6 Salmon in the Gulf of Finland

6.1 Introduction

The Gulf of Finland is a separate management unit and therefore the data on the catches, fisheries and status of the populations in the area are handled separately from the Main Basin and Gulf of Bothnia. In the light of present data this division is rather contrived from the assessment point of view, because the populations of the area are to a substantial rate feeding in the in the Main Basin area and partly harvested there. Also the populations from the other area, both wild and reared, contribute markedly to the catches in the Gulf of Finland. The stocks of the area, however, distinguish genetically from the stocks in the Main Basin and Gulf of Bothnia.

The latest analytical assessment that has been conducted for the area encompassing the year 2004 (ICES 2005). The following factors created the main uncertainty to the analysis: low catches, low number of tag returns, large uncertainty in recreational catch estimates, mixing of the stocks during the migrations between the Gulf of Finland, Main Basin and Gulf of Bothnia. The Group has, however, planned to include the Gulf of Finland (Assessment unit 6) to assessment model which is presently adopted to assessment units 1-5.

6.2 Catch and fisheries

The salmon landings in 2007 were 15 318 fish or 94 t (Tables 2.1.3 and 2.1.4), which was about the same as in 2006. Offshore fishery in the area was little (about 500 salmon) and the coastal fishery effort has levelled off to low level in Finnish coastal areas, where the main harvesting occurs. Main part (90 %) of commercial catch was taken by trap nets. Recreational catches were about 23 % from the total catch in the area. However, the estimates of recreational catches contain large uncertainty. In many areas at the Finnish coast seals hinder the fishing at the traditional trapnet sites by damaging salmon in gears. Seal damages have escalated even to the inner archipelago in the last few years. According to Finnish logbook records, approximately 14 % of the commercial salmon catch (1,757 fish) was discarded due to seal damages. The rate of damages, however, was clearly lower than in years 2000-2004 possibly because fishers have partly changed their equipment to seal-proof models in the last three years (Table 6.2.1). Also in Estonia the harm caused by seals has increased in coastal fishery, but no estimates on these damages are available.

The total effort and catch in the Finnish offshore fishery (mainly long-lining) has strongly decreased in the last few years, and was so low in 2003-2007 that it was too uncertain to draw any conclusions regarding the CPUE development. Because of the low CPUE together with seal damages there has been decreased interest in long line fishing. CPUE in trap nets in the Finnish coastal waters was 1.0 salmon, which was slightly lower than in 2006 (Table 6.2.2). Fishermen operate closer to a shore and with fewer trap nets than earlier, as it is necessary for them to examine the trapnets in shorter intervals to keep seal damages low. The adoption of seal-proof trapnet models, however, has to some extent permitted a return back to the outer sites, too.

Only Finnish vessels operated in the off-shore. In commercial offshore fishery 8 vessels reported salmon catches in 2007. Only 1 vessel was out in more than 10 fishing days (but less than 20 days). They caught about 3 t salmon (Table 2.1.3).

The catch distribution between offshore, coastal and river catches has drastically changed in the last ten years. Exploitation has moved from the offshore fishery to coastal areas. By year 1987 about 80% of the total catch in the Gulf of Finland was taken offshore. In 1988 and 1989 the offshore fishery share was about 60% and in 1990–1994 offshore fishery was about 40% of the total catch. Since 1995 the offshore fishery has taken only about 20% or less of the total catch. In the last five years share of offshore catch has been less than 5 % (Figure 6.2.1). There is no directed commercial salmon fishery in the Estonian coast and Russian coast but salmon are caught as by-catch in other coastal fisheries. In Estonia licensed sport fishing and fishing for breeding purposes are permitted in some rivers. In Russian rivers all salmon fishery is prohibited except fishing for breeding purposes for hatcheries.

6.3 Status of salmon populations

6.3.1 General

In Estonia salmon reproduce in three wild salmon rivers: Kunda, Keila and Vasalemma. These rivers are small and their potential production is low. In addition there is natural reproduction in other 7 rivers: Purtse, Selja, Loobu, Valgejõgi, Jägala, Pirita ja Vääna. In these rivers, however, the natural reproduction is very low and enhancement releases has been carried out during the last ten years (Table 6.3.1.1). In River Luga as well as in River Kymijoki, salmon populations are mostly based on smolt releases but also natural reproduction occurs in them (Table 6.3.1.2). Salmon in the rivers Narva, Neva and Vantaanjoki are of reared origin (Figure 5.3.1.3).

6.3.2 The water level in the small Estonian salmon rivers

In the small Estonian salmon rivers the spawning migration occurs shortly before spawning (from October till November). It seems that there is a certain effect of the water level before and during spawning season on the strength of next year class. The water level data from 90s till today is collected from Kunda, Keila and Valgejõgi rivers, but the data is not available for this year’s report.

6.3.3 Status of wild and mixed populations

In Estonia, nine rivers supported wild salmon reproduction in 2007 (Table 6.3.3.1). No 0+ parr were observed in the River Vääna. In 2006 and 2007, wild-born salmon parr were also observed in river Purtse. Some year classes has been lacking occasionally in Estonian rivers during the last 30 years (Figures 6.3.3.2 and 6.3.3.3).

In the River Valgejõgi the restoration stockings of salmon was initiated in 1996 and in the River Jägala in 1998. The enhancement stockings were carried out in the River Selja in 1997–2007, River Pirita 1998–2007, River Vääna 1999-2005 and in the River Loobu 2002-2007. According to a plan by Estonian Ministry of Environment (for the period 2002-2010) the releases will be continued in these rivers. After establishment in Polula Fish Rearing Centre captive brood stocks of rivers Kunda and Keila the releases of River Narva salmon (Neva strain) will be replaced with salmon of those two rivers. The most important change in the 1990s was the occurrence of natural spawning after many years interval in the rivers Selja, Valgejõgi, and Jägala.

Salmon used for stocking in Estonian rivers in late 1990s originate from spawners caught in the rivers Narva and Selja brood fisheries and in addition Neva strain smolts imported as eyed eggs from a Finnish hatchery. In 2003-2007 brood fishes were caught from the River Narva and also captive stock from the River Kunda was used.

In the Finnish side of the Gulf of Finland all wild salmon populations were lost by 1950s due to establishment of paper mill industry and closing the river Kymijoki by dams. The nearest available salmon strain, Neva salmon, was imported in 1970s. Status of mixed population in the river Kymijoki is based on hatchery reared smolt releases and the magnitude of natural reproduction (44,000 in 2007) is still small compared to the number of released smolts (280,000 in 2007). The brood stock of salmon is held in hatcheries and has been partially renewed by the ascending spawners.

