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AN ANALYSIS OF AN INTERNATIONAL FISHERY COMPANY. INTRODUCTION TO A FISHERY MANAGEMENT STRATEGY COMPATIBLE WITH THE FISHING SECTOR.

MASTER IN SUSTAINABLE MANAGEMENT OF FISHERIES RESOURCES.

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ANALYSIS OF AN INTERNATIONAL FISHERY COMPANY.

INTRODUCTION TO A FISHERY MANAGEMENT STRATEGY

COMPATIBLE WITH THE FISHING SECTOR.

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RESUMEN

En el contexto político y socioeconómico actual, donde las grandes economías emergentes incorporan al mercado internacional una mayor demanda de productos pesqueros, se ha de hacer especial hincapié en la gestión sostenible de los recursos marinos. Las medidas proteccionistas carecen generalmente de pautas compatibles con los intereses de los agentes económicos que ejercen el esfuerzo pesquero. Esta circunstancia dificulta en gran medida la aplicabilidad de modelos de gestión sostenible.

En un marco académico, no se han propuesto estudios que diriman los límites de actuación de una potencial estrategia de gestión de recursos en base a los intereses del sector pesquero, ni que analicen las posibles consecuencias económicas de una serie de medidas proteccionistas.

En este estudio se han analizado precios, composición de tallas comerciales, biomasa extraída y longitudes de primera madurez de una serie de especies objetivo procedentes de la pesca producida por un armador asiático de primera magnitud. A través del análisis de las 1919 ventas ocasionadas en el mercado europeo durante un periodo de 31 meses, se han establecido las pautas de comportamiento de los precios respecto a las tallas y su relación con la biomasa extraída y con los beneficios brutos obtenidos.

ABSTRACT

In the present political and socio-economic context, where the big emerging economies leads to increasing demand for seafood products, special emphasis needs to be given to the sustainable management of fishery resources. Protectionist measures are deprived of guidelines being compatible with interest of the economic agents that exhort the fishing effort.

In an academic framework, there is a lack of studies leading to neither establish the intervention level of a potential resource management strategy based on the interests of fishery sector, nor to analyze the possible economic consequences of a series of protectionist measures.

In this study it has been analyzed prices, commercial size compositions, extracted biomass and length at first maturities of a series of target species from an important Asian fishery company. By mean of analyzing 1919 sales of European market during 31 months, the prices behaviors along the sizes of the target species, has been established and also their relationship with the extracted biomass and the obtained revenues.

INTRODUCTION

As a source of nutrients, the seafood comprise a wide range of alimentary characteristics that make it very valuable in terms of enhance a diversified and healthy diets (MacManus & Newton, 2011). However, the fish consumption is not only appreciated according to the quality of its nutrients but to the global contribution in quantity. In 2009, fish accounted for 16.6% of the global population’s intake of animal protein and 6.5% of all protein consumed (FAO, 2010). Globally, fish provides about 3000 million people with almost 20% of their average per capita intake of animal protein, and 4300 million people with about 15% of such protein (FAO, 2010). According to FAO, it is important to highlight that the increasing of seafood consumption has grown over the 1.7% per year in the world`s population and therefore the tendency rate is positive. Also it indicates that the world per capita fish consumption increased from an average of 9.9 kg in the 1960s to 11.5 kg in the 1970s, 12.6 kg in the 1980s, 14.4 kg in the 1990s, 17.0 kg in the 2000s and reached 18.4 kg in 2009. Those evidences show that the seafood has not only been an important source of nutrients on the past and in present but a need for the future. In the case of Europe, the current consumption (2009) of fish per capita is 22.0 kg and a 20% over the global amount (FAO, 2010).

Fishery has to be understood from the perspective of the international trading. It is worth nothing that in 2010, fishery trade represented about 10% of total agricultural exports, excluding forest products and 1% of world merchandise trade in value terms (FAO, 2012). The share of total fishery production in 1976 was a 25% meanwhile in 2010 it was 38% (FAO, 2012). This reflects the degree openness of the sector to the international trade.

In the period 1976–2008, world trade in fish and fishery products grew significantly also in value terms, rising from US$8000 million to US$102000 million, with annual growth rates of 8.3% in nominal terms and of 3.9% in real terms (FAO, 2012). As a response of the international demand of fishery as source of proteins, and richness, an important industry arose supported by the development of innovative technologies. “Technological advances applied to fisheries have fed the increasing global demand for fish products by a growing human population and led to a global network of international trade in fish and fish products (Caddy & Cochrane 2001).The application of some post second world war technological innovations, allow the increasing of the fishing power of the fleets.(i.e.: diesel engines, on board freezing progress, radio positioning and communication systems and the application of computerization that increase the fishing effort) (Pauly & Maclean, 2003).

This tendency of stimulation of fishery is reflected in the evolution of global captures. The main general increasing was experimented from 16.8 millions of tonnes fished in 1950 to the historic peak of 86.4 millions of tonnes reached in 1996 (FAO, 2012). After 1996, the amount is stabilized at about 80 millions of tonnes with inter-annual fluctuations (FAO, 2012). As the result of this trending evolution, the seafood resources have experimented serious depletion processes.

According to FAO (2012), in 2009, the 29.9% of the stocks were overexploited; the 57.4% were fully exploited. The proportion of non-fully exploited stocks has decreased gradually since 1974.

Since the Second Word War, until nowadays, the development of fishery has been characterized by a drastic increment of captures (Pauly & Maclean, 2003). Garcia (1992) and Garcia and Newton (1994), characterized the period from 1959 to 1972 as one of further ‘‘Expansion of fisheries and an intensification of research’’ in support of fisheries development. During this period, the reported global landings increased from the 28 million tonnes of 1958 to 60 million tonnes by 1972 (Caddy & Cochrane 2001).

The main milestone in the allowance of fishery management strategies is maybe the acceptance of the boundary of 200 miles as limit of Exclusive Economic Zone (United Nations, 1998), but it had not solved the overfishing problem (Caddy & Cochrane 2001).

During the last decade of the millennium, the consolidation of the "Sustainable Challenges" was headed by the FAO Code of Conduct (FAO, 1995). This voluntary code was adopted in the FAO conference in 1995 to ensure responsible and sustainable fishing practices.

By mean of the exposed international instruments adopted in the last 2 decades of the century, an appropriate framework has been create to allow countries to implement strategies toward an improved global management system. However, the adopted management measures have not reached the goals of sustainability they were designed for. The primary reasons for the failure of management has been summarized by Cochrane (Cochrane, 2001) as: high biological and ecological uncertainty as to resource dynamics, the conflict between social and economic priorities, and the lack of definition or observance of constraints imposed by limits to production of the resources.

According to Caddy and Cochrane (2001), the eight mayor population themes to be concerned about in order to be included into the management strategies in the future are resumed in: (a) Considering the complexity of the spatial distribution of the fish stocks, (b) conflict in access that have not been solved by the Law of the Sea, (c) application of economic theory as a crucial part of fishery management, (d) multispecies fisheries as a main target for the management, (e) By-catch and (f) utilization of discards as to be avoid, (g)effects of fishing on genetic diversity and (g) effects of the environment.

The fishing intensity of the multispecies fisheries and its impact on the ecosystems need to be carefully analyzed in order to find management solutions. On the other hand, as Caddy and Cochrane (2001) state, there will also be a need to estimate the economic implications of optimal stock recovery strategies which are now a top priority for many depleted resources.

The key problem in achieving effective fisheries management, however, remains in the problem of dealing with conflicting objectives, coupled with the widespread tendency to give priority to social and economic demands over sustainable utilization of resources (Cochrane, 2001).

In this context, the aim of this master thesis is to analyse the commercial information of a multispecies trawl fishery company in order to understand the economic dynamic of the industry and to find out new management strategies based on an optimized commercial approach. Using this commercial, fishing and biological information, the fishery will be analysed in terms to economic efficiency according to the predominance of one or several length classes in the commercial categorization of capture length size distribution of each species. It is possible to calculate the price increasing in €/cm of the capture as its mean length increase centimetre to centimetre.

MATERIALS AND METHODS

For the realization of this study in which an industrial fishery is analysed in terms of economic and eco-biology relationships, different data bases have been consulted. The information that has been used in this research can be classified in (a) Commercial material; (b) fishery information, in order to clarify the lengths of different commercial sizes, the boxes weights distribution and number of pieces per box, and (c) biological data as first maturity length and maximum and minimum size when available.

(A) COMMERCIAL MATERIAL

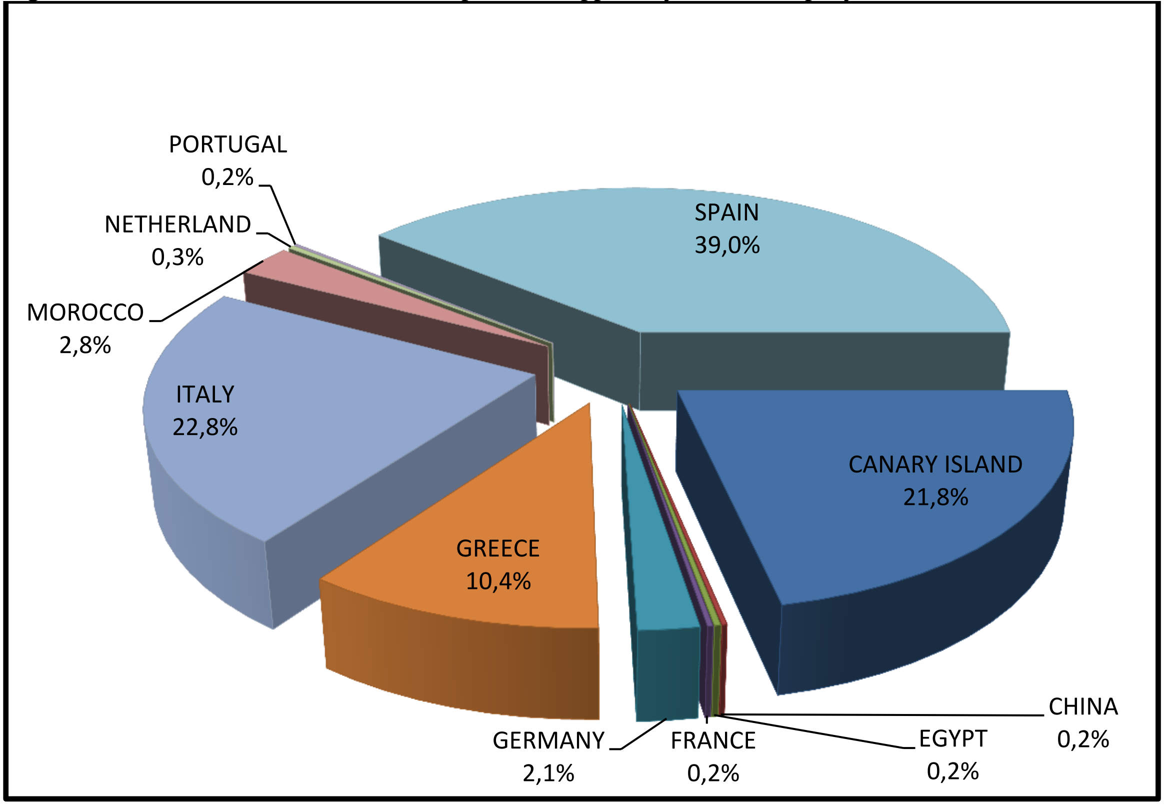
A total of 362 sales confirmations have been analysed. Those cover a commercial period of 31 months starting on December of 2009 and finishing on June of 2012 and a total of 1919 product sales. During this time, an amount of 11170 tons of seafood has been sold, comprising a number of 23 different commercial species.

By mean of collecting those 362 sales confirmations signed by an important international fisheries company and its European clients, all the commercial information of the fishery has been collected. These valuable documents that issued as a single sale contract contains:

- (i)The name of the client purchasing the goods
- (ii) list of commercial names of the products including respective sizes to be sold (for the correct understanding of this study it is important that the term "product" will define the specie plus its size since this is what defines the price. –e.g:
    - Comercial name: WHITE SHRIMP
    - Specie: *Penaeus notialis*
    - Product: White shrimp B3 where B3 is the size).
- (iii) Number of cartons per product of the purchase,
- (iv) price per kilogram of every single product,
- (v) destination and
- (vi) INCOTERM under which the conditions of the sale is signed.

It is important to define the European market concept in relation with the company to be analysed. European market include all the companies that buy the products once those products are European Union import customs cleared by mean of importation duty payment. The biggest portion of that seafood is destined to European countries but there are some cases where the product is re-exported to third countries. It can be considered that those sales as valid since third countries clients are bidding under the same conditions and currency. The percentage distribution of the exportations is shown in figure 1 where the residual portion of non-EU clients is revelled. A 97% of the weight is sold to an EU country indeed.

Figure 1: market distribution of the seafood products supplied by studied company.



Mediterranean countries are the main market for the product offered by the company (Fig. 1). In fact, it is known that clients from Canary Island, once they buy products, mainly export those parcels to Mediterranean countries, overall to Spain and Italy.

