

**EU Data Collection Regulation (DCR)**  
**No 1543/2000, No 1639/2001 and No 1581/2004**

**PILOT STUDY REPORT**

**ON THE EVALUATION OF DISCARDS  
OF THE CYPRUS FISHERY**

*As Part of Cyprus's National Fisheries Data Collection Programme 2006*

**November 2007**

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## ABSTRACT

This report presents the outcomes of the pilot study on the evaluation of discards of the Cyprus fishery, conducted during 2006. The study involved the on board sampling of two fisheries, the bottom otter trawl fishery around Cyprus waters and the large pelagic longline fishery in the Eastern Mediterranean. Results from the bottom otter trawl fishery show that catches are composed by a large number of species (~80), with one species dominating the catches (*Spicara smaris*). Total quantities discarded, including non-commercial species, represented 13% of the total catch. The commercial species with relatively high ratio of discards were *Pagellus erythrinus* and *Spicara smaris*, the latter exhibiting seasonal discard variation. The sampled catches of the large pelagic longline fishery were dominated by two species, *Thunnus alalunga* and *Xiphias gladius*. Discards were composed by species of low/no commercial value, including the marine turtle *Caretta caretta*. In both fisheries, sporadic occurrence of high value of discards created difficulties in raising discards to the population levels. It is proposed that a routine discard sampling scheme is established for both fisheries, on a triennial basis.

# 1. INTRODUCTION

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## 1.1. GENERAL FRAMEWORK

This report presents the outcomes of the pilot study conducted during 2006 for the evaluation of discard rates from the Cyprus fishery around Cyprus waters, in accordance with the requirements of the Data Collection Regulation (DCR) (Community Regulations 1543/2000, 1639/2001, 1581/2004).

The report was prepared in accordance with the Guidelines for the Presentation of Pilot Study Reports on Discards, included in the SEC (2004)1066 STECF-SGRN Report.

The participating bodies involved in the conduction of the pilot study are provided in Annex 1.

## 1.2. GENERAL DESCRIPTION OF THE CYPRUS FISHERY

According to the Cyprus Fisheries Law<sup>1</sup>, the Cyprus fishing fleet is categorised into three fleet segments: the small scale inshore boats, the polyvalent vessels and the bottom otter trawlers.

The small scale inshore boats, with an overall length between 6 to 12m, operate with passive polyvalent gears, mainly with bottom set nets and bottom longlines, targeting demersal species. Until 2006 Cyprus Fisheries Law provided that a maximum number of 500 licenses are provided for this segment annually. A number of restriction measures on the use of fishing gears and minimum landing sizes are enforced, according to the national and community law. **Table 1 of Annex II** presents the production of the inshore fleet and its percentage in the Cyprus landings, as well as information on effort and capacity for the last three years (2004-2006).

The polyvalent vessels have an overall length between 12-24 m and operate with passive polyvalent gears. The term “polyvalent vessels” is used because these vessels are engaged in two fisheries; mainly in the large pelagic fishery using drifting longlines and operating around Cyprus waters and the eastern Mediterranean (targeting swordfish, bluefin tuna and albacore), but also in the inshore demersal fishery using mostly bottom set nets and bottom longlines. A limited number of licenses is provided for this segment annually. Furthermore, closed seasons, restriction measures on the use of gears and minimum landing sizes are employed, in accordance to national and community regulations. Concerning the large pelagics, a minimum landing size is employed only for bluefin tuna; this species is also the only species in the Mediterranean for which a TAC and quotas are set. The production of the polyvalent fleet, its relative importance in the Cyprus landings, as well as information on effort and capacity for the last three years are provided in **Table 2 of Annex II**.

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<sup>1</sup> Basic Fisheries Law Cap. 135 and subsequent amendments of 1961 to 2007, Fisheries Regulations of 1990 to 2007 based on Article 6 of the Basic Law

The bottom otter trawlers have an overall length between 21-27 m and are categorised, based on their type of license, in those fishing in the territorial waters of Cyprus and those fishing in international waters (eastern and central Mediterranean). All trawlers use the same mesh size at cod-end (40mm, diamond shape), targeting demersal species. Until 2005, there were eight licensed vessels fishing in territorial waters (with eight being the maximum number of licenses to be provided, according to the National Fisheries Law); since 2006 the licenses are limited to 4. In 2006 there were 8 trawlers licensed to operate in international waters. A closed season, restriction measures on the use of trawl nets and minimum landing sizes are employed, in accordance with national and community law. Information concerning the trawl fishery in Cyprus and international waters, for the last three years, is given in **Tables 3a and 3b of Annex II**, respectively.

In summarising, there are three main fishing activities exercised by the Cyprus fishing fleet:

- the passive polyvalent gears fishing demersal species (basically exercised by the inshore small scale fleet)
- the drifting longlines targeting large pelagic fish, and
- the bottom otter trawl targeting demersal species.

### **1.3. AIM – JUSTIFICATION OF SELECTED FISHING ACTIVITIES IN THE PILOT STUDY**

The aims of the pilot study were:

1. To evaluate the composition, volume and percentage of discards of i. the bottom trawl fishery in the territorial waters of Cyprus and ii. the large pelagic longline fishery, by sampling on board commercial vessels;
2. To suggest, based on the results, whether a discard sampling scheme should be included in the future National Programmes for these fishing activities and whether any modifications would be needed.

As it is shown in Tables 2 and 3a of Annex II, the two selected fisheries (large pelagic longline and bottom trawl fishery) represent a major component of the Cyprus production (27.2 % and 15.5 % respectively).

Concerning the third main metier (i.e. passive polyvalent gears targeting demersal species), Cyprus was granted a derogation by SGRN for not performing discard sampling, as the discards of this fishery are negligible [SEC(2007)470 STECF-SGRN Report].

## 2. SAMPLING METHODOLOGY AND ANALYSIS

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### 2.1 . SAMPLING METHODOLOGY

#### 2.1.1. Bottom otter trawl fishery

Before setting up the methodology for collecting discard information from the Cyprus bottom trawl fishery with on-board observation, the following were taken into account:

- There is a closed fishing season between 1<sup>st</sup> of June and 7<sup>th</sup> of November;
- The licensed vessels are much less than 10, with length varying between 20-27 m;
- Retained catches are separated on board by quality grade and not by species. A quality grade may include a number of species, while one species may be represented in different quality grades, depending on the individuals' size. This separation requires time for estimating catch quantities by species and length composition;
- There are five demersal species of interest, for which biological sampling and stock assessment are conducted: *Boops boops*, *Mullus barbatus*, *Mullus surmuletus*, *Pagellus erythrinus* and *Spicara smaris*.

The sampling methodology used was the following:

- ✓ All vessels were considered to belong in the same length category (12-24m, in accordance with Annex III of DCR);
- ✓ On-board discard sampling was planned to be conducted for at least two random fishing trips per month, taking into account the closed fishing season;
- ✓ During each sampled trip, at least half of the hauls were planned to be sampled;
- ✓ The required information to be collected by the observers were:
  - Trip level
    - Vessel's name;
    - Port, date and time of departure and arrival;
    - Total number of hauls and haul durations.
  - Haul level
    - Date;
    - Haul number;
    - Hauling time – duration;
    - Hauling depth and position;
    - Gear damage (if any);
    - Quantities of discards and retained individuals for estimation of total catch by species: in terms of biomass, for all species (not only those required by DCR Appendix XII), and in terms of number for the five species of interest;
    - Length information of discarded individuals for the species of interest.
- ✓ Furthermore, discard samples of the species of interest would be taken to the laboratory (for age estimation in case discard length classes were not represented in landings, and for contribution to the estimation of other biological parameters).

### 2.1.2. Large pelagic longline fishery

Before setting up the methodology for collecting discard information from the Cyprus large pelagic longline fishery with on-board observation, the following were taken into account:

- There is a closed fishing season for swordfish (in territorial waters) from December to February;
- All vessels belong to the same length category (12-24m, in accordance with Annex III of DCR);
- In 2006, biological sampling under the DCR was performed only for bluefin tuna<sup>2</sup>.

The sampling methodology used was the following:

- ✓ On-board discard sampling was planned to be conducted for at least two random fishing trips per month;
- ✓ During each sampled trip, information was planned to be collected for all sets
- ✓ The required information to be collected by the observers were:
  - Trip level
    - Vessel's name;
    - Port, date and time of departure and arrival;
    - Total number of sets.
  - Set level
    - Date;
    - Set number;
    - Setting time – duration;
    - Depth and position;
    - Quantities (in terms of biomass and number) of discards and retained species for estimation of total catch by species. Information should be collected for all species, not only those required by Appendix XII of DCR;
    - Length information of discarded individuals of *Thunnus thynnus*. In case of dead discarded individuals of the species, information on maturity and spines for age estimation should be collected.

## 2.2. ANALYSIS

The formulas used for the analysis are provided in **Annex III**; these formulas were proposed by the Workshop on Discard Sampling Methodology and Raising Procedures (ICES, 2004) and by Vigneau (2006). Also, the outcomes and the Discard Raising Procedure Key, suggested by the Workshop on Discard Raising Procedures (ICES 2007) were taken into account.

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<sup>2</sup> Since 2007 swordfish and albacore are also included in the biological sampling.

## 2.2.1 Bottom otter trawl fishery

### *Volume of sampled catches*

#### *Haul and trip level*

The biomass of total, discarded and retained catch, as well as ratio of discards to total catch, were calculated per trip for all species. The associated variances of the catches between hauls within trips were also calculated. For the five species of interest (*B. boops*, *M. barbatus*, *M. surmuletus*, *P. erythrinus* and *S. smaris*), quantities of catches and ratio of discards to total catch were estimated in terms of numbers as well.

#### *Stratum level*

Each sampled quarter (1<sup>st</sup>, 2<sup>nd</sup> and 4<sup>th</sup>) was considered as a different stratum. The average total, retained and discarded catch per sampling trip was estimated for each stratum, with the associated variance between trips.

### *Biological sampling*

Length and age composition of the discards of the species of interest were estimated per stratum.

### *Raising discards to population levels*

An attempt to raise discards to population levels was made by using the number of trips performed during each stratum of 2006; the number of trips was calculated from logbook information.

Also, a second attempt to estimate discards per stratum was made by raising discards with landings, as an auxiliary variable. Mean ratio of discards per landings, as well as the associated variance, were estimated.

Furthermore, discards were plotted against 3 auxiliary variables (landings, no. of hauls, fishing time).

## 2.2.2 Large pelagic longline fishery

### *Volume of sampled catches*

#### *Longline set and trip level*

The volume of total, discarded and retained catch, as well as ratio of discards to total catch (in terms of weight and number), were calculated for each fishing trip, for all species. The associated variances of catches between sets within trips were also calculated.

#### *Stratum level*

Each sampled quarter was considered as a different stratum. As sampled trips included two trip categories, trips targeting swordfish - bluefin tuna and trips targeting albacore, with different effort characteristics between them (see **Table 2 of Annex VII**), the average of total, retained and discarded catch was estimated:

- i) per trip, with all trips combined, and



- ii) per fishing day (with one day corresponding to one longline set), separately for each trip category.

In each case, the associated variations were calculated.

### ***Raising discards to population levels***

An attempt to raise discards to population levels was made by using the number of trips performed during each stratum.

Discards were not raised separately for the two trip categories, as it was difficult from the records to compile separately the 2006 number of sets targeting swordfish - bluefin tuna and the number of sets targeting albacore. Furthermore, as discards were composed by species not represented in landings, landings were not used as an auxiliary variable for raising discards.

### ***Discards data recorded in the logbooks***

In addition to the analysis of the on board observer scheme, the discards information recorded in the logbooks of the polyvalent fleet during 2006 were reviewed, compiled and raised, for comparison with the results from the on board observer plan.

## **3. RESULTS AND DISCUSSION**

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### **3.1 BOTTOM OTTER TRAWL FISHERY**

#### **3.1.1. Deployed sampling effort**

The deployed sampling effort for the estimation of discards from the bottom otter trawl fishery is provided in **Table 1 of Annex IV**. In total, 13 commercial trips were sampled during the whole sampling period. Discard sampling covered a range of 1.6-4.5 %, in respect to fishing trips performed in each sampling stratum, and 0.9-3.5 %, in respect to fishing days per stratum. Information on the fishing effort of the Cyprus fleet derived from logbooks and the Department of Fisheries and Marine Research (DFMR) database records.

There was some shortfall in the programmed sampling scheme; during the first quarter one sampled trip was performed per month, while during April no sampling was conducted. The reason for the shortfall was the delay in the assignment of the pilot study through a tender's procedure; the sampling period covered by the tenderer was from May to December. From January to March, sampling was conducted by the DFMR, which was able to perform one sampling trip per month.

#### **3.1.2. General trip and haul characteristics**

The duration of fishing trips ranged from 1 to 2 days. The number of hauls per fishing trip ranged from 2 to 12, with an average of 6 hauls. The average duration of hauls was about 2 hours, while the average interval among hauls was estimated to be about 45 min.

Fishing operations were usually conducted from the afternoon until dawn. More detailed information per quarter is provided in **Table 2 of Annex IV**.

### 3.1.3. Composition and quantities of catches

#### - All quarters

*All species:* During the whole sampling period (13 trips), a total of 10130 kg catches were sampled, composed by 79 species. The total discarded catches were 1350kg, composed by 62 discarded species. The ratio of discards to total catches was 13%.

*Species of DCR App. XII:* From the 79 identified species, the 24 are included in the Appendix XII of the DCR, with catches reaching 8183 kg. 20 of them were included in discards; their discarded catch was 660kg, with a resulting 8% ratio of discards to total catches.