In the Finnish rivers Kymijoki and Vantaanjoki the salmon population is based on annual smolt releases, which have been started in the early 1980s. The Neva strain has been used in these releases. The River Kymijoki is mainly used for hydroelectric production and pulp industries. The quality of water, however, has improved significantly since early 1980s, and today salmonid species reproduce naturally in the river. In addition, significant amounts of reproduction habitat areas still exist in the in the lowest 40 kilometres of the river. Ascending spawners originating mainly from hatchery-reared smolt releases spawn in the river, and annual natural production has been estimated to vary between 2,000 and 44,000 thousand smolts in the last ten years.

A study on the River Kymijoki from 2006 explored the smolt production areas in the eastern branches of the river and it suggested a total area of 75 ha between the sea and Myllykoski (40 km from sea), the uppermost site which salmon could originally reach. About 15 ha of the rapids are situated in the lower reaches with no obstacles for migration and about 60 ha beyond the dams, accessible only in years with high discharge. The potential smolt production was assessed on the basis of parr density (max > 1 parr/ 1 m2) and smolt age (1-3 yr). The annual mean potential was assessed to be 1 340 smolts per ha, and the total potential of the river about 100,000 smolts per year. From this potential, annually about 20, 000 smolts could be produced in the lower reaches and 80,000 smolts in the upper reaches of the river. The new information on the production areas changed significantly the earlier smolt production estimates of the river Kymijoki in years 1993-2005 (Table 6.3.1.2).

Despite of the very rainy autumns most of areas in the lower part dried because of the water regulation between the power plants. The better production habitats are above the lowest power plants, but only a small part of the spawning salmon has access there. The smolt production areas beyond the dams are now only occasionally and partially utilised. In the most eastern branch (Korkeakoski), there is no fish ladder or possibility to ascend the dam. The fish ladders in the neighbouring Langinkoski branch do not function well and salmon can ascend the dam only in rainy summers with high discharge. Trials to move ascending salmon over the dam in the Korkeakoski branch have shown that salmon can successfully ascend and spawn also in the upper reaches of the river. Usually the most of the spawning salmon ascend to the Korkeakoski branch where is no fish ladder. The success of ascending salmon to find their way to the stream supplied with the fish ladder (Langinkoski) is depending on the drainage arrangements between the three main streams. Building an additional fish ladder to the other main branches would allow for an access to a much higher number of spawning salmon to the better spawning and rearing habitats above the dams. This would magnify the natural smolt production of the river significantly observed seen in the last few years

At present, the annual smolt production is highly dependent on the discharge and on the regulation of river flow for the electric power plants. Especially earlier the lower branches below the dams had in some winters so low discharge that the shallow parts of the rapids dried or froze and the spawn thus largely died. Now the regulation has partially been changed and the present minimum discharge of 4 m3/s in winter allows a continuous smolt production but does not ensure the maintenance of the full potential in this area.

Due to a rainy summer in year 2004 the flow in the Kymijoki was on exceptional high level and for the spawners the river was easy to ascent. The spawning areas above the lowest power stations were also occupied, and high parr densities were observed both above and below the powers stations in 2005 and 2006. In 2007 the parr densities were on the moderate level (Figure 6.3.3.1). No electrofishing was carried out in the river Vantaanjoki in 2006-2007 (?).

In Russian rivers Luga and Neva the salmon populations are supported by large long-term releases. Neva strain has been used in the river Neva. In the river Luga released smolts are based on ascending Luga and Narva river spawners as well as on the brood stock of mixed origin. In River Luga a smolt trapping survey has been conducted in 2001-2007. The natural reproduction was estimated to be from about 2,000 to 8,000 smolts in different yeas. No evidence on natural smolt production in the River Neva exists for last years. The status of potential salmon river Gladyshevka is described in Chapter 3.3.

6.3.4 Status of reared populations

The Estonian/Russian river Narva lost its native salmon stock in 1950s. A new population was established using Neva stock and strains from Latvian rivers. During 1990s all hatchery production is based on ascending spawners caught in the river. No evidence on natural smolt production in river exists. The number of spawners returning to River Narva has been sufficient for breeding purposes in the last two years.

6.4 M74

In 2007 M74 in the river Kymijoki salmon got worse, so that the mean yolk-sac fry mortality was 23% and the proportion of females with offspring that displayed M74 symptoms was 26%. Ascending Neva stock spawners of the River Kymijoki have been caught every second or third year to add genetic material to the broodstock. M74 mortality among these brood fish was estimated to be 45%−70% in 1992−1993. M74 has been monitored annually with some exceptions since 1995, during which time period the yolk-sac fry mortality has been at its highest 56%, in 1997, when the proportion of salmon females whose offspring were affected by M74 was over 70% (Table 3.5.1). In other years from 1995 to 2002 (year 2001 data is missing) the mean yolk-sac fry mortality has varied from 24% to 47% (the proportion of M74 females from 23% to 57%). In the years 2003–2006 the mean yolk-sac fry mortality was below 10% (affected females 0−11%).

In the Estonian hatchery Põlula the M74 mortality was less than 10 % in 1997-2006. On year class 2007 data are not yet available. In Estonia there is no clear evidence of the existence of the M74 syndrome in wild populations. However, the abundance of salmon parr shows large variation (Table 6.3.2.1).

Data for M74 mortality in Russian hatcheries are not available.

6.5 Smolt Production

Natural smolt production in Estonian, Finnish, and Russian rivers in the Gulf of Finland area was estimated at about 57,000 in 2007. Hatchery-reared smolt releases were 689,000 fish in 2007 (Table 2.4.1). The smolt releases in the region has increased in the last ten years, but the catches have decreased being the record low in the last few years (Figure 6.5.1).

6.6 Indices of post-smolt mortality and yield

Tagging results of the releases in the area shows that the post-smolt survival has been very low in last seven years compared to the early 1990s (Figure 2.10.2.1.). However, no quantitative estimate of initial smolt survival of wild salmon populations in the area is available for the last few years.

Although there is exchange of salmon in terms of feeding and spawning migration between the Gulf of Finland and Main Basin and Gulf of Bothnia, the rough analysis of comparing the catches in the area and the number of released smolts indicates a dramatic change in the productivity of the releases (Figure 6.2.1). There are no indications that any significant numbers of the surplus salmon would exist in the rivers with releases in the area.

