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## Discard sampling of the Dutch pelagic freezer fishery in 2008 and 2009

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## Summary

This report contains the results of the discard sampling programme on the Dutch pelagic trawl fisheries in the North East Atlantic in 2008 and 2009, which was instigated as part of the EC regulation 1543/2000 and 1693/2001 on data collection in European waters. Twelve trips in 2008 and eleven trips in 2009 on board of pelagic vessels were sampled.

The Dutch fleet of freezer trawlers target pelagic species, namely herring (*Clupea harengus*), horse mackerel (*Trachurus trachurus*), mackerel (*Scomber scombrus*), blue whiting (*Micromesistius poutassou*), greater argentine (*Argentina sila*) and pilchard (*Sardina pilchardus*). The total landings of this fleet were about 223,000 tonnes in 2008 and about 174,000 in 2009. Herring, blue whiting and horse mackerel were the most abundant landed species. Different species are targeted during different parts of the year (different fishing seasons); blue whiting is mainly targeted during the first half of the year and herring is targeted during the second half of the year.

The estimated discard percentage for the pelagic freezer trawler fleet in 2008 and for 2009 was 8% in weight. This is similar to the discard percentage found in previous years.

On board freezer trawlers two different discarding methods are observed: 1) The common procedure of discarding: discarding after the catch is sorted. A small part of the catch is removed after a sorting procedure because fish are damaged or under minimum landings size. 2) Besides the discards that are sorted by the crew it occasionally happens that part or the total catch is discarded before the catch has been sorted, an incident, in this report, referred to as "unsorted discards". Due to practical reasons this type of discarding cannot be sampled. The discard composition and length frequency data shown in this report are therefore only based on routinely sorted discards. Unsorted discards are separately raised to fleet level. Although accounting for a relatively large part of the total annual discard estimate (23%-24% in weight), incidents of unsorted discards are not frequently observed during the sampled trips (observed during 4%-6% of the hauls). Motivations for discarding unsorted catch remained unclear during this study. Lack of storage capacity or undesirable mixtures of species in the catch are plausible reasons for discarding unsorted catch.

Discard percentages of target species herring, horse mackerel and blue whiting (within the season) are relatively low (2%, 1% and 3% respectively in 2008 and 4%, 1% and 1% in 2009). It occasionally happens that these species are caught and discarded in small amounts outside the season. For mackerel the discard percentage is significantly higher (32% in 2008 and 21% in 2009). Mackerel is discarded in all seasons and areas. The length frequency distribution of discarded mackerel show that a large part of the discarded fish were above the minimum landing size. Increasing abundance of mackerel in north European waters in combination with a limited quota and price differences between size-classes, possibly trigger high-grading of this species.

The results illustrate the high efficiency of freeze trawlers in targeting commercially important pelagic species, with relative low discard rates.

## Samenvatting

Dit rapport bevat de resultaten van het discard bemonsteringsprogramma van de Nederlandse pelagische visserij in het noordoost Atlantische gebied in 2008 en 2009, dat is opgezet naar aanleiding van EC regelingen 1543/2000 en 1693/2001 voor gegevensverzameling in Europese visserijen. Er werden twaalf reizen in 2008 en elf reizen in 2009 aan boord pelagische schepen bemonsterd.

De Nederlandse pelagische vriestrawlervloot gericht op een aantal pelagische doelsoorten, namelijk haring (*Clupea harengus*), horsmakreel (*Trachurus trachurus*), makreel (*Scomber scombrus*), blauwe wijting (*Micromesistius poutassou*), grote zilversmelt (*Argentina sila*) en pelser (*Sardina pilchardus*). In 2008 werd 223,000 ton aangeland en in 2009 174,000 ton. Haring, blauwe wijting en horsmakreel waren de belangrijkste soorten. De aanvoer van de soorten wordt grotendeels bepaald door de vangstquota die Nederland voor deze soorten bezit. De gerichtheid van de visserij op doelsoorten varieert gedurende het jaar (verschillende visserijseizoenen). In het begin van het jaar wordt op blauwe wijting gevestigd en tijdens de tweede helft van het jaar wordt op haring gevestigd.

In zowel 2008 als in 2009 was de naar vloot opgewerkte discard percentage 8% in gewicht. Dit komt overeen met het discard percentage dat in de afgelopen jaren berekend is.

Aan boord pelagische trawlers worden twee verschillende discard methode waargenomen: 1) De meest voorkomende methode: discards die door de bemanning uit de vangst gesorteerd worden. Een klein deel van de vangst wordt gedumpt in zee omdat vissen zijn beschadigd of kleiner zijn dan de wettelijk toegestane aanlandingsmaat. 2) Incidenteel komt het ook voor dat een gedeelte of de gehele vangst overboord wordt gegooit zonder dat er sortering plaatsvindt. Dit wordt in dit rapport omschreven als "ongesorteerd discards". Om praktische redenen is het niet mogelijk om een monster van de ongesorteerde discards te bemachtigen, waardoor het onmogelijk is een goede inschatting van de soortensamenstelling en lengte frequentie verdeling van de vangst te maken. Daarom is informatie over soortensamenstelling en lengte frequentie gegevens in dit rapport alleen gebaseerd op de discardgegevens die verkregen zijn tijdens het normale sorteringsproces aan boord. Totale hoeveelheden ongesorteerde discards zijn apart opgewerkt naar vlootniveau. Hoewel een groot deel van de discards veroorzaakt wordt door ongesorteerde discards (23%-24% van het totaal discardgewicht), is het aantal incidenten hiervan relatief laag (geobserveerd gedurende 4%-6% van de trekken). Gebrek aan opslagcapaciteit of minder lucratieve vangsten zijn mogelijk redenen voor deze manier van discards.

Discardpercentages voor de doelsoorten haring, horsmakreel en blauwe wijting (in het visseizoen) zijn relatief laag (respectievelijk 2%, 1% en 3% in 2008 en 4%, 1% en 1% in 2009). Buiten het seizoen kan dezelfde vissoort, als het niet commercieel interessant beschouwd wordt, compleet gediscard worden. Het discard percentage voor makreel ligt echter significant hoger dan bij de andere soorten (32% in 2008 en 21% in 2009). Waarschijnlijk ligt een combinatie van veel makreel, gelimiteerd quota en het grote prijsverschil tussen kleine en grote lentematen hier aan ten grondslag. De lengte frequentie diagrammen laten dan ook zien dat een groot deel van de makreelvangst boven de minimum aanlandingsmaat gediscard wordt.

Resultaten uit dit rapport laten zien dat de Nederlandse pelagische visserij met vriestrawlers een hoge mate van efficiëntie vertoont als het aankomt op het vangen van commerciële doelsoorten met relatief lage discardpercentages als gevolg.

# 1 Introduction

The Dutch fleet of freezer trawlers use a midwater pelagic trawl to target pelagic species (Box 1). Their most important fishing grounds in European waters are situated on the continental slope west of the British Isles, in the Channel, along the British east coast, the northern North Sea and the Norwegian Sea.

Depending on the season Dutch freezer trawlers target herring (*Clupea harengus*), blue whiting (*Micromesistius poutassou*), horse mackerel (*Trachurus trachurus*), mackerel (*Scomber scombrus*), greater argentine (*Argentina silus*) and pilchard (*Sardina pilchardus*). Differences in catch composition are caused by seasonal changes, fishing ground, or changes in the market situation; i.e. market prices fluctuate by season per species. Since the fishing companies

concentrate on different markets and have different quota shares, the fleet is usually spread over a number of different areas throughout the year.

On board of the trawlers, the catch is sorted. Unwanted catch is flushed over board, a practice called *discarding*. Fish normally will not survive the catch and sorting procedure. Estimations of the discarded part of the catch is important, since it is landings and discards together that describe fishing mortality and explain changes in fish population size caused by fishing activity.

## Box 1: Pelagic freezer fishery

Pelagic freezer trawlers target schooling fish. Echo-sounding equipment on board of the trawlers provides information on the size and position of a shoal of fish, which makes this fishery very efficient. As a full net is too large to get on board, a hauled net remains in the water, while the catch is pumped on board, using hydraulic pressure. Catch is temporally stored in cooling tanks until it can be processed in the factory below deck. During the sorting process unwanted catch (discards) is dumped into the sea and landings are frozen into blocks of 20-25 kg. The duration of each fishing trip depends mainly on the catch of target species and the storage capacity of the ship. The vessels usually return when all freezing stores are full. Smaller vessels make trips of 2-4 week, larger vessels of 5-6 weeks. A more detailed description of the fishery is given by (Coulnerus *et al* 2004)

Main reasons for discarding are:

- 1 Species have no commercial interest (depending on the market);
- 2 fish is below minimum landing size;
- 3 low quality or damage;
- 4 limits on quota;
- 5 lack of storage space on board (e.g. during the last haul on a trip) (Morizur *et al.*, 1995; Napier *et al.*, 1999; ICES, 2004a; Borges *et al.*, 2008).

In addition, pelagic trawlers occasionally discard relatively large amounts of catch without sorting (unsorted discards). This type of discarding is often described as slippage. This terminology suggest that catch is discarded, slipped, from the net. However, for pelagic freezer trawlers the term slippage does not sufficiently describe the process of discarding unsorted catch as it also includes catch that is discarded via the conveyer belt from the cooling tanks. In this report it is therefore referred to as "unsorted discards". At present, species composition and length frequency of unsorted discards are unknown within this fishery. Accurate numbers per species for can, therefore, not be calculated.

From 2002 onwards discard data of pelagic freezer trawlers are monitored by IMARES under the EC Data Collection Regulations 1543/2000 and 1639/2001 and Commission Decision 949/2008 (EC, 2000; 2001; Anon., 2002; ICES, 2003). This report gives an overview of the Dutch pelagic discard sampling programme for 2008 and 2009.

## 2 Methods

### 2.1 Landings fleet

Information on landings and fishing effort by the Dutch pelagic freezer fleet in 2008 were derived from the Dutch official logbook database (VIRIS – Visserij Registratie Informatie Systeem) owned by the Ministry of Agriculture, Nature Management and Fisheries. In 2009 a switch was made to a new system, VISSTAT (Visserij Statistieken). Information and landings and fishing effort in 2009 was derived from VISSTAT.

### 2.2 Sampling procedures

Biological sampling of catch and discards is carried out on board the vessels through an observer programme. Selecting vessels is done in co-operation with the pelagic fishery companies, and is considered random. The choice of fishing area and target species is usually a last minute decision, and even may change during the trip. It is not uncommon that during one trip several fishing and management areas are visited.

Sampling is conducted by one observer who takes samples of at least 80% of the hauls (Box 2) (Beek, 2001). From each sampled haul the total catch of the haul ( $CW_h$ ) is estimated from the bridge in cooperation with the skipper and verified with the number of cooling tanks filled (with help of the fish quality manager or a tank board). The observer validates his estimates of the total catch, several times during the trip, by comparing his estimates with the actual number of boxes of retained catch (landings) on board the vessel. For each sampled haul the discard percentage is estimated by the ratio of catch and discards, preferably, by sampling unsorted catch from the conveyor belt (straight from the cooling tanks) and discards from the discard-gutter, during a fixed period of time (Box 3). Consequently, the proportion of the discards relative to the landings can be estimated. This proportion is used to calculate the total weight of the discards in each haul ( $DW_h = \text{proportion} * CW_h$ ). Furthermore, for each sampled haul a sub-sample of the catch and discards is taken and weighted. The weight of each species in the samples is recorded and all fish are measured to the cm below. Otoliths are collected from the major species for age readings. After each trip, the data is stored into a computer program on haul-by-haul basis and later transferred into the central database.

**Box 2: Sampling protocol for a haul on a pelagic trawler**

- 1) Estimation and registration of total catch ( $CW_h$ ).
- 2) Estimation of discard percentage (Box 3).
- 3) Take a sample of the unsorted catch ( $Cw_h$ ):
  - a. Take a sample of the unsorted catch (total sample size: 20-25 kg). This sample includes landings and discards. In order to get a representative sample, sub-samples are taken repeatedly at different moments whilst sorting the haul.
- 4) Take a sample of discards ( $Dw_h$ ):
  - b. Take a sample of the discards (total sample size: 20-25 kg). In order to get a representative sample, different sub-samples are taken repeatedly at different moments whilst processing the haul.
- 5) Measuring catch sample:
  - c. Sort all the fish species and take length ( $Cn_{l,h,c}$ ) and weight ( $Cw_{h,s}$ ) measurements for each species. Register the total number by species and length class.
- 6) Measuring discard sample:
  - d. Sort all the fish species and take length ( $Dn_{l,h,c}$ ) and weight ( $Dw_{h,s}$ ) measurements for each species. Register the total number by species and length class.
- 7) Age estimations of the unsorted catch:
  - e. Take a sample of the unsorted catch.
  - f. Otoliths from this sample are prepared and analysed.
  - g. The sample of age analysis consists of 'sized' and 'undersized' fish. A sample consists of minimal 3 individuals per length class per area (ICES quadrant).
- 8) Registration of total landings:
  - h. Information on total landings is collected at the end of the trip

**Box 3: Protocol of estimating the discard percentage**

- 1) Take weight sample of discards from the gutter over a certain time period.
- 2) Take weight sample of catch from conveyer belt over the same time period as the discard sample.
- 3) Calculate discard percentage from the proportion between the two samples

*Example:*

The sample is taken over a time period of 30 seconds. This results in:

- A weight sample of the discards of 2 kg

- A weight sample of the catch of 26 kg

The percentage discards is calculated by taking the ratio between the discard sample and catch sample:

- Percentage discards =  $(2\text{kg} / 26\text{ kg}) * 100 \approx 8\%$

**2.3 Raising procedures***2.3.1 Total weight per species*

Total catch weight per species and haul ( $CW_{h,s}$ ) has been calculated by multiplying the estimated total catch weight ( $CW_h$ ) by the ratio of weight of the catch sample ( $Cw_h$ ) to the weight of the species in the catch sample ( $Cw_{h,s}$ ).

$$CW_{h,s} = CW_h * (Cw_h / Cw_{h,s})$$

Total catch weight per species and trip ( $CW_{t,s}$ ) has been calculated by summing the catch weight per species over all hauls:

$$CW_{t,s} = \sum_h CW_{h,s}$$



Total discards weight per species and haul ( $DW_{h,s}$ ) has been calculated by multiplying the estimated total weight of the discards ( $DW_h$ ) by the ratio of weight of the discards sample ( $DW_h$ ) to the weight of the species in the discards sample ( $DW_{h,s}$ ).

$$DW_{h,s} = DW_h * (DW_{h,s} / DW_h)$$

Total discard weight per species and trip ( $DW_{t,s}$ ) has been calculated by summing the discard weight per species over all hauls:

$$DW_{t,s} = \sum_h DW_{h,s}$$

Total landings weight per species and trip ( $LW_{t,s}$ ) has been calculated by subtracting discard weight from the catch weight per species:

$$LW_{t,s} = CW_{t,s} - DW_{t,s}$$

### 2.3.2 Total length per species

The total numbers caught at length ( $CN_{l,h,s}$ ) have been calculated per species and haul by multiplying the numbers at length in the catch sample ( $Cn_{l,h,s}$ ) by the estimated total catch weight ( $CW_h$ ) and the ratio of weight of the catch sample ( $CW_h$ ) to the weight of the species in the catch sample ( $CW_{h,s}$ ).

$$CN_{l,h,s} = Cn_{l,h,s} * CW_h * (CW_{h,s} / CW_h)$$

Total numbers caught at length per species and trip ( $CN_{l,t,s}$ ) have been calculated by summing the numbers at length per species over all hauls:

$$CN_{l,t,s} = \sum_h CN_{l,h,s}$$

The total numbers discarded at length ( $DN_{l,h,s}$ ) have been calculated per species and haul by multiplying the numbers at length in the discards sample ( $Dn_{l,h,s}$ ) by the estimated total weight of the discards ( $DW_h$ ) and the ratio of weight of the discards sample ( $Dw_h$ ) to the weight of the species in the discards sample ( $Dw_{h,s}$ ):

$$DN_{l,h,s} = Dn_{l,h,s} * DW_h * (Dw_h / Dw_{h,s})$$

The total numbers discarded at length per species and trip ( $DN_{l,t,s}$ ) have been calculated by summing the numbers at length per species over all hauls.

$$DN_{l,t,s} = \sum_h DN_{l,h,s}$$

The total numbers landed at length per species and trip ( $LN_{l,t,s}$ ) have been calculated by subtracting discards numbers at length from numbers caught at length per haul.

$$LN_{l,t,s} = CN_{l,t,s} - DN_{l,t,s}$$

### 2.3.3 Unsorted discards

During the observed trips it occasionally happened that a part of the catch within a haul was discarded before the sorting process; unsorted discards. In such occasions the weight of the unsorted discarded catch was estimated by the observer. Sampling of the species composition and the length frequency distribution of such incidents was not possible. Consequently, slipped catch could not be raised by the raising procedure described above. It was therefore decided to interpret "unsorted discards" as a separate discard component ( $DWS_h$ ). When only a part of the catch within a haul was discarded without sorting, the raising procedure was used for the sampled part of the catch while the unsorted part was treated as unsorted discards. Total "unsorted discards" within a trip ( $DWS_t$ ) was calculated by summing the unsorted discard catch over all hauls:

$$DWS_t = \sum_h DWS_h$$

### 2.3.4 Not sampled

During the sampled trips it sporadically happened that the observer only estimated the weight of the catch and the discard percentage. Because it is unclear what the species composition and length frequency distribution of both the catch and discards is for such hauls, it was decided to interpret "not sampled" hauls as a separate component in this report.

### 2.3.5 Raising the sampled trips to fleet level

Total discard weight per species and trip ( $D_{wt}$ ) has been raised to fleet level per quarter by multiplying the sampled average ( $d_{wt}$ ) with the total number of trips of the entire fleet ( $N_t$ ) per quarter ( $q$ ). The sampled average is the total weight of discards per trip per species ( $D_{wt}$ ) divided by total number of sampled trips ( $N_s$ ):

$$(d_{wt})_q = (\sum D_{wt} / N_s)_q$$

When target species are not caught during a sampled trip they are marked zero. Total discard weight per species per year at fleet level ( $D_{wf}$ ) has been calculated by summing the total discard weights per species per quarter for each year:

$$D_{wf} = \sum (N_t)_q * (d_{wt})_q$$

## 3 Results

### 3.1 Landings (total fleet)

Target species of the Dutch freezer trawler fleet fishing in European waters differ by season and area. The total landings of this fleet were about 223,000 tonnes in 2008 and about 174,000 tonnes in 2009 (Table 1). Blue whiting, horse mackerel and herring were the most abundant landed species (Figure 2, Table 1). Blue whiting was mainly targeted during the first half of 2008 and 2009, while herring was the main target during the second half of the years (Figures 2, 3). Most blue whiting landings originated from areas VIa and VIc, while herring was mainly caught in areas II, IVa, VIa and VIId. Horse mackerel is caught throughout the year in a number of different areas (Figures 2, 3).

### 3.2 Estimated discards from sampled trips

#### 3.2.1 Sampled trips

In 2008 and 2009 twelve and eleven trips respectively were made by observers onboard of pelagic freezer trawlers. Six different fishing ground were sampled; Norwegian Sea, Faroes Plateau, North Sea, Celtic Sea, English Channel and Bay of Biscay (Figure 4). During the sampled trips a total of 401 hauls in 2008 and 345 hauls were sampled, which was 92% and 86% respectively of all the hauls during these trips (Table 2). In 2008 during 19 hauls (4% of all the hauls) and in 2009 during 24 hauls (6% of all the hauls) unsorted discarding was observed (Table 2). Haul duration was on average 4-4.5 hours (Figure 5).

During one or more sampled trips blue whiting, greater argentine, herring, horse mackerel, mackerel and pilchard were targeted (Tables 3, 4). The species composition of catch, landings and discards per trip is presented in Figure 6 (Catch), Figure 7 (landings) and Figure 8 (discards).

The length frequency distributions of landed and discarded fish are presented in Figures 9 - 14 per trip and over all trips combined for herring, horse mackerel, mackerel, blue whiting, greater argentine and pilchard. For all species except mackerel the length frequency distributions show a regular bell-shaped pattern over the different trips (Figures 9, 10, 12, 13 and 14). The length frequency distribution for mackerel show a divergent pattern in some trips, with an extra peak for undersized discards (<25 cm) (Figure 11).

It should be noted that trip P60 and some hauls during trip P71 took place in Norwegian waters (Figure 4). According to the Norwegian discard ban it is not allowed to throw fish overboard in this area. Fish that would otherwise have been discarded is therefore frozen as waste product. It was possible for the observer to sample this waste product and has been classified as discards in this report.

#### 3.2.2 Discards

The total catch, landings and discards per species per trip and corresponding sampling period is reported in Table 4. In this table the total amount of "unsorted discards" observed during each trip and "not sampled" hauls are presented separately. The first variable (unsorted discards) was taken into account in determining the total discard percentage per trip. Values were raised to fleet level and are presented in Table 6.

#### Discard estimates

For 2008, the raised data show a discard percentage of 1% for horse mackerel 2% for greater argentine and herring and 3% for blue whiting and pilchard (Table 6). Mackerel was by far the most dominant species in the discards during the samples trips (Table 5), which resulted in a discard percentage of 32%. Overall (including unsorted discards) the discard percentage for the Dutch pelagic fleet in 2008 based on the sampled trip is estimated at 8% (Table 6).

The non-target species, saithe (*Polachius virens*) and hake (*Merluccius merluccius*), were landed during trip P55, black seabream (*Spondyliosoma cantharus*), during trip P62 (Table 4, Figures 7, 15). The discarded "other species" mainly consisted of boarfish (*Capros aper*). Also, a basking shark (*Cetorhinus maximus*) was caught and discarded during 1 trip (Table 5).

For 2009, the raised data show a discard percentage of 1% for blue whiting, horse mackerel and pilchard. Herring and greater argentine both show a discard percentage of 4% (Table 6). Mackerel was again the most dominant species in the discards during the sampled trips (Table 5), which resulted in a discard percentage of 21%. Overall (including unsorted discarding) the discard percentage for the Dutch pelagic fleet in 2009 based on the sampled trip is estimated at 8% (Table 6). The non-target species sea bass (*Dicentrarchus labrax*), hake and black seabream (*Spondyliosoma cantharus*) were landed during trips P64, P68 and P73 respectively (Table 4, Figure 7).

