
***TRAWLING BAN IN THE GULF OF CASTELLAMMARE:
EFFECTS ON THE SMALL-SCALE FISHERY ECONOMICS
AND ON THE ABUNDANCE OF FISH***

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ABSTRACT

The present study intends to update a previous study (EC MED92/011) in order to (i) assess the effect of an eight-year trawl ban on the demersal resources (over trawlable and non-trawlable bottoms) in the Gulf of Castellammare, and (ii) investigate how these resources are now being exploited by the small-scale fishery, as well as the extent of any social or economic gain arising as a result of the trawl ban. The study is made of two parts: A) biological section, and B) socio-economic section.

A - Biological section

Four seasonal trawl surveys were carried out from June 1998 to March 1999 on the continental shelf. The stratum that yielded the highest CPUE was stratum A (10-50 m: 61248 gr/haul), followed by str. B (51-100 m: 47914 gr/haul) and str. C (101-200 m: 26356 gr/haul). Considering the seasons, CPUEs were 34663 gr/haul in spring, 52234 in summer, 53079 in autumn and 27578 in winter. *Mullus barbatus* was the most abundant species overall. Highly commercial species were the dominant category in almost all the seasons and strata, with a peak in str. A in summer.

Twelve trammel-gillnet surveys were carried out on a monthly basis in shallow waters on sandy bottoms (SB), rocky bottoms (RB) and an artificial reef area (ARA), from June 1998 to May 1999. The area that yielded the highest CPUE was SB (4000 gr/trip), followed by RB (3646 gr/trip) and ARA (3322 gr/trip). Considering the seasons, CPUEs were 2709 gr/trip in spring, 3569 in summer, 3168 in autumn and 4006 in winter. The most abundant species overall was *Boops boops*. Moderately commercial species dominated the trammel-gillnet catches; highly commercial species reached a peak in abundance in RB in summer.

The CPUEs of the total catch in the trawl surveys was larger in 1998-99 than in 1993-94, especially in str. A. Considering the single strata and seasons, CPUEs were larger in 1993-94 only in winter (str. B, C and total area) and in spring (stratum B). The CPUEs of the following target species (mean over the total area) decreased in 1998-99: *M. barbatus* (which increased in str. A), *Lithognathus mormyrus*, *Sepia officinalis*, *Eledone moschata*. The proportion of highly- and non-commercial species decreased in 1998-99, while that of moderately commercial species increased.

The CPUEs of the trammel-gillnet surveys were larger in 1998-99 than in 1993-94, especially in SB. Considering the single areas and seasons, there was a decrease in 1998-99 in spring (in ARA and RB). The CPUEs of following species decreased in 1998-99: *Octopus vulgaris* in RB, *Scorpaena porcus* in RB, *S. officinalis* in ARA and RB. The proportion of highly commercial species decreased in 1998-99, while that of moderately commercial species increased.

A landings survey of the small-scale fishery catches was carried out on a fortnightly basis from July 1998 to June 1999. The highest catches of the set net fishery were made in winter and spring, the lowest in summer. Fishermen in Castellammare and Balestrate obtained the largest CPUEs. Considering the Balestrate FAD fishery, dolphin fish (which is the target species) was the most abundant fish, followed by amberjack and juvenile bluefin tuna.

B - Socio-economic section

In 1998-99 there were 147 fishing vessels registered to fish in the Gulf of Castellammare. Of these, 96 were registered artisanal fishing boats. The main gear used by fishermen was a set net (trammel or gillnet). The economic assessment of the small-scale fishery required primary data, which were collected through a landings survey, a fishing characteristics survey and a motivations survey. The assessment of the financial performance of artisanal fishermen also data on fish price and capital costs were collected.

Net financial profit (boat income) of trammel netters in 1998-99 averaged 8.7 million lira (= 4493 Euro). Just fewer than 7% of operators incurred losses, while some 13% earned profits in excess of 25 million lira (= 12911 Euro). The fishery has the potential to be economically sustainable, since the capital necessary for its long-term continuation would be expected to earn a competitive return.

Biological data based on experimental trawl surveys and trammel net surveys showed a large increase in demersal stocks since the ban was imposed. However, over the period species composition has changed, with most of the biomass increase being for varieties classed as only

'moderately commercial'. This may therefore have attenuated the financial gains for artisanal fishermen.

Recreational fishing was identified as the single most important problem facing professional artisanal fishermen. As far as the ban is concerned, most fishermen felt that fishing was "better" or "much better" since the ban, 14% "worse" or "much worse". This contrasts with their view of prospects, where 24% believed fishing would be "better" or "much better" while 55% stated it would be "worse" or "much worse". Despite their apparent pessimism, the overwhelming majority (86%) signalled their intention of carrying on fishing in the Gulf in the future.

SUMMARY FOR NON-SPECIALISTS

The Gulf of Castellammare (NW Sicily, Mediterranean Sea) was the location of an important management measure in 1990, which is still in place: a year round trawling ban. This measure aimed at rebuilding the depleted demersal stocks. A study (MED92/011) co-funded by EC DGXIV was carried out by I.R.M.A. (formerly: I.T.P.P.) in 1993-95: that study highlighted the dramatic increase of demersal resources four years after the ban, compared to data collected two years before the ban.

The trawling ban also has helped to give the small-scale fishermen the chance of fishing in much safer conditions on a much more abundant resource. The present study had two main objectives:

- i) to update the data obtained in the previous study in order to establish whether the abundance of demersal fish stocks is still increasing and whether the fish assemblage composition and structure have further changed. This was achieved through fishing surveys aimed at assessing the current state of resources;
- ii) to investigate how these resources are now being exploited by the small-scale fishery (which now dominates the fishing sector in the Gulf of Castellammare), and the extent of any social or economic gain arising as a result of the trawling ban. This was achieved through interviews and data collection at landings, aimed at assessing the amount of catches and at investigating both the fishing habits of artisanal fishermen and their attitude towards the trawling ban and towards possible changes in the management regime.

This report is thus made of two parts: **(A)** a biological section made by IRMA – Laboratory of Marine Biology of Castellammare del Golfo (Italy); **(B)** a socio-economic section, including a legislative appendix, made by CEMARE – University of Portsmouth (Great Britain).

A - Biological section

METHODOLOGIES

Trawlable area

Four trawl surveys were carried out seasonally from June 1998 to March 1999, for a total of 105 30-min hauls. The study area extended from the shallowest bottoms compatible with trawling as far as the –200 m isobath, and was divided in three strata: A (10-50 m), B (51-100 m) and C (101-200 m). A commercial trawler was hired for the sampling operations. Yields were expressed as CPUEs (catch per unit effort) in gr/haul. The abundance of target species at sea was expressed as density in the study area (kg/km²). The species caught were grouped in three commercial categories, based on their market price: highly commercial (h.c.), moderately commercial (m.c.) and non-commercial (n.c.). The size structure of twelve target species was presented in the form of bar charts and discussed. The fish assemblage was analysed in terms of species richness and biological diversity, and multifactorial analyses were performed on the 1993-94 and 1998-99 data, to investigate possible changes in the community structure.

Non-trawlable area

Twelve trammel-gillnet surveys were made in the following three areas (each including two stations) from June 1998 to May 1999: RB (rocky bottom), ARA (artificial reef area) and SB (sandy bottom), for a total of 72 samplings. CPUEs were expressed in gr/500 m net/12 hrs fishing time. The fish assemblage was analysed in terms of species richness and biological diversity.

Effect of the trawl ban

The effect of the trawl ban eight years after its start was estimated through a comparison with the data of MED92/011.

Commercial landings

Data on the landings of the small-scale fishery were collected on a fortnightly basis in the four harbours of the Gulf, from July 1998 to June 1999, and standardized to kg/1000m set net/trip.

RESULTS

Trawlable area

The CPUE for total catch (mean over the year and the total area) was 41752 gr/haul. The most abundant species was red mullet, *Mullus barbatus* (9095 gr/haul, 356.6 kg/km²) followed by hake, *Merluccius merluccius* (3479 gr/haul, 114.7 kg/km²). Considering the single strata (yearly mean), the highest CPUE (61248 gr/haul) was given by str. A, followed by str. B (47914 gr/haul) and str. C (26356 gr/haul). Considering the seasons (mean over the whole area), spring yielded 34663 gr/haul, summer 52234 gr/haul, autumn 53079 gr/haul, winter 27578 gr/haul. The overall trend of commercial categories was h.c.>m.c.>n.c., except in autumn (m.c.>h.c.>n.c.); the highest CPUE of highly commercial species was in str. A in summer, while the lowest was in str. C in winter.

The analysis of the size structure shed light on the size-related distribution of target species, and helped to identify nursery areas for some species.

119 species were caught in the trawl surveys. The most frequent species in the samples was the midsize squid, *Alloteuthis media* (97.1%). Considering the whole year, the spatial trend of species richness was C>B>A, and that of diversity was B>C>A.

Non-trawlable area

The CPUE of the total catch was 3363 gr/trip (yearly mean over the year), 2709 in spring, 3569 in summer, 3168 in autumn and 4006 in winter. The most abundant species was the bogue, *Boops boops* (311 gr/trip). There were slight differences in the CPUEs of the total catch in each location over the whole year: 3322 gr/trip in ARA, 3646 in RB and 4000 in SB. The spatial trend for the commercial categories was m.c.>h.c.>n.c. in every season and in each location, with the only exception of SB in autumn, where the scale was m.c.>n.c.≡h.c..

95 species were caught with the trammel-gillnet. The most frequent species was the annular seabream, *Diplodus annularis* (68.1% of samples). Species richness and diversity showed a spatial trend SB>RB>ARA.

Effect of the eight-year trawl ban (comparison with the 1993-94 data)

Considering the yearly average, the total catch was always larger in 1998-99, both in the total area and in each stratum. Considering the single seasons, 1993-94 CPUEs were larger only in winter (str. B, C and total area) and in spring (stratum B). In the remaining cases 1998-99 CPUEs were always larger than 1993-94. In 1998-99 there was a reduction of highly commercial species (especially in stratum A) and an even more evident reduction of non-commercial species, with an increase of the moderately commercial group. Considering the target species, some increased (in one or more strata) while some decreased: for example the red mullet, *M. barbatus* and the hake, *M. merluccius* increased dramatically in str. A but decreased in other strata. Considering the mean CPUE over the total area, the following species decreased: red mullet (-9%), striped seabream, *Lithognathus mormyrus* (-56%), cuttlefish, *Sepia officinalis* (-45%), musky octopus, *Eledone moschata* (-41%). All the other target species increased.

The CPUEs of the eastern sector (which includes some non-protected ESUs plus an area where trawlers fish illegally) were compared to those of the western sector (where illegal trawlers do not encroach). This analysis showed that lower catches were obtained in the eastern sector, due most probably to the increased trawling activity in both the open area (legal trawling) and the protected area (illegal trawling).

The community structure showed some differences in the two periods, due to changes in the relative abundance of many species. Only minor changes resulted from the analysis of the geographical location of faunal assemblages.

The CPUEs of the trammel-gillnet surveys were always larger in 1998-99, especially in SB (3100 gr/trip in 1998-99 vs. 1148 gr/trip in 1993-94). The increase recorded in SB (sandy bottom area) is worth to be mentioned. This is an area commonly exploited by artisanal fishermen, and it has been clearly positively influenced by the trawl ban. The other two areas (rocky bottom and artificial reefs) are probably only indirectly affected by the ban, due to the fact that they host to a great extent either fish species linked to hard substrata or pelagic species and hence not likely to be directly influenced by the reduction of fishing pressure imposed on soft bottoms of the Gulf.

Further, the heavy pressure caused by recreational spear fishers in summer probably counterbalances any possible gain caused by the ban in RB.

In the non-trawlable area there was a reduction of the highly commercial species and an increase of the moderately commercial group.

The landings survey

The highest yields (total species) were obtained in winter and spring, followed by autumn. Summer was the worst season for set netters. The largest CPUEs (yearly average) were obtained by fishermen in Castellammare and Balestrate, followed by Trappeto and Terrasini. Overall, the Terrasini artisanal fishery did not seem to gain any benefit from the trawling ban, whereas most fishermen based in the harbours located within the banned area declared that they had at least two positive outcomes from the ban: i) an increase of resources (especially hake, red mullet and pandora, *Pagellus erythrinus*), and ii) the chance to set their gear in much safer conditions than before.

B - Socio-economic section

Characteristics of the fishery

In 1998-99 there were 147 fishing vessels registered to fish in the Gulf of Castellammare. Of these, 96 were registered artisanal fishing boats, 13 were trawlers, 29 were purse seiners and 9 were unlicensed artisanal boats (which, however, were registered as active on the coastguard register). Within the artisanal fleet the main gear types and fishing methods were trammel nets, set gillnets, FAD seine and squid jigging. Over 80 commercial varieties of fish are caught and sold locally, some of the more important being red mullet, *M. barbatus*, picarel, *Spicara flexuosa*, seabream (*Diplodus sargus*, *D. vulgaris* and *Pagellus* spp.), hake, *M. merluccius*, amberjack, *Seriola dumerili* and dolphin fish, *Coryphaena hippurus*.

In recent years the artisanal fisheries in the Gulf have been affected by two main developments: (i) recreational fishing, which since the mid 1990s has expanded rapidly and now represents a major source of conflict with small-scale professional fishermen; (ii) effort restriction in the form of a self-imposed vessel tie-up of 45 days per year. This is still being observed but the 'biological rest payment' to fishermen which accompanied it was ended prior to 1998.

METHODOLOGIES

Economic assessment of the artisanal fishery required the collection of primary data, the main sources of which were fishermen, fish retailers and equipment suppliers. Data collection in 1998-99 involved three major survey instruments:

(i) a landings survey designed to obtain information on the operating performance of fishermen

(ii) a fishing characteristics survey aimed at identifying gear use, fishing patterns and markets.

(iii) a motivations survey intended to elicit fishermen's attitudes and opinions, particularly in respect of the trawl ban.

To assess the financial performance of fishermen it was necessary to supplement these surveys with data on (i) fish prices, obtained from wholesalers and retailers, and (ii) capital costs, obtained from gear manufacturers and boat builders. Data from experimental trawl surveys and trammel net surveys, collected mainly for biological purposes over a period of several years, were also used in the economic assessment.

RESULTS

Financial performance

Net financial profit (boat income) of trammel netters in 1998-99 averaged 8.7 million lira (= 4493 Euro), though there were large inter-vessel variations in performance. Just under 7% of operators incurred losses, while some 13% earned profits in excess of 25 million lira (= 12911 Euro). Compared with small fishing vessels throughout Sicily as a whole, artisanal vessels in the Gulf landed a higher unit value catch but incurred higher operating costs per kg. Capital investment appraisal indicated that artisanal fishing would be financially viable, given current operating conditions and the expected costs of vessel purchase. This implies that the fishery has the potential to be economically sustainable, since the capital necessary for its long-term

continuation would be expected to earn a competitive return. Financial simulation modelling demonstrated that changes in catch rates have a disproportionate effect on boat incomes (a 25% +/- change in catch rates leads to a 50% +/- change in net profits), a result which highlights the sensitivity of financial performance to variations in fish stock abundance.

Effects of the trawl ban

Biological data based on experimental trawl surveys and trammel net surveys showed a large increase in demersal stocks since the ban was imposed. Of particular note was the fact that the abundance of shallow water species caught with trammel nets increased by 77% between 1990 and 1999. However, over the period species composition has changed, with most of the biomass increase being for varieties classed as only 'moderately commercial'. This may therefore have attenuated the financial gains for artisanal fishermen. Trammel net fishermen operating from a port outside the trawl ban area fished fewer days per year (possibly due to "crowding out" by trawlers) and incurred higher running costs (possibly because of the need to travel further afield) compared to trammel netters based inside the area. Such vessels may also have been disadvantaged by lower catch rates, since the experimental trawl surveys demonstrate that stock density was markedly lower on fishing grounds outside the trawl ban area than inside.

Fishermen's attitudes

Recreational fishing was identified as the single most important problem facing professional artisanal fishermen. Recreational boats in the Gulf currently outnumber artisanal vessels by 14:1. Asked about the effects of the trawl ban, 80% of artisanal fishermen felt that fishing was "better" or "much better" since the ban, 14% "worse" or "much worse". This contrasts with their view of prospects, where 24% believed fishing would be "better" or "much better" while 55% stated it would be "worse" or "much worse". Despite their apparent pessimism, the overwhelming majority (86%) signalled their intention of carrying on fishing in the Gulf in the future, which if true presumably indicates some confidence in the ability of the fishery to return a profit. The results of the financial analysis summarised above suggest that this confidence may not be misplaced.