6.7 Harvest pattern of wild and reared salmon

Salmon originating from the Gulf of Bothnia and Baltic Sea Main Basin contribute to the catches in the Gulf of Finland (Bartel 1987, ICESa 1994). The salmon from the Main Basin stocks migrate to the Gulf of Finland for feeding, meanwhile the salmon from Gulf of Bothnian stocks appearing in the catches in the Gulf of Finland, visit the area in the early summer during their spawning migration to the Gulf of Bothnia. In 2002-2007 catch samples has been collected from Finnish commercial fisheries, however in the last four year only from the coastal fishery in the eastern part of the area. Offshore catches were simply too small to get a hold of them for sampling.

Catch samples were aged and defined by wild/reared origin by scale reading and stock proportions were estimated by DNA-analysis methods. The latest analysis results for year 2007 suggested that the clearly largest contribution (61%) was made by locally released Neva salmon. The proportion of wild stocks originating from the Gulf of Bothnia was about 27 %. (Table 6.7.1). The Estonian wild stocks were not recorded in these catch samples. As the numbers of the feeding wild salmon from the Estonian rivers are low at present the probability to observe them is minimal in the catch samples collected from different fisheries in their feeding area in the Gulf of Finland and Main Basin. Some part of the smolts migrates from the Gulf of Finland to the Main Basin for the feeding. According to tagging results from the Finnish releases to the river Kymijoki 9-37 % of the fish has been caught from the Main Basin during the last 25 years. A slight increase in the share returned from the Main Basin can be observed in the last few years being, however, of the same order as in the mid 1980s (Table 6.7.2). Tagging results from Estonian releases in 1997-2006 suggested an average share of 37 % of returns being caught from the Main Basin. In the Main Basin off-shore fishery these fish have been exposed to about 20-30 % harvest rate since mid-1990s (Figure 6.7.1). The estimated harvest rate applies to the 2SW fish returning from the Main Basin to the Gulf of Finland. Taking into account a rather high proportion of salmon from the Gulf of Bothnia and Main Basin observed in the catches in 2003-2005 and in 2007 (23 %- 34 %), the exchange of recruits between the areas has considered being significant. The balance of exchange of salmon, however, between the areas has not been quantified.

6.8 Management recommendations

In three wild rivers and 7 rivers with mixed populations in Estonia the estimated smolt production has been varying a lot in the last few years. In some years from

Keila and Vasalemma no smolts emigrated. The measured parr densities and estimated smolt production decreased in 2007, potential production capacity of these rivers are uncertain the status of these populations are considered to be endangered. In addition the potential smolt production of these rivers is small (because of small rearing habitat area) compared to the most of other wild salmon populations in the Baltic Sea. For example the spawning and rearing habitats of the three wild rivers is in total about 7 hectares and their potential smolt production is estimated to be about 7000 smolts. A rough estimate of the spawning population in full production state for these rivers would be in the order of a few hundred spawners in total.

As described in earlier chapters the tagging data and DNA-analysis data shows there is exchange of salmon between stocks of the Gulf of Finland and Main Basin and Gulf of Bothnia in terms of feeding areas and spawning migration routes. Clearly the Gulf of Finland salmon partly share the Main Basin as a feeding area with the other stocks. Therefore the management of Gulf of Finland salmon cannot be treated entirely separate from the management of Main Basin and Gulf of Bothnia salmon.

It is quite evident that even a significantly reduced TAC of the Gulf Finland could not improve the status of the three Estonian wild salmon populations, because also other fisheries like Main Basin offshore commercial salmon fishery and Estonian coastal recreational fishery are affecting these populations. The only commercial fisheries in the area are the Finnish offshore and coastal fisheries, and some small-scale coastal fishery in the Estonia. The offshore fishery has decreased substantially since year 1990 and had low catches in years 2003-2007 (about 500 salmon). Also catches and effort in the coastal fishery have decreased considerably. These reductions in the efforts should have resulted an increase in the number of spawners escaping from the sea fisheries, but the status of wild populations has remained weak (Table 6.3.1.1 and 6.3.3.1). One of the main reasons preventing the recovery of these small Estonian populations is poaching for salmon in the rivers.

To improve the status of populations in the area the regional and temporal regulatory measures should be promoted in coastal and river fishery directing to these populations. Wherever the enhancement activities to avoid possible extinction of these stocks are carried out, the original river strains should be used. In Estonian salmon rivers spawners can ascend only to a short stretch in these rivers because of the natural or artificial migration obstacles. Salmon is not known to have been able to ascend above these obstacles. It is estimated, however, that a total of about 20 hectares of additional rearing habitat exists above these obstacles, increasing the potential production by well more than 20,000 smolts. In Estonia there is an ongoing project on reconstruction of fish passes on the rivers Kunda, Pirita, Vasalemma, Loobu and Valgejõgi. The project is supported by European Commission. At present the proposed measures in the project are undergoing environmental impact assessment (EIA). Construction is supposed to begin in 2010-2013. The Working Group recommends that migration obstacles in these rivers will be supplied with the fish passes according to Estonian project plans to increase the spawning areas. This would improve the potential production capacity and resilience of these populations.

The Working Group also recommends that the present fishing regulations are thoroughly implemented, including the campaigns for decreasing poaching. In addition extended spatial fishing restrictions, mesh size rules for gillnets and effort limitations should be implemented for the fisheries at the coast area of these rivers. All kind of fishing in these rivers should be prevented. In addition the Working Group recommends actions to improve the water and habitat quality in these rivers.

Table 6.2.1 Salmon cathes (in numbers) by year, country and fishery in the Gulf of Finla in 2000-2007.

