

## 4 Present management measures and other factors influencing salmon fishery

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### 4.1 Description of the Present Management Measures

#### 4.1.1 International regulatory measures

##### **Minimum landing size, minimum mesh size, number of gears / vessels**

International management measures adopted by IBSFC have regulated the salmon fishery in the convention area of IBSFC until end of the 2005. However, since the IBSFC was superseded by bilateral cooperation with the Russian Federation the new technical measures will be developed for the Baltic salmon fishing. European Community has provided the rules, which do not follow strictly those recommendations made by the IBSFC but should rather seek to establish a comprehensive and consistent system of technical measures for Community waters, based on existing rules. Council Regulation (EC) No 2187/2005 laid down certain measures for the conservation of fishery resources in the waters of the Baltic Sea, the Belts and the Sound (ICES 2006). Regulatory measures to be used in the Russian federation waters are not available.

Technical management measures in the Community waters have slightly been changed.

Minimum landing size (60 cm) is still valid in sub-divisions 22-30 and 32, but in sub-division 31 it has been decreased to 50 cm. Additionally, there is a rule for minimum landing size for sea trout; in subdivisions 22-25 and 29-32 (40 cm), and in sub-divisions 26-28 (50 cm).

Minimum mesh size of driftnets (157 mm) is still valid until the end of the year 2007 when drift netting will be closed in the Baltic Sea. Minimum hook size (19 mm) in long lining has been deleted. Restrictions in number of gear used per fishing vessel have also changed. Previously it was permitted to use a maximum of 600 driftnets but according to new rule it is as follows; "Where fishing is conducted using gillnets, entangling nets or trammel nets, the use of more than 9 km of nets for vessel with an overall length of up to and including 12 m and 21 km of nets for vessel with an overall length of more than 12 m shall be prohibited". At present there are no restrictions in number of long line hooks per vessel fishing for salmon (previously 2000 hooks per vessel).

##### **Summer closure**

In the EU Community waters there are not any more gear based summer closures. Those have been compensated by restrictions on fishing for salmon and sea trout (Article 17 of the Council Regulation (EC) No 2187/2005) and they are as follows;

1. The retention on board of salmon (*Salmo salar*) or sea trout (*Salmo trutta*) shall be prohibited
  - a) From 1 June to 15 September in waters of sub-divisions 22 to 31
  - b) From 15 June to 30 September in waters of sub-division 32
2. The area of prohibition during the closed season shall be beyond four nautical miles measured from the baselines
3. By way of derogation from paragraph 1, the retention on board of salmon (*Salmo salar*) or sea trout (*Salmo trutta*) caught with trap-nets shall be permitted.

## TAC

Since 1981 WGBAST recommended adopting a TAC to regulate the Baltic salmon fishery. In 1990, IBSFC adopted a TAC system for Baltic salmon fishery management and it was implemented for the first time in 1991. There are two separate management areas; Baltic Main Basin and Gulf of Bothnia (subdivisions 22–31) and Gulf of Finland (subdivision 32). The TACs implemented for 2006 are given in Section 3.2. EC has divided salmon fishing possibilities in the Main Basin and the Gulf of Bothnia in 2007 and in the Gulf of Finland in 2007 between EC countries as follows (Council regulation (EC) N:o 1941/2006). In the Main Basin and Gulf of Bothnia (subdivisions 22-31) the quota to be harvested by EC countries in 2007 was 5% smaller compared to year 2006. In the Gulf of Finland the EC quota is the same as in 2006. No TACs between EC and Russian federation have been agreed.

Management area: Main Basin and Gulf of Bothnia (subdivisions 22-31)

COUNTRY	ALLOCATION KEY %	QUOTA
Estonia	2.0660	9,028
Denmark	20.3287	88,836
Finland	25.3485	110,773
Germany	2.2617	9,884
Latvia	12.9300	56,504
Lithuania	1.5200	6,642
Poland	6.1670	26,950
Sweden	27.4783	120,080
<b>Russian Federation</b>	1.9000	
<b>Total</b>	<b>100</b>	<b>428,697</b>

Management area: Gulf of Finland (subdivision 32)

Country		
Estonia	9.3000	13,836
Finland	81.4000	
<b>Russian Federation</b>	9.3000	<b>15,419</b>
<b>Total</b>	<b>100</b>	

### 4.1.2 National regulatory measures

In **Denmark** all salmon and sea trout streams with outlets wider than 2 m are protected by closed areas within 500 m of the mouth during the whole year; otherwise the closure period is four months at the time of spawning run. Estuaries are usually protected by a more extended zone. Gillnetting is not permitted within 100 m of the water mark. A closed period for salmon and sea trout has been established from November to 15 January in freshwater. In the sea this only applies for sexually mature specimens.

The Danish quota was in 2006 93512 salmon. This was divided into 5 time periods (from “Bekendtgørelse om regulering af fiskeriet i 2006 og visse vilkår for fiskeriet i følgende år” (paragraf 82)):

However, due to the limited marketing possibilities, the distribution was not followed in 2006, and the quota was only utilised by less than 33 % in total.

The dioxin contents in the salmon was in 2004 found to be above levels accepted by EU regulations meat, for salmon above 4.4 (whole weight). After this time weight limits have changed and in 2006 two different sets of rules were in force:

As from 1. Jan. 2006 until 21. Nov. 2006 salmon with weight up to 4.4 kg (ungutted round weight) could be marketed without restrictions. Salmon with weight between 4.4 and 6.0 kg could be marketed after a trimming process (deep skinning) removing the skin, the layer of fat next to the skin and certain parts of the muscle tissue.

After 22. Nov. 2006 salmon with weights of less than 2.0 kg (gutted weight) could be marketed for human consumption without restrictions. Salmon with weights between 2.0 and 5.5 kg (gutted weight) could be marketed for human consumption only after trimming as described above.

Salmon with weights above 5.5 kg had to be landed, cut in half and made unsuitable for human consumption.

The effect of these regulations was that in the period from 1.st of January 2006 to 21.November 2006 it has only been possible to sell salmon up to 6.0 kg (ungutted round weight), and from 22. November salmon up to 5.5 kg (gutted weight). (BEK Nr. 861 af 15/09/2205 and BEK nr 1117 af 10/11/2006)

To minimize the by-catches of sea mammals, only 9 Danish salmon fishing vessels were granted a licence to fish by drift-net in 2005.

The Danish quota in 2006 93512 salmon was divided in five shares. From 1 January-31 March 25%, from 1 April-30 June 15%, from 1 July-15 September 5%, from 16 September-15 November 40%, and from 16 November-31 December 15% could be caught. In the fifth period the number of salmon per boat with fishing licence was limited in order to stay within the TAC. However, due to the interruption of the fishery as result of the dioxin findings, the distribution was not followed in 2005, and the quota was not fully utilised in 2005.

In **Estonia** an all-year-round closed area of 1000 m radius is established at the river mouths of present or potential salmon spawning rivers Kunda, Selja, Loobu, Valgejõgi, Jägala, Pirita, Keila, and Vasalemma and at the river mouths of the sea trout spawning rivers Punapea, Öngu, and Pidula. In the case of other most important sea trout spawning rivers (Pada, Toolse, Vainupea, Mustoja, Altja, Võsu, Pudisoo, Loo, Vääna, Vihterpadu, Nõva, Riguldi, Kolga, Rannametsa, Vanajõgi, Jämaja) a closed area of 500 m is established from 15 August to 1 December. In the case of smaller sea trout spawning streams, an area of 200 m radius around the river mouths is closed from 1 September to 30 November. Apart from lamprey fishing no commercial fishery in salmon and sea trout spawning rivers is permitted. In most of these rivers also angling with natural bait is prohibited. Besides, only licensed sport fishing is permitted. A closed period for salmon and sea trout sport fishing is established in the rivers Narva, Kunda, Selja Loobu, Valgejõgi, Jägala, Pirita, Keila, Vasalemma, and Pärnu from 1 September to 30 November, in other rivers from 1 September to 31 October. Exceptions in sport fishing closure are allowed by decree of the Minister of Environment in the rivers with reared (the River Narva) or mixed salmon stock (the rivers Selja, Valgejõgi, Jägala, Pirita and Vaana). Below of dams and waterfalls all kind fishing is prohibited at a distance of 100. In the River Pärnu this distance is 500 m.

In **Finland** salmon quota for the Main Basin and Gulf of Bothnia has been divided between Åland Islands and mainland in ratio 20:80. Offshore fishing outside four nautical miles from the baseline is regulated by international regulatory measures. Number of licences for drift net fishing Coastal salmon fishing is prohibited with all kinds of set nets, trapnets, driftnets, and longlines in Finnish territorial waters in the Main Basin and in the Gulf of Bothnia as follows:

1. from the beginning of 15 April to the end of 15 June in the area between latitudes 59°00'N and 62°30'N, excluding Gulf of Finland, and the area east of longitude 22°30'E, joining the Gulf of Finland.
2. from the beginning of 15 April to the end of 20 June in the area between latitudes 62°30'N and 64°00'N.
3. from the beginning of 1 April to the end of 25 June in the area between latitudes 64°00'N and 65°30'N.
4. from the beginning of 1 April to the end of 30 June in the area north of 65°30'N.