INCOTERM, the acronym of International Commercial Terms, is a set of rules provided by International Commercial Chamber (ICC) to regulate foreign trades and to facilitate the operational logistic of the transactions. Therefore, any foreign trade contract in which commodities are involved is made under a specific Incoterm in order to allow the two sides to interpret the agreement in which the tasks, costs and risks associated with the transportation and delivery of the goods are communicated.

In order to the study a homogenous commercial market, only the European Market of this company has been evaluated. All the prices were reported in € and were established taking into account the assigned incoterm for the sales terms in order to obtain the real value of a parcel. The Incoterm used by the company are described in table 1.

Table 1: share of incorterms of the studied sales (CFR- Cost and Freight-: means that the seller pays the freight to the destination port; CPT-Cost Paid To-: means that the seller pays the freight (or transportation) to an agreed point; FOB -Free on Board- means that client pays the freight; EXFrigo or ExWorks means that client retires by his own the merchandising in the cold store and also pays the import custom clearance of the products; When CPT, FOB or CFR are applied the seller pays the EU import customs clearance).

INCOTERM	-SALE-	VALUE-€
CFR	834	38,86%
CPT	205	13,97%
EXFRIGO	288	22,36%
FOB	588	24,81%
Total	**1915**	**100,00%**

As the price in this study, is going to deal with the economic value of the specific commercial seafood size, the commercial dynamic of the sales department of the company has been analysed in order to check what it is the importance of the Incoterm in the products prices. Due to the minimal impact in cost, CPT and CFR are taken as equals and its use in a contract implies an extra-cost in the price per kilogram over FOB and this extra cost varies depending on the destination. Therefore, for European market, 4 areas have been defined to set the "over-FOB-extracost" for CPT and CFR that varies depending on the destination. Although ExFrigo should receive incentive in price setting, due to the fact that this operates mainly for local producers, there are not especial conditions in prices and it has been considered as an equivalent of FOB basin. In table 2, the extra cost in € per kilogram to transform CFR prices in FOB prices for the 4 destinations area considered and to supply a homogenous base for the study has been recorded. For extracting all this information, the sales department team has been consulted.

Table 2: € per kg to be added to the price to convert CFR into FOB price. The conversion depends on the area and is based on freight cost to those areas.

	CONVERSION CFR TO FOB €/Kg	COUNTRY
AREA 1	0,1	SPAIN
AREA 2	0,12	ITALY
		PORTUGAL
AREA 3	0,15	EGYPT
		FRANCE
		GREECE
		MOROCCO
		NETHERLAND
AREA 4	0,16	CHINA

(B) FISHERY INFORMATION

The fishery information used for this study is that provided by 70 trawlers belonged to an Asiatic Multinational Company that operates in the Gulf of Guinea. The capture is composed by 23 species. However, based on the species predominance in the catch and in the revenue importance, it can be considered that cephalopods and decapods are the target species (Figs 2 and 3), and the rest can roughly be considered as by-catch.

Figure 2 : Capture composition per group of species in % of tonnes.

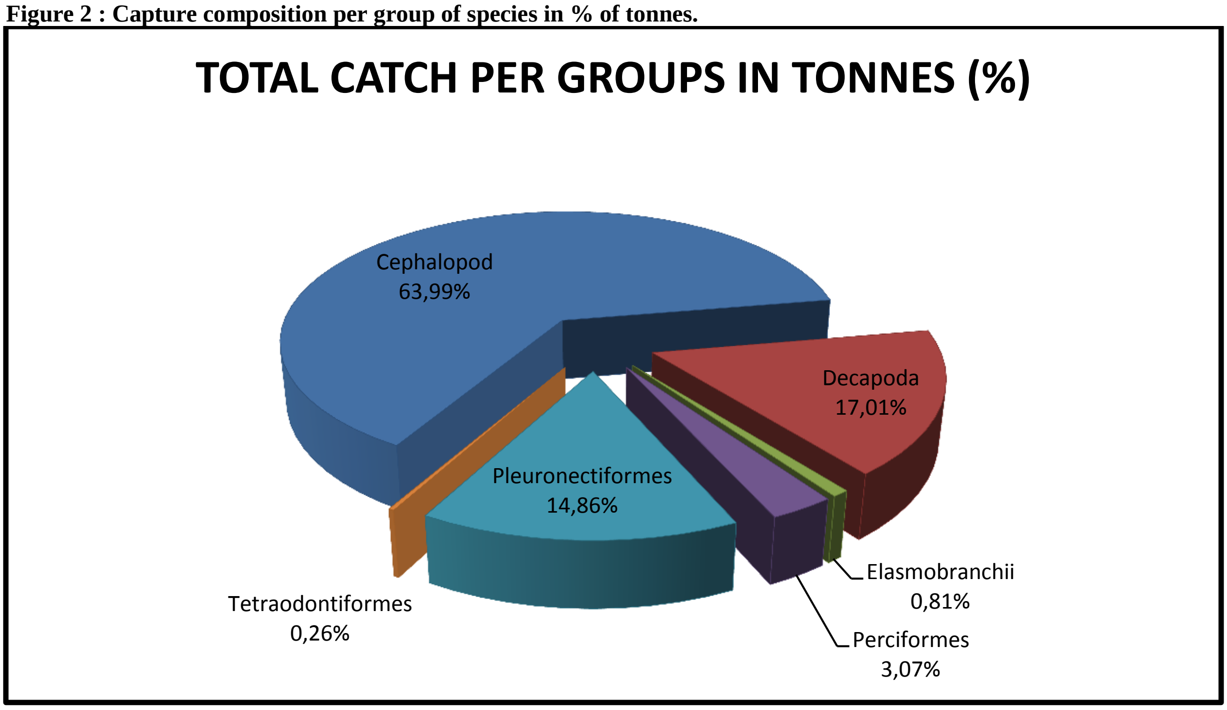
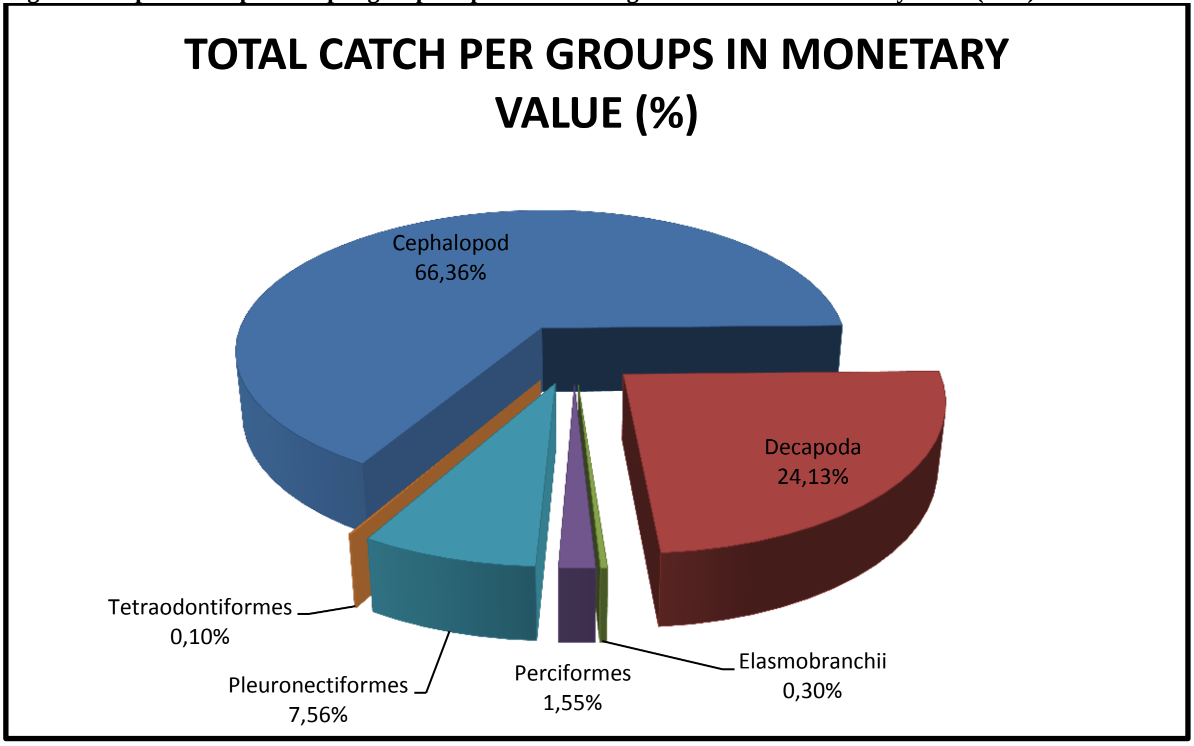


Figure 3: Capture composition per group of species according to their relative monetary value (in%).



In order to clarify the specie identity of the products, the Company Catch Certificates have been consulted. According to article 6 and 13 of the COUNCIL REGULATION (EC) No 1005/2008 in which "prior notice" and "catch certificates" are introduced and annex II of that regulation and annex IIIA of the COMMISSION REGULATION (EC) No 1010/2009, demands that the commercial name of the landed product must be referred to the FAO alfa-3 code. As each FAO alfa-3 code defines single specie or group of them (Table 3), the commercial name can be matched to its scientific name through the "Prior Notice Document" or the "Catch Certificate". Moreover, the local authorities of the European landing port, by mean of routine inspection of the discharge procedures, can verify and validate that information. Those inspections are carried on not only for achieving the environmental or health EU concerning but for assigning the specific duty corresponding to each specie. The local authorities by mean of random inspections verify the landed seafood in order to assure the exact correspondence between landed species and those reported in the discharge procedure documents.

On the other hand, it is not possible to be said that the lower share species (Table 3) are considered by-catch, but at any case we can obviously determine that those species are not the target specie of this fishery. Even, many non-target species captured are discarded.

Table 3 composition of the capture by species and 3 alfa code assigned to each.

GROUP OF SPECIES	HOMOGENEOUS NAME	SCIENTIFIC NAME	3 ALPHA CODE	WEIGHT SOLD
Cephalopod	**PULPO**	**Octopus vulgaris**	**OCC**	25,07%
Cephalopod	**SEPIA**	**Sepia officinalis**	**CTC**	28,16%
Cephalopod	**SEPIOLA**	**Sepia spp**	**IAX**	10,76%
Decapoda	**CANGREJO**	**Portunus validus**	**PVQ**	3,66%
Decapoda	**LANGOSTA**	**Panulirus regius**	**LOY**	0,20%
Decapoda	**LANGOSTINO BLANCO**	**Penaeus notialis**	**SOP**	7,80%
Decapoda	**LANGOSTINO TIGRE**	**Penaeus kerathurus**	**TGS**	4,79%
Decapoda	**YUMBO**	**Penaeus monodon**	**GIT**	0,56%
Elasmobranchii	**CANE**	**Rhizoprionodon acutus**	**RHA**	0,51%
Elasmobranchii	**CAZON**	**Mustelus mustelus**	**SMD**	0,30%
Perciformes	**ABAE**	**Epinephelus costae**	**EPK**	0,06%
Perciformes	**CHERNE**	**Epinephelus aeneus**	**GPW**	1,91%
Perciformes	**MAQUEREAU**	**Scomberomorus spp**	**KGX**	0,03%
Perciformes	**OMBRINE**	**Pseudotolithus spp**	**CKW**	0,66%
Perciformes	**SABLE**	**Trichiurus lepturus**	**LHT**	0,12%
Perciformes	**BOBO**	**Pseudotolithus elongatus**	**PSE**	0,29%
Pleuronectiformes	**LENGUA**	**Cynoglossus spp**	**YOX**	0,01%
Pleuronectiformes	**LENGUADO**	**Solea solea**	**SOL**	2,93%
Pleuronectiformes	**SEIS MONEDA**	**Dicologlossa hexophthalma**	**DHZ**	9,43%
Pleuronectiformes	**SOLE TIGRE**	**Synaptura lusitanica**	**YNU**	0,06%
Pleuronectiformes	**SOLE TURBO**	**Psettodes belcheri**	**SOT**	1,74%
Pleuronectiformes	**SOYA**	**Solea lascaris**	**SOS**	0,70%
Tetraodontiformes	**UMA**	**Aluterus spp**	**ALT**	0,26%

The seafood captured by trawlers is sorted on boards by species and sizes and then frozen in the hold. The captured is classified into specific specie-size cartons that are filled by the crew attending to a predefined homogeneous weight or length per individual of each specie and carton. In order to establish a standardized size per product, a book is given to fishermen that specify the range of weight or length that defined every size of product and the number of individuals to fill a carton on the precise size range.

As soon as cold chambers are full of fish, fishing vessel gathers in a reefer ship in order to carry out high sea transhipment. The operation time of filling reefer ship takes around 2-3 months of continued fishing. Once the reefer is full, it sails to Las Palmas port to discharge the goods in a cold-store (the discharge procedure is very complicated and it is not the objective of this Master Thesis to define it). The discharged products, after passing documental and empirical inspections carried out by the Spanish Custom Agency and the Agriculture and Fisheries Ministry (MAGRAMA) to verify that all has been done according to requirements for fishery and health policies of European Union, is stored in a customs warehouse pending of EU import customs clearance. When a parcel is sold and consequently imported to any European Union company, a trade contract is signed between the buyer and the seller.