YEAR	COUNTRY	Commercial catch	Recreational catch	Discards, seal damages	Discards, other reasons	Grand Total
2000	EE	3166				3166
	FI	19844	11200	3631	66	34741
	RU	914				914
2000 Total		23924	11200	3631	66	38821
2001	EE	2344				2344
	FI	12082	11200	3394	15	26691
	RU	808				808
2001 Total		15234	11200	3394	15	29843
2002	EE	2076				2076
	FI	9371	5700	3127	30	18228
	RU	426				426
2002 Total		11873	5700	3127	30	20730
2003	EE	1358				1358
	FI	6865	4200	3454	2	14521
	RU	431				431
2003 Total		8654	4200	3454	2	16310
2004	EE	858				858
	FI	6892	4900	3682	14	15488
	RU	497				497
2004 Total		8247	4900	3682	14	16843
2005	EE	1126	206			1332
	FI	9462	6200	1711	2	17375
	RU	636				636
2005 Total		11224	6406	1711	2	19343
2006	EE	865	138			1003
	FI	10798	5100	2598	9	18505
	RU	450				450
2006 Total		12113	5238	2598	9	19958
2007	EE	1053				1053
	FI	10348	1577	1757	1	13683
	RU	520				520
2007 Total		11921	1577	1757	1	15256

Table 6.2.2 Catch per unit effort in number of salmon caught in trapnets, driftnets and long-lines in the Finnish fisheries in Sub-division 32 (number of salmon per trapnetdays, 100 driftnetdays, 1000 hookdays).

Year	CPUE		
	Trapnet	Driftnet	Long-line
1988	0.70		
1989	1.00		
1990	1.60		
1991	1.50		
1992	1.50		
1993	1.40		
1994	0.86		
1995	1.15		
1996	1.27		
1997	1.52		
1998	1.34		
1999	1.30		
2000	0.94	7.60	23.90
2001	0.92	7.00	23.20
2002	0.95	7.80	22.00
2003	0.67	5.20	8.00
2004	0.87	4.90	13.60
2005	1.10	4.40	17.80
2006	1.30	5.70	12.70
2007	1.00	5.10	18.40

Table 6.3.1.1 Estonian wild and mixed salmon rivers in the Gulf of Finland.

River	Wild or mixed	Water quality[1)]	Flow m³/s		First obstacle km	Undetected parr cohorts 1997-2007	Production of >0+ parr 1997-2007
			mean	min			
Kunda	wild	III	4.3	0.8	2	0	0.3-21.5
Selja	mixed	V	2.4	0.8	42	3	0.1-3.7
Loobu	mixed	II	2.0	1.3	10	1	0.5-7.1
Valge- jogi	mixed	IV	3.4	0.6	8	2	0.8-4.9
Jagala	mixed	II	7.3	0.7	2	6	0-<1
Pirita	mixed	V	6.8	0.4	24	2	0.3-6.4
Vaana	mixed	V	1.9	0.3	21	8	0-0.3
Keila	wild	V	6.2	0.5	2	2	0-6.8
Vasa- lemma	wild	II	3.5	0.2	4	2	0-1.5

[1)] Classification of EU Water Framework Directive

Table 6.3.1.2. Natural salmon smolt reproduction in 1993-2008 in assessment unit 6 (Sub-division 32). Most probable number (x 1000) of smolts from natural reproduction with the associated uncertainty (95% probability interval). In the previous report medians of the probability distributions were presented in the corresponding smolt production table. Because of the change in presentation, current point estimates are generally lower than previous ones . Extention of these time series backwards are made to provide longer time series as results of the modeling; the extension is based on old WGBAST reports and should be regarded as preliminary. Uncertainty associated with some of the estimates are missing. Also some of the predictions of the 2007-2008 are not available.

Assessment unit, sub-division, country	Category	Reprod. area (ha, mode)	Potential (*1000)	Wild smolt production (x 1000) 1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Pred 2008	Method of estimation: Pot. prod.	Method of estimation: Pres. prod.	Reared smolts 2007
Finland:																						
Kymijoki	mixed	15[1)]+60[2)]	20[1)]+80[2)]	3	18	4	3	18	2	3	2	13	14	22	14	7	25	44	20	7	4	
95% PI			57-224	2-4	14-21	3-5	2-4	14-22	1-3	2-4	1-3	10-16	11-17	17-27	11-18	5-9	20-31	34-53				
Russia:																						
Neva	mixed	20	20			7	7	7	7	7	7	6	6	6	0	0	0	0		7	2	
95% PI			13-36			4.5-13	4.5-13	4.5-13	4.5-13	4.5-13	4.5-13	3.8-11	3.8-11	3.8-11								
Luga	mixed	40	80			4	4	4	4	4	5	2.5	8	7.2	2	2.6	7.8	7	6	7	2	
95% PI			51-144			3.8-4.2	3.8-4.2	3.8-4.2	3.8-4.2	3.8-4.2	4.8-5.2	2.4-2.6	7.7-8.3	6.9-7.5	1.9-2.1	2.0-3.5	5.1-16.5	4-10				
Estonia:																						
Purtse	mixed	6	6																0.05			0
95% PI																						
Kunda	wild	1.5	2.1	+	+	+	+	+	+	+	1.8	0.8	1.5	0.5	0.4	0.08	1	1	0.5	7	3, 4	0
95% PI											1.4-2.4	0.6-1	1.2-2	0.4-0.7	0.3-0.5	0.04-0.12	0.8-1.2	0.8-1.2				
Selja	mixed	9	10	+	+	+	+	+	0.0	0.0	1.4	0.2	2.2	0.0	0.1	0.4	1.3	0.3	0.06	7	3, 4	23
95% PI									0-0.1	0-0.1	0.6-7.4	0.1-1.1	0.9-11.6	0-0.1	0-0.5	0.2-0.6	1.0-1.7	0.1-0.5				
Loobu	mixed	10	6	+	+	+	+	+	+	0.0	0.3	0.3	0.2	0.0	1.2	1.6	2.9	0.9	0	7	3, 4	22
95% PI										0-0	0.2-0.5	0.2-0.5	0.1-0.4	0-0.1	0.8-2.2	1.2-2.3	2.2-3.6	0.7-1.3				
Pirita	mixed	10	10	+	+	+	+	0.0	0.0	0.0	0.0	0.6	0.2	0.3	1.5	1.0	3.0	1.6	1.3	7	3, 4, 8	21
95% PI								0-0	0-0	0-0	0-0	0.4-0.9	0.1-0.3	0.2-0.4	1.1-2.2	0.8-1.3						
Vasalemma	wild	2	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.03	7	3, 4	0
95% PI				0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0.1-0.3	0.1-0.3	0-0.1	0-0	0.0-0.1	0.0-0.1	0.1-0.4				
Keila	wild	3.5	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.5	0.5	0.2	0.0	0.0	0.6	1.6	0.6	7	3, 4	0
95% PI				0-0	0-0	0-0	0-0	0-0	0-0	0-0	0.2-0.4	1.2-2	0.4-0.7	0.2-0.3	0-0	0.0-0.1	0.4-0.8	1.3-2.0				
Valgejögi	mixed	1.5	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.1	0.4	0.4	0.2	0.5	7	3, 4	21
95% PI				0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.5	0.1-1.1	0-0.1	0-0.5	0.3-0.7	0.3-0.7	0.1-0.4				
Jägala	mixed	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	7	3, 4	5
95% PI				0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0	0	0				
Vääna	mixed	3.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.15	7	3, 4	0
95% PI				0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1				
Sum of +, Estonia				0.04	0.04	0.04	0.04	0.05	0.06	0.07	4	4	5	1	3	4	9	6				
Assessment unit 6 (Sub-div. 32), total			**243**			**15**	**14**	**29**	**13**	**14**	**19**	**26**	**35**	**36**	**19**	**13**	**47**	**55**				
95% PI			177-334			12-21	11-20	24-36	10-19	11-20	15-26	21-31	29-44	31-43	16-24	11-16	39-56	47-66				

