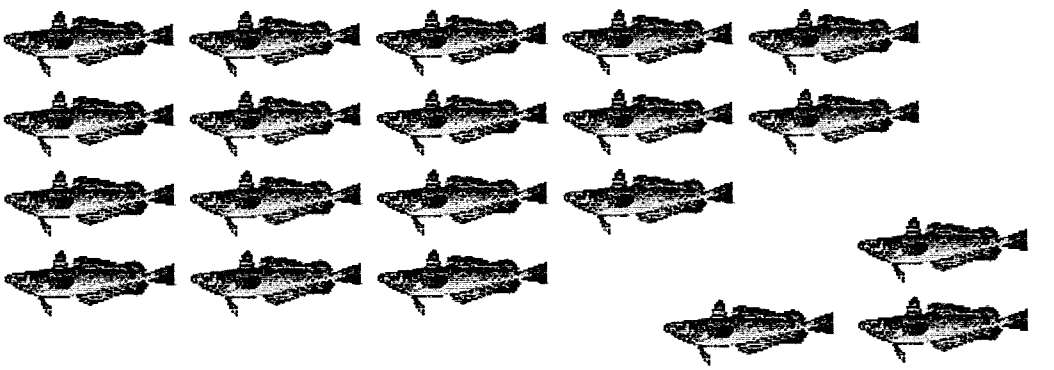
DG FISHERIES Study 00/009
FINAL REPORT November 2001

ESTIMATION OF TRAWL DISCARDS IN THE WESTERN MEDITERRANEAN. EUROPEAN HAKE (*Merluccius merluccius*) AS CASE STUDY



UNIVERSITÀ DI PISA

CSIC

INSTITUTO ESPAÑOL DE OCEANOGRAFÍA

DG FISHERIES Study 00/009

ESTIMATION OF TRAWL DISCARDS IN THE WESTERN MEDITERRANEAN. EUROPEAN HAKE (*Merluccius merluccius*) AS CASE STUDY

Final Report

INSTITUTE COORDINATOR OF THE PROJECT
ICM -CSIC

Project leader: **Dr PALOMA MARTÍN ICM-CSIC**
P. Marítim de la Barceloneta, 37-49, 08003 Barcelona, SPAIN

Responsible Scientists

Ms AINA CARBONELL
IEO: Avenida Brasil, 31, 28020 MaDrid, SPAIN

Dr PAOLA BELCARI
DSUA: Via Volta 6, 56126 Pisa , ITALY

ISSUING DATE: 26-11-2001

LIST OF PARTICIPANTS

ICM-CSIC:INSTITUTO DE CIENCIAS DEL MAR
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS
Dr PALOMA MARTÍN
Dr ANTONI LOMBARTE
Ms BALBINA MOLÍ
Dr LAURA RECASENS
Dr PILAR SANCHEZ

IEO:INSTITUTO ESPAÑOL DE OCEANOGRAFIA
Centro Oceanográfico de Baleares
Ms AINA CARBONELL
Ms ANA TORRES
Ms MAGDALENA GAZA
Mr GABRIEL POMAR

Centro Oceanográfico de Murcia
Mr ANGEL FERNÁNDEZ
Ms PILAR PEREDA
Mr ANTONIO ESTEBAN
Mr ROMAN MARTÍNEZ

DSUA: DIPARTIMENTO SCIENZE UOMO E AMBIENTE, UNIVERSITÀ DI PISA
Dr PAOLA BELCARI
Dr CLAUDIO VIVA
Dr PAOLO SARTOR
Dr MARIO SBRANA
Dr VELIA CHIERICONI
Dr ILARIA ROSSETTI
Dr BARBARA FRANCESCONI
Dr SILVIA GAMBACCINI
Dr MARINA SARTINI
Mr DANILO BERTOLINI

EXTERNAL ASSISTANCE
MSM: MEDITERRANEO SERVICIOS MARITIMOS, S.L.
Mr MANUEL MARHUENDA
Mr PEDRO SERRANO
Mr MARCOS SÁNCHEZ
Mr FRANCISCO ROMÁN
Mr LARA MARIA GARCIA
Mr DANIEL DEVESA
Mr HUGO GALLARDO

Data collection in coordination with
EC STUDY PROJECT NO 2000/21
INSTITUTO ESPAÑOL DE OCEANOGRAFÍA
Co-ordinator: Ms PILAR PEREDA
INSTITUT FRANÇAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER-LABORATOIRE DE SÈTE
Dr HENRI FARRUGIO
Ms ANGELIQUE JADAUD
Mr PATRICK LESPAGNOL

Summary

The aim of the project has been the assessment of the discards by the trawl fleets in the western Mediterranean. Discard refers to that part of the gross catch thrown back into the water by fishermen. The study has focused on the European hake *Merluccius merluccius* because it is one of the main target species for trawling and the fact that it was known to be partially discarded.

Field work has been conducted in five fishing ports located in the western Mediterranean, from the northern Tyrrhenian sea to the Gulf of Lions, coasts of Catalonia and Valence, and Balearic Islands. The duration of the sampling has been six months, from February to July 2001. Data collection included sampling on board commercial trawlers, examination of the discard samples in the laboratory, and data on the trawl fleets and landings in the study ports.

The more relevant result to the management of the European hake is that discards can represent a significant part of the total European hake catch both in weight and in number. It is thus necessary considering them in the evaluations to assess the state of exploitation of *M. merluccius* by trawling.

The monthly length frequency distributions in all five study ports show that most part of the European hake catch consists of immature individuals. Nevertheless, the proportion of the catch and sizes that are discarded can be very different, as observed when comparing the different study ports. The percentage of discarded European hake during the six-months sampling ranged between less than 1% and more than 70% of the total individuals caught, depending on the month and port; as for the European hake discards expressed as percentage of the total hake catch, it ranged between less than 1% and 30% of the total *M.merluccius* catch.

Hake trawl fisheries impact over the benthic and epibenthic communities of the continental shelf and upper slope, as highlighted by the number of species identified during six-months sampling on board commercial trawlers (for example, 319 only in one of the study ports). The vessels targeted to *Merluccius merluccius* include other species in their objectives. The number of species caught by trawl that are commercialised is also high, around 90 in three of the study ports. Within the study ports, on average during the six-months sampling, the amount of discarded catch ranged between 17% of the total catch and 34%. The main reason for discarding part of the catch is the low or nil commercial interest of the discarded species. In general, the incidence of discards in species with commercial interest is low.

Significant changes in *M. merluccius* abundance have been observed from month to month. Therefore, sampling frequency of this study, monthly, 3 days at sea so as to minimize the effect of autocorrelation of the hauls performed during the same day, seems to have been adequate to detect the changes in hake abundance.

When there is an active European hake discard as observed in one of the study ports, both the total European hake catch and time of the year have a significant effect on the amount of discarded hake. The highest hake catches and discards corresponded to the time of the year with more intense recruitment of European hake to trawling. This result is important when considering the possibility of closed seasons for trawling.

Non- specialists summary

Trawling is a non- selective fishing since the gear catches all the species found in its way while being towed by the vessel close to the sea bottom. Because of this, the number of species affected by trawling is very high. Discarding at sea part of the catch is a common practice all around the Mediterranean. Discard refers to that part of the gross catch thrown back into the water by fishermen. The main reason for doing so is the lack of commercial value of many of the caught species, although part of the catch can also be discarded so as to comply with the fishing regulations in force.

The aim of the project has been the assessment of the discards by the trawl fleets in the western Mediterranean. The study has focused on the European hake *Merluccius merluccius* because it is one of the main target species for trawling and the fact that it was known to be partially discarded.

Field work has been conducted in five ports located in Italy, France and Spain, and the duration of the sampling has been six months, from February to July 2001. Data collection included sampling on board commercial trawlers, examination of the discard samples in the laboratory, and data on the trawl fleets and landings in the study ports. Sampling of the discards was done on board commercial trawlers during normal fishing activity, so that the collected data regarding fishing grounds visited, duration of hauls, and composition of catches were representative of the activity of the fleet. An overall result of the sampling is that the amount of discarded catch ranged between 17% and 34% of the total catch, depending on the month and port.

The more relevant result to the management of the European hake is that *M. merluccius* discards can represent a significant part of the total European hake both in weight and in number. Furthermore, the monthly length frequency distributions in all five study ports show that most part of the European hake catch consists of immature individuals. The percentage of discarded European hake during the six-months sampling ranged between less than 1% and more than 70% of the total individuals caught, depending on the month and port; as for the European hake discards expressed as percentage of the total hake catch, it ranged between less than 1% and 30% of the total *M.merluccius* catch.

Hake trawl fisheries impact over the benthic (linked to the sea bottom) and epibenthic communities of the continental shelf and upper slope, the number of species affected being very high (for example, 319 vertebrate and invertebrate species only in one of the study ports, of which 90 were totally or partially commercialised).

In the assessment of the results of the bottom trawling activity it is necessary to take into account the amount and characteristics of that part of the catch that is never landed. Not doing so might lead to wrong conclusions on the effect of bottom trawling on the populations, given that this type of fishing affects a large number of species, many of which are not commercialised, and also, because the discarded catch can include the smaller individuals of commercial species, which would be otherwise underestimated.

Introduction

This document is the final report of the EC Study Project Contract no 00/009 "Estimation of trawl discards in the western Mediterranean. European hake (*Merluccius merluccius*) as case study". The aim of the project has been the assessment of the discards by the trawl fleets in the western Mediterranean. The study has focused on the European hake because it is one of the main target species for trawling and the fact that it was known to be partially discarded.

The institutions that have carried out the study are the Consejo Superior de Investigaciones Científicas- Instituto de Ciencias del Mar (Spain), co-ordinator; the Instituto Español de Oceanografía (Spain); and the Università di Pisa- Dipartimento di Scienze dell'Uomo e dell'Ambiente (Italy). Field work has been conducted in three areas off the western Mediterranean: northern Tyrrhenian sea, catalan coast and southern coast of Valence; the sampling ports have been Porto Santo Stefano and Castiglione della Pescaia, Vilanova i La Geltrú and Santa Pola. Furthermore, data collection on board commercial trawlers has been done in coordination with the EC Study Project no 2000/21 "Collection and management of data for the assessment of the Spanish and French Mediterranean fisheries". Data regarding European hake landings and discards from the fishing ports of Palma de Mallorca and Sète (fishing ports included in the sampling programme of the EC Study Project no 2000/21) and from the fishing port of Vilanova i la Geltrú (sampling port included in this project, Figure 1) have been exchanged and used by both studies.

The duration of the project has been nine months, from January 2001 to September 2001. During the course of the project three working meetings have been held. The kick-off meeting in Barcelona, to discuss in detail the sampling strategy and data collection, taking into account the particularities of each study port; the second in June, in Pisa, to review all the available information and define the structure of the final report; and a last meeting again in Barcelona for the preparation of this report. In order to co-ordinate the data collection of the two studies above mentioned, the co-ordinator of the EC Study Project no 2000/21 attended the kick-off meeting in Barcelona, and the co-ordinator of this study attended the final working meeting of the partners of the EC Study Project no 2000/21, held in Sète in September.

We wish to express our gratitude to the fishermen's associations for their collaboration during the development of the project and the Institut Français de Recherche pour l'Exploitation de la Mer- Laboratoire de Sète, for the data collected in the port of Sète.

1 Study area

Field work has been conducted in three areas off the western Mediterranean: northern Tyrrhenian sea, Catalan coast and southern coast of Valence; the sampling ports have been Porto Santo Stefano and Castiglione della Pescaia, Vilanova i la Geltrú and Santa Pola (Figure 1). Sampling in the northern Tyrrhenian sea has been performed by the University of Pisa- Dipartimento di Scienze dell'Uomo e dell'Ambient, in the Catalan coast by the Consejo Superior de Investigaciones Científicas- Instituto de Ciencias del Mar, and in the southern coast of Valence by the Instituto Español de Oceanografía.

Furthermore, data collection on board commercial trawlers has been done in coordination with the EC Study Project no 2000/21 "Collection and management of data for the assessment of the Spanish and French Mediterranean fisheries". Sampling in the fishing port of Sète has been done by IFREMER- Sète Laboratory, and in Palma de Mallorca by the Instituto Español de Oceanografía. Data obtained in the fishing port of Palma de Mallorca and Sète (fishing ports included in the sampling programme of the EC Study Project no 2000/21) and from the fishing port of Vilanova i la Geltrú (sampling port included in this project) have been exchanged and used by both studies.

1.1 Porto Santo Stefano and Castiglione della Pescaia

The northern Tyrrhenian Sea is delimited to the north by the Elba Island and by the Promontory of Piombino and to the south by the Promontory of Argentario and by the Giannutri Island. The continental shelf results so vast that the sea bottom with depth lower than 200 m represents about 50% of the total surface.

The coastline of the continental area is characterised by sandy and rocky coasts, the most important of which are represented by the Piombino and Argentario Promontories. The landing points of the fishing fleet, from north to south, are the following: Piombino, Follonica, Castiglione della Pescaia, Marina di Grosseto, Talamone, Orbetello, Porto Santo Stefano and Porto Ercole.

1.2 Vilanova i La Geltrú

The port of Vilanova i la Geltrú is situated in a central zone of the Catalan coast. The littoral where the fishing fleet from this port operates shows two distinct configurations. To the north is found the Garraf massif, of karst origin, with large cliffs and rocky bottoms. Further south the relief becomes much softer, and the coast is formed by large sandy beaches.

Sandy and muddy bottoms predominate in the first 150 m, being sandier closer to the coast. *Posidonia oceanica* meadows can be found at <30 m depth and also within the first 100 m there are rocky zones and zones of gravel.

From 150-200 m muddy bottoms predominate, typical of the end of the shelf and slope, being more homogeneous at greater depth. The presence of a submarine canyon, the Foix canyon, gives rise to a characteristic topography, allowing the fishing of

species of great depth, between 500 and 800 m, such as the decapod crustacean *Aristeus antennatus*. These fishing grounds are found relatively close to the coast.

1.3 Santa Pola

Santa Pola port is located on the Spanish Levant Coast (38° 11.30' N and 000° 32.25'W). The area affected by the trawl fleet activity has an extension of 70 miles (130 km). The shelf in this area reaches a depth of 140 m and has bottoms of sand and mud. The slope has muddy bottoms and is scored by some canyons.

The fishing grounds for this port are located in the same bay and on the neighbouring slope down to a depth of 700 m. In addition, some vessels go to the Ibiza Channel, between the mainland and the Balearic Islands, to fish on the slope for red shrimp.

1.4 Palma de Mallorca

Sampling was carried out in the port of Palma de Mallorca in the Balearic Islands, north-western Spanish Mediterranean Sea. Palma Bay has an approximate extension of 2,890 km^2 and it is characterised by bottoms of muddy sand or maërl substrate (coraligen algae). The slope surrounding this bay, and where the fleet also works at depths down to 800 m, has an extension estimated at 3,305 km^2 with bottoms of mud and sandy mud.

The fishing grounds are located in the same bay and on the neighbouring slope. The fishery is developed in narrow corridors (passages) of variable extension distributed inside the bay and on the slope.

1.5 Sète

Sète is the most important fishing port in the Gulf of Lions. The trawling fleet operates on the shelf, down to 200 m depth. Because of the topography, with a wide continental shelf, fishing grounds are mainly located over the shelf, and trawlers in general do not go to fishing grounds on the slope.

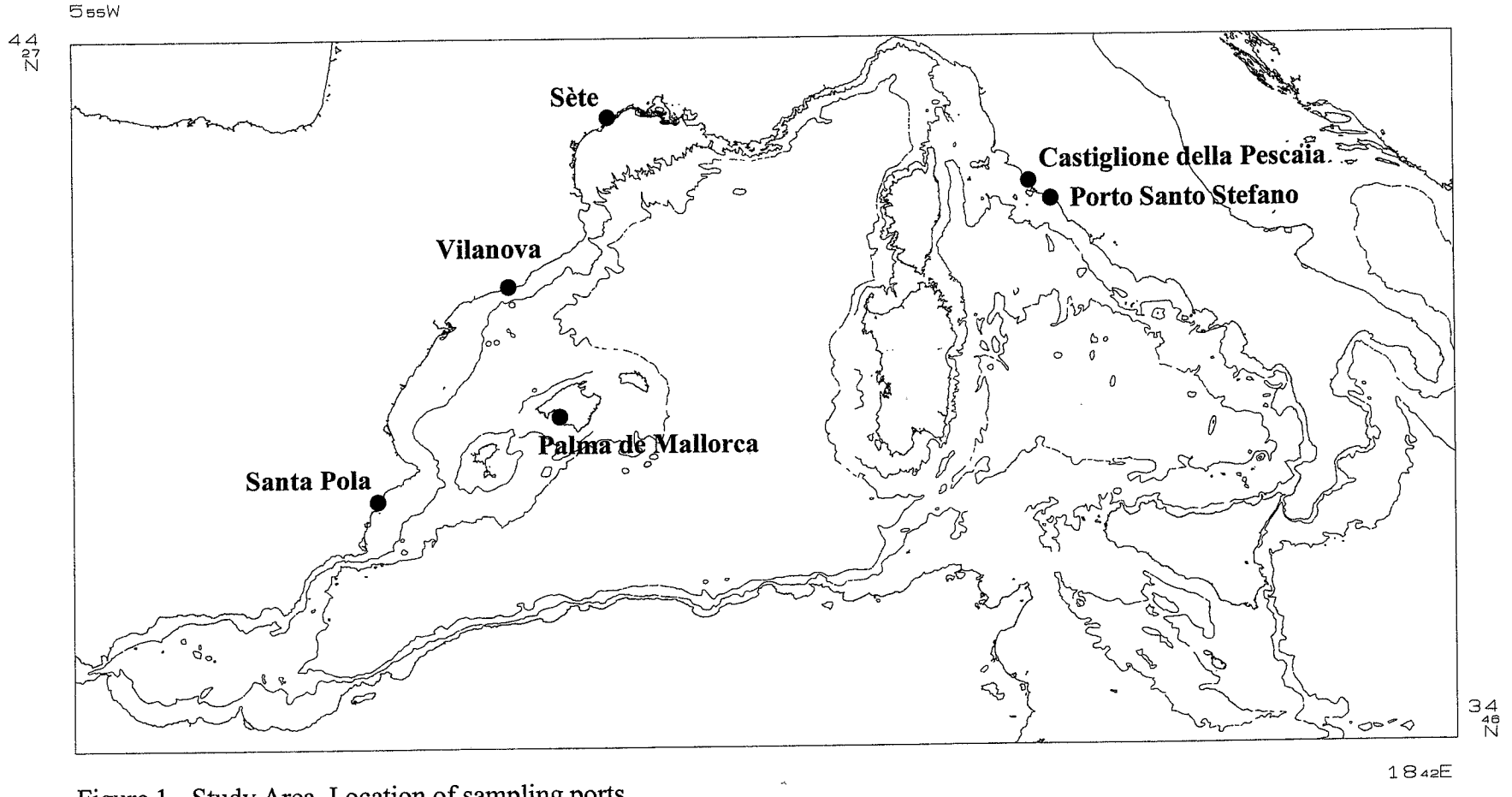


Figure 1.- Study Area. Location of sampling ports.

2 Data collection and Methodology

2.1 Porto Santo Stefano and Castiglione della Pescaia

Trawling fleets of Porto Santo Stefano and Castiglione della Pescaia

Data collection on the structure of the fishing fleets was carried out at the beginning of the project. The characteristics of each boat were obtained from the consultation of the official archives at the harbour offices ("Capitanerie di Porto") of Porto Santo Stefano and Castiglione della Pescaia. The choice of these ports was done on the basis of their interest in the zone for the dimension of the fleets and for the biomass landed as well.

For each vessel the following information was collected:

administrative port, base port, number of registration, vessel length, engine power (kW), gross tonnage (GRT, in tons), year of construction of the engine and the hull, hull material, fishing type (trawling, purse seine and artisanal), fishing licences.

At the same time, interviews with the fishermen were performed in order to check the reliability of the collected data and to obtain a better knowledge of the fishing activity.

Sampling of the commercial landings in the study ports

Each of the two ports selected commercialised the landings at a fish auction. At Porto Santo Stefano, all the trawlers brought the catches at the public auction; at Castiglione della Pescaia, almost half of the trawl fleet commercialised the catch by means of private wholesalers. In the two ports, the auction activity took place in the afternoon; the sale by auction was performed by voice to the highest bidder. The landing was sold separately for each vessel, following the order of arrival of the boats to the port.

Some species belonged to a single commercial category, whereas others were commercialised in different categories according to the size classes. Moreover, boxes with mono or multi-specific composition could be presented to the auction.

At Porto Santo Stefano and Castiglione della Pescaia, the administrations of the fish auction registered the production into main commercial categories, making it impossible to utilise this information for the aim of the project. Thus, a sampling was carried out by scientific observers directly at the auctions.

According to the sampling protocol, the landing data were recorded monthly at the auctions for a minimum of three consecutive days. Each day of sampling, the following data have been recorded for each vessel:

- type of gear utilised;
- number of fishing days;
- landing, classified to the species level, when possible;
- kg or number of boxes of each species;

Table 2.1.1. shows the number of days of the sampling carried out during this study for the estimation of the production in the sampled ports.

Table 2.1.1. Number of days of observation, per month, of the commercial landing.

	CASTIGLIONE DELLA PESCAIA	PORTO SANTO STEFANO
February 2001	3	4
March	3	4
April	3	4
May	3	4
June	3	4
July 2001	3	4

Monthly total landings were estimated raising the sampled data collected at the auction to the total fishing days of the fleet in that month. The Landing per Unit of Effort (LPUE) was calculated considering as effort unit the fishing day. Fishing effort data were computed monthly by consulting the official archives. In order to estimate the total trawl landing of Castiglione della Pescaia, the sample data collected at the auctions were expanded to the total fleets, considering that half of the vessels commercialise their production in a different way.

Sampling on board of commercial trawlers.

The principal aim of the sampling on board was to obtain data about the specific composition of the total commercial catch, the European hake *Merluccius merluccius* catch, the biomass discarded by species or main groups; weight, number and size of the specimens of *M. merluccius* in commercial and discarded fractions were assessed.

The sampling programme was carried out from February 2001 to July 2001. Monthly, scientific observers performed the fishing trips on board of a commercial vessel for three consecutive days. The same commercial vessel was utilised for all the period of study. It presented the following technical characteristic:

kW = 342.9, LFT = 21.4, GT = 46.0,
cod end mesh size: 44.80 mm.

However, in most case the net was provided with a cod-end outer/inner liner with mesh size smaller than the cod-end itself.

During the fishing trips there wasn't any interference with the habitual "*modus operandi*" of the fishermen; the characteristics of the hauls (position, duration, sorting, etc.) were decided uniquely by the crews. For each commercial haul were noted: length of the warps, date, position, depth, course. The commercial fraction was registered and weighted to the species level. Depending on the quantity, a sub-sample of the discard fraction was prepared. The compositions of the discards was determined by species and weight. For European hake sizes were registered (Total Length, TL, to the nearest 0.5 cm below) both for the commercial fraction (according to the subdivision into the commercial categories A, B, C, D) and discarded fraction. The commercial categories of European hake were roughly characterised as follows:

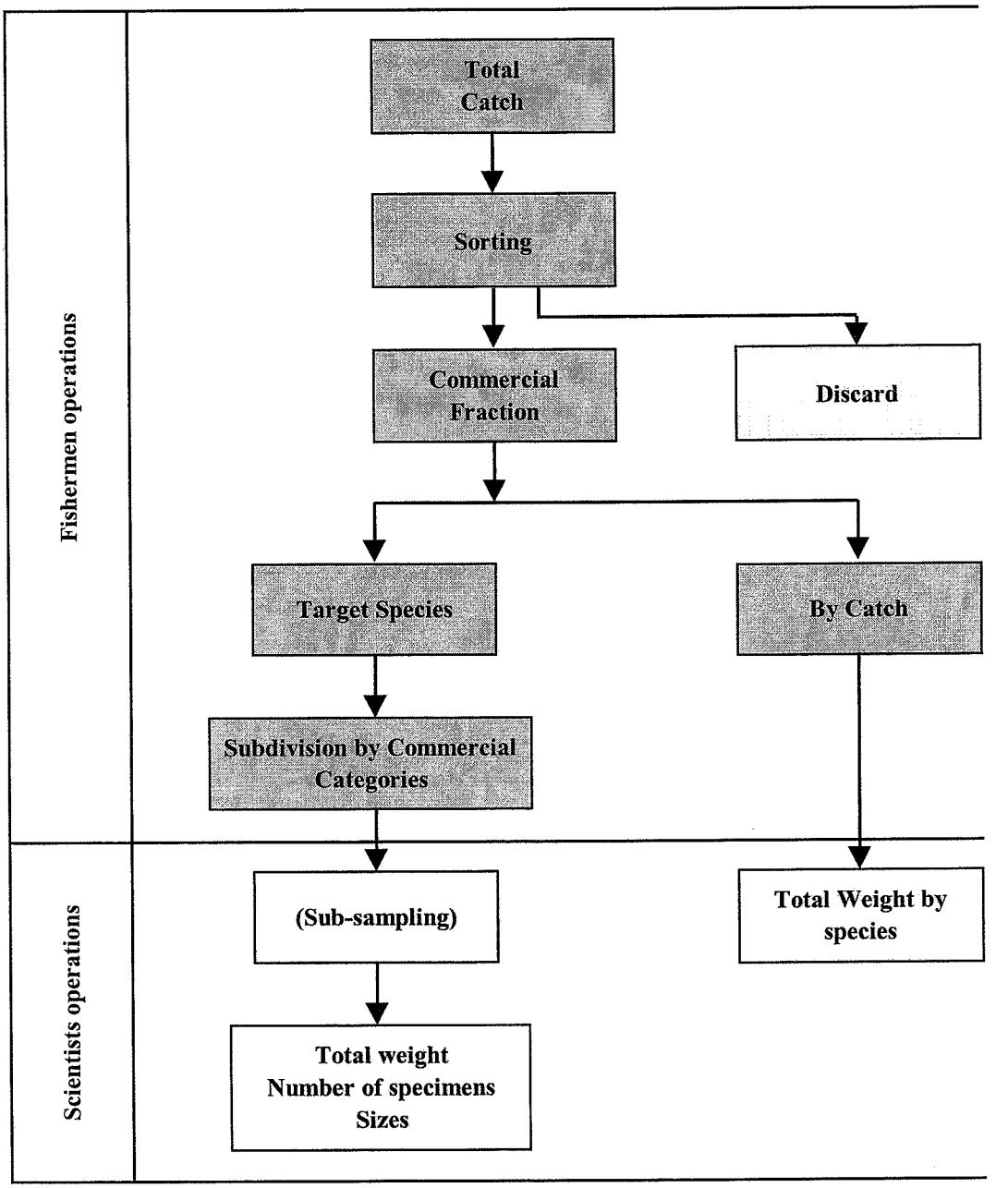


Figure 2.1.1. Description of the activities on board.

category A: specimens bigger than 40 cm TL;
category B: specimens between 20 and 40 cm TL;
category C: specimens between 13 and 20 cm TL;
category D: specimens lower than 15 cm TL.

A scheme of the activity carried out on board is explained in Figure 2.1.1.

The common English name of the species or group of species under consideration is given in accordance with Relini *et al.*, 1999.

2.2 Vilanova i La Geltrú

Trawling fleet of Vilanova i la Geltrú

Data on the composition of the trawling fleet and characteristics of the vessels were obtained from the fishermen's association in Vilanova i La Geltrú. The daily activity, hours at sea per day, of the fleet, was known from the sampling on board commercial trawlers.

Sampling on board commercial trawlers

Sampling of the trawl catches was done monthly from February to July 2001 during normal fishing activity, three fishing days per month. To carry out the sampling two different vessels representative of the fraction of trawl fleet targeted to *M.merluccius* were chosen in the port of Vilanova i La Geltrú. Data collection, for each haul, included: characteristics of the haul (fishing ground, duration), estimation of the total catch and discarded catch, determination of the specific composition of the commercial catch and corresponding weight by species, and length measurement of the European hake that was going to be commercialised. A sample of the discarded catch was kept to be examined in detail in the laboratory.

Sampling of the discarded catch in the laboratory.

The aim of the work at the laboratory was the determination of the specific composition of the discards, the corresponding weight by species, and European hake length frequency measurement.

Data on the specific composition of the commercial and discarded catch, by haul, allowed the elaboration of tables and figures regarding the specific composition of catches, by month (expressed in kg/day/vessel), and for the whole six-months sampling period (all data combined, data expressed in percentage).

European hake measurements of the commercial and discarded catch, by haul, allowed the elaboration of monthly length frequency distributions, in number and in weight, for the total and discarded catch, expressed in 100 trawling hours. These data set was used for the elaboration of a "pseudocohort" used as input for the length cohort analysis performed to assess, if any, the underestimation of the state of exploitation in case data on hake discards are not taken into account in the evaluations.

Sampling of commercial trawl fleet landings

These data were obtained through the catch statistics elaborated by the fishermen's associations corresponding to the daily sales at the auction by the trawl fleet during the days of the sampling on board. The three days sampling was expanded to the total days of fishing activity of each month.

Merluccius merluccius catch data, and length frequency data, obtained for the commercial and discarded catch allowed the estimation of monthly discards rates. These rates were used to estimate the European hake discards generated by the trawl fleet in a given port, by applying the discards rates to the monthly hake landings.

2.3 Santa Pola

Trawling fleet of Santa Pola

Data regarding the trawling fleet and characteristics of the vessels were obtained from the Fishermen's Association of Santa Pola.

Sampling on board commercial trawlers

Samplings on board commercial trawlers were carried out from February to July 2001. Observers were placed on board three times a month and they used three different vessels. During May the area was closed to fishing as a routine annual measure related to fishery management. Trawlers carried out two or sometimes three hauls per day.

In each tow the observer recorded information concerning the characteristics of the haul, such as situation, depth and time, that were taken during the tow at regular intervals, until the end of the haul. In addition, once the catch was on board, the catch weight for each commercial species was taken by means of a dynamometer. Moreover, for mixed commercial categories, which were composed of several different species of fish sold together (e.g. sparids, triglids or scorpaenids, etc.), the weight of each species in a sample was estimated and then used to estimate the total weight for each species in the commercial catch. The total weight of discards was estimated by counting the number of known capacity boxes filled with discards that were thrown into sea. A discards sample was also taken for later examination in the laboratory. The size distribution for the commercial fraction was obtained from a random sample. This was then used to calculate the size distribution by number for the total commercial fraction per haul.

Sampling of the discarded catch in the laboratory.

In the laboratory the specific composition of the discard samples was determined. The number and weight of each discard species were obtained. The results of the sampled discards were standardised to the total discard by number and weight per haul.

Data of size distribution for the landed and discarded fraction in each haul (sample) were standardised to hourly yield, followed by estimation of the average values per month which were then standardised to 100 hours of fishing by month.

Using the length-weight relationship parameters (García-Rodríguez and Esteban, 1995) for the Santa Pola bay (a=0.0048, b=3.1205) the sampling size distributions were estimated by weight.

Figures (number and weight) were drawn as a percentage for the total (landing and discard) and discarded fractions with the indications of total number and weight for each month per 100 hours.

The total size frequency distributions for the whole sampling period were estimated by the average of the monthly size frequency distribution. This figure was used to analyse the length frequency data by considering the landing and/or the total size frequency distribution by means of dynamic models such as length cohort analysis, LCA (VIT; Lleonart and Salat, 1998).

Sampling catch compositions in weight by month were obtained by summation of the sampling hauls of each month and these were presented in two separate tables for landings and discards.

Percentage catch compositions in weight by landings and discards considered the main groups Osteichthyes, Chondrichthyes, Crustaceans, Cephalopods, other Mollusca, Tunicata, Equinoderma, Annelida, Cnidaria and Porifera, and the European hake (*M. merluccius*). The catch compositions were estimated for the whole period and are represented as pie-chart figures. The same figures were also produced by considering the number of different species for these groups.

Sampling of commercial trawl fleet landings

The IEO sampling and information network (SIN) in the ports gives the monthly landings of Santa Pola port by species and commercial category from the sales sheets. These records were used to estimate the total landings by species per month for the trawl fleet.

From the landing size distribution obtained in the on board sampling programme the average proportion of discards in each size class below 14 cm was calculated, which allowed the landed and discarded number and weight by fleet and month to be obtained.

2.4 Palma de Mallorca

Trawling fleet of Palma de Mallorca

Data of the trawl fleet of Palma de Mallorca have been obtained from the fishermen's associations of Palma de Mallorca. Since 1992, the daily sales sheet landings by vessel have been collected from the Fishermen associations.

Sampling on board commercial trawlers

The port of Palma is one of the ports of the sampling programme project "Collection and management of data for the assessment of Spanish and French Mediterranean Fisheries. Study Project Nº 2000/21" and its working methodology was designed for sampling the shelf and slope demersal fisheries.

Observers carried out two samplings per month on the shelf-break bottoms where the fishery mainly catches European hake. In the other two cases (shelf and slope), the landed hake fraction was always sampled. In the slope fishery, catches corresponded to the largest hake sizes and there were no discards. In the coastal zone, the size ranges were similar to the shelf-break zone, although the quantities fished were lower and the landings were less important in weight. In the shelf-break zone, 97% of the hake by weight and 70% by number were fished.

The sampling programme was carried out from February to July 2001 and sampling was undertaken by observers on board commercial trawlers during their normal fishing activity.

The methodology was as follows. For each haul the characteristics of the vessel, gear used, and cast (date, position, duration, depth and course) were noted. The weight of the commercialised catch was estimated by species and the boxes in which the catch was stored were weighed by dynamometers. In addition, the total weight of the discard was also calculated by counting the number of known capacity boxes that were thrown into the sea. Moreover, a sample of the discard was separated and sampled later in the laboratory. The length distribution (total length 'TL' to the nearest cm) for the commercial European hake was recorded from a representative random sample. The size distribution for the commercial fraction was obtained randomly from the total hake catch without considering categories.

Sampling of the discarded catch in the laboratory.

The specific composition of the sampled trawl catches was estimated quantitatively in weight and number for both the landed and discarded fractions.

The sample discard of each haul was analysed in the laboratory. The catch weight by species was recorded and the size distribution of the discarded European hake was obtained. The catch composition of the discard sample was standardised to the total discard by haul.

Data of size distribution for the landed and discarded fractions in each haul (sample) were standardised to the hourly yield, which was followed by the estimation of the average values per month and these were then standardised for 100 hours of fishing per month.

Using the length-weight relationship parameters (Merella *et al.*, 1997) for the zone of Mallorca (a=0.0041, b=3.1305), the sampling size distributions were estimated by weight.

Figures (number and weight) were drawn as percentages of the total (landing and discard) and discarded fractions with the indications of total number and weight for each month per 100 hours.

The total size frequency distributions for the whole sampling period were estimated by the average of the monthly size frequency distribution. This figure was used to analyse the length frequency data by considering the landing and/or the total size

frequency distribution by means of dynamic models such as length cohort analysis, LCA (VIT; Lleonart and Salat, 1998).

Sampling catch compositions in weight by month were obtained by summation of the sampling hauls of each month and these were presented in two separate tables for landings and discards.

Percentage catch compositions in weight by landings and discards considered the main groups Osteichthyes, Chondrichthyes, Crustaceans, Cephalopods, other Mollusca, Tunicata, Equinoderma, Annelida, Cnidaria and Porifera, and the European hake (*M. merluccius*). The catch compositions were estimated for the whole period and are represented as pie-chart figures. The same figures were also produced by considering the number of different species for these groups.

Sampling of the commercial trawl fleet landings

Fishermen's association daily record sheets to report landings by species, boat and day for the Palma port trawl fishery were used to estimate the total landings by species per month for the trawl fleet.

2.5 Sète

Data collection on board commercial trawlers was done in co-ordination with the EC Study Project 2000/21 "Collection and management of data for the assessment of the Spanish and French Mediterranean fisheries". Sampling in the fishing port of Sète was performed by IFREMER- Sète Laboratory.

The hake landings and discards data collection was carried out monthly on board commercial trawlers. Data for each haul including characteristics of the haul (duration, geographic position, etc.), estimation of the total catch and discarded catch, hake total catch and hake discarded catch, and hake length frequency (landed and discarded) were recorded. Sampling on board also allowed the determination of the specific composition of the landed and discarded catch, by month. The examination of the discarded catch was done in the laboratory.

3 Description and activity of the trawl fleet in the study ports

3.1 Porto Santo Stefano and Castiglione della Pescaia

Data collection was carried out at Porto Santo Stefano and Castiglione della Pescaia during the period February 2001 – July 2001. The fleet of these two ports accounted for 71% of the total trawlers of the northern Tyrrhenian Sea (Sbrana, 2000).

Most of the trawlers utilised the traditional trawl net, locally called "tartana" and/or "volantina", characterised by a vertical opening of about 1 m. This kind of gear was used by the all trawlers of Castiglione della Pescaia and by half of those operating at Porto Santo Stefano, where vessels utilised also a wide vertical opening trawl net (about 2-3 m of vertical opening).

Porto Santo Stefano was the most important trawling port of the northern Tyrrhenian Sea. The trawl fleet was constituted of 29 vessels (Table 3.1.1.). Depending on the characteristics of the boat, the vessels with traditional trawl net could operate along the continental shelf or on the slope, devoted their effort to catch European hake (*M. merluccius*), red mullet (*Mullus barbatus*), horned octopus (*Eledone cirrhosa*), Norway lobster (*Nephrops norvegicus*), deep-water rose shrimp (*Parapenaeus longirostris*) and red shrimps (*Aristaeomorpha foliacea, Aristeus antennatus*). The boats using the wide vertical open net generally trawled on shallow bottoms fishing European hake, red and stripped mullet (*Mullus sp.*,), common octopus (*Octopus vulgaris*), common pandora (*Pagellus erythrinus*).

At Castiglione della Pescaia the fleet was composed of 12 small-medium sized trawlers employing the traditional trawl net (Table 3.1.1.). Generally, the vessels operated on the continental shelf, directing their fishing effort to European hake, red mullet, horned octopus, common octopus and spottail mantis shrimp (*Squilla mantis*). With particularly favourable weather conditions, the larger trawlers of this port could operate to deeper fishing grounds, in order to catch deepwater rose shrimps. All these vessels always carried out one day trips, leaving the port at about 3.00 - 4.00 a.m. and returning in the afternoon, at about 6.00 – 7.00 p.m.

Considering that European hake represents the most important target species for both type of trawl nets; in the present study Port Santo Stefano trawl fleet has been considered as a single fleet.

During the study period, the trawl fleet of Porto Santo Stefano showed a notable reduction in number of vessels, due to the policy of reducing the fishing effort. For Porto Santo Stefano table 3.1.1. shows the characteristics of the trawl fleet at the beginning and at the end of the study period.

Table 3.1.1. Technical characteristics of the trawl fleets in Castiglione della Pescaia and Porto Santo Stefano. a = start of study; b = end of study.

	CASTIGLIONE DELLA PESCAIA	PORTO SANTO STEFANO (a)	PORTO SANTO STEFANO (b)
N° of boats	12	29	16
KW/boat	198	354.5	346.2
S.D.	51	126.7	114.1
Minimum	110	165.4	165.4
Maximum	289	676.8	507.6
Tons/boat	23	50.8	53.7
S.D.	10	14.4	13.7
Minimum	8	28.0	33.0
Maximum	41	88.0	87.1

3.2 Vilanova i la Geltrú

Different types of fishing are practised in this port. The fishing fleet of Vilanova i la Geltrú consists of a 106 vessels: bottom trawlers (31 vessels), purse seiners (14), and artisanal gears, as longline (4), trammel net (25) and dredges (32). The total GT of the fishing fleet is 2465.55 and the total KW is 9786.

Table 3.2.1.- Vilanova i la Geltrú trawling fleet (data from the fishermen association, 2001; KW= power, GT= gross tonnage).

Vilanova	Vessels	Total KW	Min KW	Max KW	Total GT	Min GT	Max GT
Small	15	755	20	117	243	6	43
Big	16	3854	83	733	1371	33	159
Total	31	4609	20	733	1614	6	159

Bottom trawl represents the 29% of the total vessels, 65% of the total GT and 47% of the total KW, mean values per vessel being 52 GT and 149 KW. There are however two types of vessels, the locally called "arrastrillos" or small trawlers, and the group made up by the bigger trawlers. These two classes differ clearly in their characteristics, fishing grounds more frequently visited, and catches, both regarding the amount of catches and their species composition. The small trawlers, in average, are vessels of 16 GT and 50 KW, while the bigger trawlers, in average, are vessels of 86 GT and 241 KW.

The characteristics of the bottom trawl gear used in this port are the same as in the other ports of Catalonia: vertical opening of about 2 meters, and horizontal opening of about 18 m, and the mesh size is 40 mm.

The bottom trawl fleet operates 5 days a week, for Monday to Friday. According to the fishing regulations the vessels can spend a maximum of 12 hours at sea, per day. In this port, however, the time at sea, by fishermen agreement, is shorter. Vessels start their working day around 6 a.m. and return to port the same day at 4 p.m.

Regarding European hake catches, most of them are obtained by the vessels included in the group of "big" trawlers. Because of this, the trawlers used in the sampling at sea were selected among this group. Two different vessels were used in the monthly sampling at sea performed from February to July 2001.

3.3 Santa Pola

The Santa Pola trawling fleet during the sampling months was composed of 70 trawlers. Some of these corresponded to neighbouring ports, which fish in the same fishing grounds and sell at the Santa Pola auction market.

GRT total	5,307.70
GRT maximum	158.14
GRT minimum	19.92
kW total	14,535.30
kW maximum	564.80
kW minimum	60.20

The fleet was distributed between the shelf and the shelf-break (59 boats) and the slope (30 boats). This distribution corresponded to three different fisheries. The first was the coastal fishery where the target species were red mullet and octopus. The second was the shelf-break fishery between depths of 150 to 400 m where the hake fishery was developed. The main target species of this fishery were European hake (*M. merluccius*) and blue whiting *(M. poutassou*), and also crustaceans such as white shrimp (*P. longirostris*) or Norway lobster (*N. norvegicus*). The third was the slope fishery that corresponded to the red shrimp (*Aristeus antennatus*) fishery, which was developed mainly on the slope between depths of 500 and 700 m.

Since 1992, the daily sales sheets by vessel have been collected and species are divided into size categories. For the European hake there are four categories which are distributed as follows:

Very Small.....Less than 17-18 cm
Small.....Between 16 and 24 cm
Medium.....Between 23 and 40 cm
Large.....More than 40 cm.

Trawl fishing activity was daily and the boats returned to the port every day. The schedule used was 5 days a week and 12 hours a day as a maximum. The trawlers left at 5:00 or 6:00 in the morning and returned at 17:00 or 18:00 in the afternoon.

