L.N. 354 of 2013

FISHERIES CONSERVATION AND MANAGEMENT ACT (CAP. 425)

Implementation and Enforcement of Certain Fisheries Management Plans Order, 2013

BY VIRTUE of the powers conferred by article 32 of the Fisheries Conservation and Management Act, the Minister for Sustainable Development, the Environment and Climate Change has made the following Order:-

Citation and scope.

1. (1) The title of this Order is the Implementation and Enforcement of Certain Fisheries Management Plans Order, 2013.

(2) The scope of this Order is the implementation and, where applicable, the enforcement of management plans in conformity with the obligations of Malta under Article 19 of the Council Regulation (EC) No 1967/2006 of 21 December 2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea, amending Regulation (EEC) No 2847/93 and repealing Regulation (EC) No 1626/94.

Interpretation.

2. (1) In this Order, unless the context otherwise requires:

Cap. 425.

"the Act" means the Fisheries Management and Conservation Act;

"Director" shall have the same meaning as that assigned to it in the Act;

"management plans" means the management plans as provided under article 3 of this Order;

"the Regulation" means Council Regulation (EC) No 1967/2006 of 21 December 2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea, amending Regulation (EEC) No 2847/93 and repealing Regulation (EC) No 1626/94.

(2) Save as otherwise provided in this Order, the definitions provided for in the Act are to apply to this Order.

Management plans.

3. (1) Management plans for certain fisheries are hereby being adopted, made applicable and enforceable, as the case may be and according to law in Malta, the said management plans being those provided for in the First Schedule and in the Second Schedule.

(2) Without prejudice to the general applicability of subarticle (1), the management plans referred in under subarticle (1) include tables with the objectives, indicators and targets as found in the Third Schedule, in the Fourth Schedule and in the Fifth Schedule, which tables are, respectively:

(a) Table 1 which shows the objectives, indicators and targets for *lampara*;

(b) Table 2 which shows the objectives, indicators and targets for bottom otter trawlers;

(c) Table 3 which shows the objectives, indicators and targets for *lampuki* fisheries.

(3) Without prejudice to the general applicability of subarticle (1), as referred in the management plans, it is expected that within the time periods or under those circumstances as established hereunder, or as established in the management plans or according to the discretion of the Director, there shall be:

(a) a reduction of *lampara* fisheries by 20% (equivalent to 3 vessels) by the end of 2015; and

(b) a reduction of the fishing effort in the case of bottom otter trawl fisheries through the introduction of a capacity reduction plan targeting 20% reduction in capacity, as well as a reduction of the same fishing effort by 10% through the introduction of a temporary cessation for the period spanning from 15 August to 15 September; and

(c) in the case of *lampuki* fisheries, the number of fishing vessels authorised to fish in the Fishing Aggregating Devices fishery will be retained to 130 vessels and on such vessels there will be a tracking system installed as from the 15th August 2014 onwards, while the same vessels, including those under 10 metres length, will have to register their landings in their catch logbook and land in a designated port.

(4) Without prejudice to the general applicability of subarticle (1), as referred in the management plans, the Director shall enhance data collection and research on:

(a) the identification of stock units in the Mediterranean sub-regions; and

(b) the identification of critical habitats (nursery and spawning sites) and of ecological requirements for the development of eggs and larvae; and

(c) the definition of some biological aspects like growth paramenters and maturity ogives; and

(d) the impact of fisheries based on Fishing Aggregating Devices on by-catch species and on the environment.

(5) The Director shall be responsible for the implementation and enforcement of the management plans referred to under this article and for such purposes shall have all those powers pertaining to said Director under the Act.

FIRST SCHEDULE

[Article 3(1)]

Fisheries Management Plan
Bottom otter trawl fishery
Lampara fishery

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Abbreviations used

AIS	Automatic Identification System
CFP	Common Fisheries Policy
CPUE	Catch per Unit Effort
CU	Capacity utilisation
DCF	Data Collection Framework
DCR	Data Collection Regulation
DFA	Department of Fisheries and Aquaculture
EnerCost	Energy cost
EU	European Union
FAO	Food and Agriculture Organisation
FTE	Full-time equivalent
FMZ	Fisheries Management Zone
FVR	Fishing Vessel Register
GFCM	General Fisheries Commission for the Mediterranean
GT	Gross Tonnage
GNP	Gross National Product
GVA	Gross Value Added
ICCAT	International Commission on the Conservation of Atlantic Tuna
NoVarCost	Non-variable costs
OCF	Operating cash flow
OECD	Organization for Economic Co-operation and Development
RepCost	Repair and maintenance costs
RightsCost	Lease/rental payments for quota and other fishing rights
SGBRE	Subgroup on Balance between Resources and Exploitation
STECF	Scientific, Technical and Economic Committee for Fisheries
TotDepHist	Value of physical capital: depreciated historical value
TotDepRep	Value of physical capital: depreciated replacement value
VarCost	Variable costs
VMS	Vessel Monitoring System

1. Introduction

The Maltese archipelago lies more or less at the centre of the Mediterranean, 93 km south of Sicily and 288 km north of Africa in a maritime area largely characterised by international waters.

Malta is geographically the smallest EU Member State and its coastline amounts to around 0.8% of the total EU coastline*.

The Maltese fleet is predominantly small-scale with a rich and extensive artisanal portfolio. It accounts for around 0.03% of the total EU catch**.

The Scientific, Technical and Economic Committee for Fisheries (STECF) notes that because most of the resources are shared with other countries, the current status of stocks depends little on the activity of the Maltese fleet. The STECF concludes that this fact creates many problems for identifying actions that the Management Plan can carry out unilaterally.

Malta's geographic position and size, the scale of its fishery, and the scale of its fishery, the spatial distribution of exploited stocks and fishing grounds shared with neighbouring EU and non EU countries, severely restrain the scope of any unilateral conservation effort and de-facto limit the applicability of Article 19 of Council Regulation 1967/2006.

2. The Common Fisheries Policy and the Mediterranean Sea

The Common Fisheries Policy (CFP) sets out the main framework for managing the fisheries sector in the EU. Because of the characteristics of the Mediterranean fishery, EU catch limits or quotas are not applicable, with the exception of limits on bluefin tuna that have been introduced in response to recommendations by the International Commission on Conservation of Atlantic Tuna (ICCAT). Apart from the general absence of catch limits, in all other respects, the region is subject to a range of EU wide management measures, including requirements relating to the EU vessel register, licensing, monitoring and control arrangements, and data collection measures.

The core of EU Mediterranean fisheries management measures are set out in EU Council Regulation (EC) 1967/2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean. Article 19 of the said regulation, together with Council Regulation (EC) No 2371/2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy, form the legal framework for the implementation of management plans.

3. The Maltese fisheries

3.1 The 25 nautical mile Fisheries Management Zone (25NM FMZ)

The provisions related to the 25 nautical mile management zone (25 NM FMZ) around Malta are outlined in Article 26 of the Council Regulation 1967/2006. Therefore the fisheries covered by this management plan are already subject to a number of targeted measures including measures limiting fishing effort, capacity, vessel size, engine power and fishing areas for certain modes of fishing.

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* Including data on Croatia
** Based on 2009 Eurostat data

The main fleet segment which is allowed to fish in the 25 NM FMZ is that composed of vessels smaller than 12 m. The small scale artisanal sector is the most sustainable fishing segment and this measure limits impacts on the marine environment to a minimum. The maximum fishing capacity for the 25 NM FMZ is set in the Treaty of Accession and is reflected in Council Regulation (EC) 1967/2006.

A number of fishing activities conducted by vessels larger than 12 m are allowed to fish in the FMZ by way of derogation. These include a limited number of trawlers, vessels fishing for dolphinfish and vessels fishing with small pelagic purse seines and longlines.

Annex V of Council Regulation (EC) 1967/2006 also sets the authorised trawlable areas within the 25 NM FMZ. In this regard it is also pertinent to note that the Maltese authorities are currently studying the possibility of relocating part of the authorised trawlable areas due to the closure of parts of the areas due to protected habitats present in the zones and the zones within 3 NM. This issue will be examined under different cover and will include a review on the trawlability of the said zones.

3.2 The Maltese commercial fishing fleet

As from January 2013, the Maltese fishing fleet is currently composed of 399 full time vessels and 635 part time vessels. Out of these vessels 959 (92.7%) vessels are below 12 m and are considered to be small-scale fishing vessels, while the remaining 75 (7.3 %) vessels are over 12 m.

The main fisheries in Maltese waters are those for bluefin tuna, dolphinfish, swordfish, demersal and small pelagics. These fisheries are mostly operated on a seasonal basis, according to the particular targeted species' migratory or biological behaviour.

3.3 Recreational fisheries

As of January 2013, the recreational category of vessels in the Maltese Fishing Vessel Register (FVR) is composed of 1,915 vessels. In accordance with Article 17 of Council Regulation 1967/2006, the use of towed nets, surrounding nets, purse seines, boat dredges, mechanised dredges, gillnets, trammel nets and combined bottom-set nets and longlines for highly migratory species are prohibited for recreational fisheries. Fish caught by vessels in this category cannot be sold.

A Recreational Fisheries Board to discuss possible management measures including the possibility of restricting fishing effort has been set up. The Recreational Fisheries Board will provide a report with possible management measures and this, together with a consultation exercise with stakeholders, will be used as a basis to draft a Legal Notice on recreational fishing establishing minimum thresholds in terms of effort, gear selectivity and licensing to fish.

4. Fisheries covered by the multi-annual national management plan

In line with Article 19 of Council Regulation 1967/2006, two management plans have been developed; one for the lampara purse seine fishery and one for the bottom otter trawler fishery. The management plans have been developed taking into account biological, economic and social objectives and will be implemented for the vessels within the 25 NM FMZ. For each plan the following steps will be followed:

1. Definition of the objectives and quantifying targets to reach such objectives
2. Review of the status of the stocks based on indices of stock abundance obtained from

stock assessments where possible and on Catch per Unit Effort (CPUE)

3. Review of potential management tools and possible scenarios
4. Assessment of the socio-economic impact of the potential management measures
5. Selection of best management tools
6. Implementation of the management measures and
7. Monitoring and evaluation of the results.

The submitted management plans should be considered as a living document. The plans will be revised on the basis of new information (data) and in terms of the biological and socio-economic performance of the chosen measures. Step 7 is therefore of paramount importance.

4.1 Lampara fishery

The management plan applies to Lampara fishing vessels authorised to carry out pelagic fisheries. The main target species include Chub Mackerel (Scomber japonicus) and Round Sardinella (Sardinella aurita).

The lampara fleet consists of 18 boats having an overall tonnage of 520 GT, a total main engine power of 3,236 kW and provides 25 jobs. This represents less than 2% of the number of vessels registered in the Commercial fishing register. 17 vessels in this fleet are on average 16 m long, with an average tonnage of 25 GT and average engine power of 151 kW.

In 2011, lampara production amounted to 176 metric tonnes (€191,000 in value terms) which represents 9% of total landings but less than 2% of the selling value. In the same year, landings from Chub Mackerel (Scomber japonicus) and Round Sardinella (Sardinella aurita) represented 58% and 28% of the ‘lampara’ landings respectively.

All stocks targeted by the Maltese lampara fishery are stocks shared with Sicily due to the population distribution over the Malta Bank, which connects the Maltese Islands with Sicily.

Stock assessment information for the Central Mediterranean is at present not available for Chub Mackerel (Scomber japonicus) and Round Sardinella (Sardinella aurita).

Irrespective of their length overall, all lampara vessels are fitted with a tracking system and are requested to complete a catch logbook in order to better monitor their fishing activity. In addition the fishing capacity in terms of GT and dimensions of the gear are not allowed to increase.

4.2 Bottom otter trawling fishery

The management plan applies to trawlers authorised to carry out demersal fisheries within the 25 NM fishing management zone. The main target species include Red Shrimps (Aristeomorpha foliacea), Red Mullet (Mullus spp.) and Pink Shrimp (Parapenaeus longirostris).

The trawler fleet authorised to fish within the 25 NM FMZ consists of 12 boats having an overall tonnage of 1,056 GT, a total main engine power of 3,700 kW and provides 59 jobs. This represents less than 2% of the number of vessels registered in the Commercial fishing register. The vessels in this fleet are on average 22 m long, have an average tonnage of 88 GT and average engine power of 333kW.

In 2011, trawler production amounted to almost 171 metric tonnes (€1.6m in value terms) which represents 8% of total landings but less than 14% of its selling value. Landings from Red Shrimps (Aristeomorpha foliacea), Red Mullet (Mullus spp.) and (Parapenaeus longirostris) represent 23%, 18% and 12 % of the trawler landings respectively.

4.3 Biological Review

For the lampara fishery, the Department of Fisheries and Aquacultureexamined several options with regards to the biological review of the stocks and possible extrapolation of data, to assess the possible impacts of the scenarios on the stocks. However in the light that no stock assessment of the target species is available at regional level and due to the fact that that the main species exploited by the Maltese fleet are part of a shared stock, and due to the fact that the Maltese catches are substantially low when compared to catches by other countries, the only review which is viable and could be considered to be reliable was the results of the trends of the CPUE.

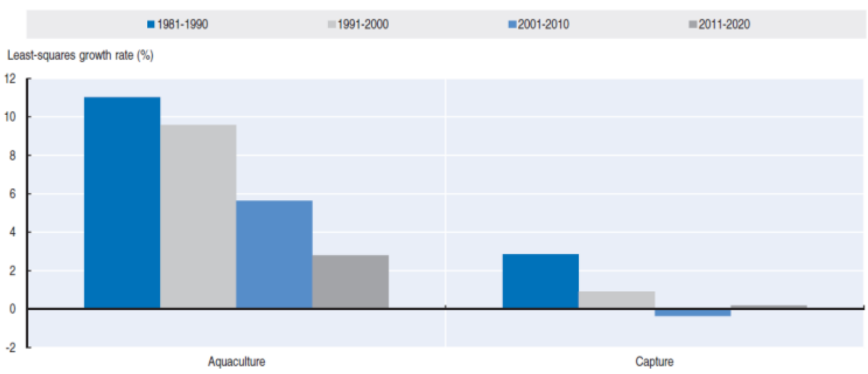
For the bottom otter trawler fishery, the stock assessments conducted at regional level were used to determine the status of the stocks.

4.4 Socio-economic review

For each of the identified scenarios mentioned in sections 5.2.1 and 6.2.1, the Department of Fisheries and Aquaculturehave estimated the catches for each of the main target species by reference to growth rates in the past as well as production growth expectations for the future.

The Organization for Economic Co-operation and Development (OECD) expects world fisheries production in 2020 to grow by about 15% above the average level for 2008-2010. It is anticipated that the major increases in the quantity of fish produced will originate from aquaculture.

However, when considering the annual growth rate of aquaculture for the same projected period it is estimated to be 2.8% which is lower than the rate of 5.6% observed during the previous decade. Capture fisheries are expected to register small growth over the next ten years as shown in Figure 1: Declining growth rate of fish production. below.



Source: OECD and FAO Secretariats.

Figure 1: Declining growth rate of fish production.

On the other hand, the revised CFP estimates that a rise in average consumption of between 0.5% to 1% average yearly growth rate is expected in the majority of European countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, the Netherlands, Italy, Luxembourg, Malta and the United Kingdom).[3]

The effects that the planned management measures might have on the fishing effort have been taken into consideration in this analysis.

4.4.1 Projected price trends

OECD/the Food and Aquaculture Organisation (FAO) expects world fish prices to continue the growing trend experienced in 2010 and early 2011. They will be affected by income and human population growth, stagnant capture fisheries production, increasing feed cost and higher crude oil prices. All these factors will contribute to the rise in fish prices over the medium term.

However, OECD/FAO opines that there will be different scenarios for capture fisheries production and for aquaculture. With the growing price of fishmeal and the higher price of other feeds, the spread between the average price of output from aquaculture and capture will grow over the medium term. In addition, the average price for wild fish should increase less than farmed species due to expected changes in the catch composition, with more catches of lower value fish.

OECD/FAO expects the average world price for captured species to increase by 23% and for aquaculture species by a 50% by 2020 compared to the average 2008-10. In addition to the need to compensate for the higher cost of fish meal, prices of aquaculture will also grow due to strong domestic demand.

The price-quantity relationship has been specified by various formulae in the literature (Huang, 2005). The price elasticity co-efficient from Nielsen (2000) were derived and are summarised below:

Table 1: Price elasticity co-efficient for some of the target species of the trawl

Species	**Price elasticity co-efficient for every 1% fall in production**
Hake	-0.37
Mullet	-0.22
Shrimp	-0.20

Choice of ordinary or inverse demand model may be based on the realism of causality. In the case of food, the causality from demand changes to price is found more realistic than vice versa, as demand for food seems more determined by human needs, regardless of the price, than the demand for other goods. In the case of seafood in particular, the causality from demand changes to price is found more realistic than vice versa. This is because seafood is food and that demand is given by a marked exogenous supply, which is determined by circumstances such as bio-economy, weather, fishery management etc.

In the literature ordinary demand models are used to forecast demand and inverse demand models are used to forecast price. In a part of this literature both models are used on the same data set and thereby forecast properties are tested. Burton (1992) finds that the inverse demand model forecasts price of wet fish in UK significantly better than the ordinary model forecasts demand for wet fish in UK. Eales et. al. (1997) reach the same conclusion regarding Japanese fish markets.

4.4.2 Projected income streams

Revenues by species are obtained as a product of the projected price and the estimated landings of a particular species. The costs of each fleet segment are broken down in categories that include salaries and wages, energy costs, repairs and maintenance costs, variable costs and non-variable costs. The cost projections are based on cost relationships that are derived from actual results registered in the period 2008 to 2011.

4.4.3 Supporting workings with respect to loss of profits estimates

The following table includes the workings that were used in estimating the loss of profits that could be incurred in the different scenarios envisaged in the management plans.

Table 2: Profitability estimate per vessel

	Lampara	Trawlers
Five year revenues	895,304	7,187,896
Number of vessels	18.60	12.00
Average five year revenue per vessel	48,135	598,991
Average profit conversion	46%	15%
Average five year contribution per vessel	22,030	89,849

The information is based on the economic data collected annually for the purpose of the EU Data Collection Programme by means of a sample survey. This data provides indications of the revenues generated by each type of fleet, nature and split of operational costs between fixed and variable costs and resultant profit contributions. The number of vessels is based on the fishing vessel register information.

5. Maltese management plan for the lampara fishery

5.1 Objectives

Based on the biological, social and economic aspects of the fisheries the following objectives have been defined:

1. Ensuring the sustainability of the stock
2. Ensuring financial stability for fishers
3. Safeguarding artisanal fishing activity

For each objective specific indicators and benchmarks were established so as to reach the objectives of the plan.

As explained in section 4, stock assessments for the related stocks were not available and thus the biological indicators and targets reference points were calculated based on CPUE data. The data used in the calculations were collected through logbooks for vessels over 10 m and Market Sales Vouchers for vessels smaller than 10 m. As from 2012, all of the landings of the fleet were recorded by officials at landing. However, the data collected at landing for 2012 was not included in this analysis, so as to avoid variances arising due to sampling methodologies. Thus 2012 data was extracted using the same methodology as for previous years; through logbooks for vessels over 10 m and Market Sales Vouchers for vessels smaller than 10 m. CPUE trends were established to indicate the status of the stocks.

The socio-economic indicators and targets were calculated based on a set of variables and indicators based on the economic data collected annually.

With this data the several scenarios were presented and assed in order to select the best management measures for the Maltese lampara fishery within the 25 NM FMZ.

The objectives, indicators and targets are presented below in Table 3: Objectives, indicators and targets for the lampara fishery management plan.

Table 3: Objectives, indicators and targets for the lampara fishery management plan

Objectives	Indicator	Targets
Biological 1. Ensuring sustainability	1. Catch Per Unit Effort	1. CPUE trend does not decrease below the annual 25 % threshold for Chub Mackerel (*Scomber japonicus*) and Round Sardinella (*Sardinella aurita*) which lie at CPUE of 3.09 and 2.15 kg/kW*fishing days respectively
Socio-economic- 1. Ensuring financial stability of fishers 2. Safeguarding artisanal fishing activity	1. Stability or increase of profit per vessel 2. Ensuring that fishing capacity in terms of number of vessels, GT and gear dimensions does not increase	1. Gross profit per vessel 2. Number of vessels, GT, kW and gear dimensions at that of 2012 or less

5.2 Review of the status of the stocks based on Catch per Unit Effort (CPUE)

This section will give a summary of the in depth review conducted on the stocks concerned and attached as annex 1.

5.2.1. Status of the stocks

All stocks targeted by the Maltese lampara fishery are stocks shared with Sicily due to the population distribution over the Malta Bank, which connects the Maltese Islands with Sicily.

Stock assessment information for the Central Mediterranean is at present not available for

Chub Mackerel (Scomber japonicus) and Round Sardinella (Sardinella aurita). Stock assessments of the relevant species will thus have to be carried out in collaboration with Italy.

Malta's relative contributions to the landings of the main species caught with the lampara in the Central Mediterranean are presented in Table 4 below. Malta's contributions towards catches of these species are below 10 % for the majority of the species except for Sardinella aurita which is slightly higher (24.9%). This slightly higher percentage can be attributed to the grouping of clupeoids under one name in Maltese landings data. Table 4 indicates that Maltese contribution to the fishing pressure on the stocks is very minimal and any effort to reduce fishing effort cannot be taken by Malta unilaterally.

Table 4: Central Mediterranean landings (t) of species targeted by the lampara fishery. Malta's values include landings from all of the Maltese fleet and not only from the lampara fishery. Source: GFCM Production Statistics; reference year 2010.

English Name	***Scientific Name***	***Italy***	***Malta***	***% Contribution***
Chub Mackerel	*Scomber japonicus*	594	61	9.3
Round Sardinella	*Sardinella aurita*	130	43	24.9
Jack Mackerel	*Trachurus* spp	1708	13	0.8
Anchovy	*Engraulis encrasicolus*	13898	5	0.0

Total annual landings of the lampara fishery were plotted and the trend analysed by a regression analysis. Linear regression shows that although there was an overall increasing trend, the trend was not linear due to important inter-annual fluctuations in the data (R^2 = 0.67).

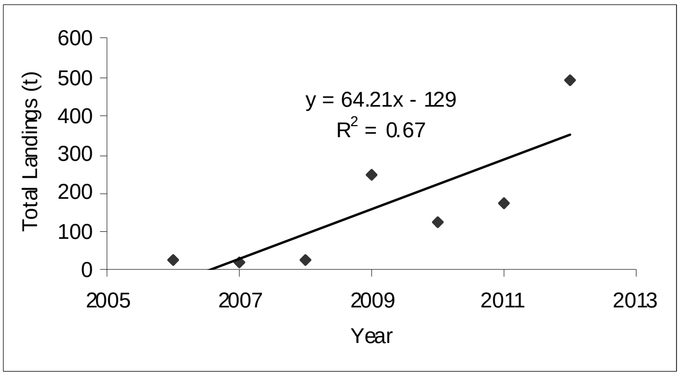


Figure 2: Regression analysis of total annual landings of the lampara fleet recorded in 2006-2012.

5.2.2 Species Composition of Landings

Available landings data for the Maltese lampara fishery contains records of at least 42 different taxa. The rise in total annual landings observed in 2012 is due to two species: Chub Mackerel (Scomber japonicus) and Round Sardinella (Sardinella aurita).

Landings of Chub Mackerel were low in 2006-2008 (mean 12 tonnes), increased dramatically to 223 tonnes in 2009 before dropping to lower values in 2010 and 2011 (mean 81 tonnes) and rising to the highest levels recorded in the entire time series in 2012 (248 tonnes). Round Sardinella landings were low in 2006-2009 (mean 4 tonnes) before increasing significantly in 2010-2011 (mean 47 tonnes) and again in 2012 (193 tonnes).

Landings of all other species combined on average only contributed 25% to total catches.

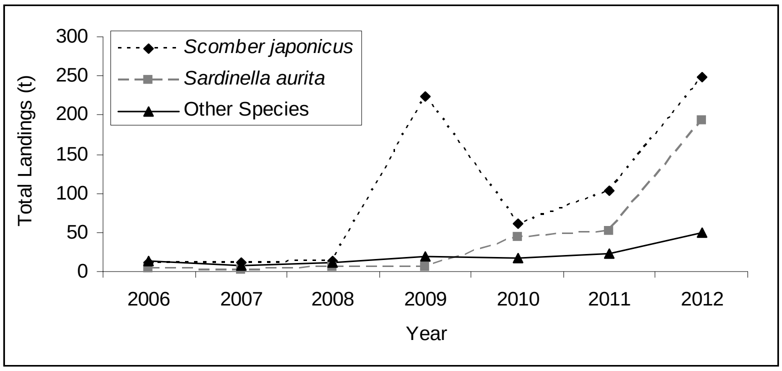


Figure 3: Total annual landings of the lampara fleet for the key target species Chub Mackerel (Scomber japonicus) and Round Sardinella (Sardinella aurita) compared to the combined annual landings of all other species recorded for the period 2006-2012.

An assessment was made to quantify the relative monthly landing contributions of Chub Mackerel (Scomber japonicus), Round Sardinella (Sardinella aurita) and total landings of other species. Results show that non target species in 2006-2012 dominated catches during the months of October, November, December and January. Chub Mackerel (Scomber japonicus) on average was the most important species caught in February-September. The relative contribution of Round Sardinella (Sardinella aurita) catches increased during the second and third quarters, but the species was never the dominant species in recorded catches.

Whilst these patterns give an indication of the species composition of monthly landing patterns, the recorded high standard deviation values show that there was considerable variation over the analysed time period.

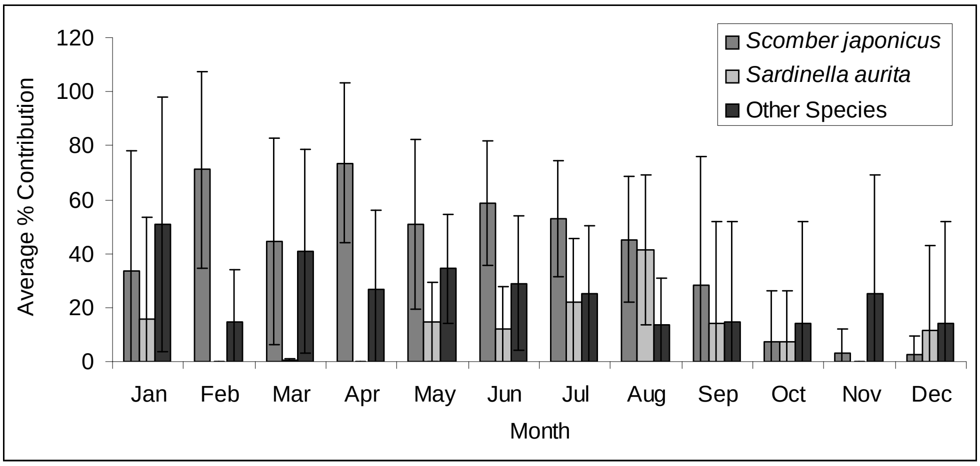


Figure 4: Relative contribution of Chub Mackerel (Scomber japonicus), Round Sardinella (Sardinella aurita) and other species as mean percentage contribution to total monthly landings (±1SD) recorded for the period 2006-2012.

5.2.3 Trends from Catch per Unit Effort data

A CPUE analysis was carried out for the two key target species Scomber japonicus and Sardinella aurita based on kW*fishing days and GT*fishing days. Results showed increasing trends in CPUE for both species during 2006-2012; GT*fishing days and KW*fishing days give virtually identical patterns. Overall, the data suggests that neither chub mackerel nor round sardinella are currently overfished.

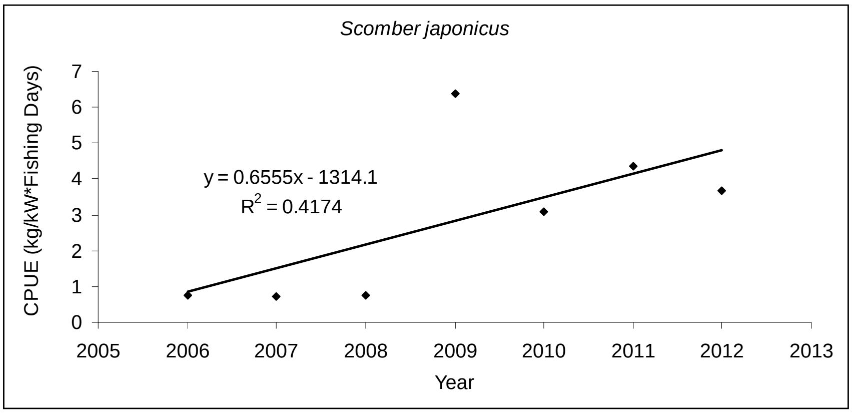


Figure 5: Catch per unit effort (as kg/kW*Fishing Days) for Chub Mackerel (Scomber japonicus) recorded in the Maltese lampara fishery for the period 2006-2012, with fitted regression line.

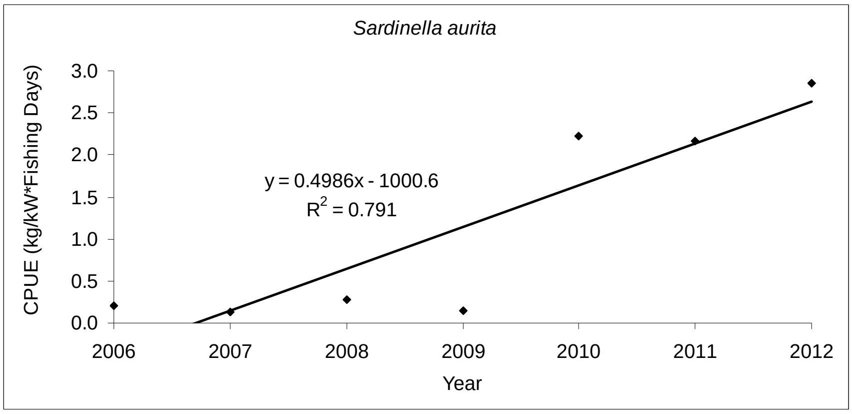


Figure 6: Catch per unit effort (as kg/kW*Fishing Days) for Round Sardinella (Sardinella aurita) recorded in the Maltese lampara fishery for the period 2006-2012, with fitted regression line.

5.2.4 Trends of biomass from the MEDIAS survey

In addition to the trends observed through the CPUE data presented above, it was possible to calculate the biomass indices for the two main target species caught by the lampara; Sardina pilchardus and Engraulis encrasicolus, obtained from the MEDIAS survey. The graphs are presented in Annex 1.1.6. Interannual fluctuations were observed for both species but over the last 4 years the biomass of E. encrasicolus showed an overall increase whilst that of S. pilchardus showed an overall decrease.

5.2.5 CPUE Thresholds

In the absence of biomass target reference points such as ‘maximum sustainable yield’ from stock assessments, CPUE effort thresholds were used as an alternative until sufficient biological data has been collected to carry out a full stock assessment. Since the lampara fishery is targeting small pelagic species, the limitations of the CPUE as a relative index of stock size need to be kept in mind, and lower threshold levels need to be set than would be required for demersal species.

CPUE thresholds were calculated for the two main target species, chub mackerel and round sardinella. The thresholds were only calculated for CPUE trends in kW*fishing days since effort data based on engine strength and gross vessel tonnage seem to be closely correlated for vessels in the Maltese lampara fishery.

Annual CPUE thresholds as well as monthly CPUE were calculated; the latter was deemed necessary due to the observed seasonal fluctuations in catch volumes. The CPUEs corresponding to the 25% percentile of the datasets are indicated in Tables 4-10 below. These were then used as minimum reference points for CPUE trends recorded for the lampara fleet.

The annual 25% threshold for chub mackerel and round sardinella catches lie at a CPUE of 3.09 and 2.15 kg/kW*fishing days, respectively.

The months during which over 80% of landings of the two key target species chub mackerel (Scomber japonicus) and round sardinella (Sardinella aurita) were recorded during 2006-2012 were identified in order to determine the respective species’ main fishing seasons. Monthly CPUE thresholds were calculated for the relevant months; for Scomber japonicus, on average 87% of landings were made in April – August, whilst for Sardinella aurita on average 95% of landings were made in May – August.

A summary of the monthly 25% threshold CPUE thresholds for chub mackerel and round sardinella catches which could be used as the basis of monthly safety thresholds to maintain the long term sustainability of catches are shown in Table 5: Monthly CPUE threshold limits for the Maltese lampara fleet based on 25th percentile of monthly CPUE recorded during 2006-2012..

Table 5: Monthly CPUE threshold limits for the Maltese lampara fleet based on 25th percentile of monthly CPUE recorded during 2006-2012.

Species	**Month**	**CPUE Threshold**
Chub Mackerel	April	2.88
	May	4.2
	June	3.31
	July	3.46
	August	3.76
Round Sardinella	May	0.57
	June	1.66
	July	2.62
	August	4.37

5.3 Potential management tools

As explained in section 3, in line with Council Regulation 1967/2006 several management tools are already in force in the Maltese Fisheries. In addition to these management tools, other tools are also being considered. In this section a list of possible management tools will be established and a brief description of each tool will be given.

5.3.1 List of possible management tools

Freezing capacity - In order to ensure that the capacity of the current fleet does not increase, the capacity of the fleet may be frozen at current levels. The capacity freezing may be done by limiting the number of vessels and/or gross tonnage (GT) and/or gear dimensions and/or length of vessels.

Reducing capacity - A reduction of current capacity may be introduced by temporarily or permanently reducing the number of vessels from the specific fishery or from the whole commercial fishing fleet.

Gear size restrictions - Such restrictions are already set in Council Regulation 1967/2006. Article 9 establishes a minimum mesh size of 14 mm for surrounding nets. While Annex II of Council Regulation 1967/2006 establishes the length of netting which must not exceed 800 m and the drop to 120 m. Further national gear restrictions may be considered for this fishery to reduce the impacts on the environment so as to reduce discards.

Minimum landing sizes - Minimum landing sizes for certain species have been established at EU level in Annex III of Council Regulation 1967/2006.

Fishing prohibited areas - Article 13 of Council Regulation 1967/2006 restricts fishing activity within 300 meters of the coast or within the 50 metres isobath where that depth is reached at a shorter distance from the coast.

Catch Logbook - Article 14 of the Control Regulation (EC) 1224/2009 obliges vessels over 10m to record catches in a fishing logbook. This requirement has been extended to all vessels to better monitor the catches and landings.

Vessel Monitoring System- Article 9 of the Control Regulation (EC) 1224/2009 obliges vessels over 12m to have a satellite based monitoring system to better monitor fishing activities. This requirement has been extended to all vessels in the fishery.

Fishing authorisations: Article 19 of Council Regulation 1967/2006 obliges MS to have fishing authorisation for vessels included in the management plan.

Fishing seasons: National fishing seasons may be considered to protect juveniles during spawning seasons of the targeted species.

Total Allowable Catch and Quotas: A total allowable catch may be established for the targeted species so as to limit the fishing morality of the said stocks.

Based on the above possible management tools the following scenarios were developed and assessed.

