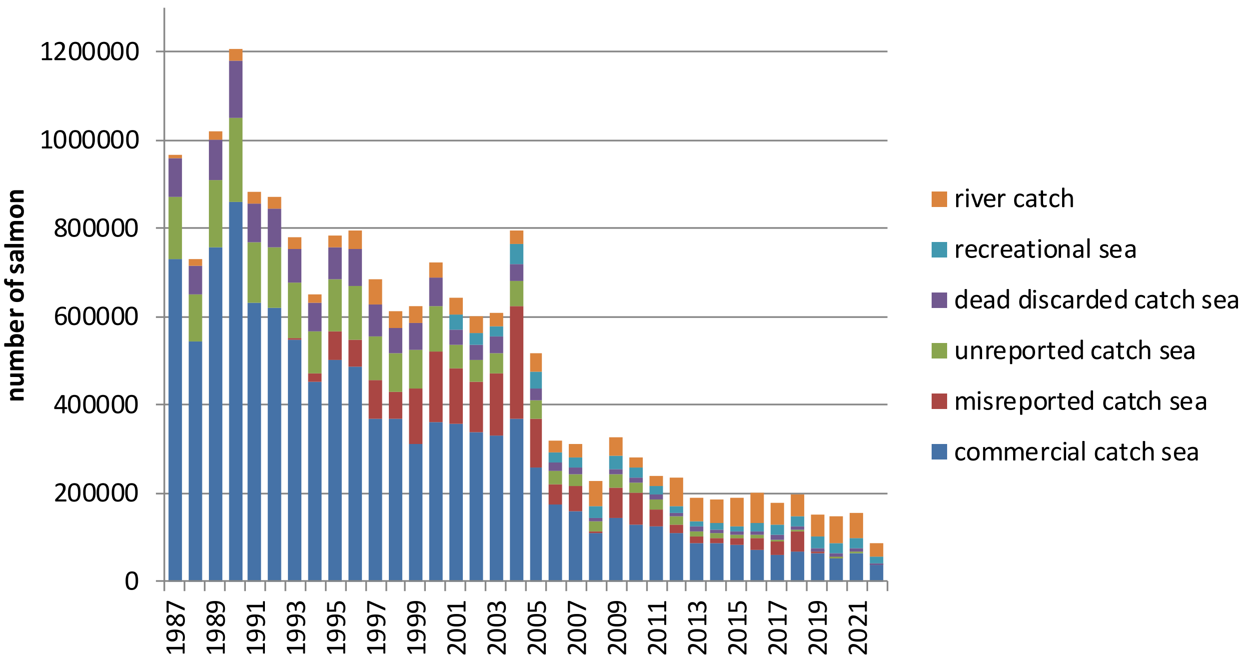

Figure 1 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Total number of removals (dead catch) in the years 1987–2022: river catches (mainly recreational, but also including some commercial fishing) and removals at sea (split into commercial and recreational nominal landings, unreported and misreported commercial landings, and dead discards). Note that commercial sea catch also includes recreational sea catch in the years 1987–2000.

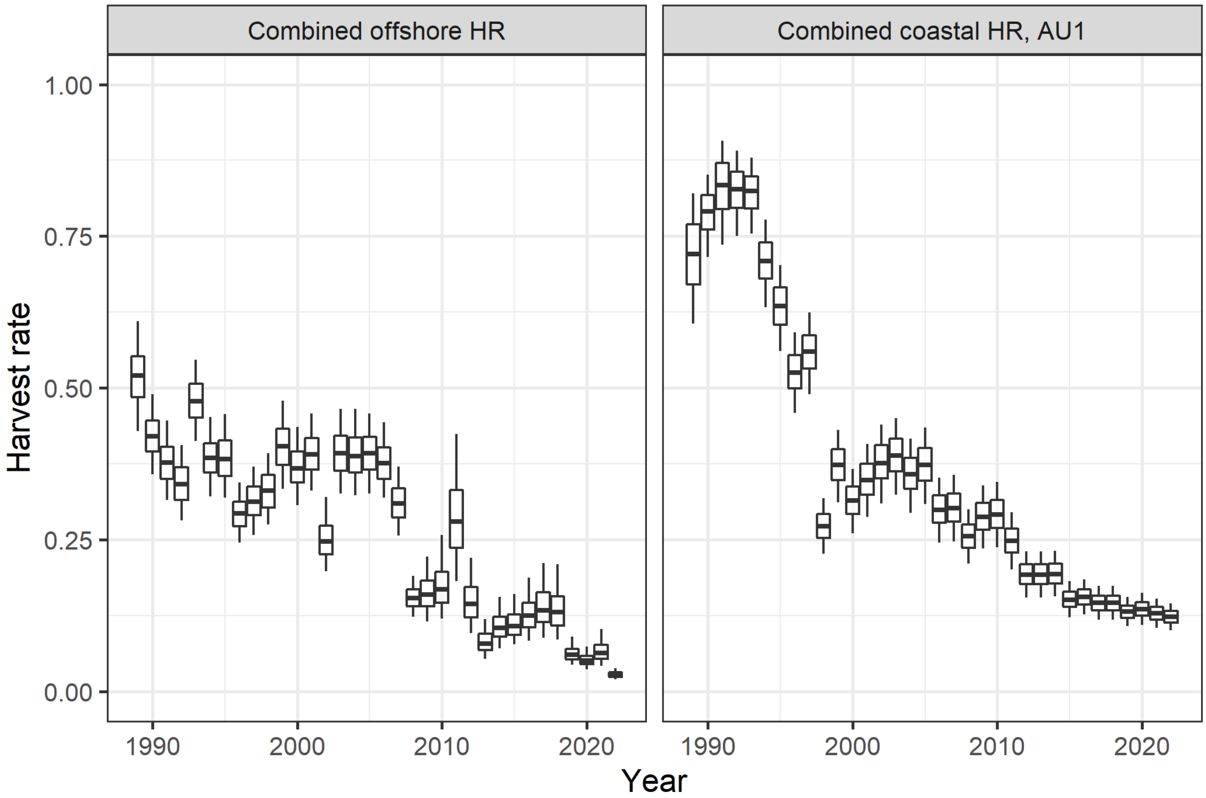

Figure 2 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Harvest rates (medians) in offshore (by fishing season; left panel) and coastal (by calendar year; right panel) fisheries for wild multi-sea-winter (MSW) salmon in 1989–2022. The coastal harvest rate is displayed for salmon from AU 1 rivers (northeastern Bothnian Bay). Boxes and whiskers indicate 50% and 90% probability intervals, respectively.

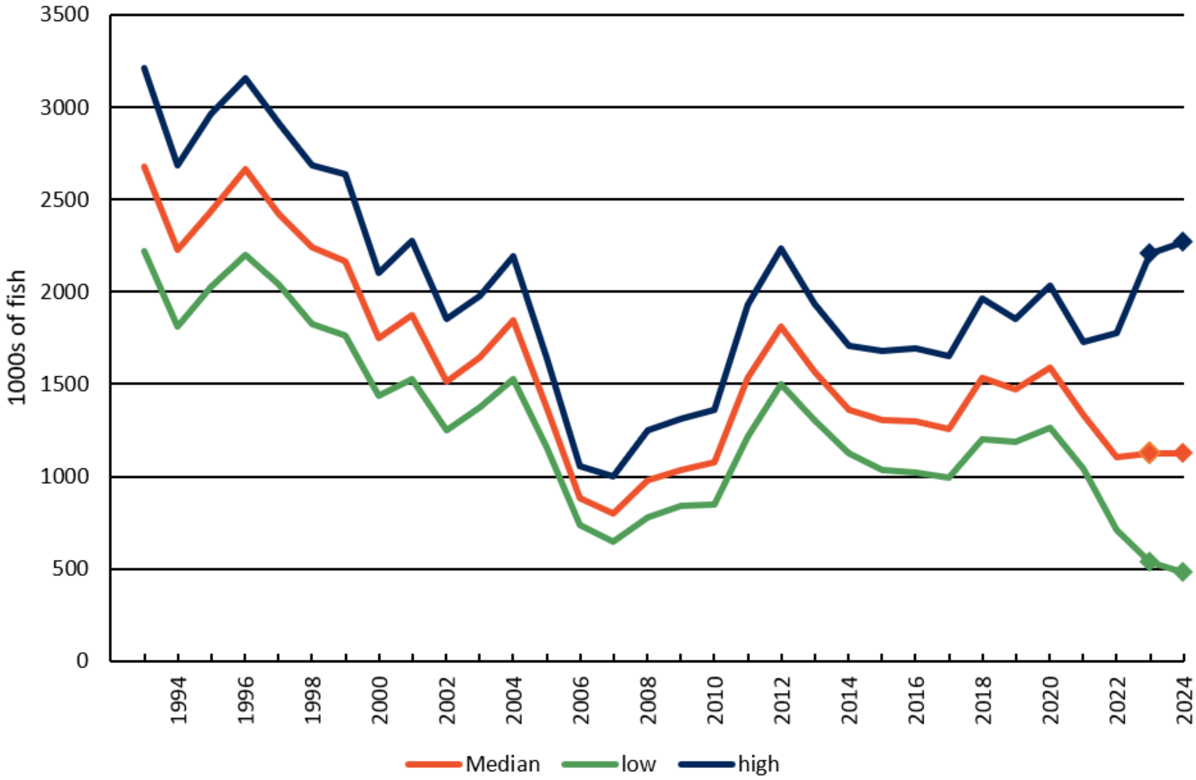

Figure 3 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Estimated pre-fishery abundance (PFA) in the sea, 1993–2022 (for wild and reared, one-sea-winter [1SW], and MSW combined). The median estimate and 90% probability intervals are plotted, with the diamond symbols indicating model projections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

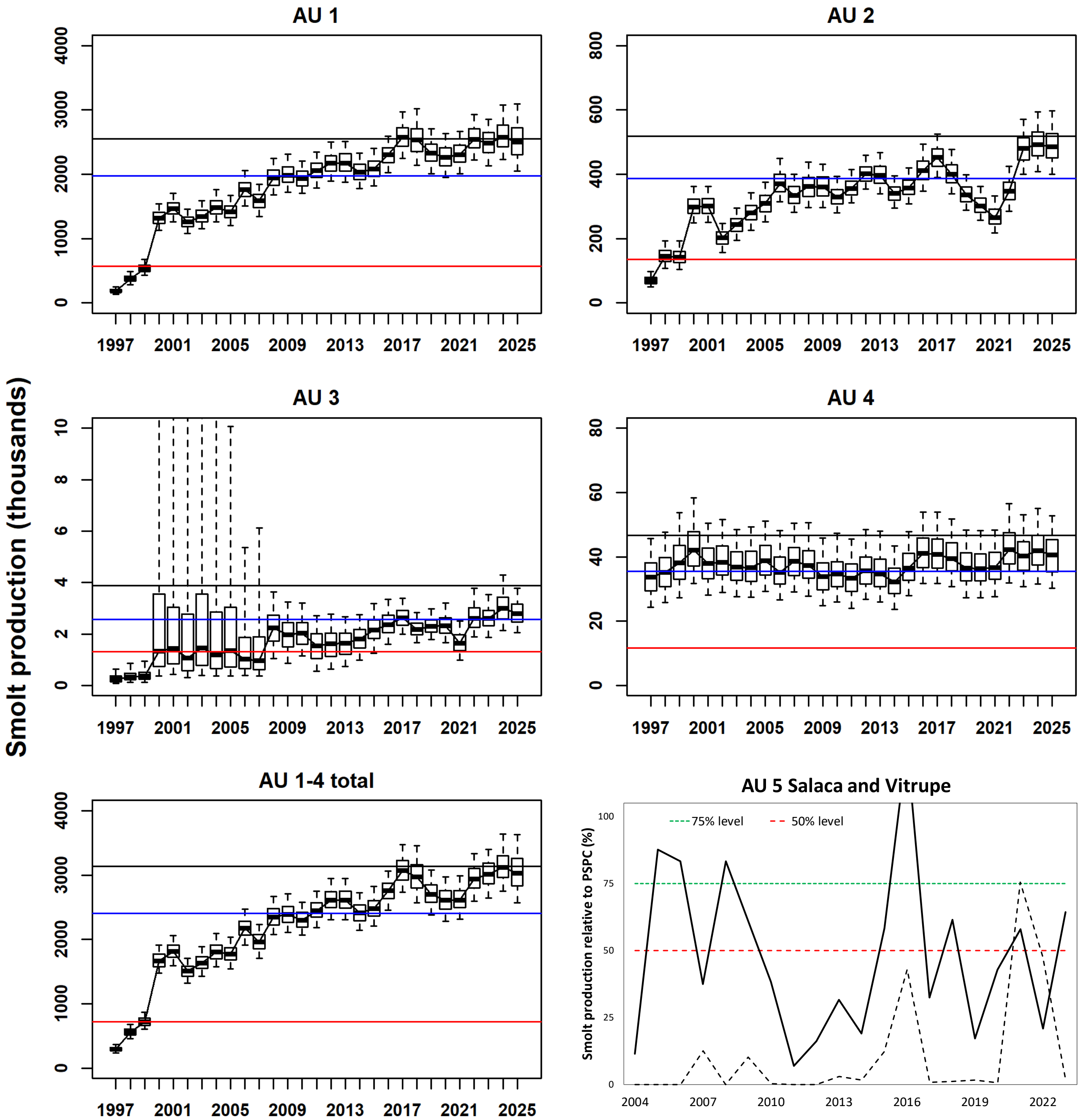

Figure 4 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Smolt production (median estimates - the boxes and whiskers indicate 50% and 90% probability intervals, respectively) relative posterior median for the unit-specific PSPC (black line), R_{MSY} (blue line), and R_{lim} (red line) in AUs 1–4. The smolt production estimates predicted for 2023–2025 are based on data collected until 2022. Bottom right panel: percentage of smolt production relative to PSPC in the Salaca river (bold line) and Vitrupe (dotted line) in AU 5, for which 50% (dashed red line) and 75% of PSPC (dashed green line) are shown as reference.

