

Stichting DLO Centre for Fishery Research (CVO)

P.O. Box 68
1970 AB IJMUIDEN
Phone: 0317-480900
Fax: 0317-487326
Visitor address: Haringkade 1,
1976 CP IJmuiden

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Discard sampling of the Dutch pelagic freezer fishery in 2003-2007

Ir. A.T.M. van Helmond and drs. H.M.J. van Overzee

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Postbus 20401
2500 EK Den Haag

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Approved by: Drs. F.A. van Beek
Head WOT, Centre for Fishery Research

Signature: _____

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Table of Contents

Table of Contents	2
Summary.....	3
Samenvatting.....	4
1 Introduction.....	5
2 Methods.....	6
2.1 Landings fleet.....	6
2.2 Sampling procedures	6
2.3 Raising procedures	7
3 Results.....	9
3.1 Landings (Total fleet)	9
3.2 Estimated discards from sampled trips	9
4 Discussion	11
Acknowledgements.....	13
5 References	14
6 Tables and figures.....	16

Summary

This report contains the results of the discard sampling programme on the Dutch pelagic trawl fisheries in the North East Atlantic in the period 2003-2007, which was instigated as part of the EC regulation 1543/2000 and 1639/2001 on data collection in European waters. Five to twelve trips were sampled per year.

The Dutch fleet of freezer trawlers fishing in the North East Atlantic consisted of 13 to 15 vessels in the period 2003-2007. Freezer trawlers target pelagic species: herring (*Clupea harengus*), horse mackerel (*Trachurus trachurus*), mackerel (*Scomber scombrus*), blue whiting (*Micromesistius poutassou*), greater argentine (*Argentina silus*) and pilchard (*Sardina pilchardus*). Herring, blue whiting and horse mackerel are the most abundant species in the landings. This coincides with the relative large quota the Netherlands possesses for these 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, herring is targeted during the second half of the year and horse mackerel is mainly targeted during the winter.

The results show that the overall discard percentage raised to fleet level was highest in 2003 (17%). The overall discard percentages raised to fleet level for the following years (2004-2007) appears to be considerably lower (6%-8%).

Besides the discards that are sorted by the crew it occasionally happens that part of or the total catch is discarded before the catch has been sorted, an incident referred to as "slippage". Due to practical reasons this type of discarding could not be sampled for length. The discard composition and length frequency data shown in this report are therefore only based on routinely sorted discards. Slippage is separately raised to fleet level. Although, accounting for a relative large part of the total annual discard estimates (17%-40% in weight), incidents of slippage are not frequently observed during the sampled trips between 2003 and 2007 (4%-8% of the sampled hauls). Undesirable mixtures of species in the catch or lack of storage capacity at the end of the trip could be reasons for slipping catch.

Discard percentages of the target species herring, horse mackerel and blue whiting (within the season) are relatively low (1%-6%). It occasionally happens that these species are caught and discarded in small amounts outside the season. For mackerel the discard percentages appear to be significantly higher (16%-37% in the period 2003-2007). This species is discarded in all seasons and areas. It is suggested that a large price differential between small and large mackerel and a relatively small quota for mackerel for the Netherlands are the main reasons for this discarding behaviour. The length frequency distributions of discarded mackerel indeed show that a large part of the discarded fish were above the minimum landing size. The cause for this deviant discard pattern could be a product of a single-species management for a fishery that has multi-species targets. Boarfish is the most discarded non-commercial species.

The present study suggests that, with the exception of mackerel, discarding of target species on an annual level (includes discard data of season) in the pelagic freezer fleet is low. Concluding that this fishery has a high level of efficiency when targeting fish.

Samenvatting

Dit rapport bevat de resultaten van het discards bemonsteringsprogramma van de Nederlandse pelagische visserij in het noordoost Atlantisch gebied in de periode 2003-2007, dat is opgezet naar aanleiding van EC regelingen 1543/2000 en 1639/2001 voor gegevensverzameling in Europese visserijen. Vijf tot twaalf reizen per jaar zijn gedurende deze periode bemonsterd door waarnemers aan boord van bedrijfsschepen.

De Nederlandse pelagische vriestrawlervloot bestond in de periode 2003-2007 uit 13-15 schepen. Deze visserij is gericht op een aantal pelagische doelsoorten: haring (*Clupea harengus*), horsmakreel (*Trachurus trachurus*), makreel (*Scomber scombrus*), blauwe wijting (*Micromesistius poutassou*), grote zilversmelt (*Argentina silus*) en pelser (*Sardina pilchardus*). Haring, blauwe wijting en horsmakreel worden het meest aangeland. De aanvoer van de soorten wordt grotendeels bepaald door de vangstquota die Nederland voor deze soorten bezit. De gerichtheid van de visserij op de doelsoorten varieert gedurende het jaar (verschillende visserijseizoenen). In het begin van het jaar wordt op blauwe wijting gevestigd. Op haring wordt tijdens de tweede helft van het jaar gevestigd en op horsmakreel voornamelijk in de winter.

In 2003 was de naar vloot opgewerkte discard percentage het hoogst (16%). De opvolgende jaren (2004-2007) blijkt dit percentage aanzienlijk lager te zijn (6%-8%).

Naast de discards die door de bemanning uit de vangst gesorteerd worden, komt het ook incidenteel voor dat een gedeelte of de gehele vangst overboord wordt gegooid zonder dat er sortering plaatsvindt. Dit wordt ook wel "slippage" genoemd. Om praktische redenen is het erg moeilijk om een monster van een 'geslipte' vangst te bemachtigen, waardoor het onmogelijk is een goede inschatting van de soortsaamenstelling en lengte frequentie verdeling van de vangst te maken. Daarom is informatie over soortsaamenstelling en lengte frequentie gegevens in dit rapport alleen gebaseerd op discardgegevens verkregen tijdens het normale sorteringsproces aan boord. Totale hoeveelheden slippage zijn apart opgewerkt naar vlootniveau. Hoewel een groot deel van de discards wordt veroorzaakt door slippage (17%-40% van het totale discardgewicht), is het aantal incidenten van slippage relatief laag (4%-8% van de bemonsterde trekken per jaar). Minder lucratieve vangsten, door een hoog percentage laagwaardige of niet-commerciële vis, of gebrek aan opslagcapaciteit aan het einde van een reis, zijn mogelijke redenen voor deze manier van discards. Evens is de meest abundant vis van de niet-commerciële soorten die gediscard werd.

Discardpercentages voor de doelsoorten haring, horsmakreel en blauwe wijting (in het seizoen) zijn relatief laag (1%-6%). Buiten het seizoen kan dezelfde vissoort, als het niet commercieel interessant worden beschouwd, compleet gediscard worden. Voor makreel, echter, ligt dit percentage significant hoger dan bij de andere soorten (16%-37% in de periode 2003-2007). Waarschijnlijk liggen het grote prijsverschil tussen kleine en grote makreel en het relatief kleine makreelquota voor Nederland 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. De mogelijke reden voor dit afwijkende discardpatroon is waarschijnlijk het gevolg van het toepassen van een 'single-species' managementstrategie op een visserij dat 'multi-species' georiënteerd is.

Resultaten uit dit rapport geven aan dat, met uitzondering van makreel, discards van commerciële en niet-commerciële soorten op jaarbasis (inclusief discards buiten het seizoen) van de Nederlandse pelagische visserij met vriestrawlers relatief laag is. Concluderend dat deze visserij een hoge mate van efficiëntie vertoont als het aankomt op het vangen van commerciële doelsoorten.

1 Introduction

In the period 2003-2007 the Dutch freezer trawler fleet consisted of 13-15 vessels, varying between 86 to 120 m in length. These vessels use a midwater pelagic trawl to target pelagic species. The 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. 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. When the net is hauled, it remains in the water, the catch is pumped on board where it gets stored in cooling tanks until it can be processed. The sorted catch (landings) is transported to frosters where they are frozen into blocks of 20-25 kg fish. The duration of each fishing trip depends mainly on the catch rates and the storage capacity of the ship. The vessels usually return when all freezing stores are full. Smaller vessels make trips of 2-4 weeks, larger vessels of 5-6 weeks. A more detailed description of the fishery is given by (Couperus et al., 2004).

The target species of Dutch freezer trawlers are 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 due to seasonal changes, the behaviour of fish or due to changes in the market situation. 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. The species composition of the landings has gradually changed over the years (Van Helmond & van 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. (Van Helmond & Van Overzee, 2007).

On board pelagic freezer trawlers, the catch is sorted and the unwanted fish is dropped into a gutter and flushed over board, a practice called *discarding*. Fish normally will not survive the catch and sorting procedure. Since it is landings and discards together that drives changes in fish population size, estimations of total amounts of discards in a fishery play an important role in stock assessments. During the normal procedure of processing catch on board, discards are removed from the conveyor belt where the catch is sorted. They are removed because fish have no commercial interest, are below minimum landing size, have low quality or are damaged. Discarding also occurs due to limits on quota or lack of storage space on board (e.g. during the last haul on a trip) (Morizur et al., 1995; Napier et al., 1999; ICES, 2004, Borges et al., 2008). A less frequent, but more rigorous way of discarding is referred to as slippage (Borges et al., 2008). Relatively large amounts of catch are released from the cooling tanks (tank slippage) or straight from the net (net slippage). The reason why certain catches are subjected to slippage can vary. At present, species composition and length frequency of "slipped" catch is unknown within this fishery. Accurate numbers of discards per species can therefore not be calculated.

From 2002 onwards discards data are monitored by Wageningen IMARES under the EC Data Collection Regulations 1543/2000 and 1639/2001 (EC., 2000, 2001; Anon., 2002; ICES, 2003). This report gives an overview of the Dutch pelagic discard sampling programme for the period 2003-2007 (discard monitoring in the year 2002 is reported by Couperus et al., 2004).

2 Methods

2.1 Landings fleet

Information on landings and fishing effort by the Dutch pelagic freezer fleet were derived from the Dutch official logbook database (VIRIS – Visserij Registratie Informatie Systeem) owned by the Ministry of Agriculture, Nature Management and Fisheries.

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 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 60% of the hauls (Box 1) (Van 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 2). 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 1: Sampling protocol for a haul on a pelagic trawler

- 1) Estimation and registration of total catch (CW_h).
- 2) Estimation of discard percentage (Box 2).
- 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 2: 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 ($Cw_{h,s}$):

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

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 ($Dw_{h,s}$):

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

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 Slippage

During the observed trips it occasionally happened that a part of or the catch within a haul was discarded before the sorting process, an incident that is usually referred to as slippage. 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 "slippage" as a separate discard component: "slipped discards" (DWS_h). When only a part of the catch within a haul was "slipped", the raising procedure was used for the sampled part of the catch while the "slipped" part was treated as slippage. Total "slippage" within a trip (DWS_t) was calculated by summing the "slipped" 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_f) 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:

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

3 Results

3.1 Landings (Total fleet)

Target species of the Dutch freezer trawler fleet fishing in European waters differs by season and area. The total landings of this fleet in the period 2003-2007 varied between 256,000 and 352,000 tonnes (Tables 1a,b). Herring, blue whiting and horse mackerel are the most abundant species in the landings. Blue whiting is mainly targeted during the first half of the year (Figure 2). In the period 2003-2007 most blue whiting landings came from areas VIa and VIIc. However, in 2003 a considerable amount of the landings also originated from areas Vb and VIb (Figure 3). Herring is the most landed species during the second half of the year (Figure 2). Through time it appears that herring was mainly caught in areas IIa, IVa, IVb, VIa and VIId (Figure 3). Horse mackerel is mainly caught in the winter in several ICES areas. However, through time constant high landings originated from area IVc (Figures 2,3).

3.2 Estimated discards from sampled trips

3.2.1 Sampled trips

In 2003 and 2004 five and six trips respectively were made by observers onboard of pelagic freezer trawlers. Thereafter the number of annual trips increased to twelve. This resulted in a total of 47 trips in 5 years (Table 2). The trawl positions of the sampled trips per year are illustrated in Figure 4. During the sampled trips 87%-96% of all hauls were sampled and during 4%-8% of the hauls "slippage" occurred (Table 2). Haul duration was on average 3.5 to 4 hours (Figure 5).

Every year during one or more sampled trip(s) blue whiting, greater argentine, herring, horse mackerel and mackerel were landed and/or discarded (Table 3). The species composition of catch and landings for the sampled trips for the period 2003-2007 is presented in Figure 7 (catch) and Figure 8 (landings). The species composition of discards for the different years is presented in Table 4. The compositions for the periods 2003-2004 and 2004-2007 appear to be alike and are presented in Figure 9.

During the observed trips in the different years mackerel was by far the most dominant species in the discards, with a radical increase in tonnage of discards in 2005 (Table 4 and Figure 10). The other important commercial species are discarded in a lesser extend than mackerel and show no particular trends over the years. Boarfish, is the most discarded non-commercial species.

The length frequency distributions of landed and discarded fish over all years combined per year are presented in Figures 11 to 16 for blue whiting, greater argentine, herring, horse mackerel, mackerel and pilchard respectively. For all species except mackerel the length frequency distributions show a regular bell-shaped pattern over the years (Figures 11,12,13,14 and 16). The length frequency distributions for mackerel show a divergent pattern, with an extra peak for undersized discards (< 25 cm) (Figure 15).

3.2.2 Discards

The total catch, landings and discards per species per trip and corresponding sampling period and ICES area is reported in Table 3. In this table the total amount of "slippage" observed during each trip and "not sampled" hauls are presented separately. Both variables were taken into account in determining the total discard percentage per trip. All values were raised to fleet level (Table 5).

Discard estimates

For 2003 the raised discard data show a discard percentage of 2%, 5% and 7% for blue whiting, horse mackerel and herring respectively. Mackerel, pilchard and greater argentine show a discard percentage of 22%, 25% and 32% respectively (Table 5). All "other species" were discarded (Table 5). They mainly consisted of striped red mullet (*Mullus surmuletus*) and boarfish (*Capros aper*) (Table 4). Overall (including slippage and not

sampled hauls) the discard percentage for the Dutch pelagic fleet in 2003 based on the sampled trips is estimated at 17% (Table 5).

For 2004 the raised discard data show a discard percentage of 1% for both blue whiting and horse mackerel, while greater argentine and herring show a discard percentage of 2% and 3% respectively. Mackerel and pilchard show a discard percentage of 16% and 22% respectively (Table 5). Furthermore, it appears that 19% of "other species" were landed. These were mainly landings of the non-target species white seabream (*Diplodus sp.*) during trip P14 (Table 3). The discarded "other species" mainly consisted of boarfish and haddock (*Melanogrammus aeglefinus*) (Table 4). Overall (including slippage and not sampled hauls) the discard percentage for the Dutch pelagic fleet in 2004 based on the sampled trips is estimated at 6% (Table 5).

Trip P25 was left out of the analysis of 2005 because discards were not sampled during this trip (Table 3). The raised discard data show a discard percentage of 1% for horse mackerel, 2% for blue whiting and 3% for herring. Pilchard and mackerel show a discard percentage of 8% and 37% respectively (Table 5). No greater argentine was discarded during the sampled trips. Consequently, the raised discard data show a discard percentage of 0% for this species (Table 5). However, this discard percentage is only based on one trip (Table 3). Nearly all "other species" were discarded (97%; Table 5). They mainly consisted of boarfish (Table 4). Overall (including slippage and not sampled trips) the discard percentage for the Dutch pelagic fleet in 2005 based on the sampled trips is estimated at 8% (Table 5).

For 2006 the raised discard data show a discard percentage of 1% for both blue whiting and horse mackerel, 3% for herring and 12% for greater argentine. Pilchard and mackerel show a discard percentage of 23% and 28% respectively (Table 5). Furthermore, 10% of "other species" were landed (Table 5). These were landings of the non-target species black seabream (*Spondyliosoma cantharus*) and saithe (*Polachius virens*) during trips P34 and P36 (Table 3). The discarded "other species" mainly consisted of boarfish (Table 4). Overall (including slippage and not sampled hauls) the discard percentage for the Dutch pelagic fleet in 2006 based on the sampled trips is estimated 7% (Table 5).

For 2007 the raised discard data show a discard percentage of 1% for blue whiting, greater argentine, horse mackerel and pilchard, and 2% for herring. Mackerel shows a discard percentage of 28% (Table 5). Furthermore, 21% of "other species" were landed (Table 5). These were landings of the non-target species norway pout (*Trisopterus esmarkii*), golden redfish (*Sebastes marinus*), whiting (*Merlangius merlangus*) and black seabream during several trips (Table 4). The discarded "other species" mainly consisted of saithe. Overall (including slippage and not sampled hauls) the discard percentage for the Dutch pelagic fleet in 2007 based on the sampled trips is estimated at 7% (Table 5).

Spatial distribution discards

The spatial and temporal distributions of the discards differ per species (Figure 6). Mackerel was discarded throughout the whole year, while greater argentine was only discarded during the second quarter of the year. The distribution of the herring discards through the year from North to South is in accordance with the spatial pattern of the herring fishery which shows an annual pattern from Norwegian waters in quarter 2 and 3 towards the English Channel in quarter 4.

4 Discussion

The annual landings of the Dutch pelagic fleet show that this fishery is highly seasonal. The target species change with season and area. This means that within one year a species could be targeted in one season and be discarded in the next season. Blue whiting, herring and horse mackerel are the most abundant species in the landings. This coincides with the relative large quota the Netherlands possess for these species.

At present, the lack of an international agreed procedure into raising discard data to fleet level for the pelagic fleet is under discussion (ICES WKDRP, 2007). For this report it was decided to raise the discard data 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 (Borges et al., 2008), the catches of some species are not well covered by the sampling programme. Therefore, the results of this study should therefore be interpreted with caution.

The results show that the overall discard percentage was highest in 2003 (17%). However, the raised discard data for this year is only based on 5 trips (3.8% of all trips in 2003; Table 2) with a high amount of slippage dissimilar to the subsequent years (Table 5). The overall discard percentages for the following years appear to be considerably lower (6%-8% in 2004-2007; Table 5). These percentages are relatively low in comparison with discard percentages in other fisheries (e.g. bottom trawling; SGMOS-STEFC, 2007).

Improvements in raising procedures and a better understanding in discarding practices has lead to different discard estimations in comparison with previous work (Couperus et al., 2004; van Keeken et al., 2005; van Helmond & van Overzee, 2007; Borges et al., 2008). Unfortunately, the weight composition per species of "slipped" and "not sampled" catch still remains unclear. In this report, it was therefore decided to present these variables separately (Tables 3, 5). The results show that slippage is an important component in the annual discard estimates of the pelagic fleet; it represents 17%-40% of the total discard estimations (Table 6). Although, being an important element in the discarding behaviour, incidents of slippage are not frequently observed during the sampled trips between 2003 and 2007; 4%-8% of the sampled hauls were "slipped" (Table 6). Anecdotal information does suggest that most incidents of slippage take place at the end of the trip, when the hold of the ship is full and they just release the "left-over" of the last haul. However, the sampled trips have shown that part of the slippage occurs half-way, or even at the beginning, of a trip. It could be that fish-quality issues or unprofitable mixtures of species are the reasons for this behaviour, although, evidence and data to prove this are lacking.

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. During the same year a species can be a highly valuable target during one season and considered as a not valuable during the other season. Within a season, e.g when a species is targeted, discard percentages appear to be marginal (1%-6%). Outside a season, when a species is not targeted, discard percentages are high (90%-100%). However, discard percentages, calculated on an annual basis (total discards as a ratio over total catch per species per year) are low (Table 5). Based on the results of this report it can be concluded that the Dutch pelagic freezer fishery has a high level of efficiency, when it comes to targeting (marketable) fish.

