8.4.14 Salmon in the Main Basin and the Gulf of Bothnia (Subdivisions 22–31)

In order to better support the management of wild salmon stocks, ICES has established five assessment units for the Baltic Main Basin and the Gulf of Bothnia (Figure 8.4.14.1). The division of stocks into units is based on management objectives and biological and genetic characteristics of the stocks. Stocks of a particular unit are assumed to exhibit similar migration patterns. It can therefore be assumed that they are subjected to the same fisheries, experience the same exploitation rates, and could be managed in the same way (e.g. through the use of coastal management measures it might be possible to improve the status of stocks in a specific assessment unit). Even though stocks of units 1–3 have the highest current smolt productions and therefore have an important role in sustaining economically viable fisheries, the stocks in units 4 and 5 contain a relatively high proportion of the overall genetic variability of Baltic salmon stocks.

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

State of the stock

The total wild smolt production has increased about fourfold in assessment units 1–3 since the Salmon Action Plan was adopted in 1997 (Figure 8.4.14.2). Wild smolt production is now estimated to be around two thirds of the potential total smolt production but smolt production is still low particularly in the 'potential' rivers, i.e. rivers where salmon were extirpated and are now being reintroduced.

The post-smolt survival in 2004 and 2005 (Figure 8.4.14.3) was low. However, the overall estimated smolt production has been increasing and will continue to stay high in the near future. The number of spawners are estimated to increase slightly in 2008 and again in 2009. Overall though, the smolt production during the early 2010s is expected to be low.

To evaluate the current state of the stock, ICES uses the smolt production relative to the level of natural production capacity on a river-by-river basis. Stocks are considered *very likely* to reach the reference point in case the probability is more than 90%. They are *likely* to reach the reference point in case the probability is between 70% and 90% and *uncertain* when the probability lies between 30% and 70%. When the probability of reaching the reference point is less than 30%, it is considered *unlikely*.

Reaching 50% of the natural production capacity is *likely* or *very likely* to be met for several large rivers in the Northern Baltic Sea area while the status of less productive wild stocks, especially in the Southern Baltic Sea area is poor. Within assessment unit 4 a decreasing trend in smolt production has been observed (Figure 8.4.14.2).

The nominal catch in the Baltic Sea (including rivers) has declined from 5636 tonnes (1990) to 1125 tonnes (2007) (Table 8.4.14.1). The nominal catch in the offshore and coastal fisheries decreased by 10% from 2006 to 2007. Preliminary data for 2007 for salmon catches indicate that in-river fisheries increased by 21% (Table 8.4.14.2).

Only 69% of the TAC of 444 000 salmon in the Baltic was utilized in 2007 (Table 8.4.14.3).

There has been an increase in the proportion of wild relative to reared salmon in catches, which reflects the increased wild smolt production (e.g. Figure 8.4.14.4). The share of non-commercial (recreational) catches has increased and will likely increase further.

Management objectives

The objective of the Salmon Action Plan (SAP), as adopted in 1997 by the former IBSFC, was to increase the natural production of wild Baltic salmon to at least 50% of the natural production capacity of each river by 2010, while retaining the catch level as high as possible. In addition, objectives stated that the genetic diversity of the stocks should be maintained.

IBSFC ceased to exist after 2005. The EU Commission has taken initiatives for the development of a management plan for Baltic salmon.

Reference points

To evaluate the state of the stock ICES uses the smolt production in 2010 relative to the 50% level of the natural production capacity on a river-by-river basis. Due to difficulties with a submodule of the assessment model the production capacity for the individual rivers is not available for this report.

Management advice

Because of the low at-sea survival of salmon in recent years in combination with the past high harvest rate, the spawning populations of salmon are estimated to be low. Due to the ban on the driftnet fishery as of January 2008, the catches for 2008 are expected to be lower than in 2007. This will likely result in an increased number of spawners during the next few years; however, the impact of this increased number of spawners will be offset by continued low rates of at-sea survival. In order to ensure recovery of the salmon stocks ICES recommends for 2009 that landings do not exceed the reduced catches expected for 2008.

Salmon management should be based on the assessments of the status of individual stocks in the rivers. Fisheries on mixed stocks, either in coastal waters or open sea areas, pose particular difficulties for management, because the fisheries cannot target only those stocks that are close to or above their targets. Fisheries in estuaries and rivers are more likely to fulfil this requirement.