Approximately 60 trawlers developed their activity on the shelf and shelf-break where almost all the hake were caught. A proportion of hake was obtained on the slope and this corresponded to the largest specimens. All of these vessels returned to the port daily to sell the fish at the market auction in the same port.

The sampling was carried out on three selected trawlers that fished between depths of 42 and 384 m. The main characteristics of these vessels were a horse power between 136 and 256 hp, with a size of 48 and 59 grt.

During the study period the fleet stopped fishing in May due to the management plan of the Autonomic Government which is designed to allow recovery of the fisheries.

The gear used was a traditional trawl gear. The mesh size was 40 mm and the gears had the following characteristics:

Vessel	Total length	Headline	Headline height
Nº 1	90 m	12 m	3.0 m
Nº 2	94 m	18 m	1.8 m
Nº 3	96 m	20 m	1.8 m

3.4 Palma de Mallorca

Nº vessels	Total kW	kW min	kW max	Total GRT	GRT min	GRT max
22	2,899.28	104.398	422.066	1,314.73	32.53	115.20

Twenty-two trawlers composed the trawling fleet of Palma port at the time of the study. The fleet was distributed between the shelf (4 boats), the shelf-break (9 boats) and the slope (9 additional boats). This distribution corresponded to the following different fisheries. The coastal fishery where mullets and a large number of different coastal species such as scorpaenids, triglids and sparids, among others, were caught. The shelf-break fishery (between depths of 140 to 400 m) where the hake fishery was carried out. The main target fish species of this fishery were European hake (*M. merluccius*) and blue whiting (*Micromesistius poutassou*), whilst the more important crustaceans were Norway lobster (*Nephrops norvegicus*) and white shrimp (*Parapenaeus longirostris*). The third fishery using trawlers corresponded to the red shrimp fishery (*Aristeus antennatus*) which was undertaken below a depth of 500 m.

For the European hake fishery, trawlers usually undertook two hauls. Both hauls could be devoted to catch hake, blue whiting, and white shrimp among other valuable species.

Alternatively, only the first haul could be targeted towards these species and the second was deployed on the slope for the red shrimp fishery.

Since 1992, the daily sales sheet landings by vessel have been collected from the Fishermen associations and species are divided into size categories. For the European hake there are three categories, which are distributed as follows:

Small.....Between 16 and 24 cm.
Medium.....Between 23 and 30 cm.
Large.....More than 30 cm.

Trawl fishing activity was daily and the boats returned to the port every day. The schedule used was 5 days a week and 12 hours a day as a maximum. The trawlers left at 5:00 or 6:00 in the morning and returned at 17:00 or 18:00 in the afternoon.

Landings were sold through a daily auction, which was carried out in the fish market of the same port the next day at 6:00 in the morning.

The hake fleet had an average power of 223 kw per vessel, while the average for the whole fleet was 188.8 kw.

Reductions in the number of trawlers have been made since 1994, when the fleet had 27 trawlers. At the moment the fleet is composed of 22 trawlers. However, this reduction in the number of vessels has not been followed by a reduction in the total power of the fleets, due to an increase in the individual power of some new units that replaced the old ones.

The sampling was carried out on different boats, although mainly on only two boats, one with an official engine power of 223.7 kW and the other with 126.8 kW, and they were 19 and 21 m in length, respectively. The former usually undertook two hauls, the first on hake bottoms, and a second deeper one designed to catch crustaceans such as Norway lobster or red shrimp. The second vessel fished mainly on the shelf at intermediate depths between 60 to 300 m. A third boat, with less engine power (77.6 kW), which fished in a more coastal zone, was also sampled in spring and summer. This boat carried out two or three casts, the first at a shallower depth with a shorter duration and the second or third at greater depths for a longer period of time.

The trawl gear used was the "huelvano", which is a classical trawl gear. It is between 65 to 110 m long, 1.5 to 2 m deep and has a 17 to 20 m headline. It is used with a codend that has a mesh size of 40 mm and it can be modified by adding struts that allow a greater headline height.

3.5 Sète

Forty boats distributed in two categories compose the fleet of Sète: 11 bottom trawlers (CF) oriented exclusively toward benthic and demersal species and 29 trawlers that use high vertical opening trawl (GOV) and that target benthic and demersal species alternately with small pelagic as anchovy and sardine.

The vessels using these two types of fishing gear show different characteristics: the trawlers using the CF correspond to the smallest (16 to 20 m) and oldest vessels (>30 years on average). Trawlers operating with GOV fishing gear are newer and larger (24.5 min mean) and better equipped (Table 3.2.5.1).

Table 3.5.1. Characteristics of Sète's trawlers (GOV: high vertical opening trawler; CF: bottom trawler)

	Length (m)	Engine power (kw)	Tonnage (gt)	Year of launching
C.P.	19.5 (3.9)	290 (51.8)	44 (24.8)	1967 (4)
G.O.P.	24.5 (1.5)	315 (4.1)	64.3 (19)	1978 (7)

Data are from the network inter auctions RIC (Réseau Inter Criée), department which is responsible for the Direction of Fishing Administration for data collection. The RIC is responsible for the control of the reliability of the information transmitted by the different auctions by checking them against files of reference previously established.

4 Results from the sampling on board commercial trawlers

4.1 Characteristics of the hauls

The sampling on board commercial trawlers consisted of a total of 180 hauls. Differences among ports were observed regarding the amount of catch that was discarded, and, within a given port, the amount of discarded catch changed during the time of the year. An overall result of the sampling is that the amount of discarded catch ranged between 17% of the total catch in Vilanova, and 34% in Sète. These percentages were estimated from all the hauls performed in each port during the sampling period.

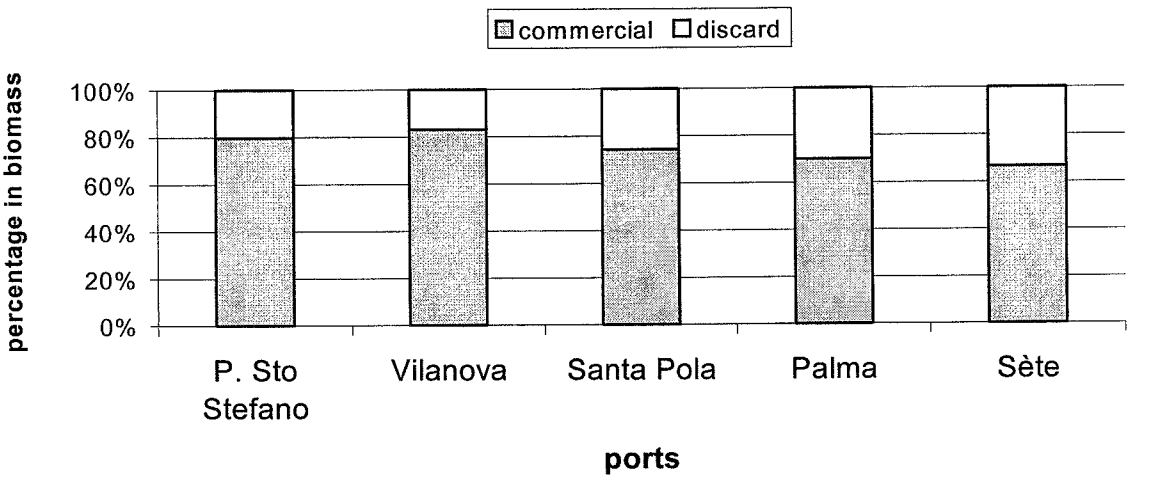


Figure 4.1. Percentage of discarded and commercialised fraction of the sampled catches in the studied five ports.

4.1.1 Porto Santo Stefano

During the study period 40 commercial hauls (Tab. 4.1.1.1) were carried out in the batimetric range 80 m-580 m, more than 50% of these in the range 100m-300 m. The average duration of the haul was 3.9 hour (min 1.25, max 6.0 hours) corresponding to 11.65 nautical miles covered (min 3.68, max 18.0). There wasn't a general rule concerning the fishing zones; they were decided daily by the fisherman taking into account the variations of the local market and the weather condition.

Table 4.1.1.2. shows the catches for each haul, in terms of commercialised and discarded amounts both for total catch and for European hake catch.

The average total discard represented 20.5% in weight of the total catch with a minimum of 6.8% and a maximum of 44.0%. Highest values in percentage of total discards in weight were found in the batimetric range 100 m-250 m, whereas no relationship seems to exists between total catches and discards.

The European hake catch represented an important fraction of the total catches, with values ranging from 1.4 to 41.3 % (average 12.8%). The discard of European hake varied from a minimum of 0 to a maximum of 47.8% in weight and 75.8% in number of the total catch of the species, corresponding to average values of 11.3% and 33.1%, in weight and number, respectively. Taking into account only the hauls where the discards of European hake were present (24 hauls), the average discard increased from 11.3 to 18.9% in weight and from 33.9 to 45.9 % in number.

Table 4.1.1.1. Porto Santo Stefano. Summary of the characteristics of the hauls.

HAUL	DATE	INITIAL LAT (N)	INITIAL LONG (E)	FINAL LAT (N)	FINALD LONG (E)	INITIAL DEPTH (m)	FINAL DEPTH (m)	START TIME GMT	DURATION (hour)	NM COVERED
1	21/02/01	42 32 04	10 32 47	42 25 38	10 17 21	210	225	4.45	2.25	6.88
2	21/02/01	42 26 13	10 17 53	42 30 88	10 36 18	228	235	9.45	4.75	14.24
3	22/02/01	42 31 82	10 29 49	42 26 19	10 17 42	220	223	4.35	3.58	10.72
4	22/02/01	42 26 44	10 17 33	42 30 61	10 41 02	217	234	9.00	5.92	17.76
5	23/02/01	42 31 61	10 33 75	42 27 09	10 17 93	220	220	5.45	3.75	11.04
6	23/02/01	42 27 02	10 17 93	42 30 78	10 35 95	220	240	10.18	4.30	14.21
7	21/03/01	42 36 80	10 25 40	42 37 90	10 36 15	135	125	8.30	2.50	7.36
8	21/03/01	42 38 04	10 37 99	42 30 70	10 55 37	127	115	11.25	4.83	15.08
9	22/03/01	42 37 58	10 48 00	42 24 00	10 47 13	150	200	4.00	3.00	10.05
10	22/03/01	42 24 47	10 48 57	42 23 81	10 53 81	170	150	7.35	2.00	6.70
11	22/03/01	42 22 85	10 55 74	42 25 70	10 58 30	142	125	11.00	2.50	7.59
12	22/03/01	42 23 90	10 59 15	42 29 88	11 03 22	100	80	14.05	2.33	7.37
13	23/03/01	42 31 85	10 44 18	42 22 90	10 46 00	200	200	4.15	3.00	10.05
14	23/03/01	42 22 76	10 48 90	42 20 90	10 57 31	185	140	8.00	2.50	7.71
15	23/03/01	42 22 02	10 57 15	42 29 03	11 02 98	145	90	11.00	4.83	15.30
16	18/04/01	42 19 07	10 23 69	42 07 92	10 14 69	350	330	4.10	4.00	12.80
17	18/04/01	42 10 24	10 15 75	n.a.	n.a.	350	460	9.10	4.83	14.40
18	19/04/01	42 32 30	10 45 99	42 25 88	10 29 82	300	370	3.20	4.33	13.44
19	19/04/01	42 24 69	10 31 97	42 15 06	10 45 26	400	410	9.00	6.00	18.00
20	20/04/01	42 30 06	10 34 97	42 24 55	10 18 63	260	290	3.50	4.33	12.30
21	20/04/01	42 25 63	10 19 38	42 20 74	10 37 61	294	450	9.00	5.00	15.50
22	16/05/01	42 16 94	10 23 19	42 05 64	10 15 13	395	420	4.30	4.50	13.76
23	16/05/01	40 07 79	10 16 33	42 14 71	10 26 03	415	456	10.10	3.83	7.75
24	17/05/01	42 27 35	10 41 95	42 24 33	10 28 07	280	370	4.30	3.50	10.56
25	17/05/01	42 23 50	10 28 80	42 15 45	10 45 79	440	350	8.50	4.67	14.08
26	18/05/01	42 29 66	10 29 64	42 25 50	10 19 30	270	300	3.30	4.75	14.24

Table 4.1.1.1. (Cont.) Porto Santo Stefano. Summary of the characteristics of the hauls.

HAUL	DATE	INITIAL LAT (N)	INITIAL LONG (E)	FINAL LAT (N)	FINALD LONG (E)	INITIAL DEPTH (m)	FINAL DEPTH (m)	START TIME GMT	DURATION (hour)	NM COVERED
27	18/05/01	42 25 60	10 21 24	42 23 10	10 37 00	290	440	9.00	5.00	16.00
28	20/06/01	42 26 25	10 29 52	42 19 25	10 41 67	355	317	8.55	4.92	13.20
29	21/06/01	42 18 46	10 24 03	42 07 75	10 14 72	416	340	3.00	4.50	12.90
30	21/06/01	42 08 08	10 12 77	42 14 72	10 18 23	350	330	8.50	3.17	9.61
31	22/06/01	42 15 82	10 45 18	42 24 97	10 39 44	350	310	3.00	4.50	13.33
32	22/06/01	42 27 22	10 40 80	42 32 55	10 41 37	285	200	8.00	3.00	9.60
33	22/06/01	42 32 45	10 46 24	42 30 51	10 56 72	170	110	12.00	2.75	7.84
34	18/07/01	42 14 95	10 46 13	42 21 76	10 30 45	400	500	2.30	5.50	15.90
35	18/07/01	42 21 74	10 31 19	42 14 55	10 45 01	500	525	9.10	4.75	13.35
36	19/07/01	42 27 84	11 02 05	42 23 07	10 55 93	96	90	5.10	4.67	14.08
37	19/07/01	42 22 33	10 56 88	42 29 79	10 56 58	140	110	9.40	2.92	8.42
38	19/07/01	42 30 29	10 56 07	42 26 11	11 03 21	113	80	13.25	2.50	7.59
39	27/07/01	42 18 08	10 35 53	42 14 55	10 47 69	580	512	8.00	4.00	11.60
40	27/07/01	42 17 26	10 47 99	42 21 57	10 49 39	200	200	13.00	1.25	3.68

Table 4.1.1.2. Porto Santo Stefano. Summary of the total catches and discard (in weight) and total catches and discards of hake in weight and number of individuals, by haul.

HAUL	CATCH (kg) total	DISCARD (kg) total	DISCARD %	HAKE CATCH (kg)	HAKE DISCARD (kg)	HAKE DISCARD % kg	HAKE CATCH number	HAKE DISCARD number	HAKE DISCARD % number
1	140.3	61.7	44.0	8.2	3.5	42.8	852	594	69.7
2	175.6	41.3	23.5	15.7	7.5	47.9	1596	1168	73.2
3	102.5	26.5	25.9	8.3	2.3	27.6	706	432	61.2
4	158.0	44.9	28.4	25.1	6.8	27.3	1354	1026	75.8
5	138.2	42.3	30.6	13.9	3.7	26.5	858	636	74.1
6	169.4	40.8	24.1	18.4	5.1	27.6	1025	764	74.5
7	147.8	17.1	11.6	10.0	1.6	15.5	569	235	41.3
8	115.8	13.2	11.4	24.1	4.0	16.5	1449	482	33.3
9	75.5	13.3	17.6	12.9	1.9	14.8	801	235	29.3
10	122.2	32.0	26.2	18.2	3.2	17.6	942	391	41.5
11	66.5	13.4	20.1	13.8	0.0	0.0	291	6	2.1
12	41.1	8.2	20.0	8.2	0.0	0.0	188	24	12.8
13	38.9	2.6	6.8	16.1	1.3	7.9	1032	169	16.4
14	70.8	13.0	18.4	12.4	2.0	15.8	720	298	41.4
15	161.1	44.6	27.7	15.6	1.1	7.2	468	190	40.6
16	195.6	16.1	8.2	16.7	0.0	0.0	717	54	7.5
17	136.1	14.3	10.5	8.9	0.0	0.0	323	10	3.1
18	121.8	19.4	15.9	12.7	0.0	0.0	326	138	42.3
19	111.1	22.8	20.5	5.9	0.0	0.0	23	9	39.1
20	91.8	11.0	12.0	12.3	0.0	0.0	353	54	15.3
21	135.1	19.9	14.7	10.5	0.0	0.0	277	16	5.8
22	145.9	44.4	30.4	8.0	0.0	0.0	52	8	15.4
23	106.2	22.6	21.3	1.5	0.0	0.0	25		0.0
24	120.0	15.3	12.8	9.5	0.0	0.0	283	47	16.6

Table 4.1.1.2. (Cont.) Porto Santo Stefano. Summary of the total catches and discard (in weight) and total catches and discards of hake in weight and number of individuals, by haul

HAUL	CATCH (kg) total	DISCARD (kg) total	DISCARD %	HAKE CATCH (kg)	HAKE DISCARD (kg)	HAKE DISCARD % kg	HAKE CATCH number	HAKE DISCARD number	HAKE DISCARD % number
25	102.1	18.7	18.3	17.9	0.0	0.0	58	4	6.9
26	167.1	21.4	12.8	33.3	9.5	28.5	2750	1843	67.0
27	116.3	12.9	11.1	10.9	0.0	0.0	343	169	49.3
28	148.2	14.3	9.7	6.5	0.3	4.4	183	46	25.1
29	118.8	33.9	28.6	4.5	0.1	3.1	125	8	6.4
30	301.7	60.7	20.1	38.4	2.0	5.2	1204	248	20.6
31	82.7	13.2	16.0	3.2	1.1	33.4	241	156	64.7
32	99.5	7.9	7.9	31.7	2.2	6.9	3425	481	14.0
33	79.7	34.1	42.7	9.8	2.2	22.7	528	372	70.5
34	90.2	8.9	9.9	11.7	0.0	0.0	22	0	0.0
35	83.6	6.0	7.2	8.7	0.0	0.0	13	1	7.7
36	79.3	24.4	30.8	10.7	0.8	7.5	541	184	34.0
37	53.3	22.9	43.0	7.4	0.7	9.6	382	150	39.3
38	57.2	18.4	32.2	6.7	0.7	10.2	317	120	37.9
39	51.4	8.0	15.5	7.2	0.0	0.0	8	0	0.0
40	59.1	19.4	32.8	13.6	3.7	27.3	2201	1092	49.6

4.1.2 Vilanova i La Geltrú

Sampling was performed monthly from February to July 2001 using commercial otter bottom trawlers in the port of Vilanova i La Geltrú (Table 4.1.2.1). A total of 39 hauls were conducted in the usual fishing grounds of the fleet. The duration of the tows was between 1 hour to 4.8 hours depending on the bottom characteristics. Sampling depth ranged between 21 and 476 m. All hauls were done during daylight hours.

Table 4.1.2.2 shows the summary, for each haul, of total catch, total discard and the percentage this discard represents, total hake catch, total hake discard and its percentage in weight and number of individuals with regard to total hake catch.

The total hake catch, per haul, ranged between 2.11 to 105.33 kg. Hake discards were negligible in all the hauls, the maximum percentage of hake discard being 12.75 % of the total hake catch (haul 32, performed in June, with very high catch of *Micromesistius poutassou*). Regarding the number of individuals discarded, the bigger proportion, arriving to 81.82 %, corresponded to this same haul. In all the cases the individuals discarded were small or damaged.

Data were standardised to 1 trawling hour, for subsequent numerical and comparative processing.

Table 4.1.2.1. Vilanova i La Geltrú. Summary of the characteristics of the hauls.

HAUL	DATE	KW CAPAC.	INITIAL LAT	INITIAL LONG	FINAL LAT	FINAL LONG	DEPTH MIN	DEPTH MAX	START TIME	DURATION (HOURS)	NM COVERED
1	20.02.01	377	41°07,79' N	1°40,81' E	41°04,64' N	1°29,58' E	70	93	06:22	3	
2	20.02.01	377	41°05,17' N	1°29,77' E	41°08,56' N	1°45,77' E	66	90	09:40	4.3	
3	20.02.01	377	41°08,78' N	1°41,03' E	41°05,90' N	1°30,10' E	59	77	07:17	2.2	
4	21.02.01	377	41°03,46' N	1°30,48' E	41°07,77' N	1°41,54' E	70	247	10:52	4.1	
5	21.02.01	377	41°04,35' N	1°40,40' E	41°00,91' N	1°30,41' E	243	284	07:42	2.8	
6	21.02.01	377	41°00,87' N	1°30,54' E	41°06,25' N	1°89,85' E	216	258	10:50	3.7	
7	20.03.01	241	41°09,24' N	1°49,01' E	41°07,27' N	1°52,21' E	48	313	07:30	3.5	11
8	20.03.01	241	41°07,05' N	1°53,48' E	41°06,97' N	1°48,94' E	108	302	11:30	3.3	10
9	21.03.01	241	41°12,34' N	1°43,70' E	41°09,53' N	1°57,33' E	49	55	07:36	1.7	7
10	21.03.01	241	41°07,97' N	1°53,53' E	41°07,70' N	1°50,66' E	86	143	09:45	2.4	8
11	21.03.01	241	41°06,54' N	1°49,03' E	41°07,84' N	1°46,69' E	75	178	12:30	1.7	8
12	22.03.01	241	41°08,53' N	1°51,11' E	41°08,84' N	1°56,35' E	66	73	07:36	1.3	
13	22.03.01	241	41°07,18' N	1°53,54' E	41°06,81' N	1°50,99' E	106	275	09:34	2.1	8
14	22.03.01	241	41°05,18' N	1°50,70' E	41°06,81' N	1°40,12' E	110	384	12:08	3.1	9
15	23.04.01	241	41°11,42' N	1°38,57' E	41°03,57' N	1°29,48' E	152	157	07:45	2.7	8
16	23.04.01	241	41°03,57' N	1°29,48' E	41°07,35' N	1°40,52' E	68	124	12:00	2.5	11
17	24.04.01	241	41°07,44' N	1°49,61' E	41°06,36' N	1°45,22' E	128	275	07:35	2.4	8
18	24.04.01	241	41°03,82' N	1°45,17' E	41°08,56' N	1°48,98' E	73	329	11:00	3.3	10
19	25.04.01	241	41°04,04' N	1°44,60' E	41°03,93' N	1°49,59' E	110	476	07:45	5.0	9
20	25.04.01	241	41°04,36' N	1°49,09' E	41°07,79' N	1°43,05' E	73	293	13:15	2.5	6
21	22.05.01	241	41°08,24' N	1°39,75' E	41°00,51' N	1°39,82' E	34	262	05:20	2.6	
22	22.05.01	241	41°01,86' N	1°44,84' E	41°01,85' N	1°43,99' E	257	340	08:46	1.9	10
23	23.05.01	241	41°07,54' N	1°49,31' E	41°03,05' N	1°43,84' E	66	380	05:33	2.5	8.5
24	23.05.01	241	41°03,29' N	1°44,22' E	41°10,16' N	1°42,18' E	262	290	08:30	4.8	11
25	24.05.01	241	41°12,24' N	1°38,28' E	41°04,71' N	1°54,46' E	76	210	05:28	1.9	6
26	24.05.01	241	41°02,10' N	1°52,04' E	41°04,71' N	1°54,46' E	70	300	08:00	3.1	12
27	18.06.01	241	41°07,17' N	1°39,63' E	41°00,65' N	1°40,81' E	41	280	07:30	2.3	7.5

Table 4.1.2.1. (Cont.) Vilanova i La Geltrú. Summary of the characteristics of the hauls.

HAUL	DATE	KW CAPAC	INITIAL LAT	INITIAL LONG	FINAL LAT	FINAL LONG	DEPTH MIN	DEPTH MAX	START HOUR	DURATION (HOURS)	NM COVERED
28	18.06.01	241	41°02,21' N	1°44,13' E	41°07,42' N	1°51,22' E	250	266	10:30	2.8	7
29	19.06.01	241	41°05,58' N	1°40,17' E	40°39,82' N	1°39,64' E	66	280	07:40	1.8	7
30	19.06.01	241	41°04,56' N	1°40,25' E	41°05,97' N	1°40,51' E	140	280	10:25	3.4	10
31	20.06.01	241	41°05,30' N	1°40,40' E	41°00,19' N	1°40,25' E	160	283	08:10	1.8	7
32	20.06.01	241	40°59,88' N	1°40,15' E			170	300	10:34	2.3	11
33	17.07.01	241	41°08,79' N	1°47,61' E	41°02,86' N	1°48,13' E	35	190	05:18	2.7	9
34	17.07.01	241	41°05,58' N	1°49,56' E	41°06,23' N	1°49,05' E	80	270	08:40	2.8	8
35	18.07.01	241	41°09,42' N	1°47,88' E	41°10,69' N	1°52,16' E	22		05:15	1.0	3
36	18.07.01	241	41°08,46' N	1°48,02' E	41°09,06' N	1°55,32' E	21	36	06:50	1.7	5.5
37	18.07.01	241	41°09,06' N	1°55,36' E	41°09,06' N	1°47,00' E	36	90	09:00	1.8	7.5
38	20.07.01	241	41°08,60' N	1°46,93' E	41°07,65' N	1°56,23' E	33	190	05:15	2.3	7.6
39	20.07.01	241	41°08,66' N	1°56,25' E	41°07,46' N	1°44,03' E	43	60	08:05	3.1	10.5

Table 4.1.2.2. Vilanova i La Geltrú Summary of the total catches and discard (in weight) and total catches and discards of hake in weight and number of individuals, by haul.

HAUL	CATCH (kg) total	DISCARD (kg) total	DISCARD %	HAKE CATCH (kg)	HAKE DISCARD (kg)	HAKE DISCARD % kg	HAKE CATCH number	HAKE DISCARD number	HAKE DISCARD % number
									10.63
1	29.12	5.22	17.91	6.18	0.18	2.91	207	22	6.64
2	64.52	7.42	11.50	19.15	0.15	0.78	497	33	4.25
3	50.84	9.44	18.57	11.16	0.16	1.43	635	27	0.71
4	84.24	14.34	17.02	12.01	0.01	0.05	141	1	0.00
5	94.68	13.78	14.55	8.00	0.00	0.00	59	0	0.00
6	104.53	23.73	22.70	20.00	0.00	0.00	173	0	2.84
7	415.90	22.80	5.48	12.22	0.22	1.80	176	5	8.22
8	428.80	89.80	20.94	105.33	0.33	0.31	73	6	62.50
9	350.70	143.70	40.98	2.11	0.11	5.21	16	10	10.32
10	423.73	91.78	21.66	11.12	0.12	1.05	126	13	0.78
11	74.40	25.45	34.21	22.05	0.05	0.23	645	5	7.14
12	100.23	21.43	21.38	8.03	0.03	0.39	98	7	11.54
13	298.43	71.58	23.99	6.01	0.01	0.20	52	6	3.97
14	262.64	16.34	6.22	22.03	0.03	0.11	151	6	9.09
15	174.76	18.26	10.45	20.11	0.11	0.55	330	30	0.00
16	674.83	603.33	89.40	25.00	0.00	0.00	142	0	23.53
17	99.60	10.65	10.69	8.06	0.06	0.73	85	20	0.00
18	276.41	7.41	2.68	15.00	0.00	0.00	147	0	0.00
19	217.70	16.70	7.67	8.00	0.00	0.00	37	0	4.29
20	64.42	18.37	28.51	19.01	0.01	0.04	70	3	52.08
21	203.50	53.45	26.27	11.90	0.80	6.72	288	150	13.79
22	104.71	15.86	15.15	11.12	0.02	0.18	29	4	2.70
23	124.85	5.35	4.28	6.01	0.01	0.22	148	4	7.14
24	122.47	9.97	8.14	19.01	0.01	0.07	56	4	12.90
25	191.06	35.56	18.61	4.06	0.06	1.36	155	20	19.05
26	154.02	34.02	22.09	16.02	0.02	0.15	42	8	15.15

Table 4.1.2.2. (Cont.) Vilanova i La Geltrú Summary of the total catches and discard (in weight) and total catches and discards of hake in weight and number of individuals, by haul.

HAUL	CATCH (kg) total	DISCARD (kg) total	DISCARD %	HAKE CATCH (kg)	HAKE DISCARD (kg)	HAKE DISCARD % kg	HAKE CATCH number	HAKE DISCARD number	HAKE DISCARD % number
27	391.50	31.50	8.05	12.29	0.29	2.32	693	105	10.63
28	755.30	82.20	10.88	4.00	0.10	2.48	21	12	57.14
29	419.47	47.27	11.27	5.24	0.04	0.76	17	5	29.41
30	512.62	38.62	7.53	70.02	0.01	0.02	20	5	25.00
31	313.91	33.71	10.74	3.31	0.11	3.32	63	10	15.87
32	421.76	21.56	5.11	4.24	0.54	12.74	66	54	81.82
33	402.57	24.17	6.00	20.11	0.11	0.54	2395	8	0.33
34	164.38	14.57	8.86	5.11	0.11	2.06	69	9	13.04
35	105.27	19.27	18.31	9.00	0.00	0.00	257	0	0.00
36	57.02	27.52	48.26	8.00	0.00	0.00	249	0	0.00
37	116.38	29.63	25.46	40.08	0.08	0.20	725	18	2.48
38	119.69	32.94	27.52	10.00	0.00	0.00	403	0	0.00
39	124.20	29.90	24.08	35.07	0.07	0.21	498	8	1.61

4.1.3 Santa Pola

Table 4.1.3.1 gives the characteristics of the hake hauls sampled. Depths were between 42 and 384 m. During the sampling period the mean fishing depth increased with an average in February and March of 117 m, whereas in April it was 222 m, and in June and July it was 268 m. The average sampling depth for the whole sampling period was 168 m, the lower and upper sample quartile depths were 87 and 287 m, respectively, and the interquartile range was 200 m.

The duration of the hauls was between 3 and 5 hours, with an average of 3.88 hours. The tow distance was between 8 and 15 miles, and the average distance covered was 12.42 miles per haul.

Table 4.1.3.2 shows the main characteristics of the sampled catches. The average catch per haul was 239.5 kg and the mean discard was 61.6 kg. The total hake catches varied between 5 and 90.5 kg, with an average of 36.9 kg. Hake discards ranged between 0 and 0.4 kg per haul, and the average was 0.138 kg per haul. In number, the total hake catches varied between 5,939 and 14 individuals and the discards between 360 and 0 individuals. The maximum hake discard percentages were produced in one sampling carried out in June and reached 20.9%.

Table 4.1.3.1. Santa Pola. Summary of the characteristics of the hauls.

HAUL	DATE	KW CAPACITY	INITIAL LATITUDE	INITIAL LONGITUDE	FINAL LATITUDE	FINAL LONGITUDE	MIN.DEPTH	MAX.DEPTH	START.HOUR (GMT)	DURATION	DISTANCE MILES
1	060201	400	37°51'41 N	00°28'30 W	37°41'38 N	00°35'23 W	48	66	5.57	4.35	13.92
2	060201	400	37°47'54 N	00°33'34 W	38°00'11 N	00°30'98 W	42	54	11.05	3.80	12.16
3	130201	1000	38°02'99 N	00°16'97 W	38°11'51 N	00°00'52 E	94	97	5.12	4.40	14.08
4	130201	1000	38°10'86 N	00°01'95 W	38°02'25 N	00°18'36 W	96	99	10.12	4.30	13.76
5	150201	1000	37°57'88 N	00°19'85 W	37°42'89 N	00°26'19 W	90	91	5.28	4.44	14.21
6	150201	1000	37°44'1 N	00°25'45 W	37°59'02 N	00°19'04 W	87	91	10.47	4.65	14.88
7	050301	400	38°04'51 N	00°33'27 W	37°53'65 N	00°35'02 W	63	66	4.66	4.06	12.99
8	050301	400	37°53'99 N	00°34'31 W	37°45'83 N	00°33'39 W	79	90	9.27	2.85	9.12
9	050301	400	37°50'27 N	00°32'87 W	37°59'53 N	00°30'86 W	82	95	12.82	2.80	8.96
10	070301	1000	38°03'53 N	00°15'5 W	37°48'14 N	00°23'37 W	179	183	4.85	4.65	14.88
11	070301	1000	37°48'78 N	00°22'48 W	38°03'42 N	00°14'56 W	190	221	10.05	4.60	14.72
12	120301	1000	37°41'09 N	00°21'78 W	37°34'24 N	00°31'18 W	198	205	6.20	3.05	9.76
13	120301	1000	37°34'52 N	00°30'64 W	37°42'34 N	00°22'71 W	205	227	9.90	4.82	15.42
14	030401	400	37°58'89 N	00°19'99 W	37°49'14 N	00°24'03 W	161	165	5.50	4.18	13.38
15	030401	400	37°49'84 N	00°24'57 W	38°00'15 N	00°18'96 W	156	165	10.42	3.93	12.58
16	090401	1000	37°57'41 N	00°19'71 W	38°08'92 N	00°07'39 W	168	198	5.50	4.62	14.78
17	090401	1000	38°08'43 N	00°07'03 W	37°57'39 N	00°19'89 W	168	200	10.63	4.40	14.08
18	100401	1000	37°49'01 N	00°17'76 W	37°41'16 N	00°16'32 W	333	337	6.23	3.25	10.40
19	100401	1000	37°43'94 N	00°16'95 W	37°51'14 N	00°19'06 W	313	331	10.68	2.19	7.01
20	100401	1000	37°51'83 N	00°20'56 W	37°59'93 N	00°18'13 W	221	240	13.57	2.46	7.87
21	040601	1000	38°02'65 N	00°15'11 W	38°09'02 N	00°02'04 E	275	293	5.47	4.28	13.70
22	040601	1000	38°08'88 N	00°00'07 E	38°02'58 N	00°15'28 W	275	287	10.47	4.01	12.83
23	060601	400	37°46'97 N	00°33'45 W	38°00'02 N	00°30'87 W	79	97	4.78	4.37	13.98
24	060601	400	37°51'80 N	00°37'62 W	38°04'36 N	00°32'62 W	51	62	9.90	4.63	14.82
25	110601	1000	37°51'62 N	00°18'51 W	37°41'59 N	00°16'89 W	318	333	5.45	3.20	10.24
26	110601	1000	37°42'68 N	00°16'83 W	37°52'06 N	00°18'74 W	328	333	9.65	3.00	9.60
27	110601	1000	37°50'29 N	00°24'02 W	37°58'11 N	01°19'79 W	160	161	13.52	2.50	8.00
28	020701	400	37°52'85 N	00°29'33 W	37°42'05 N	00°33'26 W	104	112	5.12	4.75	15.20
29	020701	400	37°42'50 N	00°33'26 W	37°52'85 N	00°29'33 W	104	112	10.20	4.52	14.46

Table 4.1.3.1. (Cont.) Santa Pola. Summary of the characteristics of the hauls.

HAUL	DATE	KW CAPACITY	INITIAL LATITUDE	INITIAL LONGITUDE	FINAL LATITUDE	FINAL LONGITUDE	MIN.DEPTH	MAX.DEPTH	START.HOUR (GMT)	DURATION	DISTANCE MILES
30	040701	1000	37°58'72 N	00°17'9 W	37°41'02 N	00°16'89 W	316	329	5.17	4.58	14.66
31	040701	1000	37°43'69 N	00°16'61 W	38°00'84 N	00°16'96 W	315	384	10.42	4.98	15.94
32	090701	1000	37°54'17 N	00°18'92 W	37°42'15 N	00°16'59 W	333	340	5.50	3.00	9.60
33	090701	1000	37°44'03 N	00°16'36 W	37°54'07 N	00°18'69 W	322	342	9.33	2.95	9.44
34	090701	1000	37°54'29 N	00°18'07 W	38°03'71 N	00°12'51 W	313	320	12.93	3.35	10.72

Table 4.1.3.2. Santa Pola. Summary of the total catches and discard (in weight) and total catches and discards of hake in weight and number of individuals, by haul.

HAUL	CATCH (kg) total	DISCARD (kg) total	DISCARD %	HAKE CATCH (kg)	HAKE DISCARD (kg)	HAKE DISCARD % kg	HAKE CATCH number	HAKE DISCARDED number	HAKE DISCARD % number
1	199.6	44.6	22.33	75.4	0.436	0.58	3745	191	5.11
2	250.0	49.3	19.72	47.1	0.100	0.21	1425	30	2.11
3	158.1	53.0	33.53	17.7	0.228	1.29	812	114	14.04
4	172.7	53.3	30.86	26.0	0.032	0.12	1164	32	2.74
5	302.7	77.7	25.68	45.4	0.408	0.90	1681	157	9.34
6	186.8	66.0	35.31	32.4	0.368	1.14	1113	50	4.50
7	315.9	190.9	60.42	10.0	0.000	0.00	41	0	0.00
8	313.9	169.7	54.06	27.0	0.000	0.00	520	0	0.00
9	136.2	68.6	50.36	14.5	0.000	0.00	151	0	0.00
10	125.0	19.2	15.34	29.2	0.168	0.58	898	84	9.35
11	245.4	28.3	11.51	75.4	0.410	0.54	1741	142	8.14
12	222.8	15.0	6.73	21.0	0.000	0.00	723	0	0.00
13	166.3	56.2	33.79	15.8	0.000	0.00	444	0	0.00
14	211.0	43.6	20.68	83.0	0.953	1.15	5939	359	6.05
15	214.9	36.5	16.99	90.5	0.499	0.55	5476	159	2.90
16	206.2	33.5	16.26	53.0	0.000	0.00	2972	0	0.00
17	262.5	26.1	9.93	50.1	0.036	0.07	243	15	6.17
18	96.5	0.0	0.00	18.0	0.000	0.00	397	0	0.00
19	130.4	3.4	2.60	7.0	0.000	0.00	14	0	0.00
20	180.9	18.9	10.43	63.1	0.068	0.11	972	25	2.54
21	739.0	59.7	8.08	5.0	0.000	0.00	60	0	0.00
22	275.7	38.8	14.06	26.0	0.000	0.00	166	0	0.00
23	423.4	193.2	45.62	24.1	0.127	0.53	172	32	18.53
24	268.0	114.6	42.76	22.3	0.311	1.39	426	89	20.86
25	136.4	31.4	23.02	25.0	0.044	0.17	101	15	14.38
26	173.8	46.5	26.73	40.1	0.086	0.21	362	32	8.86
27	316.1	177.7	56.21	80.4	0.396	0.49	1881	136	7.23
28	552.6	150.2	27.17	70.0	0.000	0.00	709	0	0.00
29	452.9	120.0	26.49	45.0	0.000	0.00	528	0	0.00

Table 4.1.3.2. (Cont.) Santa Pola. Summary of the total catches and discard (in weight) and total catches and discards of hake in weight and number of individuals, by haul.

HAUL	CATCH (kg) total	DISCARD (kg) total	DISCARD %	HAKE CATCH (kg)	HAKE DISCARD (kg)	HAKE DISCARD % kg	HAKE CATCH number	HAKE DISCARDED number	HAKE DISCARD % number
30	134.5	30.0	22.27	18.0	0.000	0.00	110	0	0.00
31	147.5	25.0	16.95	19.5	0.021	0.11	108	7	6.34
32	127.5	15.9	12.49	16.0	0.000	0.00	112	0	0.00
33	171.1	17.8	10.42	50.0	0.000	0.00	267	0	0.00
34	127.5	19.5	15.31	10.0	0.000	0.00	92	0	0.00

4.1.4 Palma de Mallorca

Table 4.1.4.1 gives the characteristics of the trawl hauls sampled. The fishing depth for hake sampling was between 118 and 526 m. The mean trawling depth was 253.8 m. A slightly lower fishing depth was used in spring and summer. The lower and upper sample quartile depths were 126.4 and 356.5 m, respectively, and the interquartile range was 230 m.

The duration of the hauls was between 3.25 and 6.33 hours, with a mean of 4.74 hours. The distance covered by the haul varied between 8 to 17 miles, with an average of 13 miles per tow.

Table 4.1.4.2 shows the principal characteristics of the sampled catches. The catches were between 131 and 323 kg. The total average sampling catch per haul was 323.4 kg and the discard was 106.4 kg, which represented 32% of the haul catch. The coastal zone produced the highest and more variable catches, between 31 to 2,106 kg per haul. The average discard by haul in the coastal zone was 47%. The slope fishery was characterised by the lowest mean catch, since catches were between 91 and 340 kg. The discard was 19% of the total haul catch.

The total hake catches varied between 4.5 and 121.2 kg. The average hake catch per haul was 38 kg (±33.66 S.D.). By number the average catch was 174 (±166.60 S.D.) and the hake discards ranged from 0.0 to 7.1 kg. The average discard by weight was 2.8 kg (±3.66 S.D.) and 137.8 (±174.09 S.D.) by number. The maximum hake discard percentages were produced in the sampling carried out at the end of May and June, with 11.3 and 8.8% of the total hake catch, respectively. The minimum percentage discards (0%) corresponded to February and March.

Table 4.1.4.1. Palma de Mallorca. Summary of the characteristics of the hauls.