KEY-WORDS

Trawling ban - resources management - stock enhancement - fishery reserve - economic performance - small-scale fishery - Gulf of Castellammare – Sicily - Mediterranean Sea.

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PART A - BIOLOGICAL SECTION

THE STATE OF DEMERSAL RESOURCES IN THE GULF OF CASTELLAMMARE EXCLUSION ZONE

1 - INTRODUCTION

1.1 – THE FISHERIES

The Gulf of Castellammare (NW Sicily, Mediterranean Sea), though not very big (approximately 116 nm² – 397 km² – from Capo San Vito to Punta Raisi, Fig. 1) is characterised by a huge variety of submersed habitats and accommodates a mixture of fisheries operating out of five coastal towns: Terrasini, Trappeto, Balestrate, Castellammare and San Vito Lo Capo (Fig. 1). A small fish market exists only in Terrasini.

We identify (i) an **artisanal fishery**, based on small vessels operated by one or two crew members, utilising several different gears (trammel net, gillnet, bottom longline, jig, small purse seines used with FADs) according to the resources available at any given period of the year; (ii) a **purse seine fishery** exploiting the sardine and anchovy stocks, which reportedly is experiencing a rather big crisis (as stated by fishermen); (iii) a **trawl fishery** exploiting both coastal and deep sea demersal stocks (Arculeo *et al.*, 1988, 1990). It is a complex framework which has in the past not favoured the smaller scale fisheries. A harsh conflict has arisen between the artisanal and the trawl fisheries, due to the limited area available for set-gear operations and to frequent intrusion of trawlers within the –50 m isobath, where trawling is forbidden by law. Competition became strong, also because of the general overfishing of coastal demersal stocks caused by trawling over the last few decades (Arena & Bombace, 1970) (Arculeo *et al.*, 1988). On top of this, the artisanal fishery has experienced frustrating pressures from political and economic factors.

1.2 – THE MANAGEMENT OF RESOURCES

Particular types of protected areas such as fishery reserves and gear exclusion zones have been considered a possible approach to the management of fish stocks especially in socially and biologically complex situations like the Gulf of Castellammare, as opposed to traditional approaches based on limitation and control of catch and/or effort, which are usually highly demanding in terms of data and labour. The preference given to protected areas is due to their potential in i) the recovery of depleted stocks, ii) the prevention of recruitment overfishing, and iii) the spillover of fish to adjacent fished areas (Polunin, 1990; Dugan and Davis, 1993; Dayton *et al.*, 1995; Bohnsack, 1996; Holland and Brazee, 1996; Auster and Shackell, 1997; Roberts, 1997). One possible approach involves the establishment of exclusion zones devoted to multiple uses, where bottom trawling is banned due to its heavy impact on demersal stocks and on the substrate (Dayton *et al.*, 1995; Auster *et al.*, 1996), while small-scale fishing with

artisanal gears is permitted. This was the pathway followed by the Sicilian Assembly with LR 25/1990, which banned trawling in a large part of the Gulfs of Castellammare (Fig. 2), Patti and Catania.

While trawling bans are not unique to the three gulfs, their use here represents a milestone, the importance of which is worth stressing. The scientific literature reports on the adoption of similar management measures (fishing bans and/or selective fishing closures aimed at stock enhancement), however, most of this experience focuses on tropical areas and reef fish stocks. Few such measures have been adopted in temperate areas and even fewer have been analysed in respect of their socio-economic effects. Further, it has become evident from the Gulf of Castellammare experience (through interviews with artisanal fishermen and recent data collection) that the socio-economic character of the traditionally weak, small-scale fishery within the Gulf may well be changing significantly as a result of the trawling ban, receiving a boost from the higher incomes and reduced levels of conflict that have arisen since the ban. The clarification of any such socio-economic effects will be vital not only for future management activities in the Gulf, but also for the deployment of similar measures elsewhere.

We should add at last that San Vito Lo Capo was excluded from the collection of landings data and from the interviews. The rationale behind this decision is that the artisanal fishermen of that port operate almost exclusively at the far western end of the Gulf over grounds close to very deep rocky bottoms, presumably not influenced by the trawling ban.

A previous EC-funded research program was carried out by IRMA (formerly ITPP) in 1993-94 (Study MED92/011: D'Anna *et al.*, 1995). That Study, besides providing an overview of the environmental and fishery aspects of the Gulf and a detailed description of the composition, structure and abundance of demersal fish populations on the continental shelf, revealed a dramatic increase in the stock biomass four years after the ban start (Pipitone *et al.*, 2000). This provides a strong basis for further assessment work and for a brand new socio-economic investigation, and makes the Gulf of Castellammare a strong candidate as a case study: especially, as no studies have presently been made on the effect of the ban in the Gulf of Catania and very little work has been undertaken in the Gulf of Patti (Potoschi *et al.*, 1995).

2 - OBJECTIVES OF THIS STUDY

Keeping in mind the huge increase of the demersal fishery resources observed in the frame of Study MED92/011, as well as its wide potential for the fisheries sector, the objectives of the present Study are:

- iii) to update the data obtained in the previous Study in order to establish whether the abundance of demersal fish stocks is still increasing and whether the fish assemblage composition and structure have further changed. This was achieved through fishing surveys aimed at assessing the current state of resources;

- iv) to investigate how these resources are now being exploited by the small-scale fishery (which now dominates the fishing sector in the Gulf of Castellammare), and the extent of any social or economic gain arising as a result of the trawling ban. This was achieved through interviews and data collection at landings, aimed at assessing the amount of catches and at investigating both the fishing habits of artisanal fishermen and their attitude towards the trawling ban and towards possible changes in the management regime.

This report is thus made of two parts: **(A)** a biological section, whose work was carried out by IRMA – Laboratory of Marine Biology of Castellammare del Golfo (Italy); **(B)** a socio-economic section, including a legislative appendix, whose work was carried out by CEMARE – University of Portsmouth (Great Britain).

The data collected should provide a scientific and socio-economic basis for fine tuning and/or possible changes within local fishing regulations and, more generally, through wider dissemination through this report and academic articles, assist in the development of coastal resources management measures in zones with environmental and socio-economic characteristics similar to the Gulf of Castellammare.

The main findings of this Study will be disseminated through this report and through a booklet: the latter aimed at communicating the findings to fishermen, local fishery managers and Sicilian political administrators (considering that Sicily, as a Special Statute Region, has the faculty of legislate over its seas). Since fishermen consented to provide data and answers as long as the confidential basis was respected, with special attention to the monetary aspects, the booklet refers only to those parts of the Study dealing with the results of experimental fishing and with the social and technological issues addressed by the interviews.

3 – METHODOLOGICAL APPROACH

Most of the Gulf has trawlable bottoms, with the following exceptions:

- a) the infralittoral and part of the circalittoral area of the easternmost and westernmost sectors;
- b) a portion of the central sector between the depths of about 15 and 50 m, where artificial reefs have been deployed in the last two decades (Badalamenti *et al.*, 2000). Due to recent deployments, the overall trawlable portion within the study area underwent a reduction of about 19% since Study MED92/011, passing from about 58 nm² (199 km²) to about 47 nm² (161 km²).

In order to assess the current species composition, abundance and size structure of demersal stocks in the Gulf, trawlable and non-trawlable areas of the continental shelf were surveyed (trawl surveys and trammel-gillnet surveys respectively) over one year. Working methods were based to a great extent on those employed in Study MED92/011 (D'Anna *et al.*, 1995). The main difference lies in the fact that while the previous Study was much more into the characterization (composition, biology, distribution, abundance) of fish populations, this one is directed towards the assessment of the effect of the trawl ban on the stocks. For this reason

some of the previous methods were judged of no use, as well as the double diurnal/nocturnal sampling adopted for the trawl and the trammel-gillnet survey in Study MED92/011.

3.1 - TRAWLABLE AREA

3.1.1 - Sampling design

Four trawl surveys were planned, in order to account for seasonal fluctuations in the abundance and distribution of demersal stocks. A stratified random sampling design based on depth strata was chosen, according to standard procedures used in trawl surveys (Nielsen and Johnson, 1983). Three bathymetric strata were selected (Fig. 3), corresponding to the depth intervals 10-50m (stratum A), 51-100m (stratum B) and 101-200m (stratum C). The study area was divided in 52 ESUs (Elementary Sampling Units). Sampling sites were randomly selected within each stratum using proportional allocation.

Initially 26 hauls of 30 minutes (5 in stratum A, 10 in stratum B and 11 in stratum C) were planned for each survey. After exploration of the artificial reef area with the colour-display echosounder and acquisition of new information by local fishermen, slight changes were made during the Study due to a newer estimation of the trawlable area. The number of valid hauls made in each survey is shown in the table below (details on each haul are given later on in Tab. 4):

	SPRING	SUMMER	AUTUMN	WINTER
str. A	5	5	5	6
str. B	10	10	10	11
str. C	11	11	11	10
Total	26	26	26	27

3.1.2 - Fishing vessel and fishing gear

In order to allow a reliable comparison with the data collected during Study MED92/011, the same vessel and fishing gear were employed.

The vessel chosen was the F/V GIAGUARO, a commercial wooden trawler built in 1993; the net used to suit our requirements at best was different in many aspects from the one commonly used in commercial hauls. The trawler had a gross tonnage of 40.10 t, measured 18.36 m of overall length, and was powered with a 160 HP diesel engine. It was equipped with two loran sets (one of which with a plotter), a radar, an echosounder with a colour display, and a radio set. The winch had two drums holding 1900 m of steel trawl warp each. Fish were stored in a fish-hold (15 m³) at about 0°C. A complete description of the boat features is given in Tab. 1.

The fishing gear was a bottom trawl equipped with wooden otter boards. The net was made of nylon and polyamide and composed by the different parts described in Fig. 4 and Tab. 2.

The upper side of the net included the codend ("pozzale"), two baitings ("cioletto anteriore" and "cioletto posteriore"), the top gusset ("scaglietto di summo"), two wings ("chiarazzo") and a headline ("lima di summo") with 43 plastic floats.

The lower side of the net included the codend, the belly ("sottano" I, II and III), the lower gusset ("scaglietto di piombo"), the wings and the groundrope. A small wooden cylindrical piece (about 30 cm long and 6 cm thick) linked each wing, through two ropes, to the bridles made of five twines of steel covered with polyamide. The bridles were connected to the otter boards that were in turn connected to the drums by the trawl warp.

The stretched mesh side, the mesh number and the length of the components and accessories of the gear are reported in Tab. 3 and in the plan of the trawl net (Fig. 5).

3.1.3 - Fishing operations

Four seasonal experimental trawl surveys were carried out in the Gulf of Castellammare: survey I (spring) from 6 to 10 June 1998; survey II (summer) from 27 August to 2 September 1998; survey III (autumn) from 10 to 15 December 1998; survey IV (winter) from 26 February to 2 March 1999. Four crew members and three research members took part to the operations. 105 valid hauls were made overall (Tab. 4, Figs. 7a to 7d). Each haul lasted 30 minutes; when towing lasted less than 20 min, or when the net was damaged by rocks or wrecks or did not work properly, hauls were considered non-valid. Haul details were recorded in a suitable form (Tab. 5). The following information was recorded directly aboard the vessel after each haul (Tab. 6): type of substrate and bionomic *facies*, weight of non-commercial benthic invertebrates and/or algae, weight and type of waste material.

The hauls were made from about one hour after sunrise to about one hour before sunset. Fishes were refrigerated on board and landed after each trip to be frozen in the lab.

3.1.4 - Laboratory operations

Following the work done in Study MED92/011, we divided all the species in three groups (Tab. 7) according to their commercial importance and to their abundance in the study area:

Group I (= target species): hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), striped mullet (*Mullus surmuletus*), pandora (*Pagellus erythrinus*), striped seabream (*Lithognathus mormyrus*), pink shrimp (*Parapenaeus longirostris*), cuttlefish (*Sepia officinalis*), European squid (*Loligo vulgaris*), broadtail squid (*Illex coindetii*), horned octopus (*Eledone cirrhosa*), musky octopus (*Eledone moschata*) and common octopus (*Octopus vulgaris*). The following individual data were recorded (Tab. 8): total (TL) and standard length (SL) at the lowest half centimetre for finfishes, mantle length (ML) at the lowest half centimetre for cephalopods, carapace length without rostrum (CL) at the lowest millimetre for pink shrimp, weight (W) at the nearest gram (first decigram for pink shrimp), sex and maturity stage.

Group II: it included 4 crustaceans, 5 cephalopods and 10 finfishes. The following individual data were recorded (Tab. 9): length (as above), and weight at the nearest gram.

Group III: it included all the remaining species; only total number and weight in each haul were recorded (Tab. 10).

The species collected (Annex I) were identified mainly with the aid of the FAO Identification Sheets (Fischer *et al.*, 1987), which also provided the English common names. For the nomenclature and systematic order the following publications were used: Whitehead *et al.* (1984/86) for fishes, D'Udekem D'Acoz (1999) for decapod crustaceans and Bello (1986) for cephalopods.

3.1.5 - Data analysis

3.1.5.1 - Fishing yields

The catch per unit effort (CPUE) was calculated as weight per haul (gr/30min). For tows lasting more than 31 minutes or less than 29 minutes, the weight was standardized by means of a correction factor, *i.e.*, standardized weight=catch weight/(tow duration/30).

An arbitrary indicator of monetary value was used for each species, in order to look for any change in the value of experimental catches since 1994 (Study MED92/011). Highly commercial species (h.c.) were those with a wholesale price >10000 ITL, moderately commercial (m.c.) were those <10000 ITL, and non-commercial (n.c.) all those that are not sold at all. Prices were assigned according to information collected during the landings survey in the four ports (see Section B.1.1 in Part B of this report)

In order to compare the yields obtained in different strata or seasons in this Study, the Mann-Whitney U test for two samples, and the Kruskal-Wallis ANOVA for more than two samples were used to test the differences between mean values (Siegel, 1956).

3.1.5.2 - Biomass estimates

The absolute biomass of the target species in the total study area, by season and year-round, was estimated by the "swept area" method (Sparre and Venema, 1992). Due to the different surface of the trawlable area in the two Studies, the biomass of target species was also expressed in terms of density (kg/km²) to allow a comparison with Study MED92/011. To estimate the swept area (*i.e.*, the bottom area swept by the trawl net during one tow) it is necessary to know the length of the tow and the wing spread of the trawl net. The first parameter was measured by means of the loran equipment; for the second we used the measurements taken during Study MED92/011 with a SCANMAR system by the I.R.Pe.M. (Istituto di Ricerca sulla Pesca Marittima del C.N.R., Ancona, Italy) staff (D'Anna *et al.*, 1995), given that the vessel and the fishing gear were exactly the same in the two Studies. The wing spread measures employed to calculate the swept area are shown in the table below:

Stratum	Depth (m)	Wing spread (m)
A	30	11.04
B	75	12.29
C	150	13.39

Afterwards the mean density (*i.e.* biomass per nm², \bar{y}_h) of each species in each stratum was estimated dividing the catch per haul (=CPUE) by the corresponding swept area (the catchability coefficient (*i.e.*, the proportion of fish actually caught by the gear) was assumed equal to 1), and the mean stratified density (\bar{y}_{st}) of each species was obtained employing the following formula:

$$\bar{y}_{st} = \sum_{h=1}^3 W_h \bar{y}_h = \sum_{h=1}^3 W_h \sum_{i=1}^{n_h} y_{hi} / n_h, \text{ where:}$$

$$W_h = \frac{\text{Surface of stratum } h}{\text{Total surface of trawlable grounds in the study area}} \text{ (=“weight” of stratum } h),$$

\bar{y}_h = mean density in the *h*th stratum,

y_{hi} = density in the *i*th haul of the *h*th stratum,

n_h = number of hauls in the *h*th stratum.

The weights (W_h) proportional to the surface of each stratum are shown in the following table (figures calculated on the trawlable portion of the study area):

Stratum	A_h (area in nm ²)	W_h
A	20.45	0.3542
B	18.57	0.3216
C	18.72	0.3242
Total	57.74	1.0000

In order to estimate the appropriate weights for the above formula, we digitised the study area from a nautical map and used a Geographic Information System implemented on the computer.