In 2007 professional fishermen (making more than 35% of their income by fishing) will be allowed to start earlier the salmon fishing with at maximum 2 seal protected trapnets. The start of the fisheries will be advanced by 14 days in each area in 2007. During this period of so-called selective salmon fishery, fisherman release salmon more than 85 cm long back to the sea. Apart from seal protection the trapnets has to be constructed of such material, which prevent the salmon be entangled in meshes in any part of the gear, and consequently allows the release of salmon in unharmed and vital shape. Finnish Game and Fisheries Research Institute will monitor and study the effects of this fishery (e.g. the relative change on harvest rate).

In addition to the restrictions described above salmon fishery is not permitted using any kind of net or trapnet from the beginning of 1 July to the end of 15 July in the sea in the special area outside the River Simojoki. Salmon fishery using all kinds of nets is likewise prohibited in the River Simojoki from the river mouth to the lake Portimonjärvi from the beginning of 1 May to the end of November. In the specially determined areas outside the dammed rivers Oulujoki, Ijoki, and Kemijoki there are no temporal restrictions for salmon fishing.

In addition it was permitted to carry out drift net fishing of salmon at the Åland Islands in May 1-10 inside four nautical miles from baseline. Between 11 May and 31 May within the four nautical miles from the base line it is permitted in 2007 to harvest quota of 3500 salmon. Additionally it was permitted to catch salmon with at maximum 2 seal protected trapnets per fisherman. In this fishing fisherman release salmon more than 85 cm long back to the sea. The fishing rules in details in salmon fishing in the Åland Island for 2007 are still under negotiations.

Salmon fishery at the mouth of the River Tornionjoki was allowed to start on 3rd July. Fishing had been prohibited in the area in 1991-2001. No changes in the national management measures were adopted for the year 2007.

No significant reduction of the drift net effort is expected among the most active vessels in 2007. The effort reduction has occurred through scrapping of the less active registered vessels at the end of year 2004.

**Latvia** has the following national salmon fisheries regulations. In the Gulf of Riga salmon drift net and long line fishing are not permitted. In the coastal waters salmon fishing is prohibited from 1 of October to 15 of November. Salmon fishing in coastal waters has been restricted indirectly by limiting the number of gears in the fishing season. In May, October and November, only small meshed gears (mesh size below 30 mm) are permitted. In the rivers all angling and fishing for salmon and sea trout are prohibited with the exception of licensed angling of sea trout and salmon exists in the rivers Salaca and Venta in spring time season. Daily bag limit is one sea trout or salmon. All fisheries by gill nets is prohibited all year round in a 3 km zone around the River Salaca outlet from 2003. Fisheries restriction zones were enlarged around the rivers Gauja and Venta from 1 to 2 km in 2004.

Special terminal fishery area in the Southern part of the Gulf of Riga was established in 2002 for increasing of the hatchery reared salmon fishing near the Rivers Daugava and Lielupe

outlets. Regulatory measures for fishing in this region were mitigated to increase fishing effort:

- no salmon fishing prohibition in October- November
- no fishing gear number limitation in late autumn fishing.

In the River Daugava there are no restrictions for salmon and sea trout angling from 2006.

The Latvian catch quota is divided between the offshore and coastal fisheries.

In **Lithuania** the coastal fishery in the Baltic Sea is limited by quotas in numbers, by mesh size and minimal fish size. Salmon and sea trout fishery is not permitted by any gears in areas within a radius of 1 km from the river outlets into the sea. Salmon and sea trout fishery is not permitted in separate regions in the sea from 15 August to 31 October. Salmon and sea trout fishery by gillnets is prohibited from 15 of June to 15 of September, and by long line from 1 April to 15 November. In the rivers and Curonian Lagoon commercial fishing is prohibited all year. Fishery is prohibited by set gillnets in an area within 3 km of the eastern coast of the Curonian Lagoon from 1 September to 31 October. License fishing is allowed from 1 January of 2007 till 1 of October in designated stretches of listed rivers. Angler fishery is not permitted from boats, by bottom lines, or by spinning using live bait from 1 October to 30 November.

In **Poland** the international fishery rules are extended to the coast line. Salmon fishery in the mouths of Pomeranian rivers, in the River Drweca and in the Vistula River and tributaries from the dam in Wloclawek to the mouth is forbidden from 1<sup>st</sup> October to 31<sup>st</sup> December. From dam in Wloclawek to the mouth fishing is prohibited in July-August. In the Vistula River forbidden commercial catch on Fridays, Saturdays and Sundays. In 2003 a vessel monitoring system was introduced. No changes in the fishery rules in 2006.

For 2006 a system of granting the individual salmon quota for Polish fishermen was introduced based on Regulation of Ministry of Agriculture and Rural Development of 23.12.2005 on following principles:

- The whole quota was divided between only vessels which had in 2005 been given individual quota of salmon and which carried out salmon fishing.
- Out of the whole TAC 6% (1,702 fish) was given to vessels smaller than 10 metres without dividing into individual quota.
- The rest – 94% (26,666 fish) was divided equally among vessels of length over 10 metres (408 salmon per vessel).
- Owner of vessel over 10 metres who applied for granting quotas of cod and salmon received alternatively:

100% of salmon quota and 50% of cod quota or

100% cod quota and 50% of salmon quota.

Based on financial support from EU aimed at decreasing fishing effort in the Baltic area, many of Polish vessels were listed for scrapping in 2006. Among them there were 56 fishing vessels of length range 4 - 26 m, which were fishing salmon and sea trout in the last years. Total amount of salmon caught by those vessels in 2006 was 985 fish (ca 5 t), but in 2005 they caught 3,684 salmon, which was 13% of national TAC.

Commercial fisheries for salmon/sea trout in rivers is based on new implemented rules. Fisheries opportunities are sold by the state on a tender basis, where the bidder must submit a fishing ten-year operational plan including restocking.

In **Russia** the international fishery rules are extended to the coast line. In all rivers and within one nautical mile of their mouth fishing and angling for salmon is prohibited during all year, except fishing for breeding purposes for hatcheries. No changes in fishery regulations in 2001-2006.

In **Sweden** south of latitude 62°55'N, coastal salmon fishery is allowed from the start of the fishing season. North of this latitude salmon fishery could start in coastal area outside of protected areas on the 11<sup>th</sup> June. Exemptions from this early season regulation of salmon fishery was allowed to professional fishermen by the local county board in the area north of 62°55'N up to the border between the counties Västernorrland and Västerbotten.

Terminal fishing areas were introduced in 1997 in the coastal region around three rivers with reared production (River Luleälven, Skellefteälven and Gideälven). In these areas salmon fishery was allowed from the start of the fishing season.

In the protected areas outside the river mouths of all wild salmon rivers, usually divided into an inner and outer part, generally all salmon and sea trout fishery was generally forbidden. Fishery with trap nets for other was allowed in these areas from the 26<sup>th</sup> of June. In the outer parts, exemptions from this early season regulation of salmon fishery may be allowed for licensed fishermen by the local county board after the 10<sup>th</sup> of June, however outside the rivers Öreälven, Vindelälven, Sävarån, Rickleån, Kågeälven, Piteälven and Råneälven not until 18<sup>th</sup> of June. In the areas outside the rivers Ume älv, Ljungan and Kalix älv fish lacking adipose fin could be caught, even when catch of fish with adipose fin was banned.

Angling for salmon was allowed in all wild salmon rivers in the Gulf of Bothnia until the 31<sup>th</sup> of August. In the rivers Öreälven, Vindelälven, Sävarån, Rickleån, Kågeälven, Piteälven and Råneälven the angling period was limited to the period 19 June-31 August. There was a bag limit of one salmon per fisherman and day in all rivers. In the rivers Eman and Morrumsan, angling was allowed from the 1<sup>th</sup> of March to the 30<sup>th</sup> of September.

Since 1997 fishing regulations in the border part of river Torneälven are decided upon by the Swedish Ministry of Agriculture and the Finnish Ministry of Agriculture and Forestry. In 2006 angling was allowed in the river from 1 May to 15 August. There was a bag limit of one salmon per day. In addition there were possibilities for a limited river fishery with traditional driftnets during two days. The regulations also provided possibilities for exemptions for licensed fishermen to use trap nets in parts of the protected area outside the river mouth.

In 2006 the Swedish total quota 120,080 fish was divided into two parts. South of the latitude 59° 30' N half of the quota could be caught, in 2006 about 60,040 salmon and north of this latitude the same number salmon. If the coastal salmon fishery north of 59° 30' N does not manage to catch this number of salmon until 15 September, the fish may be caught south of the latitude 59° 30' N.

To comply with the EU regulation 88/98 that implies that the effort in the drift net fishery should be gradually reduced until drift nets are completely prohibited in the Baltic in 2008, the Swedish Board of fishery has reduced the number of permissions to use drift nets from 55 in 2005 to 35 in 2006. In order to be allowed to fish with in 2007 the fishermen must have been active fishing in 2006.

In order to improve the situation for the poor sea trout stocks in Subdiv 31 a number of changes were implemented from July 1 2006. The minimum size for sea trout was raised from 40 to 50 cm in the sea. Furthermore a ban of fishing with nets in areas with a depth of less than 3 meters during the period 1 April-10 June and 1 October-31 December in order to decrease the bycatch of trout in other fishery. In the period 1 October-31 October fishery with nets with a mesh size of less than 37 mm (knot to knot) is allowed.

