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Report of the Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries (SGBYSAL)

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Bergen, Norway

International Council for the Exploration of the Sea

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TABLE OF CONTENTS

Section **Page**

EXECUTIVE SUMMARY

Section 1

Gives terms of reference, lists the six participants from the three nations represented at the meeting (Ireland, Norway and Russia). Background for the Study Group was the observed large number of post-smolts taken together with large catches of mackerel in Norwegian research surveys in the Norwegian Sea (div. during June-August since the start of dedicated salmon surveys in 1995. These observations gave rise to an apprehension that the large commercial fisheries for mackerel in these areas might heavily intercept the post-smolt cohorts mowing northwards during the summer months. Russian observers on board commercial mackerel trawlers did, however, detect only negligible amounts of post-smolts in the catches screened, resulting in a large discrepancy in the estimates of post-smolts taken if the observed ratios were used when scaling up with the total catch in these areas (from 60 to > 1 million post-smolts taken). Based on quarterly catch data, the overlap between post-smolts and the fisheries in the Norwegian Sea was seemingly high, but the absence of disaggregated data (per week and statistical rectangle) impeded an assessment of the true overlap of post-smolts. When the Working Group on North Atlantic Salmon (WGNAS) in 2003 received indications that also the herring fisheries occurring in August in northerly areas of ICES areas might intercept adult salmon, the necessity to pool data from pelagic Working Groups and WGNAS in order to progress on these issues became apparent.

Section 2

An overview of the marine distribution of salmon in the North East Atlantic is given. Some areas of denser distribution of post-smolts have been identified (1995–1997) in mid- June on the shelf areas west of UK-Scotland (IVa) and in the strong surface currents in the Faroe-Shetland Channel (VIa west). Another high-density migration area of post-smolt cohorts has been identified west and north of the Vøring Plateau in the Norwegian Sea (IIa).

Distribution charts for post-smolts broken into weeks 16–20, 21–26, 27–31 and 32–36 illustrate the northward progression of post-smolt cohorts predominantly of Irish and UK origin (assessed from smolt ages read from scales and tagged fish), but it also shows areas where the knowledge basis is weak due to lesser number of cruises performed (Figure 2.2.2). I t is also pointed out that due to deficient knowledge of the distribution of pre-adults and adult fish, it is difficult to evaluate the degree of overlap salmon distribution and major fisheries occurring in the Norwegian Sea and the transition areas for homing salmon.

Section 3

Describes the major pelagic fisheries in the Norwegian Sea, the North Sea and areas west and south of UK and Ireland. Disaggregated data for landings to the UK and Germany enabled a closer study of mackerel and herring fisheries in the western (VIa) and northern North Sea areas (IVa) per week and statistical rectangle. Possible areas of interception were detected, but due to lack of information on salmon distribution, an assessment of the impact on salmon could not be performed. In addition the catches are rather small at the time when the salmon are thought to move through these areas. For the other nations no disaggregated data were provided, and the Study Group used quarterly catch records from ICES working group reports. Due to lack of data, a complete overview of boats and gear types used could not be made.

Section 4

The Study Group received some information on whether salmon have been detected in the screening of catches performed by various countries and this is summarized in Table 4.2.1. Some methods of screening catches for bycatches are described in more detail. Information of salmon registered from logbooks from catches landed in the Netherlands was provided to the Study Group. A large proportion of these “salmon” may be sea trout due to lack of proper headings to enable discrimination between different salmonid species. The bycatches are small but consistently occurring, and the largest bycatches have been reported from various types of trawl fisheries. Also in Iceland adult salmon have been observed in various trawl fisheries. These records indicate that bycatches of adult salmon may be more frequently occurring than previously thought. An EU regulation launched in 1998 rendered landing of salmon from non-static gear illegal and after that the Dutch recorded bycatches have gone down from more than1000 kg to less than 20 kg annually. The Study Group evaluated the advantages and constraints of different on board and land based screening methods and concluded that observer based screening on board following different protocols for different species is the most effective way of screening. Screening discards from filleting factories should also be explored as a source of information.

Section 5

The Study Group explored analytical methods to allow catch rates of salmon in research surveys to be extrapolated to catch rates in commercial fisheries. Comparing research results form surveys and observer based screening on board, the Group considered that the best method of estimating bycatches of salmon would be derived from direct observation on board commercial pelagic fishing vessels performed according to agreed protocols. These estimates would be based on consistent gear types and fishing methods and would not require any assumptions about the transferability of research catches.

A range of estimates of potential post-smolt bycatch based on the data available at the meeting were developed (Table 5.1) as illustration of the likely ranges of values obtained by applying different methods to the mackerel fishery in the Norwegian Sea. The purpose was to assess the performance of the various methods. There are obvious risks of over- or underestimations depending on which sources used for scaling up with commercial catch. These need to be discussed further when more adequate data sets are available.

Section 6

The Study Group was presented with a method for estimating the progress in time and space of post-smolts cohorts in the Norwegian Sea, the "smolt passage model". Based on data from research surveys on the north – south extension of the post-smolt cohorts, the minimum time the main concentration of post-smolts migration through a fishing area can be estimated at different anticipated migration speeds (1–2 body lengths s^{-1}), and the time of overlap between fisheries and post-smolts can be assessed. The model is based on a rather limited set of data today, and needs further refinement when more data become available, but the group considers it a useful tool assessing and minimizing the risk of post-smolts being intercepted by the commercial fishery in the area of passage.

Section 7

A set of ten recommendations for following up is given. These pertain to continuation of screening research and commercial catches for salmon, on board observer based screening of commercial catches and establishment of protocols for screening of salmon bycatches in catches of different species, screening of discards at filleting factories, development of methods of estimating of salmon post-smolt bycatches primarily via observer screening programmes on commercial fishing vessels. The application of a range of bycatch estimates to known data on salmon abundance and survival trends in the stocks in question is recommended to determine whether crude levels of potential bycatch can account for recent changes in abundance or survival at sea. Under a range of bycatch rate scenarios the scale and nature of any tagging programme that would be required to yield reliable estimates of bycatch should be determined. It is not considered appropriate to reconvene the SGBYSAL until disaggregated catch data for the mackerel fishery in the Norwegian Sea and for other fisheries and areas where such data are lacking become available.

1 INTRODUCTION

1.1 Main Tasks

At its 2003 Statutory Meeting, ICES resolved (C. Res. 2003/2101) that a **Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries** [SGBYSAL] (Chair: Marianne Holm, Norway) will meet at the Institute of Marine Research, Bergen, Norway, 9–12 March 2004 to consider questions posed to ICES by the North Atlantic Salmon Conservation Organisation (NASCO). The terms of reference and sections of the report in which the answers, where possible, are provided, are as follows:

		Section
a)	work with the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine, and Anchovy to disaggregate data on the commercial catches of mackerel and herring in the Norwegian Sea (ICES Divisions IIa and Vb), the Northern North Sea (Division IVa), and the west of Ireland and Scotland (Divisions VI a and b; VII b,c,j and k) by ICES Division and standard week;	S.2.1,2.2; S.3.1.1–3.1.5
b)	Work with the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine, and Anchovy to disaggregate data on the number of boats and gear types used in the commercial fishery of mackerel, herring and horse mackerel in the Norwegian Sea (ICES Divisions IIa and Vb), the Northern North Sea (Division IVa), and the west of Ireland and Scotland (Divisions VI a and b; VII b,c,j and k) by ICES Division and standard week;	S.3.1.1–3.1.5
c)	Provide estimates of the bycatch of Atlantic salmon in the mackerel and herring fisheries in the Norwegian Sea with measures of their reliability;	S.5.
d)	Explore analytical methods to allow catch rates of salmon in research surveys to be extrapolated to catch rates in commercial fisheries;	S.5
e)	Review methods used for intensive screenings of pelagic research hauls for the presence of post-smolts (small salmon in their first year at sea, generally < 45 cm) and older salmon.	S.4.1–3

The Study Group considered data submitted by electronic mail from members of the WGMHSA and WGNPBW or their colleagues; other references cited in the report are given in Section 8.

1.2 Participants

Belikov, S.	Russian Federation
Crozier, W.	UK (Northern Ireland)
Holm, M. (Chair)	Norway
Holst, J. C.	Norway
Iversen, S.	Norway
Mullins, E.	Ireland

A full address list for the participants is provided in Appendix I.

1.3 Background

Reports of salmon being taken during pelagic fishing operations for a number of fish species in the eastern north Atlantic have been circulating for some years, but these have been sporadic and often anecdotal in nature and did not provide evidence of any potentially significant bycatch of salmon in these fisheries.

However, during the last 4–5 years, high numbers of Atlantic salmon post-smolts have been taken together with large numbers of mackerel in a Norwegian research fishery for salmon in the Norwegian Sea. These catches, taken using surface trawls (Holm *et al.*, 2000), indicated that there can be coincidence in time and space which may give rise to a potential for salmon to be taken as bycatch in the mackerel fishery in particular. Smolt age distribution for the fish caught in the research surveys indicates a mainly southern European origin and this is supported by analysis of tags taken from captured fish (for example in 2002, 9 out of 10 tags taken were from Irish stocks). Accumulating information on the distribution of salmon at sea has also raised the possibility of interactions between salmon and other pelagic fisheries, such as herring. Accordingly, in 2002 NASCO asked ICES to *"provide an estimate of the bycatch of salmon post-smolts in the pelagic fisheries based on the scientific information currently available"*.

ICES reviewed information on the catch rates of salmon and of mackerel from surveys carried out in the Norwegian Sea during a salmon research cruise in 2001. Based on the ratio of number of post-smolts and weight of mackerel captured, a first approach was made to estimate post-smolt bycatches by scaling up these data using statistics on the 2000 commercial mackerel trawl catch in the Norwegian Sea (area IIb and IVb) and the catch in areas west of Ireland and Great Britain (IVa, VI and VII) (ICES, 2002a). This produced estimates of potential bycatch ranging from 608k-950 K post-smolts, depending on method applied. While there are no reliable estimates of the smolt production of the NEAC salmon countries to compare this with, these estimates of post smolt bycatch, if verified, would represent a significant portion of the estimated pre fishery abundance of this stock complex (~ 3.5 mill. fish, ICES 2003a). It was stressed however that these preliminary estimates were not reliable. For example, in order to provide a better basis for assessing level of bycatch in the mackerel fishery and to fully assess the impact on salmon stocks it would be necessary to disaggregate the catches (which are assessed on a quarterly basis) into weekly periods, considering catches only during the short period of time that salmon are in the area of the fishery. Furthermore, it was necessary to consider whether other pelagic fisheries may have significant bycatches of salmon.

In 2003 ICES examined further information from a variety of sources, including Norwegian salmon research cruises, from Norwegian and Russian pelagic research cruises and from observer based scanning of Russian commercial mackerel caches in the Norwegian Sea (ICES, 2003a).

ICES also received additional information on bycatch in other fisheries. Almost 200 salmon (1–2 kg) were reported from an Icelandic herring catch of 800 metric tonnes taken in the Spitsbergen area in August 2002.

In 2003, ICES also began to examine information on a range of pelagic fisheries, in order to identify those that may be relevant for salmon bycatches. Fisheries of potential interest included the Norwegian spring spawning herring fishery, the blue whiting fishery, the horse-mackerel fishery, the Icelandic summer-spawning herring fishery, the capelin fishery in Iceland/E. Greenland/Jan-Mayen areas (ICES 2002b, ICES, 2003a, b) and the herring fishery south of 62°N (including northern North Sea).

ICES noted that there were large discrepancies between the substantial numbers of post-smolts caught together with mackerel in the Norwegian research fishery and the low bycatch observed in the screening of the commercial mackerel fishery. There were a number of possible explanations:

- Detection rates may decrease with increasing sample size. Therefore the rate of non-detection may be higher in the Russian commercial catch surveys, as larger numbers of fish were sampled in the catches. However, Russian samplers considered it unlikely that significant numbers of post-smolts were overlooked.
- The targeted Norwegian research fishery, and the trawl methods used, may lead to over-estimation of the salmon bycatch in commercial pelagic fisheries.
- Most of the post-smolts may have migrated through international waters before the large-scale mackerel fishery starts. In contrast, the research fishery specifically aims to sample the peak post-smolt migration in the area.
- There are substantial differences between the Norwegian research trawl and the gear used in the commercial mackerel fishery. Furthermore, the behaviour of post-smolts in relation to these different gears is not known.

Given the large differences between the results from the Norwegian bycatch studies in 2001–02 and the Russian research trawling and screening of commercial catches, ICES did not make further estimates of salmon bycatch for the mackerel fishery, as these would have varied widely, depending on the methods used for estimation. Therefore, ICES made a number of recommendations for further research on this topic and specified information that would be required to lead to reliable estimates of bycatch:

- Further studies of distribution of post-smolts in relation to pelagic fisheries.
- Studies on vertical distribution of post-smolt and older salmon and their behaviour in relation to different commercial gear types.
- Further intensive screening of pelagic research trawls covering a range of species.
- Further data on mackerel and herring fisheries, especially disaggregation of catches by standard week by statistical rectangle, and additional information on gear types, fishing techniques etc.

- ICES also stated that direct screening by trained observers of catches on board commercial vessels engaged in pelagic fishing should be encouraged.

While some of these recommendations will require specific research programmes on salmon, ICES considered that further progress could be made on the analysis of pelagic catch data and derivation of estimates of bycatch of Atlantic salmon

Accordingly, a Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries (SGBYSAL) was convened in March 2004, with the task of disaggregating catch and other information on pelagic fisheries, exploring analytical methods of allowing catch rates of salmon in research surveys to be extrapolated to catch rates in commercial fisheries; and to provide estimates of the bycatch of salmon in the mackerel and herring fisheries in the Norwegian Sea with measures of their reliability. SGBYSAL would also review methods used for intensive screening of pelagic research hauls and commercial catches for presence of salmon post-smolts.

In recent years, data on monitored stocks have indicated significant declines in survival rates of wild Atlantic salmon in the ocean, which, together with other factors, appear to be contributing to an overall degradation of stock status across wide areas of the North Atlantic range of the species. For example, recent indices of survival from wild smolt migration to coastal return (pre-fishery) in some southern European stocks have been at levels below 50% of those experienced during the 1980's (ICES, 2003a).

The most recent assessment of status of European salmon stocks carried out by ICES (ICES, 2003c) places the aggregate European stock complex outside safe biological limits, with the exception of the multi-sea-winter component of the northern NEAC stock complex. Similarly, ICES has noted that in 2002, with the exception of the Newfoundland stocks, most of the North American stock complex did not meet its conservation requirement for two sea winter fish and hence was outside safe biological limits (ICES, 2003c).

It is clear that the problems facing salmon in the sea are potentially many and are likely to operate at various scales and in various ways, such that no single responsible factor has been identified (see Potter *et al*., 2003 for a recent review). Research and monitoring activities have in recent years sought to identify some of the potential factors influencing survival at sea, including; transitional effects during smolt migration, poor marine growth conditions, food availability, predator abundance, disease and parasites. The present examination of potential for bycatches in pelagic fisheries forms part of that wide spectrum of investigations. Greater understanding of the many factors underpinning stock status in salmon is necessary in order that advice can be given to managers to appropriate the necessary actions to conserve and if possible enhance stock status.

2 STATUS OF KNOWLEDGE OF THE MARINE DISTRIBUTION OF SALMON - IMPLICATIONS FOR INTERCEPTION BY FISHERIES

2.1 Historical data

Much of our earlier knowledge of the distribution of adult salmon in the sea is derived from the high seas salmon fisheries that started in the 60s, and which resulted in both increased tag returns and subsequent research programmes to assess the impact of these fisheries (Figure 2.1.1 and Møller Jensen 1988, Jakupstovu 1988, Hansen *et al.* 1993 and Hansen and Jacobsen 2003). From these early studies came evidence that salmon from the southernmost areas of the distribution range of the northeast Atlantic, i.e., Spain, France, Ireland and the UK, occur both in the Norwegian Sea and off western Greenland (Nielsen 1961, Menzies and Shearer, 1957, Møller Jensen 1988, Hansen and Jacobsen 2003). Northern European stocks comprising fish from the western Sweden, southern and mid-Norway, Iceland and the Faroes are believed to be distributed predominantly in the Norwegian Sea (Hansen and Jacobsen 2003), although some tagged fish from these countries have been retrieved near western Greenland. Salmon from the American continent seem to stay mostly on the western side of the Atlantic, i.e., in the Bay of Fundy, the Labrador Sea and off western Greenland (Reddin 1988), but a few fish tagged north of the Faroes in the early 1990s have been recovered from Canadian rivers, proving that these stocks too may perform transoceanic migrations (Hansen and Jacobsen 2003).

Until 1990-ties no directed research had been made on post-smolts in the sea. However, a large scale marine ecology programme for studying the Norwegian Sea provided a platform also for studying the marine life of the post-smolts.

A particular problem in studying young salmon at sea is that the post-smolt are too small to be caught by ordinary salmon fishing methods. In addition, they do not occur densely enough, and live too close to the surface to allow surveying by standard acoustic survey methods. With the introduction of new pelagic trawl technology in 1991 (Valdemarsen and Misund 1995, Holst and McDonald 2000 with modifications, Figure 2.1.2), substantial numbers of post-smolts started to occur in the catches during pelagic surveys in the northeast Atlantic. Systematic registration of salmon during the IMR pelagic surveys in the Norwegian Sea and adjacent areas on an annual basis did not start until 1995. Thus data on the early oceanic life-stages have been generated for less than a decade, and our knowledge of the distribution and ecology of these young salmon is still rather patchy.

By July 2003, the pelagic trawl surveys in May to August/September in the Norwegian Sea with adjacent areas had generated records of >5000 post-smolts and >250 adult salmon captured from 1990 onwards predominantly in the Norwegian surveys, but also in Scottish and Russian research fishery. Figures 2.1.3 and 2.1.4 show the distribution of the Norwegian research trawl-stations and post-smolt catches 1990–2003. The figures clearly indicate that the post-smolts are not evenly distributed, but are markedly concentrated in certain areas that bear a striking resemblance to the dominating branches of the North Atlantic Current (NAC) and the dominating currents in the NE Atlantic (Figure 2.1.5) When analysing the recorded temperatures and salinities at 5 m depth on the trawl stations in 1995 to 1998, a close association between post-smolt captures and the warm saline water typical of the NAC appears, as almost all captures are made in water salinities above 35 and temperatures between 8 – 11°C (Figure 2.1.6 and Holm *et al*. 2000). Analyses of the post-smolt captures in the following years also show the same close association with Atlantic water (Holm *et al.* 2003). In the same manner catches in 1996–1997 north of Scotland reveal that the fish appeared to move northwards with the warm shelf edge current (Shelton *et al.* 1997).

2.2 Distribution of post-smolts and salmon by origin in time and space

Of more than 30 microtags retrieved up to 2003 from catches in the Norwegian Sea, all but one have been of UK or Irish origin, with Irish fish dominating the catches (Holm *et al*. 2003 and Holst and Holm, unpublished data). Indirect evidence for the southern NEAC origin of the post-smolts is further given by the smolt ages recorded by scale and otolith readings. Around 90% of the salmon captured in the Norwegian Sea have made the transition into sea water at the age of 1–2 years, indicating a "southerly" distribution of their region of origin because most "northerly" stocks (comprising the area from west Norway into the White Sea and the Icelandic stocks) are dominated by fish with a smolt age of three years or higher.

The CPUE of post-smolts recorded during the Norwegian research cruises may vary considerably depending on area and time when the cruise has been carried through, and may also be depending on whether there has been a dedicated effort to look for the salmon (Table 2.2.1 and Appendix III). From the CPUEs registered during the dedicated salmon surveys in the Norwegian Sea 2000–2003 it can be seen that the densest cohorts of post-smolts (resulting in high CPUEs) have been found at varying latitudes at varying dates Figure 2.2.1, indicating that there may have been differences in the timing of the smolt runs forming these cohorts, or possibly also that the cohorts may have been held back on their northward migration by meteorological/hydrographical events occurring on their way, or, alternatively that they have been feeding.

When the pooled post-smolt captures are broken down into shorter time periods, a picture of progression of the migration becomes clearer. In Figure 2.2.2 the temporal distribution of the captures is presented in 5-week slices. The figure illustrates the northward progression of the densest concentrations of post-smolts to a certain extent, but it also to some degree reflects where there has been a concentration of research activity and hence an accumulation of knowledge. It also demonstrates the patchiness of areas with denser coverage of research trawling. The southern NEAC areas are very poorly covered, and in order to get an understanding of the spatial and temporal progression of the post-smolt cohorts from e.g., Ireland and UK (including N. Ireland, England, Wales and Scotland) it would be necessary to perform surveys from the coast and outwards to the shelf areas in these countries (see panel A) until they are concentrated in the shelf current west and north of Scotland (panel B). This would also be vital knowledge for assessing the risk of these cohorts to be intercepted by any fisheries going on in the areas they have to pass.

The surface near position of the migrating post-smolts in the sea is demonstrated in Figure 2.2.3. The catch per unit of effort (CPUE) is highest by far in those hauls where the head-rope has been kept at the surface during the entire tow. Similarly, the proportion of hauls containing salmon (prevalence) is highest when the head-rope is kept at 0 m, although the difference from the hauls where the head-rope was kept within the uppermost 15 m is less striking meaning that occasionally salmon can be found also deeper down. Experiments performed in 2002 and 2003, in which the head-rope was lowered 5–10 m beneath the surface, resulted in substantially fewer post-smolt captures, further confirming the near-surface positions of the fish (Holst and Holm, unpublished results). In the deepest hauls both the prevalence and CPUE for salmon were very low.

The adult salmon captures do not have as distinct distribution pattern as the post-smolts do. This can be seen in Figure 2.2.4 showing the distribution of adult salmon recorded in pelagic research catches performed by Institute of Marine Research (IMR), Norway, during summer months in 1990–2003. Such a distribution may be expected from the fact that many of these fish have been in an early stage of maturation and thus must have started their homing migration.

Recapture data from several thousand tagged salmon strongly suggest that the oceanic homing migration, opposite to the smolt migration, is independent of currents and that the homing fish often seem to move along the shortest distance from tagging site to the coast (Hansen *et al*. 1993).

2.3 Salmon distribution and intercepting fisheries

Up to 2003 only the international zone west and north of the Vøring Plateau has been identified as a risk area for post-smolts due to the high degree of overlap in time and space between mackerel and post-smolt cohorts from the southern NEAC countries (ICES 2002; 2003a, Holm *et al.* 2003; 2004). However, there are indications that also other parts of the known post-smolt distribution area may be intercepted. This will be further explored in Sections 3 and 4.

Both during some periods of the feeding migration and on their return migration the pre-adult and adult salmon are likely to pass through areas with intensive fishing, although it is not known where or by which fisheries such an interception might be most prominent.

Table 2.2.1. Norwegian research cruises with surface trawling (flotation on trawl wings) 2003, captures of post-smolts and older salmon and smolt catch per unit of effort (trawl hours) and summary of catches 1990–2002.

Year and Cruise	Gear	Dates	Total number of surface hauls	% hauls with post-smolt captures	Number of post-smolts captured	Number of salmon captured	Mean CPUE Post-smolts	Area surveyed
2003–1[SS]	*Salmon trawl* [A]*; Fish lift*	*17.5 – 24.05*[SS]	*35*	*47*	*475*	*55*	*9.3*	*Mid Norwegian coast- west of the mid-Norwegian shelf edge (63.4–65.4°N; 8.0–11.1°E*
2003- 2[SS]	*Salmon trawl* [A]*; Fish lift*	*16.06 – 07.07*[SS]	*64 (81*[XX]*)*	*44*	*436*	*16*	*8.4*	*Norwegian Sea east (Norway's EEZ and International zone, mackerel bycatch investigations), 61 – 73.3°N; 1.5°W- 13°E*
2003–3	*Åkra trawl*[B]	*01 –22.07*	*34 (74)*	*0*	*0*	*2*	*	*North Sea-Norwegian Sea (south), Herring and Blue whiting Pelagic survey*
2003–4	*Midwater trawl*	*15 – 29.07*	*47 (57)*	*7*	*6*	*1*	*0. 5*	*Norwegian Sea 62.7=>71.0 °N; 5 °W – 15°E, Mackerel survey*
2002–5	*Midwater trawl*	*18 – 30.07*	*21 (33)*	*0*	*0*	*1*	*	Norwegian Sea, 69.5 => 62.7°N; *5 °W - 14* °E
		TOTAL 2003	***218 (280)***		***917***	***75***		
		1990 – 2002	***2438***		***4164***	***171***		
TOTAL	**1990 - 2003**		**2656**		**5081**	**246**		

(..) total nr of trawl hauls deeper hauls included
[A] Dimensions of trawl opening 10 x 40
[SS] Cruises dedicated to salmon investigations

* CPUE not calculated, because no smolts were captured
[B] Dimensions of the Åkra trawl opening 25 x 25 m

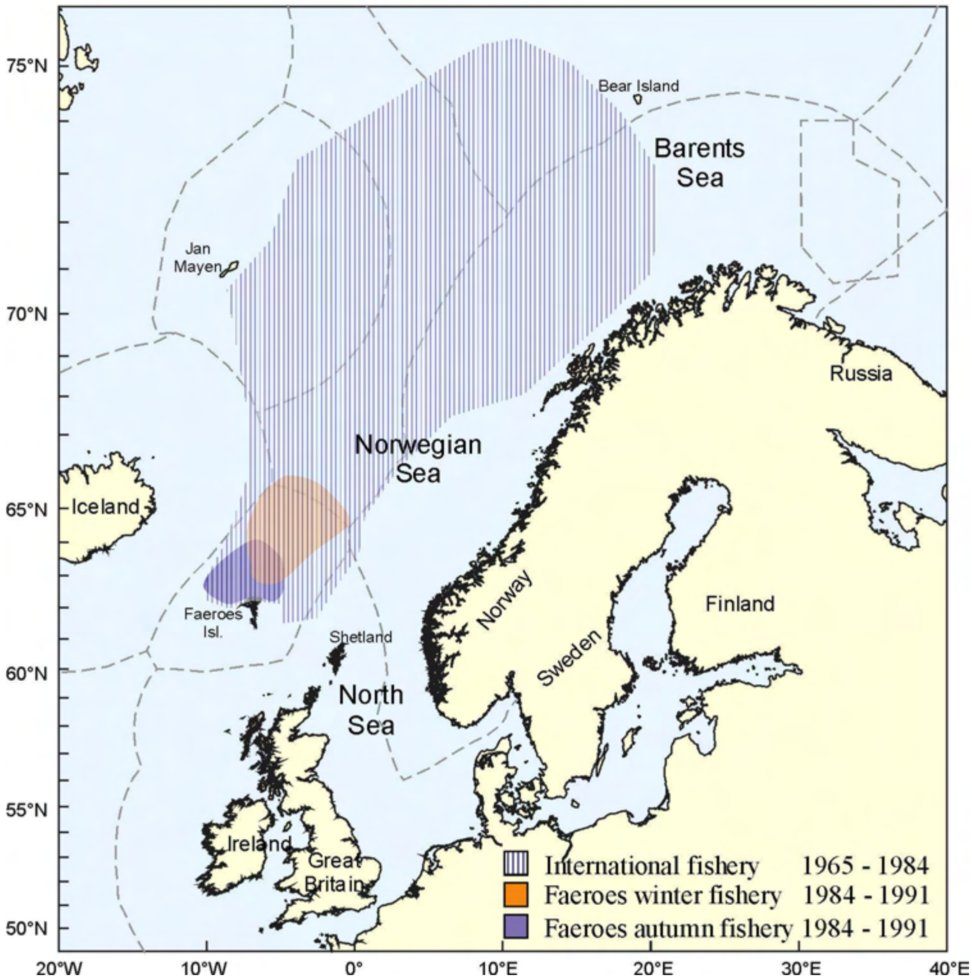


Figure 2.1.1. Distribution of adult salmon in the sea during October – June as evidenced by the distribution of oceanic salmon fisheries in 1965 – 1991, (redrawn from Jacobsen *et al*. 2000).