Associated variance of the mean density was assessed by the following unbiased estimator:

$$\hat{V}(\bar{y}_{st}) = \sum_h \frac{W_h^2 s_h^2}{n_h},$$

where $s_h^2 = \frac{1}{n_h - 1} \sum_{i=1}^{n_h} (y_{hi} - \bar{y}_h)^2$ = sample variance in stratum *h*,

which is the appropriate formula when the area trawled in the sampling programme is small relative to the total survey area and therefore finite population correction, here estimated smaller than 0.01, may be ignored (Cochran, 1977).

Finally, the **total stratified biomass in the study area** (\hat{Y}_{st}) for each of the twelve target species was assessed by multiplying the stratified mean density (\bar{y}_{st}) by the total surface of trawlable grounds (A_{tot}), approximately 57.7 nm².

The variance for total biomass was estimated by:

$$\hat{V}(\hat{Y}_{st}) = \sum_h \frac{A_h^2 s_h^2}{n_h} = A_{tot}^2 \sum_h \frac{W_h^2 s_h^2}{n_h} = A_{tot}^2 V(\bar{y}_{st}),$$

from which we can assess the standard error of total biomass estimates:

$$SE(\hat{Y}_{st}) = \sqrt{\hat{V}(\hat{Y}_{st})} = A_{tot} SE(\bar{y}_{st}).$$

Gain in precision due to the adoption of a stratified random sampling design (and hence an estimated stratified biomass) was evaluated by the Relative Precision index (*RP*), which is given by the following ratio:

$$RP = \frac{\hat{V}(\bar{y}_{st})}{\hat{V}(\bar{y}_{ran})},$$

where $\hat{V}(\bar{y}_{ran}) = s^2/n$ is the estimated variance of the estimated mean density for simple random sampling. A ratio <1 indicates a gain in precision.

3.1.5.3 – Size structure

The mean length and length range as well as the length frequency distributions of each target species were calculated in each season. The tables and charts provided depict the size structure of females, males and total (*i.e.*, females, males, sexually indeterminate juveniles and specimens without any clear sex identification due to poor preservation after catch) in the whole study area, as well as that of total specimens in each stratum.

3.1.5.4 - Fish assemblage*

Five indexes were used to characterize the structure of the fish assemblages in the study area (Loya, 1972). These indexes were calculated for each sample (=haul), then the mean and standard deviation were calculated over each stratum and over the total study area.

The species richness was calculated in terms of number of species (*S*) and of Margalef index $d' = S - 1/\ln N$ (Margalef, 1958) where *N* is the total number of specimens in the sample.

The biological diversity was expressed with the following two indexes:

* A section on multivariate analysis has been included in Annex II

$$\lambda = \sum_{i=1}^S \frac{n_i(n_i - 1)}{N(N - 1)} \text{ (Simpson, 1949),}$$

$$H' = \sum_{i=1}^S \frac{n_i}{N} \times \ln \frac{n_i}{N} \text{ (Shannon-Weaver, 1963),}$$

where n_i = number of specimens of the i th species and N = total number of specimens in each sample.

An expression of "evenness" $J' = H'/H'_{\max}$ (Pielou, 1966) was also computed.

Statistics included the Kruskal-Wallis ANOVA and the Mann-Whitney U test to assess differences between samples.

3.2 - NON-TRAWLABLE AREA

The non-trawlable area surveyed in this Study was represented by:

- a) natural rocky bottoms and *Posidonia oceanica* meadows located in the western part of the Gulf;
- b) the artificial reef area located in the central part of the Gulf on sandy bottoms.

In these areas a trammel-gillnet survey was carried out in order to compare the current state of the shallow water resources, which are the main target of the artisanal fishery in the Gulf of Castellammare, with their state in 1993-94, as assessed in Study MED92/011.

3.2.1 - Fishing gear

A trammel-gillnet was used for this survey. It is a combined bottom-set gear made by a trammel net in the lower section and a gillnet in the upper section (Fig. 8). This is a set net widely used in the Gulf (see the gear breakdown, Section B.2.1 in Part B of this report). The two nets had the following characteristics:

- height of trammel net = 1.8 m
- height of gill net = 3.5 m
- total length = 500 m
- stretched mesh size of gillnet and of inner wall of the trammel net = 54 mm
- stretched mesh size of outer wall of the trammel net = 320 mm.

3.2.2 - Sampling sites

Three locations were chosen in different portions of the infralittoral zone of the Gulf (Fig. 9):

- a) **RB** (Rocky Bottom) in the western rocky area;
- b) **ARA** (Artificial Reef Area) in the central sandy area;

- c) **SB** (Sandy Bottom) in the central sandy area.

Two stations were chosen at each location (Fig. 9):

- a) TU and MS (in **RB**) were located in proximity of hard substrates that slope down either towards large irregular rocky boulders scattered on a sandy bottom, or towards *Posidonia oceanica* beds at a depth of approximately 20-25 m;
- b) AR1 and AR2 (in **ARA**) were located inside the artificial reef area at a depth of 16-20 m. The artificial reef is composed of 8m³ concrete blocks assembled to form three-layer pyramids;
- c) CS1 and CS2 (in **SB**) were located about 5 km west of the artificial reef area and about 8 km from the nearest natural rocky bottom, at a depth of 17 m.

3.2.3 - Fishing operations

One nocturnal sample was collected monthly at each station, from June 1998 to May 1999, for 72 samples overall. The net was set from sunset to sunrise for a mean soaking time of 12 hours.

3.2.4 - Laboratory operations

All specimens caught by trammel-gillnet were measured and weighed individually, like group II species of the trawl surveys. Data of each sample were recorded on the form shown in Tab. 11.

3.2.5 - Data analysis

3.2.5.1 - Fishing yields

The catch per unit effort (CPUE) was calculated as weight (gr) of fish per 500 m of net per 12 h of fishing time.

Statistics included the Kruskal-Wallis ANOVA and the Mann-Whitney U test to assess differences between samples.

3.2.5.2 – Fish assemblage

See chapter 3.1.5.4 for the indexes used to study the fish assemblages in the surveyed area.

3.3 - ASSESSMENT OF THE EFFECT OF THE TRAWL BAN

In order to assess the effect of the trawling ban on the abundance of demersal stocks, we compared the results of the experimental fishing made in this Study with those obtained four years before in Study MED92/011. In particular the following variables were presented in paired tables or graphs (1993-94 vs. 1998-99) for an easy comparison:

- a) trawlable areas:
- CPUEs (for total catch and for single target species)

- W% (contribution in weight of each species to the total catch)
 - CPUEs of value categories (h.c., m.c. and n.c.) within the total catch
 - density (kg/km²) of target species
 - LFDs and mean size of target species (day plus night catches were used in 1993-94, only day catches in 1998-99)
 - F% (frequency of occurrence of species in the samples)
 - community structure indexes
 - Factorial Correspondence Analysis
- b) non-trawlable areas:
- CPUEs
 - W%
 - CPUEs of value categories (h.c., m.c. and n.c.) within the total catch
 - F%
 - community structure indexes

The Mann-Whitney U-test and the Kruskal-Wallis Anova were performed to test the differences between the mean values.

3.4 - COMMERCIAL LANDINGS

Data on the artisanal fishery and on catch landings are reported and discussed mainly in Part B of this report. Here only a few data on the detailed composition of the fishing fleet and of the catches are given.

3.4.1 – Pre-survey

A pre-survey aimed at a complete knowledge of the structure and composition of the fishing fleet in the Gulf of Castellammare was carried out in October 1998. The registers of vessels at the Port Authorities of Castellammare and Terrasini were consulted, and the recorded data were validate with field trips to the harbours of Terrasini, Trappeto, Balestrate and Castellammare.

3.4.2 – Collection of catch data

Catch landings of the artisanal fishermen were collected fortnightly on a census basis at the harbours of Terrasini, Trappeto, Balestrate and Castellammare, from July 1998 to June 1999*. The data collected included weight of each species fished and type and specifications of the gear used. Although occasionally longlines and drift nets were employed, only catches made with the most common gears were included in this report: set nets (i.e., trammel net, gillnet and mixed trammel-gillnet) and purse seines of the dolphin fish FAD fishery. CPUEs were expressed in kg/1000 m set net/trip or kg/700 m purse seine/trip.

4 – RESULTS OF THE DATA ANALYSIS

4.1 – TRAWLABLE AREA

4.1.1 – Fishing yields

CPUEs for single species and for the total catch in each stratum and in the overall area, by season and over the year round are reported in Tabs. 12 to 16, while their percentage in weight is reported in Tab. 17. The results of the statistical tests are reported in Tabs. 18 to 21.

4.1.1.1 – Total catch

Considering the cumulated yearly data in the overall area, the CPUE for the total catch was 41752 gr. The most abundant species was red mullet, *Mullus barbatus* (9095 gr, W% 21.8) followed by hake, *Merluccius merluccius* (3479 gr, W% 8.3). Considering the single strata, the highest CPUE for total catch (61248 gr) was given by str. A, followed by str. B (47914 gr) and str. C (26356 gr). Red mullet was the most abundant species in str. A (24044 gr) and B (8449 gr), followed respectively by axillary seabream, *Pagellus acarne* (8636 gr) and large-scaled gurnard, *Lepidotrigla cavillone* (4890 gr). In str. C hake was the most abundant species (3731 gr), followed by large-scaled gurnard (2819 gr).

Survey I (spring): in the overall area the CPUE for the total catch was 34663 gr. The most abundant species was red mullet (8009 gr, W% 23.1), followed by large-scaled gurnard (3635 gr, W% 10.5). Considering the single strata, the highest CPUE for total catch (40166 gr) was given by str. B, followed by str. A (39716 gr) and str. C (27365 gr). Red mullet was the most abundant species in str. A (22199 gr) and B (6588 gr), followed respectively by axillary seabream (4771 gr) and large-scaled gurnard (5175 gr). In str. C hake was the most abundant species (3992 gr), followed by large-scaled gurnard (3770 gr).

Survey II (summer): in the overall area the CPUE for the total catch was 52234 gr. The most abundant species was red mullet (12458 gr, W% 23.8), followed by picarel, *Spicara flexuosa* (5281 gr, W% 10.1). Considering the single strata, the highest CPUE for total catch (82884 gr) was given by str. A, followed by str. B (66877 gr) and str. C (24991 gr). Red mullet was the most abundant species in str. A (36039 gr) and B (11030 gr), followed respectively by axillary seabream (11555 gr) and picarel (11004 gr). In str. C hake was the most abundant species (4351 gr), followed by red mullet (3038 gr).

Survey III (autumn): in the overall area the CPUE for the total catch was 53079 gr. The most abundant species was red mullet (9976 gr, W% 18.8), followed by horse mackerel, *Trachurus trachurus* (6025 gr, W% 11.3). Considering the single strata, the highest CPUE for total catch (75755 gr) was given by str. A, followed by str. B (62621 gr) and str. C (34097 gr). Red mullet was the most abundant species in str. A (24127 gr) and B (11676 gr), followed respectively by axillary seabream (12422 gr) and horse mackerel (8848 gr). In str. C horse

* usually not all the fishermen were interviewed, due to unforeseen modifications of their activity on the survey date.

mackerel was the most abundant species (4172 gr), followed by black-bellied anglerfish, *Lophius budegassa* (4143 gr).

Survey IV (winter): in the overall area the CPUE for the total catch was 27578 gr. The most abundant species was red mullet (6055 gr, W% 21.9), followed by hake (3476 gr, W% 12.6). Considering the single strata, the highest CPUE for total catch (49072 gr) was given by str. A, followed by str. B (24350 gr) and str. C (18234 gr). Red mullet was the most abundant species in str. A (15516 gr) and B (4860 gr), followed respectively by axillary seabream (6269 gr) and hake (4295 gr). In str. C hake was the most abundant species (3748 gr), followed by large-scaled gurnard (2337 gr)

4.1.1.2 - Commercial categories

Tab. 22 reports the CPUEs of commercial categories. The results of the statistical tests are reported in Tabs. 18 to 21. Considering the whole area, the scale of abundance was always h.c.>m.c.>n.c., except in autumn (m.c.>h.c.>n.c.). The same is true also considering each stratum in the single surveys, except str. B in spring (m.c.>h.c.>n.c.), str. C in spring (h.c.>n.c.>m.c.), str. B in summer (m.c.>h.c.>n.c.), str. B in autumn (m.c.≅h.c.>n.c.), str. C in autumn (m.c.>h.c.>n.c.) and str. B year round (m.c.>h.c.>n.c.). In summary the highest CPUE of highly commercial species was found in str. A in summer, while the lowest was in str. C in winter.

4.1.1.3 - Target species

Hake – Hake was the second most abundant among the target species after red mullet. Considering the overall area, hake CPUEs were 3479 gr (W%=8.3) over the year, 2859 gr (W%=8.2) in spring, 3241 gr (W%=6.2) in summer, 4341 gr (W%=8.2) in autumn and 3476 gr (W%=12.6%) in winter. It also was among the top-ranking species in every stratum and every season. Although being generally more abundant in str. B (B>C>A), hake apparently moved at different depths along the shelf during the year, as suggested by CPUEs obtained in each survey in the three strata: in spring it stays deeper, in summer starts moving towards shallower bottoms, in autumn it is abundant in the 10-100 m belt and in winter it starts moving back to the shelf edge. Anyway hake distribution and population structure, like for several other target species as well, cannot be studied in detail in this report due to its depth distribution extending beyond the 200 m limit of the study area.

Red mullet – Considering the study area as a whole, red mullet was the most abundant species in the catch, with 9095 gr/haul (W%=21.8) on a yearly basis, 8009 gr/haul (W%=23.1) in spring, 12458 gr/haul (W%=23.8) in summer, 9976 gr/haul (W%=18.8) in autumn and 6055 gr/haul (W%=21.9) in winter. Being essentially a coastal species, the spatial scale of abundance was str. A > str. B > str. C in every season. The highest CPUE was obtained in str. A in summer (36039 gr), the lowest in str C in winter (1694 gr).

Striped mullet – The yields of this species were very poor (112 gr/haul, W%=0.3 on the whole area over the year). Although it is considered generally a shallow water species, its CPUEs were so irregularly distributed in space and time that no clear trend was detected at all. This may be

due to the fact that the central and eastern sectors of stratum A, where this species proved to be more abundant during Study MED92/011, are now non-trawlable areas due to the recent deployment of artificial reefs.

Pandora – This was among the top-ranking target species, with 1800 gr/haul (W%=4.3) in the overall area over the whole year, 1258 gr/haul (W%=3.6) in spring, 2772 gr/haul (W%=5.3) in summer, 1999 gr/haul (W%=3.8) in autumn and 1194 gr/haul (W%=4.3) in winter. Pandora is essentially a shallow-water species (4009 gr/haul in str. A, 2486 gr/haul in str. B and only 67 gr/haul in str. C, over the whole year), which only moves towards the centre of the shelf in spring (str. B > str. A > str. C).

Striped seabream – This strictly coastal species was caught only in str. A, where it lives on sandy bottoms within 30 m. Generally not very abundant (W%=0.5 on the whole year), its CPUEs were higher in summer and autumn (2161 gr and 1740 gr respectively) than in the rest of the year (417 gr in spring and 413 gr in winter).

Pink shrimp – The distribution and population structure of this as well as other target species cannot be analysed in detail in this report, due to a habitat extending much beyond the bathymetric limits of our surveys. In fact it is a deep-water species caught almost exclusively in stratum C (1361 gr/haul on the whole year). The spatial distribution of its catches in our surveys suggests that it starts to move up along the slope in summer, then in autumn it reaches the highest abundance in stratum C (3024 gr/haul), then it again descends down along the slope in winter.

Cuttlefish – This cephalopod seems to live preferentially in the central part of the shelf (191 gr/haul in str. A, 434 gr/haul in str. B, 212 gr/haul in str. C over the whole year). Considering the total area, it was much more abundant in autumn (421 gr/haul, W%=0.8) and winter (679 gr/haul, W%=2.5) than in the rest of the year (47 gr/haul, W%=0.1 and 15 gr/haul, W%=0.03 in spring and summer, respectively).

European squid – This species was more abundant in the surveyed area in autumn (749 gr/haul and W%=1.4 on the total area), when it concentrated in shallow waters (2074 gr/haul in stratum A). In winter it was still more abundant in stratum A (1222 gr/haul), then it tended to move towards the central part of the shelf (it was caught only in stratum B in spring), while in summer it again started moving to shallower waters.