There are a number of rivers that need longer-term stock rebuilding measures, including habitat restoration and removal of physical barriers. For the smallest and weakest rivers (Emån, Rickleån, Öreälven, Pärnu, and Nemunas basin), it is recommended that extra measures be taken to further decrease exploitation of these stocks. In addition to reduction of mixed stock fisheries in the Main Basin due to the driftnet ban, exploitation in the coastal and estuarine fisheries should be further reduced. Salmon of the rivers Rickleån and Öreälven pass the Åland Sea and Bothnian Sea on their spawning migration. Salmon spawners of the river Pärnu pass the coastal waters of the Gulf of Riga. Salmon of the river Emån pass the coastal waters around the Öland Island, and salmon of the Nemunas basin pass the coastal waters around the Curonian lagoon on their spawning migration.

Management considerations

A key factor influencing the abundance of stocks is the lower survival rate of post-smolts in the past decade (Figure 8.4.14.3). The reasons for the decrease in post-smolt survival are still unclear, but it was found to be negatively correlated with seal abundance and with smolt abundance, and positively correlated with abundance of 0+ herring. As noted earlier the very low post-smolt survival in 2004 and 2005, and the slightly increased levels in 2006, and probably also in 2007 will limit the abundance of spawners. Despite lowered fishing exploitation, the low post-smolt survival will lead to only a minor increase in smolt production in 2009–2012 compared to the levels of the last few years.

The lower post-smolt survival rate is the main reason for low abundance of salmon and underutilization of the TAC; only 69% of the TAC of 444 000 salmon in the Baltic was utilized in 2007 (Table 8.4.14.3). In the period 2004–2006, the survival past the post-smolt phase was 10-15% for wild, and lower for reared salmon. Thus the harvest possibilities will be lower also in the future because the low post-smolt survival is expected to continue. Therefore, although exploitation rates have been reduced, only a gradual increase in smolt production can be expected.

Exploitation in the Main Basin offshore fisheries affects possibilities for recovery of the Gulf of Finland salmon stocks as 10–40% of catches of Gulf of Finland salmon occur within the Main Basin.

The M74 syndrome is a reproduction disorder of Baltic salmon, affecting mixed and wild stocks of Baltic salmon, and it can cause high mortality rates in yolk-sac fry. A linkage between the syndrome and a deficiency of thiamine has been established. The factors influencing the development of M74 are poorly understood and future mortality rates due to M74 can therefore not be predicted. The M74 mortality has varied over the years and sudden changes in the incidence of the disease are likely to occur in the future. The prevalence of M74 has been decreasing since the mid-1990s to a low level in the mid-2000s. The present advice has taken into account this pattern of incidence of M74.

Recent efforts to re-establish self-sustaining salmon stocks in ‘potential’ rivers, where salmon stocks existed in the past, but have now been extirpated, present exceptional challenges to management. The numbers of spawners in the ‘potential rivers’ are likely to be particularly low following the initial re-introductions, and productivity is likely to be lower than average. The considerations presented above for the existing weak salmon stocks also apply to re-established stocks. Therefore, even small mortality rates in fisheries may be enough to deter re-establishment and recovery of

salmon in these 'potential' rivers. Exploitation presents a particularly high risk at the present low level of post-smolt survival.

The estimated population parameters for rivers in the southern Baltic suggest low productivity. This implies that mixed-stock fisheries pose a special problem in managing these stocks. In the absence of specific management objectives a precautionary approach would be to move fisheries towards stock-specific harvesting, i.e. fishing mainly in estuaries and rivers. The reasons for the low productivity may, at least partly, be tracked down to special problems in the freshwater environment. For instance, in the river Emån the poor functioning of a fish ladder is likely the main reason for the limited response of the stock to the management measures. Tagging results from reared salmon also indicate a post-smolt survival among the southern stocks which is even lower than that of the northern stocks.

Catch losses from seal damage are not included in the TAC, but are a source of mortality associated with the fisheries. Catch losses have decreased due to changes in the fishing gear and are expected to decrease further as more fishers change fishing gear.

The assessment highlights the importance of collecting information from wild salmon stocks within each assessment unit. The data collected under the minimum programme of the EU Data Collection Regulation would need to cover parr density data from each wild-salmon river and smolt trapping data, spawner abundance data, and tagging data from at least one wild salmon index river within each assessment unit. The combination of parr density data from every wild-salmon river with data from index rivers would allow ICES to apply the same assessment methods across all rivers within the Baltic Sea.

Factors affecting the fisheries and the stock

Regulations and their effects

The decreased offshore (Table 8.4.14.2) landings are expected to prevail after the start of the driftnet ban in 2008. These will likely lead to an increase in the number of spawners provided that there is no major increase in coastal fishing effort. Whether the decreased exploitation is sufficient to safeguard smolt production on a longer time scale will depend on the further development of post-smolt survival and on the future incidences of M74.