For mackerel the discard percentages appear to be significantly higher than the other target species. The estimated annual raised discard percentages fluctuated between 16% and 37% (Table 5). Figure 6 points out that mackerel is discarded, and evidently caught, in all seasons and areas. These findings suggest that mackerel is an abundant species in the catch on different fishing grounds. Borges et al. (2008) suggest that the two crucial factors for discarding mackerel are a large price differential between small and large mackerel and a relatively small quota for mackerel for the Netherlands, about 9% of the EU quota. The combination of the two initiate a strong incentive to discard mackerel that will not provide the best price when landed. The length frequency distribution indeed shows that a large part of the mackerel discards consisted of fish that were above the minimum landing size (MLS = 30cm). Most undersized mackerel is caught during the third and fourth quarter of the year in the fishery directed to horse mackerel season (Borges et al., 2008). The large catches of these undersized fish suggest that this fishery operates in an area with a great

abundance of juvenile mackerel. According to our data analysis these areas are west of the British Isles and the southern North Sea (areas VII and IVc; Figure 3). A decrease in quota of mackerel for the Netherlands in the North Sea in 2005 resulted in a major increase in discards (Figure 10). Based on the data presented in this report one could insinuate that the fast numbers of discarded mackerel are the result of management with single species TACs of a fleet that is multispecies oriented.

The inclusion of the discard data in stock assessments is considered to reduce bias in the assessment and, therefore, provides more realistic values of fishing mortality and biomass (ICES, 2004, 2005). The way discards are used in the stock assessments varies by stock. However, in many cases available information on discard is of lower quality than the information on landings because they are based on limited sampling and raising procedures. This will increase the noise in the assessment (Dickey-Collas et al., 2007). The present study suggests that, with the exception of mackerel, discarding of target species in the pelagic freezer fleet is low and that including the discard information in the assessment will not lead to significant different results compared with not using them. In the case of mackerel, the inclusion of discards in the assessment is important because the discard information may lead to a different perception of the dynamics of the stock and exploitation.

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6 Tables and figures

Table 1a. Continued

Year	Species	IIa	IIb	IIIa	IVa	IVb	IVc	Vb	VIa	VIb	VIIa	VIIb	VIIc	VIIId	VIIe	VIIIf	VIIg	VIIh	VIIIa	VIIIb	VIIIId	VIIj	VIIk	XII
2007	ARG								3866															
	HER	28203			42884	8550	81		8051			13		12208			148	136					179	
	JAX				2212	754	17212		2190			11748	1005	11576	7767	43		125	166		46	6274		
	MAC	10			5804				9837			2234	99	84				13	1179	14	370	4392		
	PIL						55							920	218			10						
	WHB	92						960	40516	4498				34626									38	

Table 1b. Total landings (tonnes) per species per year by the Dutch freezer trawler fleet. Data taken from the VIRIS database

Species	2003	2004	2005	2006	2007
ARG	2610	10662	3984	1062	3866
HER	90062	128705	124627	90688	100454
JAX	68614	67105	68431	64183	61118
MAC	28861	27114	24740	24054	24037
PIL	8147	2684	2230	2291	1202
WHB	57262	77185	128367	96139	80730
Total	255556	313455	352379	278417	271407

ARG = Greater argentine

HER = Herring

JAX = Horse mackerel

MAC = Mackerel

PIL = Pilchard

WHB = Blue whiting

Table 2. Overview of sampled discard trips and total fleet

Year	Number trips pelagic fleet	Number trips sampled	Number of hauls during sampled trips	Number of hauls sampled	Number of hauls with slippage	% of hauls sampled	% of hauls with slippage
2003	131	5	249	239	20	96%	8%
2004	131	6	244	212	12	87%	5%
2005	142	12	468	425	20	91%	4%
2006	122	12	451	423	25	94%	6%
2007	124	12	408	387	21	95%	5%

Table 3. Total catch, landings, discards (tonnes), discard percentage and slippage per sampled pelagic discard trip per year.

2003	Month	ICES area		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Not sampled	Slippage	Total	
P8	2	VIIId, VIIh, VIIIb, VIIj	Catch	5.3			1449.8	683.5	141.4	94.3	7	125	2506.3	
			Landings	0.0			1298.3	398.5	12.8	0.0	6.6		1716.2	
			Discards	5.3			151.5	285.0	128.6	94.3	0.4	125	790.1	
			% Discards	100%			10%	42%	91%	100%	6%	100%	32%	
P6	3, 4	VIa, VIb, VIIj	Catch	3224.7			25.7	146.0			0.0	12	3408.4	
			Landings	3224.7			25.7	146.0			0.0		3396.4	
			Discards	0.0			0.0	0.0			0.0	12	12.0	
			% Discards	0%			0%	0%				100%	0%	
P9	5, 6	IIa, VIb, VIa	Catch	1487.5	575.7	1674.5	0.1	1.6			15.3	40	3934.7	
			Landings	1430.1	531.2	1662.8	0.0	0.0			0.0	38	3662.1	
			Discards	57.4	44.5	11.7	0.1	1.6			15.3	2	272.6	
			% Discards	4%	8%	1%	100%	100%			100%	5%	100%	7%
P5	7	IVa, VIa	Catch	1.4		2699.9		88.9			0.4	115	478	3383.6
			Landings	0.0		2517.4		0.0			0.0	96		2613.4
			Discards	1.4		182.5		88.9			0.4	16	478	770.2
			% Discards	100%		7%		100%			100%	14%	100%	23%
P7	11, 12	VIa, VIIb, VIIId, VIIh, VIIj	Catch	9.6		1808.1	1764.9	41.5			125.9	0	15	3765.0
			Landings	0.0		1759.9	1747.1	19.8			0.0	0		3526.8
			Discards	9.6		48.2	17.8	21.7			125.9	0	15	238.2
			% Discards	100%		3%	1%	52%			100%		100%	6%

Table 3. Continued

2004	Month	ICES area		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Not sampled	Slippage	Total		
P10	3	VIa, VIb, VIc	Catch	1926.5			474.2	1153.7			60.7	54	150	3819.1	
			Landings	1897.8			462.4	1139.4			0.0	53.3		3552.9	
			Discards	28.7			11.8	14.3			60.7	0.7	150	266.2	
			% Discards	1%			2%	1%			100%	1%	100%	7%	
P11	3, 4	VIa	Catch	1590.6	38.7			1.1			0.7	601	10	2242.1	
			Landings	1558.1	24.1			0.0			0.0	581.4		2163.6	
			Discards	32.5	14.6			1.1			0.7	19.6	10	78.5	
			% Discards	2%	38%			100%			100%	3%	100%	4%	
P12	7	IVa	Catch			367.4		33.6			3.1	0	4	408.1	
			Landings			365.1		29.1			0.0	0		394.2	
			Discards					2.3		4.5		3.1	0	4	13.9
			% Discards					1%		13%		100%		100%	3%
P13	7, 8	IVa, IVb	Catch			3865.4		115.0			21.1		58.3	4059.8	
			Landings			3750.6		35.3			0.0			3785.9	
			Discards			114.8		79.7			21.1			58.3	273.9
			% Discards			3%		69%			100%			100%	7%
P14	10, 11	IVc, VIId, VIle	Catch			156.8	1217.1	41.0	90.3	25.2		3		1533.4	
			Landings			156.3	1188.7	0.0	39.2	21.1		3		1408.3	
			Discards			0.5	28.4	41.01	51.1	4.1		0		125.1	
			% Discards			0%	2%	100%	57%	16%		0%		8%	
P15	12	VIId, VIle, VIIh	Catch			1418.6	1125.5	111.0	18.7	0.0		25		2698.8	
			Landings			1406.8	1100.8	0.0	18.4	0.0		25		2551.0	
			Discards			11.8	24.7	111.0	0.3	0.0		0		147.8	
			% Discards			1%	2%	100%	2%			0%		5%	

Table 3. Continued

2005	Month	ICES area		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Not sampled	Slippage	Total	
P16	1, 2	VIIb, VIIc, VIIh, VIIj	Catch	0.0			1220.6	633.7			39	15	1908.3	
			Landings	0.0			1201.4	406.2			39		1646.6	
			Discards	0.0			19.2	227.5			0	15	261.7	
			% Discards				2%	36%			0%	100%	14%	
P17	1, 2	VIIb, VIIc, VIIj	Catch	3495.8			41.9	394.6					3932.3	
			Landings	3406.8			41.9	301.6					3750.3	
			Discards	89.0			0.0	93.0					182.0	
			% Discards	3%			0%	24%					5%	
P20	2, 3	VIIc, VIIk	Catch	3406.2							130.9	82.5	3619.6	
			Landings	3404.8							130.9		3535.7	
			Discards	1.4							0	82.5	83.9	
			% Discards	0%							0%	100%	2%	
P18	3	VIIh, VIIlb, VIIj	Catch	0.7			237.7	355.3	7.2	0.8			35	636.7
			Landings	0.0			232.6	199.8	3.0	0.3				435.7
			Discards	0.7			5.1	155.5	4.2	0.5			35	201.0
			% Discards	100%			2%	44%	58%	58%			100%	32%
P19	4, 5	Vb, VIa	Catch	368.9	903.2			31.9			13.9	75	25	1417.9
			Landings	339.9	903.2			22.7			0.0	75		1340.8
			Discards	29.0	0.0			9.2			13.9	0	25	77.1
			% Discards	8%	0%			29%			100%	0%	100%	5%
P21	6	IVa	Catch	0.1		3573.6		156.8			25.8	0	83	3839.3
			Landings	0.0		3470.3		82.0			0.0	0		3552.3
			Discards	0.1		103.3		74.8			25.8	0	83	287.0
			% Discards	100%		3%		48%			100%		100%	7%

Table 3. Continued

2005	Month	ICES area		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Not sampled	Slippage	Total	
P22	7, 8	IIa, IVa, VIa, VIIb, VIIIb, VIIj	Catch	89.2		3807.2	138.6	41.2		30.5	2	78.1	4186.8	
			Landings	0.0		3669.7	132.5	0.0		4.9	2		3809.1	
			Discards	89.2		137.5	6.1	41.2		25.6	0	78.1	377.7	
			% Discards	100%		4%	4%	100%		84%	0%	100%	9%	
P23	7, 8	IIa, IVa	Catch			1741.0		22.6		2.4	23		1789.0	
			Landings			1736.1		0.0		0.0	20.1		1756.2	
			Discards			4.9		22.6		2.4	2.9		32.8	
			% Discards			0%		100%		100%	13%		2%	
P25*	11	IVc, VIId	Catch											
			Landings											
			Discards											
			% Discards											
P24	11, 12	VIa, VIIb, VIId, VIIh, VIIIb	Catch	0.0		1216.9	2207.1	759.3	44.0	35.1	0		4262.4	
			Landings	0.0		1209.6	2180.7	169.6	30.3	0.0	0		3590.2	
			Discards	0.0		7.3	26.4	589.7	13.7	35.1	0		672.2	
			% Discards			1%	1%	78%	31%	100%			16%	
P26	11, 12	VIId, VIle, VIIh, VIIIb	Catch			510.0	1698.5	215.0	7.5	60.0	10	40	2541.0	
			Landings			500.9	1691.0	0.0	0.0	0.0	10		2201.9	
			Discards			9.1	7.5	215.0	7.5	60.0	0	40	339.1	
			% Discards			2%	0%	100%	100%	100%	0%	100%	13%	
P27	11, 12	VIId	Catch			1947.4		35.7			0	21	2004.1	
			Landings			1898.3		0.0			0		1898.3	
			Discards			49.1		35.7			0	21	105.8	
			% Discards			3%		100%				100%	%	

* Discards were not sampled during this trip

Table 3. Continued

2006	Month	ICES area		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Not sampled	Slippage	Total
P33	1	VIIb, VIIh, VIIIb, VIIj	Catch				2541.4	836.4	36.4	2.8		10	3427.0
			Landings				2528.4	747.1	0.0	0.0			3275.5
			Discards				13.0	89.3	36.4	2.8		10	151.5
			% Discards				1%	11%	100%	100%		100%	4%
P32	2	VIIb, VIIc, VIIj	Catch	3350.0			348.6	540.1			125	245	4608.7
			Landings	3275.5			344.0	469.0			125		4213.5
			Discards	74.5			4.6	71.1			0	245	395.2
			% Discards	2%			1%	13%			0%	100%	8%
P29	2, 3	VIb, VIc, VIj	Catch	3056.6			60.1	547.8	0.1	2.4		220	3887.0
			Landings	3036.8			54.7	542.6	0.0	0.0			3634.1
			Discards	19.8			5.4	5.2	0.1	2.4		220	252.9
			% Discards	1%			9%	1%	100%	100%		100%	7%
P31	3, 4	VIIIb	Catch				37.5	458.1					495.6
			Landings				36.1	449.9					486.0
			Discards				1.4	8.2					9.6
			% Discards				4%	2%					2%
P28	4	VIa	Catch	3375.0							100		3475.0
			Landings	3375.0							100		3475.0
			Discards	0.0							0		0.0
			% Discards	0%							0%		0%
P36	4, 5, 6	IIa, IVa, Vb, VIa	Catch	2692.8	193.8	655.9		29.4		31.9	22		3625.8
			Landings	2676.9	176.0	643.3		8.2		9.5	15		3528.9
			Discards	15.9	17.8	12.6		21.2		22.4	7		96.9
			% Discards	1%	9%	2%		72%		70%	32%		3%

Table 3. Continued

2006	Month	ICES area		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Not sampled	Slippage	Total
P35	6, 7	IVa, IVb	Catch			1742.9	0.0	24.5		8.2	45		1820.6
			Landings			1742.9	0.0	0.0		0.0	45		1787.9
			Discards			0.0	0.0	24.5		8.2	0		32.7
			% Discards			0%		100%		100%	0%		2%
P30	7, 8	IVa, VIa, VIIb, VIIe, VIIj	Catch	1.5		1396.8	791.1	141.8	3.3	16.3	4	27	2381.8
			Landings	0.0		1255.6	791.1	0.0	0.0	0.0	4		2050.7
			Discards	1.5		141.2	0.0	141.8	3.3	16.3	0	27	331.1
			% Discards	100%		10%	0%	100%	100%	100%		100%	14%
P37	7, 8	IVa, VIa	Catch			3835.0		48.4		14.2	0	55	3952.6
			Landings			3759.0		0.0		0.0	0		3759.0
			Discards			76.0		48.4		14.2	0	55	193.6
			% Discards			2%		100%		100%		100%	5%
P38	10	IVa	Catch			371.4	0.3	2652.8		3.1		50	3077.6
			Landings			336.4	0.0	2504.1		0.0			2840.5
			Discards			35.0	0.3	148.7		3.1		50	237.1
			% Discards			9%	100%	6%		100%		100%	4%
P34	11	VIId, VIIe, VIIh, VIIIb	Catch			97.3	1461.7	76.5	39.7	34.0	0	70	1779.2
			Landings			97.3	1416.9	0.0	0.0	2.0	0		1516.2
			Discards			0.0	44.8	76.5	39.7	32.0	0	70	263.0
			% Discards			0%	3%	100%	100%	94%		100%	14%
P39	12	VIa, VIIb, VIId, VIIj	Catch			1220.0	966.1	605.6	0.0				2791.7
			Landings			1214.6	962.4	124.4	0.0				2301.4
			Discards			5.4	3.7	481.2	0.0				490.3
			% Discards			0%	0%	79%					18%

Table 3. Continued

2007	Month	ICES area		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Not sampled	Slippage	Total
P40	1	IVa, VIa, VIIb, VIIId, VIIh	Catch			335.0	740.7	833.6	0.2	1.0	0	30	1940.5
			Landings			335.0	740.3	580.9	0.0	0.0	0		1656.2
			Discards			0.0	0.4	252.7	0.2	1.0	0	30	284.3
			% Discards			0%	0%	30%	100%	100%		100%	15%
P41	3, 4	IIa, VIa, VIb	Catch	3809.4			5.8	0.1		14.8	0		3830.1
			Landings	3775.1			0.0	0.0		0.0	0		3775.1
			Discards	34.3			5.8	0.1		14.8	0		55.0
			% Discards	1%			100%	100%		100%			1%
P42	4, 5	Vb, VIa	Catch	774.5	990.1		0.8	61.5		21.0	0		1847.9
			Landings	761.8	986.5		0.0	0.0		0.0	0		1748.3
			Discards	12.7	3.6		0.8	61.5		21.0	0		99.6
			% Discards	2%	0%		100%	100%		100%			5%
P43	4, 5	Vb, VIa	Catch	869.7	717.2		0.2	5.1		2.5	0		1594.7
			Landings	868.7	714.2		0.0	0.0		0.0	0		1582.9
			Discards	1.0	3.0		0.2	5.1		2.5	0		11.8
			% Discards	0%	0%		100%	100%		100%			1%
P44	6	IVa	Catch			2073.2		31.3		2.5		135	2242.0
			Landings			2073.2		5.7		0.4			2079.3
			Discards			0.0		25.6		2.1		135	162.7
			% Discards			0%		82%		83%		100%	7%
P45	6, 7	IVa	Catch			3733.7		59.5		4.0	45		3842.2
			Landings			3678.8		0.0		0.0	45		3723.8
			Discards			54.9		59.5		4.0	0		118.4
			% Discards			1%		100%		100%	0%		3%

Table 3. Continued

2007	Month	ICES area		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Not sampled	Slippage	Total		
P47	8	IVa, IVb	Catch			1203.2		97.3		8.0	100		1408.5		
			Landings			1118.5		0.0		0.0	12		1130.5		
			Discards			84.7		97.3		8.0		88		278.0	
			% Discards			7%		100%		100%		88%		20%	
P46	8, 9	IVa, IVb	Catch			3611.6		188.8		7.2	90	110	4007.6		
			Landings			3559.0		32.4		5.2	90		3686.6		
			Discards			52.6		156.4		2.0		0	110	321.0	
			% Discards			1%		83%		28%		0%	100%	8%	
P48	9, 10	IIa	Catch	52.2		3116.9				5.9	15		3190.0		
			Landings	5.5		3116.9				5.9	0		3128.3		
			Discards	46.7		0.0				0.0		15		61.7	
			% Discards	90%		0%				0%		100%		2%	
P49	10, 11	IIa	Catch	9.3		3070.7						85	3165.0		
			Landings	9.3		3070.7								3080.0	
			Discards	0.0		0.0							85	85.0	
			% Discards	0%		0%							100%	3%	
P50	12	VIIb, VIId, VIIj	Catch			1024.3	533.5	156.2			12.4		240	1966.4	
			Landings			1007.2	503.2	0.0			0.0			1510.4	
			Discards			17.1	30.3	156.2			12.4			240	456.0
			% Discards			2%	6%	100%			100%			100%	23%
P51	12	VIId, VIle	Catch			169.2	321.1	0.0	0.7	8.9	0	35	534.9		
			Landings			169.2	321.1	0.0	0.0	7.2	0			497.5	
			Discards			0.0	0.0	0.0	0.7	1.7	0		35	37.4	
			% Discards			0%	0%		100%	19%			100%	7%	

Table 4. Average amount of discards (tonnes) over sampled pelagic discard trips per year

Name	Dutch name	Discards (tonnes)				
		2003	2004	2005	2006	2007
Blue whiting	Blauwe wijting	14.7	10.2	19.0	9.3	7.9
Greater argentine	Grote zilversmelt	8.9	2.4	0.0	1.5	0.6
Herring	Haring	48.5	21.6	28.3	22.5	17.4
Horse mackerel	Horsmakreel	33.9	10.8	5.8	6.1	3.1
Mackerel	Makreel	79.4	41.9	133.1	93.0	67.9
Pilchard	Pelser	25.7	8.6	2.3	6.6	0.1
Anchovy	Ansjovis			0.0		
Anglerfish	Zeeduivel	0.1				
Blackfish	Zwarte vis			0.1	0.1	0.3
Black seabream	Zeekarper				0.0	0.1
Boarfish	Evervis	18.9	6.8	9.4	3.7	0.1
Conger	Conger			0.0		
Deal-fish	Bandvis				0.1	
Gilt head	Goudbrasem					0.8
Golden redfish	Roodbaars	0.3		0.0		0.0
Greater forkbeard	Gaffelkabeljauw			0.1		
Grey gurnard	Grauwe poon		0.3	0.6	0.3	0.1
Haddock	Schelvis	1.4	6.1	2.2	1.8	0.4
Hake	Heek	0.2	0.1	1.0	0.1	0.3
John Dory	Zonnevis	1.1			0.0	
Ling	Leng			0.0		
Loligo	Loligo	0.0				
Lumpsucker	Snotolf	0.1		0.1	0.1	
Norway pout	Kever	0.1			0.5	0.2
Oar-fish	Riemvis				0.1	1.0
Pollack	Witte koolvis			0.1		
Red gurnard	Engelse poon					0.0
Risso's barracudina	Risso's barracudina				0.0	
Saithe	Zwarte koolvis	2.7		1.0	1.0	1.7
Sea bass	Zeebaars			0.0		0.1
Silver pomfret	Zilverbraam		0.0	0.0		
Snake pipefish	Adderzeenaald				0.0	
Spurdog	Doomhaai					0.0
Striped red mullet	Mul	21.1		0.0		
Tub gurnard	Rode poon	0.1		0.0		
White seabream	Bandzeebrasem	0.0	0.7			
Whiting	Wijting	1.0	0.9	0.1	0.9	0.7
Witch	Witje			0.0		

Table 5. Total catch, landings, discards (tonnes), discard percentage, not sampled and slippage raised to pelagic fleet level per year.