#### *Spatial distribution discards*

The spatial and temporal distributions of the discards differ per species (Figure 16). The majority of the species were discarded throughout the whole year. The distribution of the herring discards coincides with the herring fishing grounds. This is not the case for the other species. The spatial temporal distribution of unsorted discards are depicted in Figure 17. Both Figures show that discarding was observed in Norwegian waters. These are the positions of the catches that were frozen as waste product as it is not allowed to discard in Norwegian waters originated from. They were, however, not thrown overboard.

## 4 Discussion

### 4.1.1 Long term trends

The species composition of the landings has gradually changed over the years (Helmond and Overzee, 2007). In the early part of the 1990s, the landings were dominated by horse mackerel whereas in the latter part of the 1990s an increase in blue whiting is observed. Herring has been a relatively constant part of the Dutch pelagic landings since 1990 (Helmond and Overzee, 2007).

The overall discard percentage for both 2008 and 2009 was 8% in weight. This is consistent with discard percentages found for the period 2004-2007 (6%-8%) (Helmond and Overzee, 2008).

### 4.1.2 Annual landings

The annual landings of the Dutch pelagic fleet illustrate the seasonality in this fishery. Every year the target species change with season and area. This means that within one year a species can be targeted in one season and discarded in the next season. Blue whiting, herring and horse mackerel are the most abundant species in the landings. This corresponds with the relative large quota the Netherlands possess for these species (Table 7).

### 4.1.3 Discards

The discard data was raised, similar as the study performed in 2008 (Helmond and Overzee, 2008), by total number of trips. This was done per quarter to take the high seasonality of this fishery into account. Although the raising procedure by trip is found to be the most robust method (Borges *et al.*, 2008), the catches of some species (pilchard and greater argentine) are not well covered by the sampling programme, and are therefore considered uncertain estimates.

At present the species composition of "unsorted discards" and "not sampled" catches remain unclear and are therefore presented separately. The results show that the estimated amount of unsorted discards represents 23%-24% of the total estimated discards. However, incidents of unsorted discards were not frequently observed during the sampled trips, only in 4%-6% of the sampled hauls catch was discarded without sorting. At present it remains unclear what triggers skippers of pelagic freezer trawlers to discard catch before sorting. Discarding part of the last haul because lack of storage at the end of the trip is a logical explanation. However, unsorted discarding is not only observed at the end of trips. Hence, a more complex combination of abundance, quality (market value) and effort (catchability and haul duration) is expected to trigger skippers to sort a catch or discard and target for a new (better) catch. A detailed study on discarding unsorted catch is in progress.

Discard percentages of target species, herring, horse mackerel and blue whiting are highly dependent of season, quota limits, market price and fish size and quality. Fish prices vary per season and, therefore, the incentive to discard a particular species depends on season. When a species is targeted, discard rates appear to be marginal (1%-5%). Outside a season, when a species is not targeted discard rates are high (up to 100%). For example, when blue whiting is targeted (January - April), discard rates do not exceed 2%. Outside this period discard rates frequently reach 100%. Nonetheless, as discard percentages are calculated on an annual basis, the total discards as a ratio over total catch per species per year, are low. Based on these results it can be concluded that the Dutch pelagic freezer fishery can have a high level of efficiency, when it comes to targeting (marketable) fish. However, the fishery on mackerel is an exception.

For mackerel the discard percentages are significantly higher than the other target species. The estimated raised discard percentage for 2008 and 2009 is 32% and 21% respectively.

The crucial factor for discarding mackerel is a large market price differential between small and large mackerel. Low prices for mackerel in the smaller length classes initiate a strong incentive to discard mackerel that will not provide the best price when landed. The length frequency indeed indicates higher discard rates for mackerel in the lower length classes (Figure 11).

#### *4.1.4 Commitments of the Pelagic Freezer-trawler Association to reduce discards*

The Pelagic Freezer-trawler Association (PFA) North Sea herring fishery was awarded the Marine Stewardship Council (MSC) certificate in May 2006. Recently (July 2009) the PFA North East Atlantic mackerel fishery has also been MSC certified. The MSC certification process recognizes and rewards willingness to fish sustainably. It is a commercial initiative that benefits certified fisheries. Certified fisheries are subject to a rigorous assessment against standardised principles and criteria they must meet. While the North East Atlantic mackerel fishery is currently certified, it did make the commitment to "develop measures to reduce incidents of incidental fishery-related mortality within its fleet (such as discarding, high-grading or slippage), in both the directed mackerel fishery and other pelagic fisheries, either through company policies and procedures or fishing practices" ([www.msc.org](http://www.msc.org)). As a result of this MSC certification we expect to observe a reduction in mackerel discard rates in the next few years.

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## Appendix 1: Tables and figures

**Table 1a.** Landings (tonnes) per year, species and ICES area by the Dutch freezer trawler fleet in 2008. Data for 2008 extracted from the VIRIS database. For areas see Figure 1.

Year	Species	II	IVa	IVb	IVc	Vb	VIaN	VIaS	VIIb	VIIc	VIIId	VIIe	VIIh	VIIIa	VIIIb	VIIIId	VIIj	VIIk	Total
2008	Greater argentine						3026												3026
	Herring	28747	11607	900	769		4075	284			9896	51	82				298		56709
	Horse mackerel		956	573	7653		999	2729	8190	2333	10700	4634	1672	5735	13	522	15811	111	62631
	Mackerel	72	1789				4798	3344	2562	118	22		678	958	106		5372		19819
	Pilchard				338						950	1109	1						2398
	Blue whiting	172				754	25064	4723	829	41487							8	5410	78447

**Table 1b.** Landings (tonnes) per year, species and ICES area by the Dutch freezer trawler fleet in 2009. Data for 2009 extracted from the VISSTAT database. For areas see Figure 1.

Year	Species	IIa	IIb	IVa	IVb	IVc	Vb	VIa	VIb	VIIb	VIIc	VIIId	VIIe	VIIh	VIIIb	VIIj	VIIk	Total
2009	Greater argentine							1797										1797
	Herring	21580	5190	8907	2555	482		5576				7940		293				52523
	Horse mackerel			1031	1033	6882		2332		7816	1504	11401	2005	2230	1400	19437	503	57574
	Mackerel	11	2	2339	67			11775		2830	71	46	1	493	493	4939		23067
	Pilchard				2	8						2455	386					2851
	Blue whiting	53	7				101	12149	203	6	23196				3	2	76	35796

**Table 2.** Overview of sampled trips

Year	Trip	Number of hauls	Number of hauls sampled	% of hauls sampled	Number of hauls with unsorted discards <sup>1</sup>	% of hauls with unsorted discards
2008	P52	46	36	78%	1	2%
	P53	25	25	100%	3	12%
	P54	26	25	96%	1	4%
	P55	50	50	100%	0	0%
	P56	40	38	95%	0	0%
	P57	35	29	83%	0	0%
	P58	43	42	98%	2	5%
	P59	28	26	93%	0	0%
	P60	32	29	91%	1	3%
	P61	22	21	95%	4	18%
	P62	38	31	82%	7	18%
	P63	51	49	96%	0	0%
2009	P64	31	19	61%	1	3%
	P65	47	37	79%	7	15%
	P66	33	30	91%	0	0%
	P67	31	31	100%	0	0%
	P68	33	27	82%	0	0%
	P69	52	49	94%	0	0%
	P70	27	26	96%	4	15%
	P71	29	29	100%	1	3%
	P72	34	31	91%	6	18%
	P73	51	34	67%	3	6%
	P74	34	32	94%	2	6%

<sup>1</sup> Occasionally, trawlers discard relatively large amounts of catch without sorting (unsorted discards). The species composition of such discards is unknown (see Introduction).

**Table 3.** Period, target species and ICES area's of the trips conducted during the observer programme

Year	Trip	Period	Target species	ICES area's
2008	P52	02/01 – 27/01	Herring, horse mackerel	IVc, VIId, VIIe
	P53	29/02 – 27/03	Blue whiting	VIIc
	P54	07/03 – 28/03	Blue whiting	VIIc
	P55	28/04 – 27/05	Blue whiting, greater argentine	Vb, VIa
	P56	13/05 – 31/05	Horse mackerel	VIIIb
	P57	12/06 – 06/07	Horse mackerel, mackerel	VIIIb, VIIj, VIIla
	P58	09/07 – 15/08	Herring	IIa
	P59	03/07 – 28/08	Herring	IIa
	P60	11/09 – 07/10	Herring	IIa
	P61	15/10 – 14-11	Mackerel	IVa
	P62	01/12 – 22/12	Horse mackerel, mackerel, herring	VIa, VIIb, VIId, VIIj
	P63	20/11 – 21/12	Herring, horse mackerel	VIIb, VIIc, VIId, VIIe, VIIj
2009	P64	02/01 – 18/01	Horse mackerel, pilchard	VIId
	P65	05/02 – 05/03	Blue whiting, horse mackerel	VIa, VIIb, VIIc, VIIh, VIIj, VIIk
	P66	13/03 – 03/04	Blue whiting, horse mackerel, mackerel	VIa, VIIc, VIIj
	P67	18/03 – 09/04	Blue whiting	VIa
	P68	25/04 – 16/05	Blue whiting, greater argentine, horse mackerel	VIa, VIIj
	P69	19/05 – 19/06	Horse mackerel, mackerel	VIIj
	P70	06/07 – 26/07	Herring	IVa, VIa
	P71	31/07 – 27/08	Herring	IIa, IIb
	P72	19/08 – 06/09	Herring, horse mackerel, mackerel	IVa, IVb, VIa
	P73	28/11 – 23/12	Herring, horse mackerel	IVc, VIId, VIIe, VIIj
	P74	03/12 – 24/12	Herring, horse mackerel, mackerel	VIIb, VIId, VIIj

**Table 4.** Total catch, landings, discards (tonnes), discard percentage and unsorted discards per sampled pelagic discard trip per year

2008	Month		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Unsorted discards <sup>1</sup>	Total	Not sampled
P52	1	Catch			473.9	1207.7	13.7	0.2	2.6	10	1708.1	10
		Landings			448.4	1204.8	0.0	0.0	0.0		1653.2	
		Discards			25.5	2.9	13.7	0.2	2.6	10	54.9	
		% Discards			5%	<1%	100%	100%	100%	100%	3%	
P53	2,3	Catch	3265.0				1.5		6.9	60	3333.4	
		Landings	3201.4				0.0		0.0		3201.4	
		Discards	63.6				1.5		6.9	60	132.0	
		% Discards	2%				100%		100%	100%	4%	
P54	3	Catch	3988.3				0.3		3.0	20	4011.6	150
		Landings	3956.7				0.0		0.0		3956.7	
		Discards	31.6				0.3		3.0	20	54.9	
		% Discards	1%				100%		100%	100%	1%	
P55	4,5	Catch	3399.4	250.7		0.4	3.8		51.0		3705.3	
		Landings	3388.6	243.6		0.0	0.0		14.0		3646.2	
		Discards	10.8	7.1		0.4	3.8		37.0		59.1	
		% Discards	<1%	3%		100%	100%		73%		2%	
P56	5	Catch	15.8	0		1734.6	79.3	3.5	5.2		1838.4	15
		Landings	0.0	0		1725.5	0.0	0.0	0.0		1725.5	
		Discards	15.8	0		9.1	79.3	3.5	5.2		112.9	
		% Discards	100%			1%	100%	100%	100%		6%	
P57	6,7	Catch	2.6			1023.0	174.0		64.5		1264.1	93
		Landings	0.0			1013.3	33.1		0.0		1046.4	
		Discards	2.6			9.7	140.9		64.5		217.7	
		% Discards	100%			1%	81%		100%		17%	

<sup>1</sup> Occasionally, trawlers discard relatively large amounts of catch without sorting (unsorted discards). The species composition of such discards is unknown(see Introduction).

**Table 4.** Continued

2008	Month		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Unsorted discards	Total	Not sampled
P58	7,8	Catch	2.9		3188.9		63.2		0.8	38	3293.8	5
		Landings	2.6		3170.4		0.0		0.0		3173.0	
		Discards	0.3		18.5		63.2		0.8	38	120.8	
		% Discards	10%		1%		100%		100%	100%	4%	
P59	7,8	Catch			1733.8		10.4				1744.2	
		Landings			1729.6		9.1				1738.7	
		Discards			4.2		1.3				5.5	
		% Discards			<1%		13%				<1%	
P60 <sup>1</sup>	9,10	Catch	73.8		2958.0				1.4	20	3053.2	120
		Landings	0.0		2923.5				0.0		2923.5	
		Discards	73.8		34.5				1.4	20	129.7	
		% Discards	100%		1%				100%	100%	4%	
P61	10,11	Catch			0.2		3025.0			210	3235.2	
		Landings			0.0		2912.8				2912.8	
		Discards			0.2		112.2			210	322.4	
		% Discards			100%		4%			100%	10%	
P62	12	Catch	0.4		1000.1	1235.4	498.9	1.3	33.0	112	2881.1	10
		Landings	0.0		994.7	1217.3	72.7	0.0	1.5		2286.2	
		Discards	0.4		5.4	18.1	426.2	1.3	31.5	112	594.9	
		% Discards	100%		1%	1%	85%	100%	95%	100%	21%	
P63	11,12	Catch	2.6	0.1	1804.6	1161.0	392.3	5.0	9.9		3375.5	
		Landings	0.0	0.0	1778.1	1146.1	0.0	0.0	0.0		2924.2	
		Discards	2.6	0.1	26.5	14.9	392.3	5.0	9.9		451.3	
		% Discards	100%	100%	1%	1%	100%	100%	100%		13%	

<sup>1</sup> This trip took place in Norwegian waters. Discards were not thrown overboard but frozen as waste product.

**Table 4.** Continued

2009	Month		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Unsorted discards	Total	Not sampled
P64	1	Catch				639.6	16.4	369.7	13.1	10	1048.8	56
		Landings				638.1	0.0	367.7	4.4		1010.2	
		Discards				1.5	16.4	2.0	8.7	10	38.6	
		% Discards				<1%	100%	1%	66%	100%	4%	
P65	2,3	Catch	1618.8			1717.4	445.8		7.3	136	3925.3	
		Landings	1601.7			1701.8	0.0		0.0		3303.5	
		Discards	17.1			15.6	445.8		7.3	136	621.8	
		% Discards	1%			1%	100%		100%	100%	16%	
P66	3,4	Catch	1612.6	7.9		62.3	42.6		2.5		1727.9	
		Landings	1611.9	7.6		61.8	32.7		0.0		1714.0	
		Discards	0.7	0.3		0.5	9.9		2.5		13.9	
		% Discards	<1%	4%		1%	23%		100%		1%	
P67	3,4	Catch	2865.0	0.1		0.3	18.5		1.4		2885.3	
		Landings	2848.0	0.0		0.0	0.0		0.0		2848.0	
		Discards	17.0	0.1		0.3	18.5		1.4		37.3	
		% Discards	1%	100%		100%	100%		100%		1%	
P68	4,5	Catch	298.9	354.0		114.1	3.7		37.7		808.4	42
		Landings	292.7	345.6		111.7	0.0		19.4		769.4	
		Discards	6.2	8.4		2.4	3.7		18.3		39.0	
		% Discards	2%	2%		2%	100%		49%		5%	
P69	5,6	Catch	5.0			1865.2	98.5		144.9		2113.6	
		Landings	0.0			1839.1	86.4		0.0		1925.5	
		Discards	5.0			26.1	12.1		144.9		188.1	
		% Discards	100%			1%	12%		100%		9%	

**Table 4.** Continued

2009	Month		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Unsorted discards	Total	Not sampled
P70	7	Catch			3390.8		50.8		7.2	80	3528.8	
		Landings			3338.1		0.0		0.0		3338.1	
		Discards			52.7		50.8		7.2	80	190.7	
		% Discards			2%		100%		100%	100%	5%	
P71 <sup>1</sup>	7,8	Catch	12.7		3280.3		15.5		1.9	10	3320.4	
		Landings	0.0		3254.1		0.0		0.0		3254.1	
		Discards	12.7		26.2		15.5		1.9	10	66.3	
		% Discards	100%		1%		100%		100%	100%	2%	
P72	8,9	Catch	0		1495.5	222.2	311.3		0.9	73	2102.9	
		Landings	0		1353.5	220.4	186.1		0.0		1760.0	
		Discards	0		142.0	1.8	125.2		0.9	73	342.9	
		% Discards			9%	1%	40%		100%	100%	16%	
P73	11,12	Catch	0.2		300.7	1271.0	4.8	1.8	76.8	85	1740.3	
		Landings	0.0		295.4	1267.4	0.1	0.0	74.9		1637.8	
		Discards	0.2		5.3	3.6	4.7	1.8	1.9	85	102.5	
		% Discards	100%		2%	<1%	98%	100%	2%	100%	6%	
P74	11,12	Catch	0.1		1557.8	419.3	646.6		7.6	28	2659.4	27
		Landings	0.0		1527.0	405.7	545.5		0.0		2478.2	
		Discards	0.1		30.8	13.6	101.1		7.6	28	181.2	
		% Discards	100%		2%	3%	16%		100%	100%	7%	

<sup>1</sup> This trip partly took place in Norwegian waters. These discards were not thrown overboard but frozen as waste product.



**Table 5.** Average amount of discards (tonnes) over sampled pelagic discard trips per year

Name	Scientific name	Discards (tonnes)	
		2008	2009
Blue whiting	<i>Micromesistius poutassou</i>	16.8	5.4
Greater argentine	<i>Argentina silus</i>	0.6	0.8
Herring	<i>Clupea harengus</i>	9.6	23.4
Horse mackerel	<i>Trachurus trachurus</i>	4.6	5.9
Mackerel	<i>Scomber scombrus</i>	102.9	73.1
Pilchard	<i>Sardina pilchardus</i>	0.8	0.4
Bib	<i>Trisopterus luscus</i>		<0.1
Blackfish	<i>Centrolophus niger</i>	1.0	0.5
Black scabbardfish	<i>Aphanopus carbo</i>		0.2
Black seabream	<i>Spondylusoma cantharus</i>	0.2	<0.1
Boarfish	<i>Capros aper</i>	7.8	13.0
Garfish	<i>Belone belone</i>		<0.1
Gilt head	<i>Sparus aurata</i>		0.1
Golden redfish	<i>Sebastes marinus</i>		0.2
Grey gurnard	<i>Eutrigla gurnardus</i>	0.2	0.2
Haddock	<i>Melanogrammus aeglefinus</i>	0.4	0.3
Hake	<i>Merluccius merluccius</i>	2.2	2.9
John Dory	<i>Zeus faber</i>		0.1
Lumpsucker	<i>Cyclopterus lumpus</i>	0.1	<0.1
Oar-fish	<i>Regalecus glesne</i>	0.2	
Poor cod	<i>Trisopterus minutus</i>	<0.1	
Saithe	<i>Pollachius virens</i>	0.8	
Seabass	<i>Dicentrarchus labrax</i>		<0.1
Silver pomfret	<i>Pterycombus brama</i>	<0.1	
Striped red mullet	<i>Mullus surmuletus</i>		<0.1
Tub gurnard	<i>Trigla lucerna</i>		<0.1
White seabream	<i>Diplodus sargus</i>	0.1	0.7
Whiting	<i>Merlangius merlangus</i>	<0.1	0.1
Loligo	<i>Loligo sp.</i>	0.3	0.1
Basking shark	<i>Cetorhinus maximus</i>	1 specimen ( $\pm$ 8.5 meter)	

**Table 6.** Total catch, landings, discards (tonnes), discard percentage and unsorted discards raised to pelagic fleet level for 2008 and 2009

		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Unsorted discards <sup>1</sup>	Total	Not sampled
2008	Catch	80541	3084	57659	63069	29196	2476	1634	4308	241967	3694
(n=12)	Landings	78447	3026	56709	62631	19819	2398	142		223172	
	Discards	<b>2094</b>	<b>58</b>	<b>950</b>	<b>438</b>	<b>9377</b>	<b>78</b>	<b>1492</b>	<b>4308</b>	<b>18795</b>	
	% Discards	<b>3%</b>	<b>2%</b>	<b>2%</b>	<b>1%</b>	<b>32%</b>	<b>3%</b>	<b>91%</b>	<b>100%</b>	<b>8%</b>	
2009	Catch	36164	1871	54555	58207	29132	2892	2547	3395	188763	1057
(n=11)	Landings	35796	1797	52523	57574	23067	2851	834		174442	
	Discards	<b>368</b>	<b>74</b>	<b>2032</b>	<b>633</b>	<b>6065</b>	<b>41</b>	<b>1713</b>	<b>3395</b>	<b>14321</b>	
	% Discards	<b>1%</b>	<b>4%</b>	<b>4%</b>	<b>1%</b>	<b>21%</b>	<b>1%</b>	<b>67%</b>	<b>100%</b>	<b>8%</b>	

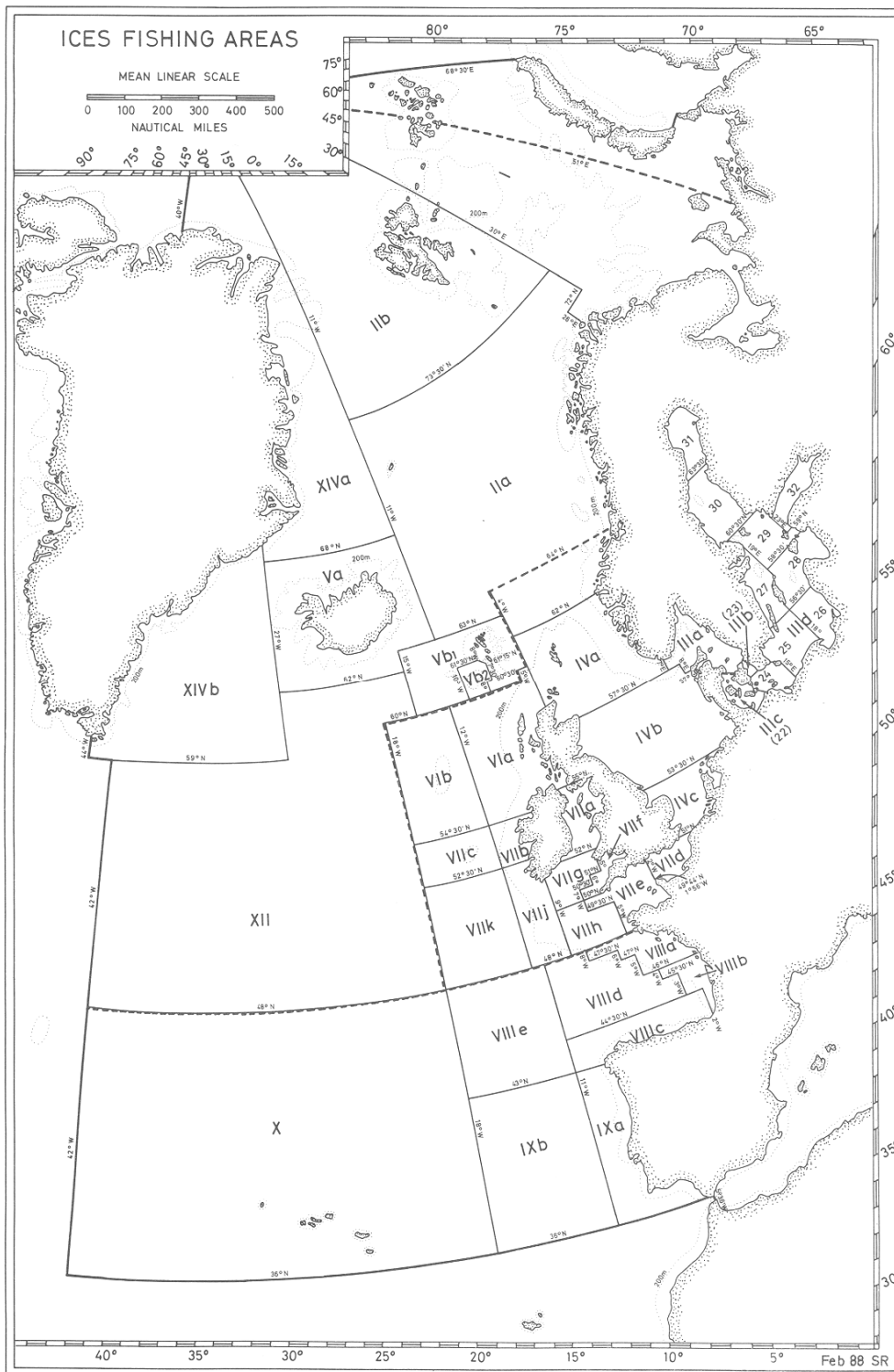
<sup>1</sup> Occasionally, trawlers discard relatively large amounts of catch without sorting (unsorted discards). The species composition of such discards is unknown(see Introduction).