On the other hand, in order to obtain information about sizes composition of captured species, the fishing books (Shanghai Fisheries University, 2000), where detailed description of the specie and their commercial sizes is recorded, have been consulted. The main problem to define sizes is the upper and lower limits that are not supplied in some cases. Some caught species were not considered in this study due to the fact that the size categories were not given divided enough to be pertinent. Species with low relevance in their contribution to captures were not also considered.

The commercial product Sepiola has been non-considered in this study because the species composition of this commercial mark is not clear enough. On the other hand, the Sepiola clases: MIX, MIX 1 and MIX 2 are high range size classifications that do not provide any relevant information.

Table 4: Commercial products refused to be included in the study and size categories.

GROUP OF SPECIES	HOMOGENEOUS NAME	SCIENTIFIC NAME	HOMOGENEOUS SIZE
Cephalopods	SEPIOLA	Sepia spp	MIX, MIX1, MIX2
Decapoda	CANGREJO	Portunus validus	C
	LANGOSTA	Panulirus regius	MIX
	YUMBO	Penaeus monodon	GG1, GG2
Elasmobranchii	CANE	Rhizoprionodon acutus	G, M, P, MIX
	CAZON	Mustelus mustelus	G, M, P, MIX
Perciformes	ABAE	Epinephelus costae	G, P, MIX
	BOBO	Pseudotolithus elongatus	2P, 3P, M, MIX, P
	MAQUEREAU	Scomberomorus spp	G, M, P
	OMBRINE	Pseudotolithus spp	2P, M, G TG, S/C
	SABLE	Trichiurus lepturus	G, M, P
Tetraodontiformes	UMA	Aluterus spp	S/C
Pleuronectiformes	LENGUA	Cynoglossus spp	K, K1
	SOLE TURBO	Psettodes belcheri	S/C
	SOYA	Solea lascaris	G, M, P, MIX

Portunus validus, *Panulirus regius*, and *Penaeus monodon* were neither taken into account due to the lack of well-defined sizes clases.

Among scale fish, only *Epinephelus aeneus* will be analyzed because the other fish species (Table 4) have a limited presence in landings and/or they are not properly size-divided.

Also, into the flatfish, *Solea solea* and *Dicologlossa exophtalma* have been selected according to their relevance in landings and its sizes categorization, on the contrary, *Cynoglossus spp*, *Psettodes belcheri* and *Solea lascaris* (Table 4) has been rejected due the poor contribution in landing and/or a non-relevant size categorization.

In summary, among all captured species, eight species will be analysed in terms of size-price distribution (Table 5).

Table 5: List of species to be analysed.

GROUP OF SPECIES	HOMOGENEOUS NAME	SCIENTIFIC NAME
Cephalopod	**PULPO**	**Octopus vulgaris**
Cephalopod	**SEPIA**	**Sepia officinalis**
Decapoda	**LANGOSTINO BLANCO**	**Penaeus notialis**
Decapoda	**LANGOSTINO TIGRE**	**Penaeus kerathurus**
Perciformes	**CHERNE**	**Epinephelus aeneus**
Pleuronectiformes	**LENGUADO**	**Solea solea**
Pleuronectiformes	**SEIS MONEDA**	**Dicologlossa hexophthalma**

(C) BIOLOGICAL DATA

In order to assess the impact of the fishing effort on the recruitment, some ranges of maturity of considered species, have been integrated in the study. It is also relevant to bear on mind that, as the fishermen do not distinguish neither discriminate between male nor female, all maturity data have been treated together. On the other hand it is important to warn that not always the maturity length is referred as LC_{50} but as minimum maturity length or simply maturity range. For excluding misunderstanding, it will differentiate LC_{50} from maturity range when available.

It is necessary to be aware that minimum commercial sizes cannot be considered as length at first capture. This information is no available for this fishery.

Besides, since cephalopods are sized by weight, with the purpose to set all studied species under a homogeneous measure, length-weight relationship has been consulted to transform weight-based classifications into length.

Penaeus notialis:

Among consulted bibliography, all estimations of length of first maturity (LC_{50}) have been found in terms of cephalothorax length.

Lengths of first maturity data associated to cephalothorax are listed on table 6. Total lengths have been included according to the cephalothorax total length relationship for *Penaeus notialis* (Garcia et al.,1970).

Table 6: maturity length (Lc_{50}) of cephalothorax and total length of *Penaeus notialis*

AREA OF STUDY	SEX	LC_{50} (CM) Cephalothorax Length	LC_{50} (CM) Total Length	REFERENCE
Senegal	N/A	2.5	~5	Lhomme & García, 1984
Senegal	N/A	2.8	~5.6	Lhomme & García, 1984
Ivory Coast	N/A	3	~6	Troadec, & García, 1980
Senegal	N/A	2.7	~5.4	Troadec, & García, 1980
Ivory Coast	N/A	3.1	~6.2	García, 1977
Mauritania	MALE	1.8	~3.6	CECAF, 2007
Mauritania	FEMALE	4.6	~9.2	CECAF, 2007

Penaeus kerathurus:

In the case of Penaeaus kerathurus, unlike *P. notiali*s, it has not been widely studied. For this specie, maturation measures range between LC_{50} at 9 cm for males and at 12.2 cm for females (Rodríguez, 1985). These data define maturation of the gulf of Cádiz stock.

Octopus vulgaris:

In order to figure out an approximation to the spawning length of the specie, the maturity data selected for this study have been chosen in base of the proximity to the fishing stock.

Table 7: maturity mantle length: LC_{50} of *Octopus vulgaris*

AREA OF STUDY	SEX	LC_{50} MANTLE LENGTH (CM)	REFERENCE
Canary Islands	Male	10.5	Hernández et al. 2002
Canary Islands	Female	11.3	Hernández et al. 2002
Dakhla (Morocco)	Male	6.6	CECAF 2007
Dakhla (Morocco)	Female	12.6	CECAF 2007
Cap Blanc (Mauritania)	Male	7	CECAF 2007
Cap Blanc (Mauritania)	Female	11	CECAF 2007

As size classes supplied by the fishing company for octopus are established in base of weights of individuals, and nature date are supplied in the bibliography in mantle length (Table 7), a length-weight relationship has been used to convert weight into mantle length (Otero et al., 2007) has been used as follow:

$$Mantle\ Length(cm) = \frac{\left(\sqrt[2.51256]{\frac{Weight\ female(gr)}{0.924694}}\right) + \left(\sqrt[2.5337]{\frac{Weight\ male\ (gr)}{1.10295}}\right)}{2}$$

Equation 1

The weight-length relationship used for this study differentiates between males and females. So given that the sexuality of the species is not taking into account on the sorting procedure of fishing and not any commercial information is related to the sex of the product, a mean of both has been calculated for the length-weight conversion (Equation 1).

Sepia officinalis

According to the proximity to the studied area total of 5 maturity data have been gathered for the study in order to approximate the maturity range.

Table 8: maturity mantle length: LC_{50} and length at first maturity of *Sepia officinalis.*

AREA OF STUDY	SEX	LC_{50} MANTLE LENGTH (CM)	REFERENCE
Canary Island	Female	14	Almonacid, 2006
Canary Island	Male	14.8	Almonacid, 2006
West Sahara	Female	13.5	Roper et al., 1984
West Sahara	Male	12	Roper et al., 1984
West Sahara	Male	14	Roper et al., 1984

For *Sepia officinalis*, a mantle length-weight relationship (Almonacid, 2006) was also necessary to convert the commercial weight into mantle length in order to contrast published $LC_{50\ \text{based}}$ on mantle length (Table 8).

$$Mantle\ Length(cm) = \sqrt[2.6308]{\frac{Weight\ \ (gr)}{0.2871}}$$

Equation 2

Epinephelus aeneus, Solea solea, Dicologlossa hexophthalma

For finfish species, the information of maturity length was obtained from www.fishbase.org. Given that on this web there is not any LC_{50} reference and all data available were referred as maturity length, we will not report that figures as LC_{50} but as maturity length.

Epinephelus aeneus: range from 40 cm (Levenez, 1993) to 60 cm (Heemstra & Randall, 1993) with data referred to Senegal as nearest.

Solea solea; not any relevant data found. LC_{50} are referred to North Atlantic water and are not considered as relevant. However, assuming that colder water usually implies bigger individuals, and in base a North Atlantic data, a non-contrasted estimation of LC_{50} could set it at around 20 cm length.

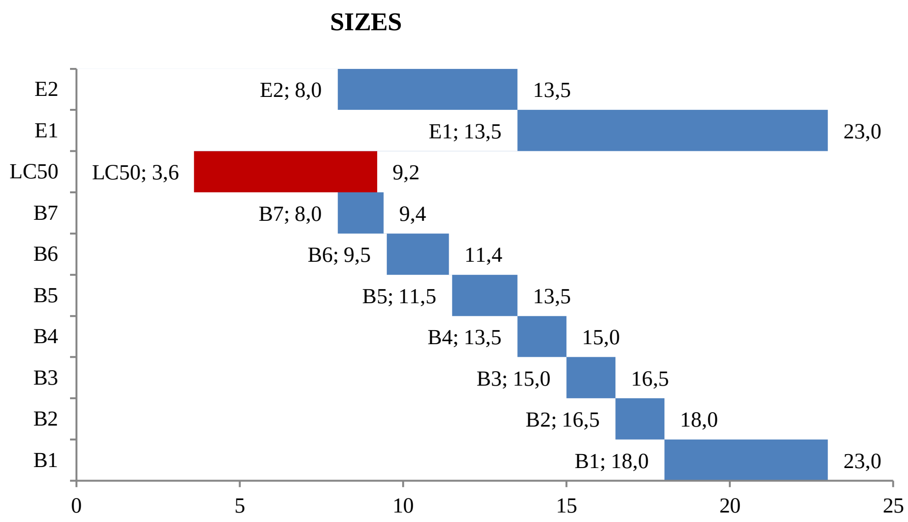
Dicologlossa hexophthalma: not any data found.

RESULTS

Species Size distributions

Penaeus notialis:

The fishing company has established a bunch of shrimp body length in base of commercial criteria. White Shrimp (*Penaeus notialis*) (Fig. 4), has been categorized into 9 length classes. In base of the same guidebook that fishermen use for sorting fish on board according to size, the length range in centimetres per individual is deduced.



	B1	B2	B3	B4	B5	B6	B7	LC50	E1	E2
.PIECE LENGTH FROM (cm)	18	16,5	15	13,5	11,5	9,5	8	3,6	13,5	8
.PIECE LENGTH UNTIL (cm)	23	18	16,5	15	13,5	11,4	9,4	9,2	23	13,5

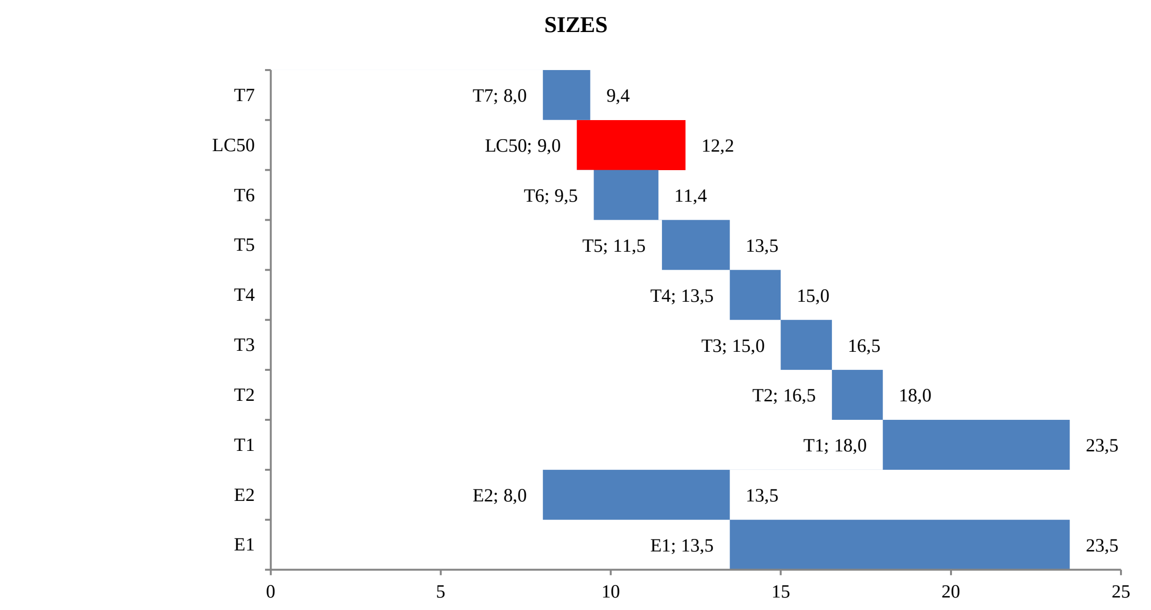
Figure 4: commercial size distribution of *Penaeus notialis* and maturity range (LC_{50}).