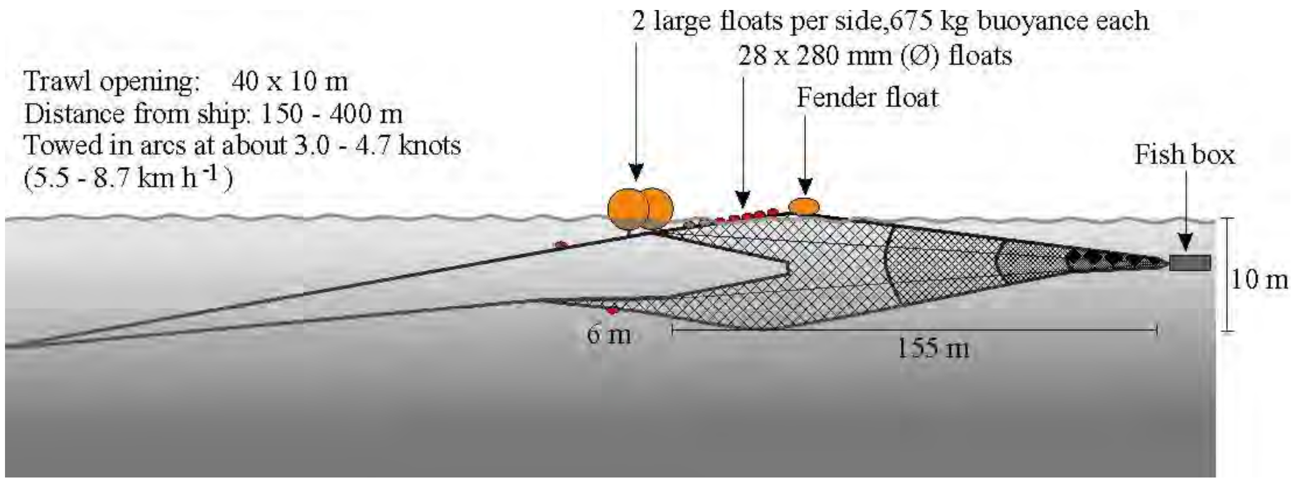


Figure 2.1.2. The 2002 version of the salmon trawl.

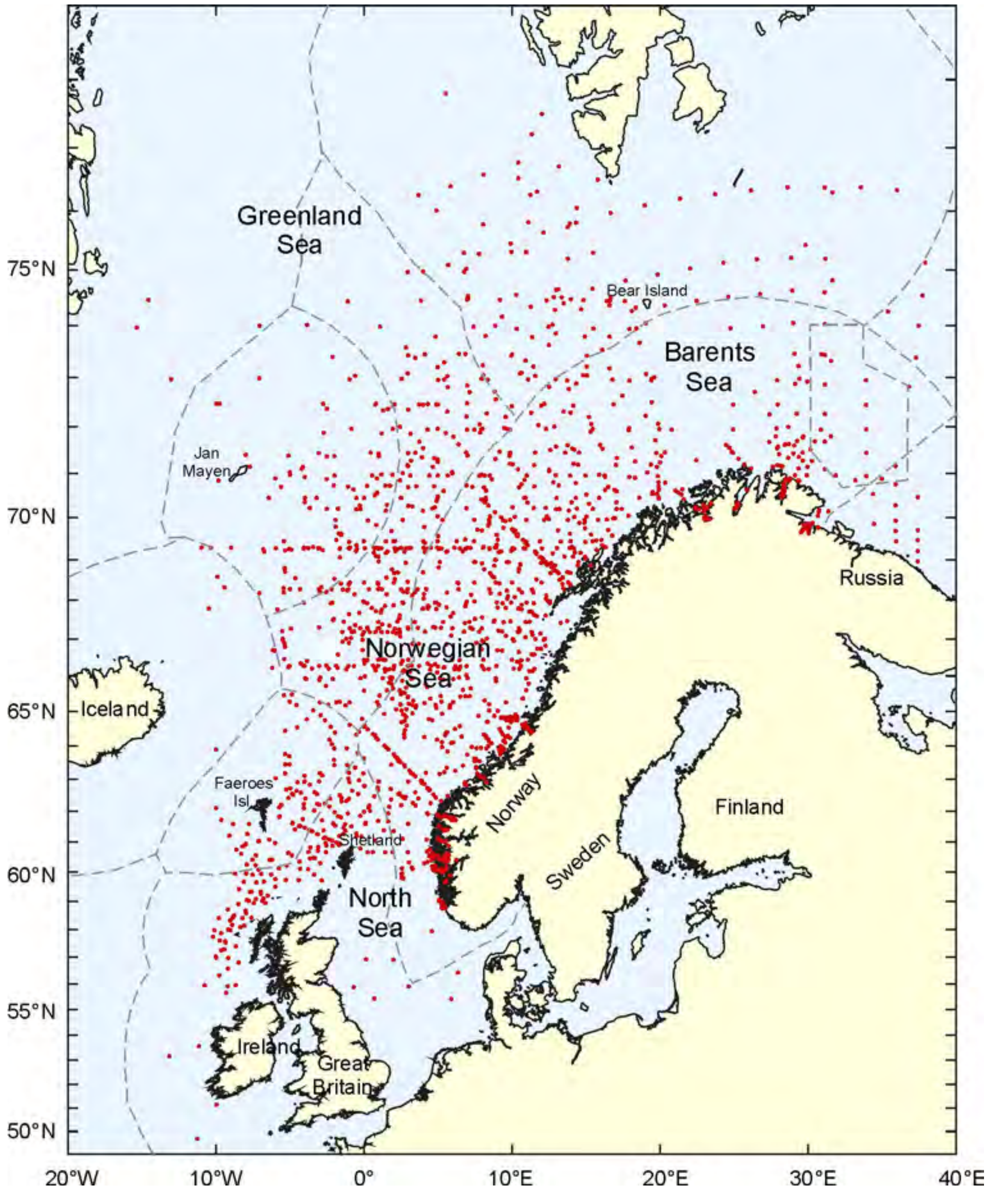


Figure 2.1.3. Distribution of more than 4000 surface-trawl hauls carried out since 1990 from mid-May to early September in the pelagic fish and special salmon research surveys carried out by the Institute of Marine Research (IMR), Norway.

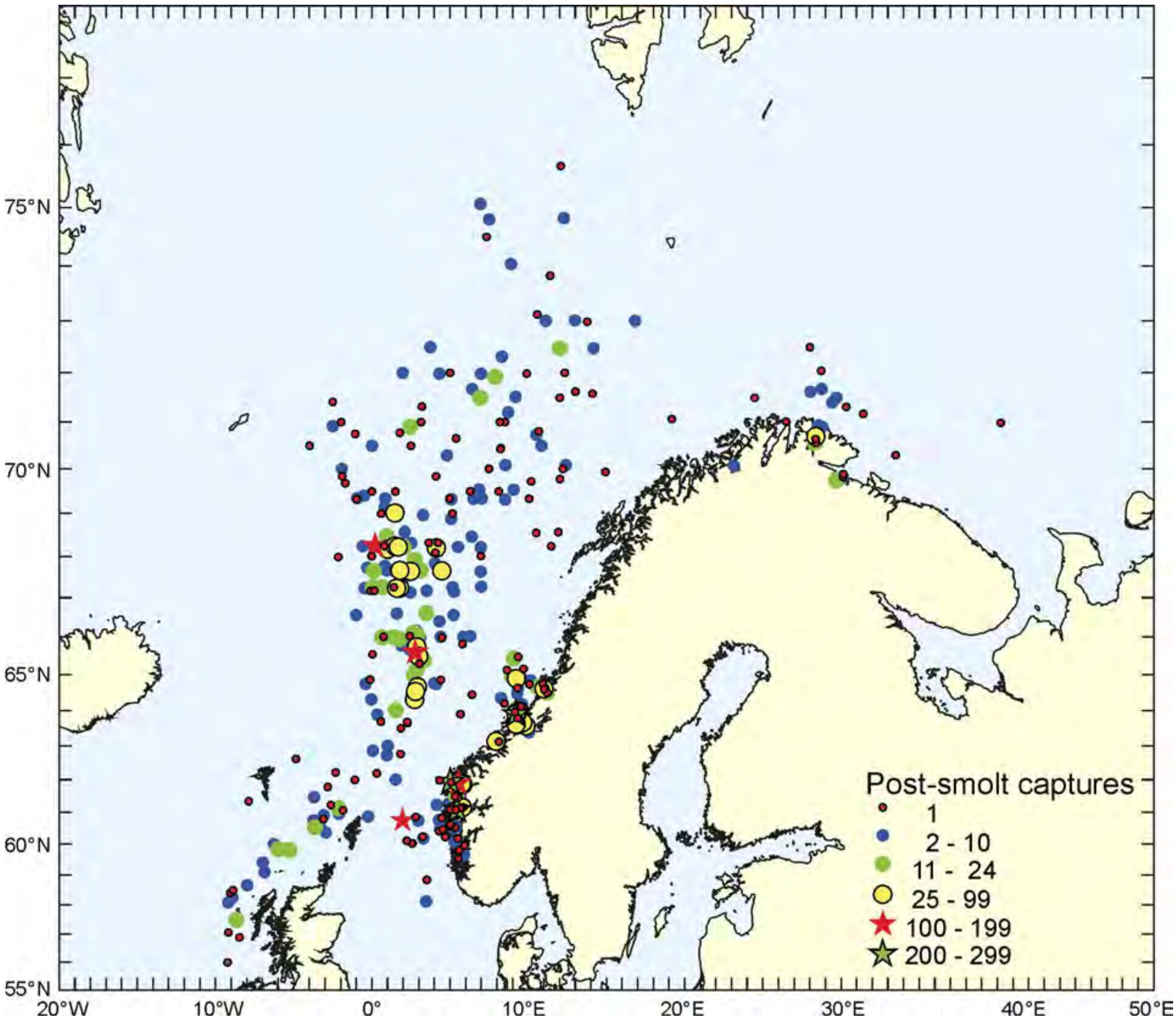


Figure 2.1.4. The distribution > 5000 post-smolts captured in IMR trawl surveys 1990 – 2003 predominantly taken in surface-trawl hauls. Symbols of different sizes denote intervals of number of fish caught in the trawl hauls, as given by legends in the panel.

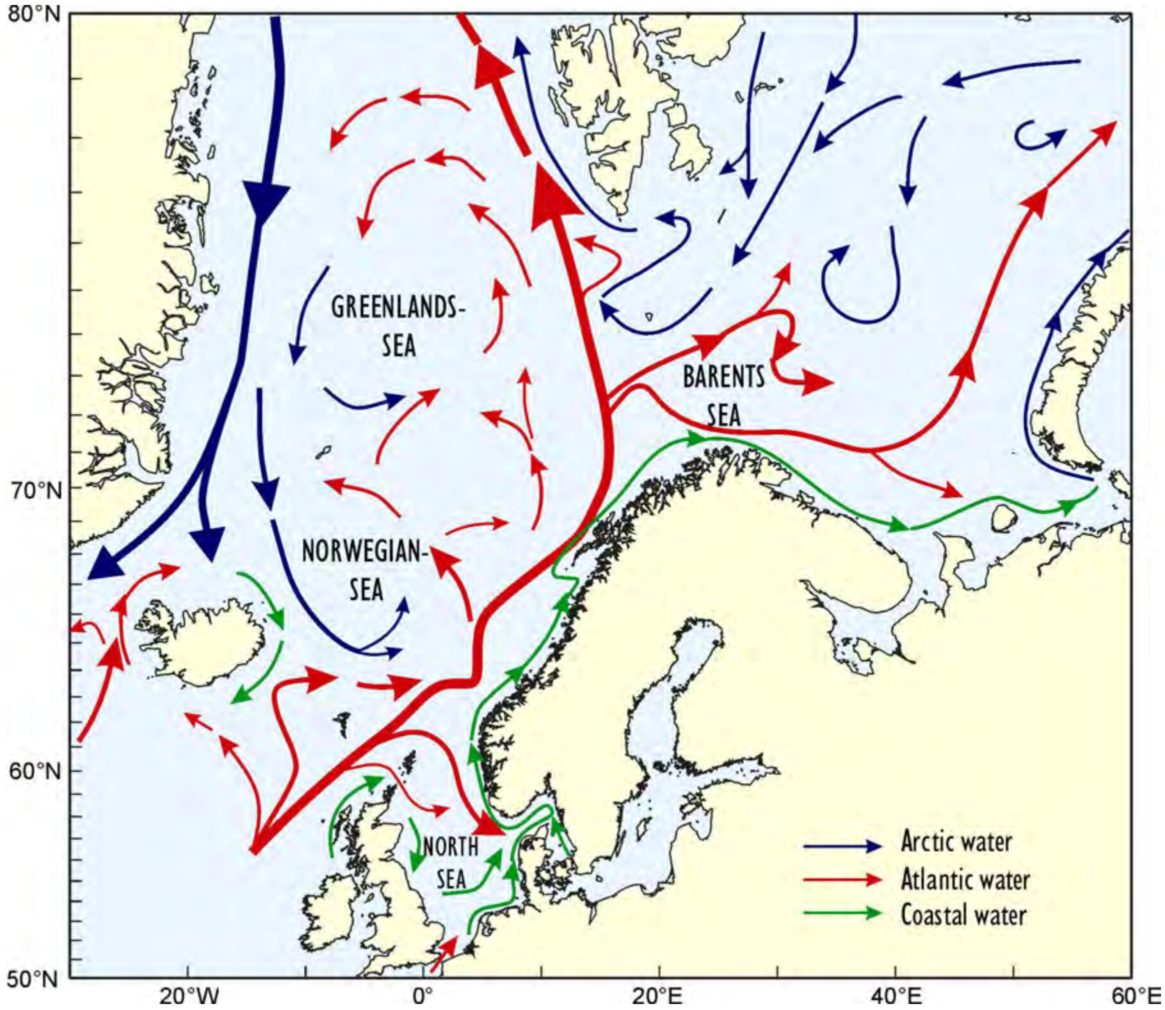


Figure 2.1.5. The main surface currents in the Norwegian Sea and adjacent areas.

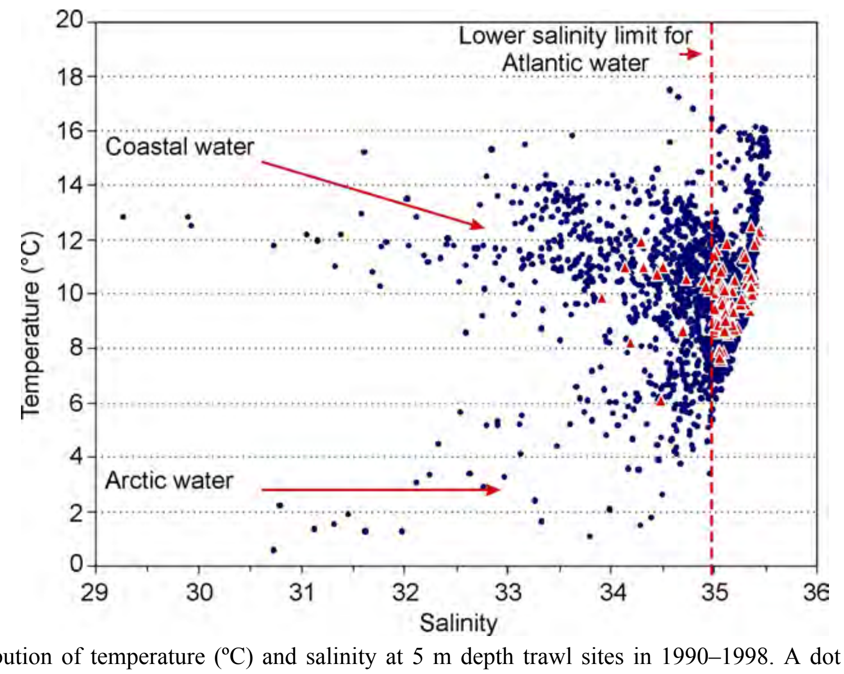


Figure 2.1.6. Distribution of temperature (ºC) and salinity at 5 m depth trawl sites in 1990–1998. A dot denotes one station (N= 1680). The stations with post-smolt captures are marked with filled triangles (N= 106). Each triangle represents 1–142 post-smolts per catch. The lower salinity, warm coastal water, and the cold, lower salinity Arctic water types are indicated with arrows, while the warm saline Atlantic water type of the NAC falls to the right of the hatched vertical line representing the lower salinity limit of the Atlantic water type (Blindheim 1989). From Holm *et al*. (2004).

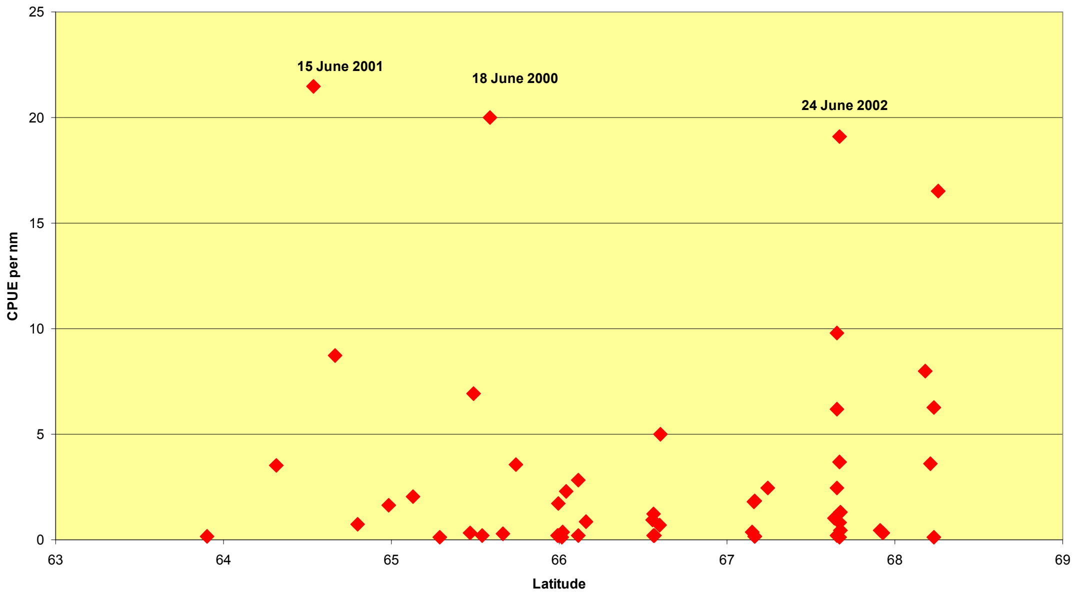


Figure 2.2.1. Distribution of CPUE (no. of fish captured per nautical mile trawled) over latitude in 2000–2002.

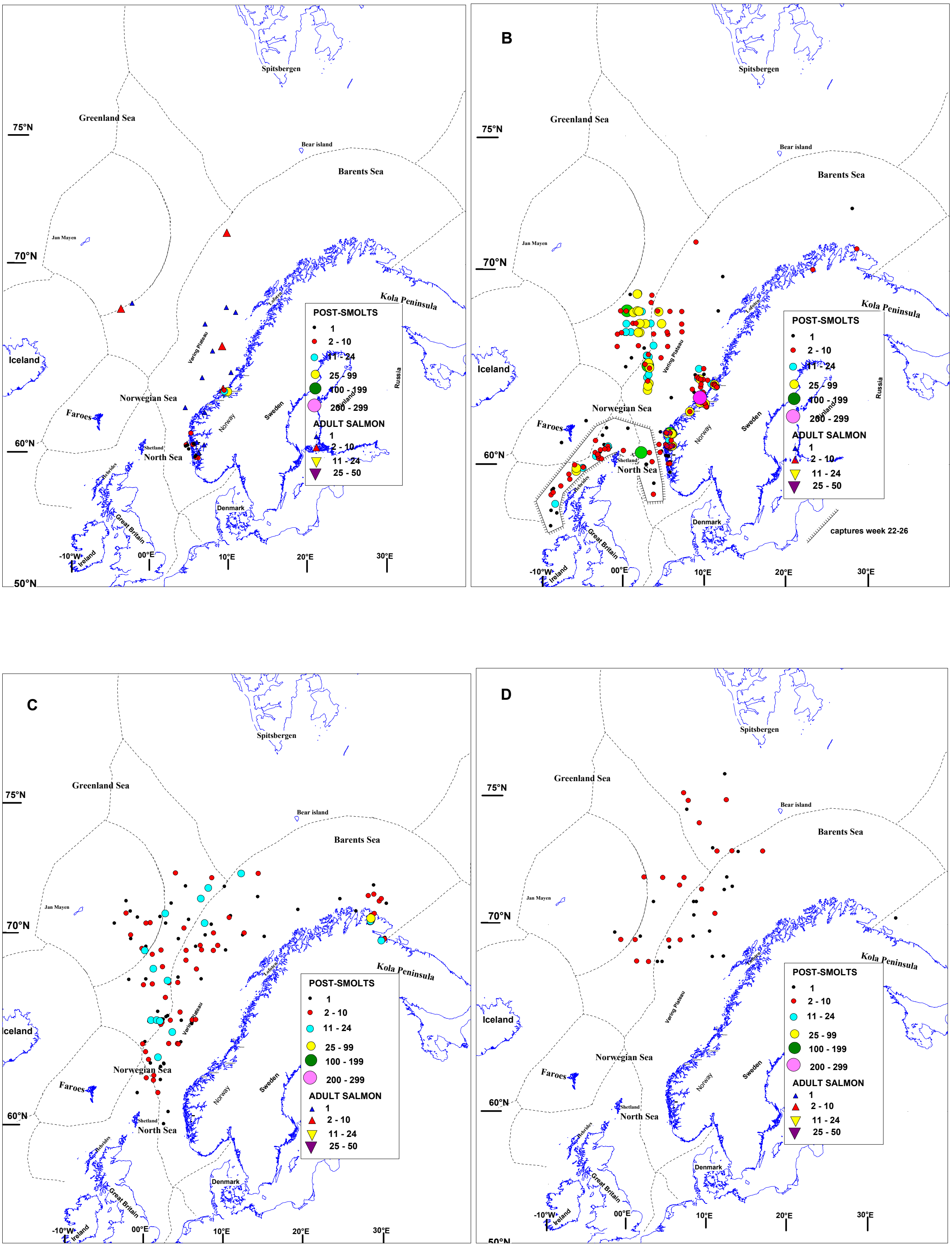


Figure 2.2.2. The distribution of post-smolt captures from Figure 2.1.4 broken down into different time periods. A: 13 April – 19 may (weeks 16 – 20), the figure includes also captures of adult salmon. B: 20 May – 30 June (week 21 – 26). C: 1 July – 4 August (weeks 27 – 31). D: 5 August- 8 September (weeks 32 – 36). Panels B- C Include also Scottish captures from 1996 and Russian data from 2002. Legends in Figure.

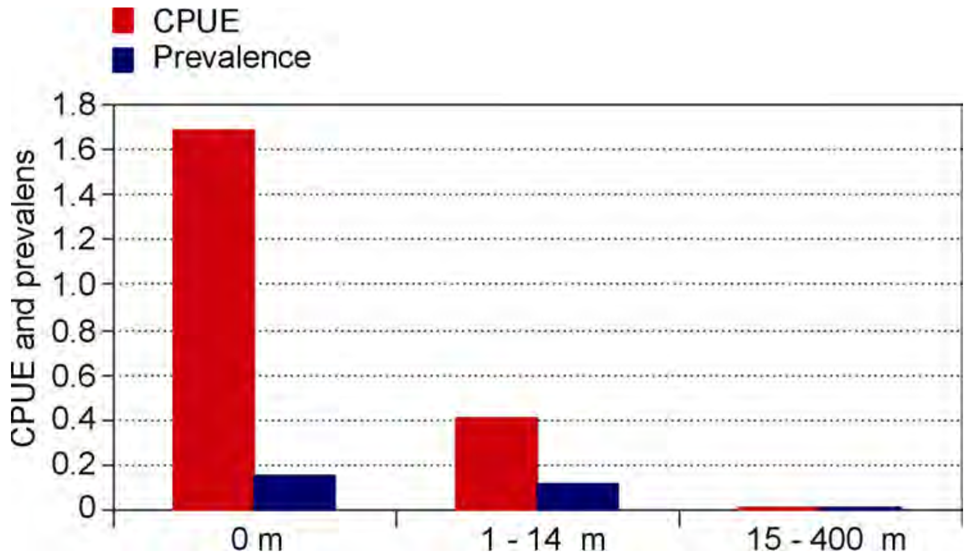


Figure 2.2.3. Vertical distributions of the proportion of trawl hauls containing salmon (prevalence) and the CPUE of salmon in trawls hauled at different depths in pelagic surveys in the Norwegian Sea in 2002.