**Table 7a.** Fishing TACs and quotas 2008 As agreed by Council Regulations (EC) No 2015/2006 of 19 December 2006, No 1404/2007 of 26 November 2007, No 1579/2007 of 20 December 2007 and No 40/2008 of January 2008

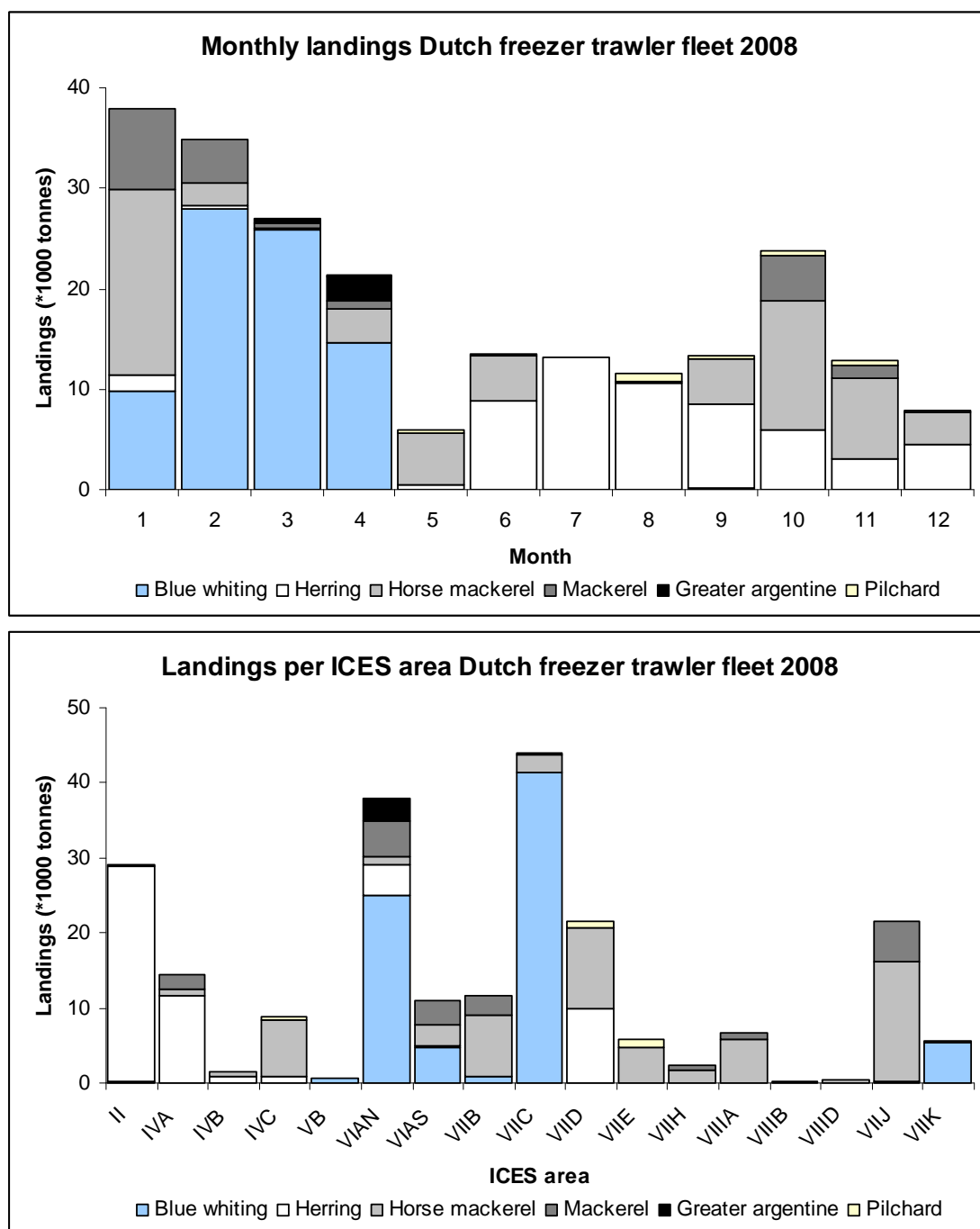
	European TAC 2008 (tonnes)	Dutch TAC 2008 (tonnes)	% Dutch TAC
Herring	2 193 123	53 537	2%
Blue whiting	1 266 282	33 180	3%
Mackerel	412 371	22 217	5%
Horse mackerel	272 819	62 191	23%

**Table 7b.** Fishing TACs and quotas 2009 As agreed by Council Regulations (EC) No 1139/2008 of 10 November 2008, No 1322/2008 of 28 November 2008, No 1359/2008 of 28 November 2008 and No 43/2009 of 16 January 2009

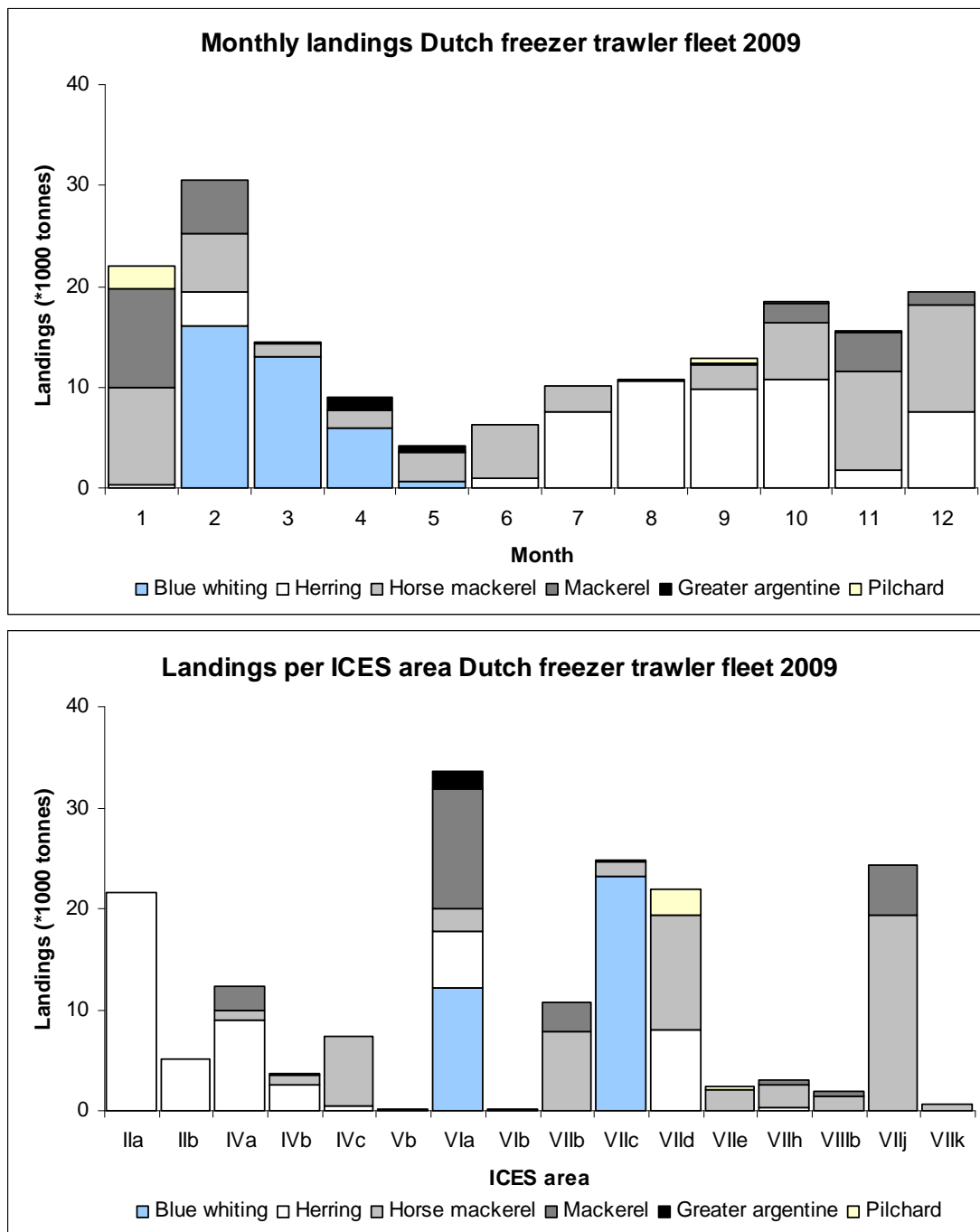
	European TAC 2009 (tonnes)	Dutch TAC 2009 (tonnes)	% Dutch TAC
Herring	2 211 051	47 755	2%
Blue whiting	590 000	13 913	2%
Mackerel	547 116	30 484	6%
Horse mackerel	272 819	61 229	22%



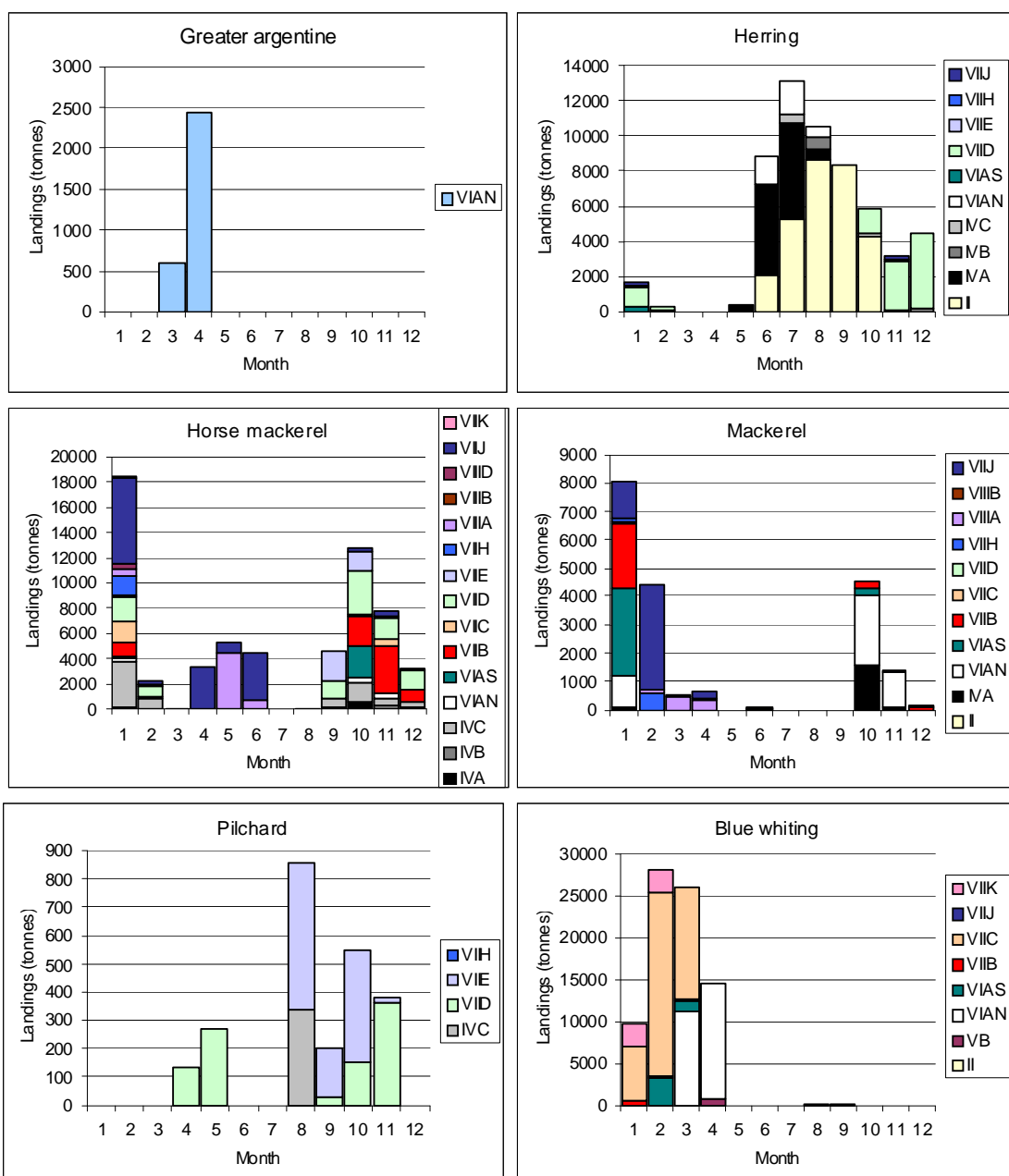
**Figure 1.** Map of ICES rectangles



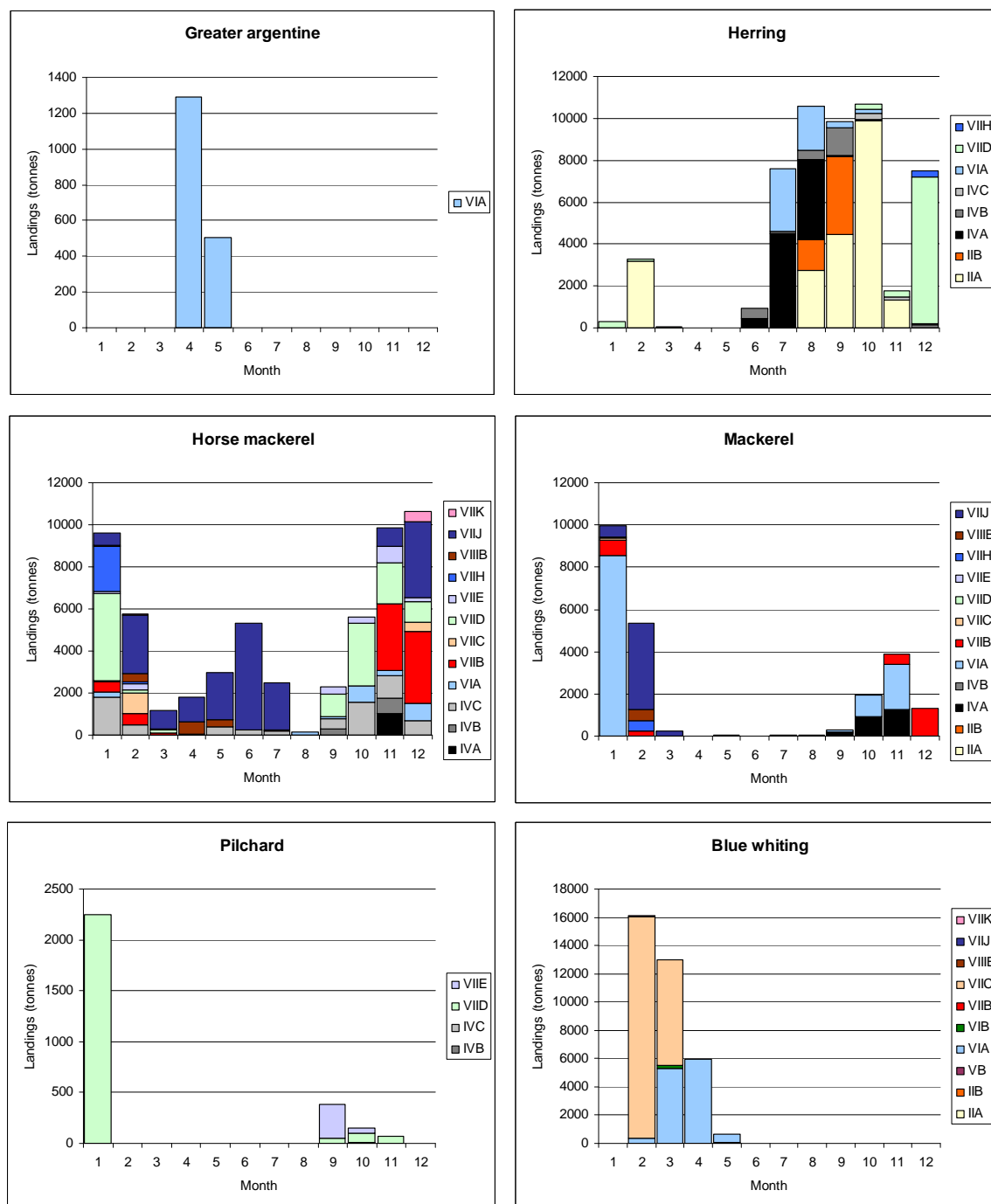
**Figure 2a.** Landings (\*1000 tonnes) from the Dutch freezer trawler fleet in 2008. Upper panel shows monthly landings by species, lower panel shows landings per ICES subarea (Figure 1) by species. Data for 2008 extracted from the VIRIS database.



**Figure 2b.** Landings (\*1000 tonnes) from the Dutch freezer trawler fleet in 2009. Upper panel shows monthly landings by species, lower panel shows landings per ICES subarea (Figure 1) by species. Data for 2009 extracted from the VISSTAT database.

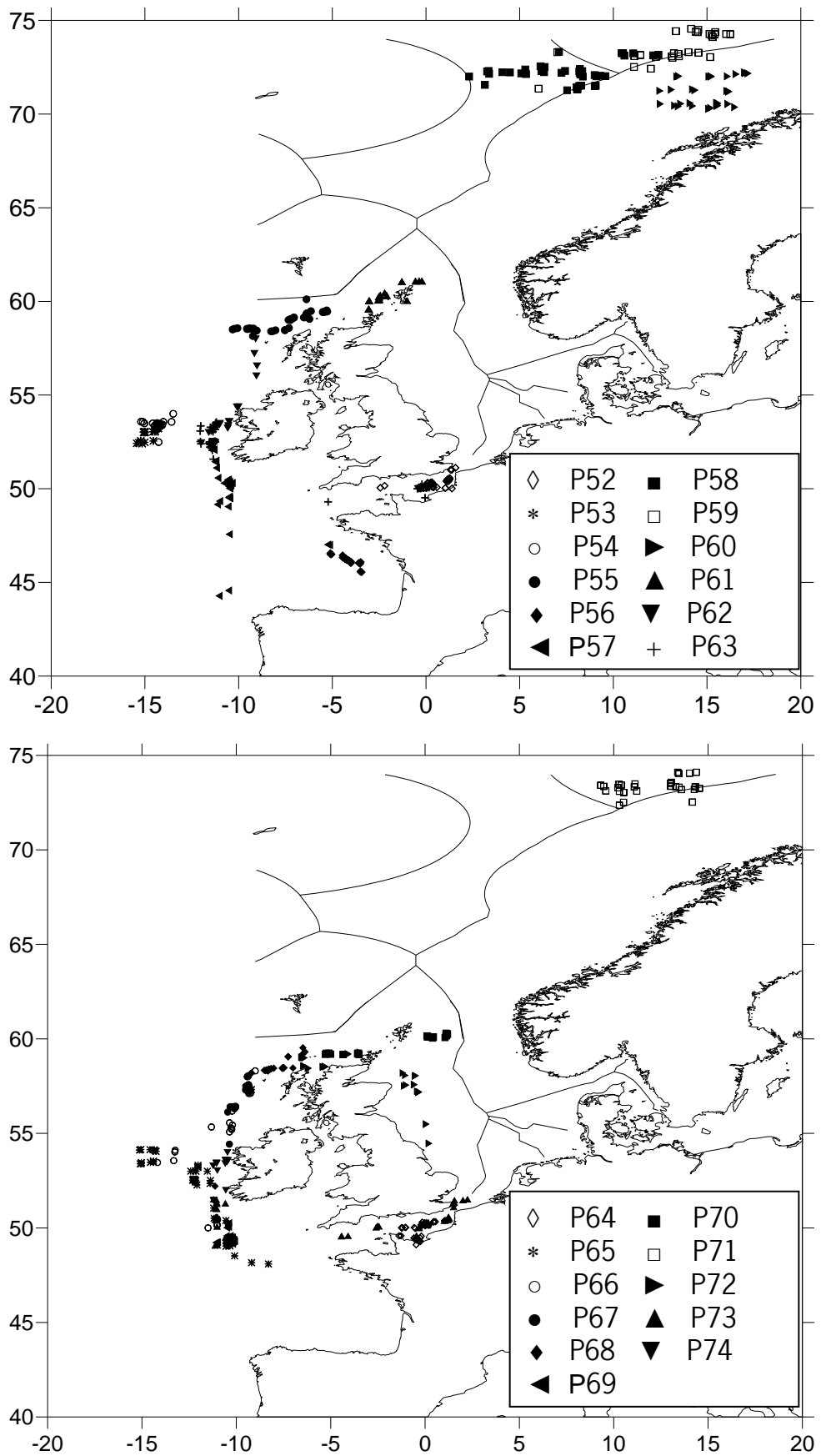


**Figure 3a.** Monthly landings in tonnes per species from the Dutch freezer trawler fleet during 2008 for the most important ICES rectangles (Figure 1). Data for 2008 extracted from the VIRIS database.