*Species of interest:* In concern to the 5 species of interest, for which biological sampling and stock assessment is performed, the results for all quarters combined were the following:

- For *B. boops*, *M. barbatus* and *M. surmuletus*, the total ratios of discards were less than 1% in terms of biomass and less than 2% in terms of numbers;
- *P. erythrinus* had a significant discard ratio both in terms of biomass and numbers (11.6 % and 31.5% respectively);
- *S. smaris* had a discard ratio slightly over 10% (10.4%) in terms of biomass and about 6% in terms of numbers, with discards varying considerably with season (see below).

More analytical information on the volume and composition of the sampled catches are provided for each stratum (quarter).

#### - 1<sup>st</sup> quarter (January, February, March)

Detailed information on the average volume of total, retained and discarded catch of all species caught during the 1<sup>st</sup> quarter, as well as the associated variation among the three sampled trips, is provided in **Table 3 of Annex IV**.

#### *Total catch*

During the 1<sup>st</sup> quarter, a total of 28 species were identified in the sampled trips, with catches varying from 170 kg to 315 kg (with an average of 241kg). From the 28 species, 11 are included in the Appendix XII of the DCR; their catches varied from 125 to 260 kg, with an average of 173 kg.

Only 4 species reached in average  $\geq 5\%$  of the total catch; these species were *S. smaris* (the dominant species, with about 38% of total catch), followed by *Serranus cabrilla*, *M. barbatus* and *B. boops*.

### *Discarded catch*

The total number of discarded species was 21 out of the 28 identified; discards had an average weight of 15 kg and an average ratio of 6% of the total catches. 6 of the discarded species are included in the Appendix XII of the DCR. Discard estimates for these species had an average weight of 4 kg, with a ratio of 2%.

*P. erythrinus*, despite its low discard weight, was the only species included in the Appendix XII with ratio higher than 10%, in terms of biomass. This species was also the only one among the five species of interest with high ratio in terms of numbers (42%).

### *Variation of discards*

Variation of discards, within and among trips, was found low.

### **- 2<sup>nd</sup> quarter (May)**

**Table 4 of Annex IV** provides detailed information on the average volume of total, retained and discarded catch of all species caught during the 2<sup>nd</sup> quarter (May), as well as the associated variation among the five sampled trips.

### *Total catch*

During May, a total of 65 species were identified in the sampled trips, with catches varying from about 85 to 2435 kg (with an average of 831 kg). 21 species are included in the Appendix XII of the DCR; their catches varied from 56 to 2334 kg, with an average of 721 kg.

The catch in each sampling trip was composed by 30-45 species; however, the species representing  $\geq 5\%$  of the total catches in each sampled trip ranged from 1 to 5. *S. smaris* dominated the catches, with an average of 79% of catches (ranging from 40% to 90%). The other species representing  $\geq 5\%$  of the total catches (in not more than one of the sampled trips) were *M. barbatus*, *B. boops*, *S. cabrilla* and the non-commercial species *Serranus hepatus* and *Macroramphosus scolopax*.

### *Discarded catch*

During May the total number of discarded species was 50; 15 of them are included in the Appendix XII of the DCR (see Table 4 of Annex IV). Discards of all species varied from 14 to 490 kg, with an average weight of 194 kg and an average ratio of 23% of the catches. Discard estimates for the species included in the Appendix XII varied from 1.9 to 380, with an average weight and ratio of 121 kg and 17% respectively.

The species dominating in discards were *S. smaris* and the non-commercial species *M. scolopax*; there were sporadic high discard values of these species, resulting to a high variation within and among trips. In respect of biomass, the discards of all remaining species were negligible.

Except for *S. smaris*, all species with discard ratio higher than 10% in terms of biomass either did not have any commercial value, or were commercial species with negligible percentage in the total catch.

Concerning the discard ratio in terms of numbers of the five species of interest, *P. erythrinus* was the only species with a discard ratio higher than 20% (about 50% of the catch).

#### **- 4<sup>th</sup> quarter (November, December)**

Detailed information on the average volume of total, retained and discarded catch of all species caught during the 4<sup>th</sup> quarter, as well as the associated variation among the five sampled trips, is given in **Table 5 of Annex IV**.

##### *Total catch*

During the 4<sup>th</sup> quarter, the catches in the sampled trips ranged from 300 to 3065kg (with an average of 1055kg). A total of 60 species were identified in the sampled trips. From the 60 species, 20 species are included in the Appendix XII of the DCR; their catches varied from 143 to 2657 kg, with an average of 852 kg.

The species representing  $\geq 5\%$  of the average catches were only 5: *S. smaris* (dominating with 42%), *Loligo vulgaris*, *M. barbatus*, *B. boops* and *Pagellus acarne* (see Table 5).

##### *Discarded catch*

During the 4<sup>th</sup> quarter, a total number of 44 species were discarded; 14 of them are included in the Appendix XII of the DCR. Discards of all species varied between 42 and 117 kg, with an average weight of about 70 kg and an average ratio of 6,5% of the catches. Discard estimates for the species included in Appendix XII of the DCR ranged from about 3 to 14kg, with an average weight and ratio of 8 kg and 1% respectively.

In respect of biomass, the average discard volume of each species was low. Species with discard ratio higher than 10%, in terms of biomass, either did not have any commercial value, or were commercial species with negligible percentage in the total catch.

Concerning the five species of interest and their discard ratio in terms of numbers, *P. erythrinus* was by far the species with the highest discard ratio (23.1%) (see Table 5 of Annex IV).

Variation of discards within and among trips was found low, except for some non-commercial species.

### **3.1.4. Biological sampling of discards**

Length and age distribution is provided for *Pagellus erythrinus* and *Spicara smaris*, which exhibited relatively important discard ratios, either seasonally or during the whole sampling period.

### *Pagellus erythrinus*

A total number of 376 discarded individuals were length measured and aged, representing a 17 % of total discarded individuals of the species (22%, 16% and 16% for 1<sup>st</sup>, 2<sup>nd</sup> and 4<sup>th</sup> quarter respectively).

The length of the discarded individuals ranged from 53 to 145 mm, with an average of 100mm, and the age ranged from 0 to 2 years old (mostly 0). The length and age distribution of the discards did not seem to vary seasonally (see **Figures 1 and 2 of Annex V**).

From the length distribution, it is shown that the reason for discarding *P. erythrinus* is the small size of the fish, which has no commercial value and is legally prohibited to be landed.

Until the end of 2006, the minimum landing size for this species was 12 cm, according to the provisions of EC Regulation 1626/2004; the new Mediterranean Regulation, 1967/2006, provides that the minimum landing size of the species increases to 15 cm. It is noted though that the selectivity of the trawl net will also increase from July 2008, as the new Mediterranean Regulation requires the use of a square meshed net of 40mm at cod-end.

### *Spicara smaris*

A total number of 160 discarded individuals were length measured and aged (representing a 31%, a 0.045% and a 2.5% for 1<sup>st</sup>, 2<sup>nd</sup> and 4<sup>th</sup> quarter respectively).

The length of the discarded individuals ranged from 74 to 170 mm, corresponding to ages from 0 to 6 years old. The distributions had a seasonal variation, particularly between the 2<sup>nd</sup> quarter and the other two, due to the dominance of large individuals in the discards during the 2<sup>nd</sup> quarter (see **Figures 3 and 4 of Annex V**); the large individuals of this protogynous species were post-spawning males, which have negligible or no commercial value during this time of the season.

Since the volume and ratio of discards during the 2<sup>nd</sup> quarter is relatively high, and discards during the 1<sup>st</sup> and 4<sup>th</sup> quarters can be considered negligible, it is clear that the basic reason for discarding *S. smaris* is the seasonal negligible commercial value of the large post-spawning individuals. This is also shown by the fact that during the 2<sup>nd</sup> quarter the ratio of discards in terms of biomass was almost double the ratio in terms of numbers.

As there is no minimum landing size for *S. smaris*, and all its size classes are marketed, the discarding of smaller length classes during the year can be considered either accidental, or intentional due to the high volume of catches.

### **3.1.5. Raising discards to population level**

The results of raising discards to the population level, by using the number of trips and the landings, are presented in **Annex VI (Tables 1-6)**. Table 1 refers to all species and the species of Appendix XII, while Tables 2 to 6 refer to the five species of interest.

In regards to all species and species combined, when comparing the discards raised by trips with the discards raised by landings, it doesn't seem that there is a certain trend between them; i.e. in some cases landings seem to overestimate discards, while in others it is the opposite. In any case, the estimations do not seem precise; the heterogeneous discards and landings data recorded, especially the sporadic occurrence of high discard values of 2 species during the 2<sup>nd</sup> quarter, suggest that a larger number of sampled trips should be used for raising discards to the whole population.

Concerning the 5 species of interest, the estimated total discards raised by trips seem to have close values with those raised by landings, with the exemption of *S. smaris*.

The recorded discards of species combined and of species of interest do not seem to be linearly related with auxiliary variables (landings, no. of hauls, fishing time) (see **Figures 1-3 of Annex VI**).

## **3.2 LARGE PELAGIC LONGLINE FISHERY**

### **3.2.1. Deployed sampling effort**

The deployed sampling effort for the estimation of discards from the large pelagic longline fishery is provided in **Table 1 of Annex VII**. In total, 11 commercial trips were sampled during the whole sampling period. Discard sampling covered a range of 1.6-4.5 %, in respect to fishing trips performed in each sampling stratum, and 0.9-3.5 %, in respect to fishing days per stratum. Information on the fishing effort of the Cyprus fleet derived from logbooks and the Department of Fisheries and Marine Research (DFMR) database records.

There was some shortfall in the programmed sampling scheme; during the four first months (January – April) no sampling trips were performed. The reason for the shortfall was the delay in the assignment of the pilot study through a tender's procedure.. It is noted however that the fishing activity during the 1<sup>st</sup> quarter was rather limited (see Table 1 of Annex VII). Furthermore, in two cases sampled trips were not performed due to bad weather conditions.

### **3.2.2. General trip and set characteristics**

The duration of fishing trips ranged from 1 to 7 days, depending on the target species; when targeting swordfish and bluefin tuna, the trip duration was about 6 days, while when targeting albacore the trips were usually daily. For all trips, one longline set corresponded to one fishing day. More detailed information per quarter is provided in **Table 2 of Annex VII**.

### 3.2.3. Composition and quantities of catches

#### - All quarters

*All species:* During the whole sampling period (11 sampled trips), a total of 675 individuals were sampled, weighting about 10600 kg, and composed by 11 species. The species dominating the catches were *Xiphias gladius* and *Thunnus alalunga*. The estimated total discarded catch was 1085kg (103 individuals), composed by 3 non-commercial species, including the marine turtle *Caretta caretta*. The ratio of discards to total catches was 10% in terms of weight, and 15% in terms of number. In most cases the discarded weight was recorded by estimation, as most of the discards were returned to sea alive, without being brought on board.

*Species of DCR App. XII:* From the 11 identified species, 5 of them are included in the Appendix XII of the DCR, representing around 85% of total catches, in terms of weight and number. None of them were included in discards; it should be noted though that currently a minimum landing size is set only for one targeted species (*Thunnus thynnus*).

More analytical information on the volume and composition of the sampled catches are provided for each stratum (quarter).

#### - 2<sup>nd</sup> quarter

Detailed information on the total, retained and discarded catch of species caught during the 2<sup>nd</sup> quarter is provided in **Table 3 of Annex VII**.

The average volume of the total, retained and discarded catches per trip (all trips combined) is given in **Table 4 of Annex VII**. **Tables 5 and 6** of the same Annex show the average value of the catches estimated per fishing day – set, separately for sets targeting swordfish – bluefin tuna and sets targeting albacore.

#### *Total catch*

During the 2<sup>nd</sup> quarter, 131 individuals were sampled, weighting about 1662 kg. 6 species were identified; 4 of the species are included in the Appendix XII of the DCR, representing 95% of the total catches: *Thunnus alalunga* and *Xiphias gladius*, which both dominated the catches, *Coryphaena hippurus*, and *Isurus oxyrinchus*.

The average catch of the sampled sets targeting *Xiphias gladius* and *Thunnus thynnus* was about 140 kg. *Xiphias gladius* represented more than 80% of the total catches, in terms of biomass and number.

The average catch of the sampled sets targeting *Thunnus alalunga* was about 340kg; this species was basically the only species caught (representing almost 100% of the catch).

#### *Discarded catch*

Discards were composed by two species that are not included in the DCR App. XII (*Mola mola* and *Pteroplatytrygon violacea*). As indicated by **Tables 3-6 of Annex VII**, their catch and discard ratio was small.

#### **- 3<sup>rd</sup> quarter**

**Table 7 of Annex VII** provides detailed information on the total, retained and discarded catch of species caught during the 3<sup>rd</sup> quarter. Information on the average catches and associated variation is provided for all trips combined, for sets targeting swordfish - bluefin tuna, and for sets targeting albacore, in **Tables 8, 9 and 10 of Annex VII**, respectively.

#### *Total catch*

During the 3<sup>rd</sup> quarter, 11 species were identified in the sampled trips, including the marine turtle *Caretta caretta*. A total number of 418 individuals were sampled (weighting about 6060 kg). The species included in the DCR App. XII were 5: *Thunnus alalunga* and *Xiphias gladius*, both dominating in catches, *Coryphaena hippurus*, *Isurus oxyrinchus* and *Thunnus thynnus*.

The average catch of the sampled sets targeting *X. gladius* and *T. thynnus* was about 380 kg. *X. gladius* represented about 80% of the total catches, both in terms of biomass and number.

The average catch of the sampled sets targeting *T. alalunga* was about 460 kg; this species represented more than 85% of the catch (both in terms of number and biomass).

#### *Discarded catch*

Discards were composed by 3 species (not included in DCR App. XII): *M. Mola*, *P. violacea* and *C. caretta*. Discard ratio of all trips combined was 13% in terms of biomass and 15% in terms of numbers. The few discarded individuals of *M. mola* and *C. caretta* were responsible for the relatively high ratio in terms of biomass, while *P. violacea* was responsible for the relatively high ratio in terms of numbers.