Several other factors have been limiting the fishery, including: 1) technical measures such as opening time of fishery and closed areas, 2) marketing restrictions on large salmon in certain countries due to the dioxin level, and 3) increased seal damage to catches and gear. Most of these factors and the resulting economic problems for the fishers are likely to continue to limit salmon fisheries in the near future. However, other factors such as increases in market price for salmon and reduced opportunities for income in other fisheries may offset these limitations.

The overall levels of dioxin and related substances in salmon tend to increase with size (sea age) of the salmon and, in general, the levels found are above the EU limit. Two countries (Finland and Sweden) have derogation from the EU until 2011, allowing national use of the salmon if dietary advice is given to the public; export to other EU countries is not permitted. In two other countries, salmon above certain weight limits may not be marketed (Denmark: 5.5 kg gutted weight, Latvia: 4.4 kg ungutted weight and 6.0 kg ungutted weight after cutting away the ventral part of the fillet). Estonia, Latvia, Lithuania, and Poland have also applied for derogation from the EU regulations on dioxin.

Restricting coastal and river fisheries directed at homing wild salmon requires additional technical measures. Many measures have been in place during the recovery period of wild stocks, nearly all established nationally. Keeping coastal harvest rates sufficiently low by technical measures is essential in the current situation in order to allow the numbers of spawners to increase. In Finland and Sweden the date of opening coastal fisheries in the Gulf of Bothnia has been delayed to restrict the harvest of the early run when the share of wild salmon is normally the largest. This has been an effective tool for protecting a proportion of the spawning run from the coastal harvest.

The environment

Environmental conditions have a marked effect on the status of salmon stocks. In many cases river damming and habitat deterioration have had a devastating effect on freshwater environmental conditions.

In the period 2004–2006, the survival past the post-smolt phase was 10-15% for wild and lower for reared salmon, while this survival rate was typically 15–20% in the first years of the 2000s and 20–30% during the 1990s. Any causal relationships explaining the decrease in the post-smolt survival have not been established, but some correlations are found between post-smolt survival and seal abundance, abundance of 0+ herring, and the number of smolt leaving the river. Seal populations have increased since the 1990s in the Gulf of Bothnia, in the Gulf of Finland, and in Subdivision 29, with a likely increase in related salmon mortality.

Scientific basis

Data and methods

The main information on the abundance and exploitation of wild salmon in the Baltic comes from electrofishing, smolt-trapping, tag returns from the fisheries, catch and effort data from the fisheries, fish ladder counts, and data on the proportion of wild and reared salmon in catches.

The assessment uses a Bayesian estimation procedure. This technique allows an explicit incorporation of prior knowledge (from previous studies, literature, and/or expert opinions) about parameters in the assessment. Within this approach uncertainties about estimated quantities are formulated as probability distributions.

The results of the assessment models are used to update expert information on the smolt production capacities for the different rivers based on a full life history model of all stocks. The estimation of smolt production capacity is based on expert knowledge and the available spawner/smolt estimates.

Uncertainties in assessment and forecast

The assessment estimates a low post-smolt survival in recent years, which has major implications for both the fisheries and predictions of the development of the stocks in the near future. It should be noted that post-smolt survival estimates are particularly sensitive to changes in tag reporting rates. Interpretation of the recapture data is difficult because of an uncertain rate of non-reported recaptures. Also in recent years, Swedish tagging data have not been available. This may also have changed the reporting rates of Finnish tags by Swedish fishers, thereby affecting the quality of the remaining tagging data.

The Bayesian approach is based on a number of assumptions; the effect of changing these assumptions on the resulting production and capacity estimates has not yet been fully explored.

Comparison with previous assessment and advice

The Bayesian approach used to assess Baltic salmon incorporates new information annually and thus updates both smolt production historically and the smolt capacity for each river. Including new information causes annual changes in these as well as in other parameter estimates. This year the decrease in smolt survival in recent years is estimated to be less than estimated last year. As noted previously, due to difficulties with the model runs during the meeting of the working group, information for individual rivers is not available for the advice this year.

The main changes in the assessment procedure are:

1. The Polish offshore fishing effort data used in the model are revised downward based on the Polish effort database;
2. The effect of the lag in reporting of tag recaptures by fishers has been taken into account;
3. Assessments are provided only at the unit level due to some difficulties in allocating production capacities to rivers;
4. Correction of data for smolt production in the Emån River.

The advice for 2009 is that there should be no increase in catch over the levels expected in 2008. This is consistent with last years advice.

Source of information

ICES. 2008. Report of the Baltic Salmon and Trout Assessment Working Group. Gdynia, Poland, 1–10 April 2008 (ICES CM 2008/ACOM:05).

Table 8.4.14.1 Nominal catches, discards (incl. seal-damaged salmon) and unreported catches of Baltic Salmon in tonnes round fresh weight, from sea, coast, and river by country in 1972–2007 for the whole Baltic Sea (Subdivisions 22–32). (mode = most likely value, 95% PI = probability).