Scenario 1: Freezing all fishing effort. This would be achieved by stabilising both the number of licences as well as the number of fishing trips and gear dimensions allowed to the current level. This should lead to a stabilisation of the fishing effort which in turn should minimise the risk of stock exploitation. Increase in fisher’s earnings would therefore depend on increases in catches per unit effort (CPUE) and increases in prices. These increases are, however, not expected to be significant.

Scenario 2: Freezing fishing capacity but allowing the number of fishing trips to fluctuate. The allowed increase in fishing trips could have an adverse effect on the stock levels of certain species. Fishers' income may benefit from reduced competition as a result of stabilisation of vessel capacity as long as fishing activities are conducted in a manner which ensures the long term sustainability of stock exploitation.

Scenario 3: Reducing fishing capacity by 20% in line with the precautionary approach in the short-term and re-visiting the situation once better and more reliable biological data is obtained. This scenario will minimise the risk of stock exploitation, whilst still providing the majority of fishers with the opportunity of maintaining their livelihoods. R

Scenario 4: Reducing fishing capacity by 20% in line with the precautionary approach and freezing of fishing effort in the short-term and re-visiting the situation once better and more reliable biological data is obtained. This scenario will minimise the risk of stock exploitation, whilst still providing the majority of fishers with the opportunity of maintaining their livelihoods.

5.4 Assessment of the socio-economic impact of the potential management measures

The management plan indicates that the current level of pelagic fishing is not threatening the conservation of the target fish stock. The fact that catch per unit effort is still on the increase indicates that the catch is still below the maximum sustainable yield and any increases in landings would not lead to negative economic rents.

However, until further research is carried out this conservation status cannot be demonstrated beyond doubt. The management plan is in essence geared to freeze the fishing capacity / effort until the necessary research is carried out to enable future plans to provide a more reliable foundation for future initiatives. The four scenarios mentioned in section 4.1 have been simulated to estimate the effects of the different management initiatives included in the plan. For each scenario, based on the results on total landings, the model was used to estimate the changes in economic variables over time. The main assumptions behind the different scenarios are included in Table 6

Table 6: Assumptions made in the scenario analysis

		2012	2013	2014	2015	2016	2017
Landings growth	Scenario 1	0.90%	0.80%	0.70%	0.60%	0.50%	0.50%
	Scenario 2	0.90%	8.00%	9.00%	10.00%	10.00%	10.00%
	Scenario 3	0.90%	2.44%	3.44%	4.44%	4.44%	4.44%
	Scenario 4	0.90%	(5.56%)	(5.56%)	(5.56%)	(5.56%)	(5.56%)
Growth in prices	Scenario 1	(0.18%)	(0.16%)	(0.14%)	(0.12%)	(0.10%)	(0.10%)
	Scenario 2	(0.18%)	(1.60%)	(1.80%)	(2.00%)	(2.00%)	(2.00%)
	Scenario 3	(0.18%)	(0.49%)	(0.69%)	(0.89%)	(0.89%)	(0.89%)
	Scenario 4	(0.18%)	1.11%	1.11%	1.11%	1.11%	1.11%
Licence revocation			Cost	% of capacity			
	Scenario 1		-	-			
	Scenario 2		-	-			
	Scenario 3		(42,000)	(5.56%)			
	Scenario 4		(42,000)	(5.56%)			

Lampara landings are projected to increase in line with the projected national average increase in landings when fishing effort is frozen i.e. growth per annum in landings drops from 0.9% to 0.5% at which level it stabilises from 2016 onwards. These landings growth projections are based on OECD and CFP studies that are referred to earlier.

When fishing effort is not regulated it is assumed that landings growth stabilises at 10% per annum from 2015 onwards.

The price-quantity relationship has been specified by various formulae in the literature [1]. The price elasticity co-efficient was derived from [2] and assume that for every 1 kg increase in landings, the price drops by 0.2%.

Every licence revocation leads to a 5.56% reduction in landings. The cost of licence revocation is set at €42,000 and is based on the estimated earnings per vessel from the lampara activity over a ten-year period.

The figures below show the outcome of the scenario analysis compared with the 2011 baseline data.

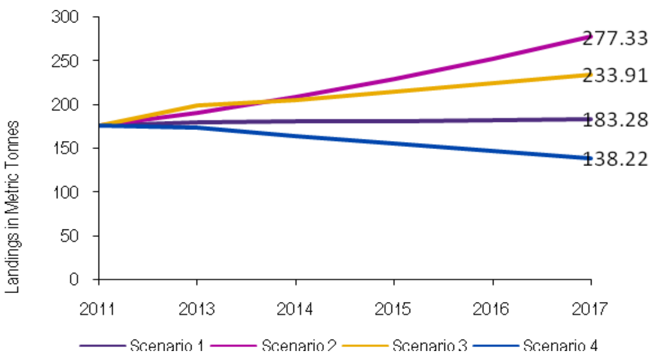


Figure 7: Landings in Metric Tonnes under each scenario

Landings are expected to stabilise under Scenario 1 wherein fishing effort is frozen at current levels, drop significantly under scenario 4 where fleet capacity is reduced by at least one vessel and fishing effort is frozen at current levels. Landings are expected to increase mostly under scenario 2 where fishing capacity is frozen but fishing effort is not regulated. However, in scenario 3 landings are still expected to increase even though to a lesser degree than in Scenario 2 since fishing effort is still allowed to fluctuate only after the fishing capacity is reduced by at least one vessel.

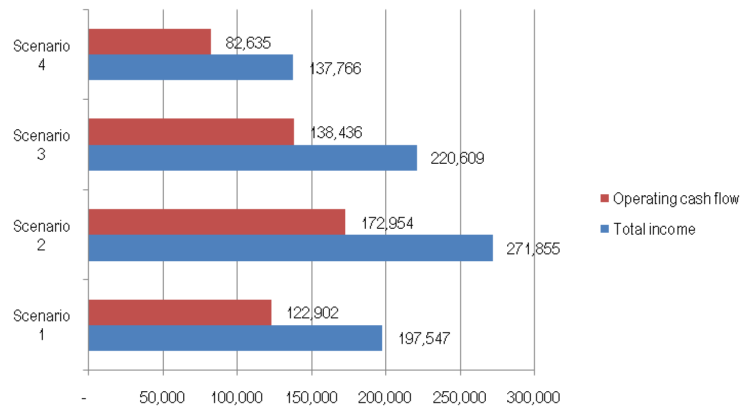


Figure 8: Income and Operating cash flow in 2017 under each scenario

Fluctuations in income are mainly determined by the dynamics of landings since price elasticity is generally low on fish products shows that income is highest under scenario 2 and lowest under Scenario 4, as indeed is operating cash flow.

Table 7: Economic net present value compared of all scenarios to scenario 1

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
% variations with Baseline	Baseline	31%	5%	(32%)

Licence revocation under scenarios 3 and 4 are assumed to be achieved at the rate of €42,000 per vessel representing lost earnings form ten years of lampara activity. While the economic net present value (ENPV, discounted at 5.5%) is positive in each of scenarios 2 and 3, scenario 4 represents the lowest return whilst scenario 2 generates the highest economic return.

5.5 Management measures to be adopted

The increasing trend in CPUE estimates measured over time for the lampara fleet seems to indicate the key target species of the lampara fishery are currently exploited at sustainable levels none-the-less; since stock assessments are not available the Department of Fisheries and Aquaculture will be implementing a reduction in capacity by 20%. With regards to results obtained through the socio-economic review the DFA believes that Scenario 3 is the plan which provides results that are closest to its objectives since increase in landings is subdued when compared to increases under Scenario 2 whilst still retaining positive net economic benefits.

As a result Malta will be reducing the fishing capacity in the short-term and re-visiting the situation once better and more reliable biological data is obtained. This scenario will minimise the risk of stock exploitation, whilst still providing fishers with the opportunity of increasing their earnings.

The definition of harvest control rules, due to very low contribution of the Maltese Lampara in terms of total landings, and the shared nature of the stock, can only be done jointly for all fleets exploiting the same stocks. This opinion is also found in the analysis put forward by STECF which, for the same reasons, also establishes that Malta's proposed reduction in effort is excessive but that would still have little impact on the overall mortality on these shared stocks. Therefore if harvest control rules were to be deemed to be required, it is necessary to establish these through regional mechanisms and not though national and unilateral management plans.

5.6 Implementation of management measures

A 20 % reduction (3 vessels) in line with the precautionary approach on the current lampara capacity in terms of number of vessels will be implemented by the end of 2015.

5.7 Review of management measures

The review of the management measures will be conducted in 2016, by when better data on landings would have been collected. Based on the results of the review new management measures may be adopted. The data collected will also include data on discards in order to develop management measures to reduce the impacts of the fishery on the environment if necessary.

6 Maltese Management Plan for the bottom otter trawler fishery

6.1 Objectives

Based on the biological, social and economic aspects of the fisheries the following objectives have been defined:

1. Aiding in the recovery of the stocks
2. Ensuring financial stability of fishers

For each objective specific indicators and benchmarks were established so as to reach the objectives of the plan.

Stock assessments are available for the following species exploited by bottom otter trawlers in the Strait of Sicily: giant red shrimp (Aristaeomorpha foliacea), thornback skate (Raja clavata), red mullet (Mullus barbatus), common Pandora (Pagellus erythrinus), black bellied anglerfish (Lophius budegassa), pink shrimp (Parapenaeus longirostris) and hake (Merluccius merluccius). The assessment of thornback skate was classed as preliminary due to the limited time series of data available.

The socio-economic indicators and targets were calculated based on a set of variables and indicators which were based on the economic data collected annually.

With this data the several scenarios were presented and assed in order to select the best management measures for the Maltese bottom otter trawler fishery within the 25 NM FMZ.

The objectives, indicators and targets are presented in Table 8: Objectives, indictors and targets for the bottom otter trawler fishery management plan below.

Table 8: Objectives, indictors and targets for the bottom otter trawler fishery management plan

Objectives	Indicator	Targets
Biological Reducing fishing mortality	Reduced number of fishing days Reduction in total kW allowed within the 25 NM FMZ	Reduction of fishing effort and reduction of capacity by at least 30%.
Socio-economic- Ensuring financial stability of fishers	Gross profit per sector	Stability or increase of income per vessel

6.2 Review of the status of the stocks

This section will give a summary of the in depth review conducted on the stocks concerned and attached as annex 2.

6.2.1 Trends from landings data

Between the period 2006 and 2011, landings showed an overall increasing trend, with inter-annual fluctuations (regression analysis, $R^2 = 0.63$).

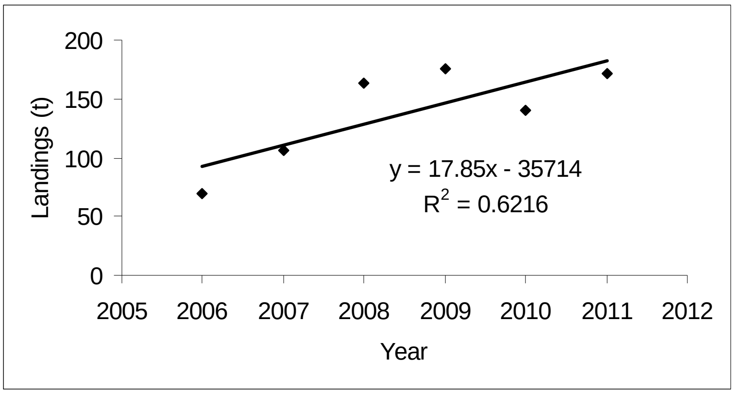


Figure 9: Regression analysis of total annual landings of the trawl fleet recorded in 2006-2011.

An analysis of monthly variations in mean landings during the period 2006-2011 showed lower levels of landings in the months of October – March, followed by a period with higher landings in April – September. This pattern mirrors the pattern of mean monthly fishing effort exerted during the same period, indicating that monthly fluctuations in landings are almost certainly due to variations in fishing effort, rather than being caused by seasonal fluctuations in the target populations. Since many of the species targeted by Maltese bottom otter trawlers are deep water species found on the continental shelf / slope, and which occur in habitats where there are much more subdued seasonal variations than in shallow waters, such a pattern can be expected.

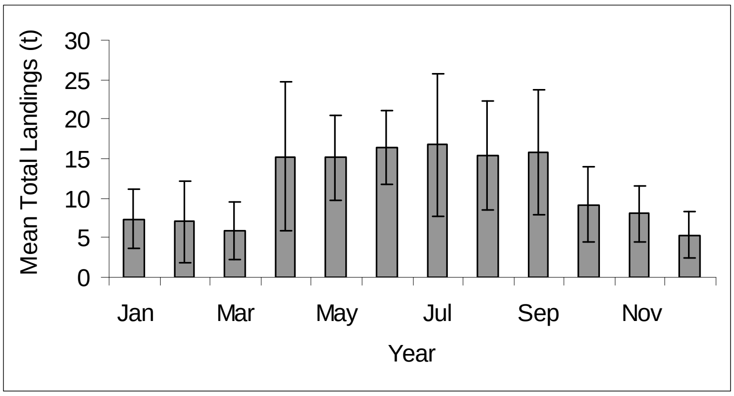


Figure 10: Mean monthly total landings (±1 SD) for the trawl fishing fleet in 2006-2011.

1.1.1.1 Species Composition of Landings

Available landings data for the Maltese trawl fishery contains records of at least 128 different taxa. An overview of key taxa fished by trawlers in 2006-2011 is presented in Table 9 below.

Table 9: Landings of key taxa fished by Maltese bottom otter trawlers in the Maltese FMZ during 2006-2011.

	Landings (t)					
Scientific name	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Aristaeomorpha foliacea	27.40	31.65	26.30	29.21	25.73	39.22
Boops boops	1.01	5.60	4.40	4.56	3.50	2.76
Lophius spp.	0.27	0.85	1.54	1.26	0.00	0.00
Merluccius merluccius	4.75	5.61	0.65	7.46	1.68	4.79
Mullus spp.	9.35	23.17	43.55	35.71	29.46	30.11
Nephrops norvegicus	0.01	0.63	1.21	1.49	2.57	1.74
Octopus spp.	1.22	1.57	3.09	1.05	1.02	0.84
Pagellus spp.	0.91	2.23	3.33	5.76	4.01	3.05
Pagrus pagrus	0.04	0.19	0.09	1.26	0.05	0.07
Parapenaeus longirostris	11.08	7.04	21.65	14.09	6.67	19.92
Raja spp.	1.32	3.24	4.64	5.87	4.70	6.07
Sepia spp.	1.18	2.54	6.18	12.36	8.37	9.83
Spicara spp.	0.12	4.60	4.17	5.54	8.73	8.66
Zeus faber	0.20	0.74	2.42	3.04	2.03	2.38
Other Species	10.55	16.38	40.53	47.16	40.98	42.42
Total	69.40	106.05	163.76	175.83	139.50	171.87

An analysis of trends in total landings of important target species (giant red shrimp, pink shrimp, hake, red mullet and striped red mullet) compared to landings of all other species combined during 2006-2011, revealed that (1) landings of giant red shrimp remained relatively stable during 2006-2010 but increased in 2011, (2) pink shrimp and hake landings underwent several fluctuations during the six year period analysed, (3) landings of red mullet and striped red mullet combined increased considerably during 2006-2008, and have been steadily decreasing since, and (4) there has been an important increase in the relative contribution to total landings by other species. The latter effect is due to an increase in landings of a variety of species, of which six were of particular importance during 2006-2011 (Table 10): common cuttlefish (Sepia officinalis), blue whiting (Micromesistius pouassou), Norway lobster (Nephrops norvegicus), common pandora (Pagellus erythriunus), golden shrimp (Plesionika martia) and unicorn octopus (Scaergus unicirrhus).

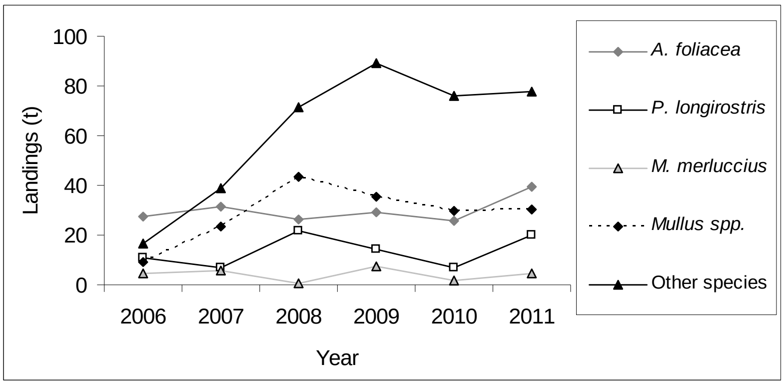


Figure 11: Total annual landings of the trawl fleet for the key target species: giant red shrimp (Aristaeomorpha foliacea), pink shrimp (Parapenaeus longirostris), hake (Merluccius merluccius), red mullet and striped red mullet (Mullus spp.), compared to the comb

Table 10: Species characterised by an important increase in landings recorded from Maltese bottom otter trawlers in the Maltese FMZ during 2006-2011.

	Landings (t)					
Scientific Name	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Sepia officinalis	1.18	2.54	6.18	12.28	8.29	9.77
Micromesistius poutassou	0.01	0.00	0.09	6.04	8.11	4.51
Nephrops norvegicus	0.01	0.63	1.21	1.49	2.57	1.74
Pagellus erythrinus	0.90	1.81	3.32	5.50	3.98	2.99
Plesionika martia	0.00	0.00	3.49	3.07	4.24	6.73
Scaergus unicirrhus	0.00	0.00	0.00	5.14	4.98	4.12
Total	2.10	4.98	14.29	33.51	32.17	29.84

When mean monthly landings information was analysed, no major fluctuations in the relative monthly contributions of the main target species to mean landings recorded in 2006-2011 were observed.

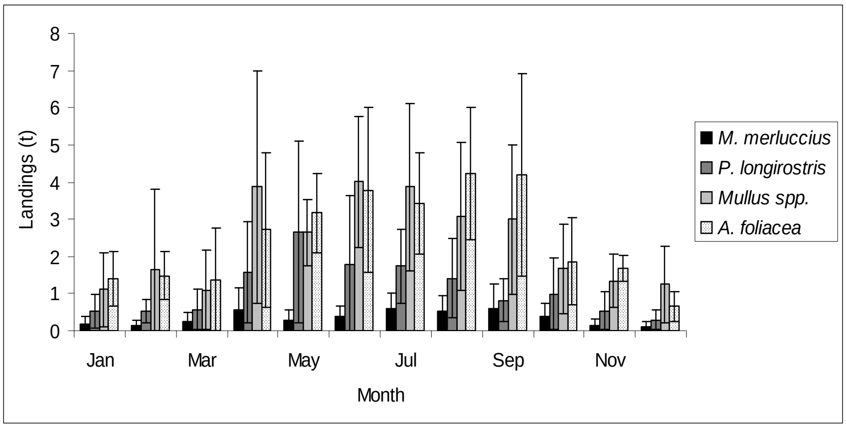


Figure 12: Relative contribution of the key target species: giant red shrimp (Aristaeomorpha foliacea), pink shrimp (Parapenaeus longirostris), hake (Merluccius merluccius), red mullet and striped red mullet (Mullus spp.), to total mean monthly landings (±1SD) recorded for the period 2006-2012

6.2.2 Trends from Catch per Unit Effort data

Overall, CPUE for giant red shrimp, hake and pink shrimp decreased during 2006-2011, whilst CPUE for red mullet and striped red mullet combined increased in 2006-2008, before decreasing gradually back to 2006 levels during 2008-2011. The latter could be the result of an artefact since data is only available for the two species in an aggregated form; it is generally not advisable to combine CPUE indicators for several species. CPUE for all species during 2006-2011 expressed in terms of GT*fishing days and KW*fishing days give virtually identical patterns.

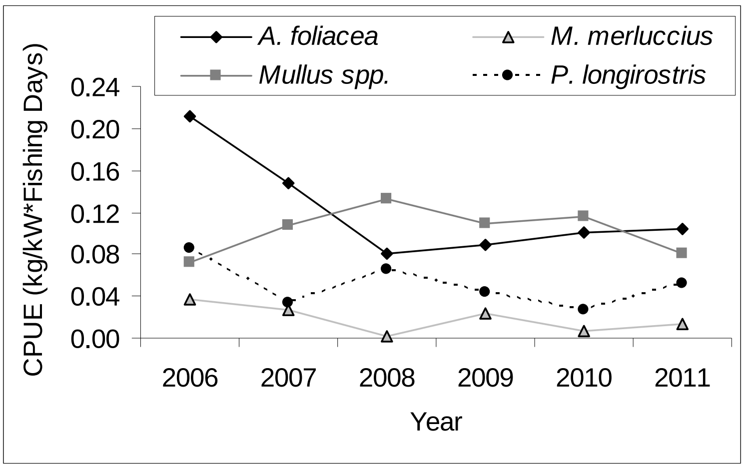


Figure 13: Catch per unit effort (as kg/kW*Fishing Days) for the key target species: giant red shrimp (*Aristaeomorpha foliacea*), pink shrimp (*Parapenaeus longirostris*), hake (*Merluccius merluccius)*, red mullet and striped red mullet (*Mullus spp*.), recorded in the Maltese trawl fishery for the period 2006-2011.

6.2.3 Trends of biomass from the MEDITS survey

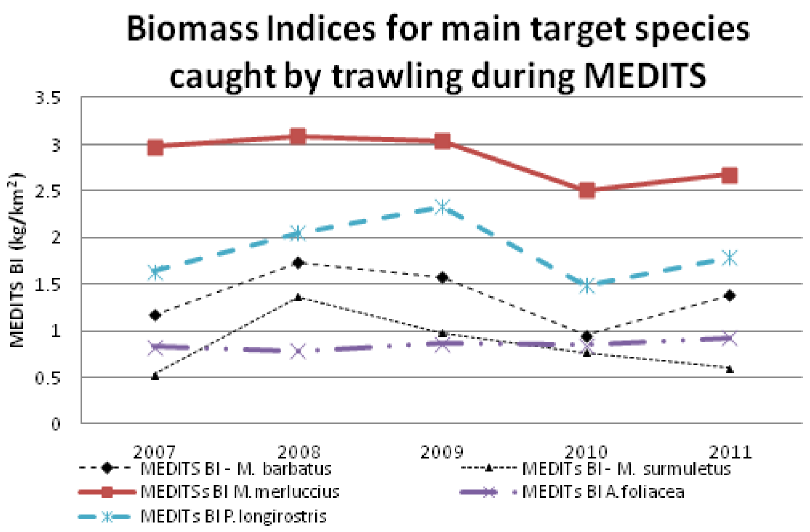


Figure 14: Biomass indices for the main target species caught during the MEDITS survey for the years 2007-2011

Apart from CPUE data, fisheries-independent data obtained from the annual spring-summer MEDITS survey, is used and presented below in order to show the trend of the main target species in the bottom otter trawl fishery.

MEDITS data shows that over a 5 year period (2007 – 2011) the biomass index (BI) of Merluccius merluccius showed a considerable decline, while that of Mullus barbatus, Mullus surmuletus and Parapenaeus longirostris remained relatively stable, while that of Aristaeomorpha foliacea increased.

6.2.4 Stock assessments

Table 11: Results of stock assessments conducted in 2011 and 2012; Fcur = current fishing mortality (F). shows the results of available stock assessments carried out at a regional level. The biological reference points used for the assessments were F_{cur} and $F_{0.1}$. F_{cur} refers to the present fishing mortality, and $F_{0.1}$ refers to the target fishing mortality taking into account the precautionary principle. Using $F_{0.1}$ as a target reference point, all of the assessed stocks were overexploited.

Table 11: Results of stock assessments conducted in 2011 and 2012; F_{cur} = current fishing mortality (F).

English Name	**Scientific Name**	F_{cur}	$F_{0.1}$	**Stock Status**	**Maltese Share of 2010 Landings (%)**
Pink shrimp	*P. longirostris*	1.20	0.92	Overexploited	0.07
Hake*	*M. merluccius*	0.60	0.1	Overexploited	0.23
Giant red shrimp	*A. foliacea*	1.09	0.42	Overexploited	2.04**
Red mullet	*M. barbatus*	1.3	0.45	Overexploited	3.6**

Common Pandora	*P. erythrinus*	0.72	0.30	Overexploited	4.8**
Black bellied angler	*L. budegassa*	0.3	0.16	Overexploited	1.6**

* Preliminary assessment; ** Excluding Tunisian landings.

The ratio between $F_{estimated}$ and F_{target} for the demersal species which were subject to a stock assessment at GFCM / SGMED in 2011 (Table 11) shows that the Maltese trawling fleet is overall catching the amount of fish expected under desirable fishing mortality rates from the entire national fleet.

Nevertheless, the same results also indicate that while Malta is fishing the pink shrimp at $F_{0.1}$, below $F_{0.1}$ for the common pandora, the fleet is overexploiting stocks above $F_{0.1}$ levels both for the giant red shrimp and hake.

Table 12: Ratio between $F_{estimated}$ and F_{target} (F/Ft) for the Maltese bottom otter trawl (OTB) fleet in 2011. The target F used in the calculations was F0.1, which was the target F calculated in the stock assessments and which is considered to be a proxy for F_{MSY}.

	Pink Shrimp	**Giant Red Shrimp**	**Hake**	**Common Pandora**	**All other species and total**
Catch in Fleet segment	7.3	27.4	6	7.11	Unknown
Total catch of the stock for all the countries	9641	1341.3	2173	319.08	Unknown
Current F (Stock assessment)	1.2	1.09	0.6	0.72	Unknown
Current F applied to fleet segment	0.001	0.022	0.002	0.016	Unknown
Target F (stock assessment)	0.92	0.42	0.1	0.36	Unknown
Quota of the Member State	0.1%	2%	0.3%	6.3%	Unknown
Target F split according to Member State quota	0.001	0.009	0.00028	0.02268	Unknown
F/Ft for species in the fleet segment	1.41	2.60	5.92	0.71	Unknown
Catch composition of fleet segment	3.80%	14.70%	3.20%	3.80%	75%(of 100%)
F/Ft weigthed by catch composition of assessed species	0.21	1.53	0.76	0.11	Unknown
Sum of all weighted F/Ft for the fleet segment	2.61	2.61	2.61	2.61	Unknown
Weight for each stock	0.15	0.57	0.13	0.15	Unknown
F/Ftarget multiplied by Weight for each stock	0.03	0.88	0.10	0.02	Unknown
Biological indicator ***(sum of all weighted F/Ft)***	**1.02**				
Percentage of fleet segment catch used for F/Ft calculation					25%

However, when taking into account the Maltese share of total landings (composed of vessels fishing both within and outside the Malta FMZ) made in the Central Mediterranean (Table 11) and the $F_{estimated}$ and F_{target} for the demersal species (Table 12) it is clear that any action taken by the Maltese authorities to address the overexploitation will not have an effect on the status of the stock.

6.3 Potential management tools

In line with Council Regulation 1967/2006 several management tools are already in force in the Maltese Fisheries, with specific reference to Article 26 of the said regulation which makes reference to the 25NM FMZ. In addition to these management tools several other tools are also being considered. In this section a list of possible management tools will be established and a brief description of each tool will be given.

6.3.1 List of possible management tools

Freezing capacity- Capacity within the zone is limited by Article 16 of Council Regulation 1967/2006. For the whole FMZ maximum capacity is 4800 kW, for Maltese vessels 3600 kW

Reducing capacity- A reduction of the current capacity may be introduced by temporarily or permanently reducing the number of vessels from the entire commercial fishing fleet. If such reductions are applied on a permanent basis the total threshold of 4800 kW established in Council Regulation 1967/2006 the threshold of 3,600 kW for Maltese towed vessels will need to be revised. It should be noted that once such reductions take place, the capacity cannot be replaced.

Gear size restrictions- Such restrictions are already set in Council Regulation 1967/2006. Article 9 establishes a minimum mesh size of 40 mm square or 50 mm diamond for towed nets. Further national gear restrictions may be considered for this fishery to reduce the impacts on the environment so as to reduce discards.

Minimum landing sizes- Minimum landing sizes for certain species have been established at EU level in Annex III of Council Regulation (EC) 1967/2006.

Fishing prohibited areas- Annex V of Council Regulation 1967/2006 established the authorised fishing zones within the FMZ. Further restrictions at a national level have also been applied in order to comply with Article 4 of the same regulation. Further studies are also currently underway under a different cover to relocate the authorised fishing zones found within the 3 NM zone to further reduce the impacts on the environment.

Catch Logbook- Article 14 of the Control Regulation (EC) 1224/2009 obliges vessels over 10 m to record catches in a fishing logbook.

Vessel Monitoring System- Article 9 of the Control Regulation (EC) 1224/2009 obliges vessels over 12 m to have a satellite based monitoring system to better monitor fishing activities.

Fishing authorisations: Article 19 of Council Regulation obliges MS to have fishing authorisation for vessels included in the management plan.

Fishing seasons: National fishing seasons may be considered to protect juveniles during spawning seasons of the targeted species.

Total Allowable Catch and Quotas: A total allowable catch may be established for the targeted species so as to limit the fishing morality of the said stocks.

In view of the results obtained from stock assessments, the Maltese authorities have decided to opt for a 30% reduction in fishing effort; which reduction is slightly bigger than reduction usually suggested as a precautionary approach in order to take into account the species which are overexploited by the Maltese fleet; A. foliacea and M. merluccius. Based on the possible management tools presented above the following scenarios were developed and assed:

Scenario 1: Reduce over-capacity through the reduction of capacity by 30%. This option would reduce the fishing capacity within the FMZ but not necessarily reduce the fishing effort.

Scenario 2: Reduce fishing capacity through 20% reduction in capacity and the reduction in effort by a further 10% through the introduction of a temporary cessation for the period spanning from 15 August to 15 September. This option will ensure that if the capacity reduction initiative is not successful in reducing the fishing effort, the temporary cessation will at least reduce the effort by 10% which is equivalent to the fishing effort that is normally dedicated in the 15 August to 15 September period which coincides with the reproductive season of some of the targeted species.

Scenario 3: Reduce fishing capacity through 10% reduction in capacity and the reduction in effort by a further 20% through the introduction of a temporary cessation for the period spanning from 15 August to 15 October. This option will ensure that if the capacity reduction initiative is not successful in reducing the fishing effort, the temporary cessation will at least reduce the effort by 20% which is equivalent to the fishing effort that is normally dedicated in the 15 August to 15 October period which coincides with the reproductive season of some of the targeted species.

Assessment of the socio-economic impact of the potential management measures

The statistical data indicates that the current level of bottom otter trawling carried out by Maltese fishers is not significant in the Central Mediterranean context. However, biological studies prove that the target fish stock is overexploited. Level of fishing is therefore beyond the maximum sustainable yield and yielding negative economic returns.

The management plan should therefore be designed to reduce the fishing capacity / effort through different initiatives that include permanent and temporary cessation actions in order to reduce the fishing effort below the maximum sustainable yield, thus turning the current situation of negative economic rents into one that generates positive economic rents. The three scenarios mentioned in section 6.3.1 have been simulated to estimate the effects of the different management initiatives included in the plan. For each scenario, given the results on total landings, the model was used to estimate the changes in economic variables over time. The main assumptions behind the different scenarios are included in Table 13.

Table 13: Assumptions made in the scenario analysis

		2012	2013	2014	2015	2016	2017
Landings growth	Scenario 1	0.00%	(30.00%)	1.00%	2.00%	3.00%	4.00%
	Scenario 2	0.00%	(30.00%)	0.50%	0.50%	0.50%	0.50%
	Scenario 3	0.00%	(30.00%)	0.50%	0.50%	0.50%	0.50%
Growth in prices	Scenario 1	0.00%	0.00%	(0.20%)	(0.40%)	(0.60%)	(0.80%)
	Scenario 2	0.00%	0.00%	(0.10%)	(0.10%)	(0.10%)	(0.10%)
	Scenario 3	0.00%	0.00%	(0.10%)	(0.10%)	(0.10%)	(0.10%)
Permanent cessation			Cost	% of current capacity			
	Scenario 1		(640,000)	67%			
	Scenario 2		(370,000)	83%			
	Scenario 3		(260,000)	92%			

Growth in landings beyond 2013 is assumed to be in line with the projected national average increase in landings i.e. growth per annum of 0.5% at which level it stabilises from 2014 onwards. The only exception is scenario 1 where fishing effort might still increase due to lack of actions earmarked at freezing fishing effort under this scenario. These landings growth projections are based on OECD and CFP studies that are referred to earlier.

The price-quantity relationship has been specified by various formulae in the literature[1]. The price elasticity co-efficient was derived from [2]and assume that for every 1kg increase in landings, the price drops by 0.2%.

The figures below show the outcome of the scenario analysis compared with the 2011 baseline data.

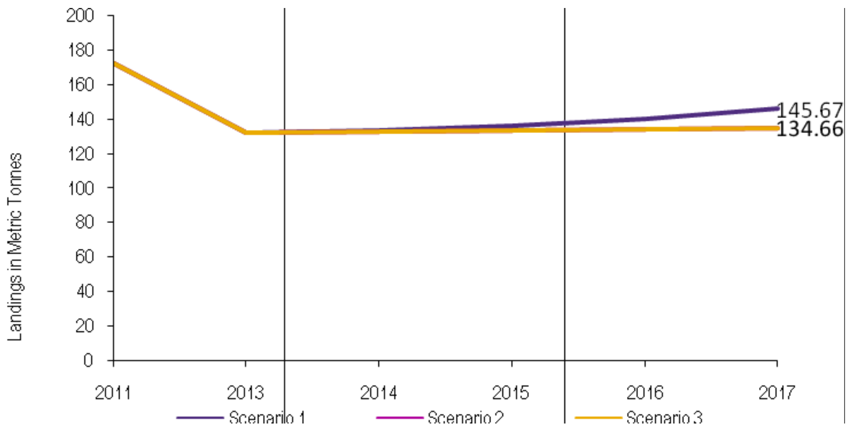


Figure 15: Landings in Metric Tonnes under each scenario

Landings are expected to grow under Scenario 1 wherein fishing capacity is reduced by 30% but no measures with respect to fishing effort are introduced. In scenarios 2 and 3 landings are expected to drop substantially where measures at controlling fishing effort are introduced in conjunction with capacity reduction cessation initiatives.

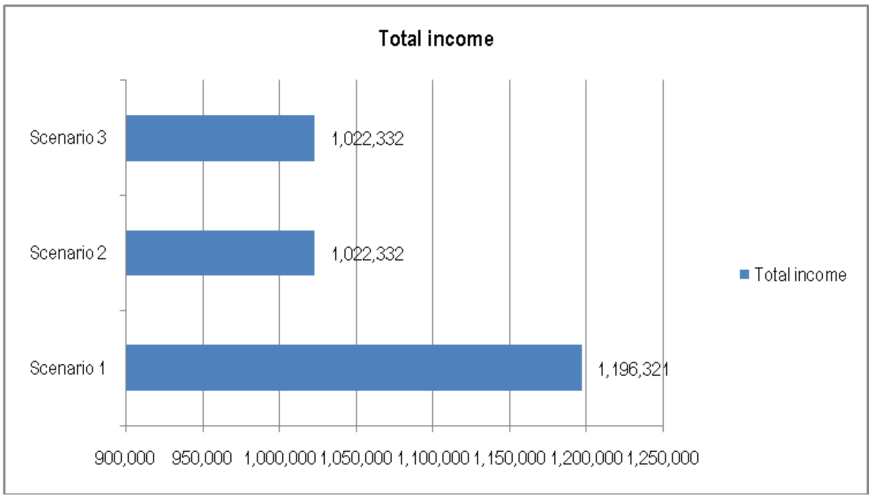


Figure 16: Income in 2017 under each scenario

Fluctuations in income are mainly determined by the dynamics of landings since price elasticity is generally low on fish products. Figure 16 shows that the income is highest under scenario 1 and lowest under Scenarios 2 and 3.