Broadtail squid – This species was caught almost exclusively in str. B and C, and was always more abundant in the latter. CPUEs were generally very poor, with a peak in autumn (155 gr/haul in str. B, 596 gr/haul in str. C). Probably it is more abundant over grounds deeper than those surveyed here.

Horned octopus – This cephalopod was caught only in the two deepest strata within the surveyed area. It was always more abundant in str. C (574 gr/haul over the whole year). The highest CPUEs were obtained in spring (648 gr in str. B, 1648 gr in str. C, 946 gr in the total area), followed by a dramatic decrease in summer and by a gradual increase in the following two seasons.

Musky octopus – This species, although less abundant, followed closely the same spatial and temporal patterns of the congeneric horned octopus. It was only caught in str. B and C, and its peak season (spring) was followed by a strong decrease in summer and a gradual increase in autumn and winter.

Common octopus – This common and well-known species has got a wide bathymetric distribution, and was caught in all the strata (except in winter, when it was missing in the stratum A samples). Its CPUEs in the total area were 748 gr (year round, W%=1.8), 1271 gr (spring, W%=3.7), 636 gr (summer, W%=1.2), 548 gr (autumn, W%=1.0) and 546 gr (winter, W%=2.0). Our trawl surveys did not allow us to sample this species adequately on the very shallow waters it inhabits especially in spring (large mature specimens) and in summer (juveniles), on sandy as well as rocky bottoms. On the surveyed area it was more abundant in stratum B (1164 gr/haul in the whole year). The spatial and temporal pattern of the CPUEs suggests a displacement of this species towards the shallow coastal area starting in spring and leading to a peak in autumn in stratum A (778 gr), followed by an apparent drastic displacement towards deeper grounds in winter (0 catch in stratum A).

4.1.2 – Biomass estimates

The biomass of target species in the total study area was expressed in terms of density (Tab. 23) as well as of absolute biomass (Tab. 24). The values were estimated in each season and also as a mean value over the whole year of study. As already indicated by the analysis of CPUEs, the most abundant among the target species were red mullet (density: 356.6 kg/km², biomass: 57.0 t) and hake (density: 114.7 kg/km², biomass: 18.3 t). The values of the relative precision index (Tab. 24) revealed that in 37 cases out of 48 (77%) there has been a gain in the precision of the estimates, due the adoption of a stratified random sampling vs. simple random sampling. The existence of highly significant differences between CPUEs and of a high dispersion around the mean (see Tabs. 12-16 and 18) may have reduced in some cases the potential gain inherent in the adoption of a stratified sampling design.

4.1.3 – Size structure of target species

Tabs. 25 to 30 and Figs. 10 to 57 depict the size structure by season of the twelve target species in the samples of 1998-99 trawl surveys. Tab. 31 and Figs. 58 to 69 show the size structure of the total measured specimens (four surveys cumulated). In the following cases anyway the number of observations was probably too small to allow a reliable assessment of the size structure, at least in some seasons: striped mullet, striped seabream, cuttlefish, European squid, broadtail squid, musky octopus.

Hake – The largest mean size was generally found in stratum A (stratum B in summer only), while the smallest specimens were generally fished in stratum C: this might suggest the existence of a nursery in deep waters out of the study area. Recruitment took place in winter (Fig. 13a), with juveniles (mode at around 75 mm SL) fished in stratum C.

Red mullet – This species displays a marked shift of largest specimens towards the deepest stratum within the study area. It is a multiple spawner with a year-round reproductive activity and a peak in May-June, (Orsi Relini and Arnaldi, 1986); recruits are generally found in shallow waters within 30 m to 40 m in late summer (see Fig. 80 for the LFD of summer 1994), when they are targeted in some areas by illegal trawlers encroaching the coastal zone. We have found only two small recruit peaks in summer and autumn and a bigger one in winter (Figs. 15a to 17a), which might be explained by a highly successful spawn in late summer.

Striped mullet – Very few striped mullet were fished in our trawl surveys, and the LFD of the samples do not shed light on the size structure of the whole population. Anyway it seems that the largest specimens lived in deeper waters, and that the recruitment took place in spring (Fig. 18a), accordingly to the known spawning period for this species (Gharbi and Ktari, 1981).

Pandora – This species occurred almost exclusively in str. A and B, with the largest specimens found in B. The recruits were found in autumn in stratum A (Figs. 24a, 24b). Being a hermaphroditic protogynous species, males are generally larger than females on average in the whole population.

Striped seabream – This species lives on sandy bottoms within a depth of about 20-30 m. The small size of our samples do not describe well its size structure, although the growth process along the year is clearly represented by the progression of the modal length from spring to winter (Figs. 26a to 29a).

Pink shrimp – The mean size of pink shrimp was larger in stratum C (except in spring). Winter mean size was smaller than in the other seasons, due to recruits (modal length: 6 mm CL, Fig. 33b) in stratum B and probably to a displacement of larger adults to deeper waters.

Cuttlefish – The sample size in spring and summer was very small and no useful information on the size structure of the population could be obtained for those seasons. No recruitment peak was apparent. The mean size increased along with the depth.

European squid – The summer and autumn samples had a larger mean size in stratum A, while in winter the size was the same in these two strata. No true recruitment peak was detected; the smallest specimens were found in winter in stratum A (Fig. 41b), which should be the result of early winter spawning.

Broadtail squid – The samples were bigger and with a smaller mean length in stratum C (except in spring, when length was larger in stratum C). The smallest specimens were caught in stratum C in summer and autumn, and in stratum B in winter.

Horned octopus – Juveniles between 20 and 45 mm ML were found in stratum C in spring, summer and autumn (Figs. 46b to 48b). The mean size was higher in stratum B

Musky octopus – Also this species, like the previous one, was caught only in stratum B and C. The sample size was very small, thus making a picture of the population size structure was a difficult task. The smallest individuals were caught in summer in stratum B (Fig. 51b). No particular trend was detected however in the size distribution with depth.

Common octopus – The rather big portion of the population living in shallow waters was not adequately sampled in our trawl surveys. The bigger samples were fished in stratum B. The oldest fraction of the population seems to live in deeper waters in winter and spring and to move to shallower bottoms in autumn. The smallest specimens (20-25 mm ML) were caught in summer, autumn and winter in str. B and C.

4.1.4 – Fish assemblage*

Community structure

One hundred and nineteen species plus eight unidentified higher taxa were collected in the four trawl surveys. The complete list of species (trawl and trammel-gillnet surveys) is reported in Annex I. Crustaceans included four families with five species, cephalopods included five families with fourteen species, fishes included forty-seven families with one hundred species. Considering the whole year of study, the most frequent species in the samples (Tab. 32) was the midsize squid, *Alloteuthis media* (97.1%). Other species with $F > 90\%$ were the red mullet (96.2%), the large-scaled gurnard (94.3%), the hake (94.3%), the brown comber, *Serranus hepatus* (94.3%), the sculdfish, *Arnoglossus laterna* (92.4%) and the horse mackerel (90.5%). The most frequent species in each season were the brown comber in spring (96.2%), the midsize squid in summer (100%), the hake in autumn (100%) and midsize squid, red mullet and sculdfish in winter (100%). At the other end, fourteen species were fished only one time in the four surveys. The community structure indexes are reported in Tab. 33, and the results of the statistical tests in Tabs. 34 to 37. Considering the whole year, the highest species richness was found in stratum C ($S=32.07$) and the lowest in stratum A ($S=24.62$); the highest diversity in stratum B ($H'=2.13$) and the lowest in stratum A ($H'=1.74$). Considering the seasons, autumn had the highest richness ($S=31.54$) and summer the highest diversity ($H'=2.13$), while winter had the lowest richness ($S=26.04$) and spring the lower diversity ($H'=1.93$). In particular the highest species richness ($S=34.55$) was found in autumn in stratum C, and the lowest ($S=20.80$) in spring in stratum A; the highest diversity ($H'=2.24$) was found in summer in str. B and C, and the lowest ($H'=1.60$) in spring in stratum A.

4.2 – NON-TRAWLABLE AREA

4.2.1 – Fishing yields

CPUEs for single species and for the total catch in each location and in the overall area, by season and over the year round are reported in Tabs. 38 to 42, while the percentage in weight is reported in Tab. 43. The results of the statistical tests are reported in Tabs. 44 to 47.

- Total area

The CPUE of the total catch was 3363 gr over the whole year, 2709 gr in spring, 3569 gr in summer, 3168 in autumn and 4006 gr in winter. The most abundant species was the bogue,

* A section on multivariate analysis has been included in Annex II

Boops boops (311 gr, W%=9.2), which was more abundant in winter (584 gr, W%=14.6) and in spring (400 gr, W%=14.8) than in the rest of the year. The second most abundant species was the horse mackerel (292 gr, W%=8.7), which was by far more abundant in winter (703 gr, W%=17.5). Other species accounting for more than 3% each of the total catch in weight were the moray eel, *Muraena helena*, the black scorpion fish, *Scorpaena porcus*, the annular seabream, *Diplodus annularis*, and the round sardinella, *Sardinella aurita*. The most abundant species in the single seasons were the bogue in spring (400 gr, W%=14.8), the black scorpionfish in summer (512 gr, W%=14.3), the horse mackerel in autumn (239 gr, W%=7.5) and in winter (703 gr, W%=17.5).

- Sampling locations

There were slight differences in the CPUEs of the total catch in each location over the whole year: 3322 in ARA, 3646 in RB and 4000 gr in SB. The differences are much more evident if we take into account the different season in each area. In ARA the scale of importance is Wi>Su>Au>Sp, in RB the scale is Su>Wi>Au>Sp, in SB the scale is Au>Sp>Wi>Su. The differences in the CPUEs of single species obtained at each location reflect to some extent the differences in the habitats. This is particularly evident in RB (rocky bottom area), where the most abundant species (moray eel: 736 gr, and black scorpionfish: 660 gr over the whole year) were two typical rocky substrate species. This is also true - although less evident - in the other two locations, where there is a common sandy substrate to which the concrete boulders add a hard bottom component in ARA (artificial reef area). The most abundant species in ARA (yearly average) were horse mackerel (628 gr), bogue (493 gr) and round sardinella (341 gr), which are three pelagic or benthopelagic species probably attracted by the concrete boulders. In SB the most abundant (yearly average) were annular seabream (357 gr), anglerfish (223 gr) and cuttlefish (205 gr), which are generalist species not linked to a particular type of substrate. Bogue is still an abundant species in RB in spring (269 gr) and in SB in winter (172 gr).

- Commercial categories

Tab. 48 reports the CPUEs of commercial categories. The results of the statistical tests are reported in Tabs. 44 to 47. Considering the total area, the scale of abundance was m.c.>h.c.>n.c. in every season and in each location, with the only exception of SB in autumn, where the scale was m.c.>n.c.=h.c.. The season with the highest CPUE of highly commercial species was summer (1394 gr). Considering the location, the highest h.c. (2161 gr) was obtained in RB in summer, the lowest (231 gr) in ARA in spring. In general the CPUEs of non-commercial species were low (gross mean 203 gr), ranging from 1 gr (ARA in winter) to 877 gr (SB in autumn).

4.2.2 – Fish assemblage

Ninety-five species plus three unidentified higher taxa were collected in the one-year sampling. The complete list of species (trawl and trammel-gillnet surveys) is reported in Annex I. Crustaceans included four families with five species (only one in common with the trawl net

samples), cephalopods included four families with five species (four of which in common with the trawl net samples), fishes included thirty-seven families with eighty-five species (sixty-two of which in common with the trawl net samples). Considering the whole year of study, the most frequent species in the samples (Tab. 49) was the annular seabream (68.1%). Other frequent species with $F > 40\%$ were the horse mackerel (62.5%), the bogue (59.7%), the spot-tail mantis shrimp, *Squilla mantis* (47.2%) and the red mullet (41.7%). The most frequent species in each season were the annular seabream in spring (94.4%) and in summer (77.8%), the annular seabream and the horse mackerel in autumn (66.7%) and the bogue in winter (83.3%). At the other end, twenty-seven species were found only one time in the seventy-two samples.

The community structure indexes are reported in Tab. 50, and the results of the statistical tests in Tabs. 51 to 54. Considering the whole year, the highest species richness ($S=12.83$) and the highest diversity ($H'=2.14$) were found in SB, while the lowest values ($S=10.25$, $H'=1.90$) were found in ARA. Considering the seasons, summer had the highest richness ($S=13.17$) and autumn the highest diversity ($H'=2.21$), while winter had the lowest richness ($S=8.89$) and the lowest diversity ($H'=1.82$). In particular the highest species richness ($S=16.83$) was found in autumn in SB, and the lowest ($S=6.67$) in winter in SB; the highest diversity ($H'=2.43$) was found in autumn in SB, and the lowest ($H'=1.62$) in winter in SB.

4.3 - ASSESSMENT OF THE EFFECT OF THE TRAWL BAN

4.3.1 – TRAWLABLE AREA

4.3.1.1 – Fishing yields

4.3.1.1.1 - Total catch

Fig. 71 depicts the CPUEs of the total catch in 1993-94 and in 1998-99. The results of the statistical tests for these data are reported in Tab. 55. Considering the yearly average, the total catch was always larger in 1998-99, both in the total area and in each stratum, with the highest differential in stratum A and the lowest in stratum B. Considering the single seasons, 1993-94 CPUEs were only larger in winter (str. B, C and total area) and in spring (stratum B). In the remaining cases 1998-99 CPUEs were always larger than 1993-94. The most striking differential was found in summer and autumn, especially in stratum A.

In Tab. 56 the percentage in weight of the various species is reported. In some cases there has been an evident change in the percent contribution to the total catch. If we compare 1998-99 with 1993-94, we find major changes (generally an increase) in the following commercially important species: John Dory, *Zeus faber* (77.1 vs. 35.5), bogue (63.8 vs. 45.2), broadtail squid (53.5 vs. 23.4), tongue sole, *Citharus linguatula* (41.0 vs. 8.1), tub gurnard, *Trigla lucerna* (31.4 vs. 53.2).

4.3.1.1.2 – Commercial categories

Fig. 72 shows the proportion of commercial categories in the 1993-94 and 1998-99 trawl surveys (yearly averages). The results of the statistical tests for these data are reported in Tab. 55. In 1998-99 there was a reduction of highly commercial species (especially in stratum A) and

an even more evident reduction of non-commercial species, with an increase of the moderately commercial group. Considering the total area, in 1998-99 there was the following change with respect to 1993-94: h.c. = 19.0 vs. 16.5 kg/haul, m.c. = 16.7 vs. 7.7 kg/haul, n.c. = 6.1 vs. 8.8 kg/haul.

4.3.1.1.3 – Target species

Tab. 57 reports the CPUEs of target species in the two periods, by stratum and in the total area. For most species there has been an increase, except in a few cases when some species have decreased in single strata. The only species with a decrease in every stratum were cuttlefish (-8% in stratum A, -40% in stratum B, -39% in stratum C) and musky octopus (absent in stratum A, -57% in stratum B, -2% in stratum C). Some species had a dramatic increase in particular strata: hake (+226% in stratum A, from 585 to 1909 gr/haul), red mullet (+418% in stratum A, from 4639 to 24044 gr/haul), pandora (+116% in stratum A, from 1853 to 4009 gr/haul), European squid (+223% in stratum A, from 287 to 925 gr/haul). In general stratum A seems to have gained the highest benefits from the trawl ban in the last five years. Anyway such high increases have been counterbalanced by decreases in other strata, hence a modest increase or even a decrease on the total area for these species. Fig. 73 shows how the differential of densities between the two periods, expressed as a mean over four seasons, is very low. Some species have slightly increased whereas others have slightly decreased. The highest differential was found in red mullet (430.5 kg/km² in 1993-94 vs. 356.6 kg/km² in 1998-99).

We have also analysed the time trend of some species of major interest either for their commercial value or for their abundance/frequency in the considered habitats, comparing their CPUEs before and during the trawl ban (Fig. 74). For this purpose, we have taken data from the spring surveys made in 1987-89 (D'Anna *et al.*, 1995; Pipitone *et al.*, 2000) and compared them with the spring data collected in 1993-94 and in 1998-99. It is immediately clear the dramatic increase of all the species considered between 1987-89 and 1993-94. The only exception was the striped mullet. Its apparent decrease can be an artefact explained with the difficulty of collection due to the reduction of the trawlable areas in the south-eastern sector, where it was more abundant before the ban and in the early phase of the 1993-94 surveys, prior to the deployment of new artificial reefs. Between spring 1993-94 and 1998-99 the increase was in many cases small, and some species (red mullet, pandora, anglerfishes, picarel) have decreased.