+ = Low and uncertain production (not added into sub-totals or totals)

++ = Same method over time series; only the extension backwards

*** = Tributaries

n/a No data available.

1) Below the lovest dams

2) Above the lowest dams

Methods of estimating production

Potential production

1. Bayesian modeling of expert knowledge
2. Estimate of reproduction area and production capacity per area.
3. Accessible linear stream length and production capacity per area.
4. Accessible linear stream length and peak production per area from other sources.
5. No data.
6. Not known.
7. Expert opinion with associated uncertainty
8. By smolt trapping data

Present production

1. Bayesian regression model (see section 4.2.3)
2. Sampling of smolts and estimate of total smolt run size.
3. Estimate of smolt run from parr production by relation developed in the same river.
4. Estimate of smolt run from parr production by relation developed in another river.
5. Inference of smolt production from data derived from similar rivers in the region.
6. Count of spawners.
7. Estimate inferred from stocking of reared fish in the river.
8. Salmon catch, exploitation and survival estimate.

Table 6.3.2.1 Densities of wild salmon parr in electrofishing surveys at permanent stations in rivers discharging into the Gulf of Finland, Sub-division 32.

River	Year	Number of parr/100m2		Number of parr	River	Year	Number of parr/100m2		Number of parr
		0+	1+ and older	in survey			0+	1+ and older	in survey
Kunda					Pirita				
(wild)	1992	7.4	12.9	118	(mixed)	1992	1.9	0.7	11
	1993	0	4.5	26		1993			
	1994	2.4	0.0	7		1994	0	0	0
	1995	15.4	3.1	60		1995	0	0	0
	1996	22.6	13.7	98		1996	0	0.1	1
	1997	1.2	21.5	78		1997			
	1998	13.8	0.9	68		1998	0	0	0
	1999	6.4	18.1	103		1999	6.5	0	55
	2000	20.8	7.6	75		2000	0	0.9	13
	2001	30.3	14.7	156		2001	1.2	0.3	18
	2002	13.2	4.9	55		2002	0	0.3	10
	2003	0.7	3.6	13		2003	0	2.3	38
	2004	23.8	0.3	70		2004	0.2	1.5	8
	2005	5.3	10.2	38		2005	12.8	6.4	185
	2006	18.6	13.3	91		2006	5	1.5	84
	2007	5.1	4.7	69		2007	2.2	1.8	56
Selja					Väana				
(mixed)	1995	1.3	6.5	18	(mixed)	1998	0	0.1	1
	1996	0.0	0.4	1		1999	0	0	0
	1997	0.0	0.0	0		2000	0.1	0	1
	1998	0.0	0.0	0		2001	0	0	0
	1999	0.1	2.3	26		2002	0	0.2	1
	2000	1.2	0.4	32		2003	0	0	0
	2001	1.4	3.7	33		2004	0	0	0
	2002	0.0	0.0	0		2005	0	0	0
	2003	0.0	0.1	1		2006	13.9	0	42
	2004	0.0	0.6	3		2007			
	2005	4.3	2.1	58	Keila				
	2006	1.3	0.7	18	(wild)	1994	1.1	1.1	12
	2007	0.2	0.1	3		1995	6.9	0.3	105
						1996	11.7	1.1	115
Loobu						1997	0	5.2	47
(mixed)	1994	1.2	2.8	23		1998	0	1.1	10
	1995	0.2	0.2	2		1999	95	1.3	154
	1996	0.0	0.4	2		2000	3.8	6.6	52
	1997	0.0	0.3	3		2001	0	2.2	21
	1998	0.2	0.0	1		2002	6.3	0.7	38
	1999	10.5	0.8	70		2003	0.0	0	0
	2000	0.6	0.8	17		2004	0.2	0	2
	2001	0.0	0.5	3		2005	25.2	2.5	76
	2002	0.1	0.1	2		2006	5.0	6.8	26
	2003	0.0	2.9	21		2007	15.4	2.5	58
	2004	1.0	3.9	30					
	2005	2.5	7.1	112	Vasalemma				
	2006	0.8	1.8	27	(wild)	1992	3.4	2.6	23
	2007	2.5	0.0	36		1993			
Valgejõgi						1994	1.9	0	7
(mixed)	1998	0	0	0		1995	18.7	0.4	99
	1999	2.4	0	26		1996	4.8	5	51
	2000	0.4	1	14		1997	0	1.5	8
	2001	4.4	1.6	58		1998	0	0.2	2
	2002	7.1	0	3		1999	13.5	0	80
	2003	0.2	0.8	5		2000	3.5	1.7	27
	2004	0.5	3.7	16		2001	0.4	0.9	3
	2005	5.4	2.7	66		2002	7.1	0.3	23
	2006	9.5	2.1	86		2003	0.0	0	0
	2007	6.6	4.9	100		2004	0	0	0
Jägala						2005	18.4	0	39
(mixed)	1998	0	0	0		2006	7.8	0.8	32
	1999	0.5	0	2		2007	3.3	0.2	19
	2000	0	0	0	Purtse				
	2001	16.2	0	38	(mixed)	2006	2.5	0	12
	2002	0	0	0		2007	4.3	0.14	32
	2003	0	0	0					
	2004	0.5	0	3					
	2005	1.9	0	6					
	2006	0	0.1	1					
	2007	0.1	0	1					

*) = no electrofishing
**)= Flow was extremely small and fish were concentrated on little area
+ = minor production.