		Blue whiting	Greater argentine	Herring	Horse mackerel	Mackerel	Pilchard	Others	Slippage	Not sampled	Total
2003	Catch	58522	3857	96954	72405	36830	10847	6181	20174		306252
(n=5)	Landings	57262	2610	90062	68614	28861	8147	0			255556
	Discards	1260	1247	6892	3791	7969	2700	6181	20174	482	50696
	% Discards	2%	32%	7%	5%	22%	25%	100%	100%		17%
2004	Catch	78316	10890	132399	68117	32095	3430	2419	4854		332963
(n=6)	Landings	77185	10662	128705	67105	27114	2684	461			313916
	Discards	1131	228	3694	1012	4981	746	1958	4854	443	19047
	% Discards	1%	2%	3%	1%	16%	22%	81%	100%		6%
2005	Catch	131280	3984	128763	69057	38970	2424	2175	4900		381590
(n=11)	Landings	128367	3984	124627	68431	24740	2230	67			352446
	Discards	2913	0	4136	626	14230	194	2108	4900	37	29144
	% Discards	2%	0%	3%	1%	37%	8%	97%	100%		8%
2006	Catch	97085	1211	93157	64795	33583	2975	1148	6883		300908
(n=12)	Landings	96139	1062	90688	64183	24054	2291	117			278534
	Discards	946	149	2469	612	9529	684	1031	6883	71	22374
	% Discards	1%	12%	3%	1%	28%	23%	90%	100%		7%
2007	Catch	81832	3911	101993	61528	33293	1212	911	6562		292306
(n=12)	Landings	80730	3866	100454	61118	24037	1202	193			271600
	Discards	1102	45	1539	410	9256	10	718	6562	1064	20706
	% Discards	1%	1%	2%	1%	28%	1%	79%	100%		7%

* In 2005 12 trips were made onboard pelagic trawlers. One trip was left out of the analysis as discards were not sampled during this trip.

Table 6. Total discards, slippage (tonnes), slippage percentage and percentage of incidents of slippage per year

Year	Discards (tonnes)	Slippage (tonnes)	% slippage of total discards in weight	Incidents of slippage (% of sampled hauls)
2003	50696	20174	40%	8%
2004	19047	4854	25%	5%
2005	29144	4900	17%	4%
2006	22374	6883	31%	6%
2007	20706	6562	32%	5%

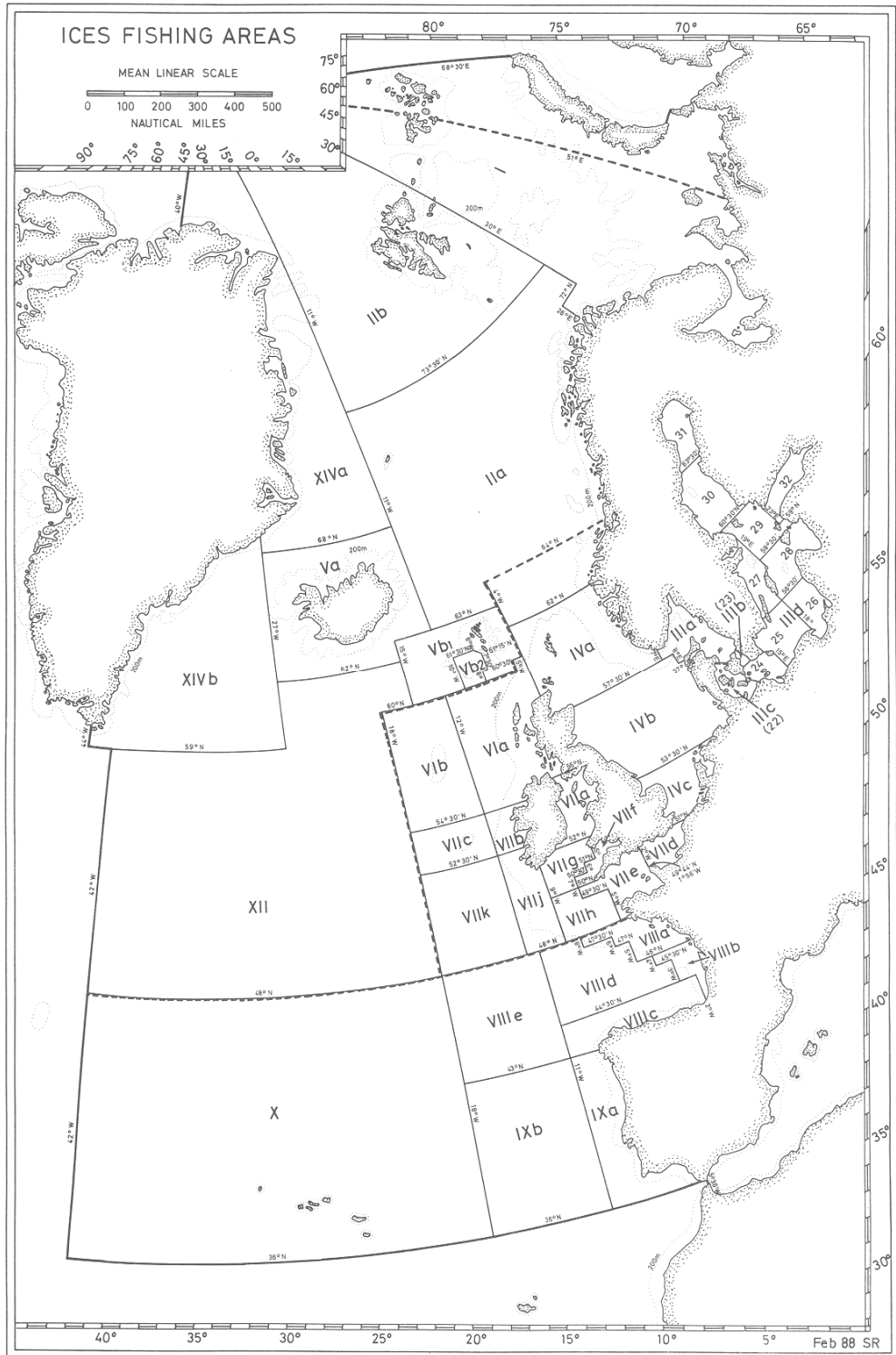


Figure 1. Map of ICES rectangles

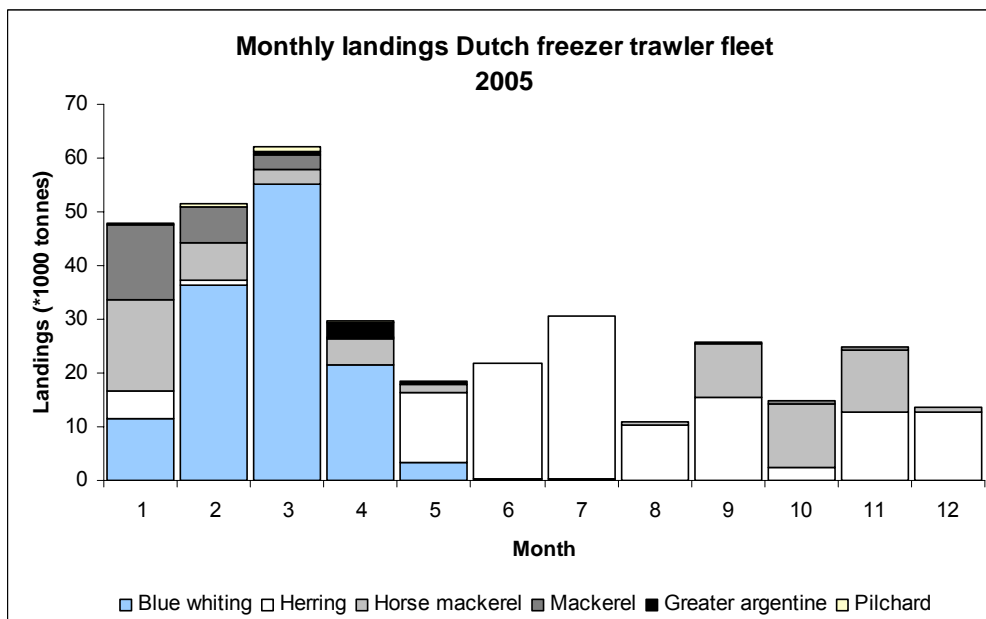
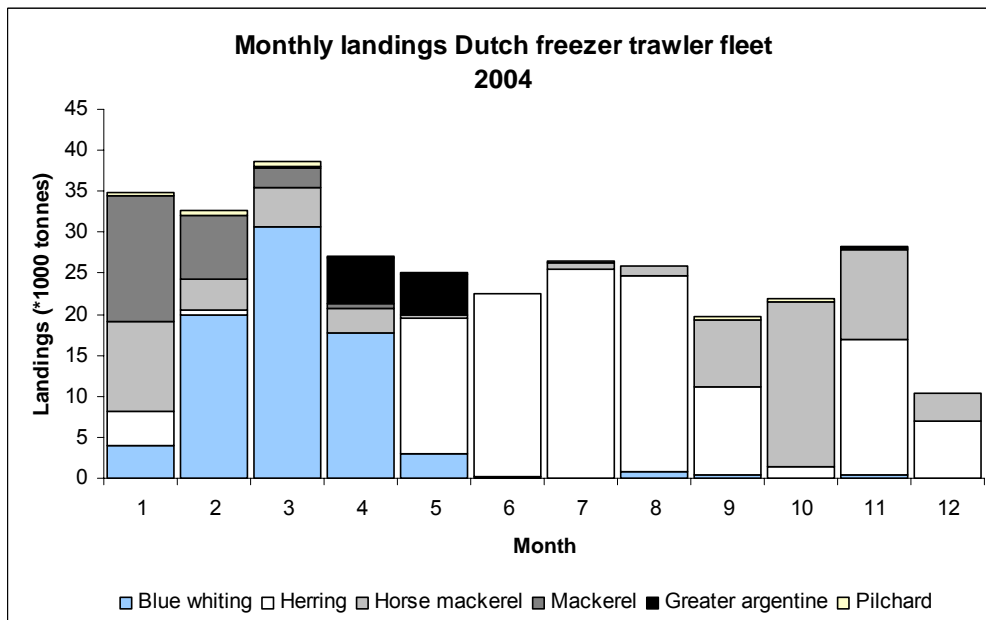
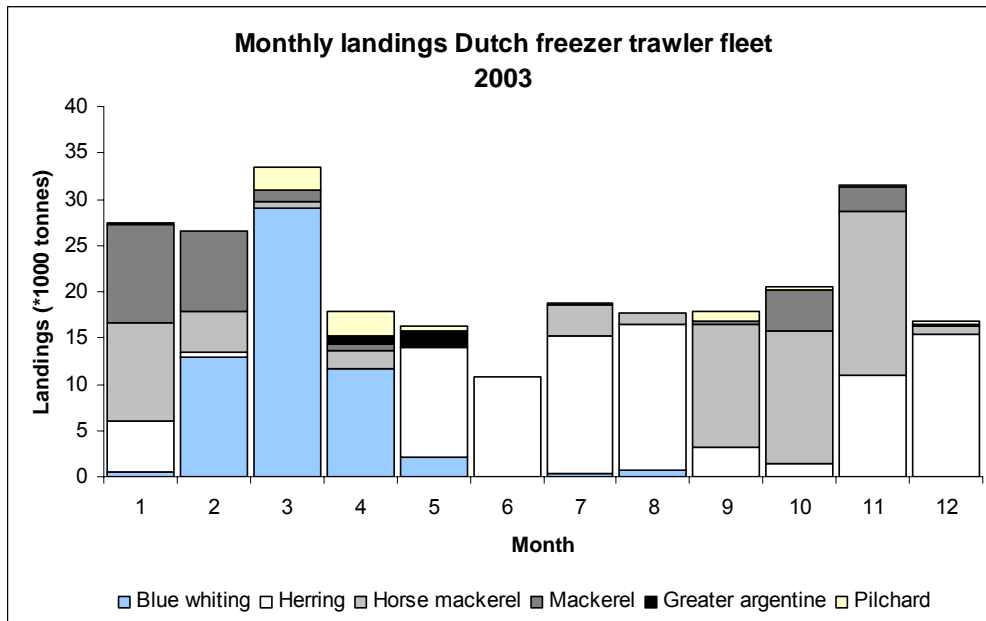


Figure 2. Monthly landings (*1000 tonnes) by species from the Dutch freezer trawler fleet in 2003, 2004, 2005, 2006 and 2007. Data from the VIRIS database.

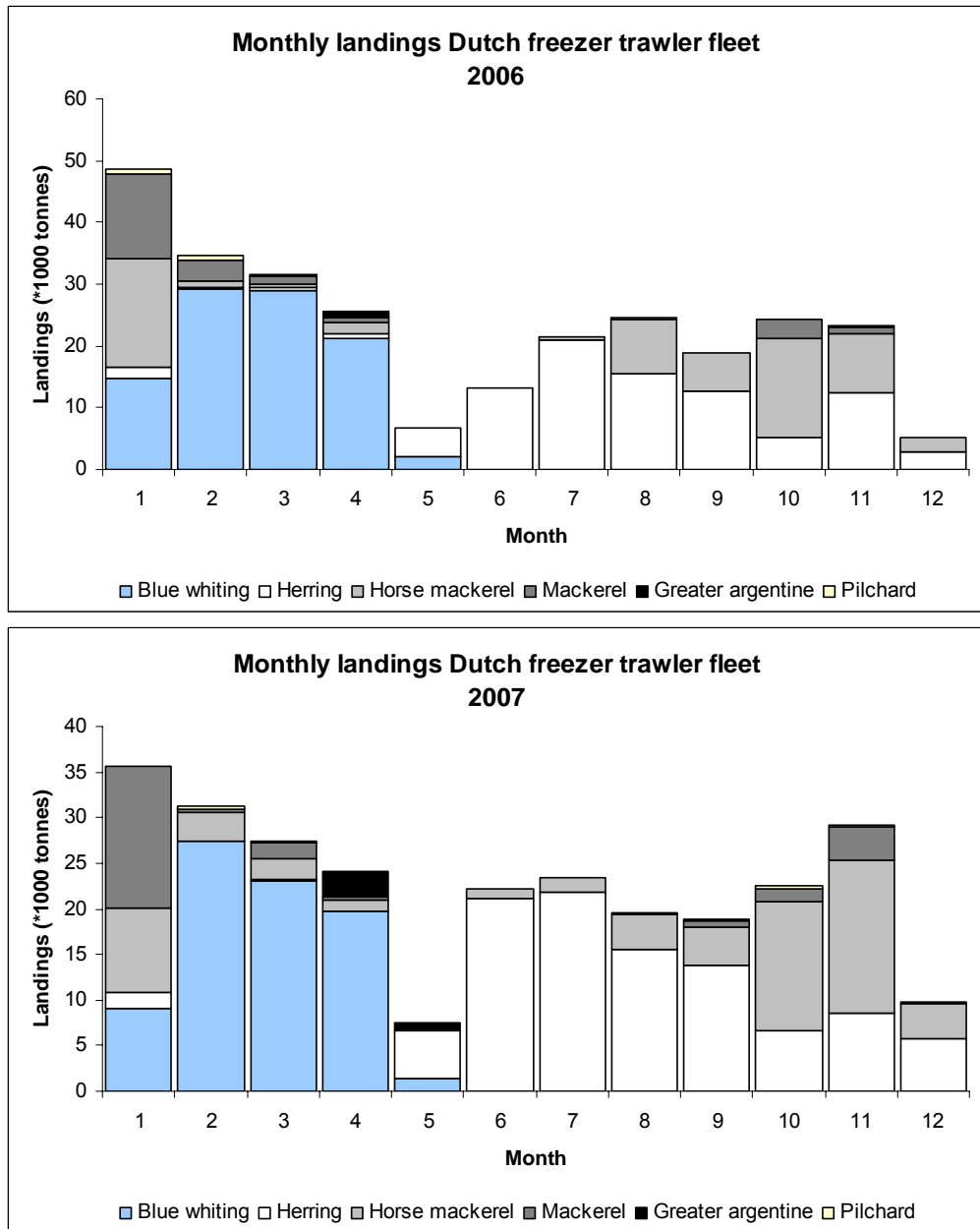


Figure 2. Continued

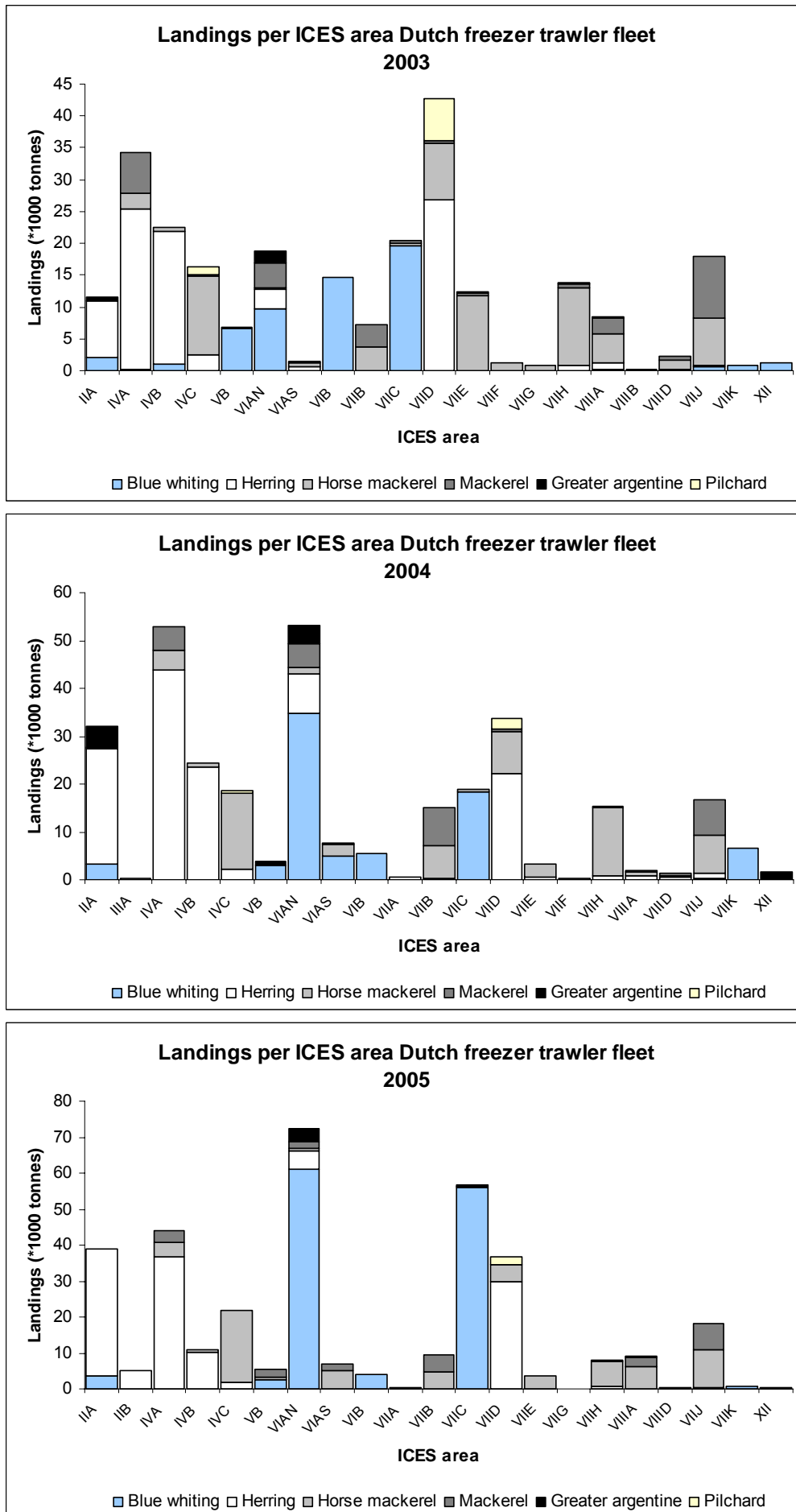


Figure 3. Landings per ICES area (*1000 tonnes) from the Dutch freezer trawler fleet in 2003, 2004, 2005, 2006 and 2007. Data from the VIRIS database.