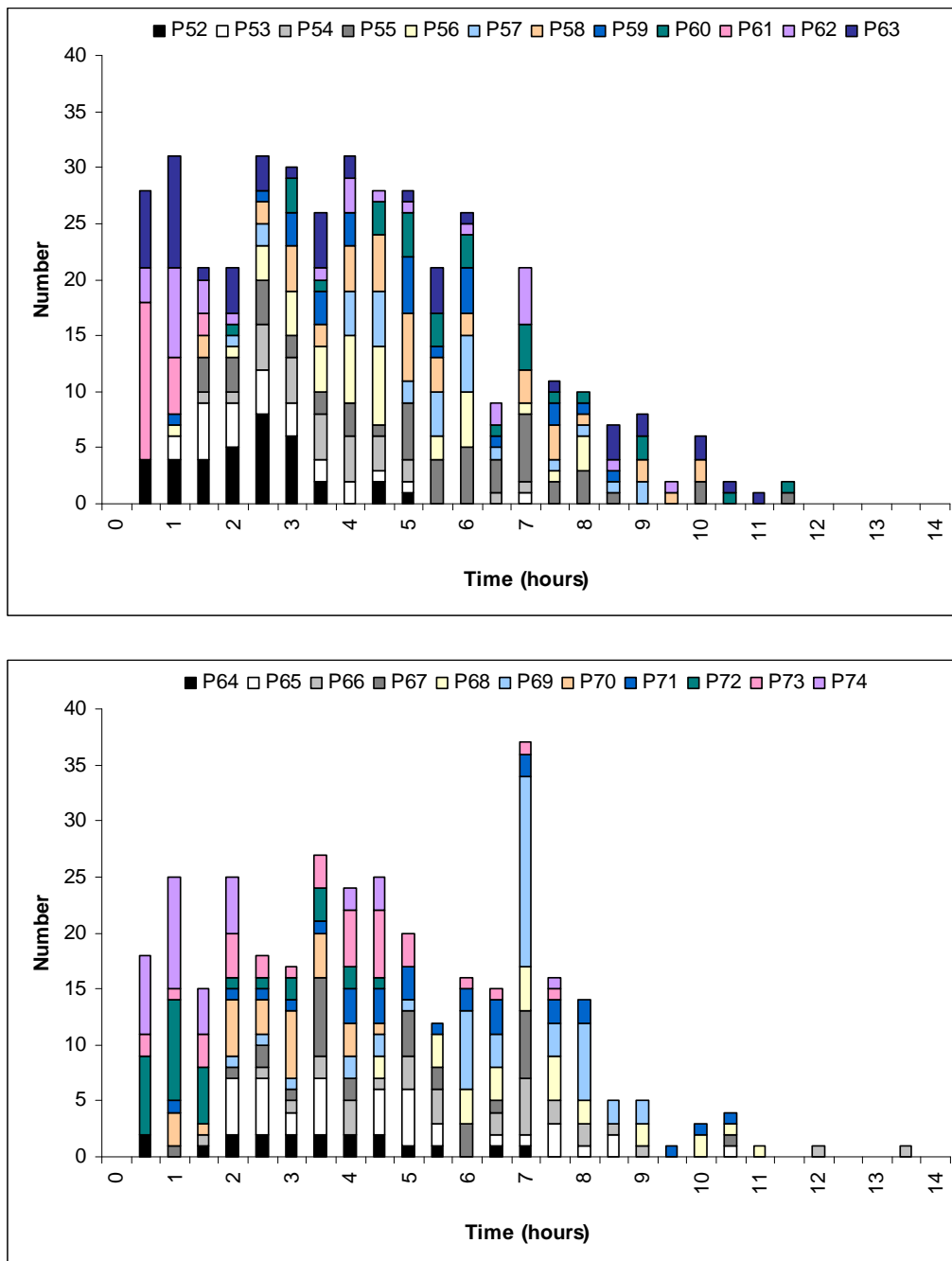


**Figure 3b:** Monthly landings in tonnes per species from the Dutch freezer trawler fleet during 2008 for the most important ICES rectangles (Figure 1). Data for 2009 extracted from the VISSTAT database.

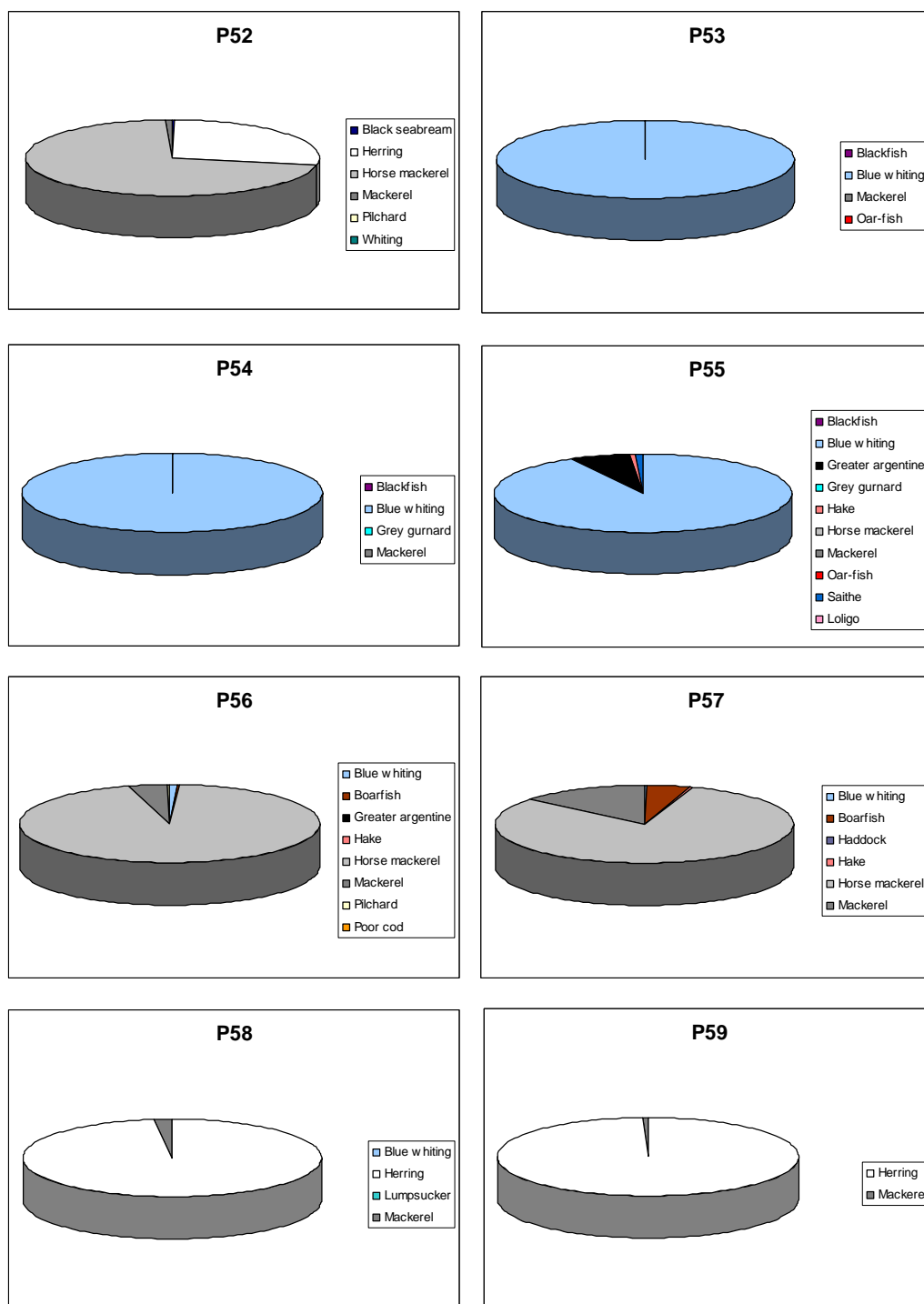




**Figure 4.** Trawl positions per haul for each trip sampled in 2008 (upper) and 2009 (lower)



**Figure 5.** Frequency of haul durations for the sampled trips in 2008 (upper) and 2009 (lower)



**Figure 6.** Composition of the total catches per trip

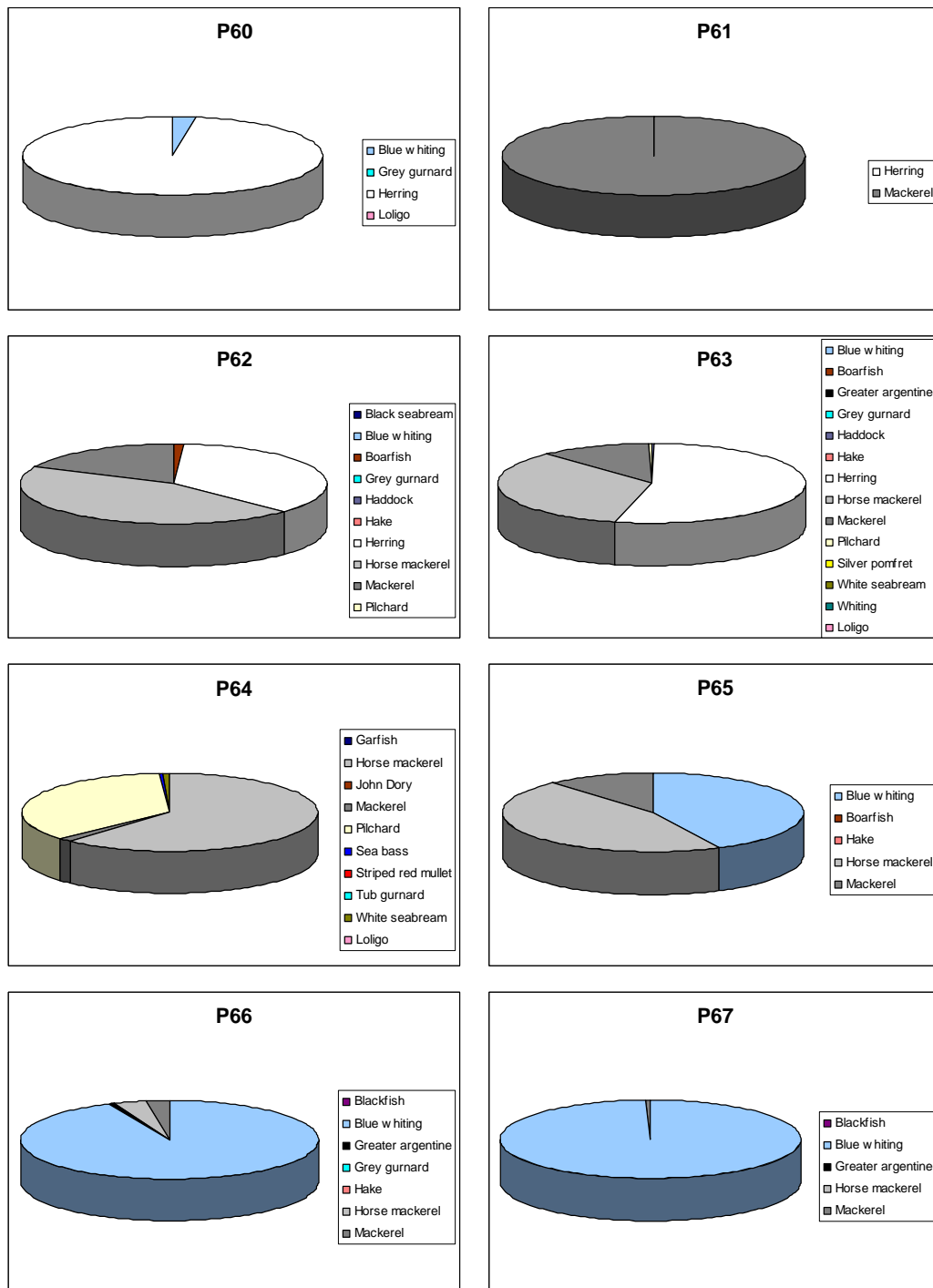


Figure 6. Continued

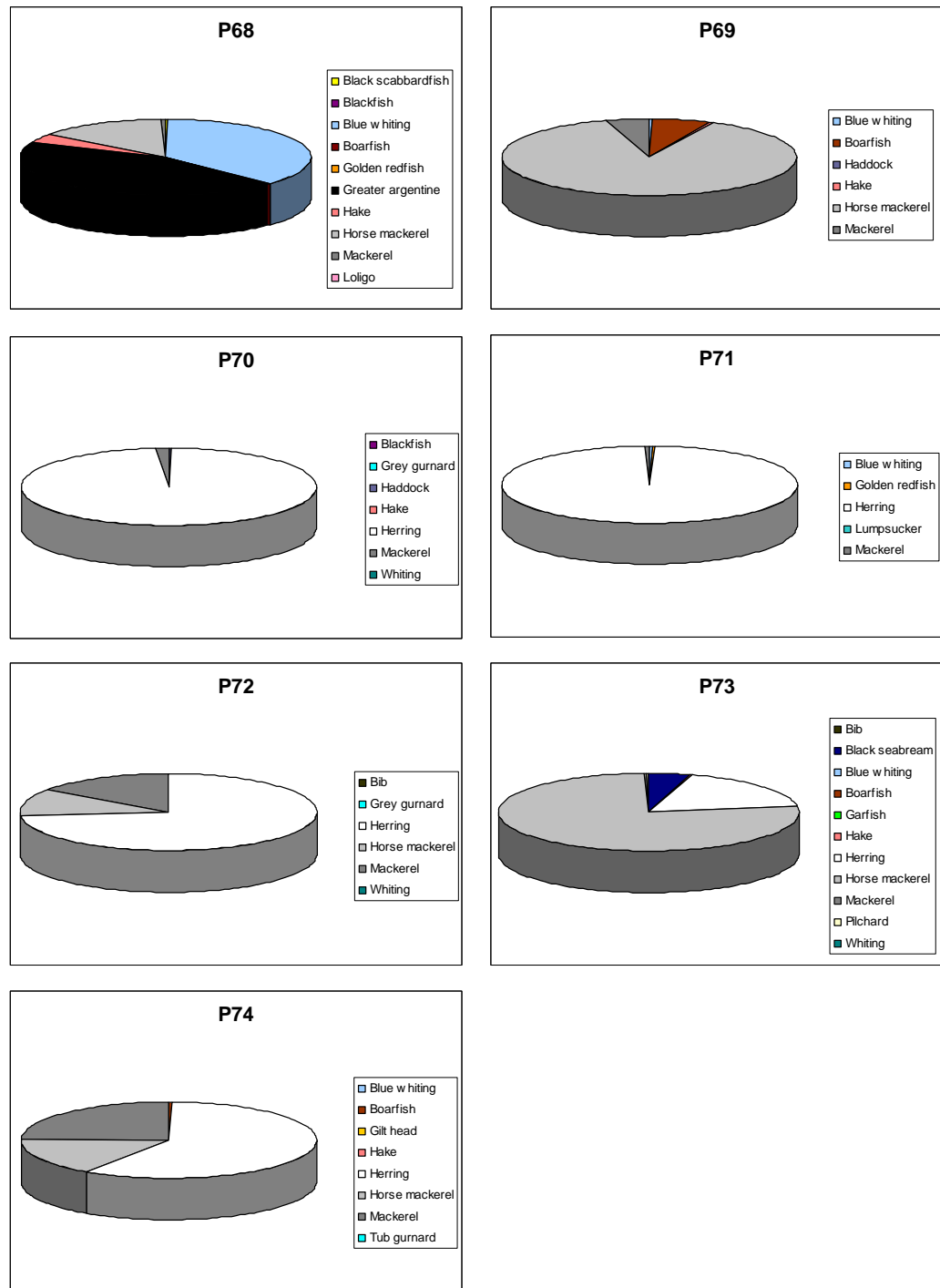
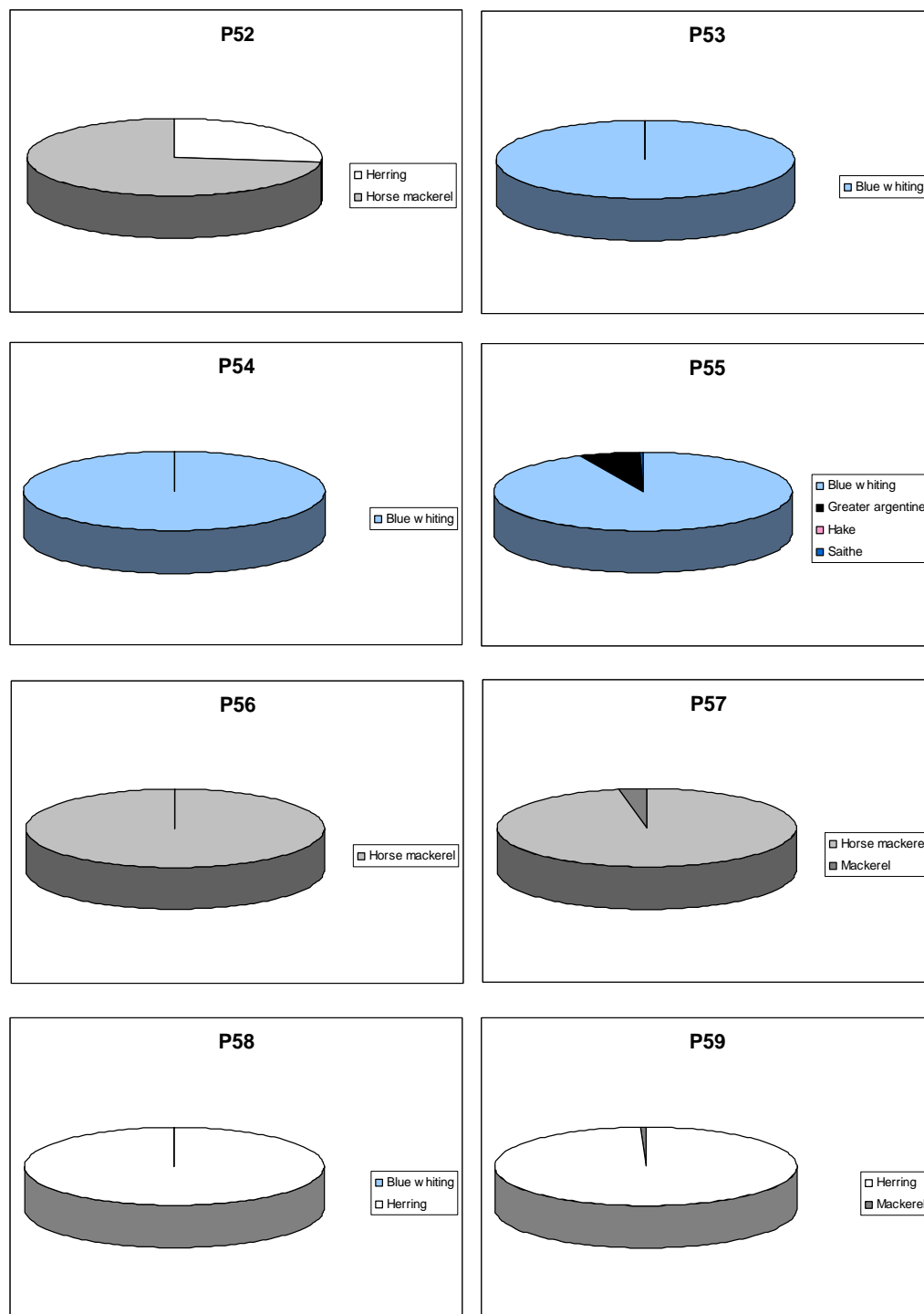
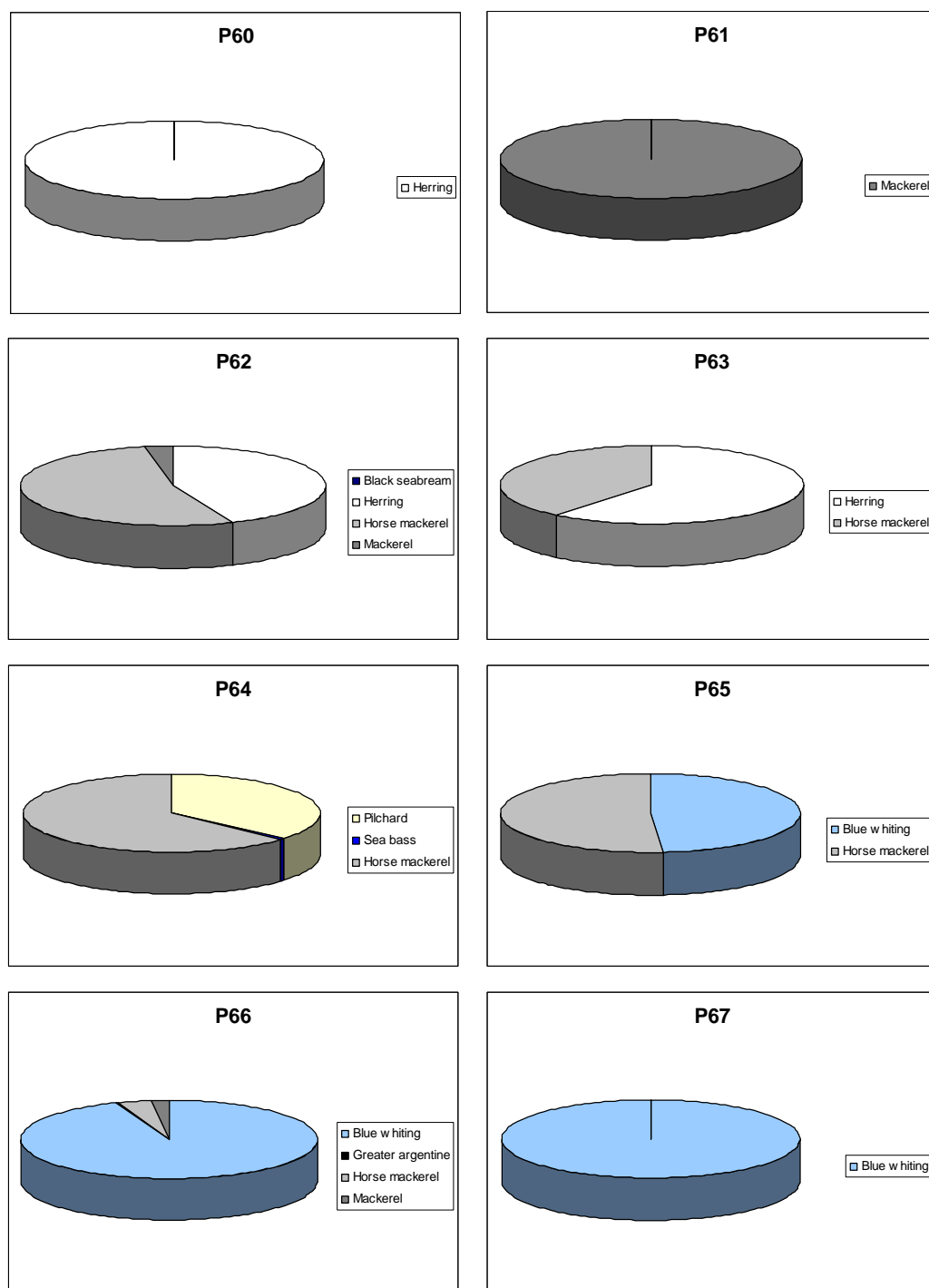
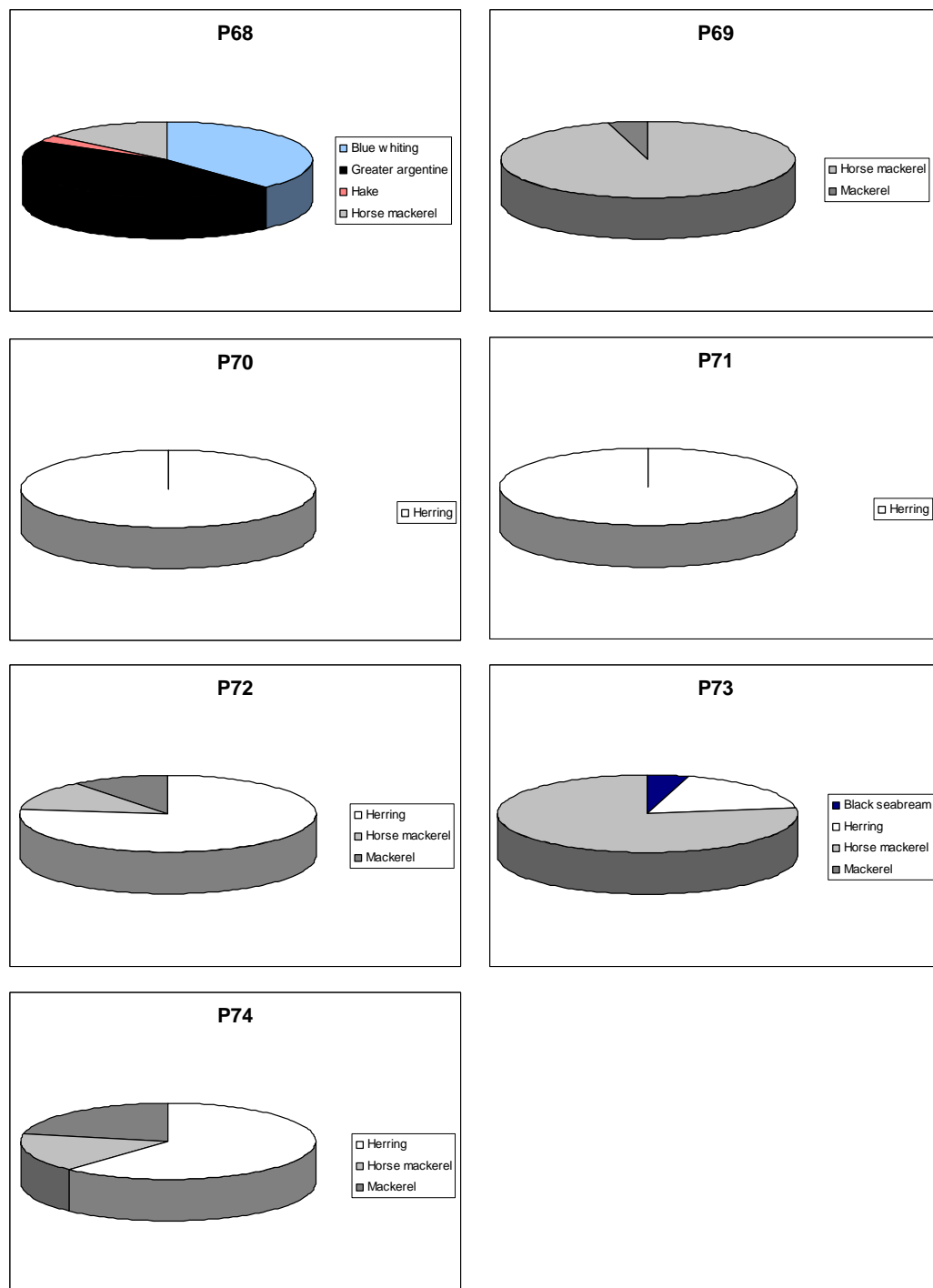