Year	Reported catches by country										Reported catches	Discard		Unreported catches	
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	USSR	total	mode	95% PI	mode	95% PI
1972	1045	na	403	117	na	na	13	na	477	107	2162	na	na	na	na
1973	1119	na	516	107	na	na	17	na	723	122	2604	na	na	na	na
1974	1224	na	703	52	na	na	20	na	756	176	2931	na	na	na	na
1975	1210	na	697	67	na	na	10	na	787	237	3008	na	na	na	na
1976	1410	na	688	58	na	na	7	na	665	221	3049	na	na	na	na
1977	1011	na	699	77	na	na	6	na	669	177	2639	na	na	na	na
1978	810	na	532	22	na	na	4	na	524	144	2036	na	na	na	na
1979	854	na	558	31	na	na	4	na	491	200	2138	na	na	na	na
1980	886	na	668	40	na	na	22	na	556	326	2498	na	na	na	na
1981	844	25	663	43	184	36	45	61	705		2606	319	193-498	456	144-1101
1982	604	50	543	20	174	30	38	57	542		2058	246	148-386	352	110-864
1983	697	58	645	25	286	33	76	93	544		2457	302	182-471	430	135-1040
1984	1145	97	1073	32	364	43	72	88	745		3659	428	256-678	616	192-1533
1985	1345	91	963	30	324	41	162	84	999		4039	457	271-736	655	193-1693
1986	848	76	1000	41	409	57	137	74	966		3608	437	264-685	624	197-1519
1987	955	92	1051	26	395	62	267	104	1043		3995	463	278-736	656	198-1673
1988	778	79	797	41	346	48	93	89	906		3177	381	229-600	555	178-1339
1989	850	103	1166	52	523	70	80	141	1416		4401	542	327-847	780	246-1866
1990	729	93	2294	36	607	66	195	148	1468		5636	801	481-1245	1098	324-2512
1991	625	86	2171	28	481	62	77	177	1096		4803	654	382-1039	937	278-2139
1992	645	32	2121	27	278	20	170	66	1189		4548	640	356-1046	912	254-2149
1993 1)	575	32	1626	31	256	15	191	90	1134		3966	560	338-864	771	235-1753
1994	737	10	1209	10	130	5	184	45	851		3181	410	248-637	594	189-1365
1995	556	9	1324	19	139	2	133	63	795		3040	422	254-654	594	187-1339
1996	525	9	1316	12	150	14	125	47	940		3138	475	282-738	640	200-1457
1997	489	10	1357	38	170	5	110	27	824		3030	450	260-716	631	196-1441
1998	495	8	850	42	125	5	118	36	815		2494	353	214-541	501	168-1102
1999	395	14	720	29	166	6	135	25	672		2162	319	191-494	440	142-987
2000	421	23	757	44	149	5	144	27	771		2342	242	135-391	466	159-1022
2001	443	16	606	39	136	4	180	37	616		2076	311	189-476	423	137-945
2002	334	16	509	29	108	11	197	66	572		1841	290	177-442	377	120-851
2003	454	10	410	29	47	3	198	22	454		1627	251	159-373	327	109-719
2004	370	7	654	35	34	3	88	16	879		2087	326	190-511	430	126-1007
2005	214	8	616	24	23	3	114	15	719		1736	264	152-418	360	108-834
2006	178	8	370	18	14	2	117	5	497		1208	210	121-331	268	73-639
2007	79	7	410	15	26	2	95	6	484		1125	160	91-255	241	79-535

All data from 1972-1994 includes sub-divisions 24-32, while it is more uncertain in which years sub-divisions 22-23 are included. The catches in sub-divisions 22-23 are normally less than one ton. From 1995 data includes sub-divisions 22-32.
Catches from the recreational fishery are included in reported catches as follows: Finland from 1980, Sweden from 1988, Denmark from 1998. Other countries have no, or very low recreational catches.
Danish, Finnish, German, Polish and Swedish catches are converted from gutted to round fresh weight w by multiplying by 1.1.
Estonian, Latvian, Lithuanian and Russian catches before 1981 are summarized as USSR catches.
Estonian, Latvian, Lithuanian and Russian catches are reported as whole fresh weight.
Sea trout are included in the sea catches in the order of 3 % for Denmark (before 1983), 3% for Estonia, Germany, Latvia, Lithuania, Russia, and about 5% for Poland (before 1997).
Estimated non-reported coastal catches in Sub-division 25 has from 1993 been included in the Swedish statistics.
Danish coastal catches are non-profesional trolling catches.
1. In 1993 fishermen from the Faroe Islands caught 16 tonnes, which are included in total Danish catches.
In 2007 data from Finland, Russia and Sweden are preliminary.