#### **- 4<sup>th</sup> quarter**

Detailed information on the volume of total, retained and discarded catch of all species caught during the 4<sup>th</sup> quarter is given in **Table 11 of Annex VII**, while **Tables 12 and 13** of this Annex show the average volume of catches and associated variation per trip and per set respectively.

#### *Total catch*

During the 4<sup>th</sup> quarter, 5 species were identified in the sampled trips, including the marine turtle *C. caretta*. A total number of 126 individuals were sampled (weighting about 2860 kg, with an average of 1430 kg per trip and 360kg per set). 2 of the species are included



in DCR App. XII and composed all commercial landings: *X. gladius*, which dominated the catches, and *C. hippurus*.

#### *Discarded catch*

The species discarded during the 4<sup>th</sup> quarter were: *M. mola* (1 individual), *P. violacea*, and *C. caretta* (1 individual). Discard ratio was 8% in terms of biomass and 27% in terms of numbers.

### **3.2.4. Biological sampling of discards**

During the sampling period there were no discards of bluefin tuna, or for the other large pelagic target species (albacore and swordfish).

As mentioned before, from the 3 target large pelagic species, only for bluefin tuna a minimum landing size is set.

Concerning swordfish, the Mediterranean Regulation 1967/2006 provides that management measures are set for the protection of juveniles by the end of 2007; in view of a possible establishment of a minimum landing size for swordfish, which would create reasons for discarding undersized individuals, the length composition of swordfish catches is provided in **Figure 1 of Annex VIII**, for future estimation of the % of undersized individuals in the catches.

Length of swordfish individuals ranged from 55 – 179 cm (LJFL). Most catches (45%) had a length ranging from 110-120 cm, while about 11% had length less than 100cm, caught mostly during the 3<sup>rd</sup> quarter and also during the 4<sup>th</sup> quarter.

### **3.2.5. Raising discards to population level**

The results of raising discards to the population level, by the number of trips combined, are presented in **Tables 1 and 2 of Annex IX**; Table 1 refers to the 3 discarded species, while Table 2 refers to the common discarded species, *P. violacea*.

Due to the sporadic occurrence of the non-commercial discard species, it is difficult to raise discard to the population levels. Raising the common discarded species, *P. violacea*, could be considered that it provides accurate information.

### **3.2.6. Discards data recorded in the logbooks**

During 2006, discards data were recorded in the logbooks of 8 fishing vessels involved in the large pelagic longline fishery (out of a total of 23 vessels actively involved); 5 of the logbooks provided systematically information, while the rest provided data occasionally, referring to damaged/eaten fish from dolphins. **Table 1 of Annex X** presents a summary of the discards data derived from the 5 logbooks with systematic records, and their raising to all trips. Though the information recorded cannot be crosschecked, it is worth reviewing it and comparing it with the results from the on board observer sampling scheme.

As it is shown in **Table 1 of Annex X**, the discarded species recorded by the fishermen were *P. violacea*, *Alopias* spp., and *T. alalunga* (damaged or eaten by dolphins). The records covered about 21% of the sampling trips conducted during the 2<sup>nd</sup> quarter, and about 22% of the sampling trips conducted during the 3<sup>rd</sup> quarter. Discard catches were mostly recorded in terms of biomass.

The results of raising recorded discards of *Pteroplatytrygon violacea* to all sampling trips of the relevant quarters suggest much higher discards than those estimated from the on board observer sampling scheme.

## **4. CONCLUSION**

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### **4.1. BOTTOM OTTER TRAWL FISHERY**

In conclusion, the results of the pilot study concerning discards from the trawl fishery around Cyprus waters are the following:

#### *Catches:*

Catches are composed by a large number of species (~80), though the majority of them, including all non-commercial species, have very low percentage in the average catches. The dominating species is *S. smaris*; this species is included in the DCR Appendix XII and is a species of interest.

#### *Discards:*

Total discard quantities, including non-commercial species, represented a 13% of the total catch. Apart from *S. smaris*, all commercial species had low discard volumes in terms of biomass.

The commercial species with high average ratio of discards (in terms of biomass and/or number) were:

- *P. erythrinus*, in both terms of biomass and number, during all sampled quarters; the reason for discarding was the non-commercial value and the prohibition of landing of small sizes.
- *S. smaris*, in terms of biomass, during the 2<sup>nd</sup> quarter; the reason for discarding was the seasonal low/non commercial value of large individuals.

Both species are included in the DCR Appendix XII and are species of interest.

#### *Discard variation:*

Variations of discarded biomass between hauls within trips and among trips within strata seem to be low, except for the 2<sup>nd</sup> quarter (May), in which high values of discards of *S. smaris* and a non-commercial species occurred sporadically.

Seasonal variation on the discard biomass and ratio has been observed, particularly between the 2<sup>nd</sup> quarter and the other sampled quarters. The commercial species responsible for the variation on stratum level was *S. smaris*.

*Raising to the population level:*

It seems that the number of sampled trips is not sufficient for obtaining precise information on discards for the population level, due to the sporadic occurrence of high discard values during the 2<sup>nd</sup> quarter.

*Provisions of Mediterranean Regulation 1967/2006:*

The new Mediterranean Regulation requires the increase of the minimum landing size of several species, including *P. erythrinus* (the only species of interest); it also provides for the increase of the selectivity of the trawl net, with the mandatory use of a squared meshed net of 40mm at cod-end. These two provisions are expected to affect the discard rates of the bottom otter trawl fishery.

## **4.2. LARGE PELAGIC LONGLINE FISHERY**

In conclusion, the results of the pilot study concerning discards from the large pelagic longline fishery around Cyprus waters are the following:

*Catches:*

The dominating species in the sampled catches were *T. alalunga* and *X. gladius*. Other species of DCR App. XII caught with low/negligible percentage were *C. hippurus*, *I. oxyrinchus* and *T. thynnus*.

*Discards:*

There were no sampled discards of the species included in the DCR App. XII. Discards were composed by 3 species, *P. violacea* (with low/no commercial value) and a few individuals of *M. mola* (no commercial value) and the marine turtle *C. caretta*. Most discards were returned to sea alive.

According to fishermen's information, individuals of *Alopias* spp. are caught and discarded as well.

*Discards variation:*

There was high discard variation, basically due to the occurrence of the few individuals of *M. mola* and *C. caretta* in the catches.

*Raising to the population level:*

Due to the sporadic occurrence of non-commercial species, it is difficult to raise discards to the population levels.

## **5. SUGGESTIONS**

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### **5.1. BOTTOM OTTER TRAWL FISHERY**

Cyprus suggests the establishment of a routine discard sampling scheme for the bottom otter trawl fishery within its national programme, on a triennial basis as required by the DCR for the Mediterranean. The methodology to be followed is the one included in the

pilot study, with the addition of the estimation of discard ratio in terms of numbers for all species. It is proposed that the sampling effort is set to 6 trips per quarter (stratum), except for the 2<sup>nd</sup> quarter, in which the effort will be 7 trips.

The current DCR provides that the estimation of discards should lead to a certain level of precision (level 1) for the stocks of App. XII for which an annual estimation of discards is required. In view of the reform of the DCR, the sampling scheme suggested will be modified accordingly, if required.

## **5.2. LARGE PELAGIC LONGLINE FISHERY**

The pilot study suggests that discards from the large pelagic longline fishery are not significant and involve species of no commercial value. However, it should be noted that:

- On board sampling is the only way for collecting biological (maturity) data for swordfish, since this species is not landed as whole;
- The minimum landing size for bluefin tuna has increased greatly since 2007, increasing also the possibility of catching undersized individuals;
- From 2008 a minimum landing size may be set for swordfish, creating reasons for discarding;
- On board sampling is useful for collecting information on bycatches of protected and/or vulnerable species, such as marine turtles and elasmobranches, and for assessing the effects of fishing to the ecosystem.

Taking into account the above, Cyprus proposes to establish a routine discard sampling scheme for its large pelagic longline fishery, on a triennial basis as required by the DCR.

The methodology to be followed is the one used in the pilot study, with the addition of length-recording of all species caught. It is suggested that the two trip categories (targeting swordfish-bluefin tuna and targeting albacore) are considered as different strata, and that sampling effort is planned, analysed and raised to the population in terms of fishing days-sets, instead of trips, for reducing variation among samples. The proposed sampling effort for the fishery targeting swordfish-bluefin tuna is 8 fishing days per quarter (with a minimum of two trips), and for the fishery targeting albacore 6 fishing days per quarter. In view of the reform of the DCR and its new provisions, the methodology suggested will be modified accordingly, if required.

## 6. REFERENCES

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## **7. ANNEXES**

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## **Annex I: Participating bodies**

- The on board sampling was performed by:

AP Marine Environmental Consultancy Ltd  
2, Acropoleos St. Aglanjia  
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- The analysis presented and the preparation of the report were conducted by:

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## Annex II: Detailed information on the Cyprus fisheries

**Table 1:** Inshore small scale fleet - Landings, effort and capacity information (2004-2006)

Year	No. of licensed boats	Total KW	Working Days	Landings (tons)	Average % of total Cyprus landings
2004	500	17,619.98	73,072	964.2	53.8
2005	500	19,383.62	84,400	946.9	
2006	457	17,922.80	89,152	1,006.9	

**Table 2:** Polyvalent fleet - Landings, effort and capacity information (2004-2006)

Year	No. of licensed boats	Total KW	Large pelagic fishery			Inshore fishery		
			Landings (tons)	Working Days	Average % of total Cyprus landings	Landings (tons)	Working Days	Average % of total Cyprus landings
2004	38	7,089.3	320	1303	27.2			0.7
2005	34	7,108.0	527	1208		11.9	1017	
2006	34	5,766.9	623	1119		13.6	880	

**Table 3a:** Trawl fishery in Cyprus waters - Production, effort and capacity information (2004-2006)

Year	No. of licensed boats	Total KW	Working Days	Landings (tons)	Average % of total Cyprus landings
2004	8	2500	1,380	387.3	15.5
2005	8	2379	1,018	217.6	
2006	4	1077.2	726	233.8	

**Table 3b:** Trawl fishery in international waters - Production, effort and capacity information (2004-2006)

Year	No. of licensed boats	Total KW	Working Days	Landings (tons)	Average % of total Cyprus landings
2004	16	5127	874	123.4	9.8
2005	6	800	591	147.8	
2006	8	1147	910	259.7	



### Annex III: Formulas used for the analysis of data collected during the on-board discard sampling pilot study

Symbols	Sample	Population
Number of trips	$n$	$N$
Discards in a haul $h$ of a trip $t$	$d_{th}$	
Reference to a trip	$t (t=1, \dots, n)$	$t (t=1, \dots, N)$
Number of hauls in a trip $t$	$m_t$	
Reference to a haul	$h (h=1, \dots, m_t)$	
Landings in a trip	$l_{st}$	
Landings in stratum	$L_s$	

#### Formulas for estimating discards and variance from samples \*

	Sample	
Mean discards between hauls within a trip $t$	$\bar{d}_t = \frac{1}{m_t} \sum_{h=1}^{m_t} d_{th}$	
Variance of discards (between hauls and within trip $t$ )	$\sigma_t^2 = \frac{1}{m_t - 1} \sum_{h=1}^{m_t} (d_{th} - \bar{d}_t)^2$	
Total discards in a trip $t$	$d_t = \sum_{h=1}^{m_t} d_{th}$	
Mean discards between trips within a stratum $s$	$\bar{d}_s = \frac{1}{n_s} \sum_{t=1}^{n_s} d_{st}$	
Variance of discards (between trips and within a stratum $s$ )	$\sigma_s^2 = \frac{1}{n_s - 1} \sum_{t=1}^{n_s} (d_{st} - \bar{d}_s)^2$	

\*the formulas were also used for estimating landings and variance from samples

#### Formulas for raising discards by number of trips

	Population
Raised discards in stratum $s$	$\hat{D}_s = N_s \bar{d}_s$
Variance of raised discards in stratum $s$	$Var(\hat{D}_s) = \left(1 - \frac{n_s}{N_s}\right) N_s^2 \frac{\sigma_s^2}{n_s}$
Raised discards across strata	$\hat{D} = \sum_s \hat{D}_s$
Variance of raised discards across strata	$Var(\hat{D}) = \sum_s Var(\hat{D}_s)$

#### Formulas for raising discards by landings

	Sample	Population
Ratio (between discards and landings in stratum $s$ )	$r_s = \frac{\bar{d}_s}{l_s}$	
Variance (between observed and raised discards, per trip)	$\tau_s^2 = \frac{1}{n_s - 1} \sum_{t=1}^{n_s} (d_{st} - r_s l_{st})^2$	$Var(\hat{D}_s) = \left(1 - \frac{n_s}{N_s}\right) N_s^2 \frac{\tau_s^2}{n_s}$
Raised discards in stratum $s$		$\hat{D}_s = L_s r_s$
Raised discards across strata		$\hat{D} = \sum_s \hat{D}_s$
Variance of raised discards across strata		$Var(\hat{D}) = \sum_s Var(\hat{D}_s)$

## Annex IV: Detailed results from the discard pilot study concerning the bottom otter trawl Cyprus fishery

**Table 1:** Deployed sampling effort for estimating discards from the bottom otter trawl Cyprus fishery

Sampling stratum	Sampling month	No. of trips sampled (no. of fishing days)	Total no. of sampling trips (total no. of fishing days)	Number of failures to get on board for sampling (due to bad weather conditions)	Coverage of sampling trips (fishing days)
1 <sup>st</sup> quarter	January	1 (1)	187 (327)	1	1.6% (0.9%)
	February	1 (1)		--	
	March	1 (1)		--	
2 <sup>nd</sup> quarter	April	--	132 (198)	--	3.8% (2.5%)
	May	5 (5)		--	
4 <sup>th</sup> quarter	November	2 (3)	110 (198)	1	4.5% (3.5%)
	December	3 (4)		--	

**Table 2:** Haul and trip characteristics recorded during on board observation, per stratum

Stratum	Average fishing days / trip	Total fishing hours / trip		No. of hauls / trip		Duration of hauls/trip		Time interval (h) between hauls / trip		Average Depth (m)
		Range	Average	Range	Average	Range	Average	Range	Average	
1st quarter	1	7.20 - 10.55	9.40	5-8	6	1.20 - 2.10	1.45	0.30 - 0.45	0.40	70
2nd quarter	1	4.45 - 8.35	6.20	2-6	3.4	1.25 - 2.40	2.00	0.21 - 1.25	0.45	80
4th quarter	1.4	11.10 -29.55	18.40	5-12	7.8	2.00 - 2.50	2.20	0.30 - 1.00	0.45	70

**Table 3:** Average volume of total, retained and discarded catch, and associated variation, of sampled trips during the 1<sup>st</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR. The species of interest are indicated by an additional (\*).