Figure 6. Continued

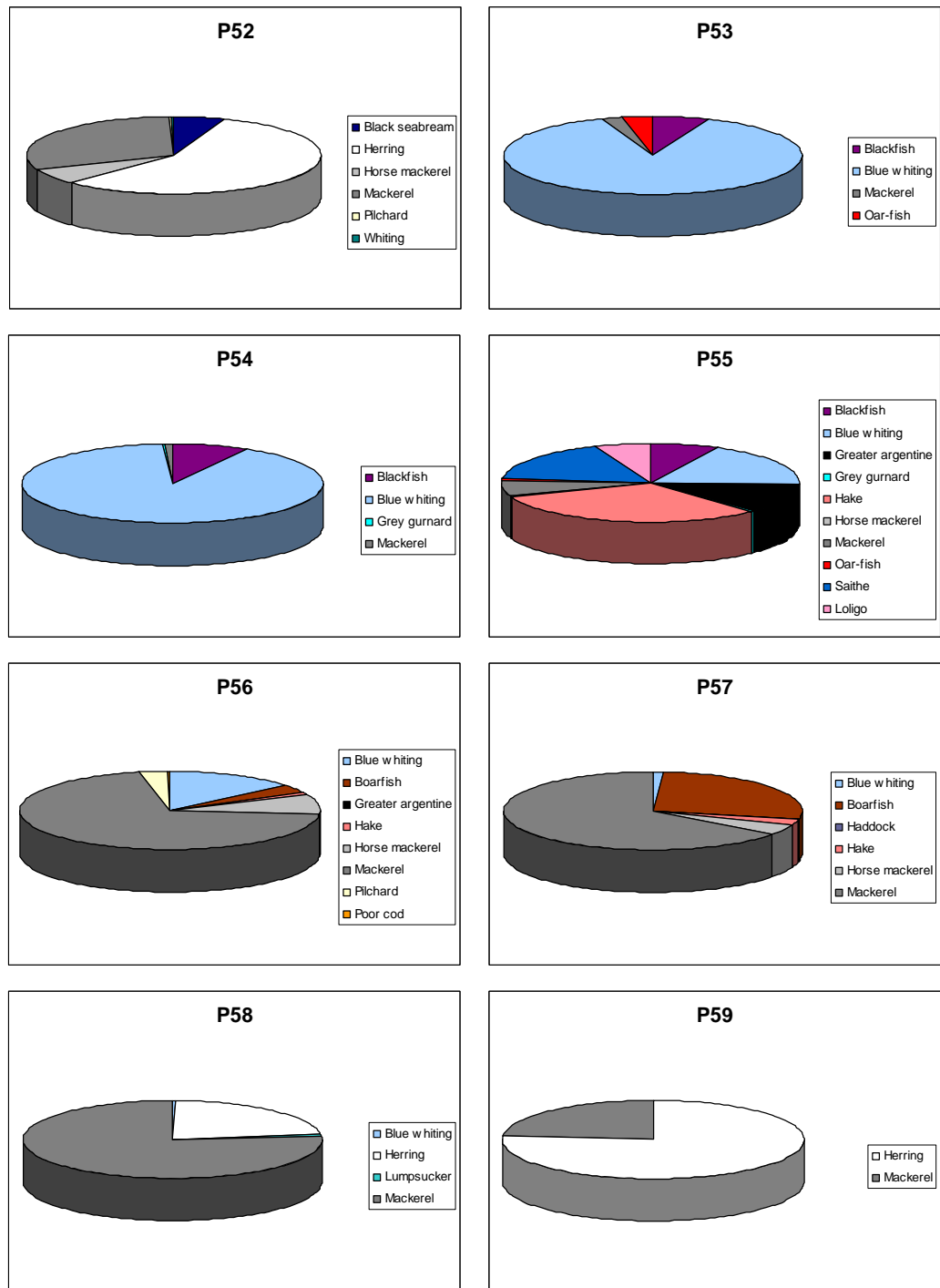


**Figure 7.** Composition of the landings per trip

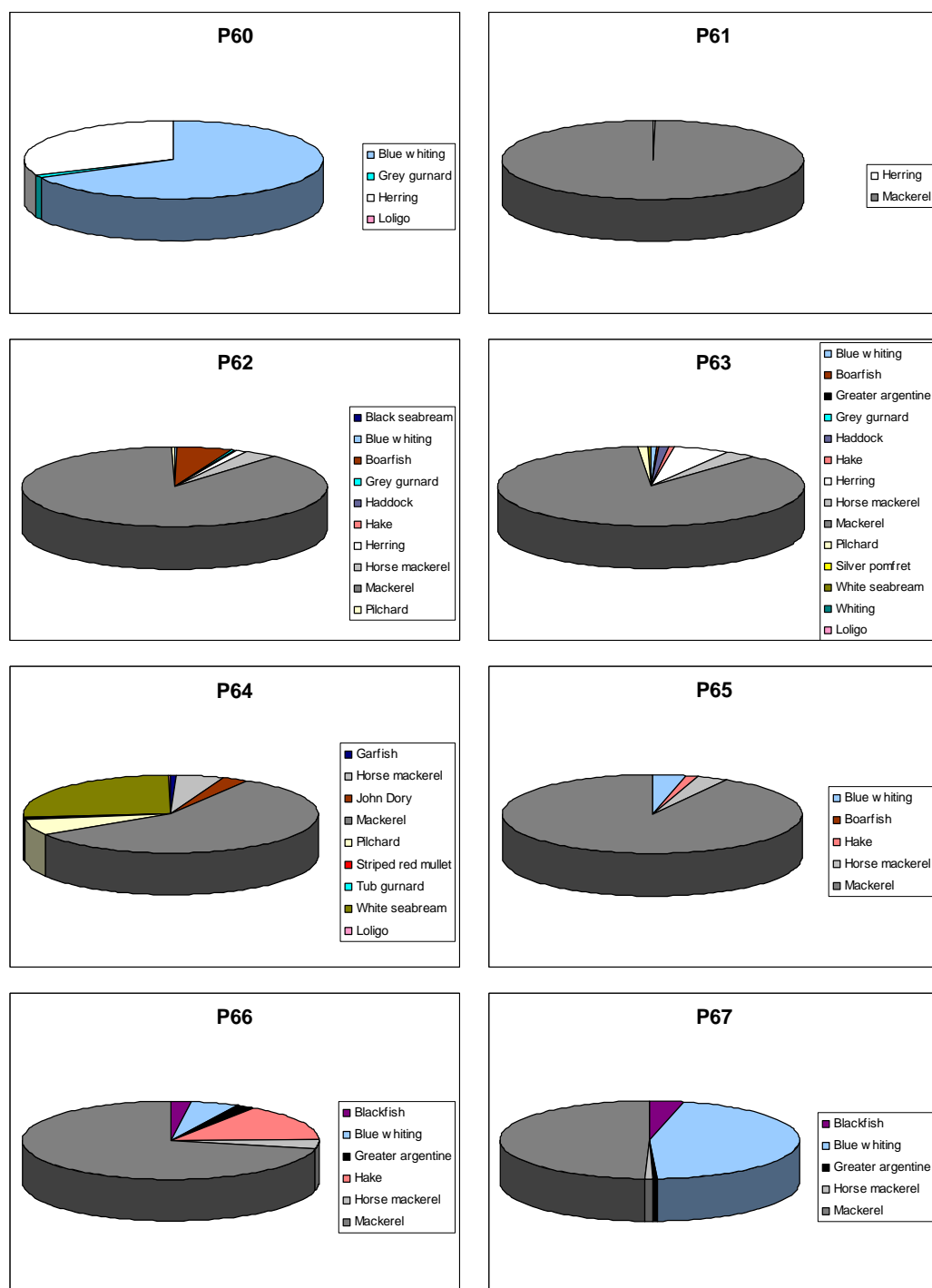
**Figure 7.** Continued

**Figure 7.** Continued





**Figure 8.** Composition of the discards per trip



**Figure 8.** Continued. Note that P60 took place in Norwegian waters. Discards were not thrown overboard during this trip but frozen as waste product.

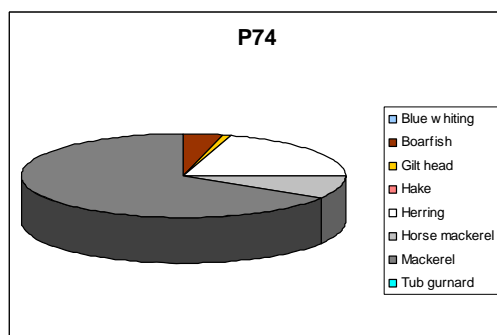
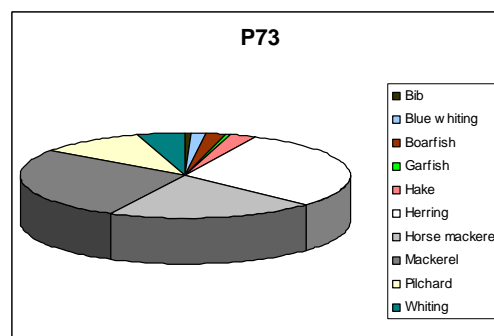
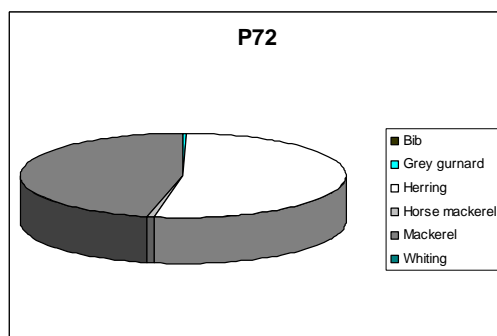
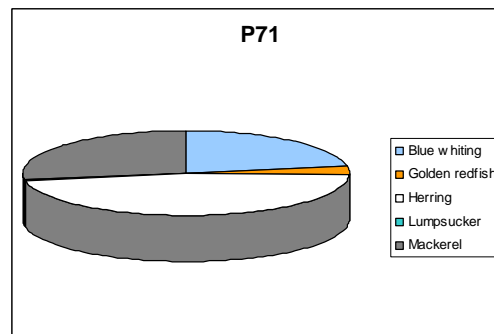
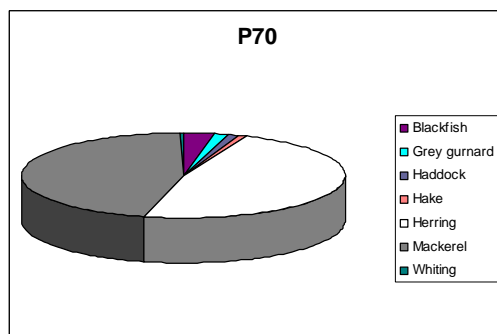
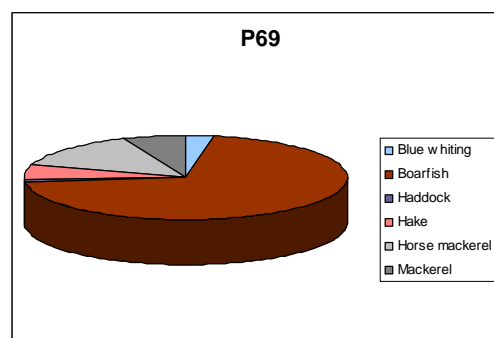
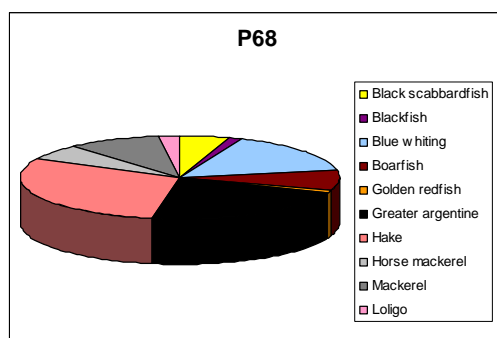
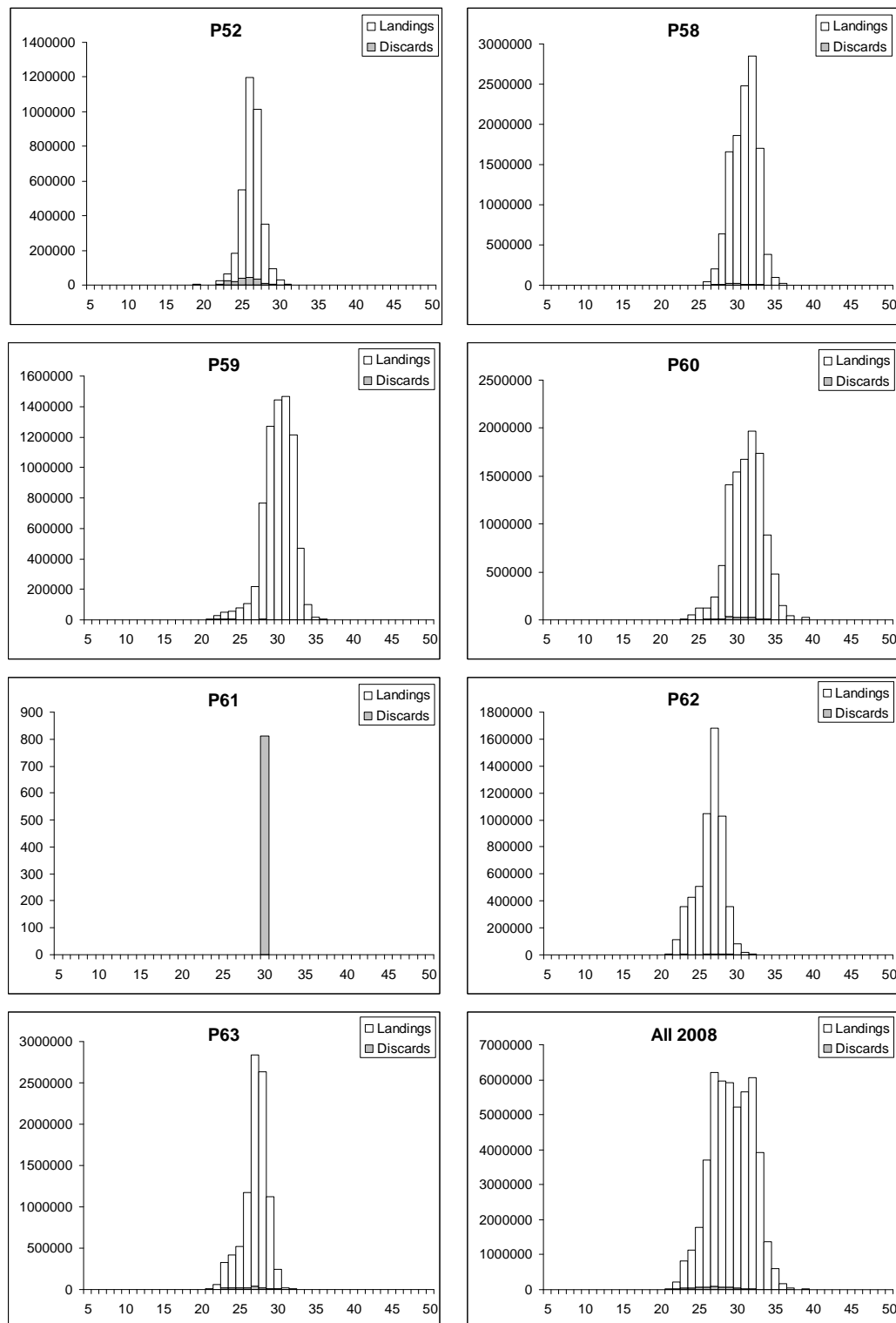
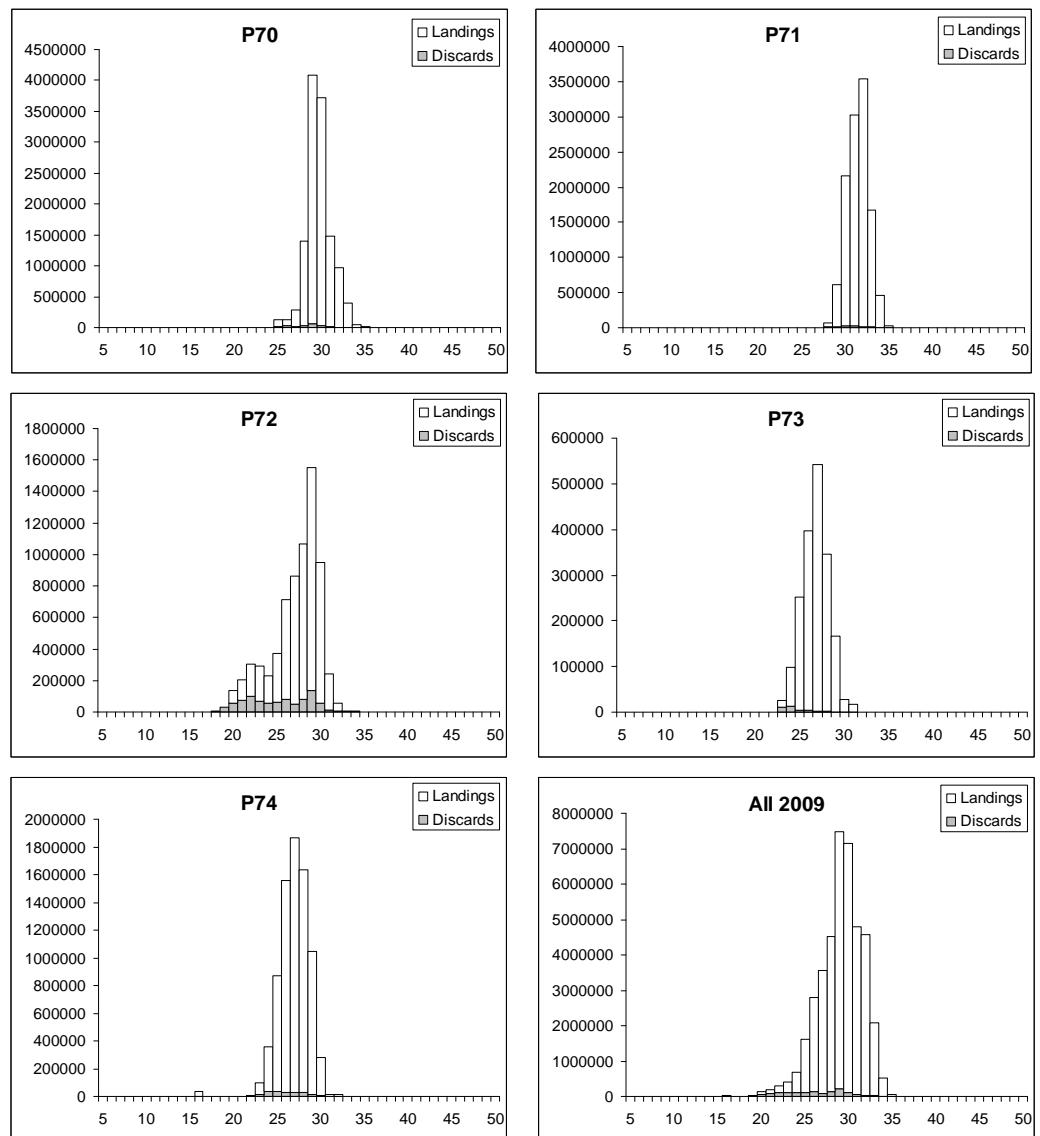
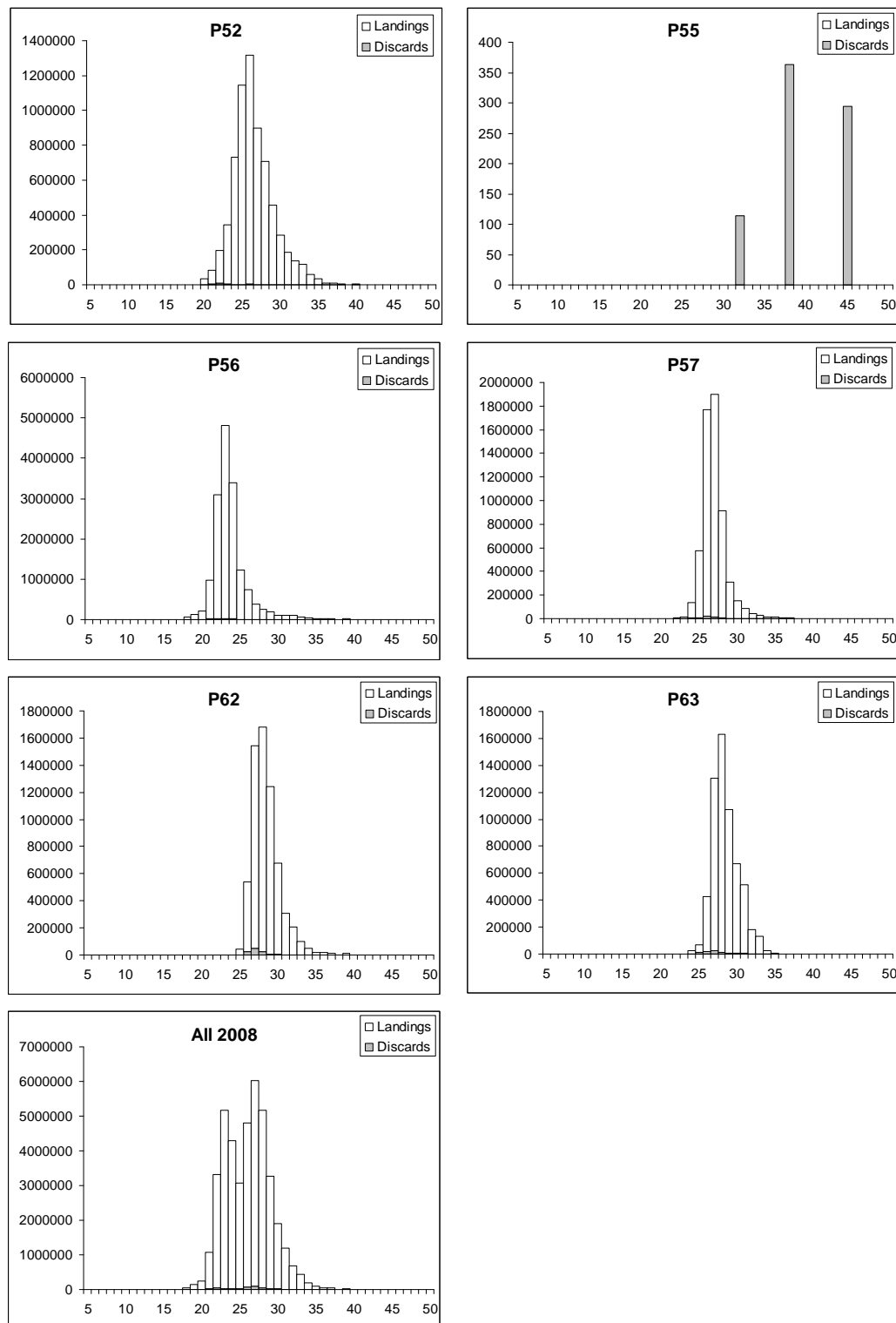