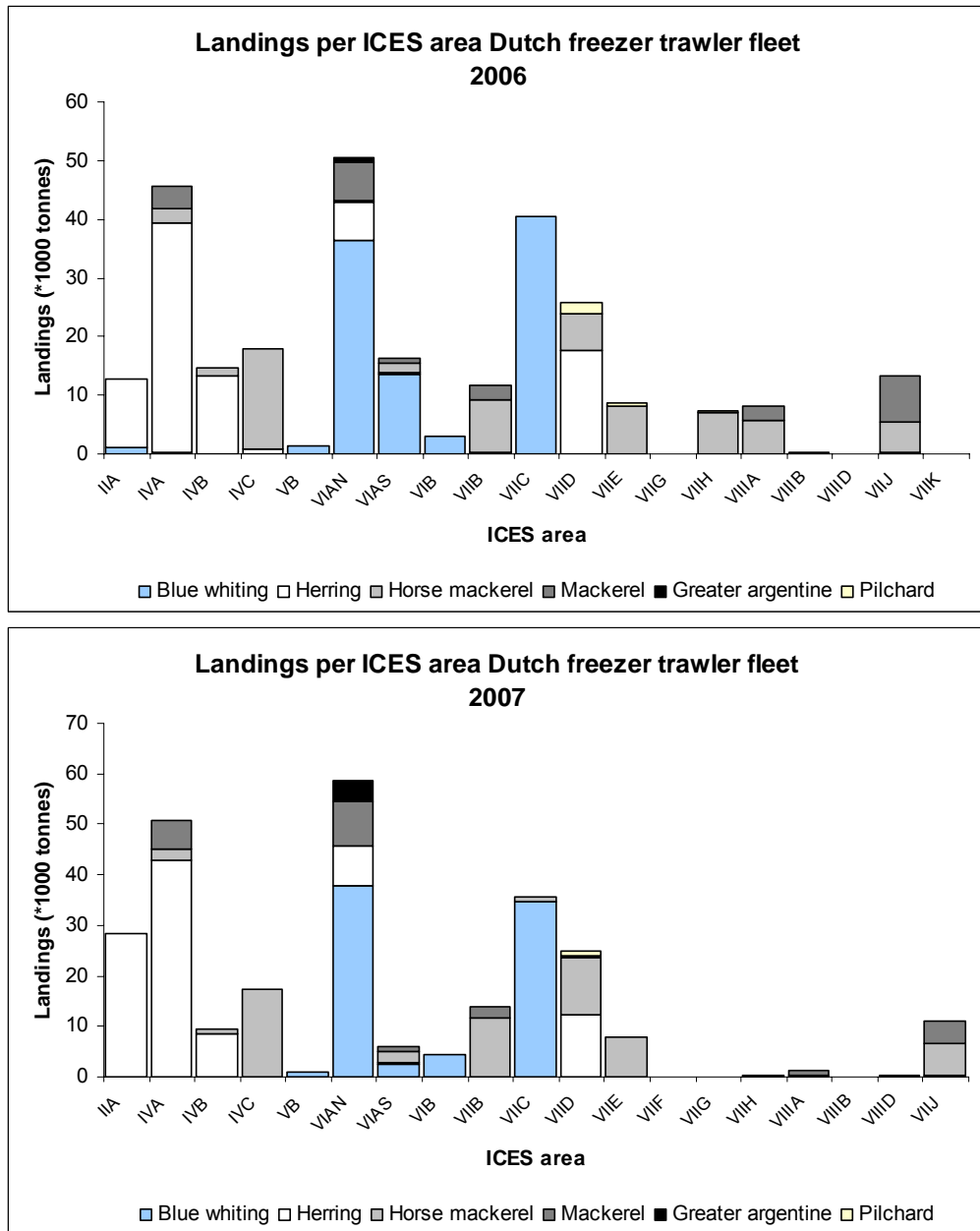


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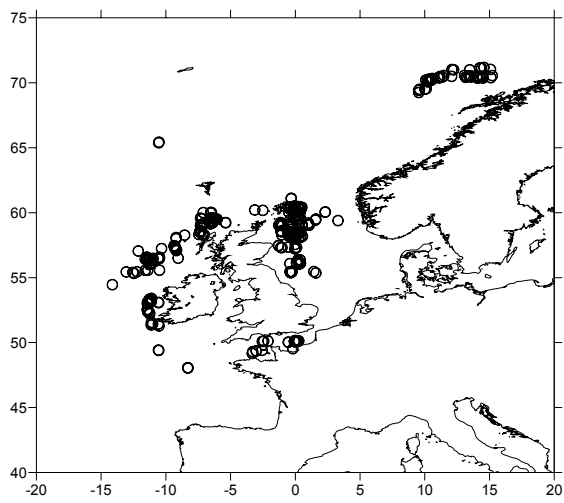
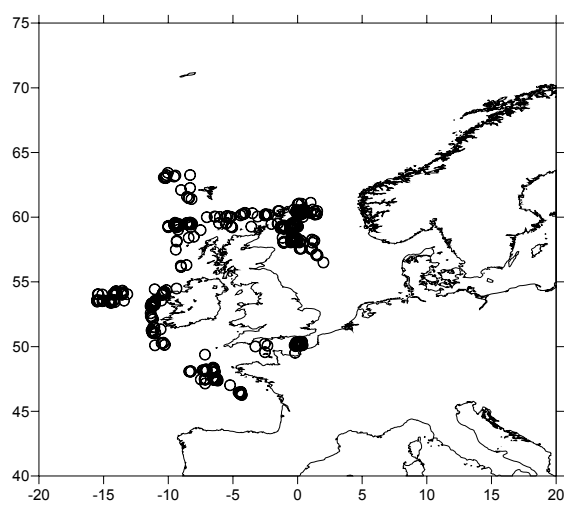
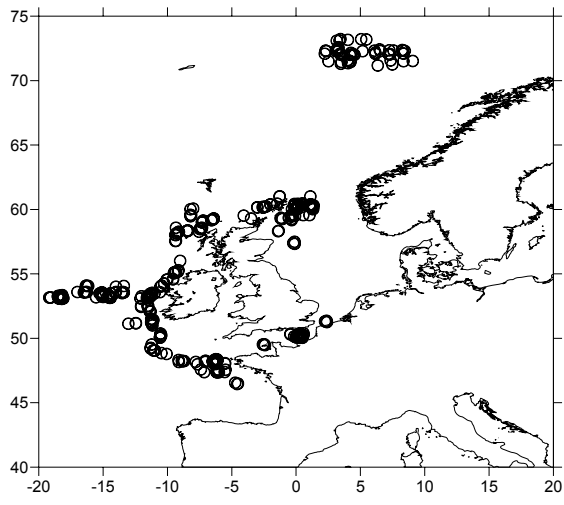
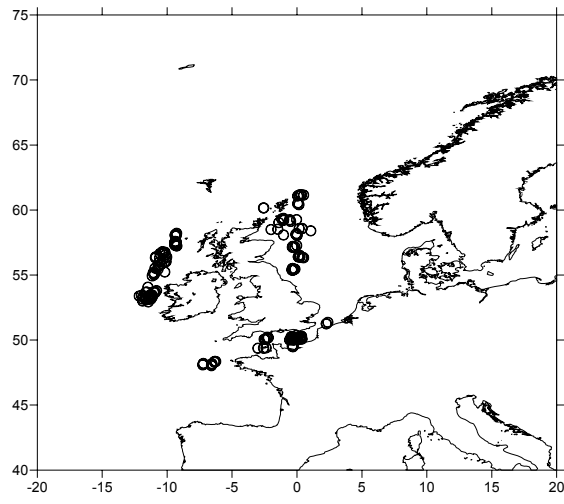
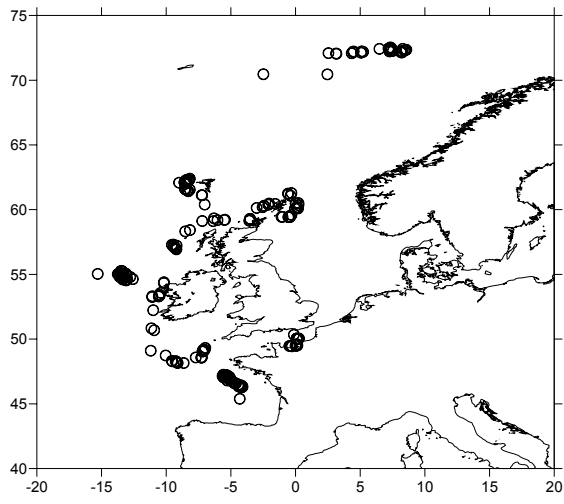


Figure 4. Trawl positions of sampled pelagic discard trips per haul for 2003 (upper left), 2004 (upper right), 2005 (middle left), 2006 (middle right), 2007 (lower left)

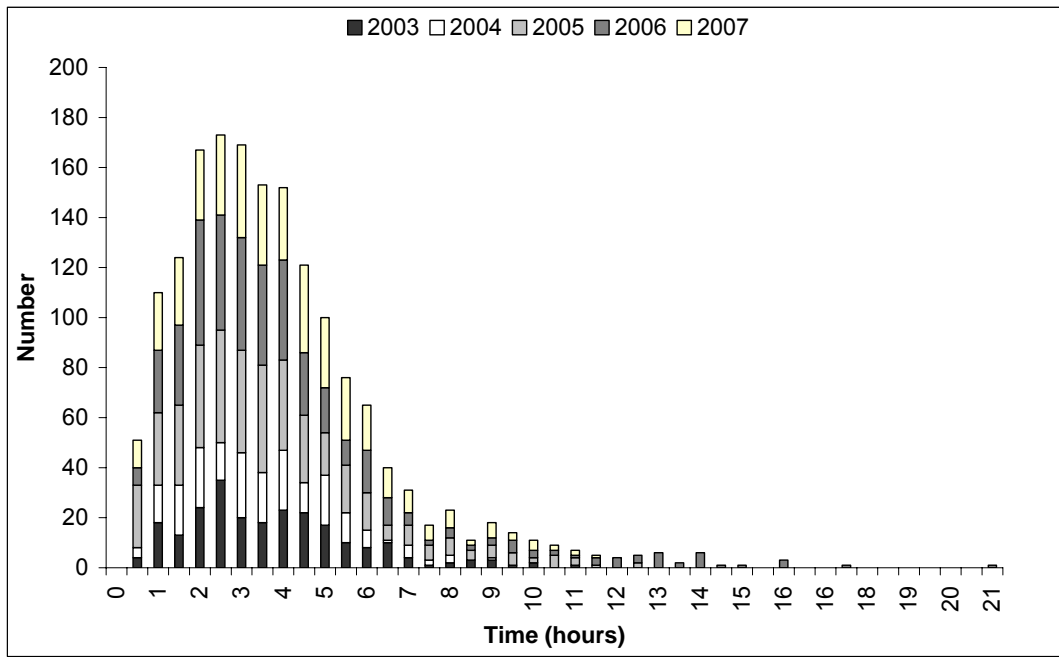


Figure 5. Frequency of haul durations of the sampled pelagic discard trips per year.

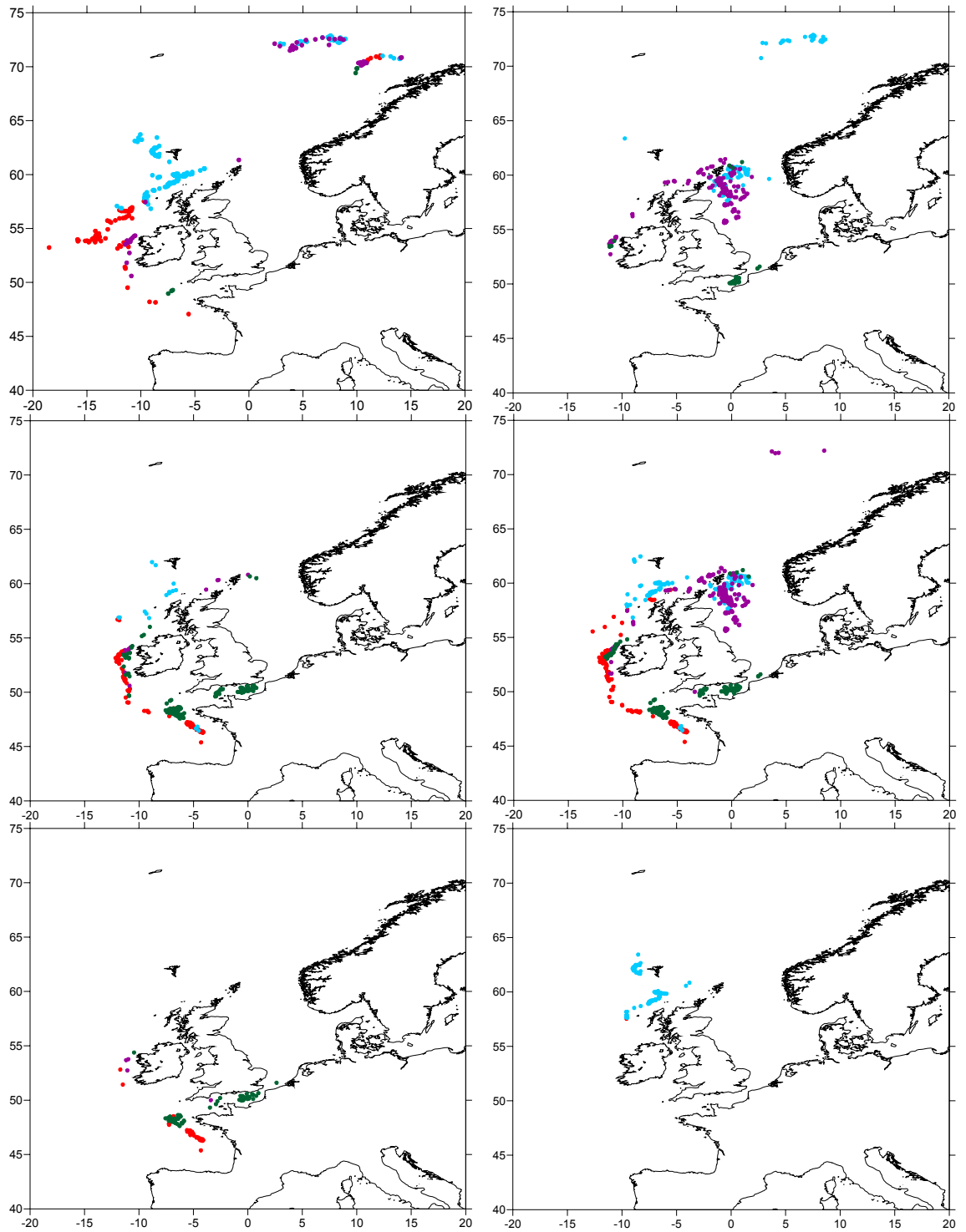


Figure 6. Positions of discards per quarter (red=1, blue=2, purple=3, green=4) for blue whiting (upper left), herring (upper right), horse mackerel (middle left), mackerel (middle right), greater argentine (lower left) and pilchard (lower right).

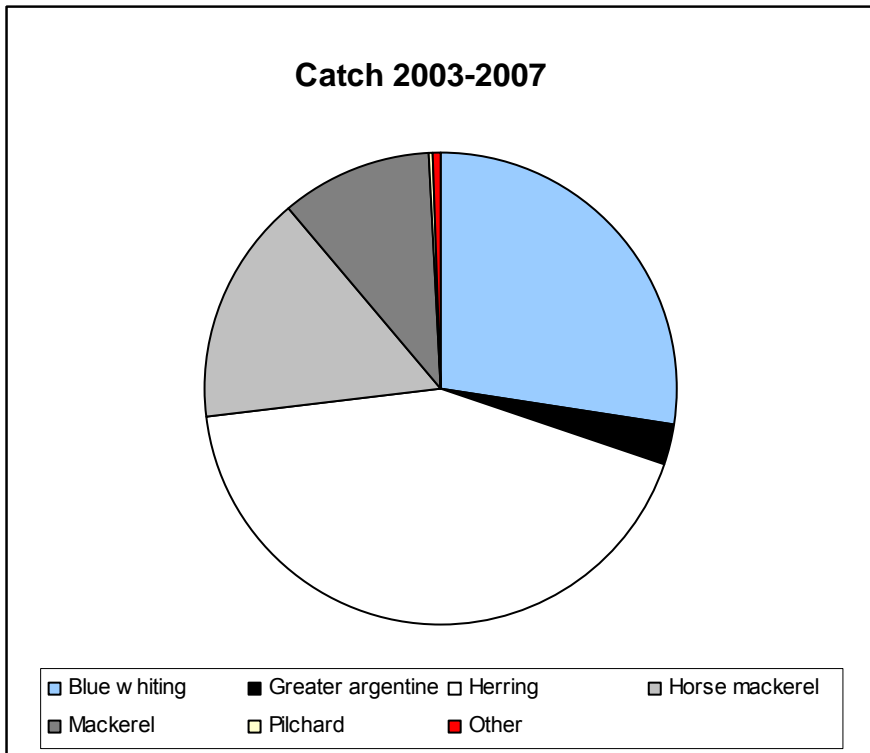


Figure 7. Composition of the average catches (in weight) for the sampled pelagic discard trips for the period 2003-2007

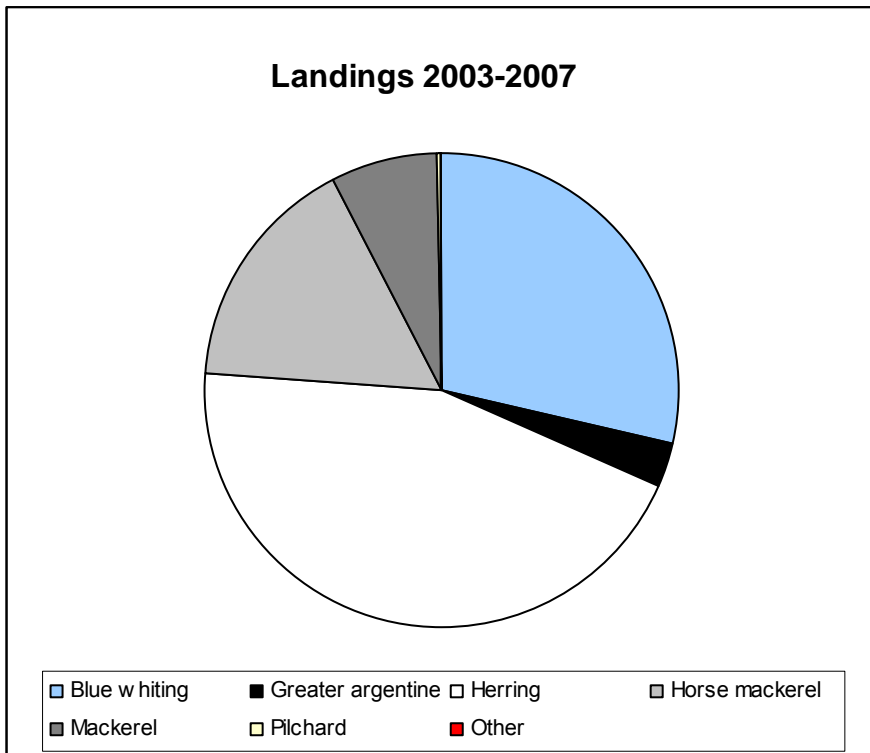


Figure 8. Composition of the average landings (in weight) for the sampled pelagic discard trips for the period 2003-2007