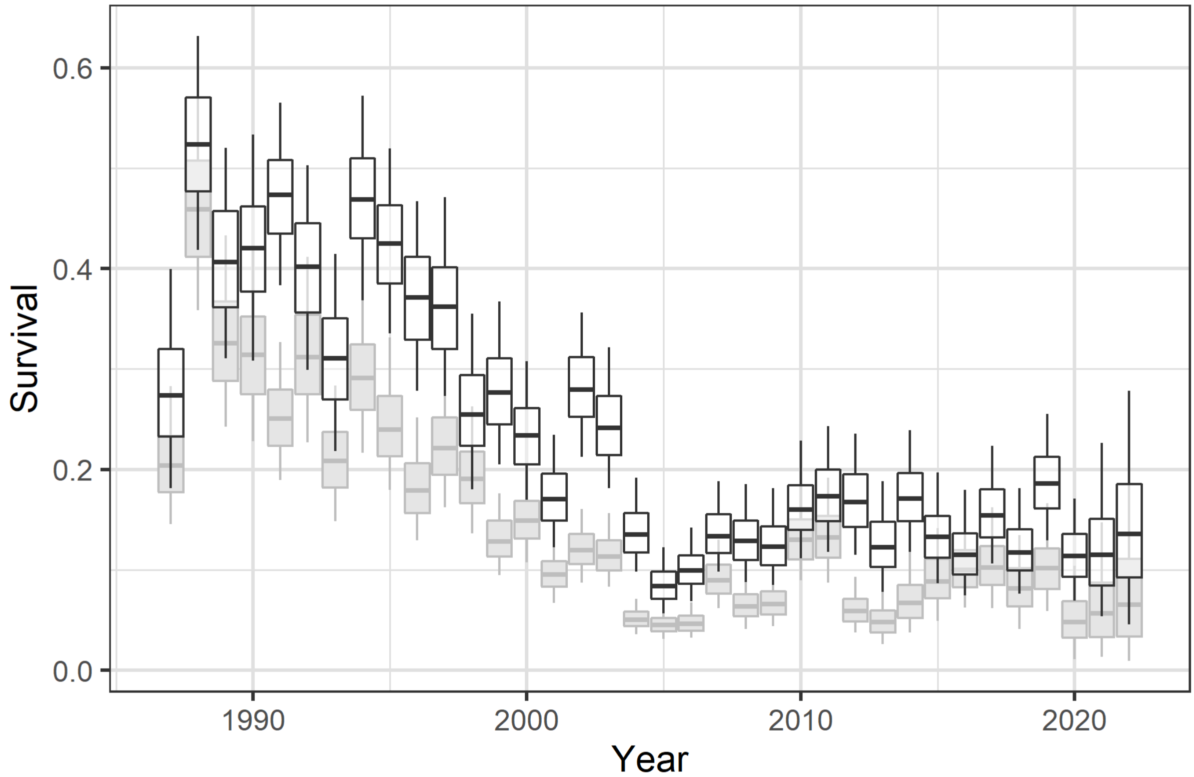

Figure 5 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Post-smolt survival (median) for wild (black boxplots) and hatchery-reared (grey boxplots) salmon per year of smoltification. Boxes and whiskers indicate 50% and 90% probability intervals, respectively.

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 salmon) stocks. AU 1–4 stocks are assessed in terms of the 2022 probability of being above R_{lim} and R_{MSY}. The probability values have been classified into four groups: above 95%, between 70% and 95%, between 50% and 70%, and below 50%.

		Probability to be above R_{lim}					Probability to reach R_{MSY}				
	Stock	Prob.	>95%	>70-95%	50-70%	<50%	Prob.	>95%	>70-95%	50-70%	<50%
AU 1											
	Tornionjoki	1.00	X				1.00	X			
	Simojoki	0.99	X				0.53			X	
	Kalixälven	1.00	X				0.82		X		
	Råneälven	1.00	X				0.81		X		
AU 2											
	Piteälven*	1.00	X				0.78		X		
	Åbyälven	0.95		X			0.61			X	
	Byskeälven	1.00	X				0.85		X		
	Kågeälven	0.89		X			0.56			X	
	Rickleån	0.93		X			0.24				X
	Sävarån	0.98	X				0.57			X	
	Vindelälven	1.00	X				0.14				X
	Öreälven	0.72		X			0.17				X
	Lögdeälven	0.64		X			0.16				X
AU 3											
	Ljungan	0.27				X	0.18				X
	Testeboån*	1.00	X				0.93		X		
AU 4											
	Emån	0.82		X			0.55			X	
	Mörrumsån	1.00	X				0.85		X		

* Status uncertain; see Sections 4.2.1 and 4.4.2 in ICES (2023a) 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 (rivers with hatchery stocked and wild salmon; marked with grey-filled cells) stocks. AU 5 stocks are assessed in terms of the year 2022 and the average smolt production in the years 2020–2022 in relation to PSPC.

	Stock	Category	Average smolt production (2018-2020) in relation to PSPC	Current smolt production (2020) in relation to PSPC
Unit 5	Pärnu	mixed	4%	5.7%
	Salaca	wild	41%	21%
	Vitrupe	wild	41%	48%
	Peterupe	wild	15%	<1%
	Gauja	mixed	4%	<1%
	Daugava	mixed	<1%	<1%
	Irbe	wild	4%	<1%
	Venta	mixed	4%	2%
	Saka	wild	4%	< 1%
	Uzava	wild	2%	3%
	Barta	wild	<1%	<1 %
	Nemunas	mixed	37%	23%

Catch scenarios

Fifteen fishing scenarios were considered, using estimates of PFA at the beginning of 2024 (Table 2) and assuming full uptake of the TAC and similar recreational harvest as in 2022:

- scenario 1 illustrates stock development in the case that all fishing (both at sea and in rivers) is closed,
- scenario 2 is similar but with the exception that only sea fisheries (both recreational and commercial) are closed but river fisheries continue (assumed constant harvest rate),
- scenarios 3–4 illustrate fishing according to the fishing pattern that prevailed in 2021 (offshore longline, recreational offshore trolling, coastal trapnetting and river fisheries) with different total catches at sea,
- scenarios 5–9 illustrate a fishing pattern with only coastal trapnetting in Gulf of Bothnia and Ålands Sea (SDs 29north–31) and river fisheries (i.e. no offshore longline or offshore recreational trolling) with various amounts of total catches,
- scenarios 10-11 illustrate the same fishing pattern but also including recreational offshore trolling, and
- scenarios 12-15 assume that all coastal and offshore fisheries in subdivisions (SD) 22–30 are closed (both recreational and commercial), but coastal fisheries in the Bothnian Bay (SD 31) and river fisheries would be allowed.

For management purposes, coastal salmon fisheries are those conducted from the beginning of May to the end of August within 4 nm of the shore. In scenarios 2–15, in all rivers in AUs 1-4, fisheries are assumed to continue except in Kågeälven, Sävarån, Ume/Vindelälven, Ljungan, Testeboån, and Emån according to current fishing regulations.

ICES advises that, under the current management system, scenario 2 corresponds to the MSY approach.

The outlook table for 2024 (Table 2) presents the projected total sea catch and corresponding fishing mortality, the resulting offshore, coastal and river catches, 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 2024. All values in the table are in thousands of fish.***

Basis	Total commercial + recreational sea catch (2024)	F total sea catch (2024)	Offshore catch (2024)	Coastal catch (2024)	River catch (2024)	Spawners 2024*	% change in spawners ##	Reared surplus 2024**
ICES advice basis								
MSY approach#	0	0	0	0	55.5	172.8	-2.4	56.0
Other scenarios								
1	0	0	0	0	0	219.4	24	69.7
3	50	0.051	24.0	25.4	49.3	156.6	-11.5	48.0
4	100	0.118	33.9	65.6	42.1	133.3	-25	40.8
5	20	0.023	0	20.0	52.3	163.1	-8	52.8
6	40	0.047	0	40.0	48.9	153.0	-13.6	49.5
7	60	0.072	0	59.9	45.8	143.0	-19.2	46.1
8	80	0.097	0	80.0	42.5	132.5	-25	42.8
9	100	0.123	0	99.9	39.2	122.0	-31	39.6
10	40	0.038	17.7	21.4	50.5	160.1	-9.5	49.0
11	80	0.088	17.7	62.0	44.0	138.4	-22	42.8
12	20	0.025	0	20.1	52.2	162.2	-8	53.4
13	40	0.051	0	40.1	49.0	151.2	-15	50.7
14	60	0.077	0	60.0	45.6	140.4	-22	48.1
15	100.0	0.134	0	100.0	38.8	118.0	-33	42.9

* 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 2024 relative to spawners in 2022 (177 000 fish).

Summary of the assessment

Tables 3a and 3b show the probabilities of being above R_{lim} and R_{MSY}, respectively, in the smolt production of the years 2028 (stocks in AUs 1–3) and 2027 (stocks in AU 4) (year varies depending on smolt age), which reflect the direct, immediate effects of the 2024 fishing on future salmon smolt production (i.e. recruitment). In Figures 7a–e, the river-specific annual probabilities of being above R_{lim} under a few selected scenarios (1, 5, 7, 12 and 14) are presented for the 17 wild rivers of AUs 1–4 included in the stock projections, whereas probabilities to meet R_{MSY} under the same scenarios are presented in Figures 7f–j.

Table 3a Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). River stock and AU specific probabilities of being above R_{lim} in year 2028 (AUs 1–3) or 2027 (AU 4 [year depends on smolt age]) under different projection scenarios (ICES, 2023). The current status values refer to level of smolt production in 2022 (the last available data year [Table 1]). Rivers with a probability ≤ 50% R_{lim} are marked in red.

AU	River	Current status	Probability to be above R_{lim}														
			Scenario														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Tornionjoki	1.00	1.00	1.00	1.00	1.00	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	0.99	0.98	0.98	0.99	0.98	0.98	0.98	0.97	0.98	0.98	0.99	0.98	0.98	0.96
	Kalixälven	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Råneälven	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	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	1.00	1.00	1.00	1.00	1.00
	Åbyälven	0.95	0.98	0.97	0.97	0.96	0.97	0.97	0.97	0.97	0.96	0.97	0.97	0.97	0.97	0.97	0.97
	Byskeälven	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Kågeälven	0.89	0.92	0.92	0.91	0.88	0.92	0.91	0.90	0.88	0.87	0.91	0.89	0.92	0.91	0.90	0.88
	Rickleån	0.93	1.00	0.98	0.98	0.97	0.98	0.98	0.97	0.97	0.96	0.98	0.97	0.98	0.98	0.98	0.97
	Sävarån	0.98	1.00	1.00	1.00	0.99	1.00	1.00	0.99	0.99	0.99	1.00	0.99	1.00	1.00	0.99	0.99
	Vindelälven	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Öreälven	0.72	0.95	0.93	0.91	0.90	0.92	0.91	0.90	0.90	0.89	0.92	0.90	0.92	0.92	0.91	0.90
	Lögdeälven	0.64	0.91	0.86	0.85	0.82	0.86	0.85	0.84	0.82	0.81	0.85	0.83	0.86	0.85	0.85	0.82
3	Ljungan*	0.27	0.36	0.35	0.33	0.31	0.34	0.34	0.33	0.32	0.31	0.34	0.32	0.35	0.35	0.35	0.35
	Testeboån*	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
4	Emån	0.82	0.76	0.75	0.74	0.72	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	Mörrumsån	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	Salaca		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Vitrupe		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Peterupe		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Irbe		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Saka		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Uzava		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Barta		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗

* Status uncertain, see Quality of the assessment section of this advice sheet and Sections 4.2.1 and 4.4.2 in ICES (2023a) for additional information.

Table 3b Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). River stock and AU specific probabilities of achieving R_{MSY} in year 2028 (AUs 1–3) or 2027 (AU 4 [year depends on smolt age]) under different projection scenarios (ICES, 2023a). The current status values refer to level of smolt production in 2022 (the last available data year [Table 1]). Rivers with a probability ≤ 50% R_{MSY} are marked in red.

AU	River	Current status	Probability to be at or above R_{MSY}														
			Scenario														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Tornionjoki	1.00	0.89	0.87	0.85	0.81	0.86	0.85	0.84	0.81	0.79	0.86	0.83	0.86	0.85	0.83	0.78
	Simojoki	0.53	0.85	0.76	0.68	0.60	0.71	0.67	0.64	0.60	0.56	0.70	0.63	0.71	0.67	0.63	0.53
	Kalixälven	0.82	0.87	0.85	0.84	0.82	0.85	0.84	0.83	0.82	0.80	0.84	0.83	0.84	0.84	0.83	0.79
	Råneälven	0.81	0.89	0.85	0.82	0.79	0.84	0.82	0.80	0.79	0.76	0.83	0.80	0.84	0.82	0.80	0.73
2	Piteälven*	0.78	0.80	0.77	0.77	0.76	0.77	0.77	0.77	0.76	0.76	0.77	0.76	0.77	0.77	0.77	0.76
	Åbyälven	0.61	0.82	0.76	0.71	0.67	0.74	0.71	0.70	0.68	0.65	0.72	0.69	0.74	0.72	0.71	0.68
	Byskeälven	0.85	0.88	0.85	0.84	0.81	0.84	0.83	0.83	0.82	0.81	0.84	0.82	0.85	0.84	0.83	0.82
	Kågeälven	0.56	0.73	0.73	0.69	0.63	0.71	0.69	0.67	0.64	0.61	0.70	0.65	0.71	0.70	0.69	0.65
	Rickleån	0.24	0.69	0.57	0.53	0.47	0.55	0.53	0.50	0.48	0.45	0.54	0.49	0.56	0.54	0.53	0.48
	Sävarån	0.57	0.82	0.81	0.78	0.75	0.79	0.78	0.77	0.76	0.74	0.79	0.76	0.80	0.79	0.78	0.76
	Vindelälven	0.14	0.75	0.75	0.70	0.65	0.72	0.70	0.69	0.66	0.63	0.71	0.68	0.73	0.71	0.70	0.67
	Öreälven	0.17	0.58	0.48	0.46	0.41	0.47	0.46	0.44	0.41	0.39	0.46	0.43	0.48	0.46	0.45	0.41
	Lögdeälven	0.16	0.52	0.43	0.40	0.35	0.42	0.40	0.38	0.37	0.34	0.41	0.37	0.42	0.41	0.40	0.37
3	Ljungan*	0.18	0.25	0.25	0.24	0.22	0.25	0.24	0.24	0.22	0.21	0.24	0.23	0.25	0.25	0.25	0.25
	Testeboån*	0.93	0.87	0.86	0.85	0.82	0.86	0.85	0.84	0.83	0.82	0.85	0.83	0.86	0.86	0.86	0.86
4	Emån	0.55	0.50	0.48	0.47	0.46	0.48	0.48	0.48	0.48	0.48	0.47	0.47	0.48	0.48	0.48	0.48
	Mörrumsån	0.85	0.84	0.81	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
5	Salaca		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Vitrupe		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Peterupe		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Irbe		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Saka		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Uzava		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗
	Barta		↗	↗			↗	↗	↗	↗	↗			↗	↗	↗	↗

* Status uncertain, see Sections 4.2.1 and 4.4.2 in ICES (2023a) for additional information.