Figure 8. Continued

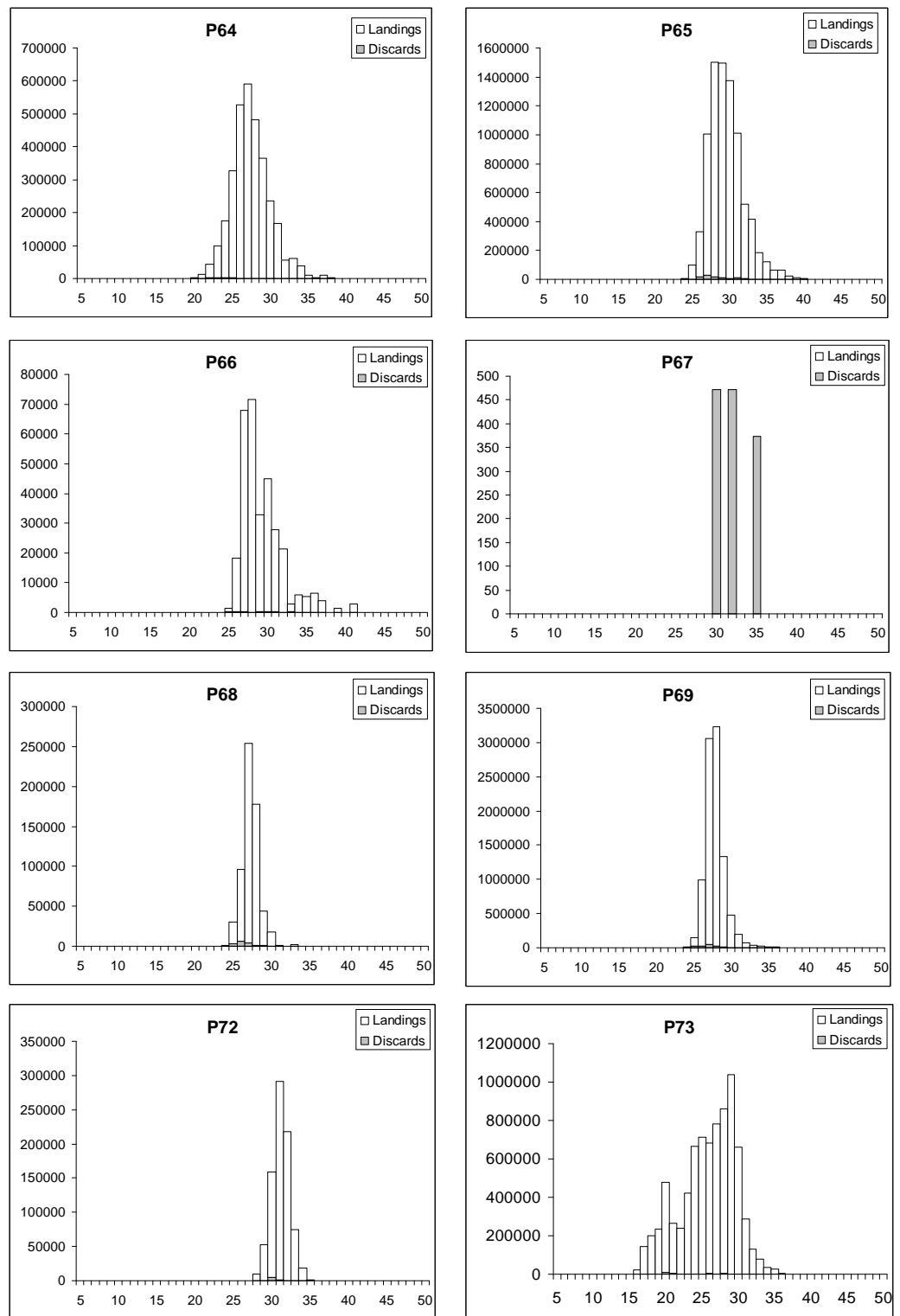


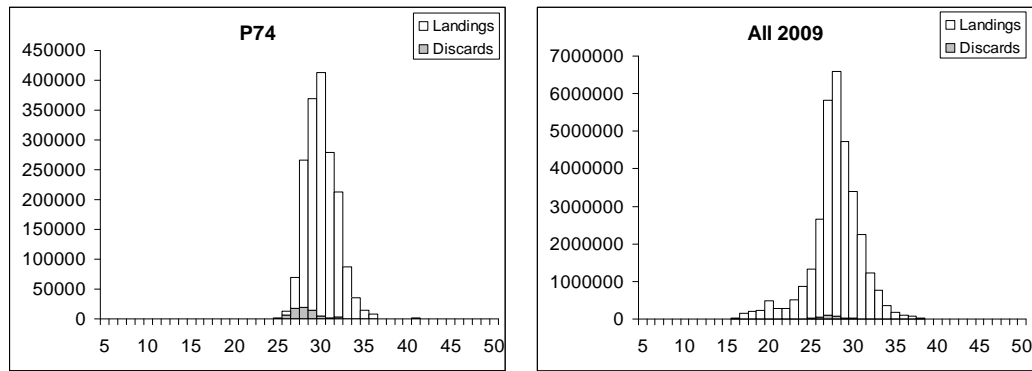
**Figure 9.** Numbers of herring landed and discarded against length (cm) per trip and for all trips combined for 2008 and 2009. Note that P60 took place in Norwegian waters. Discards were not thrown overboard during this trip but frozen as waste product.

**Figure 9.** Continued

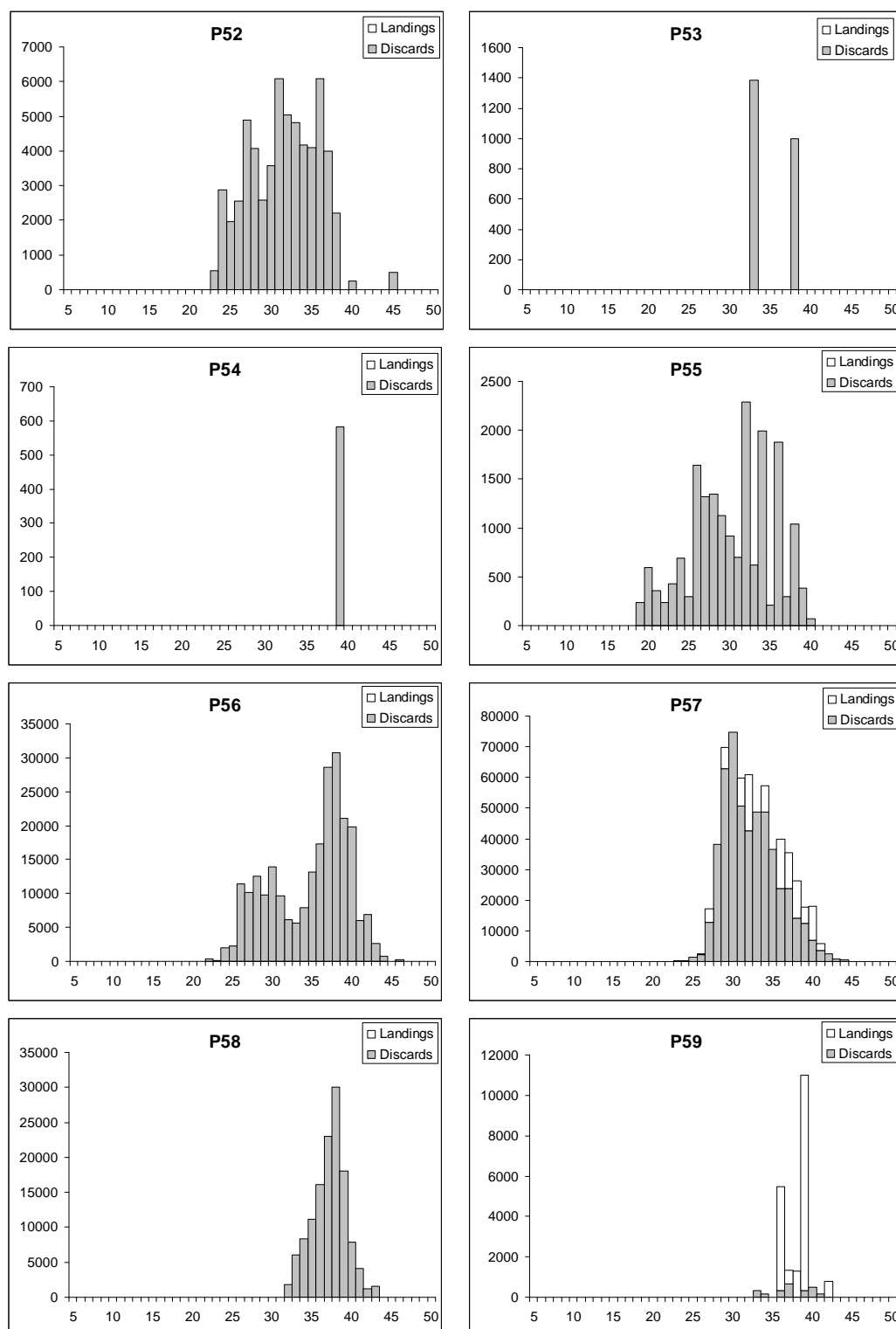


**Figure 10.** Numbers of horse mackerel landed and discarded against length (cm) per trip and for all trips combined for 2008 and 2009.