Table 6.3.3.1 Densities of wild salmon parr in electrofishing surveys at permanent stations in rivers discharging into the Gulf of Finland, Sub-division 32.

River	Year	Number of parr/100m2 0+	1+ and older	Number of parr in survey
Kunda				
(wild)	1992	7.4	12.9	118
	1993	0	4.5	26
	1994	2.4	0.0	7
	1995	15.4	3.1	60
	1996	22.6	13.7	98
	1997	1.2	21.5	78
	1998	13.8	0.9	68
	1999	6.4	18.1	103
	2000	20.8	7.6	75
	2001	30.3	14.7	156
	2002	13.2	4.9	55
	2003	0.7	3.6	13
	2004	23.8	0.3	70
	2005	5.3	10.2	38
	2006	18.6	13.3	91
	2007	5.1	4.7	69
Selja				
(mixed)	1995	1.3	6.5	18
	1996	0.0	0.4	1
	1997	0.0	0.0	0
	1998	0.0	0.0	0
	1999	0.1	2.3	26
	2000	1.2	0.4	32
	2001	1.4	3.7	33
	2002	0.0	0.0	0
	2003	0.0	0.1	1
	2004	0.0	0.6	3
	2005	4.3	2.1	58
	2006	1.3	0.7	18
	2007	0.2	0.1	3
Loobu				
(mixed)	1994	1.2	2.8	23
	1995	0.2	0.2	2
	1996	0.0	0.4	2
	1997	0.0	0.3	3
	1998	0.2	0.0	1
	1999	10.5	0.8	70
	2000	0.6	0.8	17
	2001	0.0	0.5	3
	2002	0.1	0.1	2
	2003	0.0	2.9	21
	2004	1.0	3.9	30
	2005	2.5	7.1	112
	2006	0.8	1.8	27
	2007	2.5	0.0	36
Valgejõgi				
(mixed)	1998	0	0	0
	1999	2.4	0	26
	2000	0.4	1	14
	2001	4.4	1.6	58
	2002	7.1	0	3
	2003	0.2	0.8	5
	2004	0.5	3.7	16
	2005	5.4	2.7	66
	2006	9.5	2.1	86
	2007	6.6	4.9	100
Jägala				
(mixed)	1998	0	0	0
	1999	0.5	0	2
	2000	0	0	0
	2001	16.2	0	38
	2002	0	0	0
	2003	0	0	0
	2004	0.5	0	3
	2005	1.9	0	6
	2006	0	0.1	1
	2007	0.1	0	1

River	Year	Number of parr/100m2 0+	1+ and older	Number of parr in survey
Pirita				
(mixed)	1992	1.9	0.7	11
	1993			
	1994	0	0	0
	1995	0	0	0
	1996	0	0.1	1
	1997			
	1998	0	0	0
	1999	6.5	0	55
	2000	0	0.9	13
	2001	1.2	0.3	18
	2002	0	0.3	10
	2003	0	2.3	38
	2004	0.2	1.5	8
	2005	12.8	6.4	185
	2006	5	1.5	84
	2007	2.2	1.8	56
Vääna				
(mixed)	1998	0	0.1	1
	1999	0	0	0
	2000	0.1	0	1
	2001	0	0	0
	2002	0	0.2	1
	2003	0	0	0
	2004	0	0	0
	2005	0	0	0
	2006	13.9	0	42
	2007			
Keila				
(wild)	1994	1.1	1.1	12
	1995	6.9	0.3	105
	1996	11.7	1.1	115
	1997	0	5.2	47
	1998	0	1.1	10
	1999	95	1.3	154
	2000	3.8	6.6	52
	2001	0	2.2	21
	2002	6.3	0.7	38
	2003	0.0	0	0
	2004	0.2	0	2
	2005	25.2	2.5	76
	2006	5.0	6.8	26
	2007	15.4	2.5	58
Vasalemma				
(wild)	1992	3.4	2.6	23
	1993			
	1994	1.9	0	7
	1995	18.7	0.4	99
	1996	4.8	5	51
	1997	0	1.5	8
	1998	0	0.2	2
	1999	13.5	0	80
	2000	3.5	1.7	27
	2001	0.4	0.9	3
	2002	7.1	0.3	23
	2003	0.0	0	0
	2004	0	0	0
	2005	18.4	0	39
	2006	7.8	0.8	32
	2007	3.3	0.2	19
Purtse				
(mixed)	2006	2.5	0	12
	2007	4.3	0.14	32

*) = no electrofishing
**)= Flow was extremely small and fish were concentrated on little area
+ = minor production.

Table 6.7.1. Atlantic salmon stock group proportions in the eastern Gulf of Finland based on 17-loci DNA microsatellite data and freshwater age and proportion of wild fish according to scale reading

	Gulf of Bothnia, wild	2.5 %	97.5 %	**G. of Bothnia, hatchery, FIN**	2.5 %	97.5 %	**G. of Bothnia, hatchery, SWE**	2.5 %	97.5 %	**Gulf of Finland, wild**	2.5 %	97.5 %	**Gulf of Finland, hatchery**	2.5 %	97.5 %	**Western Main B., wild, SWE**	2.5 %	97.5 %	**Eastern Main Basin**			**Sample size**	*Scale reading - wild %*
2002	**3**	1	7	**3**	1	7	**1**	0	3	**0**	0	2	**88**	81	93	**0**	0	0	**4**	1	9	**150**	*6*
2003	**34**	30	39	**11**	8	15	**0**	0	2	**0**	0	0	**53**	49	58	**0**	0	0	**0**	0	1	**448**	*31*
2004	**34**	25	41	**7**	3	14	**1**	0	3	**0**	0	2	**57**	51	64	**0**	0	0	**0**	0	2	**229**	*30*
2005	**23**	18	29	**0**	0	5	**0**	0	1	**0**	0	1	**76**	70	80	**0**	0	0	**0**	0	1	**295**	*18*
2006	**11**	8	15	**1**	0	3	**0**	0	1	**0**	0	1	**85**	81	89	**0**	0	0	**2**	1	5	**264**	*9*
2007	**27**	21	34	**4**	2	8	**3**	1	5	**0**	0	2	**61**	54	68	**0**	0	0	**4**	2	8	**200**	*25*
Mean	***22***	*17*	*28*	***4***	*2*	*8*	***1***	*0*	*3*	***0***	*0*	*1*	***70***	*64*	*75*	***0***	*0*	*0*	***2***	*1*	*4*		

Table 6.7.2 Share of tag returns from the Main Basin for the salmon released to the river Kymijoki in 1980-2007.