HAUL	DATE	KW CAPACITY	INITIAL LATITUDE	INITIAL LONGITUDE	FINAL LATITUDE	FINAL LONGITUDE	MIN.DEPTH	MAX.DEPTH	START.HOUR (GMT)	DURATION	DISTANCE MILES
1	15/02/01	225.9	39°19.355 N	02°44.963 E	39°16.835 N	02°48.803 E	55.6	74.1	5.50	1.50	4.50
2	15/02/01	225.9	39°15.207 N	02°28.108 E	39°19.318 N	02°16.762 E	264.8	363.0	9.16	4.16	8.32
3	20/02/01	105.4	39°26.998 N	02°31.366 E	39°27.037 N	02°25.329 E	38.0	79.6	5.00	1.00	2.80
4	20/02/01	105.4	39°27.130 N	02°21.320 E	39°24.171 N	02°17.365 E	88.3	105.6	7.25	1.50	4.35
5	20/02/01	105.4	39°25.996 N	02°27.180 E	39°25.930 N	02°33.833 E	65.0	82.8	10.75	1.75	5.25
6	06/03/01	199.5	39°14.760 N	02°07.450 E	39°13.240 N	02°27.060 E	537.1	677.8	6.50	9.17	
7	15/03/01	225.9	39°20.788 N	02°44.366 E	39°20.497 N	02°44.496 E	50.0	51.9	5.33	0.16	0.48
8	15/03/01	225.9	39°11.254 N	02°34.690 E	39°16.677 N	02°26.428 E	340.8	361.1	7.16	3.50	8.75
9	20/03/01	105.4	39°29.590 N	02°20.660 E	39°35.840 N	02°18.240 E	85.0	95.4	6.00	2.75	7.70
10	20/03/01	105.4	39°31.270 N	02°24.790 E	39°28.905 N	02°27.365 E	48.9	60.2	10.75	1.25	3.50
11	27/03/01	199.5	39°18.800 N	02°25.700 E	39°11.400 N	02°24.800 E	481.5	787.1	6.35	6.40	
12	25/04/01	225.9	39°36.499 N	02°04.537 E	39°44.318 N	02°15.667 E	311.1	359.3	8.50	4.52	11.75
13	26/04/01	128.0	39°18.430 N	02°44.122 E	39°16.032 N	02°41.361 E	53.7	75.9	4.50	1.50	3.75
14	26/04/01	128.0	39°13.818 N	02°40.458 E	39°09.208 N	02°45.524 E	129.6	185.2	6.75	5.25	14.70
15	26/04/01	199.5	39°20.380 N	01°59.520 E	39°20.660 N	02°00.000 E	670.4	727.8	5.42	6.58	
16	15/05/01	105.4	39°27.150 N	02°21.142 E	39°22.550 N	02°16.580 E	91.9	115.2	5.00	1.75	4.90
17	15/05/01	105.4	39°21.070 N	02°16.670 E	39°21.410 N	02°28.361 E	118.5	183.3	7.75	3.25	9.43
18	30/05/01	128.0	39°28.471 N	02°38.690 E	39°24.884 N	02°37.744 E	77.8	103.7	3.50	1.50	4.50
19	30/05/01	128.0	39°17.760 N	02°31.810 E	39°12.812 N	02°30.070 E	155.6	526.0	6.00	6.00	15.00
20	31/07/01	199.5	39°29.730 N	02°01.740 E	39°43.610 N	02°08.250 E	694.5	779.7	5.00	7.00	
21	19/06/01	105.4	39°26.399 N	02°19.361 E	39°21.110 N	02°16.946 E	96.5	129.1	5.00	2.00	5.80
22	19/06/01	105.4	39°20.311 N	02°18.772 E	39°17.824 N	02°31.442 E	127.8	170.4	7.75	3.83	12.26
23	21/06/01	128.0	39°28.710 N	02°34.660 E	39°15.880 N	02°30.090 E	50.0	70.4	3.50	1.75	5.25
24	21/06/01	128.0	39°19.300 N	02°24.390 E	39°09.940 N	02°38.070 E	279.7	355.6	6.50	5.75	14.38
25	04/07/01	199.5	39°47.020 N	02°16.170 E	39°47.270 N	02°19.410 E	561.2	698.2	4.93	7.57	
26	25/07/01	105.4	39°25.765 N	02°19.464 E	39°22.473 N	02°15.490 E	94.5	117.8	4.12	2.55	7.14
27	25/07/01	105.4	39°20.650 N	02°17.307 E	39°17.480 N	02°32.491 E	122.2	187.1	7.80	4.83	14.49
28	31/07/01	128.0	39°29.792 N	02°37.310 E	39°26.444 N	02°31.433 E	92.6	92.6	3.25	1.85	7.03
29	31/07/01	128.0	39°20.010 N	02°22.674 E	39°17.775 N	02°23.040 E	259.3	275.0	6.16	6.33	17.09

Table 4.1.4.2.Palma de Mallorca. Summary of the total catches and discard (in weight) and total catches and discards of hake in weight and number of individuals, by haul.

HAUL	CATCH (kg) total	DISCARD (kg) total	DISCARD %	HAKE CATCH (kg)	HAKE DISCARD (kg)	HAKE DISCARD % kg	HAKE CATCH number	HAKE DISCARDED number	HAKE DISCARD % number
1	225.7	64.5	28.6	4.0					
2	207.5	34.9	16.8	26.5	0.0	0.0	86	0	0.0
3	2105.7	2000.0	95.0	1.4					
4	273.8	85.0	31.0	3.0					
5	133.7	44.6	33.3	2.9					
6	91.1	22.2	24.3	1.5	0.0				
7	30.7	21.9	71.4	0.0					
8	204.5	30.5	14.9	13.3	0.0	0.0	71	0	0.0
9	324.9	121.4	37.4	6.8					
10	102.1	38.3	37.5	0.9					
11				1.6					
12	521.2	243.0	46.6	4.5	0.2	4.2	36	19	52.8
13	236.8	88.8	37.5	0.2					
14	204.2	38.2	18.7	57.8	1.3	2.2	704	97	13.8
15	155.1	25.7	16.6	0.0	0.0				
16	526.1	197.3	37.5	6.8					
17	296.3	131.3	44.3	27.8	0.2	0.6	144	28	19.4
18	339.7	127.4	37.5	0.0					
19	739.5	262.5	35.5	62.2	7.1	11.3	714	500	70.0
20	135.5	12.9	9.5	1.0	0.0	0.0			
21	217.8	108.9	50.0	1.2					
22	130.5	79.8	61.2	12.1	1.1	8.8	230	154	67.0
23									
24	326.0	91.9	28.2	41.1	1.1	2.7	234	57	24.4
25	112.2	8.0	7.1	3.8					
26									
27	257.4	87.0	33.8	22.1	2.1	9.4	551	97	17.6
28									
29	347.0	64.4	18.6	121.2	4.5	3.7	346	107	30.9

4.1.5 Sète

In the port of Sète sampling was performed on March, April, May, July and August 2001 using commercial trawlers (Table 4.1.5.1). A total of 38 hauls were done in the usual fishing grounds where the fleet operates. The nautical miles covered during the tows were between 1.8 and 18.4 depending on the bottom characteristics. The mean depth of the hauls ranged between 29 and 192 meters.

Table 4.1.5.2 shows the monthly mean values, in kg per fishing day/management unit, of the total catch, hake catch and associated discards. Values were estimated from the statistics prepared from the auction data (landings) and from the sampling on board commercial trawlers (discards).

The total hake catch by fishing day/vessel ranged between 104.84 and 203.84 kg. Hake discards were negligible or small in all months except in July, in which the percentage of hake discard was 13.6 % of the total hake catch. Hake catches in this month were the lowest within the sampling period.

Table 4.1.5.1.Séte. Summary of the characteristics of the hauls.

HAUL	DATE	KW CAPACITY	INITIAL LAT	INITIAL LONG	FINAL LAT	FINAL LONG	DEPTH (m)	START HOUR	NM COVERED
1	26/03/01	232	43°03.43'N	3°48'E	43°02.32'N	3°43.76'E	174	4.67	15.0
2	26/03/01	232	43°03.43'N	3°48'E	43°02.32'N	3°43.76'E	174	9.22	6.0
3	26/03/01	232	43°02.32'N	3°43.76'E	43°06.56'N	3°37.72'E	165	11.17	6.0
4	26/03/01	232	43°14.27'N	3°33.02'E	43°19.6'N	3°39.93'E	64	14.4	7.4
5	06/04/01	232			42°51.318'N	3°53.363'E	183	4.9	1.8
6	06/04/01	232	42°51.318'N	3°53.363'E	42°54.43'N	3°39.297'E	183	8.17	11.0
7	06/04/01	232	42°54.43'N	3°39.297'E			176	11.15	10.2
8	22/05/01	232	43°12.9'N	3°52.05'E	43°07.6'N	4°14.97'E	176	4.08	17.6
9	22/05/01	232	43°07.51'N	4°15.76'E	43°04.97'N	4°00.7'E	168	8.65	11.0
10	22/05/01	232	43°04.97'N	4°00.7'E	43°11.7'N	3°54.2'E	170	11.55	6.8
11	29/05/01	232							
12	29/05/01	232							
13	10/07/01	232	43°22.74'N	3°40.22'E	43°19.88'N	3°35.75'E	165	3.07	4.4
14	10/07/01	232	43°10.32'N	3°43.84'E	43°03.38'N	3°57.3'E	165	5.5	10.0
15	10/07/01	232	43°02.76'N	3°57.64'E	43°10.56'N	4°09.65'E	176	8.45	10.2
16	10/07/01	232	43°10'N	4°08.15'E	43°11.54'N	3°57.85'E	176	11.33	9.3
17	11/07/01	232	43°09.538'N	3°47.461'E	43°02.068'N	3°59.573'E	174	4.33	11.6
18	11/07/01	232	43°02.901'N	3°58.325'E	43°10.013'N	3°48.449'E	172	5.95	18.4
19	11/07/01	232	43°10.013'N	3°48.449'E	43°09.786'N	3°38.7'E	152	11	8.2
20	11/07/01	232	43°17.423'N	3°37.418'E	43°21.988'N	3°46.133'E	55	13.92	8.6
21	17/07/01	232	43°22.805'N	3°40.73'E	43°19.25'N	3°35.483'E	31	3.2	4.9
22	17/07/01	232	43°23.511'N	3°47.045'E	43°26.815'N	3°50.673'E	37	5.45	10.0
23	17/07/01	232	43°26.759'N	3°50.702'E	43°30.566'N	4°00.496'E	29	8.02	7.6
24	17/07/01	232	43°30.29'N	3°59.436'E	43°25.15'N	3°50.549'E	37	10.2	8.6
25	17/07/01	232	43°24.233'N	3°48.965'E	43°21.41'N	3°46.079'E	46	12.7	11.6
26	24/07/01	232	43°13.065'N	3°43.09'E	43°04.69'N	3°47.66'E	128	4.23	14.8
27	24/07/01	232	43°05.49'N	3°27.23'E	43°08.66'N	3°37.29'E	117	8.4	9.0
28	24/07/01	232	43°08.99'N	3°38.29'E	43°18.63'N	3°45.4'E	113	11.28	12.2
29	01/08/01	232	43°14.801'N	3°46.221'E	43°04.759'N	3°30.5'E	143	4	15.7
30	01/08/01	232	43°04.815'N	3°30.672'E	43°10.366'N	3°38.37'E	143	8.28	7.9
31	01/08/01	232	43°19.339'N	3°35.568'E	43°17.276'N	3°37.403'E	46	11.83	9.7

Table 4.1.5.1. (Cont.). Sète. Summary of the characteristics of the hauls.

HAUL	DATE	KW CAPACITY	INITIAL LAT	INITIAL LONG	FINAL LAT	FINAL LONG	DEPTH (m)	START HOUR	NM COVERED
32	01/08/01	232	43°15.258'N	3°34.736'E	43°20.752'N	3°40.585'E	59	14.75	7.2
33	02/08/01	232	43°00.059'N	4°03.803'E	42°56.412'N	4°18.048'E	172	6.02	10.4
34	02/08/01	232	42°55.807'N	4°18.905'E	42°57.063'N	4°08.175'E	192	8.83	11.5
35	02/08/01	232	42°57.364'N	4°07.94'E	43°01.925'N	3°56.41'E	178	11.92	10.0
36	07/08/01	232	43°18.129'N	3°51.212'E	43°12.451'N	4°13.651'E	145	3.88	18.4
37	07/08/01	232	43°12.317'N	4°15'E	43°19.146'N	4°02.48'E	145	8.75	10.8
38	07/08/01	232	43°18.9'N	4°03.24'E	43°17.8'N	3°47.861'E	132	11.73	10.7

Table 4.1.5.2. Sète. Summary of average total and hake catches and discards standardized in kg per fishing day/management unit, by month.

MONTH	CATCH (kg) total	DISCARD (kg) total	DISCARD %	HAKE CATCH (kg)	HAKE DISCARD (kg)	HAKE DISCARD % kg
March	1422.23	122.28	8.60	213.84	1.24	0.58
April	1021.95	200.95	19.66	122.31	0.11	0.09
May	3463.62	1174.12	33.90	160.41	0.30	0.19
July	1711.09	1068.21	62.43	104.84	14.26	13.60
August	783.91	249.96	31.89	115.29	3.56	3.09

4.2 Specific composition of the commercial and discarded catch. Description of the communities vulnerable to trawling

4.2.1 Porto Santo Stefano

During the period of investigation, a total of 209 species were identified belonging to the following groups: *Chondrichthyes*, 10 species, *Osteichthyes*, 88 species, *Mollusca*, 45 species, Crustacea, 44 species, *Echinodermata*, 12 species, *Cnidaria*, 3 species, *Poriphera*, 3 species, *Tunicata*, 2 species, *Brachiopoda*, 1 species and *Phanerogama*, 1 species. The commercial fraction was composed of 89 species, the discards of 185.

Main taxonomic groups constituting the commercialised and discarded catches, in percentage of weight and number of species, are showed in Fig. 4.2.1.1. The presence of *Osteichthyes* was relevant, 70.0% and 58.5% in weight and number of the total commercial catch, respectively. In this group, 59.0% of the species collected were commercialised. Although crustaceans were, in number, less than cephalopods, 12.4% against 23.6%, their importance in weight was higher 19.5% against 8.9%. Almost the totality of the species of cephalopods collected were commercialised, on the contrary only 25% of crustaceans gathered was commercialised. Elasmobranchs represented only a small part of the commercialised fraction, both in weight and in number, 2.1% and 5.6% respectively.

In the discarded fraction represented in Fig. 4.2.1.1., in addition to the groups above described, were collected species belonging to the following taxonomic groups: *Bivalvia, Gasteropoda, Echinodermata, Cnidaria, Porifera, Tunicata, Brachiopoda, Fanerogama*. The total number of the species belonging to these groups accounted for 23.8% of the total number of the discarded species, but only for 5% of the total weight. Their scanty presence in the catch was probably due to a low presence at the trawled bottoms where the vessel was operating and/or to the low suitability of the gear. 36 species presented the highest frequencies of occurrence, highlighted in Tab. 4.2.1.2.

The species object of this project, *M. merluccius*, played an important role both in the commercial catches and in the discards fraction, representing respectively 13.2 % and 8.0% of the total weight (Fig. 4.2.1.1.).

The list of the collected species present in the commercial and discard fractions are reported respectively in the Tables 4.2.1.1 and 4.2.1.2. The most important commercialised species, in kg/day/vessel, were: *Lepidopus caudatus* (scabbardfish), *M. merluccius* (European hake), *Micromesistius poutassou* (blue whiting), *M. barbatus* (red mullet), *Phycis blennoides* (greater forkbeard), *Trisopterus minutus capelanus* (poor cod), *Trachurus trachurus* (Atlantic horse mackerel), *A. antennatus, A. foliacea,* (giant and red shrimp) *N. norvegicus* (Norway lobster), *P. longirostris* (deep water rose shrimp), *Pasiphaea sivado, E. cirrhosa* (horned octopus), *Galeus melastomus* (black-mouthed dogfish) (Tab. 4.2.1.1.). The importance in biomass of each of these species changed during the different months of the study. This could be accidentally or due to the peculiarities of the specie or to fishing strategies. For example, the catches of the horned octopus increased during the summer period, in relation with recruitment and with the great fishing pressure exerted on the small, high marketable, individuals. Black-mouthed dogfish and *P. sivado*, by catch of giant and red shrimp fishery, were present in the catches when the fishery devoted to these crustaceans was carried out.

The European hake showed high value of catches in the whole studied period, pointing out the importance of this specie in the fishery of the northern Tyrrhenian sea.

Figure 4.2.1.2. shows the monthly incidence of discards in the most important commercialised species. Discard strategy could change according to the abundance of the species in the catch, that can affect the fish market. This is the case of the Atlantic horse mackerel and the scabbardfish, which were discarded independently by the size. Small individuals of the poor cod and the blue whiting were discarded for their scarce commercial value. *M. merluccius* is the only specie with economic value presenting discards. The discard rate resulted affected not only by the low economic value of the small specimens but also by a sort of compliance of the regulation in force, which prevents fishermen to sell huge quantities of very small individuals.

E. cirrhosa, *A. antennatus, A. foliacea, N. norvegicus, P. longirostris* never presented discards, for the high commercial value of the individuals of every size.

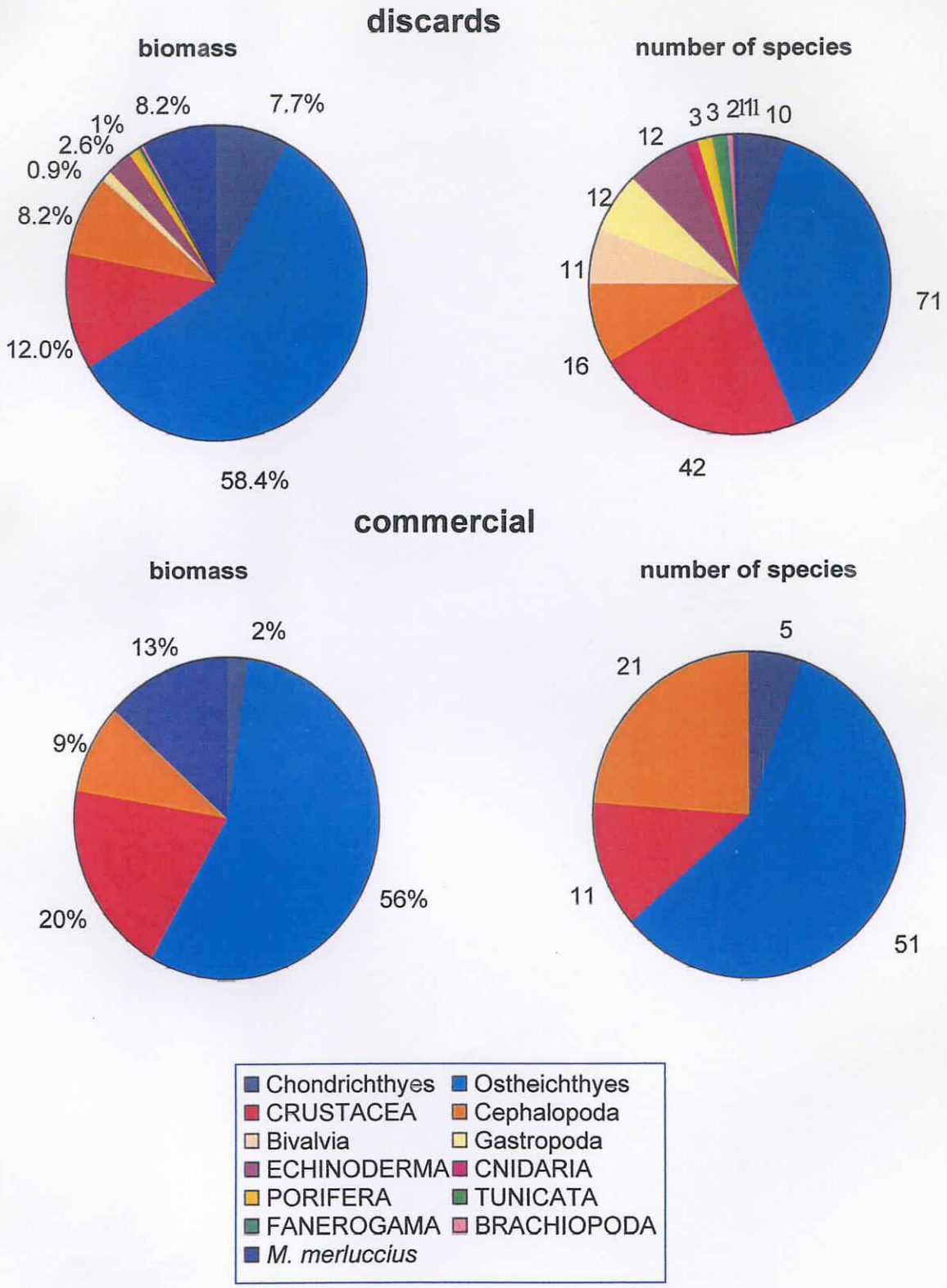


Figure 4.2.1.1.Porto Santo Stefano.. Taxonomic composition in biomass and in number of species of discard and commercial fractions of the sampling catches.

Table 4.2.1.1. Porto Santo Stefano. Specific composition of the commercial fraction of total trawl catches (kg/day/vessel)

	February	March	April	May	June	July
PISCES Chondricthyes						
Dalatias licha						0.86
Galeus melastomus			7.17	1.59	2.89	1.82
Raja oxyrinchus					0.92	
Raja sp.					3.25	0.71
Scyliorhinus canicula			0.80		0.17	
Torpedo marmorata		0.70				
PISCES Osteichthyes						
Aspitrigla cuculus		0.40				
Alosa fallax nilotica						1.52
Argentina sphyraena		0.26	0.43	0.83	2.74	0.17
Boops boops					0.28	2.43
Chlorophthalmus agassizii			1.80	1.28	1.70	
Conger conger	5.90	0.28	2.51	1.33	1.22	1.64
Citharus linguatula		0.26				0.28
Centrolophus niger			0.64	0.63		
Engraulis encrasicolus					2.78	
Gobius niger						0.20
Helicolenus d. dactylopterus	0.20	0.50	0.38	0.10	0.40	
Lepidorhombus boscii	0.13	0.56	0.70		1.45	0.90
Lophius budegassa	1.27	0.11	0.77	4.34	2.45	
Lepidopus caudatus	28.14	14.54	62.37	23.57	84.56	1.86
Lepidotrigla cavillone		1.46				
Lophius piscatorius		3.33	6.39	0.42	3.33	
Lophius sp.	5.32			1.15		
Mullus barbatus	0.70	11.45			0.60	1.25
Merluccius merluccius	2.85	4.62	22.20	23.76	39.69	3.87
Micromesistius poutassou	24.39	4.65	44.48	45.50	29.49	1.42
Mullus surmuletus		0.73	0.15		0.30	1.97
Ophisurus serpens			0.67			
Pagellus acarne			0.13		0.90	
Polyprion americanus				0.85		
Phycis blennoides	0.15		1.22	11.14	4.52	2.89
Pagellus bogaraveo			0.95	0.18	0.58	0.40
Pagellus erythrinus		0.20				0.50
Serranus cabrilla						0.18

Table 4.2.1.1. (Cont.)

	February	March	April	May	June	July
PISCES Osteichthyes						
Spondyliosoma cantharus		0.20				
Seriola dumerili		13.89				
Scorpaena elongata					0.20	
Spicara maena		0.50				
Scorpaena notata		0.11				
Scomber scombrus		0.44		0.60		4.00
Scorpaena scrofa		0.54	0.19			
Spicara smaris		0.20				
Solea vulgaris vulgaris		0.23				0.21
Scorpaena sp.			0.10			
Trachinus draco						0.30
Trigla lucerna		0.17			0.83	0.80
Trisopterus m. capelanus	1.92	25.00	2.25	1.33	5.56	6.62
Aspitrigla obscura						0.30
Trachurus trachurus	4.44	8.37	9.29	24.40	23.57	2.60
Trachurus sp.	16.54					
Triglidae indet.			0.50		0.15	
Uranoscopus scaber		0.30			0.11	1.15
Zeus faber	0.13	0.72	0.20		2.81	0.79
CRUSTACEA						
Aristeus antennatus			0.40			4.12
Aristaeomorpha foliacea						11.58
Maja squinado		0.40				
Nephrops norvegicus	2.44	2.36	22.10	28.73	7.61	1.95
Parapenaeus longirostris	77.79	4.98	23.53	18.85	13.60	4.77
Plesionika martia				0.21		
Pasiphaea multidentata						0.30
Pasiphaea sivado						11.79
Pasiphaea sp.				5.83		
Plesionika sp.			1.70			0.65
Squilla mantis		1.11				0.28
MOLLUSCA Cephalopoda						
Alloteuthis sp.	0.70	0.30				0.42
Eledone cirrhosa	7.87	8.74	3.49	4.51	17.26	28.43
Eledone moschata		1.41				0.62
Illex coindeitii	3.10	6.12	2.44	1.70	3.30	3.45

Table 4.2.1.1. (Cont.)

	February	March	April	May	June	July
MOLLUSCA Cephalopoda						
Loligo vulgaris		1.70		0.11		
Loligo sp.		0.20				
Neorossia caroli					0.20	
Octopus salutii	0.25					
Octopus vulgaris		2.67				0.60
Rossia macrosoma		0.30	0.30	0.43		
Sepia elegans				0.20		0.10
Sepia orbignyana		0.67	0.10		0.23	
Sepietta oweniana			0.47			0.40
Scaeurgus unicirrhus	0.69	0.60	0.20	0.35		
Sepietta sp.	0.17		0.21			0.33
Sepiolidae indet.	2.12	0.28	2.31	3.73	2.79	0.57
Sepia sp					0.14	
Todaropsis eblanae	0.13		0.58	0.54		
Todarodes sagittatus			0.13			

Table 4.2.1.2. Porto Santo Stefano. Specific composition of the discarded fraction of total trawl catches (kg/day/vessel). In Bold letter are indicated the most frequent discarded species.

	February	March	April	May	June	July
PISCES Chondricthyes						
Chimaera monstrosa				0.10		
Dalatias licha			0.30			
Etmopterus spinax			1.12	0.22		0.90
Galeus melastomus			4.86	11.23	4.59	0.87
Raja asterias	0.16		0.40			
Raja oxyrinchus			0.20		0.12	
Raja sp.	0.13					
Scyliorhinus canicula	2.70		0.34	0.21		
Scyliorhinus stellaris					0.69	
Torpedo marmorata		0.90				
PISCES Osteichthyes						
Alosa fallax nilotica					0.71	0.33
Argyropelecus hemigymnus						
Arnoglossus laterna		0.30	0.14		0.50	0.12
Antonogadus megalokynodon	0.90	0.30	0.70	0.60		0.40
Argentina sphyraena	1.32	1.60	0.74	0.29	0.52	0.49
Boops boops		0.40			0.29	0.23
Benthosema glaciale				0.10		0.10
Blennius ocellaris		0.70				
Chlorophthalmus agassizii	0.50	0.20	0.19	0.37	0.59	
Capros aper	0.10	0.63	0.27	0.17	2.52	3.40
Coelorhynchus coelorhynchus			0.90	0.10	0.20	
Conger conger	0.10	0.50	0.10	0.20		0.27
Citharus linguatula		0.28			0.10	0.54
Callionymus maculatus		0.34			0.10	0.60
Ceratoscopelus maderensis				0.80	0.30	0.10
Callanthias ruber		2.42				
Cepola rubescens		0.10				0.28
Chauliodus sloani				0.10		0.90
Deltentosteus quadrimaculatus		0.14				0.10
Echiodon dentatus	0.20					
Epigonus constanciae				0.50		
Epigonus denticulatus				0.10		
Epigonus telescopus			0.40			0.10
Engraulis encrasicolus		0.10			12.93	14.77
Eutrigla gurnardus gurnardus		0.60				
Gadiculus argenteus argenteus	22.39	0.17	7.58	7.93	8.20	

Table 4.2.1.2. (Cont.)

	February	March	April	May	June	July
PISCES Osteichthyes						
Gobius geniporus						0.40
Glossanodon leioglossus		0.30	0.60		0.62	0.90
Gnathophis mystax	0.20		0.21		0.20	
Helicolenus dactylopterus dactylopterus	2.60	1.71	1.40	1.30	1.17	0.39
Hymenocephalus italicus			0.19	0.90	0.90	0.30
Hoplostethus mediterraneus			0.50	0.10		0.70
Lepidorhombus boscii	0.52	0.15	0.61	1.43	2.60	0.24
Lepidopus caudatus	9.47	6.15	1.45	0.12	15.00	13.94
Lepidotrigla cavillone		0.72				0.21
Lampanyctus crocodilus			1.36	0.25		0.10
Lesueurigobius friesii	0.18			0.10	0.10	0.10
Lesueurigobius suerii	0.20	0.10	0.30	0.30		0.90
Lesueurigobius sp.			0.10			
Mullus barbatus		0.60				
Merluccius merluccius	1.25	5.48	0.55	3.59	3.76	6.21
Micromesistius poutassou	1.33	0.15	0.21	0.29	0.53	0.30
Myctophum punctatum						
Macroramphosus scolopax	0.23	1.29	0.30	0.10	0.30	0.91
Microchirus variegatus		0.10				
Nezumia sclerorhynchus				0.27	0.20	
Pagellus acarne		0.11				
Phycis blennoides	0.13	0.90	0.55	3.81	1.68	1.21
Peristedion cataphractum	0.23		0.60	0.10	0.90	
Pagellus erythrinus						0.20
Stomias boa boa			0.10	0.10		
Serranus cabrilla		0.11				0.19
Spicara flexuosa		1.50	0.20		0.12	0.23
Serranus hepatus		0.20	0.10	0.30	0.40	0.70
Symphurus ligulatus				0.20	0.10	0.20
Spicara maena		0.33		0.40	0.10	0.11
Symphurus nigrescens	0.60		0.10	0.40		0.17
Scorpaena notata		0.10				
Synchiropus phaeton	0.32		0.42	0.40	0.65	0.10
Sardina pilchardus		0.20			0.31	0.47
Scomber scombrus						0.60
Spicara smaris		0.86	0.70	0.20		0.30
Trachurus mediterraneus mediterraneus			0.40		0.15	0.42
Trisopterus minutus capelanus	14.28	3.79	0.24	0.10	0.35	0.45
Trachurus picturatus						0.60
Trachurus trachurus		12.21	0.26		1.55	1.27

Table 4.2.1.2. (Cont.)

	February	March	April	May	June	July
PISCES Osteichthyes						
Zeus faber					0.20	
CRUSTACEA						
Aristaeomorpha foliacea						0.50
Alpheus glaber		0.20	0.20	0.20		0.10
Chlorotocus crassicornis	1.61	0.11	0.87	1.24	0.30	0.30
Dardanus arrosor		0.20				
Gennadas elegans			0.10			
Geryon longipes						0.14
Goneplax rhomboides	0.23	0.10	0.50	0.70	0.10	0.20
Inachus communissimus		0.20				
Inachus sp.		0.10				
Liocarcinus depurator	0.48	0.23		0.11	0.17	
Monodaeus couchi				0.10		0.60
Munida intermedia	0.10			0.35	0.28	
Medorippe lanata	0.10	0.40				0.19
Macropodia longipes	0.10					
Munida tenuimana	0.10		0.30	0.19		0.40
Macropipus tuberculatus	1.77	0.16	0.32	0.46	0.62	0.63
Nephrops norvegicus	0.70		0.16	0.20	0.40	
Pagurus alatus	0.30		0.40			
Plesionika antigai	0.10		0.19	0.38	0.14	0.20
Processa canaliculata	0.20			0.20	0.10	0.10
Paromola cuvieri			0.15			0.11
Plesionika edwardsii			0.33	0.28	0.12	0.10
Plesionika gigliolii				0.54	0.15	
Plesionika heterocarpus	13.24		0.66	2.10	2.37	0.30
Penaeus (Melicertus) kerathurus				0.30		0.10
Pontocaris lacazei	0.10	0.30				
Parapenaeus longirostris	0.52	0.10	0.13	0.70	0.29	0.11
Parthenope macrochelos		0.18	0.20		0.22	0.20
Plesionika martia			0.10			
Pasiphaea multidentata						0.30
Processa nouveli	0.10		0.10			
Pasiphaea sivado			0.72	0.85	0.50	1.86
Pontophilus spinosus	0.20	0.40	0.10	0.10	0.10	0.10
Polycheles typhlops			0.10	0.50		0.27
Pagurus sp.	0.80					0.10
Plesionika sp.	0.47		1.41		0.30	0.20

Table 4.2.1.2. (Cont.)

	February	March	April	May	June	July
CRUSTACEA						
Processa sp.						
Rissoides pallidus	0.20	0.10		0.10		
Squilla mantis		0.20				0.50
Solenocera membranacea	1.79	0.19	0.23	0.39	0.12	0.30
MOLLUSCA Cephalopoda						
Alloteuthis subulata			0.20			
Alloteuthis sp.	0.40	0.12	0.10		0.10	0.80
Eledone cirrhosa					0.10	
Histioteuthis bonnellii						1.56
Illex coindetii	0.10	0.60			0.12	0.10
Loligo sp.						0.80
Octopus salutii	7.54	4.60	2.48	7.11	1.66	0.22
Rondeletiola minor	0.12	0.13	0.10	0.11	0.90	0.10
Sepia elegans	0.20				0.10	
Sepia orbignyana	0.30	0.30			0.30	
Sepietta oweniana	0.45	0.15	0.34	0.39	0.51	0.13
Scaeurgus unicirrhus						0.30
Sepiola sp.		0.10				0.40
Todaropsis eblanae	0.80	0.30	0.50	0.20	0.20	
MOLLUSCA Bivalvia						
Acanthocardia echinata						0.30
Aequipecten opercularis						0.70
Bivalvia indet.						0.37
Glossus humanus		0.10				0.19
Ostrea edulis						0.10
Ostrea sp.		0.40				0.30
Peplum clavatum			0.10			
Pteria hirundo	0.10	0.13				
Solecurtus strigilatus						0.10
Tellina nitida						0.10
MOLLUSCA Gastropoda						
Aporrhais pespelecani		0.80	0.90			
Aporrhais serresianus	0.39	0.32	0.20		0.20	0.20
Bolinus brandaris	0.20					
Calliostoma granulatum	0.40	0.70	0.20			0.50
Cassidaria echinofora	0.21	0.35	0.80	0.13	0.60	0.11
Cassidaria thyrrena		0.20	0.40	0.20	0.50	0.28
Cavolinia tridentata						0.10

Table 4.2.1.2. (Cont.)

	February	March	April	May	June	July
MOLLUSCA Gastropoda						
Fusinus rostratus	0.30	0.30	0.30	0.10	0.10	
Naticarius sp.	0.22	0.10	0.40		0.10	
Nudibranchia indet.						0.20
Scaphander lignarius		0.40				0.90
Turritella communis		0.10				
ECHINODERMA						
Astropecten arantiacus	0.70	0.10				
Astropecten irregularis pentacanthus	0.69	1.15	0.16	0.11	0.32	0.67
Cidaris cidaris		0.21				
Echinoidea indet.			0.10		0.90	
Echinus melo	0.88	0.29			0.33	0.30
Holothuria tubulosa		0.31				
Holothurioidea.	0.40	0.34	0.30	0.10		0.90
Ophiuroidea indet.		0.10				0.38
Stichopus regalis	0.48	1.21				1.37
Thyone fusus		0.20				
Trachythyone elongata		0.10				
Trachythyone tergestina		0.13				0.90
CNIDARIA						
Alcyonum palmatum	0.30	0.60	0.20		0.30	0.50
Calliactis parasitica						0.10
Pennatula rubra	0.10					0.10
TUNICATA						
Microcosmus sp.						0.90
Ascidiacea indet.		0.50				
BRACHIOPODA						
Terebratula vitrea					0.15	0.10
PORIFERA						
Porifera indet.		1.74				
Suberites domuncula		0.19				
Thenea muricata	2.68					
FANEROGAMA						
Posidonia oceanica		0.45				0.49

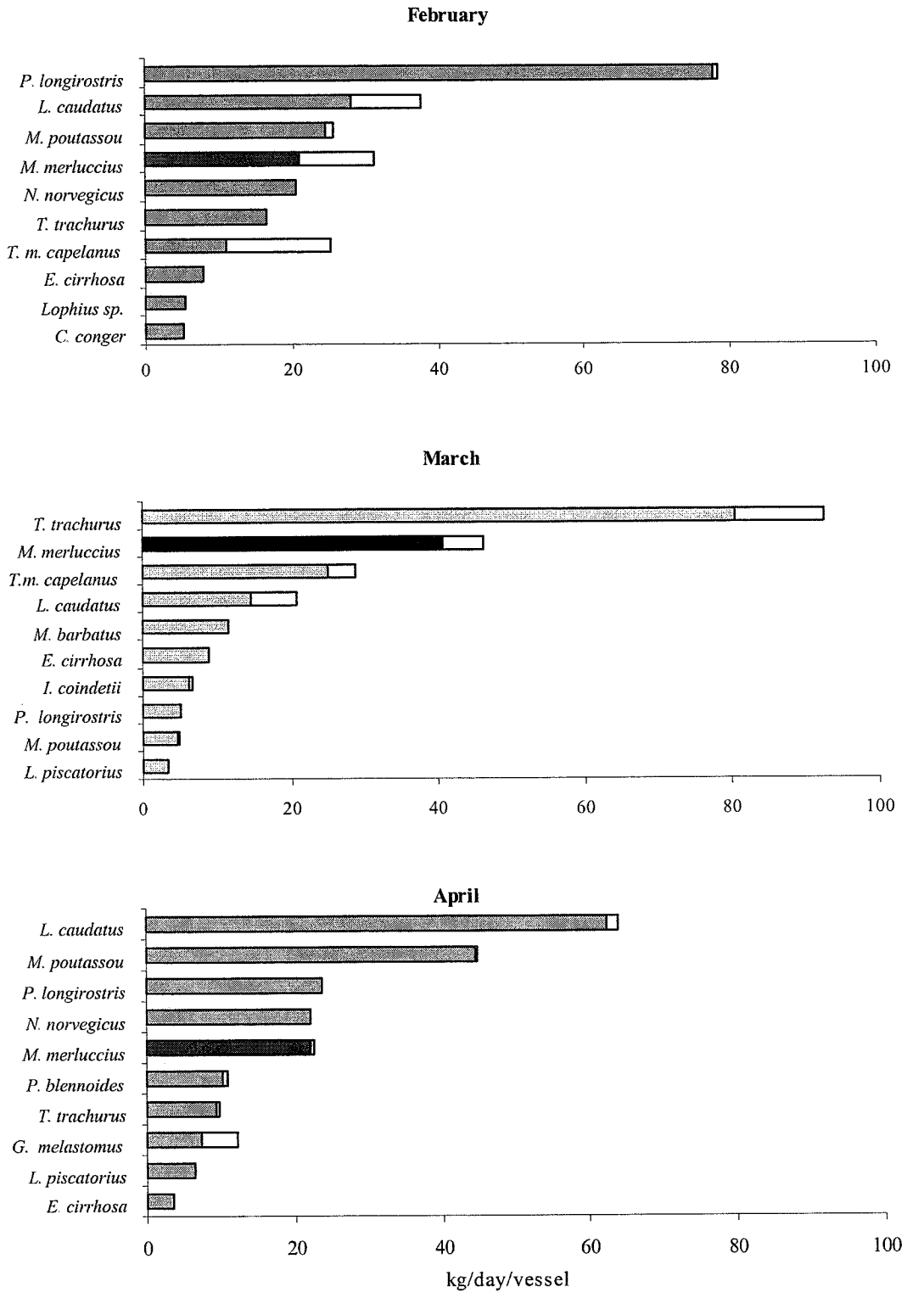


Figure 4.2.1.2a. Porto Santo Stefano. Commercial landings (in grey colour) and discards (in white colour) of the 10 most abundant species expressed in kg/day/vessel. Commercial landings of *M. merluccius* are indicated in black colour.

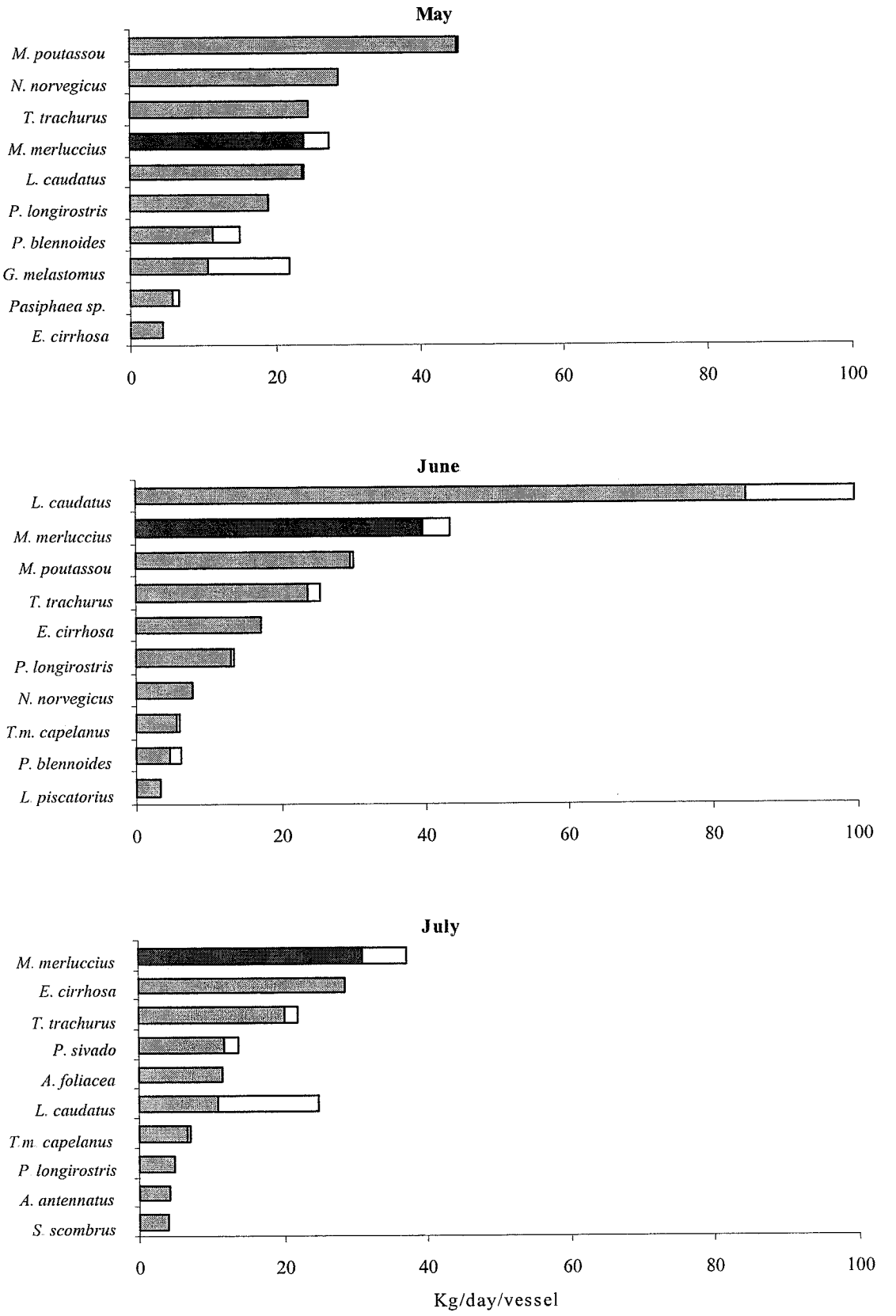


Figure 4.2.1.2b. Porto Santo Stefano. Commercial landings (in grey colour) and discards (in white colour) of the 10 most abundante species expressed in kg/day/vessel. Commercial landings of *M. merluccius* are indicated in black colour.

4.2.2 Vilanova i La Geltrú

Specific composition of total catches

A total of 319 species belonging to 11 Phyla were identified, of which 315 correspond to animal species and only 4 to plant species. The most frequently represented animal Phyla was Vertebrata (Ostheichtya and Chondrychtya fishes) with 132 species, Mollusca with 64 species and Crustacea with 60 species. In order of abundance these were followed by Echinoderma with 23 species, Cnidaria with 21 species, Tunicata with 9 species, and finally Annelida and Porifera, both groups with 3 species.