Species	Total Catch ( C )			Retained Catch (L)			Discarded Catch (D)			Dw/Cw (%)	Dn/Cn (%)
	W (kg)	% of C across species	Variation (VCw)	No.	W (kg)	VLw	No.	W (kg)	VDw		
<i>Boops boops</i> **	18.62	7.73	203.41	433	18.60	202.5	1	0.02	0.00	0.1	0.2
<i>Merluccius merluccius</i> *	2.33	0.97	16.33		2.33	16.3		0.00	0.00	0.0	
<i>Mullus barbatus</i> **	31.09	12.91	615.07	975	30.42	617.3	49	0.67	0.56	2.2	4.8
<i>Mullus surmuletus</i> **	0.38	0.16	0.44	6	0.38	0.4	0	0.00	0.00	0.0	0.0
<i>Pagellus erythrinus</i> **	11.36	4.72	75.95	143	9.43	60.1	103	1.92	1.32	16.9	41.8
<i>Raja clavata</i> *	1.00	0.42	3.00		1.00	3.0		0.00	0.00	0.0	
<i>Sardina pilchardus</i> *	0.13	0.06	0.05		0.13	0.1		0.00	0.00	0.0	
<i>Spicara smaris</i> **	90.36	37.54	11468	4995	89.50	11199.3	35	0.86	1.78	1.0	0.7
<i>Trachurus mediterraneus</i> *	1.74	0.72	9.06		1.67	8.3		0.07	0.02	4.1	
<i>Loligo vulgaris</i> *	11.36	4.72	37.89		11.00	31.0		0.36	0.39	3.2	
<i>Octopus vulgaris</i> *	4.83	2.01	11.58		4.83	11.6		0.00	0.00	0.0	
<i>Blennius ocellaris</i>	0.90	0.37	0.17		0.00	0.0		0.90	0.17	100.0	
<i>Centracanthus cirrus</i>	2.00	0.83	12.00		2.00	12.0		0.00	0.00	0.0	
<i>Citharus linguatula</i>	0.13	0.06	0.05		0.00	0.0		0.13	0.05	100.0	
<i>Echelus myrus</i>	0.13	0.06	0.05		0.00	0.0		0.13	0.05	100.0	
<i>Gobius spp.</i>	0.63	0.26	0.60		0.00	0.0		0.63	0.60	100.0	
<i>Lepidotrigla cavillone</i>	1.71	0.71	1.12		0.00	0.0		1.71	1.12	100.0	
<i>Macror. scolopax</i>	0.20	0.08	0.04		0.00	0.0		0.20	0.04	100.0	
<i>Microchirus variegatus</i>	0.04	0.02	0.01		0.00	0.0		0.04	0.01	100.0	
<i>Pagellus acarne</i>	4.35	1.81	16.48		4.33	16.3		0.01	0.00	0.3	
<i>Scorpaena spp.</i>	7.36	3.06	1.28		6.58	0.1		0.78	0.60	10.6	
<i>Serranus cabrilla</i>	31.55	13.11	179.05		30.42	197.1		1.13	0.83	3.6	
<i>Serranus hepatus</i>	4.56	1.89	4.42		0.00	0.0		4.56	4.42	100.0	
<i>Stephanolepis diaspros</i>	0.15	0.06	0.05		0.00	0.0		0.15	0.05	100.0	
<i>Synodus saurus</i>	10.93	4.54	116.00		10.75	110.4		0.18	0.09	1.6	
<i>Trachinus draco</i>	0.54	0.22	0.49		0.00	0.0		0.54	0.49	100.0	
<i>Trigloporus lastoviza</i>	2.27	0.94	4.66		2.27	4.7		0.00	0.00	0.0	
<i>Zeus faber</i>	0.07	0.03	0.01		0.00	0.0		0.07	0.01	100.0	
<b>All species</b>	240.7	100	5238		225.7	5203.1		15.1	1.91	6.3	
<b>Species of appendix XII</b>	173.2	72	5640		169.3	5565.8		3.9	0.25	2.3	

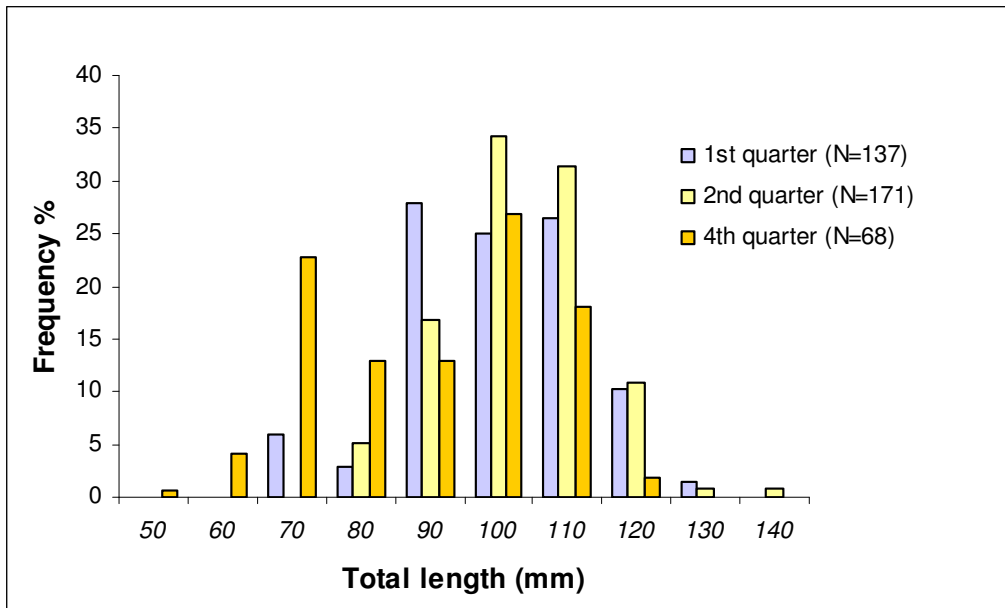
**Table 4:** Average volume of total, retained and discarded catch, and associated variation, of sampled trips during the 2<sup>nd</sup> quarter (May). The asterisk (\*) indicates the species included in the Appendix XII of DCR. The species of interest are indicated by an additional (\*\*).

Species	Total Catch (C)			Retained Catch (L)			Discarded Catch (D)			Dw/Cw (%)	Dn/Cn (%)
	W (kg)	% of C across species	Variation (VCw)	No.	W (kg)	VLw	No.	W (kg)	VDw		
<i>Anguilla anguilla</i> *	0.02	0.00	0.00		0.0	0.00		0.02	0.00	100.0	
<b><i>Boops boops</i>**</b>	22.39	2.70	277.74	334	22.3	275.18	1	0.06	0.01	<b>0.3</b>	<b>0.4</b>
<i>Lophius budegassa</i> *	2.10	0.25	3.30		2.1	3.30		0.00	0.00	0.0	
<i>Merluccius merluccius</i> *	2.77	0.33	11.02		2.8	11.03		0.00	0.00	0.1	
<b><i>Mullus barbatus</i>**</b>	17.76	2.14	418.15	842	17.6	405.04	8	0.17	0.11	<b>1.0</b>	<b>1.0</b>
<b><i>Mullus surmuletus</i>**</b>	1.65	0.20	1.15	26	1.7	1.15	0	0.00	0.00	<b>0.0</b>	<b>0.0</b>
<b><i>Pagellus erythrinus</i>**</b>	12.93	1.56	133.77	169	10.3	101.62	167	2.67	21.58	<b>20.6</b>	<b>49.8</b>
<i>Raja clavata</i> *	0.26	0.03	0.34		0.2	0.20		0.06	0.02	23.1	
<i>Scyllorhinus canicula</i> *	0.54	0.07	0.28		0.0	0.00		0.54	0.28	100.0	
<i>Spicara flexuosa</i> *	0.08	0.01	0.03		0.1	0.03		0.00	0.00	0.0	
<i>Spicara maena</i> *	0.18	0.02	0.16		0.2	0.16		0.00	0.00	0.0	
<b><i>Spicara smaris</i>**</b>	651.13	78.40	754862	32257	533.8	514895	3543	117.3	26643	<b>18.0</b>	<b>9.9</b>
<i>Trachurus mediterraneus</i> *	0.36	0.04	0.29		0.2	0.29		0.12	0.02	32.6	
<i>Trachurus trachurus</i> *	0.59	0.07	1.63		0.5	1.24		0.08	0.03	13.9	
<i>Eledone moschata</i> *	1.56	0.19	0.79		1.5	0.77		0.02	0.00	1.3	
<i>Illex coindetti</i> *	0.26	0.03	0.14		0.1	0.10		0.12	0.05	45.0	
<i>Loligo vulgaris</i> *	2.69	0.32	22.68		2.7	22.71		0.01	0.00	0.3	
<i>Octopus vulgaris</i> *	3.30	0.40	5.33		3.3	5.29		0.02	0.00	0.6	
<i>Sepia officinalis</i> *	0.38	0.05	0.20		0.4	0.20		0.01	0.00	1.9	
			0.00								
<i>Aristeomorpha foliacea</i> *	0.20	0.02	0.20		0.2	0.20		0.00	0.00	0.0	
<i>Squilla mantis</i> *	0.11	0.01	0.05		0.1	0.02		0.03	0.01	30.3	
<i>Arnoglossus</i> spp.	0.50	0.06	0.78		0.0	0.00		0.50	0.78	100.0	
<i>Blenius ocellaris</i>	0.75	0.09	0.42		0.0	0.00		0.75	0.42	100.0	
<i>Bothus podas</i>	1.00	0.12	4.76		0.0	0.00		1.00	4.76	100.0	
<i>Centracanthus cirrus</i>	1.85	0.22	8.12		1.4	6.43		0.44	0.48	23.8	
<i>Cepola macrophalma</i>	0.32	0.04	0.40		0.0	0.00		0.32	0.40	100.0	
<i>Citharus linguatula</i>	0.47	0.06	0.15		0.0	0.00		0.46	0.15	97.9	
<i>Conger conger</i>	0.87	0.10	1.36		0.1	0.05		0.73	1.48	83.9	
<i>Diplodus annularis</i>	0.21	0.03	0.11		0.2	0.11		0.00	0.00	0.0	
<i>Diplodus vulgaris</i>	0.15	0.02	0.11		0.2	0.11		0.00	0.00	0.0	
<i>Echiichthys vipera</i>	0.42	0.05	0.88		0.4	0.88		0.00	0.00	0.0	
<i>Fistularia commersonii</i>	0.02	0.00	0.00		0.0	0.00		0.02	0.00	100.0	
<i>Gobius</i> spp.	0.09	0.01	0.04		0.0	0.00		0.09	0.04	100.0	
<i>Heptranchias perlo</i>	3.20	0.39	51.20		0.0	0.00		3.20	51.20	100.0	
Labridae	0.00	0.00	0.00		0.0	0.00		0.00	0.00	100.0	
<i>Lepidotrigla cavillone</i>	1.71	0.21	2.11		0.0	0.00		1.71	2.11	100.0	
<i>Macror. scolopax</i>	50.71	6.11	11883		0.0	0.00		50.71	11883	100.0	
<i>Microchirus variegatus</i>	0.05	0.01	0.01		0.0	0.00		0.05	0.01	100.0	
<i>Muraena helena</i>	0.06	0.01	0.02		0.0	0.00		0.06	0.02	100.0	
<i>Mustelus mustelus</i>	0.20	0.02	0.20		0.2	0.20		0.00	0.00	0.0	
<i>Oblada melanura</i>	0.10	0.01	0.05		0.1	0.05		0.00	0.00	0.0	
<i>Ophidium</i> spp.	0.07	0.01	0.02		0.0	0.00		0.07	0.02	100.0	
<i>Pagellus acarne</i>	11.28	1.36	574.86		11.1	557.13		0.17	0.14	1.5	
<i>Pagrus pagrus</i>	1.70	0.20	8.44		1.7	8.44		0.00	0.00	0.0	
<i>Phycis blennoides</i>	3.35	0.40	13.92		1.6	0.00		1.79	0.00	53.3	
<i>Raja</i> spp.	3.35	0.40	37.16		1.6	6.44		1.79	13.42	53.3	
<i>Sardinella aurita</i>	0.02	0.00	0.00		0.0	0.00		0.02	0.00	100.0	
<i>Scomber scombrus</i>	0.02	0.00	0.00		0.0	0.00		0.02	0.00	100.0	
<i>Scorpaena</i> spp.	3.11	0.37	2.54		1.7	2.54		1.40	3.91	45.1	
<i>Serranus cabrilla</i>	9.81	1.18	36.16		6.9	29.68		2.95	16.81	30.1	
<i>Serranus hepatus</i>	1.76	0.21	2.31		0.0	0.00		1.76	2.31	100.0	
<i>Sphyaena sphyraena</i>	0.12	0.01	0.07		0.1	0.07		0.00	0.00	0.0	
<i>Symphodus ocellatus</i>	0.05	0.01	0.01		0.0	0.00		0.05	0.01	100.0	
<i>Synodus saurus</i>	6.10	0.73	14.49		6.1	14.49		0.02	0.00	0.2	
<i>Trachinus draco</i>	2.01	0.24	2.17		0.2	0.08		1.81	1.73	90.0	
<i>Trigloporus lastoviza</i>	0.89	0.11	0.67		0.9	0.67		0.00	0.00	0.0	
<i>Uranoscopus scaber</i>	2.24	0.27	1.67		2.1	1.52		0.16	0.03	7.0	
<i>Zeus faber</i>	0.44	0.05	0.77		0.0	0.00		0.44	0.77	100.0	
			0.00								
<i>Alloteuthis media</i>	0.00	0.00	0.00		0.0	0.00		0.00	0.00	100.0	
<i>Octopus macropus</i>	0.23	0.03	0.26		0.2	0.26		0.00	0.00	0.0	
<i>Sepia elegans</i>	0.03	0.00	0.00		0.0	0.00		0.03	0.00	100.0	
<i>Sepia orbignyana</i>	0.00	0.00	0.00		0.0	0.00		0.00	0.00	100.0	
<i>Sepiola</i> spp.	0.00	0.00	0.00		0.0	0.00		0.00	0.00	100.0	
<i>Crangon crangon</i>	0.03	0.00	0.00		0.0	0.00		0.03	0.00	100.0	
<i>Plesionika</i> spp.	0.01	0.00	0.00		0.0	0.00		0.01	0.00	100.0	
<b>All species</b>	<b>830.6</b>	<b>100.0</b>	<b>862320</b>		<b>636.8</b>	<b>630572</b>		<b>193.8</b>	<b>54394</b>	<b>23.3</b>	
<b>Species of appendix XII</b>	<b>721.3</b>	<b>86.8</b>	<b>650272</b>		<b>600.0</b>	<b>592320</b>		<b>121.2</b>	<b>27124</b>	<b>16.8</b>	