Year class	Share of recaptures from the Main Basin	Total (n) recaptures	Total (n) tagged	Recapture rate total
1980	20%	168	1792	9%
1981	18%	640	5976	11%
1982	25%	693	3999	17%
1983	25%	843	6920	12%
1984	32%	564	5409	10%
1985	19%	831	5955	14%
1986	31%	1783	10223	17%
1987	19%	610	3478	18%
1988	15%	840	6045	14%
1989	12%	633	4915	13%
1990	9%	528	4988	11%
1991	8%	262	3449	8%
1992	9%	1091	9837	11%
1993	8%	500	3974	13%
1994	2%	125	1998	6%
1995	11%	198	3996	5%
1996	5%	94	1997	5%
1997	24%	21	998	2%
1998	12%	51	2000	3%
1999	28%	25	1999	1%
2000	16%	49	4500	1%
2001	38%	42	3999	1%
2002	42%	12	1991	1%
2003	25%	16	1994	1%
2004	16%	56	2992	2%
2005	12%	43	3996	1%
2006	0%	3	1991	0%
2007		1	3997	0%

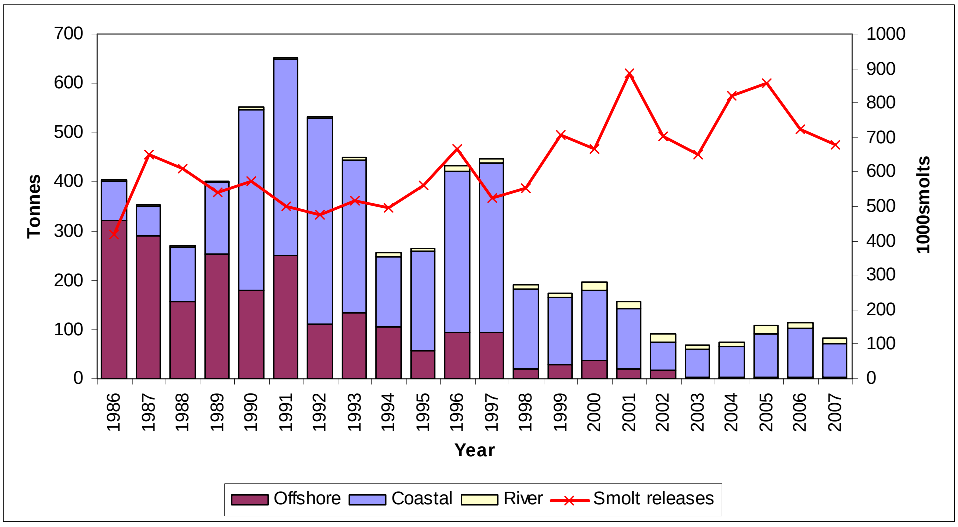

Figure 6.2.1 Salmon catches and smolt releases in the Gulf of Finland in 1986-2007.

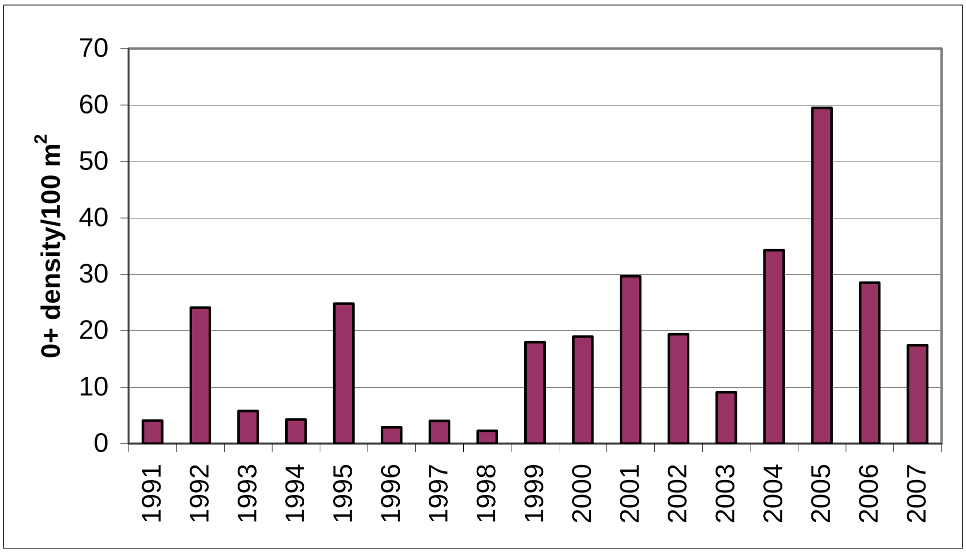

Figure 6.3.2.1. Average densities of wild 0+ salmon parr on five regular electrofishing sites in the river Kymijoki in 1991-2007.

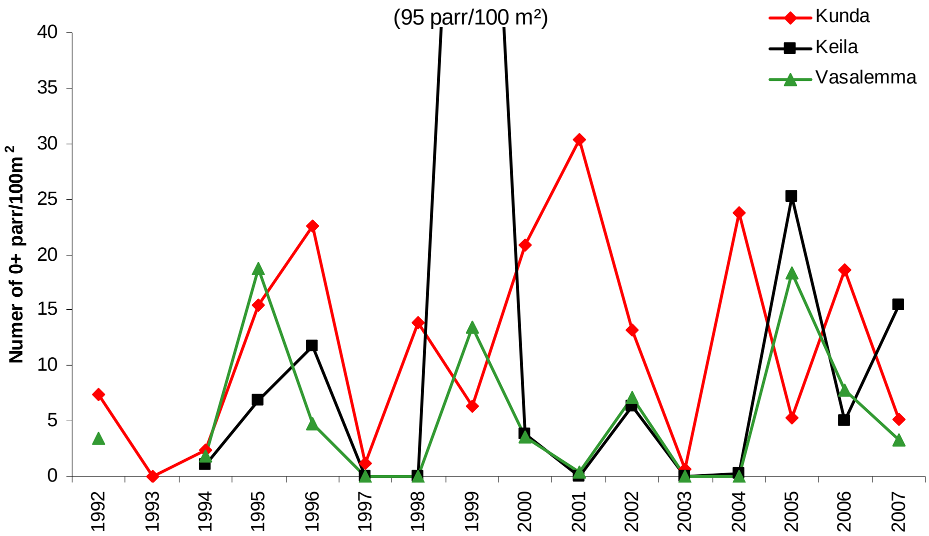

Figure 6.3.3.2 Densities of 0+ (one-summer old) salmon parr in the three wild Estonian salmon rivers. In 1999, the exceptionally high parr density (95 ind./100 m²) was observed in Keila in the conditions of summer drc