For the whole range of evaluated scenarios, all the assessed river stocks (AU 1–4) have probabilities > 0.5 to be above R_{lim} in 2028/2027, except the Ljungan stock with probabilities < 0.5 in all scenarios. Scenarios 1-2 and 12-15 (no sea fisheries, or sea fisheries confined to Bothnian Bay where Ljungan salmon do not occur), results in a slightly higher recovery rate for the Ljungan stock (highest probability to be above R_{lim} in 2028), but the difference compared to other scenarios is marginal. 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, 5-9 and 12-15 (no sea fisheries, or sea fisheries confined to the Gulf of Bothnia and Åland Sea or Bothnian Bay) do not include exploitation of these AU 5 stocks, which is likely to increase their possibilities to recover.

Compared to the current (2022) situation, the probabilities of being above R_{lim} (and R_{MSY}) in 2028/2027 is higher for almost all AU 1–4 river stocks with a current low status under all fishing scenarios (Tables 3a and 3b, Figure 7), indicating a positive development for the weak river stocks in these AUs. 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 2028/2027 will stay at approximately the same levels or increase compared to the current situation. In the absence of an analytical assessment, the probabilities (and development trend) for AU 5 stocks cannot be estimated; however, it is very likely that, in all scenarios, the status of the majority of rivers in AU 5 will remain weak, with some improvement expected in scenarios 1-2, 5-9 and 12-15.

Figures 8a–d display estimated past and projected future smolt production and spawner abundance under scenarios 1, 12 and 15, corresponding to a sea catch of between 0 and 100 000 salmon (see above). For all three scenarios, smolt production in 2028/2027 is expected to either remain around current levels or to increase, the magnitude of change depending on the exploitation level.

Basis of the advice

Table 4 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

In the 2023 assessment, some aspects of the model were modfied to improve model convergence.

Since the last full assessment in 2021, the following changes have been made (ICES, 2023a):

- The distribution for lognormally-distributed process errors in recruitment was modified to have a mean (rather than a median, as before) of zero.
- A Log-Normal approximation to the Beta distribution is now used in the observation model for the proportion of wild salmon in offshore catches, to aid convergence of some model parameters.
- Few data are available on the amount of salmon discarded and even less is known about the proportion of discarded salmon that survive.
- Smolt trapping information for Öreälven (2022) was used for the first time.
- For Mörrumsån, a spawner counting observation of relative abundance (camera count) was added for 2022.
- An earlier error coupled to river harvest rate for Mörrumsån and Emån was corrected, and both rivers now have non-zero harvest rates in the river fisheries.
- For Vindelälven, changes were made to the prior for survival after counting (revised upwards) in the assessment model. Survival after counting was also set equal to one in stock projection scenarios, instead of using the average of the historical time series as in 2021.

The Baltic salmon assessment incorporates all available uncertainties, which 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.

In both the historical assessment model and the future stock projections (scenarios), river harvest rates are assumed to be the same for all wild stocks with no additional regulations (or 10% of this harvest in rivers where strict fishing regulations have been enforced). This is clearly a simplification and could lead to bias in stock-recruit parameter estimates and/or status estimates.

Using the analytical method described in ICES (2021a; 2021b; 2023a) to obtain reference points makes the implicit assumption that salmon would be harvested instantaneously upon smoltification. This is not the case in reality, especially considering patterns of fishing that target maturing fish (for example the coastal and river fisheries), which is expected to cause our status estimates to be biased high, although to an unknown extent, depending on the fishing pattern in a particular scenario.

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.

Status evaluations of the river stocks in Piteälven, Ljungan and Testeboån are uncertain and possibly biased (see Section 4.2.1 and 4.4.2 in ICES [2023a]). The reasons for this situation are uncertain.

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).

Figure 6 shows relatively consistent PFA assessment results among years.

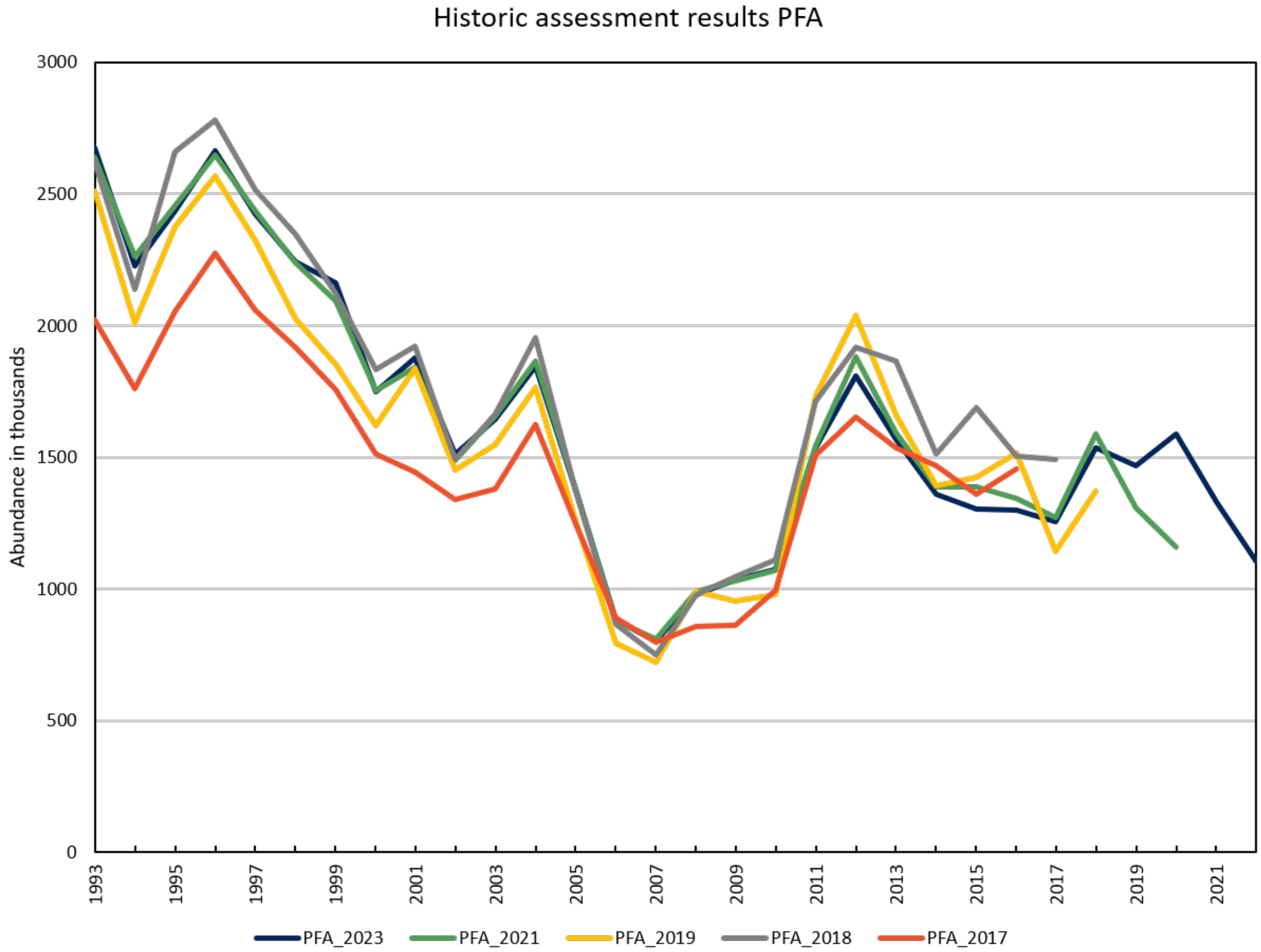

Figure 6 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Historical assessment results. Estimated pre-fishery abundance (PFA) in the sea (for wild and reared, 1SW, and MSW combined) until the assessment-specific advice year from the assessments in 2017, 2018, 2019, 2021, and 2023 (no analytical assessment was performed in 2020 and 2022). 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 at sea fisheries while taking into account the river catches. 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.

The advice of 60 000 fish for AU 1 is based on the assumed split of catches by river.

This advice is the same as the one given in 2021, since under the current management regime any mixed-stock at 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.

In the analytical assessment of salmon rivers in AUs 1-4, stock-recruitment dynamics and status are estimated under prevailing conditions regarding size and quality of spawning and rearing habitats and river migration possibilities. Also the targets used to assess the status of AU 5 stocks are set based on prevailing conditions in those rivers regarding e.g. accessible production areas. ICES stock assessment is thus intended to be used primarily for evaluations of fishing opportunities and the impact of fishing on the status and development of individual river stocks. For evaluations of impact factors other than fisheries exploitation, e.g. effects of power plants and dams on salmon abundances in rivers, additional analyses are needed.

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.

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). The same analyses indicate that the stock of Ljungan, which is currently below R_{lim} and which will not reach R_{lim} in 2028 even without any fishing, does not occur in the salmon catches of the Bothnian Bay (SD 31) (ICES, 2021a; ICES, 2023a).

If the sea fishery is limited to the Bothnian Bay, all stock projections (scenarios 12-14) ranging up to a catch level of 60 000 salmon indicate that salmon could be harvested in this sea area while allowing all stocks in AUs 1–4 (except Ljungan) to stay well above R_{lim} while not affecting the weakest AU 5 stocks nor Ljungan in AU3 (Tables 3a and b). In addition, two AU 2 rivers in SD 31, Öreälven and Lögdeälven, have probabilities to reach RMSY lower than 50% in the short term, but are forecasted to have positive development and reach RMSY in the medium term (Figure 7h). Given the uncertainty around the projection and the calculation of reference points, scenario 15 is considered to be less precautionary than scenario 14.

Several of the weak river stocks in AU 5 have shown limited recovery despite previous reductions in exploitation rates at sea, indicating the need for longer term stock-specific rebuilding measures. There should be zero catches of these stocks in all habitats (sea and freshwater) in 2024.

Recreational trolling fisheries have been decreasing since 2019 (ICES, 2023a). The current regulation allows for landing of one fin-clipped salmon per day; all wild salmon must be released. ICES estimates a post-release fishing mortality of 25% leading to the death of approximately 4000-5000 wild salmon in this fishery. Further measures (e.g. closed areas or seasons) should be taken to decrease the impact of the recreational trolling fishery on wild salmon.

The increased disease-related mortality observed among spawners in rivers Vindelälven (AU 2) and Ljungan (AU 3) during the last few years has resulted 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.

Issues relevant for the conservation advice

Other anthropogenic impacts (non-fishing) are substantial and can be grouped into the following: (a) hydropower, pumping stations, and other water intakes; (b) habitat loss or degradation; (c) pollution, diseases, and parasites; and (d) other management actions that may affect levels of predation (e.g. conservation vs. control of predators).

Environmental impacts in marine, transitional, and freshwaters all contribute to the anthropogenic stresses on salmons, their mortality, and their reproductive success. The implementation of environmental legislation (e.g. the EU Water Framework [WFD] and the Marine Strategy Framework directives [MSFD]) aims to improve the continental environment and could have a positive effect on the reproductive potential of salmon.

Besides reducing exploitation rates including actions to reduce poaching where necessary, also non-fishery-related actions including habitat restoration and removal of physical barriers, may be necessary for these stocks to recover (ICES, 2020c).

Apart from wild salmon, substantial amounts of reared-origin salmon stocked mainly in regulated rivers without reproduction possibilities become exempted from sea fisheries as a result of reduced exploitation. Unless harvesting of these fish cannot be increased in their stocking sites, large-scale hatchery production and stocking is unproductive and creates a risk of genetic contamination of wild stocks by reared-origin strayers. Case-by-case re-evaluation and revisions of the hatchery programmes is therefore highly recommended in order to reduce non-utilised surplus of hatchery-reared salmon.

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. five-six 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, 2023a).

Table 5 Summary statistics for probability distributions of smolt production at maximum sustainable yield (R_{MSY}; in thousands), smolt production corresponding to recovery to R_{MSY} level in one generation's time (R_{lim}, limit smolt production; in thousands), and long-term equilibrium unfished smolt production (R_0 = PSPC; in thousands) in AU 1–4 rivers. These estimates serve as reference points to evaluate the status of the stocks (Table 1a). The posterior distributions are summarized in terms of their median, mean, and 90% probability interval (PI). In the last column, also the relative changes compared to the last full assessment (% change from the 2021 estimates) in the updated median values of R_0 are shown.