## 4.2 Evaluation of the Management Measures

### 4.2.1 International regulatory measures

An evaluation of the effects of minimum landing size, mesh size in gill nets and minimum hook size was provided in ICES. 2000. However, the changes in the regulatory measures in the EC waters (Council Regulation (EC) 2187/2005) might change the situation compared to previous years.

The minimum landing size in sub-division 31 has now been decreased from 60 cm to 50 cm. Therefore, the new minimum landing size permits fishermen to utilize smaller salmon than before. In sub-division 31 all directed salmon fishing is targeting salmon spawners. However, those small salmon are all grilse and in the Baltic Sea almost 100% of grilse are males. Only few of the grilse are smaller than 60 cm and the lower escapement of grilse to spawning populations will hardly have any effect on the reproductive capacity.

Secondly, in Finland, in the northern part of the sub-division 31 a harvest of salmon with a minimum landing size of 50 cm have already been going on for several years. This measure has been established on national basis, but it has not been in force valid in the area outside four nautical miles measured from the base line. Also on the Swedish side of sub-divisions 30 and 31 the minimum landing size has been 50 cm for years, established similarly as in Finland.

There is no longer a minimum hook size in long lining in EC waters. However, the effect of this change is probably minimal, as it hasn't been possible to demonstrate that hook size affects size selectivity.

The increased fishing period with long lining, especially in sub-divisions 22-31 will probably have small effects on the fishery. This is based on findings by fishermen in all countries around the Baltic where longline fisheries occur that this fishery is possible only during the winter months, from November / December to February or possibly March. The rule concerning a maximum number of hooks per vessel (previously 2000) has also been dropped from the EC Council regulation. This measure might contribute to an increased fishing effort by long lining. As long line fishery is very labour intense, it is not possible to increase the number of hooks so much.

According to Council regulation (EC) No. 812/2004 of 26.4.2004 the maximum number of vessels which may be authorised by a Member State to keep on board, or use for fishing, driftnets in 2005, shall not exceed 60% and in 2006 40% of the number fishing vessels which used drift-nets during the period 2001 to 2003. Until now, this has effect only on the drift net fishery, not the total effort or catch.

In November 2005 the Council of Ministers reached unanimously a political agreement on a new set of technical measures for the conservation of fishery resources in the Baltic Sea. This new Regulation will provide for a limited derogation to the phasing out of driftnets in the Baltic Sea area. The final date for the closure of the driftnet fishery was not changed but the number of vessels allowed to fish with driftnets in 2007, the last year when driftnet fishing will still be allowed, was increased from 20% to 40% of the number of vessels fishing with driftnet in the period 2001 to 2003.

In September 2005 the Union of Polish Fishermen has applied for an permanent derogation from the provisions of the regulation in ICES sub-divisions 22-29 in the Baltic Sea. The handling of this petition was unaccomplished by the time of compiling this report.

Despite the Polish petition the working group assumed that with high probability the regulations will come to a force and driftnet fishing will stop in the Baltic Sea from year 2008

onwards. The effort scenarios were set for the forward projections accordingly (see Chapter 5).

In the period 2000-06 up to around 70% of the total offshore catch in weight was taken with drift nets. The disappearance of drift net fishery from January 1 2008 will therefore have considerable effects on the fishery. Normally salmon fishery have been carried out by fishermen who have specialized on this kind of fishery. They have used drift nets in the autumn and spring and some of them have used longlines in the winter months. After adopting the new EC Council regulation the allowable fishing period in long-lining has increased and there is no limit for the maximum number of the hooks per vessel. However, the present type of long-line does catch salmon only from December to early March, which in practice prevent extending the fishing season. Assuming the present price and CPUE level in the offshore fishery the season will be too short for the most of the vessels to get sufficient income. There are signs that some of the salmon fishermen will stop fishery even with longlines. On the other hand there is a possibility that small 1-2 person vessels can increase their fishery with longlines. The possible effort scenarios were explored by the Group members, and as a whole there is was doubt that there will be a considerable reduction in total fishing exploitation in the offshore fishery (Table 4.2.1). It is highly unlikely that an increased longline fishery will compensate substantially for the disappearance of the drift nets.

#### **4.2.2 Non-exploited salmon in rivers with reared production**

Mark-recovery studies to estimate the total number of salmon spawners entering the rivers have been carried out in two Swedish rivers with reared stocks, river Luleälven, Sub-division 31, and river Dalälven, Sub-division 30, in the 1990s, 2001 and 2002.

The results were in contrast with the idea of a large non-exploited surplus in many rivers. There is indeed a surplus that may be exploited but the number of fish is only a fraction of the 500,000 salmon often believed to be available for harvest (ICES. 2004).

River Dalälven is located in the southernmost part of Sub-division 30. Spawners leaving the Main Basin in order to ascend this river are not caught in the fishery at Åland, but instead they migrate along the Swedish coast where only little coastal fishery occurs. Furthermore the broodstock fishery in River Dalälven is operated throughout the entire summer season when spawners enter the river. This suggests that catches in this fishery can be used as a relative index of the escapement, even without mark-recapture estimates of the total run. As grilse are not normally exploited in the offshore fishery, an analysis of the number of the number of grilse entering the broodstock fishery will also give an indication of the survival of the smolt-year-class, Figure 4.2.3.1. The results indicate that the grilse catch from the smolt-year-class 2005 is by far the lowest in the time series 1997-2006 and the catch from the year-class 2004 is also low. This fits in with the suggestions of a very low postsmolt survival in these two years, see Section 5.

#### **4.2.3 Evaluation of the effects of delayed opening of the coastal fishery in the Gulf of Bothnia**

##### **4.2.3.1 Introduction**

Variation in the timing of salmon spawning migration is generally assumed to be an adaptation to the long-term average regimes of temperature, flow and other physical factors experienced by adults and their progeny. This means that the average migration timing in salmon populations display a certain amount of variation each year. In the Baltic Sea, this is evident from both catch statistics, where peak salmon catch is correlated with sea temperatures (Karlsson and Karlström 1994), and from salmon populations where peak arrival varies with several weeks among years (Dahl et al. 2004).

One of the management measures beside the TAC-system has been delayed openings of the coastal fishery in the Gulf of Bothnia, which has been applied in both Sweden and Finland (Section 4.2.2). The restrictions seem to have been effective, because a larger numbers of salmon has been able to ascend into the salmon rivers in the north part of Gulf of Bothnia (Romakkaniemi et al. 2003).

As the migration timing is relatively variable among years, it is obvious that the date of opening will affect the effectiveness of the fishing. In order to better understand how different starting dates affect the catches in commercial fishing and how that is translated into number of escaping spawners, a study was initiated with data from the commercial fishing in Åland which is not affected by temporal regulatory measure because fishery is allowed to start there in good time before spawning salmon arrive to the area (Pakarinen et al. 2006).

The effect of a delayed opening of the salmon fishery on the total number of adults escaping to the Gulf of Bothnia rivers has been recently studied by Jounela et al (2006). This work clearly shows that the number of escaping adults can be reasonably well controlled by the opening date of the salmon fishery. According to Jounela et al (2006), the delayed opening dates of coastal fishery in 1999-2003 were able to protect, by average, 48% of the migrating stock in the Southern most management area of Gulf of Bothnia, and by average, 31%-37% of migrating stock in the northern management areas in Bothnian Sea and in Bothnian Bay.

Jounela et al (2006) demonstrated that delays in the opening of the fishery will eventually result in increased escapement if the delay is long enough. This year the approach of the working group was to study the effects of delayed opening in the light of number of MSW salmon observed in fish ladders in Gulf of Bothnia rivers in comparison to run timing and estimated number of MSW salmon approaching the coast.

#### 4.2.3.2 Data and notation

The number of MSW salmon observed in fish ladders ( $L_{\text{year, river}}$ ) in rivers Kalix, Pite, Öre and Ume/Vindel were used in the analysis. The data on fish counts are presented in Table 3.2.1.2.

The day of the peak run ( $R_{\text{year}}$ ) of MSW salmon at the Åland islands was taken from the results of the study analysing the CPUE development at Åland driftnet fishery between the years 1981-2005 (Pakarinen et al. 2006). They assumed that CPUE is an indicator of the relative abundance of the salmon migrating past the Åland Islands at any point in time. The higher the CPUE, the higher is the number of salmon migrating. The analysis was based on the log-book records from vessels participating the Åland Islands coastal driftnet fishery in 1981-2005. The spawning migrating salmon pass the Åland Island coast in early summer on their way from the Main Basin feeding areas to the Gulf of Botnian rivers or release sites. The coastal driftnet fishery targeting these salmon developed around 1986 and since then it has occurred annually during a 3 to 4 week period, usually starting in late May. Being the first fishery at the coast harvesting the mature migrating salmon, the catch records are ideal to study the annual timing of the spawning run.

The number of MSW salmon available to fishery at the Åland islands ( $H_{\text{year, river}}$ ) was estimated by the full life history model used in the stock assessment.