4.3.1.1.4 – The eastern sector of the Gulf

We have seen in previous chapters that in some cases species have declined from 1993-94 to 1998-99, as suggested by the experimental trawl surveys data, and that the increase of some of them as well as of the total catch has been much lower than the increase recorded between 1987-89 and 1993-94. Thus we have compared the CPUEs from the eastern sector of the study area, which includes ESUs open to trawling or where trawlers reportedly enter illegally (no. 1033, 2022, 2023, 2041, 2042, 2043, 2044, 3022, 3023, 3041, 3042, 3043, 3044), with the

CPUEs from the rest of the banned area, where usually trawlers not dare to fish. Tabs. 58-59 show the result of this analysis, conducted on three target species of high commercial value (hake, red mullet and pandora) and on the total catch. From Tab. 58 (*“within year” analysis*) it is clear that, within each study period, experimental catches were higher inside than outside the banned area, and the differential was more pronounced in 1998-99 than in 1993-94. This (i) means that the trawl ban has caused a strong increase of the protected portion of the stocks, and (ii) suggests that more recently the non-protected portion is probably suffering a higher exploitation by trawlers than five years ago. As can be drawn from interviews and sparse information gathered in the harbours, trawlers encroach more often than in the past within the banned zone, in correspondence of a reduced coastguard patrolling action. In Tab. 59 (*“between years” analysis*) two results stem out: (i) comparing the *inside* CPUEs in the two periods, these are to a large extent higher in 1998-99: this again means that in the banned area the stocks have increased in the last five years (there is the exception of winter: in this season CPUEs were generally lower than in 1993-94, see Fig. 71); (ii) comparing the *outside* CPUEs in the two periods, these are in many cases (although not always) lower in 1998-99: this suggests evidence of a decrease of the non-protected portion of the stocks outside the banned area, probably due to an excessive trawling effort. In summary this analysis suggests that the demersal stocks have been effectively protected and enhanced by the trawl ban, and that the trawling effort outside and partly inside the eastern sector of the banned area has probably increased in the last four-five years.

4.3.1.2 – Size structure of target species

Tab. 31 and Figs. 58 to 69 depict the size structure of the entire sample (four surveys cumulated) in 1993-94 and in 1998-99 (1993-94 samples include both day and night trawl hauls), while Tab. 60 and Figs. 75 to 122 refer to the seasonal samples in the two periods. The 1998-99 mean size decreased for all target species (Tab. 31) except the following: striped mullet, pandora, striped seabream, cuttlefish. This is a somewhat unexpected result, since in protected areas (or generally in areas where the fishing pressure has been strongly reduced) a larger size (mean and maximum) of most species is one of the most likely output (Bohnsack, 1996). For all the species with a decreased mean size the bar charts indicate a 1998-99 distribution skewed towards smaller sizes, coupled with a smaller proportion of aged individuals (Figs. 58, 59, 63, 65 to 69). This might be due to one or a mixture of several hypotheses: (i) a strong fishing pressure on the oldest age groups, (ii) an increased proportion of recruits, (iii) other factors.

The first hypothesis is hard to demonstrate with our data: for some species with a depth range extending well beyond the study area (*hake, pink shrimp, broadtail squid, horned octopus*) it could be explained with the trawling effort exerted on the portion of the stock living outside. For others (*red mullet, common octopus, partly hake*) it could be explained with the artisanal fishing

effort, although the catches of these species as estimated from the landings survey do not let us suspect a particularly high fishing pressure.

The second hypothesis seems very likely for the following species: a) *hake* - the highest differentials in mean length (Tab. 60) were found in autumn ($\Delta=26.5$ mm) and especially in winter ($\Delta=65.6$ mm), when a much higher proportion of recruits occurred in 1998-99 (Figs. 77, 78). Further, in these two seasons (as well as in spring) the length range included occasionally caught larger fishes in 1993-94; b) *red mullet* – also in this case the highest differentials (Tab. 60) were found in correspondence of a higher 1998-99 proportion of recruits, that is spring ($\Delta=11.3$ mm) and especially winter ($\Delta=17.1$ mm); c) *pink shrimp* – in this case probably several different factors played a role in lowering the mean length, *i.e.*, a larger maximum length in 1993-94 as well as a higher proportion of recruits and a smaller proportion of aged individuals in 1998-99. It is very likely that for this species, intensely exploited in the fishing grounds adjacent to the banned area, trawling effort caused to a great extent the reduction in mean size; d) *European squid* – this species had a higher proportion of recruits in autumn and winter 1998-99 as well as a much larger maximum length in the 1993-94 samples. This squid displayed an opposite trend in spring, with a 1998-99 mean length much higher than in 1993-94. e) – For the other species it was not easy to suggest possible causes for the reduction of mean length.

The third hypothesis, among several others theoretically possible for a reduced mean length of some target species in 1998-99, includes a density dependent decrease of the growth rate for some species. At the moment this is not easy to demonstrate with our data. Anyway it seems likely at least for the red mullet, looking at its trend between 1993 and 1999. In spring 1993-94 (D'Anna *et al.*, 1995; Pipitone *et al.*, 2000) it was much more abundant in every stratum (+3225% on the total area) if compared to spring 1987-89 (=before the ban start), and it accounted for 30.3% in weight of the yearly total catch. In 1998-99 it accounted for 21.8% in weight of the total catch (although being still the most abundant species overall), and had a -9% decrease (CPUE on the total area). This can be seen as a stop, or even a reduction, in the population growth rate, maybe due to the attainment to the environmental carrying capacity.

A species like *pandora* reacted to the ban exactly like foreseen: from 1993 to 1999 it increased in abundance and length. On the other side, also the higher 1998-99 recruit proportion in the aforementioned species could be a positive consequence of the ban, linked to a larger spawning biomass.

4.3.1.3. – Fish assemblage*

Tab. 61 reports the community structure indexes calculated in the trawlable area in 1993-94 and in 1998-99. The results of the statistical tests are reported in Tab. 63. Apparently the fish community in the three strata has undergone only very slight changes between the two periods, with the exception of stratum C, where species richness increased and diversity decreased

* A section on multivariate analysis has been included in Annex II

significantly. The F% of some species has undergone major changes in 1998-99 (Tab. 64), which reflect the changes in W% observed in Tab. 56: John Dory (77.1% vs. 35.5%), bogue (63.8% vs. 45.2%), broadtail squid (53.3% vs. 23.4%), tongue sole (41.0% vs. 8.1%), tub gurnard (31.4% vs. 53.2%)

4.3.2 – NON-TRAWLABLE AREA

4.3.2.1 – Fishing yields

Fig. 123 shows the CPUEs of the total catch in each sampling location and in the total area, by season and the year round. The results of the statistical tests are in Tab. 65. Considering the yearly average, catches were always larger in 1998-99, with the highest differential in SB (3100 gr vs. 1148 gr). This differential is high also in the single seasons, especially in autumn, when the increase in ARA and RB were very low instead. The only evident decreases were in ARA and RB in spring. The increase recorded in SB (sandy bottom area) is worthy of particular mention. It is an area commonly exploited by artisanal fishermen, and it has been obviously positively influenced by the trawl ban. The other two areas (rocky bottom and artificial reef) are probably only indirectly affected by the ban, due to the fact that they host to a great extent either fish species linked to hard substrata or pelagic species and hence not likely to be directly influenced by the reduction of fishing pressure imposed on soft bottoms of the Gulf. Further, the heavy pressure caused by recreational spear fishers in summer probably counterbalances any possible gain caused by the ban in RB.

The percent contribution of species to the weight of the total catch is reported in Tab. 66. Major changes occurred for some species in 1998-99: bogue (9.3% vs. 1.2%), moray eel (7.3% vs. 2.7%), annular seabream (6.5% vs. 10.1%), cuttlefish (2.5% vs. 15.3%).

In Fig. 124 the 1993-94 and 1998-99 CPUEs of some commercially important species are shown. The following species have undergone a marked increase in 1998-99 (even though sometimes the CPUEs were still low): anglerfish in SB, hake in SB, red mullet in SB, pandora in ARA and in SB, stargazer in ARA. A strong decrease was recorded for the following species instead: common octopus in RB, black scorpion fish in RB, cuttlefish in ARA and RB. Again, as a general rule, the sandy bottom area seems to have experienced the highest gain from the trawl ban (notwithstanding the artisanal fishing pressure), while the other type of substrate don't seem to be influenced.

The trend of commercial categories between 1993-94 and 1998-99 resembled closely that of trawlable areas, with a reduction of the highly commercial species and an increase of the moderately commercial group in every sampling location as well as on the total area (Fig. 125, statistical tests in Tab. 65).

4.3.2.2 – Fish assemblage

The community structure indexes for the non-trawlable area are reported in Tab. 62 (statistical tests in Tab. 67). Species richness and diversity have increased in ARA ($S = 10.25$

vs. 9.79; $H' = 1.90$ vs. 1.85) and in SB ($S = 12.83$ vs. 7.42; $H' = 2.14$ vs. 1.74), while in RB there were the same S and a lower H' in 1998-99.

The most evident changes in $F\%$ of species caught in the in 1998-99 surveys compared to 1993-94 were as follows: horse mackerel (62.5% vs. 36.1%), bogue (59.7% vs. 19.4%), mantis shrimp (47.2% vs. 16.7%), axillary seabream (38.9% vs. 16.7%), cuttlefish (23.6% vs. 62.5%), greater weever (16.7% vs. 4.2%).

4.4 – COMMERCIAL LANDINGS

4.4.1 – Pre-survey

The pre-survey carried out in the four ports has yielded a detailed picture of the whole fishing fleet operating in the Gulf of Castellammare (as of October 1998). Tab. 69 reports all the vessels in Terrasini, Trappeto, Balestrate and Castellammare. A detailed discussion on the composition and structure of the fleet is made in Part B of this report, Section B.2.1.

4.4.2 – Catch data

4.4.2.1 – *The set net fishery*

As explained in Part B, Section B.2.1, artisanal fishermen adapt their gear, or even switch to a completely different one, according to the main resources available in the various seasons, based on their knowledge (rather deep and accurate) of the distribution, biology and ecology of target species. The most used fishing gear in the Gulf is the set net, including in this term trammel nets, gillnets and mixed trammel-gillnets. We have only reported here the catches made with this gear, leaving out the anecdotal use of pots, jigs, drift nets and longlines. The data of Tab. 70 are also presented in the form of charts (Fig. 126) to give a good visual idea of the fluctuations of the catch along the year, as drawn by the catches recorded in each port.

The highest yields (total catch) were obtained in winter and spring, followed by autumn. Summer was the worst season for set netters. The largest CPUEs (yearly average) were obtained by fishermen in Castellammare and Balestrate, followed by Trappeto and Terrasini. In spring the fishing activity was apparently higher, as suggested by the higher number of boat surveyed (with the exception of Trappeto, where the most intense activity was in summer). The spring intense activity is explained with the potentially good catches typical of the season and with the fair weather. The good weather conditions normally occurring in summer are counterbalanced by lower catches and by a strong pressure by recreational fishermen (see Part B of this report), that cause fishermen to slacken their activity.

Although based on a small number of interviews, the data collected in Terrasini suggest that fishermen out of the banned area fish much less, as can be seen by the low CPUEs of total catch and especially of hake and red mullet. Overall, the Terrasini artisanal fishery did not seem to gain any benefit from the trawling ban, whereas most fishermen based in the harbours located within the banned area declared (see Section B) that they had at least two positive outcomes

from the ban: i) an increase of resources (especially hake, red mullet and pandora), and ii) the chance to set their gear in much safer conditions than before.

4.4.2.2 – The FAD purse seine fishery

Fishermen in Balestrate set up a FAD fishery in late summer and autumn. In this period they make FADs (Fishing Attracting Devices) with palm branches and deploy them in radial rows offshore, perpendicular to the coastline. Dolphin fish, *Coryphaena hippurus* is the target species of this fishery. Other species that can be fished as a bycatch are bluefin tuna (*Thunnus thynnus*), pilotfish (*Naucrates ductor*) and greater amberjack (*Seriola dumerili*). They use a small purse seine operated by two men on a small boat. Catches are highly variable and can be very abundant, considering that the average fishing trip to FADs lasts three or four hours overall: the largest single catch recorded in our survey was 40 kg dolphin fish in one trip. Tab. 70 reports the CPUEs of Balestrate purse seiners. The most abundant species was the dolphinfish (17.1 kg/trip in summer, 12.2 kg/trip in winter), followed by amberjack and bluefin tuna.

5 – CONCLUSIONS

The present study has allowed us to assess the current state of demersal resources in the Gulf of Castellammare, and shed light on the effect of an eight-year trawl ban imposed with a Sicilian Assembly Act in 1990. The knowledge acquired with a previous EC-funded Study carried out in 1993-94 (MED92/011) provided baseline data for the biological part of this Study (the socio-economic issues are dealt with separately in this report). Since that Study had already assessed the short-term (four-year) effect of the ban on the abundance of demersal stocks, highlighting their increase if compared with the pre-ban period, the present Study aimed at investigating the stocks reactions on the mid-term (after eight years of ban), analysing in particular the modifications of the absolute and relative abundance of target species, of their size structure and of the composition and structure of fish assemblages, with special attention to the resources targeted by the small-scale artisanal fishery. Both the trawlable (up to 200 m depth) and the coastal non-trawlable areas have been surveyed. The former make up most of the Gulf bottoms, and are obviously those directly affected by the trawl ban. They are also currently exploited by artisanal fishermen, some of whom go as far as 200 m deep bottoms or deeper to set their gear. The latter occupy a much lesser surface, and are probably less affected by the trawl ban, but are still the main fishing ground for the artisanal fishery. Thus knowledge of the current state and of the benefits gained since the trawl ban from both types of bottom can give precious indications for fishery management.

Overall the experimental CPUEs on the trawlable area has increased by 27% (yearly mean over the total study area) since 1993-94. Every single species has experienced highly different increase rates from the others, and this is also suggested by their percent contribution to the weight of the total catch, which was in some cases very different from 1993-94. We could cite two high-value species to summarize the different observed reactions to the ban: (a) the red

mullet, which dramatically increased in 1993-94 with respect to 1987-89 (*i.e.* the pre-ban period), has had a decrease of density (-17%) and of mean length in 1998-99; (b) the pandora, which already had an increase (though not so huge) in 1993-94, has kept on growing in stock size (density +8.5%) and in mean length. These two cases testify (although maybe in a simplistic way) to how different can be the reaction of single species to a very big change in the exploitation pattern, namely the trawl ban. Similarly, the response at the community level was not easily predictable, as shown by the highly different increase rate (which indeed was a decrease sometimes) shown by the fish fauna as a whole in each stratum (as for the trawlable area) or in each shallow-water habitat (as for the non-trawlable area). Stratum A (including sandy and muddy bottoms between 10 and 50 m) had the highest benefits in terms of biomass increase, as well as SB (*i.e.* the 15-20 m sandy bottom) among the trammel-gillnet sampling locations. It is difficult to hypothesize the reasons for such different responses: research programmes including benthic sampling and fine ecological studies on food webs and on the life history of key species are necessary to shed light on the complex reactions to the trawl ban at the ecosystem level.

That said, there is little doubt that the demersal stocks as well as the small-scale fishery (as discussed in Part B of this report) have benefited from the ban. The gains to the artisanal fishermen would have been even higher if a more restrictive regime (*e.g.*, control and regulation of recreational fishing) and a more effective anti-poaching control would be enforced. An abandonment of the ban with the subsequent dramatic increase of fishing mortality would lead most probably, in the medium or even the short run, to the loss of the acquired biological and economic benefits.

There are still several crucial questions on the biological and on the fishery side, which go beyond the scope of this Study and that should be urgently addressed by *ad hoc* future research: (i) what will the trend of fish populations and of fish assemblages be under the ban regime in the future? (ii) what is the current state of the upper slope resources in the offshore central part of the banned area? (iii) could these resources, currently not available to either fishery, be made available to trawlers through a modification of the extension of the banned area? (iv) what is the current state of the shelf resources outside the Gulf, compared with the past decade, given that the trawling effort has been displaced and concentrated there since the ban is in place?