		R_{MSY} (thousands)			R_{lim} (thousands)			R_0 (thousands)			
		Median	Mean	90% PI	Median	Mean	90% PI	Median	Mean	90% PI	% change in medians from 2021
Assessment unit 1											
1	Tornionjoki	1382	1381	1181-1582	422	424	330-517	1801	1805	1598-2016	6%
2	Simojoki	31	31	22-43	16	16	12-23	46	48	36-65	-3%
3	Kalixälven	519	525	416-653	118	119	69-168	640	644	515-785	-3%
4	Råneälven	44	47	32-70	15	16	9-28	59	63	41-96	-4%
Total assessment unit 1		**1979**	**1984**	**1704-2256**	**574**	**574**	**453-697**	**2555**	**2559**	**2295-2834**	**2%**
Assessment unit 2											
5	Piteälven	22	22	19-26	4	4	2-6	26	26	23-30	-0.3%
6	Åbyälven	5	6	4-13	2	3	1-7	8	9	5-19	-8%
7	Byskeälven	98	100	74-131	28	29	14-49	125	129	95-176	-5%
8	Kågeälven	16	16	3-29	8	9	3-15	24	24	6-43	-25%
9	Rickleån	6	6	4-11	3	3	1-5	9	9	5-16	-17%
10	Sävarån	7	8	4-15	3	4	2-7	11	12	6-22	-19%
11	Ume/Vindelälven	180	182	150-218	63	63	47-81	242	245	210-289	7%
12	Öreälven	16	22	7-55	7	9	2-24	23	31	10-79	-44%
13	Lögdeälven	21	26	9-58	10	13	4-30	31	39	13-87	-33%
Total assessment unit 2		**387**	**389**	**319-465**	**135**	**136**	**104-174**	**519**	**525**	**440-625**	**-9%**
Assessment unit 3											
14	Ljungan	0.9	1.4	0.2-4.2	0.6	1.0	0.1-2.9	1.5	2.4	0.4-7	-1.4%
15	Testeboån	1.6	1.7	1.2-2.3	0.6	0.7	0.3-1.2	2.2	2.3	1.7-3.4	-22%
Total assessment unit 3		**2.6**	**3.1**	**1.5-6.1**	**1.3**	**1.7**	**0.6-3.7**	**4**	**5**	**2.3-10**	**15%**
Assessment unit 4											
16	Emån	6	7	2-13	4	5	2-8	10	11	4-21	-21%
17	Mörrumsån	29	29	22-36	7	7	1-14	36	36	30-44	-0.9%
Total assessment unit 4		**35**	**36**	**26-45**	**12**	**12**	**6-19**	**47**	**48**	**38-61**	**7%**
Total assessment units 1-4		**2409**	**2412**	**2076-2721**	**720**	**725**	**594-858**	**3137**	**3136**	**2826-3445**	**0.2%**

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 6 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 7 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). The basis of the assessment.

ICES stock data category	1 (ICES, 2023b)
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, 2023a).
Input data	Commercial removals (international landings and effort by fishery [1987–2022], 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. Russian hatchery fish releases are not available since 2021.
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 8 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 2022 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

Year	ICES advice	Predicted catch corresponding to advice	TAC†	Commercial reported landings at sea††	Landings at sea^	Catch at sea^^	River catch^^^
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	102	138	51
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	99	132	55
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	93	126	64
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	88	131	68
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	81	128	49
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	93	148	48
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	66	91	101	50

Year	ICES advice	Predicted catch corresponding to advice	TAC†	Commercial reported landings at sea††	Landings at sea^	Catch at sea^^	River catch^^^
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	53	76	86	60
2021	Precautionary approach	116 (9%, 83%, 7%, 1%)	94	64	87	99	56
2022	MSY approach	0	64	36	50	56	32
2023	MSY approach	0	64				
2024	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 9 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Catch distribution by category in 2022 as estimated by ICES (median values from probability distributions).

Catch (2022; dead catch, including recreational and river catches)	Landings		Discards (dead)*
588 tonnes	Nominal landings (commercial and recreational at sea and in rivers) 97.6%	Unreported and misreported 2.4%	19 tonnes
	569 tonnes		

* 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 10 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, offshore, and 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	445	68	166	33	870	141	88	109
2014	311	43	421	69	163	31	894	142	86	106
2015	318	49	369	65	143	28	830	142	82	96
2016	350	53	378	62	126	27	854	142	72	96
2017	210	39	312	52	143	28	665	120	59	96
2018	241	42	392	57	190	36	823	136	69	91
2019	293	43	389	57	210	34	893	134	66	91
2020	315	53	326	53	149	23	789	129	54	87
2021	290	49	335	53	200	34	825	136	64	94
2022**	199	27	282	40	72	10	553	77	36	64

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

** Preliminary.

Table 11 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 2022 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	61090	47440-83360	41080	37450-45600	658300	643600-681500
2002	76122	3247	116533	5762	21808	3351	39374	13230	146197	425624	115000	59060	45620-81620	38030	34740-42210	602800	588400-626300
2003	108845	2055	112662	5766	11339	1040	35800	4413	119820	401740	143200	52890	40390-74020	42830	38700-48100	603000	589200-625500
2004	81425	1452	143107	7087	7700	704	17650	5480	199335	463940	254300	67310	50570-96970	43450	39130-49270	789200	771000-819700
2005	42491	1721	124427	4799	5629	698	22896	3069	150174	355904	110800	53740	41020-75550	30350	27910-33510	518600	505200-541000
2006	33723	1628	73092	3551	3195	488	22207	1002	102339	241225	46900	36980	28210-51370	22470	20820-24540	322700	313500-337500
2007	16145	1315	83544	3086	5318	537	18988	1408	98076	228417	54310	35840	27620-49430	18350	17040-20030	315100	306700-329100
2008	7363	1890	86749	4151	2016	539	8650	1382	94066	206806	3295	37880	28370-54230	9727	9199-10500	242900	233300-259400
2009	17116	2064	82000	2799	3323	310	9873	584	112971	231040	66500	42830	31650-64510	13440	12190-15170	340000	328500-362000
2010	29714	1459	48281	1520	2307	243	9520	491	84774	178309	74800	29990	22650-43250	12180	10720-14300	282800	275100-296500
2011	21125	1332	52350	1483	1470	317	6149	470	93454	178150	37000	31180	23450-45310	11490	10520-12840	243700	235800-258000
2012	23180	1915	77434	1362	1371	355	5605	412	85834	197468	17500	34360	26360-47350	9732	8935-10930	243700	235600-256700
2013	25461	2426	59764	1210	2842	285	4808	387	62972	160155	15000	22640	16890-31990	12530	10630-14450	193200	187400-202700
2014	24596	2139	71906	1264	2650	388	2999	418	58488	164848	13600	22170	16410-31280	10620	8966-12230	191300	185400-200500
2015	19367	2597	65746	2009	2572	2580	3745	406	63361	162383	16600	21870	16380-30850	10660	9261-11810	191400	185800-200400
2016	17701	3180	65356	1623	2881	3803	3659	419	62549	161171	26000	22720	17010-31700	10740	9342-11750	201500	195800-210500
2017	9644	3005	55193	5632	2435	1702	10760	380	50771	139522	32000	16240	12160-22930	10560	8974-11460	178700	174600-185500
2018	14624	1042	40379	6613	1531	2223	12336	458	57172	135920	42600	12930	9793-17600	5914	5487-6506	200900	197600-205700
2019	13831	1038	45057	6502	4118	1836	11438	602	51010	134830	600	10270	7665-14160	7017	6774-7386	157300	154700-161200
2020	11065	815	43065	1605	3365	2825	8653	752	57938	129331	200	11120	8263-15590	8052	7855-8339	152100	149200-156600
2021	11333	501	49368	2549	3788	3007	16330	NA	49309	136185	0	10670	7887-14890	9597	9356-9937	154400	151600-158700
2022	5395	231	34077	638	1609	98	1803	NA	34315	78166	0	6458	4730-9049	3612	3431-3889	90840	89090-93460

* Not available (NA).

Table 12 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Catch components and their shares in 2019–2022 in the Main Basin and Gulf of Bothnia combined and separately in the Åland Sea and Gulf of Bothnia, and in the Bothnian Bay 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									
2019	65560	1530	900	5250	3120	600	25660	43530	6060	50.6 %	16.9 %	32.6 %
2020	52980	1380	680	6590	2700	200	22580	52740	7260	43.9 %	15.3 %	40.8 %
2021	63650	1440	1000	8320	2980	0	23150	48970	6960	49.5 %	14.8 %	35.7 %
2022	36300	1050	580	2720	1980	0	14180	27430	3930	48.3 %	16.1 %	35.6 %
	Catches at sea only, shares							**Total**				
2019	63.9 %	1.5 %	0.9 %	5.1 %	3.0 %	0.6 %	25.0 %	75.0 %				
2020	60.8 %	1.6 %	0.8 %	7.6 %	3.1 %	0.2 %	25.9 %	74.1 %				
2021	63.3 %	1.4 %	1.0 %	8.3 %	3.0 %	0.0 %	23.0 %	77.0 %				
2022	63.9 %	1.8 %	1.0 %	4.8 %	3.5 %	0.0 %	25.0 %	75.0 %				
	Commercial cathes at sea only, shares											
2019	85.2 %	2.0 %	1.2 %	6.8 %	4.1 %	0.8 %						
2020	82.1 %	2.1 %	1.1 %	10.2 %	4.2 %	0.3 %						
2021	82.2 %	1.9 %	1.3 %	10.8 %	3.9 %	0.0 %						
2022	85.2 %	2.5 %	1.4 %	6.4 %	4.6 %	0.0 %						

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									
2019	48400	1430	600	2050	2450	0	2880	42390	5670	51.9 %	2.7 %	45.4 %
2020	43870	1320	530	1920	2270	0	3950	51000	6670	44.8 %	3.5 %	51.7 %
2021	43450	1300	610	2440	2190	0	4820	48230	6710	45.5 %	4.4 %	50.1 %
2022	35150	1020	530	2400	1790	0	4170	26830	3720	54.1 %	5.5 %	40.4 %
	Catches at sea only, shares							**Total commercial**				
2019	83.7 %	2.5 %	1.0 %	3.5 %	4.2 %	0 %	5.0 %	95.0 %				
2020	81.5 %	2.5 %	1.0 %	3.6 %	4.2 %	0 %	7.3 %	92.7 %				
2021	79.3 %	2.4 %	1.1 %	4.5 %	4.0 %	0 %	8.8 %	91.2 %				
2022	78.0 %	2.3 %	1.2 %	5.3 %	4.0 %	0 %	9.3 %	90.7 %				
	Commercial cathes at sea only, shares											
2019	88.1 %	2.6 %	1.1 %	3.7 %	4.5 %	0 %						
2020	87.9 %	2.6 %	1.1 %	3.8 %	4.5 %	0 %						
2021	86.9 %	2.6 %	1.2 %	4.9 %	4.4 %	0 %						
2022	86.0 %	2.5 %	1.3 %	5.9 %	4.4 %	0 %						

Bothnian Bay (SD 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									
2019	35020	1040	430	1490	1770	0	1600	37720	5050	47.3 %	1.9 %	50.8 %
2020	32210	970	390	1410	1660	0	2400	43430	5680	41.6 %	2.7 %	55.7 %
2021	33970	1020	480	1910	1710	0	2400	41150	5720	44.2 %	2.7 %	53.0 %
2022	26430	770	400	1800	1340	0	2400	23670	3280	51.2 %	4.0 %	44.8 %
	Catches at sea only, shares							**Total commercial**				
2019	84.7 %	2.5 %	1.0 %	3.6 %	4.3 %	0 %	3.9 %	96.1 %				
2020	82.5 %	2.5 %	1.0 %	3.6 %	4.3 %	0 %	6.1 %	93.9 %				
2021	81.9 %	2.5 %	1.2 %	4.6 %	4.1 %	0 %	5.8 %	94.2 %				
2022	79.8 %	2.3 %	1.2 %	5.4 %	4.0 %	0 %	7.2 %	92.8 %				
	Commercial cathes at sea only, shares											
2019	88.1 %	2.6 %	1.1 %	3.7 %	4.5 %	0 %						
2020	87.9 %	2.6 %	1.1 %	3.8 %	4.5 %	0 %						
2021	86.9 %	2.6 %	1.2 %	4.9 %	4.4 %	0 %						
2022	86.0 %	2.5 %	1.3 %	5.9 %	4.4 %	0 %						