In the case of *Penaeus notialis*, there are 7 commercial sizes (B7 to B1) progressively ordered and also 2 wide range sizes (E1 and E2). E2 encompass B7, B6 and B5 length sizes and E1 correspond with B4, B3, B2 and B1 length sizes. This responds to the operational procedure of sorting in every tow. Once capture is properly sorted, there are prawns left that, being a little amount that cannot fill one single carton of a size, this is classified as mixed wide range sizes E2 and E1. This sorting process means that E1 and E2 are the products with worst treatment (late to be frozen and longer time on deck). This situation is reflected in the downgrade of the quality and consequently in the price of E1 and E2 categories. According to this commercial length range classification and maturity range assigned to the species, it is possible to determine the proportion of immature individuals in the capture.

Given that every size class is defined by a unitary price that encompasses all the individual dimensions into a single length range, the mean size will be used to define every length class (Table 11).

Penaeus kerathurus

This species possess the same commercial size distribution that *Penaeus notialis* as shown on figure 5 and table 11. The range of maturity has been also included.



	E1	E2	T1	T2	T3	T4	T5	T6	LC50	T7
.PIECE LENGTH FROM (cm)	13,5	8	18	16,5	15	13,5	11,5	9,5	9	8
.PIECE LENGTH UNTIL (cm)	23,5	13,5	23,5	18	16,5	15	13,5	11,4	12,2	9,4

Figure 5: commercial size distributions of *Penaeus kerathurus* and maturity range (LC_{50}).

Octopus vulgaris:

Due to the fact that the company classifies the octopus caught attending to their weight, to convert it to the length classes it was necessary to apply length-weight relationships described previously (Equation 1) (Table 9).

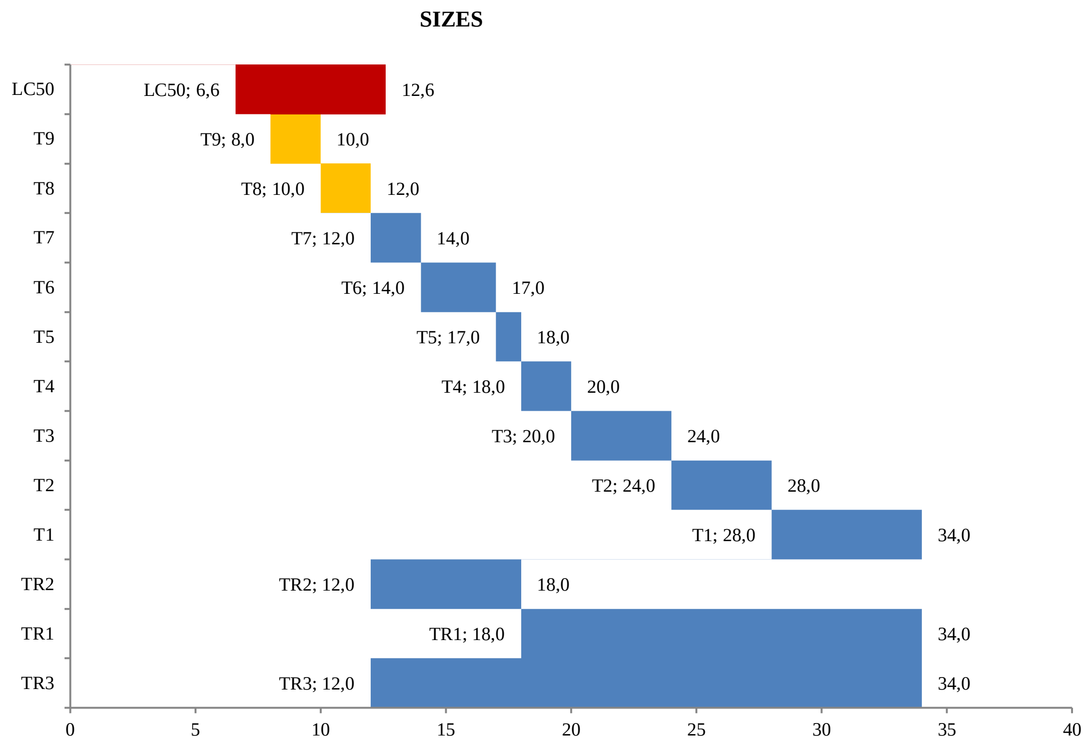
Table 9: Length categories of *Octopus vulgaris* obtained after weight conversion using equation 1.

SCIENTIFIC NAME	SIZE	(g.)/piece FROM	PIECE LENGTH FROM (cm)	(g.)/piece UNTIL	PIECE LENGTH UNTIL (cm)	-MEAN LENGHT cm-
Octopus vulgaris	T1	4500	28	7500	34	31
Octopus vulgaris	T2	3000	24	4500	28	26
Octopus vulgaris	T3	2000	20	3000	24	22
Octopus vulgaris	T4	1500	18	2000	20	19
Octopus vulgaris	T5	1200	17	1500	18	17,5
Octopus vulgaris	T6	800	14	1200	17	15,5
Octopus vulgaris	T7	500	12	800	14	13
Octopus vulgaris	TR1	1500	18	7500	34	26
Octopus vulgaris	TR2	500	12	1500	18	15
Octopus vulgaris	TR3	500	12	7500	34	23

Octopus vulgaris capture is divided into 12 commercial sizes classes (Fig. 6). There are no data for classes T8 and T9 since the capture of individuals of these sizes is forbidden by the EC Council Regulation No 1936/2005 that amend EC Regulation No 27/2005 that establish 450g as the minimal weight for octopus to be landed or commercialized in European countries and also fished into CECAF fishing area.

So, length categories TR1, TR2 and TR3 have not been considered for the study due to the fact that those include the lower quality part of the capture. Those wide range sizes include the lower quality part of the capture. The TR category is the abbreviation of *"Tako Roto" and* means that the Octopus pieces are damaged with individuals that have missed one or more legs and therefore receive a lower price indication that cannot be compared with the regular octopus.

According to data supplied previously, the maturity range has been included to be compared with commercial sizes classes.



	TR3	TR1	TR2	T1	T2	T3	T4	T5	T6	T7	T8	T9	LC50
.PIECE LENGTH FROM (cm)	12	18	12	28	24	20	18	17	14	12	10	8	6,6
.PIECE LENGTH UNTIL (cm)	34	34	18	34	28	24	20	18	17	14	12	10	12,6

Figure 6: commercial size distribution of *Octopus vulgaris* and maturity ranges (LC50).

Given that every size class is defined by a unitary price that cover all the individuals into the same length range, the mean length of the category has been used to define every length class (Table 11).

Sepia officinalis.

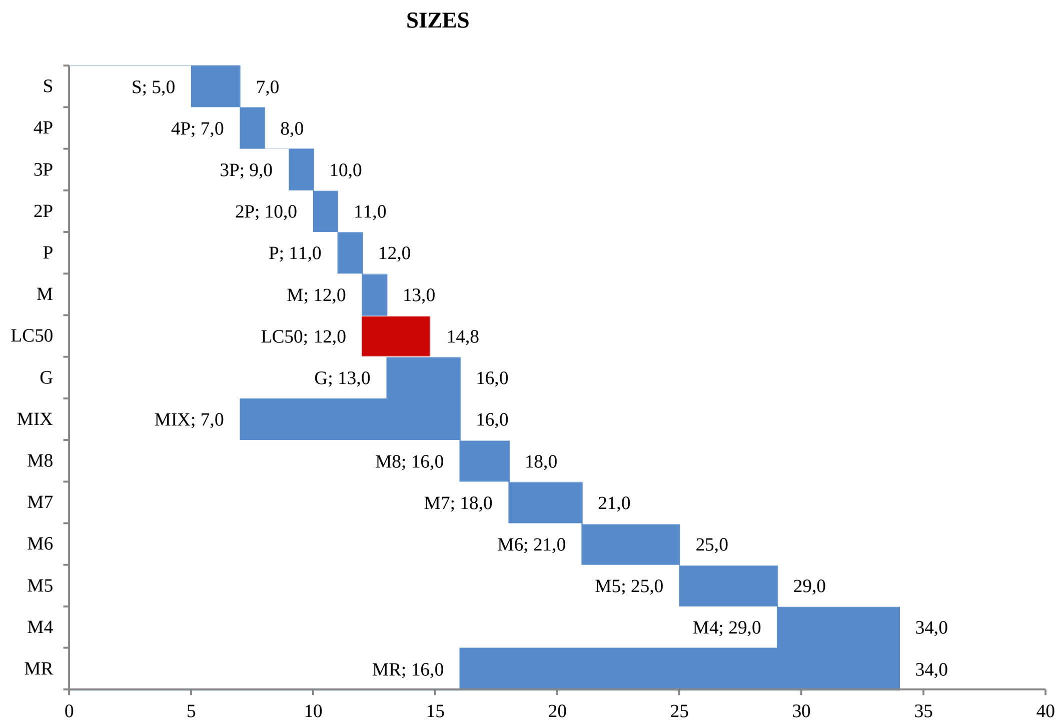
Captures of this species is the most categorized into length classes by the Fishing Company. There are 14 weight classes that were transformed into length ones (Table 10) according to the means obtained from two length-weight relationships shown in previous section (Equation 2).

Table 10: Length categories of *Sepia officinalis* obtained after weight conversion using equation 2.

SCIENTIFIC NAME	SIZE	(g.)/piece FROM	PIECE LENGTH FROM (cm)	(g.)/piece UNTIL	PIECE LENGTH UNTIL (cm)	-MEAN LENGHT cm-
Sepia officinalis	2P	114	10	158	11	**10,5**
Sepia officinalis	3P	81	9	113	10	**9,5**
Sepia officinalis	G	250	13	400	16	**14,5**
Sepia officinalis	M	191	12	250	13	**12,5**
Sepia officinalis	M4	2000	29	3000	34	**31,5**
Sepia officinalis	M5	1300	25	2000	29	**27**
Sepia officinalis	M6	900	21	1300	25	**23**
Sepia officinalis	M7	600	18	900	21	**19,5**
Sepia officinalis	M8	400	16	600	18	**17**
Sepia officinalis	MIX	50	7	400	16	**11,5**
Sepia officinalis	MR	400	16	3000	34	**25**
Sepia officinalis	P	159	11	190	12	**11,5**
Sepia officinalis	S	24	5	50	7	**6**

Given that every size class is defined by a unitary price that include all the individual dimensions into a single length range, the mean size will be used to define every length class (Table 11).

According to data supplied previously, the maturity range has been included to be compared with commercial sizes classes.



	MR	M4	M5	M6	M7	M8	MIX	G	LC50	M	P	2P	3P	4P	S
.PIECE LENGTH FROM (cm)	16	29	25	21	18	16	7	13	12	12	11	10	9	7	5
.PIECE LENGTH UNTIL (cm)	34	34	29	25	21	18	16	16	14,8	13	12	11	10	8	7

Figure 7: commercial size distribution of *Sepia officinalis* and maturity ranges (LC_{50}).

This species is most divide one. This is because the specie is split into two commercial names that respond to different commercial dynamics. The sizes from S to G are defined by seven size classes and one mix. This range of small sizes is gathered under the name of “Choco” and the larger sizes, from M8 to M4 (five classes), are embraced under the name of “Mongo”. This detail will be important to understand the behavior of commercial aspects of this specie.

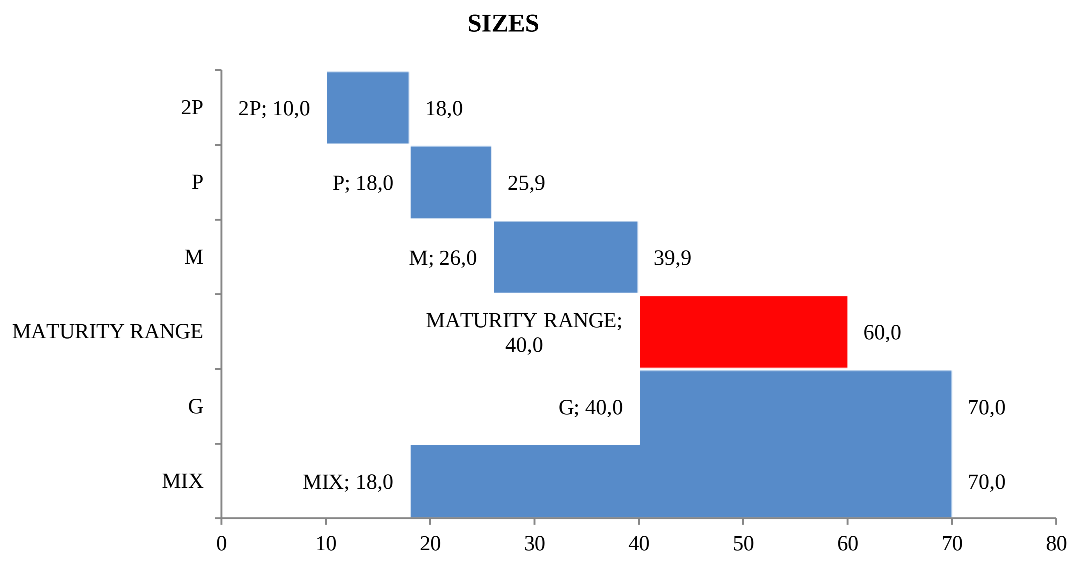
Epinephelus aeneus, Solea solea and Dicologlossa hexophthalma

Finfish species considered possess a less complicated length distribution. They normally are sorted in 3 or four categories plus a mix one that includes all or almost all the sizes.