The case of the Gulf of Castellammare is of high relevance to fishery management in the Mediterranean context. The coastal fisheries of most Mediterranean areas present several similarities with the Gulf before the ban: depleted multispecies stocks, hardly viable multi-gear artisanal fisheries, competition for resources in a conflict regime, and last but not the least research centres that, if properly funded, could monitor the effects of any possible management option. A year-round trawl ban implemented under the necessary biological and economic

monitoring, could be an effective way of managing stocks as opposed to traditional methods based on the control of effort and/or catch.

ANNEX I - List of the taxa collected during the present study by means of trawl net (TrN) and trammel-gill net (TGN)

Family	Taxon	Common name	TrN	TGN
	CRUSTACEA			
SQUILLIDAE	<i>Squilla mantis</i> (Linneo 1758)	Spot-tail mantis shrimp	x	x
PENAEIDAE	<i>Parapenaeus longirostris</i> (Lucas 1846)	Pink shrimp	x	
	<i>Penaeus kerathurus</i> (Forsskal 1775)	Caramote prawn		x
PANDALIDAE	<i>Plesionika edwardsii</i> (Brandt 1851)	Striped soldier shrimp	x	
	<i>Plesionika heterocarpus</i> (Costa 1871)	Arrow shrimp	x	
SOLENCERIDAE	<i>Solenocera membranacea</i> (Risso, 1816)	Atlantic mud shrimp	x	
PALINURIDAE	<i>Palinurus elephas</i> (Fabricius 1787)	Common spiny lobster		x
SCYLLARIDAE	<i>Scyllarus arctus</i> (Linneo 1758)	Small European locust lobster		x
	<i>Scyllarides latus</i> (Latreille 1803)	Mediterranean locust lobster		x
	CEPHALOPODA			
SEPIIDAE	<i>Sepia elegans</i> (Blainville 1827)	Elegant cuttlefish	x	
	<i>Sepia officinalis</i> (Linneo 1758)	Common cuttlefish	x	x
	<i>Sepia orbignyana</i> (Ferussac 1826)	Pink cuttlefish	x	
	Sepiidae unident.	---	x	
SEPIOLIDAE	<i>Rossia macrosoma</i> (Delle Chiaje 1829)	Stout bobtail	x	
	Sepiolinae unident.	---	x	
	Sepiolidae unident.	---	x	
LOLIGINIDAE	<i>Alloteuthis media</i> (Linneo 1758)	Midsized squid	x	
	<i>Loligo vulgaris</i> (Lamarck 1798)	European squid	x	x
	Loliginidae unident.	---	x	
OMMASTREPHIDAE	<i>Illex coindetii</i> (Verany 1839)	Broadtail squid	x	
	<i>Todarodes sagittatus</i> (Lamarck 1798)	European flying squid		x
	<i>Todaropsis eblanae</i> (Ball 1841)	Lesser flying squid	x	
OCTOPODIDAE	<i>Eledone cirrhosa</i> (Lamarck 1798)	Horned octopus	x	
	<i>Eledone moschata</i> (Lamarck 1799)	Musky octopus	x	x
	<i>Octopus macropus</i> (Risso 1826)	White-spotted octopus	x	
	<i>Octopus vulgaris</i> (Cuvier 1797)	Common octopus	x	x
	<i>Pteroctopus tetracirrhus</i> (Delle Chiaje 1830)	Fourhorn octopus	x	
	<i>Scaevurgus unicolor</i> (Orbigny 1840)	Unihorned octopus	x	
	Octopodidae unident.	---	x	
	PISCES			
TORPEDINIDAE	<i>Torpedo marmorata</i> (Risso 1810)	Marbled electric ray	x	x
	<i>Torpedo torpedo</i> (Linneo 1758)	Common torpedo		x
RAJIDAE	<i>Raja radula</i> (Delaroche 1809)	Bullray	x	x
CLUPEIDAE	<i>Alosa fallax</i> (Lacepede 1803)	Twaite shad	x	x
	<i>Sardina pilchardus</i> (Walbaum, 1792)	European pilchard	x	x
	<i>Sardinella aurita</i> Valenciennes 1847	Round sardinella	x	x
ENGRAULIDAE	<i>Engraulis encrasicolus</i> (Linneo 1758)	European anchovy	x	x
ARGENTINIDAE	<i>Argentina sphyraena</i> Linneo 1758	Argentine	x	
SYNODONTIDAE	<i>Synodus saurus</i> (Linneo 1758)	Atlantic lizardfish	x	x
CHLOROPHTHALMIDAE	<i>Chlorophthalmus agassizi</i> Bonaparte 1840	Shortnose greeneye	x	
MURAENIDAE	<i>Muraena helena</i> Linneo 1758	Mediterranean moray		x
	Muraenidae unident.	---		x
CONGRIDAE	<i>Conger conger</i> (Linneo 1758)	European conger	x	x
	<i>Gnathophippoglossus</i> (Delaroche 1809)	Thinlip conger	x	
OPHICHTHIDAE	<i>Dalophis imberbis</i> (Delaroche 1809)	---	x	

	<i>Echelus myrus</i> (Linneo 1758)	Painted eel	x	x
	<i>Ophisurus serpens</i> (Linneo 1758)	Serpent eel	x	
EXOCOETIDAE	<i>Cheilopogon heterurus</i> (Rafinesque 1810)	Mediterranean flyingfish		x
MACRORAMPHOSIDAE	<i>Macroramphosus scolopax</i> (Linneo 1758)	Longspine spinefish	x	
SYNGNATHIDAE	<i>Hippocampus ramulosus</i> Leach 1814	Sea-horse	x	
MACROURIDAE	<i>Coelorhynchus coelorhynchus</i> (Risso 1810)	Blackspot grenadier	x	
MERLUCCIIDAE	<i>Merluccius merluccius</i> (Linneo 1758)	Hake	x	x
GADIDAE	<i>Gadiculus argenteus</i> Guichenot, 1850	Silvery pout	x	
	<i>Micromesistius poutassou</i> (Risso 1826)	Blue whiting	x	
	<i>Phycis blennoides</i> (Brunnich 1768)	Greater forkbeard	x	
	<i>Phycis phycis</i> (Linneo 1766)	Forkbeard	x	x
	<i>Trisopterus minutus</i> (Linneo, 1758)	Poor cod	x	x
MORIDAE	<i>Gadella maraldi</i> (Risso 1810)	---	x	
ZEIDAE	<i>Zeus faber</i> Linneo 1758	John Dory	x	x
CAPROIDAE	<i>Capros aper</i> (Linneo 1758)	Boarfish	x	
SERRANIDAE	<i>Anthias anthias</i> (Linneo 1758)	Swallowtail seaperch	x	
	<i>Callanthias ruber</i> Rafinesque 1810	Parrot seaperch	x	
	<i>Epinephelus aeneus</i> (G. Saint-Hilaire E. 1817)	White grouper	x	
	<i>Epinephelus marginatus</i> (Lowe, 1834)	Dusky grouper		x
	<i>Serranus cabrilla</i> (Linneo 1758)	Comber	x	x
	<i>Serranus hepatus</i> (Linneo 1758)	Brown comber	x	
	<i>Serranus scriba</i> (Linneo 1758)	Painted comber		x
MORONIDAE	<i>Dicentrarchus labrax</i> (Linneo 1758)	European seabass	x	
APOGONIDAE	<i>Apogon imberbis</i> (Linneo 1758)	Cardinal fish	x	x
CEPOLIDAE	<i>Cepola rubescens</i> Linneo, 1756	Red bandfish	x	
CARANGIDAE	<i>Caranx crysos</i> (Mitchill 1815)	Blue runner		x
	<i>Caranx rhonchus</i> G. Saint - Hilaire 1817	False scad		x
	<i>Lichia amia</i> (Linneo, 1758)	Leerfish		x
	<i>Seriola dumerili</i> (Risso 1810)	Greater amberjack	x	x
	<i>Seriola fasciata</i> (Bloch, 1793)	Lesser amberjack		x
	<i>Trachinotus ovatus</i> (Linneo 1758)	Pompano		x
	<i>Trachurus trachurus</i> (Linneo 1758)	Atlantic horse mackerel	x	x
SCIAENIDAE	<i>Sciaena umbra</i> Linneo 1758	Brown meagre		x
MULLIDAE	<i>Mullus barbatus</i> Linneo 1758	Red mullet	x	x
	<i>Mullus surmuletus</i> Linneo 1758	Striped mullet	x	x
SPARIDAE	<i>Boops boops</i> (Linneo 1758)	Bogue	x	x
	<i>Dentex dentex</i> (Linneo 1758)	Common dentex	x	x
	<i>Diplodus annularis</i> (Linneo 1758)	Annular seabream	x	x
	<i>Diplodus sargus</i> (Linneo 1758)	White seabream	x	x
	<i>Diplodus vulgaris</i> (G. Saint-Hilaire 1817)	Common two-banded seabream	x	x
	<i>Lithognathus mormyrus</i> (Linneo 1758)	Striped seabream	x	x
	<i>Oblada melanura</i> (Linneo 1758)	Saddled seabream		x
	<i>Pagellus acarne</i> (Risso 1826)	Axillary seabream	x	x
	<i>Pagellus bogaraveo</i> (Brunnich 1768)	Blackspot seabream	x	x
	<i>Pagellus erythrinus</i> (Linneo 1758)	Pandora	x	x
	<i>Pagrus pagrus</i> (Linneo 1758)	Common seabream	x	x
	<i>Sarpa salpa</i> (Linneo 1758)	Salema		x
	<i>Spondylusoma cantharus</i> (Linneo 1758)	Black seabream	x	x
CENTRACANTHIDAE	<i>Centracanthus cirrus</i> Rafinesque 1810	Curled picarel	x	
	<i>Spicara flexuosa</i> Rafinesque 1810	Picarel	x	x
	<i>Spicara maena</i> (Linneo 1758)	Blotched picarel	x	x
	<i>Spicara smaris</i> (Linneo 1758)	Picarel	x	x

POMACENTRIDAE	<i>Chromis chromis</i> (Linneo 1758)	Damselfish		x
LABRIDAE	<i>Labrus merula</i> Linneo 1758	Brown wrasse		x
	<i>Labrus viridis</i> Linneo 1758	Green wrasse		x
	<i>Lappanella fasciata</i> (Cocco 1833)	---	x	
	<i>Symphodus cinereus</i> (Bonnaterre, 1788)	Grey wrasse	x	
	<i>Symphodus mediterraneus</i> (Linneo 1758)	Axillary wrasse		x
	<i>Symphodus roissali</i> (Risso 1810)	Five-spotted wrasse		x
	<i>Symphodus tinca</i> (Linneo 1758)	Peacock wrasse		x
	<i>Xyrichthys novacula</i> Linneo 1758	Pearly razorfish	x	x
SCARIDAE	<i>Sparisoma cretense</i> Linneo 1758	Parrotfish		x
TRACHINIDAE	<i>Trachinus draco</i> Linneo 1758	Greater weever	x	x
URANOSCOPIDAE	<i>Uranoscopus scaber</i> Linneo 1758	Stargazer	x	x
TRICHIURIDAE	<i>Lepidopus caudatus</i> (Euphrasen 1788)	Silver scabbardfish	x	
SCOMBRIDAE	<i>Euthynnus alletteratus</i> Rafinesque 1810	Little tunny		x
	<i>Sarda sarda</i> (Bloch 1793)	Atlantic bonito		x
	<i>Scomber japonicus</i> Houttuyn 1782	Chub mackerel		x
	<i>Scomber scombrus</i> Linneo 1758	Atlantic mackerel		x
GOBIIDAE	<i>Deltentosteus quadrimaculatus</i> (Valenciennes 1837)	Fourspot goby	x	x
	Gobiidae unident.	---	x	x
CALLIONYMIDAE	<i>Callionymus maculatus</i> Rafinesque 1810	Spotted dragonet	x	
	<i>Synchiropus phaeton</i> (Gunther 1861)	---	x	
BLENNIIDAE	<i>Blennius ocellaris</i> Linneo 1758	Butterfly blenny	x	
BYTHITIDAE	<i>Bellottia apoda</i> Giglioli 1883	---	x	
OPHIDIIDAE	<i>Ophidion barbatum</i> Linneo 1758	Snake blenny		x
CARAPIDAE	<i>Carapus acus</i> (Brunnich 1768)	Pearlfish	x	
CENTROLOPHIDAE	<i>Centrolophus niger</i> (Gmelin 1788)	Blackfish	x	
SPHYRAENIDAE	<i>Sphyaena sphyraena</i> (Linneo 1758)	European barracuda	x	x
MUGILIDAE	<i>Liza aurata</i> (Risso 1810)	Golden grey mullet		x
SCORPAENIDAE	<i>Helicolenus dactylopterus</i> (Delaroche 1809)	Rockfish	x	
	<i>Scorpaena elongata</i> Cadenat 1943	Slender rockfish	x	x
	<i>Scorpaena notata</i> Rafinesque 1810	Small red scorpionfish	x	x
	<i>Scorpaena porcus</i> Linneo 1758	Black scorpionfish	x	x
	<i>Scorpaena scrofa</i> Linneo 1758	Red scorpionfish	x	x
TRIGLIDAE	<i>Aspitrigla cuculus</i> (Linneo 1758)	Red gurnard	x	
	<i>Aspitrigla obscura</i> (Linneo 1764)	Longfin gurnard	x	x
	<i>Lepidotrigla cavillone</i> (Lacepede 1801)	Large-scaled gurnard	x	x
	<i>Lepidotrigla dieuzeidei</i> Audouin in Blanc & Hureau 1973	Spiny gurnard	x	
	<i>Trigla lucerna</i> Linneo 1758	Tub gurnard	x	x
	<i>Trigla lyra</i> Linneo 1758	Piper gurnard	x	
	<i>Trigloporus lastoviza</i> (Bonnaterre 1788)	Streaked gurnard	x	
PERISTEDIIDAE	<i>Peristedion cataphractum</i> (Linneo 1758)	African armoured searobin	x	
DACTYLOPTERIDAE	<i>Dactylopterus volitans</i> (Linneo 1758)	Flying gurnard	x	x
CITHARIDAE	<i>Citharus linguatula</i> (Linneo 1758)	Spotted flounder	x	x
SCOPHTHALMIDAE	<i>Lepidorhombus boscii</i> (Risso 1810)	Fourspotted megrim	x	
	<i>Lepidorhombus whiffiagonis</i> (Walbaum 1792)	Megrim	x	
	<i>Scophthalmus rhombus</i> (Linneo 1758)	Brill	x	
BOTHIDAE	<i>Arnoglossus imperialis</i> (Rafinesque 1810)	Imperial scaldfish	x	
	<i>Arnoglossus kessleri</i> Schmidt 1915	Scaldback	x	
	<i>Arnoglossus laterna</i> (Walbaum 1792)	Scaldfish	x	x
	<i>Arnoglossus rueppelli</i> (Cocco 1844)	Rueppell's scaldback	x	
	<i>Arnoglossus thori</i> Kyle 1913	Thor's scaldfish	x	
	<i>Arnoglossus</i> sp.	---	x	

SOLEIDAE	<i>Bothus podas</i> (Delaroche 1809)	Wide-eyed flounder	x	x
	<i>Buglossidium luteum</i> (Risso 1810)	Solenette	x	x
	<i>Microchirus ocellatus</i> (Linneo 1758)	Foureyed sole	x	x
	<i>Microchirus variegatus</i> (Donovan 1808)	Thickback sole	x	x
	<i>Monochirus hispidus</i> Rafinesque 1814	Whiskered sole	x	x
	<i>Solea impar</i> Bennet 1831	Adriatic sole		x
	<i>Solea lascaris</i> (Risso 1810)	Sand sole		x
	<i>Solea vulgaris</i> Quensel, 1806	Common sole	x	x
	<i>Solea</i> sp.	---		x
CYNOGLOSSIDAE	<i>Symphurus nigrescens</i> Rafinesque 1810	Tongue sole	x	
BALISTIDAE	<i>Balistes carolinensis</i> Gmelin 1789	Grey triggerfish	x	x
LOPHIIDAE	<i>Lophius budegassa</i> Spinola 1807	Black-bellied anglerfish	x	x
	<i>Lophius piscatorius</i> Linneo 1758	Anglerfish	x	x

ANNEX II - MULTIVARIATE ANALYSIS

Multivariate analyses were performed on 1993-94 and 1998-99 data, in order to compare the community structure in the two periods.