Table 14: Economic net present value compared of all scenarios to scenario 1

	Scenario 1	Scenario 2	Scenario 3
% variations with Baseline	Baseline	15%	14%

The economic net present value (ENPV, discounted at 5.5%) of scenario 2 is highest and is expected to lead to a significant reduction in landings when compared to baseline. Reduce fishing effort through the introduction of a capacity reduction plan targeting 20% reduction in capacity and the reduction in effort by a further 10% through the introduction of a temporary cessation for the period spanning from 15 August to 15 September is therefore the preferred option economically.

6.5 Selection of best management tools

Based on the stock assessments provide at a regional level a reduction in fishing effort and capacity will be implemented. The best scenario based on the socio-economic –review scenario 2 is deemed the most beneficial.

On this basis the DFA will be reducing fishing effort through the introduction of a capacity reduction plan targeting 20% reduction in capacity and the reduction in effort by a further 10% through the introduction of a temporary cessation for the period spanning from 15 August to 15 September.

This option will ensure that if the capacity reduction initiative is not successful in reducing the fishing effort, the temporary cessation will at least reduce the effort by 10% which is equivalent to the fishing effort that is normally dedicated in the 15 August to 15 September period.

The definition of harvest control rules, due to very low contribution of the Maltese bottom otter trawling in terms of total landings, and the shared nature of the stock, can only be done jointly for all fleets exploiting the same stocks. This opinion is also found in the analysis put forward by STECF which, for the same reasons, also establishes that Malta's proposed reduction in effort is excessive but that would still have little impact on the overall mortality on these shared stocks. Therefore if harvest control rules were to be deemed to be required, it is necessary to establish these through regional mechanisms and not though national and unilateral management plans.

6.6 Implementation of management measures

The 20% capacity reduction is to be concluded by end of 2016, while the temporary cessation of one month closed season will be implemented as from 2014 for the next three years.

6.7 Review of management measures

The review of the management measures will be conducted in 2016, unless there is a drastic change in the stock assessment/economic situation of the fishery. In such cases the review should take place earlier.

7 Conclusion

The Department of Fisheries and Aquaculture believes that the projected actions in this document provide a coherent plan for safeguarding the long-term future of the FMZ.

It should be noted that the stocks being managed under this management plan are shared stocks and the contribution of landings by the Maltese fishing fleet, when compared to landings of neighbouring countries are insignificant. On this basis efforts should be made so as to agree and implement management plans on a regional level to achieve the desired outcomes and to be in a position to implement more concrete measures. Nonetheless, the Department of Fisheries and Aquaculture will do its utmost to implement effective monitoring and control measures focusing on gear selectivity in order to ensure that all fishing activities within the FMZ are conducted in a responsible and sustainable manner.

This plan should be treated as a 'living document' with ongoing processes for reviewing, evaluating and amending the plan as needed. Regular review of the progress in implementing the plan and its impact to the fishery will result in continual re-examination of and improvement to policies, procedures and legislation.

Annex I - Lampara

1.1 Description of Fishery

Coastal pelagic fishing in the Maltese Islands has been practised for a very long time and at least since the 1930s when the use of the 'lampara' was first recorded locally. The lampara is a surrounding net with purse seines. The term 'lampara' is used because fishers use strong lights to attract fish, which are then caught by purse seining.

Fishing takes place all along the North side of the island but the main zone is around a shallow area covering about 13 square kilometres, known as Hurd bank located 11.5 km to the South East of the Maltese Islands. The minimum depth at Hurd Bank is approximately 50 m with the intermediate area descending to a maximum of 100 m. The fishing operation is usually undertaken from 7 p.m. to 3 or 4 a.m. Two or three small boats (tenders) use strong lights to attract the fish. When sufficient fish have been attracted, the tender signals to the purse seine and switches off the lights. Then the purse seiner surrounds the fish school, the net's purse line is closed and net is pulled out of the water.

Species targeted in this fishery in 2012 include in particular species of mackerel and mackerel like fish (Scomber japonicus, Trachurus spp., Sarda sarda), sardinella (Sardinella aurita), anchovy (Engraulis encrasicolus), bogue (Boops boops), sardine (Sardina pilchardus) and barracuda (Sphyraena sphyraena).

1.2 Fleet Structure and Capacity

In December 2012, 18 vessels were licensed to fish with the lampara. Whilst the majority of vessels are artisanal in nature (multi-purpose, luzzu and kajjik vessels), one large vessel is part of the fleet: which has a length of 27 m (compared to an average of 14 m for the rest of the fleet), gross tonnage (GT) of 97 (compared to an average of 25 for the rest of the fleet) and an engine power of 671 kW (compared to an average of 151 for the rest of the fleet).

Considering the entire fleet, vessel length ranges from 4.8 m to 27 m, and average vessel length is 14.8 m. Vessel gross tonnage ranges from 1 to 97, and average GT is 29. Vessel engine power varies ranges from 7 kW to 671 kW, and average power of the main engine is 180 kW.

The minimum, maximum and average of the dimensions of the lampara nets used by the Maltese fleet as in January 2013 are presented in Table 16 below.

Table 15: Minimum, maximum and average dimensions of Lampara nets

	Average	Max	Min
Length (m)	369.98	750.00	158.00
Width (m)	88.98	119.50	26.00
Meshsize (mm)	27.30	26.00	17.00

In order to better gauge the evolution and current capacity of the vessels licensed to use lampara gear, an indication of the 2006 - 2012 fleet capacity is presented below. As can be seen from Table 16: 2006 - 2012 fleet capacity data for the lampara fleet, fleet capacity of vessels using lampara, in terms of engine power and GT, has remained relatively stable in the 2006 to 2012 period. Nevertheless, a slight increase in kW and GT can be observed in 2009, even though the number of vessels decreased. This can be attributed to transfers of the lampara licences from one vessel owner to the other, as the new owners may have vessels of different engine power and GT.

Table 16: 2006 - 2012 fleet capacity data for the lampara fleet

Year	*Number of vessels*	*Average GT of vessels*	*Total GT of vessels*	*Average vessel length (m)*	*Average main engine power (kW)*	*Total main engine power (kW)*
2006	21	23	492	13	157	3306
2007	21	23	492	13	157	3306
2008	21	23	492	13	157	3306

2009	17	37	631	16	208	3529
2010	19	36	683	16	203	3865
2011	18	25	443	13	163	3305
2012	18	29	520	15	180	3236

1.3 Fishing effort

The available time series of effort data obtained from logbooks for vessels larger than 10 m and from market sales vouchers for smaller vessels, was used for analysis in this section. While market sales vouchers do not contain effort information, this could be estimated since fishing trips using this gear do not exceed more than one fishing day. Even though in 2012 landing officers monitored all lampara catches and recorded fishing effort information, which data is expected to be an improvement over the logbook and market sales voucher data, the latter data was still used for 2012 in order to keep methodology along the data series constant.

1.3.1 Effort Data

In order to assess whether the two fleet components which make up the Maltese lampara fishery contribute equally to the overall fishing effort, the percentage contributions of small vessels measuring less than 12 m length and of large vessels measuring over 12 m length were calculated. 12 m is the vessel length associated with vessels involved in artisanal fisheries.

Results show that the mean fishing effort exerted by small vessels in 2006-2012 was very low in terms of both kW*fishing days and GT*fishing days.

Table 17: Percentage contribution of vessels with <12 m length overall (LOA) to total lampara fleet effort. Effort data are represented in terms of kW*fishing days and GT*fishing days. SD = standard deviation.

<12m	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Mean**	**SD**
KW*fishing days	0.05	0.06	0.02	0.00	0.04	0.08	0.00	0.04	0.03
GT*fishing days	0.02	0.04	0.01	0.00	0.01	0.02	0.00	0.02	0.02

Table 18: Percentage contribution of vessels with >12 m length overall (LOA) to total lampara fleet effort. Effort data are represented in terms of kW* fishing days and GT*fishing days. SD = standard deviation.

>12m	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Mean**	**SD**
KW*fishing days	0.95	0.94	0.98	1.00	0.96	0.92	1.00	0.96	0.03
GT*fishing days	0.98	0.96	0.99	1.00	0.99	0.98	1.00	0.98	0.02

Due to the dominance of vessels measuring > 12 m LOA in the lampara fleet it is not necessary to carry out separate analyses for the two fleet segments.

1.3.2 Total Effort

The nominal annual fishing effort of the lampara fleet in terms of both kW*fishing effort and GT*fishing effort was stable in 2006 - 2008, before effectively doubling from 2008 to 2009. In 2010 fishing effort again decreased to levels similar to those observed in 2008. After only a small increase in effort in 2011, there was a drastic increase in fishing effort (by over 65%) in 2012 compared to the previous year.

Since there was no important increase in either mean vessel GT or mean engine power, and Figure 17 shows a much smaller increase in fishing days compared to the increase in kW*fishing effort and GT*fishing effort, this pattern may be attributed to increased fishing activities by the larger vessels in the Maltese lampara fleet.

Linear regression analyses were carried out for the increasing trends in fishing effort in terms of kW*fishing effort and GT*fishing effort for the period 2006 - 2012 in order to gauge the measure of variation in the data. The results returned low R^2 values (0.53 and 0.51 respectively), which confirms important inter-annual fluctuations in the data.

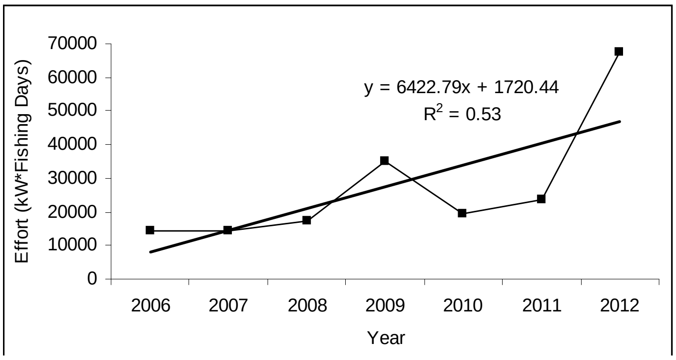


Figure 17: Temporal variation in nominal fishing effort, expressed as engine strength (kW)* fishing days, for the lampara fishing fleet, with fitted regression line.

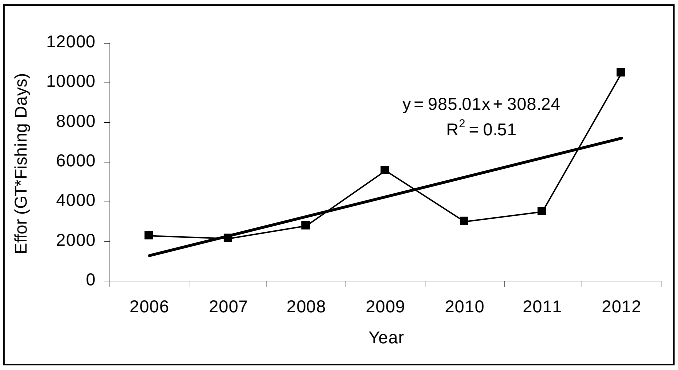


Figure 18: Temporal variation in nominal fishing effort, expressed as vessel gross tonnage (GT)* fishing days, for the lampara fishing fleet, with fitted regression line.

1.3.3Monthly Effort

An analysis of monthly variations in average fishing effort in both kW*fishing days and GT*fishing days showed low levels of fishing activity during the autumn / winter months of September – February, followed by a gradual rise in spring until reaching a clear peak in July.

Such information is important in relation to the biology of the two major target species, chub mackerel (Somber japonicus) and round sardinella (Sardinella aurita). The spawning season of both species is June-September, with a peak in July for chub mackerel. The peak reproductive period thus coincides with the period when the species are subjected to the highest fishing pressure.

Catch / effort control measures should target this period in order to allow the species to reproduce successfully and ultimately ensure long term sustainability of catches.

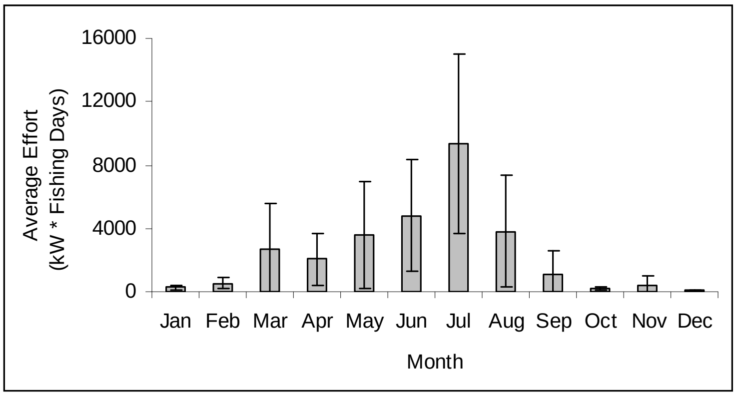


Figure 19: Mean monthly fishing effort (+/- 1 SD) for the lampara fishing fleet in 2006-2012; units are effort in engine strength (kW)* fishing days.

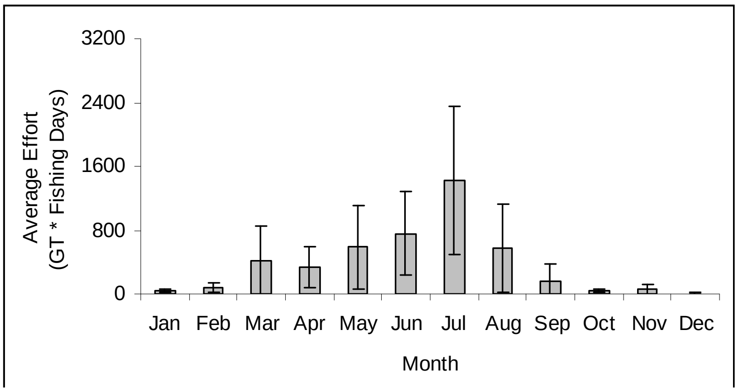


Figure 20: Mean monthly fishing effort (+/- 1 SD) for the lampara fishing fleet in 2006-2012; units are effort in vessel gross tonnage (GT)* fishing days.

1.4 Conservation Status of Stocks

Due to the low volume of landings, effort and value the 'lampara' metier was not identified by the ranking system referred to in Chapter III section B/B1 3 (1) (b) of the DCF (2008/949/EC). Consequently a series of data collected under the EU Data Collection Programme is not available to assess this fishery. Nevertheless, the available data was presented below and catch per unit effort (CPUE) was used in order to base advice for management.

1.5 Evolution of Landings

1.5.1 Evolution of Total Landings

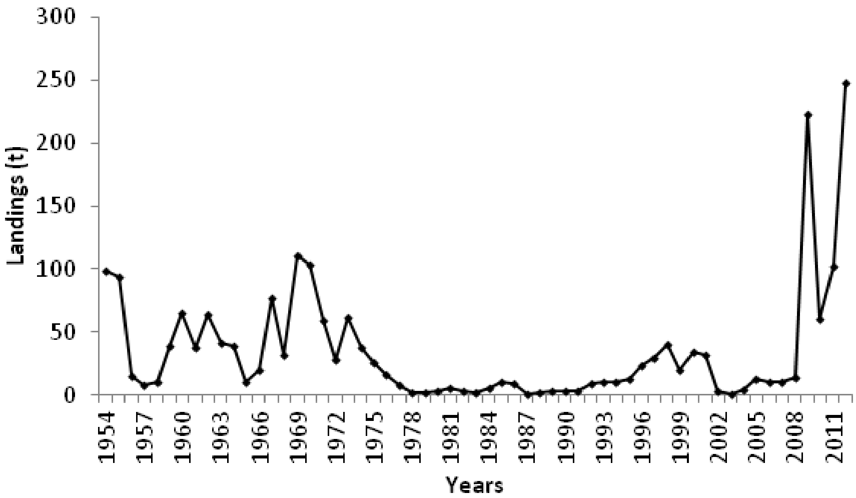


Figure 21: Chub mackerel (*Scomber japonicus*) landings recorded in the Maltese Islands in 1954-2012 (Source: Maltese National Statistics).

The pelagic species targeted by the lampara fishery used to be a very important part of the total national fish landings. Before the advent of the fisheries targeting swordfish and tuna and the targeting of demersal species such as hake and red mullet, the local market used to absorb all the catches, and especially chub mackerel was then, along with the dolphin fish, one of the most sought after species. Catch and effort for the lampara fishery have however decreased significantly since the 1960s, with an average of 27 tonnes of landings recorded in 2006-2008. The main reasons for the decline of the lampara fishery after the 1960s are the development of long-line fishing, starting with swordfish in 1964 (peaking in 1971) and the tuna fishery in 1993. These fish were more sought after by the consumer, and attracted higher prices. This is in particular the case with blue fin tuna, which is often exported directly to the Japanese market.

The percentage contribution of small (vessels with < 12 m length overall) and large (vessels with > 12 m length overall) was calculated in order to assess the relevant contributions made by the two fleet components which make up the Maltese lampara fishery.

Due to the dominance of vessels measuring > 12 m length overall in the lampara fleet it is not necessary to carry out separate landings analyses for the two fleet segments.

Table 19: Percentage contribution to total landings by small vessels (<12 m in length) and large vessels (>12 m in length) in the lampara fleet. SD = standard deviation.

	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Mean**	**SD**
<12	0.03	0.16	0.03	0.00	0.04	0.01	0.00	0.04	0.06
>12	0.97	0.84	0.97	1.00	0.96	0.99	1.00	0.96	0.06

Total annual landings of the lampara fishery were plotted and the trend analysed by a regression analysis. Linear regression shows that although there was an overall increasing trend, the trend was not linear due to important inter-annual fluctuations in the data (R^2 = 0.67).

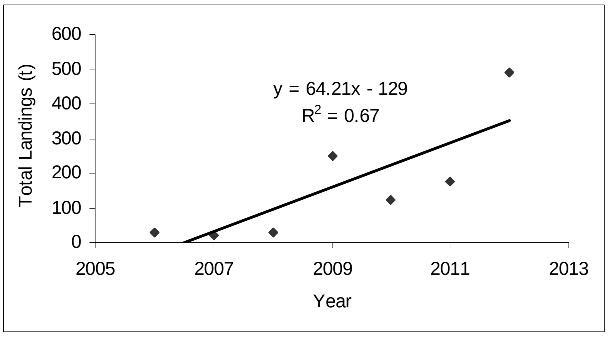


Figure 22: Regression analysis of total annual landings of the lampara fleet recorded in 2006-2012.

1.5.2 Species Composition of Landings

Detailed information on the species composition of landings is important to consider when managing a fishery. This is particularly the case if monthly catch / effort control measures are being considered for a multi-species fishery like the lampara. Monthly species composition of landings in this context need to be evaluated in order to effectively guide management measures aiming at (1) minimising the impacts of the fishery on by-catch, (2) effectively reducing fishing effort on those stocks showing the greatest signs of possible overexploitation, and (3) reducing the socio-economic impact of monthly control / effort management measures if species with different market value are being harvested.

Available landings data for the Maltese lampara fishery contains records of at least 42 different taxa. Due to a number of species which are very similar in appearance, data for landings of S. aurita may actually include more than one species. In order to solve for this problem in future years, monthly samples will be collected and the fish accurately identified and counted. The results from these samples will be extrapolated to the total landings.

Table 20: Landings (tonnes) of key target species of the lampara fishery obtained from logbooks and sales market vouchers.

		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Chub Mackerel	*Scomber japonicus*	10.74	10.51	13.37	223.09	60.33	102.43	248.41
Round Sardinella	*Sardinella aurita*	2.95	1.45	4.88	4.91	43.51	50.86	192.85
Jack Mackerel	*Trachurus spp.*	6.09	3.61	8.79	5.32	7.58	13.27	11.92
Anchovy	*Engraulis encrasicolus*	0.00	0.00	1.46	8.36	4.51	8.39	0.12
Bogue	*Boops boops*	2.80	1.43	0.96	2.99	1.86	0.64	5.35
Barracuda	*Sphyraena sphyraena*	0.00	0.52	0.08	0.00	0.23	0.03	0.00
Atlantic Bonito	*Sarda sarda*	0.00	0.21	0.00	1.18	0.29	0.02	0.03
Sardine	*Sardina pilchardus*	2.53	0.35	0.00	0.00	1.26	0.00	32.97
Other species		4.25	1.85	0.96	1.87	2.60	0.48	33.00
Grand Total		**26.82**	**19.58**	**30.51**	**247.71**	**120.91**	**176.12**	**491.67**

When landings information is plotted by species, it becomes clear that the rise in total annual landings observed in 2012 is due to two species: chub mackerel (Scomber japonicus) and round sardinella (Sardinella aurita).

Landings of chub mackerel were low in 2006 - 2008 (mean 12 tonnes), increased dramatically to 223 tonnes in 2009 before dropping to lower values in 2010 and 2011 (mean 81 tonnes) and rising to the highest levels recorded in the entire time series in 2012 (248 tonnes). Round sardinella landings were low in 2006-2009 (mean 4 tonnes) before increasing significantly in 2010-2011 (mean 47 tonnes) and again in 2012 (193 tonnes). Landings of all other species combined on average only contributed 25% to total catches.

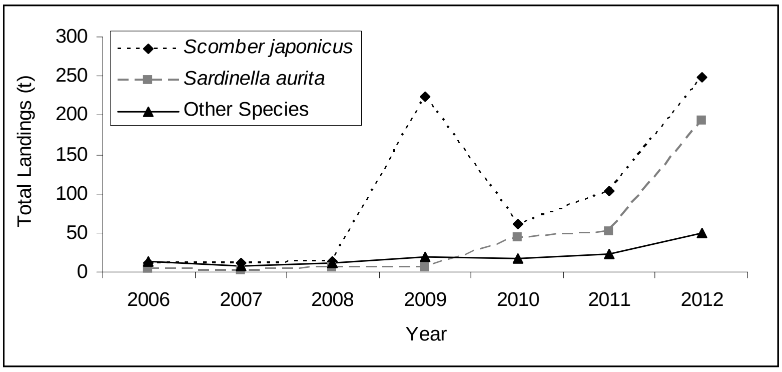


Figure 23: Total annual landings of the lampara fleet for the key target species chub mackerel (*Scomber japonicus*) and round sardinella (*Sardinella aurita*) compared to the combined annual landings of all other species recorded for the period 2006-2012.

An assessment was made to quantify the relative monthly landing contributions of chub mackerel, round sardinella and total landings of other species. Results show that non target species in 2006 - 2012 dominated catches during the months of October, November, December and January. Chub mackerel on average was the most important species caught in February-September. The relative contribution of round sardinella catches increased during the second and third quarters, but the species was never the dominant species in recorded catches.

Whilst these patterns give an indication of the species composition of monthly landing patterns, the recorded high standard deviation values show that there was considerable variation over the analysed time period.

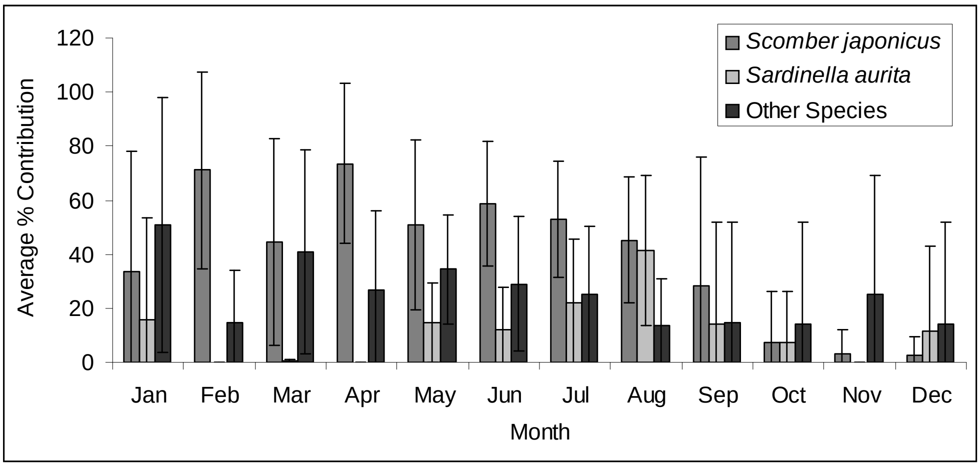


Figure 24: Relative contribution of chub mackerel (Scomber japonicus), round sardinella (Sardinella aurita) and other species as mean percentage contribution to total monthly landings (±1SD) recorded for the period 2006-2012.

1.6 MEDIAS Biomass Indices

The biomass indices (BI) for two main target species caught by the lampara fisheries were calculated using data from the MEDIAS survey. This survey uses Echosounders in order to collect abundance, biomass and other biological parameters for the target species; Engraulis encrasicolus and Sardina pilchardus. As shown in figure 25, Engraulis encrasicolus had a greater average BI (333.3 kg/km^2) than Sardina pilchardus (72.1 kg/km^2). While interannual fluctuations were observed for both species, over the last 4 years the biomass of E. encrasicolus showed an overall increase whilst that of S. pilchardus showed an overall decrease. Such interannual fluctuations are typical of small pelagic species. Furthermore it can be noticed that the BI of both species change antagonistically: when one species is abundant, the other is nearly absent.

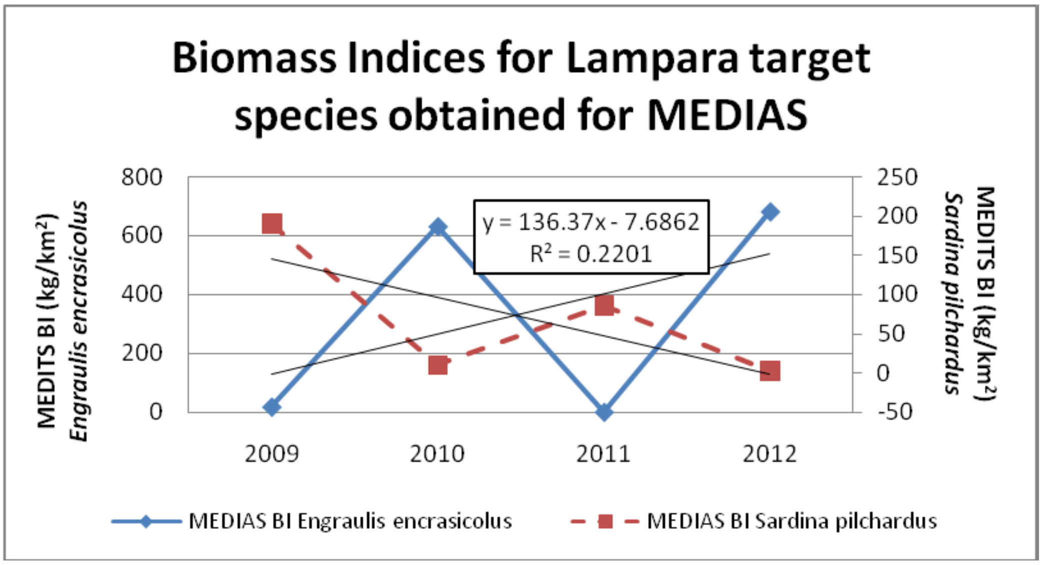


Figure 25: Biomass Indices for lampara target species obtained from MEDIAS

1.7 Catch per Unit Effort (CPUE) Data

1.7.1 Evolution of CPUE Trends

CPUE estimates provide a relative index of stock abundance; an increase in CPUE can be interpreted as a positive sign showing that species are not yet subjected to overfishing. However, inter-annual changes in CPUE can also be due to changes in fishing technology, stock abundance due to natural fluctuations in population productivity, and changes in the species targetted by fishers. All these aspects need to be taken into consideration when interpreting CPUE as an indicator. Moreover, particular caution needs to be applied in relation to stocks of small pelagic fish like chub mackerel and round sardinella. Due to the schooling behaviour of these species catch rates can remain steady for a considerable period of time even though the overall population size is is actually declining.

A CPUE analysis was nevertheless carried out for the two key target species Scomber japonicus and Sardinella aurita based on kW*fishing days and GT*fishing days.

Results showed increasing trends in CPUE for both species during 2006 - 2012; GT*fishing days and KW*fishing days give virtually identical patterns. Due to the nature of the data series and the strong inter-annual variations, linear regression analysis on the whole gave low values with regards to goodness of fit. Overall, the data seem to suggest that neither Chub Mackerel nor Round Sardinella are currently overfished.

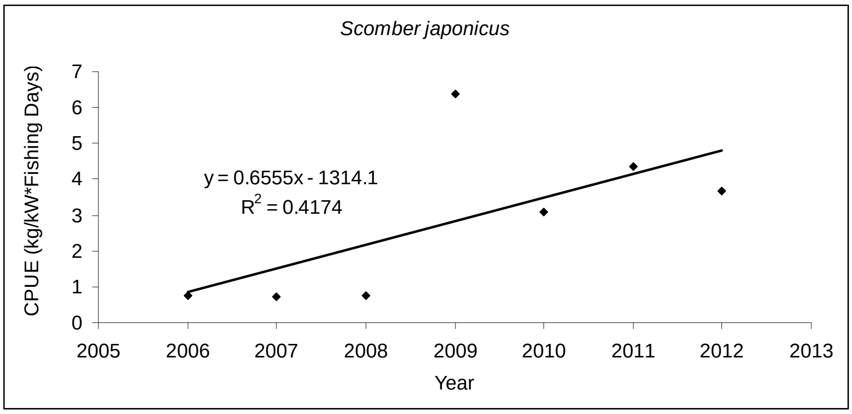


Figure 26: Catch per unit effort (as kg/kW*Fishing Days) for chub mackerel (Scomber japonicus) recorded in the Maltese lampara fishery for the period 2006-2012, with fitted regression line.

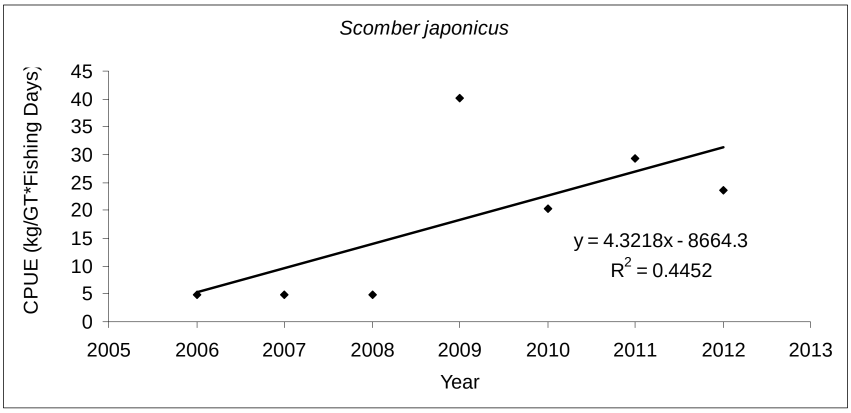


Figure 27: Catch per unit effort (as kg/GT*Fishing Days) for chub mackerel (*Scomber japonicus*) recorded in the Maltese lampara fishery for the period 2006-2012, with fitted regression line.

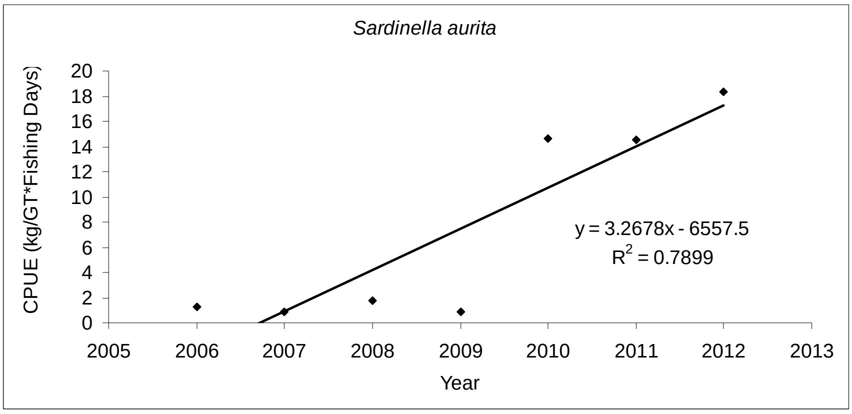


Figure 29: Catch per unit effort (as kg/GT*Fishing Days) for round sardinella (*Sardinella aurita*) recorded in the Maltese lampara fishery for the period 2006-2012, with fitted regression line.

1.7.2 CPUE Thresholds

In the absence of biomass target reference points such as 'maximum sustainable yield' from stock assessments, CPUE effort thresholds can be used as an alternative until sufficient biological data has been collected to carry out a full stock assessment. Since the lampara fishery is targeting small pelagic species, the limitations of the CPUE as a relative index of stock size need to be kept in mind, and lower threshold levels need to be set than would be required for demersal species.

CPUE thresholds were calculated for the two main target species, chub mackerel and round sardinella. The thresholds were only calculated for CPUE trends in kW*fishing days since effort data based on engine strength and gross vessel tonnage seem to be closely correlated for vessels in the Maltese lampara fishery.

Annual CPUE thresholds as well as monthly CPUE were calculated; the latter was deemed necessary due to the observed seasonal fluctuations in catch volumes. The CPUEs corresponding to the 25% percentile of the datasets are indicated in Table 21: Cumulative frequency of annual CPUE data in kg/kW*fishing days for chub mackerel (Scomber japonicus) landed by the Maltese lampara fleet during 2006-2012. The 25th percentile of the CPUE data is highlighted in bold. to Table 27: Monthly CPUE threshold limits for the Maltese lampara fleet based on 25th percentile of monthly CPUE recorded during 2006-2012. below, these can be used as minimum reference points for CPUE trends recorded for the lampara fleet.

In the case of annual thresholds, catches should not be allowed to fall under such reference points for three consecutive years, or any other time period deemed appropriate by policy makers. In the case of monthly thresholds, catches should be monitored on a quarter by quarter basis and if catches fall below the reference CPUE threshold, catch / effort restrictions as deemed appropriate by policy makers should be applied in the following quarter. Unless the CPUE subsequently recovers to above threshold levels, catch / effort restrictions should be continued during the following quarter.

The annual 25% threshold for chub mackerel and round sardinella catches lie at a CPUE of 3.09 and 2.15 kg/kW*fishing days, respectively.

Table 21: Cumulative frequency of annual CPUE data in kg/kW*fishing days for chub mackerel (Scomber japonicus) landed by the Maltese lampara fleet during 2006-2012. The

25th percentile of the CPUE data is highlighted in bold.