Epinephelus aeneus is divided into 4 length classes and one of them is a mix of individual from length P to G (Fig. 8)

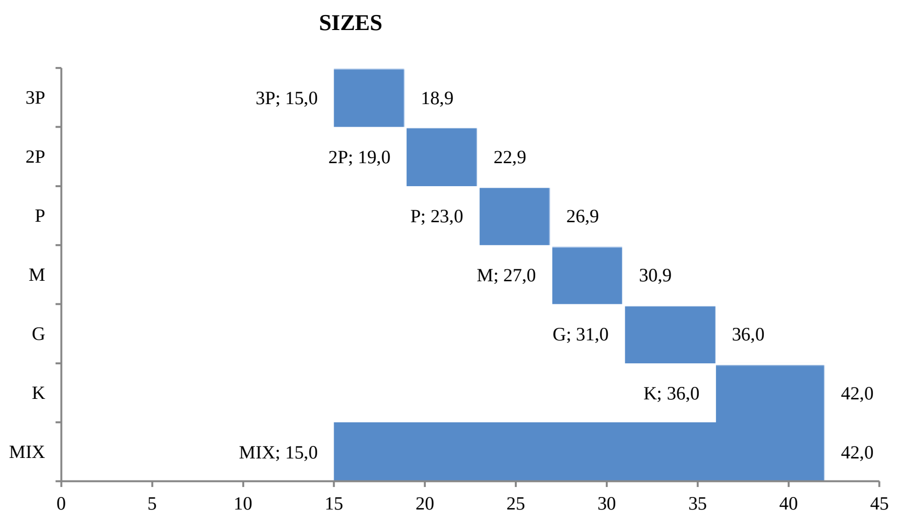
Solea solea: length classes categories are shown in figure 9. The length classes are the same than those used for *Epinephelus*.

Dicologlossa hexophthalma is divided into 4 classes, one of which is a mix of two of them (Fig. 10). See that there is no maturity range for this specie.



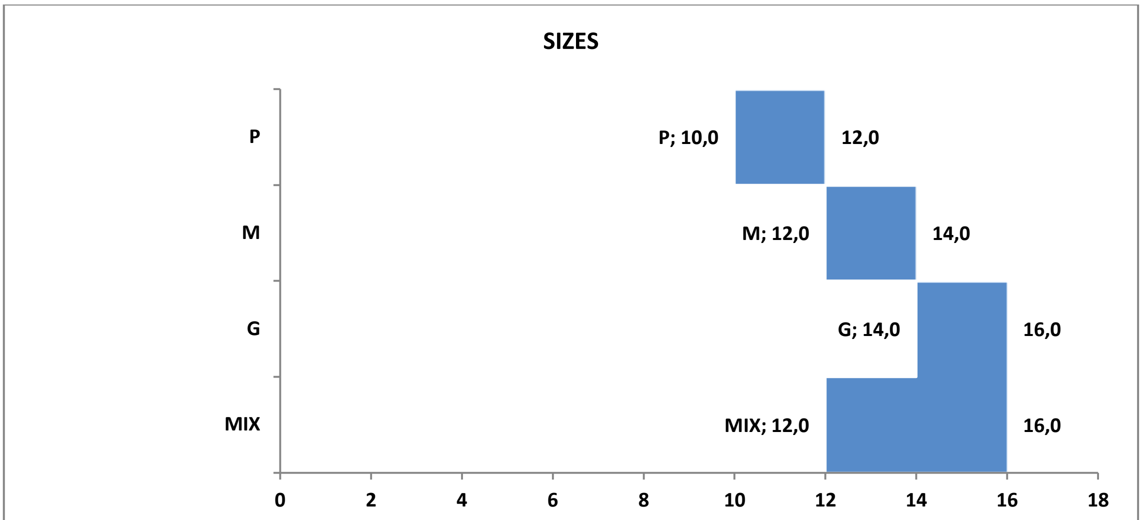
	MIX	G	MATURITY RANGE	M	P	2P
.PIECE LENGTH FROM (cm)	18	40	40	26	18	10
.PIECE LENGTH UNTIL (cm)	70	70	60	39,9	25,9	18

Figure 8: commercial size distribution of *Epinephelus aeneus* and its maturity range.



	MIX	K	G	M	P	2P	3P
.PIECE LENGTH FROM (cm)	15	36	31	27	23	19	15
.PIECE LENGTH UNTIL (cm)	42	42	36	30,9	26,9	22,9	18,9

Figure 9: commercial size distribution of *Solea solea*.



	MIX	G	M	P
.PIECE LENGTH FROM (cm)	12	14	12	10
.PIECE LENGTH UNTIL (cm)	16	16	14	12

Figure 10: commercial size distribution of *Dicologlossa hexophthalma.*

Table 11: List studied species with mean length (cm).

COMMERCIAL NAME	SCIENTIFIC NAME	COMMERCIAL SIZE	MEAN LENGTH (CM)
LANGOSTINO BLANCO	Penaeus notialis	B1	20,5
		B2	17,25
		B3	15,75
		B4	14,25
		B5	12,5
		B6	10,45
		B7	8,7
		E1	18,25
		E2	10,75
LANGOSTINO TIGRE	Penaeus kerathurus	E1	18,5
		E2	10,75
		T1	20,75
		T2	17,25
		T3	15,75
		T4	14,25
		T5	12,5
		T6	10,45
		T7	8,7
PULPO	Octopus vulgaris	T1	31
		T2	26
		T3	22
		T4	19
		T5	17,5
		T6	15,5
		T7	13
		TR1	26
		TR2	15
		TR3	23

COMMERCIAL NAME	SCIENTIFIC NAME	COMMERCIAL SIZE	MEAN LENGTH (CM)
SEPIA	Sepia officinalis	2P	10
		3P	8,5
		G	14,5
		M	12,5
		M4	33
		M5	27,5
		M6	23,5
		M7	20,5
		M8	17,5
		MIX	11,5
		MR	26
		P	11,5
		S	6
CHERNE	Epinephelus aeneus	2P	14
		G	77,5
		M	32,95
		MIX	66,5
		P	21,95
LENGUADO	Solea solea	2P	20,95
		3P	16,95
		M	28,95
		MIX	37,5
		P	24,95
SEIS MONEDA	Dicologlossa hexophthalma	G	15
		M	13
		MIX	14
		P	11

Length-price relationships

As described in the previous section, for all species, commercial categories that include a large range of lengths, has been excluded of the regressive analysis.

As a result of fitting prices in €/kg and mean length in centimetres of the commercial sizes regarded to the analysed species, a bounce of linear regression were calculated (Table 12). "N" represents the number of sales that have been gathered for every analysed species. Correlation coefficients are acceptable for the Choco (smallest sizes of the *Sepia officinalis*), *Penaeus notialis, Penaeus kerathurus* and *Epinephelus aeneus.* For the rest of the species the R^2 are not so good. At any case, the objective of the fitting is not to predict the exact price at a given length but to observe the linear tendency of the price along with the length. In fact, the lower rates of correlation coefficient respond more to a seasonal distribution of the sales of different products, or to a variation in the price based on the punctual offer of determined specie in a determined time, than a discrepancy between intra-specie size class prices.

Table 12: linear regressions length/Price. *As Mongo (larger sizes of specie) has negative slope, *Sepia officinalis* (Choco+Mongo) has been fitted as a polinomic curve.

COMMERCIAL NAME	SPECIE	LINEAR REGRESSION	R^2	N
Choco	*Sepia offinalis*	y = 0,2066x + 1,4751	0,6429	63
Mongo	*Sepia offinalis*	y = -0,0463x + 4,6529	0,074	180
Choco+Mongo	*Sepia offinalis*	y = -0,0058x2 + 0,2008x + 2,11*	0,141	243
Pulpo	*Octopus vulgaris*	y = 0,1445x + 3,422	0,1499	373
Langostino Blanco	*Penaeus notialis*	y = 0,7673x - 5,2811	0,8264	221
Langostino Tigre	*Penaeus kerathurus*	y = 0,9749x - 6,4322	0,8191	187
Cherne	*Epinephelus aeneus*	y = 0,0488x + 0,3814	0,8173	71
Seis Moneda	*Dicologlossa hexophthalma*	y = 0,0331x + 1,6055	0,0026	112
Lenguado	*Solea solea*	y = 0,1157x + 0,1948	0,1837	68

Of all the studied species, only the biggest sizes of *Sepia offcinalis* (Mongo) have a negative slope that means that the price decreases along with the increasing of the length. As the smallest sizes of *Sepia officinalis* (Choco) do experiment a positive slope, it has been included a polynomial curve that include both Choco and Mongo for describing the entire specie size classes in one single equation.

The “a” parameter, it is the number that multiply the “x” in all the linear regressions, represents the contribution in €/kg of a centimetre of increasing in the individuals that are sold. For instance, every centimetre of Penaeus kerathurus imply an increase of 0.97 euros per kilogram.

All the regressions are plotted and exposed below. Observing the figures 11 to 17, the slopes of the regressions can be graphically seen.