Table 8.4.14.2 Nominal landings of Baltic Salmon in round fresh weight, from sea, coast, and river in Subdivisions 22–31.

Year	Rivers		Coast		Offshore		Coast and Offshore[1]		Total	
	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish[2]	'000 t	'000 fish[2]
1987	0.05		0.39		3.21		3.59	891	3.64	897
1988	0.06		0.41		2.43		2.85	784	2.90	791
1989	0.08		0.65		3.27		3.92	1035	4.00	1049
1990	0.13		1.31		3.65		4.96	1113	5.08	1131
1991	0.12		1.03		3.00		4.03	757	4.15	776
1992	0.12		1.24		2.66		3.90	710	4.02	727
1993	0.11		0.83		2.57		3.40	679	3.52	657
1994	0.10		0.58		2.25		2.83	584	2.93	595
1995	0.12		0.67		1.98		2.65	553	2.77	571
1996	0.21	35	0.77	168	1.73	366	2.50	534	2.71	570
1997	0.28	45	0.80	149	1.50	282	2.31	431	2.59	476
1998	0.19	30	0.59	104	1.52	314	2.11	418	2.30	449
1999	0.17	30	0.59	104	1.23	256	1.82	360	1.99	391
2000	0.18	30	0.52	100	1.45	313	1.97	413	2.15	442
2001	0.16	30	0.57	121	1.19	262	1.76	383	1.92	413
2002	0.14	28	0.59	126	1.03	234	1.62	360	1.75	388
2003	0.12	28	0.43	113	1.00	235	1.43	348	1.56	376
2004	0.13	25	0.77	161	1.11	247	1.88	408	2.01	433
2005	0.17	31	0.61	118	0.86	175	1.47	293	1.64	323
2006	0.10	19	0.40	71	0.62	124	1.03	194	1.12	213
2007[3]	0.14	23	0.35	70	0.55	111	0.90	181	1.04	204

[1]For comparison with TAC. [2]Catch in numbers before 1993 based on estimates. [3]Preliminary.

Table 8.4.14.3 ICES advice, landings, and agreed TACs for the Baltic (Subdivisions 22–31) from 1987 to 2009.

Year	ICES Advice	Rec TAC '000 fish	Landings tonnes	Landings '000 fish	Catch[1] tonnes	Catch '000 fish	TAC32[2] '000 fish	TAC2231[3] '000 fish
1987	No increase in effort	-	3995		5256			
1988	Reduce effort		3177		4222			
1989	TAC	850	4401		5877			
1990	TAC		5636		7737			
1991	Lower TAC	-	4803		6565			
1992	TAC	688	4548		6284			
1993	TAC	500	3968	676	5436	927	109	650
1994	TAC	500	3181	584	4292	788	120	600
1995	Catch as low as possible in offshore and coastal fisheries	-	3040	553	4161	757	120	500
1996	Catch as low as possible in offshore and coastal fisheries	-	3138	650	4371	905	120	450
1997	Catch as low as possible in offshore and coastal fisheries	-	3030	553	4232	772	110	410
1998	Offshore and coastal fisheries should be closed	-	2494	489	3433	660	110	410
1999	Same TAC and other management measures as in 1998	410	2162	421	3001	583	100	410
2000	Same TAC and other management measures as in 1999	410	2342	477	3127	670	90	450
2001	Same TAC and other management measures as in 2000	410	2076	440	2884	614	70	450
2002	Same TAC and other management measures as in 2001	410	1841	406	2577	570	60	450
2003	Same TAC and other management measures as in 2002	410	1627	388	2257	542	50	460
2004	Same TAC and other management measures as in 2003	410	2086	432	2927	604	35	460
2005	Current exploitation pressure will not impair the possibilities for reaching the management objective for the stronger stocks.	-	1736	341	2410	479	17	
2006	Current exploitation pressure will not impair the possibilities for 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 SAP.	-	1208	227	1788	337	15	460
2007	ICES recommends that catches should not increase.	324	1125	217	1572	305	15	429
2008	ICES recommends that catches should be decreased in all fisheries	-					15	364
2009	ICES recommends no increase in catches of any fisheries above 2008 level for SD 22–31.	-						

[1] Includes only some recreational fish data.
[2] Agreed TAC for Subdivision 32.
[3] Agreed TAC for Subdivisions 22–31.