CPUE	Year	Cum. Freq.
0.73	2007	3.72
0.74	2006	7.46
0.77	2008	11.34
3.09	**2010**	**27.00**
3.67	2012	45.60
4.35	2011	67.61
6.40	2009	100.00

Table 22: Cumulative frequency of annual CPUE data in kg/kW*fishing days for round sardinella (Sardinella aurita) landed by the Maltese lampara fleet during 2006-2012. The 25th percentile of the CPUE data is highlighted in bold.

CPUE	Year	Cum. Freq.
0.13	2007	1.59
0.14	2009	3.35
0.20	2006	5.89
0.28	2008	9.39
2.16	**2011**	**36.41**
2.23	2010	64.32
2.85	2012	100.00

The months during which over 80% of landings of the two key target species chub mackerel (Scomber japonicus) and round sardinella (Sardinella aurita) were recorded during 2006-2012 were identified in order to determine the respective species' main fishing seasons (Table 21: Cumulative frequency of annual CPUE data in kg/kW*fishing days for chub mackerel (Scomber japonicus) landed by the Maltese lampara fleet during 2006-2012. The 25th percentile of the CPUE data is highlighted in bold. and Table 22: Cumulative frequency of annual CPUE data in kg/kW*fishing days for round sardinella (Sardinella aurita) landed by the Maltese lampara fleet during 2006-2012. The 25th percentile of the CPUE data is highlighted in bold.). Monthly CPUE thresholds were calculated for the relevant months (Table 25 and Table 26: Cumulative frequency of monthly CPUE data in kg/kW*fishing days for round sardinella (Sardinella aurita) landed by the Maltese lampara fleet during the months of May-August 2006-2012. The 25th percentile of the CPUE data is highlighted in bold.); for Scomber japonicus, on average 87% of landings were made in April – August, whilst for Sardinella aurita on average 95% of landings were made in May – August.

A summary of the monthly 25% threshold CPUE thresholds for chub mackerel and round sardinella catches which could be used as the basis of monthly safety thresholds to maintain the long term sustainability of catches are shown in Table 28.

Table 23: Percentage monthly contribution to total annual landings for chub mackerel (Scomber japonicus) landed by the Maltese lampara fleet during 2006-2012. The months which represent the main fishing season of the species are marked in bold.

	2006	2007	2008	2009	2010	2011	2012	Mean
Jan	0	4	0	0	0	2	0	1
Feb	17	3	13	0	1	0	0	5
Mar	11	1	0	4	15	5	4	6
Apr	3	45	12	1	2	13	14	**13**
May	12	5	1	11	6	8	23	**9**
Jun	16	7	18	7	26	27	17	**17**
Jul	29	9	23	69	48	29	25	**33**
Aug	11	15	34	8	1	17	17	**15**
Sep	1	8	0	0	0	0	0	1
Oct	0	4	0	0	0	0	0	1
Nov	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0

Table 24: Percentage monthly contribution to total annual landings for round sardinella (Sardinella aurita) landed by the Maltese lampara fleet during 2006-2012. The months which represent the main fishing season of the species are marked in bold.

	2006	2007	2008	2009	2010	2011	2012	Mean
Jan	0	0	0	0	2	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0
May	88	9	4	6	2	0	3	**16**
Jun	3	8	10	1	2	14	20	**8**
Jul	4	6	9	7	77	45	38	**27**
Aug	5	56	77	86	17	41	28	**44**
Sep	0	0	0	0	0	0	11	2
Oct	0	20	0	0	0	0	0	3
Nov	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0

Table 25: Cumulative frequency of monthly CPUE data in kg/kW*fishing days for chub mackerel (Scomber japonicus) landed by the Maltese lampara fleet during the months of April-August 2006-2012. The 25th percentile of the CPUE data is highlighted in bold.

Season	CPUE	Cum. Freq.	Season	CPUE	Cum. Freq.
Apr06	0.47	2.28	Jul07	0.32	1.54
Apr08	1.01	7.17	Jul08	0.53	4.08
Apr09	1.22	13.12	Jul06	0.81	8.00
Apr07	**2.88**	**27.09**	Jul10	2.66	20.86
Apr11	4.06	46.77	**Jul11**	**3.46**	**37.57**
Apr10	4.27	67.47	Jul12	3.98	56.78

Apr12	6.70	100.00	Jul09	8.95	100.00
May08	0.08	0.40	Aug10	0.21	0.40
May07	0.21	1.53	Aug07	0.95	1.53
May06	0.46	3.96	Aug08	1.05	3.96
May10	2.65	18.04	Aug06	1.31	18.04
May09	**4.20**	**40.32**	**Aug12**	**3.76**	**40.32**
May12	5.42	69.10	Aug11	4.67	69.10
May11	5.82	100.00	Aug09	5.72	100.00
Jun07	0.40	2.07			
Jun06	0.54	4.83			
Jun08	0.66	8.19			
Jun09	3.13	24.22			
Jun12	**3.31**	**41.16**			
Jun10	4.83	65.90			
Jun11	6.66	100.00			

Table 26: Cumulative frequency of monthly CPUE data in kg/kW*fishing days for round sardinella (Sardinella aurita) landed by the Maltese lampara fleet during the months of May-August 2006-2012. The 25th percentile of the CPUE data is highlighted in bold.

Season	CPUE	Cum. Freq.	Season	CPUE	Cum. Freq.
May09	0.05	2.01	Jul09	0.02	0.20
May07	0.07	4.79	Jul06	0.03	0.48
May11	0.11	9.14	Jul07	0.04	0.85
May08	0.17	15.80	Jul08	0.08	1.59
May12	**0.57**	**38.45**	**Jul11**	**2.62**	**26.68**
May10	0.59	61.87	Jul10	3.06	55.94
May06	0.96	100.00	Jul12	4.61	100.00
Jun09	0.01	0.18	Aug06	0.17	0.94
Jun06	0.03	0.67	Aug07	0.60	4.32
Jun07	0.08	2.22	Aug08	0.88	9.24
Jun08	0.14	4.79	Aug09	1.38	16.98
Jun10	0.25	9.50	**Aug10**	**4.37**	**41.47**
Jun11	**1.66**	**40.79**	Aug12	4.70	67.82
Jun12	3.14	100.00	Aug11	5.74	100.00

Table 27: Monthly CPUE threshold limits for the Maltese lampara fleet based on 25th percentile of monthly CPUE recorded during 2006-2012.

Species	Month	CPUE Threshold
Chub Mackerel	April	2.88
	May	4.2
	June	3.31
	July	3.46
	August	3.76
Round Sardinella	May	0.57
	June	1.66
	July	2.62
	August	4.37

1.8 Stock Assessments

All stocks targeted by the Maltese lampara fishery are stocks shared with Sicily due to the population distribution over the Malta Bank, which connects the Maltese Islands with Sicily. Stock assessments of the relevant species will thus have to be carried out in collaboration with Italy.

Stock assessment information for the Central Mediterranean is at present not available for chub mackerel (S. japonicus) and round sardinella (S. aurita).

Malta's relative contributions to the landings of the main species caught with the lampara in the Central Mediterranean are presented in Table 28: Central Mediterranean landings (t) of species targeted by the lampara fishery. Malta's values include landings from all of the Maltese fleet and not only from the lampara fishery. Source: GFCM Production Statistics; reference year 2010. below. Malta's contributions towards catches of these species are below 10 % for the majority of the species except for Sardinella aurita which is slightly higher (24.9%). This slightly higher percentage can be attributed to the grouping of clupeoids under one name for the Maltese landings data.

Table 28: Central Mediterranean landings (t) of species targeted by the lampara fishery. Malta's values include landings from all of the Maltese fleet and not only from the lampara fishery. Source: GFCM Production Statistics; reference year 2010.

English Name	*Scientific Name*	*Italy*	*Malta*	*% Contribution*
Chub Mackerel	*Scomber japonicus*	594	61	9.3
Round Sardinella	*Sardinella aurita*	130	43	24.9
Jack Mackerel	*Trachurus* spp	1708	13	0.8
Anchovy	*Engraulis encrasicolus*	13898	5	0.0
Bogue	*Boops boops*	1160	39	3.3
Sardine	*Sardina pilchardus*	2435	0	0.0

An attempt at performing a surplus production model was made by the Maltese Authorities, however, the model fit to the data was very poor, rendering use of the model for fisheries management purposes scientifically unjustifiable. The Department of Fisheries and Aquaculture identified the following reasons why the available data are not suitable for such an analysis:

1. The available time series of catch and effort data is very short.
2. Discard data are not available for this fishery.
3. Due to the assumptions made by the surplus production model, results can only be reliable if all catches taken from a population are included; in the present case, both Maltese and Italian catch and effort data would need to be included in the analysis, especially since the Maltese catch is very small compared to the Italian catch and the same stock is targeted by both fishing fleets.
4. No estimates of how catchability changed over time are available.

1.9 Impact on the By-Catch Species and the Environment

By-catch species which have been recorded in landings in 2006-2011 are: Sarda sarda, Sphyraena sphyraena, Loligo vulgaris, Oblada melanura, Auxis thazard, A. rochei, Sarpa salpa, Euthynnus alletteratus, Seriola dumerili, Trachinus spp, Caranx crysos, Serranus cabrilla, Dentex spp, Phycis spp, Sepia officinalis, Pagrus pagrus.

The Maltese Authorities are in the process of obtaining more statistical information on the above. However, this is not expected to have any bearing on the management plan, as these species will only form a very insignificant percentage of the catches in the Central Mediterranean.

1.10 Socio-Economic Characteristics of Fishery

The economic performance of the vessels using the ‘lampara’ gear is based on a set of variables and indicators which were calculated using the economic data collected annually for the purpose of the EU Data Collection Programme by means of a sample survey. Due to the small scale nature of this fishery, the majority of the fishers surveyed do not have any accounting practices and thus values obtained cannot be considered as precise.

It is very important to note that vessels using the lampara gear adopt a multiple-fisheries approach throughout the year. Economic variables specifically related to the lampara fishery started being collected only since 2011 (reference year), for use in the management plans, since the EU Data Collection Framework only targets indicators by vessel. The sampled population is defined as the entire commercial Maltese fishing fleet which includes the entire full-time commercial (MFA) and part-time commercial (MFB) fishing vessels. Both inactive and active vessels were considered.

In order to obtain an approximation of economic indicators specifically for the lampara gear, energy costs, repair and maintenance costs, variable costs, wages and salaries were divided by the proportion of hours worked with this gear (there was no data of previous years so the proportion in 2011 was used on data of all years). Economic indicators that are not directly related to the fishing gear in question were removed for clarity.

The different regulations upon which the National data collection was based that is, DCR (Data Collection Regulation) and DCF (Data Collection Framework) introduced differences in the type of data collected and consequently the variables available. Data collected for the reference years 2006 and 2007 is based on the DCR, while data collected for the reference years 2008 until 2011 are based on the DCF. The table below includes the values for the economic variables and indicators for the years 2006-2011. A detailed description of the sampling approach used to collect economic variables is given in Annex 3.

Table 29: Values for the economic variables and indicators for the lampara fleet, years 2006-2011. For definitions of the variables and indicators used refer to Annex 3.

		2006	2007	2008	2009	2010	2011
Economic Variables							
Gross Value of landings	EURO	28,165	62,509	110,955	105,421	23,849	191,353
Other income	EURO	N/A	N/A	0	0	0	0
Total income	EURO	28,165	62,509	110,955	105,421	23,849	191,353
Energy costs	EURO	13,171	14,478	42,073	21,784	35,991	53,138
Repair and maintenance costs	EURO	3,184	1,994	4,301	3,270	2,882	8,141
Variable costs	EURO	13,410	12,288	24,851	15,021	5,273	1,185
Non-variable costs	EURO	2,098	4,049	4,988	1,985	4,132	8,508
Total costs		31,863	32,809	76,213	42,060	48,278	70,972
Economic Performance Indicators							
Operating Cash Flow (OCF)	EURO	-17,514	6,849	17,937	48,879	-47,111	86,470
Social Variables							
Wages and salaries of staff	EURO	13,816	22,851	16,805	14,482	22,682	33,911
No. of employees	NUMBER	25	47	13	29	26	N/A
No. of FTE National	NUMBER	N/A	N/A	26	29	21	25

The highest gross value of landings and total income was experienced during the year 2011 with value of landings amounting to €191,353. Since there were no other sources of income in 2011, €191,353 is also the total income. The highest costs during the years 2006 and 2007 were spent in wages and salaries, followed by energy costs. As for the years 2008 through to 2011 the highest cost is that of energy. The lowest cost value for the all the years is that of non-variable (fixed) costs, except for 2011 where the variable costs are the lowest ones. The increase in non-variable costs was accompanied by a decrease in variable costs in 2011, the variable costs probably decreased due to the fact that fisherman were asked for costs related to lampara fishing gear only in 2011.

As a conclusion the best year in terms of operating cash flow is the year 2011 with a value amounting to €86,470.

Annex 2 - Bottom Otter Trawlers

1. Fisheries Characteristics

Different types of trawling activities are undertaken during the year, these can be grouped in Deep sea trawling during the day and night in where red shrimps (Aristaeomorpha foliacea and to a lesser extent Aristeus antennatus) are targeted. When fishing red shrimps there are low quantities of by-catch, except for small marketable by-catches of forkbeard

(Phycis blennoides) and hake (Merluccius merluccius). The trawling grounds are found in an area about 13 km to the North West of Malta. Since the terrain is composed of mud, and free from obstacles, the duration of each trawl is at least 4 hours, consequently advantage is taken of the long daylight in the summer as at least 3 trawls a day can be undertaken. The vessels with small engines cannot trawl at these depths.

Trawling in depths of around 200 m, (during the day) where the terrain is mainly muddy yields white shrimps (Parapenaeus longirostris), hake (Merluccius merluccius), red mullet (Mullus barbatus), octopus (Octopus vulgaris), squid (Illex coindetti), cuttlefish (Sepia officinalis) and marketable by-catches of dogfish, spotted dogfish, skate and rays (Raja spp.), bogue (Boops boops) and scad (Trachurus mediterraneus). These species are fished very close to land (around 6 km) and the activity is mainly carried out in winter, when the weather does not allow to fish in deeper waters by vessels that are licensed to operate in these waters.

Trawling at night in depths of between 50 and 150 meters where the bottom is hard and rocky, yields red mullet (Mullus barbatus), comber (Serranus cabrilla), Pandora (Pagellus spp.), squid (Illex coindetti), cuttlefish (Sepia spp.) and weaver (Trachinus spp.). This type of trawling is undertaken all along the Northern side of the island but the main zone is on the north-eastern side around Hurd Bank where stocks are more abundant. Trawl time can never be longer than one hour, since the rough terrain will put too much strain on the trawl nets and damage them. This allows for several trawls to be carried out during the dark hours. This trawling is restricted to vessels under 24 meters and engine power below 185 kW.

1.1 Fleet Structure and Capacity

Three types of licenses exist for the Maltese trawl fleet: license type A, where trawling is permitted within the 25 NM zone and in all waters outside the 25 NM zone, license type B, where trawling is permitted within the 25 NM zone in waters > 200m depth, and license type C, where trawling is only permitted in all waters outside the 25 NM zone. A total of 23 trawlers are currently licensed to operate on a full-time basis, 12 of which can operate within the 25 NM Malta FMZ (Table 30: Vessels licensed to use bottom otter trawl gear within the Malta FMZ.). Since the present management plan covers fisheries in the Malta FMZ, data and management measures presented will only cover the trawlers having a licence type A or B, unless stated otherwise.

Vessel length varies from 19.17 m to 23.95 m, with an average vessel length of 22.4 m. Vessel gross tonnage varies from 45.0 to 186.7 with an average gross tonnage of 88.1. Vessel engine power ranges from 147 kW to 538 kW, with an average power of 333 kW. The average age of the vessels is 34 years.

Table 30: Vessels licensed to use bottom otter trawl gear within the Malta FMZ.

License Type	Vessel Registration	Year of Construction	Vessel Length (m)	Gross Tonnage (GT)	Power (kW)
A Within 25 mile zone; All waters outside 25 miles zone	MFA0047	1967	19.3	54.72	185.01
	MFA0271	1957	19.17	45	176
	MFA0346	1959	23.92	69.72	179.04
	MFA0365	1983	19.4	64	147.06
	MFA6034	2006	23.4	145	171
	MFA7197	1962	23.7	85	184

B **Within 25 mile zone >200m;** **All waters outside 25 mile zone**	MFA0081	1996	23.95	106.46	538
	MFA0128	1954	21.8	50.05	328.24
	MFA0297	1993	23.95	186.7	538
	MFA0301	1966	23.95	66	469
	MFA0309	1995	22.21	90	375.24
	MFA7082	1995	23.9	95	410

The capacity of the Maltese Fleet within the FMZ at present (January 2013) is at 3,700.59 kW. This amount is slightly higher than the reference fishing capacity allocated for Maltese trawlers within the FMZ which corresponds to 3,600 kW (Article 26 para 3a of Council Regulation 1967/2006). This amounts to an excess of 2.79% of the total capacity. One should note however that the overall fishing capacity of the trawlers allowed to operate in the FMZ must not exceed the ceiling of 4,800 kW (Article 26 para 2a of Council Regulation 1967/2006).

In order to decrease the capacity level to 3,600kW the number of vessels has to be reduced by one. As a result at least one vessel should be removed from the vessels authorized within the FMZ.

1.2 Total landings over 2007-2011

The series of landings data available was evaluated. 2012 data was not included in the analysis as it was still being compiled at the time of preparation of this document.

1.2.1 Evolution of Total Landings

Total annual landings of the trawl fishery were plotted and the trend analysed by a regression analysis. Linear regression shows that although there was an overall increasing trend, the trend was not linear due to important inter-annual fluctuations in the data (R^2 = 0.63).

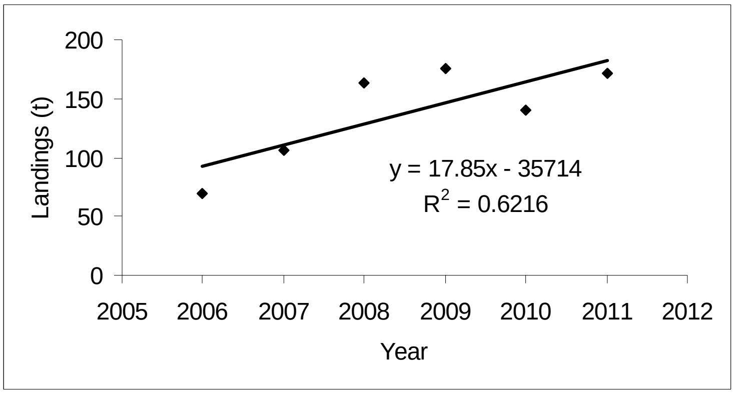


Figure 30: Regression analysis of total annual landings of the trawl fleet licensed to work within the Malta FMZ recorded in 2006-2011.

An analysis of monthly variations in mean landings during the period 2006-2011 showed lower levels of landings in the months of October – March, followed by a period with higher landings in April – September. This pattern mirrors the pattern of mean monthly fishing effort exerted during the same period, indicating that monthly fluctuations in landings are almost certainly due to variations in fishing effort, rather than being caused by seasonal fluctuations in the target populations. Since many of the species targeted by Maltese bottom otter trawlers are deep water species found on the continental shelf / slope, and which occur in habitats where there are much more subdued seasonal variations than in shallow waters, such a pattern can be expected.

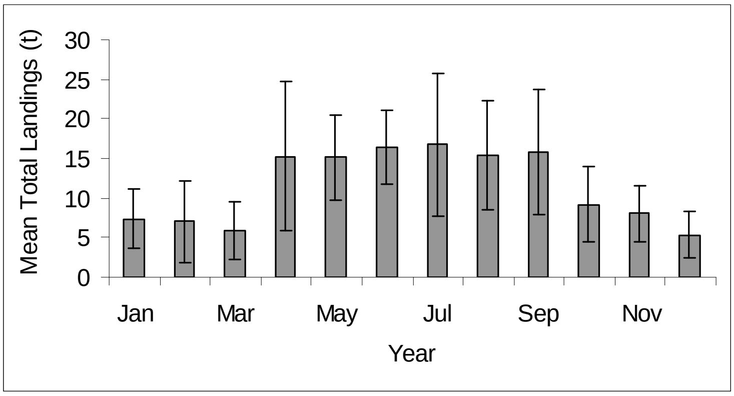


Figure 31: Mean monthly total landings (±1 SD) for the trawl fishing fleet in 2006-2011.

1.2.2 Species Composition of Landings

Detailed information on the species composition of landings is important to consider when managing a fishery. Whilst seasonal variations in species composition are likely to be less pronounced than, for instance, in a fishery targeting small pelagic fish, due to the nature of the species that the trawl fishery is targeting, it is important to note that the trawl fishery is a multi-species fishery. Species composition of landings in this context need to be evaluated in order to effectively guide management measures aiming at (1) minimising the impacts of the fishery on by-catch, (2) effectively reducing fishing effort on those stocks showing the greatest signs of possible overexploitation, and (3) reducing the socio-economic impact of monthly control / effort management measures if species with different market value are being harvested.

Available landings data for the Maltese trawl fishery contains records of at least 128 different taxa. An overview of key taxa fished by trawlers in 2006-2011 is presented in Table 31 below.

Table 31: Landings of key taxa fished by Maltese bottom otter trawlers in the Maltese FMZ during 2006-2011.

	Landings (t)					
Scientific name	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Aristaeomorpha foliacea	27.40	31.65	26.30	29.21	25.73	39.22
Boops boops	1.01	5.60	4.40	4.56	3.50	2.76
Lophius spp.	0.27	0.85	1.54	1.26	0.00	0.00
Merluccius merluccius	4.75	5.61	0.65	7.46	1.68	4.79
Mullus spp.	9.35	23.17	43.55	35.71	29.46	30.11
Nephrops norvegicus	0.01	0.63	1.21	1.49	2.57	1.74
Octopus spp.	1.22	1.57	3.09	1.05	1.02	0.84
Pagellus spp.	0.91	2.23	3.33	5.76	4.01	3.05
Pagrus pagrus	0.04	0.19	0.09	1.26	0.05	0.07

Parapenaeus longirostris	11.08	7.04	21.65	14.09	6.67	19.92
Raja spp.	1.32	3.24	4.64	5.87	4.70	6.07
Sepia spp.	1.18	2.54	6.18	12.36	8.37	9.83
Spicara spp.	0.12	4.60	4.17	5.54	8.73	8.66
Zeus faber	0.20	0.74	2.42	3.04	2.03	2.38
Other Species	10.55	16.38	40.53	47.16	40.98	42.42
Total	69.40	106.05	163.76	175.83	139.50	171.87

An analysis of trends in total landings of important target species (giant red shrimp, pink shrimp, hake, red mullet and striped red mullet) compared to landings of all other species combined during 2006-2011, revealed that (1) landings of giant red shrimp remained relatively stable during 2006-2010 but increased in 2011, (2) pink shrimp and hake landings underwent several fluctuations during the six year period analysed, (3) landings of red mullet and striped red mullet combined increased considerably during 2006-2008, and have been steadily decreasing since, and (4) there has been an important increase in the relative contribution to total landings by other species. The latter effect is due to an increase in landings of a variety of species, of which six were of particular importance during 2006-2011 (Table 32): common cuttlefish (Sepia officinalis), blue whiting (Micromesistius pouassou), Norway lobster (Nephrops norvegicus), common pandora (Pagellus erythriunus), golden shrimp (Plesionika martia) and unicorn octopus (Scaergus unicirrhus).

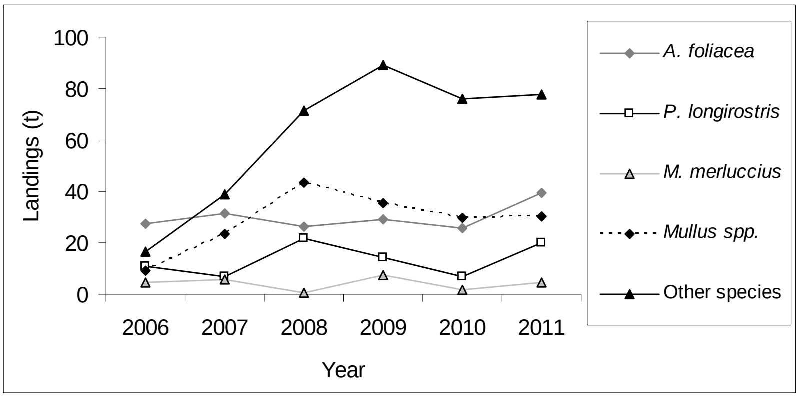


Figure 32: Total annual landings of the trawl fleet for the key target species: giant red shrimp (Aristaeomorpha foliacea), pink shrimp (Parapenaeus longirostris), hake (Merluccius merluccius), red mullet and striped red mullet (Mullus spp.), compared to the combined annual landings of all other species recorded for the period 2006-2011.

Table 32: Species characterised by an important increase in landings recorded from Maltese bottom otter trawlers in the Maltese FMZ during 2006-2011.

	Landings (t)					
Scientific Name	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Sepia officinalis	1.18	2.54	6.18	12.28	8.29	9.77
Micromesistius poutassou	0.01	0.00	0.09	6.04	8.11	4.51
Nephrops norvegicus	0.01	0.63	1.21	1.49	2.57	1.74
Pagellus erythrinus	0.90	1.81	3.32	5.50	3.98	2.99
Plesionika martia	0.00	0.00	3.49	3.07	4.24	6.73

Scaergus unicirrhus	0.00	0.00	0.00	5.14	4.98	4.12
Total	2.10	4.98	14.29	33.51	32.17	29.84

When mean monthly landings information is plotted, it becomes clear that as expected, there were no major fluctuations in the relative monthly contributions of the main target species to mean landings recorded in 2006-2011. Whilst these patterns give an indication of the species composition of the monthly landing, the high standard deviation values show that there was considerable variation over the analysed time period.

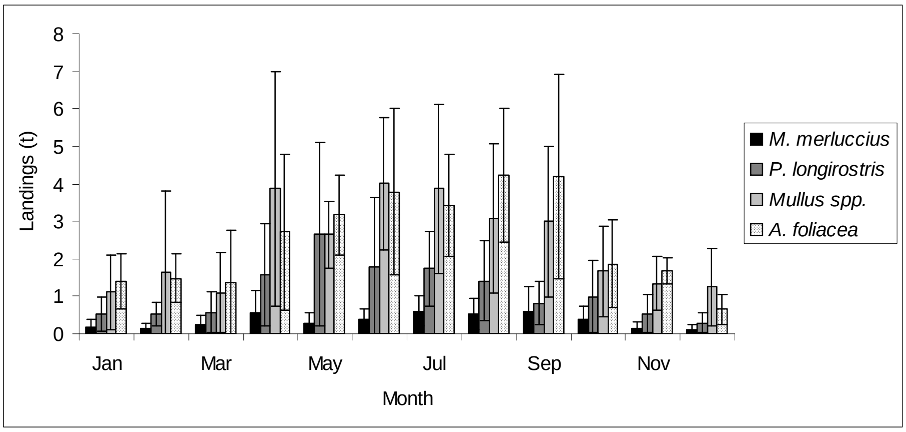


Figure 33: Relative contribution of the key target species: giant red shrimp (*Aristaeomorpha foliacea*), pink shrimp (*Parapenaeus longirostris*), hake (*Merluccius merluccius*), red mullet and striped red mullet (*Mullus spp.*), to total mean monthly landings (±1SD) recorded for the period 2006-2011.

2. MEDITS Biomass Indices

Apart from CPUE data, fisheries-independent data obtained from the annual spring-summer MEDITS survey, is used and presented below in order to show the trend of the main target species in the bottom otter trawl fishery.

The biomass index (BI) is a measure used in fisheries in order to provide an estimate of density of fish present in an area. Biomass indices (kg/m^2) for major target species caught by trawlers were computed. These included the following species:

- Merluccius merluccius
- Mullus barbatus and Mullus surmuletus
- Aristaemorpha foliacea
- Parapenaeus longirostris

The Biomass index for the European hake (M. merluccius) from 2007 till 2011 can be seen in Figure 34. There was a slight variance in BI over the last 5 years. Values ranged from 2.5 kg/km^2 to 3.1 kg/km^2. While BI remained constant between 2007 and 2009 at an average of 3.0 kg/km^2, a decline to lower levels was observed in 2010 (2.5 kg/km^2), with a slight increase in 2011 (2.7 kg/km^2). 2008 had the best BI (3.1 kg/km^2). Reasons for the decline in 2010 can be attributed to a higher fishing effort in 2009 causing a decline in the fish stock of hake.

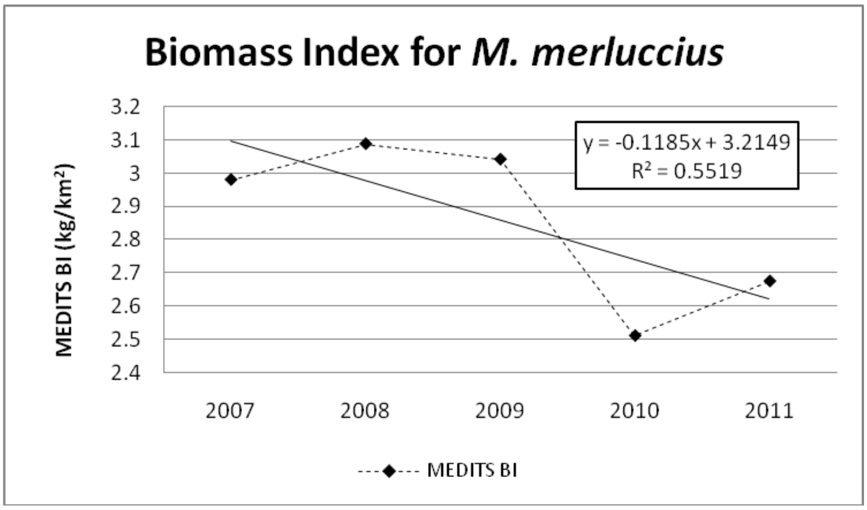


Figure 34: Biomass index for M. merluccius

Mullus spp. comprises the species Mullus barbatus and Mullus surmuletus. The BI for both species was plotted in Figure 35. M. surmuletus displayed a lower BI than M. barbatus (difference of 0.5 kg/km^2). The overall 5 year trend for these two species remained relatively stable with a slight decline. Trends of BI for one species were similar to the other with the exception of 2011. Indeed in this year M. barbatus displayed an increase in BI whilst M. surmuletus BI continued to decrease.

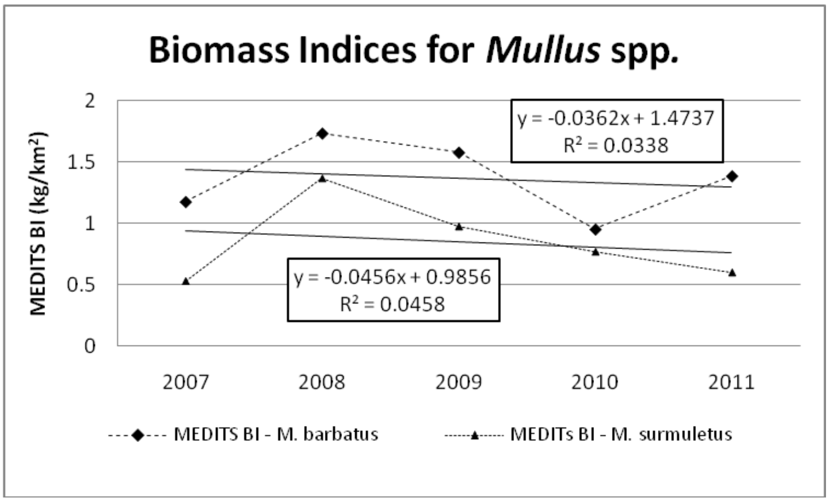


Figure 35: Biomass indices for Mullus spp.

The last two BI indices that were plotted below describe the BI of crustaceans. Figure 36 shows the BI index for Aristaemorpha foliacea. The stock population of A .foliacea increased over the last 5 years. This can be portrayed throught the staggered increments of BI values, were every two years a higher BI was achieved.

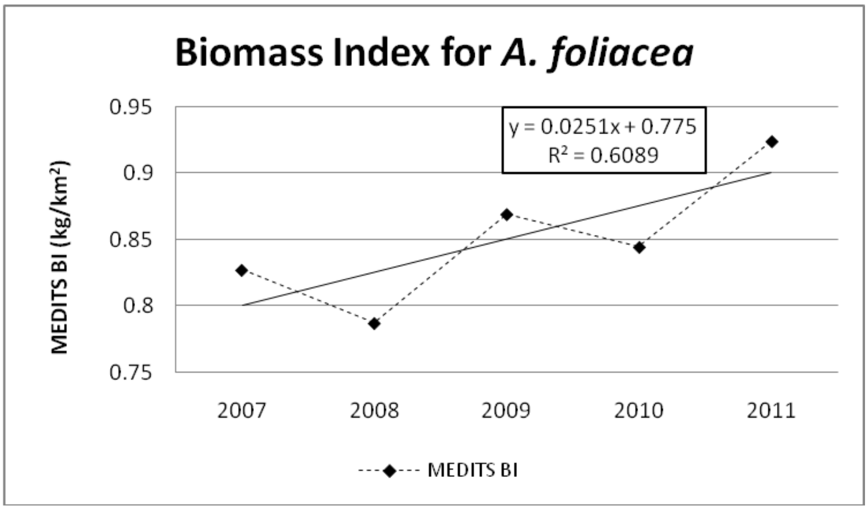


Figure 36: Biomass Index for A. foliacea

Parapenaeus longirostris (Figure 37: Biomass Index for P. longirostrisFigure 37) has a different graph profile than A. foliacea. The overall pattern for this species is very similar to that oberved for the Mullus spp, with an overall stable BI with a slight decline. An increase in BI can be observed from 2007 to 2009. Then, similarly to the other target species a decline BI for 2010 took place. The difference between 2009 to 2010 was that of 8 kg/km^2. This pattern in results can be used as a confirmation that a higher fishing effort was present in 2010. Populations of P. longirostris were given enough time to regenerate in 2011.

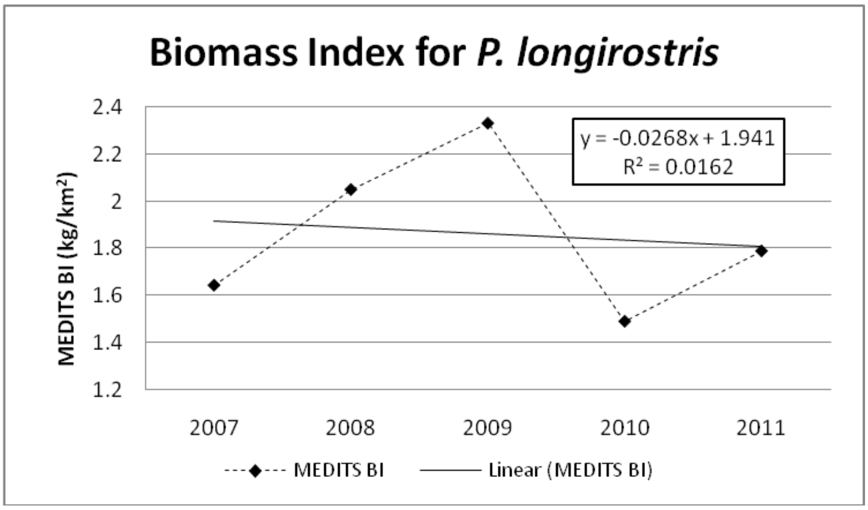


Figure 37: Biomass Index for *P. longirostris*

2.1 Fishing Effort

2.1.1 Evolution of CPUE Trends

Catch per Unit Effort (CPUE) estimates provide a relative index of stock abundance; an increase in CPUE can be interpreted as a positive sign showing that species are not yet subjected to overfishing. However, inter-annual changes in CPUE can also be due to changes in fishing technology, stock abundance due to natural fluctuations in population productivty, and changes in the species targetted by fishers. All these aspects need to be taken into consideration when interpreting CPUE as an indicator.