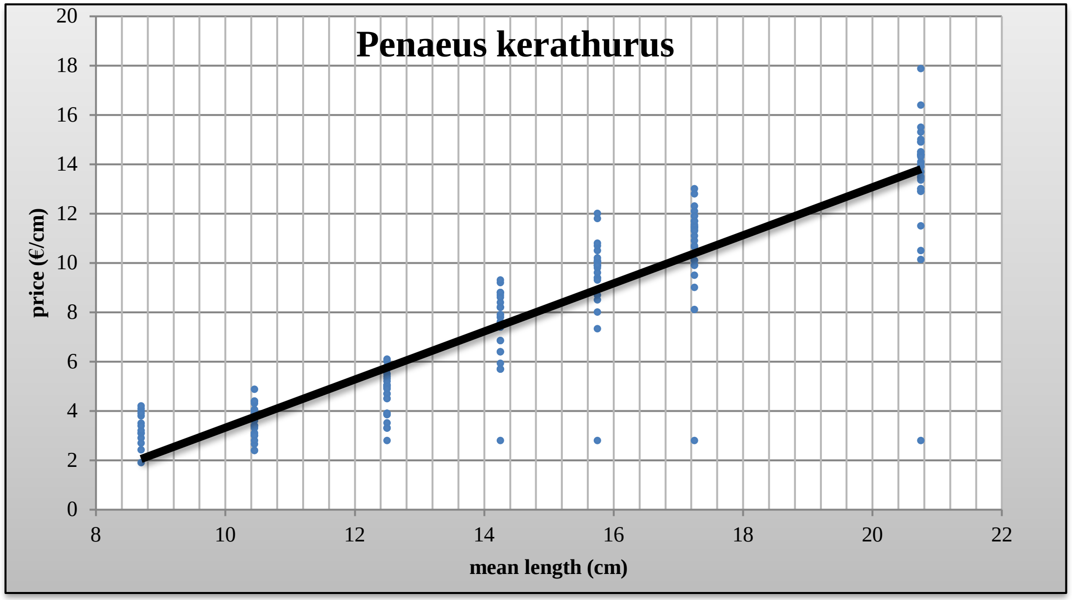


Figure 11: Regression Price/ mean length. *Penaeus kerathurus*

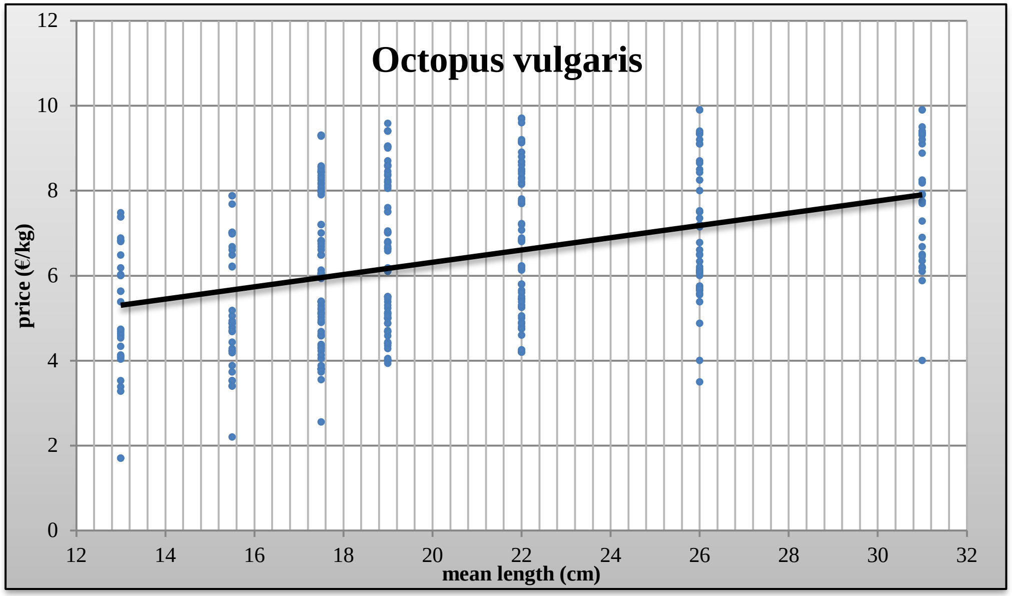


Figure 13: Regression Price/ mean length. *Octopus vulgaris*

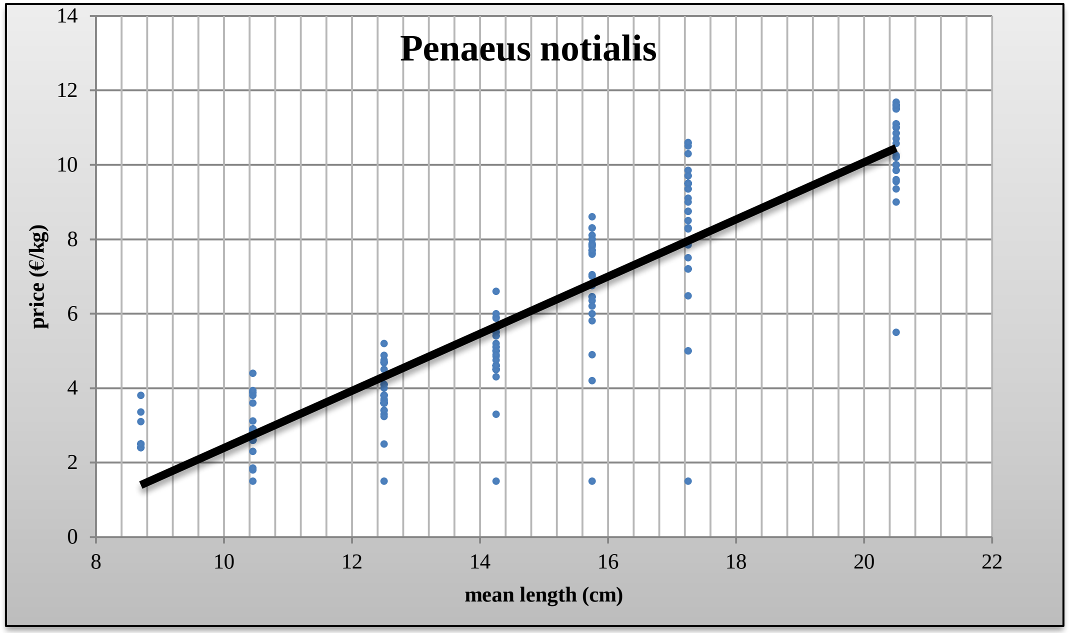


Figure 12: Regression Price/ mean length. *Penaeus notialis*

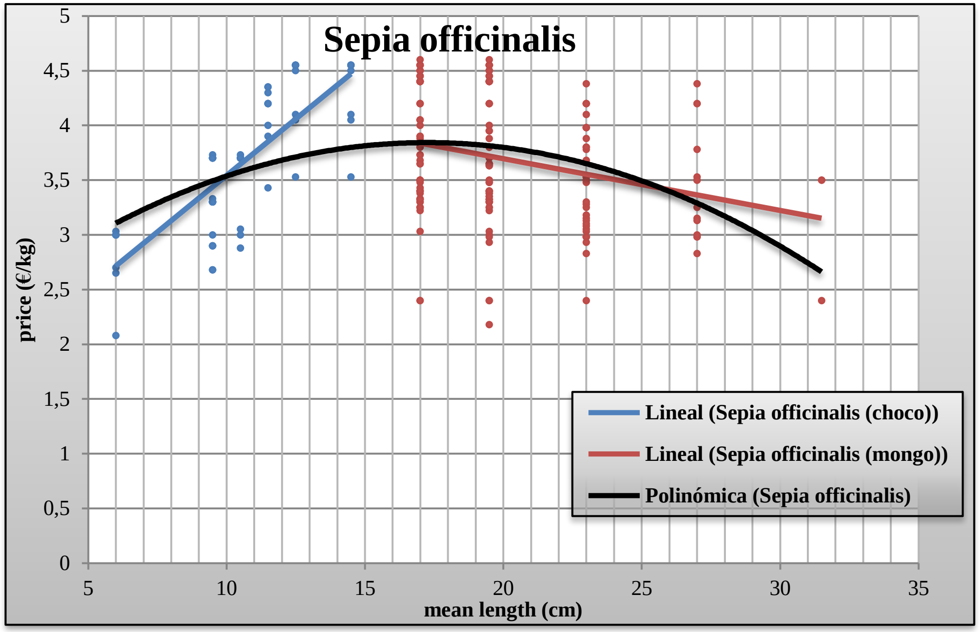


Figure 14; Regression Price/ mean length. *Sepia officinalis*

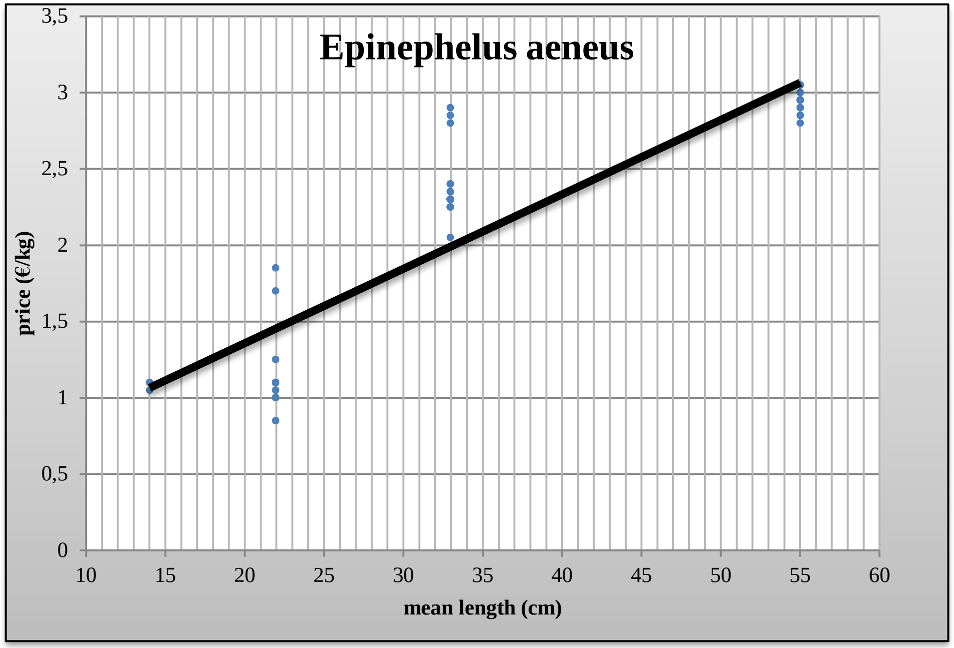


Figure 15: Regression Price/ mean length. *Epinephelus aeneus*

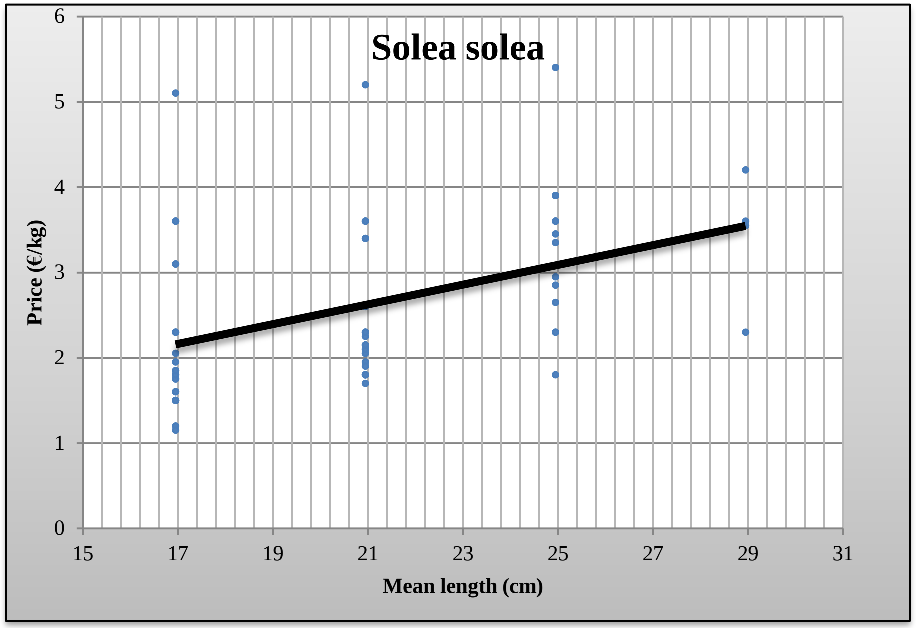


Figure 17: Regression Price/ mean length. *Solea solea*

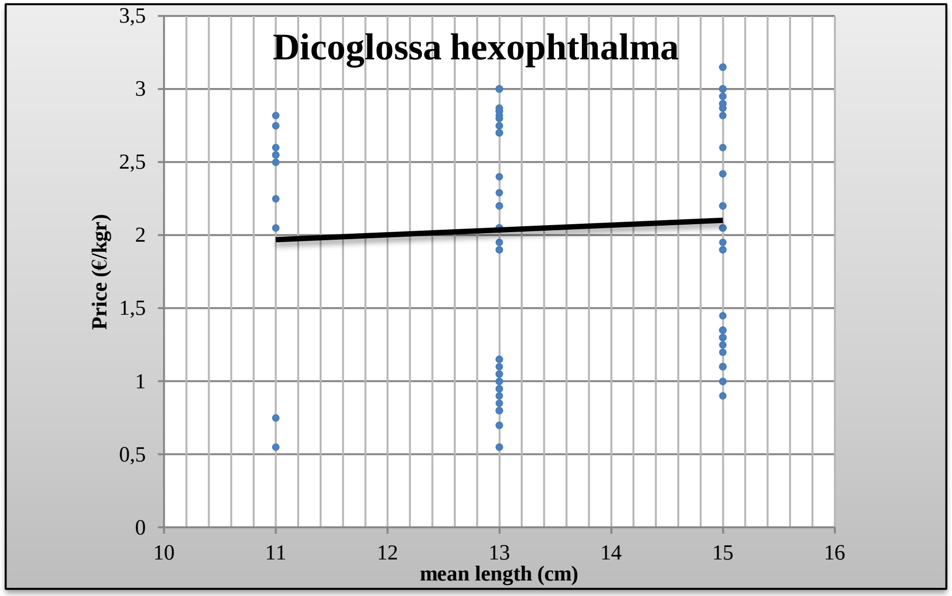


Figure 16: Regression Price/ mean length. *Dicoglossa hiexophthalma*

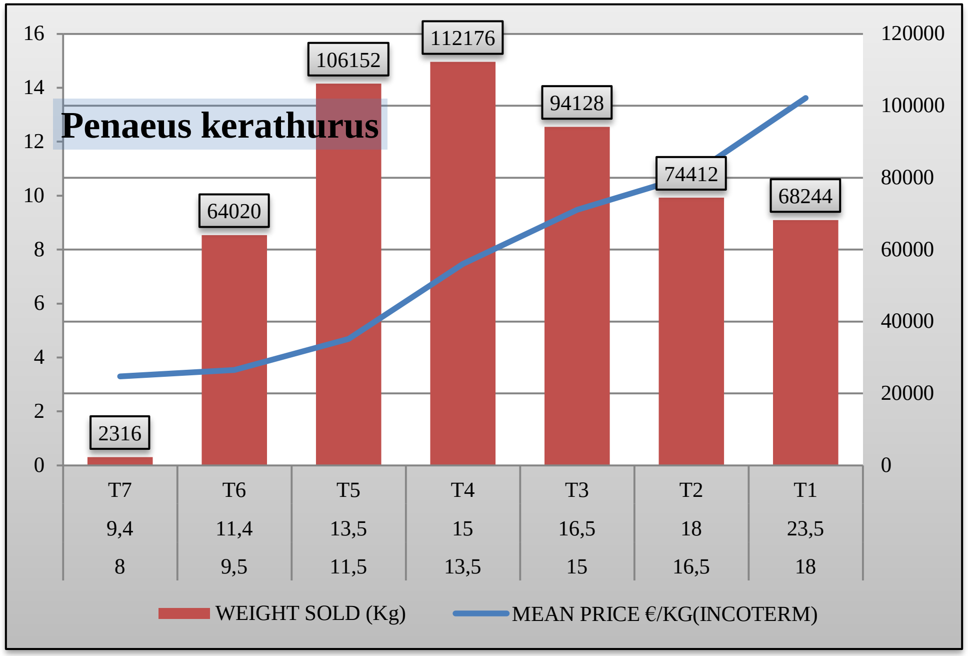


Figure 18: Relationship between weights sold and mean Price for *Penaus kerathurus*.