Further analysis of these main groups shows that the most fished belonging to the Ostheichtya group (126 species) and only 6 represented Condrichtya species. Mollusca were distributed as 31 species of Cephalopoda, 22 species of Gastropoda and 11 species of Bivalvia. Of the Crustacea , 56 species of the 60 observed species correspond to Decapoda. In Echinoderma, the most abundant were the Holothurioidea and Echinoidea groups with 7 and 6 species respectively, followed by Asteroidea and Ophiuroidea, both with 4 species and Crinoidea with 2 species. As regards Cnidaria groups, the Anthozoa Octocorallia were the most represented with 11 species.

Commercial species

A total of 90 species of different taxonomic groups form the commercialised fraction of the total catch. Figure 4.2.2.1 indicates the number of species and percentage in biomass of the commercialised fraction. The group of species that best represented the commercialised fraction was Ostheichtya fish with 56 species and 89% of the total caught biomass. The most represented species were *Micromesistius poutassou* with 56% of commercial catch, *Merluccius merluccius* with 9% and *Trachurus* spp. with 7%. Other important Osheichtya species are *Lophius piscatorius*, *Pagellus acarne*, *Phycis blennoides*, *Helicolenus dactylopterus*, *Lepidorhombus boscii*, *Boops boops*, *Trisopterus minutus*, *Mullus surmuletus* and *Conger conger* (Table 4.2.2.1). Condrychthya fishes are scarcely represented in the trawl catch (only 4 species and 1% of total biomass commercialised). Crustacean decapods is represented by 11 species and 5% of commercial biomass captured. *Nephrops norvegicus*, *Liocarcinus depurator* and *Plesionika* spp. were the most important crustaceans species commercialised. The only representative Hoplocarida was *Squilla mantis*. Mollusca Cephalopoda formed the 55% of commercialised catch and was represented by 12 species. *Eledone cirrhosa*, *Octopus vulgaris* and *Eledone moschata* were the most abundant commercialised species of Cephalopoda group. Also, 1 species of bivalves (*Pecten jacobeus*), gastropods (*Bolinus brandaris*) and holothurids (*Stichopus regalis*) were commercialised.

Table 4.2.2.1 shows the specific composition on the commercialised fraction of the total catch every month expressed in biomass (kg) by day and vessel. Some differences by month were observed, but *M. poutassou* and *M.merluccius* could be considered the target species of the studied float in Vilanova i la Geltrú along the sampled period. Monthly differences are related with bottom depth. In May and June, vessels operated in deeper bottoms and *Nephrops norvegicus* became a new target species.

Discarded species

A total of 294 species constituted the discarded fraction of the total catch. Figure 4.2.2.1. indicates the number of species and percentage in biomass of the discarded fraction. The group of species that best represented the discarded fraction was Ostheichtya fish with 109 species and 77% of the discarded biomass. Condrichthya fish were represented by 5 species and 4% of discarded biomass. Crustaceans are represented by 56 species and 6% in weight. Mollusca were the 4% of discarded biomass and included 29 species of Cephalopoda, 22 of Gasteropoda and 10 of Bivalvia. Echinoderma (23 species) and Cnidaria (21 species) represented both 3% of total discards. The rest of the taxonomic groups showed a lesser representation on the discard specific composition.

Table 4.2.2.2. shows the specific composition on the discarded fraction of the total catch every month expressed in biomass (kg) by day and vessel. *Micromesistius poutassou* was the species that accumulated the 50% of biomass discarded. Other Osteichthya fishes that represented an important part of discards were *Gadiculus argenteus*, *Lepidopus caudatus*, *Pagellus acarne*, *Trachurus trachurus*, *Boops boops*, *Trachyrhynchus trachyrhynchus*, *Spicara flexuosa*, *Capros aper* and *Coelorhynchus coelorhynchus*. *Scyliorhinus canicula*, *Galeus melastomus* and *Torpedo marmorata* were the main discarded Condrichtya fishes.

The most discarded crustaceans species were *Plesionika heterocarpus*, *Pasiphaea sivado*, *Munida intermedia*, *Dardanus arrosor*, *Pagurus prideauxi*, *Liocarcinus depurator* and *Solenocera membranacea*. Discarded Mollusca most representative species includes *Pteroctopus tetracirhus*, *Octopus salutii* and *Scaphander lignarius*.

As for Echinoderma, Echinoidea *Echinus acutus*, Asteroidea *Astropecten irregularis*, Holothuroidea *Holothuria forskali*, *H. tubulosa* and *Stichopus regalis* and Crinoidea *Leptometra phalangium* were the most important species of the discarded fraction. Some Tunicata species were well represented in discards, *Aplidium conicum*, *Microcosmus sulcatus* and *Phallusia mamillata*. *Aphrodite aculeata* (Annelida) and the Cnidarians *Calliactis parasitica*, *Pennatula phosphorea* and *Pteroides spinosum* were also part of the discard specific composition.

Discarded fraction on commercial species

Figure 4.2.2.2a,b shows the 10 target species with highest catch, by month, expressed in kg/day/vessel of the commercial and discarded catch. *Merluccius merluccius*, *Micromesistius poutassou, Nephrops norvegicus*, *Lophius piscatorius*, *Phycis blennoides* and *Eledone cirrhosa* were included in this group of main target species in the whole studied period (between February and July 2001). With exception of *M. poutassou*, the other five species showed a very small discarded fraction. *M. poutassou* was the exception among target species. In this species the discarded fraction could be important in some months (April, June). In April, the biomass of discarded fraction was bigger than the commercialised fraction. This exception is related to a recruitment period of *M. poutassou*.

Also some by catch species as *Scylliorhinus canicula*, *Pagellus acarne*, *Trachurus* spp, *Lepidopus caudatus* and *Plesionika* spp. showed relevant catches with important discarded fraction in some of the months.

Impact of discards in the communities

The list of most frequently discarded species (their presence was observed in 5 or 6 months during the six-months sampling period) indicated that hake trawl fisheries affect the benthic and epibenthic (demersal) communities of the continental shelf and upper slope (Table 4.2.2.2).

Characteristic demersal species of continental shelf are the Chondrichthya *Scyliorhinus canicula*, the Ostheichthya fishes, *Antonogadus megalokynodon*, *Gadiculus argenteus, Merluccius merluccius*, *Arnoglossus laterna*, *Lepidorhombus* spp., *Callionymus maculatus*, *Lepidopus caudatus*, *Lesueurigobius friesii, Spicara maena*, *Lepidotrigla cavillone*, *Macroramphosus scolopax* and the cephalopoda, *Alloteuthis media* and *Sepietta oweniana.* The most frequently discarded species from the benthic communities of the continental shelf make belong to a great diversity of taxonomic groups. Among them, Crustaceans as the hermit crabs, *Dardanus arrosor*, *Paguristes eremita*, *Pagurus excavatus*, the crabs *Goneplax rhomboides*, *Liocarcinus depurator*, *Macropodia longipes*, *Medorippe lanata*, and the Caridea shrimps *Alpheus glaber*, *Pontophilus spinosus*, the Mollusca gastropoda *Calliostoma granulatum* and *Lunatia fusca*, the Echinoidea *Brisopsis atlantica*, the Asteroidea *Astropecten irreg*ularis, the Holothuroidea, *Holothuria forskali*, *H. tubulosa* and *Stichopus regalis*, Annelida as *Aphrodite aculeata* and *Hyalinoecia tubicola.* The presence of cnidarians was very important, and the Hexacollaria *Calliactis parasitica* (this species exhibits a symbiotic relationship with *Dardanus arrosor*), the Octocorallaria *Alcyonum palmatum*, *Pennatula phosphorea* and *Pteroides spinosum* and the Hydrozoan *Aglaophenia acacia, Nemertesia antennina*, and *Thecocarpus myryophillum* were found among them. Also the tunicates *Corella parallelogramma*, *Microcosmus sulcatus* and *Phallusia mamillata* were present in a high frequency in discard samples.

Species discarded from the upper slope were dominated by Caridea crustaceans as *Chlorotocus crassicornis*, *Pasiphaea sivado*, *Philocheras echinulatus*, *Plesionika edwarsii*, *P. giglioli*, *P. heterocarpus*, *Pontocaris lacazei* and *Processa canaliculata.* Other frequent crustaceans species in discards were *Macropipus tuberculatus*, *Munida intermedia* and *Solenocera membranacea.* Ostheichthya fishes constituted other important group. *Chlorophthalmus agassizii*, *Stomias boa*, *Coelorhynchus coelorhynchus*, *Micromesistius poutassou*, *Phycis blennoides*, *Helicolenus dactylopterus*, *Symphurus nigrescens* and *Synchiropus phaeton* were the most frequent species in discards, as well as cephalopoda as *Abralia veranyi* and *Pteroctopus tetracirhus* and Chondrichtya fishes as *Galeus melastomus.*

Some pelagic and bathypelagic species also were affected by trawl activity. The fishes *Capros aper*, *Ceratoscopelus maderensis*, *Engraulis encrasicolus, Boops boop*s and *Trachurus* spp.; the gastropoda *Cymbulia peroni* and the Tunicata *Pyrosoma atlanticum* were frequent in discard samples.

As a summary we can conclude that hake trawl fisheries impact over the benthic and epibenthic (demersal) communities of continental shelf and upper slope. From the examination of the material obtained during the sampling on board commercial trawlers we have seen that the number of species affected by trawl is high. Thus, a total of 319 species belonging to 11 Phyla were identified in the sampling. The fraction commercialised of the catch was composed by 90 species, and the discarded fraction was formed by 294 species.

The vessels targeted to hake (*Merluccius merluccius)* include other species in their objectives. The most important were, *Micromesistius poutassou* and *Nephrops norvegicus*. With exception of *M. poutassou*, target species showed a very small fraction that was discarded.

The observed monthly differences in discard composition and biomass are related to recruitment periods and changes in the strategy followed by the fishermen. The main target species can change depending on the time of the year.

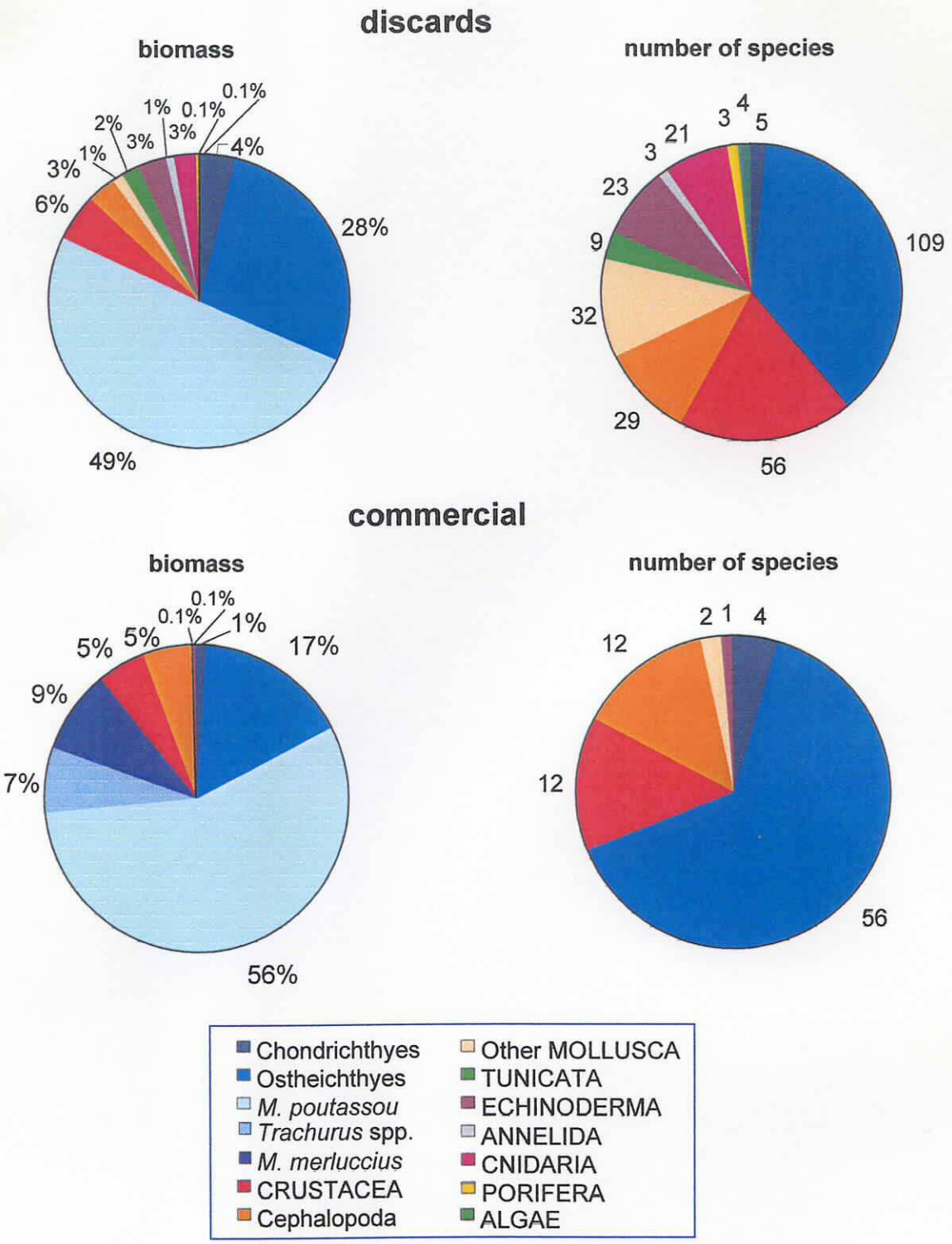


Figure 4.2.2.1. Vilanova i La Geltrú. Taxonomic composition in biomass and in number of species of discard and commercial fractions of the sampling catches.

Table 4.2.2.1. Vilanova i La Geltrú. Specific composition of commercial fraction of total trawl catches (kg/day/vessel)

	February	March	April	May	June	July
PISCES Chondrichthyes						
Galeus melastomus				0.333	0.333	
Scyliorhinus canicula		14.000		6.333	1.000	
Squalus acanthias				1.667		
Torpedo marmorata						0.750
PISCES Osteichthyes						
Anthias anthias		0.133				
Aspitrigla cuculus		0.333				
Atherina sp			0.033	0.200	1.000	0.083
Boops boops	0.667	6.633	3.333	1.200	8.333	1.000
Brama brama			0.133			
Callionymus maculatus		0.033				2.667
Centrolophus niger				0.333		
Cepola rubescens	1.167	0.200	0.700	0.700		0.233
Conger conger	3.400	4.733	0.433	3.167	1.667	1.467
Dactylopterus volitans		0.033				
Dentex dentex			0.333			
Diplodus sargus		0.100				
Diplodus vulgaris		1.000				0.033
Engraulis encrasicolus			0.017			
Eutrigla gurnadus		0.067				
Gadella maraldi		0.033				
Helicolenus dactylopterus	1.033	11.667	1.200	3.167	4.667	2.500
Lepidopus caudatus			2.667	0.333	0.333	0.500
Lepidorhombus boscii	1.833	5.233	1.900	5.500	7.667	1.867
Lophius budegassa				2.000		
Lophius piscatorius	10.667	28.333	11.000	10.000	8.667	11.717
Merluccius merluccius	25.333	62.667	31.667	22.400	32.667	42.333
Microchirus ocellatus		0.033				
Micromesistius poutassou	17.667	323.333	106.667	110.000	715.000	103.333
Molva dipterygia				0.033		
Mullus barbatus	0.833	4.000			0.033	4.333
Mullus surmuletus		6.400	3.067	0.200	0.400	7.067
Pagellus acarne		9.133		5.500	4.667	50.333
Pagellus bogavareo		0.483		0.033		
Pagellus erythrinus		3.000	1.500	0.167		1.667
Pagrus pagrus		0.367	1.167			
Phycis blennoides	4.333	10.150	4.333	9.333	8.333	2.667
Psetta maxima						0.833
Sardina pilchardus			2.700	0.500		
Scomber japonicus		0.333	4.333			
Scomber scombrus	1.200	1.200			0.667	2.400
Scorpaena notata		1.033				0.033
Scorpaena scrofa	0.100	0.867	0.417	0.833	0.500	0.250
Serranus cabrilla		0.900	0.667	0.033		0.100
Serranus hepatus	0.467	0.167				0.033
Serranus scriba						0.033
Solea vulgaris	0.100	0.500	0.333	0.167		1.000
Spicara flexuosa		0.133		0.000		

Table 4.2.2.1. (Cont.)

	February	March	April	May	June	July
PISCES Osteichthyes						
Spicara maena		0.033	3.333	0.167		
Spicara smaris		0.333				
Trachinus araneus	1.500	0.067				5.333
Trachinus draco		1.650	0.667	0.667		0.367
Trachurus sp.	2.333	59.817	47.000	3.667	2.000	58.050
Trigla lucerna	0.529	0.800	3.367	0.333		2.167
Trigla lyra	3.205	2.467	1.200	1.033	3.667	0.067
Trigloporus lastovitza		0.200	0.033		1.000	1.133
Trisopterus minutus	2.933	7.800	1.833	0.667	2.000	1.917
Uranoscopus scaber	0.167	1.067	0.083	0.033		1.233
Zeus faber		0.700	0.833	2.667	2.000	0.600
CRUSTACEA Decapoda						
Aristaeomorpha foliacea	0.300					
Liocarcinus depurator	4.833	2.383	5.200	8.667	5.667	0.467
Maja squinado				0.317		0.500
Munida intermedia	0.033			0.200	2.000	
Nephrops norvegicus	4.167	1.633	13.933	25.167	20.333	1.733
Palinurus elephas				0.167		0.167
Parapenaeus longirostris		0.033	1.667			
Pasiphaea sivado		3.833	0.083			
Plesionika spp.	5.067	12.250	2.500	6.533	0.333	
CRUSTACEA Hoplocarida						
Squilla mantis	0.167	0.100				0.200
MOLLUSCA Cephalopoda						
Eledone cirrhosa	20.667	9.667	8.333	5.667	5.533	5.667
Eledone moschata	0.067	1.667	4.000	3.333	5.833	3.667
Illex coindetii	1.000	2.800	2.333	0.700	0.667	0.267
Loligo vulgaris						9.000
Octopus salutii				0.033		
Octopus vulgaris	0.333	13.233	2.333	2.333	6.667	12.667
Sepia elegans		0.033				
Sepia officinalis	1.433	3.067				
Sepia orbignyana		0.167				
Sepiolidae	0.167	0.200				
Todarodes sagittatus	0.267			0.333		
MOLLUSCA Bivalvia						
Pecten jacobeus						0.100
MOLLUSCA Gastropoda						
Bolinus brandaris	0.033	0.233				0.133
ECHINODERMA Holothurioidea						
Stichopus regalis		0.767				2.867

Table 4.2.2.2. Vilanova i La Geltrú. Specific composition of discarded fraction of total trawl catches (kg/day/vessel). In bold letter are indicated the most frequent discarded species.

	February	March	April	May	June	July
PISCES Chondrichthyes						
Chimaera monstrosa				0.090	0.099	
Etmopterus spinax		0.217		0.037	0.052	
Galeus melastomus	0.091		0.186	0.605	1.246	0.240
Scyliorhinus canicula	6.140	1.908	1.165	3.017	0.887	1.455
Torpedo marmorata	0.104	1.710		0.350	0.047	
Ous Chondrichthya		0.250	0.021	0.014	0.004	0.018
PISCES Osteichthyes						
Anthias anthias		0.011				
Antonogadus megalokynodon	0.038	0.076	0.019	0.127	0.027	0.027
Argentina sphyraena	0.005	0.701	0.262	0.465	0.119	0.060
Arnoglossus imperialis		0.023				0.003
Arnoglossus laterna	0.243	0.346	0.196	0.184	0.006	0.211
Arnoglossuss thori		0.076				0.060
Aspitrigla obscura	0.016					0.011
Bellotia apoda				0.001		
Blennius ocellaris	0.057		0.033	0.017		
Boops boops	1.958	2.440	2.054	1.875	0.080	2.633
Callionymus maculatus	0.084	0.081	0.087	0.076	0.021	0.052
Callionymus risso	0.027	0.003	0.001			0.039
Carapus acus		0.001				0.007
Capros aper	0.043	1.091	0.494	1.976	1.229	0.290
Cepola rubescens	0.022	0.013			0.003	
Ceratoscopelus maderensis	0.658	0.057	0.040	0.277	0.047	0.005
Chlorophthalmus agassizii	0.009	0.017	0.018	0.105	0.023	
Citharus linguatula	0.047	0.062	0.006			0.040
Coelorhynchus coelorhynchus	0.055	0.991	0.175	0.920	2.479	0.385
Conger conger	0.013	0.183			0.110	
Crystallogobius linearis			0.001			
Dalophis imberbis	0.009					0.034
Deltentosteus quadrimaculatus		0.490	0.064			0.529
Diplodus annularis						0.207
Diplodus vulgaris		0.022				
Echelus myrus			0.040			1.542
Engraulis encrasicolus	0.043		0.015	0.983	0.018	0.461
Epigonus constanciae		0.150		0.041		
Epigonus denticulatus		0.012	0.038	0.286	0.282	
Epigonus telescopus	0.001			0.007	0.057	
Eutrigla gurnadus						0.032
Gadella maraldi		0.001		0.040		
Gadiculus argenteus	3.756	11.274	2.358	3.060	5.970	0.872
Gobius fallax		0.033		0.030		
Gobius niger	0.003			0.067	0.040	0.007
Helicolenus dactylopterus	1.202	1.619	0.111	0.260	0.458	0.109
Hygophum benoiti		0.020				
Hymenocephalus italicus					0.140	
Lampanyctus crocodilus				0.116	0.063	
Lepidopus caudatus	0.868	1.240	4.484	5.003	1.193	1.033

Table 4.2.2.2. (Cont.)

	February	March	April	May	June	July
PISCES Osteichthyes						
Lepidorhombus boscii	0.275	0.530	0.116	0.219	0.620	0.093
Lepidorhombus whiffagonis	0.052	0.163	0.029	0.084	0.006	0.005
Lepidotrigla cavillone	0.046	0.037	0.008	0.001	0.005	0.005
Lesueurigobius friesii	0.172	0.369	0.066	0.660	0.083	0.003
Lesueurigobius suerii	0.001					
Lophius budegassa			0.004	0.029	0.033	
Lophius piscatorius			0.007	0.023		
Macroramphosus scolopax		0.344	0.003	0.113	0.003	0.008
Maurolicus muelleri	0.014	0.004		0.004	0.004	
Merluccius merluccius	0.165	0.297	0.059	0.309	0.363	0.122
Micromesistius poutassou	0.222		199.800	0.014	49.490	2.663
Molva dipterygia	0.053			0.005		0.015
Mullus barbatus						0.023
Mullus surmuletus						0.050
Myctophum punctatum				0.007	0.068	
Nezumia aequalis				0.004		
Notacanthus bonapartei				0.213	0.181	
Notolepis rissoi				0.032	0.018	
Notoscopelus elongatus	0.622	0.273	0.046	0.590	0.199	0.009
Ophichthus rufus	0.004					
Ophidion barbatum	0.014	0.112		0.020		
Pagellus acarne						12.035
Pagellus bogavareo	0.020	0.316			0.360	0.124
Pagellus erythrinus		0.020				
Peristedion cataphractum		0.198	0.074			
Phycis blennoides	0.002	0.088	0.505	0.755	1.214	0.359
Pomatoschistus microps	0.025	0.002	0.001			0.022
Sardina pilchardus	0.077			0.467		0.391
Sardinella aurita			0.021			0.045
Scomber scombrus			0.013			0.055
Scorpaena elongata		0.033				0.003
Scorpaena loppei						0.002
Serranus cabrilla		0.005	0.006			
Serranus hepatus	0.210	0.033				0.012
Spicara flexuosa	0.482	2.360	2.047			2.317
Spicara maena	0.133	0.082	1.470	0.167		0.462
Spicara smaris		0.932				0.051
Stomias boa	0.012	0.008	0.046	0.196	0.334	
Sympbolophorus veranyi				0.005		
Symphurus nigrescens	0.024	0.094	0.007	0.267	0.080	
Synchiropus phaeton		0.020	0.087	0.094	0.156	0.065
Trachurus mediterraneus	0.313	0.599	0.045	0.416	1.040	0.068
Trachurus picturatus						0.126
Trachurus trachurus	0.047	0.030	0.002	0.490		10.562
Trachyrhynchus trachyrhynchus		0.350	0.140	7.583	1.868	
Trigla lucerna						0.051
Trigla lyra	0.028				0.012	0.013
Trigloporus lastovitza						0.040
Trisopterus minutus					0.076	0.059
Zeus faber		0.112				

Table 4.2.2.2. (Cont.)

	February	March	April	May	June	July
CRUSTACEA Decapoda						
Alpheus glaber	0.004	0.001		0.012	0.002	0.001
Atelecyclus rotundatus		0.027				0.036
Calappa granulata						0.003
Chlorotocus crassicornis	0.033	0.020	0.003		0.121	0.016
Dardanus arrosor	0.180	1.395	0.046	0.306		0.474
Dromia personata		0.043				
Galathea intermedia			0.001			0.001
Goneplax rhomboides	0.017	0.013	0.006	0.162	0.016	0.013
Inachus communissimus	0.341					0.004
Inachus thoracicus		0.040				0.067
Liocarcinus depurator		0.405	0.194	0.264	0.262	0.381
Macropipus tuberculatus	0.195	0.286	0.046	0.111	0.151	0.083
Macropodia longipes	0.008	0.036	0.030	0.138	0.018	0.026
Medorippe lanata	0.001	0.017	0.018	0.035	0.006	0.095
Monodaeus couchi			0.003	0.023		0.001
Munida intermedia	0.164	0.295	0.028	0.496	1.381	0.107
Munida iris	0.064		0.005	0.001	0.014	
Munida tenuimana					0.042	
Nephrops norvegicus			0.020	0.036	0.113	0.034
Paguristes eremita	0.002	0.023	0.000	0.001		0.007
Pagurus alatus				0.046		
Pagurus cuanensis		0.004	0.001	0.001		0.002
Pagurus excavatus	0.066	0.163	0.018	0.144	0.007	0.039
Pagurus prideauxi		0.713	0.011	0.017		1.627
Palinurus mauritanicus	0.003					
Parapenaeus longirostris					0.013	
Parthenope macrochelos		0.120		0.057		0.005
Parthenope massena			0.001	0.007		0.007
Pasiphaea multidentata					0.151	
Pasiphaea sivado	0.460	0.133	0.011	3.095	0.734	0.008
Philocheras echinulatus	0.002	0.003	0.001	0.005	0.002	
Pilumnus spinifer						0.002
Pinnotheres pinnotheres						0.003
Pissa armata		0.027				
Plesionika antigai	0.002			0.017	0.066	
Plesionika edwarsii	0.213	0.064	0.007	0.268	0.116	0.250
Plesionika giglioli	0.012	0.005	0.045	0.072	0.327	0.026
Plesionika heterocarpus	0.175	3.138	0.482	1.380	1.182	0.796
Plesionika martia				0.006	0.173	
Plesionika narval			0.010		0.008	
Polycheles typhlops		0.028		0.003	0.003	
Pontocaris cataphracta	0.007	0.004	0.003			0.023
Pontocaris lacazei	0.010	0.010	0.006	0.097	0.052	
Pontophilus spinosus	0.054	0.039	0.030	0.315	0.101	0.018
Processa canaliculata	0.038	0.002	0.005	0.042	0.058	0.002
Processa nouveli				0.003		
Scyllarus pygmaeus			0.001			
Sergestes arcticus				0.045	0.003	
Sergestes corniculum				0.007		
Sergia robusta					0.013	

Table 4.2.2.2. (Cont.)

	February	March	April	May	June	July
CRUSTACEA Decapoda						
Solenocera membranacea	0.101	0.005	0.009	0.154	0.765	0.073
CRUSTACEA Euphasiacea						
Meganictiphanes norvegicus	0.010	0.004	0.000	0.050		
CRUSTACEA Cirripeda						
Scalpellus scalpellus		0.022	0.011			
CRUSTACEA Isopoda						
Isopoda sp. 1	0.006			0.006		0.001
MOLLUSCA Cephalopoda						
Abralia veranyi	0.062	0.008	0.056	0.035	0.003	
Alloteuthis media	0.006	0.005	0.007	0.030	0.003	0.069
Bathypolypus sponsalis				0.047		
Eledone cirrhosa	0.216	0.432	0.003	0.011		
Eledone moschata	0.001					
Histioteuthis bonnellii					0.340	
Histioteuthis reversa				0.024		
Illex coindetii	0.017					
Loligo vulgaris		0.016	0.001			0.027
Neorosia caroli			0.003			
Octopus salutii	0.213	0.673	0.111		0.255	
Pteroctopus tetracirrhus	0.137	1.505	1.787	3.360	3.790	0.510
Rondeletiola minor		0.004	0.011	0.023	0.045	
Rossia caroli		0.011				
Sepia elegans	0.007	0.026		0.008		0.028
Sepia orbignyana		0.048				
Sepietta neglecta	0.010	0.017				
Sepietta obscura		0.010				
Sepietta oweniana	0.038	0.186	0.003	0.168	0.091	0.050
Sepietta sp	0.008				0.009	0.021
Sepiola aurantiaca		0.004				
Sepiola intermedia		0.013				0.003
Sepiola ligulata	0.003			0.003		
Sepiola robusta	0.002					
Sepiola sp.				0.001		
Todarodes sagittatus			0.013			
Theutoidea sp.1		0.003				0.011
Sepiolidae eggs			0.011			
MOLLUSCA Bivalvia						
Acanthocardia echinata	0.022					
Actrina pectinata		0.170				0.563
Aequipecten opercularis			0.002			
Anomia ephippium	0.002	0.026				0.031
Circomphalus casinus			0.022			
Nucula nucleus			0.000			
Ostrea edulis	0.137	0.020				
Oxinoë olivacea		0.001				

Table 4.2.2.2. (Cont.)

	February	March	April	May	June	July
MOLLUSCA Bivalvia						
Parvicardium exiguum			0.002			
Pteria hirundo		0.054	0.053			
MOLLUSCA Gastropoda Prosobranchia						
Aporrhais serresianus		0.022	0.015	0.004		0.020
Bolinus brandaris	0.002					0.004
Calliostoma granulatum	0.116	0.228	0.021	0.038	0.005	0.057
Carinaria lamarcki			0.014			
Cassidaria echinophora	0.113	0.016	0.026		0.058	
Cassidaria thyrrena	0.013	0.018				
Hexaplex trunculus			0.003	0.029		
Lunatia fusca	0.051	0.004	0.033	0.005		0.017
Turritella communis			0.005			
Turritella turbona	0.001					
Gasteropoda eggs				0.027	0.400	0.169
MOLLUSCA Gastropoda Opistobranchia						
Aplysia depilans	0.001	0.003				0.095
Aplysia punctata			0.003			
Armina tigrina	0.001		0.002			
Cymbulia peroni	0.011	0.045	0.176	0.270	0.036	
Dendrodoris grandiflora	0.004					
Dorinidae sp 1		0.183				
Dorinidae sp 2		0.162				0.038
Philine aperta		0.009	0.001	0.003		
Scaphander lignarius		1.105	0.012	0.042		0.001
Tethys fimbria	0.021	0.059		0.022		0.097
ECHINODERMA Echinoidea						
Brissopsis atlantica	0.006		0.007	0.033	0.023	0.022
Echinus acutus		0.778	0.021	0.063		0.267
Echinus melo						0.233
Paracentrotus lividus			0.017			
Psammechinus microtuberculatus	0.001	0.059	0.009	0.003		
Sphaerechinus granularis		0.038				0.455
ECHINODERMA Asteroidea						
Anseropoda placenta		0.664	0.003	0.007		0.275
Astropecten aurantiacus		0.156				0.124
Astropecten irregularis	0.481	1.053	0.622	1.205	0.454	0.112
Echinaster sepositus		0.247		0.020		0.076
ECHINODERMA Holothurioidea						
Holothuria forskali	0.265	0.242	0.136	0.300	0.088	0.400
Holothuria tubulosa	0.095	0.590	0.013	0.262	0.019	0.314
Molpadia musculus		0.001				
Ocnus planci	0.372	0.296	0.036	0.132		0.155
Phyllophorus urna			0.009			
Stichopus regalis	0.102	0.804	0.025	0.113	0.058	0.191
Trachythyone tergestina	0.013	0.001				

Table 4.2.2.2. (Cont.)

	February	March	April	May	June	July
ECHINODERMA Ophiurioidea						
Ophiura ophiura		0.168	0.006	0.367		0.130
Ophiura texturata						0.003
Ophioderma longicaudata		0.017				
Ophiothrix fragilis		0.013				
ECHINODERMA Crinoidea						
Antedon mediterraneum		0.001	0.001		0.001	
Leptometra phalangium		0.007	0.002	2.351	0.001	
ANNELIDA Polychaeta						
Aphrodite aculeata	0.117	0.683	0.015	0.313	0.165	0.938
Hermione hystrix		0.203			0.006	0.133
Hyalinoecia tubicola	0.022	0.224	0.117	0.073		0.178
CNIDARIA Scyphozoa						
Rhizostoma pulmo						0.560
CNIDARIA Anthozoa Hexacorallaria						
Adamsia palliata		0.109	0.002	0.003		0.300
Calliactis parasitica	0.149	1.363	0.130	0.297		0.525
Dendrophyllia sp	0.001					
Anthozoa Hexacorallaria spp	0.001		0.340	0.135	0.061	0.001
CNIDARIA Anthozoa Octocorallaria						
Alcyonum palmatum	0.353	1.265	0.393	0.092	0.022	0.879
Cavernullaria pusilla	0.009					
Eunicella cavolini		0.008				0.005
Eunicella singularis		0.029				0.004
Eunicella verrucosa		0.005				
Epizoanthus mediterraneus						0.022
Funiculina quadrangularis	0.003			0.002		
Leptogorgia sarmentosa	0.005	0.040		0.001		0.016
Pennatula phosporea	0.068	1.708	0.004	0.010	0.006	0.823
Pteroides spinosum	0.178	0.922	0.029	0.008	0.003	0.783
Veretillum cynomorium	0.101	0.041	0.042			0.017
CNIDARIA Hydrozoa						
Aglaophenia acacia	0.002	0.003	0.007	0.002	0.001	0.060
Nemertesia antennina	0.053		0.003	0.037	0.010	0.065
Nemertesia ramosa	0.046	0.191		0.023		0.229
Thecocarpus myryophyllum	0.004	0.005	0.082	0.010	0.008	0.006
TUNICATA Thaliacea						
Pyrosoma atlanticum	0.003	0.055	0.140	0.001	0.006	0.003
Salpa maxima	0.151		2.323			
TUNICATA Ascidiacea						
Ascidia conchilega					0.016	
Corella parallelogramma	0.008	0.335	0.201	0.125	0.014	0.113
Botrylloides leachi		0.010				
Aplidium conicum						3.944

Table 4.2.2.2. (Cont.)

	February	March	April	May	June	July
TUNICATA Ascidiacea						
Microcosmus sulcatus	0.043	1.522	0.032	0.020		0.117
Phallusia mamillata	0.050	0.110	0.103	0.041		0.786
Ascidiacea sp.1				0.120		
BRIOZOA						
Smittina cervicornis		0.050				
PORIFERA						
Ircinia muscarum				0.867		
Suberites domuncula	0.014	0.405	0.101			0.075
Porifera spp.		0.271				
ALGAE CLOROPHICEAS						
Codium bursa	0.025		0.023			
Codium tomentosum	0.009					
Dictiota dicotoma						0.108
ALGAE RODOPHICEAS						0.008

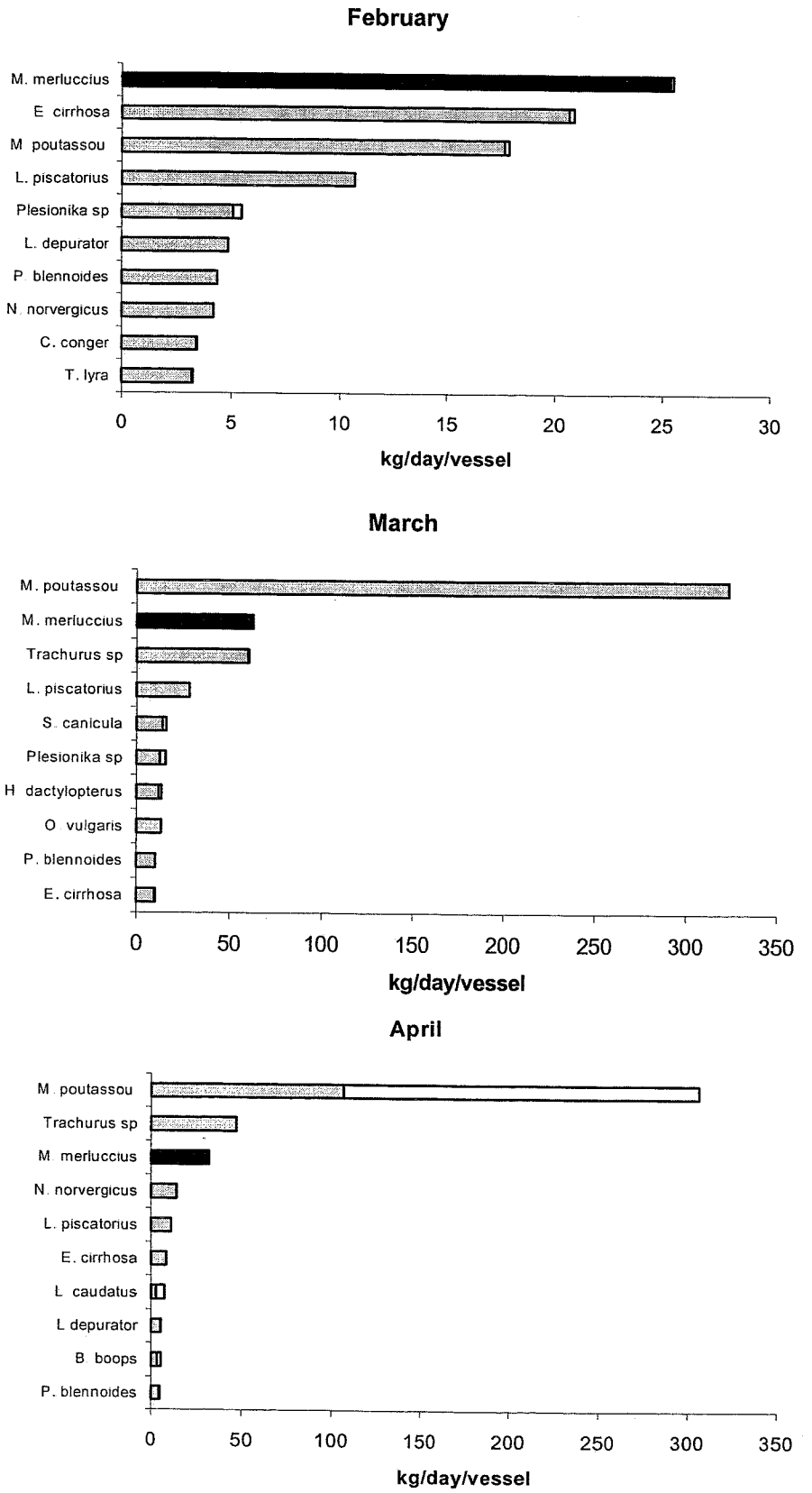


Figure 4.2.2.2a. Vilanova i La Geltrú. Commercial landings (in grey colour) and discards (in white colour) of the 10 most abundant species expressed in kg/day/vessel. Commercial landings of *M. merluccius* are indicated in black colour.

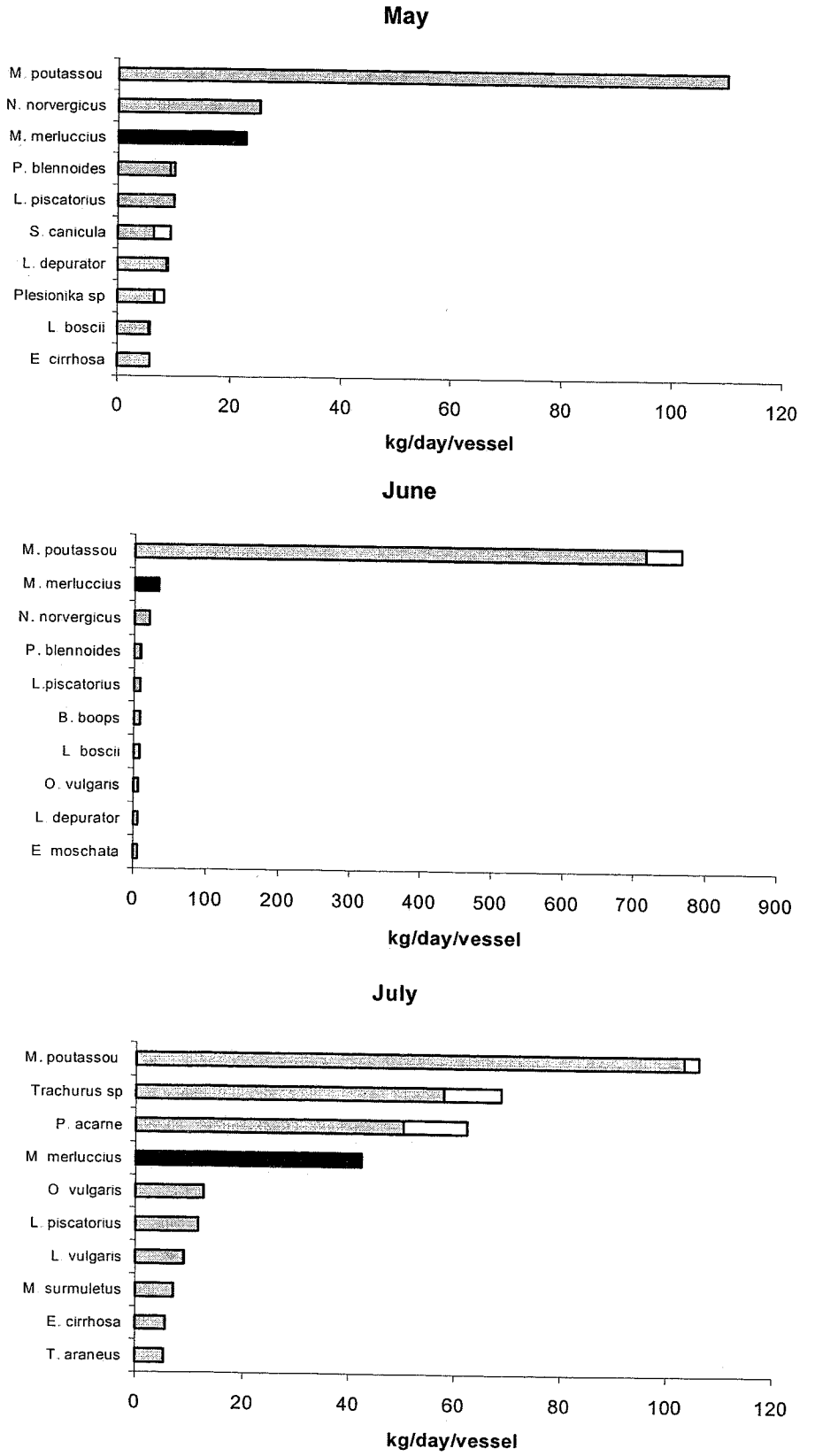


Figure 4.2.2.2b. Vilanova i La Geltrú. Commercial landings (in grey colour) and discards (in white colour) of the 10 most abundant species expressed in kg/day/vessel. Commercial landings of *M. merluccius* are indicated in black colour.