The annual reported catch at Åland islands was first split to wild and reared components by using scale reading data, and then the wild component was further allocated to wild stocks in proportion to their relative abundance estimated by the full life history model. The resulting estimate of stock specific catch is denoted here by  $C_{\text{year, river}}$ . The number of fish entering the coastal fishery is estimated by subtracting the catch of the Åland islands fishery from the number of homing fish:

$$N_{\text{year, river}} = H_{\text{year, river}} - C_{\text{year, river}}$$

The annual effort of Finnish coastal trapnet fishery is denoted by  $E_{\text{year}}$

#### 4.2.3.3 Analysis

The purpose of the analysis was to quantify the effect of the delayed opening date on the proportion of MSW salmon that have escaped from coastal fishery to fish ladders. The expected number of salmon in the ladders is assumed to consist of salmon that have avoided totally the coastal fishery by migrating before the opening date and of salmon that have become exposed to the coastal fishery after the opening date but escaped from it.

It is assumed here that the daily MSW salmon run at the Åland islands could be well described by a normal distribution with mean  $R_{\text{year}}$  and standard deviation  $\sigma_{\text{year}}$ . Then the proportion of salmon escaping ( $p_{\text{year}}$ ) before opening date  $d_{\text{year}}$  can be calculated as

$$p_{\text{year}} = \Phi((d_{\text{year}} - R_{\text{year}}) / \sigma_{\text{year}}),$$

where  $\Phi$  denotes the cumulative density function of  $N(0,1)$  distribution. Consequently, the proportion of the run facing the coastal fishery can be found as  $1 - p_{\text{year}}$ . Annual estimates of  $R_{\text{year}}$  were already estimated, but information about  $\sigma_{\text{year}}$  was not available during the working group meeting. Therefore a prior distribution based on expert knowledge about the typical duration of the run was defined as

$$\sigma_{\text{year}} \sim \text{Lognormal}(\text{mode}=10, \text{CV}=0.3).$$

The harvest rate of the Finnish coastal trapnet fishery after the opening date is modelled in a usual way as a function of an unknown catchability coefficient ( $q_{\text{river}}$ ) and fishing effort

$$h_{\text{year, river}} = 1 - \exp\{-q_{\text{river}} E_{\text{year}} / G_{\text{year}}\},$$

where  $G_{\text{year}}$  denotes number of fishing days left after the opening date, defined here as

$$G_{\text{year}} = R_{\text{year}} + 2\sigma_{\text{year}} - d_{\text{year}},$$

in order to implement an assumption that the date with 99% accumulation of migration would be the last fishing day.

The catchability is assumed to differ between rivers because of the different migration pattern of the stocks in relation to Finnish coastal trapnet fishery. Prior distributions reflecting poor prior knowledge were assigned to catchabilities

$$q_{\text{river}} \sim \text{Lognormal}(\text{median}=1, \text{CV}=1.3).$$

Given the pieces defined above, the expected number of MSW salmon can now be written as

$$E(L_{\text{year, river}}) = \alpha_{\text{river}} N_{\text{year, river}} (p_{\text{year}} + (1 - p_{\text{year}}) (1 - h_{\text{year, river}}))$$

where  $\alpha_{\text{river}}$  is an unknown river-specific scaling factor of abundance. The value of this factor depends on the proportion of ascending fish that will enter the fish ladder as well as on possible under/overestimation of the pre-fishery abundance ( $N_{\text{year, river}}$ ) and on harvest rate of other possible fishing before entering the fish ladder. For convenience in comparisons between rivers, we divide the number of salmon observed in the fish ladder by the estimated abundance  $N_{\text{year, river}}$  in order to obtain an index of survival

$$I_{\text{year, river}} = L_{\text{year, river}} / N_{\text{year, river}}$$

for which the expected value is

$$E(I_{\text{year, river}}) = \mu_{\text{year, river}} = \alpha_{\text{river}} (p_{\text{year}} + (1 - p_{\text{year}}) (1 - h_{\text{year, river}})).$$

The following prior distributions were given to the scaling factors:

$$\alpha_{\text{river}} \sim \text{Lognormal}(\text{median}=1, \text{CV}=1.3).$$

The survival indices are assumed to follow lognormal distribution conditional on mean ( $\mu_{\text{year, river}}$ ) and CV ( $\gamma$ )

$$I_{\text{year, river}} | \mu_{\text{year, river}}, \gamma \sim \text{Lognormal}(\mu_{\text{year, river}}, \gamma)$$

In order to be able to predict the run timing in future based on the previous observations, the run timing is assumed to vary according to a normal distribution between years according to a probability model

$$R_{\text{year}} | M_R, S_R \sim N(M_R, S_R),$$

$$M_R \sim N(130, 50),$$

$$S_R \sim \text{Unif}(0, 20),$$

where  $M_R$  is the mean run timing across years and  $S_R$  denotes the standard deviation of run timing between years.

The posterior predictive distribution of run timing was used to predict the timing of the run in a future year. This procedure accounts for uncertainty about the mean and standard deviation about the run timing across years. The standard deviation of the run curve for a predicted year was simulated from a distribution resembling an average posterior distribution of the past time series ( $\sigma_{\text{predicted}} \sim \text{Lognormal}(\text{mean}=15, \text{CV}=0.45)$ ). The proportion of salmon saved by delayed opening were evaluated for opening dates from April 20 to July 19.

#### 4.2.3.4 Results

The observed survival indices (Figure 4.2.3.1) showed somewhat similar pattern in three of the four rivers: the survival to fish ladders has been low in early 90's after which the survival has improved. This is not the case for river Öre, however.

The model predicts the overall pattern in survival correctly, but can not reproduce all the variation in terms of the median of the predictive distribution (Figure 4.2.3.1). The fit is clearly better for rivers Kalix and Pite and worse for rivers Öre and Ume. This can be partly explained by the smaller exposure of the latter stocks to the Finnish coastal fishery due to the likely migration pattern of these stocks. This is to some extent picked up by the estimates of catchability and is thus also reflected in model predictions: the catchability is estimated to be considerably lower for the river Öre and Ume stocks (Figure 4.2.3.2), which in turn makes the escapement from the coastal fishery after the opening date less reactive for changes in effort compared to Ume and Kalix stocks (Figure 4.2.3.3).

According to the results, the proportion of the run that had passed the coastal fishery before the opening date had varied very much in the course of years 1992-2005 (Figure 4.2.3.4). The proportion has been smallest in the beginning of the 1990's but was highest (close to 1) in years 1996 and 1997 when an early run took place and the opening of the fishery was delayed. These results are in agreement with the high number of salmon observed in rivers in the years 1996 and 1997. The results clearly shows that when the fixed multi annual opening dates are applied the escapement to the rivers vary much, because of the large variation in the timing of spawning migration.

Risk curves as a function of the opening date are presented in Figure 4.2.3.5. After deciding a target escapement before the opening of the fishery and acceptable level of probability that the target will not be achieved, the figure can be used to pinpoint the corresponding opening date. For example, if the target escapement is 50% and the chosen risk is 5%, then the opening date would be June 11<sup>th</sup>. It can also be seen from the figure that with the same opening date there is 5% chance that the proportion of run available to fishery is less than 3%. The figure can be

obviously used to assess risk associated with any opening dates. For example opening date May 15<sup>th</sup> results in 50% probability that less than 11% of the salmon run has escaped before that date and in 95% probability that the proportion is less than 35%.

The high uncertainty results to large extent from the fact that the run timing varies considerably between years with standard deviation of about 5 days meaning that in long run the dates for peak run vary within an interval of about 3 weeks.

#### 4.2.3.5 Conclusions

It can be concluded that the delayed opening of the coastal fishery is an effective tool for saving a proportion of the spawning run from the coastal harvest. However, the run timing varies between years, which means that with multi annually fixed opening dates, the saved proportion of spawning run will be highly variable as seen in the results from years 1992-2005 (Figure 4.2.3.4).

Optimally, the opening dates would be annually decided based on measurements of environmental variables, which can be used to predict the run timing to some extent (Dahl et al 2004). While good predictive models have not yet been established, another option is to find opening dates which would on average protect a suitable proportion of spawners, as indicated by Jounela et al (2006). It should be noted, however, that a more variable escapement (variable harvest rate) will obviously make the future development of the stock more unpredictable compared to more stable harvest rate.

Further research could study the predictive power of the environmental conditions measured in the river and in the sea and the effects on the run timing of salmon. Such a research would eventually produce a predictive probability model which could use annual measurements of environmental covariates to predict the timing and shape of the run, which could be then used for annual optimisation of the opening dates. Model could also make use of early opened test fishery for more precise optimisation of the dates. During the fishing season model could be used to predict the remaining run of the exploitable population, which could potentially help fishermen to allocate their effort more effectively.

### 4.3 Other factors influencing the salmon fishery

The incitement to fish salmon as an alternative to other species is likely to be influenced by a number of factors, such as the possibilities for selling the fish, problems with damage to the catches from seal and the market price for salmon compared to other species and possibilities to fish on other species.

In the following section a number of this type of factors which may affect the salmon fishery are considered.