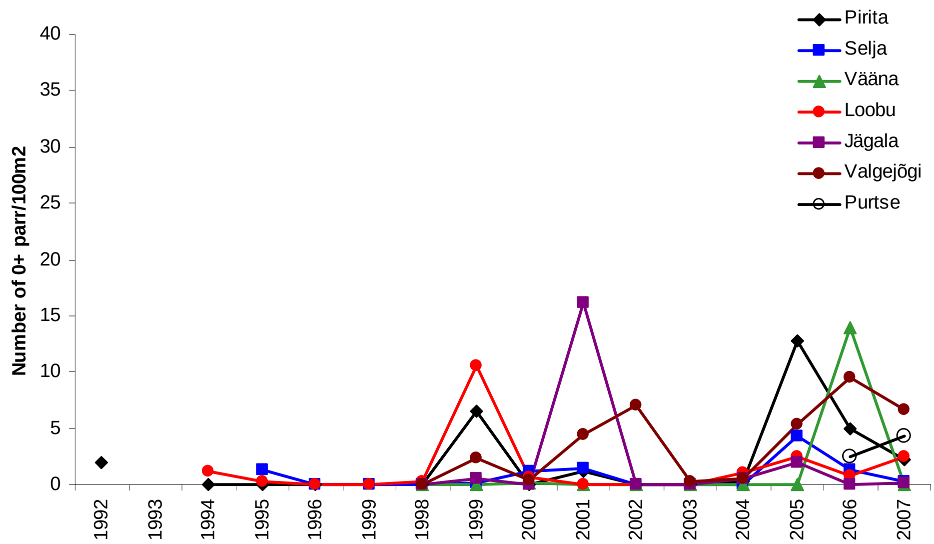

Figure 6.3.3.3 Densities of 0+ (one-summer old) salmon parr in the seven Estonian mixed salmon rivers.

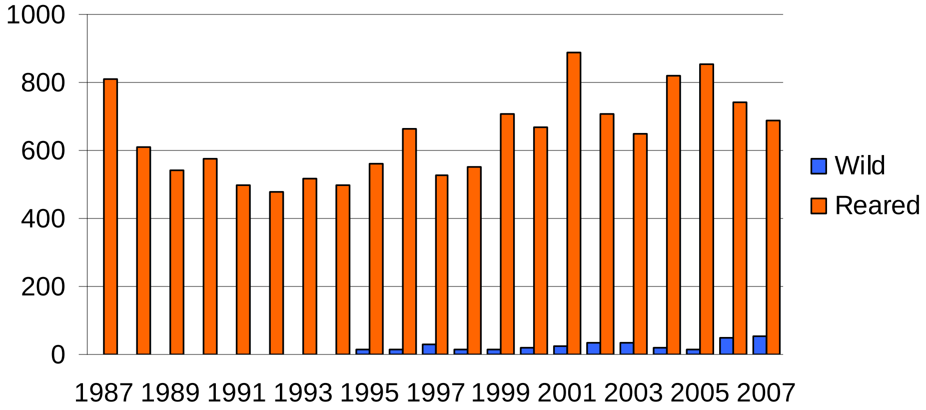

Figure 6.5.1 Annual production of wild and reared smolts in the Gulf of Finland. No information of the wild production is available before 1995.

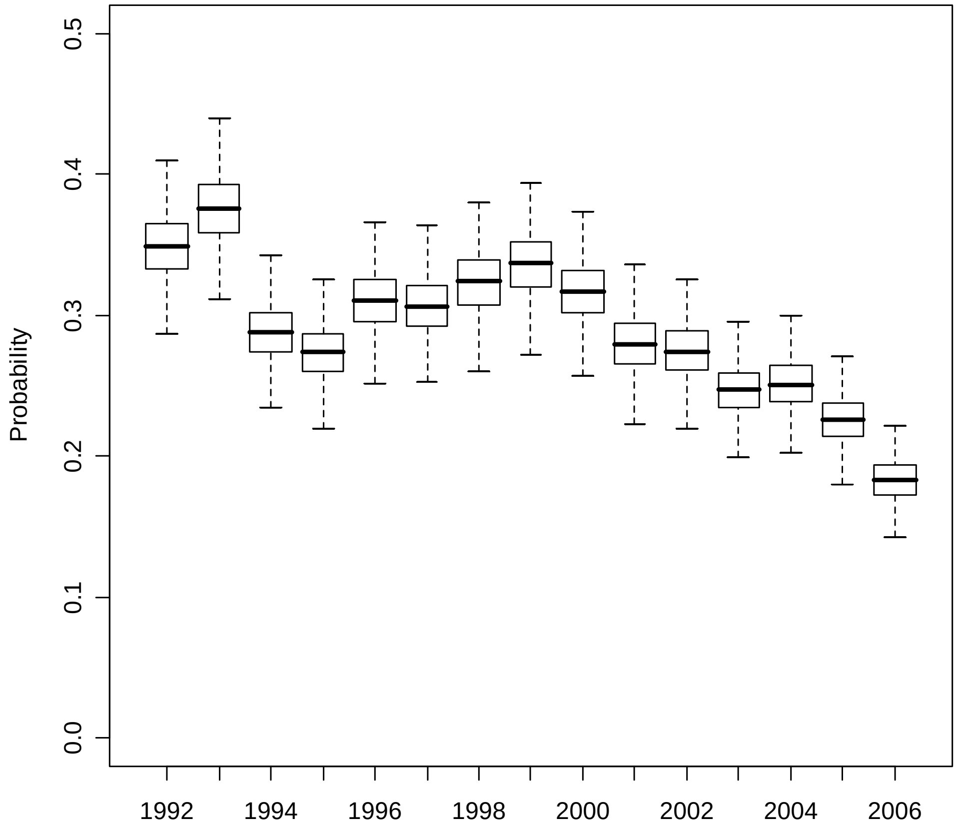

Figure 6.7.1. Probability of salmon to get caught in the Main Basin off-shore fishery for the smolt year classes 1992-2006.