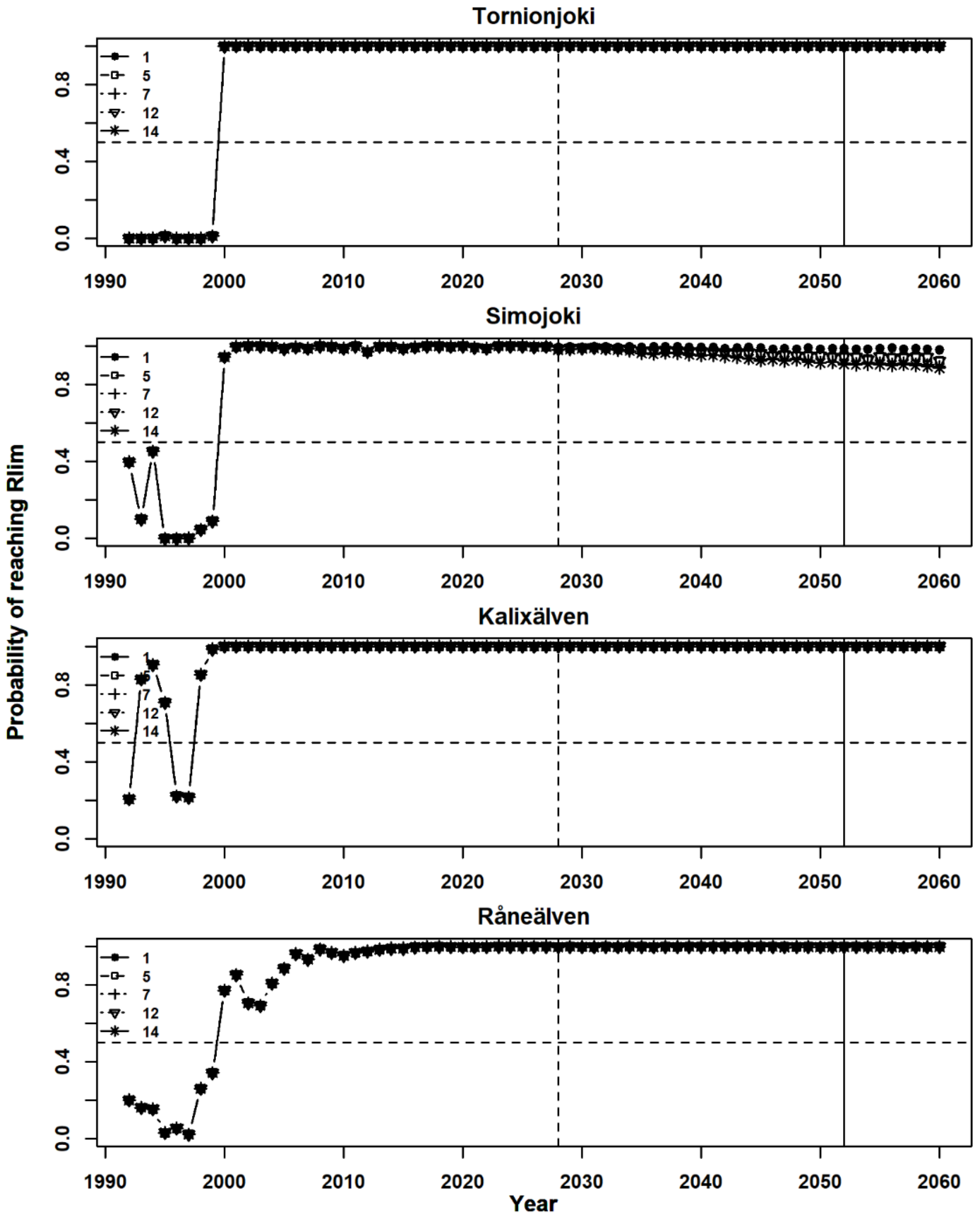

Figure 7a Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks being above R_{lim} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

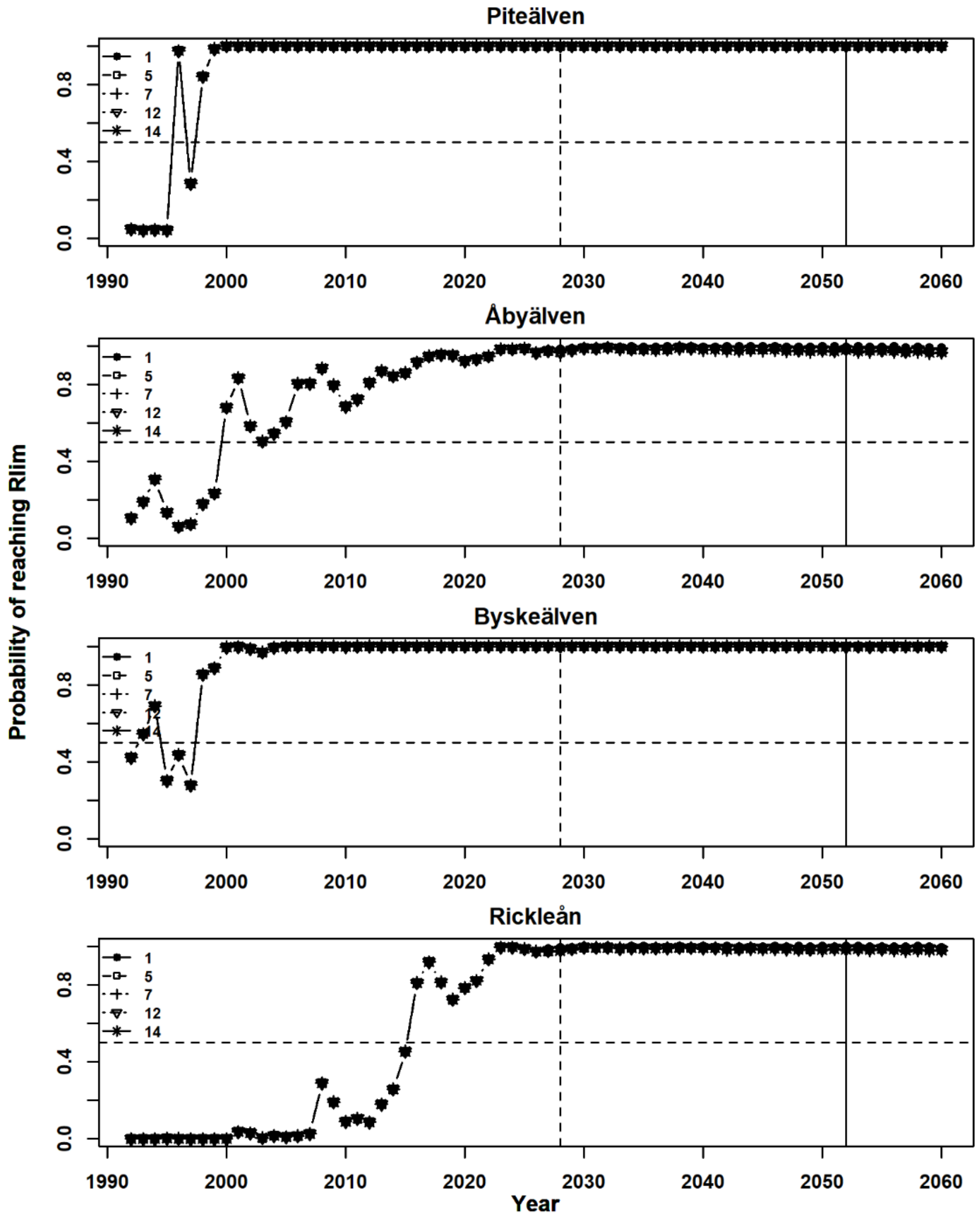

Figure 7b Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks being above R_{lim} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

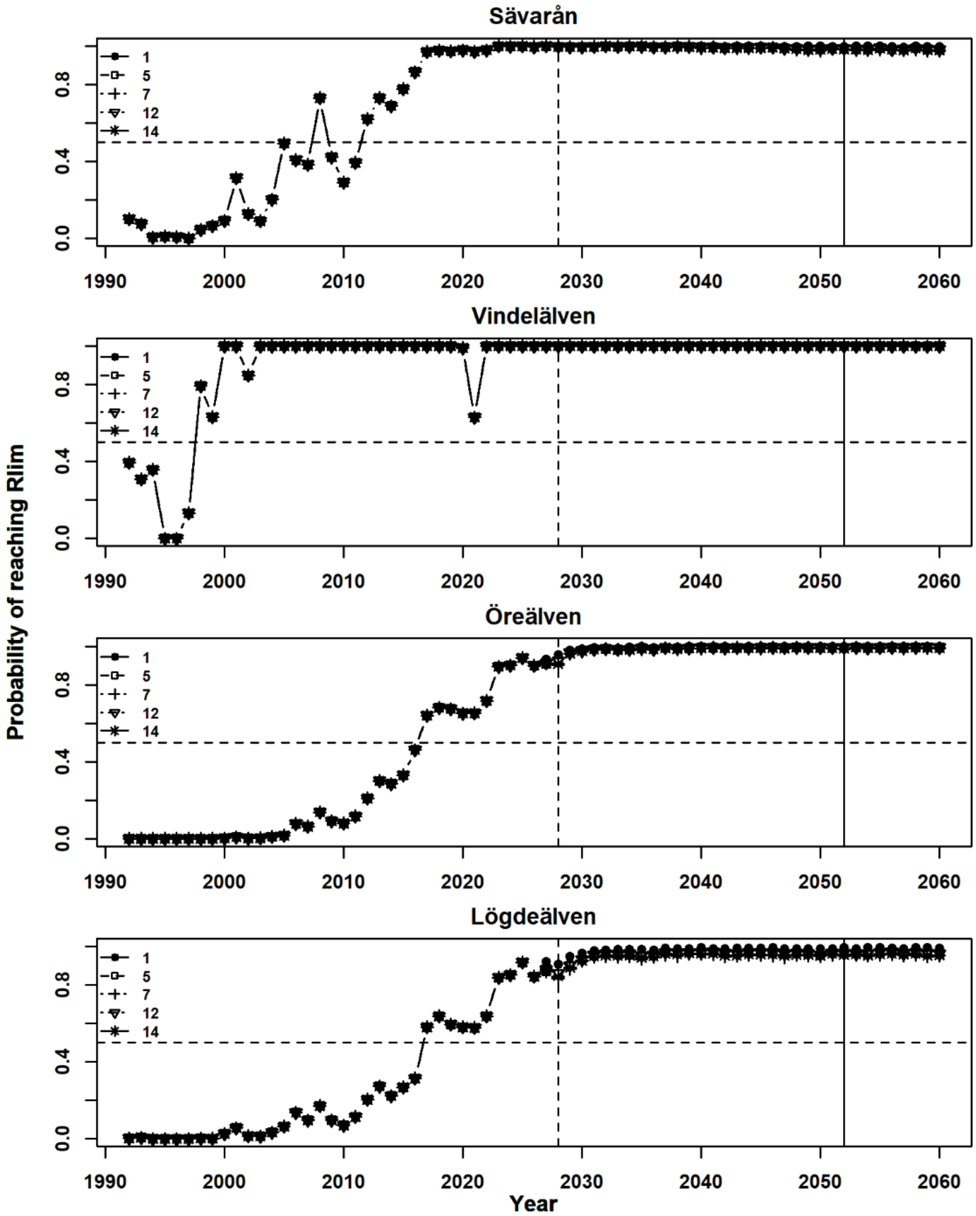

Figure 7c Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks being above R_{lim} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

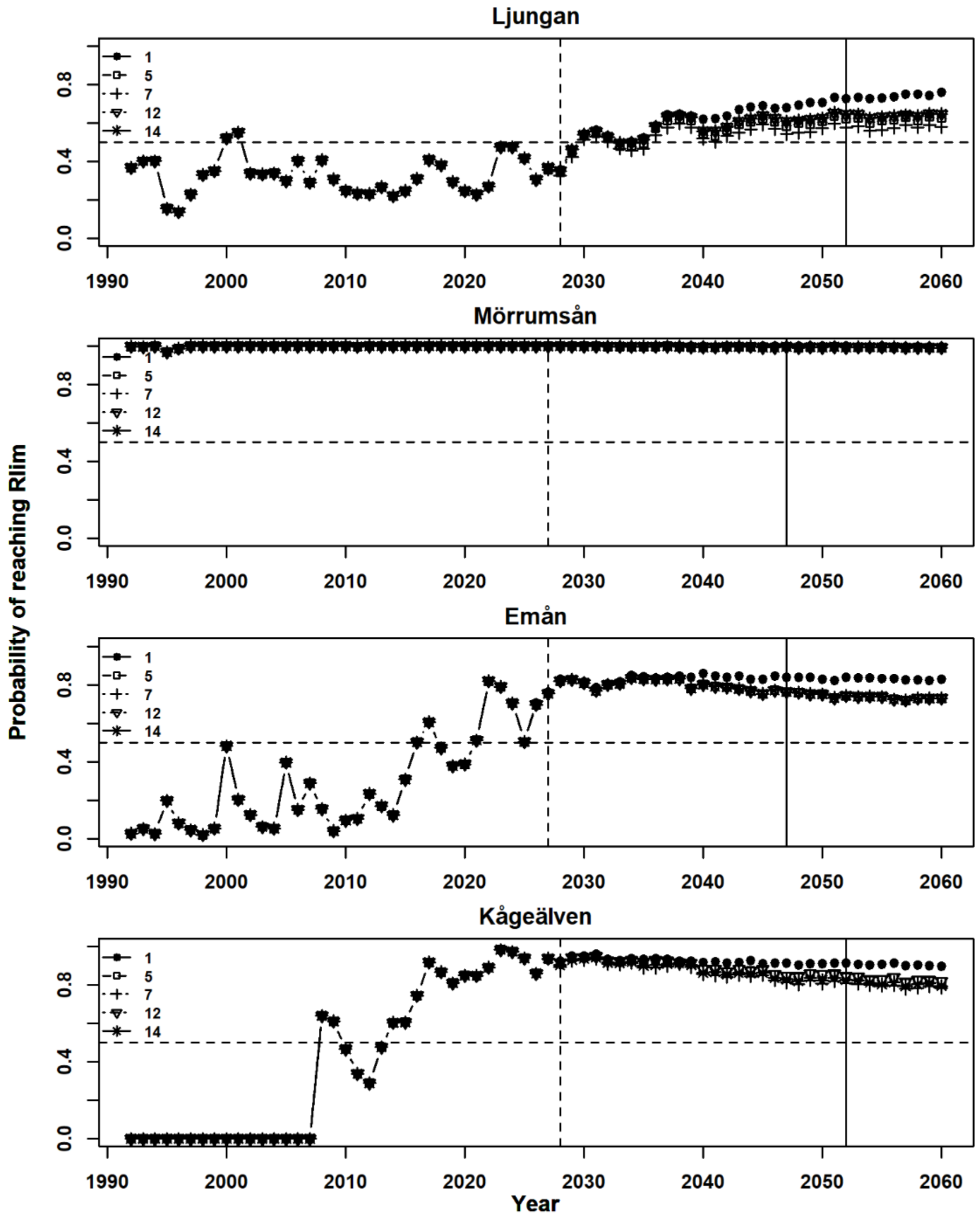

Figure 7d Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks being above R_{lim} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

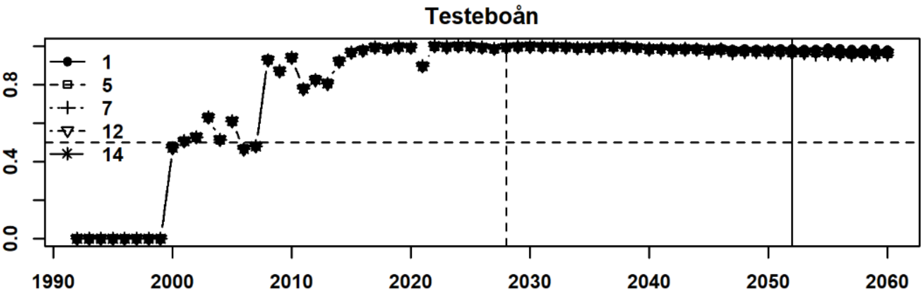

Figure 7e Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks being above R_{lim} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