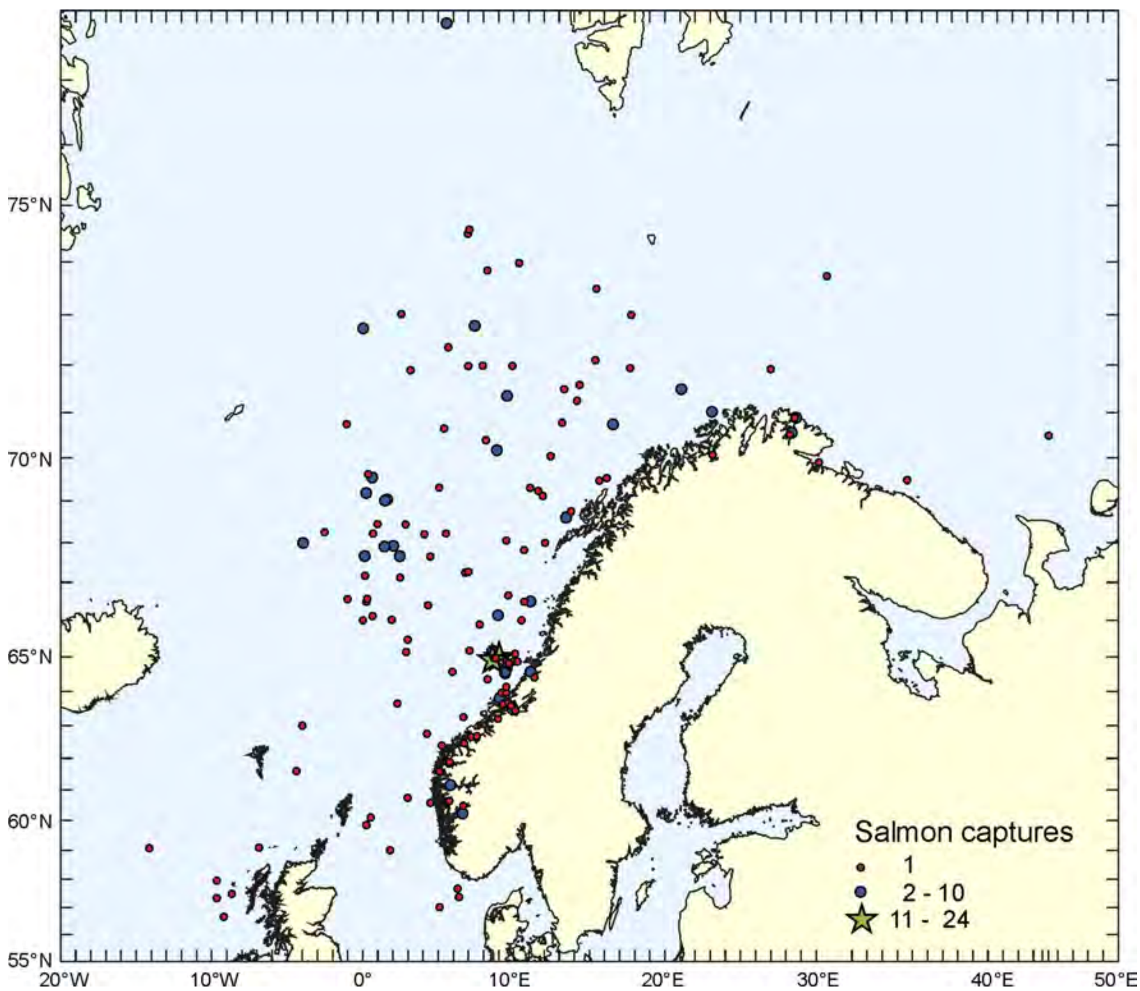


Figure 2.2.4. Distribution of 250 adult salmon taken in Norwegian research trawl catches late May – early September 1990–2003. Symbols of different sizes denote intervals of number of fish caught in the trawl hauls, as given by legends in the panel.

3 IDENTIFICATION OF FISHERIES WITH A POTENTIAL TO INTERCEPT SALMON AND FISHING AREAS OVERLAPPING WITH SALMON DISTRIBUTION 1995–2003

The Study Group agreed, that the fisheries posing the greatest danger to the salmon would be the mackerel and the herring fisheries (Norwegian spring spawning and North Sea herring), but that capelin-, horse mackerel- and blue whiting fisheries may have a potential of intercepting with the salmon as these fisheries also are carried out to a large extent with various trawl gear. Of the gear used in the various fisheries, the Study Group agreed that due to the large areas covered by active gear such as trawls; these would be the ones with the highest potential for salmon captures, and with surface near trawling as the most interceptory form of trawling.

In order to be able to grade the catch data available from different fisheries with respect to potential for intercepting post-smolts and salmon, the Study Group discussed which areas and time periods where fisheries overlapping with known salmon distribution (see Section 2) would pose greatest danger for the salmon. The Group agreed that pelagic fisheries occurring in the following areas (see Figure 3.1 for ICES' Divisions) at the time periods listed would be the ones to study in more detail:

ICES Divisions	Weeks	Date	Corresponding to Quarter
IVb, VIa,VIIb,c,j,k	16–25	Mid April-late June	2
IVa,Vb_1,Vb_2	20–26	Mid May-late June	2
IIa,b, Va	27–36	Late June-early August	3

These areas and time periods were selected based on the knowledge the group had on the migration times of smolts in different regions around the North East Atlantic. It should, however, be underlined that in the areas around Ireland and Western UK, next to nothing is known of the movements of the post-smolts after migrating post-smolts have been recorded in the rivers (in traps or by sighting in estuaries) in the beginning of Quarter 2 (weeks 13–20) and until a few research cruises have registered post-smolts on the shelf areas west of the Hebrides and northwards to the Faroes-Shetland Channel (Figure 2.2.2B, essentially between weeks 22–25). This gap in knowledge due to deficiency in adequately timed research surveys (or adequate screening of commercial catches) becomes clear if comparing panel 2.2.2A and B. Although present in relatively large numbers towards the end of 2nd quarter (panel B) around the northern parts of the British Isles, there are no recorded captures post-smolts in the preceding weeks (panel A) neither in these areas nor closer to coast although there necessarily must have been post-smolt cohorts passing through in order to arrive at the sites of capture further west and north.

Observations made with tracking post-smolts in fjords seem to indicate that the time passed in estuaries and fjords, and even close to coast is of short duration (Moore *et al.* 1998, Holm *et al.* 1984, 2003). Thus the overlap with ongoing fishery in the transition areas may be of relatively short duration.

The apparent lack of information of the timing and the paths of the post-smolt cohorts migrating both west of Ireland - UK as well as on both sides of the Northern North Sea (UK and Norway) in combination with the lack of disaggregated catch data for many of the nations fishing in these transition areas prevents inferences of the degree of interception. In order to enable assessment of the degree of overlap in the western areas, it would be necessary to set up a monitoring programme for these areas through research surveys for post-smolts, screening of commercial and research catches combined with coordinated smolt tagging efforts. Such a programme would not only benefit the assessment of the stocks migrating into the Norwegian Sea, but will also be helpful in assessing the fate of the components of the post-smolts in the southern NEAC area that migrate to West Greenland waters to feed.

The Study Group identified another area of particular interest in the northern Norwegian Sea in the 3rd quarter with respect to a similar combination of deficient knowledge of salmon distribution and lack of disaggregated data from the major fisheries occurring as in the western areas.

3.1 The distribution of fish species and fisheries

3.1.1 Mackerel

The North East Atlantic (NEA) mackerel stock consists of three spawning components named after their spawning areas. The southern component spawns in Spanish and Portuguese waters, the western component spawns west of UK and Ireland and the North Sea component spawns in the North Sea and Skagerrak. After spawning is finished in the southern and western areas the mackerel migrates into the Norwegian Sea and the North Sea in June. Those feeding in the Norwegian Sea migrate to the North Sea later in the autumn. The western and southern components stay in the North Sea until December- March the next year when they leave for their respective spawning areas.

The distribution of mackerel catches by quarters in 2002 is shown in Figure 3.1.1.1a-d (ICES, 2004). The catches by country in the Norwegian Sea, the North Sea and Skagerrak and in the western areas are shown in Table 3.1.1.1 (ICES, 2004). During 1995–2002 the catches of mackerel in these areas have declined from more than 600 K tonnes in 1995 and 1998 to 470 K tonnes in 2002.

With the exception of data from UK and Germany, the Study Group did not have disaggregated data on the mackerel fisheries at the meeting. The description by country and ICES divisions is therefore based upon quarterly data reported to the Working Group on Mackerel, Horse Mackerel, Sardine and Anchovy (WGMHSA) for 2002 (ICES, 2004), which is considered to be rather representative for the period 1995–2002.

The Norwegian Sea (IIa) - The three main countries fishing here are Russia, Norway and the Faroe Islands.

<u>*Russia*</u> is trawling in the surface layer in international waters (IIa) and in the Faroese EEZ during late June-August (Vb1). *The Faroe Islands* are carrying out a trawl fishery mainly within their own EEZ (Vb1 and Vb2) at the same time. Both these fisheries may overlap temporally and spatially with the post-smolt distribution.

<u>*Norway*</u> is fishing rather close to the Norwegian coast in the south-eastern part of the Norwegian EEZ (IIa- IVa) and to some extent also in the fjords. This fishery is carried out by purse seiners in August-September at a time when the post-smolts are anticipated to have left the area and the majority of the adult wild fish have entered the rivers. Due to the EU-Norwegian fishery agreement, in the beginning of the period (1995) some misreporting of catches occurred in the Norwegian fishery, and catches taken in the northern part of Division IVa were reported as taken in Division IIa, which may confuse the picture of potential overlap with the post-smolt distribution. However in later years there has been no misreporting because the Norwegian fleet has obtained full flexibility of where to take the quota.

The North Sea and Skagerrak (IVa, b and IIIa)- Only small catches are usually taken in Skagerrak (IIIa) in a coastal fishery. The main catches are taken in the North Sea (IVa and b) which is the major fishing area for mackerel providing 45–55% of the catches in the later years. The main catches are taken in the first, third and fourth quarters. With regard to bycatch of post-smolts, the fisheries in the western part of Division IVa during the weeks 13–26 (late March- end of June, essentially the second quarter) would be the most interesting. However, during the second quarter the western and southern spawning components of the mackerel stock are spawning west of UK and Ireland respectively in Spanish and Portuguese waters, and the North Sea stock that constitutes only 5% of the total North East Atlantic mackerel stock is the only spawning component left in the North Sea. Therefore the catches during this period are small, usually less than 1K ton (1000 tonnes), except for 1998 and 1999 when 4.3 and 1.2K tonnes respectively were reported to the WGMHMSA.

North Sea, mid part (Division IVb)- The catches are rather low during the whole year. In 2002 less than 2K tonnes were taken in this Division. Almost nothing is known where the salmon stocks bordering the North Sea make their transits through this area (see Figure 2.2.2), but it is very likely that some vulnerable salmon stocks (e.g., from France, the Rhine or East England and Scotland) are passing through on their feeding or homing migrations. Therefore, although small in comparison with other areas, the mackerel fisheries in this area cannot be excluded from the list of intercepting fisheries.

The Western areas (Sub-areas VI and VII and Divisions VIIIa,b,d,e) -The catches given in Table 3.1.1.1 and are from the western areas covering several Sub-areas and Divisions. The main fishing nations here are UK, Ireland, the Netherlands, Germany, France and Spain. In Divisions Vb, VIa (eastern part) and VIIb the fisheries overlapping with the post-smolt distribution and migration would occur in the second quarter. Because of the spawning season of the mackerel in these areas, at this time the fisheries are rather small due to poor quality of the fish. In addition, the mackerel often are too scattered to be exploited commercially during the spawning season. Only about 5% of the total mackerel catches in these areas are taken during the second quarter. The most significant catches from the potentially overlapping divisions in the second quarter were taken by England and Wales (VIa and VIIj) (Table 3.1.1.2), Ireland (VIIb and VIIj) and the Netherlands (VIIj). All these countries have a trawl fishery targeting mackerel.

The lack of disaggregated data for many of the nations prevented a closer scrutiny of all the data, but based on records of landings to the UK, the Study Group was able to extract some new information (Table 3.1.1.2). It is likely that the UK landings are representative for most of the trawl fisheries going on in these areas. From Table 3.1.1.2 can be seen that the maximum landings have been varying between weeks 21–26, but most of them occurring in the weeks 21 – 24. In the 2nd quarter the majority of the reported catches landed in the UK are made by the trawler fleet fishing with either midwater trawl or "non specified" otter trawl gear (UK gear code 7). In addition, the fact that these catches are registered mostly in the areas west of Scotland and the Hebrides (56–59°N; 4–12°W) gives this fishery a high potential of intercepting the northward migrating post-smolts (see Figure 2.2.2B). However, according to the information provided to the Study Group no salmon have ever been recorded as bycatches in the UK screenings.

3.1.2 Herring

The Norwegian Spring Spawning Herring (NSSH) is one of the largest fish stocks in the NE Atlantic, and at present the annual catch is around 700–800 K tonnes. Mainly Iceland, Russia, the Faroes, EU and Norway exploit the stock in both coastal and oceanic fisheries.

Coastal fisheries- The Norwegian catch (400–500 K tonnes) is taken mainly with purse seine in the Vestfjord area (northern Norway) in January and in September - December. In addition a varying but relatively small tonnage is taken on the spawning grounds in February. The Norwegian fishery does not overlap with any known distribution of post-smolts or adult salmon, and it does not seem probable that this fishery takes significant amount of salmon as bycatch.

The Norwegian Sea (IIa)- The nations fishing herring in the Norwegian Sea are Iceland, Russia, the Faroes and the EU.

Russia fishes its entire quota with midwater trawls. In general the fisheries start on the spawning grounds in February. This fishery ceases after the spawning season and restarts in the second part of August in the northern Norwegian Sea. The fleet then follows the herring southwards towards the wintering areas outside the Vesterålen and the Vestfjord area. All catches are taken with midwater trawls. This fishery is not anticipated to significantly intercept salmon, only occasional adults may be caught, except for possibly in the northern areas in August when the bycatches could be larger (refer to Icelandic observations, Section 4).

Iceland takes all its catch in the Norwegian Sea, whereof 50% with purse seine and the rest with trawls. The proportion taken by trawl has increased rapidly during recent years. The fishery normally starts during the first week of May and ends by the end of June. The Icelandic fleet takes most of its herring catches outside the areas where the post-smolts are believed to pass, and the fishery thus is not considered to representing any major threat to post-smolts. However, bycatches of considerable numbers of adult salmon have in some instances been documented both from purse seine and trawl catches (ICES 2003a, Gudjonsson unpublished).

The Faroese catch is taken with purse seine. In most years the bulk of the catch is taken in the international zone and the Jan Mayen zone. As for the Icelandic fleet there does not seem to be overlap with the known distribution of post-smolts. Catches of adult salmon may be taken.

The EU fleet fish both with midwater trawls and purse seines. The fishing pattern of the EU fleet is not known, but as for the Icelandic and Faroese fleets bycatch of post-smolt is not believed to occur. Catches of older fish have been registered.

<u>The North Sea herring</u> (south of 62ºN, i.e., IVa and IVb) are exploited by EU and Norway. The annual catches have varied between 560 and 230 K tonnes during 1992–2002. EU is the main stakeholder in these fisheries. The catches are taken both by purse seiners and trawlers with a growing part of the catch coming from various trawl gear in the later years.

Although the migrations of post-smolts through the North Sea are poorly understood records from a few research surveys in the northern North Sea in June indicate migration paths on the western side of the Norwegian Trench (Figure 2.2.2B). As can be seen from Figure 3.1.2.1 for the 2nd quarter there are major herring fishing activities in these waters during the period when the post-smolts from English, Scottish, Danish, Swedish and south- Norwegian rivers are anticipated to pass through various parts of the North Sea. These fisheries are evaluated by the Study Group as having significant potential of taking post-smolts as bycatch. By the 3rd quarter the post-smolts have moved northwards and out of the North Sea and the risk of interception decreases. Similar to the fisheries further north, all herring fisheries in the

North Sea would have a potential of taking occasional catches of larger salmon on their homing migration. This is also demonstrated by the Dutch salmonid bycatch statistics from the areas further south (Figure 4.2.2).

Herring fishery in the western areas (VIa)- The fisheries in VIa (southern part) have varied between 14 – 39K tonnes during the last 10 years. Ireland takes most of this catch. The main fisheries take place in the 1st and the 4th quarter when the potential intercepting post-smolts is negligible. There are no records of catches of captures of adult salmon but undoubtedly they may occur. Based on the current status of knowledge on the salmon distributions, however, it is not possible to assess the risk of interception in these areas.

The catches taken in the northern part of VIa have been around 30 K tonnes annually during the last 10 years. Also these fisheries take mainly place in the 1st and 4th quarter. As in the southern part of VIa, the lack of data on the salmon moving through these areas prevents evaluation of the potential of interception of post-smolts and adult salmon.

3.1.3 Blue whiting

Total catch figures in 2002 were provided by members of the WGNPBW. They were estimated to be 1.55 million tonnes compared to 1.78 million tonnes in 2001. The catches by nations and area for 1995–2002 are given in Appendix IV.

Spatial and temporal distribution of the catches of blue whiting in 2002 is given by quarter and ICES rectangles in Figure 3.1.3.1 and Table 3.1.3.1.

National fisheries of blue whiting in 2002 are summarized below (ICES, 2004). Germany, France, Sweden and UK (Scotland) did not provide ICES with such information.

The blue whiting fishery is not considered a threat for the post-smolts, as the trawls are operated at depths where post-smolts are not known to reside. There may be a potential for intercepting adult in certain areas, but no salmon have been detected in the cases where screening of landings have been performed (Iceland and the Faroes).

<u>Denmark:</u>

The Danish blue whiting fishery is conducted by trawlers using a minimum mesh size of 40 mm in a directed fishery. In the fisheries where blue whiting was taken as bycatch, trawls with mesh sizes between 16 and 36 mm were used.

<u>Faroe Islands:</u>

In the absence of an agreement with the EU on blue whiting no fishery was conducted in EU waters in 2002, and the fleet of 8 combined purse seiners/trawlers concentrated on the western and south-western part of the Faroese EEZ (ICES Division Vb) and in VIb and XII outside the EU zone. The fleet also operated in IIa. All catches were taken with pelagic trawl (44 mm mesh size in the cod-end). The industrial fleet (3 trawlers) operated mainly in Norwegian waters (ICES Division IVa) in 2002 with some catches of blue whiting scattered throughout the year.

<u>Iceland:</u>

Iceland and Faroes have a bilateral agreement of mutual fishing rights for blue whiting within each other's EEZs. A total of 19 Icelandic vessels participated in the directed fishery, which started in March in international waters west of the British Isles (ICES Divisions XII, VIb) and small catches in Icelandic waters at SE-Iceland. All the catches were taken by mid-water trawls with a mesh size in the cod-end of 40 mm.

<u>Ireland:</u>

The Irish fishery for blue whiting developed in response to severely restricted quotas for mackerel and herring in the 1990s. Catches peaked in 1998, but the imposition of an EU TAC and the allocation of a low quota to Ireland have caused the fishery to contract. Six vessels fished the small quota of 17,165 tonnes allocated to Ireland in 2003. Fishing takes place in February and March between Porcupine and Rockall after the completion of the spring mackerel fishery. The fishery is carried out by Refrigerated Sea Water trawlers fishing with large single trawls that have been specially modified to take large catches from deep water. Circumference of the gear may be as great as 1700 m with a brailler mesh of 35 to 40 mm.

Netherlands:

Dutch pelagic trawlers fish for blue whiting mainly in areas VIa and VIIc in the first and second quarters of the year using mesh size of 40 mm. The total catch in 2002 was restricted by a share (27 K tonnes) in a TAC set by the EU. All catches were landed frozen for human consumption.

Norway:

The main Norwegian fishery for blue whiting is a pelagic trawl fishery, regulated by vessel quotas, and is carried out west of the British Isles both at the spawning area and west of the spawning area. In 2002 the fishery started in the beginning of February in international waters off the Porcupine Bank and then moved northward towards the Rockall area. At the end of March/beginning of April the main fishery took place off the Hebrides area. From there the fishery moved into Faroese waters. The Norwegian fishery in the spawning area was stopped on 5 May when the quota in the EU zone was taken.

Portugal and Spain:

In the Portuguese fisheries, blue whiting is a bycatch in the trawl fishery for other species. Most of the landings come from bottom fish trawlers. The Spanish blue whiting fishery is carried out mainly by bottom pair trawlers in a directed fishery and by single bottom trawlers in a bycatch fishery, both using a minimum mesh size of approximately 55 mm. The catches are taken mainly on the border between Divisions VIIIc and IXa.

Russia:

The Russian blue whiting fishery is carried out by large fishing vessels using trawls with mesh size of 35 to 40 mm. In 2002 the fishery continued from January to December in different NEA areas. In January and February fishing took place mostly in the Faroese EEZ (Vb1). Further, following spawning migrations, the fishing fleet displaced southwards and operated in international waters to the west of the British Isles (XII) until the middle of April. At the end of April, following blue whiting feeding migrations, Russian fishing vessels moved to the Faroese and Norwegian EEZs and international waters in the Norwegian Sea (Vb1, IIa) and fished there till the end of September. From October to December a Russian fleet operated mostly in international waters and in the Faroese zone (IIa, Vb1).

3.1.4 Capelin

Capelin in the Iceland-East Greenland-Jan Mayen Area- The international catches are shown in Table 3.1.4.1 (ICES, 2003c). The fishery of the Iceland–East Greenland–Jan Mayen capelin has been regulated by preliminary catch quotas set prior to each fishing season. Over the years, fishing has not been permitted during April to late June and the fishing season has been opened in July/August or later, depending on the state of the stock. Due to very low stock abundance there was a fishing ban lasting from December 1981 to November 1983. In addition, areas with high abundances of juvenile age 1 and 2 capelin (in the shelf region off NW-, N- and NE-Iceland) have usually been closed to the summer and autumn fishery. The summer and autumn fisheries may overlap with the salmon distribution and there are reports of salmon occasionally being found in the capelin fishery. Considerable capelin catches are taken by Iceland, Norway, Faroe Islands, Greenland and EU during this period (Table 3.1.4.1).

The total catch in the 2002 summer and autumn season 340 K tonnes were taken and the total catch during the 2003 winter season was 648 K tonnes.

In 2003 the first spawning migration arrived in the shallow coastal waters off SE-Iceland during the last week of February and then they migrated rapidly west along the coast to spawn west of Iceland. Prior the arrival of capelin in the shallow spawning area off the eastern south coast, 450 K tonnes were caught in deeper waters east of Iceland. As usual, catch rates were high in the Icelandic coastal area and by mid March most of the TAC of 1 million tonnes, set for the 2002/2003 season, had been taken.

The Barents Sea capelin- The international catch by country and season in the years 1995–2002 is given in Table 3.1.4.2 (ICES, 2003). Russia and Norway are the main fishing nations of this stock. The main catches are taken during the winter fishery. The total catch in winter 2002 was 635 K tonnes which was 15K tonnes below the quota set for 2002. According the Mixed Norwegian-Russian Fisheries Commission (MNRFC) the capelin fishery can only take place in January-April during the pre-spawning and spawning season.

Also in the Barents Sea areas adult salmon are occasionally found in the capelin catches.

The present size of the spawning stock is so low that MNRFC has decided to close the capelin fishery in 2004.

3.1.5 Horse mackerel

ICES considers the horse mackerel fished in the North East Atlantic as belonging to three spawning stocks. These spawning stocks are also named after their respective spawning areas. They spawn in similar areas as the three spawning components of mackerel. The southern stock spawn in Portuguese and Spanish waters, the western stock spawns west of UK and Ireland and in the Bay of Biscay, The North Sea stock spawns in the southern part of the North Sea. The western stock migrates to the Norwegian Sea and the northern part of the North Sea in the autumn to feed. The availability of horse mackerel to the fishing fleet in these feeding areas is strongly correlated to the inflow of Atlantic water to the North Sea the first quarter (Iversen *et al.* 2002). The distributions of the 2002 catches by quarters are given in Figure 3.1.5.a-d (ICES, 2004). The catches of horse mackerel by countries for different areas are given in Table 3.1.5.1 (ICES, 2004).

The Norwegian Sea (Division IIa)- Rather low catches are taken in this region (Table 3.1.5.1). The largest catches are taken in a Norwegian purse seine fishery that is carried out in October-November on horse mackerel of western origin.

The North Sea and Skagerrak (area IV and Division IIIa) -The largest catches are taken by Norway, the Netherlands and Scotland (Table 3.1.5.1). The Norwegian catches are taken in NEZ during October–November. No catches were taken in Divisions IVa and IVb during the second quarter of 2002.

Area VI - Most of the catches (Table 3.1.5.1) are taken in Division VIa by Ireland and Scotland. In 2002 Ireland and Scotland caught respectively 1% and 0% of their catches in VIa during the second quarter.

The Area VII- This is an important fishing area with relatively large catches. Most countries fishing are taken considerable catches (Table 3.1.5.1). However only minor catches if any were taken during the second quarter of 2002 in Divisions VIIb and VIIc. England and Wales, Ireland and the Netherlands caught 300–1250 tonnes during the second quarter of 2002 in Division VIIj. No catches were reported taken in Division VIIk in 2002.

3.2 Potential fisheries and areas of overlap, which should be investigated further

Based on data provided to the working group by Germany and UK it was possible to pick out some areas of overlap. The potential areas for overlap for the other countries are extracted from the respective working group reports or from data provided for these working groups. Based on these sources of information, the potential areas of overlap between salmon and different fisheries at different time periods are tabled (Table 3.2.1.). The Study Group was not provided with detailed information about the fishery with respect to fishing gear used, fishing depth and number of boats. With the exception of UK and Germany weekly catches by statistical rectangles were not provided to the Study Group in time for the meeting. It is recommended that such information on the fisheries is provided by NEAFC and the different nations with data disaggregated per week, per statistical rectangles within the Divisions and time periods listed in Table 3.2.1 before it is appropriate to hold any future Study Group meeting.

Table 3.1.1.1. Mackerel catches (1000 tonnes) by country and area 1995–2002 (ICES 2004).