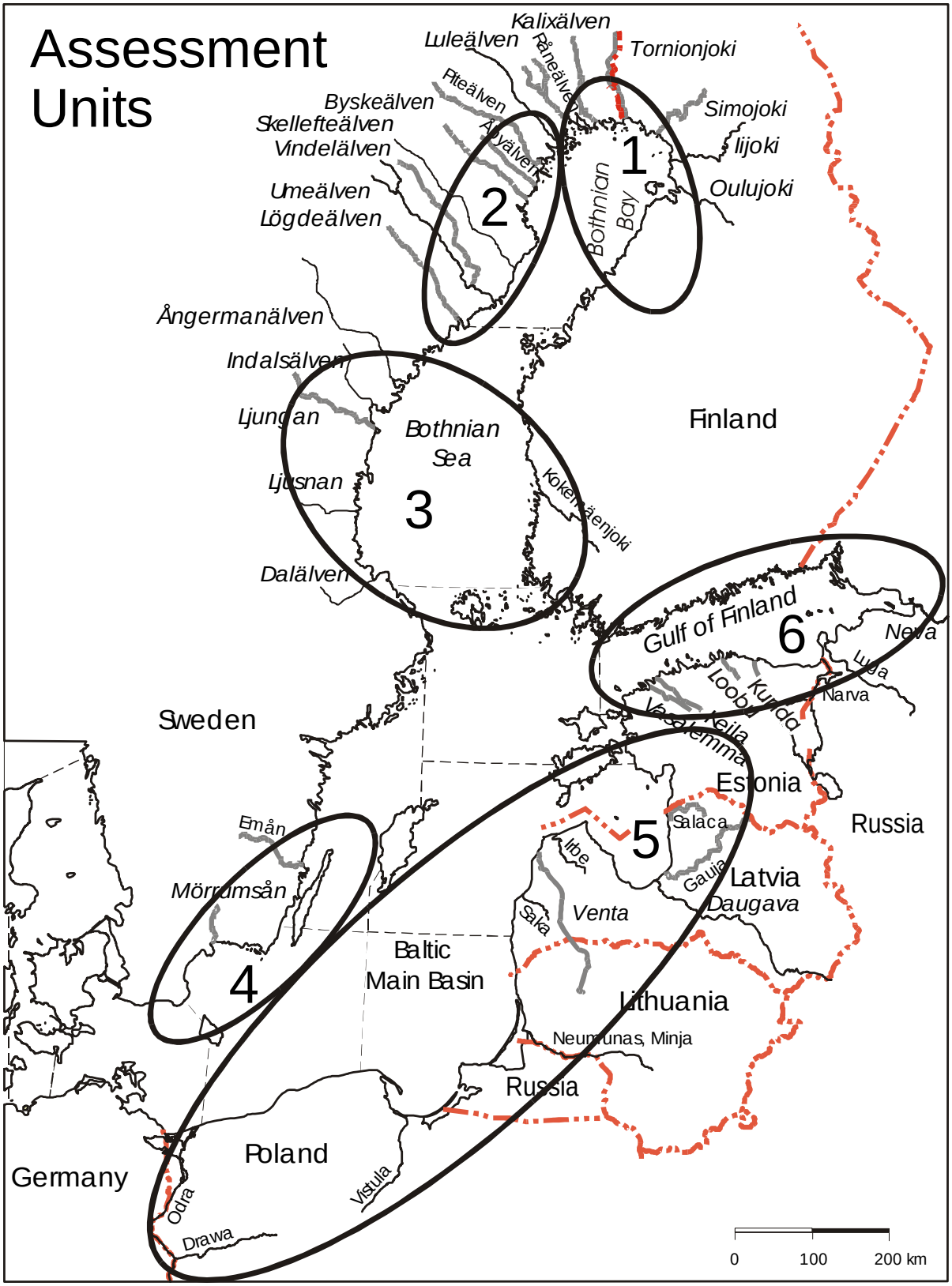

Figure 8.4.14.1 Grouping of salmon stocks in 6 assessment units in the Baltic Sea. The genetic variability between stocks of an assessment unit is smaller than the genetic variability between stocks of different units. In addition, the stocks of a particular unit exhibit similar migration patterns.