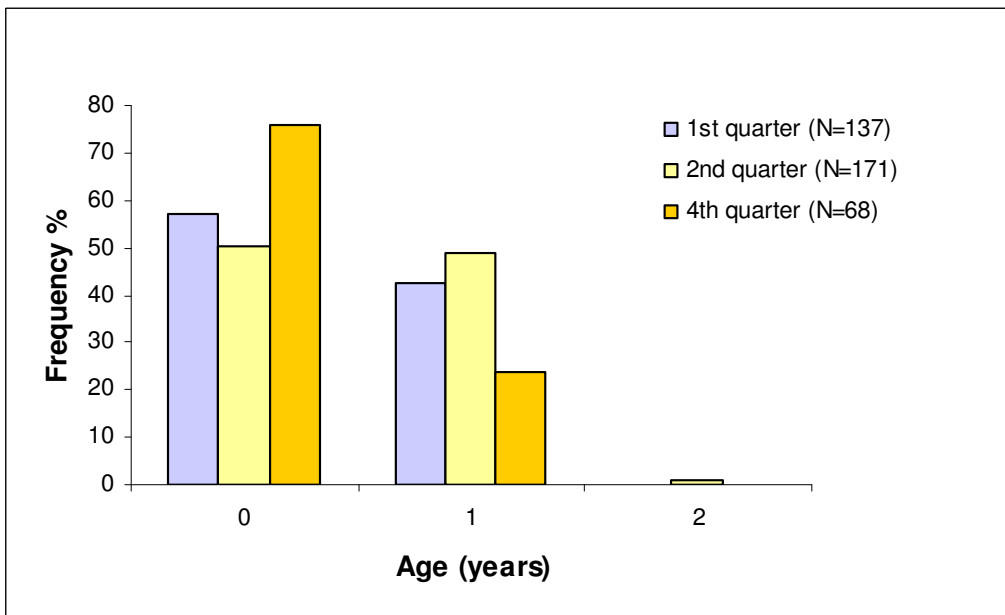
**Table 5:** Average volume of total, retained and discarded catch, and associated variation, of sampled trips during the 4<sup>th</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR. The species of interest are indicated by an additional (\*\*).

Species	Total Catch (C)			Retained Catch (L)			Discarded Catch			Dw/Cw (%)	Dn/Cn (%)
	W (kg)	% of C across species	Variation (VCw)	No.	W (kg)	V Lw	No.	W (kg)	VDw		
<b>Boops boops</b> **	57.7	5.5	795.7	1518	57.3	787.06	37	0.4	0.64	<b>0.8</b>	<b>2.4</b>
<i>Merluccius merluccius</i> *	1.7	0.2	7.2		1.5	5.26		0.2	0.16	10.5	
<b>Mullus barbatus</b> **	94.1	8.9	2958.5	3941	93.8	2928.9	30	0.4	0.08	<b>0.4</b>	<b>0.8</b>
<b>Mullus surmuletus</b> **	24.1	2.3	2414.8	527	24.1	2399.0	7	0.1	0.03	<b>0.3</b>	<b>1.3</b>
<b>Pagellus erythrinus</b> **	43.0	4.1	3446.7	702	39.5	3481.8	211	3.5	2.94	<b>8.1</b>	<b>23.1</b>
<i>Raja clavata</i> *	0.4	0.0	0.4		0.4	0.44		0.0	0.00	0.0	
<i>Sardina pilchardus</i> *	50.3	4.8	11405		50.2	11394		0.1	0.01	0.2	
<i>Scylliorhinus canicula</i> *	0.7	0.1	2.4		0.7	2.45		0.0	0.01	6.4	
<i>Spicara flexuosa</i> *	15.9	1.5	543.3		15.8	535.64		0.1	0.04	0.9	
<i>Spicara maena</i> *	0.1	0.0	0.0		0.0	0.00		0.1	0.02	100.0	
<b>Spicara smaris</b> **	443.5	42.1	579434	25823	441.0	579990	393	2.5	15.30	<b>0.6</b>	<b>1.5</b>
<i>Squalus blainvillei</i> *	2.2	0.2	9.2		2.2	9.20		0.0	0.00	0.0	
<i>Trachurus mediterraneus</i> *	4.8	0.5	16.9		4.0	14.37		0.8	0.23	15.8	
<i>Eledone moschata</i> *	2.0	0.2	5.3		2.0	5.33		0.0	0.00	0.0	
<i>Illex coindetti</i> *	0.2	0.02	0.2		0.03	0.005		0.18	0.16	85.7	
<i>Loligo vulgaris</i> *	64.5	6.1	7070.3		64.4	7049.75		0.1	0.02	0.1	
<i>Octopus vulgaris</i> *	29.1	2.8	77.9		29.0	76.98		0.0	0.01	0.2	
<i>Sepia officinalis</i> *	1.6	0.2	1.8		1.6	1.81		0.0	0.00	0.0	
<i>Parapenaeus longirostris</i> *	15.4	1.5	488.9		15.4	488.85		0.0	0.00	0.0	
<i>Squilla mantis</i> *	0.4	0.0	0.3		0.4	0.32		0.0	0.00	0.0	
<i>Arnoglossus</i> spp.	2.9	0.3	22.7		0.7	2.18		2.2	11.09	77.0	
<i>Balistes</i> spp.	0.0	0.0	0.0		0.0	0.00		0.0	0.00	0.0	
<i>Blennius ocellaris</i>	1.6	0.1	1.8		0.0	0.00		1.6	1.78	100.0	
<i>Bothus podas</i>	5.6	0.5	95.4		0.0	0.00		5.6	95.42	100.0	
<i>Centracanthus cirrus</i>	1.3	0.1	8.8		1.2	7.20		0.1	0.08	9.7	
<i>Cepola macrophalma</i>	2.6	0.2	15.5		0.0	0.00		2.6	15.42	99.7	
<i>Citharus linguatula</i>	4.0	0.4	6.9		0.2	0.17		3.7	6.23	94.2	
<i>Conger conger</i>	5.7	0.5	25.9		3.3	15.40		2.3	4.85	41.0	
<i>Dasyatis pastinaca</i>	7.5	0.7	281.3		7.5	281.25		0.0	0.00	0.0	
<i>Dentex dentex</i>	0.1	0.0	0.0		0.1	0.04		0.0	0.00	0.0	
<i>Diplodus annularis</i>	0.1	0.0	0.0		0.0	0.00		0.1	0.04	90.9	
<i>Etrumeus teres</i>	0.1	0.0	0.0		0.0	0.00		0.1	0.01	64.3	
<i>Fistularia commersonii</i>	0.1	0.0	0.0		0.0	0.00		0.1	0.02	100.0	
<i>Gobius</i> spp.	0.9	0.1	1.1		0.0	0.00		0.9	1.13	100.0	
Labridae	0.3	0.0	0.4		0.0	0.00		0.3	0.38	100.0	
<i>Lagocephalus</i> spp.	0.4	0.0	0.9		0.0	0.00		0.4	0.92	100.0	
<i>Lepidotrigla cavillone</i>	12.9	1.2	39.7		0.0	0.00		12.9	39.70	100.0	
<i>Macror. scolopax</i>	2.5	0.2	25.5		0.0	0.00		2.5	25.46	100.0	
<i>Ophidium</i> spp.	1.0	0.1	1.9		0.0	0.00		1.0	1.92	100.0	
<i>Pagellus acarne</i>	56.5	5.4	2814.4		55.3	2647.10		1.2	3.24	2.1	
<i>Pagrus pagrus</i>	10.5	1.0	505.6		10.5	505.62		0.0	0.00	0.0	
<i>Phycis blennoides</i>	1.9	0.2	11.9		1.9	11.90		0.0	0.00	0.0	
<i>Raja</i> spp.	0.9	0.1	1.7		0.4	0.42		0.5	0.56	56.7	
<i>Scorpaena</i> spp.	7.7	0.7	38.1		6.9	35.30		0.8	1.22	10.1	
<i>Serranus cabrilla</i>	19.4	1.8	176.2		19.2	176.01		0.2	0.19	1.1	
<i>Serranus hepatus</i>	15.4	1.5	146.9		0.0	0.00		15.4	146.92	100.0	
<i>Solea vulgaris</i>	0.1	0.0	0.0		0.1	0.03		0.0	0.00	0.0	
<i>Sparisoma cretense</i>	0.4	0.0	0.7		0.0	0.00		0.4	0.74	100.0	
<i>Sphyaena sphyraena</i>	0.2	0.0	0.2		0.2	0.16		0.0	0.00	0.0	
<i>Synodus saurus</i>	18.9	1.8	1394.7		18.5	1326.42		0.4	0.86	2.2	
<i>Torpedo nobiliana</i>	0.1	0.0	0.0		0.0	0.00		0.1	0.04	100.0	
<i>Trachinus draco</i>	2.1	0.2	4.7		0.0	0.00		2.1	4.70	100.0	
<i>Trigloporus lastoviza</i>	12.4	1.2	111.0		12.3	109.62		0.0	0.01	0.4	
<i>Uranoscopus scaber</i>	1.6	0.2	2.8		1.0	2.69		0.6	0.40	37.2	
<i>Zeus faber</i>	2.6	0.2	22.9		2.6	22.89		0.0	0.00	0.0	
<i>Alloteuthis media</i>	0.1	0.0	0.0		0.0	0.00		0.1	0.00	100.0	
<i>Octopus macropus</i>	0.2	0.0	0.2		0.2	0.20		0.0	0.00	0.0	
<i>Sepia elegans</i>	0.6	0.1	0.4		0.0	0.00		0.6	0.41	100.0	
<i>Plesionika</i> spp.	1.6	0.2	8.0		0.0	0.00		1.6	8.03	100.0	
<i>Scyllarides latus</i>	0.04	0.0	0.0		0.04	0.01		0.00	0.00	0.0	
<b>All species</b>	1054.5	100.0	1343584		985.6	1347971		68.9	1023	6.5	
<b>Species of appendix XII</b>	851.9	80.8	1077400		843.4	1073421		8.4	20	1.0	

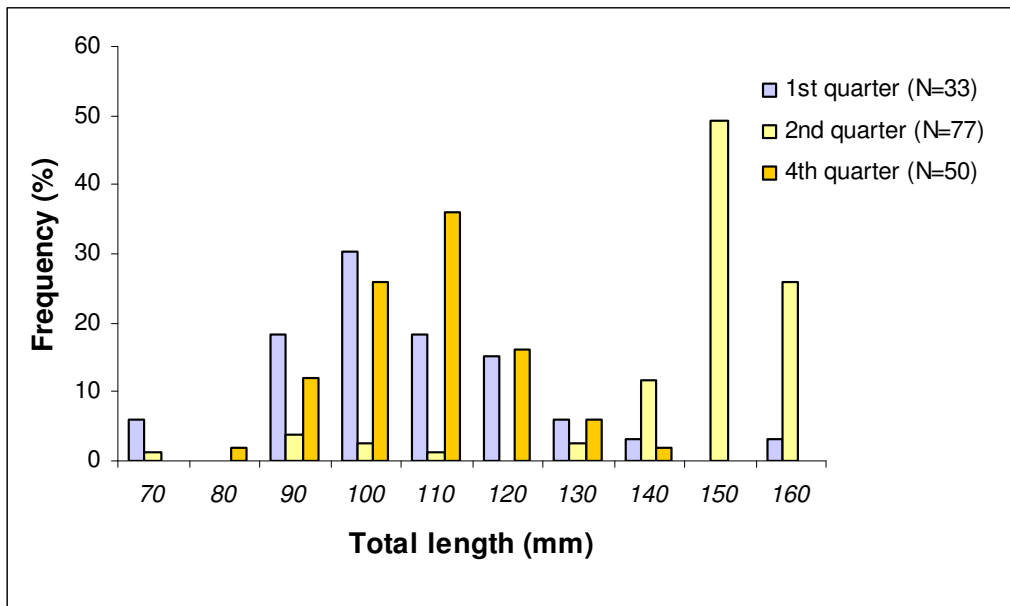
**Annex V: Biological sampling of discards from the Cyprus bottom otter trawl fishery**