	Norwegian Sea (IIa)								North Sea and Skagerrak (IV, IIIa)								Western areas (VI, VII and VIIIa,b,d,e)							
Country	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Belgium									0.1	0.1	0.1	0.1	0.2	0.1	0.1									
Denmark	4.7	3.2	0.1	2.1	0.1	1.4			30.9	24.1	21.9	25.3	29.4	27.7	21.7	34.4	1.4	1.3			0.6	0.1	0.1	
Estonia	1.9	3.7	4.4	7.3	3.6	2.7	0.2										0.4							
Faroe Islands	9	3	5.8	2.7	3	5.5	3.3	4.7	17.8	13.9	3.3	4.8	4.4	10.6	18.6	12.5	4.2		2.4	3.7	4.2	4.9	2.2	2.5
France	0.1	0	0.3						1.6	1.3	1.5	1.9	2.1	1.6	2	2.2	10.2	14.3	19.1	15.9	14.3	17.9	19	19.7
Germany									0.7	0.5	0.2	0.4	0.5	0.1	4.5	3.9	23.7	15.6	15.2	21	19.5	22.9	20.8	22.6
Iceland		0.1	0.9	0.4				0.1									72.9	49	52.8	66.5	48.3	61.3	60.2	51.5
Iceland													0.4											
Ireland					0.1				5.6	5.3	0.3	0.1	11.3	10	10.3	20.7								
Latvia	0.4	0.2																						
Lithuania						2.1																		
Netherlands		0.6			0.7			0.6	1.3	2	1	1.4	2.8	2.3	2.4	11	34.5	34.2	22.7	28.8	25.1	30.1	33.7	21.8
Norway	93.3	48	41	54.5	53.8	31.8	22	22.7	109	88.4	96.3	104	107	142	158	162			-	-			0.2	
Russia	44.5	44.5	50.2	67.2	51	49.1	41.6	45.8			3.5	0.6	0.3	1.7										
Spain																	4.5	2.3	7.8	3.3	4.1	4.5	4.1	3.5
United Kingdom	0.2	0.1	0.9	0.2	0.7		0.1	0.7	21.6	18.5	19.2	19.8	31.6	57.1	50.2	58.9	190	128	129	166	127	127	140	132
Poland			0.1																					
Sweden									6.3	5.3	4.7	5.1	5.2	5	5	5.2								
Misreported (IVa)	-18.6			-0.2	-40												-107	-51.8	-73.5	-98.3	-60	-3.8	-39	-43.3
Misreported (VIa)					-0.1				107	51.8	73.5	98.4	59.9	8.6	39	49.9								
Misreported (IIa)									18.6	-	-	-	40											
Misreported (unknown)								-0.6																
Unall									1	0.2	1.1	3.1	4.9	3.2	-0.3		28.2	10.6	4.6	8.4	9.3		12.8	
Discards									0.7	1.4	2.8	4.8		1.9		8.5	7	10	16.1	3.3		1.9	1.2	15.2
Total	136	103	104	134	72.9	92.6	67.2	74	322	213	229	270	300	272	312	369	270	213	196	219	193	266	255	225

Table 3.1.1.2. Landings of mackerel (tonnes) recorded in the UK for week 21–26 (~ second half of quarter 2) in 1990–2003.

Year	Week 21	22	23	24	25	26	Total, week 21–26 Tonnes
1990	88.5	122.9	2.0	284.7	1.9	51.4	551.5
1991	351.4	32.0	307.0	1.9	10.0	253.7	956.0
1992	94.0	64.1	13.0	109.6	68.2	35.9	384.8
1993	13.8	14.7	12.0	1291.0	9.0	329.6	1670.2
1994	172.4	520.9	10.0	644.8	2.7	6.3	1357.1
1995	855.3	8.1	69.5	1612.8	1244.2	5.0	3794.9
1996	4.6	488.6	5.5	4.2	382.0	237.8	1122.7
1997	12.7	46.5	2.0	125.9	5.1	749.9	942.2
1998	10.9	36.5	1220.7	8.6	7.2	265.9	1549.8
1999	3.3	13.8	207.7	503.1	21.4	4.9	754.1
2000	9.9	57.6	11.3	2540.9	4.8	3.8	2628.2
2001	1143.4	42.4	5.6	3.3	3.8	317.3	1515.7
2002	3112.5	3.4	5.0	8.5	648.2	18.2	3795.8
2003	1365.7	719.5	19.4	41.2	9.0	167.1	2321.9

Table 3.1.3.1 Total landings of blue whiting by country and area for 2002 in tonnes. Landing figures provided by Working Group members and these figures may not be official catch statistics and therefore cannot be used for management purposes.

Area	Denmark	Faroe Islands	France	Germany	Iceland	Ireland	Norway	Portugal	Russia	Scotland	Spain	Sweden	Netherlands	Grand Total
I														186
IIa	13,608	36,126		1,072	53,271		100,922		145,463			850	906	352,218
IIIa	6,454											17,610		24,064
IVa	28,621	7,163				4	85,062					79	50	120,979
IVb	455	154												609
IXa								1,659						1,659
V									107,900					107,900
Va		46,851			140,415									187,266
Vb		90,682			87,316		16,318					10		194,326
Vb,VI,VII			14,688											14,688
Via	1,428	1,315		8,598		11,394	105,434			4,135			12,099	144,403
VIab+VIIbc					1,915									1,915
VIb		22,739		500			203,133						4,104	230,476
VIIb	713					19				7,944			54	8,730
VIIbc									33,674					33,674
VIIc				6,280		6,310	41,121			14,324			17,108	85,143
VIIgk+XII					2,622									2,622
VIIIa,b,d													3,203	3,203
VIIIc+IXa											17,506			17,506
VIIIe						35								35
VIIj				600		63							5	668
VIIk							13,509							13,509
XII		391					5,980		2,845					9,216
Grand Total	51,279	205,421	14,688	17,050	285,539	17,825	571,479	1,659	290,068	26,403	17,506	18,549	37,529	1,554,995

Table 3.1.4.1 The international catches (1000 tons) of capelin in the Iceland-East Greenland-Jan Mayen Area

	Winter season					Summer and autumn season						T
Year	Iceland	Norway	Faroes	Greenland	Total	Iceland	Norway	Faroes	Greenland	EU	Total	
1995	539.4	0.0	0.0	0.4	539.8	175.5	28.0	0.0	2.2	0.0	205.7	
1996	707.9	0.0	10.0	5.7	723.6	474.3	206.0	17.6	15.0	60.9	773.8	
1997	774.9	0.0	16.1	6.1	797.1	536.0	153.6	20.5	6.5	47.1	763.7	
1998	457.0	0.0	14.7	9.6	481.3	290.8	72.9	26.9	8.0	41.9	440.5	
1999	607.8	14.8	13.8	22.5	658.9	83.0	11.4	6.0	2.0	0.0	102.4	
2000	761.4	14.9	32.0	22.0	830.3	126.5	80.1	30.0	7.5	21.0	265.1	
2001	767.2	0.0	10.0	29.0	806.2	150.0	106.0	12.0	9.0	17.0	294.0	
2002	901.0	0.0	28.0	26.0	955.0	180.0	118.7	0.0	13.0	28.0	339.7	
2003	585.0	0.0	40.0	23.0	648.0							

Table 3.1.4.2 International catches in 1000 tons of Barents Sea capelin.

	Winter				Summer-Autumn			Total
Year	Norway	Russia	Others	total	Norway	Russia	total	
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
1998	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
1999	46.0	32.0	0.0	78.0	0.0	23.0	23.0	101.0
2000	283.0	95.0	8.0	386.0	0.0	28.0	28.0	414.0
2001	368.0	180.0	8.0	557.0	0.0	11.0	11.0	568.0
2002	391.0	228.0	17.0	635.0	0.0	16.0	16.0	651.0
2003	179.0	107.0						

Table 3.1.5.1 catches of horse mackerel (1000 tonnes) by country and areas 1995-2002

	The Norwegian Sea								The North Sea and Skagerrak								Area VI								Area VII							
Country	1995	1996	1997	1998	1999	2000	2001	2002	1995	1996	1997	1998	1999	2000	2001	2002	1995	1996	1997	1998	1999	2000	2001	2002	1995	1996	1997	1998	1999	2000	2001	2002
Belgium									0.1		-					1									-	-			-		-	-
Denmark	0.2	-	-	1.8			-		2.4	1.4	0.6	2.1	8	4.4	2.3	1.4	0.1	0.1	0.8						28.3	43.3	60.4	25.5	19.2	14	20.6	10.1
Estonia										-	-		-	-																		
Faroe Islands	1	1.6	0.8	0.2	0.1	0.3	-		-	-	0.3		0.9		-	0.7														0.6		
France									-	-	-	0.4	0.1	0.1	0.1	-	-	-	0.1	0.2	25	-	0.4	0.1			27.2	24.2	-	20.4	11.1	6.5
Germany, Fed.Rep.									1.6		7.6	4.6	4.1	3.1	0.2	2.7	1.4	0.9	0.2	0.4	1	0.2	0.3	0.1	17.4	15.9	28.5	25.4	15.3	9.7	8.3	10.8
Ireland									0.2	1.1	8.2	-	0.4	0.1	0.4	0.1	120.1	87.9	22.5	21.6	31.7	15.8	20.2	12.3	58	38.5	43.6	51.7	25.8	33	30.2	23.4
Netherlands									5.3	6.2	37.8	3.8	3.6	3.4	4.7	6.6	2.3	0.6	0.5	0.9	1.1	0.7	0.6	0.5	116.1	114.7	81.5	91.9	56.2	50.1	46.2	37.6
Norway	11.3	0.9	1.2	0.2	2.3	0.8	0.1	1.3	84.8	14.6	45.3	13.1	44.3	1.3	7.5	35.4									-	-	-					
Poland									-	-	-																					
Spain																														0.1		
Sweden									-	0.1	0.2	3.4	2	1.1	0.1	0.6																
UK (Engl. + Wales)									0.5	0.1	0.2				0.3	1.2	0.2	0.6	0.1		0.3		0.1	-	31.6	28.6	17.5	12.8	8.9	3	8.9	5.5
UK (N. Ireland)									-	-	-						-	-	0.8	1.1	-	-			-	-	1,093	-	-	-	-	-
UK (Scotland)									3.7	2.4	10.5	3	1.7	3.5	3.2	0.3	0.8	2.7	14.5	10.4	4.5	1.8	3.1	1.1	10.5	11.2	7.9	5.1	5	5.2	1.8	1.5
USSR / Russia (1992 -)	1.6	0.9	0.6	0.3	0.1	0.1						-	-		-	-																
Unallocated + discards										0.1	-31.6	0.7	-0.3	14.6	0.7	-0.1	-41.3	-11.5	0.8	0.1	1.5	2			68.6	26.8	58.7	12.7	31.2	1.9	11.1	2.6
Total	14.1	3.4	2.6	2.5	2.5	1.2	0.1	1.3	98.6	26	79.1	31.1	64.8	31.6	19.5	49.9	83.6	81.3	40.3	34.7	65.1	20.5	24.7	14.1	330.5	279	325.3	249.3	161.6	138	138.2	98

Table 3.2.1 Summary of countries fishing and fisheries with potential overlap with salmon distribution. ***Italic*** text indicates peak salmon migration time (mid May-early August).

	Weeks 16–25						Weeks 20–26		Weeks 27–36		
Fishery	IVb	VIa	VIIb	VIIc	VIIj	VIIk	***IVa***	***Vb***	***IIa***	***IIB***	***Va***
	2Q	2Q	2Q	2Q	2Q	2Q	***2Q***	***2Q***	***3Q***	***3Q***	***3Q***
Mackerel	Denmark Norway	*England* ***Scotland*** ***Ireland*** ***Germany***	England Scotland Ireland	Ireland	England Scotland France Ireland Germany Netherlands		***England*** ***Scotland***	***Russia***	***Norway*** ***Russia*** ***Faroes***		
Herring		Scotland					***Norway*** ***Scotland*** ***Germany*** ***Denmark***	***Germany***	***Iceland*** ***Faroes*** ***Russia***	***Iceland*** ***Faroes*** ***Russia***	
Blue whiting		Netherlands Norway Germany		Netherlands Germany				***Russia*** ***Iceland*** ***Faroes*** ***Norway***	***Russia*** ***Norway*** ***Faroes*** ***Germany***		***Ice-*** ***land***
Capelin (Iceland-East Greenland-Jan Mayen)								***Iceland***	***Iceland***		
Horse-mackerel					England Ireland Netherlands			***Norway*** ***Faroes***	***Norway***		

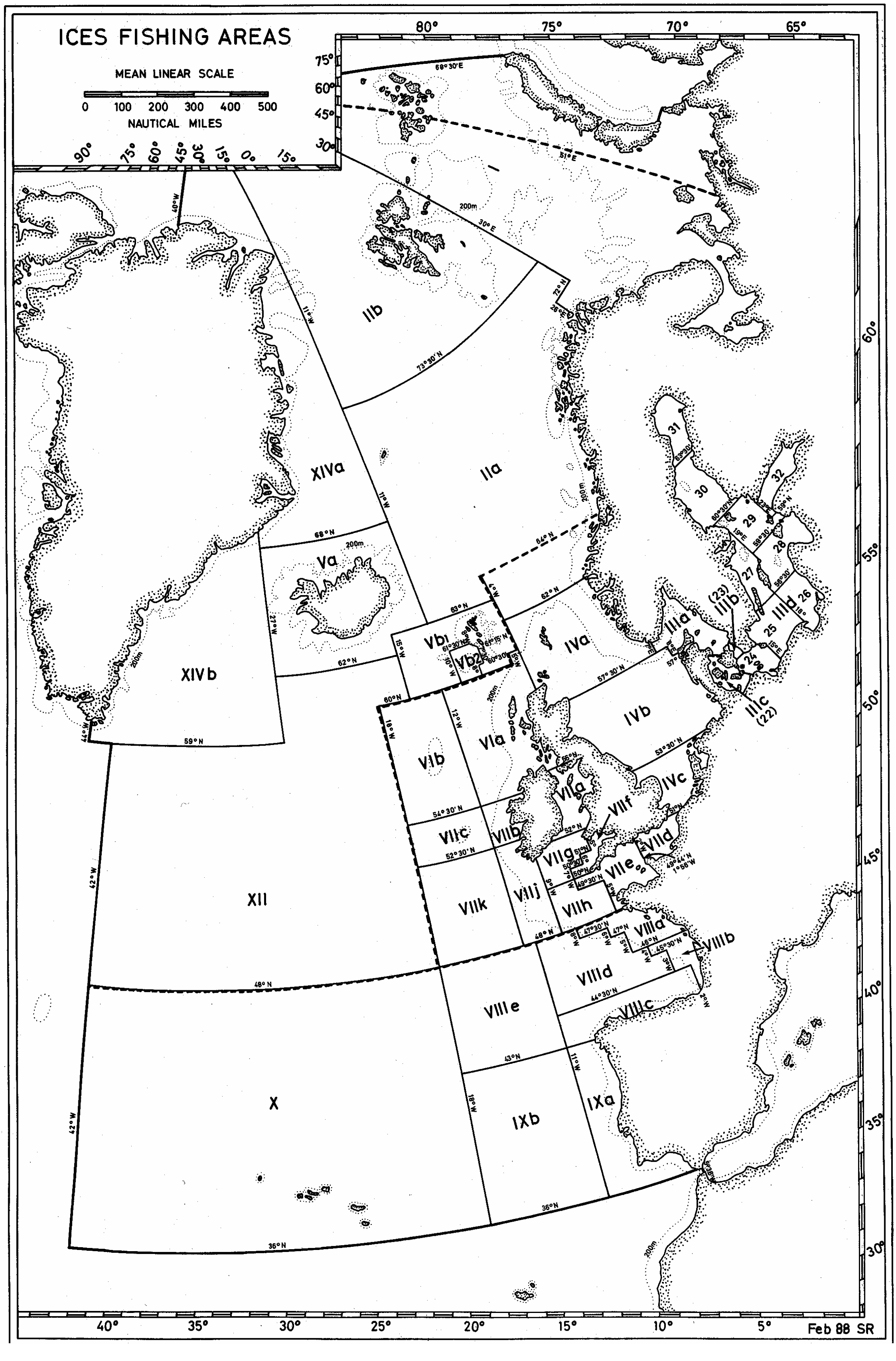


Figure 3.1. The ICES' Areas and Divisions.

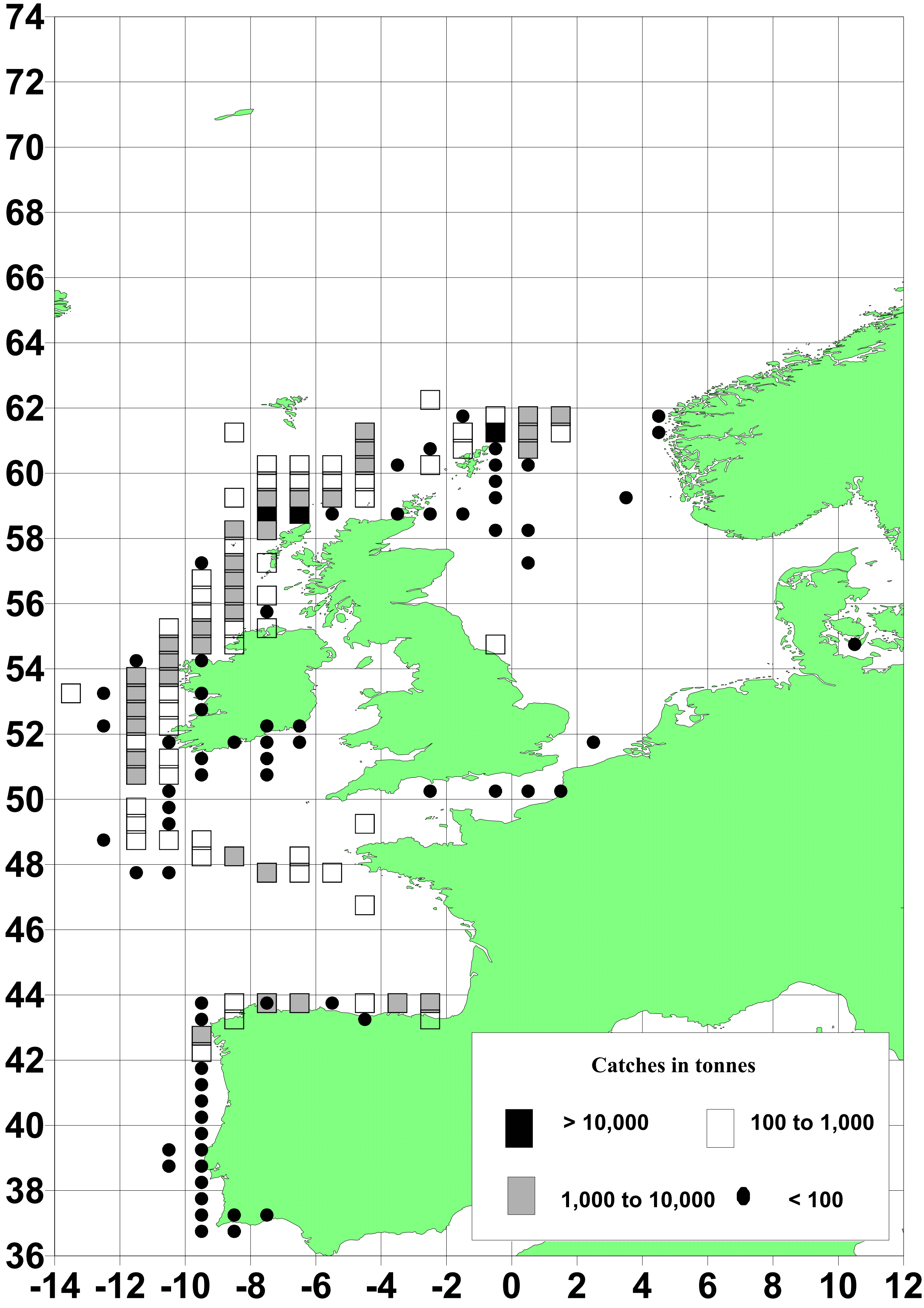


Figure 3.1.1.1a. Mackerel commercial catches in quarter 1, 2002.

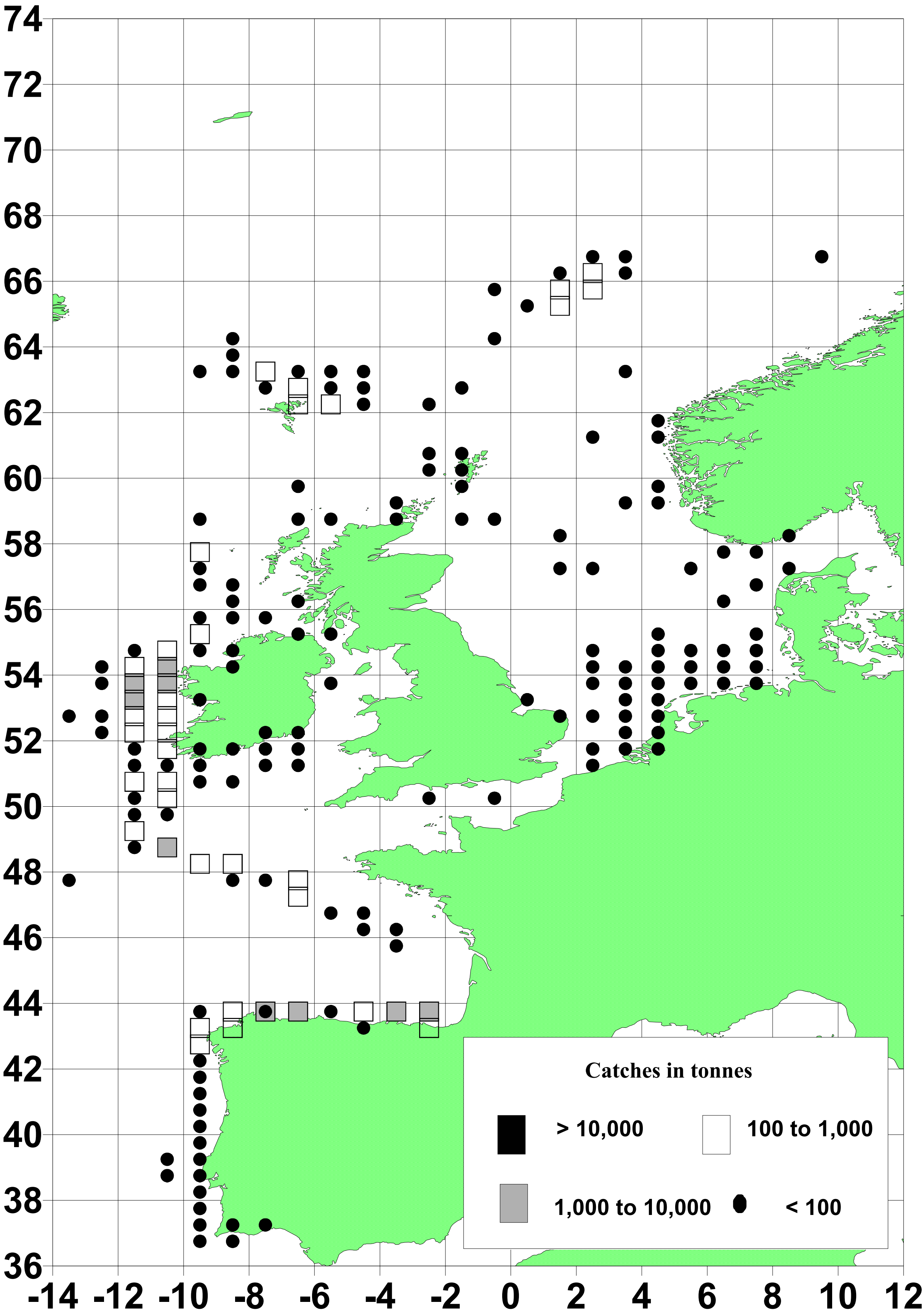


Figure 3.1.1.1b. Mackerel commercial catches in quarter 2, 2002.

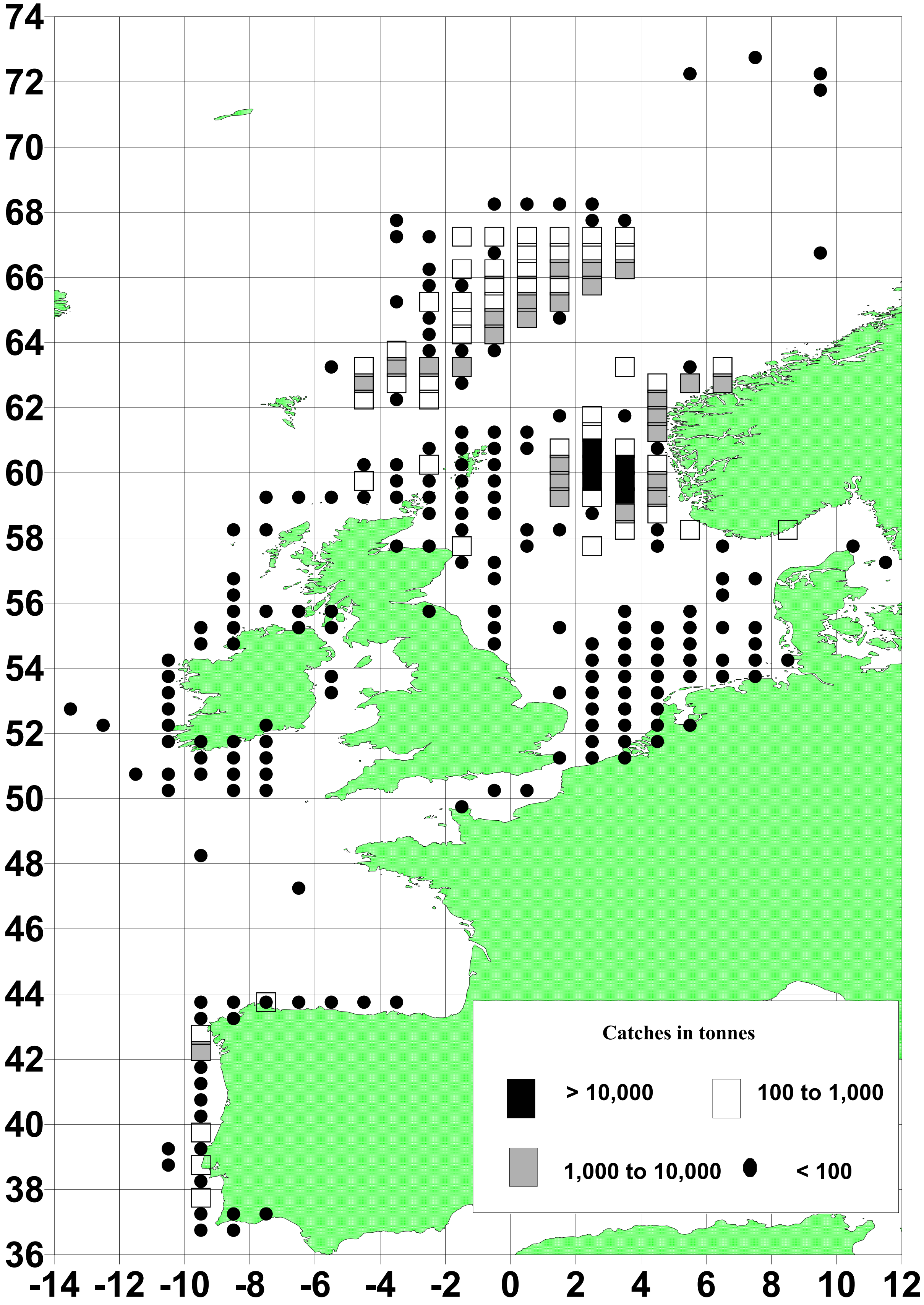


Figure 3.1.1.1c. Mackerel commercial catches in quarter 3, 2002.