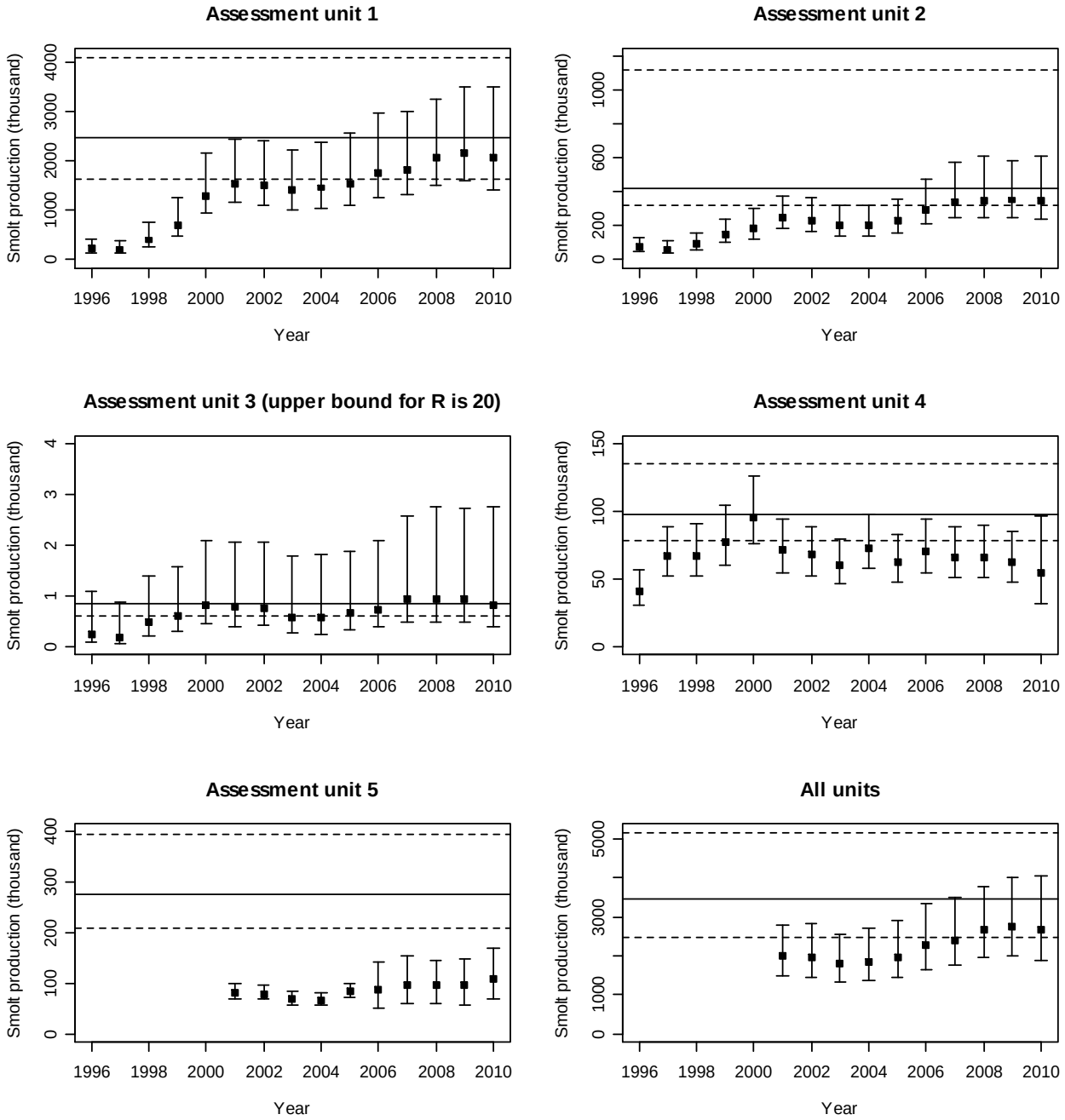

Figure 8.4.14.2 Posterior probability distribution (mode and 95% PI) of the total smolt production within units 1–5 and for all units in total; the solid horizontal line is the estimated mode of the potential production capacity for 2007 and the dashed lines are the 95% PIs. Updated by 22 May 2008 due to minor model corrections.