4.2.3 Santa Pola

Figure 4.2.3.1 shows the biomass composition as a percentage of the discarded and commercialised main groups in the sampling catches and the number of species for each group for both fractions.

The Osteicthyes discard biomass represented 80% of the total biomass, while for Chondrichthyes it was 2%. The second group most discarded was comprised of crustaceans that represented 15% of the biomass. In landings, Osteicthyes represented 49% of the landed biomass, Chondrichthyes and crustaceans were both 22%, and cephalopods reached 7%.

European hake (*Merluccius merluccius*) discards represented 0.1% of the total discarded biomass whereas by landing it was 20.5% (Figure 4.2.3.1).

The discard incidences (Figure 4.2.3.2a,b) in the most valuable species were very low or null such as was the case for *M. merluccius*, *Lophius budegassa, Octopus vulgaris* and *Parapenaeus longirostris*. A similar null incidence of discards could be seen in other less abundant but high commercial value species such as *Mullus* spp., *Sepia officinalis*, *Zeus faber* and *Scomber scombrus*.

The European hake was always among the three most important species by weight. The other two species were blue whiting (*Micromesistius poutassou*) and white shrimp (*P. longirostris*). The increased importance of white shrimp in June and July could be more related to the increasing depth of trawling than to the period of the year. Nevertheless, the spring could have some importance in the blue whiting catches, since there was an increase from March to June.

Table 4.2.3.1 shows the list of commercialised species. In total, 92 species were commercialised, of which 65 corresponded to fish, 14 were crustaceans and 13 were cephalopods.

The most important landed fish species corresponded to *M. poutassou*, *M. merluccius*, *Trachurus trachurus*, *Trachurus mediterraneus*, *L. budegassa* and *Cepola rubescens*, as well as the shark *Scyliorhinus canicula*. Among the crustaceans *P. longirostris, Plesionika heterocarpus* and *Liocarcinus depurator* were the most landed. Cephalopods mostly caught were *O. vulgaris* and *Todarodes sagittatus*.

There were 113 discard species (Table 4.2.3.2), of which 73 were fishes, 20 were crustaceans and 9 were cephalopods. Among the fish, 31 discarded species were also commercialised. There were 9 crustacean species and 8 cephalopod species that were commercialised and also discarded.

Other groups, such as gastropods and urchins (including the starfish), were present with 3 and 4 species respectively and they were completely discarded. Other invertebrates were very scarce in the samples.

The most discarded species by quantity were *Boops boops*, *Lepidopus caudatus*, *Sardina pilchardus*, *Helicolenus dactylopterus*, *Pagellus acarne* and *Gadiculus argenteus*.

The most important discarded species with commercial value among the Chondrichthyes was *S. canicula*. For the Osteichthyes, *H. dactylopterus*, which was also commercialised in the red shrimp fishery where the largest specimens were captured, *P. acarne* and *Diplodus annularis* were discarded by size.

Blue whiting (*M. poutassou*), with a considerable commercial value and one of the most important species in this fishery, was discarded when large quantities were caught in one single haul since this increased the number of small and damaged specimens.

European hake (*M. merluccius*) was discarded in very small quantities, since out of a total of 34 hauls only 1.7 kg was discarded. The hake discards were composed of deteriorated individuals and small size specimens (< 14 cm TL). European hake represented 20% of the total haul landings sampling. The discards for the whole period were 0.24% of the discarded sampled catches. Landings were highest at the end of March and May. The discard by weight followed the same pattern as the landings by weight.

Some species, such as *Boops boops* and *L. caudatus*, could have been commercialised but they had no real commercial value, and although they could be caught in large quantities they were almost completely discarded. The most discarded crustaceans corresponded to the pandalid shrimp *P. heterocarpus* and the crab *L. depurator*.

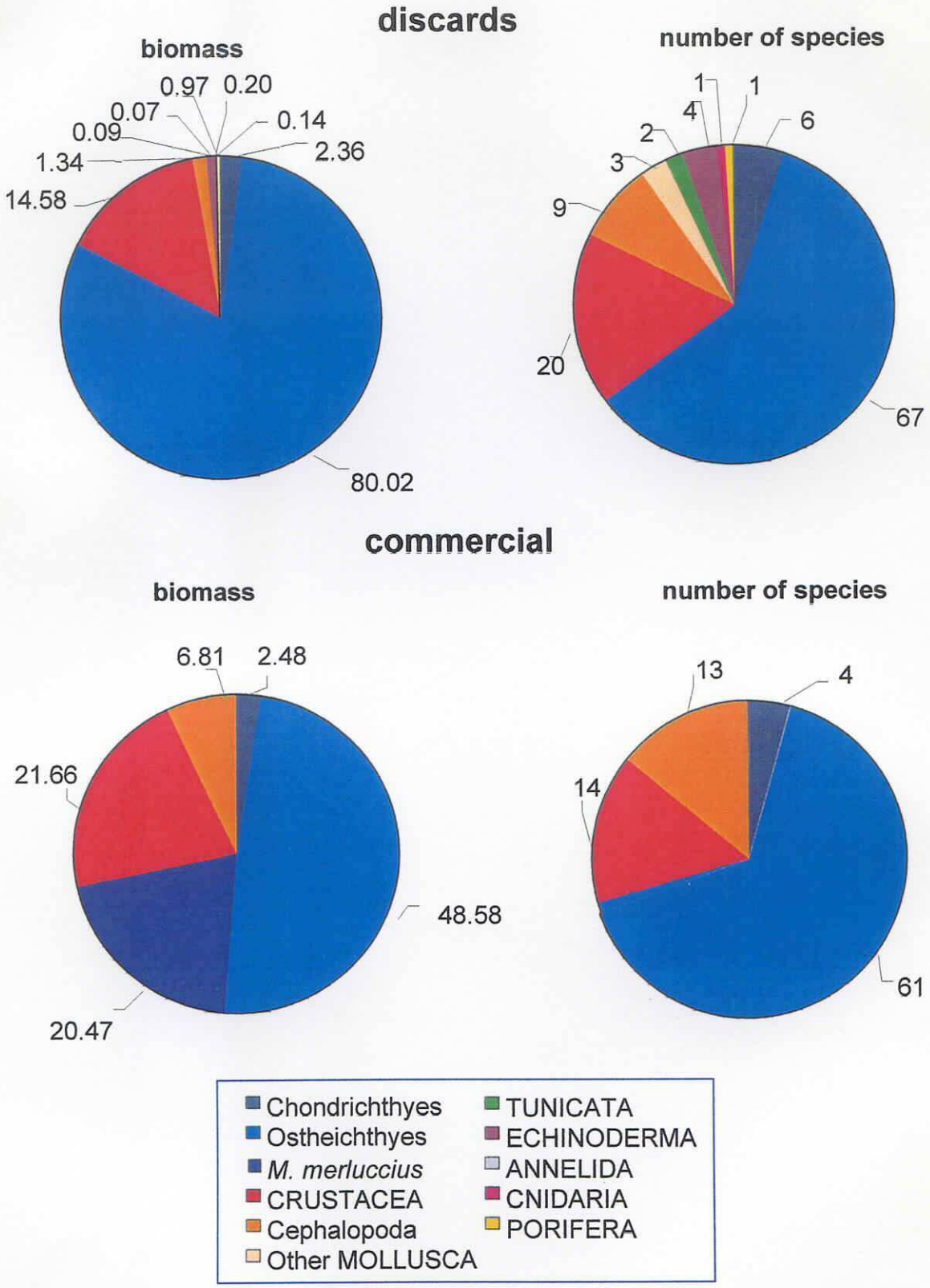


Figure 4.2.3.1.Santa Pola. Taxonomic composition in biomass and in number of species of discard and commercial fractions of the sampling catches.

Table 4.2.3.1. Santa Pola. Specific composition of commercial fraction of total trawl catches (kg/day/vessel)

	February	March	April	June	July
PISCES Chondrichthyes					
Pleurotremata					
Scyliorhinus canicula	8.900	4.000	2.333	2.667	25.833
Hypotremata					
Raja asterias		0.237	0.069		
Raja clavata	1.333	0.333			
Raja sp		0.183	0.079		4.000
PISCES Osteichthyes					
Anthias anthias		0.050			0.043
Antonogadus megalokynodon				0.006	
Argentina sphyraena					0.013
Arnoglossus laterna		0.003		0.002	
Arnoglossus rueppelli		0.008			
Aspitrigla cuculus		0.025			
Atherina boyeri	1.333	5.000		0.667	0.667
Blennius ocellaris	0.080	0.040	0.016		0.062
Boops boops	8.000	0.048			20.083
Callionymus maculatus		0.001			
Capros aper	0.001				0.012
Caranx rhonchus					0.102
Centracanthus cirrus		0.018			
Cepola rubescens	6.736	1.676	21.232	16.107	7.492
Chlorophthalmus agassizii					0.006
Citharus linguatula		0.833		0.431	
Conger conger	2.667	1.000	2.022		6.667
Deltentosteus quadrimaculatus		0.002			
Diplodus annularis				3.745	
Diplodus vulgaris		0.015			
Engraulis encrasicolus				2.673	2.333
Gadiculus argenteus	0.002	0.006		0.005	
Gobius niger		0.694		0.817	
Helicolenus dactylopterus	8.260	5.488	2.909	4.044	1.860
Lepidopus caudatus	0.007		0.031		
Lepidotrigla cavillone	0.186	0.847	0.055	0.867	8.813
Lesueurigobius sp	0.001				
Lophius budegassa	18.460	8.386	11.323	12.720	14.600
Macroramphosus scolopax	0.009				0.003
Maurolicus muelleri	0.001		0.001		
Merluccius merluccius	80.837	64.091	117.690	74.000	76.167
Microchirus variegatus	0.009	0.037			0.050
Micromesistius poutassou	23.000	69.333	76.669	249.675	27.667
Mullus barbatus	3.500	4.167	2.333	5.667	11.667
Mullus surmuletus	3.500	4.833	1.333	7.333	8.333
Ophidion barbatum		0.012	0.013	0.201	0.001
Pagellus acarne		2.967	8.826		
Pagellus bogaraveo	0.135	0.516	3.592	2.804	4.800
Pagellus erythrinus		0.374			
Pagrus pagrus				3.333	
Peristedion cataphractum	0.170	0.088	0.019	0.096	0.020
Phycis blennoides	6.706	2.500	2.333	7.335	7.667
Sardina pilchardus		31.667			11.667
Sardinella aurita			0.733		

Table 4.2.3.1. (Cont.)

	February	March	April	June	July
PISCES Osteichthyes					
Scomber scombrus	3.811			0.058	16.667
Scorpaena elongata	0.079	0.048			
Scorpaena notata	0.034	0.410		1.177	
Serranus cabrilla		0.078	0.028		0.085
Serranus hepatus		1.139		2.009	7.825
Spicara flexuosa		3.674		11.667	0.703
Symphurus nigrescens	0.002				0.001
Synchiropus phaeton		0.007			
Trachinus draco		0.184		0.428	
Trachurus mediterraneus			7.000		43.333
Trachurus picturatus		0.333		0.486	
Trachurus trachurus	28.333	10.667	0.333	16.667	
Trisopterus minutus capelanus	0.691	0.667			0.667
Uranoscopus scaber		0.035		0.011	
Xiphias gladius					4.667
Zeus faber	1.559	2.264	0.022	0.897	1.000
CRUSTACEA					
Calappa granulata		0.375		0.105	0.029
Chlorotocus crassicornis	0.001		0.001		
Dardanus arrosor	0.096			0.022	0.011
Liocarcinus depurator	15.152	12.260	6.859	7.671	10.239
Macropipus tuberculatus		1.101		0.194	0.051
Munida sp.	0.002	0.042	0.006	0.003	0.003
Nephrops norvegicus		0.067	0.167	0.667	2.733
Parapenaeus longirostris	54.004	48.837	72.333	53.333	54.672
Pasiphaea sivado					2.673
Plesionika heterocarpus	0.038	0.004	23.348	23.334	21.667
Plesionika martia			2.500		3.067
Plesionika sp					10.000
Solenocera membranacea	0.001		0.003		0.008
Squilla mantis	0.005	4.708	0.014	4.379	0.001
MOLLUSCA Cephalopoda					
Alloteuthis media	8.673	2.167	1.067	1.667	3.000
Eledone cirrhosa	2.333	2.667	1.667	3.000	1.333
Illex coindetii	0.013	0.167	0.333	0.280	0.045
Loligo vulgaris		1.333	0.333	1.333	0.333
Octopus vulgaris	10.000	14.667	4.833	23.333	15.000
Rossia macrosoma				0.255	0.174
Sepia officinalis	2.000	3.333		1.000	0.333
Sepietta sp			0.500		
Sepiola sp		0.042		0.032	0.516
Todarodes sagittatus	8.000	5.000	5.167	7.667	3.577
Todaropsis eblanae		0.092			
MOLLUSCA Gastropoda					
Argobuccinum giganten		0.051			
Bolinus brandaris					0.008
ECHINODERMA Asteroidea					
Astropecten irregularis		0.001			

Table 4.2.3.2. Santa Pola. Specific composition of discarded fraction of total trawl catches (kg/day/vessel). In bold letter are indicated the most frequent discarded species.

	February	March	April	June	July
PISCES Chondrichthyes					
Pleurotremata					
Galeus melastomus				0.056	2.547
Scyliorhinus canicula	2.334	0.478	0.016	0.894	5.069
Hypotremata					
Raja asterias		1.994			
Raja clavata			0.031		
Raja sp				1.958	0.496
Torpedo marmorata			0.176	0.414	
PISCES Osteichthyes					
Antonogadus megalokynodon	0.764				
Arnoglossus imperialis	0.482	0.084	0.113	1.355	
Arnoglossus laterna	0.130	3.107	1.270	4.194	0.356
Arnoglossus rueppelli	1.318	0.378	0.686	0.827	0.039
Arnoglossus thori		0.024	0.046		
Aspitrigla cuculus			0.035		
Atherina boyeri	0.092	0.004	0.156		
Blennius ocellaris	0.032			0.421	
Boops boops	15.646	94.521	11.379		56.745
Callionymus maculatus	0.586		0.021		0.159
Capros aper	2.200	0.302	0.983	1.878	4.971
Centracanthus cirrus		0.171			
Cepola rubescens	1.567	0.310	0.174	2.234	0.096
Ceratoscopelus maderensis					0.154
Citharus linguatula				0.384	
Coelorhynchus coelorhynchus				0.142	
Conger conger	0.528	0.613	1.173	2.422	2.704
Deltentosteus quadrimaculatus		0.396	0.144		0.639
Diplodus annularis	0.115			15.989	
Echelus myrus	0.022				
Echiodon dentatus	0.073				
Engraulis encrasicolus	0.722			8.559	0.174
Epigonus telescopus					0.063
Gadiculus argenteus	4.192	5.411		17.891	3.086
Gnatophis mystax	0.022				
Helicolenus dactylopterus	23.875	0.456	2.564	25.568	
Hoplostethus mediterraneus	1.905				0.084
Lepadogaster candollei	0.461				
Lepidopus caudatus	1.188	5.289	17.170	26.659	4.312
Lepidotrigla cavillone				0.202	
Lesueurigobius friesii	0.188				
Lesueurigobius sanzoi		0.299			
Lesueurigobius sp	1.311				
Lophius budegassa		0.056	0.010	0.837	0.194
Macroramphosus scolopax	0.244		0.164		
Maurolicus muelleri	0.135	0.123		0.610	4.074
Melanostigma atlanticum				0.136	

Table 4.2.3.2. (Cont.)

	February	March	April	June	July
PISCES Osteichthyes					
Merluccius merluccius	0.524	0.315	0.519	0.325	0.007
Microchirus variegatus			0.107		
Micromesistius poutassou		1.626		2.988	5.453
Mullus surmuletus				0.220	0.061
Nemichthys scolopaceus	2.742				
Ophidion barbatum	0.540	3.968	2.026	12.812	0.622
Pagellus acarne		5.635	0.125	43.807	
Pagellus bogaraveo	0.549			0.139	7.033
Paralepis coregonoides	0.722				
Peristedion cataphractum	0.172	0.139	0.006		
Pomadasys incisus	0.094				
Regalecus glesne	0.471				
Sardina pilchardus	0.010	29.852	0.382	20.671	2.543
Sardinella aurita	1.747			1.614	
Sarpa salpa	0.136				
Scorpaena notata					0.122
Serranus hepatus					0.719
Serranus scriba	0.011				
Spicara flexuosa			0.101		4.794
Spicara smaris	0.157				
Stomias boa					0.258
Symphurus nigrescens	0.592				
Synchiropus phaeton		0.776		0.300	
Trachinus araneus	0.042				
Trachurus mediterraneus				3.094	
Trachurus picturatus		0.707		0.622	
Trachurus trachurus	0.899	1.777	0.012		
Trisopterus minutus capelanus	0.128				1.033
Zeus faber				0.032	
CRUSTACEA					
Calappa granulata			0.131	1.818	0.086
Chlorotocus crassicornis	0.663	2.185	1.253	0.836	
Dardanus arrosor			0.190	0.167	
Liocarcinus depurator	4.223	1.475	2.841	1.588	5.076
Lophogaster typicus			0.053		
Macropipus tuberculatus					0.671
Munida sp.	1.988	3.250	3.694	9.994	2.055
Munida tenuimana			0.057		
Pagurus prideaux			0.076	0.110	
Parapenaeus longirostris	0.171				
Partenope massena	0.147				
Pasiphaea multidentata			0.047		1.572
Pasiphaea sivado	0.097	1.571	0.121		1.834
Plesionika edwarsii		0.035			0.050
Plesionika heterocarpus	17.775	0.100	0.120	0.211	0.074
Plesionika sp					0.235
Polybius henslowii	0.848				
Scyllarus sp	0.283				
Solenocera membranacea	10.958	6.560	3.864	3.113	4.649

Table 4.2.3.2. (Cont.)

	February	March	April	June	July
CRUSTACEA					
Squilla mantis	0.417	0.649	1.155	0.415	0.230
MOLLUSCA Cephalopoda					
Alloteuthis media	0.489	0.263	0.082	0.208	0.053
Eledone cirrhosa			0.603	0.524	
Eledone moschata	2.847	0.384		0.077	
Illex coindetii	0.135	0.081	0.019	0.127	
Octopus salutii	0.251		0.053	0.713	0.127
Octopus vulgaris	0.330				0.127
Sepia officinalis	0.241				
***Sepiola* spp.**	0.075	0.423	0.040	0.521	0.446
Todarodes sagittatus				0.050	0.061
MOLLUSCA Bivalvia					
Aequipecten opercularis	0.167				
Mactra corallina lignarium	0.126				
Bolinus brandaris			0.010		0.162
ECHINODERMA					
Sphaerechinus granularis		0.010			
Astropecten aurantiacus		3.354			
Echinaster sepositus		1.727			
Stichopus regalis	0.164	1.484			
CNIDARIA Octocorallia					
Funiculina quadrangularis	0.986				
TUNICATA Thaliacea					
Pyrosoma atlanticum	0.057				
Phallusia mamillata	0.167	0.406			

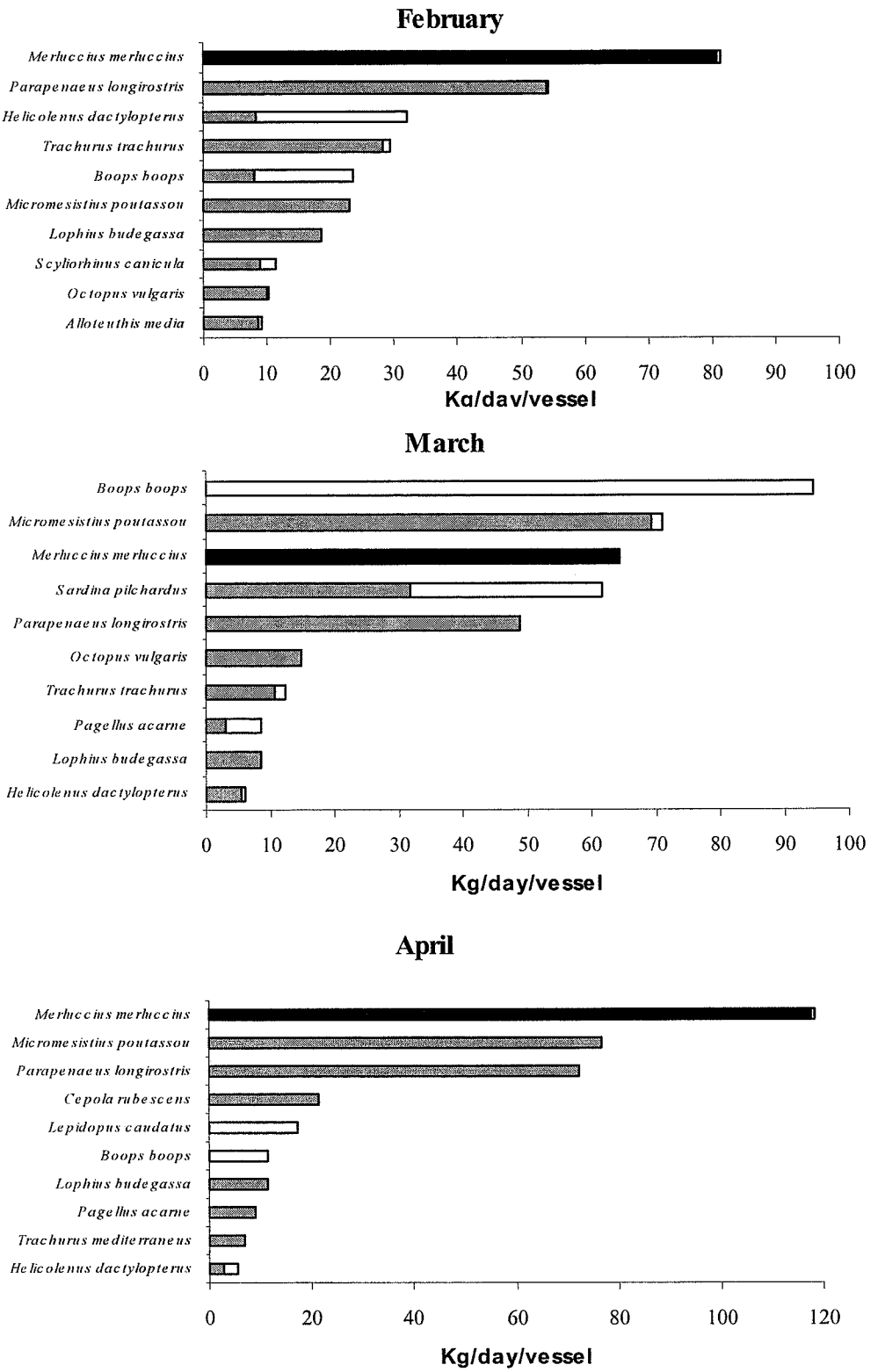


Figure 4.2.3.2a.Santa Pola. Commercial landings (in grey colour) and discards (in white colour) of the 10 most abundant species expressed in kg/day/vessel. Commercial landings of *M. merluccius* are indicated in black colour.

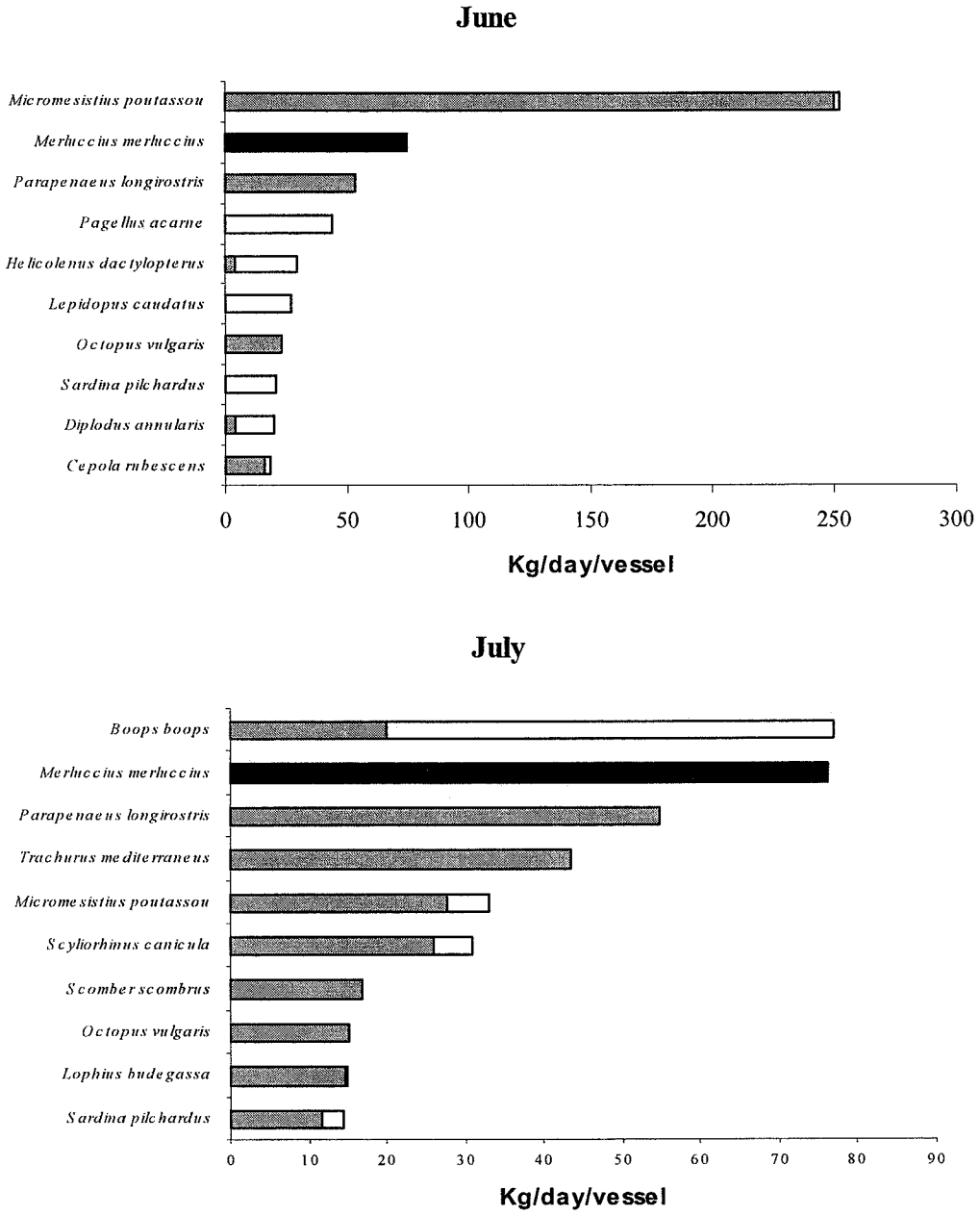


Figure 4.2.3.2b.Santa Pola. Commercial landings (in grey colour) and discards (in white colour) of the 10 most abundant species expressed in kg/day/vessel. Commercial landings of *M. merluccius* are indicated in black colour.

4.2.4 Palma de Mallorca

Figure 4.2.4.1 shows the biomass composition as a percentage of the discarded and commercialised main groups in the sampling catches and the number of species of each group for both fractions.

The Osteichthyes discard biomass represented 63% of the total biomass, while for Chondrichthyes it was 19%. The second most discarded groups were crustaceans and equinoderms, which both represented 8% of the biomass. By landings, Osteichthyes represented 70% of the landed biomass, Chondrichthyes 8%, crustaceans 17% and cephalopods 5%.

European hake (*Merluccius merluccius*) discards represented 3% of the total discarded biomass and 17% by landings sampling catches.

The incidence of discards (Figure 4.2.4.2a,b) shows that the fishery was characterised by three species. These were blue whiting (*Micromesistius poutassou*), white shrimp (*Parapenaeus longirostris*) and European hake (*M. merluccius*), although in April and July striped red mullet (*Mullus surmuletus*) was the third most abundant species. This was not due to the sampling depth in these months, since it was similar to the other months. However, it could be due to the reproductive behaviour of the striped red mullet that move to deeper zones for reproduction in spring (April). The discard for these most important species was null or very low until May when hake discards occurred and this practice continued to the end of the sampling period. The lowest hake catch occurred in March, whilst the highest catch corresponded to July.

The great fork beard (*Phycis blennoides*), blackmouth catshark (*Galeus melastomus*) and, with least importance, the spotted dogfish (*Scyliorhinus canicula*) were discarded by size. Discard fractions were between 30 and 50% of their total catches. Other important commercial species with very scarce or null discards were anglerfishes (*Lophius budegassa and Lophius piscatorius*) and John Dory (*Zeus faber*).

Tables 4.2.4.1 and 4.2.4.2 show the list of commercialised and discarded species in the sampling study. In total, 116 species were captured with 88 of these always completely discarded, while 24 were commercialised and discarded and 6 were always commercialised.

The five most important species in weight were *M. poutassou*, *M. merluccius*, *P. blennoides*, *M. surmuletus* and *Trachurus* spp. by commercial fractions and *Gadiculus argenteus*, *Capros aper*, *Lepidopus caudatus*, *Helicolenus dactylopterus* and *Trachurus trachurus* for the discarded catch.

The five most important species in number were, in order of importance, *M. poutassou*, *M. merluccius*, *M. surmuletus*, *P. blennoides* and *Mullus barbatus* for the commercial fraction and *G. argenteus*, *C. aper*, *Nezumia aequalis*, *P. blennoides* and *Coelorhynchus coelorhynchus* for the discarded fraction. Hake discards by number were in tenth place.

The chondrichthyan species *S. canicula* and *G. melastomus* represented 45% of the commercial catches for this group, whereas rays accounted for the rest of the Chondrichthyes for the commercial catches. *S. canicula* was most important in commercial weight, while *Galeus melastomus* was the most important shark species discarded by weight.

European hake represented 18% of the total haul landings sampled. The discards for the whole period were 2% of the discarded sampled catches. Landings were highest at the end of May and July. The discard by weight followed the same pattern as the landings by weight.

Pelagic species which were captured occasionally in large quantities could be almost all discarded, as was the case of *S. pilchardus*, *B. boops*, *Lepidopus caudatus*, *Gadiculus argenteus*, *Argentina sphyraena* and *Capros aper*. Benthic species affected by the trawl, such as the small flat fishes (*Arnoglossus* spp.)were among the most frequent species discarded and damaged by the trawl. Among the sharks and rays, which were all discarded by size, the larger quantities corresponded to the blackmouth catshark (*G. melastomus*). The fishes most discarded by size were *H. dactylopterus*, *Peristedion cataphractum*, *Lepidorhombus boscii*, *M. merluccius* and *P. blennoides*. The species that was always and completely discarded, which appeared in all the samples, was *Synchiropus phaeton*. The crustaceans most discarded were crabs such as the Paguridae family and the pandalid species *P. heterocarpus*.

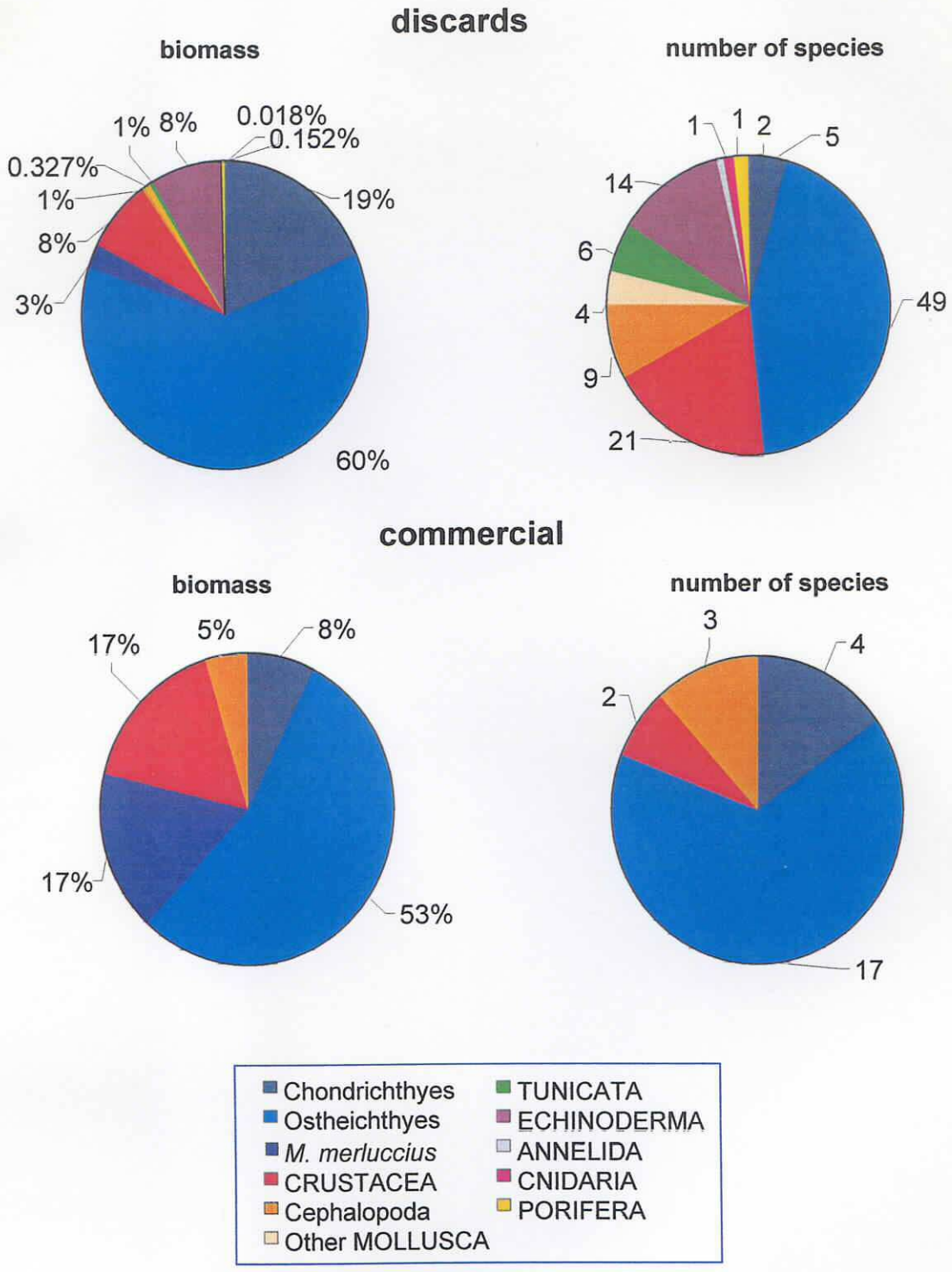


Figure 4.2.4.1.Palma de Mallorca. Taxonomic composition in biomass and in number of species of discard and commercial fractions of the sampling catches.

Table 4.2.4.1 Palma de Mallorca. Specific composition of commercial fraction of total trawl catches (kg/day/vessel)

	February	March	April	May	June	July
PISCES Chondrichthyes						
Pleurotremata						
Galeus melastomus	10.50					
Scyliorhinus canicula			7.50	5.50	10.70	8.15
Hypotremata						
Raja asterias			2.35			9.75
Raja spp.			4.00	36.10		
PISCES Osteichthyes						
Argentina sphyraena	0.01					
Centracanthus cirrus						5.00
Helicolenus dactylopterus	3.70					
Lepidorhombus boscii	2.13	0.30	7.10		2.00	
Lophius budegassa		2.00	4.25	7.00	3.00	
Lophius piscatorius	7.60			6.50	1.15	4.65
Merluccius merluccius	26.50	13.30	31.15	45.00	26.60	71.65
Micromesistius poutassou	58.00	98.50	80.00	118.50	45.00	54.15
Mullus barbatus			2.50	10.00	1.50	
Mullus surmuletus		0.70	16.75	1.80	2.95	24.85
Pagrus pagrus					0.15	
Phycis blennoides	15.80	3.10	7.15	14.00	3.50	4.10
Sardina pilchardus						5.00
Scorpaena elongata	0.12					
Scorpaena scrofa		0.60	0.45	0.15		
Trachurus trachurus			5.00			
Trachurus spp.			4.00			20.00
Trigla lyra	0.14		1.50		0.43	
Zeus faber			16.45	2.80	1.50	
CRUSTACEA Decapoda						
Parapenaeus longirostris	42.30	55.50	15.50	43.10	37.50	9.70
Plesionika edwarsii						3.60
MOLLUSCA Cephalopoda						
Eledone cirrhosa	2.60					1.10
Illex coindetii			4.35	4.75		1.75
Loligo vulgaris			0.85	1.20		1.70
Octopus vulgaris			6.00	19.50	7.50	2.15
Todarodes sagittatus	3.20					2.45

Table 4.2.4.2. Palma de Mallorca. Specific composition of discarded fraction of total trawl catches (kg/day/vessel). In bold letter are indicated the most frequent discarded species.

	February	March	April	May	June	July
PISCES Chondrichthyes						
Galeus melastomus	16.028	0.488	35.531	2.863	27.180	6.273
Scyliorhinus canicula			1.032	6.097	0.616	1.376
Raja asterias			1.195	0.945		
Raja clavata						0.080
Raja miraletus			0.671			
PISCES Osteichthyes						
Argentina sphyraena	0.042		0.541	0.913	0.832	0.164
Arnoglossus imperialis					0.084	
Arnoglossus rueppelli	0.205	0.776	0.694	1.201	1.110	1.132
Aspitrigla cuculus			0.405	0.413		
Blennius ocellaris				0.161		
Boops boops			4.296	4.522		3.208
Callionymus maculatus						0.026
Capros aper	0.028	0.720	21.716	37.000	2.595	3.139
Carapus acus					0.035	
Centracanthus cirrus			1.907			
Cepola rubescens			0.051	0.182		
Chlorophthalmus agassizi	0.653	0.672	1.568		0.365	
Citharus linguatula			0.541	0.280		
Coelorhynchus coelorhynchus	0.547	0.276	11.372			
Deltentosteus quadrimaculatus				0.392	0.021	0.092
Epigonus costanciae				0.825		
Epigonus denticulatus					0.075	
Gadiculus argenteus	0.621	2.600	20.065	42.000	3.022	0.270
Helicolenus dactylopterus	0.868	2.716	1.596	8.725	1.550	2.817
Hygophum benoiti				0.175		
Hymenocephalus italicus						0.055
Lampanyctus crocodilus					0.052	
Lepidopus caudatus	0.201	0.512		3.950	14.490	0.826
Lepidorhombus boscii	0.925	2.460	1.820	2.325	0.935	1.528
Lepidotrigla cavillone			0.734	2.958	0.189	0.212
Lophius budegassa	0.198			0.325		
Lophius piscatorius			2.252		0.509	0.302
Macroramphosus scolopax			0.442		1.183	1.956
Merluccius merluccius			0.708	3.602	1.092	3.651
Microchirus variegatus			0.147	0.105		
Micromesistius poutassou	0.547	0.640				
Molva dipterygia	0.187					
Molva dipterygia macrophtalma			6.223			
Nezumia aequalis				16.850	0.330	
Notoscopelus elongatus	0.282			0.275		0.215
Peristedion cataphractum	0.092	0.024	0.628	7.925	0.125	0.230
Phycis blennoides	0.134	0.018	0.029	14.125	0.330	0.028
Sardina pilchardus				0.553		
Sardinella aurita			0.360			
Serranus cabrilla						0.680

Table 4.2.4.2. (Cont.)

	February	March	April	May	June	July
PISCES Osteichthyes						
Serranus hepatus			0.205	0.455	0.595	
Spicara smaris						4.220
Stomias boa				0.225		
Synchiropus phaeton	2.507	4.436	3.661	2.375	1.279	1.742
Trachurus mediterraneus			0.292	0.812	0.602	0.501
Trachurus picturatus					0.427	0.268
Trachurus trachurus			0.887	15.675		0.732
Trigla lyra			1.188		0.010	
Trisopterus minutus capelanus					0.049	
CRUSTACEA Decapoda						
Chlorotocus crassicornis	0.046	0.064				
Dardanus arrosor	0.141		1.282	2.303	0.410	0.801
Liocarcinus depurator		0.232	0.095			
Macropipus tuberculatus	0.706	1.984	0.915	1.925	0.882	0.154
Macropodia longipes			0.019			
Munida intermedia			0.038	0.500	0.057	0.091
Munida iris	0.198	1.032		0.150	0.040	0.075
Pagurus alatus			0.019			
Pagurus prideaux	0.053	0.004	0.189	4.715	1.245	2.327
Parapenaeus longirostris	0.364		0.580	0.088	0.210	0.419
Partenope macrochelos			0.418			
Pasiphaea multidentata		0.544				
Pasiphaea sivado	0.004			1.050		
Plesionika antigai			0.057		0.086	0.034
Plesionika edwarsii				1.263	0.206	0.513
Plesionika gigliolii	0.053	0.136			0.035	0.137
Plesionika heterocarpus	1.200	0.692	1.501	2.175	3.090	3.213
Pontocaris cataphracta				0.050		
Procesa acutirostris		0.004				
Processa canaliculata					0.021	
Solenocera membranacea		0.024		0.050		
MOLLUSCA Cephalopoda						
Abralia veranyi				0.425		
Abraliopsis pfefferi						0.045
Alloteuthis media						0.024
Alloteuthis subulata						0.044
Illex coindetii			0.183			
Loligo vulgaris			0.019			0.112
Octopus vulgaris			0.691			
Sepia elegans						0.012
Sepietta oweniana	0.279		0.105	0.175	0.445	0.126
MOLLUSCA Bivalvia						
Pygnodonte cochlear					0.021	
MOLLUSCA Gastropoda Prosobranchia						
Scaphander lignarius				0.056	0.007	0.016
Xenophora crispa				1.386	0.077	

Table 4.2.4.2. (Cont.)