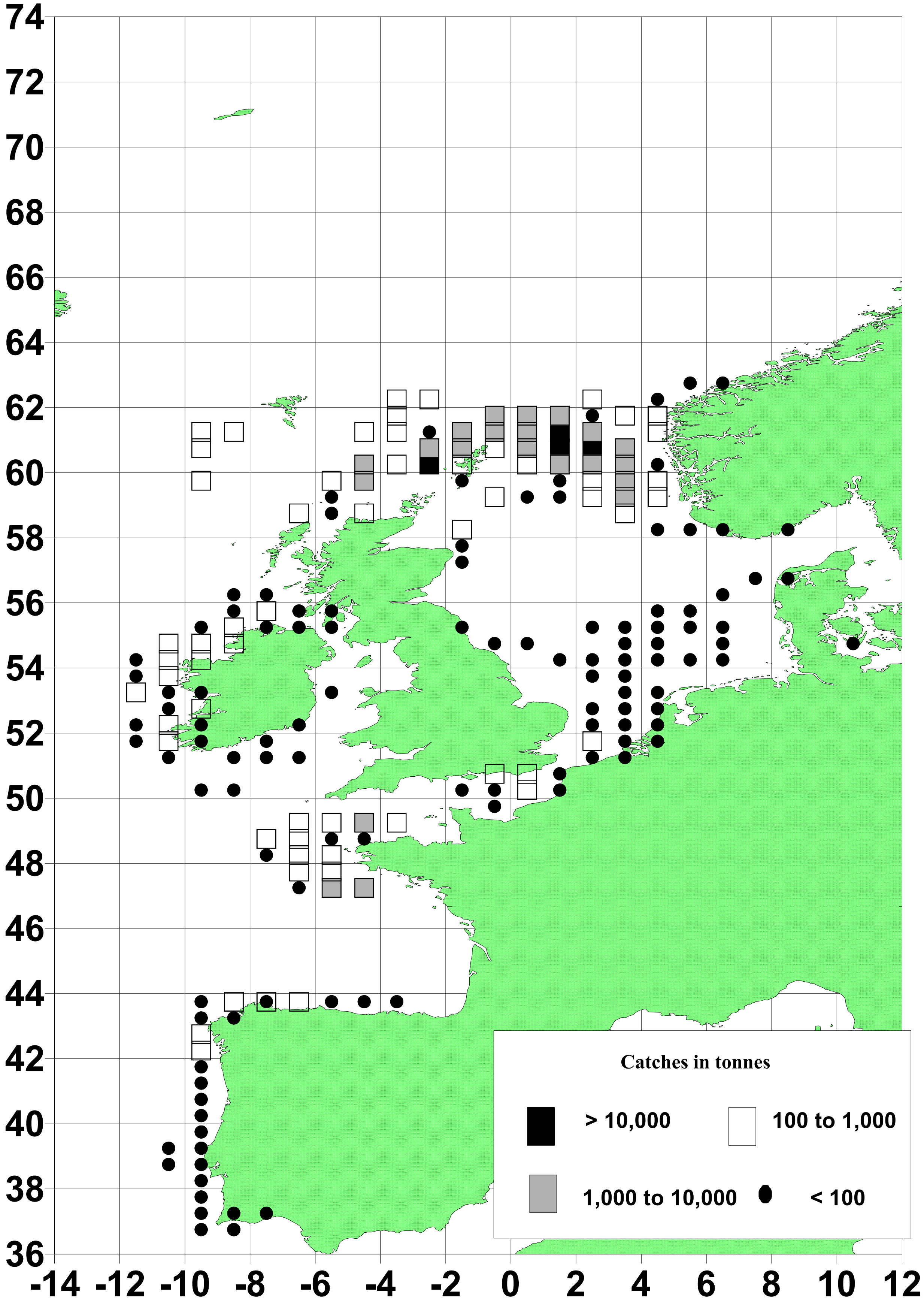


Figure 3.1.1.1d. Mackerel commercial catches in quarter 4, 2002.

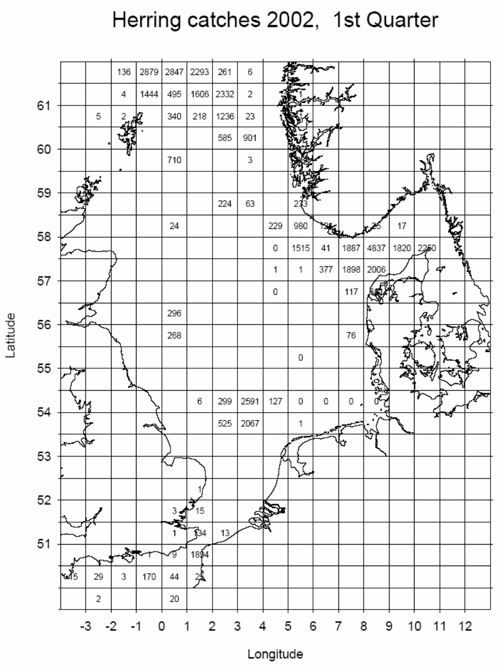


Figure 2.1.1 Herring catches in the North Sea (in tonnes) in 2002 by statistical rectangle. Working group estimates (if available). **a.:** 1st quarter

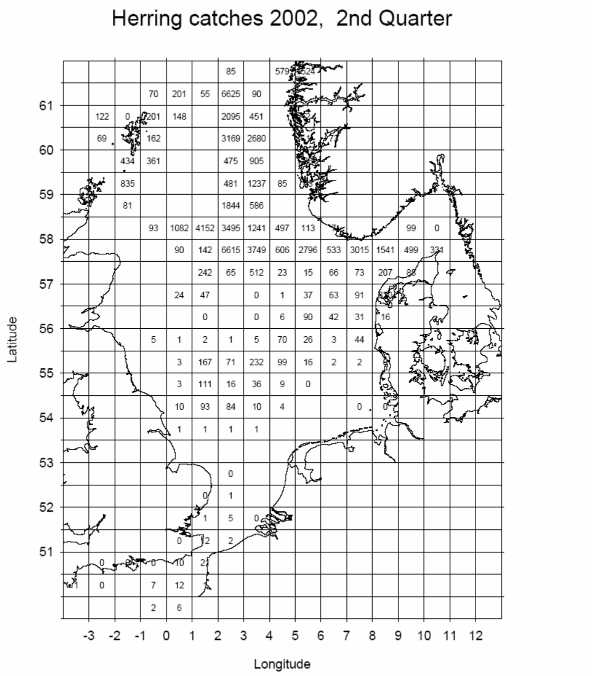


Figure 2.1.1 Herring catches in the North Sea (in tonnes) in 2002 by statistical rectangle. Working group estimates (if available). **b.:** 2nd quarter

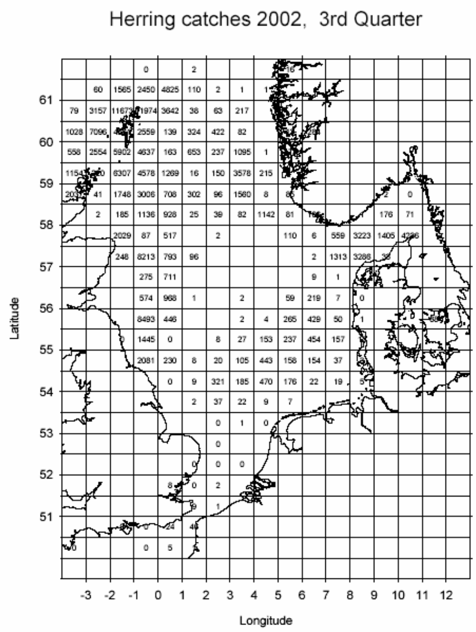


Figure 2.1.1 Herring catches in the North Sea (in tonnes) in 2002 by statistical rectangle. Working group estimates (if available). **c.:** 3rd quarter

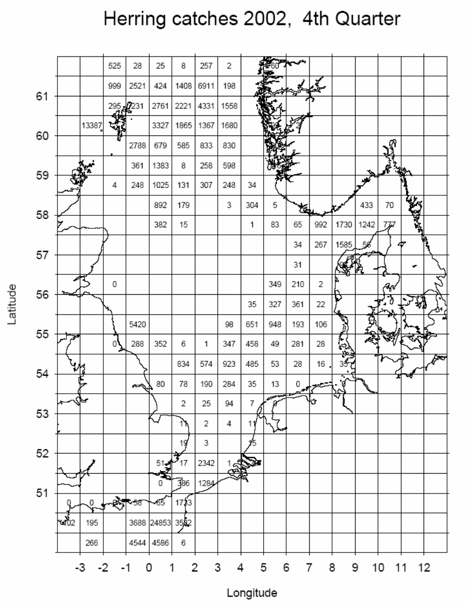
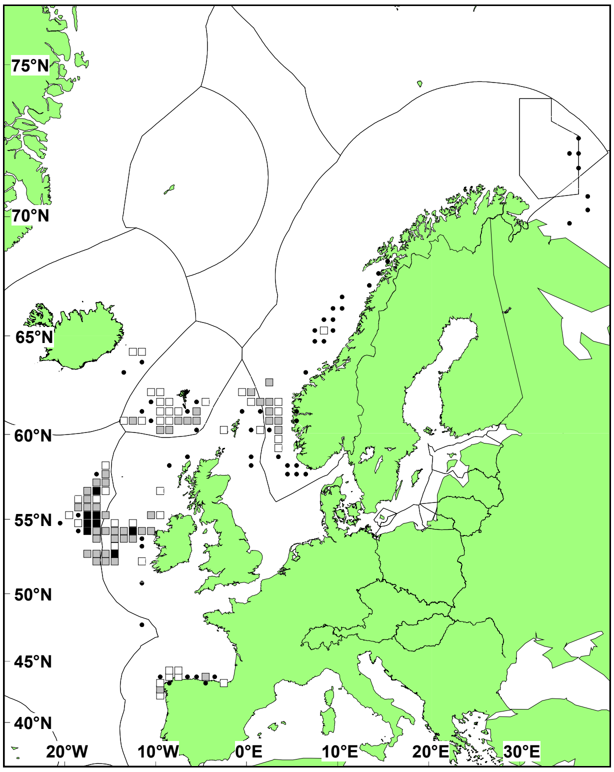
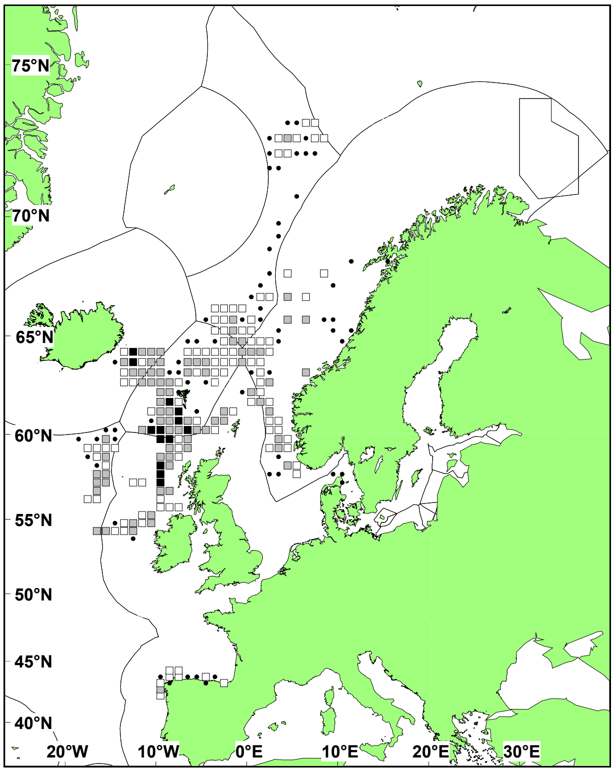


Figure 2.1.1 Herring catches in the North Sea (in tonnes) in 2002 by statistical rectangle. Working group estimates (if available). **d.:** 4th quarter

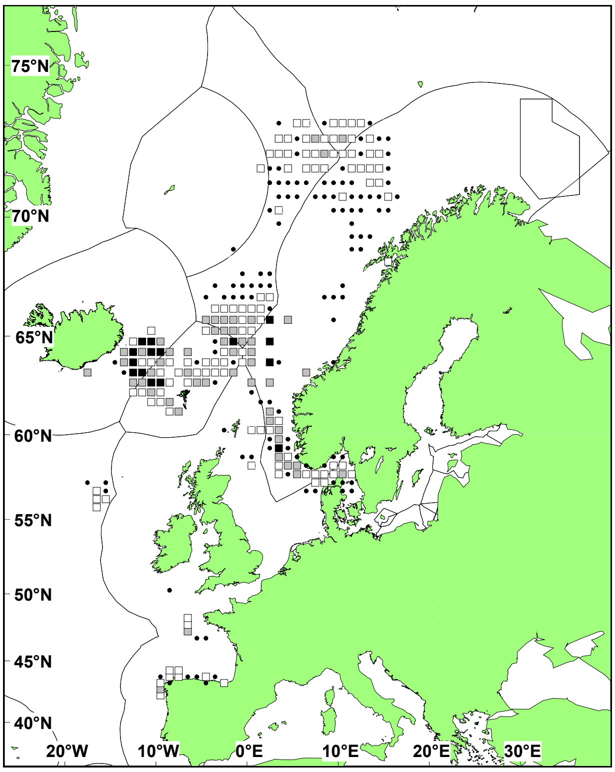
Figure 3.1.2.1. Herring catches in the North Sea, 1st – 4th quarter. From ICES (2003c). Explanations in the panels.



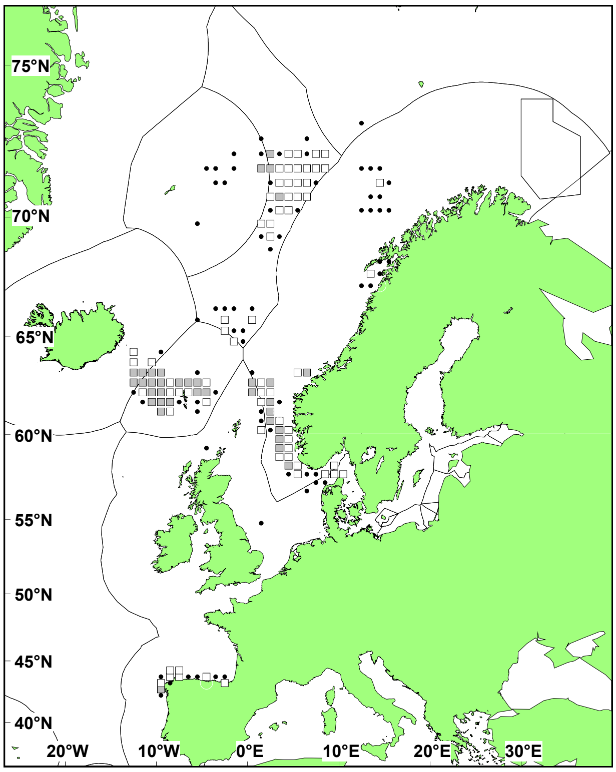
Quarter 1



Quarter 2



Quarter 3



Quarter 4

Figure 3.1.3.1. Total catches of blue whiting in 2002 by quarter and ICES rectangle. Grading of the symbols: small dots 10–100 t, white squares 100–1 000 t, grey squares 1 000–10 000 t, and black squares > 10 000 t. Excluding France, Sweden and Portugal.

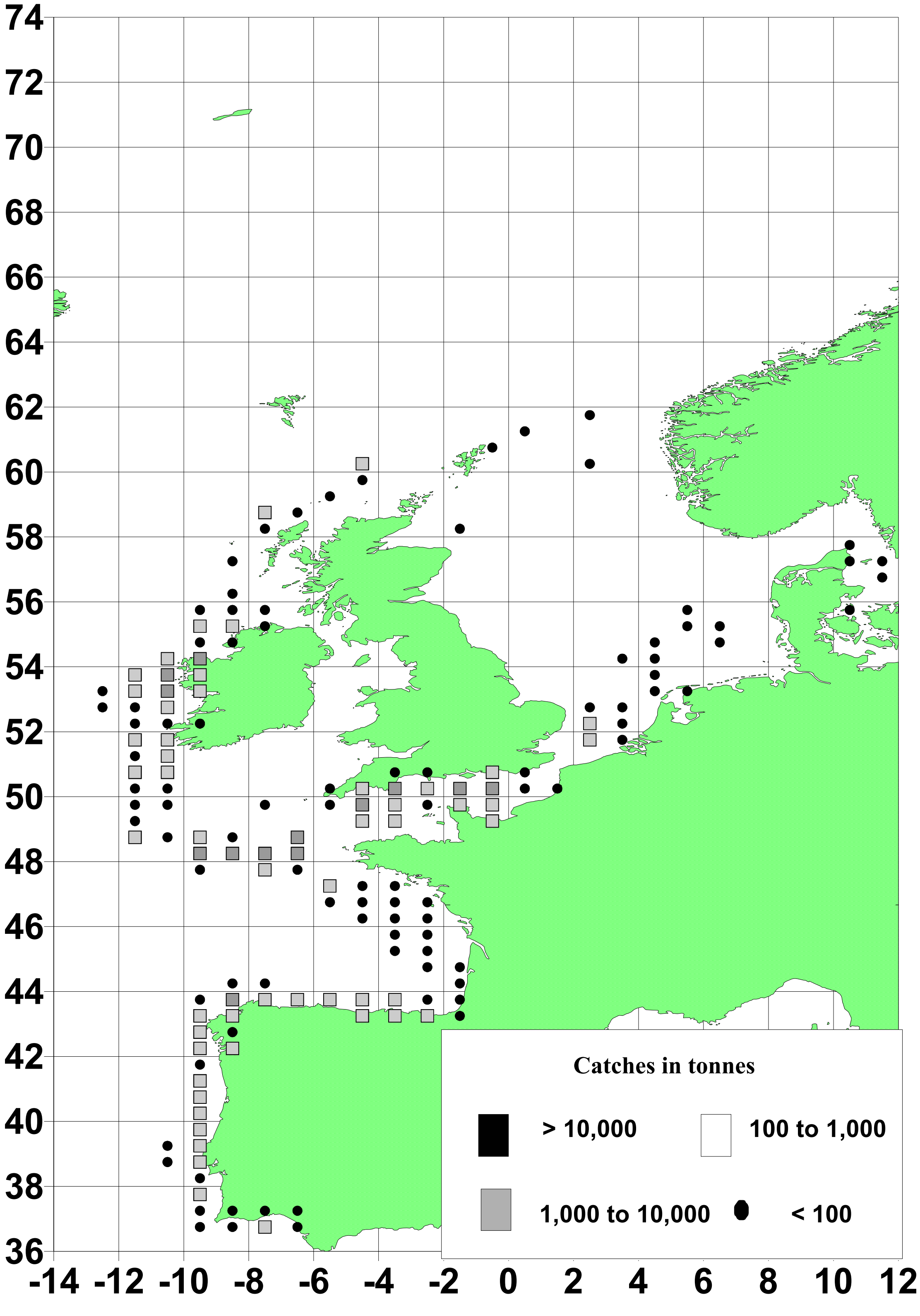


Figure 3.1.5a. Horse Mackerel commercial catches in quarter 1, 2002 (ICES 2003b).

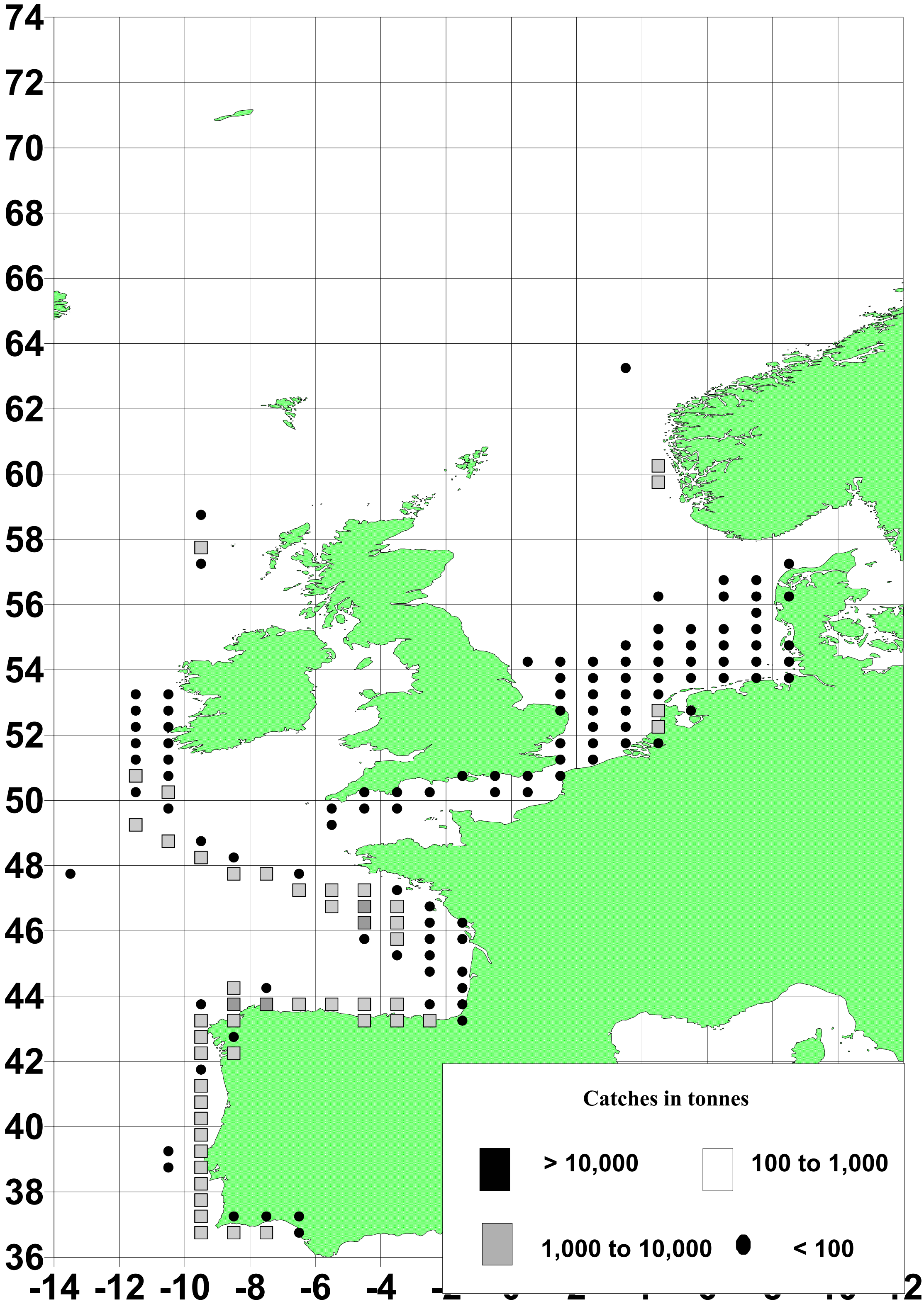


Figure 3.1.5b. Horse Mackerel commercial catches in quarter 2, 2002 (ICES 2003b).

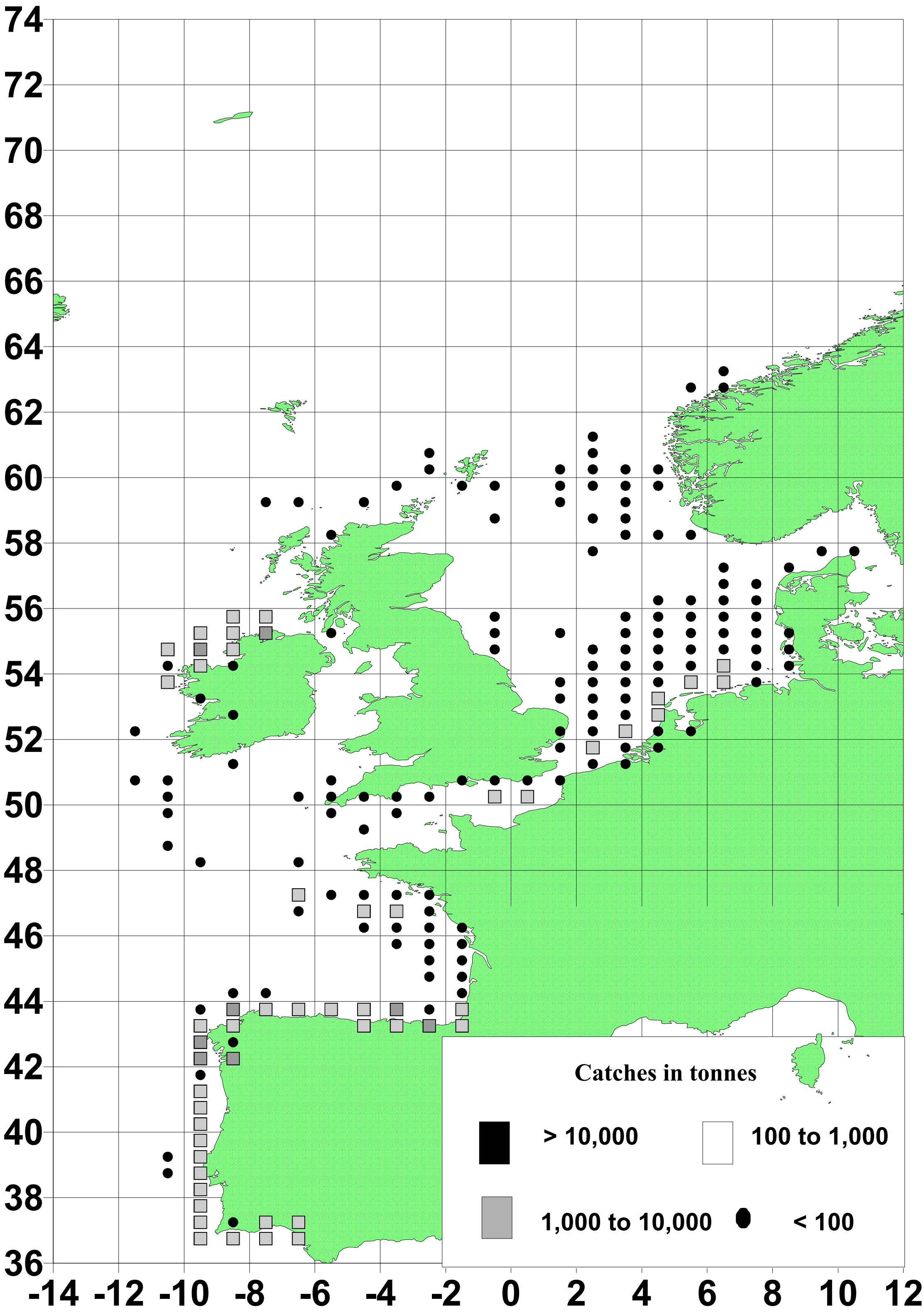


Figure 3.1.5c. Horse Mackerel commercial catches in quarter 3, 2002 (ICES 2003b).