#### 4.3.1 Dioxin

The level of dioxin in salmon of the Baltic has been monitored by authorities in Sweden since 2000 and in Finland since 2001. The maximum level of dioxin and dioxin like PCB set for the flesh from salmon will be 8 pg WHO-PCDD/F-PCBTEQ (COMMISSION REGULATION (EC) No 1881/2006). Overall levels of dioxin and related substances tend to increase with size (sea age) of the salmon. In general the levels found are above the maximum EU level. Two countries have a dispensation 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 Denmark investigations on the dioxin level have the implication that as from 22. November 2006 salmon above 5.5 kg (gutted weight) are not permitted to be marketed, but must be brought to the harbour and destroyed. Salmon with a weight below 2 kg (gutted weight) can be

marketed without restrictions, while salmon with weight between 2 and 5.5 kg can be marketed only after deep skinning. By deep skinning the more fatty parts of the salmon are removed.

In Latvia dioxin analyses of salmon demonstrated results similar to the Danish results. Dioxin level in fish exceeds the maximum allowed level in the all salmon with a sea age of 2-3 years.

After an initial ban on marketing salmon it has after 30. November 2005 again been possible market salmon in Latvia. Salmon with ungutted (whole) weight below 4.4 kg (length limit 72 cm) can be marketed on the home market without restrictions and salmon with weight below 6 kg (ungutted) can be marketed if the ventral part of the fillet is cut off.

Sweden and Finland both have derogation from the EU until 2011 allowing national use of the salmon if dietary advice is given to the public. Export to other countries is not permitted.

However, in a proposition from the European Commission, sent into hearing in the member states February 2005, a continuation of this exception is suggested, including also Estonia. Latvia, Lithuania and Poland have also applied for derogation from the EU regulations on dioxin.

#### **4.3.2 Size (weight) distributions of catches**

The enforced and future weight limits for marketable salmon affects strongly the fishing practice and possibilities in the future. It is likely that, if possible, specific marketable sizes will be targeted by the fishery.

Weight distribution of sampled Polish (years 2005 and 2006) and Danish (years 2003-2006) are presented in Figures 4.3.2.1- 3.

For the Danish samples the fraction of marketable salmon increased in 2006 compared to earlier years, particularly in the size group 5-7 kg. On average 89 % of the sampled salmon were below 7 kg for the years 2003 – 2006.

Also in the sampled Polish salmon the proportion of salmon being below the 6 kg limit constituted the majority of the sampled catch.

If a future weight limit of 2 kg (based on dioxin and dioxin like PCBs) should be implemented in the entire Baltic this would with high probability result in a total stop of the commercial salmon fishery.

#### **4.3.3 Predation on salmon by seals and damage caused by seals to fishing gears and to salmon in fishing gears**

The effects of seal on salmon and salmon fishery have consequences at several levels:

1. Direct catch loss due to damaged or escaped fish.
2. Capital losses due to damage of gear.
3. Indirect effects through seals disturbing the fishing operations.
4. Changes of fishing grounds or methods as a response to seal interaction.
5. Reduced value of catches due to scars and parasite infections.
6. Effects on fishery through competition for the salmon resource and / or altered fish behaviour.

All effects are difficult to quantify. Item number 1 and 2 are the parts of the total damage where the best data is available for quantitative estimate, but still with substantial uncertainty. The indirect effects can only be estimated in a very crude manner, and an estimate of the seal

population effect on recruitment of commercial species is not possible, since this requires a good knowledge of the total seal population size and also the composition of the diet.

In Denmark, Russia and Poland influence by seals on salmon fishery is insignificant. No data are available from Germany or Lithuania.

In Estonia the seal damage is most accentuated in the salmon and sea trout gill net fishery. Damage Losses? increased in last years (pers. comm. of fishermen). Quantitative assessment of damage is not available as fishermen in most cases did not present claims for gear compensation.

In Finland the share of discarded fish is reported by fishermen in numbers of salmon damaged. It was recorded in 2006 that 8,111 salmon (44 t) salmon were discarded due to seal damages. Seals caused severe damages to all fisheries mainly in sub-divisions 29-32 where seal damages comprised 18 % of the total commercial catch in the region. This can be compared to 10,800 fish in 2005 and 12,171 salmon in 2004. Most of the damaged fish has to be discarded.

In Latvia, direct catch losses of salmon by seal damages increased significantly from 2003. In the most affected area, the southern part of the Gulf of Riga, the percentage of salmon damaged by seal in coastal fishery increased from 5% in 2002 to 40% in 2003 and 60% in 2004. In 2005 salmon fishery near the outlet of the river Daugava was moved inside the river to decrease damage from seals. The number of discarded salmon due to seal damage was in 2004 was 525 individuals (4.2 tonnes). Discarded salmon was not reported in catch statistics. In 2005 and 2006 there was no significant damage to the broodstock fishery, because it was moved from coastal water to rivers. However the number of seals continued to increase in 2006. For this reason salmon fisheries in coastal waters in late autumn (especially by gillnets) have become economically unfavourable.

In Sweden the total percentage of the salmon catch in trap nets that is discarded due to damage by seals is estimated to be about 15% and this leads to an estimated discard in 2006 of 35 tonnes or 6,192 salmon (in 2005 49 tonnes and 9,860 salmon).

#### 4.3.4 Fisheries economics

Figure 4.3.4.1 presents the monthly salmon price per kilogram paid for fishermen in Bornholm 1998-2006. During the period 1998 – 2004 prices were relatively stable. during the winter 2003 – 2004 catches of salmon were very high in the sea close to Bornholm. Later in 2004 dioxin levels in Danish samples were found to be above levels set by EU authorities, resulting in a closure of the fishery for part of the year 2004. This meant that the market situation for the salmon fishermen was very uncertain and the changes in the prices in 2004 are most likely a result of these facts.

The price of salmon has increased during 2006. This is most likely due to the increase in salmon world market price and decrease in landings. The salmon import from Norway to Denmark has started to increase again in 2006 (Figure 4.3.4.2).

The salmon price in Finland has also increased during 2006 so that in November and December the price was 5.49 €/kg and the annual average salmon price was 4.80 €/kg. In Sweden, the annual average salmon price in 2006 was 3.29 €/kg.

#### 4.3.5 Reductions in drift netting

According to Council regulation (EC) No. 812/2004 of 26.4.2004 the maximum number of vessels which may be authorised by a Member State to keep on board, or use for fishing, driftnets in 2005, shall not exceed 60% and in 2006 40% of the number fishing vessels which used drift-nets during the period 2001 to 2003. Until now, this has effect only on the drift net fishery, not the total effort or catch.

In November 2005 the Council of Ministers reached unanimously a political agreement on a new set of technical measures for the conservation of fishery resources in the Baltic Sea. This new Regulation will provide for a limited derogation to the phasing out of driftnets in the Baltic Sea area. The final date for the closure of the driftnet fishery was not changed but the number of vessels allowed to fish with driftnets in 2007, the last year when driftnet fishing will still be allowed, was increased from 20% to 40% of the number of vessels fishing with driftnet in the period 2001 to 2003.

In September 2005 the Union of Polish Fishermen has applied for a permanent derogation from the provisions of the regulation in ICES sub-divisions 22-29 in the Baltic Sea. The handling of this petition was unaccomplished by the time of compiling this report.

Despite the Polish petition the working group assumed that with high probability the regulations will come to a force and driftnet fishing will stop in the Baltic Sea from year 2008 onwards. The effort scenarios were set for the forward projections accordingly (see Chapter 5).

In the period 2000-06 up to around 70% of the total offshore catch in weight was taken with drift nets. The disappearance of drift net fishery from January 1 2008 will therefore have considerable effects on the fishery. Normally salmon fishery has been carried out by fishermen who have specialized on this kind of fishery. They have used drift nets in the autumn and spring and some of them have used longlines in the winter months.

#### **4.4 Conclusions for the fishery**

The disappearance of the drift net fishery from 2008 is expected to have considerable effect on the fishery. This fishery is conducted by fishermen having specialized on this, using drift nets in the autumn and spring and some of them longlines in the winter months. It is not expected that catches with longlines can compensate for the catches previously taken by driftnets, on the contrary it is expected that the overall effort also in this fishery will decrease.

Only the coastal trap net fishery is likely to increase in the future.

Dioxin contents in the salmon is not expected to influence the catch in Sweden, Finland, Poland, Lithuanian, Estonia and Germany, because either the countries have a derogation from the EU rules, have asked for a derogation or have results from analysis of dioxin contents that permits marketing of the salmon.

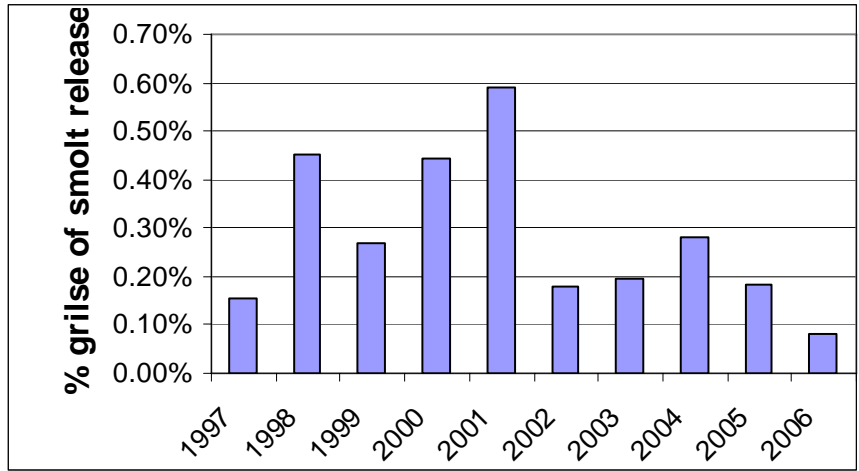
As a consequence of the reduced possibilities to market salmon due to the EU regulations on dioxin and dioxin related PCB's together with the ban on EU enforced ban on the use of driftnets from 2008 the incitement to fish salmon in Denmark is presently so low, that the fishery most likely will decrease even further than it has already. At the same time the fishing fleet is continuously decreasing as a result of scrapping. Also in Latvia part of the catch cannot be marketed and therefore the salmon fishery most likely will not increase.