	February	March	April	May	June	July
MOLLUSCA Gastropoda Opistobranchia						
Cymbulia peroni			0.067	0.125		
ECHINODERMA Echinoidea						
Cidaris cidaris			0.542	0.098		0.068
Echinidae						
Echinus acutus	0.763					0.460
Echinus melo			0.577	6.867	3.724	0.670
Spatangus purpureus						0.571
Sphaerechinus granularis			0.439			
ECHINODERMA Asteroidea						
Astropecten aurantiacus						0.766
Astropecten sp.	0.971		0.022			
Hacelia attenuata					0.034	
Luidia ciliaris						0.076
Tethyaster subinermis						0.120
ECHINODERMA Ophiuroidea						
Ophioderma longicauda						0.120
Ophiura texturata					0.035	
ECHINODERMA Holothurioidea						
Mesoturia intestinalis			3.477			
Stichopus regalis			0.393	0.823	1.260	2.156
ECHINODERMA Crinoidea						
Antedon mediterranea						12.000
Leptometra phalangium					6.440	
ANNELIDA Polychaeta						
Serpula vermicularis					0.098	
TUNICATA Ascidiacea						
Ascidia conchilega					0.265	
Ascidia sp			0.084			
Halocynthia papillosa					0.052	
Microcosmus sp	0.177		0.115			1.261
Microcosmus sulcatus				0.871	0.285	
Phallusia mammillata			0.646			
BRACHIOPODA						
Gryphus vitreus			0.152	0.756	0.826	1.180
PORIFERA						
Porifera sp	0.706		0.057			
Suberites domuncula					0.025	0.024
ALGAE						
Codium bursa					0.510	

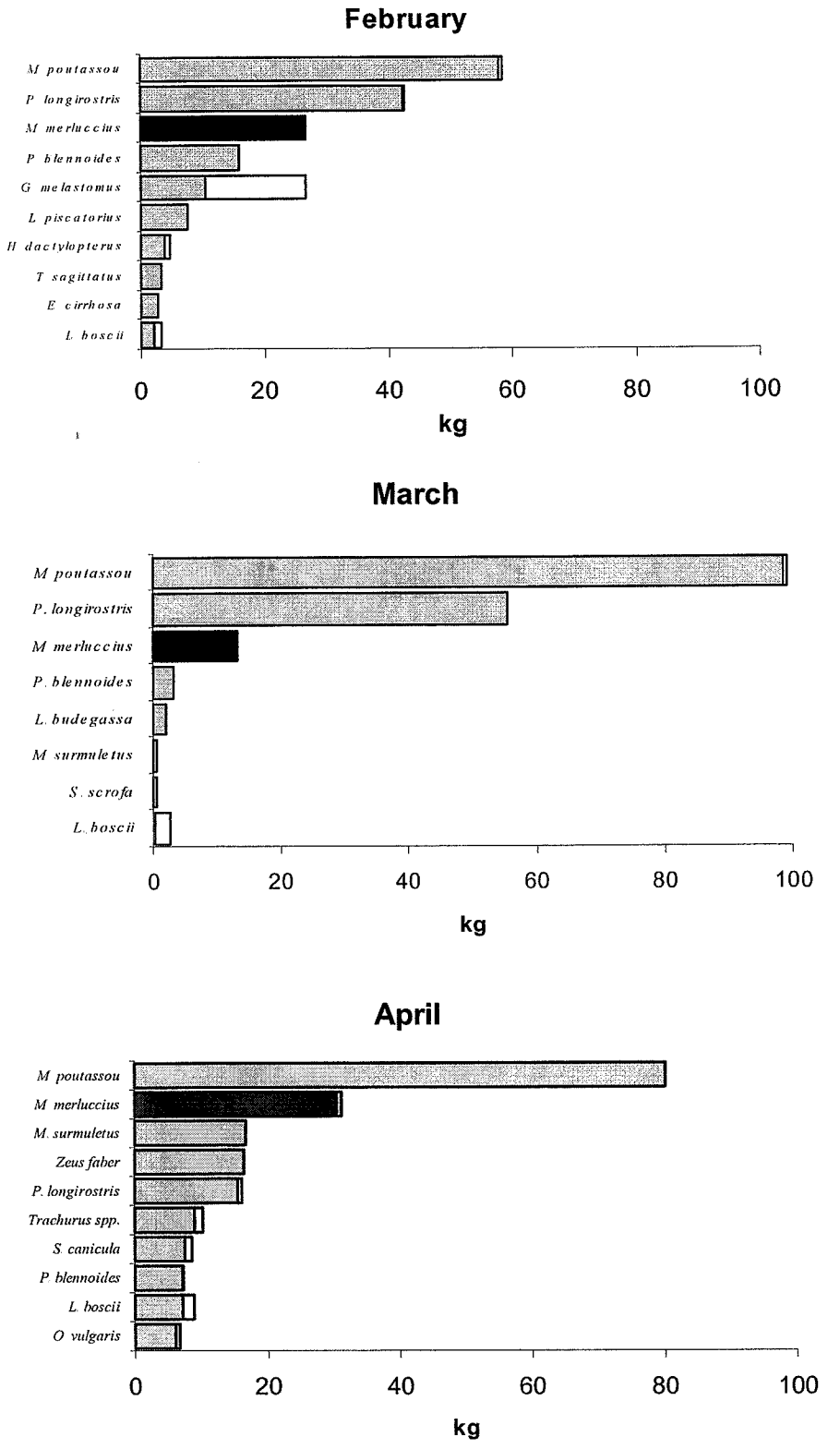


Figure 4.2.4.2a. Palma de Mallorca. Commercial landings (in grey colour) and discards (in white colour) of the 10 most abundant species expressed in kg/day/vessel. Commercial landings of *M. merluccius* are indicated in black colour.

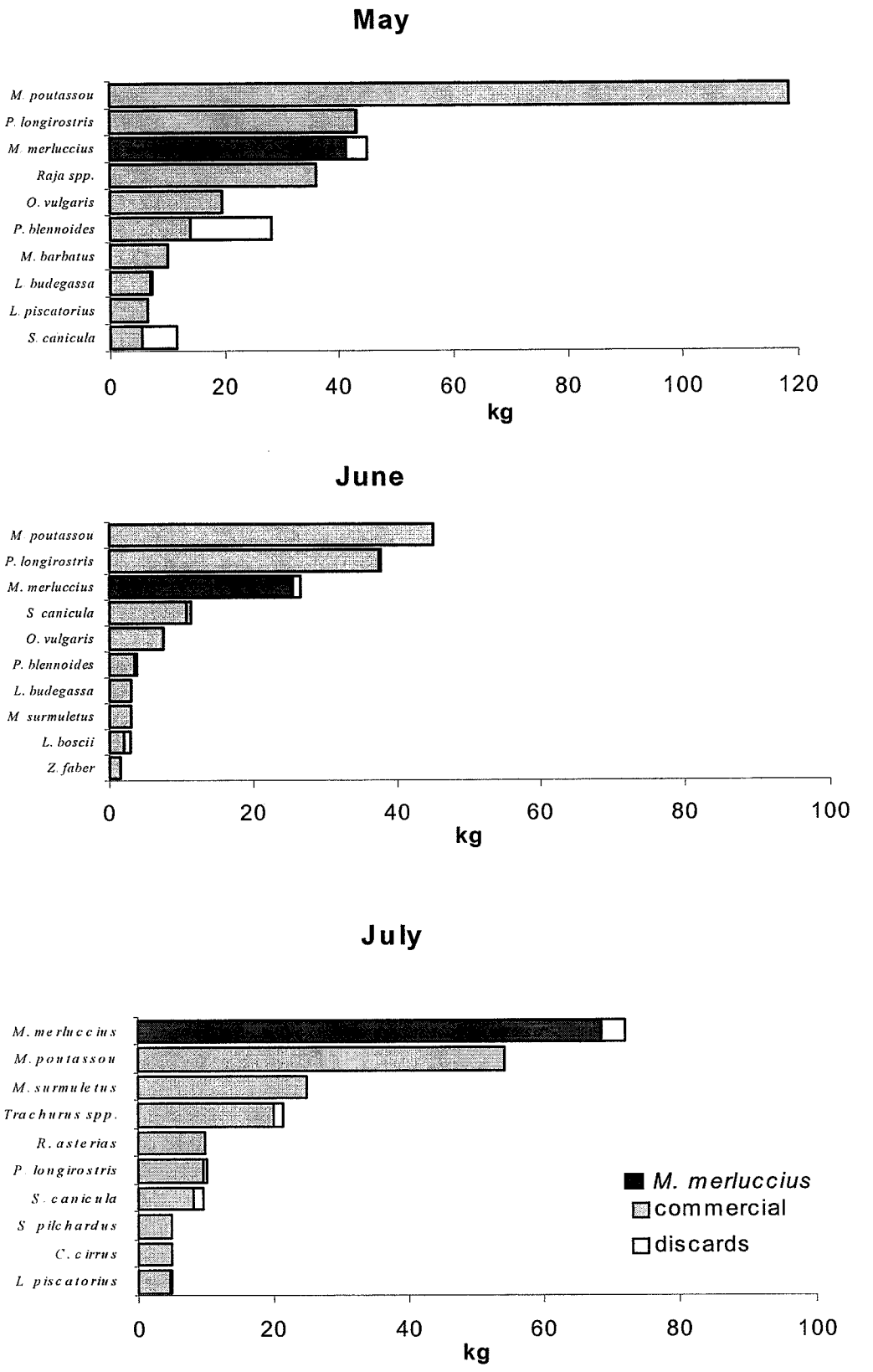


Figure 4.2.4.2b. Palma de Mallorca. Commercial landings (in grey colour) and discards (in white colour) of the 10 most abundant species expressed in kg/day/vessel. Commercial landings of *M. merluccius* are indicated in black colour.

4.2.5 Sète

Table 4.2.5.1 shows a summary of the specific composition of the commercial and discarded catches obtained from the monthly sampling on board trawlers carried out in Sète. This table is presented in the EC Study Project no 2000/21 "Collection and management of data for the assessment of the Spanish and French Mediterranean fisheries" and the information is given according to the target species of the study. European hake is included among this group.

Among the selected species, *Merluccius merluccius* catches were the highest during the study period, and the amount of hake discarded was very low from March to May, while in July it represented 13.6% of the total hake catch. Discards of the other target species were negligible. Nevertheless, the percentage of discards of by-catch species was important especially in May, July and August with a maximum value of 63.03% of the total catches in July.

Table 4.2.5.1. Sète. Specific composition of catches, landings and discards (kg/day/vessel). Target species, by-catch and non commercial species.

March	Landings	Discards	Total catches	% discards (of total catches)
Merluccius merluccius	212.60	1.24	213.84	0.58
Mullus barbatus and *M. surmuletus*	12.20	0.00	12.20	0.00
Sparus aurata	0.00	0.00	0.00	0.00
Dicentrarchus labrax	0.00	0.00	0.00	0.00
Other Commercial Fishes and invertebrates	1075.15	120.89	1196.04	10.11
Other non-Commercial Fishes and invertebrates	0.00	0.15	0.15	100.00
TOTAL	1299.95	122.28	1422.23	8.60

April	Landings	Discards	Total catches	% discards (of total catches)
Merluccius merluccius	122.20	0.11	122.31	0.09
Mullus barbatus and *M. surmuletus*	63.00	0.55	63.55	0.87
Sparus aurata	0.00	0.00	0.00	0.00
Dicentrarchus labrax	0.00	0.00	0.00	0.00
Other Commercial Fishes and invertebrates	635.80	29.90	665.70	4.49
Other non-Commercial Fishes and invertebrates	0.00	170.39	170.39	100.00
TOTAL	821.00	200.95	1021.95	19.66

May	Landings	Discards	Total catches	% discards (of total catches)
Merluccius merluccius	160.11	0.30	160.41	0.19
Mullus barbatus and *M. surmuletus*	0.00	0.00	0.00	0.00
Sparus aurata	0.00	0.00	0.00	0.00
Dicentrarchus labrax	0.00	0.00	0.00	0.00
Other Commercial Fishes and invertebrates	2129.39	1163.48	3292.87	35.33
Other non-Commercial Fishes and invertebrates	0.00	10.34	10.34	100.00
TOTAL	2289.50	1174.12	3463.62	33.90

July	Landings	Discards	Total catches	% discards (of total catches)
Merluccius merluccius	90.58	14.26	104.84	13.60
Mullus barbatus and *M. surmuletus*	0.70	0.00	0.70	0.00
Sparus aurata	30.33	0.00	30.33	0.00
Dicentrarchus labrax	1.73	0.00	1.73	0.00
Other Commercial Fishes and invertebrates	519.55	1009.95	1529.50	66.03
Other non-Commercial Fishes and invertebrates	0.00	44.00	44.00	100.00
TOTAL	642.88	1068.21	1711.09	62.43

August	Landings	Discards	Total catches	% discards (of total catches)
Merluccius merluccius	111.73	3.56	115.29	3.09
Mullus barbatus and *M. surmuletus*	2.70	0.00	2.70	0.00
Sparus aurata	0.00	0.00	0.00	0.00
Dicentrarchus labrax	1.33	0.00	1.33	0.00
Other Commercial Fishes and invertebrates	418.20	237.59	655.79	36.23
Other non-Commercial Fishes and invertebrates	0.00	8.81	8.81	100.00
TOTAL	533.95	249.96	783.91	31.89

4.3 Monthly *Merluccius merluccius* length and weight frequency distributions

4.3.1 Porto Santo Stefano

Figures 4.3.1.1. and 4.3.1.2. show the monthly size frequency distributions of the European hake, in number and weight, for the total catch and discards standardised per 100 hours of trawls.

European hake was widely distributed over the study area; it ranged from 4.0 cm to 80.0 cm TL. Although with differences in the total number, the pattern of the frequency distribution remained more or less constant during all the investigated period (Fig. 4.3.1.1.). The presence in number of individuals with size greater than 20.0 cm TL was very low and the values of distribution close to 0. The frequency distributions of the discards and of the total catch showed the same pattern up to 10 cm TL, then the curve related to discards detaches from the other, reducing to 0 before achieving 15 cm TL.

The pattern of the frequency distribution in weight is similar to the frequency distribution in number up to 20 cm TL; discards seem less relevant, for the low weight of the discarded animals (Fig. 4.3.1.2.).

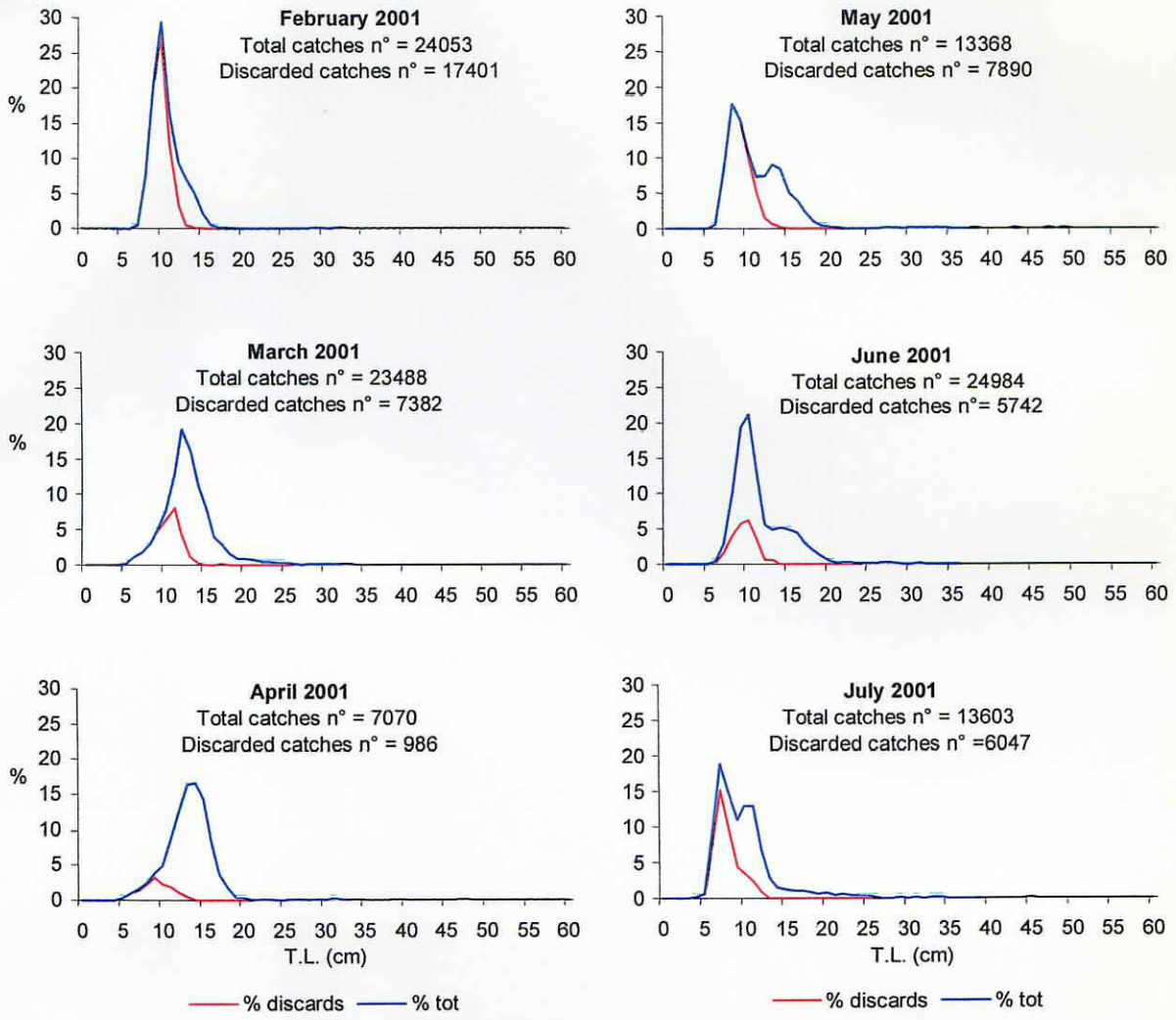


Figure 4.3.1.1. Porto Santo Stefano. *Merluccius merluccius* monthly length frequency distribution in percentage of number per 100 trawling hours.

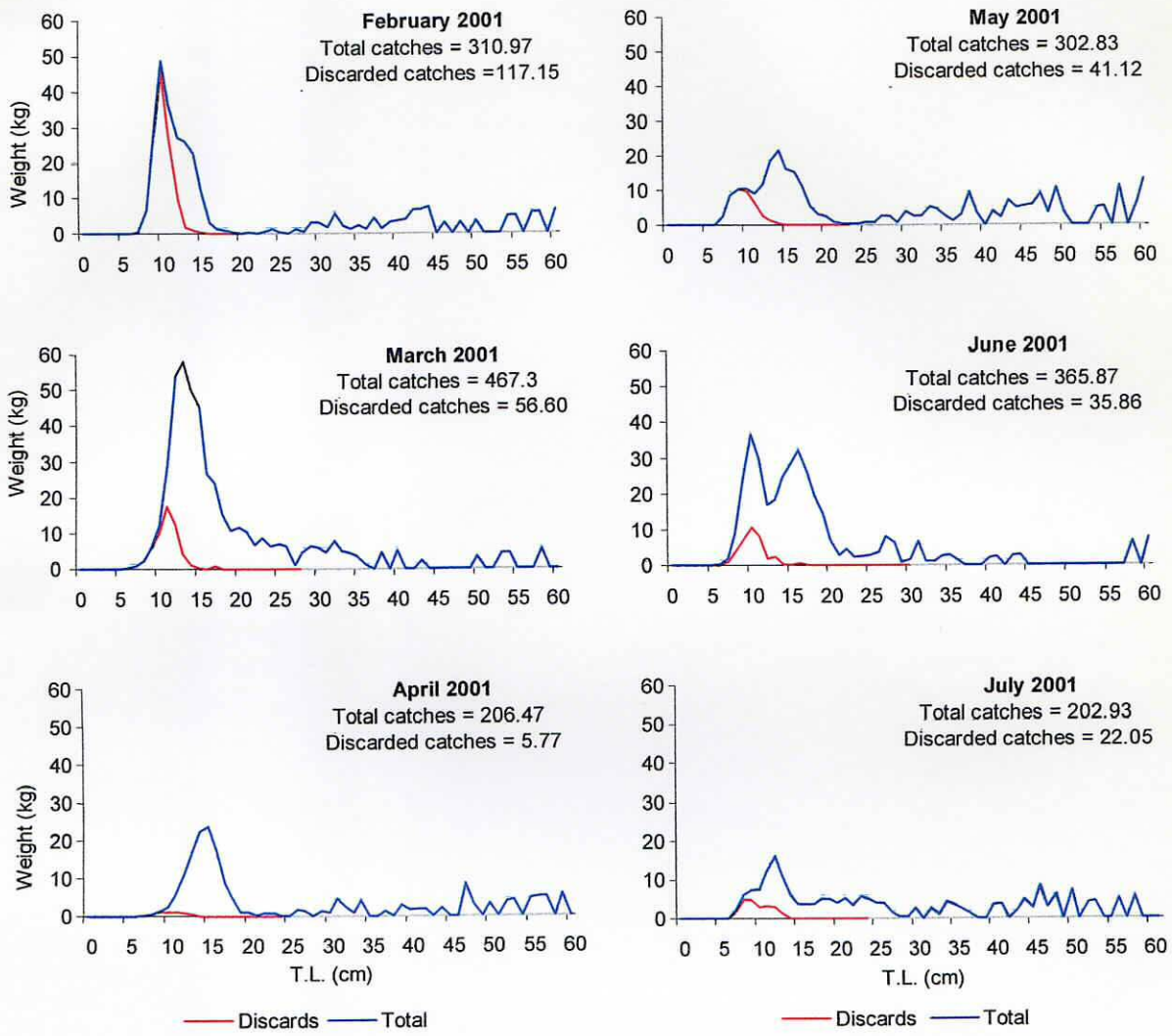


Figure 4.3.1.2. Porto Santo Stefano. *Merluccius merluccius* monthly length frequency distribution in percentage of weight (kg) per 100 trawling hours.

4.3.2 Vilanova i La Geltrú

European hake discards in the port of Vilanova i La Geltrú were small. Overall results from the sampling of the monthly length frequency distributions indicate that 7% of the *Merluccius merluccius* individuals caught were discarded. The same data expressed in weight indicate that during the six-months sampling 1.0% of the catch was discarded. The sizes caught ranged between 4 and 58 cm TL, and those that were discarded ranged between 4 and 21 cm TL. It is evident, anyway, that sizes >15 cm TL were very rare in the discards, and their presence can be considered just accidental or because of damage of the individuals.

A number of modes can be observed in the monthly distributions (Figure 4.3.2.1). Although the size range affected by trawling is wide, most of the catch is made up of < 20 cm TL individuals. Because of the time of the year when the sampling was performed, recruitment of the European hake to trawling in the area could be observed. Highest catches were obtained in July, while highest discards rate in number were observed in May and June, when 26.4% and 21.7% of the individuals were discarded.

European hake discards when expressed in weight is very low (Figure 4.3.2.2). The small number of individuals >20 cm LT is sufficient to move the mode of the distribution towards higher sizes, except in July, when highest contribution in weight corresponded to a mode around 15 cm. In February, April and July the discarded catch represented less than 1% of the total catch, while in March and May 1.1% and 1.5% of the hake catch was discarded. Highest discard was observed in June, 3.5% of the catch. This percentage corresponded to 26.4% of the discarded individuals.

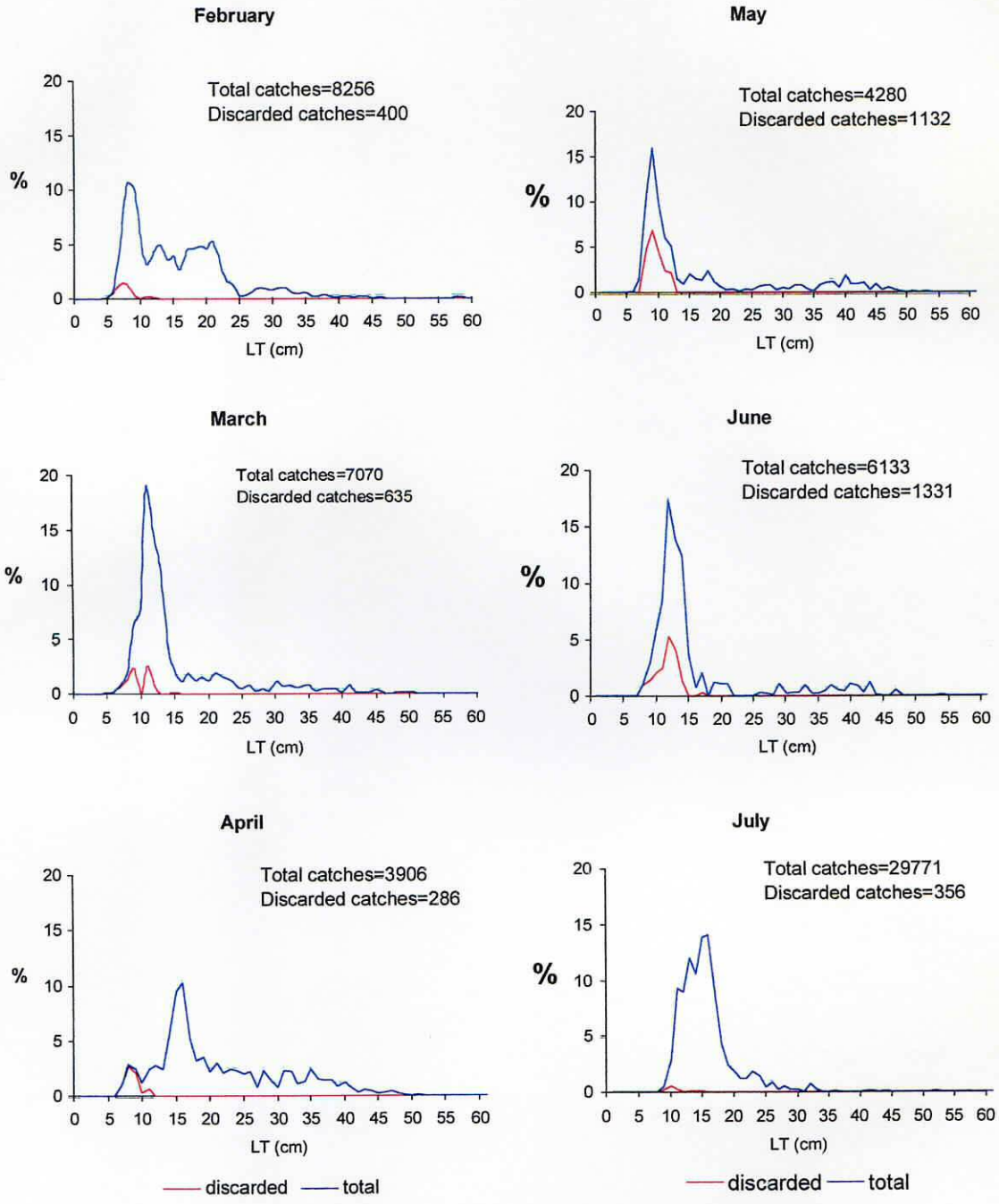


Figure 4.3.2.1. Vilanova i La Geltrú. *Merluccius merluccius* monthly length frequency distribution in percentage of number per 100 trawling hours.

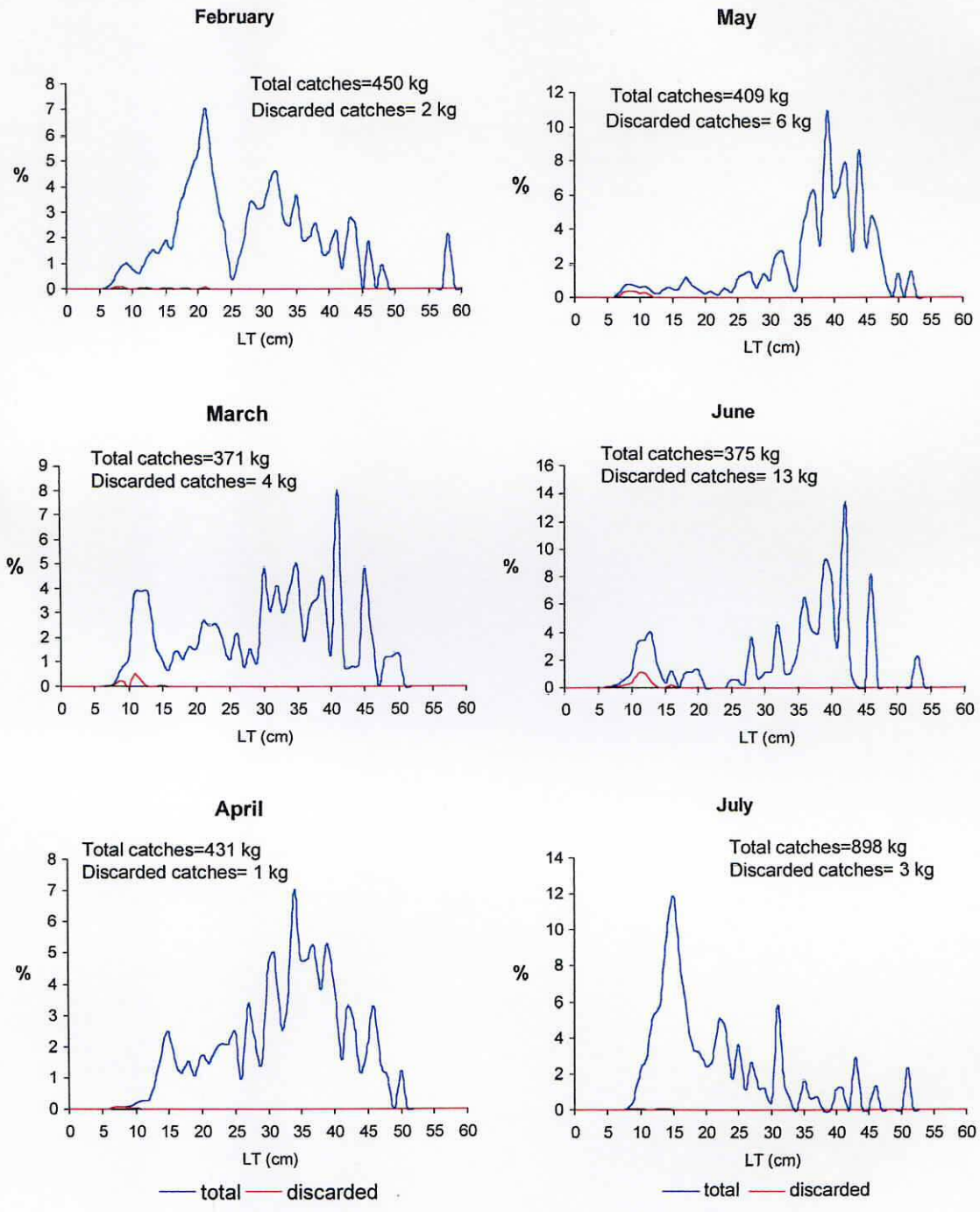


Figure 4.3.2.2. Vilanova i La Geltrú. *Merluccius merluccius* monthly length frequency distribution in percentage of weight (kg) per 100 trawling hours.

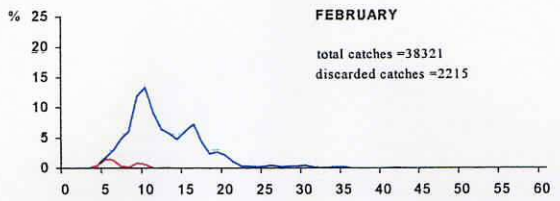
4.3.3 Santa Pola

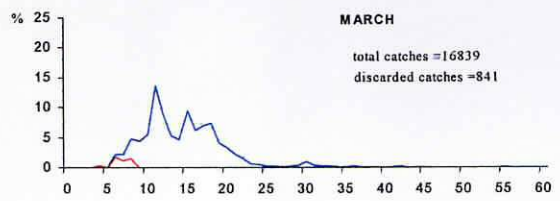
Figure 4.3.3.1 gives the monthly total and discard size frequency distributions by number for the European hake. During the period a peak of around 10 to 15 cm TL was observed. In particular, a peak of 10 cm in February and April was detected. Juveniles caught in February, with a modal size around 10 cm TL, could be related to the fishing depth in this month. After February the modes progressively increased, and the first peak in March, June and July was between 15 and 20 cm TL.

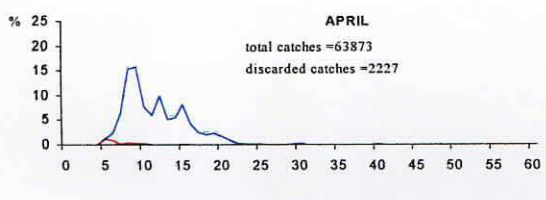
February was the month when smaller individuals were more important in number. In subsequent months the size of the juveniles increased (<20 cm), while larger individuals were also detected in the size distribution. The main modal classes detected for this latter fraction were around 25, 30-35 and 40-45 cm TL. The importance of adults in the catches was similar during the whole sampling period.

Discards in number occurred between 5 and 15 cm TL, although there were some larger isolated individuals (up to 20 cm). Most frequent discards were between 5 to 10 cm, and they were always a small proportion of their total length class caught.

In weight (Figure 4.3.3.2) the size distributions showed a higher relative importance for the adult fraction. The length classes over 30 cm TL, which could not be easily detected in the size frequency distribution by number, reached biomass peaks of around 30, 40, 45, 50 and 55 cm TL. Adults over 30 cm were more abundant in March, June and July.







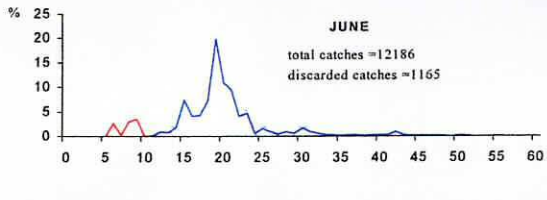
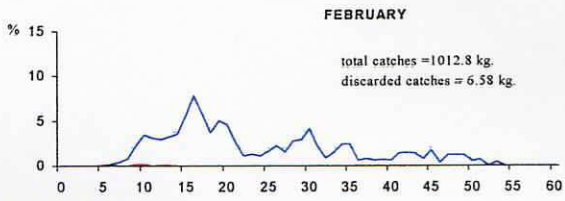
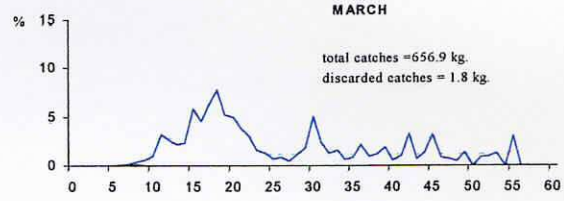
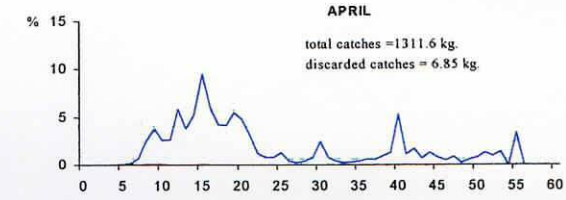


Figure 4.3.3.1. Santa Pola. *Merluccius merluccius* monthly length frequency distribution in percentage of number per 100 trawling hours.







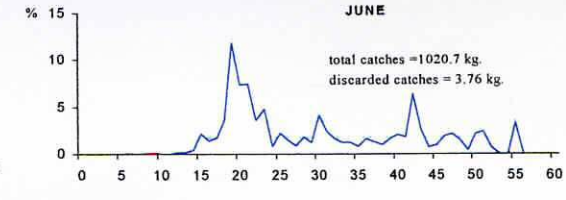


Figure 4.3.3.2. Santa Pola. *Merluccius merluccius* monthly length frequency distribution in percentage of weight (kg) per 100 trawling hours.

4.3.4 Palma de Mallorca

The size frequency distributions for the total (landing and discard) and the discards by month in number and weight are presented in Figure 4.3.4.1.

The landing size distribution was between 14 and 72 cm TL. Nevertheless, 80% of the commercialised catches in number were between 14 and 30 cm TL. The mean landed sizes were between 25 and 31 cm TL and the mean size increased through the sampling period (March to July). The discard size distribution was between 6 to 22 cm TL. The mean discarded size by month was between 13 to 16 cm TL during the sampling period.

Discards were less important in weight, although in number it increased through the sampling period. The discard size in May and June corresponded to the small size and almost all of them were between 10 to 15 cm TL. In July, two groups of discard sizes could be identified. The first corresponded to individuals between 6 to 14 cm TL, discarded in larger quantities than the other group which was between 16 and 22 cm TL, and was due to isolated individuals discarded because of damage.

The main modal classes were always between 25 and 30 cm TL. A peak of around 15 cm appeared from April and continued until July. From May to July the proportion of juveniles between 5 and 10 cm increased.

In weight (Figure 4.3.4.2), the size distributions showed a higher relative importance for the adult fraction. Nevertheless, the sizes around 20 to 40 cm were the most important contributions to the landing weight.

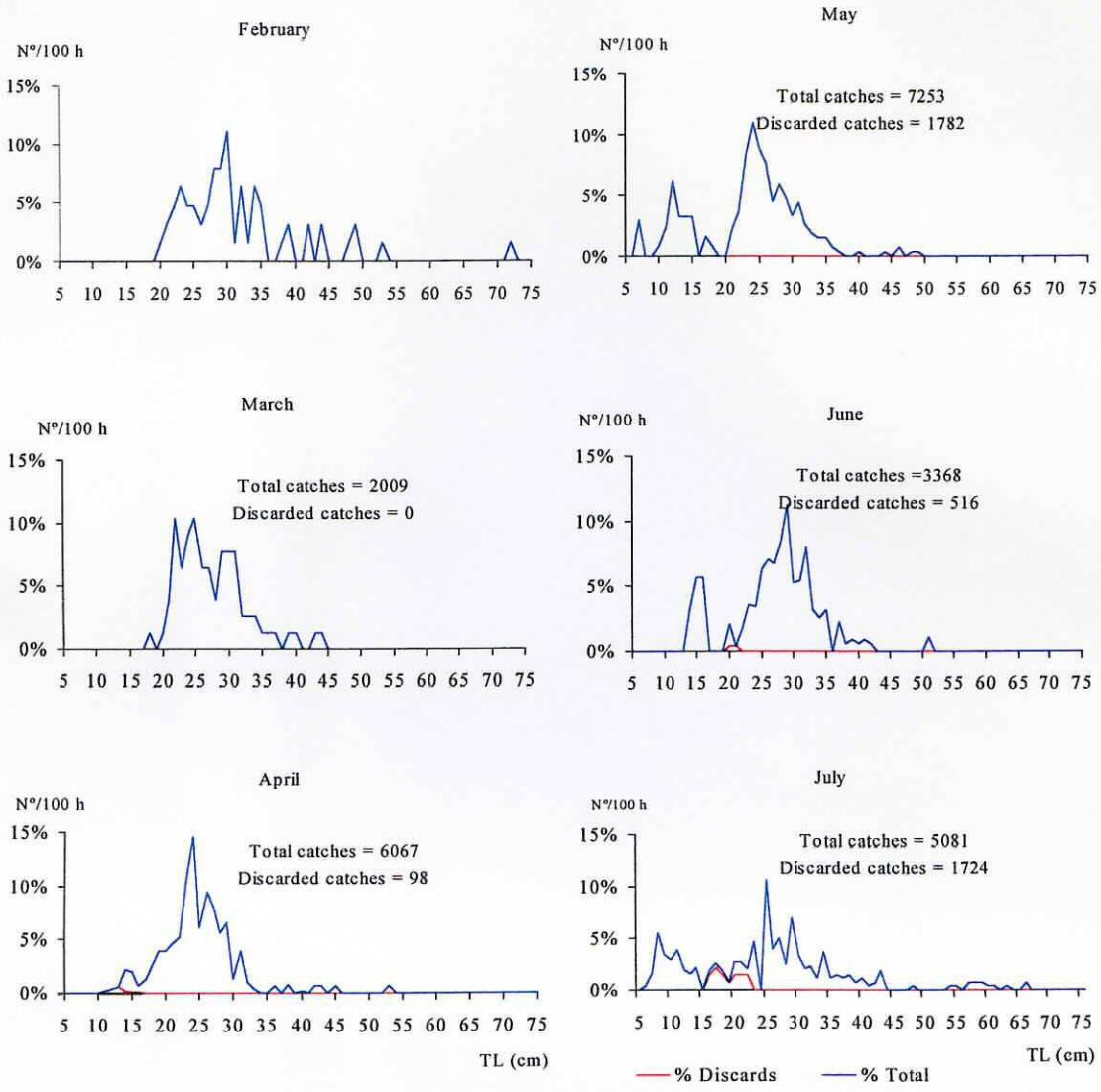


Figure 4.3.4.1. Palma de Mallorca. *Merluccius merluccius* monthly length frequency distribution in percentage of number per 100 trawling hours.