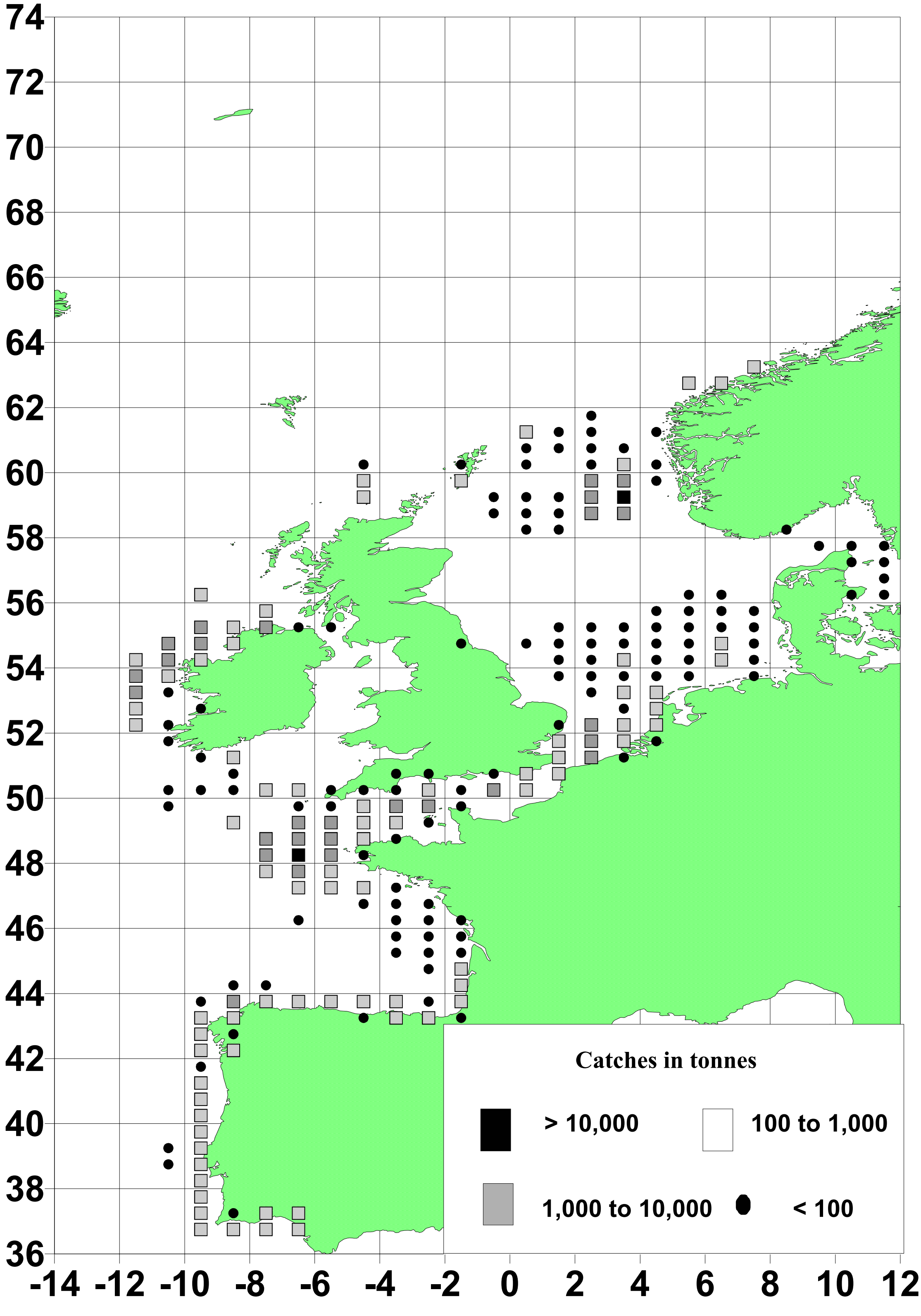


Figure 3.1.5d. Horse Mackerel commercial catches in quarter 4, 2002 (ICES 2003b).

4 SCREENING OF CATCHES AND REPORTS OF BYCATCHES OF SALMON IN RESEARCH AND COMMERCIAL FISHERIES

4.1 Observing salmon in pelagic catches

While adult salmon are relatively easy to observe even in large catches of any of the pelagic species dealt with in the present report, the post-smolts may pose a much greater problem to any observer. When washed around in the cod end of a trawl during a tow the salmon loose their scales and their normal silvery colour becomes bluish green on the dorsal side (Holm pers. obs). Their coloration then becomes much more like that of herring, sprat and mackerel. When lying on deck or passing rapidly over a conveyor belt it will thus be very difficult to distinguish the post-smolts from the other species, especially if their size range is similar or if the post-smolts are present in small numbers within large amounts of other fish. If again they are smaller than the target species, they might be lying unseen under larger fish

Approximate post-smolt sizes as observed in Norwegian research cruises

Area	Weeks 16 – 20	Weeks 21 – 26	Weeks 27 – 31	Weeks 32 – 36
Western UK and Faroes - Shetland Trench areas	No data	15 – 21 cm	--	--
Fjords and coast of Norway	Mean ~ 11.5 cm (west and mid-Norway)	--	~ 12.5 – 13 cm (Northern Norway)	--
Norwegian Sea south	--	17 – 23	21 – 28	--
Norwegian Sea north	--	20 – 25	22 – 29	25 – 32

4.2 Methods of screening and reports from various countries

The Study group has been tasked with reviewing methods used for intensive screenings of pelagic research hauls for the presence of post-smolt. This was felt to be too narrow, because some of the reports of bycatch involved commercial fisheries and also because some of the potential methods for estimating bycatch of salmon in pelagic fisheries may involve screening of other sources of catch. The information available to the Study group on methods used and the results of screening data was provided directly to the group from some of the countries approached for data or from WG reports. Therefore, the Group considered the following screening methods:

- Research surveys (small catch, complete screening, different gear types)
    - Salmon targeted research surveys
    - General pelagic research surveys (e.g., PGSPFN)
- Commercial fishery
- On-shore fish plants

Faroes- No specific land based sampling screening for salmon post-smolts has been initiated in recent years. However, ordinary samples of catches of herring, blue whiting and mackerel from the purse-seiners landed to a fish-meal factory in the Faroes have not revealed any salmon bycatch.

No post-smolt bycatches have been reported in the herring fisheries north of the Faroes in 2003.

Germany- The German pelagic fleet consists of 5 large freezer trawlers (operated in a similar way as the Dutch vessels), fishing for herring, mackerel, horse mackerel and blue whiting. These vessels conducted 34 trips in 2003 (and a similar number in 2002), but reported not a single salmon from these. Germany had observers on board sampling the catch on 21% (7 trips) of the trips in 2003 – but no salmon were recorded. The Study Group was informed that it is considered unlikely that any single larger salmon would be detected by the observers, because those fish would not be recorded in the logbook sheets but used on board instantly. However, it is expected that a larger number of post-smolts would be observed in a catch (Zimmermann, pers. com.). Salmon were not recorded through any other sources of information nor from other fisheries in Germany.

Iceland

Special study on blue whiting fisheries

Screening of blue whiting catches for all non-target-species has been carried out in May – December 2003 at four of the most important landing sites at the east coast of Iceland and two at the south-west coast. The methods used and preliminary results of this study were cordially handed over to the SGBYSAL (Paalsson, in prep). The study is based on samples, as randomised as possible, from 42 fishing trips performed by the operating blue whiting fleet which consisted of 21 vessels.

During landing the catch was weighed continuously in bins of 500 kg. From the first 1000 tonnes of a catch one sample per 100 tonnes was taken. From the part exceeding 1000 tonnes sampling was calculated as (catch-1000)/200, i.e., one sample per 200 tonnes, arriving at a maximum of 15 samples from a catch as a whole. The samples were distributed randomly over the catch by generating a set of random numbers in accordance with the size of the catch, and samples were taken from the catch when landed weight matched those numbers. Every sample was processed in a standardized manner: 1) the total weight of a sample was recorded and was mostly in 400 – 600 kg interval, aiming at a mean of 500 kg; 2) bycatch species were identified, counted measured and weighed. Catch of blue whiting was calculated by subtraction.

Except for two samples coming from trips south west of the Faroes, most other samples until August were collected from catches taken in deep waters east of Iceland. In September through November, however, the samples came from trips in the south-west area of the Iceland-Faroe-Ridge. The fishing area is shown in (Figure 4.2.1). No sampling was carried out in March and April because facilities for accessing and handling the samples were not in place.

The fishing activity was low during these months (22.3K tonnes). No salmon were found during inspections.

Other pelagic fisheries

The Icelandic herring fishery has not been screened as systematically as the blue whiting fishery. Only two trips were sampled in 2003 for the Icelandic fishery on the Atlanto-Scandian spring spawning herring, and no salmon identified. The fishery on the Icelandic summer spawning herring was sampled somewhat more (~ 10 trips), but no salmon identified. However, in several occasions there have been reports on bycatches of salmon in different commercial fisheries in Iceland (Sturlaugsson pers com). A report of a bycatch of 200 1-SW salmon in 800 tonnes of herring taken with a pelagic trawl in the Svalbard area was provided to the NASWG in 2003 (ICES 2003). The fishing took place in early August 2002 southwest of Svalbard at 75° 40´ N and 9° 20´ E. Among the salmon, a tagged fish (Drammen River, Norway) was found. There is also historical information from the 1960s indicating bycatches of up to 30 salmon per haul in the herring fishery in Iceland. (Gudjonsson unpublished, cited in ICES 2003a). There is no information of whether such bycatches are occurring annually, or if they are rare events only occurring in certain years.

Ireland- The Irish Marine Institute conducts regular biological sampling of its pelagic fisheries as part of its sampling programme for the EU data directive. Random samples (50–150 kg) are taken for length, weight, sex, maturity and age. Samples are taken from commercial hauls at sea, commercial landings as well as research hauls particularly for mackerel, blue whiting, horse-mackerel and herring. No observations have been recorded for post-smolt and adult salmon during sampling and communication between fishermen and processors has not revealed any salmon bycatch. The main pelagic fisheries take place during Q1 and Q4 with only a limited fishery in early Q2 outside the main time frame for smolt migration, so bycatch should not be considered a problem for the post-smolts.

Netherlands - The Dutch perform screening on board their commercial ships and when ships are landing the catch in the Netherlands the log book data where all non-target species should be recorded together with the catch has to be handed over.

After the meeting, the Study Group Chair was provided with information on by- catches of salmon recorded from official logbooks from North Sea catches landed by the Dutch and foreign fleet at landing sites in the Netherlands in 1995–2003. Since this is the only known data set where salmon have been recorded on a regular basis from commercial catches, the group felt that it should be included although it has not been dealt with at the meeting.

The data is summarized in the text table while the raw data are appended (Appendix II).

Year	Dutch vessels, kg	Other vessels, kg	Grand Total*, kg
1995	1,284	85	1,369
1996	1,661	147	1,808
1997	892	55	947
1998	778	151	929
1999	661	121	782
2000	444	39	483
2001	106	5	111
2002	13	no record	13
2003	12	no record	12
Total	5,851	603	6,454*

*It should be noted that a large portion of the catch may be sea trout, see below.

According to information provided to the Study Group (Eltink pers. com.) the log books give only "salmon" as an option for recording salmonid bycatches, and many fish registered as salmon are in fact sea trout. Studies carried out by RIVO in the Ijssel Lake 1994–2003 for investigating bycatches of salmonids indicated that of the bycatch > 90% were sea trout and < 10% were salmon. A sampling programme in the river Rhine indicated that over 80% were sea trout and less than 20% were salmon (Eltink, pers. com.).

The distribution of bycatches of salmonids per statistical rectangle in the North Sea are presented in Figure 4.2.2, while the monthly data pooled for 1995–2003 are presented in Figure 4.2.3.

The Study Group was informed that the decrease in recorded landings of salmon in the Netherlands can be attributed to two factors:

1) There is an EU regulation 850/98, which prohibits landings of salmon by fishing vessels using non-static gears in ICES Sub-areas IV, VI, VII, VIII and IX, which explains the decrease since 1998.
2) Landings of less than 50 Kg do not have to be reported for the official catch statistics (it is not known from what period this applies).

Information provided by RIVO, Netherlands, indicates that sale slips from the fish markets could provide a better source of information on the bycatches of salmon, because these would include the landings smaller than 50 kg. e.g., when the official catch in 2003 is 12 kg, the total of the sale slips indicate landings of 103 kg. The RIVO is negotiating to get access to the Dutch sale slip data base. However, the Dutch consider it less useful to use sale slips for recording salmon after the introduction of the EU regulation 850/98, which makes all other landings of salmon illegal, except those from static gears. This implies that it is now more or less impossible to extract any useful information on salmon bycatches either from the Dutch landing statistics or the sale slips from the fish markets. In this situation, the most useful information could possibly be obtained from reports from the discard trips on board of pelagic and bottom trawlers, which should report on salmon bycatches, if there are any. (Eltink, pers. com).

From Figure 4.2.2 can be seen that the highest densities of salmonid bycatches are recorded close to the coast with a peak occurring outside the Rhine estuary. These catches consist probably to a high degree of sea trout (see above) as this species has a more coastal distribution pattern than the salmon. It is also worth noting that on a temporal scale the recorded bycatches are highest in June (Figure 4.2.3), which may reflect a homing pattern for both species. Another peak is occurring in October (Figure 4.2.3). In the absence of data on the fishery in these areas it is impossible to tell whether the latter peak arises from higher fishing activity or whether it reflects a true aggregation of salmonids.

During 1995–1999 the fishermen were not obliged to log from which fishing gear the bycatches were derived, therefore the salmon bycatches distributed per fishing gear (kg) in the table below only covers the years 2000–2003:

	Gear								
Year	GNS	GTR	MIS	OTB	PTB	PTM	TBB	TBS	Grand Total
2000	2		15	129	108	1	190	38	483
2001	6	97	3				5		111
2002	3		3	5			2		13
2003				12					12
Total	11	97	21	146	108	1	197	38	619

GNS and GTR = gill nets and tramle net. TBB = beam trawl MIS = miscellaneous TBS = shrimp trawl
OTB and PTB = otter trawl (single boat or as pair trawler) PTM = pelagic midwater trawl (pair trawler)

The distribution of the bycatches indicate that salmon occur consistently as bycatches in most types of fisheries. As could be expected, the largest bycatches have been retrieved from different trawl gears.

Although the Study Group recognises that a large proportion of these bycatches may not be salmon, but sea trout, the conclusion to be drawn from the Dutch data set is that the interception of adult salmon might be much higher than earlier anticipated. The absence of salmon records from the pelagic catches may thus arise from "non-reporting" rather than from "non-presence". It may also be noted that as long as landing of salmon from certain gear types is illegal, land based screening of catches will be of no use.

Norway

Commercial screening

The commercial fisheries sampling in Norway is similar to the Irish sampling. Small random samples from commercial landings are taken. No salmon have been recorded.

Research surveys

Data on occasional by catches of posts-smolts in the pelagic surveys have been recorded in a few cases dating back to the 1980-ties, but consistent records of post-smolts did not occur until the 1990s. The Norwegian research surveys are described in Section 2. Since 2001 high ratios of post-smolts per catch of mackerel have been recoded in salmon surveys in areas west – northwest of the Vøring Plateau. Ratios that would correspond to up to 57 post-smolts per ton of mackerel have been found in the research surveys (see text table below). It is anticipated that the introduction of a special salmon trawl (Figure 2.1.2) may lead to overestimation of the number of post-smolt taken, as this gear is specially designed to catch salmon and is operated with the head-line constantly in an on-surface mode.

Post-smolts and bycatches in Norwegian research trawls					**Post-smolts per ton Mackerel**	
	Norwegian EEZ		International zone		Norwegian EEZ	International zone
Year	No	Mackerel tonnes	No	Mackerel tonnes	ratio	ratio
2001	198	7. 96	-	-	25	-
2002	159	2.78	431	16.35	57	26
2003	66	11.19	370	14.57	6	25

Russian Federation

Commercial screening

In 2002 the Russian Federation carried out a comprehensive programme to study potential bycatch of Atlantic salmon and post-smolts in the Russian mackerel fishery in the Norwegian Sea.

In June-August 16 scientific observers and fisheries inspectors worked onboard Russian fishing vessels. Their tasks included, *inter alia*, screening of the mackerel catch for potential bycatch of Atlantic salmon. With assistance from the vessels' crews, catches by 20 of the nearly 50 Russian fishing vessels, which fished mackerel in the Faroese EEZ and international waters in 2002, were screened on board during the discharging of the trawl catch into bins and at a ship factory during grading.

Commercial hauls were done by pelagic trawl (without additional floats on the head-line), in which the horizontal opening varying from 50 to 100 m between vessels. Mesh size in the front part of the trawl near the headline was 10–40 m. The minimum mesh size in the blinder was 40 mm. Hauls were done at a speed of 4.8 to 6.5 knots. Catches from a total of 1070 hauls, or 25% of all hauls done by the Russian vessels during the fishing season were screened in the Norwegian Sea in 2002.

Month	Number of hauls		% screened
	Total	Screened	
June	232	46 (5 vessels)	20
July	2897	595 (20 vessels)	21
August	1222	429 (14 vessels)	35
Total	4351	1070 (20 vessels)	25

Catch from screened hauls varied from a few hundreds of kilos to 87 t. The average catch of mackerel per haul for inspected vessels was 17.5 t varying from 2 t to 42 t between vessels. From catches exceeding 10 tonnes one to three samples of 3000 kg each were taken for screening.

In June 46 of 232 hauls done by 5 vessels were screened (Figure 4.2.4). In two hauls three post- smolts and three adult salmon were found. The catch from one haul (2 post-smolts) contained 150 kg of mackerel and from the other (1 post-smolt and three salmon) 3 t of mackerel. Russian catch of mackerel in this period was 2,135 t.

In July 595 hauls of 2,897 were screened. In 9 hauls with a varying catch of 1.5 t to 12 t of mackerel 9 post-smolts were found. In another 9 hauls (catch of mackerel from 100 kg to 15 t) 9 salmon were found. Russian catch of mackerel in this period was 29,802 t.

In August 429 hauls of 1 222 were screened. No post-smolts were reported. In three hauls with a catch from 100 kg to 7 t of mackerel three salmon were found. Russian catch of mackerel in this period was 7,509 t. The bycatch data found during screening are summarized in the text table below.

It is reported that the observers were certain that, even in large catches, they were able to detect most of the salmon present.

Month	Catch, tonnes					
	Total*		In screened hauls			
	All species	Mackerel	All species	Mackerel	Post-smolts, indiv.	Salmon, indiv.
June	2344	2135	289	245	3	3
July	35744	29802	5683	4156	9	9
August	14334	7509	4940	3359	-	3
Total	52422	39446	10912	7760	12	15

* Provisional figures

United Kingdom Screening is performed but no salmon reported.

The detection of salmon from screening performed on commercial catches and biological samplings reported by various countries is summarised in Table 4.2.1. No data were available to the Study Group for the countries not listed in the table.

4.3 Evaluation of bycatch screening methods

The Group considered the screening methods reported (Sectiom 4.2) applying to the categories above (Section 4.1) and examined their advantages and disadvantages in providing data of use in input into bycatch estimation methodologies and whether existing protocols had been established for catch screening.

Research surveys- The advantages of the research survey based screening methods lie in the manageable small catches per haul, which facilitate detailed sorting of the catch by hand by experienced scientists. This is likely to provide the best estimates of distribution of salmon in the ocean, but has a major disadvantage as input data for estimation of bycatch, as the methods of fishing and the gear used are usually considerably different from the commercial fisheries (see Section 4.2 for details).

Similar comments apply to the research surveys carried out as part of pelagic fishery stock assessments, as again catches are small and are sorted by highly experienced persons, while fishing gear and methods differ from commercial fisheries. This is a necessary feature of these surveys, as they are not designed to replicate commercial fishing, but to assess abundance and distribution of a range of pelagic species. ICES has not established protocols for these research surveys.

Evaluation: The Group considered that scanning research survey catches for salmon although highly accurate was not viable for the purpose of extrapolation to estimated bycatch in the commercial fishery, unless extensive inter-calibration trials of the research and commercial gear were carried out. It was felt that the resources involved in doing this to provide conversion factors would be better expended on improving and intensifying screening of commercial catches. As screening will necessarily involve slowing down the commercial operation (perhaps only half the tows normally undertaken would be possible), some payment may have to be made to achieve access to catches as there will be commercial penalties for the lower catches that result.

Clearly, commercial catch screening methods cannot examine all the catch, as numbers are large, thus it is necessary to sub-sample many of these hauls to provide coverage of the catch. This principle was applied by Russia in the large scale observed based screening programme of the mackerel fishery in the Norwegian Sea in 2002 as reported to ICES in 2003 (ICES, 2003).

While ICES have established protocols for the screening of catches in mixed and industrial fisheries (e.g., sandeels), there are no set protocols for the mackerel or herring fisheries because they are seldom mixed with other species. The Russian screening operation described above is however regarded by ICES (NASCO 2003) as a viable screening protocol. Further consideration may need to be given to differ protocols for the herring fishery, as the numbers are much higher and this may indicate either a large number of small sub-samples are needed, or alternatively a small number of much larger samples.

In order to assure a best possible detection rate of salmon the study group suggested that when carrying out intensive screening programmes on board commercial mackerel vessels, a system of grids should be used to segregate catch into size classes with grids spaced such that salmon are separated from mackerel.

The Group endorsed observer based screening programmes for pelagic fisheries and concluded that it should be possible to establish suitable protocols for such screening. For example, the analysis by the Study Group of the overlap in time and space between salmon and the mackerel fishery suggests that screening may only be required during a relatively restricted period of time in the fishery, thus a more intensive programme may be considered. The group noted that screening is most viable on board factory vessels, where fish pass along conveyor belts, in contrast to tank vessels where catch is pumped directly into holding tanks and screening is not possible.

The Study Group has examined some reports of screening carried out at fishmeal plants on shore. In these cases, numbers of fish processed are even higher than at sea and throughput is fast, making reliable screening very difficult. Furthermore, the origin of the catch is not fully known in some cases and fish samples may in fact not be from the locations and times of interest. The Study Group did not recommend this method for estimating bycatches of salmon.

However, in other fish plants like filleting factories, non- target species are sorted out, as they will not fit into the filleting machines, the group therefore felt that this method should be further explored

Based on the above evaluation the Group made the following recommendations:

1) Research catches should continue to be screened for presence of salmon, as this will add to the knowledge base on distribution of salmon at sea and will help refine the spatial and temporal coincidence of pelagic species and salmon.
2) The Group strongly recommends screening of commercial catches on board commercial fishing vessels in pelagic fisheries that are of relevance to potential salmon bycatch. Protocols should be established for screening herring and mackerel fisheries, as these are likely to require special screening methods.
3) The possibility for screening of discards from filleting factories should be explored.

Table 4.2.1. Summary of screening and sampling carried out by some of the NEAC countries and results of screening with reference to salmon.