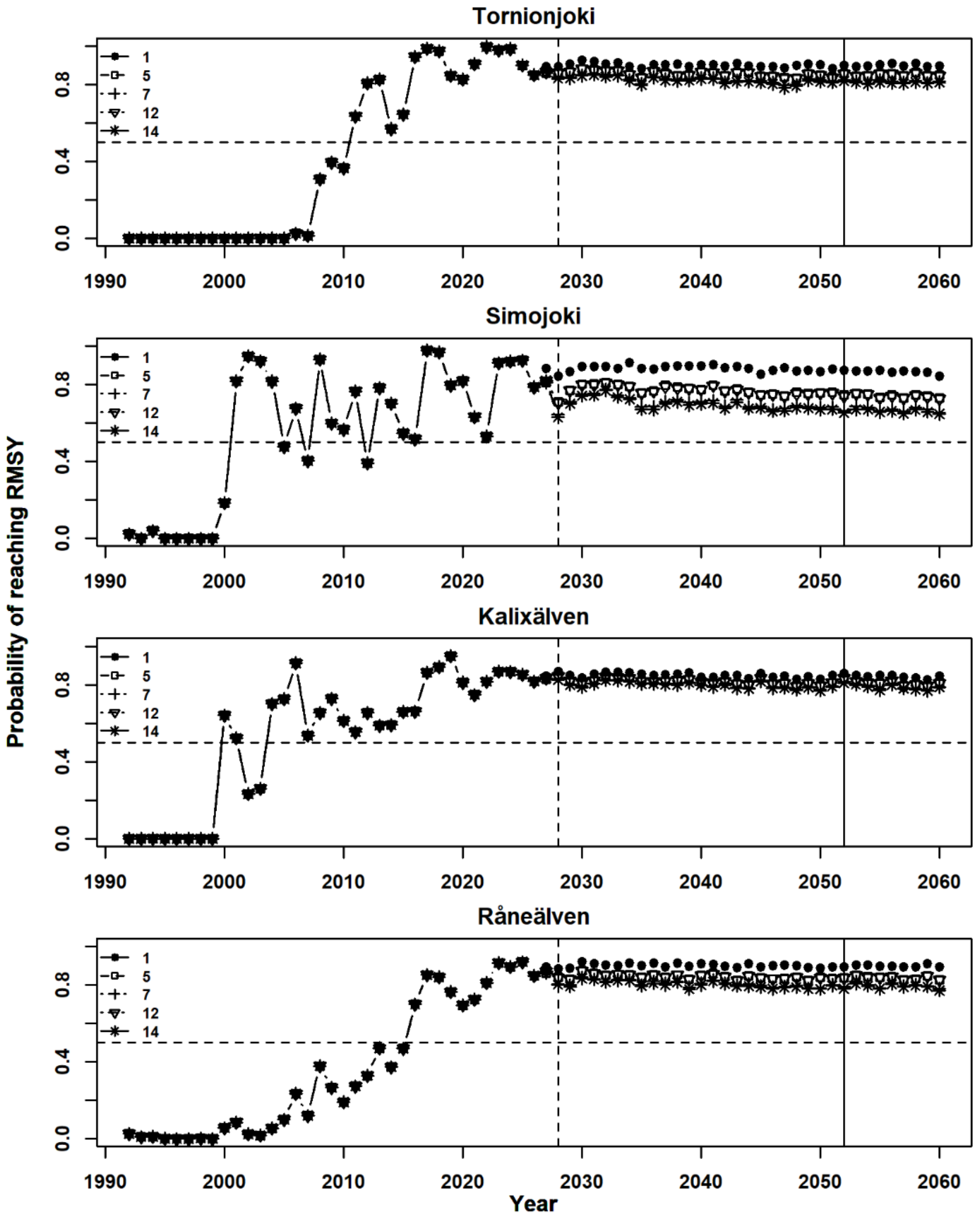

Figure 7f Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

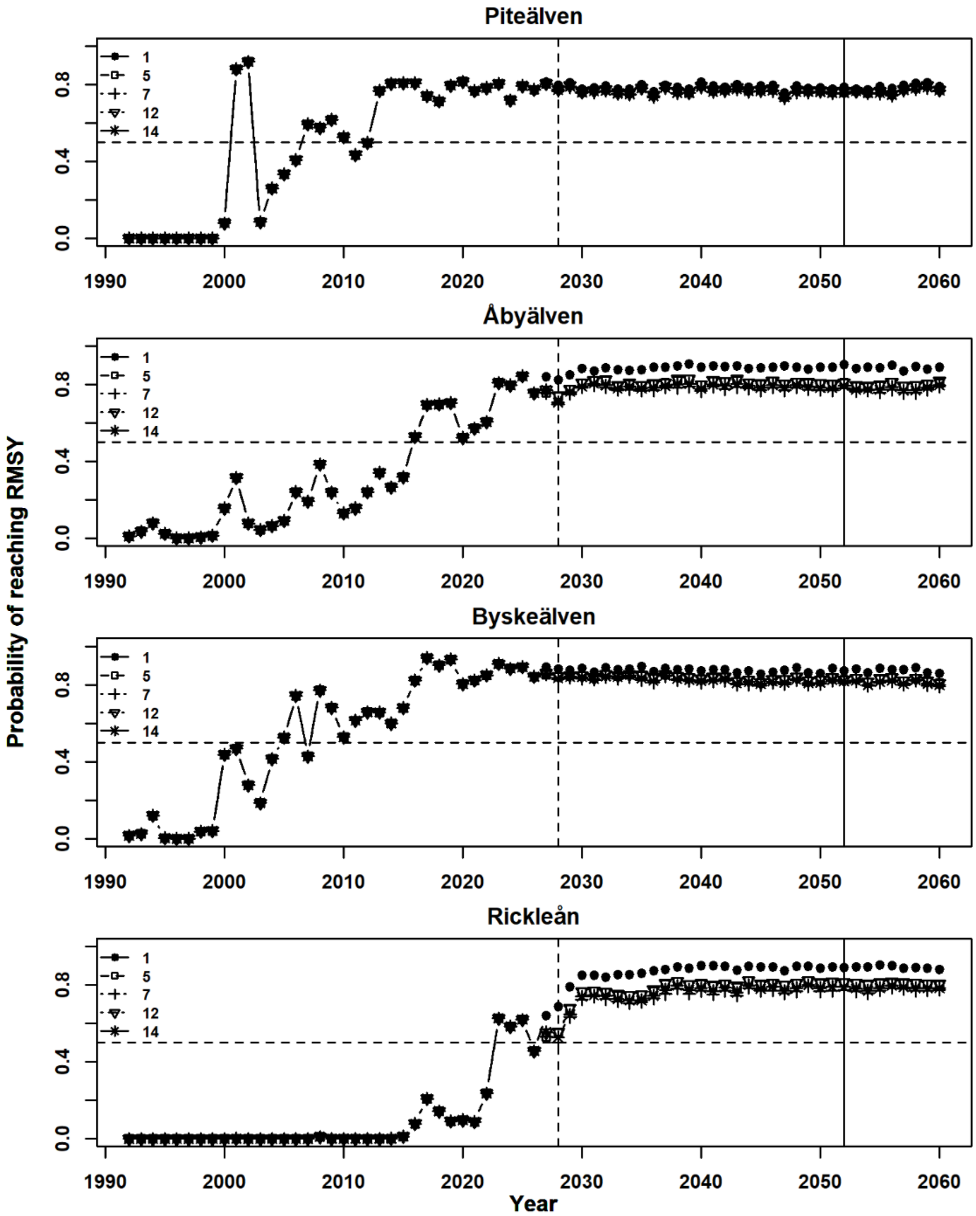

Figure 7g Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

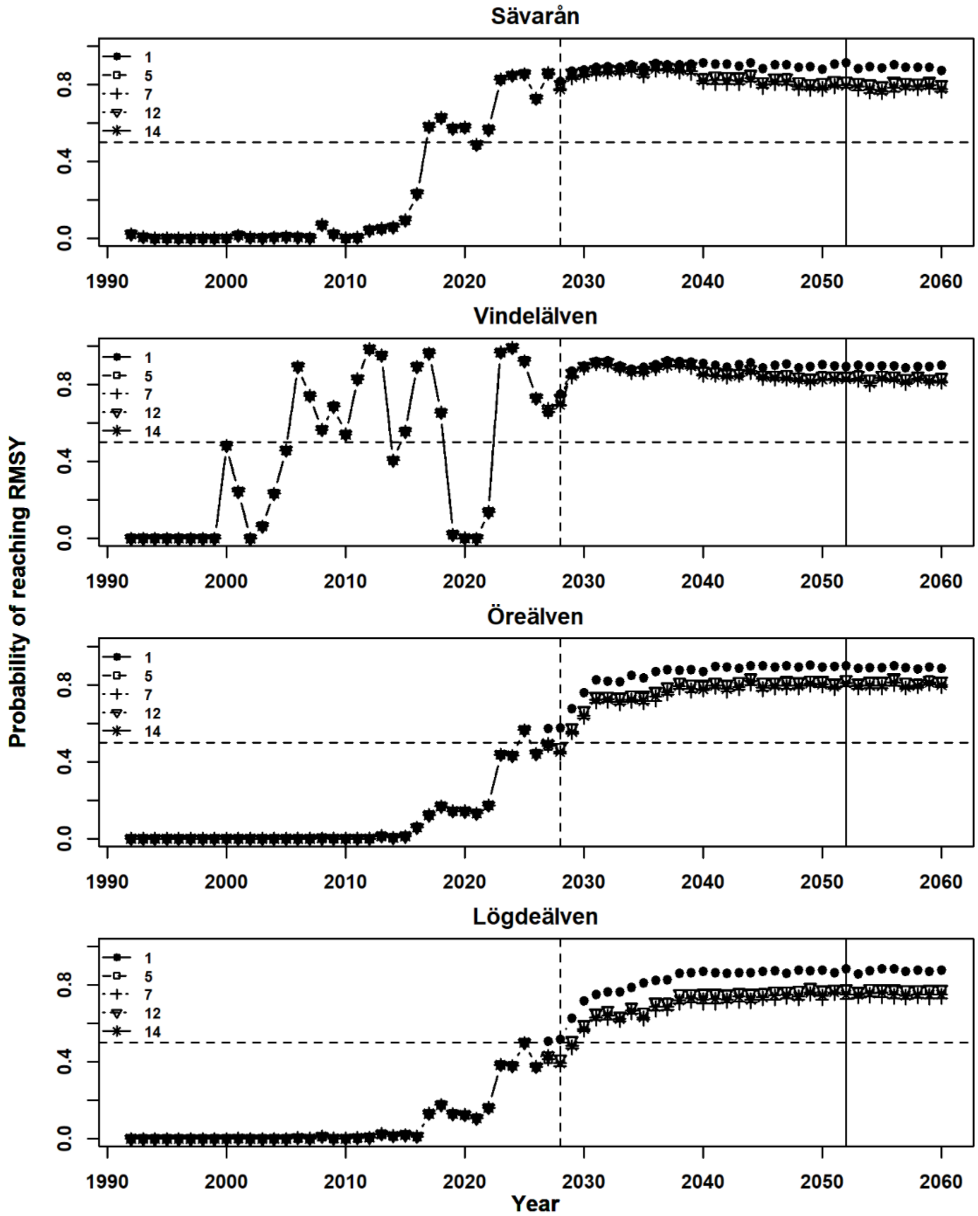

Figure 7h Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

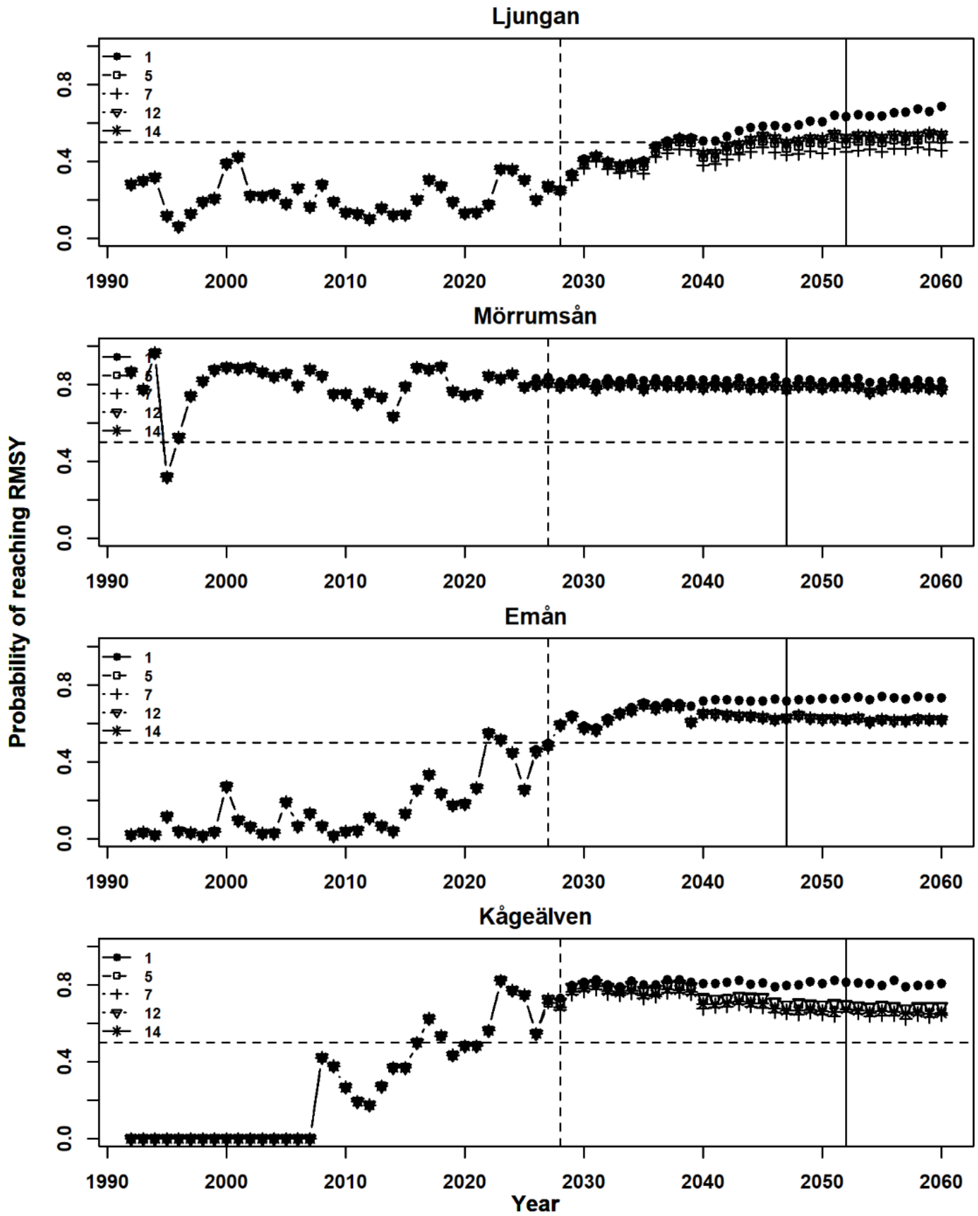

Figure 7i Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

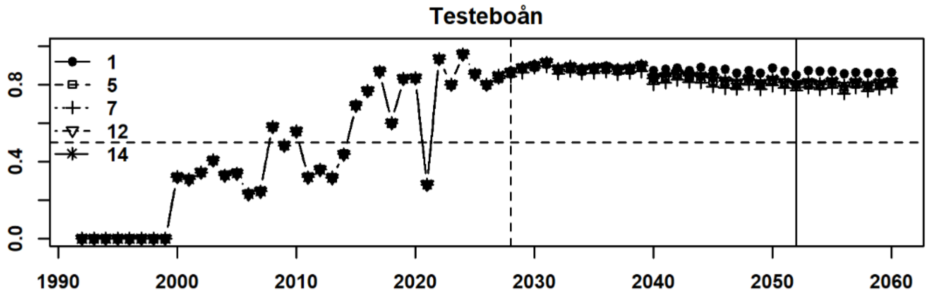

Figure 7j Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of stocks meeting R_{MSY} under projection scenarios 1, 5, 7, 12 and 14. Vertical lines mark predicted status in 2028 (AUs 1–3) or 2027 (AU 4) and approximately five salmon generations ahead (from 2022). Fishing in 2024 mainly affects smolt production in the years 2028/2027 (year depending on AU).

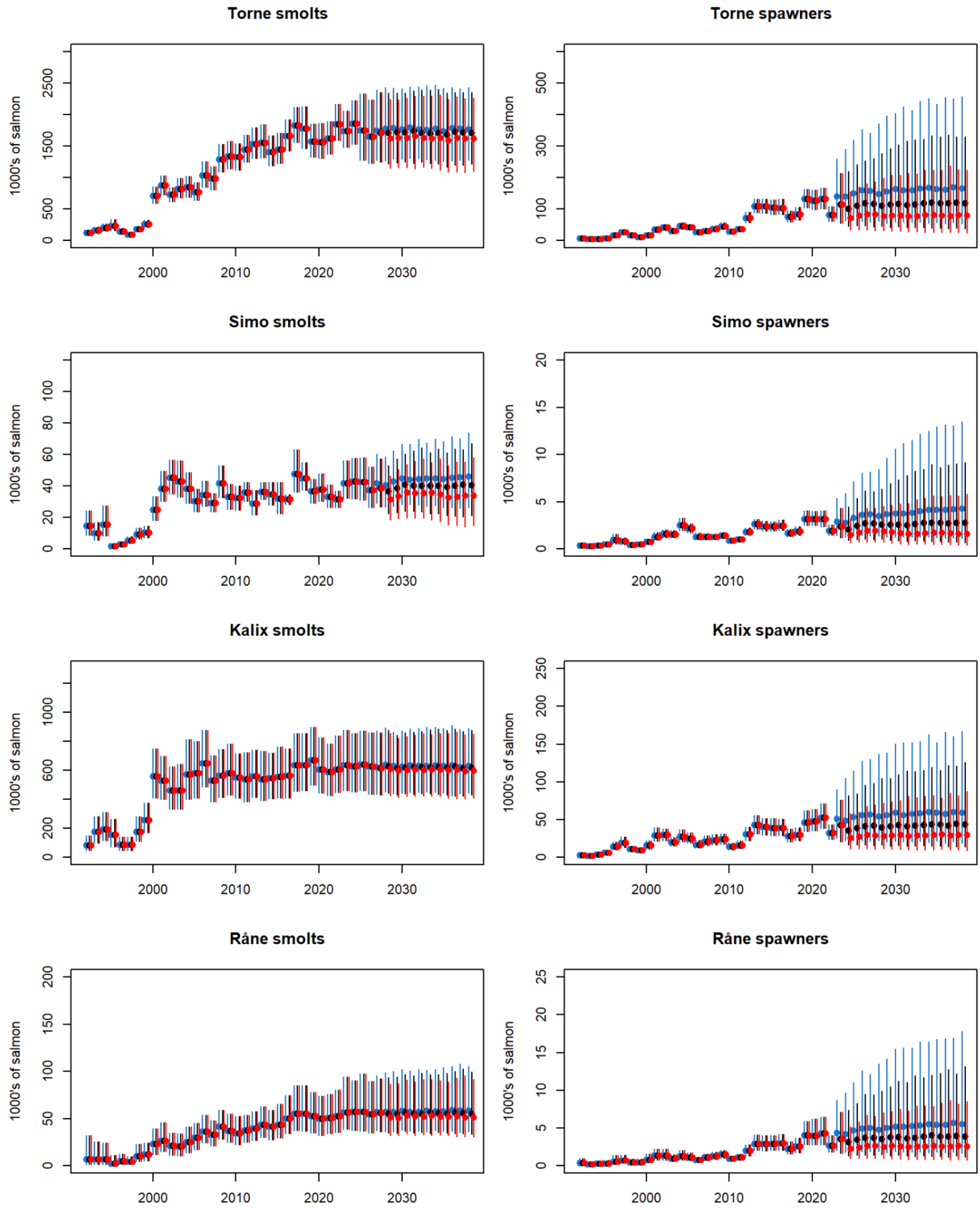

Figure 8a Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Long-term predictions of river-specific smolt and spawner abundances for three scenarios (medians with 90% probability intervals). Blue, scenario 1 (zero fishing); black, scenario 12 (20 000 sea catch); red, scenario 15 (100 000 sea catch). The two most extreme scenarios (1 and 15) illustrate the predicted effects of contrasting amounts of fishing. Fishing in 2024 mainly affects smolt production in the years 2028/2027.