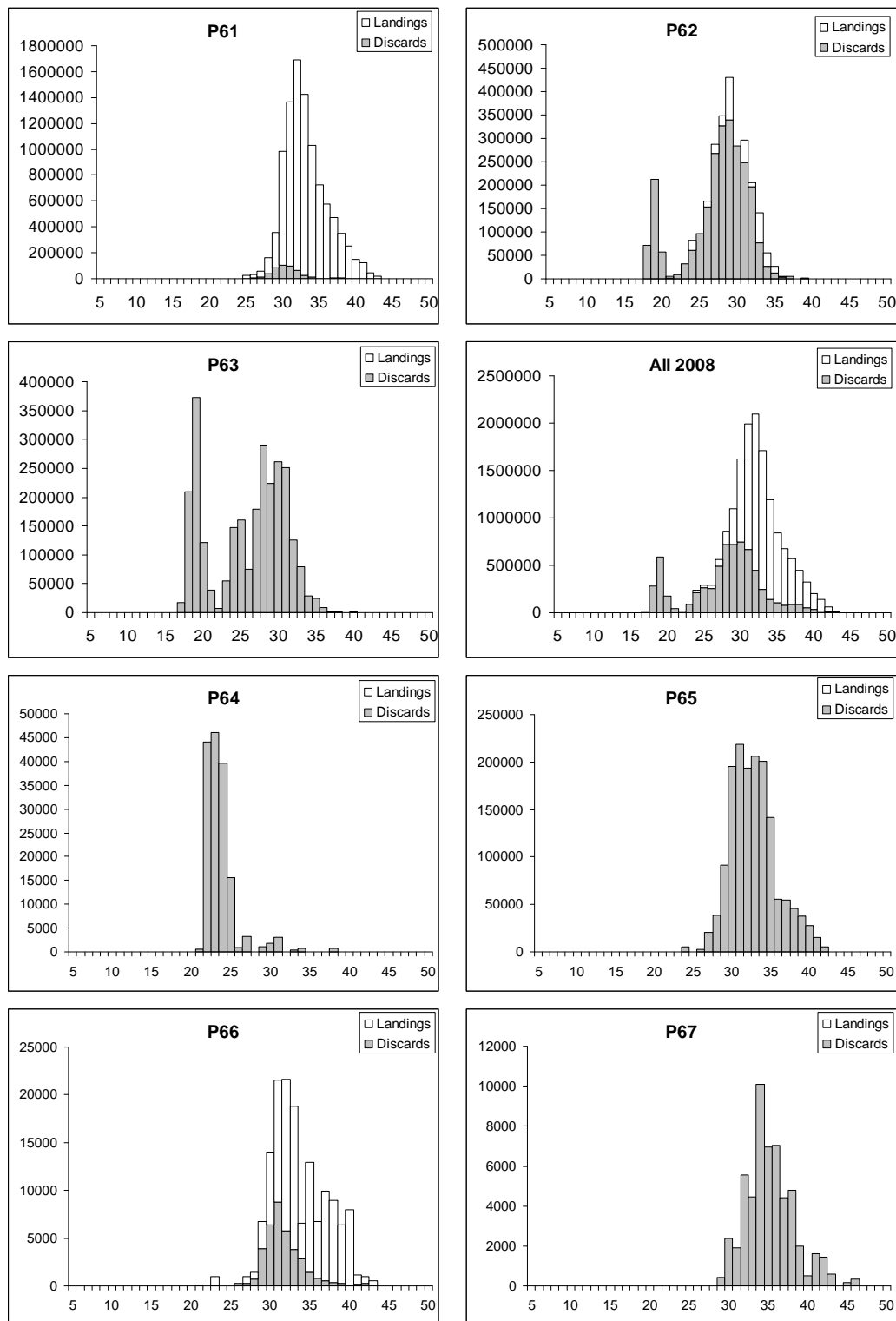
**Figure 10.** Continued

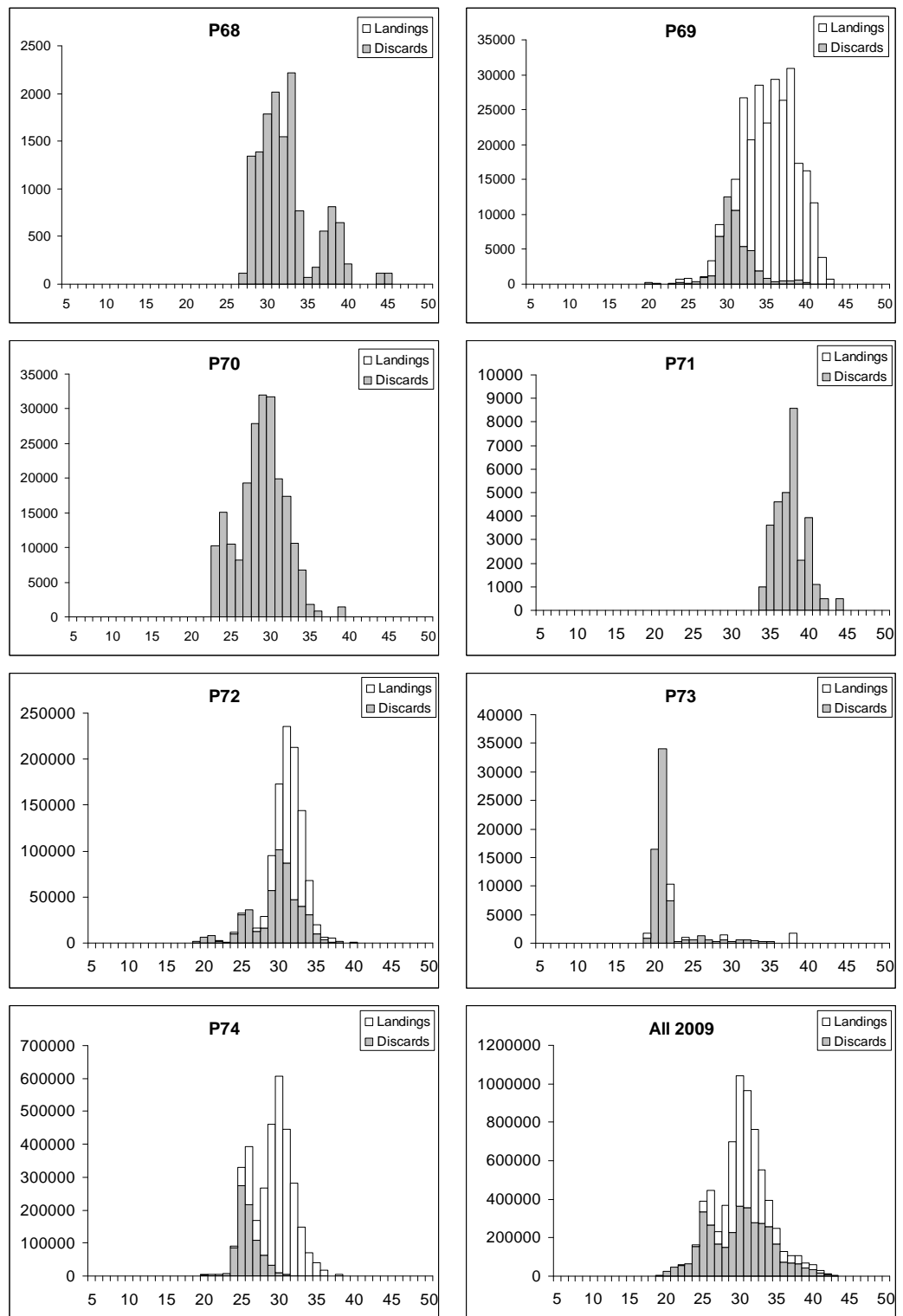
**Figure 10.** Continued

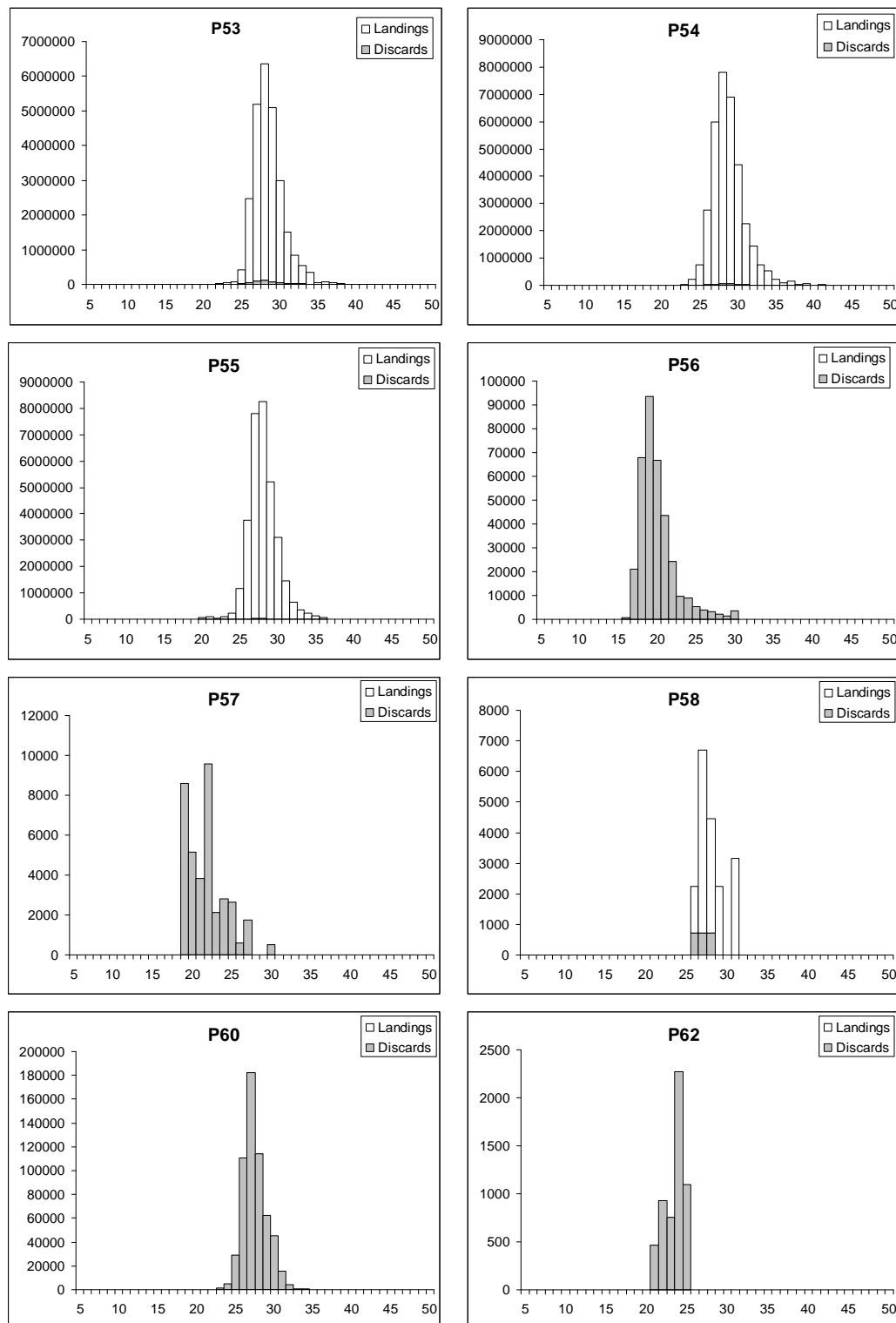




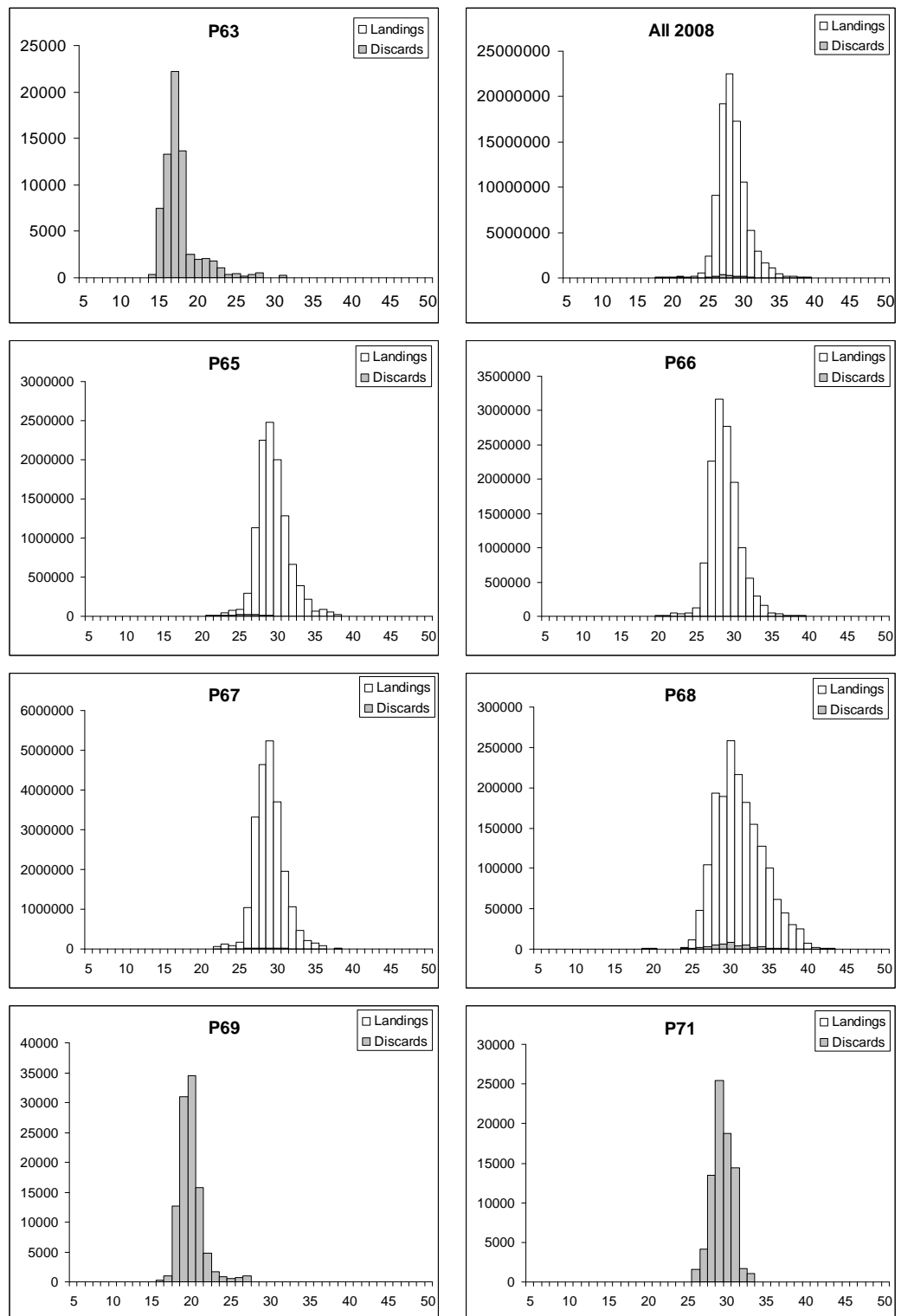
**Figure 11.** Numbers of mackerel landed and discarded against length (cm) per trip and for all trips combined for 2008 and 2009

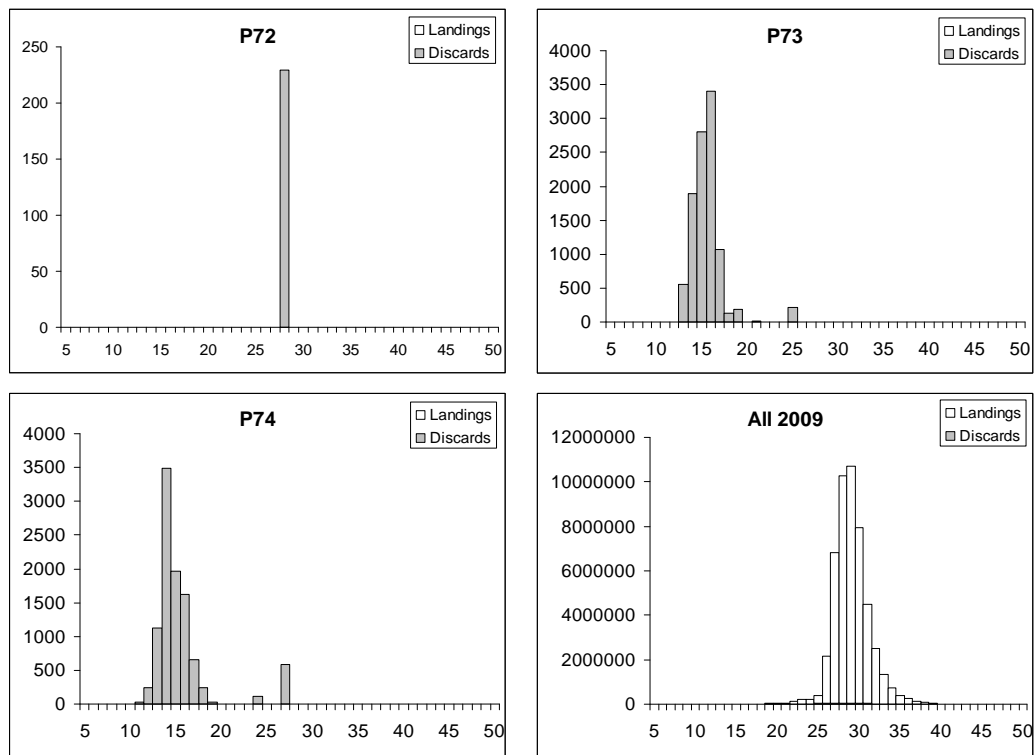
**Figure 11.** Continued

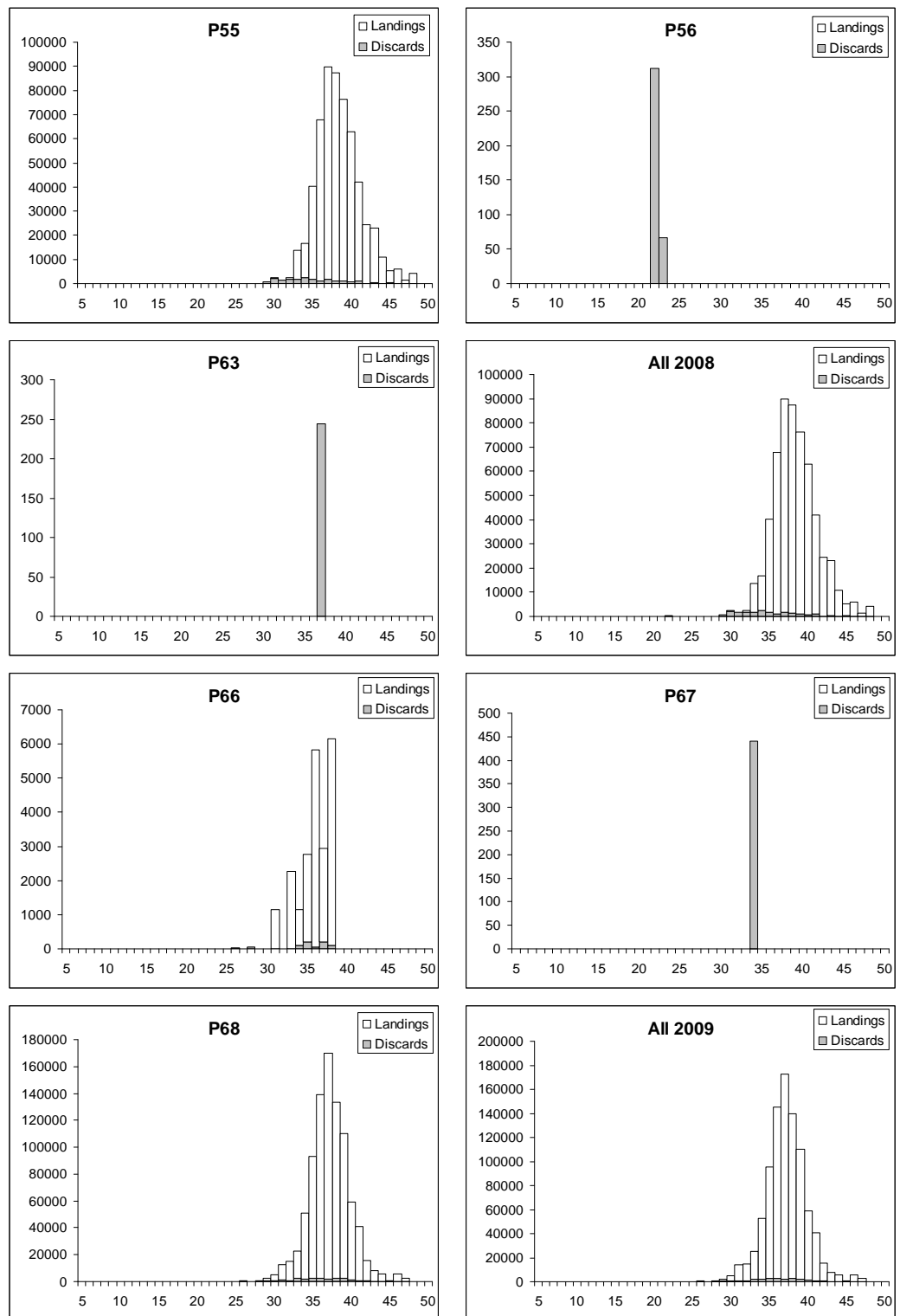
**Figure 11.** Continued



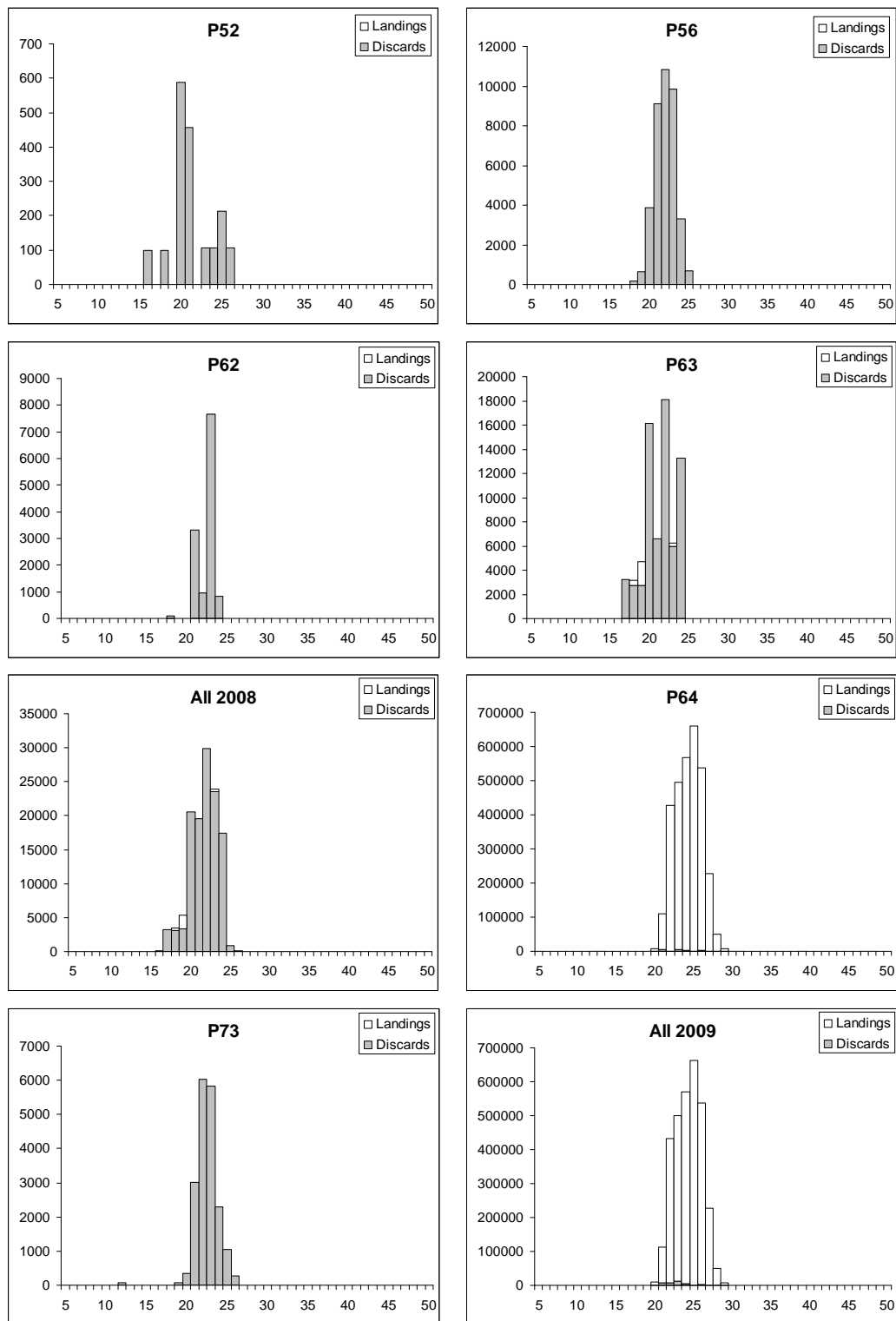
**Figure 12.** Numbers of blue whiting landed and discarded against length (cm) per trip and for all trips combined. Note that P60 took place in Norwegian waters. Discards were not thrown overboard during this trip but frozen as waste product.