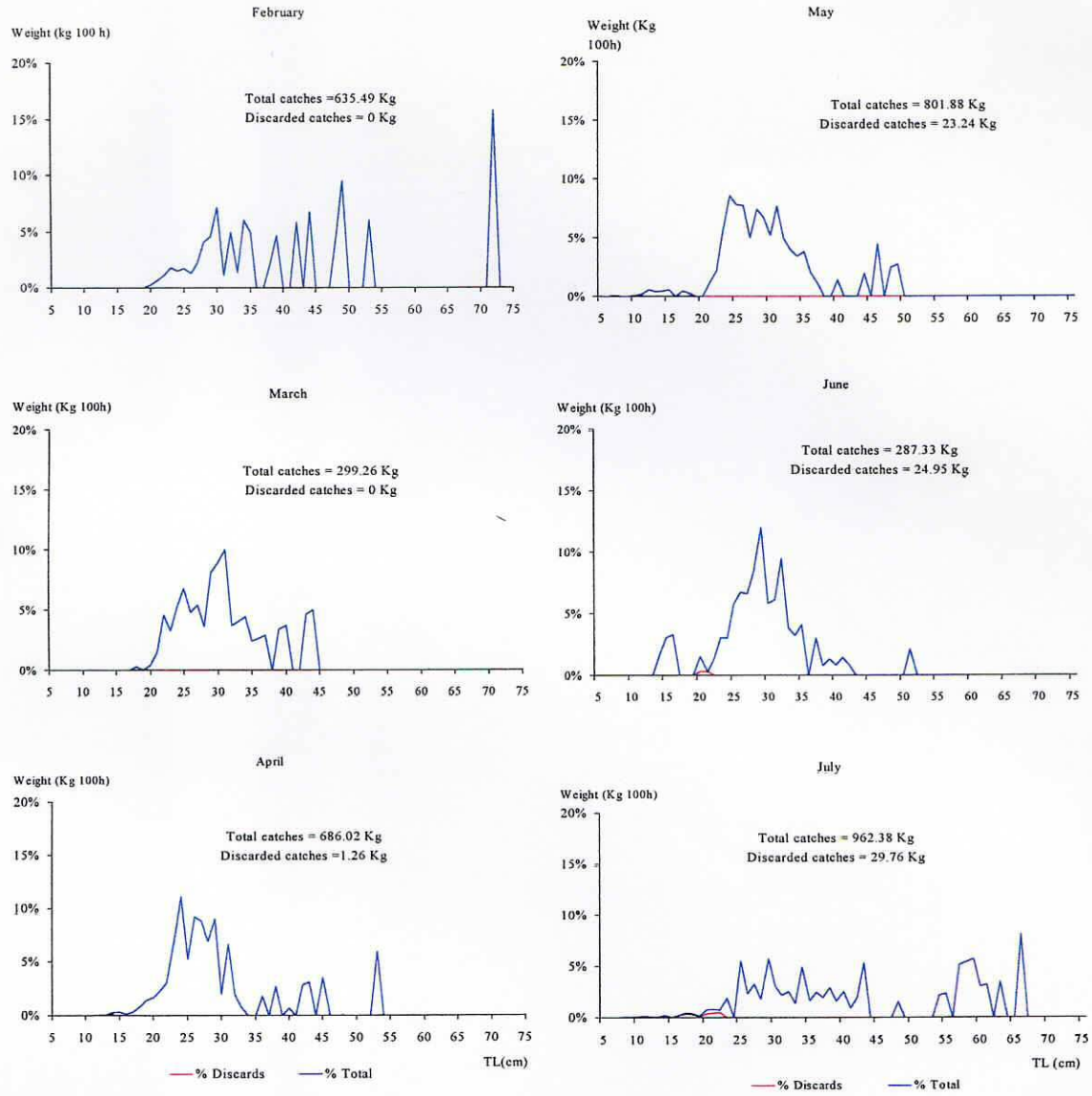


Figure 4.3.4.2. Palma de Mallorca. *Merluccius merluccius* monthly length frequency distribution in percentage of weight (kg) per 100 trawling hours.

4.3.5 Sète

Figure 4.3.5.1 shows the length distribution by number, in percentage, for the hake total and discarded catch, obtained during the sampling period, from March to August 2001. The European hake total length ranged between 6 to 70 cm. The biggest discarded size was 15 cm and, in general, individuals measuring less than 9 cm TL were discarded, although this can change in the different months. Thus, in March and April all the individuals smaller than 9 cm were discarded, while in July and August 26% and 49 % respectively of the individuals smaller than 10 cm were landed. Hake discards by the trawl fleet have been high during the study period, the highest observed value corresponding to July, when 63.5 % of the individuals were discarded.

Monthly frequency distribution expressed in percentage of weight (figure 4.3.5.2) shows the importance of larger animals in the catches. In March the individuals larger than 20 cm represented the 93.9 % of the catches in weight. The month in which this proportion is lowest is August (69.3% of the total catch). The month with higher hake discards in weight was also July, when highest discards in number were observed. The month with highest yield (2923.8 kg per 100 trawling hours) and lower discards was May (see also table 5.2.5.1).

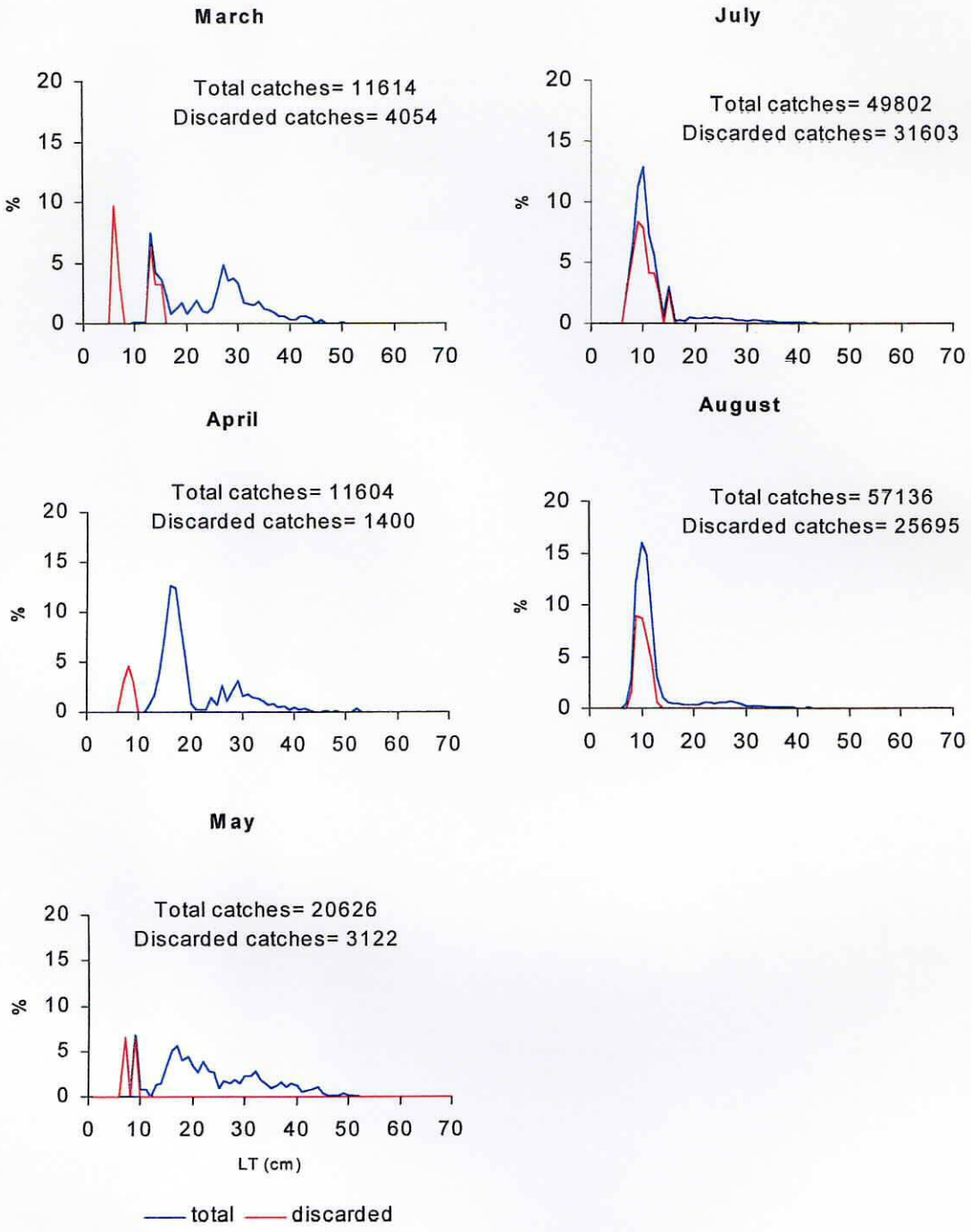


Figure 4.3.5.1. Sète. *Merluccius merluccius* monthly length frequency distribution in percentage of number per 100 trawling hours.

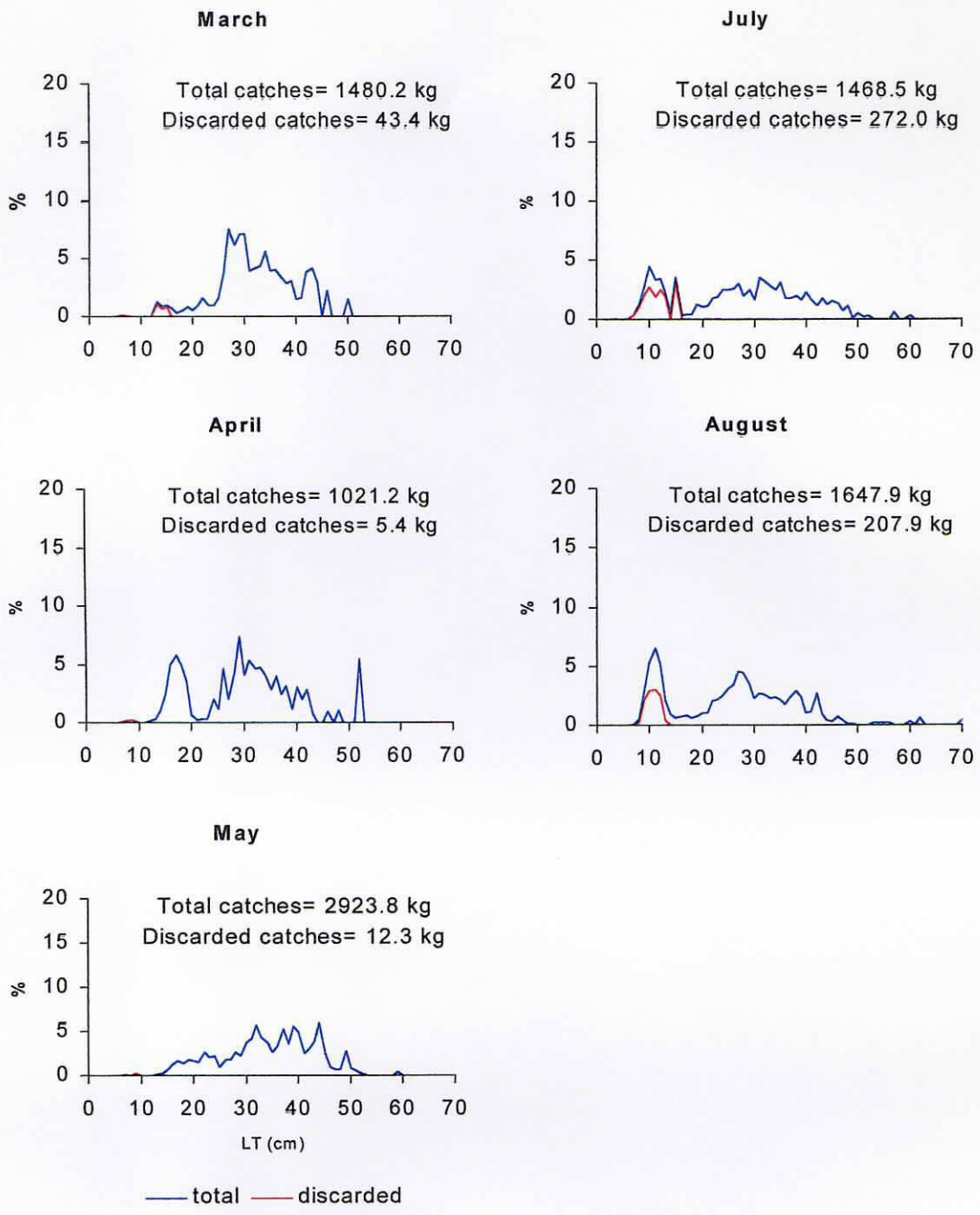


Figure 4.3.5.2. Sète. *Merluccius merluccius* monthly length frequency distribution in percentage of weight (kg) per 100 trawling hours.

5 Monthly landings and discards by the trawl fleet in the study ports

5.1 Specific composition

5.1.1 Porto Santo Stefano

Tables 5.1.1.1 and 5.1.1.2. show the estimated monthly landing by species and port during the sampling period. The landing showed values ranging from 65 tons in July to 85 tons in May at Porto Santo Stefano and from 52 tons in July to 83.5 tons (May) in Castiglione della Pescaia.

The species composition of the landing showed a high degree of species diversity, more than 100 species or taxonomic groups were recorded in the landings of Porto Santo Stefano whereas 60 were observed in Castiglione della Pescaia.

At Porto Santo Stefano, Norway lobster, deep water rose shrimp, giant and red shrimps and European hake, horned octopus and red mullet, according to size, constituted a relevant part of the first commercial category, to which contributed also coastal or continental shelf species as striped red mullet (*Mullus surmuletus*), European squid (*Loligo vulgaris*), common cuttlefish (*Sepia officinalis*), John dory (*Zeus faber*), tun gurnard (*Trigla lucerna*) and common octopus. Size was the determining factor for the attribution of these species to a higher or lower commercial category. Monkfish (*Lophius sp.*), skate (*Raja sp.*), argentine (*Argentina sphyraena*) and broad tail shortfin squid (*Illex coindetii*) were important both in biomass and in economic value, belonging to the second commercial category. Other species important in biomass, but of low commercial value (third commercial category), were silver scabbard fish, greater forkbeard, European conger (*Conger conger*), blackmouth catshark and Atlantic horse mackerel. Blue whiting and poor cod, depending on the size, belong to the second or third commercial category.

At Castiglione della Pescaia, the landing showed a species composition characterised mainly by coastal or continental shelf species. In fact in this port, bogue (*Boops boops*), stargazer (*Uranoscopus scaber*), poor cod, spottail mantis shrimp, red mullet, Atlantic and Mediterranean horse mackerel, common octopus, horned octopus and musky octopus (*Eledone moschata*) contributed with an high percentage to the total landing. Common sole (*Solea vulgaris*), John dory, European squid, common cuttlefish, midsize squid (*Alloteuthis media*) and European common squid (*A. subulata*), caramote prawn (*Penaeus kerathurus*) represented the most important species of high economic value. This richness of coastal and continental shelf species in the production of Castiglione della Pescaia was due to the composition of the fleet, constituted of small boats, and to the characteristics of the bottoms, the deeper being far from the coast.

In both ports, *M. merluccius* resulted always the most abundant species in the landings, varying among 16 and 22% of the total biomass caught in Porto Santo Stefano and from 15% to 21% in Castiglione della Pescaia. Considering the landings of the species by category, it was evident the importance of the category C and D, corresponding to specimens with TL less than 20.0 cm. In both the studied ports these two categories accounted for at least 60 % of the total catches of European hake. This importance was marked in Castiglione della Pescaia, where the small fraction could achieve 98.5 % of the total catch of the species (see section 2.1, page 7, for the definition of commercial categories).

Table. 5.1.1.1. Porto Santo Stefano. Monthly landing by species.

Species		February	March	April	May	June	July
Alloteuthis sp.		299.4	276.9	56.4	151.9	171.9	1010.4
Alosa fallax		0	0	0	0	0	528.2
Argentina sphyraena		112.2	140.6	432.1	296.4	127.8	126.6
Aristeomorpha foliacea		297.9	445.3	595.3	621.1	1179.4	1722.1
Aristeus antennatus		140.7	487.3	243.7	120.8	767.6	579.7
Boops boops		674.8	605.5	2630.2	956	3148.2	2082.5
Centrolophus niger		8	10.5	55.4	45.3	46.8	5
Cepola rubescens		0	25.4	7.4	34.4	196.6	10.2
Chlorophthalmus agassizii		28.8	0	166.2	48.5	410.7	0
Citharus linguatula		14.5	92.1	8.3	13.6	103.2	265.1
Conger conger		325.7	266.6	316.8	281.2	476.2	417.8
Dentex dentex		4.8	244.3	203.1	181.2	117	20.8
Dicentrarchus labrax		11.3	48.9	0	0	53.8	0
Diplodus annularis		0	0	8.3	172.5	842.4	281.3
Diplodus sp.		4.8	85	107.1	85.2	48.2	45.8
Eledone cirrhosa		3789.2	4612.4	4405.5	7326	4095.2	2156.1
E.cirrhosa		0	10.5	443.1	523.4	2585.8	5482.1
Eledone moschata		168.1	1205.1	520.7	548.3	1123.3	501.1
Engraulis encrasicolus		161.6	0	664.7	1550.5	608.4	376.9
Galeus melastomus		791.2	0	277.9	154.2	586.9	959.6
Gobidae indet.		0	106.5	73.9	0	30	0
Brachyura		287.7	445.3	480.1	103.5	18.7	153.5
Helicolenus dactylopterus		99.7	8.4	78.3	107.6	146	8.5
Lepidopus caudatus		4393.2	2955.6	6227.9	6505.6	5752	1229.5
Lepidorhombus boscii		29.6	25.2	93.1	42.9	37.4	0
Lichia amia		0	0	0	0	23.4	0
Lithognathus mormyrus		0	0	0	85.2	16.4	41.7
Loligo sp.		1191.4	851.1	588.6	335.7	238.9	1137.8
Lophius sp.		2748.6	1853.1	2129.8	2641.7	3887	1746.8
Maja squinado		0	50.4	7.4	60.4	22.5	8.5
Merluccius merluccius	**A**	**1309.8**	**1409.4**	**1525.1**	**1010.2**	**723.1**	**748.8**
M.merluccius	**B**	**3507.9**	**2081**	**3236.7**	**2805.8**	**3512.5**	**2654.3**
M.merluccius	**C**	**4089.4**	**10572.6**	**8102.7**	**8457.7**	**6156.2**	**5980.9**
M.merluccius	**D**	**3569.3**	**4205.2**	**2890.5**	**3974**	**2175.6**	**2814.2**
Micromesistius poutassou		0	259.6	232.6	103.5	561.6	255.8
M.poutassou		4815.8	6232.9	5085	4452.4	4170.1	598.5
M.poutassou		639	105	563.2	366.4	70.2	0

Table. 5.1.1.1. (Cont.)

Specie	February	March	April	May	June	July
Mixed I cat	254.7	82.8	199	333.9	103.2	437.9
Mixed II cat	620.1	435.4	771.8	1245	643.5	275.3
Mixed III cat	2753.3	1917.1	3792.5	4057.8	1613.6	5352.3
Mugilidae indet.	0	0	0	415.3	173.4	54.2
Mullus barbatus	1299.9	334.1	899.8	896	399	623.7
M.barbatus	4958.1	5757.3	6250.1	7657.3	4223.9	6458.9
M.barbatus	1838.9	1223	1620.2	1245.7	610.8	993.8
Mullus surmuletus	533.2	147.3	497.6	796.5	360.4	436.7
M.surmuletus	646.5	23.4	707.2	553.7	716.1	770.2
M.surmuletus	0	0	423.7	460	315.9	274
Muraena helena	0	0	20.3	0	0	0
Nephrops norvegicus	1438.8	1640.7	1602.7	1879.2	2267.1	417.7
N.norvegicus	688.7	631.6	896.5	894.4	1081.1	590.8
Octopus salutii	358	162.2	245.6	166.1	262.1	118
Octopus vulgaris	1001.7	3038.7	1325.7	1735.5	973	983.2
Pagellus bogaraveo	0	0	36.9	0	0	0
Pagellus erythrinus	121.1	97.7	443.1	308.8	491.4	362.5
P.erythrinus	415.4	176.3	600.1	491.5	175.5	137.8
P.erythrinus	121.2	0	457.9	117.1	241	366.7
Pagellus sp.	226.1	47.7	8.3	532.3	21.1	114.2
Pagrus pagrus	0	0	0	42.6	0	0
Palinurus elephas	0	0	0	25.6	1.9	40.7
Palombo	64.7	1073.8	486.9	203.9	84.2	225.9
Paramola cuvieri	61.5	0	0	0	74.7	0
Parapennaeus longirostris	4011.2	4654.7	4829.1	2428.7	2083.7	803.5
Pasiphaea sp.	0	0	0	291	589.7	1014.5
Pennaeus kerathurus	9.7	0	9.2	31.9	7	125
Phycis blennoides	95.9	298.2	212.3	291.2	58.5	341
P.blennoides	346.8	535.6	747.8	642.8	1076.5	170.5
P.blennoides	295.7	319.2	336	53.9	117	149.2
Plesionika sp.	191.8	289	214.2	250.2	599.1	272.8
Polyprion americanus	0	0	0	0	70.2	0
Raja oxyrinchus	307	73.4	107.1	42.6	244.3	49.4
Raja sp.	1539.7	282.2	1113.7	1690.9	1121.1	448.8
Bothidae	0	31.9	16.6	0	18.7	13.3
Sarda sarda	6.5	0	36.6	0	0	0
Sardina pilchardus	0	67.5	0	22.6	24.8	111.9
Sarpa salpa	0	0	0	0	23.4	0

Table. 5.1.1.1. (Cont).

Specie	February	March	April	May	June	**July**
Scomber japonicus	0	0	92.1	99.9	0	0
Scomber scombrus	524.9	48.7	42.8	168.3	108.6	765.8
Scorpaena sp.	111.8	91.4	274.2	286.3	226.8	281.3
Scyliorhinus sp.	391.3	586	444.1	757.7	905.6	38.4
Scyliorhinus stellaris	0	0	0	0	0	75
Sepia officinalis	42.3	268.8	52.1	517.6	53.4	14.3
Sepiolidae indet.	121.6	134.5	264	334.4	227	212.6
Seppiette	153	299.6	487.4	173.3	285.5	383.3
Seriola dumerili	0	138.6	110.8	0	524.2	0
Serranus cabrilla	0	0	0	0	0	1.7
Serranus sp.	0	76.5	132.9	102.2	10.5	0
Solea vulgaris	0	49.7	50.8	38.3	89.4	187.2
Solenocera membranacea	52.2	92.9	42.1	8.2	0	0
Sparus aurata	0	42.5	0	42.6	35.1	162.5
Sphyraena sphyraena	0	0	0	8.5	28.1	143.3
Spicara sp.	14.4	57.1	66.5	0	94.8	0
Spondylosoma cantharus	0	21.2	27.7	10.6	23.4	0
Squilla mantis	835.1	3259.9	1917.3	966.5	1801.9	1144.2
Torpedo sp.	37.5	0	21.4	0	54.3	0
Teuthida	1220.6	1293.3	1002.6	894.1	509.7	495.3
Trachurus sp.	3540.8	6190	4538.2	1382.8	2497	926.3
Trachynidae sp.	0	38.1	58.2	134.4	101.1	268.9
Triglidae indet.	69.6	182.2	127.6	232	160.1	86.5
Triglidae indet.	57.9	152.6	54.8	149.5	667.6	90.5
Triglidae indet.	550.7	361.7	478.6	380.3	1059.4	264.2
Trisopterus minutus	1130.3	870.2	490.2	768	315.9	507.6
T.minutus	3874	5396.6	3328.5	2360.6	1134.3	1444
Scombridae	17.8	0	0	0	0	0
Umbrina cirrosa	0	0	0	9.6	0	0
Uranoscopus scaber	91.6	486.2	131.3	374.2	452.8	571.5
Xiphias gladius	48.5	25.5	22.2	0	0	0
Zeus faber	500.4	313.8	622.2	820	994.6	349.2

Tab. 5.1.1.2. Castiglione della Pescaia. Monthly landing by species.

Species		February	March	April	May	June	July
Alloteuthis sp.		308.7	303.7	51.5	152	0	1415.9
Argentina sphyraena		963.8	0	58.6	0	0	0
Boops boops		384.1	818.8	940.3	783.2	2348.2	0
Bolinus brandaris		0	0	0	0	209.1	0
Cassidaria echinophora		0	0	0	0	0	760.6
Centrolophus niger		0	0	0	0	87.1	0
Cepola rubescens		62.1	0	234.5	0	738.9	0
Citharus linguatula		139.7	227.8	95.3	1237	1239	1026.8
Conger conger		42.7	0	0	0	191.7	104.6
Dentex dentex		124.2	74.4	0	0	0	0
Dicentrarchus labrax		0	0	32.6	0	0	0
Diplodus annularis		0	0	36.6	789.9	0	0
Diplodus sp.		0	0	0	331.2	0	0
Eledone cirrhosa		8006.8	2292.6	3932.1	6792.5	2988.6	1064.8
E.cirrhosa		310.4	446.6	81.4	1046.5	8408	3137.5
Eledone moschata		447	0	2784.2	2384.5	1829.7	228.2
Engraulis encrasicolus		0	0	0	331.2	174.3	570.5
Gobidae indet.		0	0	32.6	0	27.9	0
Lepidopus caudatus		116.4	595.5	366.3	165.6	784.2	30.4
Lepidorhombus boscii		49.7	0	130.3	0	0	410.7
Lithognathus mormyrus		0	0	0	0	0	285.2
Loligo sp.		402.9	301.3	82.9	661.7	76.7	258.6
Lophius sp.		919.6	335	903.7	758.4	392.1	157.8
Maja squinado		62.1	0	195.4	0	0	0
Merluccius merluccius	**A**	**729.4**	**163.8**	**349.2**	**215.3**	**0**	**0**
M.merluccius	**B**	**1940**	**1295.2**	**2059.7**	**2500.4**	**174.3**	**722.6**
M.merluccius	**C**	**4386**	**2344.7**	**4879.7**	**11236.9**	**2627**	**5027.3**
M.merluccius	**D**	**3247.6**	**4394.6**	**3773.4**	**2324.9**	**8939.5**	**2365.8**
Mixed I cat		0	364.7	103.7	0	0	0
Mixed II cat		271.6	893.2	252.4	0	0	190.2
Mixed III cat		1372	4335.1	4639.7	9988.4	4258.9	7811.4
Mugilidae indet.		0	0	0	322.9	0	0
Mullus barbatus		1203.6	49.1	313.4	1184	95.8	794.8
M.barbatus		2522	774.1	2426	4984.3	784.2	6807.4
M.barbatus		1487.6	3872.1	1054.3	2533.5	1607.5	1625.8
Mullus surmuletus		0	0	4.1	0	575.1	0
M.surmuletus		0	0	40.7	0	740.6	0
M.surmuletus		0	0	22	0	0	0

Tab. 5.1.1.2. (Cont.)

Species	February	March	April	May	June	July
Nephrops norvegicus	163	0	0	0	0	0
N.norvegicus	32.6	0	0	0	0	0
Octopus macropus	0	0	0	0	355.5	0
Octopus salutii	0	0	1481.7	695.5	0	0
Octopus vulgaris	5334.2	5147.9	3840.9	7998	3452.1	5723.5
Pagellus erythrinus	0	0	0	0	43.6	0
P.erythrinus	0	0	260.5	0	0	0
P.erythrinus	0	0	24.4	0	0	0
Pagellus sp.	349.2	40.2	0	1907.6	0	1026.8
Palinurus elephas	0	14.9	19.5	24.8	0	11.4
Parapennaeus longirostris	1160.9	0	65.1	112.6	174.3	45.6
Pennaeus kerathurus	217.3	491.3	73.3	592.8	0	741.6
Phycis blennoides	232.8	0	0	0	0	0
P.blennoides	38.8	0	0	0	0	0
Raja oxyrhinchus	0	0	0	96	0	0
Raja sp.	99	172.7	292.8	211.3	202.1	335.4
Bothidae	0	0	0	44.7	0	0
Sardina pilchardus	0	0	43.1	351.1	600.3	0
Scomber scombrus	387.1	276.3	94.4	268.9	0	132.3
Scorpaena sp.	41.9	40.2	0	0	117.6	308
Scyliorhinus sp.	34.9	0	0	0	0	0
Sepia officinalis	406.9	1205	92.8	2359.7	0	15.2
Sepiolidae indet.	163	74.4	24.4	0	43.6	95.1
Seppiette	465.6	0	626.9	0	1193.7	95.1
Serranus sp.	0	0	58.6	0	125.5	0
Solea vulgaris	183.9	458.5	347.6	556.4	552.4	650.3
Sphyraena sphyraena	0	0	0	781.6	0	0
Spicara sp.	0	67	95.3	0	23.5	0
Squilla mantis	2513	2947.6	3646.5	9704.9	2169.9	3848.6
Torpedo sp.	27	0	0	0	0	330.9
Teuthidae	1220.6	474.9	1746.2	710.4	239.6	104.6
Trachurus sp.	5971.3	15274.1	12807.4	1661.2	347.6	1083.9
Trachynidae sp.	0	0	22	119.2	352.9	376.5
Triglidae indet.	27.2	40.2	146.5	82.8	298	228.2
Triglidae indet.	76.8	80.4	65.9	119.2	0	15.2
Triglidae indet.	963.8	0	439.6	606.1	1435	239.6
Trisopterus minutus	4399.9	401.9	1398.6	640.8	0	0
T.minutus	3003.1	1406.8	1040.4	1609.5	1489.9	290.9
Uranoscopus scaber	188.6	308.2	534.9	1281.7	2446.6	1146.6
Zeus faber	366.3	148.9	29.3	59.6	87.1	0
Other	213.4	0	89.6	182.1	0	627.5

5.1.2 Vilanova i La Geltrú

Data presented in this chapter have been elaborated from the daily statistics of the sales at the auction, by trawler, in coincidence with the sampling on board trawlers. Thus, the monthly landings have been estimated from three days of sales at the action of the trawl fleet catch, expanded to the total fishing days of the month. These statistics are rather precise, with more than 50 species detailed in the forms. Item "others" refers to different species that are sold mixed up together because they have not been separated for the auction. This item represented 7% of the landings.

During the six months of sampling the trawling fleet of Vilanova i La Geltrú landed around 600 fish tonnes (Table 5.1.2). Highest landings during the sampling period were obtained in June, when the blue whiting and European hake landings were also highest. By far the species with highest landings was *Micromesistius poutassou,* that represented around 23% of the total landings. It is worth noticing, as already mentioned in section 4.2.2 and figure 4.2.2.2, that in species with commercial interest the amount of catch discarded is very small, except in the case of blue whiting. European hake follows the blue withing regarding the amount of landed catch, around 17% of the total landings. The relative importance of European hake in the landings increased every month, representing around 10% of the landings in February and March, 13%-14% in April- May, and 23%24-% in June- July. This species is caught during all the year, and is one of the main target species for the trawl fleet. Although in this report we do not make any reference to the prices attained at the auction by the different species, we can mention that European hake price is different depending on the sizes, but always is relatively high, although not among the highest.

Regarding cephalopods, *Eledone cirrhosa* and *Octopus vulgaris*, are among the species with highest catches. At certain time of the year, when recruitment of *Eledone cirrhosa* takes place, the price at the auction of these recruits is among the highest attained by any other species during the year. As for crustaceans, in this port a small number of trawlers are specialised in the fishing of *Aristeus antennatus* in the canyon nearby Vilanova i La Geltrú. The landings of this species are significantly higher than those of *Nephrops norvegicus*. These two species are also among those most appreciated by consumers.

Table 5.1.2.1. Vilanova i La Geltrú. Monthly landing by species.

Species	February	March	April	May	June	July
Aristeus antennatus	4123.3	3669.1	2098.6	3377.7	1971.6	743.6
Bolinus brandaris	165.3	295.6	0.0	0.0	0.0	25.0
Boops boops	1142.7	173.5	741.3	319.0	3516.8	258.5
Cepola rubescens	2131.0	1410.8	1573.5	1702.4	1151.5	1815.0
Citharus linguatula	4114.0	2490.7	5330.8	4349.4	3025.4	4822.7
Conger conger	316.3	607.2	213.8	723.8	298.9	232.9
Dentex dentex	0.0	149.3	130.2	0.0	28.4	0.0
Dicentrarchus labrax	120.7	353.1	128.3	0.0	9.8	343.5
Diplodus annularis	0.0	39.9	540.6	0.0	557.9	455.4
Diplodus sargus	0.0	279.7	0.0	0.0	0.0	0.0
Diplodus vulgaris	85.7	83.1	19.0	55.0	0.0	0.0
Eledone cirrhosa	6759.3	7020.8	2405.7	4354.5	4970.0	8344.3
Eledone cirrhosa juv.	574.7	555.0	1003.5	1962.4	476.7	309.7
Engraulis encrasicolus	0.0	68.5	2471.6	1010.9	1477.0	1912.1
Galeus melastomus	42.3	69.3	184.0	0.0	133.4	65.5
Gobius niger	0.0	162.8	27.9	88.0	0.0	28.9
Helicolenus dactylopterus	68.7	25.0	0.0	328.2	87.2	201.6
Homarus gammarus	0.0	13.5	0.0	8.1	0.0	5.0
Lepidorhombus boscii	745.0	533.2	575.1	484.0	368.6	209.0
Liocarcinus depurator	2071.3	2081.5	2145.7	3101.3	2279.9	2179.1
Lithognathus mormyrus	0.0	25.3	64.0	0.0	0.0	0.0
Loligo vulgaris	141.3	131.5	52.9	26.8	537.6	2684.8
Lophius spp	4099.3	4360.1	2016.5	3571.3	2836.1	1563.7
Merluccius merluccius	**8007.0**	**9974.8**	**9826.2**	**11216.0**	**34148.8**	**25137.5**
Micromesisteus poutassou	9950.3	24210.5	17474.6	18171.6	49237.3	16092.1
Mullus barbatus	808.7	2218.2	956.0	1177.4	1369.9	1507.6
Mullus surmuletus	756.0	0.0	367.3	0.0	0.0	404.5
Nephrops norvegicus	1091.7	1193.8	1793.6	2944.3	2286.9	1137.1
Octopus vulgaris	5569.7	4713.0	1479.8	1564.6	3554.3	4518.0
others	4414.7	7380.2	4972.3	7014.3	8351.7	6160.3
Pagellus acarne	372.7	6292.0	1412.3	1032.9	2843.4	11785.1
Pagellus erythrinus	995.7	84.4	83.3	380.2	272.7	719.1
Pagrus pagrus	321.0	186.7	236.9	112.9	21.0	0.0
Palinurus elephas	9.3	0.0	12.0	9.2	6.3	43.2
Phycis blennoides	2131.3	1568.3	1414.9	2625.0	1982.4	1296.4
Phycis phycis	0.0	14.0	0.0	0.0	0.0	0.0
Polyprion americanus	0.0	0.0	0.0	41.1	18.6	403.4
Raja asterias	113.7	320.1	40.5	146.3	156.5	578.6
Sarda sarda	0.0	0.0	82.0	0.0	0.0	0.0
Sardina pilchardus	0.0	590.2	1501.0	0.0	602.4	48.7
Scomber scombrus	1932.0	4772.1	1363.9	668.1	4328.1	2284.4
Scophtalmus rhombus	4.0	52.0	19.0	9.9	116.6	138.1
Scorpaena porcus	34.7	167.2	357.5	13.9	6.3	174.4
Scyliorhinus canicula	399.0	260.4	55.1	129.1	114.8	25.0

Table 5.1.2.1. (Cont.).

Species	February	March	April	May	June	July
Sepia officinalis	1165.0	1081.3	14.9	39.2	36.4	49.8
Seriola dumerili	119.3	51.2	106.7	0.0	179.6	0.0
Serranus cabrilla	0.0	75.4	39.9	0.0	0.0	0.0
Solea vulgaris	39.7	78.9	33.9	69.3	40.3	1121.2
Sphyraena sphyraena	0.0	0.0	0.0	0.0	0.0	20.1
Spicara spp	0.0	1183.6	0.0	0.0	143.5	0.0
Squilla mantis	0.0	101.8	0.0	0.0	28.7	335.2
Stichopus regalis	52.0	15.7	0.0	16.1	20.0	18.7
Trachinus draco	618.3	820.6	433.8	2079.0	1781.2	1786.7
Trachurus spp	8399.0	8343.2	6658.6	3960.0	5621.0	6550.2
Trigla lucerna	220.3	190.6	170.4	297.7	617.1	543.7
Trisopterus minutus	1541.0	1530.9	529.8	385.0	67.9	107.3
Trunculariopsis trunculus	38.0	0.0	0.0	0.0	0.0	0.0
Uranoscopus scaber	301.6	550.8	302.4	695.6	475.3	306.4
Xiphias gladius	0.0	0.0	0.0	43.6	0.0	36.0

5.1.3 Santa Pola

Total monthly landings varied between 312 t in April and 372 t in March. For the whole period they were 1,714 t. For the European hake the landings ranged between 48 t in April and 85 t in July. For the whole period, 325 t of hake were landed. Landings for the most important species during the whole period were 245 t for the blue whiting, 68 t for white shrimp, 222 t for octopus, 130 t for mackerel and 224 t for mixed species (Table 5.1.3).

In total, 72 species and commercial categories were landed in the trawl fishery, of which 51 were fish, 10 were crustaceans and 6 were cephalopods. The rest were commercial categories. In weight, fish represented 75% of the landings, whereas 10% corresponded to crustaceans and 15% to cephalopods.

The six most abundant species landed were European hake *M. merluccius* (18%), blue whiting *M. poutassou* (14%), octopus *O. vulgaris* (13%), coastal mixed species (12%), mackerel *T. trachurus* (12%) and white shrimp *P. longirostris* (4%). In total, these species represented 66% of the total landings. The rest of the species represented between 0.0 and 2% of the total landed weight.

Landed hake corresponding to very small and small size categories were from the coastal and shelf fisheries, while medium and large size categories were landings from the shelf-break and slope fisheries. From the small scale fishery some quantities of medium and large hake were captured.

The very small size landings varied between 2,812 and 5,558 kg per month and represented 6% of the total hake landed for the whole sample period. The small sizes were between 18,158 and 22,595 kg and represented 34%, whereas the medium sizes varied from 7,115 to 12,084 kg and represented 15%, and large sizes were between 20,069 and 41,439 kg and represented 45% of the total hake landed.

Table 5.1.3.1 Santa Pola. Monthly landing by species.

Specie	February	March	April	June	July
Argyrosomus regius		25	58	7	19
Aristeus antennatus	5032	6438	7477	9455	7034
Atherina boyeri	2023	400	151	175	1064
Boops boops	7396	6620	4330	2694	8543
Citharus linguatula	683	531	607	552	408
Conger conger	361	290	492	328	563
Dalatias licha	119	238	151	281	236
Dentex dentex	37	198	296	75	110
Dicentrarchus labrax	795	447	327	318	199
Diplodus annularis	20	113	658	201	522
Diplodus sargus	191	463	497	69	84
Elasmobranquii	376	244	94	371	1331
Eledone cirrhosa	21	27	34	6	248
Engraulis encrasicolus	1155	1157	529	651	2757
Geryon longipes	27	162	585	1245	1384
Helicolenus dactylopterus	459	354	518	237	250
Lepidopus caudatus	528	4965	6409	986	1120
Liocarcinus depurator	4996	3705	3575	3943	4062
Lithognathus mormyrus	403	233	829	838	746
Loligo vulgaris	3703	2264	1911	2755	3154
Lophius spp	8735	7766	5110	5863	6793
***Merluccius merluccius* big**	**4122**	**2812**	**2978**	**3914**	**5558**
***Merluccius merluccius* medium**	**24590**	**22001**	**18158**	**19974**	**25595**
***Merluccius merluccius* small**	**10552**	**8549**	**7115**	**11499**	**12084**
***Merluccius merluccius* very small**	**20493**	**22441**	**20069**	**41217**	**41439**
Micromesistius poutassou	30031	85458	56385	30494	42138
Mullus barbatus	4745	4710	3845	3710	8957
Mullus surmuletus	9162	7381	7146	11291	10468
Mustelus mustelus	158	305	47	78	86
Myliobatis aquila	120	106	37	16	107
Nephrops norvegicus	957	1092	917	1425	1883
Octopus vulgaris	48056	50804	35856	56595	30507
Pagellus acarne	4868	4610	6837	2708	6395
Pagellus bogaraveo	428	1295	907	722	514
Pagellus erythrinus	275	325	560	1966	3267
Pagrus pagrus	345	374	741	281	164
Palinurus elephas	102	97	34	30	145
Pandalidae	5083	4746	4078	6116	4934
Parapandalus narval	1186	732	803	1331	1084
Parapenaeus longirostris	17387	15074	12241	13430	9660
Phycis blennoides	2230	2612	2184	4729	4417
Plesionika edwardsii	1258	1589	1231	994	1403
Raja spp	1805	1562	1038	761	1723
Sardina pilchardus	2172	3810	2482	2707	8616
Sciaena umbra	16		16	15	7
Scomber spp	4036	2893	1628	4166	7909

Table 5.1.3.1. (Cont.).

Specie	February	March	April	June	July
Scophthalmus rhombus	22	34	44	35	49
Scorpaena porcus	172	70	211	1224	1983
Scorpaena scrofa	190	197	87	36	225
Scyliorhinus canicula	943	1392	945	1569	1283
Scyllarus spp	6	4	2	5	
Sepia officinalis	6115	4629	3229	1415	615
Sepia orbignyana	355	241	112	100	64
Seriola dumerili	63	40	21		45
Solea solea	107	121	105	83	79
Sparus aurata	92	69	236	68	168
Sphyraena sphyraena	101	19	758	38	595
Spicara spp	8270	5959	5498	6214	5009
Squilla mantis	1068	1405	1139	308	365
Todarodes sagittatus	2466	2115	1964	1355	1444
Trachinotus ovatus	34	13	105	6	23
Trachinus spp	609	610	538	317	428
Trachurus trachurus	30281	27991	31371	17302	23961
Triglidae	132	94	51	129	288
Trisopterus minutus	2728	2667	1382	1018	1042
Xiphias gladius	329	274	87	180	174
Zeus faber	624	644	906	1129	1937
Other	316	416	3031	2710	2987
*Coastal mixed spicies big	22213	24523	24132	33835	34826
*Coastal mixed spicies small	6674	7920	7622	9475	9336
*Variet	10769	8471	6910	8759	8382

5.1.4 Palma de Mallorca

Total monthly landings from the total fleet varied between 65 and 109 t per month. For the whole period landings were 523 t (Table 5.1.4.).

Landings by the most important demersal species for the whole period were 131 t for blue whiting (*M. poutassou*), 40.2 t for great fork beard (*P. blennoides*), 40.1 for the red shrimp (*A. antennatus*), 29.7 t for white shrimp (*P. longirostris*), 28 t for European hake (*M. merluccius*), 25 t for the striped red mullet (*M. surmuletus*) and 25.6 t for octopus (*O. vulgaris*). However, some pelagic species were also captured and landed in relatively high densities, such as 48.5 t for the caramel (*Centracanthus cirrus* and *Spicara smaris*) and 18.9 t for the mackerels (*Trachurus* spp.). In addition, there were two or three categories called "coastal mixed", which were composed of a variety of species, that reached 25 t for the whole period.

In total, 75 species were landed, of which 59 corresponded to fish, 11 to crustaceans and 5 to cephalopods. In weight, fish represented 80% of the landings, while crustaceans and cephalopods represented 13 and 7%, respectively.

The seven most abundant species landed were blue whiting (24%), Great great fork beard (7.9%), red shrimp (7.8%), white shrimp (5.8%), European hake (5.5%), striped red mullet (5%), and octopus (5%). In total, these species represented 63% of the total landings. The rest of the species represented between 0.0 and 4% of the total landed weight.

Small size landings varied between 190.8 and 1,074.2 kg per month and represented 12% of the total hake landed for the whole period sampled. The medium size varied from 1,318.1 to 4,013.6 kg and represented 46%, whereas the large size was between 1,483.7 and 2,298.5 kg and represented 42% of the total hake landed.