A CPUE analysis was carried out for the key target species: giant red shrimp (Aristaeomorpha foliacea), pink shrimp (Parapenaeus longirostris), hake (Merluccius merluccius), red mullet and striped red mullet (Mullus spp.), based on two nominal effort parameters: kW*fishing days and GT*fishing days. Since the trends were clearly not linear, no attempt was made at fitting regression lines.

Overall, CPUE for giant red shrimp, hake and pink shrimp decrease during 2006-2011, whilst CPUE for red mullet and striped red mullet combined increased in 2006-2008, before decreasing gradually back to 2006 levels during 2008-2011. The latter could be the result of an artefact since data is only available for the two species in an aggregated form; it is generally not advisable to combine CPUE indicators for several species. CPUE for all species during 2006-2011 expressed in terms of GT*fishing days and KW*fishing days give virtually identical patterns.

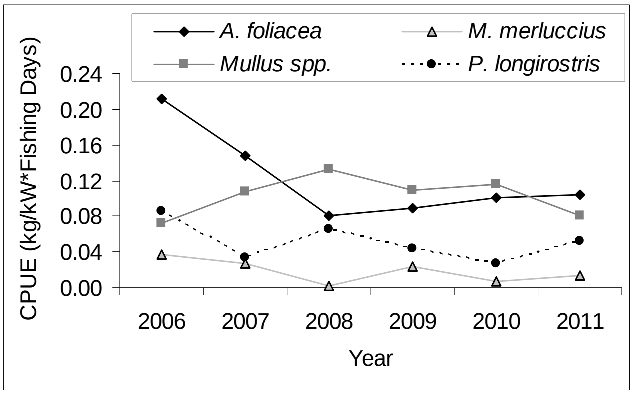


Figure 38: Catch per unit effort (as kg/kW*Fishing Days) for the key target species: giant red shrimp (*Aristaeomorpha foliacea*), pink shrimp (*Parapenaeus longirostris*), hake (*Merluccius merluccius*), red mullet and striped red mullet (*Mullus* spp.), recorded in the Maltese trawl fishery for the period 2006-2011.

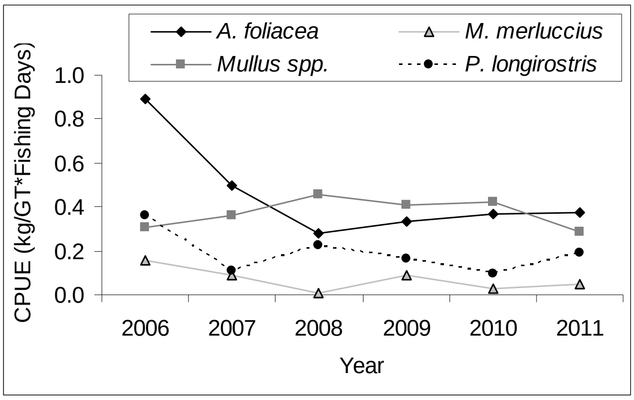


Figure 39: Catch per unit effort (as kg/GT*Fishing Days) for the key target species: giant red shrimp (*Aristaeomorpha foliacea*), pink shrimp (*Parapenaeus longirostris*), hake (*Merluccius merluccius*), red mullet and striped red mullet (*Mullus* spp.), recorded in the Maltese trawl fishery for the period 2006-2011.

CPUE can be used as an index of relative stock abundance and as such CPUE trends can be expected to be correlated with trends in biomass indices from fisheries independent data such as scientific surveys. In the case of the Maltese bottom otter trawl fishery, biomass indices are available from the annual MEDITS trawl survey. An attempt was thus made to correlate the commercial CPUE trends for each of the key target species: giant red shrimp (Aristaeomorpha foliacea), pink shrimp (Parapenaeus longirostris), hake (Merluccius merluccius), red mullet and striped red mullet (Mullus spp.), with trends in MEDITS biomass indices recorded during 2006-2011.

Since MEDITS surveys are carried out during the summer months (generally in May-July), an attempt was made to compare MEDITS biomass indices to commercial CPUE data recorded during the same period of the year by calculating mean monthly CPUE indices for May-July for the period 2006-2011 for each of the key target species being assessed. There was no improvement in the correlation between trends, so only the analysis using annual commercial CPUE as an index of relative stock abundance is presented below.

For giant red shrimp there was no correlation in trends in 2006-2008, possibly due to problems with the estimation of commercial CPUE trends. Trends in pink shrimp, hake and red mullet / striped red mullet commercial CPUE and MEDITS biomass indices were similar although not exactly correlated. Whilst survey biomass indices are estimated following a standardised scientific sampling protocol, commercial indices are influenced by changes in catchability. Improvements in fishing technology, changes in fishing gear, and in particular, fisher experience, can all affect commercial CPUE; it is possible that experienced fishermen maintain high CPUE even during periods of stock decline. Such a phenomenon could, for instance, explain why decreases in MEDITS biomass indices recorded for Mullus spp. seem to appear in commercial CPUE trends with a time lag

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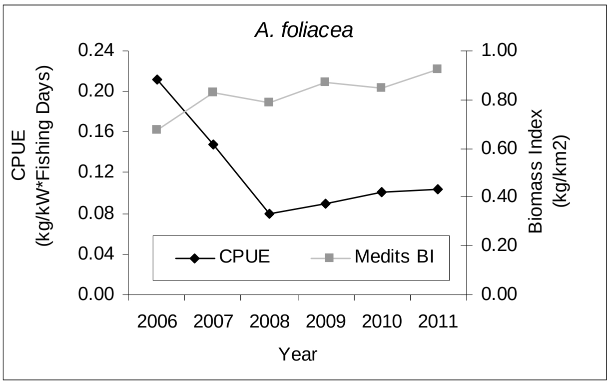


Figure 40: Trends in catch per unit effort (as kg/kW*Fishing Days) for giant red shrimp (*Aristaeomorpha foliacea*) recorded in the Maltese trawl fishery for the period 2006-2011, and in MEDITS biomass indices recorded during annual scientific surveys for the period 2006-2011. Both indices are shown for data from the 25 NM FMZ only.

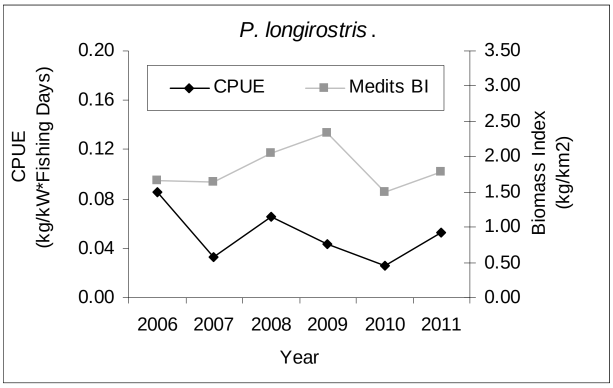


Figure 41: Trends in catch per unit effort (as kg/kW*Fishing Days) for pink shrimp (*Parapenaeus longirostris*) recorded in the Maltese trawl fishery for the period 2006-2011, and in MEDITS biomass indices recorded during annual scientific surveys for the period 2006-2011. Both indices are shown for data from the 25 NM FMZ only.

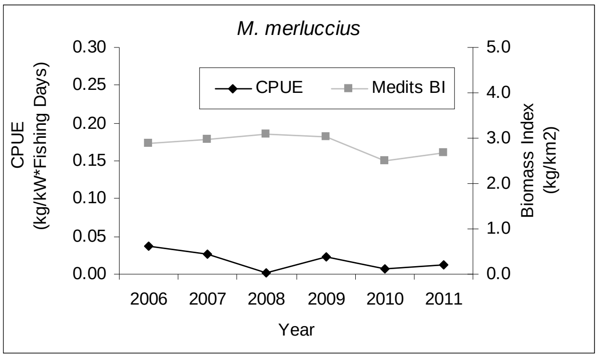


Figure 42: Trends in catch per unit effort (as kg/kW*Fishing Days) for hake (*Merluccius merluccius*) recorded in the Maltese trawl fishery for the period 2006-2011, and in MEDITS biomass indices recorded during annual scientific surveys for the period 2006-2011. Both indices are shown for data from the 25 NM FMZ only.

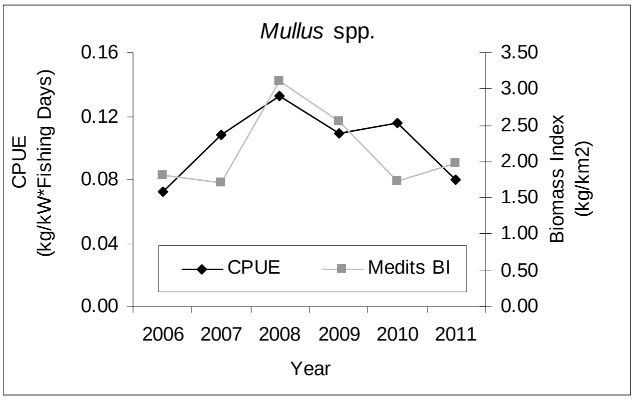


Figure 43: Trends in catch per unit effort (as kg/kW*Fishing Days) red mullet and striped red mullet (*Mullus* spp.) recorded in the Maltese trawl fishery for the period 2006-2011, and in MEDITS biomass indices recorded during annual scientific surveys for the period 2006-2011. Both indices are shown for data from the 25 NM FMZ only.

3. Biological characteristics of the main species caught

A brief description of the main target species distribution has been included in Table 33: Species distribution of targeted species below, while Table 34: Maximum age, maturity and spawning season of targeted species depicts information on the targeted species' age, maturity and spawning season. The information provided in the table has been gathered from several different literature reviews since such information is not available for the Maltese waters.

Table 33: Species distribution of targeted species

Scientific name	Vernacular name	Species distribution			
		Geographical Distribution	Species habitat	Bathymetric distribution	Spawning/ Nursery site
Aristaeomorpha foliacea	Giant red shrimp	Atlantic, the Mediterranean and Indo-Pacific. [3]	Benthopelagic, Lives on bottom mud and also on sandy bottoms.[3]	61 - 1300 m Moves to midwater at night [4]	N/A
Mullus barbatus	Red mullet	Eastern Atlantic, Mediterranean and Black Sea. [5]	Found on gravel, sand and mud bottoms of the continental shelf. [6]	10-300 m [6]	eggs and larvae are pelagic [5]
Mullus surmuletus	Red striped mullet	Eastern Atlantic, Mediterranean and Black Sea.[5]	Occurs on rough grounds but also found over sand and soft bottoms at depths less than 100 m. [6]	5-60 m [6]	eggs and larvae are pelagic [5]

Parapenaeus longirostris	Pink shrimp	Atlantic and Mediterranean Sea [7]	Bottom mud or muddy sand. [7]	Depth 20 to 700 m [7]	eggs and larvae are pelagic [5]
Merluccius merluccius	Hake	Eastern Atlantic, Mediterranean and Black sea [8]	Adults live close to the bottom during day-time, but move off-bottom at night. [8]	Found usually between 70 and 370 m depth [8]	N/A

Table 34: Maximum age, maturity and spawning season of targeted species

Species	Max Age	Maturity (L_{50})	Spawning Season
Giant red shrimp	N/A	(CL50) was estimated 42 mm for females, and 26 mm for males. [9] CL = carapace length	Females start maturing in March, reaching a peak between July and September [10]
Red mullet	N/A	L_m 11.1 cm [11]	late spring and summer (May, June, July) [11]
Red striped mullet	10 yrs [12]	L_m 16.0 [6]	May – July [5]
Pink shrimp	N/A	9.7 cm [13]	Spawns throughout the year peaking in December, April-May and September-October [13]
Hake	20 yrs [8]	42.8 cm [8]	January to May, peaking in February and May, (Tyrrhenian Sea) August to December, peaking in September and December. (Catalan Sea) [14]

3.1 Stock assessments

Stock assessments are available for the following species exploited by bottom otter trawlers in the Strait of Sicily: giant red shrimp (Aristaeomorpha foliacea), thornback skate (Raja clavata), red mullet (Mullus barbatus), common Pandora (Pagellus erythrinus), black bellied anglerfish (Lophius budegassa), pink shrimp (Parapenaeus longirostris) and hake (Merluccius merluccius). The assessment of thornback skate was classed as preliminary due to the limited time series of data available.

The biological reference points used for all three assessments were F_{cur} and $F_{0.1}$. F_{cur} refers to the present fishing mortality, and $F_{0.1}$ refers to the target fishing mortality taking into account the precautionary principle. Using $F_{0.1}$ as a target reference point, all of the assessed stocks were overexploited.

However, when taking into account the Maltese share of total landings (composed of vessels fishing both within and outside the Malta FMZ) made in the Central Mediterranean (see Table 35: Results of stock assessments conducted in 2011 and 2012; Fcur = current fishing mortality (F).) it is clear that any decision to reduce fishing effort needs to be taken together with the political authorities of neighbouring jurisdictions which are also targeting these shared stocks. In fact the Commission's Scientific, Technical and Economic Committee for Fisheries (STECF) advisory body when evaluating the previous draft version of the Maltese fisheries management system for trawl nets, boat seines, and surrounding nets within Maltese territorial waters as per Article 19 of Council Regulation (EC) 1967/2006, stated that it is impossible to 'identify actions that the MP can carry out unilaterally' since 'the resources are shared with other countries' and that the 'current status of the stocks depend few on the activity of the Maltese fleet'.

Table 35: Results of stock assessments conducted in 2011 and 2012; Fcur = current fishing mortality (F).

English Name	Scientific Name	F_{cur}	$F_{0.1}$	Stock Status	Maltese Share of 2010 Landings (%)
Pink shrimp	*P. longirostris*	1.20	0.92	Overexploited	0.07
Hake*	*M. merluccius*	0.60	0.1	Overexploited	0.23
Giant red shrimp	*A. foliacea*	1.09	0.42	Overexploited	2.04**
Red mullet	*M. barbatus*	1.3	0.45	Overexploited	3.6**
Common Pandora	*P. erythrinus*	0.72	0.30	Overexploited	4.8**
Black bellied angler	*L. budegassa*	0.3	0.16	Overexploited	1.6**

* Preliminary assessment; ** Excluding Tunisian landings.

In addition it is impossible for Malta to carry out stock assessments unilaterally for stocks shared with other countries: attempting a stock assessment for species with a data set which is only representative of < 5% of the catch is not feasible from a scientific point of view.

Moreover, Malta calculated the ratio between $F_{estimated}$ and F_{target} for the demersal species which were subject to a stock assessment at GFCM / SGMED in 2011: pink shrimp (Parapenaeus longirostris), giant red shrimp (Aristaeomorpha foliacea), hake (Merluccius merluccius) and Common Pandora (Pagellus erythrinus). In the absence of officially updated calculation guidelines, the indicators were based on the proposal made at the STECF meeting SGBRE 10 01. Instead of recording the proportion of the MS quota, the proportion of the MS catch on the total catch of the stock was recorded. The target F used in the calculations was $F_{0.1}$, which was the target F calculated in the stock assessments and which is considered to be a conservative proxy for F_{MSY}.

Table 36: Ratio between $F_{estimated}$ and F_{target} (F/Ft) for the Maltese bottom otter trawl (OTB) fleet in 2011.

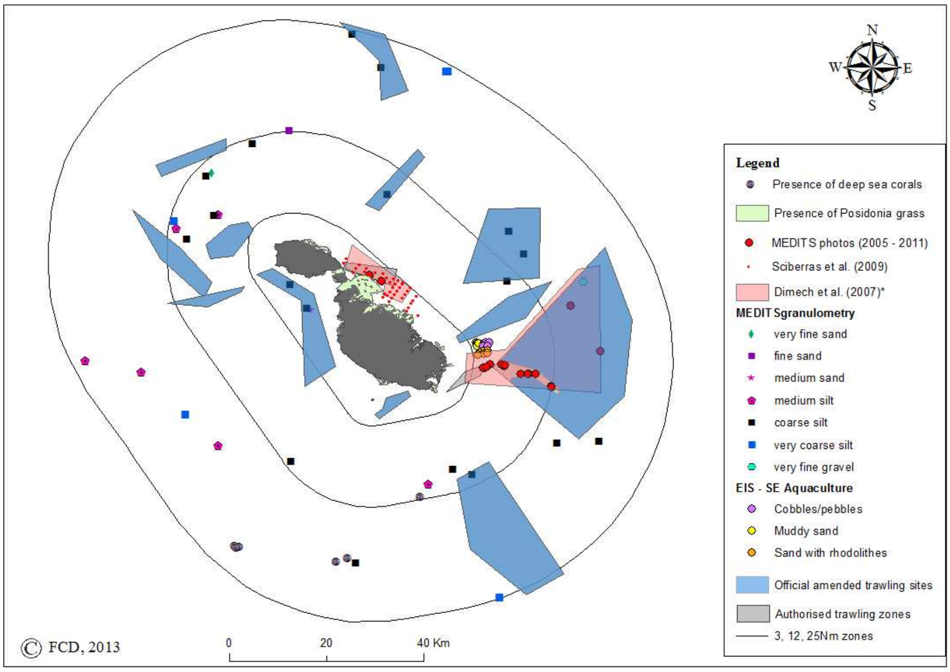
	Pink Shrimp	Giant Red Shrimp	Hake	Common Pandora	All other species and total
Catch in Fleet segment	7.3	27.4	6	7.11	Unknown
Total catch of the stock for all the countries	9641	1341.3	2173	319.08	Unknown
Current F (Stock assessment)	1.2	1.09	0.6	0.72	Unknown
Current F applied to fleet segment	0.001	0.022	0.002	0.016	Unknown
Target F (stock assessment)	0.92	0.42	0.1	0.36	Unknown
Quota of the Member State	0.1%	2%	0.3%	6.3%	Unknown
Target F split according to Member State quota	0.001	0.008	0.00028	0.02268	Unknown
F/Ft for species in the fleet segment	1.41	2.60	5.92	0.71	Unknown
Catch composition of fleet segment	3.80%	14.70%	3.20%	3.80%	75%(of 100%)
F/Ft weigthed by catch composition of assessed species	0.21	1.53	0.76	0.11	Unknown
Sum of all weighted F/Ft for the fleet segment	2.61	2.61	2.61	2.61	Unknown
Weight for each stock	0.15	0.57	0.13	0.15	Unknown
F/Ftarget multiplied by Weight for each stock	0.03	0.88	0.10	0.02	Unknown
Biological indicator ***(sum of all weighted F/Ft)***	**1.02**				
Percentage of fleet segment catch used for F/Ft calculation					25%

The above table shows that Malta is fishing the pink shrimp at $F_{0.1}$, below $F_{0.1}$ for the common pandora, while the fleet is overexploiting stocks above $F_{0.1}$ levels both for the giant red shrimp and hake.

Table 35 also indicates that taking into account regional catch data when available (no total landings data was available from Tunisian vessels for giant red shrimp and common Pandora), the ratio between $F_{estimated}$ and F_{target} (F/F_t) is one. This ratio indicates whether the individual fleet segment is catching more fish than would be expected under desirable fishing mortality rates from the entire national fleet. This value verges in between green and yellow in a traffic light system approach, since values larger than one are attributed a yellow colour. Nevertheless, these results can only be viewed in the light that due to the fishery being characterised by a high species diversity and that insufficient data is available for some of the non-prominent species to carry out analytical stock assessments, stock assessment results were only available for 25% of the fleet segment.

4. Environmental Impacts

4.1 Impact on Marine Habitats



A map showing bottom types and habitats overlying trawling areas (Figure 44) was compiled using currently available data and literature. This was carried out in order to analyse the impact of trawling on sensitive habitats within the Malta 25 NM FMZ.

Figure 44: Map showing the available information about the presence of sensitive habitats within the Malta FMZ, areas where trawling is authorised as per Annex V of Council Regulation 1967/2006/EC (marked as 'Authorised trawling zones'), trawling zones as amended trawling zones').

Figure 44 indicates that the most predominant bottom type around the Maltese Islands is silt varying in size from medium to very coarse. Parts of the coasts of the Islands are characterized by the presence of Posidonia oceanica (in green), with its distribution extending up to depths where light is available.

Live deep water corals Lophelia pertusa, Madrepora oculata and Desmophyllum dianthus were recorded in seven different locations within the FMZ [15-17]. The first two coral species, which although common as fossils or sub-fossils where until recently considered all but extinct from the Mediterranean, are together considered as reef building [15].

The presence of rhodoliths (in red dots) was recorded in two areas around the Islands: southeast of Malta between 3 NM and 17 NM off the coast and northeast to the Maltese Island with a maerl bed ca. 10 nautical miles long and between 1 and 3 nautical miles wide [18]. Whilst the maerl bed located to the NE of Malta has been mapped in detail [18], data on the precise boundary of the maerl bed to the SE of Malta is lacking. [19] provide any information about the methodology used in order to deduce the boundary of both maerl beds. It is thought that the boundaries presented in [19] are rough extrapolations of several points where maerl nodules have been recorded.

Zones C and G (parts of) as referred to in Annex V of Council Regulation 1967/2006/EC were found to be overlapping with maerl beds. In order to address this situation, the trawl zones were amended and all areas where conclusive evidence exists for the presence of maerl beds were closed to trawling in 2012.

4.2 Impact on Coastal Resources

Due to the impacts of trawling, it is advisable that such an activity is performed away from the coast. This zone, being under the direct influence of many physical processes and also much affected by human activities is continuously exposed to pressures. This is especially true in the Mediterranean sea where the vast majority of the fishing activities are concentrated along the continental shelf, resulting in serious concerns about overfishing of the shelf-associated resources [20]).

Since the Maltese Islands do not boast of a broad continental shelf it is important to protect shelf resources. [20] found that in Greece, a large part of the population of several commercially important species (e.g. Mullus barbatus, Pagellus erythrinus and Octopus vulgaris) (over 50%) is found in depths up to 100 m, indicating that shallow waters of the continental zone are very important for fisheries targeting these species. Similar results were found for Mullus surmuletus [21] and O. vulgaris [22] around the Maltese Islands.

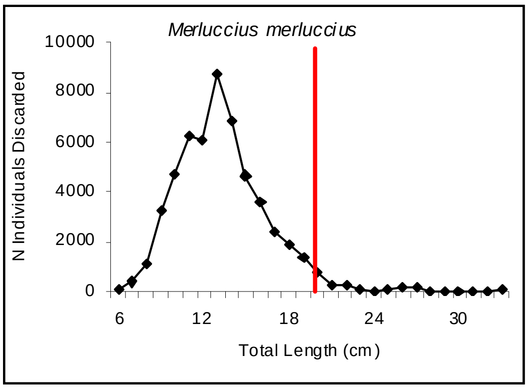
The authorised trawling zones as per Annex V of Council Regulation 1967/2006/EC) include areas which are either totally (zones A, B, D) or partially (zones C and E) found within 3 NM from the coast.

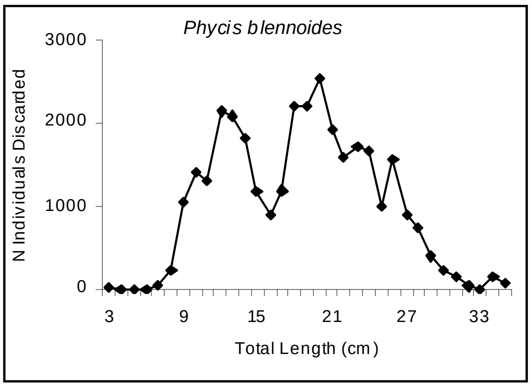
Permitting trawling within the 3 NM is surely having an impact on the Maltese artisanal fleet, whose activity is mainly coastal and whose catches depend on shelf productivity. It is advisable that such zones are removed from the 3 NM boundary such that coastal resources are protected from trawling activities and priority given to artisanal fisheries. This area, especially shallower parts, is very important for these fishers since small boats are not able to travel long distances. This area is also more productive when compared to deeper waters and provides much of the fish upon which the artisanal fleet depends. It is recognised that on an individual unit basis, artisanal fishing gear, which in some cases is quite selective and passive, may have limited impacts on the ecosystem [23].

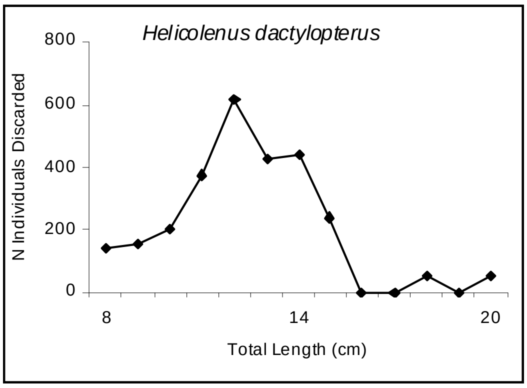
4.3 By-Catch and Discards

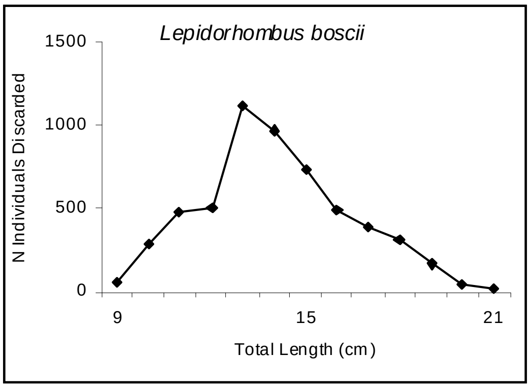
In order of decreasing importance the following discarded species were recorded in significant amounts (more than 1% of recorded discards) during 2011 on-board observations of Maltese bottom otter trawlers, irrespective of whether they trawl inside or outside the FMZ: blackmouth catshark (Galeus melastomus), greater forkbeard (Physis blennoides), small-spotted catshark (Scyliorhinus canicula), deepwater rose shrimp (Parapenaeus longirostris), giant red shrimp (Aristaeomorpha foliacea), four spotted megrim (Lepidorhombus boscii), velvet belly lanternshark (Etmopterus spinax), Norway lobster (Nephrops norvegicus), hake (Merluccius merluccius), blackbelly rosefish (Helicolenus dactylopterus), thornback ray (Raja clavata), longnosed skate (Dipturus oxyrinchus), rabbit fish (Chimaera monstrosa), several species of grenadier (Hymenocephalus italicus, Nezumia sclerorhynchus, Coelorhynchus coelorhynchus), argentines (Argentina sphyraena, Glossanodon leioglossus) and shortnose greeneye (Chlorophthalmus agassizi).

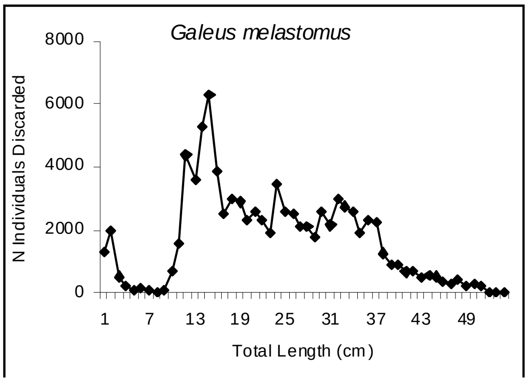
Average length frequency distributions of discards from all of the Maltese trawling fleet measured in 2009-2011 are displayed in Figure 45. The red line in the first and last two graphs indicates minimum landing size as per Council Regulation 1967/2006/EC respectively. This data pictures the situation prior to the adoption of the 40 mm square or 50 mm diamond mesh size at cod-end. Thus, a significant decrease in the volumes of discards following the change in mesh size in the cod end of Maltese trawlers is expected. DCF data will be analysed to monitor whether such a change has taken place once 2012 data becomes available.

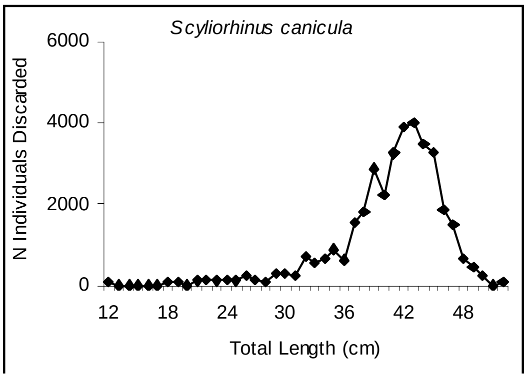

Merluccius merluccius
N Individuals Discarded
10000
8000
6000
4000
2000
0
6
12
18
24
30
Total Length (cm)

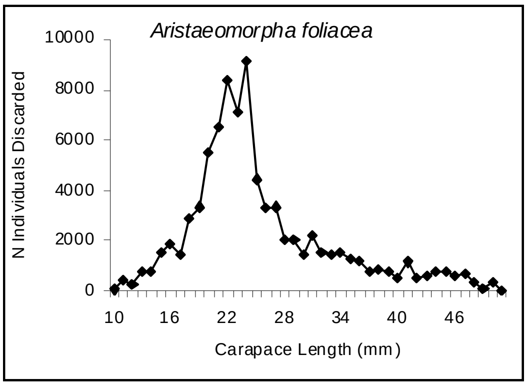

Phycis blennoides
N Individuals Discarded
3000
2000
1000
0
3
9
15
21
27
33
Total Length (cm)

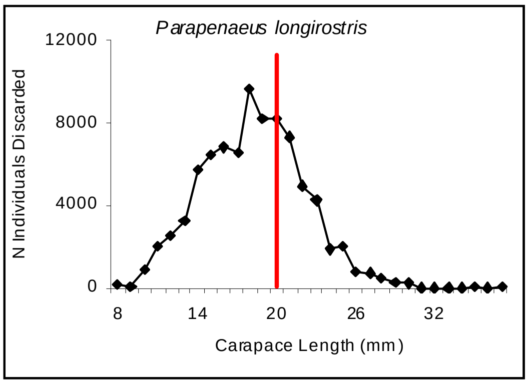

Helicolenus dactylopterus
N Individuals Discarded
800
600
400
200
0
8
14
20
Total Length (cm)


Lepidorhombus boscii
N Individuals Discarded
1500
1000
500
0
9
15
21
Total Length (cm)


Galeus melastomus
N Individuals Discarded
8000
6000
4000
2000
0
1
7
13
19
25
31
37
43
49
Total Length (cm)


Scyliorhinus canicula
N Individuals Discarded
6000
4000
2000
0
12
18
24
30
36
42
48
Total Length (cm)


Aristaeomorpha foliacea
N Individuals Discarded
10000
8000
6000
4000
2000
0
10
16
22
28
34
40
46
Carapace Length (mm)


Parapenaeus longirostris
N Individuals Discarded
12000
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32
Carapace Length (mm)

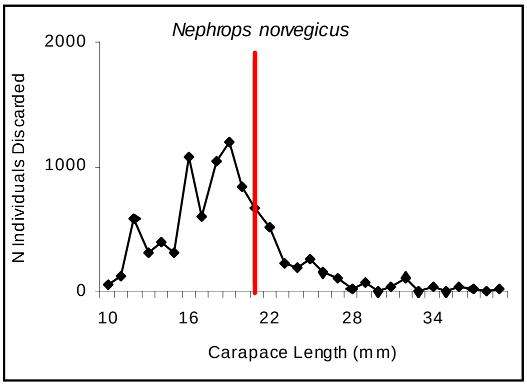

Figure 45: Average length frequency distributions of discards measured for the whole Maltese trawling fleet in 2009-2011; red line indicates minimum landing size as per Council Regulation 1967/2006/EC where applicable.

5. Socio-Economic Characteristics of Fishery

5.1 Capacity utilization

A technical indicator was calculated in order to estimate the ratio between the maximum effort that could in theory have been exerted by Maltese bottom otter trawling fleet and the effort which was in fact deployed. The indicator was calculated by taking the ratio between the average effort per vessel in the bottom otter trawl fleet segment and the observed maximum effort actually expended by a vessel in the segment in the reference year as recommended in the report of STECF meeting SGBRE 10 01. The calculation was carried out in both kW*days at sea and in GT*days at sea in order to take into account different vessel characteristics, in particular the fact that trawl vessels with larger engines have greater catches than those with small engines.

Capacity utilisation was estimated in reference to the maximum number of days fished. Table 36 shows the aggregated data used to calculate the technical indicator. The results (Table 38) show that overall between the years 2007 and 2011, capacity utilisation has increased.

Table 37: Data used to calculate fleet capacity indicator for the Maltese trawl fleet.

Year	Average days	Max. Days	Average of kW* days at sea	Average of Max KW* days at sea	Average of GT* days at sea	Average of Max GT* days at sea
2007	57	181	17107	62464	4871	15199
2008	83	282	30414	93451	8700	23123
2009	76	268	29718	97558	7757	22870
2010	62	215	22918	74950	5927	18068
2011	81	185	31089	64099	7851	16305

Table 38: Summary of the technical indicator for the Maltese trawl fleet.

	2007	2008	2009	2010	2011
Capacity Utilisation (days)	0.31	0.29	0.28	0.29	0.44
Capacity Utilisation (Kw*days)	0.27	0.33	0.30	0.31	0.49
Capacity Utilisation (GT*days)	0.32	0.38	0.34	0.33	0.48

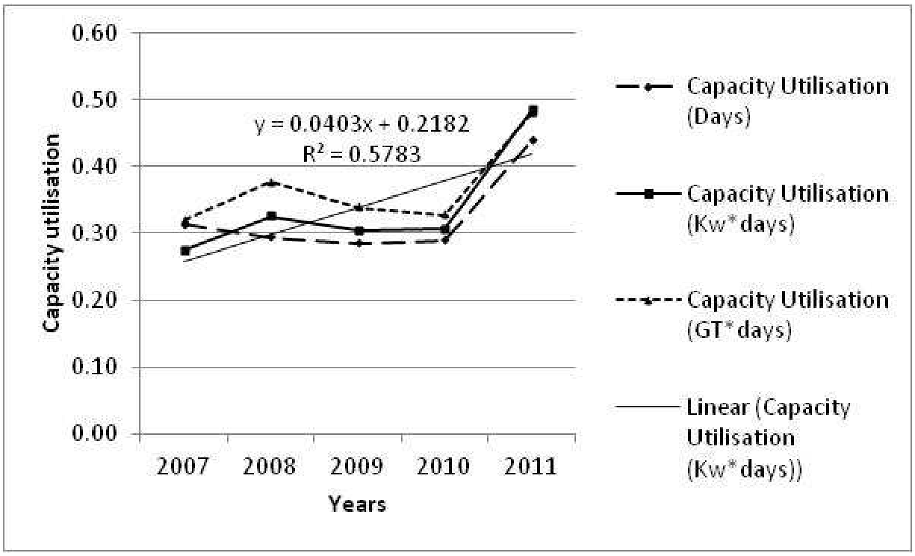

Figure 46: Ratio between actual per vessel effort deployed and maximum effort (observed and theoretical) for the Maltese bottom otter trawl fleet in 2006-2011.