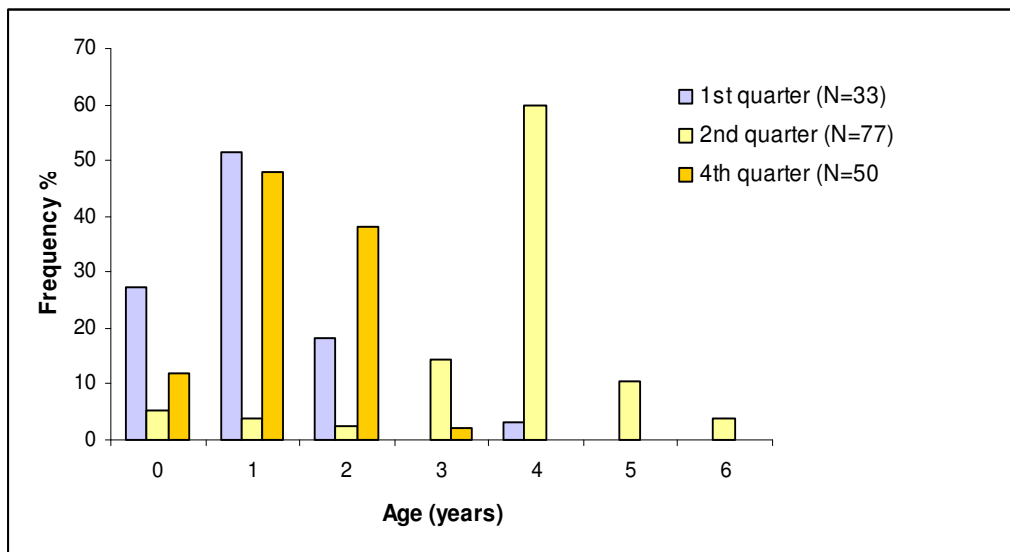
**Figure 1:** Length distribution of discarded *P. erythrinus* from the bottom otter trawl Cyprus fishery. (Note: the MLS in 2006 was 120mm).



**Figure 2:** Age distribution of discarded *P. erythrinus* from the bottom otter trawl Cyprus fishery.



**Figure 3:** Length distribution of discarded *S. smaris* from the bottom otter trawl Cyprus fishery.



**Figure 4:** Age distribution of discarded *S. smaris* from the bottom otter trawl Cyprus fishery.

## Annex VI: Results of raising discards from the bottom otter trawl fishery to the population level

Table 1: Total discard biomass estimates (in kg) and achieved precision per stratum for all species (with “\*” for species of DCR App. XII).

Stratum	Raising by trip			Raising by landings				
	Average discards in stratum $\bar{d}$	Discard sample variance ( $\sigma^2$ )	Total discards in stratum $\bar{d}$	Estimated ratio ( $r$ )	Variance of ratio ( $\tau^2$ )	Average landings in sample $\bar{l}$	Total monthly landings $L$	Total discards in stratum $\bar{d}$
1st quarter	15.1	1.9	2824	0.07	23	226	92651	6486
	3.9*	0.2*	729*	0.02*	1.5*	169*	88336*	1766*
2nd quarter	193.8	54394	25582	0.30	50715	635	62360	18850
	121.2*	27124*	15998*	0.2*	5160*	596*	59156*	11831*
4th quarter	68.9	1023	7579	0.07	8007	986	78790	5507
	8.4*	20*	924*	0.01*	88*	843*	72775*	728*

Table 2: Discard biomass estimates (in kg) and achieved precision per stratum for *Boops boops*.

Stratum	Raising by trip			Raising by landings				
	Average discards in stratum $\bar{d}$	Discard sample variance ( $\sigma^2$ )	Total discards in stratum $\bar{d}$	Estimated ratio ( $r$ )	Variance of ratio $\tau^2$	Average landings in sample $\bar{l}$	Total monthly landings $L$	Total discards in stratum $\bar{d}$
1st quarter	0.02	0.001	4	0.001	0.000	19	6488	6
2nd quarter	0.06	0.010	8	0.003	0.007	22	3466	9
4th quarter	0.40	0.640	44	0.008	0.623	57	4956	38

Table 3: Discard biomass estimates (in kg) and achieved precision per stratum for *Mullus barbatus*.

Stratum	Raising by trip			Raising by landings				
	Average discards in stratum $\bar{d}$	Discard sample variance ( $\sigma^2$ )	Total discards in stratum $\bar{d}$	Estimated ratio ( $r$ )	Variance of ratio $\tau^2$	Average landings in sample $\bar{l}$	Total monthly landings $L$	Total discards in stratum $\bar{d}$
1st quarter	0.7	0.56	125	0.022	0.93	30	5682	125
2nd quarter	0.2	0.10	22	0.010	0.10	18	2689	27
4th quarter	0.4	0.08	44	0.004	0.01	94	7254	27

Table 4: Discard biomass estimates (in kg) and achieved precision per stratum for *Mullus surmuletus*.

Stratum	Raising by trip			Raising by landings				
	Average discards in stratum $\bar{d}$	Discard sample variance ( $\sigma^2$ )	Total discards in stratum $\bar{d}$	Estimated ratio ( $r$ )	Variance of ratio $\tau^2$	Average landings in sample $\bar{l}$	Total monthly landings $L$	Total discards in stratum $\bar{d}$
1st quarter	0.0	0.00	0	0.000	0.0000	0.4	2351	0
2nd quarter	0.0	0.00	0	0.000	0.0000	2	1852	0
4th quarter	0.1	0.03	11	0.003	0.0002	24	2742	8

Table 5: Discard biomass estimates (in kg) and achieved precision per stratum for *Pagellus erythrinus*.

Stratum	Raising by trip			Raising by landings				
	Average discards in stratum	Discard sample variance ( $\sigma^2$ )	Total discards in stratum $\bar{d}$	Estimated ratio r	Variance of ratio $\tau^2$	Average landings in sample $\bar{l}$	Total monthly landings $L$	Total discards in stratum $\bar{d}$
1st quarter	1.9	1.3	355	0.2	0.8	9	1430	286
2nd quarter	2.7	21.6	356	0.3	25.7	10	945	246
4th quarter	3.5	2.9	385	0.1	41.9	40	3145	276

Table 6: Discard biomass estimates (in kg) and achieved precision per stratum for *Spicara smaris*.

Stratum	Raising by trip			Raising by landings				
	Average discards in stratum	Discard sample variance ( $\sigma^2$ )	Total discards in stratum $\bar{d}$	Estimated ratio r	Variance of ratio $\tau^2$	Average landings in sample $\bar{l}$	Total monthly landings $L$	Total discards in stratum $\bar{d}$
1st quarter	0.9	2	168	0.01	0.3	90	60744	607
2nd quarter	117.3	26643	15484	0.22	4632	534	44351	9757
4th quarter	2.5	15	275	0.006	40	441	38904	222

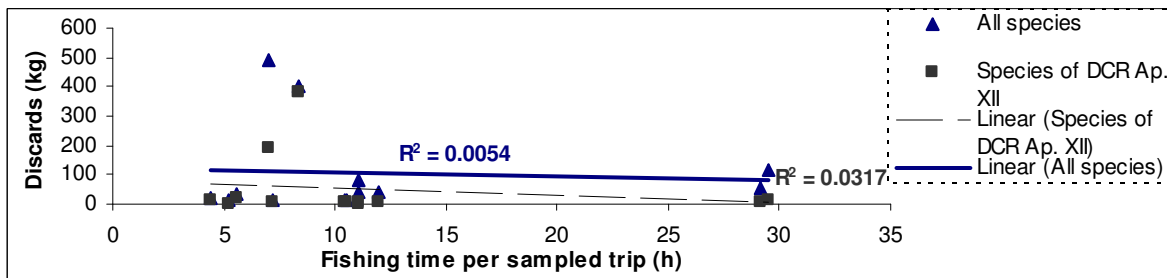
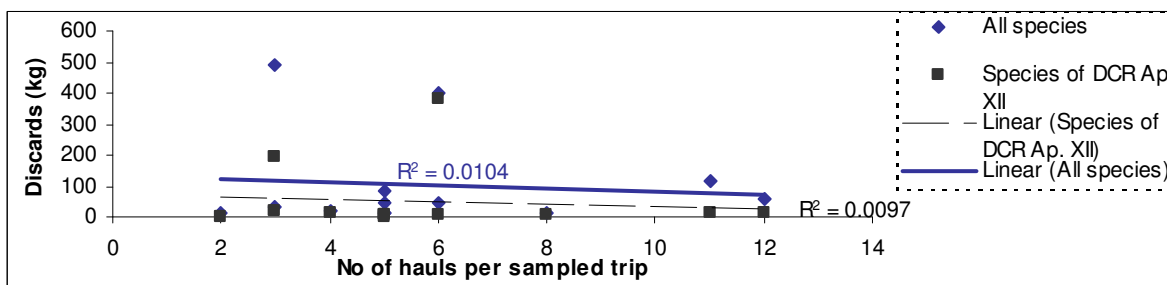
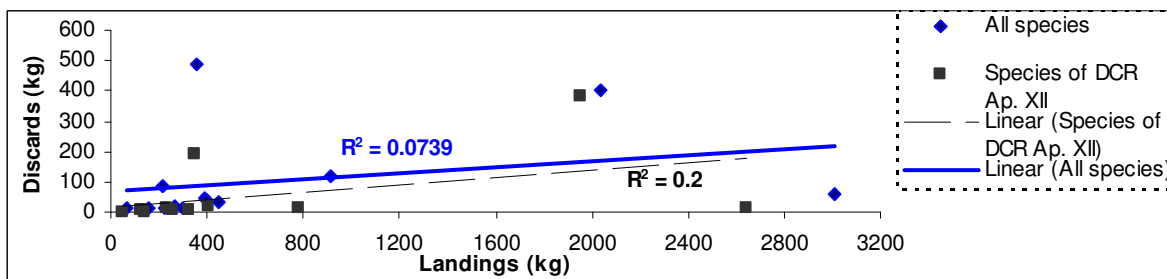
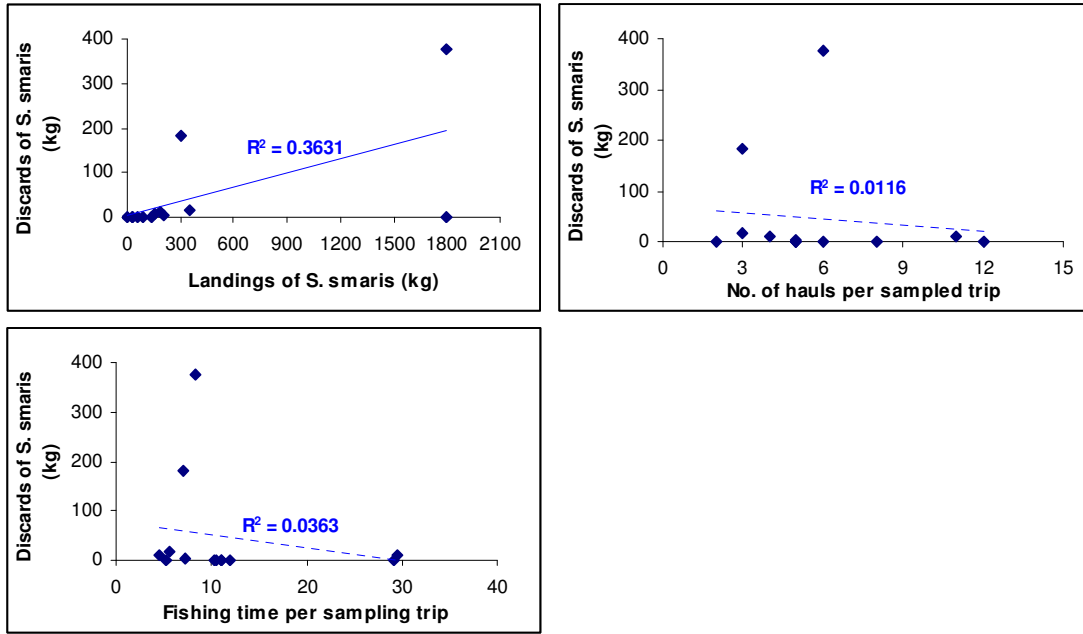
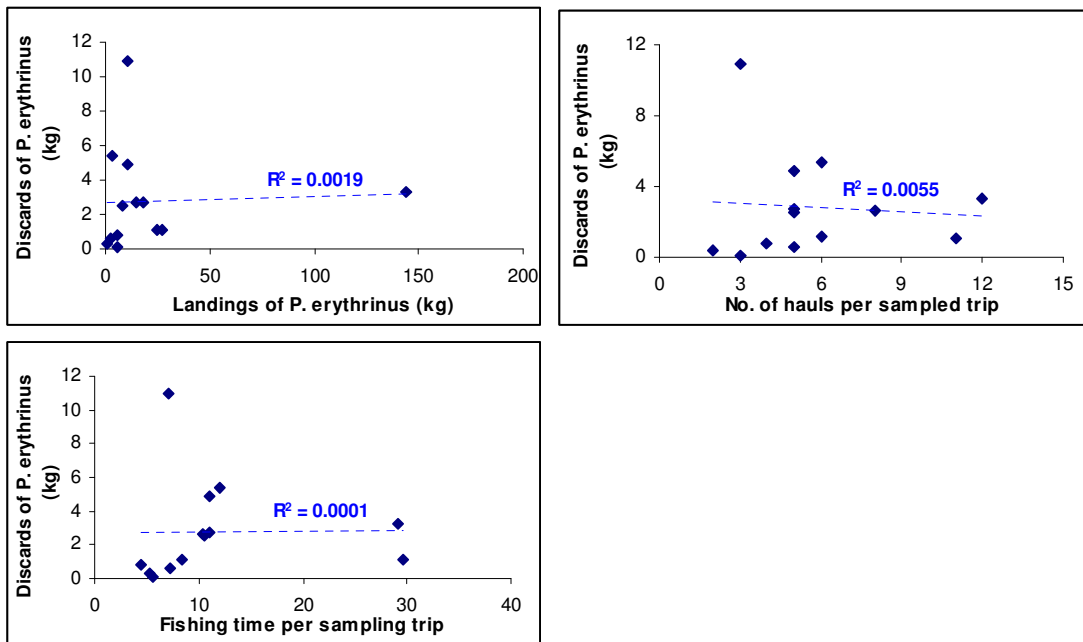


Figure 1: Scatterplot of discards with different auxiliary variables per sampled trip.