5.1.5 Sète

Data on monthly landings by species for the trawl fleet during the study period was not available for the fishing port of Sète. We refer to section 4.2.5 where a summary the commercial and discarded catch obtained from the sampling on board trawlers is presented, by month, and the unit used is daily catch/trawler.

Table 5.1.4.1. Palma de Mallorca. Monthly landing by species.

	February	March	April	May	June	July
Argentina sphyraena	1004.2	1948.0	2215.5	1943.3	881.7	2575.1
Aristaeomorpha foliacea	91.2	6.2	0.0	60.5	28.1	56.7
Aristeus antennatus big	2297.1	2621.1	3482.5	5500.6	4835.1	4422.6
Aristeus antennatus small	2583.1	2097.6	2092.3	5059.5	3584.4	1547.2
Boops boops	332.5	0.0	0.0	0.0	165.0	0.0
Bothus podas podas	115.9	7.1	69.3	173.8	69.3	20.5
Centracanthus cirrus	4045.6	2290.9	3151.8	7892.5	3173.5	3937.5
Centrolophus niger	264.6	162.5	1045.5	320.7	220.6	123.4
Centrophorus granulosus	6.2	319.7	0.0	8.8	14.3	94.5
Cetorhinus maximus	0.0	0.0	0.0	0.0	1588.4	1147.1
Conger conger	270.8	640.8	1551.3	1611.0	1229.8	930.3
Dentex dentex	0.0	12.4	0.0	0.0	31.9	0.0
Diplodus annularis	183.8	0.0	0.0	0.0	0.0	0.0
Diplodus sargus	66.5	0.0	0.0	119.9	0.0	0.0
Diplodus vulgaris	65.1	14.3	0.0	23.7	0.0	0.0
Engraulis encrasicolus	0.0	0.0	0.0	0.0	0.0	13.1
Epinephelus caninus	0.0	0.0	0.0	0.0	0.0	220.5
Galeus melastomus	399.5	637.0	1255.5	1153.4	93.5	356.5
Geryon longipes	700.6	540.6	628.6	882.8	921.3	1445.3
Helicolenus dactylopterus	52.3	50.4	105.4	74.3	5.0	178.0
Illex coindetti	1871.0	767.1	1371.9	2430.5	1099.5	2170.4
Lepidorhombus boscii	255.6	426.6	428.0	256.9	435.6	643.7
Loligo vulgaris	449.4	329.9	273.7	446.6	345.7	205.8
Lophius spp.	1508.1	875.9	1315.0	966.9	1442.1	1878.5
***Merluccius merluccius* big**	**2029.7**	**2298.5**	**2156.9**	**2261.6**	**1598.9**	**1483.7**
***Merluccius merluccius* medium**	**1318.1**	**1423.1**	**1453.9**	**1867.8**	**2671.4**	**4013.6**
***Merluccius merluccius* small**	**726.3**	**452.2**	**190.8**	**420.8**	**564.3**	**1074.2**
Micromesistius poutassou	12816.0	16366.6	29479.7	30361.1	22317.9	19803.0
Mullus barbatus	1257.3	758.6	755.7	1874.4	1228.2	1051.1
Mullus surmuletus	3380.1	3270.4	4643.1	6770.5	3710.3	3416.7
Muraena helena	9.5	0.0	0.0	0.0	0.0	0.0
Mustelus spp.	50.4	3.3	136.4	136.4	1958.0	1082.0
Nephrops norvegicus big	32.8	9.5	4.3	12.1	11.0	62.0
Nephrops norvegicus medium	72.2	52.7	54.4	68.8	69.3	344.9
Nephrops norvegicus small	61.8	46.6	40.8	108.4	250.3	532.4
Oblada melanura	0.0	0.0	0.0	110.0	0.0	0.0
Octopus vulgaris	2044.4	2423.9	3383.4	5226.1	8400.7	4129.7
Pagellus acarne	284.1	0.0	747.2	264.6	643.0	252.5
Pagellus erythrinus	563.4	67.0	210.0	462.0	408.7	182.2
Pagrus pagrus pagrus	0.0	0.0	2.6	55.6	30.3	0.0
Palinurus elephas	0.0	0.0	0.0	0.0	1.7	0.0
Palinurus mauritanicus	0.0	0.0	0.0	47.3	44.6	5.3
Paramola cuvieri	142.5	61.8	29.8	5.5	77.0	183.8
Parapenaeus longirostris	4316.3	4816.0	4876.0	5574.3	5102.9	5041.1

Table 5.1.4.1.(Cont.).

	February	March	April	May	June	July
Peristedion cataphractum	0.0	0.0	0.0	6.6	0.0	0.0
Phycis blennoides	3849.9	4716.8	7330.0	8389.2	7876.0	8076.1
Plesionika edwadsii	240.8	137.3	268.6	419.7	167.2	1093.1
Plesionika spp.	2007.4	1323.4	1595.5	3514.0	3263.7	3099.1
Raja spp.	1359.5	1512.9	2199.0	3790.1	3637.7	3019.8
Sardina pilchardus	95.0	665.0	42.5	181.5	385.0	262.5
Sardinella aurita	0.0	0.0	0.0	165.0	0.0	0.0
Scorpaena scrofa	95.0	30.4	96.1	96.3	75.9	65.1
Scyliorhinus canicula	1727.6	2237.7	1800.3	1987.2	2167.6	2032.8
Scyllarides latus	0.0	0.0	0.0	6.1	44.6	0.0
Sepia officinalis	33.3	35.6	14.5	5.0	74.3	19.4
Sepietta spp.	0.0	0.0	4.3	6.1	5.5	0.0
Seriola dumerili	0.0	0.0	3.4	650.1	0.0	0.0
Serranus cabrilla	115.0	87.4	40.8	66.0	77.0	108.7
Solea kleini	27.1	5.7	48.0	23.7	47.3	54.1
Sparus aurata	0.0	26.1	0.0	0.0	0.0	0.0
Spicara maena	0.0	47.5	85.0	0.0	0.0	0.0
Spicara smaris	2735.1	2143.2	5256.4	7976.1	3588.8	1947.8
Squalus spp.	0.0	20.0	0.0	50.6	2.8	208.4
Trachinus radiatus	6.7	0.0	6.8	66.6	35.8	62.0
Trachurus spp.	5614.5	2994.9	3214.7	3572.3	1696.8	1837.5
Trigla lucerna	0.0	11.9	38.3	96.3	234.9	12.6
Trigla lyra	21.4	0.0	33.6	15.4	13.2	162.8
Trisopterus minutus capelanus	0.0	0.0	0.0	0.0	23.1	0.0
Uranoscopus scaber	0.0	0.0	1.7	34.1	31.4	5.3
Zeus faber	119.2	195.7	470.1	327.3	260.2	288.0
*Coastal mixed species big						
Diplodus vulgaris	22.2	16.0	24.6	31.2	23.7	29.5
Pagellus acarne	23.1	16.7	25.6	32.6	24.7	30.7
Pagellus bogaraveo	6.8	4.9	7.5	9.5	7.2	9.0
Scorpaena porcus	7.7	5.6	8.5	10.9	8.2	10.2
Scorpaena scrofa	11.6	8.4	12.8	16.3	12.4	15.4
Serranus cabrilla	794.8	574.3	880.1	1118.8	849.3	1055.3
Spicara smaris	586.4	423.8	649.4	825.5	626.7	778.6
Trachinus draco	92.6	66.9	102.5	130.3	98.9	122.9
Trigloporus lastoviza	729.2	526.9	807.5	1026.5	779.2	968.2
*Coastal mixed species small						
Blennius ocellaris	35.5	22.0	34.3	52.4	72.3	58.8
Lepidotrigla cavillone	26.6	16.5	25.8	39.3	54.2	44.1
Microchirus variegatus	23.3	14.4	22.5	34.4	47.4	38.6
Pagellus acarne	90.4	56.1	87.6	133.6	184.3	150.0
Pagrus pagrus	16.0	9.9	15.5	23.6	32.5	26.5
Scorpaena notata	1259.1	781.3	1219.4	1860.5	2566.4	2088.2
Scorpaena scrofa	10.2	6.3	9.9	15.1	20.8	16.9
Serranus cabrilla	186.2	115.5	180.3	275.2	379.5	308.8
Serranus hepatus	29.9	18.6	29.0	44.2	61.0	49.6

Tabla 5.1.4.1. (Cont.)

	February	March	April	May	June	July
Spicara smaris	16.8	10.5	16.3	24.9	34.3	27.9
Spondyliosoma cantharus	11.3	7.0	10.9	16.7	23.0	18.7
Trigloporus lastoviza	60.3	37.4	58.4	89.1	122.9	100.0
Trisopterus minutus capelanus	4.2	2.6	4.1	6.2	8.6	7.0
*Variet						
Diplodus vulgaris	43.9	34.7	58.7	75.6	230.1	56.7
Pagellus erythrinus	37.6	29.7	50.3	64.8	197.2	48.6
Scorpaena scrofa	50.2	39.6	67.1	86.4	263.0	64.8
Solea vulgaris	18.8	14.9	25.2	32.4	98.6	24.3
Trachinus radiatus	12.5	9.9	16.8	21.6	65.7	16.2
Zeus faber	25.1	19.8	33.5	43.2	131.5	32.4

5.2 Estimated *Merluccius merluccius* monthly discards

5.2.1 Porto Santo Stefano

Tables 5.2.1.1. and 5.2.1.2. show the proportion of discards of *M. merluccius*, in weight and number, respect to the total amount commercialised and to the commercial category D, computed using the data collected on board in the study period. European hake discards were, more or less, 10% in weight and 30% in number, as an average, of the total catch of the species commercialised; considering only the commercial category D, the average ratio was 28% in weight and 45% in number. Only small specimens of European hake were discarded, as resulted from the analysis of length frequency distributions (see Fig. 4.3.1.1.); therefore the discard took place only when the commercial category D was present in the landings.

The same percentages observed on board were utilised to estimate the total monthly discards and the total monthly landing in the two ports.

The results illustrated in Tables 5.2.1.1. and 5.2.1.2. pointed out the high variability in the quantities of discarded hake. February presented the higher amounts because the fishing operations were carried out mostly at depth between 200 and 240 m, whereas April presented the lowest because the hauls were performed mostly at depths higher than 300 m. The differences observed should be related with the bathimetric range of distribution of the juveniles of European hake.

Table 5.2.1.1. Porto Santo Stefano. Estimated European hake landing and discards.

		February	March	April	May	June	July
Observed discards							
% tot comm	weight	32.3	11.6	2.4	13.4	8.3	9.0
	number	72.3	31.4	13.9	59.0	23.0	44.4
% cate D	weight	54.5	22.6	6.5	40.3	17.2	27.1
	number	73.5	37.8	17.0	69.4	27.2	48.6
Estimated European hake monthly landings							
Tot comm	weight	12476.4	18268.2	15755.1	16247.7	12567.4	12198.1
	number	406909.0	574085.0	445964.0	491646.0	389181.0	420732.0
cate D	weight	3569.3	4205.2	2890.5	3974.0	2175.6	2814.2
	number	247242.0	269216.0	175169.0	225392.0	204583.0	288828.0
Estimated European hake monthly discards							
	weight	4282.3	1225.0	201.7	2681.5	452.4	1044.5
	number	684761.0	163381.0	35808.0	511827.0	75249.0	273041.0

Table 5.2.1.2. Castiglione della Pescaia. Estimated European hake landing and discards.

		February	March	April	May	June	July
Observed discards							
% tot comm	weight	32.3	11.6	2.4	13.4	8.3	9.0
	number	72.3	31.4	13.9	59.0	23.0	44.4
% cate D	weight	54.5	22.6	6.5	40.3	17.2	27.1
	number	73.5	37.8	17.0	69.4	27.2	48.6
Estimated European hake monthly landings							
Tot comm	weight	10303.0	8198.3	11062.0	16277.5	11740.8	8115.6
	number	388009.0	354258.0	391736.0	478905.0	910558.0	345635.0
cate D	weight	3247.6	4394.6	3773.4	2324.9	8939.5	2365.8
	number	224956.0	281341.0	228668.0	131859.0	840623.0	242807.0
Estimated European hake monthly discards							
	weight	3896.3	1280.1	263.3	1568.7	1858.7	878.1
	number	623035.0	170739.0	46745.0	299430.0	309196.0	229535.0

5.2.2 Vilanova i La Geltrú

From the sampling on board trawlers we estimated the discards rates, by month, expressed in weight and in number. The discard rates estimated for the catch expressed in weight were applied to the monthly landings of *Merluccius merluccius*. By doing so we estimated the hake discards generated by a certain amount of landings. As for the generated discards expressed in number, from the monthly length frequency distributions the ratio number of discarded specimens and discarded weight was known. This values were used to estimate the number of discarded individuals corresponding to the estimated discards in weight. Finally, the number of individuals that made up the landings was estimated by the ratio individuals commercialised and individuals discarded, also known from the sampling, for each month.

The estimated European hake discards are presented in table 5.2.2. We can see that when discards are expressed in weight the amount of the catch that is discarded is low, the higher values corresponding to June. This can be somehow misleading, given that the number of individuals discarded, very small sizes, can represent up to 26.4% and 21.7% of the total caught individuals in May (highest rate) and June. The month with highest *Merluccius merluccius* landings during the study period was June, and because of this it was also June the month with highest estimated discards. All data combined, during these six months around 1% of the total catch in weight, and 7% of the individuals caught,, were discarded.

Table 5.2.2. Vilanova i La Geltrú. Estimated European hake discards

		February	March	April	May	June	July
Observed discards							
% totcomm	weight	0,4	0,4	0,2	1,5	3,5	0,3
	num	4,8	9	7,3	26,4	21,7	1,2
European hake monthly landings							
totcomm	weight (kg)	8007,0	9974,8	9826,2	11216,0	34148,8	25137,5
	num (thousands)	133,5	70,4	77,0	240,5	563,9	745,7
Estimated European hake discards							
	weight (kg)	32,0	39,9	19,7	168,2	1195,2	75,4
	num (thousands)	6,4	6,3	5,6	63,5	122,4	8,9

5.2.3 Santa Pola

Table 5.2.3 shows the estimated proportion by percentage, number and weight of the total hake landed and discarded per month. The results showed that, although discard percentages in number were between 0.4 and 8.7%, the percentages by weight were below 1% for all months. The total discard in weight was lowest in July, whereas June was the month with the highest discards in number.

Table 5.2.3. Santa Pola. Estimated European hake discards.

		February	March	April	May	June	July
Observed discards							
% totcomm	weight	0,65	0,27	0,52	0	0,37	0,01
	num	5,46	4,76	3,37	0	8,73	0,35
% cat small	weight	2,36	3,01	3,30	0	0,99	2,20
	num	12,38	12,33	10,58	0	4,43	8,36
European hake monthly landings							
totcomm	weight	59757	55803	48320	0	76604	84676
	num	2261007,1	1424600,8	2353113,3	0	914564,9	647672,6
cat small	weight	20493	22441	20069	0	41217	41439
	num	1900,3	2267,9	2343,7	0	2831	3944,2
Estimated European hake discards							
	weight	388,2	152,3	252,4	0	282,2	5,67
	num	130688,9	71149,7	82043,8	0	87433,8	2269,9

5.2.4 Palma de Mallorca

Table 5.2.4. Palma de Mallorca. Estimated European hake discards

		February	March	April	May	June	July
Observed discards							
%discard	weight	0,00	0,00	0,18	2,90	8,68	3,09
% discard	num.	0,00	0,00	1,62	24,57	15,32	33,94
European hake monthly landings							
totcomm	weight	4074,08	4173,83	3801,63	4550,15	4834,50	6571,43
	num	15150	28016	31975	32036	28069	20867
Estimated European hake discards							
	weight	0	0	7,00	135,81	459,72	209,70
	num	0	0	525	10435	5078	10720

Table 5.2.4 shows the estimated proportion of the total hake landed and discarded per month by percentage, number and weight. The results showed that discards in number could be an important fraction of the total catches. The pattern of discards increased through the sampling period, and was at a maximum in May and June, but started to decrease in July. The maximum discard was estimated for June and reached 0.46 t for the whole fleet.

The discards by weight were at a maximum in June (9%), whereas for the other months the discard was null in February and March, and between 0.1 and 3% in April, May and July.

5.2.5 Sète

The sampling on board trawlers allowed the estimation of the European hake discards, both in weight and in number. Among the five study ports it is in Sète and the ports in the Tyrrhenian that *Merluccius merluccius* discards are bigger. The amount of the catch that is discarded is important, both in weight and in number (Table 5.2.5). Highest values corresponded to July, when up to 18% of the catch and more than 60% of the individuals were discarded. Furthermore, when combining the six-months length frequency distributions we can see that the individuals discarded are bigger in this port than in the others. This fact can be related to the type of gear used by trawlers, with wide vertical opening.

Table 5.2.5. Sète. Estimated European hake discards, in weight and number, by month.

	March	April	May	July	August
weight %	2,9	0,5	0,4	18,5	12,6
number %	34,9	12,1	15,1	63,5	45,0

5.3 Factors affecting European hake discards

The sampling on board commercial trawlers performed in this study has made evident the differences regarding the practice by the fishermen of discarding part of the hake catch at sea. Figure 5.3.1. shows the pattern of hake discard *vs* hake total catch in Porto Santo Stefano, Santa Pola and Vilanova i la Geltrú. We can see that while in Porto Santo Stefano hake discards can be relatively high in some cases, with values achieving more than 3.0 $kg.h^{-1}$ of discarded hake, in the other ports hake discards are always very low, less than 0.5 $kg.h^{-1}$. From these data we considered the possibility of an active discard of hake by the fishermen in Porto Santo Stefano, which was not done in neither in Vilanova i la Geltrú nor in Santa Pola.

A multiple linear regression model has been used to identify the factors affecting European hake discards in the western Mediterranean. The fishing ports of Palma de Mallorca and Sète were not included in the analysis because of data availability (small number of hauls in the former, no detail of hake discard by haul in the latter). Catch data were standardized to kg per trawling hour. The factors considered in the analysis have been as follows:

Independent variable:
- Discarded hake catch (in weight)

Dependent variables:
- Time of the year (month), from February to July
- Port (Porto Santo Stefano, Vilanova i La Geltrú and Santa Pola)
- Total catch (in weight)
- Total European hake catch (in weight)
- Minimum depth
- Maximum depth

The analysis was expected to highlight the significance of the observed differences among the study areas (Fig. 5.3.1). These might refer to the fact that hake catch rates and discards can change during the year, depending on recruitment, and, also, because of the behaviour of fishermen. Discards being very low in most of the cases included in the analysis, results explain a very small part of the hake discards variability (R^2= 0.293). Results however identified factor "Port" as the single significant factor affecting European hake discards ($p<0.001$) (Table 5.3.1).

A second analysis was carried out for Porto Santo Stefano separately, the only port where discards were relevant. Results indicate that in the northern Tyrrhenian sea the total catch of European hake and the time of the year (month) affect significantly the discards of this species ($p<0.001$). These two factors practically explain all the variability observed in hake discards during the sampling period (R^2= 0.992).

Conclusions

Only in one of the study ports, Porto Santo Stefano in the northern Tyrrhenian, the return to the sea of part of the hake catch can be considered to take place because of an active practice of the fishermen for discarding this species.

In the other areas, with low or nil hake discards, the return of hake to the sea can be considered to be accidental during the separation of the species and preparation of the catch for the selling at the auction.

When there is an active hake discard as is the case of Porto Santo Stefano, both the total hake catch and time of the year have a significant effect on the amount of discarded hake. The highest hake catches and discards correspond to the time of the year with more intense recruitment of European hake to trawling. This result is important when considering the possibility closed seasons for trawling.

Table 5.3.1 Factors affecting European hake discards. Results of the multiple regression hake discard= f(month, port, total catch, total hake catch, minimum and maximum depth)

Factor	**Whole data**	**Porto Santo Stefano**
Month	ns	***
Port	***	ns
Totcatch	ns	ns
Tothake	ns	***
Mindepth	ns	ns
Maxdepth	ns	ns
number of hauls	112	40
R2	0.295	0.992

p-level	>0.05	ns
	<0.05	*
	<0.01	**
	<0.001	***

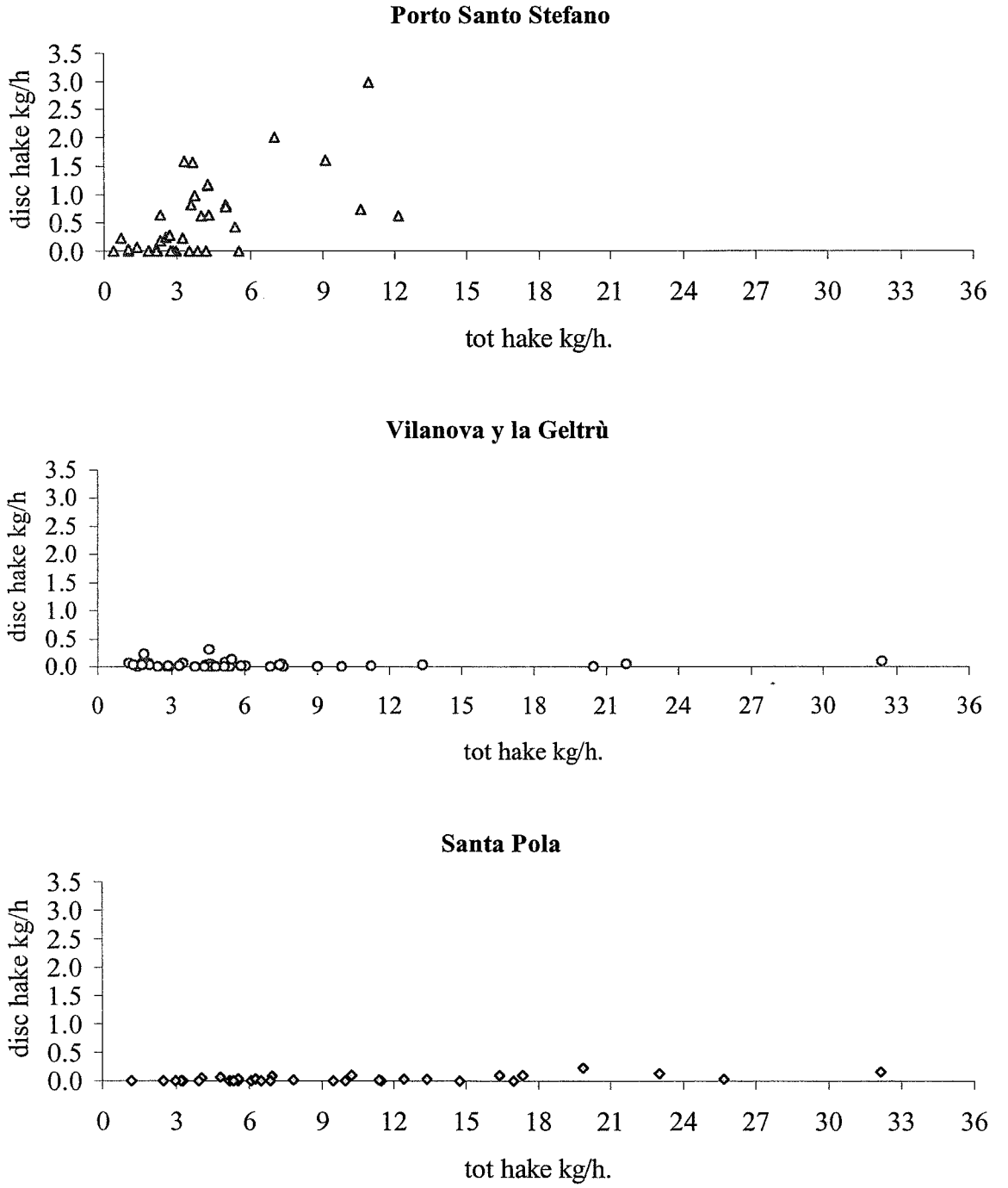


Figure 5.3.1. Hake discard *vs* total hake catch in Porto Santo Stefano, Vilanova i la Geltrú and Santa Pola.

6 Analysis of European hake length frequency data and implications for management

In most cases data used in the different analysis performed so as to assess the state of a given fishery are those obtained from the commercialised catches. Data on the discarded catch are difficult and expensive to obtain, and for this reason the discarded catch is not taken into account in the evaluations. Landings are very often used as total catch, and the length distribution of the landed catch is also considered to be representative of that of the exploited population. This assumption could be acceptable only when the discards of the target species are known to be very low or nil. This is the first point to clarify: whether or not part of the catch is returned to the sea, and, if so, we need know what happens with the discarded catch (whether the amount of discarded catch is higher at a certain time of the year, and which are the sizes concerned).

When part of the catch is returned to the sea, and the evaluations are based exclusively on data obtained from the commercialised catch, it is evident that the more important discards are, the higher error will result in the evaluation. European hake *Merluccius merluccius* trawl fishery in the western Mediterranean is our case study. We have seen that there are differences regarding hake discards in the studied fishing ports, which can be relatively high in some of the studied ports, while in the others are very small, or nil. However, although small, when including them, what is the incidence of discards in the evaluations? We present the results of a number Length Cohort Analysis performed using the available data on six monthly length distributions. Results below can only be taken as an exercise aimed at making it evident, if any, the error made in hake evaluations in case discards are not considered.

Table 6.1.- Biological parameters of hake used as input for the LCA analysis of pseudocohorts. Von Bertalanffy growth parameters ($L\infty$, K, t_o). Length-weight relationship parameters (a, b). Natural mortality (M). Terminal Fishing mortality (Fterm).

	$L\infty$ (cm)	K	t_o (year^{-1})	a	b	M	Fterm	Reference
PSS	92.98	0.119	-0.371	0.00496	3.109	0.23	0.25	(1)
Vilanova	86.75	0.137	-0.367	0.0069	3.03	0.2	0.5	(2)
Santa Pola	86.75	0.137	-0.367	0.0069	3.03	0.2	0.5	(2)
Palma	94.24	0.086	-0.59	0.0043	3.15	0.15	0.35	(3)
Sète	86.75	0.137	-0.367	0.0069	3.03	0.2	0.5	(2)

(1) Sanchez P., Alvarez F., De Ranieri S., Sartor P. 1995.
(2) Aldebert, Y. & L. Recasens. 1996.
(3) Oliver, P. 1993.

We have used VIT software package (Lleonart & Salat, 1992), and the length distributions taken as pseudocohorts are those obtained during the six-months sampling in the ports of Porto Santo Stefano, Vilanova i la Geltrú, Santa Pola, Palma de Mallorca and Sète (Figure 6.1). Input values for the analysis are given in table 6.1. The analysis was performed for each port using as input length data that corresponding to the commercialised catch, and that of the total catch (discard data added to the length distributions of the commercialised catch).

Results are shown in Figure 6.2. As mentioned above, although these must be taken with reservations, two patterns within the five situations analysed have been identified. The first one is that observed for Vilanova i la Geltrú and Santa Pola, ports where hake discards are known to be very small. The resulting values of Fishing mortality (F) and yield per recruit (Y/R) are almost coincident when using as input data the length distributions of the commercialised data and that of the total catch. The second pattern is that of Porto Santo Stefano, Palma de Mallorca and Sète. Both in Porto Santo Stefano and Sète European hake discards are not just accidental, as they happen to be in the other ports, but they can represent an important fraction of the small sized individuals. The resulting F and Y/R curves using as input data the length distributions of the total catch (discards included) or that of the commercialised catch are clearly different. As it was to be expected, highest differences in F correspond to <15cm TL individuals, the sizes eventually discarded. Nevertheless, in these four ports, all results display a marked situation of hake overexploitation, where the highest Y/R values correspond to a fishing effort much lower than the present one (Effort level=1.0). The case of Palma de Mallorca is somehow different, given that what the sampled data show is that the small sized individuals would not be fished. Thus, there would not be hake discards, and F values by size would be much lower than those estimated for the other ports.

Conclusions

The way of selecting hake by the fishermen on board regarding discards is different in the Mediterranean areas we have studied. For the accurate management of the European hake, it is needed to have updated information regarding the incidence of discards. This information can only be obtained from sampling on board commercial vessels, at least during one year.

Management regulations for hake must take into account the particularities by areas. In those ports where discards are not negligible discards data must be taken into account in the evaluations, so as not to underestimate the effect of trawling on hake populations.

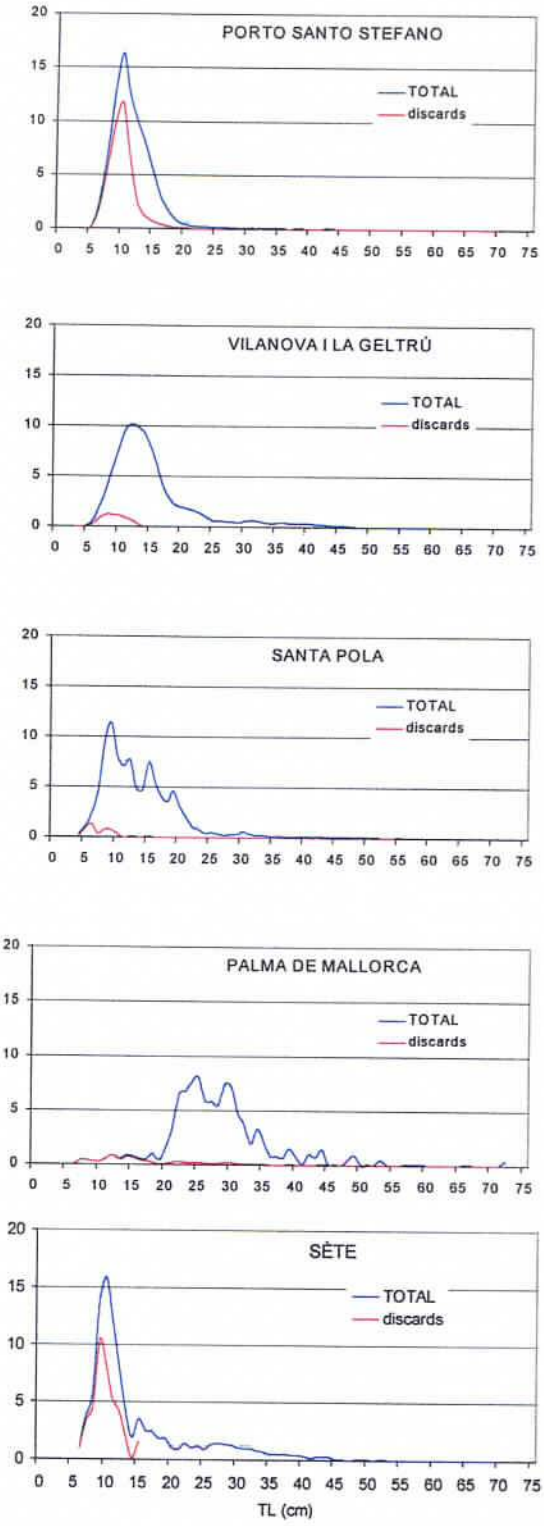


Figure 6.1.- Hake length frequency data obtained during the study period in each port. TOTAL frequency shows the total hake caught (landings + discards); discards frequency shows only the discarded fraction.

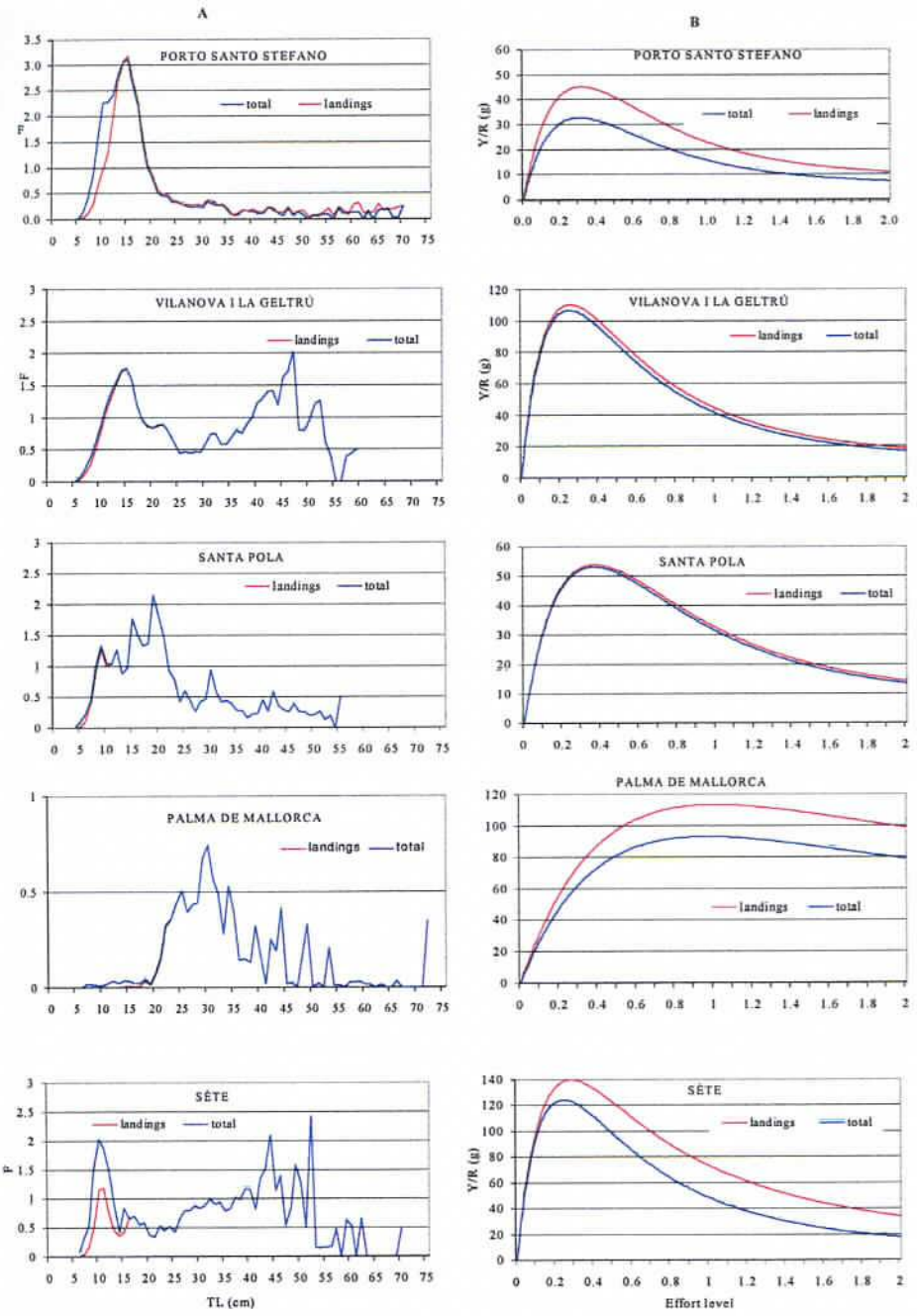


Figure 6.2. Results of the Length Cohort Analysis estimating using as input data the length distribution of total hake catch and hake landings. A, Fishing mortality (F) versus total length (TL). B, Yield per recruit (Y/R) versus Effort level.

7 Conclusions

In the present study the European hake discard rates by the trawl fleets in the western Mediterranean have been characterised. The study areas have been the northern Tyrrhenian sea (fishing ports of Porto Santo Stefano and Castiglione della Pescaia), Gulf of Lions (port of Sète), Catalan coast (port of Vilanova i La Geltrú), southern part of Valence (port of Santa Pola) and Balearic Islands (port of Palma de Mallorca).

The more relevant result to the management of this resource is that *Merluccius merluccius* discards can represent a significant part of the total European hake catch, both in weight and in number. It is thus necessary considering them in the evaluations to assess the state of exploitation of *M. merluccius* by trawling.

The length frequency distributions in all five study ports show that most part of the European hake catch consists of immature individuals. Nevertheless, the proportion of the catch and sizes that are discarded can be very different, as observed when comparing the different study ports. The percentage of discarded European hake during the six-months sampling ranged between less than 1% and more than 70% of the total individuals caught, depending on the month and port; as for the European hake discards expressed as percentage of the total hake catch, it ranged between less than 1% and 30% of the total *M. merluccius* catch.

The amounts of European hake discarded showed a marked variability during the period of study, in relation to depth and season. Although sampling duration was only six-months, this period allowed the identification of differences in the study areas regarding the months when the abundance of smaller individuals was higher. This fact should be considered when discussing the best time of the year for the implementation of closed-seasons for trawling aimed at the protection of hake recruits.

M. merluccius shows a wide bathymetric distribution. When selecting vessels for discards monitoring, trawlers must be selected that cover the European hake distribution. Not doing so may lead to the underestimation of exploitation of the smaller individuals. The highest discards in Porto Santo Stefano, the port with higher observed discards, corresponded to the hauls carried out between 180 m and 240 m depth, the bathimetric range where the juveniles of the species are known to be present massively (Biagi *et al.*, 1998; Lleonart, 2001).

Significant changes in *M. merluccius* abundance have been observed from month to month. Therefore, sampling frequency of this study, monthly, 3 days at sea so as to minimize the effect of autocorrelation of hauls performed during the same day, seems to have been adequate to detect the changes in hake abundance. Sampling frequency for the monitoring of changes in abundance and of the time of the year when recruits are more abundant, must be monthly. A quarterly sampling frequency for the monitoring of this species would not be adequate.

Discarding at sea part of the catch is a common practice all around the Mediterranean. Within the study ports, on average during the six-months sampling, the amount of discarded catch ranged between 17% of the total catch in Vilanova i La Geltrú, and 34% in Sète. The main reason for discarding part of the catch is the low or nil commercial interest of the discarded species. In general, the incidence of discards in species with commercial interest is low. High discards were observed, however, in the case of the blue whiting *Micromesistius poutassou*, when recruitment of this species to trawling occurs, because the small sized individuals have no commercial interest.

The number of species caught by trawl that are commercialised is high. We can mention among the main target species, among others, fishes as *Micromesistius poutassou* and *Mullus barbatus*, crustaceans as *Aristeus antennatus*, *Aristeomorpha foliacea*, and *Nephrops norvegicus*, or cephalopods as *Eledone cirrhosa*. Nevertheless, *M. merluccius* is one of the main target species for trawling, both regarding the amount of catches and economic value.

Hake trawl fisheries impact over the benthic and epibenthic communities of continental shelf and upper slope. From the examination of the samples of the discarded catch obtained during the sampling on board commercial trawlers, we have seen the high number of species affected, pointing out a clear multispecificity of the bottom trawling fishing activity. Thus, in Porto Santo Stefano, of a total of 209 species captured, 89 species were commercialised and 185 discarded; in Vilanova i La Geltrú a total of 319 species belonging to 11 Phyla were identified, the fraction commercialised of the catch was composed by 90 species, and the discarded fraction was formed by 294 species; in Santa Pola, 91 species were commercialised, of which 64 corresponded to fish, 14 were crustaceans and 11 were cephalopods, and 112 species were discarded, of which 72 were fishes, 20 were crustaceans and 9 were cephalopods; and in Palma de Mallorca, 116 species were captured, 88 of these species were always completely discarded, while 24 were commercialised and discarded and 6 were always commercialised.

A previous study on the discards by different trawl fleets in the western Mediterranean (Carbonell *et al.* 1997) pointed out differences among fishing ports in the practice of returning to the sea part of the catch. This previous study has allowed the comparison of the results obtained in 2001 with those of 1996, in the ports coincidental in both studies. During these five years no major changes regarding the amount of European hake discarded and the sizes commercialised have been observed. Porto Santo Stefano and Palma de Mallorca are, as they were in 1996, the ports where a higher percentage of European hake is discarded, while in Vilanova i La Geltrú and Santa Pola discards of this species are low. Regarding the sizes that are commercialised, in coincidence with the pattern observed in 1996, in Porto Santo Stefano most of <10 cm TL individuals are discarded and from 15.0 cm TL practically all of them are commercialised, while in the ports of Vilanova i La Geltrú and Santa Pola only a small part of <10 cm TL individuals is discarded.

References

Aldebert, Y. & L. Recasens. 1996. Comparison of methods for stock assessment of European hake *Merluccius merluccius* in the Gulf of Lions (Northwestern Mediterranean). *Aquat. Living Resour.*, 9: 13-22.

Alvarez F., Sbrana M., Sánchez P., Pérodou J-B and Alderstein, S. 2001. Factors affecting catch rates of NW Mediterranean trawl fleet and derivation of standardised abundance index. Final Report, Contract EU N° 98/053: 102 pp.

Biagi F., S. De Ranieri, P. Belcari, D. Bertolini, V. Chiericoni, I. Farnocchia, M. Mori, N. Nannini, B. Reale, P. Sartor, M. Sbrana, C. Viva, 1998. Valutazione delle risorse demersali nell_Arcipelago Toscano dall_Isola d_Elba all_Isola di Giannutri. *Biol. Mar. Medit.*, 5 (3): 40-52.

Carbonell A., De Ranieri S., Martin P.1997. Discards of the western Mediterranean trawl fleet. Final Report, Contract EU N° MED 94/027.

García-Rodríguez, M. and Esteban, A. 1995. Algunos aspectos sobre la biología y pesca de la merluza mediterránea *Merluccius merluccius* (Linnaeus, 1758) en la Bahía de Santa Pola (sureste de la península Ibérica). Bol. Inst. Esp. Oceanogr. 11(1). 1995:3-25.

Lleonart, J. (co-ordinator).- 2001. Impact of fishery and environment on hake recruitment in Northwestern Mediterranean. EU Contract FAIR CT-97-3522 (1998-2000). Final report. 680 pp. (mimeo)

Lleonart, J. and Salat, J. 1997. VIT: software for fishery analysis. User's manual. FAO *Computerized information Series (Fisheries)*. N° 11. Rome, FAO. 1997. 105p.

Merella, P., Quetglas, A., Alemany, F. and Carbonell, A. 1997. Length-Weight Relationship of Fishes and Cephalopods from the Balearic Islands (Western Mediterranean). Naga, ICLARM Quarterly. July-December 1997.

Oliver, P. 1993. Analysis of the fluctuations observed in the trawl fleet landings of the Balearic Islands. *Sci. Mar.*, 57 (2-3): 219-227.

Relini G., Bertrand J., Zamboni A. (eds.). 1999. Synthesis of the Knowledge on Bottom Fishery Resources in Central Mediterranean (Italy and Corsica). Biol. Mar. Medit., 6(suppl. 1): 868 pp.

Sanchez P., Alvarez F., De Ranieri S., Sartor P. 1995. Evaluation and analysis of the interaction of fishing gear in the demersal fisheries of western Mediterranean. Final Report, DG XIV contract no MED92/009, March 1995.

Sbrana M. (co-ordinator), 2000. Monitoring of the trawl and gillnet landings in the central and norther Tyrrhenian Sea. Final Report, Contract EU MED 97/0068.