The difference between the calculated indicator value and 1 indicates the technical under utilisation of the vessels. In the technological-economic approach that was adopted by FAO, full CU represents full capacity and its value is always less than or equal to one (CU<=1). If CU of one fleet is less than one, it means that the fleet can increase the production with the present state of capital or equipment or on other words that firm can raise the potential production without paying more for new capital or equipment [24]. The highest calculated indicator values were less than 0.5, indicating under utilisation of the fleet.

5.1.1 Economic performance of the trawl fleet

The economic performance of the trawl fleet is based on a set of variables and indicators which were calculated using the economic data collected annually for the purpose of the EU Data Collection Programme by means of a sample survey. Data collected is then extrapolated to the whole population to derive final estimates.

The sampling frame for the collection of economic data is based on the fishing vessel register information. The population is defined as the commercial Maltese fishing fleet which includes the entire full-time commercial (MFA) and part-time commercial (MFB) vessels fishing within the Malta FMZ. Both inactive and active vessels were considered.

The different regulations upon which the National data collection was based that is, DCR (Data Collection Regulation) and DCF (Data Collection Framework) introduce differences in the type of data collected and consequently the variables available. Data collected for the reference years 2006 and 2007 is based on the DCR, while data collected for the reference years between 2008 and 2011 is based on the DCF. Table 39 includes the values for the economic variables and indicators for the years 2006-2011. A detailed description of the sampling approach used to collect economic variables is given in Annex 3.

Table 39: Values for the economic variables and indicators for the trawl fleet, years 2007-2011. For definitions of the variables and indicators used refer to Annex 3 – Economic variables.

Trawlers		**2007**	**2008**	**2009**	**2010**	**2011**
Economic Variables						
Gross Value of landings	EURO	1,383,832	1,376,697	1,408,049	1,329,371	1,636,296
Other income	EURO	N/A	0	0	0	0
Total income	EURO	1,383,832	1,376,697	1,408,049	1,329,371	1,636,296
Energy costs	EURO	688,903	730,059	407,232	658,610	634,292
Repair and maintenance costs	EURO	122,992	183,708	152,105	97,236	89,363
Variable costs	EURO	286,927	485,937	71,247	278,321	500,044
Non-variable costs	EURO	41,089	63,740	12,780	183,827	571,047
Total costs	EURO	1,139,911	1,463,444	643,364	1,217,994	1,794,746
Economic Performance Indicators						
Operating Cash Flow (OCF)	EURO	16,926	-590,608	586,101	-215,031	-968,258
Social Variables						
Wages and salaries of staff	EURO	226,994	503,862	178,584	326,409	809,808
No. of employees	NUMBER	46	9	28	24	55
No. of FTE National	NUMBER	N/A	21	25	24	59

The economic data collection survey is a process that is improved every year, and since this table compares socio-economic variables over a number of years, new modifications were applied wherever possible to the data of previous years. The economic indicators above reflect the values of the section of the trawling fleet that operates in the Fisheries Management Zone (FMZ) only. This excludes larger vessels between 24 and 40 metres. Economic indicators that are not directly related to the fishing gear in question were removed for clarity.

The highest value for gross value of landings and total income was experienced during the year 2011 with values amounting to €1,636,296 in both cases. The lowest values were experienced during the year 2006 and amount to €936,589. These values were procured from the market and direct sales data as these have a higher probability of being accurate than the values given in the economic survey.

Energy costs are on average the highest cost as a fraction of total costs. On average, the lowest cost during the years is that of non-variable (fixed) costs, except for 2010 and 2011 where the non-variable costs increased and the repair and maintenance costs decreased slightly making them the lowest cost. The cost for wages and salaries for the year 2011 is the highest. One may state that a direct relationship between the cost of wages and salaries and the number of employees is present as the number of employees is equal to 55 which is the highest number of employees in all the years. Owners and co-owners are not part of this figure, therefore the workforce in terms of man hours, whether they are considered to be employees or not, is higher.

In conclusion the best year in terms of operating cash flow (OCF) was the year 2009 as this is the year where the OCF was the highest amounting to €586,101. 2011 was the worst year in terms of OCF, with a negative cash flow of €968,258.

Annex 3 – Economic variables

- Gross value of landings - turnover from the sales of landings.
- Subsidies- include direct payments such as compensation for stopping fishing or similar lump sum compensations. Excludes social benefit payments and indirect subsidies for example; reduced duty on inputs such as fuel.
- Other income - other income earned apart from the sales of landings, for example, tourist boat rides and recreational fishing.
- Income from leasing out quota and other fishing rights – fishers may earn income when selling quotas and fishing licences to other fishers.
- Total income – summation of the gross value of landings, subsidies, other income and income from leasing out quota and other fishing rights (where applicable).
- Energy cost (EnerCost) – fuel cost. Excludes lubrication oil.
- Repair and maintenance costs (RepCost) – gross cost of maintenance and repairs to the vessel and gear.
- Variable costs – (VarCost) includes all purchased inputs (goods and services) related to fishing effort and/or catch/landings.
- Non-variable costs (NoVarCost) - includes purchased inputs not related to effort and/or catch/landings.
- Lease/rental payments for quota and other fishing rights (RightsCost) – fishers may have bought additional/new quota and fishing rights.
- Annual depreciation - cost of capital
- Value of physical capital: depreciated historical value (TotDepHist) – value of depreciated capital valued according to historic prices; that is how much money was actually paid at the time when the asset was purchased.
- Value of physical capital: depreciated replacement value (TotDepRep) - value of depreciated capital valued according to current prices; that is how much money is to be paid if the asset would have to be replaced at present.
- Value of quota and other fishing rights – value of intangible assets.
- Investments in physical capital – improvements to existing vessel or gear during the reference year.
- Debt – total value of debt during the reference year.
- Wages and salaries of staff (CrewWageCost) – .remuneration for paid work.
- Imputed value or un-paid labour (UnpaidLab) – any labour which is not paid for is included. The value could include the owner’s own labour as well as that of other voluntary workers such as family members. This is calculated by estimating the number of hours of un-paid work multiplied by the average wage rate for the particular job done.
- Number of employees – number of persons working for and paid by the vessel.

- Number of FTE (full-time equivalent) employees - full-time equivalent (FTE) based on the national reference level for FTE working hours of the crew members on board the vessel (excluding resting time) and the working hours onshore. If the annual working hours per crew member exceed the reference level, the FTE equals 1 per crew member. If not, the FTE equals to the ratio between the hours worked and the reference level. The reference level in the case of Malta is 40 hours per week.
- Financial Position – debt-asset ratio.
- Running cost – summation of energy costs, repair and maintenance costs, variable costs and wages and salaries and lease/rental payments for quota and other fishing rights (where applicable).

List of definitions and formulas – Indicators

Indicator	Definition	Year	Formula
Gross Value Added (GVA)	Contribution to gross national product (GNP), Income minus all expenses except crew cost	2006-2007	Total income - sum(EnerCost + RepCost + VarCost + NoVarCost)
		2008-2009	Total income –sum (EnerCost + RepCost + VarCost + NoVarCost +RightsCost)
Operating Cash Flow (OCF)	Refers to the Gross Cash-Flow, Income minus all operational costs, excluding capital costs	2006-2007	Total income - sum(EnerCost + CrewWageCost + RepCost + VarCost + NoVarCost).
		2008-2009	Total income - sum(EnerCost + CrewWageCost + RepCost + VarCost +NoVarCost + RightsCost).
Economic Profit/Loss	Income minus all costs, including capital costs (Annual depreciation cost, inte rest cost is not applicable as the debt value is nil for all the years)	2006-2007	Total income -sum(EnerCost + RepCost + VarCost + NoVarcost + CrewWageCost + DepCost)
		2008-2009	Total income- sum(EnerCost + CrewWageCost + UnpaidLab + RepCost + VarCost + NoVarCost + RightsCost + DepCost)
Return on Investment (ROI)	Evaluates the efficiency of investment in tangible assets (vessel and gear, not fishing rights)	2006-2007	sum(Profit + Depcost) / Investment
		2008-2009	Sum (Profit)+ sum(totDepRep) * 'Country' Risk Free Bond Rate) / sum(totDepRep) NOTE: The ‘Country’Risk Free Bond Rate was 3.53%
		2010-2011	Sum (Profit)+ sum(totDepRep) * 'Country' Risk Free Bond Rate) / sum (totDepRep) NOTE: The ‘Country’ Risk Free Bond Rate was 3.75%

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SECOND SCHEDULE

[Article 3(1)]

Fisheries Management Plan
Lampuki FAD Fishery

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8 Conclusion

Annex 1 - Lampuki FAD Fishery

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Abbreviations

CPUE	Catch per Unit Effort
ENPV	Economic Net Present Value
FAO	Food and Agriculture Organisation
FAD	Fish Aggregating Device
FMZ	Fisheries Management Zone
OECD	Organization for Economic Co-operation and Development
STECF	Scientific, Technical and Economic Committee for Fisheries (STECF)

1. Introduction

The Maltese archipelago lies more or less at the centre of the Mediterranean, 93 km south of Sicily and 288 km north of Africa in a maritime area largely characterised by international waters.

Malta is geographically the smallest EU Member State and its coastline amounts to around 0.8% of the total EU coastline[*].

The Maltese fleet is predominantly small-scale with a rich and extensive artisanal portfolio. It accounts for around 0.03% of the total EU catch[**].

The Scientific, Technical and Economic Committee for Fisheries (STECF) notes that because most of the resources are shared with other countries, the current status of stocks depends little on the activity of the Maltese fleet. The STECF concludes that this fact creates many problems for identifying actions that the Management Plan can carry out unilaterally.

Malta's geographic position and size, the scale of its fishery, and the scale of its fishery, the spatial distribution of exploited stocks and fishing grounds shared with neighbouring EU and non EU countries, severely restrain the scope of any unilateral conservation effort and de-facto limit the applicability of Article 19 of Council Regulation 1967/2006.

2 The Common Fisheries Policy and the Mediterranean Sea

The Common Fisheries Policy (CFP) sets out the main framework for managing the fisheries sector in the EU. Because of the characteristics of the Mediterranean fishery, EU catch limits or quotas are not applicable, with the exception of limits on bluefin tuna that have been introduced in response to recommendations by the International Commission on Conservation of Atlantic Tuna (ICCAT). Apart from the general absence of catch limits, in all other respects, the region is subject to a range of EU wide management

* Including data on Croatia
** Based on 2009 Eurostat data

measures, including requirements relating to the EU vessel register, licensing, monitoring and control arrangements, and data collection measures.

The core of EU Mediterranean fisheries management measures are set out in EU Council Regulation (EC) 1967/2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean. Article 19 of the said regulation, together with Council Regulation (EC) No 2371/2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy, form the legal framework for the implementation of management plans.

3 The Maltese fisheries:

3.1 The 25 nautical mile Fisheries Management Zone (25NM FMZ)

The provisions related to the 25 nautical mile management zone (25 NM FMZ) around Malta are outlined in Article 26 of the Council Regulation 1967/2006. Therefore the fisheries covered by this management plan are already subject to a number of targeted measures including measures limiting fishing effort, capacity, vessel size, engine power and fishing areas for certain modes of fishing.

The main fleet segment which is allowed to fish in the 25 NM FMZ is that composed of vessels smaller than 12 m. The small scale artisanal sector is the most sustainable fishing segment and this measure limits impacts on the marine environment to a minimum. The maximum fishing capacity for the 25 NM FMZ is set in the Treaty of Accession and is reflected in Council Regulation (EC) 1967/2006.

A number of fishing activities conducted by vessels larger than 12 m are allowed to fish in the FMZ by way of derogation. These include a limited number of trawlers, vessels fishing for lampuki and vessels fishing with small pelagic purse seines and longlines.

3.2 The Maltese commercial fishing fleet

As from January 2013, the Maltese fishing fleet is currently composed of 399 full time vessels and 635 part time vessels. Out of these vessels 959 (92.7%) vessels are below 12 m and are considered to be small-scale fishing vessels, while the remaining 75 (7.3 %) vessels are over 12 m.

The main fisheries in Maltese waters are those for bluefin tuna, lampuki, swordfish, demersal and small pelagics. These fisheries are mostly operated on a seasonal basis, according to the particular targeted species’ migratory or biological behaviour.

3.3 Recreational fisheries

As of January 2013, the recreational category of vessels in the Maltese Fishing Vessel Register (FVR) is composed of 1,915 vessels. In accordance with Article 17 of Council Regulation 1967/2006, the use of towed nets, surrounding nets, purse seines, boat dredges, mechanised dredges, gillnets, trammel nets and combined bottom-set nets and longlines for highly migratory species are prohibited for recreational fisheries. Fish caught by vessels in this category cannot be sold.

A Recreational Fisheries Board to discuss possible management measures including the possibility of restricting fishing effort has been set up. The Recreational Fisheries Board will provide a report with possible management measures and this, together with a consultation exercise with stakeholders, will be used as a basis to draft a Legal Notice on recreational fishing establishing minimum thresholds in terms of effort, gear selectivity and licensing to fish.

4 Fisheries covered by the multi-annual national management plan

The Maltese fisheries authority's main mission is to manage the Maltese Fisheries Management Zone (FMZ) through responsible and sustainable fishing. Provisions for the lampuki FAD (fish aggregating device) fishery are set out in Article 27 of Council Regulation 1967/2006 and Article 12 of Regulation No 1343/2011 of the Parliament and Council.

The lampuki (Coryphaena hippurus) is a shared stock which cannot be managed unilaterally but requires joint management measures. In fact, the Scientific, Technical and Economic Committee for Fisheries (STECF) also notes that this stock shows a wide spatial distribution and management has to be co-ordinated with all the countries with fleets targeting such resources [1]. Furthermore, only limited data is available on the stock since data on the adult portion of the stock is limited as fisheries generally target juveniles and C. hippurus has a very wide geographical range and it being highly migratory it is not known if it is a single population or several subpopulations of the species exist. Due to these facts Malta's efforts in order to manage the lampuki resource are mainly focused on better monitoring and surveillance of the fishing fleet and its activity, together with enhancing data collection and knowledge about the biology of the species and the behaviour of the local fleet targeting it. In order to do so the following management plan has been developed.

As for other fisheries within the 25 NM FMZ, a scientific review was made in order to give a detailed description of the fishery, to establish the fleet structure and capacity, to identify the biological characteristics of the stocks involved, and to identify the impact on by-catch species and the environment. This review is appended as Annex 1 to this report.

Based on this scientific review, a list of findings and recommendations are put forward and based on these recommendations management measures were proposed.

5 Fisheries covered by the multi-annual national management plan

In line with Article 19 of Council Regulation 1967/2006, a management plan for fishing with a surrounding net has been developed. This plan has been developed for the Maltese fishing fleet licensed to fish for the lampuki using FADs inside and outside the 25NM FMZ.

The management plan has been developed taking into account biological, economic and social objectives. For this plan the following steps will be followed:

1. Definition of the objectives and quantification of targets to reach such objectives
2. Review of the status of the stocks based on Catch per Unit Effort (CPUE) and population state indicators obtained from local catches
3. Review of potential management tools and possible scenarios
4. Assessment of the socio-economic impact of the potential management measures
5. Selection of best management tools
6. Implementation of the management measures, and
7. Monitoring and evaluation of the results.

The present plan should be considered as a living document. The plan will be revised on the basis of new information (data) and in terms of the biological and socio-economic performance of the chosen measures. Step 7 is therefore of paramount importance.

6 Description of the fishery

The lampuki (C. hippurus), in Malta known as 'lampuka' (plural: 'lampuki'), is one of the most important species for the economy of the Maltese fishing industry.

Due to its traditional appeal, a consistent number of boat owners participate in this seasonal activity. Every season, in line with existent management measures, a maximum of 130 vessels are authorised to fish for lampuki using FADs in accordance to paragraph 2 of Article 27 of Council Regulation 1967/2006 and a surrounding net with a central body and 2 wings, which does not have a purse line and does not enclose the fish from below.

Lampuki FADs are of an artisanal nature. They consist of a floating rectangular artisanal float anchored to the bottom by means of a limestone block. Attached to the artisanal float are a number of palm fronds which serve as primitive devices to attract fish.

The FADs are distributed along transects all around the Maltese Islands, with the exception of another existent management measure reserving an area known as the swordfish corridor to the south-west of Malta, which is reserved for surface longline fishing. During the fishing season, during which the lampuki aggregate under the FADs, authorised vessels catch the species by the use of the surrounding net.

In line with Council Regulation 1967/2006, the surrounding net has a maximum mesh size of 18 mm bar, a maximum total length ranging between 180 and 200 m and a maximum total drop of 36 m.

7 Maltese management plan for the lampuki FAD fishery

7.1 Objectives

Based on the biological, social and economic aspects of the fishery the following objectives have been defined:

1. Ensuring the sustainability of the stock through better monitoring of Maltese vessels
2. Ensuring financial stability for fishers

For each objective, specific indicators and benchmarks were established so as to reach the objectives of the plan.

Stock assessments for the related stocks are not available and thus the long time series of landings data, together with population state indicators such as yearly minimum size at first capture and average length are used in order to deduce status of the stock. Target reference points are set based on the findings.

The socio-economic indicators and targets were calculated based on a set of variables and indicators using the economic data collected annually.

With the findings several scenarios were presented and assessed in order to select the best management measures for the Maltese lampuki FAD fishery within the 25 NM FMZ.

The objectives, indicators and targets are presented in Table 1 below.

Table 1 Objectives, indicators and targets for the lampuki fishery management plan

Objectives	Indicator	Targets
Biological 1. Ensuring sustainability	 1. Historical, stable series of landings	 1. Trends in local catches remain stable taking into consideration natural oscillations of the stock biomass. 2. Catches should remain oscillating at an annual average of 350 t
Socio-economic- 1. Ensuring financial stability of fishers	 1. Stability or increase in profit per vessel	 1. Gross profit per vessel

7.2 Status of the stocks

C. hippurus is an epipelagic, oceanic species known to migrate over considerable distances. Traditional small-scale fisheries targeting the juvenile portion of this species take place in the central Mediterranean (Sicily, Malta, Tunisia and Libya) and the Western Mediterranean (Balearic Islands). Due to the fisheries targeting only the juvenile portion of the stock, complete stock assessments of this species in the Mediterranean have never been performed, since data about the adult portion is very limited.

In view of this lack of stock assessments, other available data was used in order to deduce the status of the C. hippurus stock, which the Maltese fishers have been traditionally harvesting for several decades.

Overall length frequency distribution of lampuki catches in the Maltese Islands in 2005-2011 shows a decreasing trend in the minimum size of juvenile C. hippurus landed. The average size of the fish was found constant between 2005 and 2010, before declining from circa 40 cm to ca. 30 cm in 2011. Even though a stock assessment for C. hippurus in the Mediterranean is currently not present, from these results it is clear that growth overfishing is being exerted on the stock targeted by the Maltese fleet. Nonetheless trends in Maltese landings, for which data is available since 1954, showed a stable historic data series, with total lampuki landings oscillating around 350 t per year. This stability shows that when considered on its own, the Maltese lampuki fishery is sustainable, since catches remained stable over a long series of years. It is the recent regional increase in catches that has resulted in growth overfishing. This needs to be firmly considered for the development of any regional measures. The lampuki fishery can be described as the backbone of the Maltese fleet which has exploited the stock in a stable manner across time.

Analysed regional data showed a significant increase in the total lampuki landings in the Mediterranean, especially over the last decade. While in the 1970s the main contributor of landings was Malta (average of 96% at around 357 t), during the 1980s landings from Tunisia increased in such a way (reaching an average of 30% of a total of 556 t) that in the 1990s Tunisia became the main contributor (average 60% of a total of 793 t). The average total landings in the Mediterranean reached 2,544 t in the 2000s, this level heightening to an average of 4,015 t between 2005 and 2010. While between 2001 and 2005 on average lampuki landings in the Mediterranean were attributed 63% to Tunisia, 26% to Malta and 11% to Spain, on average between 2006 and 2010 Italy was responsible for 56%, Tunisia for 26%, Malta for 10%, Spain for 4% and Libya for 4% of landings.

Malta clearly has a long history of targeting lampuki, and seems to be the only country which did not increase its total lampuki landings over the last decade. Italian landings on the other hand seem to have increased dramatically since 2005; Tunisian and Spanish landings have increased steadily since the 1980s and the 1990s respectively, and Libyan fishermen for the first time harvested as many lampuki as Malta in 2009.

7.3 Potential management tools

As explained in section 3, in line with Council Regulation 1967/2006, several management tools are already in force for the Maltese fisheries. In addition to these management tools, other tools are also being considered. In this section a list of possible management tools is established and a brief description of each tool is given.

7.3.1 List of possible management tools

Due to the migratory characteristics of the stock, the only possible management tools that were considered are those that can be implemented at a national level.

Catch Logbook - Article 14 of the Control Regulation (EC) 1224/2009 obliges vessels over 10m to record catches in a fishing logbook. The requirement of a paper logbook will be extended to all vessels licensed to partake in the lampuki FAD fishery to better monitor the catches and landings.

Vessel Monitoring System- Article 9 of the Control Regulation (EC) 1224/2009 obliges vessels over 12 m to have a satellite based monitoring system to better monitor fishing activities. This requirement will be extended to all vessels in the fishery.

Fishing authorisations: Article 19 of Council Regulation 1967/2006 obliges MS to have fishing authorisation for vessels included fishing in the FAD fishery. This system has already been in place.

Fishing season: By Article 12 of Regulation 1343/2011 the fishing season for the lampuki fisheries using FADs extends from the 15th August till the end of December of the same year. By way of derogation from paragraph, if a Member State can demonstrate that, due to bad weather, the fishing vessels flying its flag were unable to make use of their normal fishing days that Member State may carry over days lost by its vessels in FAD fisheries until 31 January of the following year.

Designated ports: All vessels authorised to fish in the FAD fishery are obliged to land in one of the designated ports and weigh their landing prior to first sale as required under article 60 of Council Regulation 1224/2009.

7.4 Assessment of the socio-economic impact of the potential management measures

For the lampuki FAD fisheries the following possible scenarios were identified:

Scenario 1: Freezing all fishing effort. This would be achieved by stabilising both the number of licences as well as the number of fishing trips allowed to the current level. This should lead to a stabilisation of the fishing effort which in turn should minimise the risk on the stock. Increase in fishermen's earnings would therefore depend on increases in catches per unit effort (CPUE) and increases in prices. These increases are, however, not expected to be significant.

Scenario 2: Freezing fishing capacity by number of vessels but allowing the number of fishing trips to fluctuate. The allowed increase in fishing trips could have an adverse effect on the stock levels of lampuki. Fishermen's income will benefit from reduced competition resulting from stabilisation of vessel capacity.

Scenario 3: Reduce fishing effort through the introduction of a temporary cessation for the period spanning from 1 January to 31 January. This scenario will minimise the risk of stock exploitation, whilst limiting the adverse impact on fishermen earnings.

7.4.1 Estimate of production and fishing effort

For each of the identified scenarios, we have estimated the catches for lampuki by reference to growth rates in the past as well as production growth expectations for the future.

OECD [2] expects world fisheries production in 2020 to grow by about 15% above the average level for 2008-2010. Major increases in the quantity of fish produced will originate from aquaculture. However, for the projection period, the annual growth rate of aquaculture is estimated at 2.8%; a reduction compared to the rate of 5.6% of the previous decade. Capture fisheries are expected to register small growth over the next ten years as shown in Figure 1 below.

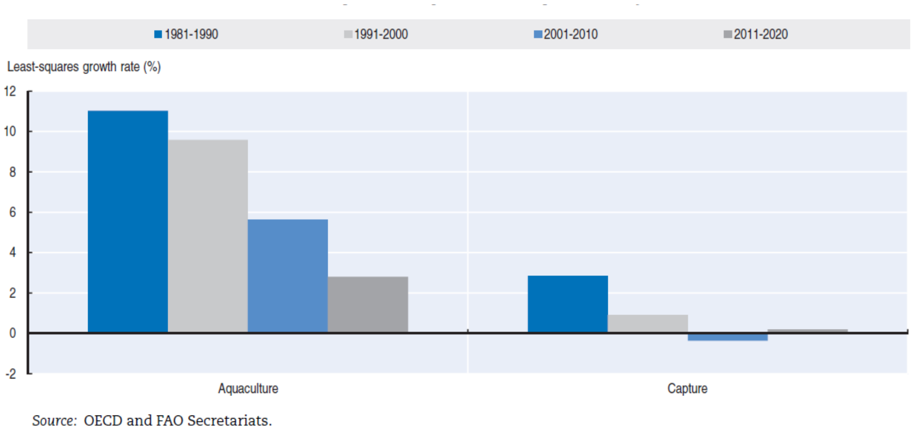

Figure 1 Declining growth rate of fish production

On the other hand, the revised CFP estimates that a rise in average consumption of between 0.5% to 1% average yearly growth rate is expected in the majority of European countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, the Netherlands, Italy Luxembourg, Malta and the United Kingdom) [3].

The effects that the planned management measures might have on the fishing effort have been taken into consideration in this procedure.

7.4.2 Projected price trends

OECD/FAO [2] expects world fish prices to continue the growing trend experienced in

2010 and early 2011. They will be affected by income and population growth, stagnant capture fisheries production, increasing feed cost and higher crude oil prices. All these factors will contribute to the rise in fish prices over the medium term.

However, OECD/FAO [2] opines that there will be different scenarios for capture fisheries production and for aquaculture. With the growing price of fishmeal and the higher price of other feeds, the spread between the average price of output from aquaculture and capture will grow over the medium term. In addition, the average price for wild fish should increase less than farmed ones due to expected changes in fish composition, with more catches of lower value fish.

OECD/FAO [2] expects the average world price for captured species to increase by 23% and for aquaculture species by a significant 50% by 2020 compared to the average 2008-10. In addition to the need to compensate for the higher cost of fish meal, prices of aquaculture will also grow due to strong domestic demand.

The price-quantity relationship has been specified by various formulae in the literature [4]. We have derived the price elasticity co-efficient from Nielsen [5] and are summarised below.

Table 2 Price elasticity co-efficient for some of the species targeted in Malta

Species	Price elasticity co-efficient for every 1% fall in production
Hake	-0.37
Mullet	-0.22
Shrimp	-0.20

Choice of ordinary or inverse demand model may be based on the realism of causality. In the case of food, the causality from demand changes to price is found more realistic than vice versa, as demand for food seems more determined by human needs, regardless of the price, than the demand for other goods. In the case of seafood in particular, the causality from demand changes to price is found more realistic than vice versa. This is because seafood is food and that demand is given by a marked exogenous supply, which is determined by circumstances such as bio-economy, weather, fishery management etc.

In the literature ordinary demand models are used to forecast demand and inverse demand models are used to forecast price. In a part of this literature both models are used on the same data set and thereby forecast properties are tested. Burton (1992) finds that the inverse demand model forecasts price of wet fish in UK significantly better than the ordinary model forecasts demand for wet fish in UK. Eales et. al. (1997) reach the same conclusion regarding Japanese fish markets.

7.4.3 Projected income streams

Revenues by species are obtained as a product of the projected price and the estimated landings of a particular species. The costs of each fleet segment are broken down in categories that include salaries and wages, energy costs, repairs and maintenance costs, variable costs and non-variable costs. The cost projections are based on cost relationships that are derived from actual results registered in the period 2008 to 2011.

7.4.4 Supporting workings with respect to loss of profits estimates

The following table includes the workings that were used in estimating the loss of profits that could be incurred in the different scenarios envisaged in the management plans.

Table 3 Profitability estimate per vessel

	Lampuki
Five year revenues	4,373,610
Number of vessels	123.00
Average five year revenue per vessel	35,558
Average profit conversion	10%
Average five year contribution per vessel	3,556

The information is based on the economic data collected annually for the purpose of the EU Data

Collection Programme by means of a sample survey. This data provides indications of the revenues generated by each type of fleet, nature and split of operational costs between fixed and variable costs and resultant profit contributions. The number of vessels is based on the fishing vessel register information.

7.4.5 Carbon footprint of capture fisheries

Global fisheries have a number of environmental consequences. These represent a cost to society, which is generally not accounted for by the industry's direct revenues and costs. Many of them are also very difficult to assign a monetary value to.

Total CO_2 emissions from fisheries globally are around 132 million tonnes [6]. The cost of carbon has a wide range of estimates across the literature. After considered analysis, the methodology adopted by the International Sustainability Unit in February 2012 [7] uses a social cost of carbon of US$29 (€23) based on Tol, 2009 [8], but recognises the high margins of error and differences of opinion inherent in this analysis.

To calculate the global cost to society of the impact of greenhouse gas emissions linked to the fishery the average global figure for CO_2 emissions of 1.7 tonnes of CO_2 per tonne of catch could be used.

7.4.6 Projected results – lampuki

The management plan applies to fishing vessels authorised to fish for lampuki using FADs. The authorised fleet in 2011 consisted of 123 boats having an overall tonnage of 1,258 GT, a total main engine power of 16,122 kW and provides 109 gainfully occupied jobs. This represents more than 11% of the number of vessels registered in the Commercial fishing register. In 2011, lampuki landings amounted to almost 342 metric tonnes (€850,786 in value terms) which represents close to 18% of total landings but only 7.5% of its selling value.

The management plan indicates that the current level of lampuki fishing is not threatening the conservation of the target fish stock as shown by the stable catch per unit effort. The management plan is in essence geared to freeze the fishing capacity/effort until the necessary research is carried out to enable future plans to provide a more reliable foundation for future initiatives. Three simulation scenarios have been simulated to estimate the effects of the different management initiatives included in the plan. For each scenario, given the results on total landings, the model was used to estimate the changes in economic variables over time. The main assumptions behind the different scenarios are included in Table 3.

Table 4: Assumptions made in the scenario analysis

		2012	2013	2014	2015	2016	2017
Landings growth	Scenario 1	0.80%	0.70%	0.60%	0.50%	0.50%	0.50%
	Scenario 2	5.00%	4.00%	3.00%	2.00%	1.00%	1.00%
	Scenario 3	(10.00%)	0.70%	0.60%	0.50%	0.50%	0.50%
Growth in prices	Scenario 1	(0.16%)	(0.14%)	(0.12%)	(0.10%)	(0.10%)	(0.10%)
	Scenario 2	(1.00%)	(0.80%)	(0.60%)	(0.40%)	(0.20%)	(0.20%)
	Scenario 3	2.00%	(0.14%)	(0.12%)	(0.10%)	(0.10%)	(0.10%)
Temporary cessation			Cost	% of current capacity			
	Scenario 1		-	100%			
	Scenario 2		-	100%			
	Scenario 3		(9,000)	100%			

Lampuki landings are projected to increase in line with the projected national average increase in landings when fishing effort is frozen i.e. growth per annum in landings drops from 0.9% to 0.5% at which level it stabilises from 2016 onwards. These landings growth projections are based on OECD and CFP studies that are referred to earlier. When fishing effort is not regulated it is assumed that landings growth stabilises at 1% per annum from 2016 onwards.

The price-quantity relationship has been specified by various formulae in the literature (Huang, 2005). We have derived the price elasticity co-efficient from Nielsen [9] and assume that for every 1kg increase in landings, the price drops by 0.2%.

Every month of temporary cessation leads to a 10% reduction in landings. The cost of temporary cessation is set at €9,000 and is based on the estimated earnings per vessel from the lampuki fishery activity over a five-year period.

The figures below show the outcome of the scenario analysis compared with the 2011 baseline data.

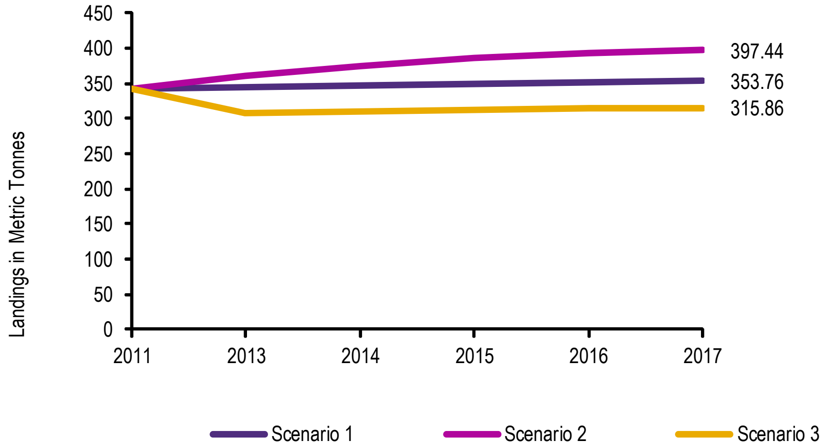

Figure 2 Landings in Metric Tonnes under each scenario

Landings are expected to stabilise under Scenario 1 wherein fishing effort is frozen at current levels, drop significantly under scenario 3 where temporary cessation policies are introduced. Landings are expected to increase mostly under scenario 2 where fishing capacity is frozen but fishing effort is not regulated.

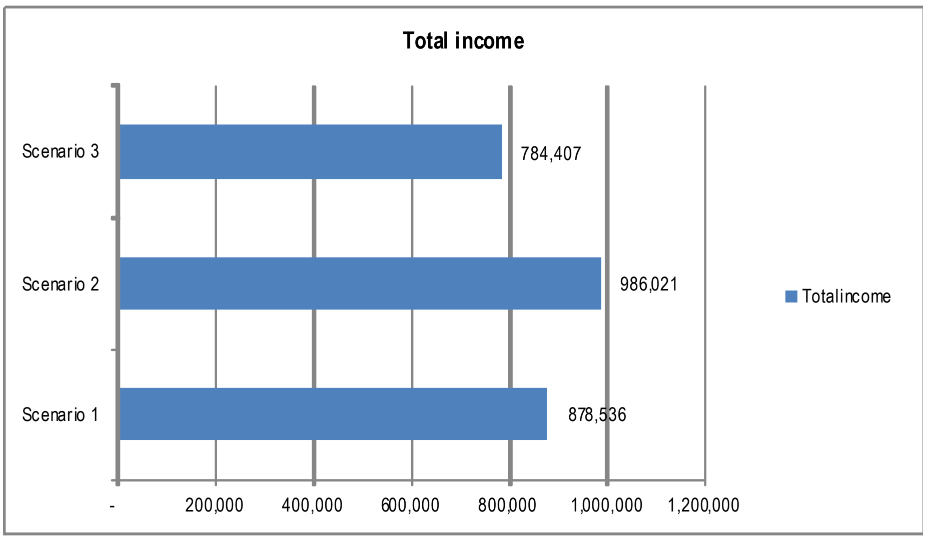

Figure 3 Income in 2017 under each scenario

Fluctuations in income are mainly determined by the dynamics of landings since price elasticity is generally low on fish products. Figure 3 shows that income is highest under scenario 2 and lowest under Scenario 3, as indeed is operating cash flow.