**Figure 2:** Scatterplot of *S. smarís* discards with different auxiliary variables per sampled trip.



**Figure 3:** Scatterplot of discards of *P. erythrinus* with different auxiliary variables per sampled trip.

## Annex VII: Detailed results from the discard pilot study concerning the large pelagic longline fishery of Cyprus

**Table 1:** Deployed sampling effort for estimating discards from the large pelagic longline Cyprus fishery

Sampling stratum	Sampling month	No. of trips sampled (no. of fishing days-sets)	Total no. of sampling trips (total no. of fishing days - sets)		Number of failures to get on board for sampling (due to bad weather conditions)	Coverage of sampling trips (fishing days -sets)
1 <sup>st</sup> quarter	January	---	---	13 (23)	--	0 %
	February	---	1 (4)		--	
	March	---	12 (19)		--	
2 <sup>nd</sup> quarter	April	---	10 (45)	193 (480)	--	1.6 % (1.9%)
	May	1 (7)	36 (146)		--	
	June	2 (2)	147 (289)		--	
3 <sup>rd</sup> quarter	July	2 (3)	162 (351)	232 (555)	--	2.6 % (2.7%)
	August	2 (6)	60 (158)		--	
	September	2 (6)	10 (46)		--	
4 <sup>th</sup> quarter	October	1 (6)	2 (16)	5 (27)	1	40% (30%)
	November	1 (2)	3 (11)		1	
	December	--	--		--	

**Table 2:** Fishing operations and trip characteristics recorded per stratum for the large pelagic longline fishery in Cyprus.

Stratum	Target species	No. of sampled trips	Sets per trip		Sets per fishing day	No. of hooks / set		Soaking time (h) /set		Average Depth (m)
			Range	Average		Range	Average	Range	Average	
2nd quarter	swo & bft	1		7	1	420 - 850	745	6.00-9.20	8.25	65
	alb	2	1 - 1	1	1	700 -2700	1700	3.00-4.45	3.50	20
3rd quarter	swo & bft	3	1 - 5	3.6	1	500 - 1100	870	6.00-8.30	7.30	63
	alb	3	1 - 2	1.3	1	2000 - 2500	2375	3.30-6.00	5.00	21
4th quarter	swo & bft	2	2 - 6	4	1	1000 - 1100	1075	7.00-9.55	8.00	70

**Table 3:** Total, retained and discarded catch of sampled trips during the 2<sup>nd</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch ( C )				Retained Catch (L)		Discarded Catch		Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	W (kg)	No.	W (kg)	No.		
<i>Coryphaena hippurus</i> *	8	1	0	1	8	1	0	0	0	0
<i>Isurus oxyrinchus</i> *	56	1	3	1	56	1	0	0	0	0
<i>Thunnus alalunga</i> *	679	87	41	66	679	87	0	0	0	0
<i>Thunnus thynnus</i> *										
<i>Xiphias gladius</i> *	832	35	50	27	832	35	0	0	0	0
<i>Brama brama</i>										
<i>Katwuwonus pelamis</i>										
<i>Mola mola</i>	80	1	5	1	0	0	80	1	100	100
<i>Pteroplatytrygon violacea</i>	7	6	0	5	1	1	5.8	5	85.3	83.3
<i>Ruvettus pretiosus</i>										
<i>Caretta caretta</i>										
<b>All species</b>	1662	131	100	100	1576	125	85.8	6	5.2	4.6
<b>Species of DCR App. XII</b>	1575	124	95	95	1575	124	0	0	0	0

**Table 4:** Average volume of total, retained and discarded catch, and associated variation, of all sampled trips during the 2<sup>nd</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)						Retained Catch (L)				Discarded Catch (D)				Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	Variation (VCw)	Variation (VCn)	W (kg)	No.	VLw	VLn	W (kg)	No.	VDw	VDn		
<i>Coryphaena hippurus</i> *	2.7	0.3	0.5	0.8	21	0.3	2.7	0.3	21	0.3	0.0	0.0	0.0	0.0	0.0	0.0
<i>Isurus oxyrinchus</i> *	18.7	0.3	3.4	0.8	1045	0.3	18.7	0.3	1045	0.3	0.0	0.0	0.0	0.0	0.0	0.0
<i>Thunnus alalunga</i> *	226.3	29.0	40.9	66.4	64826	1183	226.3	29	64826	1183	0.0	0.0	0.0	0.0	0.0	0.0
<i>Thunnus thynnus</i> *																
<i>Xiphias gladius</i> *	277.3	11.7	50.1	26.7	230741	408	277.3	12	230741	408	0.0	0.0	0.0	0.0	0.0	0.0
<i>Brama brama</i>																
<i>Katwuwonus pelamis</i>																
<i>Mola mola</i>	26.7	0.3	4.8	0.8	2133	0.3	0.0	0.0	0.0	0.0	26.7	0.3	2133	0.3	100	100
<i>Pteroplatytrygon violacea</i>	2.3	2.0	0.4	4.6	13	7.0	0.3	0.3	0.3	0.3	1.93	1.67	9.56	4.3	85	83
<i>Ruvettus pretiosus</i>																
<i>Caretta caretta</i>																
<b>All species</b>	553.9	43.7	100	100	164207	576.3	525.3	42	130008	562	28.6	2.0	2428	7.0	5.2	4.6
<b>Species of DCR App. XII</b>	525.0	41.3	95	95	129637	566.3	525.0	41	129637	566	0.0	0.0	0.0	0.0	0.0	0.0

**Table 5:** Average volume of total, retained and discarded catch, and associated variation, of sampled sets targeting *Xiphias gladius* and *Thunnus thynnus* during the 2<sup>nd</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)						Retained Catch (L)				Discarded Catch (D)				Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	Variation (VCw)	Variation (VCn)	W (kg)	No.	VLw	VLn	W (kg)	No.	VDw	VDn		
<i>Coryphaena hippurus</i> *	1.1	0.1	1	2	9	0.1	1.14286	0.1	9	0.1	0.0	0.0	0.0	0	0	0
<i>Isurus oxyrinchus</i> *	8.0	0.1	6	2	448	0.1	8	0.1	448	0.1	0.0	0.0	0.0	0	0	0
<i>Thunnus alalunga</i> *																
<i>Thunnus thynnus</i> *																
<i>Xiphias gladius</i> *	118.9	5.0	85	81	5092	8.0	118.857	5.0	5092	8	0.0	0.0	0.0	0	0	0
<i>Brama brama</i>																
<i>Katwuwonus pelamis</i>																
<i>Mola mola</i>	11.4	0.1	8	2	914	0.1	0	0.0	0	0	11.4	0.1	914.3	0.1	100	100
<i>Pteroplatytrygon violacea</i>	0.9	0.7	1	12	3	1.6	0	0.1	0	0	0.8	0.6	2.3	1.0	85	80
<i>Ruvettus pretiosus</i>																
<i>Caretta caretta</i>																
<b>All species</b>	140.4	6.1	100	100	10015	13	128	5.4	6366	9	12.2	0.7	1002.3	1.6	8.7	11.6
<b>Species of DCR App. XII</b>	128.0	5.3	91	86	6373	9	128	5.3	6373	9	0.0	0.0	0.0	0	0	0

**Table 6:** Average volume of total, retained and discarded catch, and associated variation, of sampled sets targeting *Thunnus alalunga* during the 2<sup>nd</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)						Retained Catch (L)				Discarded Catch (D)				Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	Variation (VCw)	Variation (VCn)	W (kg)	No.	VLw	VLn	W (kg)	No.	VDw	VDn		
<i>Coryphaena hippurus</i> *																
<i>Isurus oxyrinchus</i> *																
<i>Thunnus alalunga</i> *	339.5	43.5	99.96	99	52813	1105	339.5	43.5	52813	1105	0	0	0	0	0	0
<i>Thunnus thynnus</i> *																
<i>Xiphias gladius</i> *																
<i>Brama brama</i>																
<i>Katwuwonus pelamis</i>																
<i>Mola mola</i>																
<i>Pteroplatytrygon violacea</i>	0.2	0.5	0.04	1	0	0.5	0	0	0	0	0.15	0.5	0.045	0.5	100.0	100.0
<i>Ruvettus pretiosus</i>																
<i>Caretta caretta</i>																
<b>All species</b>	339.7	44	100	716	52910	1152	340	43.5	52813	1105	0.15	0.5	0	0.5	0.04	1.1
<b>Species of DCR App. XII</b>	339.5	43.5	99.96	708	52813	1105	339.5	43.5	52813	1105	0	0	0	0	0	0

**Table 7:** Total, retained and discarded catch of sampled trips during the 3<sup>rd</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)				Retained Catch (L)		Discarded Catch (D)		Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	W (kg)	No.	W (kg)	No.		
<i>Coryphaena hippurus</i> *	6	1	0.1	0.2	6	1	0	0	0	0
<i>Isurus oxyrinchus</i> *	50	1	0.8	0.2	50	1	0	0	0	0
<i>Thunnus alalunga</i> *	1679	199	28	48	1679	199	0	0	0	0
<i>Thunnus thynnus</i> *	7	1	0.1	0.2	7	1	0	0	0	0
<i>Xiphias gladius</i> *	3524	148	58	35	3524	148	0	0	0	0
<i>Brama brama</i>	1	2	0.0	0.5	1	2	0	0	0	0
<i>Katuwonus pelamis</i>	10	1	0.2	0.2	10	1	0	0	0	0
<i>Mola mola</i>	340	3	6	1	0	0	340	3	100	100
<i>Pteroplatytrygon violacea</i>	110	57	2	14	4	1	106.5	56	97	98
<i>Ruvettus pretiosus</i>	14	1	0.2	0.2	14	1	0	0	0	0
<i>Caretta caretta</i>	320	4	5	1	0	0	320	4	100	100
<b>All species</b>	6061	418	100	100	5295	355	766.5	63	13	15
<b>Species of DCR App. XII</b>	5266	350	87	84	5266	350	0	0	0	0

**Table 8:** Average volume of total, retained and discarded catch, and associated variation, of all sampled trips during the 3<sup>rd</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)						Retained Catch (L)				Discarded Catch (D)				Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	Variation (VCw)	Variation (VCn)	W (kg)	No.	VLw	VLn	W (kg)	No.	VDw	VDn		
<i>Coryphaena hippurus</i> *	1.0	0.2	0.1	0.2	6	0.2	1.0	0.2	6	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Isurus oxyrinchus</i> *	8.3	0.2	0.8	0.2	417	0.2	8.3	0.2	417	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Thunnus alalunga</i> *	279.9	33.2	27.9	47.6	164804	2323	279.9	33	164804	2323	0.0	0.0	0.0	0.0	0.0	0.0
<i>Thunnus thynnus</i> *	1.2	0.2	0.1	0.2	8.2	0.2	1.2	0.2	8.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Xiphias gladius</i> *	581.7	24.7	57.9	35.4	1396601	2742	581.7	25	1396601	2742	0.0	0.0	0.0	0.0	0.0	0.0
<i>Brama brama</i>	0.1	0.3	0.0	0.5	0.1	0.7	0.1	0.3	0.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0
<i>Katuwonus pelamis</i>	1.7	0.2	0.2	0.2	18.0	0.2	1.7	0.2	18.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mola mola</i>	56.7	0.5	5.6	0.7	8067	0.7	0.0	0.0	0.0	0.0	56.7	0.5	8067	0.7	100	100
<i>Pteroplatytrygon violacea</i>	18.3	9.5	1.8	13.6	116	37.9	0.6	0.2	2.0	0.2	17.8	9.3	98.9	35.5	96.8	98.2
<i>Ruvettus pretiosus</i>	2.3	0.2	0.2	0.2	31.3	0.2	2.3	0.2	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Caretta caretta</i>	53.3	0.7	5.3	1.0	9666.7	0.7	0.0	0.0	0.0	0.0	53.3	0.7	9666.7	0.7	100	100
<b>All species</b>	1004.6	69.7	100.0	100.0	1471806	3935.1	876.8	59	1175785	3250	127.8	10.5	25183	45.5	12.7	15.1
<b>Species of DCR App. XII</b>	872.1	58.3	86.8	83.7	1176248	3185.9	872.1	58	1176248	3186	0.0	0.0	0.0	0.0	0.0	0.0