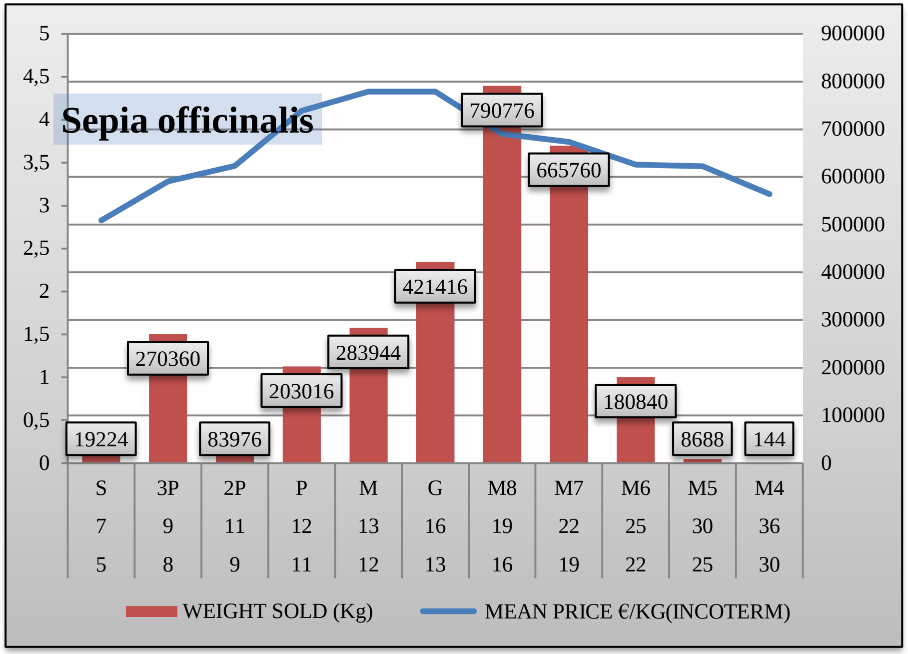


Figure 20: Relationship between weights sold and mean Price for *Sepia officinalis*

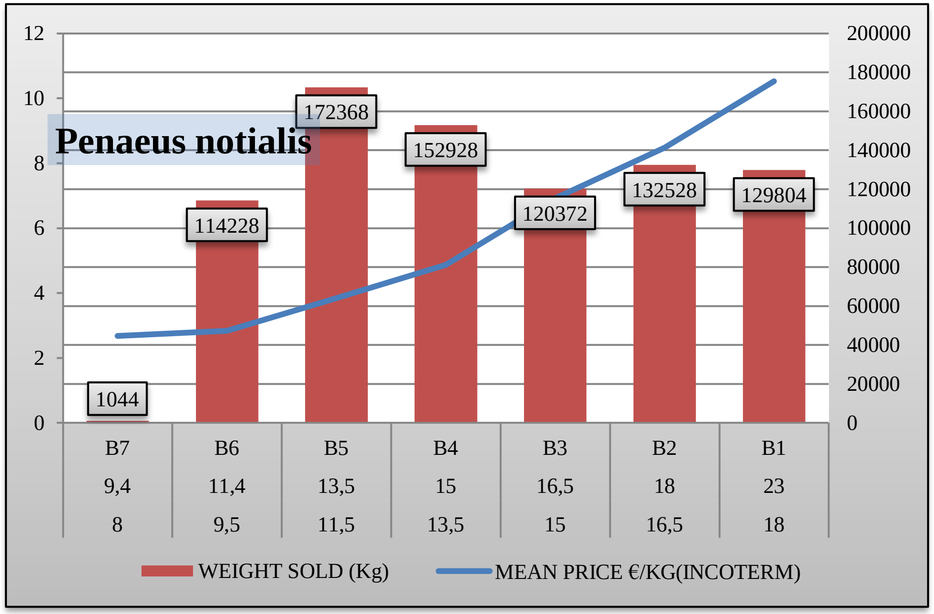


Figure 19: Relationship between weights sold and mean Price for *Penaeus notialis*

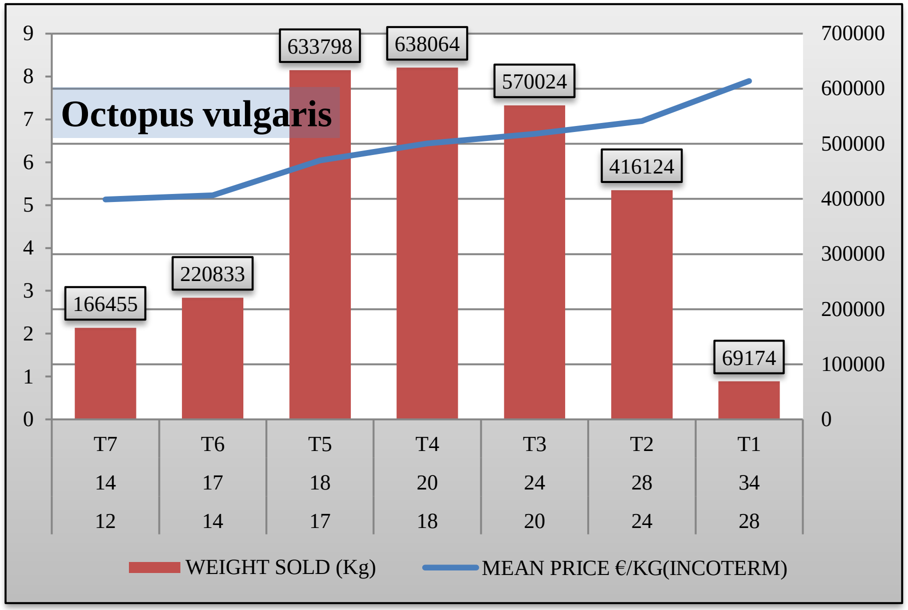


Figure 21: Relationship between weights sold and mean Price for *Octopus vulgaris*.

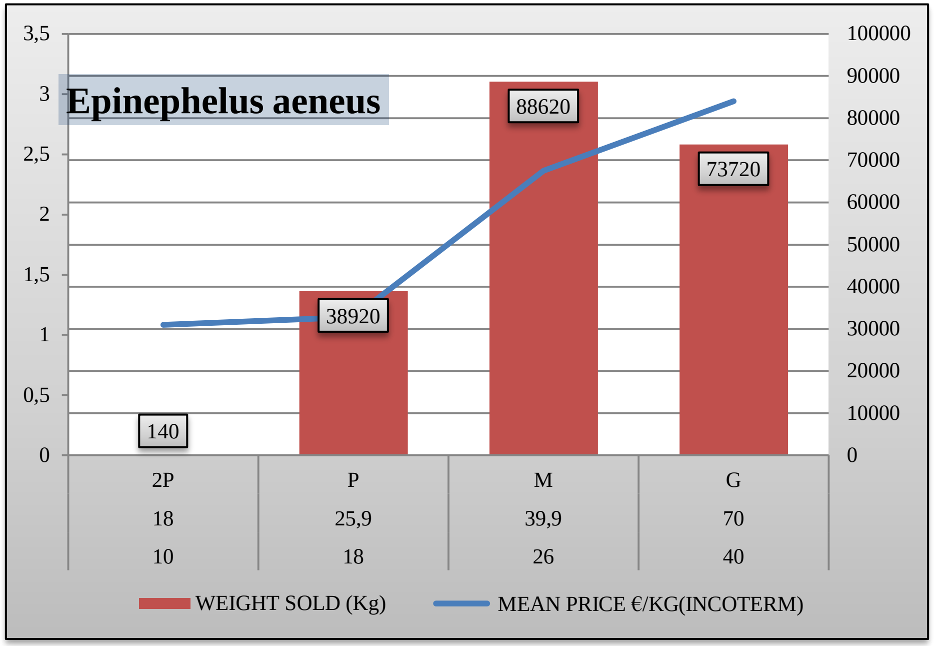


Figure 22: Relationship between weights sold and mean Price for *Epinephelus aeneus*.

Figure 23: Relationship between weights sold and mean Price for *Solea solea*

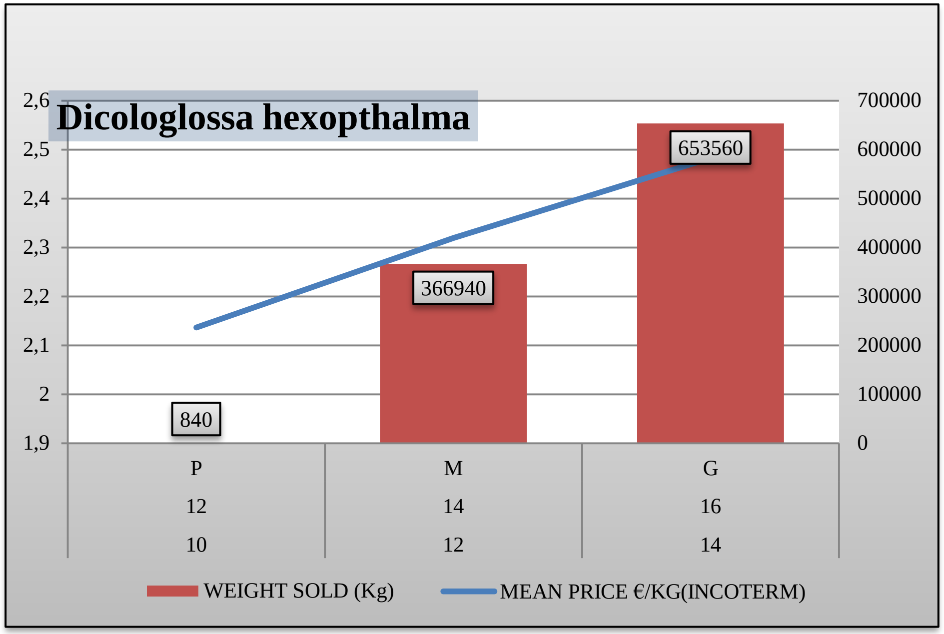


Figure 24: Relationship between weights sold and mean Price for *Dicologlossa hexopthalma.*
Figures 18 to 24: show the fished biomass per size class in kilograms and their respective mean prices. Every size class in the x axis includes the length range in centimeters. Labels over columns indicate the exact amount of fished biomass.

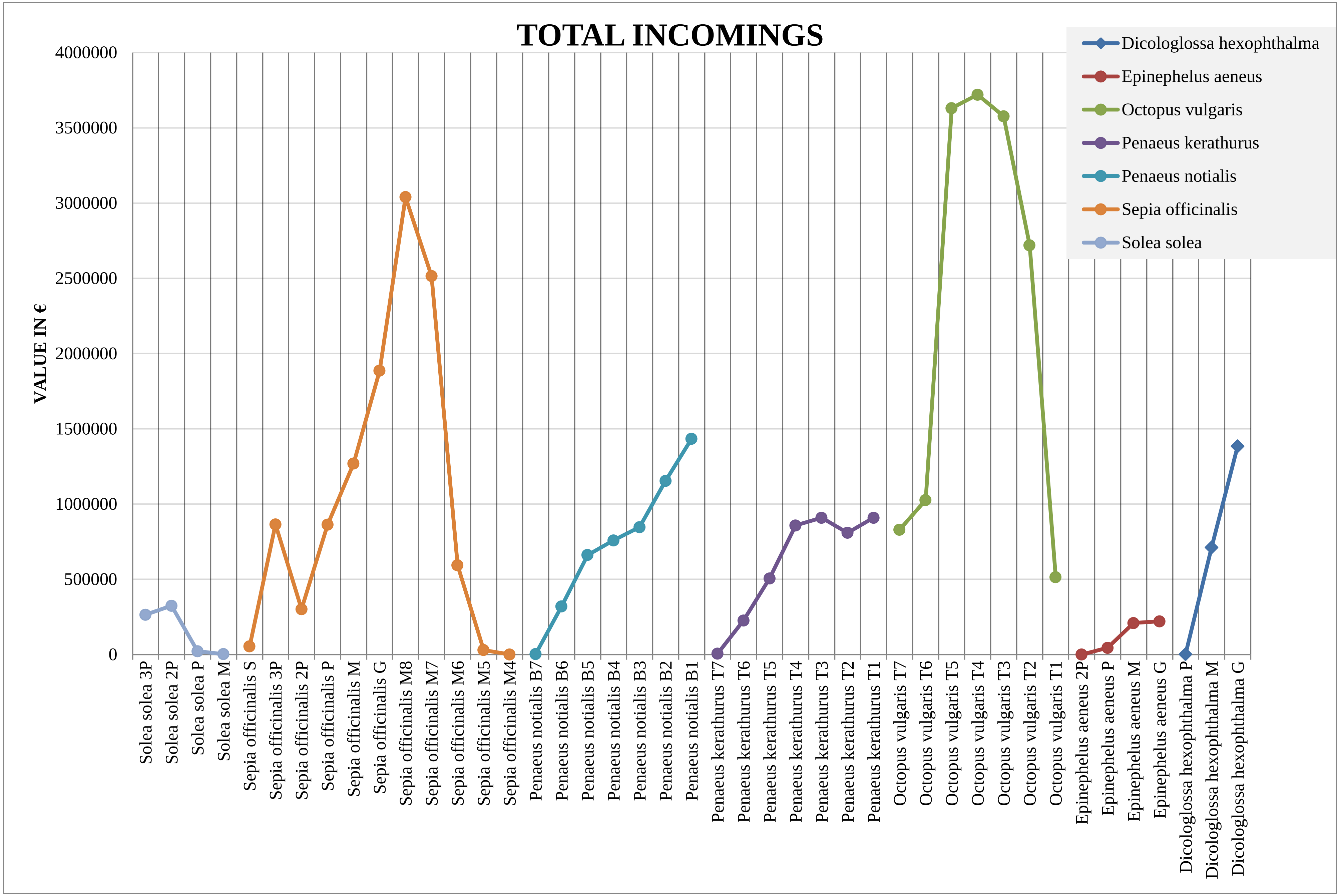


Figure 25: Incomings per species and sizes.