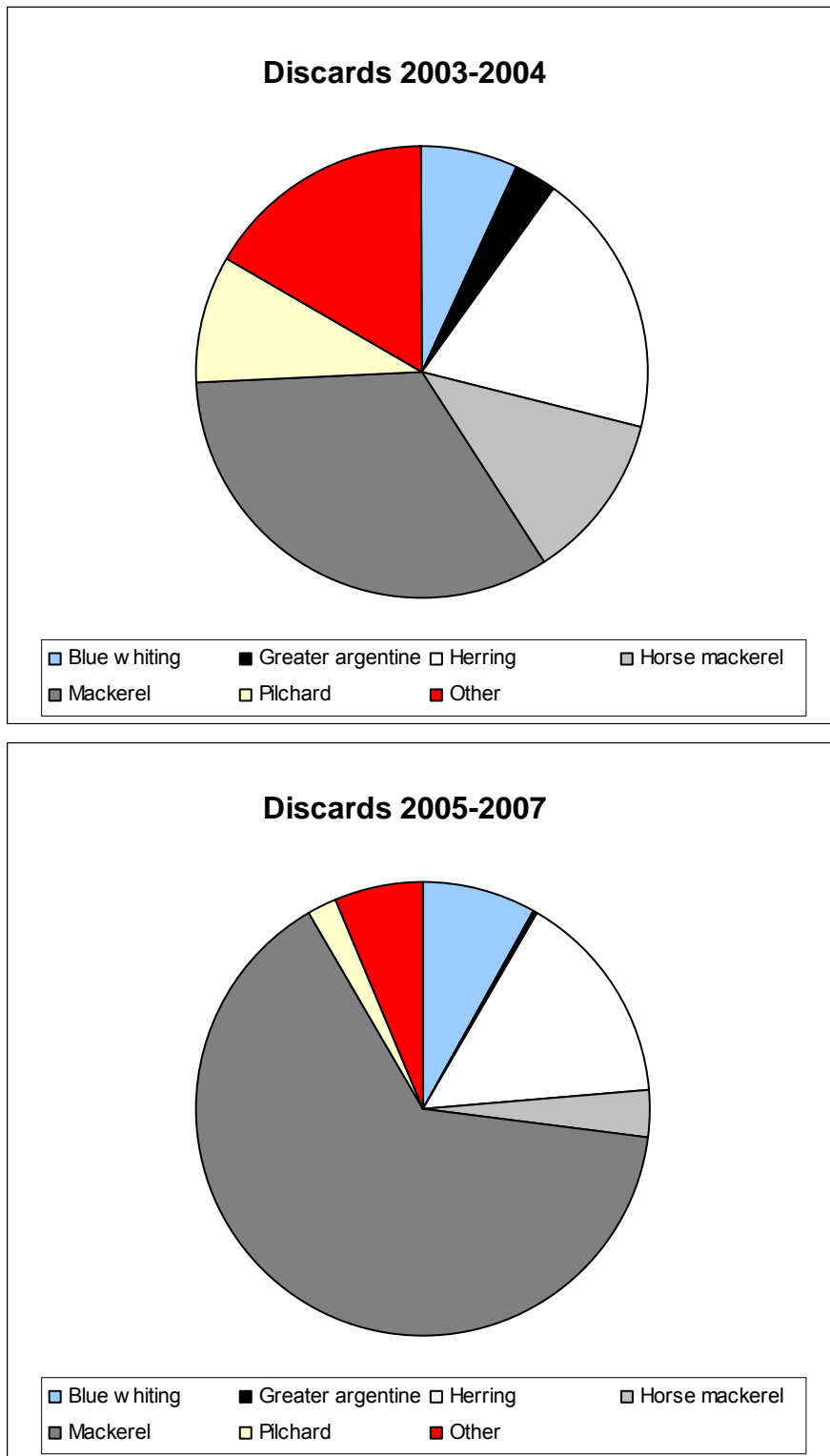


Figure 9. Composition of the average discards (in weight) for the sampled pelagic discard trips for the period 2003-2004 (upper) and 2004-2007 (lower)

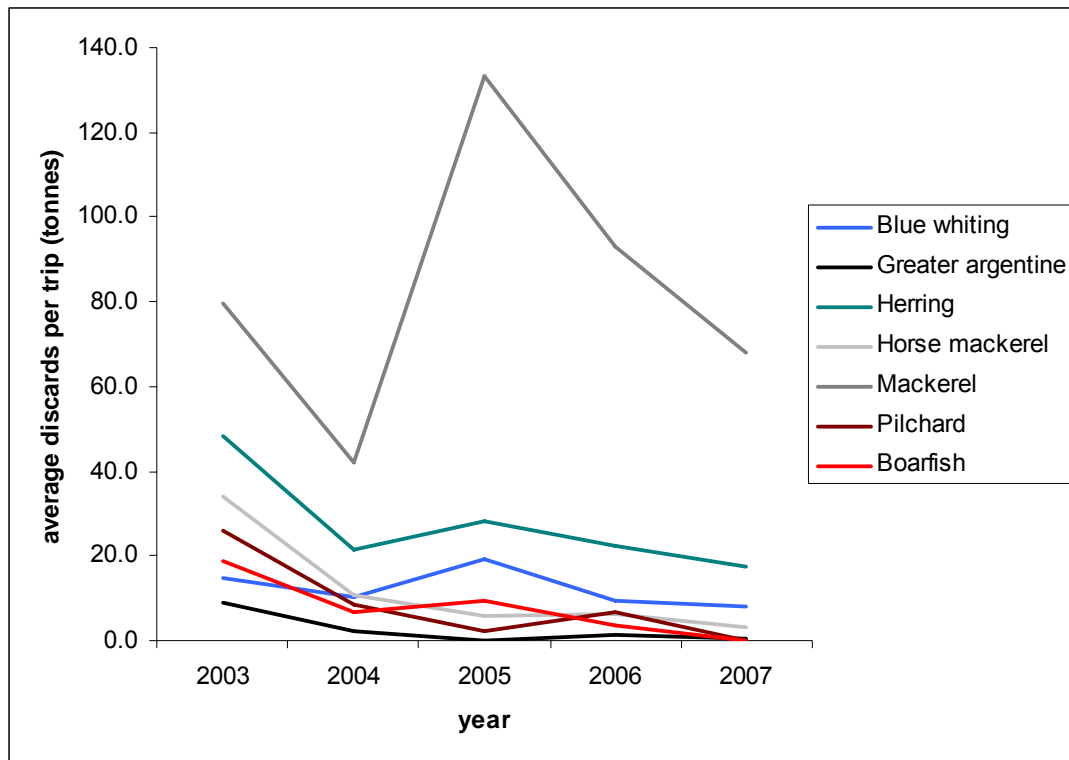


Figure 10. Average amount of discards (tonnes) over sampled pelagic discard trips per year (Information derived from Table 4).

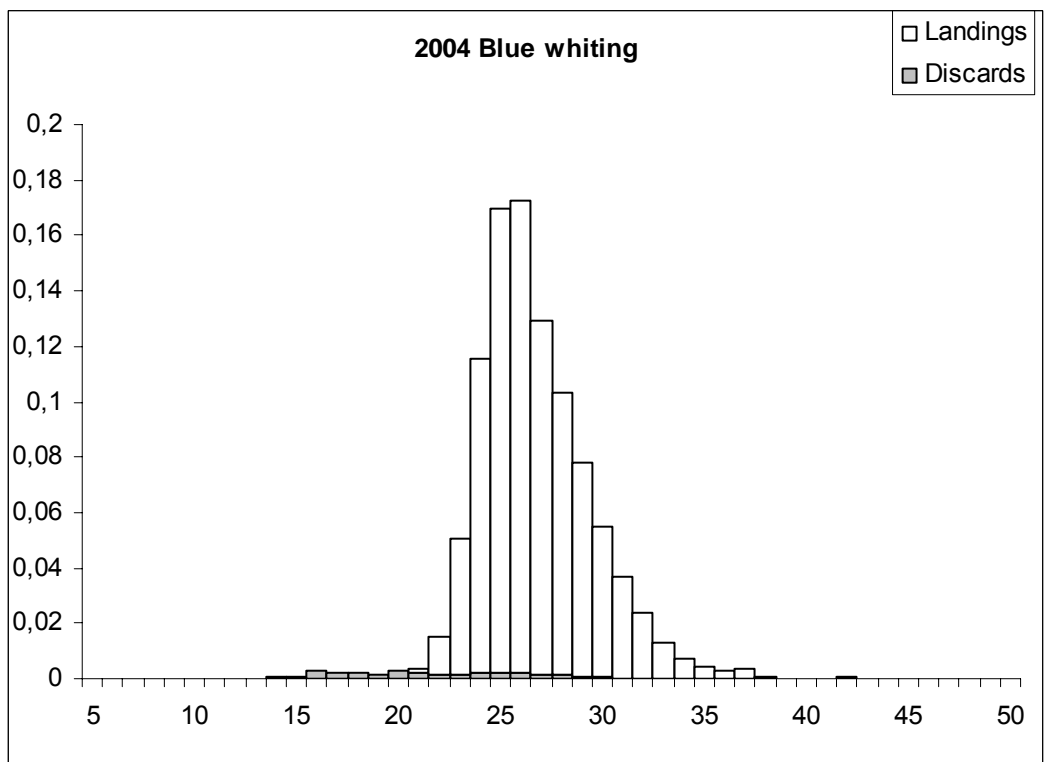
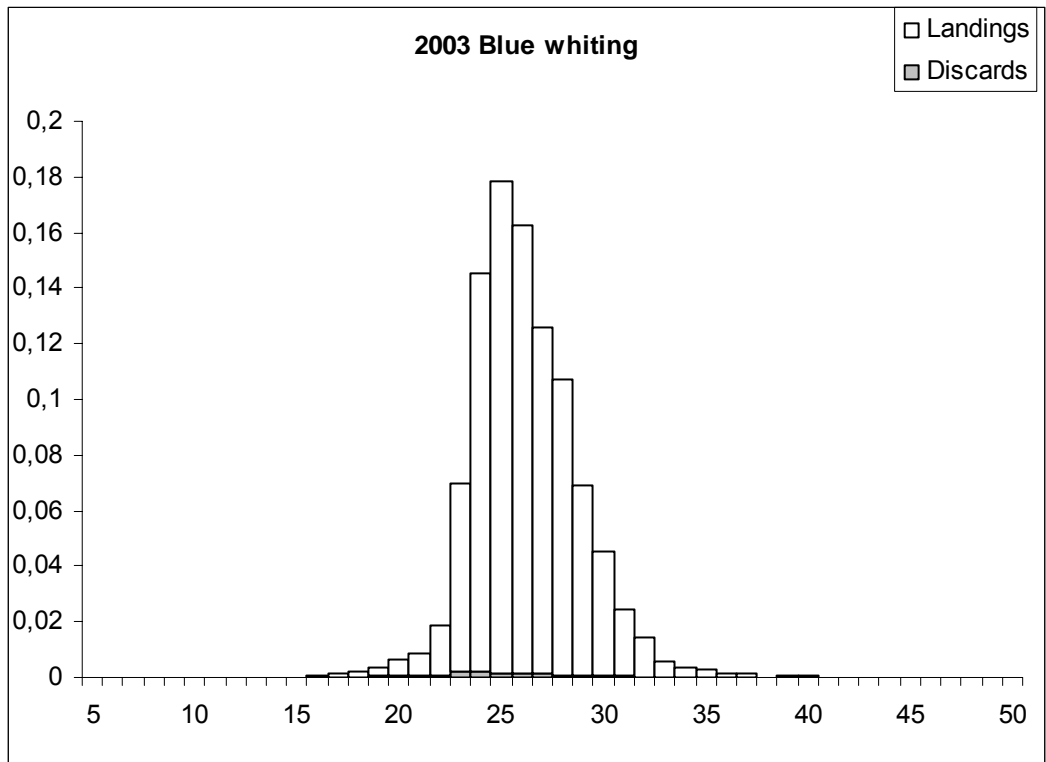


Figure 11. Relative length of discarded and landed blue whiting against length (cm) for the sampled pelagic discard trips.

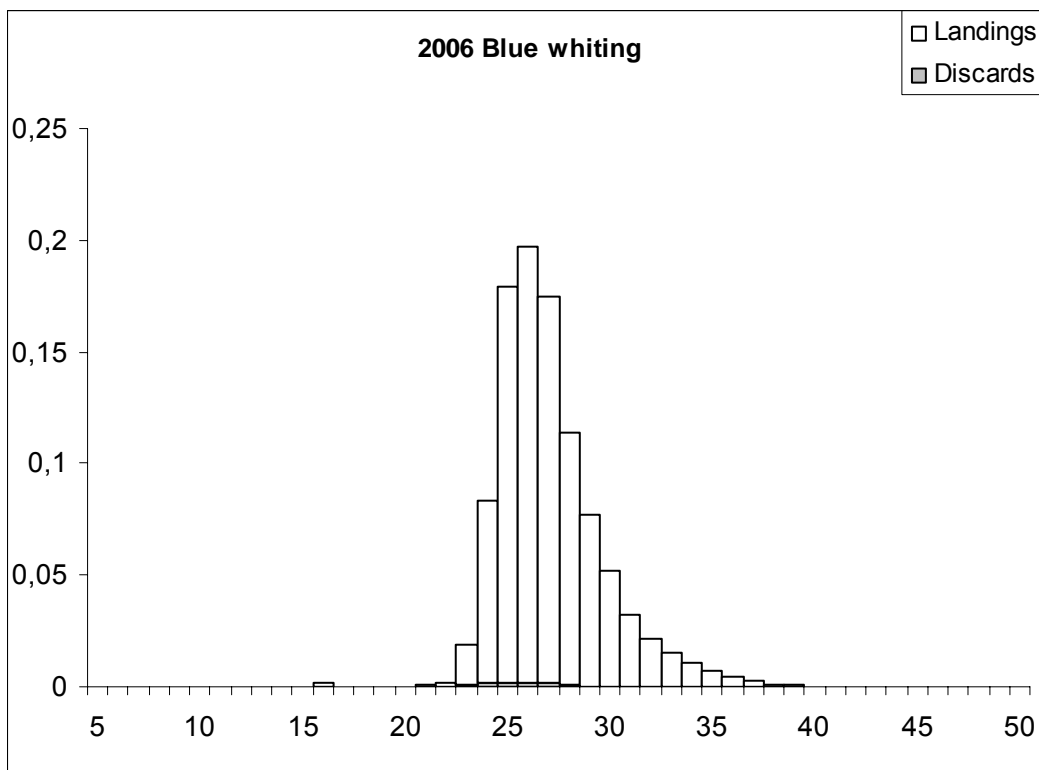
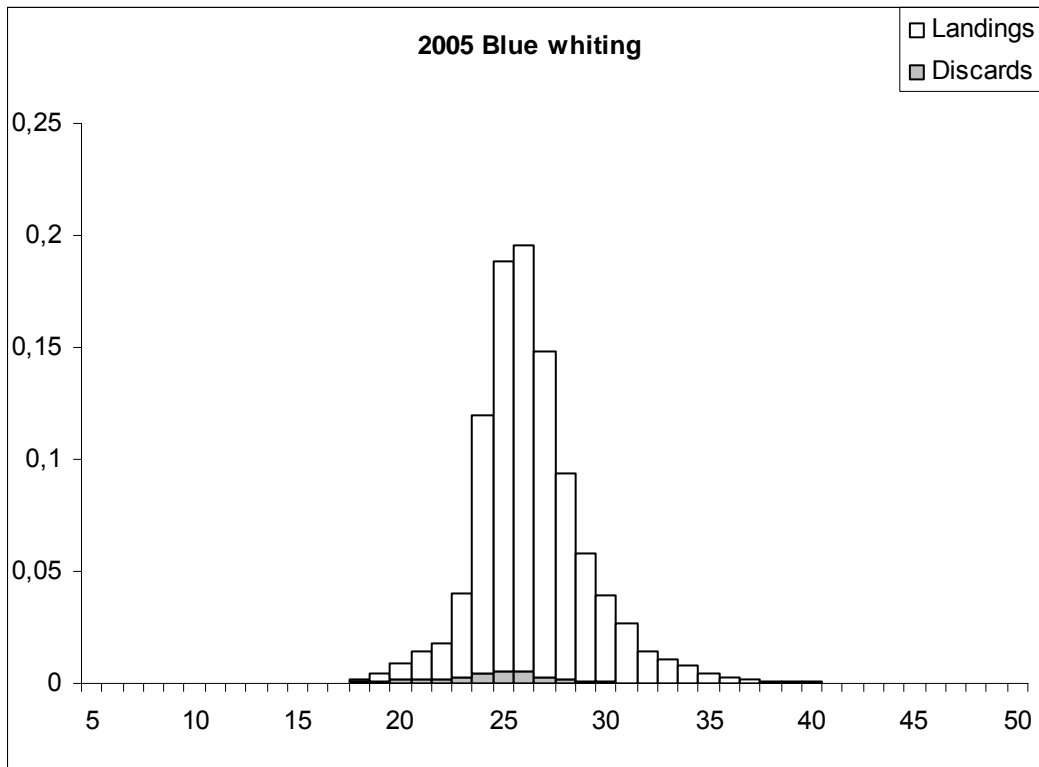
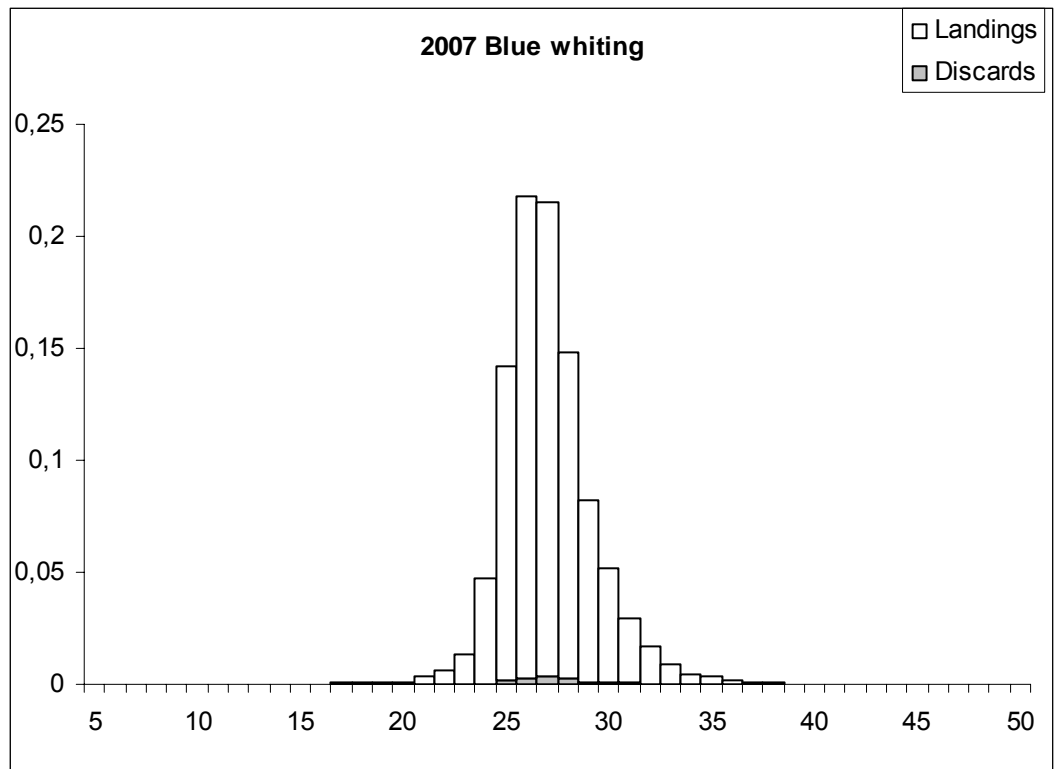