Country	Screening of commercial catches		Biol. Sampling of pelagic species	
		Salmon found		Salmon found
Germany	Yes	No	Yes	No
Faroes	No	No	Yes	No
Iceland	Yes	Yes	Yes	yes
Ireland	No	No	Yes	No
Netherlands	Yes	Yes	Yes	No
Norway	No	No	Yes	yes
Russia	Yes	Yes	Yes	yes
UK	Yes	No	Yes	No

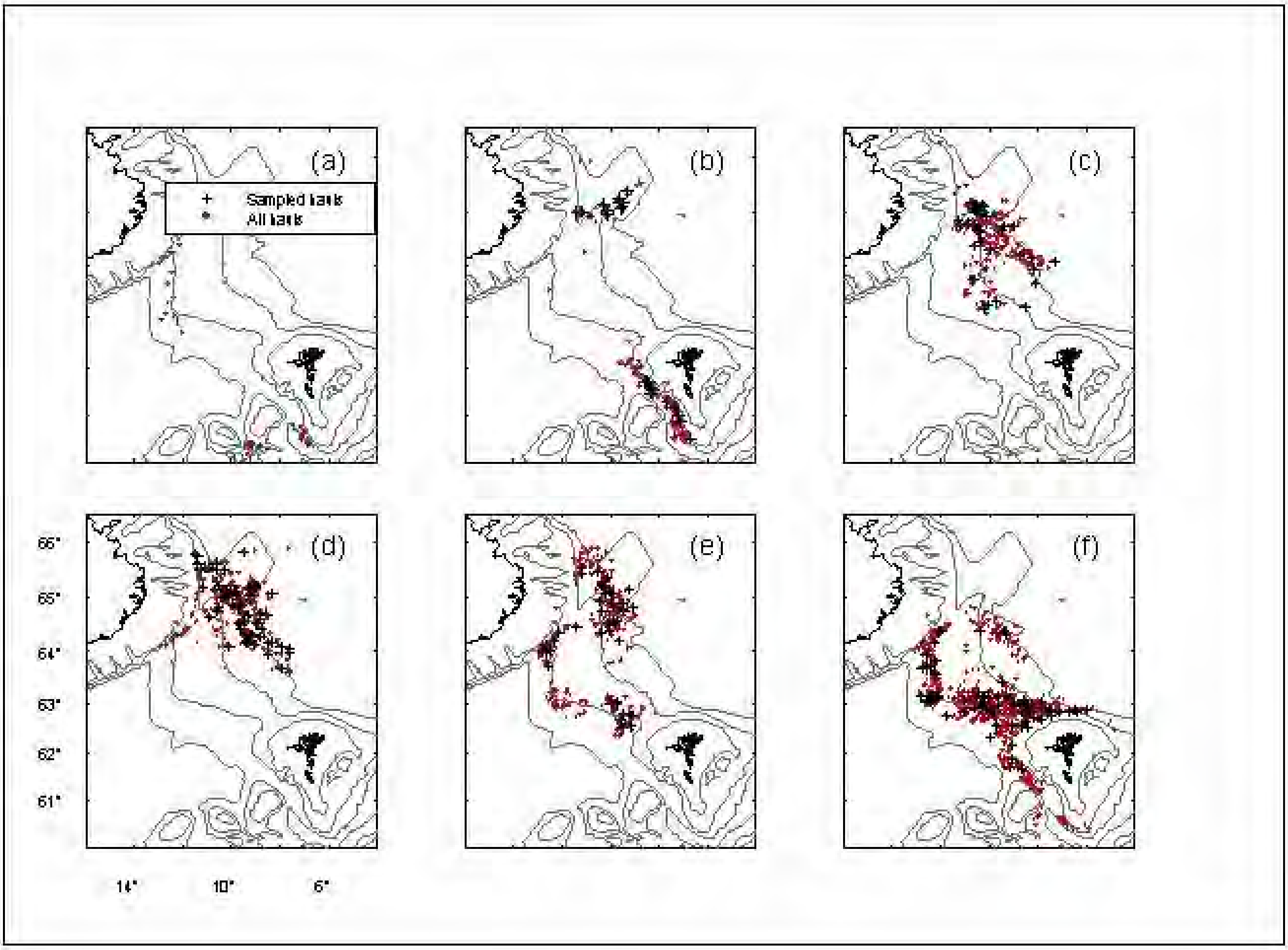


Figure 4.2.1. Plot of sampled hauls and all hauls worked by the Icelandic blue whiting fleet in 2003: a) March-April (no sampling), b) May, c) June, d) July, e) August, f) Sep.-Nov.

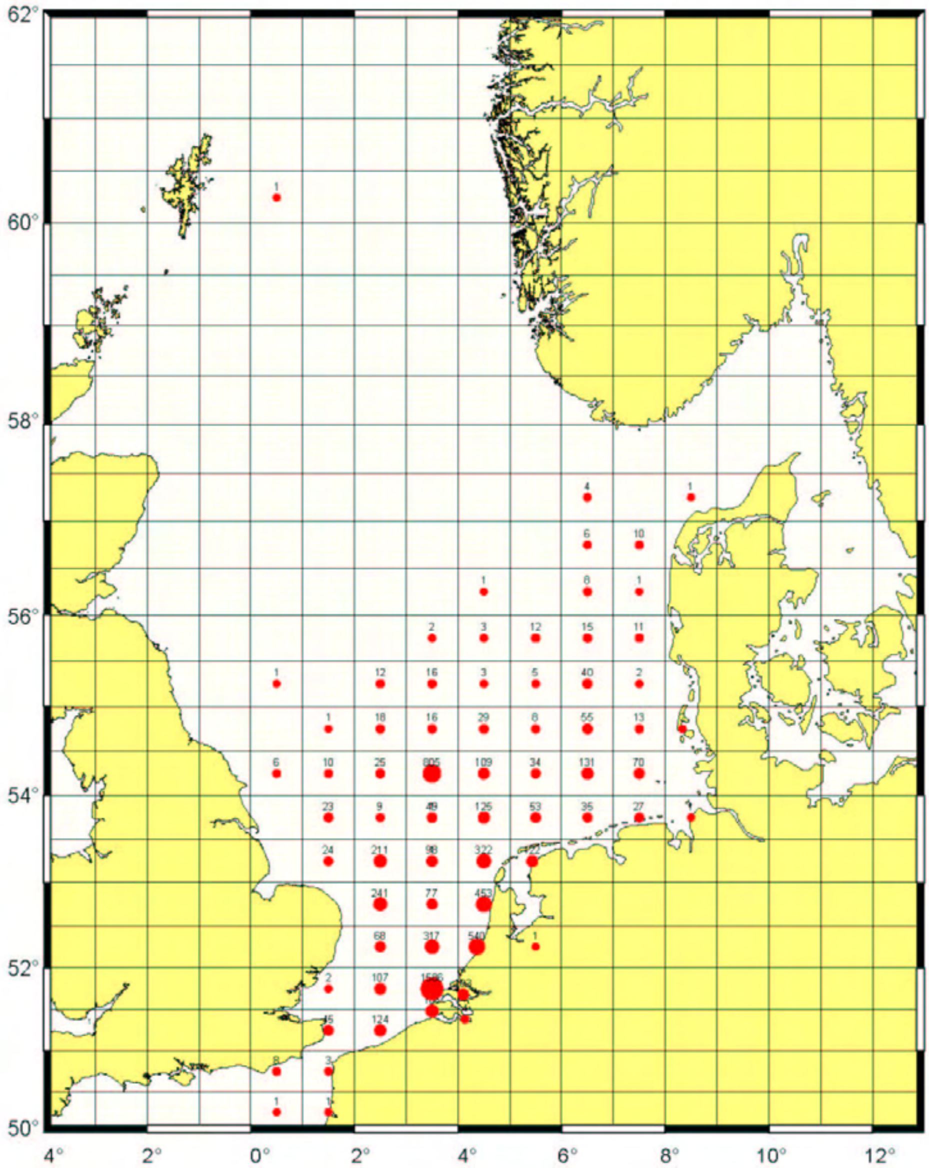


Figure 4.2.2. The distribution per statistical rectangle of landings of salmonid bycatches reported in the Netherlands in Areas IVb,c 1995–2003. The size of the filled circle indicates size interval of catch and numbers indicate the weight of the catch for each rectangle in kg pooled for 1995–2003.

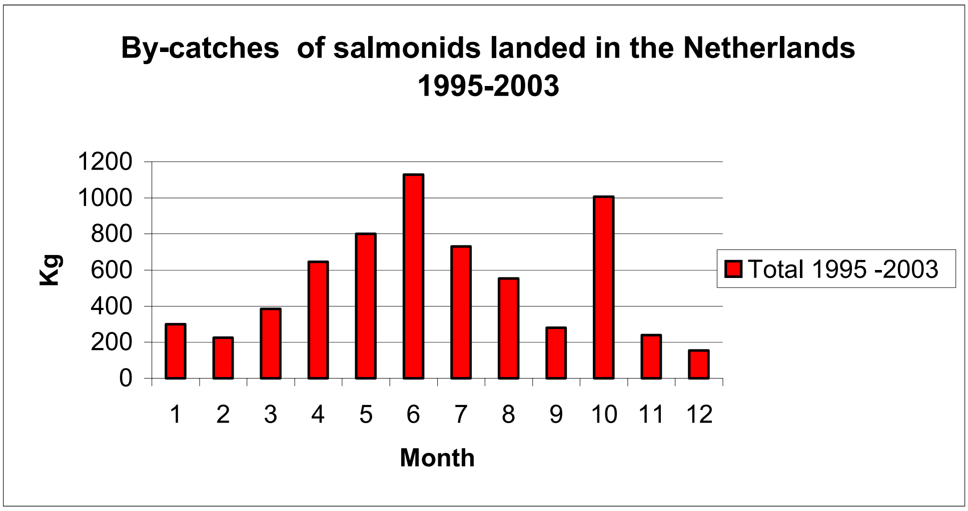


Figure 4.2.3. Monthly distribution of bycatches of salmonids recorded at landing in the Netherlands. Data from 1995–2003. The amount of fish from which these bycatches were extracted is not known.

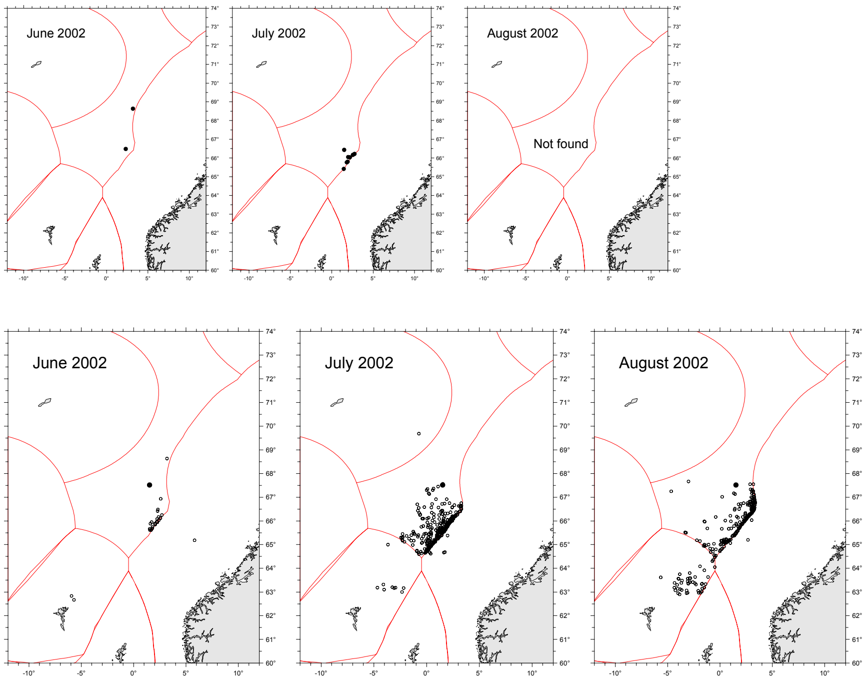


Fig. 4.2.4 Upper panels: Post-smolt by-catch in Russian mackerel fishery in 2002. lower panels: Positions of commercial trawl hauls screened for post-smolts. (Circles in NEZ show positions of screened blue whiting catches containing mackerel as by-catch).

5 EXPLORATION OF ANALYTICAL METHODS AND POTENTIAL FOR ASSESSING SALMON BYCATCHES IN PELAGIC FISHERIES

The Study Group has been asked to explore analytical methods to allow catch rates of salmon in research surveys to be extrapolated to catch rates in commercial fisheries. The Group felt that this requirement should be extended to include all possible methods of assessing salmon bycatches in pelagic fisheries, as the research fishery method, although the only one previously used for the extrapolation (ICES, 2002), was not the only approach available.

The study group examined a number of potential methods for estimating bycatches of salmon, including:

- Extrapolation from research surveys;
- Extrapolate directly from commercial fishery observer programme;
- Take all sources of catch rates for all years and establish a range of catch rates. (weighted by source/gear type) that are then applied to commercial catches;
- Others (e.g., large scale salmon tagging programmes and coordinated releases).

The research survey based method has been the only method of assessing bycatch so far applied by ICES (ICES, 2002). This requires establishing catch rates of for salmon (for example, salmon per tonne of mackerel caught).These data are then applied to tonnage's of mackerel taken by the commercial fishery during the appropriate time and place. As noted in Section 4.3 above, the Group felt that application of research survey data for assessment of potential bycatch was not viable, unless extensive inter-calibration trials of the research and commercial gears were carried out.

The Group considered that the best method of estimating bycatches of salmon would be derived from direct observation on board commercial pelagic fishing vessels (applying screening methods outlined above). These estimates would be based on consistent gear types and fishing methods and would not require any assumptions about the transferability of research catches.

An alternative might be to compile a range of estimates of catch rate derived from a variety of sources including research surveys, commercial vessel observations and any other sources of data where reliable catch rates could be developed. These would then be used to establish a range of possible values, but which would be weighted by gear and fishing methods as determined from appropriate calibration exercises or assumptions on behaviour of salmon, as such data become available. This category necessarily excludes reports of salmon bycatches where a catch rate cannot be derived.

A further method of estimating was considered which involves use of existing and/or proposed tagging programme to indicate the presence of salmon in pelagic catches. As many salmon are presently released with CWTs and several proposed studies call for large scale co-ordinated releases of tagged salmon, an opportunity may arise to use this as method of assessing salmon bycatch. It is feasible to use tag detection equipment on board fishing vessels in order to screen large volumes of catch for presence of tagged fish. However, no proper screening system is available at present.

The Study Group developed a range of estimates of potential post-smolt bycatch based on the data available at the meeting. These are given in Table 5.1 as illustration of the likely ranges of values obtained by applying different methods to the mackerel fishery in the Norwegian Sea and are presented here for the purposes of assessing the performance of the various methods. **It is emphasised that these values are not to be regarded as formal estimates of bycatch in any particular year or fishery and are not to be used for assessment or management advice**. These need to be discussed further when more adequate data sets are available.

The numbers presented in Table 5.1 indicate that with the input data currently available, the research survey method clearly leads to an overestimates the bycatches as the estimated numbers arrived at (up to several millions of post-smolts) would represent a major part of the pre fishery abundance of salmon in the whole NEAC area. On the other hand it is equally obvious that the observer based method in its present form may not detect but a fraction of the post-smolts, as the numbers arrived at by scaling up with the total commercial catch from three months of fishery in potentially high density post smolt areas, remain less than 100 fish.

Consequently the Study Group felt that there is a considerable development work to be done before the salmon bycatches in pelagic fisheries can be properly assessed.

The Group made the following recommendations:

1) Methods of estimating of salmon post-smolt bycatches should be developed primarily via observer screening programmes on commercial fishing vessels. This will minimise assumptions required to extrapolate from research surveys.
2) Regardless of whether research catches or screening of commercial catches is used to make estimates of captures of post smolts in the fishery, weekly disaggregated catch data are a prerequisite. The estimate presented by ICES in 2002 used quarterly data and thus is not viewed by the Group as reliable
3) The Study Group should reconvene when disaggregated catch data for all the different fisheries listed in Table 3.2.1 is available.
4) Work should be carried out to apply a range of bycatch estimates to known data on salmon abundance and survival trends in the stocks in question (southern NEAC stock complex mainly) to determine whether the present preliminary and crude range of levels of potential bycatch can account for recent changes in abundance or survival at sea.
5) It is recommended to develop appropriate models for estimating levels of bycatch and to raise these estimates to total numbers of salmon caught in the different fisheries
6) Work should be carried out, under a range of bycatch rate scenarios to determine the scale and nature of any tagging programme that would be required to yield reliable estimates of bycatch.

Table 5.1 Range of estimates of potential bycatch of post-smolt and salmon in the Norwegian Sea (international zone) based on data available at the meeting. Calculations as in ICES 2002.

Norway	Source of info	Year	X_1 Total no. smolts/ total catch of mackerel, t	Estimated number of post-smolts potentially taken	X_2 Unweighted mean of no. smolts / weight of mackerel, t	Estimated number of post-smolts potentially taken
	Research catches	2001	16[1]	608,000 [2]	25[1]	950,000[2]
	"	2002	26	1,024,400[3]	120	4,728,000[3]
	"	2003	25	985,000[4]	190	7,486,000
Russia	Observer data	2002- June	0.012	26	n.a	
		2002- July	0.002	64	n.a	
		2002- Aug.	0	0	n.a	

[1]Only the Norwegian EEZ sampled in 2001,
[2] Total mackerel catch given as 38 000 t
[3]Total mackerel catch given as 39 400 t
[4] Same catch as in 2002 used for calculations

6 PROSPECTS FOR REDUCING IMPACTS FROM THE PELAGIC FISHERY ON POST-SMOLTS

6.1 The "smolt passage model"

The Study Group was presented with a method for estimating the progress in time and space of post-smolts cohorts in the Norwegian Sea.

Research catches of post-smolt taken in the Norwegian Sea and adjacent waters during the last 10 years have indicated major migration paths of southern European and southern Norwegian salmon. Based on the knowledge of the progression of migrating post-smolt cohorts it should be possible to make models for indicating areas where major fisheries should not take place in periods when the main concentrations of post-smolts of Atlantic salmon are present. This chapter describes the initial principles of such a model. It must be emphasised that the model has to be further refined when more data become available.

6.2 Underlying principles

The smolts runs are known to take place in spring with the earliest runs in the southernmost rivers occurring progressively later in more northerly rivers. The progressive delay in runs with the northerly latitudes means that fishes entering the sea at different latitudes will get a denser distribution than if they would have all entered the sea at the same time. This may for instance have important anti predator effects. The research catches from the Norwegian Sea strongly indicates that the distribution of post-smolts originating from a large numbers of rivers of varying latitudes are remarkably well concentrated on their way to the feeding grounds (Holm *et al*. 2003). If possible to manage the identified intercepting fisheries in such a way that these northward progressing post-smolt concentrations are not fished upon, the potential bycatches of post-smolts could be significantly reduced. By refraining from fishery in certain areas in order allow the densest cohorts to pass, a relatively "safe passage" for the post-smolts could be attained. The model presented below tries to estimate on a temporal/ spatial scale which area would be protected.

The model is based on four years of trawl data taken in the area on and to the west of the Vøring Plateau, from about 63ºN to 69ºN, 7ºE-2ºW.

The trawl catches suggest a typical N-S extent of the main post-smolt distribution of at least 6–7 degrees latitude, equivalent to 360–420 nautical miles (670–780 km) (Figure 6.2.1). Given a swimming speed at 2 body lengths per second (0.42 m /sec), it will take 18–21 days for such a concentration of cohorts to pass a given position in the sea. If the distribution is approximately symmetric on a north-south range, the maximum concentration will pass after half of the time. Given it would be possible to find the maximum concentration of the cohorts, the area 3–4 degrees north and 3–4 degrees south of this spot would represent the latitudinal extent of the "safe passage" area. Correspondingly, east-west extent of the post-smolt cohorts would have to be assessed.. In the present context the focus is placed on the international zone in the Norwegian Sea. The model will be tried out for a larger area and presented to the ICES working group on Atlantic salmon at a later stage.

6.3 Results

The potential period of overlap between post-smolt distribution and mackerel fisheries in the international zone in the Norwegian Sea is in the latter half of June and early July. Based on the available data post-smolt captures, area and time period where surface fishing should be avoided was estimated (Figure 6.3.1). Provided a migration speed of 2 body lengths S^{-1} and based on the data sets currently available, the model would infer that a surface near fishery could commence in the southern parts of the international water in early July and then progressively move northwards to arrive at 70ºN towards the end of the month.

In addition, experiments carried out by the Institute of Marine Research in 2002 and 2003 with towing the trawl with the headline secured below 5 m indicate that further post-smolts might be saved from being intercepted.

The Study Group discussed the model and concluded that it might become a useful tool for assessing the possible degree of overlap/ segregation between the migrating salmon and fisheries in an area. Also, although it was felt that the model still needs some further refinement, it may also be explored as a method of minimizing the risk of post-smolts being intercepted by the commercial fishery in the area of passage.

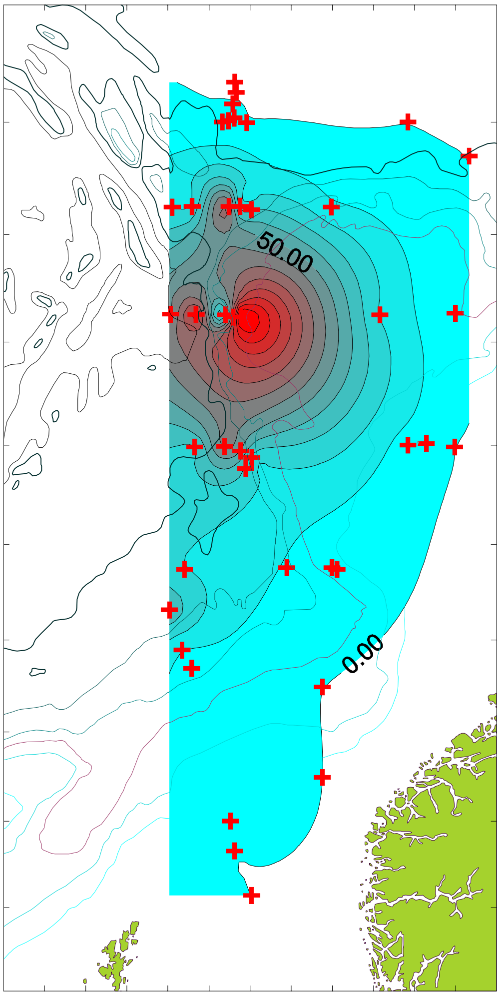


Figure 6.2.1. Distribution and number of post-smolts in surface trawl catches taken by R/V "Johan Hjort" between 23 June-8 July 2003. Isolines of 10 post-smolts per catch.

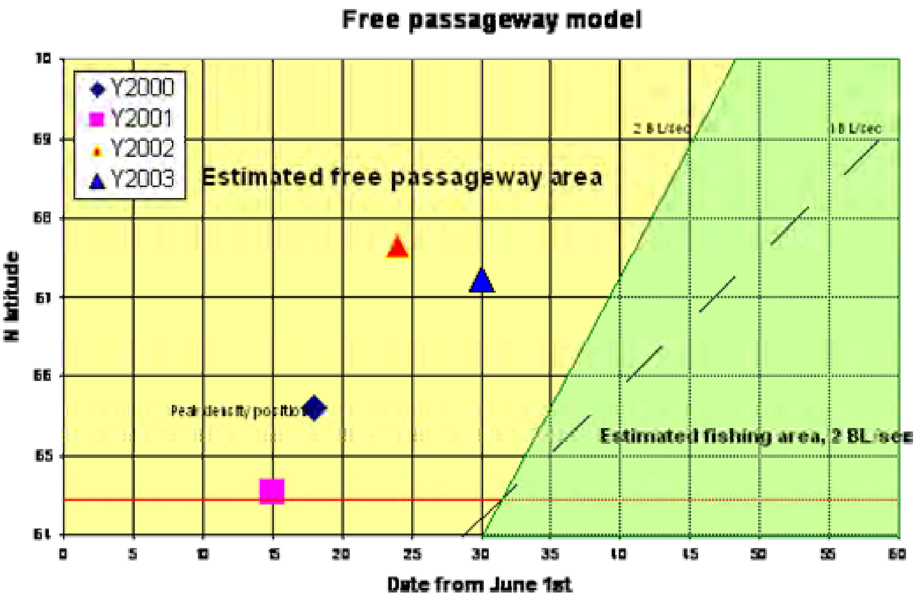


Figure 6.3.1. Areas estimated as free passageway and fishing areas given swimming velocities of 2 (green area) and 1 body lengths per second in the areas from 64ºN to 70ºN along the 0º longitude (Vøring Plateau area) in the Norwegian Sea. Red line is southern latitude of international zone. Points are estimated positions of maximum post-smolt distribution in 2000, 2001, 2002 and 2003.

7 RECOMMENDATIONS

From the information available to the Group under the different sections, the Study Group drew the following conclusions which are carried forward as recommendations for a follow up of the SGBYSAL work:

From Section 3

1) Given the obvious lack of information of the timing and the paths of the post-smolt cohorts migrating west of Ireland - UK as well as on both sides of the Northern North Sea (UK and Norway) The Study Group endorses the set up of a monitoring programme for these areas through research surveys for post-smolts, screening of commercial and research catches combined with coordinated smolt tagging efforts in order to allow for an assessment of any possible intercepting fisheries. Such a programme would not only benefit the assessment of the stocks migrating into the Norwegian Sea, but will also be helpful in assessing the fate of the component of the post-smolts in the southern NEAC area that migrates to West Greenland waters to feed.
2) It is recommended that detailed information about the fishery, i.e., the fishing gear applied, fishing depth, number of boats, weekly catches by statistical rectangles is provided by NEAFC and the different nations for the fisheries in the Divisions and time periods identified in Table 3.2.1 before it is appropriate to hold any future SGBYSAL meeting. UK, Iceland, Norway and Germany provided some of these data for the present Study Group.

From Section 4

1) Research catches should continue to be screened for presence of salmon, as this will add to the knowledge base on distribution of salmon at sea and will help refine the spatial and temporal coincidence of pelagic species and salmon.
2) The Group strongly recommends screening of commercial catches on board commercial fishing vessels in pelagic fisheries that are of relevance to potential salmon bycatch. Protocols should be established for screening herring and mackerel fisheries, as these are likely to require special screening methods.
3) The screening of discards from filleting factories should be explored.

From Section 5

1) Methods of estimating of salmon post-smolt bycatches should be developed primarily via observer screening programmes on commercial fishing vessels. This will minimise assumptions required to extrapolate from research surveys.
2) Regardless of whether research catches or screening of commercial catches is used to make estimates of captures of post-smolts in the fishery, there is a requirement for the use of weekly catch data. The estimate presented by ICES in 2002 used quarterly data and thus is not viewed by the Group as reliable.
3) The Study Group should reconvene when disaggregated catch data for the Mackerel fishery in the Norwegian Sea become available, in order to provide estimates of bycatch in this fishery.
4) Work should be carried out to apply a range of bycatch estimates to known data on salmon abundance and survival trends in the stocks in question (southern NEAC stock complex mainly) to determine whether the present preliminary and crude range of levels of potential bycatch can account for recent changes in abundance or survival at sea.
5) Work should be carried out, under a range of bycatch rate scenarios to determine the scale and nature of any tagging programme that would be required to yield reliable estimates of bycatch.

From Section 6

1) The Study Group recommends that the "smolt passage model" is further developed and refined with the aim of exploring it as a method of assessing and minimizing the risk of post-smolts being intercepted by the commercial fishery in the area of passage.

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APPENDIX I: LIST OF PARTICIPANTS

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APPENDIX II: CPUE DATA FROM NORWEGIAN RESEARCH CRUISES

Appendix IIa: Summary of Norwegian cruises with surface trawling (flotation on trawl wings) 1990–2000, including captures of post-smolts and older salmon and smolt catch per unit of effort (CPUE, trawl hours).