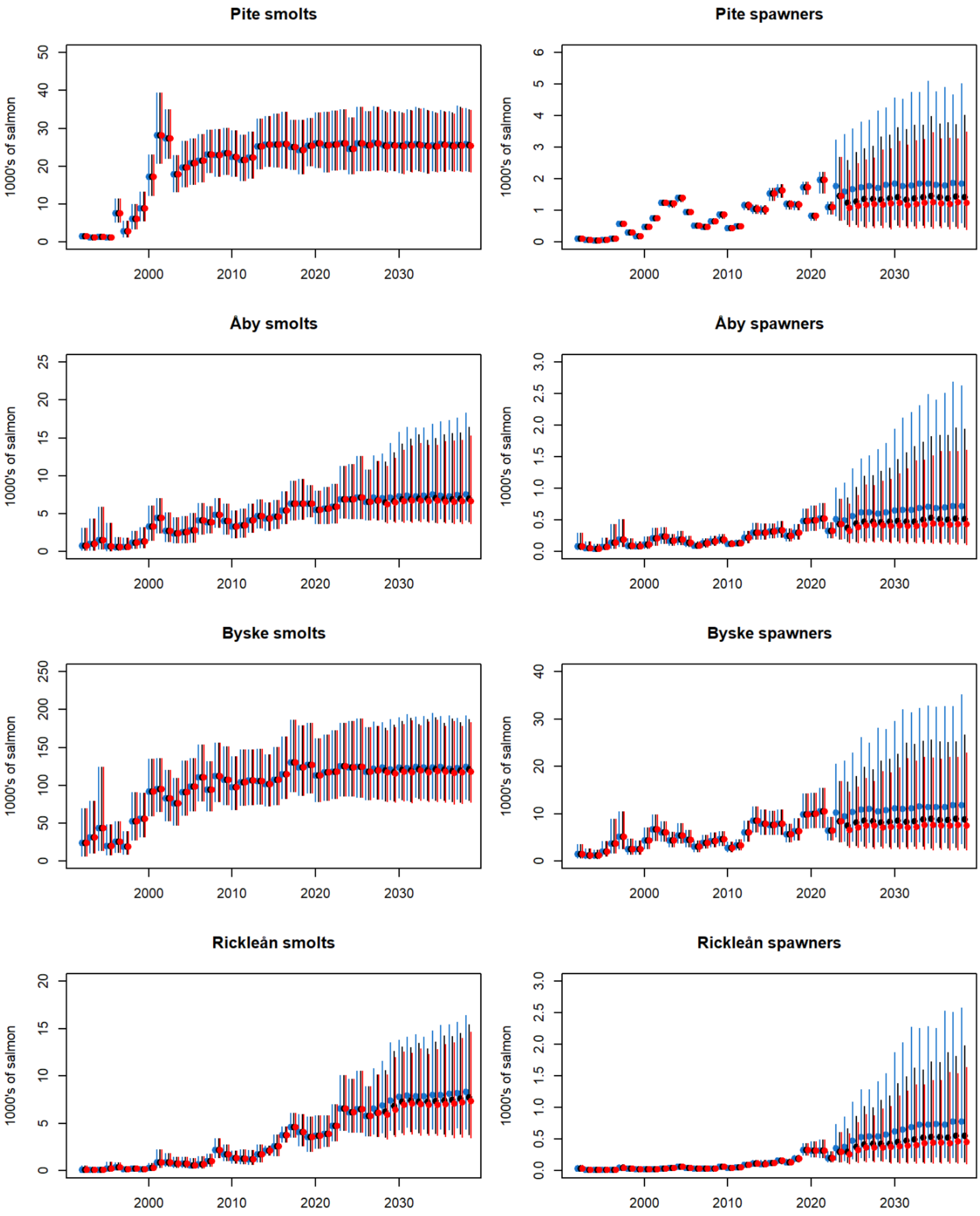

Figure 8b Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Long-term predictions of river-specific smolt and spawner abundances for three scenarios (medians with 90% probability intervals). Blue, scenario 1 (zero fishing); black, scenario 12 (20 000 sea catch); red, scenario 15 (100 000 sea catch). The two most extreme scenarios (1 and 15) illustrate the predicted effects of contrasting amounts of fishing. Fishing in 2024 mainly affects smolt production in the years 2028/2027.

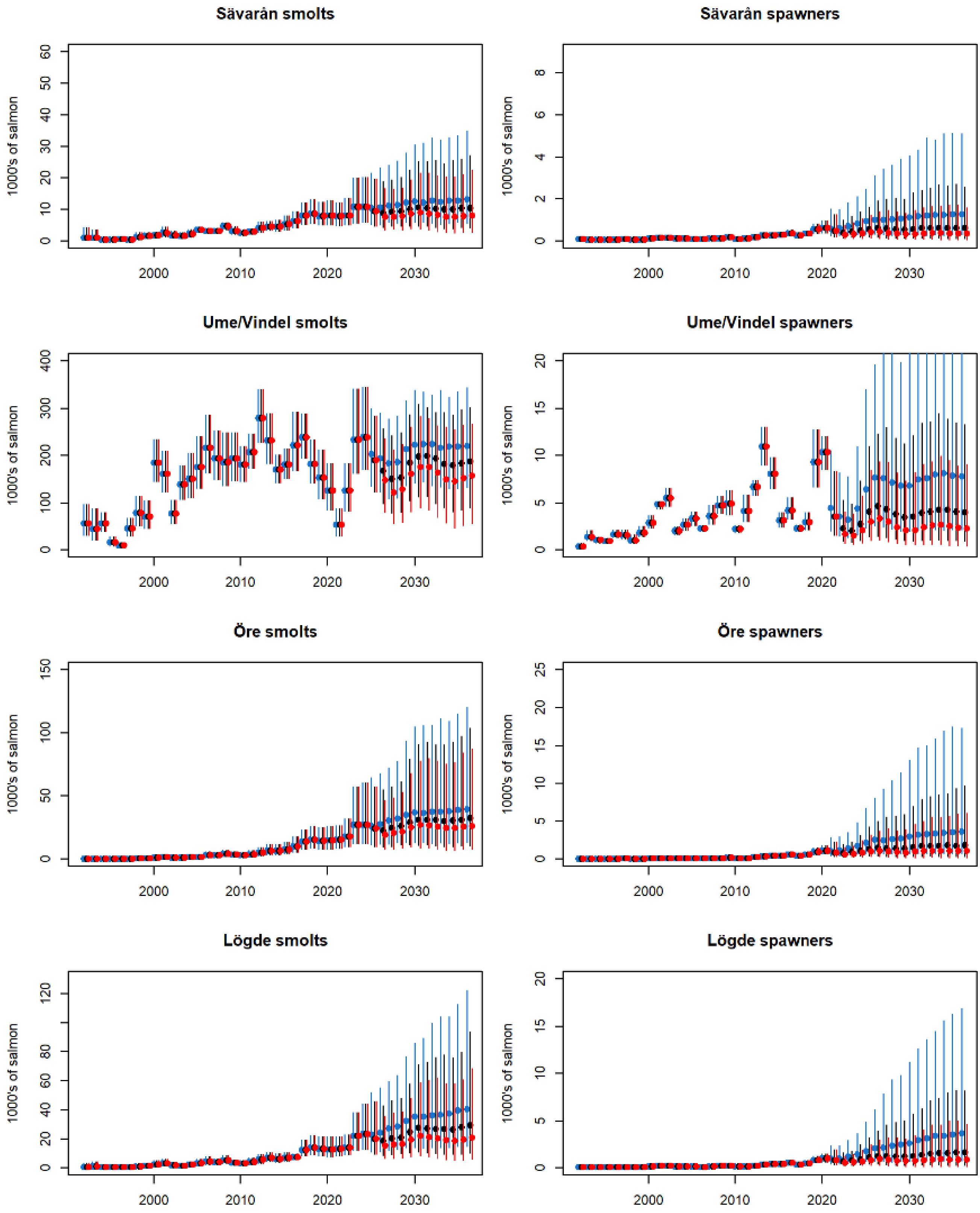

Figure 8c Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Long-term predictions of river-specific smolt and spawner abundances for three scenarios (medians with 90% probability intervals). Blue, scenario 1 (zero fishing); black, scenario 12 (20 000 sea catch); red, scenario 15 (100 000 sea catch). The two most extreme scenarios (1 and 15) illustrate the predicted effects of contrasting amounts of fishing. Fishing in 2024 mainly affects smolt production in the years 2028/2027.