Figure 11. Continued

**Figure 11.** Continued

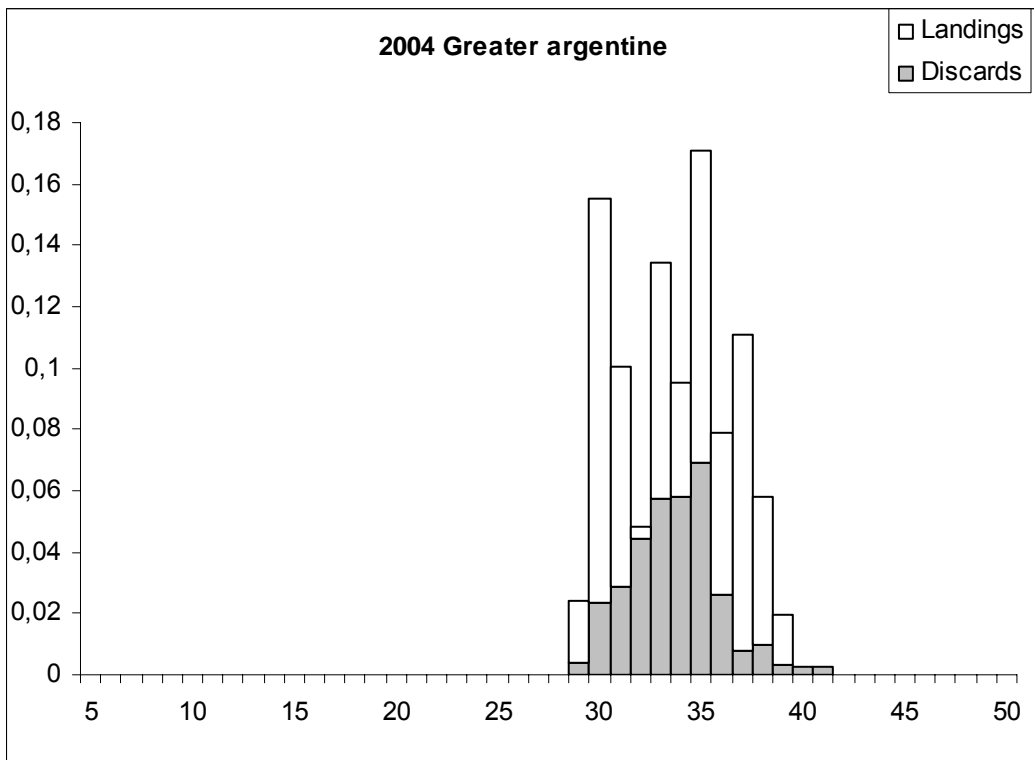
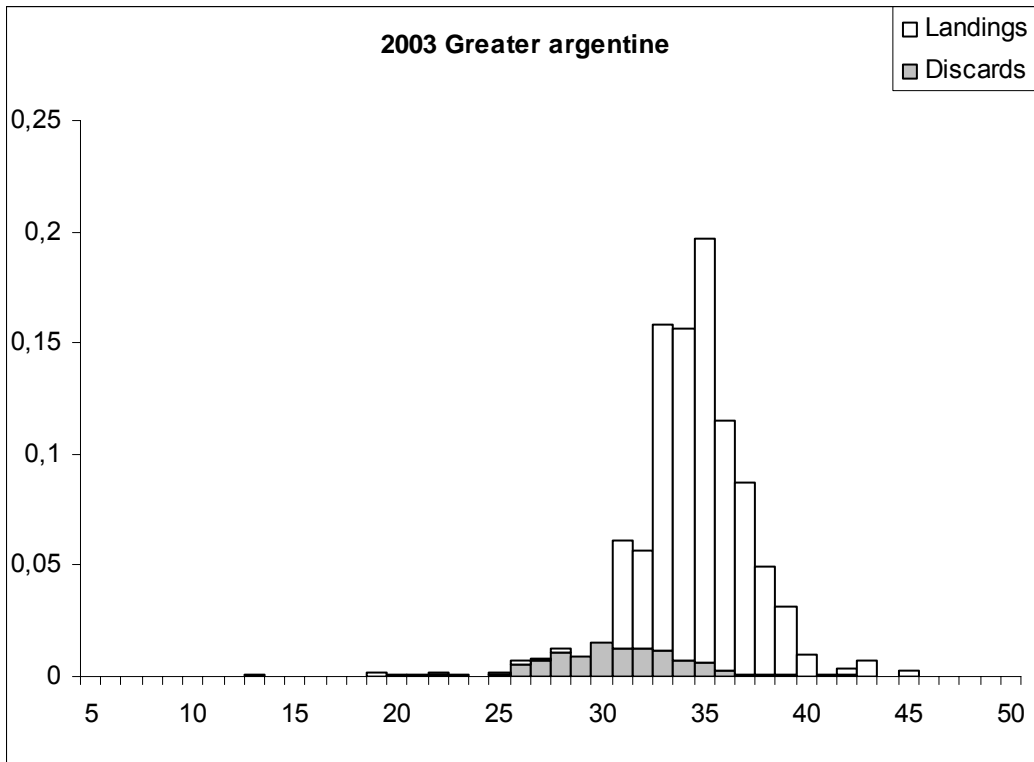


Figure 12. Relative length of discarded and landed greater argentine against length (cm) for the sampled pelagic discard trips.

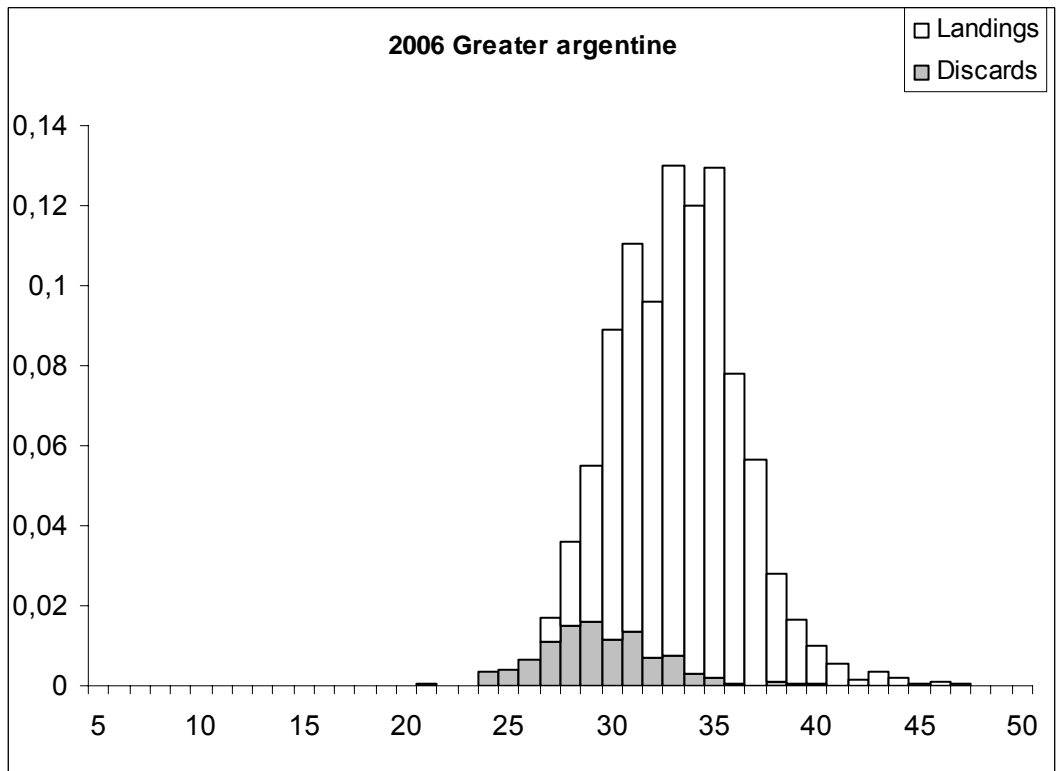
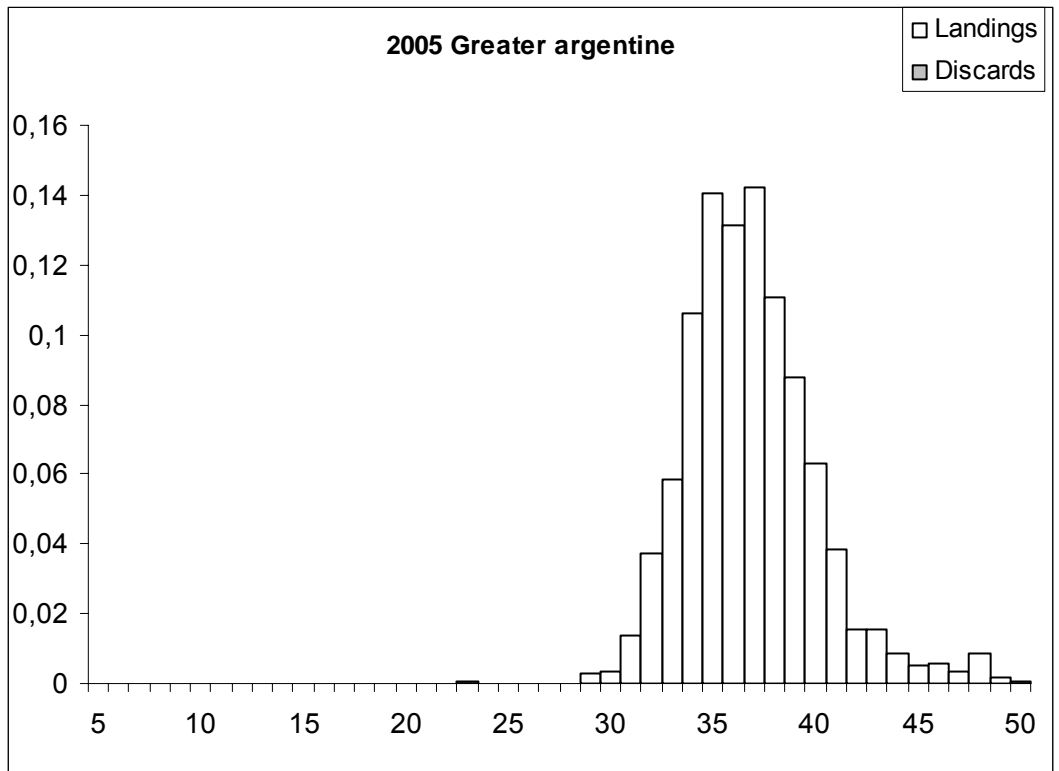


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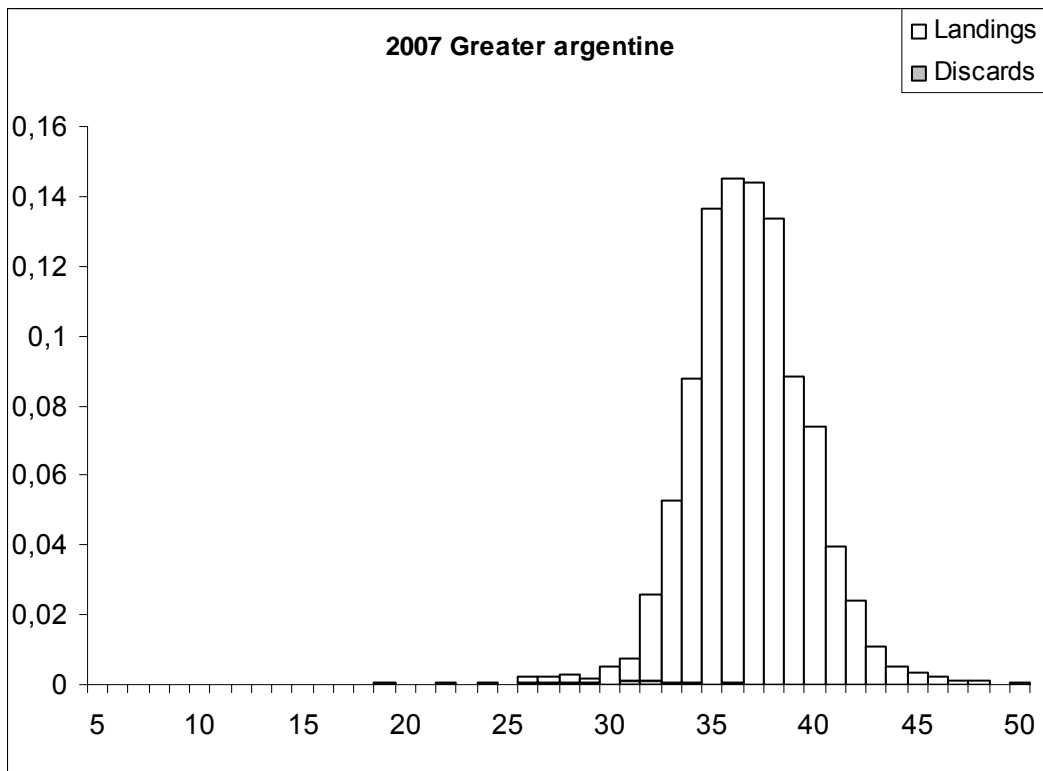


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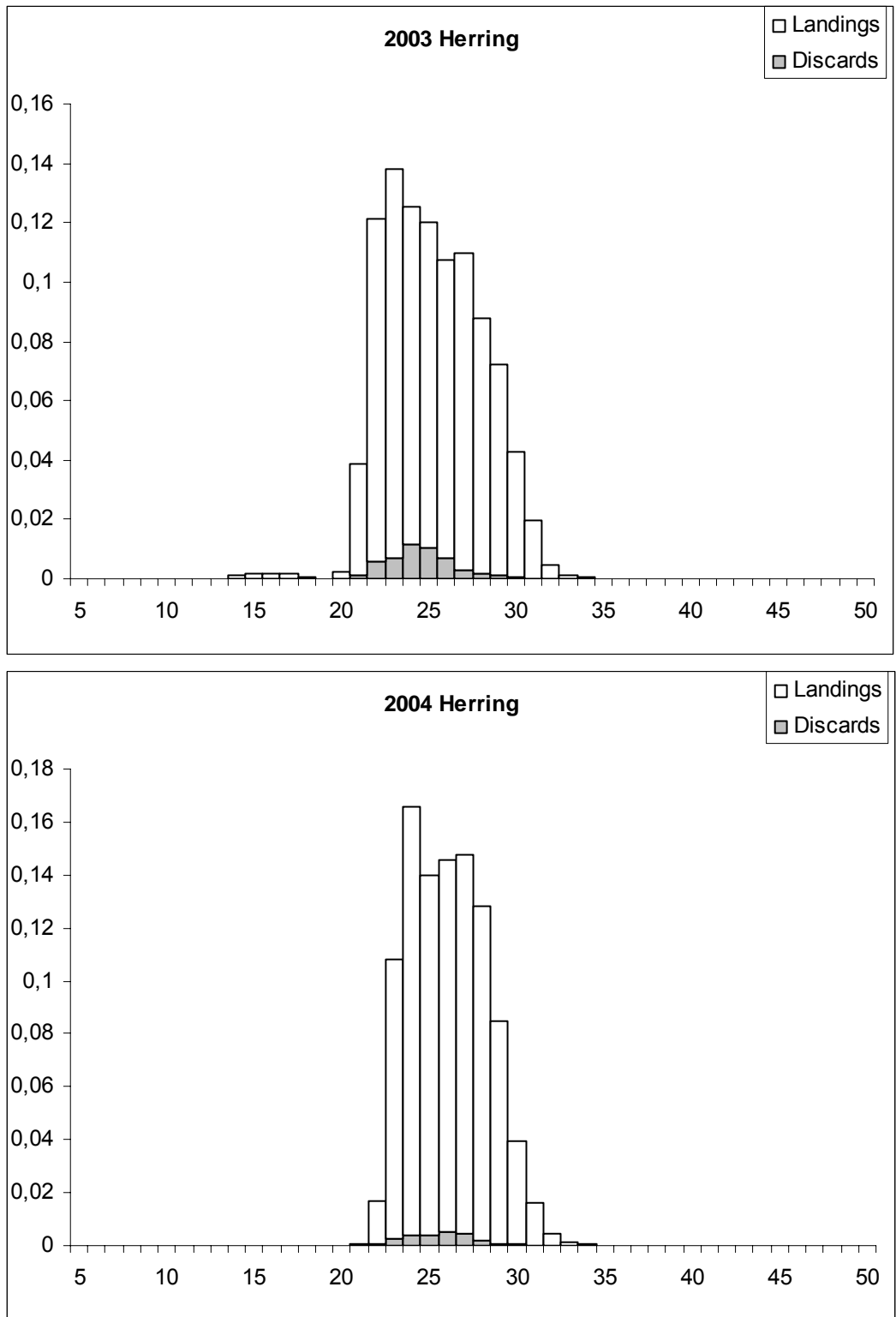


Figure 13. Relative length of discarded and landed herring against length (cm) for the sampled pelagic discard trips.

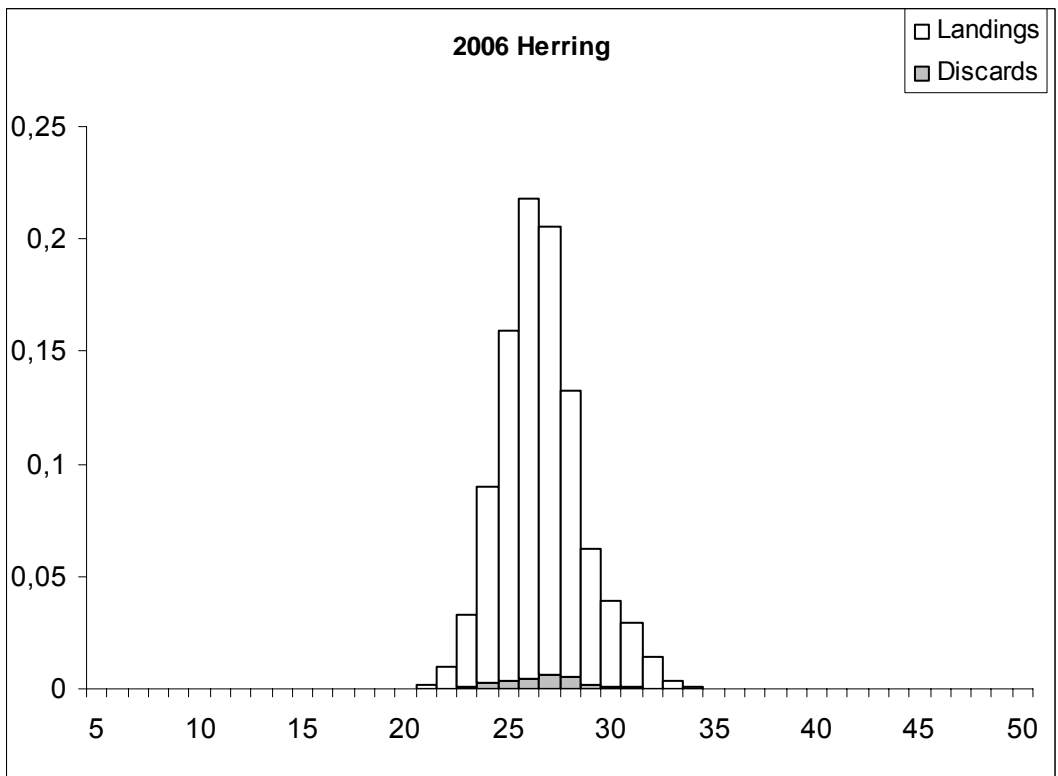
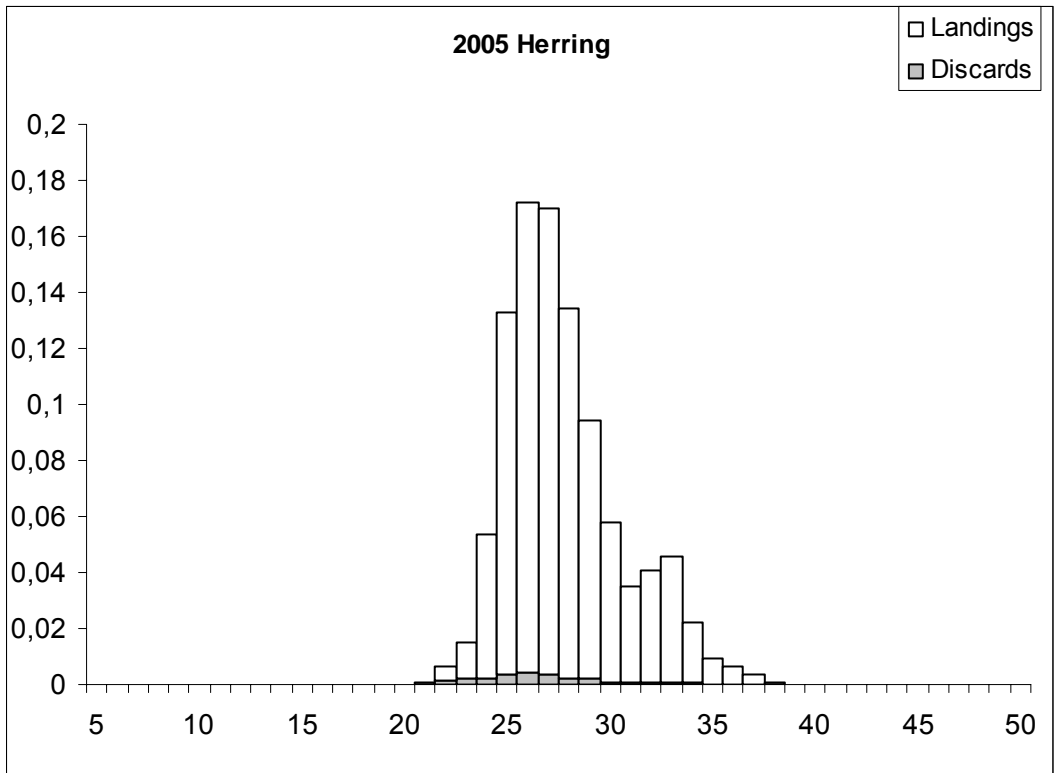