The utilizing of the TAC in the Baltic Main Basin and the Gulf of Bothnia was in 2006 at a historical low level of only 45%, and it seems very likely that the utilizing of the TAC in future also will be at a low level because of the above-mentioned limiting factors. At the same time the proportion of the catch by non-commercial fisheries continued to increase, and as these catches in numbers were close to 20% of the reported total commercial catch, it is predictable that the non-commercial catches will increasingly influence the fishery in the coming years.

Depending on the possibilities to catch other species the recently observed rise in the price on salmon is naturally an incitement to fish salmon, as soon as this is more profitable compared to other fishing possibilities.

**Table 4.2.1** Effort scenarios for the main Baltic salmon fishing effort country based on experts opinions.  
Factors are relative to the corresponding fishing effort in 2006.  
1) indicates the most likely value

Fishery	Year	DK	PL	EE	FI	LV	SE	LT	RU	DE
Offshore DN	2007	0.8	1	1	1	0.75	0.9	No fishing		
	2008	No fishing								
	2009- 2016									
Offshore LL	2007	1	0.9	No fishing	1	No fishing	0.75	No fishing		
	2008	1	0.9	No fishing	1	No fishing	0.5	No fishing		
	2009	0.8	0.9	No fishing	1	No fishing	0.5	No fishing		
	2009- 2016	0.3-0.9 0.5 <sup>1)</sup>	0.4-1.4 0.7 <sup>1)</sup>	No fishing	0.2-2.0 0.7 <sup>1)</sup>	vessel; 0-1 No fishing	0.2-1.0 0.5 <sup>1)</sup>	vessels; 0-2 No fishing		
Coastal TN	2007	No fishing	No fishing	1	1.1	0.9	1	No fishing		
	2008	No fishing	No fishing	1	1.3	0.9	1	No fishing		
	2009	No fishing	No fishing	1	1.3	0.9	1	No fishing		
	2009- 2016	No fishing	No fishing	0.5-1.0 0.9 <sup>1)</sup>	0.8-2.0 1.2 <sup>1)</sup>	0.5-1.0 0.7 <sup>1)</sup>	0.6-1.2 1.0 <sup>1)</sup>	No fishing		



**Figure 4.2.3.1** Catch of salmon grilse (A.1) in the broodstock fishery in River Dalälven given as per cent of number of smolts.

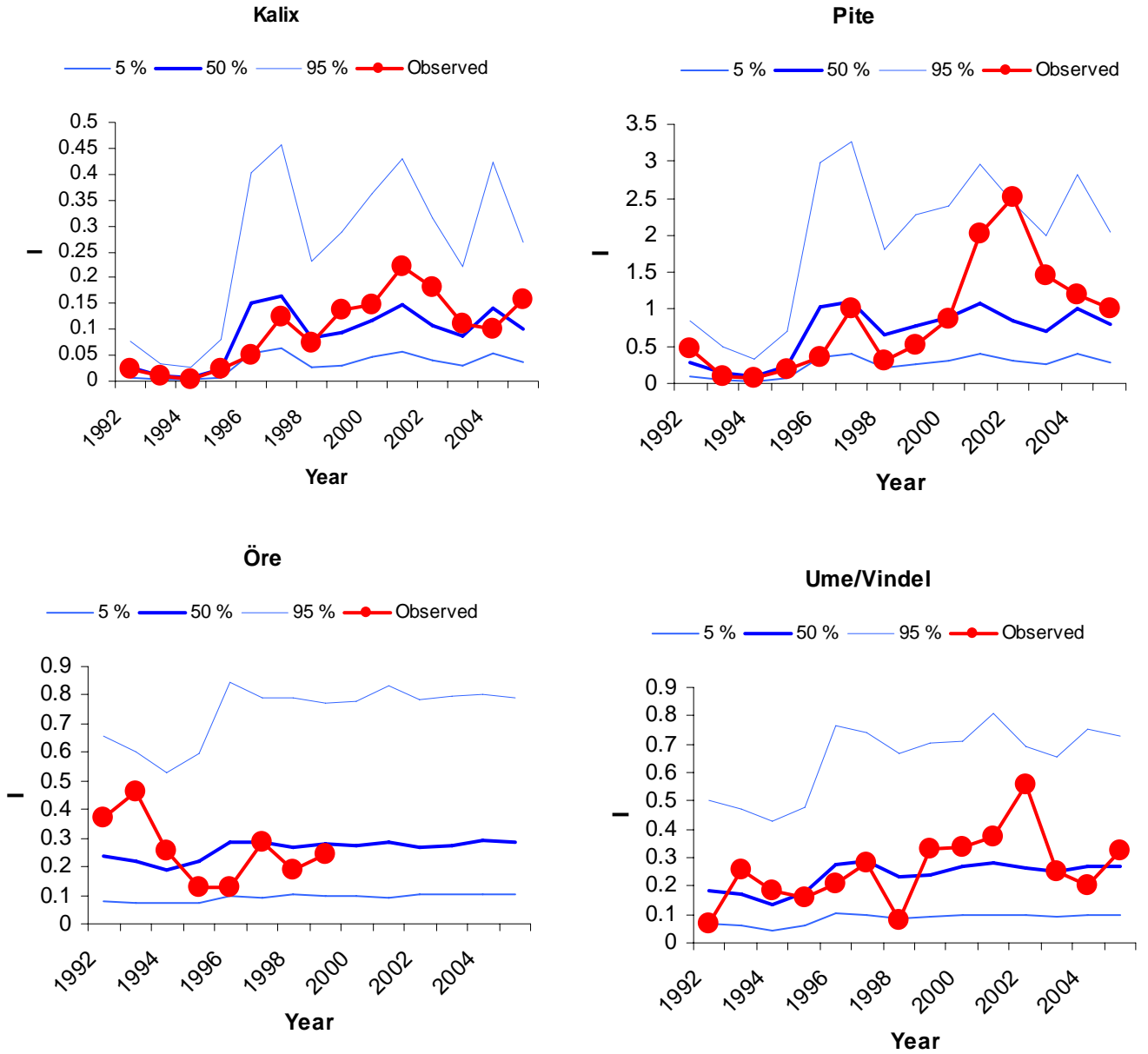
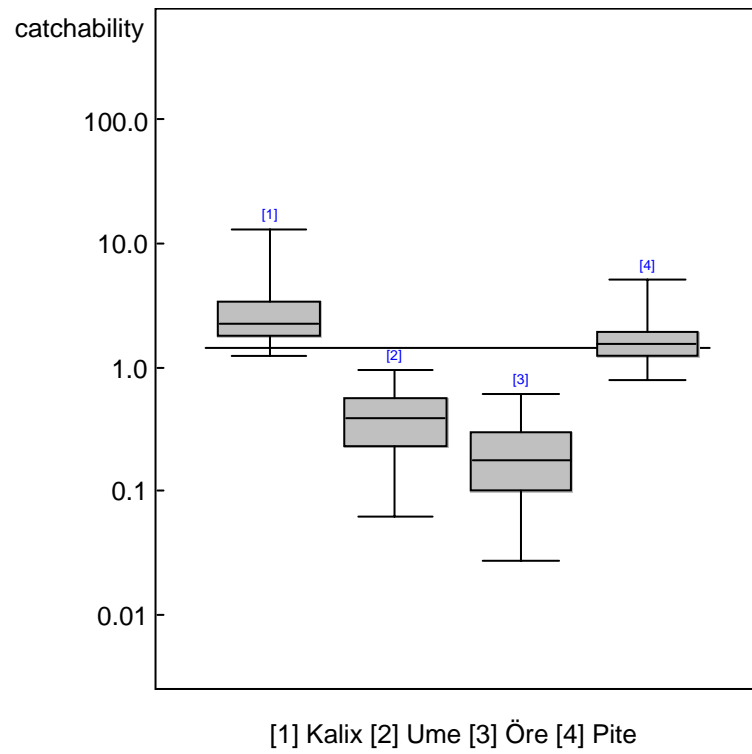
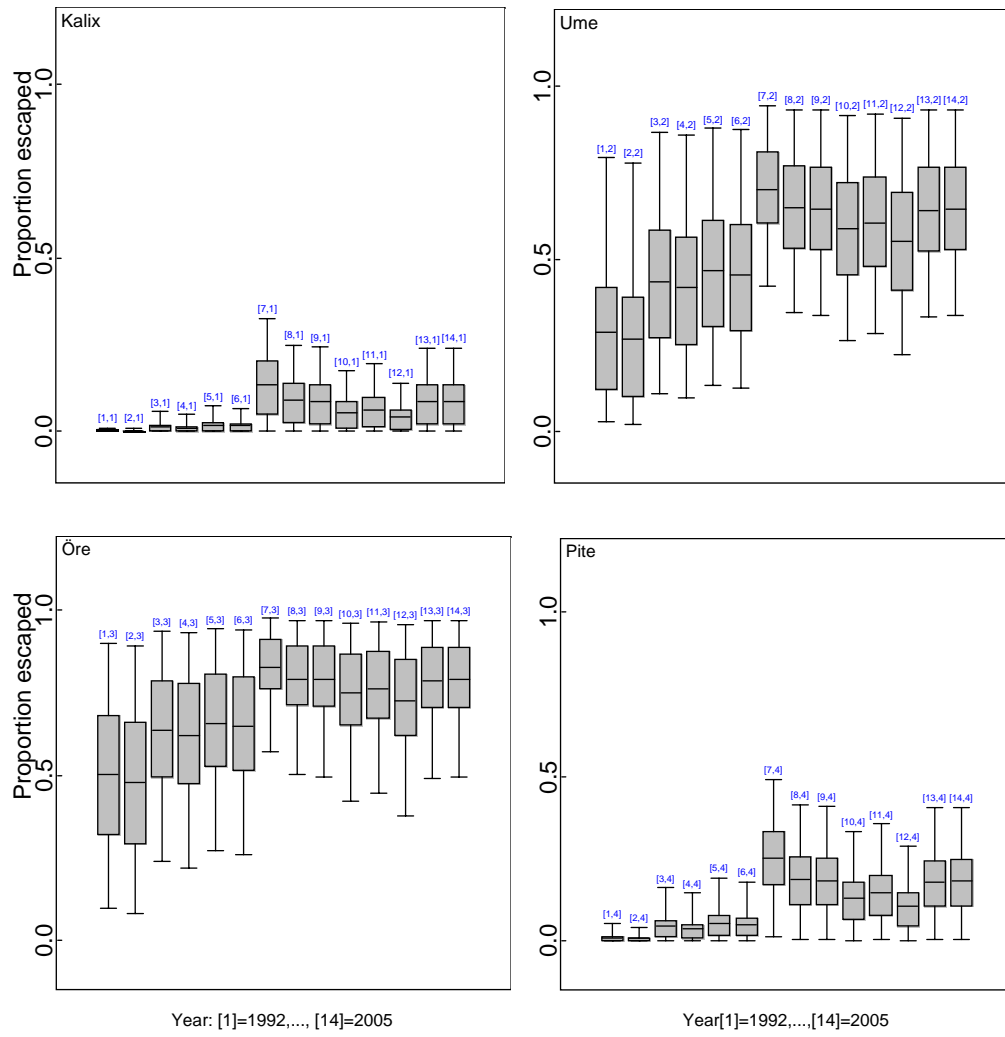