Table 5 Economic net present value of all scenarios compared to scenario 1

	Scenario 1	Scenario 2	Scenario 3
% variations with Baseline	Baseline	14.3%	(15.8%)

While the economic net present value (ENPV, discounted at 5.5%) is positive in scenario 2, scenario 3 represents the lowest return.

In view of the dual objective of conserving fish stocks and economic viability of fishing sector, it appears that Scenario 1 is the plan which provides results that are closest to its objectives since increase in landings is subdued when compared to increases under Scenario 2 whilst still retaining positive net economic benefits. Nonetheless these short term predictions must be treated with caution due to the natural oscillating pattern of the stock and thus Scenario 2 may also be considered to be viable based on the long series data provided in Figure 10.

7.5 Selection of best management tools

Since the fishery is predominantly shared with other Member States and third countries, Malta cannot unilaterally identify actions in order to manage these stocks. In view of this, regional management plans based on a level playing field with third countries are required. Malta will however continue to work towards setting up these regional plans. Efforts like participation in the MedSudMed and CopeMed II workshop and fisheries appraisal of C. hippurus in the Mediterranean will be maintained.

Malta will continue working towards data collection and research towards the following topics included in the work plan drafted by the MedSudMed CopeMed II meeting:

1. Identification of stock units in the Mediterranean sub-regions
2. Identification of critical habitats (nursery and spawning sites) and of ecological requirements for the development of eggs and larvae
3. Definition of some biological aspects like growth parameters and maturity ogives
4. Impact of fisheries based on FADs on by-catch species and on the environment

Considering the stable historical time series of Maltese lampuki landings, the state of this fishery if considered on its own is sustainable, that is, the level of current fishing pressure can be maintained. Since the number of fishers participating in the FAD fishery is already fixed, Scenario 2 is the most favourable.

7.6 Implementation of management measures

The number of fishing vessels authorised to fish in the FAD fishery will be retained to 130 vessels. Such vessels will be installed with a tracking system as from 15 August 2014. In addition all 130 authorised vessels including those below 10 m will have to record the landings in a catch logbook and land in a designated port.

Furthermore the Department of Fisheries and Aquaculture will continue to enhance data collection and research on:

1. Identification of stock units in the Mediterranean sub-regions
2. Identification of critical habitats (nursery and spawning sites) and of ecological requirements for the development of eggs and larvae

3. Definition of some biological aspects like growth parameters and maturity ogives
4. Impact of fisheries based on FADs on by-catch species and on the environment

7.7 Review of management measures

The review of the management measures will be conducted in 2018, unless there is a drastic change in the catches /economic situation of the fishery. In such cases the review should take place earlier. In the instance that regional management plans are adopted, this management plan will be reviewed.

8 Conclusion

Malta is committed to continue improving its efforts in carrying out effective monitoring and control of the fishing activity of the FAD fishery through ongoing reviews of this action plan. However, in view of the fact that the stock has a wide spatial distribution, well beyond the Malta 25 NM FMZ, considerable knowledge gaps need to be filled in order to fully understand the biology and population dynamics of lampuki; without this, scientifically sound assessment of stock status cannot be achieved. Thus, it is critical that management of this fishing activity be co-ordinated with all those countries with fleets targeting lampuki in order to develop and implement integrated effective management measures.

Annex 1 - Lampuki FAD Fishery

1. Description of the fishery

1.1 General description

The lampuki (C. hippurus) is one of the most important species for the economy of the Maltese fishing industry. Due to its importance a consistent number of boat owners participate in this seasonal activity.

Lampuki FADs are of an artisanal nature. They consist of a floating rectangular structure anchored to the bottom by means of a limestone block. Attached to the float close to the surface are a number of palm fronds which serve to attract the fish. Whether lampuki simply seek refuge or are attracted by other small fish, which serve as prey, hiding under the FADs is the subject of ongoing scientific studies. The FADs are distributed along transects all around the Maltese Islands with the exception of an area known as the swordfish corridor in the south-west of Malta, which is reserved for fishing with surface longlines. Once the lampuki are aggregated under the FADs, they are caught by surrounding nets.

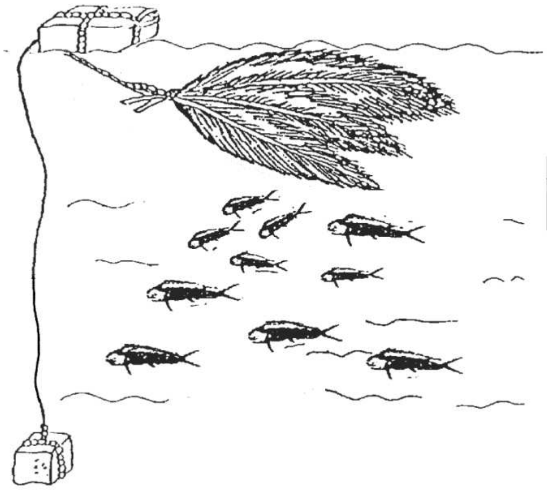

Figure 4 Fish Aggregating Device (FAD) typically used in the Maltese Islands (adapted from [10]).

1.2 The Lampuki Net

The Lampuki net is a surrounding net with a central body and 2 wings, that neither has a purse line and nor envelopes the fish from below. The net consists of four main parts: two wings, a body (centre) and a landing-bag. The centre is made up of various sections, and there are a further two strips of net running the whole length of the net, both where it is attached to the float-line and lead-line. Each section of the net has different specifications, and these vary not only from fisher to fisher, but also for the same vessel as the season progresses. It is usual to increase the number of meshes (depth), and make other modifications as the fish grow larger and occur deeper.

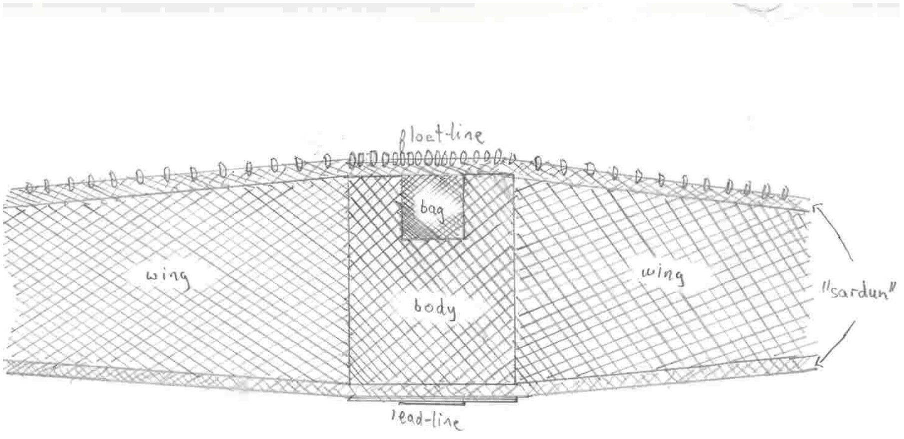

Figure 5 Diagram of a Lampuki net [11].

The total length of the net varies from 180 metres as would be used by a traditional craft of the luzzu type, to 300 metres for a large fishing vessel (20 m in length). The main component of the increase in length is in the wings, particularly the second wing. Factors having an effect on the length of the wings include length of vessel and manoeuvrability.

The setting wing (banda tal-pruwwa)

This varies in length from 54 metres for smaller vessels, to 100 metres for the larger vessels. This is usually 400 meshes deep, but can be 600 meshes for a large boat. It consists of mesh of 24-26 mm bar (usually 25 mm) and twine from denier 210/6 to 210/9. As winter approaches, a net with wings of 500/600 meshes is sometimes preferred (for reasons explained above).

The second wing (banda tal-poppa)

Though the specifications are the same as those of the setting wing in use at the time, this wing is always considerably longer varying from 85-200 metres depending on the size of the vessel.

The centre (fonti)

This consists of a central and upper landing-bag (qtil il-ħut), bordered on each side by the shoulders (spalla) and below by the ċan. Though in the past, before the introduction of mechanised winches, these parts had different specifications, now it is usually only the landing-bag which is different from the rest of the fonti. (It is possible that this name is derived from fond meaning deep, as the net deepens in the centre). A simpler version of the fonti has the landing-bag running its whole length.

The fonti varies in length from 24-50 metres (34 metres and 36 metres being more common). It varies from 500 to 600 meshes deep. A 600 mesh fonti could be 36 metres deep. The mesh size varies from 22 mm bar to 28 mm bar. Some fishermen prefer a mesh size smaller than that used in the wings, while others have it larger. The thickness of twine at the centre is thicker than at the wings; denier 210/9 to denier 210/21 is usually used.

At the fonti, one might have 24 metres of netting. This would be attached to 16 metres of floatline (thus creating a bag). Furthermore, below it is attached to 12 metres of lead-line giving a 'funnel' effect. Such a fonti would drop to a depth of about 26 metres.

The landing-bag (qtil il-ħut)

The landing-bag varies in length (at the float-line), from 10-15 metres. It consists of meshes 300 x 300 or 400 x 400. The length at the bottom end is reduced to create a funnel effect. This is the part of the net having the smallest mesh size, with a variance of from 18 mm bar to 22 mm bar. Also, this is where the net is at its strongest with a twine of denier 210/20, or for those preferring lighter nets, denier 210/27 is more common. (Another factor affecting choice of netting is number of crew, with small crews preferring lighter nets).

The sardun – border / protective strip

Running the whole length of the net, both where it is attached to the float-line and to the lead-line, is a strip of netting whose purpose is to avoid damage to the net by floats / weights when the net is being hauled in by winches. Though it is usual to have a sardun, it is not always present in smaller nets used on the traditional luzzu.

The length corresponds to the length of the net, and the depth varies from 25 to 50 meshes, with 25 being more common. The mesh size is usually similar to that of the wings 24/25 mm bar, but larger mesh of 28 mm bar is also used. The twine varies from denier 210/15 to denier 210/21.

The float-line is 6 - 6.7 mm in diameter. The number of floats varies from 450 to over 600, depending on the length, and consequently, the weight of the net and lead-line. Commonly used floats are 40 mm long. Whereas over the wings the floats are spaced roughly every 30 cm. over the landing-bag, they are practically touching. This is a result of the added lead-lines. When deeper nets are used for the wings (600 meshes) the frequency of the floats is increased (every 10 cm).

The lead-line, which is 12-14 mm diameter, weighs typically 40 kg/100 metres. While only one lead-line runs the length of the wings, three consecutive lead-lines lie under the landing-bag. The general opinion among fishers is that the more lead the better, as the net drops quicker and is therefore more efficient. On the other hand, number of crew is a limiting factor in this regard.

2. Maltese Fleet Structure and Capacity

The lampuki fishing season runs from 15 August till 31 December, but may be extended to January due to bad weather days during the season in accordance to article 12 of Regulation 1343/2011. Fishing authorisations for a maximum of 130 vessels, with a set FAD trajectory per vessel, are issued on an annual basis in accordance to article 27 of Council Regulation 1967/2009.

A summary of the 2011 fleet with lampuki fishing permits is presented below. In 2011, vessel length varied from 6 m to 24 m, with an average vessel length of 10 m. Vessel gross tonnage varied from 1 to 75 t, with an average gross tonnage of 10 t. Vessel engine power ranged from 16 kW to 597 kW, with an average power of 133 kW.

Table 6 2006-2011 fleet capacity data for the vessels licensed to fish for lampuki (C. hippurus) using FADs

Year	*Number of vessels*	*Average age of vessels (years)*[3]	*Average GT of vessels*	*Total GT of vessels*	*Average length of vessels (m)*	*Average engine power (kW)*	*Total engine power (kW)*
2006	108	23	11.7	1264.4	11	139.9	15110.6
2007	87	24	12.4	1076.6	11.2	131	11393.8
2008	115	25	9.9	1140.2	10.4	128.2	14738.6
2009	110	24	10.8	1172.9	10.6	136.4	15006
2010	112	23	10.7	1197.3	10.4	138.3	15490.1
2011	123	23	10.4	1257.7	10.3	133.2	16121.7

. [3] Average age refers to average age in reference year.

As can be seen from Table 6, fleet capacity of vessels targeting C. hippurus remained constant in 2006-2011. Catches declined from 563 tonnes to a minimum of 188.6 tonnes in 2008, but in 2010 recovered to 524.2 tonnes.

Table 7 Characteristics of vessels licensed to participate in the 2011 lampuki (C. hippurus) fishery.

Vessel LOA (m)	*Number of Vessels*	*Average GT*	*Average kW*	*Average Number of FADs*	*Total Number of FADs*
6	17	2	68	83	1320
7	27	3	95	100	2590
8	11	5	116	101	1110
9	15	6	125	122	1830
10	11	9	135	171	1880
11	12	10	159	144	1730
12	4	11	208	163	650
13	4	15	118	163	650
14	9	19	181	207	1860
15	1	24	134	200	200
16	2	36	213	225	450
17	1	37	246	300	300
18	2	40	198	160	320
19	1	46	287	300	300
20	1	52	313	250	250
21	2	49	269	300	300
23	1	75	597	80	80

On the other hand in Tunisia about 260 vessels of an average length of 11 m and engine power of 45 hp are involved in the lampuki fisheries, each boat using between 17 and 75 FADs during each fishing season [12], compared to 38 boats deploying circa 1150-1500 FADs in Majorca in 2009.

3. Fishing effort data

Effort data are currently only available in terms of the total number of vessels participating in the fishery (including vessel details such as vessel LOA, GT, engine kW) and the total number of FADs deployed. Only estimates are available on the actual number of fishing trips (since vessels < 10 m are sampled through the Catch Assessment Survey), or on the number of FADs visited during a fishing trip. Indeed the number of FADs visited during a fishing trip can be highly variable, depending on factors such as vessel size, abundance of fish and general weather conditions [13] as well as wind and current conditions, in particular since the latter may have considerable influence on capture probability [14].

3.2 Trends in Total Effort

The nominal annual fishing effort of the lampuki FAD fleet in terms of number of FADs fished * number of fishing trips showed an overall increasing trend during the period 2006-2011. This increasing trend was primarily due to an important increase in the fishing effort exerted in 2011; the nominal fishing effort recoded in 2011 increased by 64% compared to 2010.

A linear regression analysis was carried out in order to gauge the linearity of the trend in the data series (Figure 6). The results returned a R^2 value of 0.69, confirming that the trend was not linear due to important inter-annual fluctuations in the data.

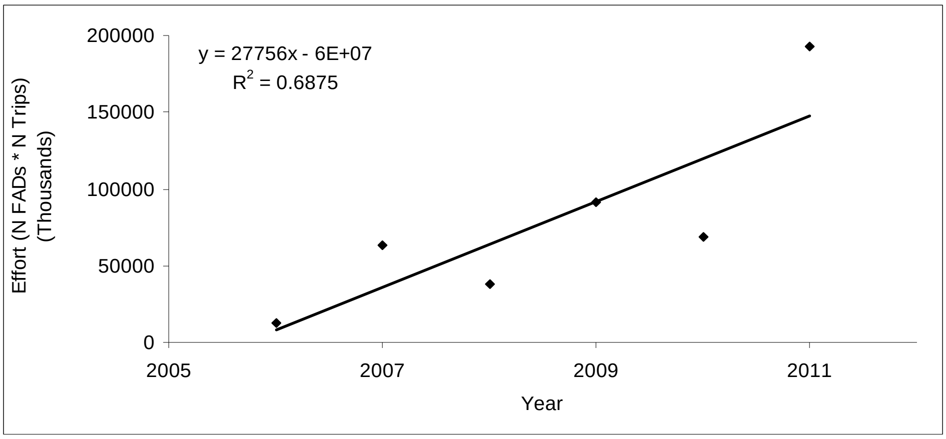

Figure 6 Temporal variation in nominal fishing effort, expressed in terms of number of FADs fished * number of fishing trips by the lampuki FAD fishing fleet in 2006-2011, with fitted regression line.

3.3 Trends in Monthly Effort

The monthly variations in mean nominal fishing effort in terms of the number of FADs fished * number of fishing trips made during a fishing season (August – January of the following year, where applicable) were analysed (Figure 7).The results showed an increase in fishing effort recorded during the month of August to peak levels of activity in September and October. Mean fishing effort in November was similar to fishing effort exerted on the lampuki stock in August; the lowest levels of activity were recorded in December and January.

Such information is important in relation to the biology of the target species. Data on the size (as fork length) composition of Maltese lampuki catches shows that the smallest individuals are caught in August and September of each fishing season; despite the rapid growth of the species, individuals which are sexually mature are only fished in October-January (Figure 16).

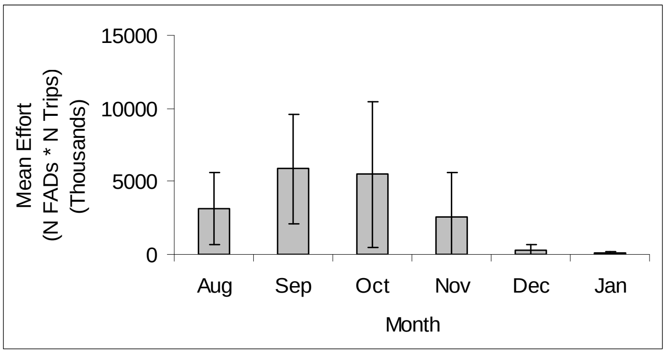

Figure 7 Mean monthly fishing effort (+/- 1 SD) for the lampuki FAD fishing fleet in 2006-2011; units are effort as number of FADs fished * number of fishing trips.

Catch/effort control measures should target the months of August and September, when the fishing effort, and thus the fishing mortality levels of the lampuki stock by the Maltese lampuki FAD fishing fleet, are highest. Such measures would allow more individuals to reproduce successfully and ultimately will ensure long term sustainability of catches.

4. Biological characteristics of the main species caught

A brief description of the distribution of the main target species has been included in Table 8 below. While Table 9 depicts information on the age, maturity and spawning season of the commercial targeted and by-catch species caught when fishing for the lampuki using FADs. The information provided in the table has been gathered from several different literature since such information is not specifically available for the Maltese waters.

Table 8 Species distribution of main species caught when fishing for lampuki using FADs

Scientific name	**Vernacular name**	**Species distribution**			
		Geographical Distribution	**Species habitat**	**Bathymetric distribution**	**Spawning/ Nursery site**
C. hippurus	Dolphin fish	Cosmopolitan, tropical and subtropical waters [15]	epipelagic, but also approaching the coast. Aggregate under floating objects in search of refuge and prey [15]	Surface waters- 200m [16]	Open water when water temperature rises. [17]

Naucrates doctor	Pilot fish	Circumtropical in tropical seas. [18]	Oceanic with a semi-obligate commensal relationship with sharks, rays, other bony fishes and turtles [19]	Surface - 30m [20]	Eggs are pelagic. Young are usually associated with jellyfish and drifting seaweed [21]
Seriola dumerili	Amberjack	Circumglobal [22]	deep seaward reefs; occasionally entering coastal bays [23]	depth range 1 - 360 m [23]	Eggs are pelagic. Juveniles associate with floating plants or debris. [24]

Table 9 Maximum age, maturity and spawning season of main species caught when fishing for lampuki using FADs.

Species	Max Age	Maturity (L_{50})	Spawning Season
Dolphin fish	4 years [25]	58.9 cm FL for males and 62.5 cm FL for females [26]	June to September (Western and Central Mediterranean)[27]
Pilot fish	3 years [28]	N/A	Probably a prolonged spawning season starting from early summer till late autumn. [29]
Amberjack	17 years [30]	109.0 cm [31]	Peak spawning off south Florida and the Florida Keys occurred during April and May [32]

5. Conservation Status of the Stock

The target species C. hippurus is an epipelagic, oceanic species known to migrate over considerable distances. Traditional small-scale fisheries for lampuki are carried out in the Central Mediterranean (Sicily, Malta, Tunisia, Libya) and the Western Mediterranean (Balearic Islands). Although there is no documented information for other areas in the Mediterranean it is likely that Algerian artisanal fishers, and possibly others, also target C. hippurus [33]. The FAD fishery targets juvenile lampuki (0 age group), despite the fact that the lifespan of this species has been estimated at four years [34].

Information on the biology, migratory patterns and population structure is limited, and the only information on the conservation status of the Mediterranean lampuki stock is a stock assessment carried out for the western Mediterranean based on fisheries dependent data from Mallorca [34]. The authors concluded that the exploited fraction of the lampuki population is composed of individuals in the 0-age class, and suggest that fluctuations in catches may be related to environmental parameters and to the migratory behaviour of the species. Since only a part of the stock was included in the assessment, the assessment was considered preliminary.

It is very likely that the Italian, Tunisian, Maltese, Spanish and Libyan fisheries are exploiting a single, shared stock. Pla and Pujolar [35] used protein electrophoresis to study the population genetic structure of lampuki in the Mediterranean and eastern Atlantic. Genetic variability characteristic of a highly migratory species was found, and the authors conclude that it is likely that lampuki form one large panmictic population across the Mediterranean.

This conclusion was confirmed in a second study carried out by Zanuy and Pla as part of the COPEMED project which assessed dolphinfish samples from Malta and Tunis [36].

Using an approach based on mitochondrial DNA, Diaz-James et al. [37] have provided evidence for the existence of a separate Mediterranean phylogroup. Samples of dolphinfish taken from the Mediterranean were found to differ significantly from those taken in the Northeastern Atlantic. Furthermore, the Mediterranean samples showed a low level of genetic diversity. This implies that despite the connection between the Mediterranean and the Atlantic via the straits of Gibraltar, the population targeted by fishers in the Mediterranean is separate to that found in the Atlantic. Diaz-James et al. [37] propose that this may be due to the fact that the Mediterranean population was isolated for long periods of time during successive ice-ages where the sea level in the Mediterranean basin decreased, separating it from the Atlantic. These periods of isolation were characterised by a decrease in the population of dolphinfish resident in the Mediterranean – which explains the high degree of homogeneity found between individuals across the Mediterranean.

A strong link between environmental factors and survival of larvae has been investigated in studies by Alemany et al. [38], Kraul [39], Sabates et al. [40], and Sabates and Saiz [41]. Larval survival appears to be coupled to areas characterised by marine fronts where currents with different densities and water temperatures meet. In these areas, downwelling occurs, concentrating debris and plankton ensuring a ready supply of food and shelter for the larvae. Survival is also dependent on anticyclonic currents that favour retention of larvae in an area, temperatures of above 16 - 18^{o}C, and marine stratification which further concentrates plankton in surface waters.

The Mediterranean population of Coryphaena hippurus spawns between June and September in the Balearic islands. This region functions as an important spawning ground for most of the large pelagic fishes inhabiting Mediterranean. Monthly progression of maturity stage and gonadosomatic index in adult fish sampled from the western and central Mediterranean show a reproduction period from June to September [42]. A pre-spawning migration of adult, mature dolphinfish into the Mediterranean from the Atlantic is suggested, following migratory patterns similar to those of bluefin tuna (Thunnus thynnus) [42]. The adult originate from a different spawning and are at least one year old. The peak spawning season occurs in June and July. This is the origin of the fish caught by traditional fisheries between August and December [42]. The capture of dolphinfish fingerlings from the western Mediterranean in June is in agreement with the proposed June - July spawning peak in the Mediterranean.

During summer, the dynamics of surface water masses in the Balearic region are mainly conditioned by the interaction between Surface Mediterranean Waters (SMW), moving southward from the northern part of western Mediterranean, and Modified Atlantic Waters (MAW), flowing northwards from the Algerian Basin. This leads to a complex hydrographic situation with strong currents in open water away from the continental shelf, fronts, and eddies present in the area [47] As summer progresses, stratification and surface water temperatures increase, while salinity decreases since a layer of MAW forms above the denser SMW due to downwelling of the latter [38]. Larvae tend to concentrate on the continental shelf where there are no strong currents and circulation is anticyclonic -

favouring larval retention. The well-mixed surface waters ensure that plankton is distributed uniformly [40].

Similar findings were made for dolphinfish in the waters around Hawaii [39]. Dolphinfish are particularly abundant during the summer months due to propitious survival of larvae spawned around July. CPUE data shows that maximum catches are recorded in the vicinity of an area where equatorial currents meet colder northern currents.

The phenomenon of meridionalisation has led to Coryphaena hippurus extending its range northwards in various marine basins. Range extensions have been observed in the Mediterranean [43], and in the Pacific [44].

In order to reliably assess the population status of lampuki, regional collaboration on data collection and data analysis is needed. In the absence of such a regional stock assessment, available data on total landings in the Mediterranean and stock parameters measured in the Maltese Islands since 2006 are presented in the rest of Section 5 below.

5.1 Trends in Regional Catches

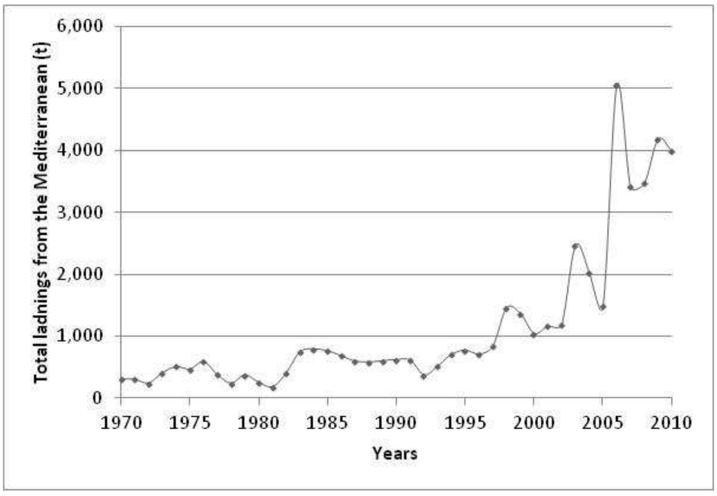

Figure 8 Evolution of total lampuki landings from the Mediterranean in the period 1970-2010 (GFCM Capture Production 1970-2010).

The lampuki fishery using FADs was a developing fishery in the Mediterranean over the last 4 decades. Based on catch data available from the GFCM Capture Production Database, the total landings of lampuki in the Mediterranean averaged around 376 t in the 1970s, increased to an average of 556 t in the 1980s and 793 t in the 1990s. Total landings continued to increase during the 2000s (with an average of 2,544 t), especially during the last few years (average total landings between 2006 and 2010 is 4,015 t). This means that the landings of lampuki in the Mediterranean increased at least ten fold over a period of forty years.

Based on the same data, changes in the exploitation pattern of this species by country can be analysed (Table 10). During the 1970s the species was mainly exploited by Malta with some landings from Tunisia, with no other country recording landings of lampuki during the period. The same pattern can be observed during the 1980s and 1990s, with increasing interest in the species from Tunisia, being the main exploiter of this species in the 1990s. Interest from other countries, mainly Italy and Spain started to be recorded during the 2000s, at which point their landings surpassed those from the Maltese Islands. The greatest change in exploitation of this resource was observed during the last 5 years of the series. While between 2001 and 2005 on average lampuki landings in the Mediterranean were attributed 63% to Tunisia, 26% to Malta and 11% to Spain, on average between 2006 and 2010 Italy was responsible for 56%, Tunisia for 26%, Malta for 10%, Spain for 4% and Libya for 4% of landings. Malta clearly has a long history of targeting lampuki, and seems to be the only country which did not increase its total lampuki landings over the last decade. Italian landings on the other hand seem to have increased dramatically since 2005; Tunisian and Spanish landings have increased steadily since the 1980s and the 1990s respectively, and Libyan fishermen for the first time harvested as many lampuki as Malta in 2009.

Whilst the data is likely to give a reliable indication of the trend in landings, earlier reports of lampuki being harvested by the Sicilian fleet do exist despite the lack of data on Italian landings prior to 2005. According to Cannizzaro [45] about 300 Sicilian, 200 Tunisian and 50 Majorcan artisanal vessels were fishing for lampuki in the 1990s.

Table 10 Average percentage contribution of lampuki landings by country from the 1970s onwards (GFCM Capture Production 1970-2010).

Country	**Average percentage contribution of lampuki landings**					
	1970-1979	**1980-1989**	**1990-1999**	**2000-2009**	**2001-2005**	**2006-2010**
Italy	0	0	0	23	0	56
Libya	0	0	0	1	0	4
Malta	96	70	40	19	26	10
Spain	0	0	1	8	11	4
Tunisia	4	30	60	49	63	26

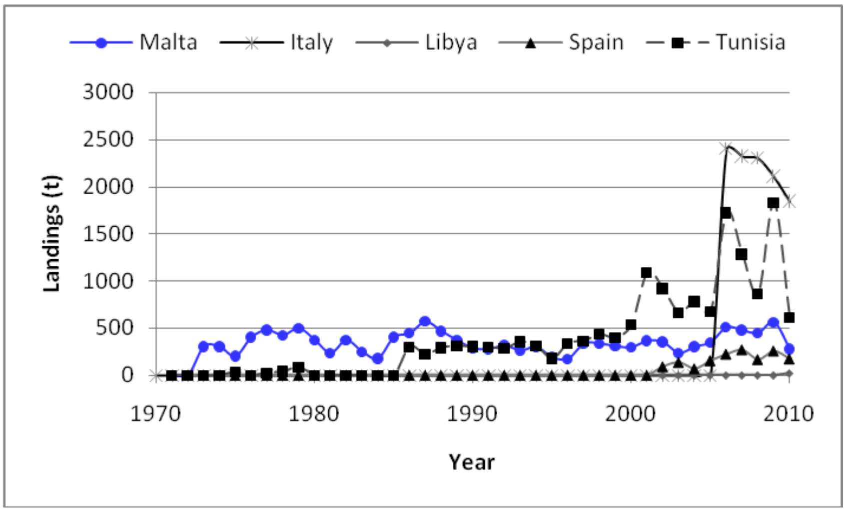

Figure 9 Evolution of lampuki landings by different Mediterranean countries in the period 1970-2010 (GFCM Capture Production 1970-2010).

5.2 Trends in Maltese Catches

Total landings data for the traditional Maltese 'lampuki' fishery have been recorded since

1954. Total landings of lampuki have oscillated around an average of 350 t per year since 1954. No pattern of increasing or decreasing landings can be discerned. The fluctuations of total catches are likely to be due to the impacts of environmental variations as well as the poorly understood migratory behaviour of C. hippurus. Lleonart et al. [34] recorded a similar pattern and suggested that these two related factors could result in both recruitment and spawning failures in the Western Mediterranean. Recruitment variations linked to fluctuations in oceanographic conditions is however likely to be the more important factor affecting the number of juveniles available to fishers, rather than spawning stock biomass [46].

In the absence of effort data for the historical time series another factor which may have caused fluctuations in total landings is weather conditions during the lampuki FAD season; rough weather will reduce the number of fishing days available to fishers.

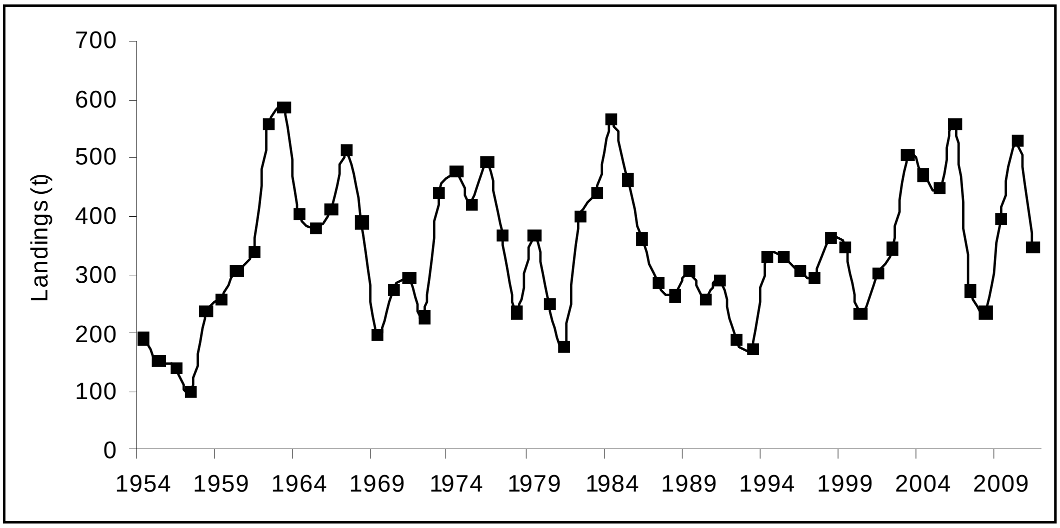

Figure 10 *C. hippurus* landings in the Maltese Islands since 1954 (historical Maltese data).

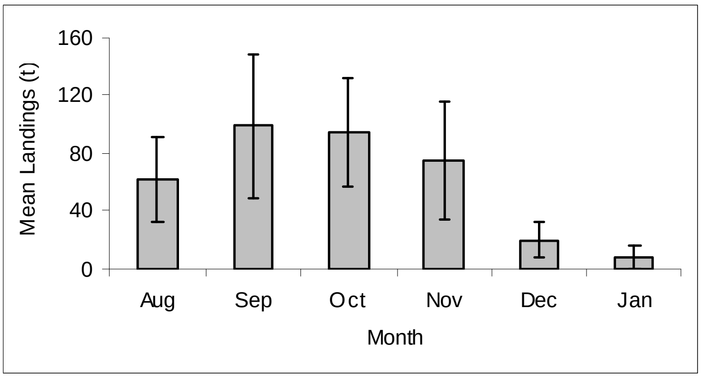

Figure 11 Mean monthly landings (+/- 1 SD9) for the lampuki FAD fishing fleet in 2006-2011

An analysis of monthly variations in mean landings during the period 2006-2011 (Figure 11) showed lower levels of landings in the month of August, followed by two months of higher landings in September-October before gradually decreasing in November. December and January only contributed 8% of the mean landings recorded in 2006-2011. This pattern is similar to the pattern of mean monthly fishing effort exerted during the same period (Figure 7 above), indicating that monthly fluctuations in landings are linked to variations in fishing effort. similar pattern of landing peaks in September-October has been identified for the Balearic Islands based on 1987-1996 and 2004 seasonal data [28, 34], and for the Tunisian lampuki fishery, where 70% of total landings in the 1990-1997 fishing seasons were landed during the months of September and October [12].

5.3 Catch per Unit Effort

Catch per Unit Effort (CPUE) estimates provide a relative index of stock abundance; an increase in CPUE can be interpreted as a positive sign showing that species are not yet subjected to overfishing. However, inter-annual changes in CPUE can also be due to changes in fishing technology, stock abundance due to natural fluctuations in population productivty, and changes in the species targetted by fishers. All these aspects need to be taken into consideration when interpreting CPUE as an indicator of stocks. Moreover, particular caution needs to be applied in relation to stocks similar to C. hippurus for which sinusoidal fluctuations are observed in time (Figure 10), especially when the series of CPUE data being considered is relatively low. In similar cases, in order fro CPUE data to have any meaning, data series must cover multiple cycles, including several crests and troughs.

A CPUE analysis was nevertheless carried out for C. hippurus based on the nominal effort parameter, number of FADs * number of fishing trips.