Figures 18 to 24 show a comparison between the biomass fished by size class and their respective mean prices have been calculated. By seeing the resulting graphics, the contribution in price and biomass per size class of every species can be observed. Besides, the total incomings per specie and size along the time of the study (Fig. 25), is valuable information that shows the importance of the sizes in terms of revenues.

Given that all regressions were lineal we can use the parameter "a" as an index of the economic value of the individuals in terms of €/kg per cm of growth.

Table 63: Index of €/kg per centimeter of growing.

COMMERCIAL NAME	SPECIE	Index
Choco	*Sepia offinalis*	0,2066€/kg.cm
Mongo	*Sepia offinalis*	-0,0463€/kg.cm
Pulpo	*Octopus vulgaris*	0,1445€/kg.cm
Langostino Blanco	*Penaeus notialis*	0,7673€/kg.cm
Langostino Tigre	*Penaeus kerathurus*	0,9749€/kg.cm
Cherne	*Epinephelus aeneus*	0,0488€/kg.cm
Seis Moneda	*Dicologlossa hexophthalma*	0,0331€/kg.cm
Lenguado	*Solea solea*	0,1157€/kg.cm

DISCUSSION

According with fact that there is no maturity data available for studied species in the specific studied area, existing maturity estimations of the nearest areas have been contrasted, as ranges of maturity, in comparison with the commercial categories of the fishery (Fig. 4 to 10).

In general, all species are affected by the fishing pressure over that part of the population that have not been already reproduced. However, meanwhile some species maturity lengths set under smallest commercial sizes and consequently permit them the opportunity to breed, there are cases in which the captured size classes set under the length at first maturity length.

As shown in figures 4 and 6, part of the LC_{50} range of *Penaeus notialis* and *Octopus vulgaris* is under the minimum commercial size class. This implies that the fishery might not be generating impact over the non-reproduced individual of these species. This circumstance can be considered as a positive factor in order to preserve the health of the stock that deals with the fact that even extracting an important amount of biomass, at least a reproductive part of the population will be present.

In the case of *Penaeus notialis*, in accordance with data supplied by CECAF (CECAF 2007), the LC_{50} of females is around 9.2cm and 3.6cm for males (Table 6). The maturity length of females is almost 3 times bigger than males is. This entails that although there is a wide range of first maturity lengths under the smallest commercial size (B7), the female LC_{50} is set into B7 size and this might be treated as an important figure.

Octopus vulgaris females also reach the LC_{50} at bigger sizes than males (Fig. 6). For this specie it is necessary to be aware that the upper limit of the first maturity range corresponds to females. This detail is important for a potential management strategy. In Fact, European Union Policy (EC Council Regulation No 1936/2005) rejects importing T9 and T8 commercial classes (Fig. 6). This banning practically avoids fishing or at least importing immature individuals.

The first maturity lengths of *Penaeus kerathurus*, *Sepia officinalis* and *Epinepheus aeneus* (Fig. 5, 7 and 8), range between the fishing commercial size categories. Those species, according with the available first maturity figures, are fished before reaching maturation length what implies that an important part of the population does not leave any offspring in its lifetime. This circumstance limits the potential capacity of reaching sustainability.

The *Penaeus kerathurus* first maturity data were found only for Cádiz gulf. Contrasting these data with the commercial size categories, it can be observed that the minimum fished length (8 cm) is under the LC_{50} of this specie which is 12.2 cm for females (Fig. 5). According to this approximation, the *P. kerathurus* is fished with 4.2 cm less than Female LC_{50} and consequently, without reaching the breeding length.

In the case of *Epinephelus aeneus*, found maturity lengths range from 4 to 6 times longer than the smaller fished size. As shown in figure 8, only a part of the biggest commercial class (size G) is over first maturity data. This information reveals that either there is an over estimation in the maturity information or that the market of this product highly impacts on non-reproductive individuals.

Given that the distribution of the commercial classes of the fishery products implies that in general, there are individuals that are fished around reaching the first maturity length, it is interesting to observe the evolution of prices (€/Kg) along individual lengths(cm) and the fished amount in kilograms per sizes class in order to find out the convenience of fishing

The resulting linear regressions (Table 12 and Fig. 11 to 17) and their subsequent indexes (Table 13) are important information in order to determine the potential economic efficiency of a fishery since the economic value of the individual growth can enhance any management strategy based on reducing the fishing pressure over small sizes. This index can be considered as a tool to show the short term benefit of setting a minimum fishing length or to apply selectivity measures in fishing gears. Furthermore, the fished biomass of every size class together with its mean price (Fig. 18 to 24) and the total incoming per species and commercial class (Fig. 25), display valuable information for analysing the fishery in terms of efficiency.

Decapods:

Analysing the resulting indexes, it is significant the increasing on the price per cm for *Penaeus kerathurus* (0,97 €/kg.cm) and *P. notialis* (0,77 €/kg.cm) (Table 13). These values are on the condition of justify a fishing restriction in size, not permitting or reducing captures of individuals under maturity leading to incentive the recruitment.

Within the 31 months of the study the biomass of *P. notialis* and *P. kerathurus* extracted from the sea, takes its lowest price and its lowest capture at the smallest sizes B7, T7 and B6, T6 (Fig. 18 & 19). It is notorious the B7 & T7 amount that is even 110 times lower than the next sizes B6 & T6 respectively. So the amount of both species for the smallest commercial categories (from 8 to 9.4cm) is by far the less representative in the capture composition. Besides, B7/ T7 (Fig. 18 & 19) prices are also the lowest and therefore, the incomings resulting from multiply prices and weight are practically insignificant. So, to eliminate the B7 and T7 categories from the capture composition would not even mean a risk factor for the business. For those species, it would be a good option to invest in let the individuals to grow. The demand on bigger individuals is over the offer which explains the rise of the price. The company revenues are even higher along increasing the size and in consequence there are reasonable arguments in favour of fishing bigger individuals.

Cepalopods:

Among all studied species, there is only an example in which the price decreases along the size of the individual. *Sepia officinalis* is divided into two commercial names the first part is composed of individuals going from 5 to 16 centimetres so called “Choco” and the second part, so called “Mongo”, range between 16 and 36. The Mongo product experiments a decrease of the price in €/kg with the increase of the length and therefore the index is negative (-0.0463€.$kg^{-1}.cm^{-1}$) (Table 13). However, the “Choco” product increase, according with the index, 0.266 € per centimetre. Analysing the prices of the entire specie length range, there is a continuous increment along the length until reaching the 13-16 cm (G class of "Choco") and then the price starts to decrease smoothly from 19 cm (M8"Mongo"class) to 36 cm (M4"Mongo"class). It is also interesting that, in general, the capture also increase with length until reaching the M8 (16-19cm) (Fig. 20). The most captured commercial sized are M8 and M7 by far and this oversupply might be the reason why the price decreases after passing 16-13 (G class of "Choco"). For this specie, the most valuable commercial class in terms of incomings are M8, M7 and G (Fig. 25). However, contrasting the LC_{50} that range between 12 and 14.8 cm, with the revenue chart, a reduction in fishing sizes under first maturity length would be a severe lose and a very complicate commitment to carry on.

In the case of *Octopus vulgaris*, according with the regressive analysis, the price increases 0.14 €/kg per cm of growth (Table 13). The capture composition of this specie is characterised by the main presence of size classes from T5 to T2 (17cm to 28cm) and a low presence in mass of the smallest sizes class T7 and T6 and the biggest class T1 (Fig. 21). Despite the fact that the Octopus market for size T6 and T7 is enough to justify its fishery, there could be reasons based on the increasing price along the size that might validate a reduction in fishing small sizes for commercial purpose. At any case, it is recommendable to keep the banning of importing T8 and T9 into EU. These two size classes coincide with the length at first maturity shown in figure 3 of the specie and lead the fishing to T8 and T9 would turn this portion of the population into a non-efficient resource.

Epinephelus aeneus, Solea solea and Dicologlossa hexophthalma

Not any relevant maturity information has been found for *Solea solea and Dicologlossa hexophthalma* for the area of the study. However, analysing the capture composition along the period of study of this species, we can extract important conclusions. The fishing pressure of *Solea solea* at the smallest sizes, it is from 15 to 22.9 cm, can be producing a lack of biomass in the biggest sizes, from 23 to 30.9 cm (Fig. 23). This population structure could entail severe consequence for a health and sustainable resource. Given the results of this study in which an increasing of 0.12 € per centimetre of growing of this specie, it might be not complicated to set restrictions based on limiting the captures at small sizes.

In the case of *Dicologlossa hexophthalma*, the amount captured is increasing along the size of the fish and the price in € per Kg is 0.03 ever centimetre of growing. This circumstance implies a mayor revenue in biggest sizes as is shown in figure 25. The low relative amount of class P (10 to 12 cm), would easily contribute to a potential reduction in the minimum allowed length.

It is very concerning the case of *Epinephelus aeneus*. The first maturity figures are set in the biggest size class (G size) (Fig. 22) and the main fishing pressure is over length under maturity length. If maturity determinations are right, the disappearance of this specie can be predicted for the fishing area due to the impediments in disappearance. A potential restriction of only fishing G sizes is not reasonable despite an increase of 0.05 €/Kg per cm of growth because even so, the fishing pressure will act over first maturity length individuals.

In general, according with the conclusions of this study in which the resource assessment is focused on the scope of a commercial perspective, there are arguments in favour of the application of management strategies based on the economic interests of the industry.

The Johannesburg Plan of Implementation that resulted from the World Summit on Sustainable Development (Johannesburg, 2002), demands that to achieve sustainable fisheries it is necessary to maintain or restore stocks to levels that can produce the maximum sustainable yield as an urgent basis and where possible not later than 2015. Bearing on mind the pessimistic current perspective of the sustainability of fisheries, it is very improbable that the international organisms, are effectively working to reach the mentioned target.

The current management solutions, although have reach many advances, cannot be considered as successful solutions. For instance, the European Union, in a Report on the Reform of the Common Fisheries Policy (Salavrakos, 2012), remarks that Europe is losing approximately EUR 1.800 million per year in potential income as a result of its failure to manage fisheries sustainably.

Diverse international legislation and management strategies have been developed without reaching the target of sustainability. It is a fact that to reduce the fishing mortality (F), or on the contrary, to increase the recruitment of fishing grounds, are necessary steps toward the goals of the World Summit on Sustainable Development (Johannesburg, 2002) whoever, despite the fact that there have been many management strategies to reach that goal, we cannot say that society are successfully going toward sustainability.

To find the reasons to explain this situation, experts attend to The Tragedy of the Commons, and to the non-capacity to develop management tools that gather solutions for all the stakeholders involved in the problem. The Tragedy of the Commons is concept introduced by Hardin (Hardin, 1968) that concludes that meanwhile resources are exploited as a common property, overexploitation and economic collapse is inevitable.

The reasons why fisheries management tools are complicated to apply are related to the short and middle-term consequences over an important part of the stakeholders. All management strategies aim to modify the established fishing methods with proposals that generally address to reduce the amount of captures. This normally led to the concerns of the industry lobbies that put pressure on government arguing loss of jobs and market. The results of this study can open a door in order to make conservationist, government and industry to share the same targets although those are accomplished under different scopes or interests.

Against this background is a growing awareness and recognition of the economic value of the sustainability of fishing grounds. Meanwhile the Reform on Common Fishery Policy Fisheries is being discussed and voted, the New Economic Foundation (Crilly and Esteban, 2012) released a report so called “No Catch Investment”, that estimates that the 10560 million euros needed to restore stocks, for example to compensate fishermen and maintain vessels, would generate 5100 million euros profit by 2023. Once all stocks were recovered, then the total value of landings would almost triple, providing an annual revenue of 14620 million. Beyond those figures are corrected or not, it is obvious that in general, the MSY target improve the economy through the increase of fishing landing in the long term that permits Europe to decrease third countries import share.

However, despite all those reasonable arguments to advocate to the sustainable fishing, there are not many advances in that direction. The fishery sector lobbies pressure on continue the activity arguing that there is an industry that cannot be stopped so easy without very negative economic consequences affecting the entire society. Therefore, due to its high socio-economic power, it is a very important subject to understand the fishery sector structure in order to find bottom up solutions that can be supported by the Industry.

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