**Table 9:** Average volume of total, retained and discarded catch, and associated variation, of sampled sets targeting *Xiphias gladius* and *Thunnus thynnus* during the 3<sup>rd</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)						Retained Catch (L)				Discarded Catch (D)				Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	Variation (VCw)	Variation (VCn)	W (kg)	No.	VLw	VLn	W (kg)	No.	VDw	VDn		
<i>Coryphaena hippurus</i> *	0.5	0.1	0	0.5	3	0.1	0.5	0.1	3	0.1	0	0	0	0	0	0
<i>Isurus oxyrinchus</i> *	4.5	0.1	1	0.5	227	0.1	4.5	0.1	227	0.1	0	0	0	0	0	0
<i>Thunnus alalunga</i> *																
<i>Thunnus thynnus</i> *																
<i>Xiphias gladius</i> *	315.5	13.4	83	79.5	83869	160.5	315.5	13.4	83869	160	0	0	0	0	0	0
<i>Brama brama</i>																
<i>Katuwonus pelamis</i>																
<i>Mola mola</i>	30.9	0.3	8	1.6	3949	0.2	0.0	0.0	0	0	30.9	0.3	3949	0.2	100	100
<i>Pteroplatytrygon violacea</i>	6.0	2.7	2	16.2	14	2.6	0.3	0.1	1	0	5.7	2.6	11	2.3	95	97
<i>Ruvettus pretiosus</i>	1.2	0.1	0	0.5	17	0.1	1.2	0.1	17	0.1	0	0	0	0	0	0
<i>Caretta caretta</i>	22.7	0.2	6	1.1	3682	0.2	0.0	0.0	0	0.0	22.7	0.2	3682	0	100	100
<b>All species</b>	381.5	16.8	100	100	98757	179	322.1	13.7	82053	163	59.3	3.1	6182	2.7	16	18
<b>Species of DCR App. XII</b>	320.6	13.5	84	81	82651	163	320.6	13.5	82651	163	0	0	0	0	0	0

**Table 10:** Average volume of total, retained and discarded catch, and associated variation, of sampled sets targeting *Thunnus alalunga* during the 3<sup>rd</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)						Retained Catch (L)				Discarded Catch (D)				Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	Variation (VCw)	Variation (VCn)	W (kg)	No.	VLw	VLn	W (kg)	No.	VDw	VDn		
<i>Coryphaena hippurus</i> *																
<i>Isurus oxyrinchus</i> *																
<i>Thunnus alalunga</i> *	419.8	49.8	91.7	85.4	150212	2112	419.8	49.8	150212	2112	0	0	0	0	0	0
<i>Thunnus thynnus</i> *	1.8	0.3	0.4	0.4	12	0.3	1.8	0.3	12	0.3	0	0	0	0	0	0
<i>Xiphias gladius</i> *	5.0	0.3	1.1	0.4	100	0.3	5.0	0.3	100	0.3	0	0	0	0	0	0
<i>Brama brama</i>	0.2	0.5	0.04	0.9	0	1.0	0.2	0.5	0.1	1.0	0	0	0	0	0	0
<i>Katwuwonus pelamis</i>	2.6	0.3	0.6	0.4	27	0.3	2.6	0.3	27	0.3	0	0	0	0	0	0
<i>Mola mola</i>																
<i>Pteroplatytrygon violacea</i>	11.0	6.8	2.4	11.6	46	24.9	0.0	0.0	0.0	0.0	11.0	6.8	45.7	24.9	100	100
<i>Ruvettus pretiosus</i>																
<i>Caretta caretta</i>	17.5	0.5	3.8	0.9	558	0.3	0.0	0.0	0.0	0.0	17.5	0.5	558.3	0.3	100	100
<b>All species</b>	457.8	58.3	100	100	167539	2818	429.3	51.0	159823	2285	28.5	7.3	514.0	28.3	6	12
<b>Species of DCR App. XII</b>	426.6	50.3	93.2	86.3	160765	2204	426.6	50.3	160765	2204	0	0	0	0	0	0

**Table 11:** Total, retained and discarded catch of sampled trips during the 4<sup>th</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)				Retained Catch		Discarded Catch		Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	W (kg)	No.	W (kg)	No.		
<i>Coryphaena hippurus</i> *	60	9	2.1	7.1	60	9	0	0	0	0
<i>Isurus oxyrinchus</i> *										
<i>Thunnus alalunga</i> *										
<i>Thunnus thynnus</i> *										
<i>Xiphias gladius</i> *	2568	83	90	66	2568	83	0	0	0	0
<i>Brama brama</i>										
<i>Katwuwonus pelamis</i>										
<i>Mola mola</i>	70	1	2	1	0	0	70	1	100	100
<i>Pteroplatytrygon violacea</i>	118	32	4	25	0	0	118	32	100	100
<i>Ruvettus pretiosus</i>										
<i>Caretta caretta</i>	45	1	2	1	0	0	45	1	100	100
<b>All species</b>	2861	126	100	100	2628	92	233	34	8	27
<b>Species of DCR App. XII</b>	2628	92	92	73	2628	92	0	0	0	0

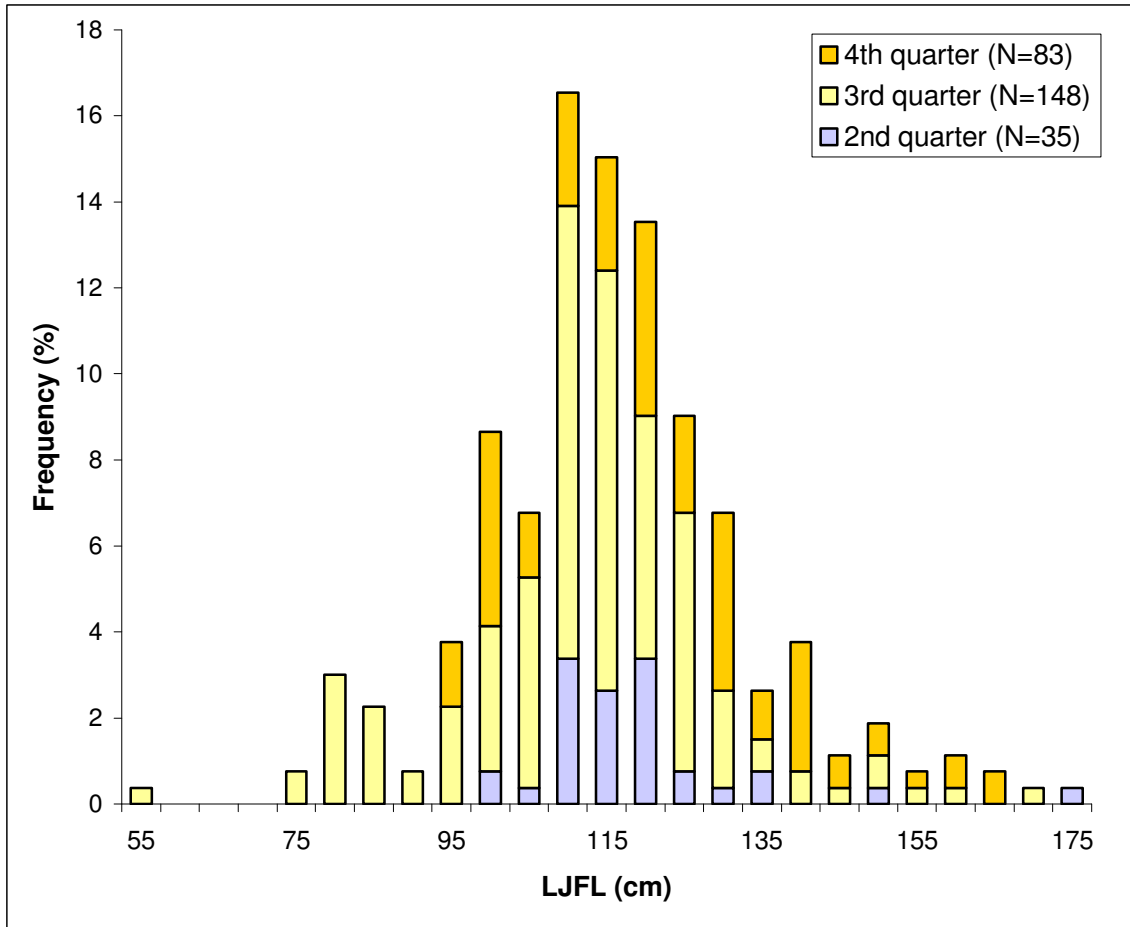
**Table 12:** Average volume of total, retained and discarded catch, and associated variation, of all sampled trips during the 4<sup>th</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)						Retained Catch (L)				Discarded Catch (D)				Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	Variation (VCw)	Variation (VCn)	W (kg)	No.	VLw	VLn	W (kg)	No.	VDw	VDn		
<i>Coryphaena hippurus</i> *	29.9	4.50	2.1	7.1	167	0.5	29.9	4.5	167	0.5	0.0	0.0	0.0	0.0	0.0	0.0
<i>Isurus oxyrinchus</i> *																
<i>Thunnus alalunga</i> *																
<i>Thunnus thynnus</i> *																
<i>Xiphias gladius</i> *	1284.2	41.50	89.8	65.9	2466154	2665	1284.2	42	2466154	2665	0.0	0.0	0.0	0.0	0.0	0.0
<i>Brama brama</i>																
<i>Katwuwonus pelamis</i>																
<i>Mola mola</i>	35.0	0.50	2.4	0.8	2450	0.5	0.0	0.0	0.0	0.0	35.0	0.5	2450	0.5	100	100
<i>Pteroplatytrygon violacea</i>	59.0	16.00	4.1	25.4	4646	242.0	0.0	0.0	0.0	0.0	59.00	16.00	4646.48	242.0	100	100
<i>Ruvettus pretiosus</i>																
<i>Caretta caretta</i>	22.5	0.50	1.6	0.8	1012.5	0.5	0.0	0.0	0.0	0.0	22.5	0.5	1012.5	0.5	100	100
<b>All species</b>	1430.5	63.0	100.0	100.0	2548785	1352.0	1314.0	46	2506964	2592	116.5	17.0	173	200.0	8	27
<b>Species of DCR App. XII</b>	1314.0	46.0	91.9	73.0	2506964	2592.0	1314.0	46	2506964	2592	0.0	0.0	0.0	0.0	0	0

**Table 13:** Average volume of total, retained and discarded catch, and associated variation, of sampled sets targeting *Xiphias gladius* and *Thunnus thynnus* during the 4<sup>th</sup> quarter. The asterisk (\*) indicates the species included in the Appendix XII of DCR.

Species	Total Catch (C)						Retained Catch (L)				Discarded Catch (D)				Dw/Cw (%)	Dn/Cn (%)
	W (kg)	No.	% of W	% of N	Variation (VCw)	Variation (VCn)	W (kg)	No.	VLw	VLn	W (kg)	No.	VDw	VDn		
<i>Coryphaena hippurus</i> *	7	1	2.1	7.1	81	3.0	7.46	1	81	3.0	0	0	0	0	0	0
<i>Isurus oxyrinchus</i> *																
<i>Thunnus alalunga</i> *																
<i>Thunnus thynnus</i> *																
<i>Xiphias gladius</i> *	321	10	89.8	65.9	37256	34.8	321	10	37256	35	0	0	0	0	0	0
<i>Brama brama</i>																
<i>Katwuwonus pelamis</i>																
<i>Mola mola</i>	9	0.1	2.4	0.8	613	0.1	0.00	0	0	0	9	0.1	613	0.1	100	100
<i>Pteroplatytrygon violacea</i>	15	4	4.1	25.4	843	50.9	0.0	0	0	0	15	4	843	51	100	100
<i>Ruvettus pretiosus</i>																
<i>Caretta caretta</i>	6	0.1	1.6	0.8	253	0.1	0	0	0	0	6	0.1	253	0.1	100	100
<b>All species</b>	358	16	100.0	100.0	33791	49	329	12	37588	32	29	4	1142	49	8	27
<b>Species of DCR App. XII</b>	329	12	91.9	73.0	37588	32	329	12	37588	32	0	0	0	0	0	0

**Annex VIII: Biological sampling of catches from the Cyprus large pelagic longline fishery**



**Figure 1:** Length composition of *Xiphias gladius* catches.

## Annex IX: Results of raising discards from the large pelagic longline fishery to the population level

**Table 1:** Total discard biomass estimates (in kg) and achieved precision per stratum for all species (with “\*” for species of DCR App. XII).

Stratum	Raising by fishing trips			
	Average discards (kg) in stratum $\bar{d}$	Discard sample variance ( $\sigma^2$ )	Total sampling trips	Total discards (kg) in stratum $\bar{d}$
2nd quarter	29	2428.0	193	5520
	0*	0*		0*
3rd quarter	128	25183	232	29650
	0*	0*		0*
4th quarter	117	173	5	583
	0*	0*		0*

**Table 2:** Total discard biomass estimates (in kg) and achieved precision per stratum for *Pteroplatytrygon violacea*.

Stratum	Raising by fishing trips			
	Average discards (kg) in stratum $\bar{d}$	Discard sample variance ( $\sigma^2$ )	Total sampling trips	Total discards (kg) in stratum $\bar{d}$
2nd quarter	1.9	9.6	193	372
3rd quarter	17.8	99	232	4130
4th quarter	59.0	4646	5	295



## Annex X: Discards Information from logbooks

**Table 1:** Discards information from logbooks with systematic records.

Stratum	No. of trips corresponding to the logbooks (% of total sampling trips)	Species	Recorded Discard catch		Raised recorded discards to total sampling trips
			W (kg)	N	W (kg)
1st quarter	0%	no records			
2nd quarter	39 (20.7%)	<i>Pteroplatytrygon violacea</i>	2125		10266
		<i>Alopias</i> spp.	600		2899
		<i>Thunnus alalunga</i> *		74	
3rd quarter	53 (22.3%)	<i>Pteroplatytrygon violacea</i>	4647		20839
		<i>Thunnus alalunga</i> *		869	
4th quarter	0%	no records			

\*Eaten by dolphins