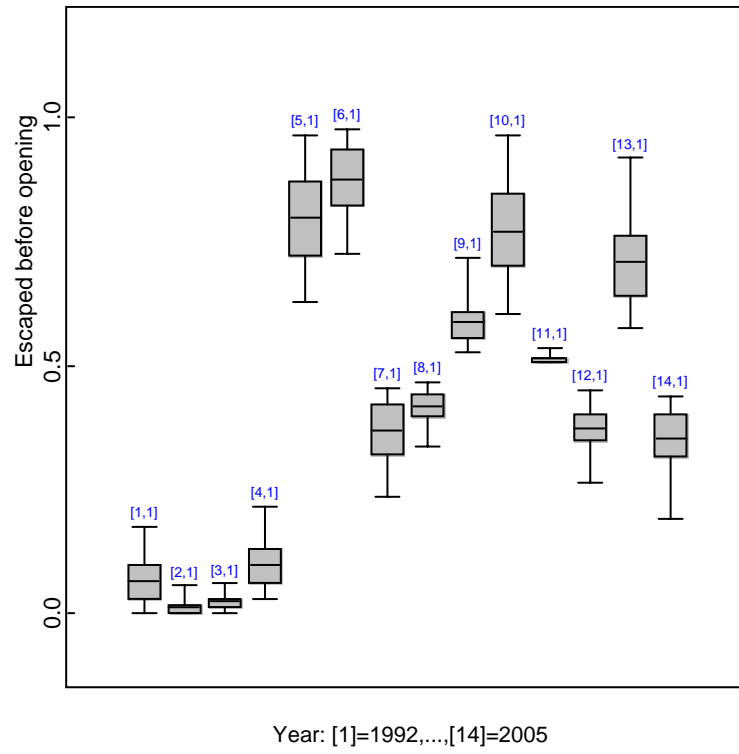
Figure 4.2.4.1. Observed survival indices together with median and 90% probability intervals of the model prediction.



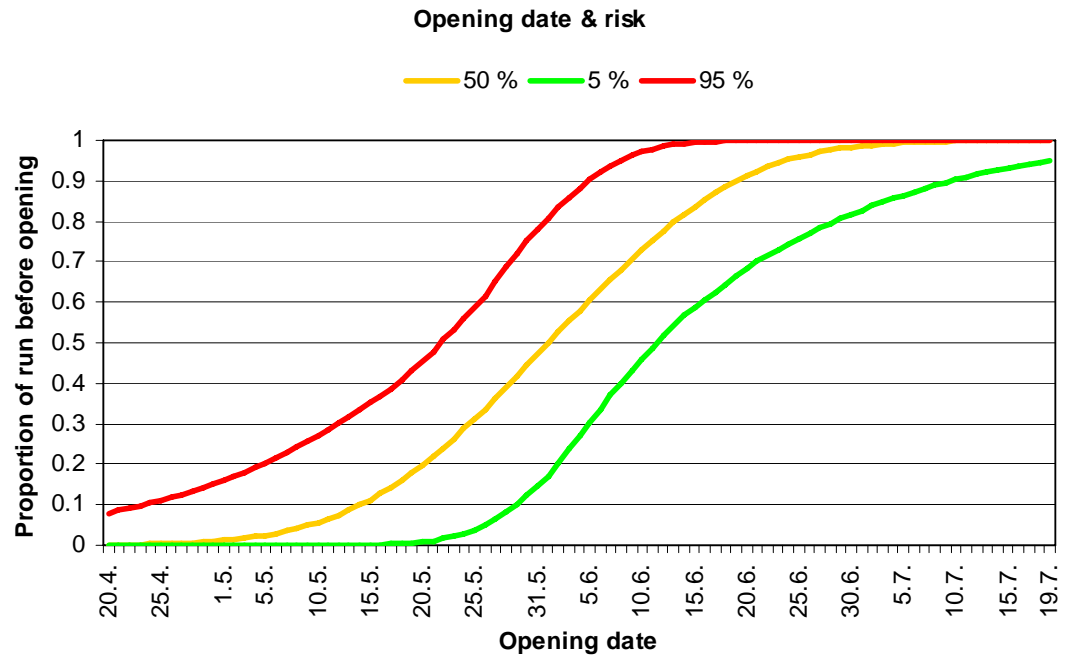
**Figure 4.2.4.2. Boxplots of posterior distributions of catchability coefficients in Finnish coastal trapnet fishery for four rivers in Gulf of Bothnia based on information about run timing, opening date of the fishery, fishing effort and the number of fish observed in fish ladders in years 1992-2005.**



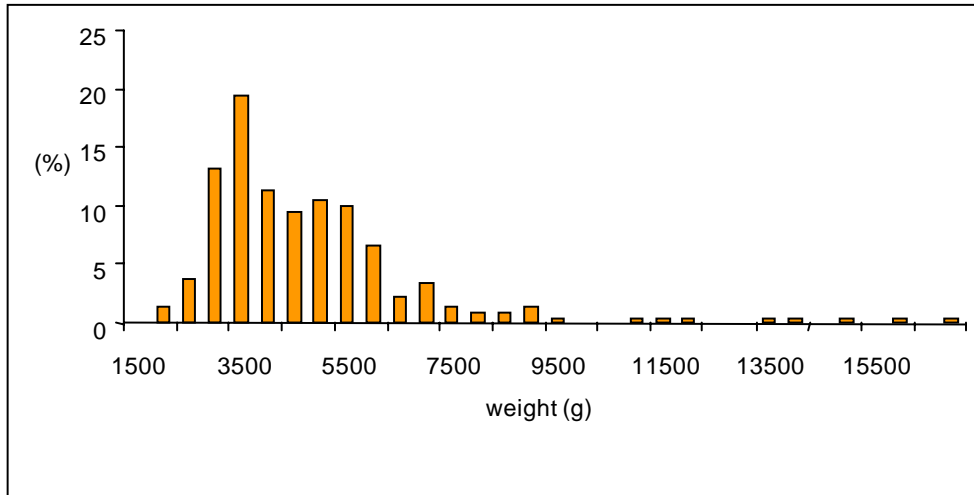
**Figure 4.2.4.3** Estimated proportions of MSW salmon escaped from the Finnish coastal trapnet fishery after the opening of the fishery in years 1992-2005. Proportions differ between stocks because of differences in migration patterns compared to the fishery.