**Figure 12.** Continued

**Figure 12.** Continued

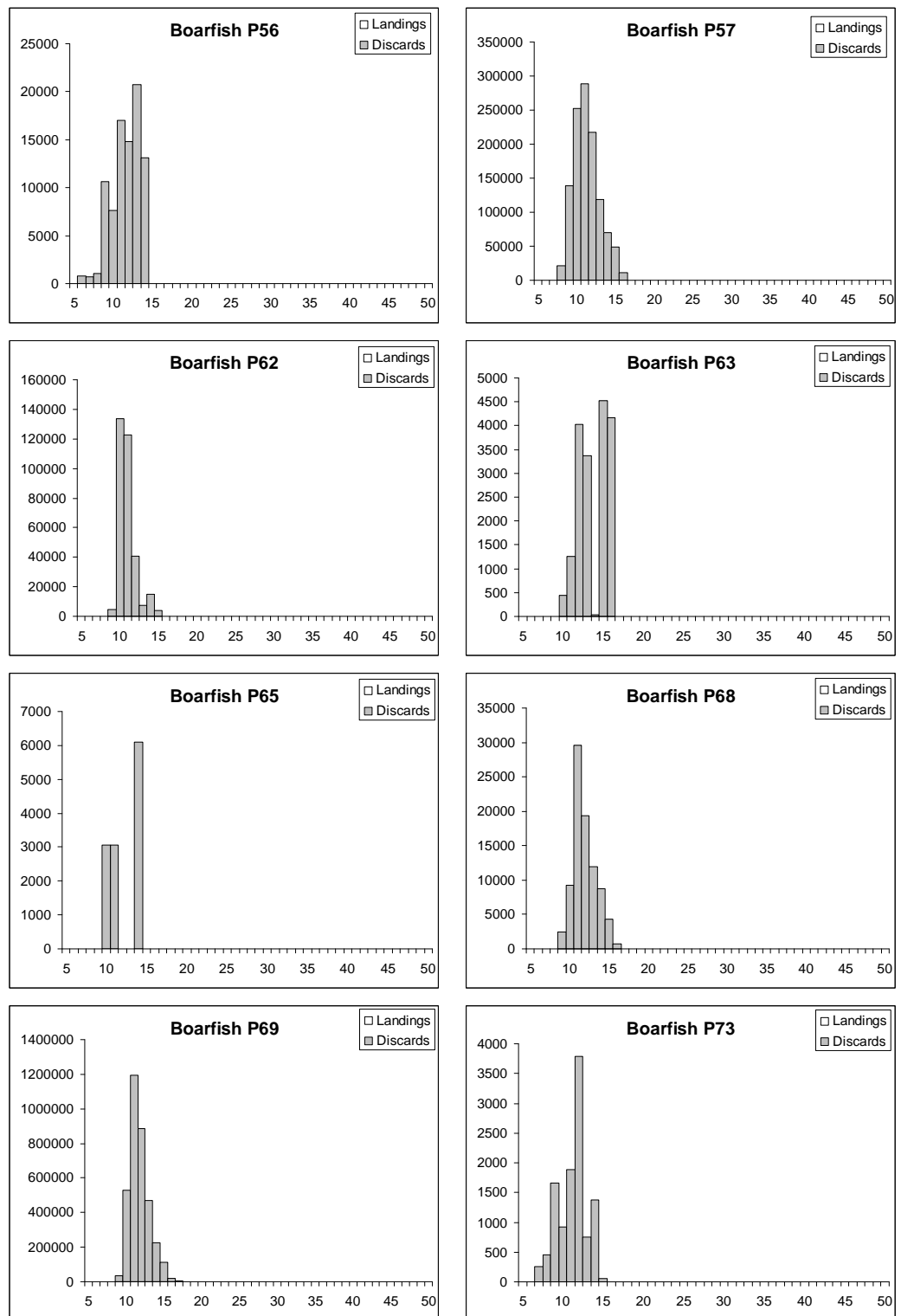


**Figure 13.** Numbers of greater argentine landed and discarded against length (cm) per trip and for all trips combined for 2008 and 2009

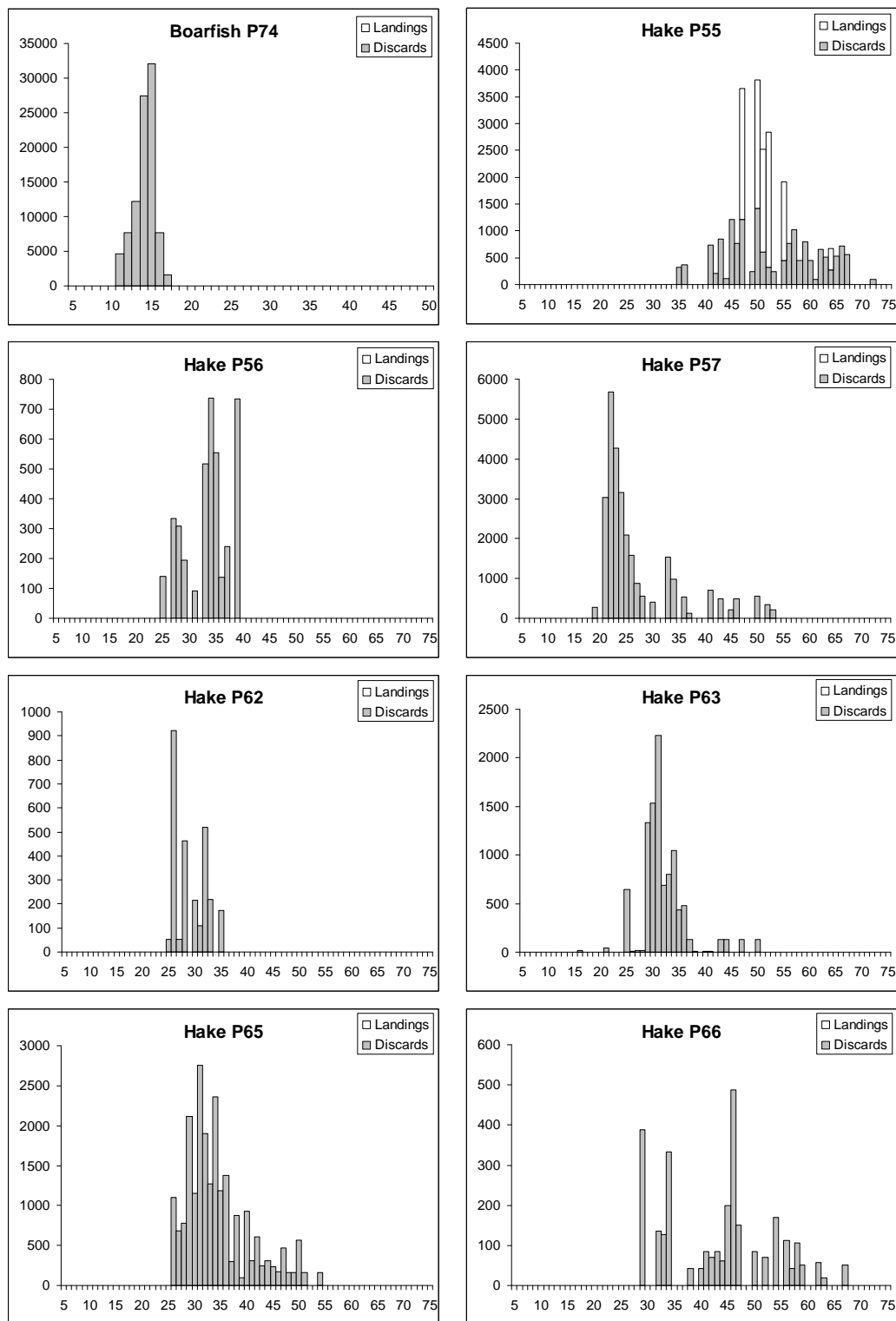


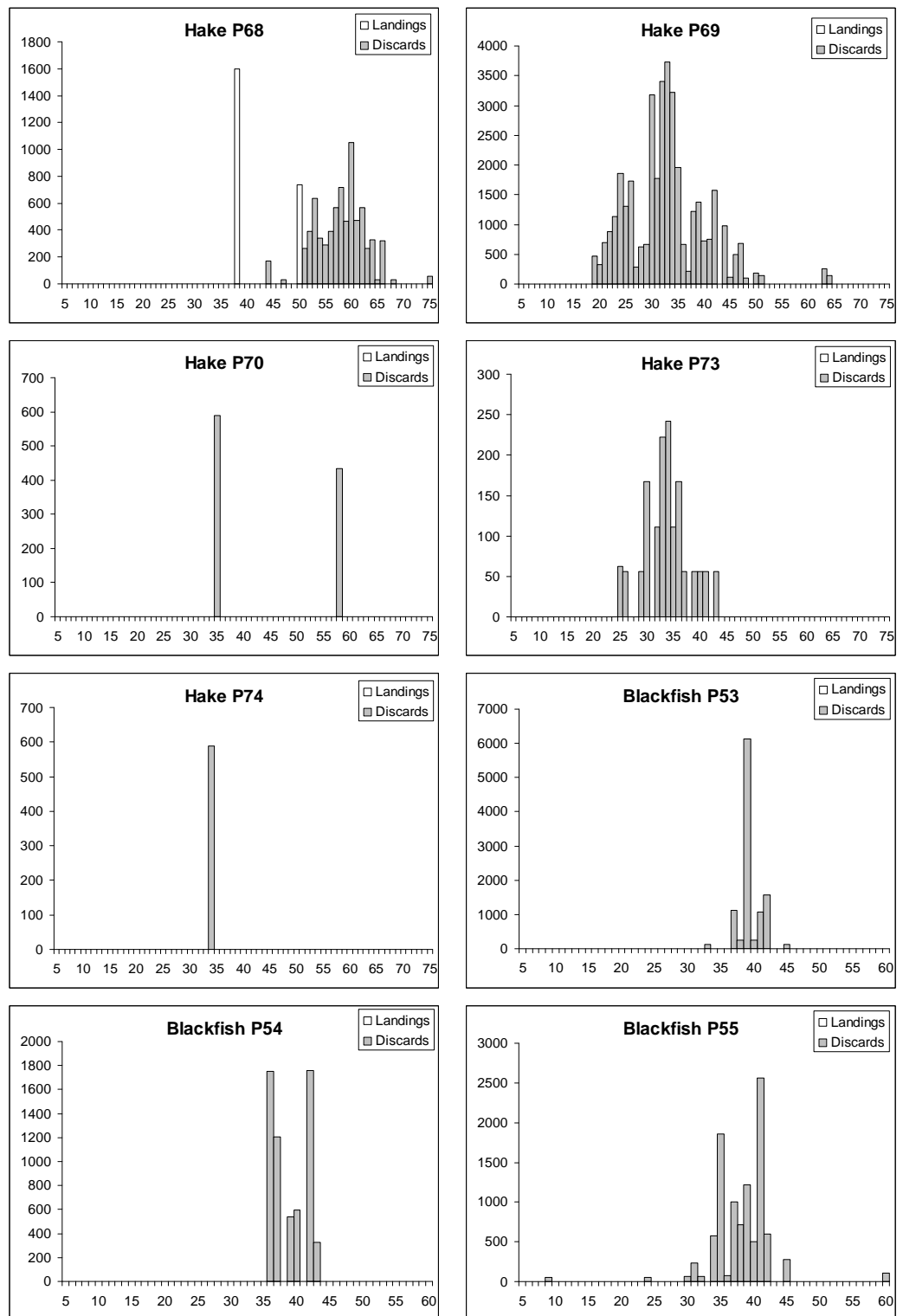
**Figure 14.** Numbers of pilchard landed and discarded against length (cm) per trip and for all trips combined for 2008 and 2009

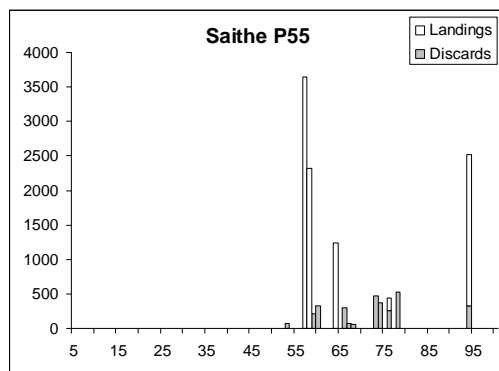




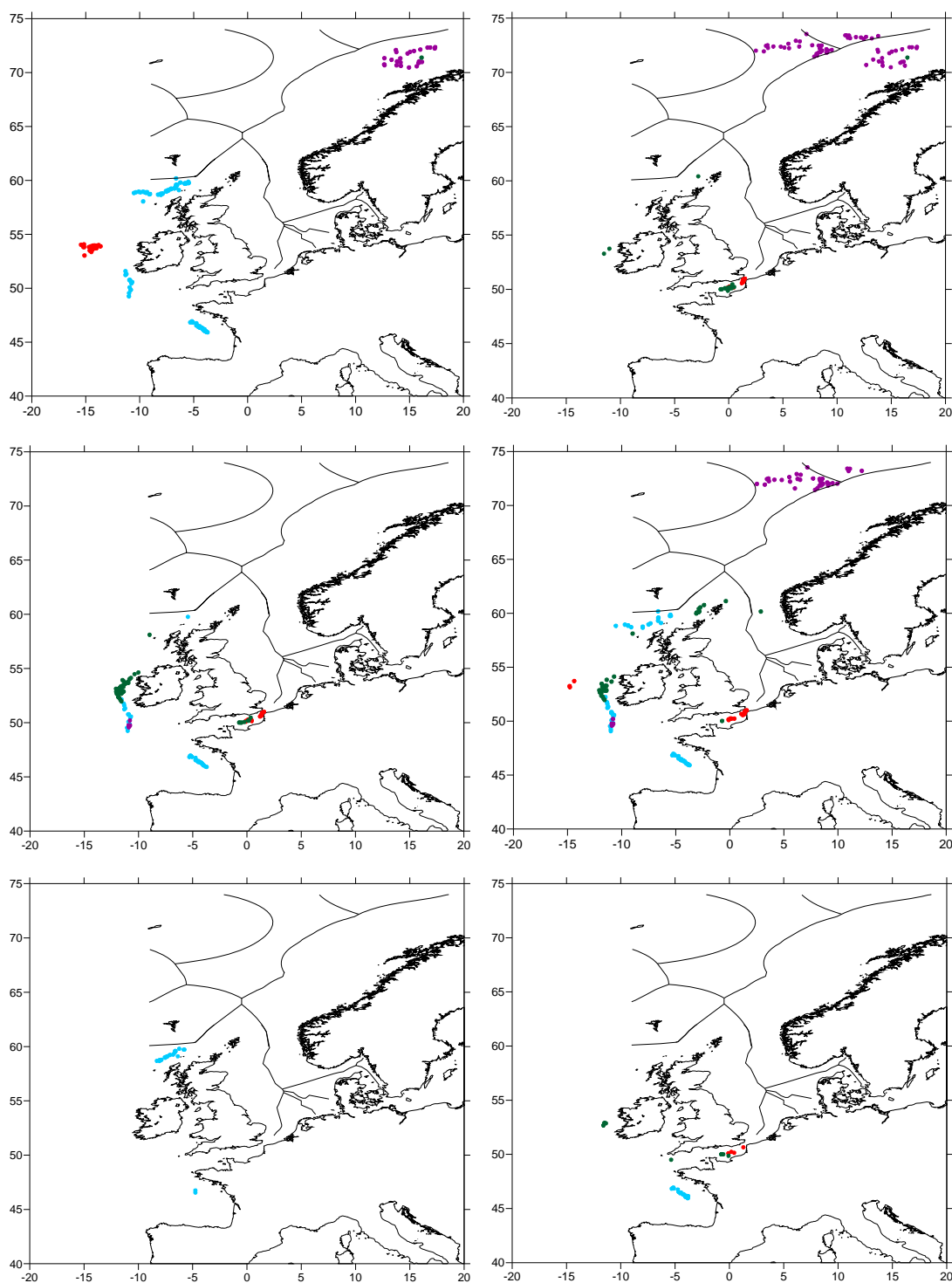
**Figure 15.** Numbers of most abundant non-target species (see Table 5) landed and discarded against length (cm) per trip for 2008 and 2009

**Figure 15.** Continued

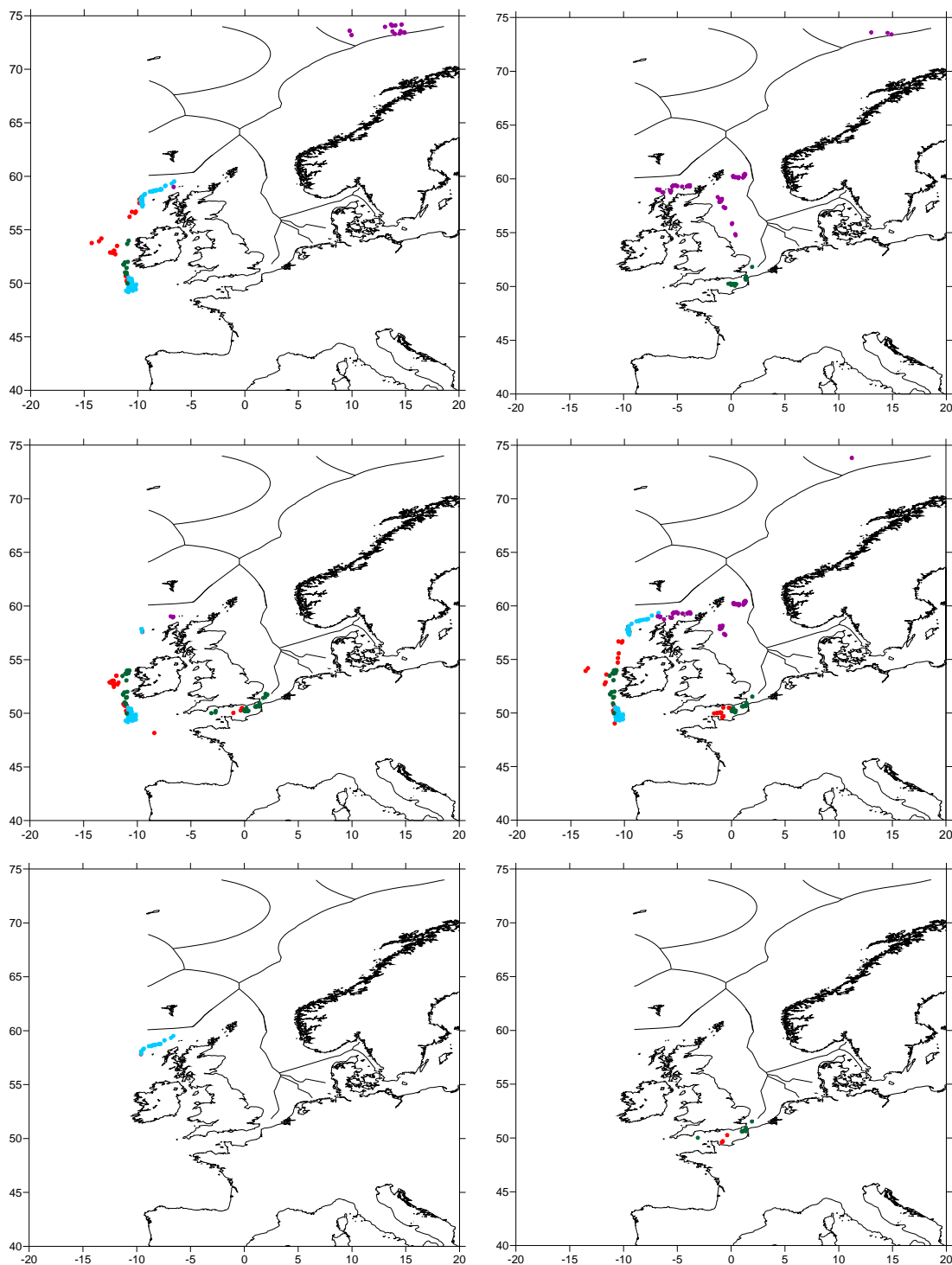
**Figure 15.** Continued



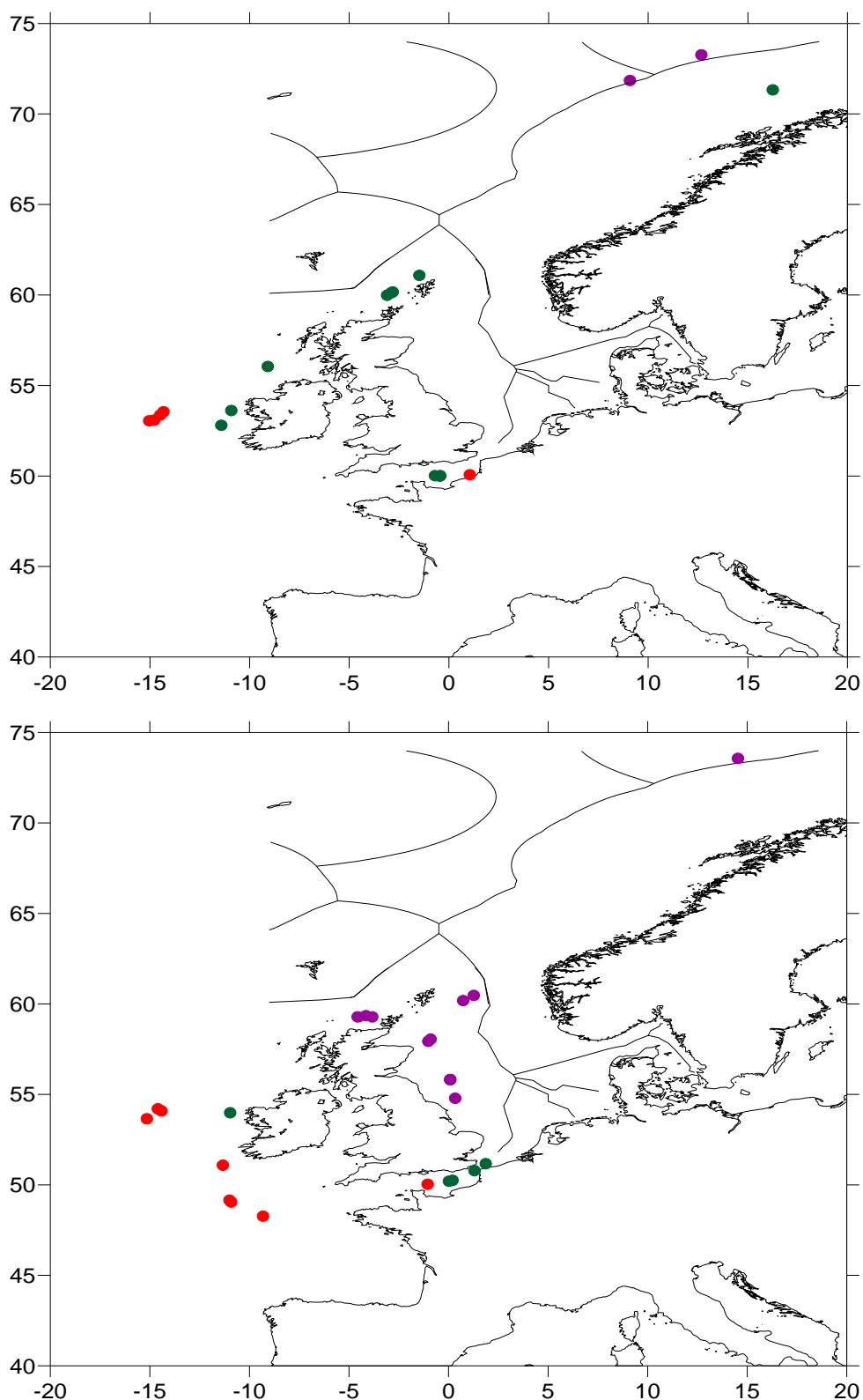
**Figure 15.** Continued



**Figure 16a.** Positions of discards per quarter (red=quarter 1, blue=quarter 2, purple=quarter 3, green=quarter 4) for blue whiting (upper left), herring (upper right), horse mackerel (middle left), mackerel (middle right), greater argentine (lower left) and pilchard (lower right) for sampled trips in 2008. Note that P60 took place in Norwegian waters. Discards were not thrown overboard during this trip but frozen as waste product.



**Figure 16b.** Positions of discards per quarter (red=quarter 1, blue=quarter 2, purple=quarter 3, green=quarter 4) for blue whiting (upper left), herring (upper right), horse mackerel (middle left), mackerel (middle right), greater argentine (lower left) and pilchard (lower right) for sampled trips in 2009. Note that P71 took place in Norwegian waters. Discards were not thrown overboard during this trip but frozen as waste product.



**Figure 17.** Positions of unsorted discards<sup>1</sup> per quarter (red=quarter 1, blue=quarter 2, purple=quarter 3, green=quarter 4) for sampled trips in 2008 (upper) and 2009 (lower). Note that P60 took place in Norwegian waters. Unsorted discarding was observed during this trip. However, discards were not thrown overboard but frozen as waste product.

<sup>1</sup> Occasionally, trawlers discard relatively large amounts of catch without sorting (unsorted discards). The species composition of such discards is unknown (see Introduction).