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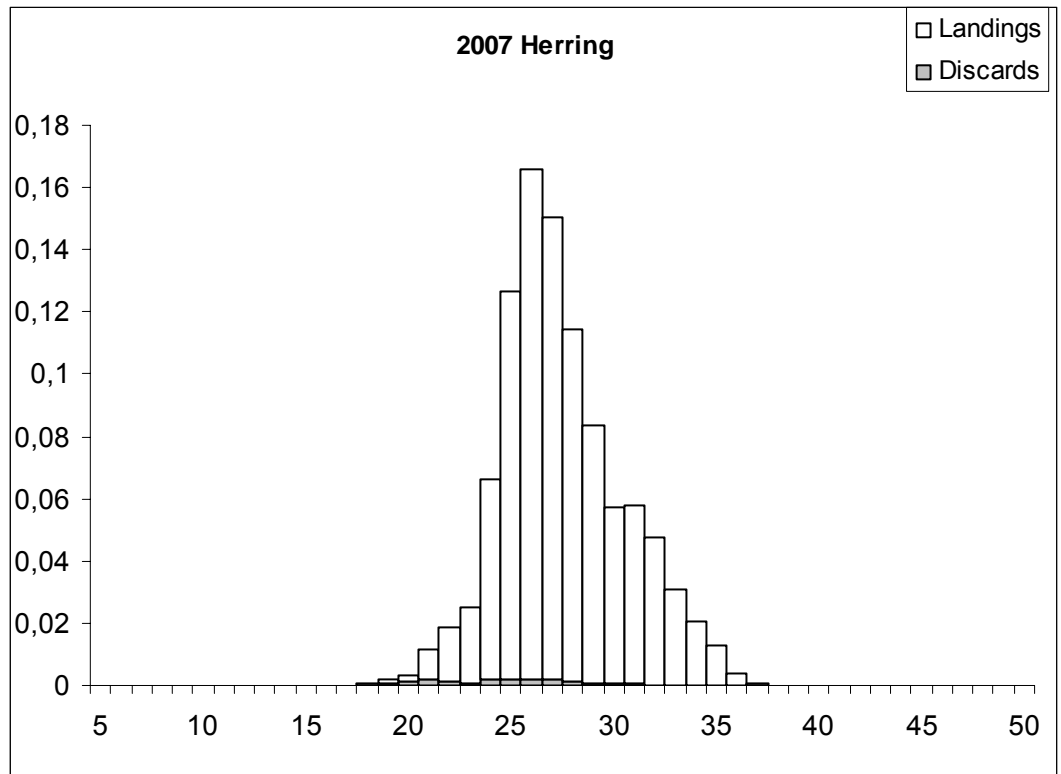


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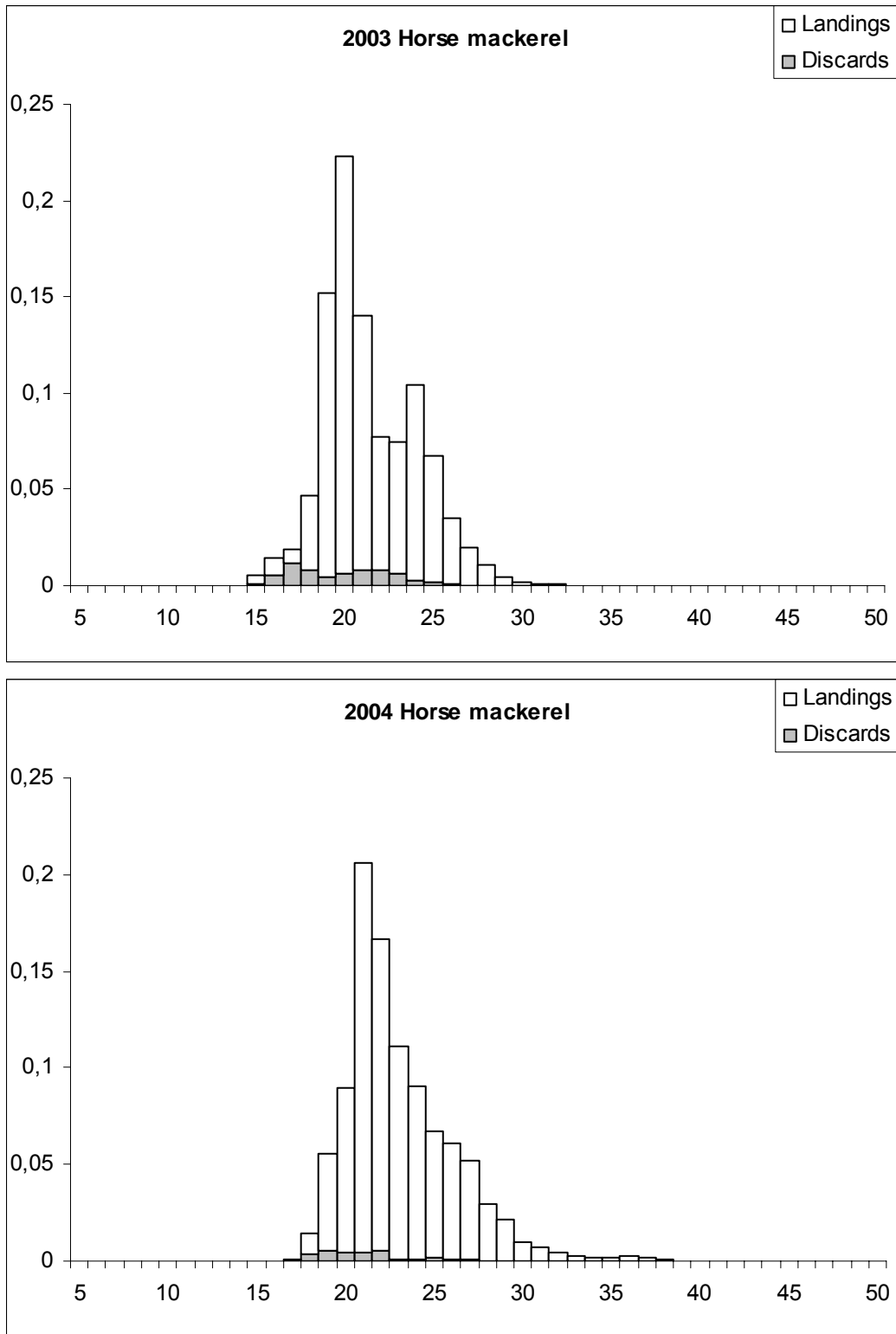


Figure 14. Relative length of discarded and landed horse mackerel against length (cm) for the sampled pelagic discard trips.

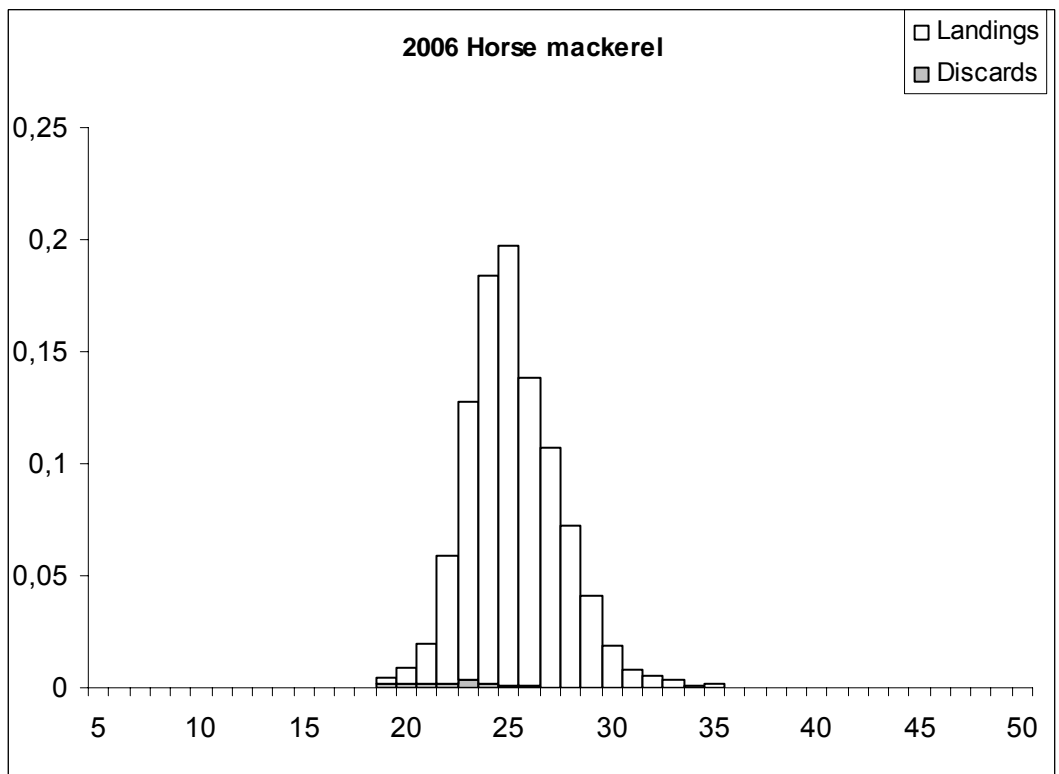
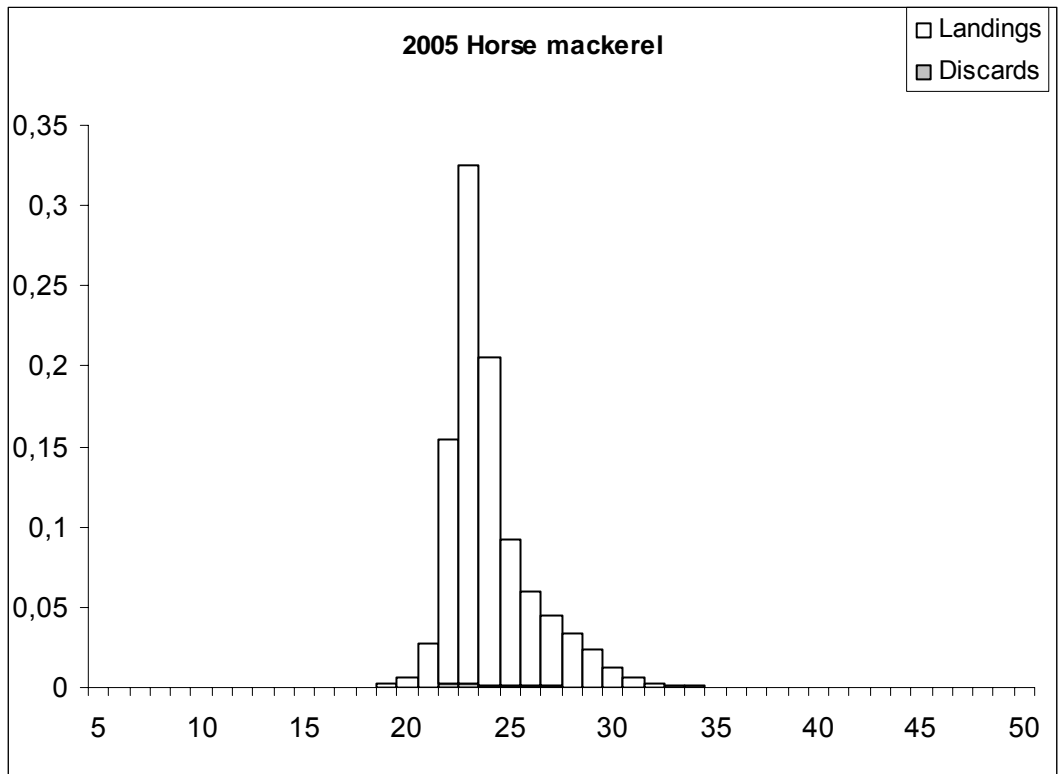


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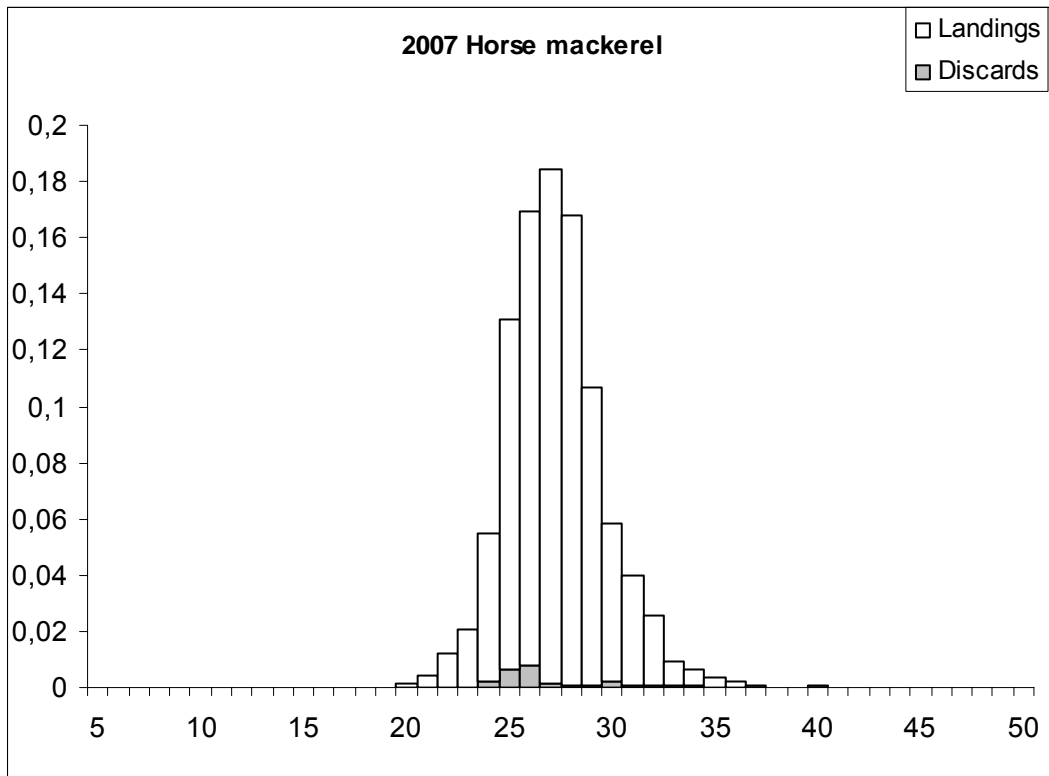


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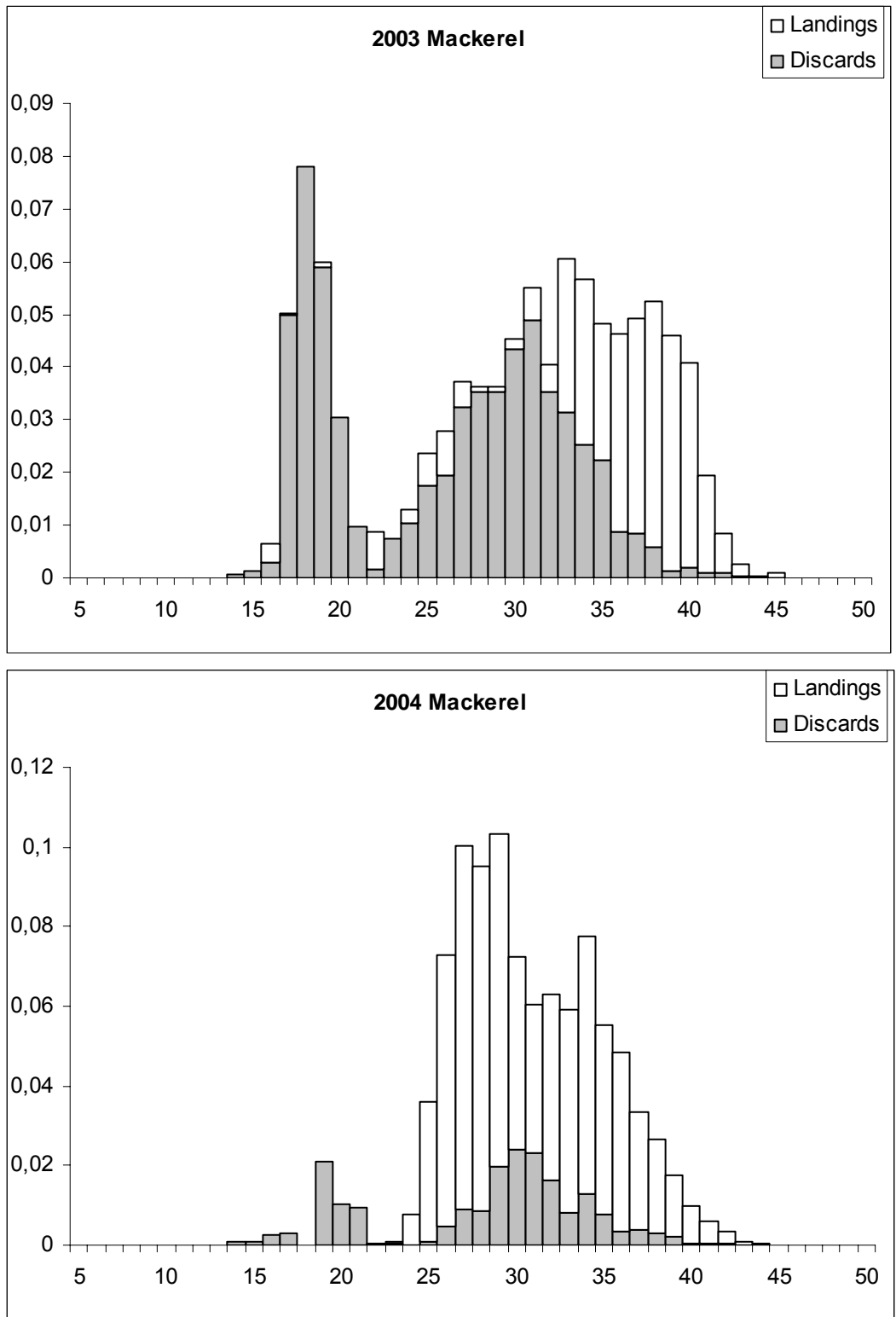


Figure 15. Relative length of discarded and landed mackerel against length (cm) for the sampled pelagic discard trips.