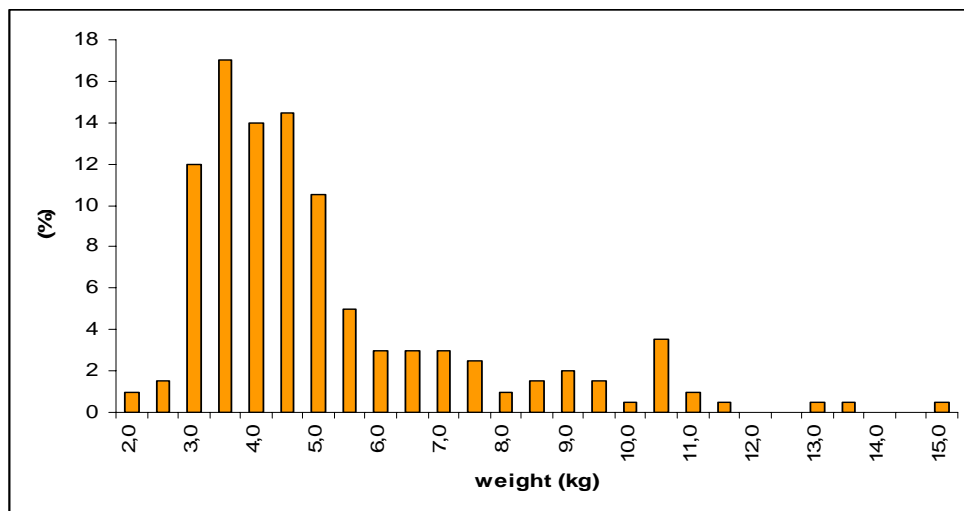
**Figure 4.2.4.4. Estimates of proportion of MSW salmon escaped before the opening of the Finnish coastal trapnet fishery in 1992-2005.**



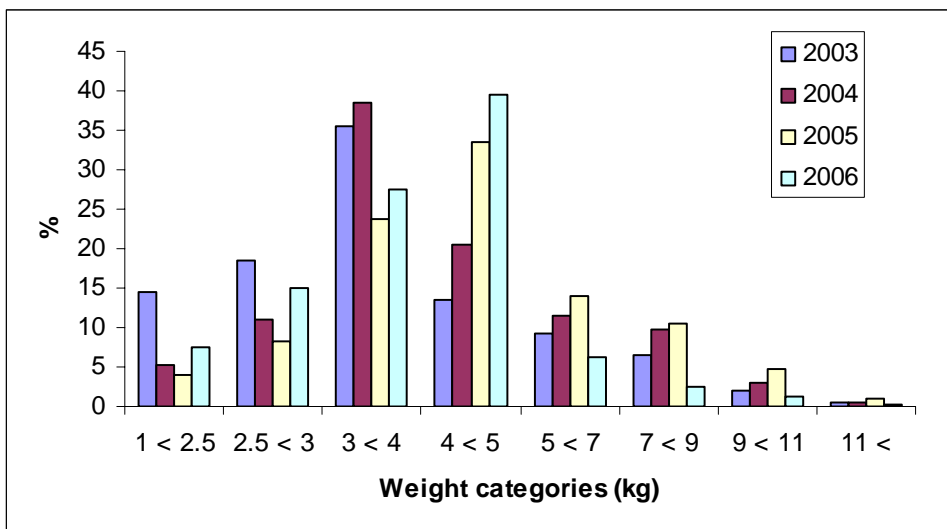
**Figure 4.2.4.5.** Proportion of MSW salmon escaping before given opening dates at various risk levels in a predicted future year. For example, the probability that the escapement before May 11<sup>th</sup> is less than 0.5 is 5%.



**Figure 4.3.2.1**  
Weight distribution of sampled Polish catches of salmon in 2005.



**Figure 4.3.2.2**  
Weight distribution of sampled Polish catches of salmon in 2006.



**Figure 4.3.2.3**  
Weight distribution of sampled Danish salmon 2003-2006 (N=254,489)

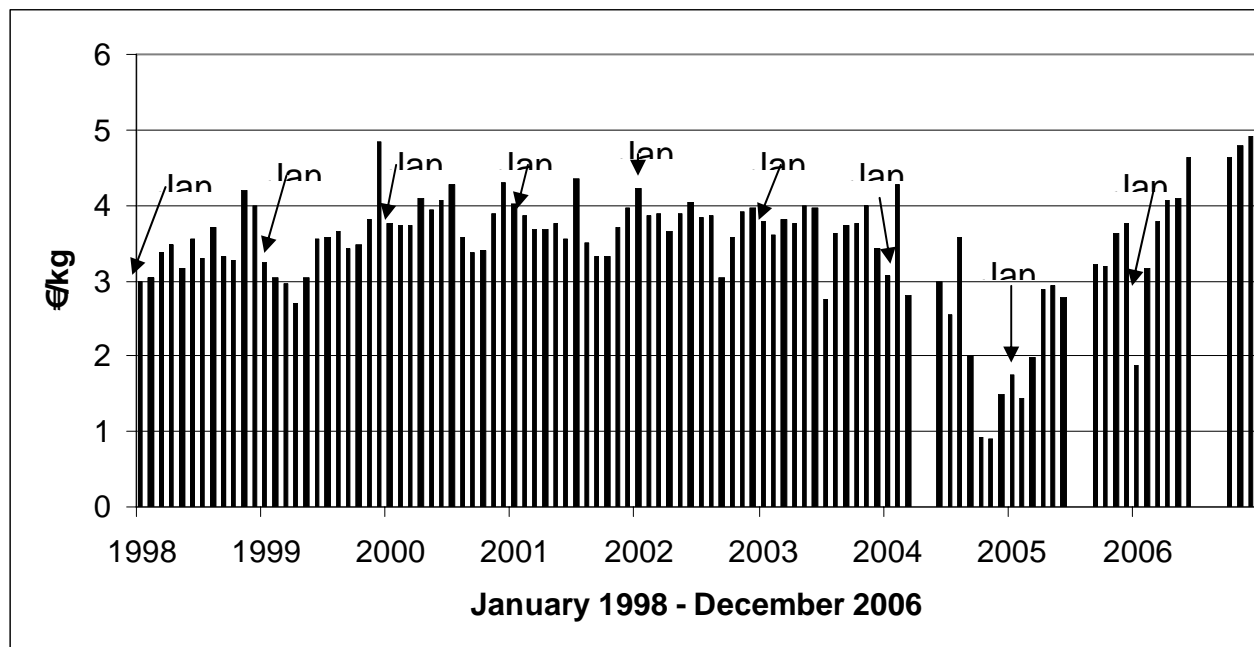
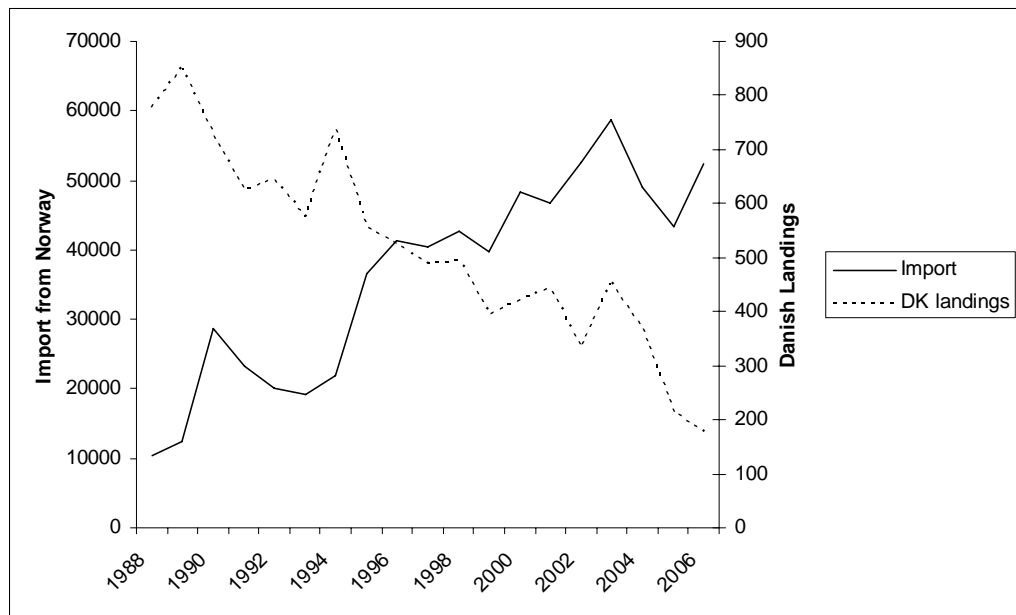


Figure 4.3.4.1. Monthly real salmon price in Denmark. The January of each year is denoted by arrows. The Danish statistics do not show a value for landings in April and May 2004. In 2005 there were no landings in July and August, and in 2006 no landings in July, August and September. The prices are converted to real values by using Danish price index for domestic supply (2000=100) for fish and related products. And the values in Danish kroner have changed to euros by using rate 1 DKK= 0,134167 € (<http://www.fd.dk>)



**Figure 4.3.4.2**

Danish landings of salmon and import to Denmark of farmed salmon from Norway during the period 1988 – 2006.

Source: Statbank Denmark, <http://www.statistikbanken.dk>