Year and Cruise	Gear	Dates	Total number of surface hauls	% hauls with post-smolt captures	Number of post-smolts captured	Number of salmon captured	CPUE	Area
1190-EJ	Harstad 16 x 16 trawl	01–22.05	157	2	0	5	0*	Norwegian Sea
1990-GS	Firkløver type and Fotø 80	27.07 – 20.08	22	42	15	0	1.36	Norwegian Sea (north)
1991-PT	Pair trawl	23.07 – 27.08	75	24	34	2	0.91	Norwegian Sea (north)
1993010	Åkra trawl [A]	25.07 – 15.08	61	2	13	1	0.03	Norwegian Sea (east and north), Greenland Sea
1995206	Åkra trawl	30.05 – 01.07	46	20	46	2	2.00	West of Ireland and Hebrides, Shetland - Faroes, Norwegian Sea (south)
1995207	Åkra trawl	07.07 – 01.08.	57	33	62	4	1.61	Norwegian Sea, (east and north)
1995013	Åkra trawl	30.07 – 14.08.	50	4	2	0	0.08	Norwegian Sea, (mid-and north) Barents Sea (south-west)
1996208	Åkra trawl and Harstad float-trawl [C]	05.06 – 07.07.	81	19	65	2	1.60	NW of Scotland - Shetland - Faroes/ North Sea
1996209	Åkra trawl	09.07 – 04.08.	34	6	2	6	0.13	Norwegian Sea (north)/ Greenland Sea (south-east)
1996010	Åkra trawl	19.07 – 15.08.	89	9	11	2	0.25	Norwegian Sea
1997007	Åkra trawl	01.05 – 01.06.	75	0	0	3	0*	Norwegian Sea
1997208	Åkra trawl	28.05 – 17.06.	78	29	197	4	5.05[1]	NW of Scotland - Shetland - Faroes/ northern North Sea
1997209	Åkra trawl	19.06 – 12.07.	34	6	1	1	0.06	Norwegian Sea, Greenland Sea (south-east)
1997010	Åkra trawl	25.07 – 15.08.	82	1	2	0	0.05	Norwegian Sea
1998–1[3]	Harstad float-trawl [C]; Fish lift	22.05 – 02.06	51	28	114	n.a.[1]	1.2	
1998108	Firkløver trawl	30.06 – 21.07.	46	11	16	2	0.69	West of Lofoten Islands
1998209	Åkra trawl	01–30.07.	84	21	61	6	1.45	Norwegian Sea
1998210	Åkra trawl	01–23.08.	22	16	8	0	0.73	Norwegian Sea (north)/ Greenland Sea
1998211	Åkra trawl	28.08 – 09.09.	9	0	0	0	0*	Barents Sea (north-west)
1998013	Åkra trawl	25.08 – 09.09.	10	0	0	8[2]	0*	Barents Sea (south-east)
1999–1	Åkra trawl	27.04 – 20.05.	30	3	0	1	0	Norwegian Sea
1999–2 [3]	Firkløver trawl[B]; Fish lift	19.05 – 04.06.	79	28	354	4	4.8	Norwegian coastal current, Fjords SW – Mid Norway.

Year and Cruise	Gear	Dates	Total number of surface hauls	% hauls with post-smolt captures	Number of post-smolts captured	Number of salmon captured	CPUE	Area
1999- 3 [3]	Harstad float trawl [C]; Fish lift	19.05 – 31.05	40	38	588	2	6.2	Selected SW- Norwegian fjords.
1999- 4	Åkra trawl	05.06 – 05.07	46	7	5	2	0.2	Barents Sea East; Tana + Alta fjord
1999- 5	Åkra trawl	01.06 – 13.06	9	56	6	1	1.2	Northern North Sea (around Frigg oil field)
1999- 6	Åkra trawl	15.06 – 09.07	33	21	21	11	1.2 (10.5)	Greenland Sea, northern Norwegian Sea, Barents Sea (W)
1999- 7	Åkra trawl	20.07 – 19.08	64	10	10	1	0.2	Norwegian Sea
1999- 8	Harstad 25 x 25m float- trawl	21.08 – 07.09	5	4	0	0	0	Barents Sea
1999–9	Firkløver trawl [B]	01.11 – 10.12	100	2	0	2	0	Fjords SW – N- Norway
2000- 1 [3]	*Harstad* [C]*; Fish lift*	*06 – 28.05*	*50*	*n.a*	*n.a.*	*n.a.*	*n.a.*	*Selected fjords SW-Norway (Salmon lice investigations)*
2000- 2 [3]	*Firkløver trawl* [B]*; Fish lift*	*10 – 31.05*	*93*	*42*	*291*	*7*	*2.2*	*Norwegian coastal current, Fjords SW – Mid Norway.*
2000- 3 [3]	*Åkra trawl* [A]*; Fish lift*	*10 – 20.06*	*14*	*64*	*268*	*6*	*9*	*Norwegian Sea, Vøring Plateau*
2000- 4	*Åkra trawl*	*24 – 28.06*	*2*	*0*	*0*	*0*	*0*	*The Halten Bank, Norwegian Sea*
2000- 5 [3]	*Firkløver trawl* [B]*; Fish lift*	*28.06 – 24.07*	*106*	*30*	*202*	*13*	*1.22*	*Selected fjords N-Norway and S- Barents Sea (special salmon cruise)*
2000- 6	*Åkra trawl*	*21.07 – 16.08*	*26*	*12*	*5*	*0*	*0.38*	*Norwegian Sea*
2000- 7	*Harstad 25 x 25m float- trawl*	*17.08 – 07.09*	*3*	*n.a.*	*0*	*1* [2]	*0*	*Western Barents Sea*
		TOTAL 2000	***294***		***766***	***38***		
TOTAL	**1990 - 2000**		**1863**		**2399**	**99**		

[1] n.a., data not available at present
[2] The salmon were captured in a sub-surface trawl haul
[3] Cruises dedicated to salmon investigations
[C] Dimensions of the Harstad float trawl opening 14 x 14b.
[A] Dimensions of the Åkra trawl opening 25 x 25 m
[B] Dimensions of the Firkløver trawl opening 18.5 x 18.5 m

Appendix IIb Norwegian research cruises with surface trawling (flotation on trawl wings) 2001, captures of post-smolts and older salmon and smolt catch per unit of effort (trawl hours) and summary of catches 1990–2000.

Year and Cruise	Gear	Dates	Total number of surface hauls	% hauls with post-smolt captures	Number of post-smolts captured	Number of salmon captured	CPUE	Area
2001–1	*Åkra trawl*[A]	*04.05 – 27.05*	*24*	*0*	*0*	*3*	**	*Norwegian Sea*
2001- 2 [SS]	Harstad [C]; *Fish lift*	*10 – 28.05**	*24*	*88*	*272*	*0*	*5.92*	*Sognefjord SW-Norway (Salmon lice investigations)*
2001- 3 [SS]	*Firkløver trawl* [B]*; Fish lift*	*10.5–- 03.06**	*91*	*28*	*98*	*9*	*0.50*	*Norwegian coastal current, Fjords SW – Mid Norway.*
2001- 4 [SS]	*Åkra trawl* [A]*; Fish lift*	*10 – 17.06**	*17*	*65*	*198*	*5*	*28*	*Norwegian Sea, west of Vøring Plateau*
2001- 5	*Åkra trawl*	*24 – 28.07*	*45*	*24*	*20*	*4*	*0.54*	*Norwegian Sea, N of 70° N*
2001- 6	*Åkra trawl*	*21.07 – 12.08*	*62*	*8*	*6*	*0*	*0.19*	*Norwegian Sea, S of 70° N*
2001–7	Pelagic trawl	*14.07 – 08.08*	*21*	*14*	*11*	*0*	*1.71*	*Norwegian Sea, 66.3°– 69.3°N*
		TOTAL 2001	***284***		***605***	***21***		
		1990 - 2000	***1863***		***2399***	***99***		
TOTAL	**1990 – 2001**		**2147**		**3004**	**120**		

** CPUE not calculated, no smolts captured

[SS] Cruises dedicated to salmon investigations

[A] Dimensions of the Åkra trawl opening 25 x 25 m

[B] Dimensions of the Firkløver trawl opening 18.5 x 18.5 m

[C]Dimensions of the Harstad float trawl opening 14 x 14

Appendix IIc Norwegian research cruises with surface trawling (flotation on trawl wings) 2002, captures of post-smolts and older salmon and smolt catch per unit of effort (trawl hours) and summary of catches 1990–2001.

Year and Cruise	Gear	Dates	Total number of surface hauls	% hauls with post-smolt captures	Number of post-smolts captured	Number of salmon captured	Mean CPUE Post-smolts	Area surveyed
2002–1	*Åkra trawl[A]*	*16.05 – 28.05*	*29 (47)*	*0*	*0*	*4*	*	*Northern Norwegian Sea 68.3–74.3°N; 9.2 – 18.5°E*
2002- 2 [SS]	*Smolt trawl[B]; Fish lift*	*19.05 –29.05*[SS]	*20*	*45*	*310*	*2*	*9.22*	*The Sognefjorden (Salmon lice investigations) 61.05 – 61.15°N; 4.9- 6°E*
2002- 3[SS]	*Salmon trawl [C]; Fish lift*	*22.5 – 05.06*[SS]	*54*	*39*	*248*	*21*	*2.44*	*Mid Norwegian coast- west of the mid-Norwegian shelf edge (63.4–65.4°N; 9.0–11.1°E*
2002- 4[SS]	Salmon trawl [C]; Fish lift	*20.06 – 05.07*[SS]	*64*	*47*	*590*	*17*	*10.51*	*Norwegian Sea east (Norway's EEZ and International zone, mackerel bycatch investigations), 66 – 69.7°N; 1°W- 17.4°E*
2002- 5	*Harstad trawl1, 10* [D]	*09.06 – 04.07*	*47 (49)*	*4*	*2*	*5*	*0.09*	*Barents Sea, 70.2–71.9°N;19.1- 32.0°E*
2002- 6	*Åkra trawl*	*28.07 – 13.08*	*24 (54)*	*17*	*9*	*2*	*0.81*	*Norwegian Sea (north east), Barents Sea (west), 63.1 – 77.5°N; 2°W – 17.00°E*
2002–7	*0-group surface trawl, 10* [E]	*24.08 – 07.09*	*55 (59)*	*2*	*1*	*0*	*0.04*	Norwegian Sea North, 70.9- 79.9°N; 3.5 – 21.4°E
	TOTAL	2002	291		1160	51		
	TOTAL	1990 – 2001	2147		3004	120		
	TOTAL	**1990 – 2002**	**2438**		**4164**	**171**		

* CPUE for post-smolts not calculated, only salmon captured. Area surveyed and timing of cruise was far out of range for likelihood of post-smolt occurrence
(..) total nr of trawl hauls deeper hauls included
[A] Dimensions of the Åkra trawl opening 25 x 25 m
[B] Dimensions of the trawl opening 12 x 25 m
[C] Dimensions of trawl opening 14 x 20
[D] Dimensions of the trawl opening 18 x 18 m
[E] Dimensions of the trawl opening 10 x 10 m
[SS] Cruises dedicated to salmon investigation

Appendix IId. Norwegian research cruises with surface trawling (flotation on trawl wings) 2003, captures of post-smolts and older salmon and smolt catch per unit of effort (trawl hours) and summary of catches 1990–2002.

Year and Cruise	Gear	Dates	Total number of surface hauls	% hauls with post-smolt captures	Number of post-smolts captured	Number of salmon captured	Mean CPUE Post-smolts	Area surveyed
2003–1[SS]	*Salmon trawl [A]; Fish lift*	*17.5 – 24.05[SS]*	*35*	*47*	*475*	*55*	*9.3*	*Mid Norwegian coast- west of the mid-Norwegian shelf edge (63.4–65.4°N; 8.0–11.1°E*
2003- 2[SS]	*Salmon trawl [A]; Fish lift*	*16.06 – 07.07[SS]*	*81*	*44*	*436*	*16*	*8.4*	*Norwegian Sea east (Norway's EEZ and International zone, mackerel bycatch investigations), 61 – 73.3°N; 1.5°W- 13°E*
2003–3	*Åkra trawl[B]*	*01 – 22.07*	*34 (74)*	*0*	*0*	*2*	*	*North Sea-Norwegian Sea (south), Herring and Blue whiting Pelagic survey*
2003–4	*Midwater trawl*	*15 – 29.07*	*47 (57)*	*7*	*6*	*1*	*0. 5*	*Norwegian Sea 62.7=>71.0 °N; 5 °W – 15°E, Mackerel survey*
2002–5	*Midwater trawl*	*18 – 30.07*	*21 (33)*	*0*	*0*	*1*	*	Norwegian Sea, 69.5 => 62.7°N; *5 °W - 14* °E
		TOTAL 2003	***218 (280)***		***917***	***75***		
		1990 — 2002	***2438***		***4164***	***171***		
TOTAL	**1990 - 2003**		**2656**		**5081**	**246**		

(..) total nr of trawl hauls deeper hauls included

[A] Dimensions of trawl opening 10 x 40

[SS] Cruises dedicated to salmon investigations

* CPUE not calculated, because no smolts were captured

[B] Dimensions of the Åkra trawl opening 25 x 25 m

APPENDIX III: LOG BOOK DATA ON BYCATCHES OF SALMON FROM LANDINGS IN THE NETHERLANDS

Appendix IIIa, Monthly data of bycatches of salmonids, 1995–2003 provided by RIVO (Netherlands). Records from official logbooks of catches from various fisheries in the North Sea landed in the Netherlands.

spec	SAL			
		flag		Sum of catch_
Year	Month	Dutch vessels	Other vessels	Grand Total
1995	1	56	1	57
	2	29	1	30
	3	16		16
	4	46	6	52
	5	168	2	170
	6	390	14	404
	7	170	12	182
	8	105	36	141
	9	109		109
	10	126	5	131
	11	60	4	64
	12	9	4	13
1995 Total		**1284**	**85**	**1369**
1996	1	22	10	32
	2	40	13	53
	3	12	4	16
	4	158	18	176
	5	106	10	116
	6	200	12	212
	7	117	15	132
	8	70	43	113
	9	55	6	61
	10	810	2	812
	11	45	11	56
	12	26	3	29
1996 Total		**1661**	**147**	**1808**
1997	1	60	1	61
	2	22	6	28
	3	37	8	45
	4	101	11	112
	5	148	2	150
	6	105		105
	7	196	4	200
	8	109	14	123
	9	40		40
	10	17	1	18
	11	26		26
	12	31	8	39
1997 Total		**892**	**55**	**947**
1998	1	46	2	48
	2	53	1	54
	3	118	14	132
	4	126	28	154
	5	93	34	127
	6	115	30	145

		flag		Sum of catch_
Year	Month	Dutch vessels	Other vessels	Grand Total
1998 ctd.	7	90	31	121
	8	39		39
	9	19	2	21
	10	6	1	7
	11	32	3	35
	12	41	5	46
1998 Total		**778**	**151**	**929**
1999	1	32	5	37
	2	29	5	34
	3	85	10	95
	4	58	6	64
	5	59		59
	6	181	46	227
	7	76	14	90
	8	22	5	27
	9	26	11	37
	10	33	2	35
	11	38	13	51
	12	22	4	26
1999 Total		**661**	**121**	**782**
2000	1	59	6	65
	2	17	9	26
	3	78	3	81
	4	81	3	84
	5	162	4	166
	6	20	14	34
	7	4		4
	8	6		6
	9	3		3
	10	4		4
	11	8		8
	12	2		2
2000 Total		**444**	**39**	**483**
2001	7	2		2
	8	99	5	104
	9	5		5
2001 Total		**106**	**5**	**111**
2002	4	4		4
	5	3		3
	8	1		1
	9	5		5
2002 Total		**13**	**0**	**13**
2003	5	10		10
	6	2		2
2003 Total		12	0	12
Grand Total		**5851**	**603**	**6454**

Appendix IIIb, Bycatches of salmonids by statistical rectangle, 1995–2003, provided by RIVO (Netherlands). Records from official logbooks of catches from various fisheries in the North Sea landed in the Netherlands.

	Kg salmon recorded by Dutch vessels, year									Kg salmon recorded by other vessels, year							Grand Total
ICES statistical rect.	1995	1996	1997	1998	1999	2000	2001	2002	2003	1995	1996	1997	1998	1999	2000	2001	kg
29/F0											1						1
29/F1												1					1
30/F0											4		3	1			8
30/F1													3				3
31/F1	2	2	2	13	25								1				45
31/F2	4	9	19	25	30	28					1	4	1	2	1		124
31/F3		20	12	43	14	26				2	14	11	9	22	13		186
31/F4				4													4
32/F1					2												2
32/F2	7	53	12	17	6	12											107
32/F3	839	198	183	142	116	62				2	32	4	5	3			1586
32/F4	5	6	35	13	41			3									103
33/F2	11	12	6	4		11				23			1				68
33/F3	44	119	46	56	20	29				2		1					317
33/F4	22	96	100	57	49	72		2		20	45	11	31	35			540
33/F5														1			1
34/F2	22	67	110	20	16	6											241
34/F3	18	5	8	28	11	1						5		1			77
34/F4	8	101	76	84	66	82				7	7	2	12	1	7		453
35/F1			11	13													24
35/F2	59	33	54	39	25	1											211
35/F3	15	18	27	11	18	9											98
35/F4	26	6	23	43	54	14	100	8	12	2			34				322
35/F5	44	11	9	18	2	28	6					4					122
36/E6			1														1
36/F1		2	8	7		6											23
36/F2	4		5														9
36/F3	11	15	7	10	5	1											49
36/F4	54	9	22	12	12	9					7						125
36/F5	7	7	14		5	10					2	1	4	3			53
36/F6	2	6	14	3	1						8		1				35
36/F7				9		6					8	2		2			27
36/F8	1																1
37/E3			1														1
37/F0				5											1		6
37/F1		4	5	1													10
37/F2			7	1	8	4							5				25
37/F3	1	777	3	2	10	6				2				2	2		805
37/F4	5	36	18	7	18	2				1			13	7	2		109
37/F5	7	2	2	3	11					4				5			34
37/F6	11	17	8	51	33						6		1	3	1		131
37/F7	24		18	9	11					5			2	1			70
38/F1					1												1
38/F2	2	2	8	4	1						1						18
38/F3	2	10		1	3												16
38/F4	1	3	4	3									6	8	4		29
38/F5				2	6												8
38/F6	7	8	7	6	8	10				2	2	3		1	1		55
38/F7	9				1								3				13

	Kg salmon recorded by Dutch vessels, year									Kg salmon recorded by other vessels, year							Grand Total
ICES statistical rect.	1995	1996	1997	1998	1999	2000	2001	2002	2003	1995	1996	1997	1998	1999	2000	2001	kg
29/F0											1						1
38/F8	2																2
39/F0												1					1
39/F2			2							9			1				12
39/F3		1	3	8						1	1				2		16
39/F4				1	1	1											3
39/F5					2									3			5
39/F6	6	3		3	5	4				1	8	4	2	4			40
39/F7					2												2
40/F3		2															2
40/F4			2										1				3
40/F5					2	4								6			12
40/F6					11							1		2	1		15
40/F7	2				8					1							11
41/F4					1												1
41/F6													4		4		8
41/F7													1				1
42/F6													1			5	6
42/F7													2	8			10
43/F6													4				4
43/F8										1							1
49/F0		1															1
Grand Total	1284	1661	892	778	661	444	106	13	12	85	147	55	151	121	39	5	6454

APPENDIX IV: BLUE WHITING CATCH STATISTICS

Table 3.1.3.2 Landings (tonnes) of BLUE WHITING from the directed fisheries (Sub-areas I and II, Division Va, XIVa and XIVb) 1995–2002, as estimated by the Working

Country	1995 3)	1996	1997	1998	1999	2000	2001	2002
Denmark					15	7,721	5,723	13,608
Estonia	-	377	161	904	-	-	-	-
Faroes	-	345	-	44,594	11,507	17,980	64,496	82,977
Germany	3	32	-	78	-	-	3117	1,072
Greenland	-	-	-	-	-	-		-
Iceland	369	302	10,464	64,863 4)	99,092	146,903	245,814	193,686
Latvia	-	-	-	-	-	-	-	-
Netherlands	72	25	-	63	435	-	5180	906
Norway 5)							64,581	100,922
Norway 6)	-	58	1,386	12,132	5,455	-	28,812	-
Poland	-	-	-	-	-	-	-	-
Sweden	-	-	-	-	-	-	-	850
USSR/Russia 1)	23,289	22,308	50,559	51,042	65,932	103,941	173,860	145,649
Total	23,733	23,447	62,570	173,676	182,436	276,545	591,583	539,670

3) Icelandic mixed fishery in Va.

4) include mixed in Va and directed in Vb.

5) Directed fishery

6) By-catches of blue whiting in other fisheries.

Table 3.1.3.3 Landings (tonnes) of BLUE WHITING from directed fisheries (Division Vb,VIa,b, VIIb,c. VIIg-k and Sub-area XII) 1995–2002, as estimated by the Working

Country	1995	1996	1997	1998 1)	1999	2000	2001	2002
Denmark	-	269	-	5051	19,625	11,856	18,110	2,141
Estonia	7754	10,605	5,517	5,416	-	-	-	-
Faroes	26,009	18,258	22,480	26,328	93,234	129,969	188,464	115,127
France	720	6,442	12,446	7,984	6,662	13,481	13,480	14,688
Germany	6,310	6,844	4,724	17,891	3,170	12,655	15,862	15,378
Iceland	-	-	-	-	61,438	113,280	119,287	91,853
Ireland	222	1,709	25,785	45635	35,240	25,200	29,854	17,723
Japan	-	-	-	-	-	-	-	-
Latvia	-	-	-	-	-	-	-	-
Lithauen	-	-	-	-	-	-	-	-
Netherlands2)	26,703	17,644	23,676	27,884	35,408	46,128	68,415	33,365
Norway	261,272	337,434	318,531	519,622	475,004	460,274	399,932	385,495
UK (Scotland)	10,583	14,325	33,398	92,383	98,853	42,478	50,147	26,403
Sweden	-	-	-	-	-	-	-	10
USSR/Russia 3)	83,931	64,547	68,097	79,000	112,247	141,257	141,549	144,419
Total	423,504	478,077	514,654	827,194	940,881	996,578	1,045,100	846,602

1) Including some directed fishery also in Division IVa.

2) Revised for the years 1987, 1988, 1989, 1992, 1995,1996,1997

3) From 1992 only Russia

Table 3.1.3.4 Landings (tonnes) of BLUE WHITING from directed fisheries and by-catches caught in other fisheries in Divisions IIIa, IVa 1995–2002, as estimated by the WG.

Country	1995	1996	1997	1998 [2)]	1999	2000	2001	2002
Denmark [4)]	4,848	29,137	9,552	40,143	36,492	30,360	21,995	35,530
Denmark [5)]	7,591	22,695	16,718	16,329	8,521	7,749	7,505	
Faroes [4) 6)]	-	6,068	6,066	-	-	-	60	7,317
Faroes [5) 6)]				296	265	42	6,741	
Germany [1)]	-	-	-			-	81	
Ireland	-	-	-	-	-	-	-	4
Netherlands	-	-	793			-	-	50
Norway [4)]	78,565	57,458	27,394	28,814	48,338	73,006	21,804	85,062
Norway [5)]							58,182	
Russia							69	
Sweden	13,000	4,000	4,568	9,299	12,993	3,319	2,086	17,689
UK	-	1	-			-	-	
Total	104,004	119,359	65,091	94,881	106,609	114,476	118,523	145,652

[1]) Including directed fishery also in Division IVa.

[2]) Including mixed industrial fishery in the Norwegian Sea

[4)] Directed fishery

[5)] By-catches of blue whiting in other fisheries.

[6)] For the periode 1987-2000 landings figures also include landings from mixed fisheries in Division Vb.

Table 3.1.3.5 Landings (tonnes) of BLUE WHITING from the Southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e) 1995–2002, as estimated by the Working Group.

Country	1995	1996	1997	1998	1999	2000	2001	2002
Germany	-	-	-	-	-	-	-	600
Ireland								98
Netherlands	-	-	-	10 [1)]	-	-	-	3,208
Norway	-	-	-			-	-	
Portugal	2,285	3,561	2,439	1,900	2,625	2,032	1,746	1,659
Spain	25,379	21,538	27,683	27,490	23,777	22,622	23,218	17,506
UK	-	-	-	-	-	-	-	
France	-	-	-	-	-	-	-	
Total	27,664	25,099	30,122	29,390	26,402	24,654	24,964	23,071

[1)] Directed fisheries in VIIIa

Table 3.1.3.6 Landings (tonnes) of BLUE WHITING from the main fisheries, 1995–2002, as estimated by the Working Group.

Area	Norwegian Sea fishery (Sub-areas 1+2 and Divisions Va, XIVa-b)	Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb-c)	Directed- and mixed fisheries (Divisions IIIa and IV)	**Total northern areas**	Total southern areas (Subareas VIII and IX and Divisions VIId, e, g-k)	**Grand total**
1995	23,733	423,504	104,004	**551,241**	27,664	**578,905**
1996	23,447	478,077	119,359	**620,883**	25,099	**645,982**
1997	62,570	514,654	65,091	**642,315**	30,122	**672,437**
1998	173,676	827,194	94,881	**1,095,751**	29,400	**1,125,151**
1999	182,436	940,881	106,609	**1,229,926**	26,402	**1,256,328**
2000	276,545	996,577	114,477	**1,387,599**	24,654	**1,412,253**
2001	591,583	1,045,100	118,523	**1,755,206**	24,964	**1,780,170**
2002	539,670	830,471	145,652	**1,515,793**	39,202	**1,554,995**

Table 3.1.3.7 Total landings of blue whiting by quarter and area for 2002 in tonnes. Landing figures provided by Working Group members.

Area	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Grand Total**
I	185	1		0	186
IIa	5,255	82,296	219,109	45,558	352,218
IIIa	1,796	3,387	12,140	6,741	24,064
IVa	19,541	27,045	47,910	26,483	120,979
IVb		3	493	113	609
V	15,832	45,575	2,857	43,636	107,900
Va	640	55,290	124,938	6,398	187,266
Vb	5,719	120,900	48,369	19,338	194,326
VbVIVII	4,565	5,307	4,320	496	14,688
VIa	2,526	141,853	7	17	144,403
VIab+VIIbc	1,335	580			1,915
VIb	210,817	19,659			230,476
VIIb	8,727	3			8,730
VIIbc	13,327	18,907	1,440		33,674
VIIc	76,479	8,664			85,143
VIIgk+XII	8,602				8,602
VIIj	645	18	5		668
VIIk	13,509				13,509
VIIIabd			3,203		3,203
VIIIc+IXa	4,713	4,827	4,525	3,442	17,506
VIIIe	35				35
IXa	274	572	586	226	1,659
XII	3,179	57			3,236
Grand Total	397,702	534,944	469,901	152,448	1,554,995