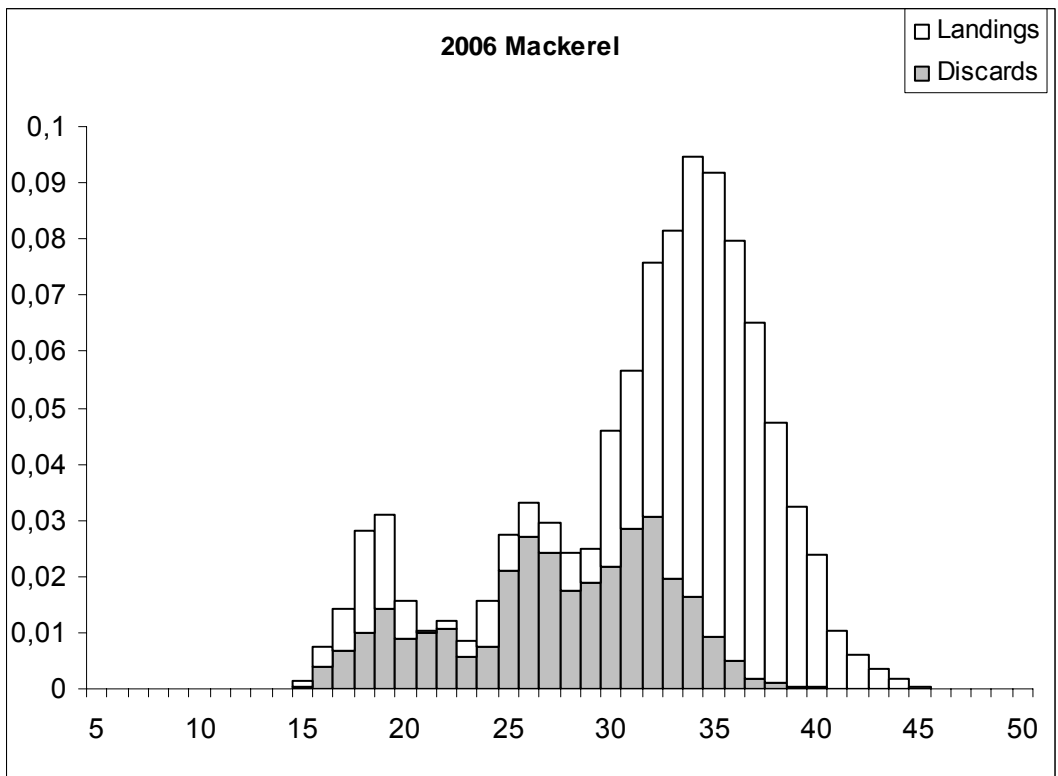
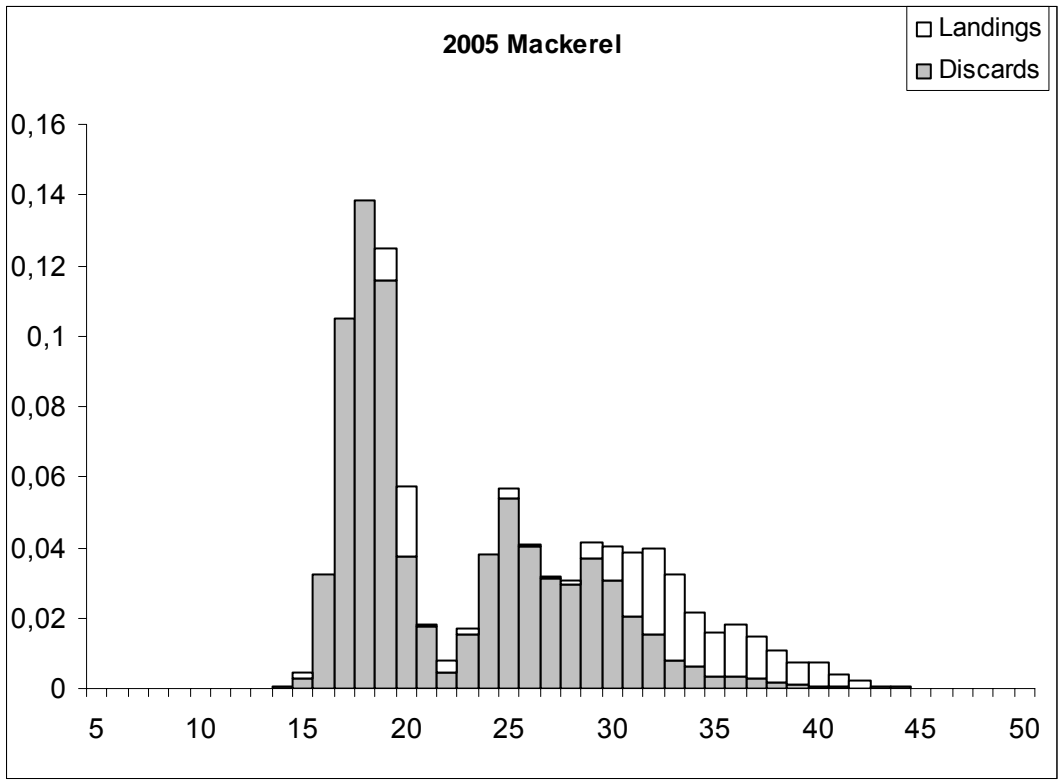


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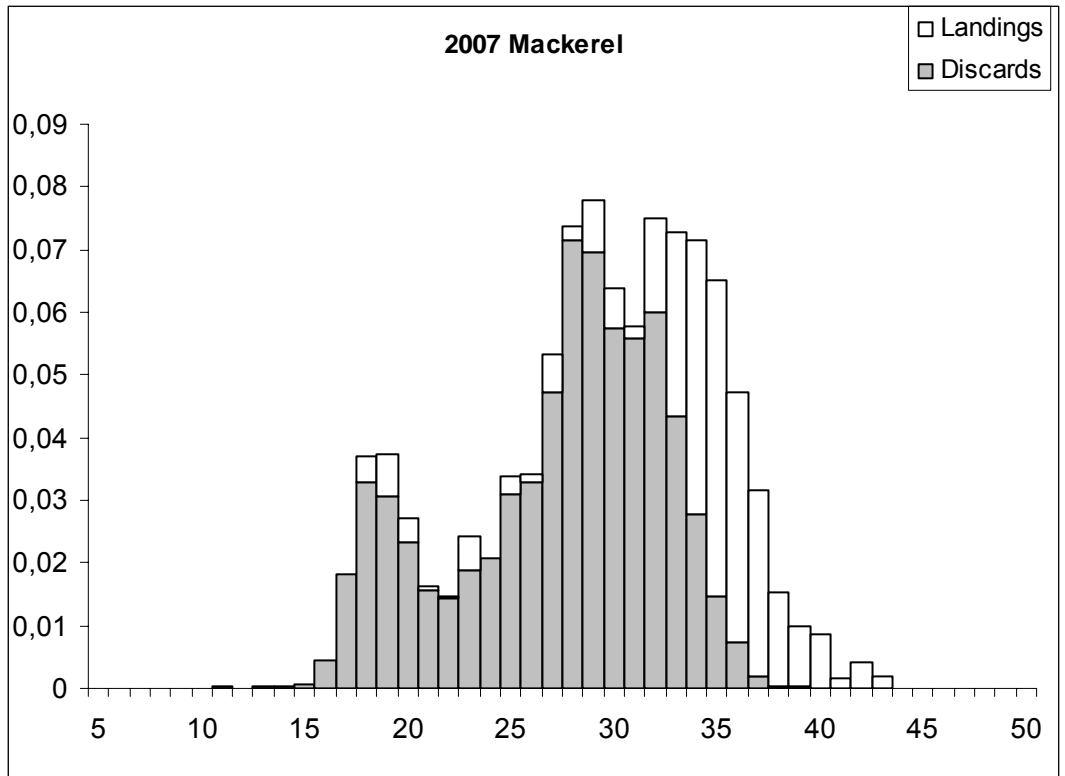


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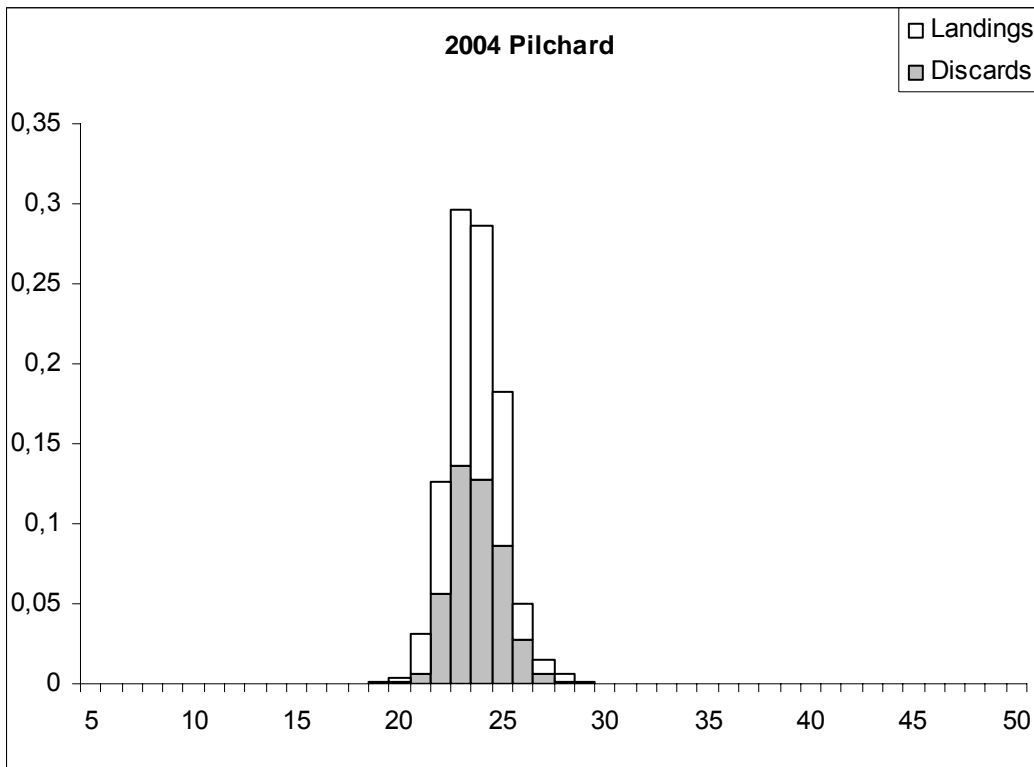
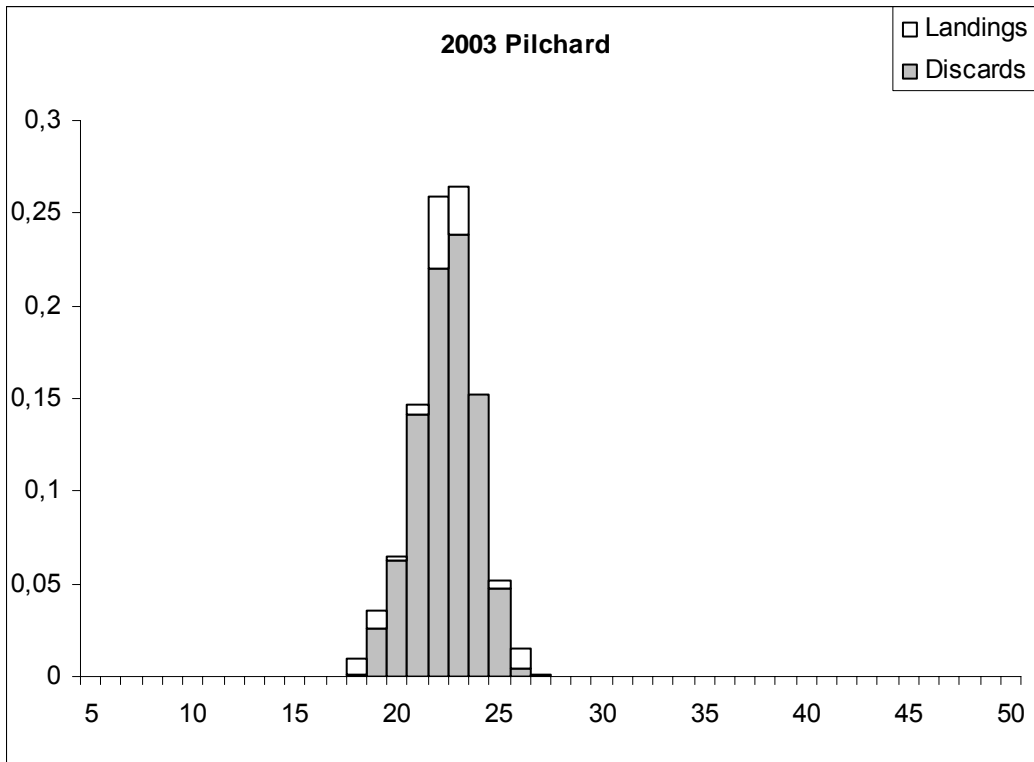


Figure 16. Relative length of discarded and landed pilchard against length (cm) for the sampled pelagic discard trips.

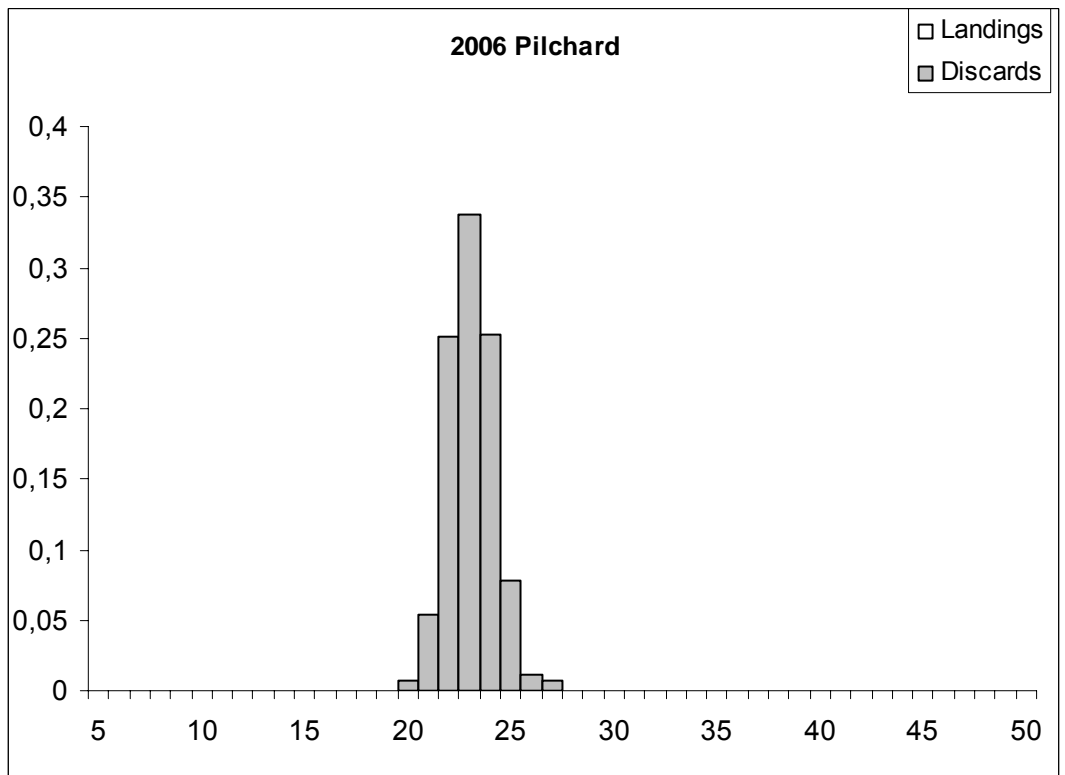
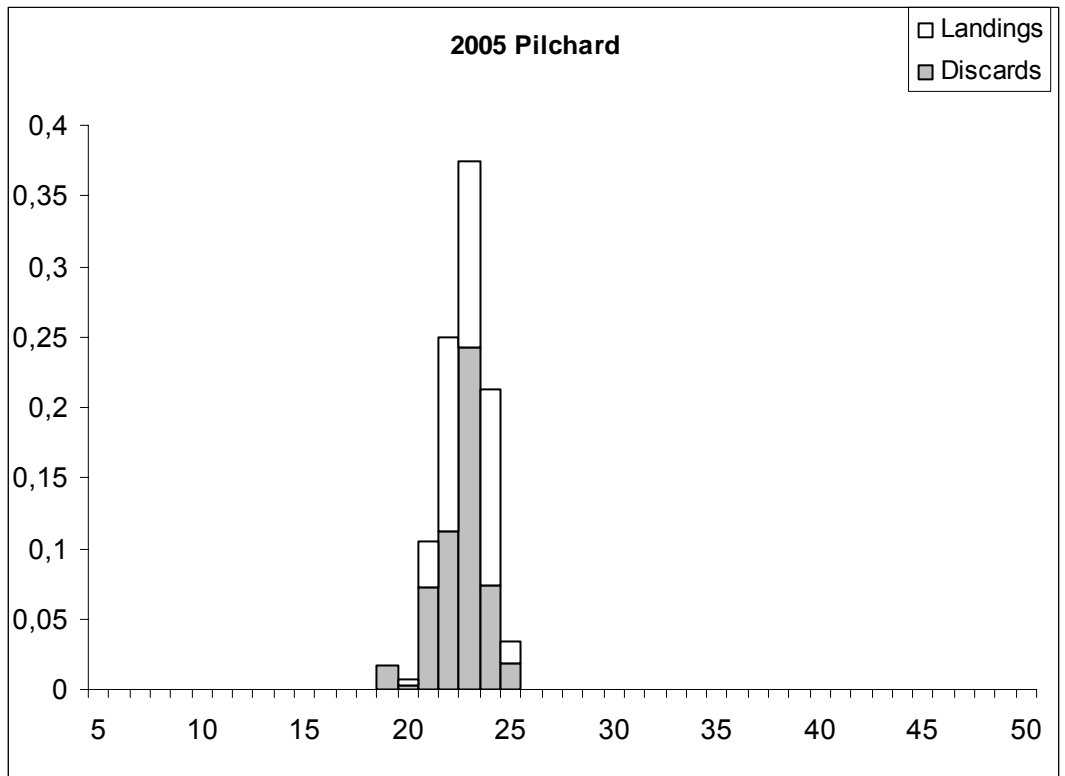


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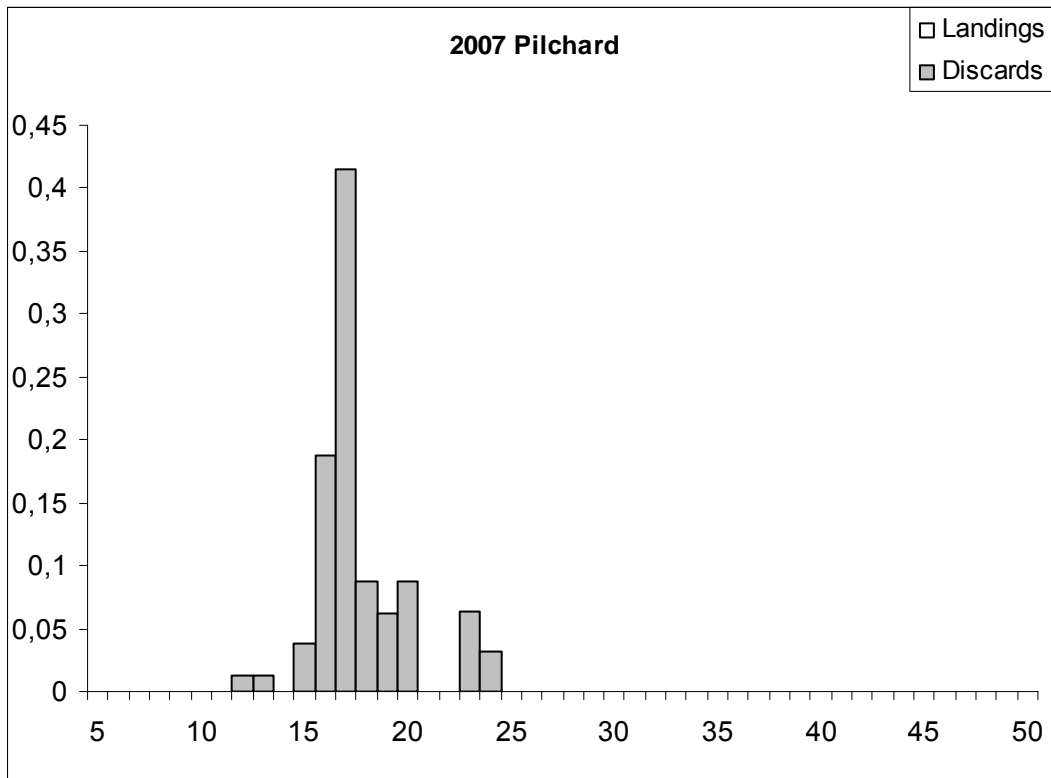


Figure 16. Continued