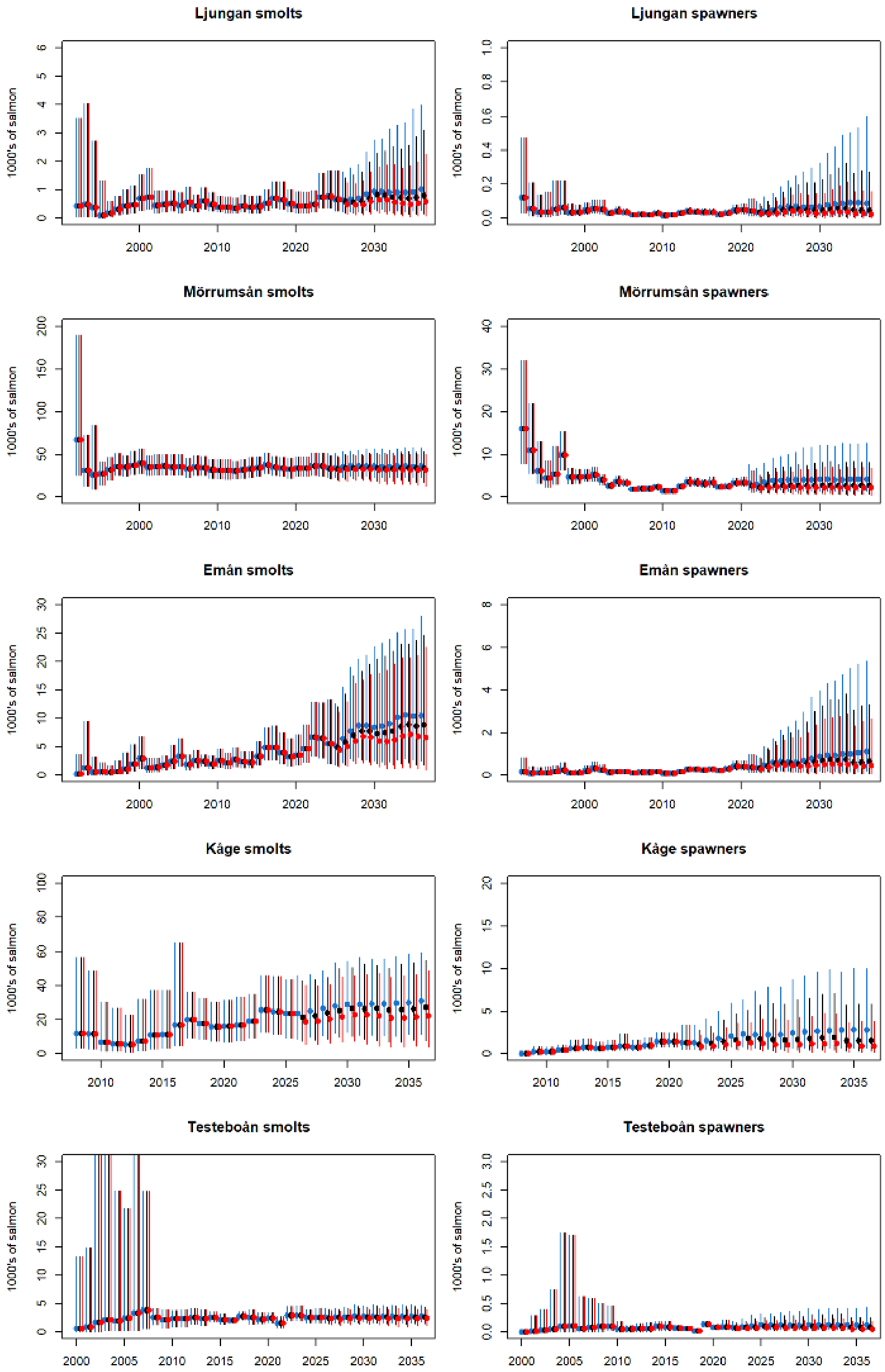

Figure 8d Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Long-term predictions of river-specific smolt and spawner abundances for three scenarios (medians with 90% probability intervals). Blue, scenario 1 (zero fishing); black, scenario 12 (20 000 sea catch); red, scenario 15 (100 000 sea catch). The two most extreme scenarios (1 and 15) illustrate the predicted effects of contrasting amounts of fishing. Fishing in 2024 mainly affects smolt production in the years 2028/2027.

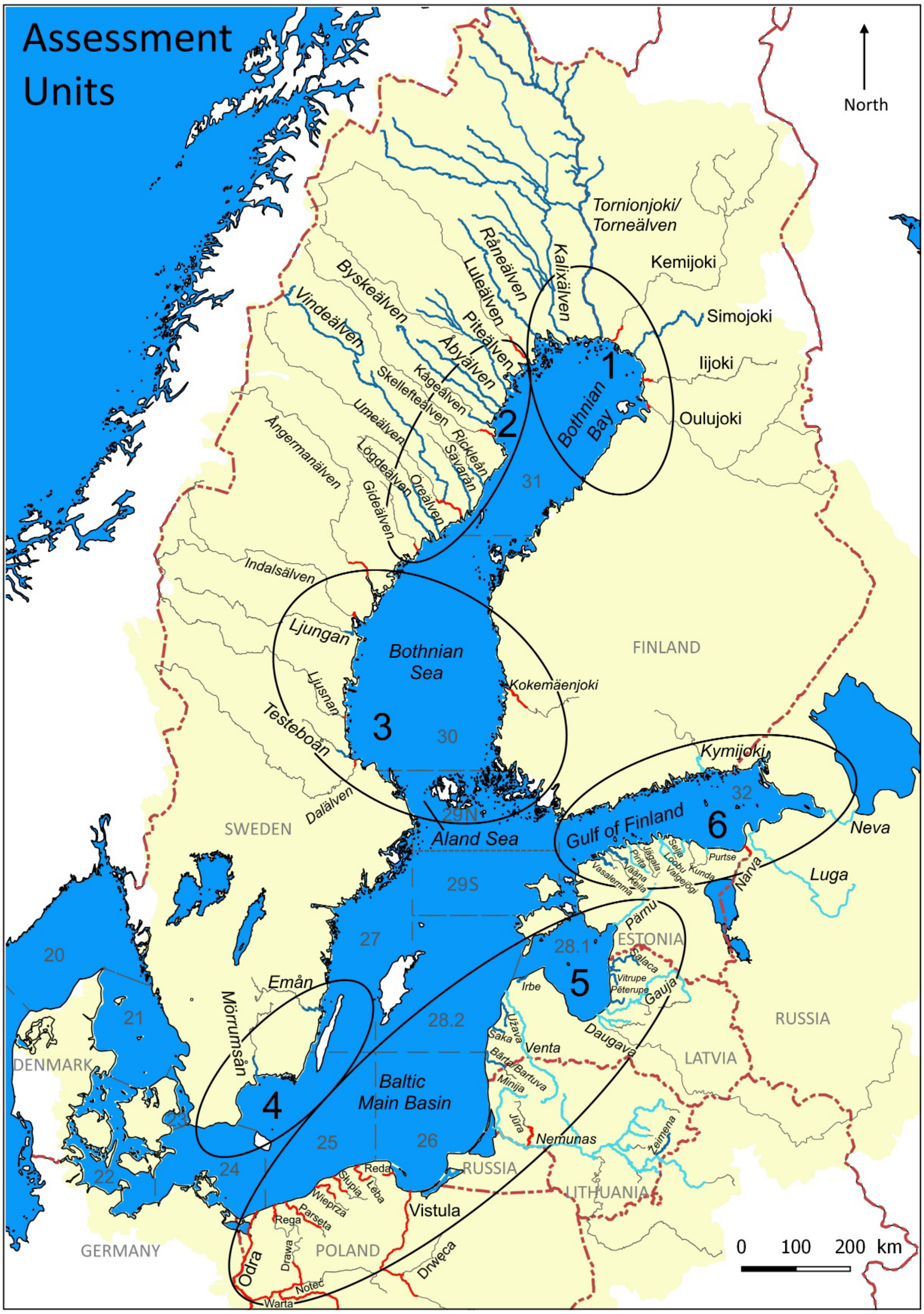

Figure 9 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Grouping of salmon stocks in six assessment units (AUs) in the Baltic Sea, including the Gulf of Finland. The genetic variability between stocks of an AU is smaller than the genetic variability between stocks of different AUs. In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

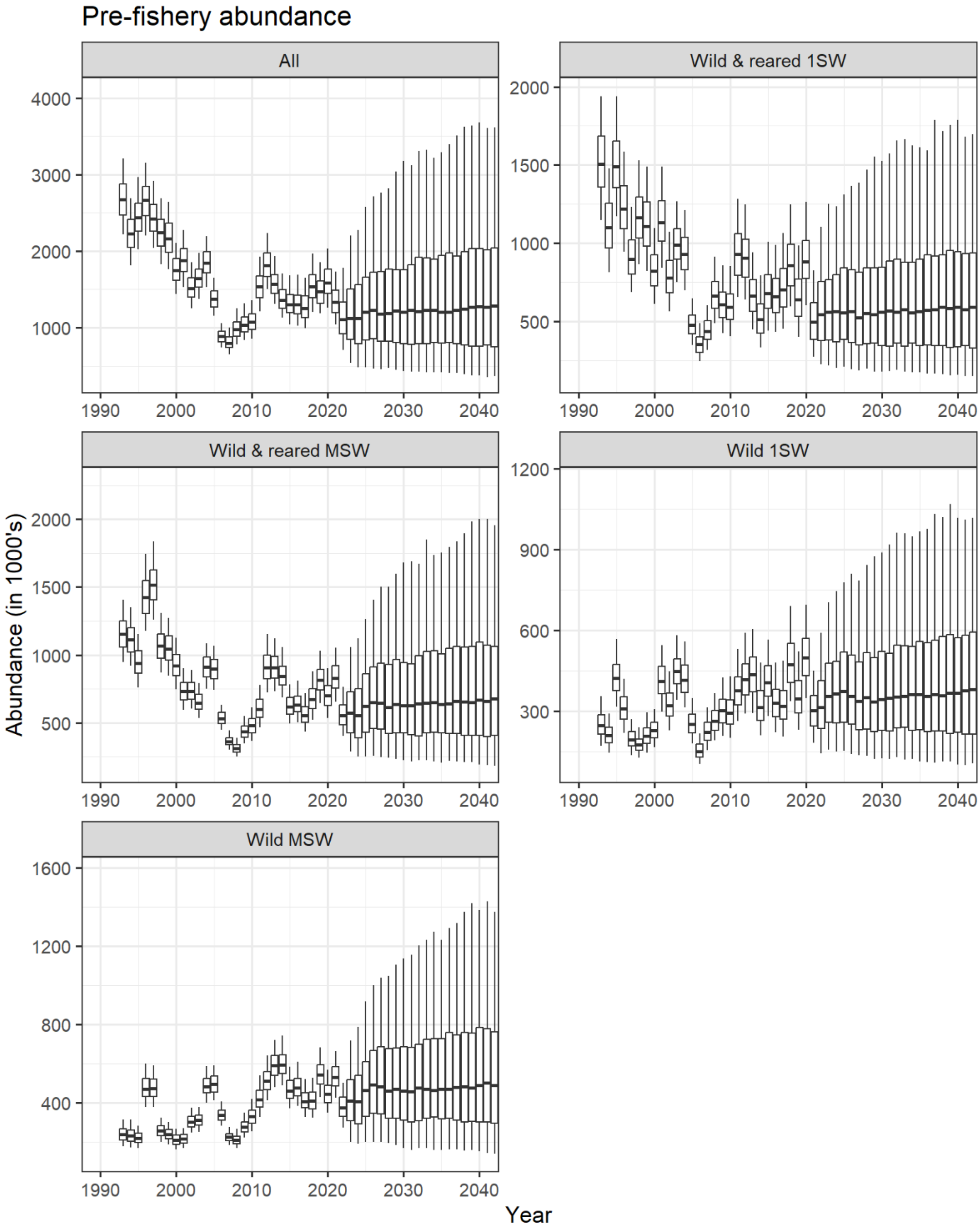

Figure 10 Salmon in subdivisions 22–31 (Main Basin and Gulf of Bothnia). Top left panel: total annual abundance (medians with 90% probability intervals) of salmon available to sea fisheries. Other panels: abundance divided on origin (wild or reared) for different sea ages. For one sea winter fish (1SW) 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 (2023–2042) in abundance following projection scenario 15 (sea catch of 100 000 salmon in Bothnian Bay) is also indicated.

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