Methodology

The fish communities of the two Studies were compared also by means of multivariate analyses made using the CLUSTER, MDS, SIMPER AND ANOSIM options of the PRIMER software (Clarke and Warwick 1994). Data from the eight seasonal trawl surveys were pooled together as yearly mean values of abundance and biomass calculated for each ESU, and a common (1993-94 plus 1998-99) matrix of data including all the species in the rows and all the ESUs in the columns was arranged. The matrix was made by 82 columns and 147 rows.

Individual species abundances were firstly analysed as a species/strata matrix, obtained by pooling the ESUs belonging to the same stratum together, and then as a species/assemblage matrix, where the assemblages were obtained from a cluster analysis (see below) performed on the matrix as a whole (i.e., not pooling the ESUs).

All the analyses were made on square root transformed data, converted to triangular matrices of similarities between every pair of samples using the Bray-Curtis similarity coefficient. Similarities between samples were graphically represented by a dendrogram (with comparisons made at about 50% Bray-Curtis similarity level) or ordination plots using multidimensional scaling MDS.

The species principally responsible for sample grouping in each of the two arrays were identified using SIMPER (Clarke and Warwick 1994). Those contributing cumulatively to about 90% of the total average similarity within sites (defined as typical of those sites) were identified. To allow a comparison of the species contributions between periods, in each stratum or assemblage, both average similarity (averaged across all sites sampled in each period) and average dissimilarity (averaged across all pairs of site/samples in each period) were calculated for these species only. Starting from this, the species most consistently contributing over the years were identified and the inter-annual variation in their contribution determined as the percentage in number to the total catch of each assemblage.

The non-parametric ANOSIM test for a 2-way (crossed) layout was used to compare ranked similarities between and within groups selected *a priori*, and was conducted on the 2 periods and 3 strata or 2 periods and 6 assemblages matrices (groups: strata or assemblages and period), with each test involving several simulations.

The abundance and biomass data were illustrated as cumulative dominance curves.

Results

Analysis on 3 strata and 2 periods

ANOSIM revealed significant differences for strata and periods ([Tab. I](#)), although the R-value of the latter was very low. The pairwise comparisons between strata revealed significant

differences for all the couples. The differences increased with the distance between strata, showing a gradient from the str. A to str. C.

The similarity within each stratum exceeded 55% of the Bray-Curtis index ([Tab. II](#)). Values were very close in the two periods, the smallest being reached in str. A in 1993-94 (57.3%) and the largest in str. B in 1998-99 (64.3%). The species which most contributed to similarity in both periods were *Mullus barbatus* in str. A and B, *Lepidotrigla cavillone* in str. B and C and *Parapenaeus longirostris* in str. C ([Tab. III](#)). *Pagellus acarne* highly contributed to the overall similarity in str. A in 1998-99.

[Tab. IV](#) shows the Bray-Curtis dissimilarity matrix of the 3 strata in the 2 periods. Overall the strata did not differ much. Str. A had the highest value of dissimilarity (45.7%) and str. B the lowest (37.4%). Four species contributed most to the dissimilarity in str. A between the two periods ([Tab. V](#)), i.e., *Pagellus acarne*, *M. barbatus*, *Trachurus trachurus* and *Bothus podas*; six species in str. B (*M. barbatus*, *L. cavillone*, *T. trachurus*, *Pagellus bogaraveo*, *Serranus hepatus* and *Spicara flexuosa*); and four species in str. C (*Macroramphosus scolopax*, *Argentina sphyraena*, *P. longirostris* and *L. cavillone*).

Post stratification

In Study MED92/011, starting from the matrix of species and ESUs of all the hauls made, a dendrogram was constructed (see D'Anna and Badalamenti, 1995 for the methodology adopted). This allowed us to identify six faunal assemblages. Using both the fish and the benthic samples collected, the six assemblages were identified as follows, using the Peres and Picard (1964) nomenclature:

- 1 - fine well sorted sandy bottoms (SFBC) up to about 30 m depth;
- 2 - terrigenous mud bottoms (VTC) between 30 and 100 m depth;
- 3 - mixed soft bottoms between 50 and 100 m depth including VTC, coastal detritus (DC) and sand and gravel submitted to bottom currents (SGCF);
- 4 - muddy detritus bottoms (DE) between 100 and 150 m depth;
- 5 - shelf edge detritus bottoms (DL) between 100 and 150 m depth;
- 6 - epibathyal muddy bottoms (VP) deeper than 150 m.

[Fig. I](#) shows the dendrogram obtained, according to the method used in Study MED92/011, analysing all the ESUs without any *a priori* stratification (i.e., without considering the three strata adopted in the trawl survey sampling design). Seven major clusters can be identified, which are very close to those identified using both day and night data in 1993-94. With very few exceptions the ESUs belong to the same cluster/assemblage in the two periods. [Figs. II](#) and [III](#) show the location of assemblages in the study area. A possible explanation of the slight differences is that the “changing” ESUs are located at the border of two assemblages, thus one ESU can happen to belong to either assemblage according to the precise location of the hauls made in that ESU. So some ESUs appear non-consistently linked to assemblages, and maybe in the future we should take into consideration the geographical position of each haul rather than the ESU for

further studies and analyses. A good approach might include a geomorphologic and bathymetric map fitting our catch data.

From the left side of the dendrogram, and in analogy to Study MED92/011, the following assemblages are recognizable: SFBC, VTC, DE, DL, MIX and VP. The MIX ESUs are of difficult attribution, since the species and the type of substratum they contain are so variable that in one haul more than one type of substratum and possibly more than one assemblage can be sampled.

Analysis on 6 assemblages and 2 periods

The results of the cluster analysis are strengthened by the ordination model made using the multi-dimensional scaling (MDS) approach ([Fig. IV](#)). The stress value in the two dimensions (2-D), which is a measure of the “goodness of fit” of the ordination, was 0.09 and the three-dimension (3-D) stress value was lower (0.06). Such values indicate that the ordination was potentially useful for pattern interpretation when used in conjunction with the relevant dendrogram (Clarke and Warwick, 1994).

[Fig. IV](#) shows quite clearly the six assemblages along the horizontal axis. There are not many differences between the two periods, except for the SFBC points, which are quite separated along the vertical axis. To explain this, it is important to remember that the trawable surface of str. A (which includes most of the SFBC ESUs) decreased in 1998, due to the presence of artificial reefs deployed after 1994.

ANOSIM revealed significant differences both for assemblages and periods ([Tab. VI](#)), although the R-value of the latter was very low. The pairwise comparisons of the assemblages revealed significant differences for all the couples, showing a gradient of increasing difference along to the depth of the assemblage.

The similarity within each stratum exceeded 55% of the Bray-Curtis index, and values were very close in the two periods ([Tab. VII](#)). The smallest value was reached in DL in 1998-99 (55.1%), and the largest in DE again in 1998-99 (80.3%). The species which most contributed to similarity in both periods ([Tab. VIII](#)) were *M. barbatus* in SFBC and VTC, *M. barbatus* and *L. cavillone* in VTC, *L. cavillone* and *S. hepatus* in DE, *L. cavillone* and *P. longirostris* in DL. *A. sphyraena* and *P. longirostris* contributed to the similarity of VP in 1993-94 and 1998-99 respectively. Other differences between the two periods were given by *P. acarne*, which greatly contributed to the similarity of SFBC in 1998-99, and by *M. barbatus* that was much more important in DE in 1994 than in 1998.

[Tab. IX](#) shows the dissimilarity matrix of the 6 assemblages in the 2 periods. Overall the assemblages did not differ very much. SFBC and MIX had the highest values of dissimilarity (46.9% and 46.6% respectively), while DE and DL had the lowest (28.6% and 29.4% respectively). Four species contributed most ([Tab. X](#)) to the dissimilarity in SFBC (*P. acarne*, *M. barbatus*, *T. trachurus* and *B. podas*), in VTC (*T. trachurus*, *M. barbatus*, *P. bogaraveo* and *L. cavillone*), in DE (*T. trachurus*, *P. longirostris*, *M. barbatus* and *P. bogaraveo*), in DL (*P. longirostris*, *A. sphyraena*, *T. trachurus* and *Capros aper*), and in VP (*M. scolopax*, *C. agassizi*,

A. sphyraena and *P. longirostris*), while three species contributed in MIX (*P. longirostris*, *T. trachurus* and *A. sphyraena*).

Comment on the results of the two analyses

ANOSIM detected significant differences between bathymetric strata as well as between assemblages (Tabs. I, VI). The Bray-Curtis within-site average similarity was however about 10% higher when calculated with assemblages than with bathymetric strata both in 1993-94 and 1998-99 (Tabs. II, VII). Also the among-site average dissimilarities in the two periods were about 10% higher (=lower values) when assemblages instead of bathymetric strata were considered (Tabs. IV, IX). The stratification based on assemblages seems thus more efficient and more precise than that based on depth, due to the several different assemblages occurring within a depth stratum. This should be taken into account in future research, if more precise estimates are desired.

Cumulative dominance curves for biomass and abundance

Biomass dominance curves for the six assemblages show a less steep trend in 1998-99 than in 1993-94, except for SFBC (Fig. V). This means that in 1998-99 there was a lesser dominance and a greater diversity in general. SFBC showed instead a very steep curve in 1998-99, when only two species were enough to account for 50% dominance. VP had lower dominance in 1998, when 50% dominance was obtained with 6 species. Most of the 1998 assemblages needed 5 species to reach the 50% threshold, while 3 species were needed for most of the 1994 assemblages.

Abundance dominance curves are more comparable (Fig. VI) and in some cases they showed a different trend if compared with biomass curves. In this case the curves were less steep in 1994 for SFBC, MIX, DL and VP. The lowest dominance is shown by MIX in 1994, when 50% dominance was reached with 4 species, all other assemblages reached this level with 1-3 species.

Comparison between 1993-94 and 1998-99

Tab. XI shows the inter-annual variation of the percent numerical contribution to the total catch of the species that contributed most to dissimilarity in each assemblage. In SFBC *M. barbatus* (the most abundant species) remained nearly constant, while *P. acarne*, *B. podas* and *Lithognathus mormyrus* changed their contribution by +15.4%, -10.5% and +4.9% respectively. The most remarkable changes in VTC were those of *M. barbatus* (-9%) and *T. trachurus* (+5.5%). In DE three species decreased (*M. barbatus* -8.4%, *L. cavillone* -15.1% and *S. hepatus* -4.3%), and two species increased (*P. longirostris* +10.3% and *T. trachurus* +16.6%). In DL two species decreased (*M. barbatus* -4% and *T. trachurus* -4.4%), while *P. longirostris* and *M. merluccius* increased (+12.0% and +4.8% respectively). In MIX *P. longirostris* underwent a +19.8% increase, followed by *S. flexuosa* (+5.8%), while *A. sphyraena* went -13.0%. Finally

some major changes occurred in VP: *P. longirostris* +5.1%, *M. scolopax* +34.1%, *C. agassizi* +7.3%, *A. sphyraena* -24.5%, *C. aper* -9.5%, *Gadiculus argenteus* -5.4.

It is worth to highlight a substitution of the dominant species in VP, where *M. scolopax* became the most important species in 1998-99, replacing *A. sphyraena*.

Another important change among the top-ranking species occurred in MIX, where *P. longirostris* became the dominant species replacing *M. merluccius* (-1.7%) and *A. sphyraena* (-13.0%). The changes in MIX are difficult to interpret, due to the high internal variability of this heterogeneous assemblage highlighted also by the relatively low similarity within the assemblage in 1993-94 and 1998-99.

L. cavillone underwent a strong increase (more than 500-fold) in 1993-94 if compared to the pre-ban period (Pipitone *et al.*, 2000); in 1998-99 this species decreased in almost all the assemblages and particularly in DE, where it still contributed highly to the catch in number.

In SFBC there was an important change linked to *P. acarne* becoming the second most important species of this assemblage (+15.4%), taking over *B. podas* and *L. mormyrus*. This change can be an artefact due to the reduction of the shallow (10-20 m) sandy bottoms after 1994 (see chapter 3 of the Biological Section in the main text), where *B. podas* and *L. mormyrus* have their habitat.

PART B - SOCIO-ECONOMIC SECTION

THE ARTISANAL FISHERY OF THE GULF OF CASTELLAMMARE: ECONOMIC ACTIVITY, FINANCIAL PERFORMANCE AND FISHERMEN'S ATTITUDES

1 THE CURRENT STATE OF THE FISHERY

1.1 Sources of economic and financial information

1.1.1 Methodology and data collection

As with any fishery around the world in order to make the best and most informed decisions, fishery managers, policy makers and individual fishing enterprises must have specific information readily available to them. Of prime importance in the decision making process is information on stock availability (through remaining TAC's or through quota allocations and uptake), the current state of the fish stocks and the current economic performance of the fishing fleet.

The current state of the demersal resources in the Gulf have already been examined in the preceding chapters, and here we will discuss the current economic state of the fishermen themselves. As is suggested above, there are specific data requirements that must be met if we are to achieve this goal.

If we look at the history of costs and earnings studies, we can see that it was not until after the Second World War that interest in economic performance of the worlds fishing fleets developed. The interest grew out of a need for information in the primary food producing sectors following the period of attrition during the war. As would be expected this interest was, for several years, restricted only to the already developed fishing industries of the west such as are found in Europe and North America.

This fact highlights the main reason for undertaking research and studies of the economics of fishing vessel performance. Initially these studies were carried out by private enterprises, with government agencies and institutes taking ever more interest. The most common reason for the conducting of cost and earnings surveys has been to evaluate the current state of particular fishing enterprises at specific times in the past or present. The purpose being to evaluate a particular management strategy or to give basic background information to provide fisheries managers with data to enable informed decision making to be conducted.

The literature on cost and earnings studies is not extensive, and where such studies have been conducted they are limited in their scope, focusing perhaps upon only one specific fishing method or single species fisheries (Hamilton et al. 1996, Noetzel and Wojnowski 1975).

Very little work has been published on specific methodologies for the conducting of such surveys (Ovenden, 1961), or for the requirements of fisheries managers for such information (European Commission (1) 1996).

The most commonly found and recent studies concern western fisheries, concentrating on the USA or European fisheries (Hamilton et al. 1996, Davidse. W.P et al. 1993, European Commission (2) 1996. European Commission (3) 1998, Pascoe S. 1994).

The European studies are faced with a great diversity of fishing methods often in multi species fisheries. For this reason some of the European studies consider several different fishing methods and fisheries, rather than concentrating on single species and single gear fisheries.

Several studies have been carried out in the developing world, mainly as components of sector reviews. These have focused on the artisanal nature of most of the fisheries and like the European studies, they have considered the greater diversity of fishing technologies and the multi species dimensions of the fisheries (Koromo, M. 1988, Kurien J. and Willmann, R. 1982, Bailey et al. 1987).

Generally, however, we find a bias towards the collection of data from commercial rather than artisanal fisheries. The reason for this collection of data from only commercial fisheries is largely due to the relative ease of collection of data from these sectors. On a political level it is these vessels and sectors that frequently contribute most significantly to the production of food and revenue in most of the worlds fisheries. Indeed, one corollary of this has been a tendency for management decisions based on this data to be aimed primarily at the larger-scale commercial fisheries. This orientation may be unwarranted, however, since from an employment point of view commercial fisheries often have a much smaller impact and we find that artisanal enterprises by far outnumber the larger commercial enterprises, and often also have far reaching socio-economic importance, particularly in developing countries.

In several countries around the world there is a legal requirement for fishing operators to submit cost and earnings details to, usually, the ministry of fisheries. However, frequently there are sectors of the industry that are excluded from the data collection process. Within the EU there are wide disparities in the quality and range of cost and earnings data (Whitmarsh et al. 2000).

The aim of this project is to determine the financial and economic performance of the artisanal fishermen of the Gulf. With this in mind we need to have knowledge of those factors that affect financial performance and also some indicators of performance. Factors determining performance can be loosely grouped into three categories; Revenue, operational cost and non-operational costs.