Results show a clear decreasing trend in CPUE for the lampuki FAD fishery of the Maltese Islands over the analysed period 2006-2011. Due to the short time series available and the considerable inter-annual variations in CPUE, linear regression analysis gave a low value with regards to goodness-of-fit (R2 = 0.62). As already stated above, such results are to be treated with caution, since the data series analysed is too short in order to be able to extract any conclusive advice using CPUE trends.

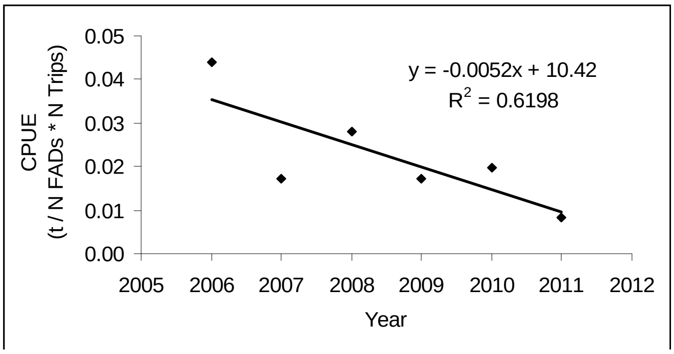

Figure 12 Catch per unit effort (as t/number of FADs fished * number of fishing trips) for lampuki (C. hippurus) estimated for the Maltese FAD fishery during the period 2006-2011, with fitted regression line.

Total CPUE of C. hippurus fluctuates on a seasonal basis, and a migratory pattern around the Maltese Islands has been hypothesised [46] was based on an analysis of annual catch data from sales vouchers and the number and location of FADs allocated to vessels in 2005, 2006, 2008 and 2009, as well as fishers’ knowledge with regards to seasonal changes in fish distribution patterns.

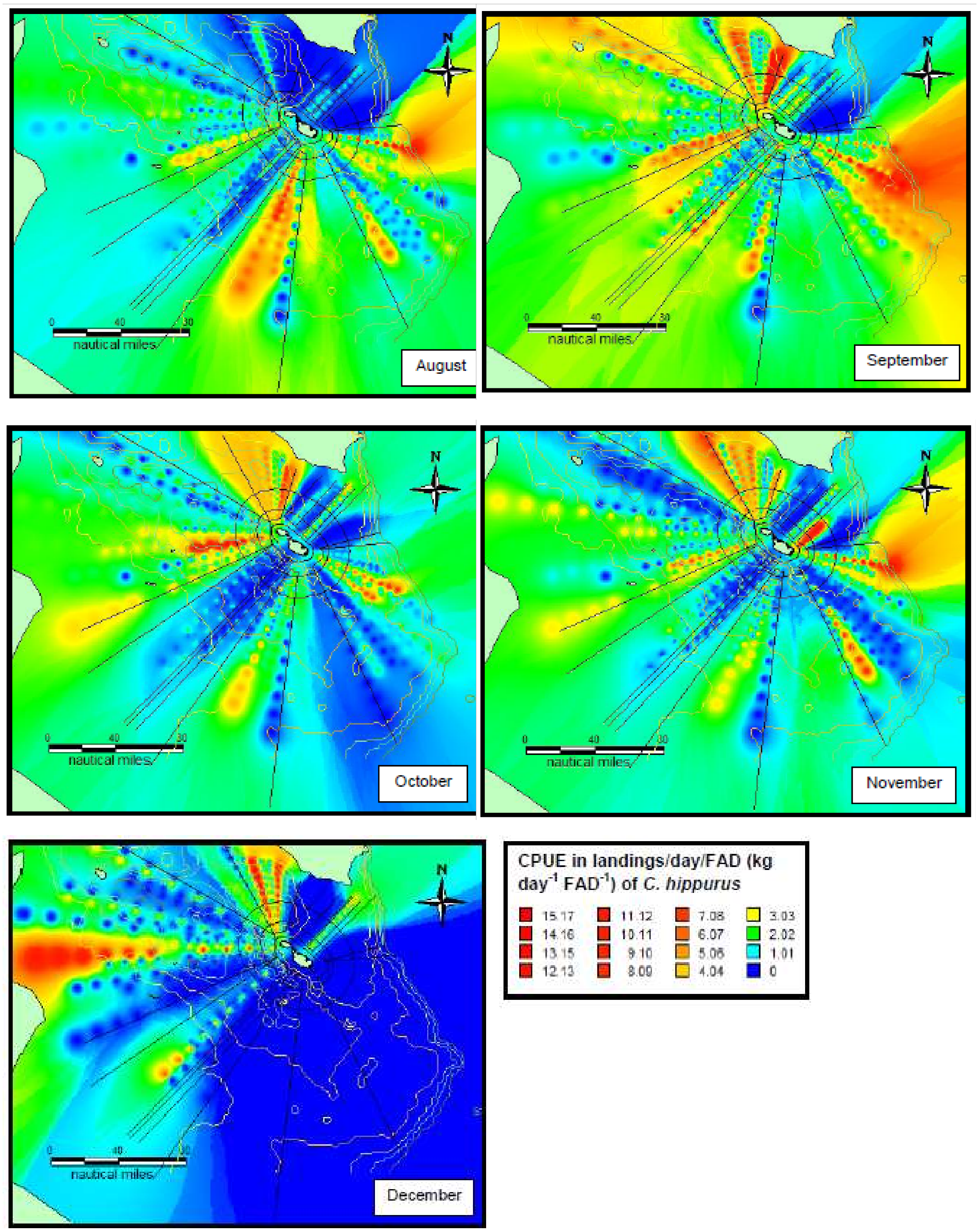

Figure 13 Density map of average CPUE in kg day^{-1} FAD^{-1} of C. hippurus for the 2009 fishing season (August – December) [46].

Based on information from professional fishermen and patterns from the monthly density maps of Maltese lampuki catches (Figure 13), C. hippurus seem to migrate in a counter-clockwise direction from the South of Malta (Marsaxlokk) to the west of Gozo (Xlendi) as the FAD fishing season progresses from August to December. Statistical analysis confirmed that mean landings per month were significantly different between districts during the studied months. When mean landings per transect per season were analysed, the district of Xlendi had significantly higher values compared to other districts [46].

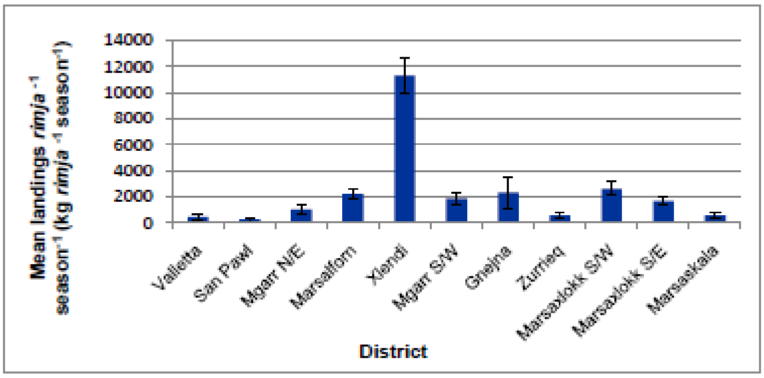

Figure 14 Mean C. hippurus landings per transect per season (kg/transect/season) for each district in 2005, 2006, 2008 and 2009 FAD fishing seasons; error bars show 95% confidence intervals [46].

A limitation of this study was however that the number of fishing days was only calculated based on the days fishers reported any catches; no data were available on the number of days fishers went to sea without landing fish. Moreover the number of FADs visited during a trip is highly variable and depends on the weather and abundance of fish; the only data available was for the total number of deployed FADs on each transect.

5.4 Population State Indicators from Maltese Data

In the absence of information on stock parameters from Italy, Tunisia, Spain and Libya, information from the Maltese Islands is presented below. Considering the fact that Malta was only responsible for 10% of total landings in 2006-2010 it is clear that any reliable assessment of population state or fishing pressure will need to also incorporate Italian and Tunisian data. Nevertheless the available, fisheries-dependent, data from Malta was presented below. At present, no fisheries-independent surveys of C. hippurus have been carried out, and hence, no fisheries independent population state indicators are available.

Figure 15 below shows the length frequency distributions for catches of vessels measuring 6-12 m and 12-18 m, in 2005-2011. Lampuki have very rapid growth rates and metabolism.

The length frequency distribution for 2011 illustrates an increase in landed individuals measuring less than 30 cm fork length in 2011.

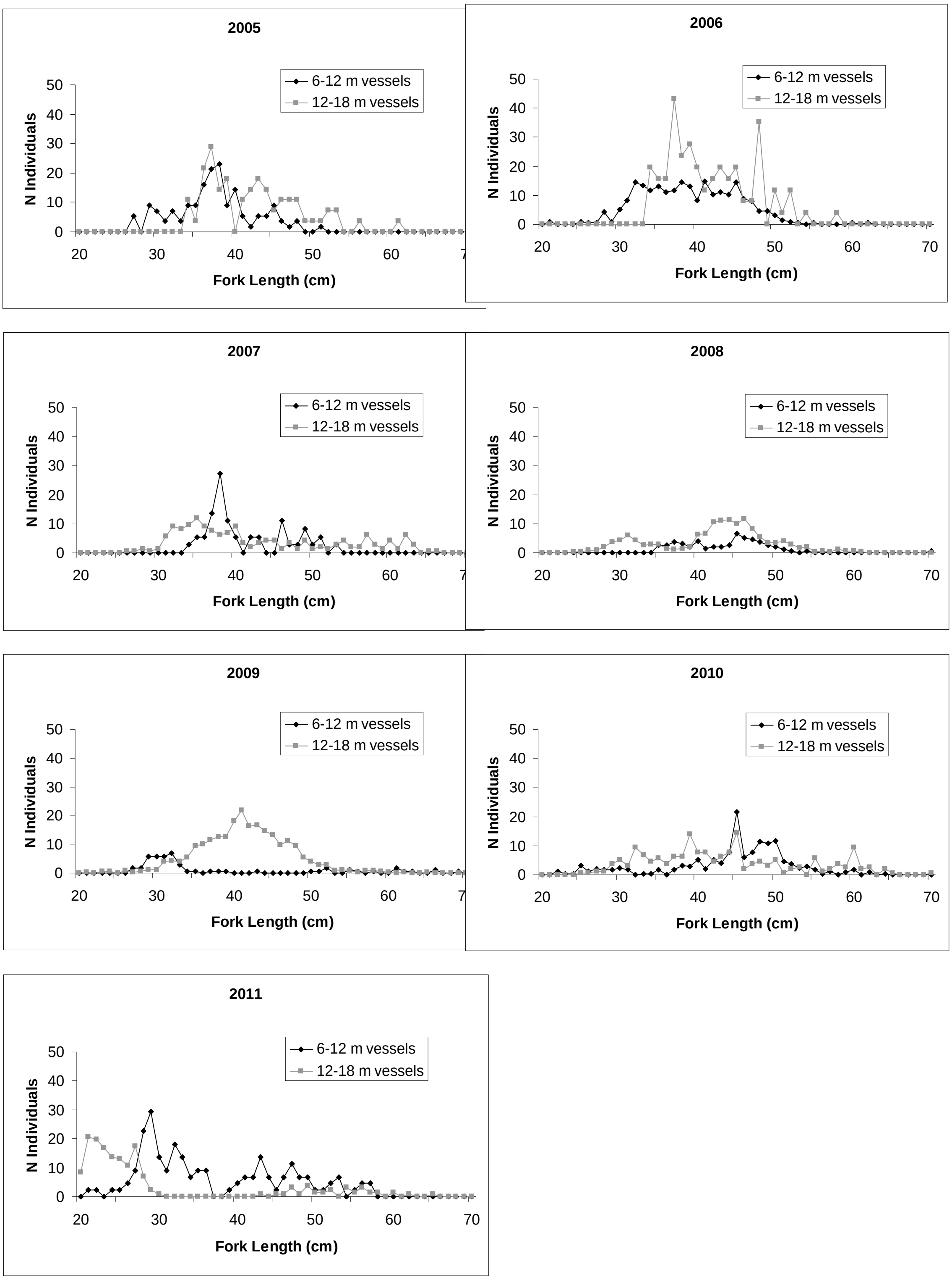

Figure 15 Length frequency distributions of FAD lampuki (*C. hippurus*) catches in by the 6-12 m and 12-18 m vessel length fleet segments in the Maltese Islands.

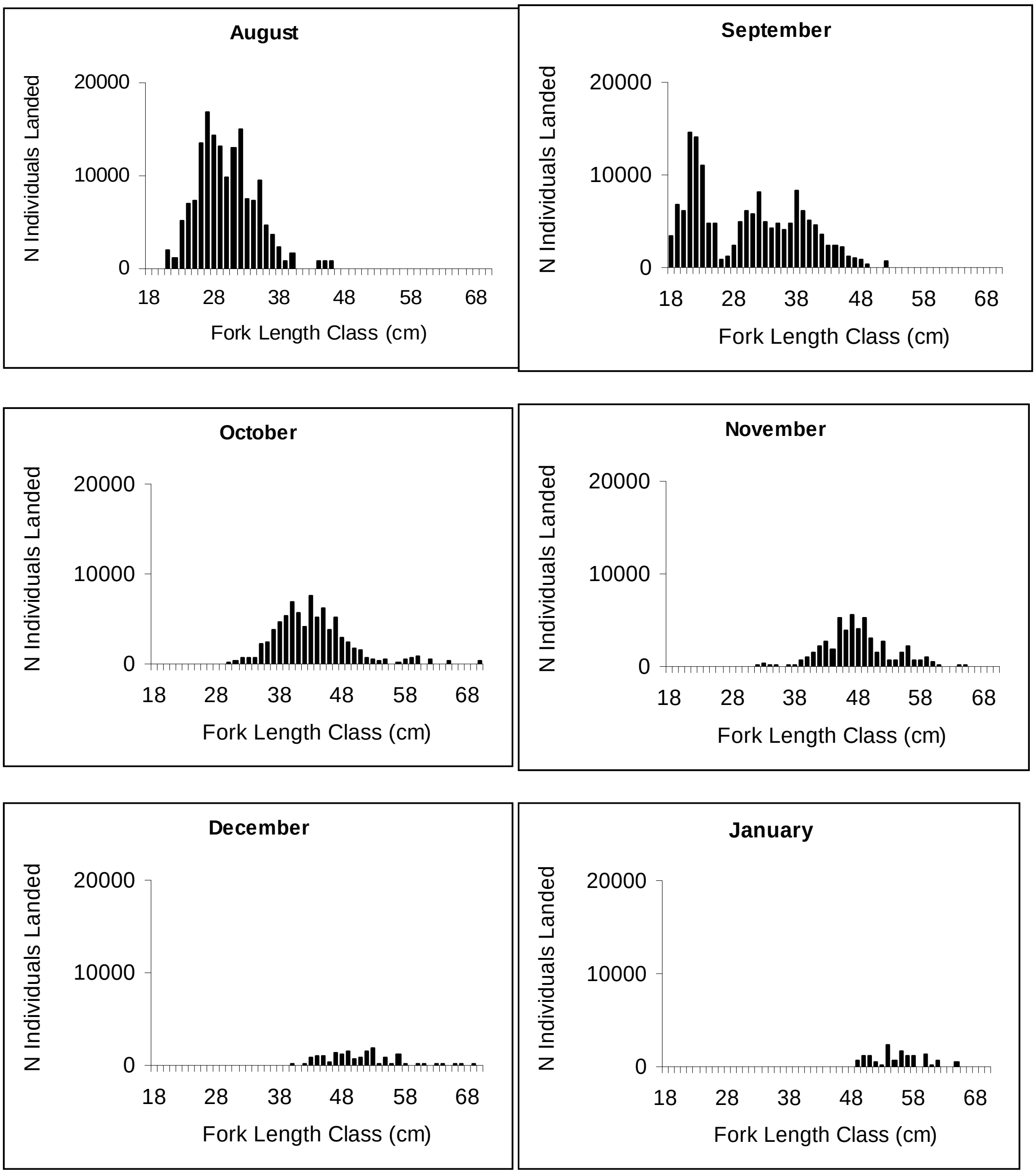

Figure 16 Average monthly length frequency distribution of *C. hippurus* recorded in the Maltese Islands in 2009-2011; fork length composition of catches increases rapidly over the fishing season as a result of the high growth rates of this species.

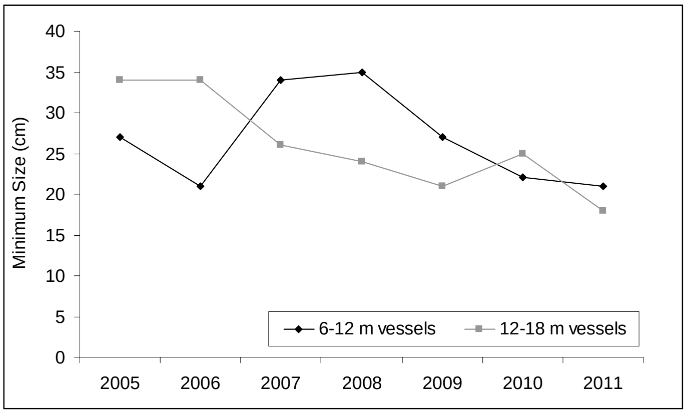

Figure 17 Minimum size of lampuki (C. hippurus) caught by the 6-12 m and 12-18 m fleet segments in the Maltese Islands

An analysis of the overall length frequency distributions of lampuki catches in the Maltese Islands in 2005-2011 shows a decreasing trend in the minimum size of juvenile C. hippurus landed, both by the 6-12 m and the 12-18 m fleet segments.

When considering maximum sizes of C. hippurus landed, an increasing trend was observed from 2005 to 2009, followed by a decline in 2010 to 2011. This is most likely due to the fact that until 2007 the fishery closed at the end of December, whereas in 2008-2010 the season was extended until the end of January, thus enabling fishers to target larger sized individuals.

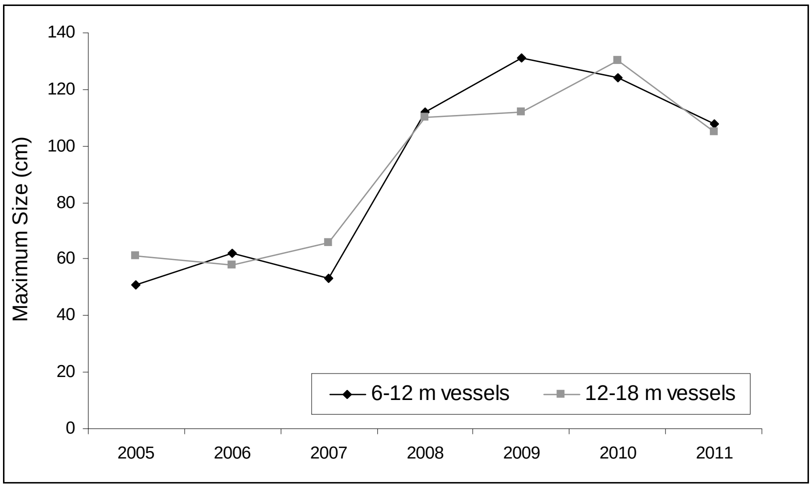

Figure 18 Maximum size of lampuki (C. hippurus) caught by the 6-12 m and 12-18 m fleet segments in the Maltese Islands

Average size of fish caught remained constant in 2005-2010, before declining from circa 40 cm to circa 30 cm in 2011.

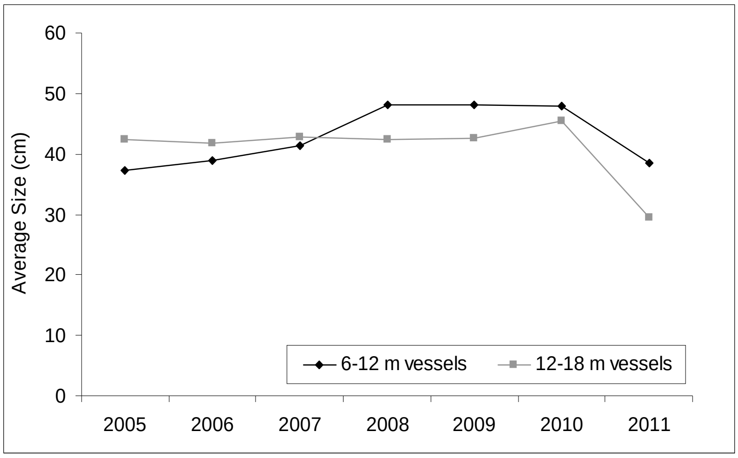

Figure 19 Average size of lampuki (C. hippurus) caught by the 6-12 m and 12-18 m fleet segments in the Maltese Islands.

Overall the decrease in minimum and average sizes of fish caught in recent years indicates a cause for concern. Although the precise stock status is unknown since a regional stock assessment would be necessary, it is clear that growth overfishing is being exerted on the stock of C. hippurus caught by the Maltese fleet.

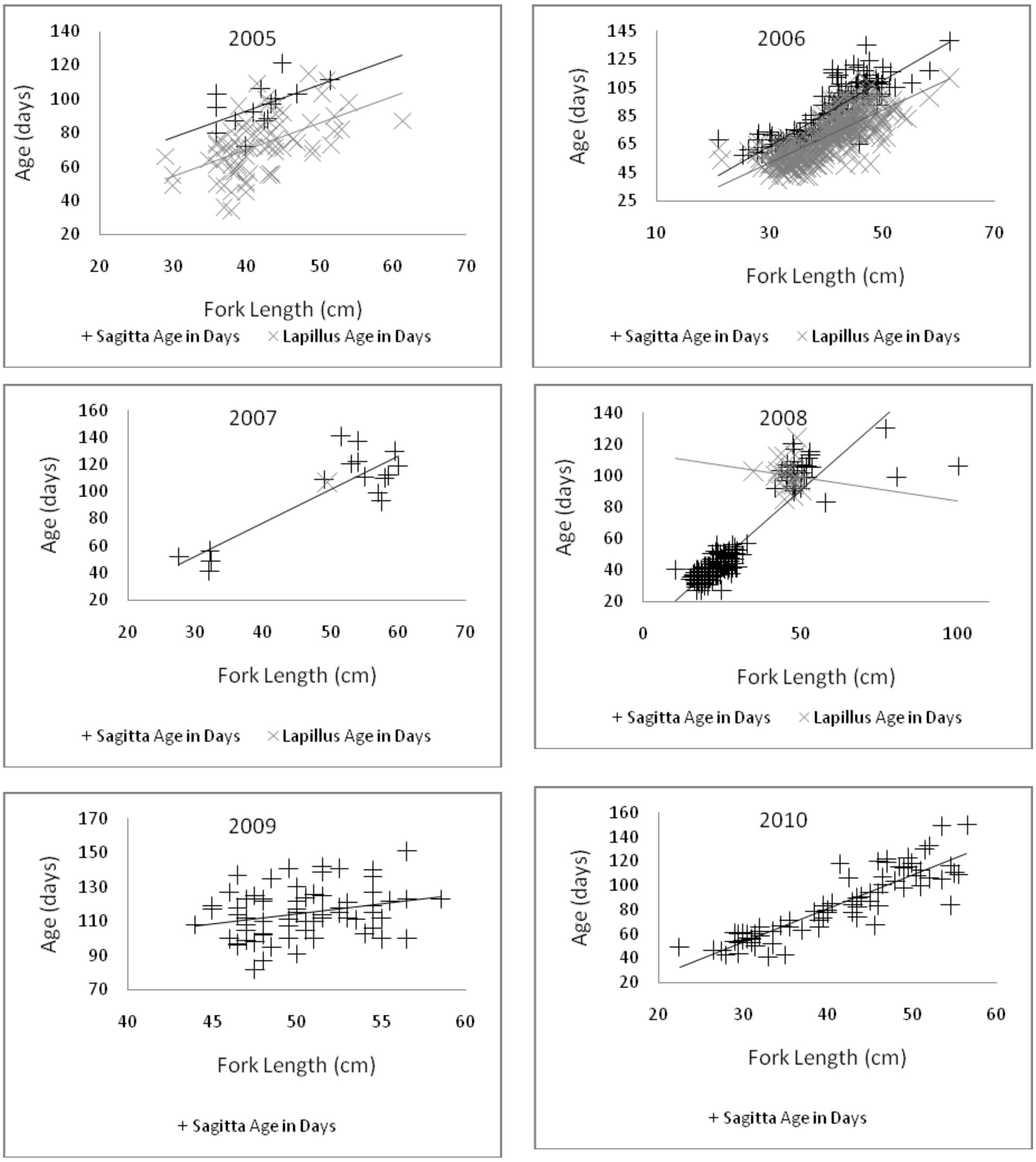

Figure 20 Age in days against fork length (cm), for market samples of lampuki (C. hippurus) caught in the Maltese islands in 2005-2010.

Table 11 Mean sagitta age (days), mean lapillus age (days) and mean fork length (cm) for market samples of lampuki (C. hippurus) caught in the Maltese islands in 2005-2010.

	2005	2006	2007	2008	2009	2010
Mean Sagitta Age (days)	95.6	88.6	100.2	46.6	114.8	83.0
Mean Lapillus Age (days)	72.7	69.6	107.0	100.4	N/A	N/A
Mean Fork Length (cm)	41.7	39.8	49.4	26.7	50.4	40.8

Mean sagittal age rose between the years of 2007 – 2009, falling to pre-2007 levels in

2010. A similar pattern can be observed for age determined via the use of the lapillus method, although the latter was not carried out for 2009 and 2010. Since Maltese lampuki fisheries tend to target juveniles from the 0 age class only a few individuals older than a year were obtained for sampling in the laboratory. A total of 3 individuals were identified as being over 1 year old in 2008. In 2009, 27 individuals were found to be 1 year old, while 4 individuals were 2 years old. Finally, in 2010, 5 individuals were found to be 1 year old, and 8 individuals were found to be 2 years old

Although effort data is only available for a short time series, six decades of landings data fluctuating around a stable mean seems to indicate that even if the fishery is not harvesting the lampuki stock at a maximum yield, the yield from the Maltese fishery by itself is sustainable even in the long term. The recent rise in overall landings of the species in the Mediterranean, and in particular the dramatic rise in Italian landings may not be sustainable and potentially may be the cause for the decrease in size of lampuki caught by Maltese fishermen in recent years.

Nevertheless there are considerable knowledge gaps to be filled in order to fully understand the biology and population dynamics of lampuki, without which scientifically sound conclusions on stock status cannot be derived. For this reason Malta is involved in a number of ongoing research initiatives, described in more detail below.

6.Impact on By-Catch Species and the Environment

6.2 By-catch species

By-catch is taken to mean the total catch of untargeted fish which are of commercial value. With regards to by-catch pilot fish (Naucrates ductor) and a small number of small amberjack (Seriola dumerili) are caught besides the target species in this fishery. The same species are caught as bycatch in the Sicilian and Mallorcan lampuki fisheries [45, 47]. Other by-catch which is taken on occasion includes chub mackerel (Scomber japonicus) and horse mackerel (Trachurus trachurus).

Very rarely, at times catches include juvenile albacore (Thunnus alalunga) and juvenile bluefin tunas (Thunnus thynnus)) which are returned to sea alive since most species caught are below the minimum landing size.

6.3 Environmental Impacts

A study on the number and distribution of limestone slabs in Maltese waters carried out by Pace et al. (2007a) found a much lower than expected abundance of slabs. However, the study was carried out in areas where trawling is permitted within the 25 nautical mile Maltese Fisheries Management Zone; it is thus possible that the low number of recorded slabs was due to the fact that trawlers clear trawling lanes from such obstructions. Another potential explanation for the lower than expected number of limestone slabs is that the slabs may be gradually sinking into the sediment until they are completely buried and the possible disintegration resulting from natural erosion reactions.

Limestone slabs dropped on sandy/muddy habitats may in fact have a positive impact on the benthos of GSA 15 by providing a more heterogeneous habitat, effectively acting as small artificial reefs and thus increasing biodiversity.

7. Ongoing Research

A workshop on fisheries and appraisal of C. hippurus in the MedSudMed and CopeMed II

Project areas was held in Palermo, Italy on 05 - 06 July 2011. The meeting was attended by researchers from the institutions involved in MedSudMed and CopeMed II activities, namely from Malta, Tunisia, Italy and Spain.

The main objective of the meeting was to initiate a process that in the medium term would lead to a better description of the fisheries and the stock of C. hippurus in the Mediterranean region. In order to achieve this, ongoing national activities on C. hippurus in the south-central and western Mediterranean were reviewed together with the data available at national level on this species.

The knowledge gaps to be filled in order to understand the biology and population dynamics of this species in the Mediterranean region were identified, thus beginning the process toward a joint regional stock assessment of C. hippurus. The following topics were identified as topics to be included in a work plan in order to progress on assessing the stock status of C. hippurus:

- Identification of stock units in the Mediterranean sub-regions
- Identification of critical habitats (nursery and spawning sites) and of ecological requirements for the development of eggs and larvae
- Definition of some biological aspects like growth parameters and maturity ogives
- Impact of fisheries based on FADs on by-catch species and on the environment

The Italian project Ritmare has recently made available funds to begin with the study on stock connectivity of C. hippurus. Samples are currently being collected throughout the Mediterranean in order to carry out a genetic comparison and identify potential population sub-units. The sampling process is being co-ordinated by the FAO regional projects CopeMed II, MedSudMed, AdriaMed and EastMed; samples are being collected from the following locations:

- North Tunisia
- South Tunisia
- Malta
- Libya
- Morocco Atlantic / Mediterranean
- Spain (incl. Balearic Islands)
- Tyrrhenian Sea
- Northern Sicily
- Southern Sicily
- Adriatic (Montenegro)
- Eastern Mediterranean

Samples from some of the locations mentioned above, including Malta, have already been collected and sent to the University of Palermo, where they will be analysed. A presentation of preliminary results is planned for a joint MedSudMed - CopeMed II meeting on C. hippurus in 2013. Although this project is a step in the right direction more funding to carry out scientific work on C. hippurus is crucial if future management measures are to be based on sound scientific advice.

8. Socio-economic characteristics of the fishery

The economic performance of the lampuki FAD fishery is based on a set of variables and indicators which were calculated using the economic data collected annually for the purpose of the EU Data Collection Programme whereby surveys are carried out to owners of vessels chosen through stratified random sampling. It must be noted that the majority of the fishers surveyed do not have any accounting practices and thus values obtained cannot be considered as precise. The population is defined as the entire Maltese commercial fishing fleet which includes the entire full-time commercial (MFA) and part-time commercial (MFB) fishing vessels. Both inactive and active vessels were considered.

It is very important to note that vessels using FADs also use other fishing gear throughout the year. Economic variables related only to the fishery using FADs started being collected for the reference year 2011 specifically for use in the management plans. For previous years, in order to estimate data solely related to the use of FADs, energy costs, repair and maintenance costs, variable costs, wages and salaries were divided by the proportion of working hours spent on FADs obtained for the reference year 2011.

The different regulations upon which the national data collection was based that is, DCR (Data Collection Regulation) and DCF (Data Collection Framework) introduce differences in the type of data collected and consequently the variables available. Data collected for the reference year 2006 and 2007 are based on the DCR, while data collected for the reference years 2008 to 2011 are based on the DCF.

Table 12 Values for the economic variables and indicators for the vessels licensed to fish for lampuki (C. hippurus) using FADs.

FADs		**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Economic Variables							
Gross Value of landings	EURO	875,106	805,285	725,564	873,405	1,049,133	850,786
Other income	EURO	N/A	N/A	46,370	196,429	0	0
Total income	EURO	875,106	805,285	771,934	1,069,834	1,049,133	850,786
Energy costs	EURO	241,378	116,778	106,172	159,141	416,503	392,366
Repair and maintenance costs	EURO	40,256	20,966	56,259	43,070	60,241	78,817
Variable costs	EURO	225,860	101,345	264,134	177,457	196,757	8,506
Non-variable costs	EURO	25,865	9,674	28,841	37,823	60,033	90,981
Total costs	EURO	533,359	248,763	455,406	417,491	733,534	570,670
Economic Performance Indicators							
Operating Cash Flow (OCF)	EURO	269,041	515,498	261,414	507,126	32,858	87,768
Social Variables							
Wages and salaries of staff	EURO	72,706	41,024	55,114	145,217	282,741	192,348
No. of employees	NUMBER	105	99	61	132	386	N/A
No. of FTE National	NUMBER	N/A	N/A	90	139	213	109

The highest value for gross value of landings was experienced during the year 2010 and amounted to €1,049,133, while the highest value for total income was that for the year 2009 and amounted to €1,069,834. The latter's positive difference is attributed to the substantial value of other income for the year 2009, amounting to €196,429. Variable costs and energy costs for all the years are the highest costs as a fraction of total costs except for 2011 where the variable costs were very low. This low value may be attributed to the fact that the 2011 questionnaires were directed towards getting data directly related to the lampuki fishery while in previous years they were not. The next highest costs are the wages and salaries followed by the repair and maintenance costs. The lowest cost value for all the years is that of the non-variable (fixed) costs with the exception of 2011 where the non-variable costs surpass the repair and maintenance costs. Again this exception is probably due to the fact that fishers were asked for costs related to FADs fishing gear only in 2011.

Wages and salaries for the year 2010 are the highest amongst the six year trend and amount to €282,741. In practice this type of seasonal fishery mainly applies the concepts of cost-sharing and profit sharing amongst all the people working on board.

In conclusion, the best year in terms of operating cash flow was the year 2007 with a gross profit amounting to €515,498.

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THIRD SCHEDULE

[Article 3(2)]

Table 1: Lampara objectives, indicators and targets

Objectives	Indicator	Targets
Biological 1. Ensuring sustainability	1 Catch Per Unit Effort (CPUE)	1. CPUE trend does not decrease below the annual 25% threshold for Chub Mackerel (Scomber japonicus) and Round Sardinella (Sardinella aurita) which lie at CPUE of 3.09 and 2.15 kg/kW * fishing days respectively
Socio-economic 1. Ensuring financial stability of fishers 2. Safeguarding artisanal fishing activity	1. Stability or increase of profit per vessel 2. Ensuring that fishing capacity in terms of number of vessels, GT and gear dimensions does not increase	1. Gross profit per vessel 2. Number of vessels, GT, kW and gear dimensions at that of 2012 or less

FOURTH SCHEDULE

[Article 3(2)]

Table 2: Bottom Otter trawler objectives, indicators and targets

Objectives	Indicator	Targets
Biological 1. Reducing fishing mortality	1. Reduced number of fishing days 2. Reduction in total kW allowed within the 25 NM FMZ	1. Reduction of fishing effort and reduction of capacity by at least 30%
Socio-economic 1. Ensuring financial stability of fishers	1. Gross profit per sector	1. Stability or increase of income per vessel

FIFTH SCHEDULE

[Article 3(2)]

Table 3: Lampuki objectives, indicators and targets

Objectives	Indicator	Targets
Biological 1. Ensuring sustainability	1. Historical, stable series of landings	1. Trends in local catches remain stable taking into consideration natural oscillations of the stock biomass. 2. Catches should remain oscillating at an annual average of 350 metric tonnes
Socio-economic 1. Ensuring financial stability of fishers	1. Stability or increase in profit per vessel	1. Gross profit per vessel

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