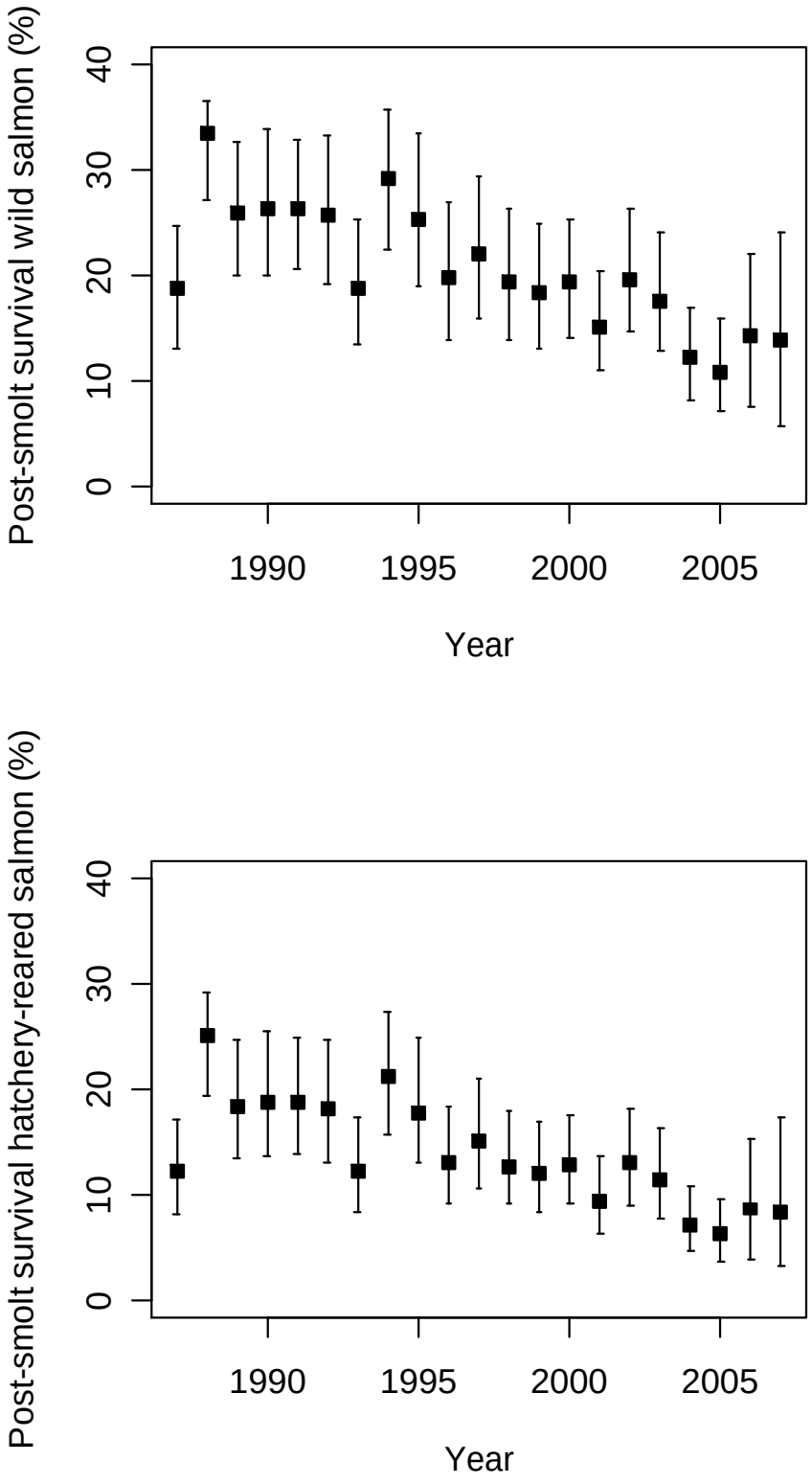

Figure 8.4.14.3 Post-smolt survival for wild (upper panel) and hatchery-reared (lower panel) salmon. Updated by 22 May 2008 due to minor model corrections.

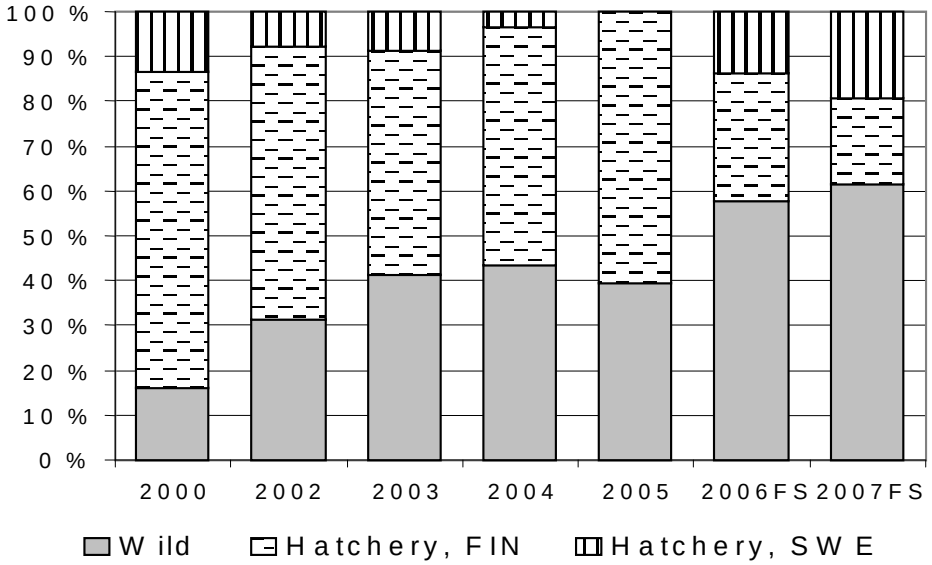

Figure 8.4.14.4 Proportions of wild and reared salmon in catch samples in the Bothnian Bay in 2000–2007. "FS" on the x-axis label means both Finnish and Swedish samples have been used. For 2000, 2002–2005 only Finnish samples were used.