This is where we come across several problems related to the fisheries of the Gulf. The first is that no economic data are officially recorded, despite being a requirement under Italian law, and it is often the case that there are only the most superficial of recording processes and many elements are excluded. For example, a fish market exists only in one of the harbours (Terrasini); where a market does not exist no catch data are recorded for the National Statistics Office. The second problem that we encounter is that there is very limited detailed data published on the state of Italian artisanal fisheries. With this in mind the collection of data from the artisanal fishers of the Gulf proved to be particularly taxing.

1.1.2 Data Collection in the Gulf

Several data collection methods have been developed for developing world situations, by far the most widespread and most developed being a Rapid Rural Appraisal approach. RRA was officially raised in 1978 at the University of Sussex (Pido et al. 1996). The idea stemmed from the fact that local communities were not actively being included in the decision making and research processes affecting themselves and their development. The literature on the RRA approach is now quite extensive, important contributors being, (Neiland and Sarch, 1996). RRA is principally a semi-structured process that utilises a multidisciplinary approach to answer research questions. It is best suited to those areas where there is no formal recording of data and where there may be very high illiteracy levels, as well as in those areas which demonstrate marked dimorphism between different groups or sexes.

As the name suggests the purpose of RRA is to obtain information rapidly (Pido et al, 1996 suggest that RRA studies be carried out in less than one week). The whole purpose is to start interviews, obtain information, write up, reassess the questions, re-interview, write up, reassess and conclude very quickly.

Initially RRA was used solely in agricultural / rural situations and has many parallels to AEA (*Agroecosystem analysis*), and PRA (*Participatory Rural Assessment*) (incorporating *farming*

systems research and integrated rural development). These are essentially similar and indeed the terms PRA and RRA are often used interchangeably (Pido et al 1996).

More recently attention has been drawn to its application in all manner of areas, fisheries being only one of these. In many areas (particularly those relating to artisanal practices, for which RRA has most relevance) there is a lack of even the most basic base line data, in addition to this, most of these areas demonstrate a very dynamic nature, changing with the seasons, or years.

To this end, it may appear to be well suited to the Sicilian situation, because of the small rural communities, the marked differences between male and female roles and low levels of education and high illiteracy levels.

The method is based on group organisation and description of certain aspects, such that there is a participatory mechanism whereby the whole community can, at certain times, be involved in the descriptive process. The tools that are used can vary widely depending upon the situation; an example may be using different size piles of stones to determine catches at different time of year or different levels of wealth. The process is very labour intensive and requires long periods of training. Outputs from the approach are in the form of data tables showing subjective differences in opinion or output and maps etc. Although a very useful socio-economic tool for describing whole sectors and looking at the subjective differences between types of communities, areas and operations, it is not very useful for producing solid quantitative data, as is required in an economic impact assessment.

For this reason it was felt that perhaps the method was unsuitable in a Sicilian context. Although there is fairly high illiteracy, the fishermen are well developed and knowledgeable, and in fact most have spent at least some period working abroad. Accordingly it was felt that the RRA approach might have been seen as being patronising and irrelevant.

Instead a different approach to data collection had to be developed, involving the use of a series of fairly simple questionnaires, distributed at different times throughout the year. The approach is not identical to that used in normal financial surveys of fishing, however.

Most cost and earnings surveys have tended to be a one off collection of data measuring performance at a specific point in time. This approach works well where there is either published, or at the very least recorded data. In the Gulf, however, we faced the problem of there being no recording of data at all, and though all fishermen do pay fees to an accountant (Commercialista), who presumably keeps records for them, there is absolutely no access to this data. What we attempted to do was to record information throughout the course of the year, in order to provide both annualised data, as well as being able to plot the activities of the fleet throughout the year (assuming that the year 1998/1999 was typical of a normal years activities). It is this 'real time' dimension, which represents one of the main distinctive characteristics of our survey.

1.1.3 The Landings Survey

The fishermen in the Gulf were already familiar with the concept of the landings' surveys, as the group at CNR-IRMA had conducted a similar study in 1994/1995. The questionnaire used in this study was a little more complicated and introduced not only questions on catch, but also on area fished, time of fishing, gear type used as well as asking questions on trip expenses and revenues. A sample questionnaire can be found in the attached Appendix.

The design of the questionnaire was fairly straightforward, the data that we wanted to record being on catches, total weights, the weight of the individual species caught, and the species caught. The start time and finish time of the fishing trip were recorded, as were the gear used on any particular trip. In addition to these biological characteristics, we also recorded information on trip expenses, such as fuel, bait or other, and revenues received. The revenue question often proved quite difficult to extract and instead of asking the fishermen directly the revenue figure

was calculated in most cases by asking the wholesaler how much he was buying the fish for. Prices were recorded for all major species purchased on the day.

The way in which the landings surveys were conducted was that researchers from CNR-IRMA would, every fourteen days, survey the four ports, Castellammare on Wednesday, Balestrate on Thursday, Trappeto on Friday and Terrasini on Saturday. The surveys were undertaken on a census basis, with all active fishermen on any given day being surveyed, except those that for particular reasons were not available within a reasonable lapse of time. Those fishermen not active were also surveyed and the reason for their inactivity recorded.

The survey was piloted in September 1998, and few alterations were necessary, the only exception being the inclusion of additional expense questions that specified fuel, gear and bait expenses, plus a question on 'other' fishing expenses. The survey was piloted in both Balestrate and Castellammare, where all fishermen were responsive and co-operative. In fact the whole project generated considerable interest among the fishermen.

The results of the landings survey are presented later in the report. Some 96 species of fish were recorded throughout the period and were recorded down to sizes as small as 50 grammes in weight, reflecting the size of fish that are actually landed in the Gulf.

1.1.4 The Logbook Survey

In addition to the Landings survey, logbooks were also distributed to all interested fishermen. An example of the logbook can be found in the appendix. The logbooks were issued in a batch of 16 sheets, each one was used to record a single days fishing. In addition a map of the Gulf was also issued for recording the sites fished during the sixteen-day period.

As can be seen from the appendix, the logbooks record all information, both biological and economic, on a daily basis, with the fishermen being expected to complete the forms after each trip. Initially there was success with the logbooks, with seven fishermen in Balestrate and two in Castellammare completing them regularly. The first three months logbook returns were used to corroborate the data collected in the landings surveys, which were shown to be very accurate. The one important difference between the logbooks and the landing surveys is that capital expenditure would have been captured in the logbooks, whereas it may have been completely ignored in the landings' surveys. Also the logbooks used actual revenues, rather than imputed prices.

Unfortunately initial enthusiasm for the logbooks faded, resulting in only two fishermen in Balestrate completing them throughout the whole year period. There were probably several reasons for this failure, the first being that the fishermen could not really see the point of completing the forms, given that they were giving most of the information during the landings surveys. The logbooks were designed to collect a lot of detailed information, and where fishermen were using the same gear and fishing in the same places consistently, they could not see the point in multiple completion of the logbooks, other than for recording catches. The final reason for the limited success was due to a lack of consistency in their collection. Rather than have a fixed day every fourteen or sixteen days (and thus recording blanks for days not fished) when the logbooks were collected, it was decided that the best collection method would be to take them as and when the fishermen had completed them. Failure to have a rigid collection regime caused the fishermen to lose interest in the logbooks and have disrespect for the data being collected.

That said, the fishermen continued to co-operate with the landings' survey fully.

The two fishermen in Balestrate that continued to submit logbooks proved to be very helpful throughout the study. The information given by their logbook submissions, although not enough to analyse on its own, was used in a triangulation process to verify, in part, that the information collected during the landings surveys was accurate and correct.

1.1.5 The fishing characteristics survey

In order to be able to fully describe the fisheries of the Gulf it was necessary to collect data on the actual fishing methods and patterns at work in the Gulf. To a certain extent it was hoped that the logbook survey would elicit these points. Given the logbooks limited success however, it was necessary to design a further survey that sought to identify these points. Interviews were held with individual fishermen in May 1999. The sample copy of the fishing Characteristics survey can be found in Appendix.

The data collected from the gear characteristic survey has been used in the following section to describe the fisheries of the gulf. The survey set out to describe all of the relevant fishing activities, such as which species are targeted and when, what gear are used and why, where most fishing takes place, when do fishing patterns change and what is the labour force actively involved in fishing. We also identified the relationships between the fishers, both within ports and between the separate ports.

The survey was conducted on a census basis and 39 responses were obtained in total, 60 per cent of fishermen in Balestrate, 82 per cent in Trappeto and 50 per cent in Castellammare answered the questionnaires. The port of Terrasini was also surveyed, but less successfully, with only 3 fishermen (approximately 20 per cent) responding.

1.1.6 The Fishermen's motivation Survey

In addition to the physical characteristics of the Gulf we also sought to identify those characteristics and attitudes most prevalent amongst the fishermen of the Gulf. The aim was to determine how the fishermen themselves saw the trawling ban, and to identify their attitudes towards the future. The motivation survey was conducted in conjunction with the fishing Characteristic Survey. The response rates were; 70 percent in Balestrate, 82 percent in Trappeto and 83 percent in Castellammare, once again the port of Terrasini was also surveyed but with very limited success (30 percent). An example of the motivation survey can be seen in Appendix 1.

Through the survey we were able to identify how long fishermen had been active in the Gulf of Castellammare, and whether they had been persuaded to move back into the Gulf on the basis of the trawling ban excluding competition. We have been able to examine the patterns of migration and training of fishermen. We have been able to explain how the trawling ban has effected the fishermen's attitudes towards its' worth and towards the future state of the resources in the Gulf. In addition we have identified those things that the fishermen deem to be of greatest importance for 'their' fisheries management. A detailed analysis of the motivation survey is given in a later chapter. The results of the motivation survey may be of crucial importance in determining how best to manage the fishery in the future.

1.1.7 Other information collected

In order to complete the overall picture of the fisheries of the Gulf it was also necessary to examine fish prices throughout the area. Fish prices were obtained, directly, from the fish wholesalers as they purchased fish from the boats upon landing. However, full co-operation was frequently not forthcoming, with many wholesalers giving prices for only a very limited number of fish, or for the whole catch. To rectify this situation the researchers at CNR-IRMA conducted fortnightly surveys of the local fish retailers, two in Castellammare, one in Balestrate, one in Trappeto and two in Terrasini (including the only fish market in the Gulf). Both retail and wholesale prices were recorded (where available).

Additional, one off, interviews were held with the main gear manufacturer/supplier in the area. There is one net and line supplier in the Gulf (who is Terrasini's only net supplier and is the main supplier of trammel and gill nets, and associated gear to all vessels in our study. The next nearest supplier is based in Palermo. There is another manufacturer based in land a short way, but he only supplies specialist fish fry nets (Raustina). These interviews were held to obtain

prices for all of the inputs that would be required by the fishermen throughout the course of a year.

Boat builders were also interviewed with a view to determining the major capital cost associated with entering the fishery. Two boat builders were identified, but once again only one operated as the sole supplier to the fishermen in the study area, with many fishermen purchasing more than one vessel from him over their lifetime.

1.1.8 The fishermen's accountant

Of utmost importance were the interviews held with the fishermen's accountants in the area. The fishermen are represented by two accountants, one based in Castellammare, responsible for all of the fishermen there, and an accountant based in Terrasini who represents fishermen from Balestrate, Trappeto and Terrasini. The accountants were instrumental in describing the conditions under which the fishermen operate; for instance there, is a strong fishing co-operative in operation in Balestrate and in Trappeto, but none in Castellammare and a weak one in Terrasini, that represents mainly the trawler and large purse seine fishermen. From an expenditure point of view, membership of a co-operative can have considerable tax advantages, and while it might have also have been expected to have marketing advantages this proved not to be the case in practise. The accountants were also able to corroborate some of the information given by the fishermen with regards to the local politicians' role.

1.2 The regulatory framework governing the artisanal fisheries in the Gulf of Castellammare

Italy is divided into twenty regions and five of these have special autonomy, of which Sicily is one. As such Sicily has long had the capacity to manage its own fishery resources. Although potentially far reaching, the region must maintain compliance with European Community legislation and also maintain consistency with the other regions of Italy (art. 1(2) LR26/1987). In accordance with this, regional legislation largely pertains to the extrapolation of national and international provisions to fit the local conditions.

Locally administration of the seas (including fishing) is the responsibility of the Harbour Masters' Offices. The shoreline of the Italian Republic is divided into 10 marine zones, which are further sub-divided into 48 naval districts¹, the centre of each being the Harbour Master's Office (L 381/1988). The administrative functions of the Harbour Masters' Offices pertain to navigation, marine traffic, the registration of fishing enterprises, the surveillance of fishing activities, the trade in fish products and the determination of violations of the laws and regulations entrusted to them.

It is with the Harbour Master's Office that all fishing enterprises, vessels and fishermen are required to be registered. Each is classified in terms of type of fishing they can undertake, which is associated with the type of vessels they operate:

- Vessels that are suitable and equipped with appropriate gear and refrigeration and processing equipment for fishing outside the Mediterranean
- Vessels that are suitable and equipped with appropriate gear and refrigeration and processing equipment for fishing in the Mediterranean
- Vessels that are suitable and equipped with suitable gear for inshore fishing (*), up to 20 miles from the coast
- Vessels that are suitable and equipped with gears for local coastal fishing (*), up to 6 miles from the coast
- Vessels used in support of fixed fishing systems (arts. 8 and 9, DPR 1639/1968)

(*) *Classified as coastal fishing*

¹ Determined by the Ministry for the Merchant marine in conjunction with the Minister for the Environment.

The artisanal vessels of the Gulf of Castellammare fall into the fourth category, those that are suitable for fishing up to 6 miles from the coast². Registration is either with the Harbour Master's Office in Palermo (covering Terrasini, Trappeto and Balestrate) or Trapani (covering Castellammare and San Vito).

All fishermen have to be registered before fishing professionally (art. 9 L963/1965), and although there is no fee involved there are certain costs³ that occur in relation to the number of registered fishermen per vessel. For this reason many of the artisanal vessels operating in the Gulf choose to operate with unregistered crew.

The registration of fishing enterprises requires details of the company, its owners, the location and categories of the vessels used (including its characteristics) and the type and category of fishing undertaken (arts. 63 and 66, DPR 1639/1968, as amended by art. 4 D219). It should be noted that professional fishing is classed separately from sport fishing, the latter also being subject to different controls. Vessels used for recreational fishing purposes must be 'pleasure craft' as distinct from fishing vessels as defined under the law. Sale of fish from sport fishing is also prohibited, though the evidence obtained during the course of the research suggests that this prohibition is widely disregarded.

If all of the above criteria are met then the vessel should be issued with a licence to fish. Italy operates a system of restrictive licensing, in line with EU MAGP goals and objectives, whereby no new licences will be issued without the prior removal of equal capacity. Exceptions to this rule apply where a vessel of less than 2.5 tons is applying for a licence to fish, and given that artisanal vessels in the Gulf are typically below this threshold it would appear that the regulation serves no effective role in restricting catching capacity expansion in the fishery.

Once a licence is issued it is then valid for a period of 8 years, though the owner must register the vessel as active with the Harbour Master every year⁴. The licence specifies what gear may be carried and used in relation to the fishing enterprise (see Appendix 2). The transfer of existing licences and the issue of new licences are restricted, and the Ministry for Agricultural Policy reserves the right to suspend new licence issues if this conflicts with the objectives of the National Fisheries Plan. Though there are several licensing regimes in place, specifying up to five gear types, the majority of artisanal fishermen are licensed to use no more than three types of gear. This is one of the contentions that were raised by the fishermen as being a problem at certain times of the year, as several fishermen change fishing method throughout the year to target different species.

With regards to the gear, there are minimum mesh sizes in place for all types of fixed and towed gear. However, this is only 20mm as measured across the diagonals, and for sardine and anchovy fishing there are no minimum mesh sizes. Minimum mesh sizes are only in force for species with an adult life stage with total length greater than 7cm (art. 86 and 87, DPR 1639/1968). Mesh size restrictions are not an issue in the Gulf as the one gear wholesaler in Terrasini supplies all gear. In addition, minimum landing sizes are seldom enforced. There are no legal restrictions on the length of gear that can be used, this being something that is determined in the main by the size of the vessel; for the artisanal vessels of the Gulf, most use nets of between 1000m and 2000m in length. There are no quotas in operation and the fishermen are free to land whatever they catch.

Of particular importance to the fishermen of the Gulf are the regulations pertaining to the exploitation of fish fry. The fry fishery provides valuable income to the fishermen at times when otherwise fishing would be poor, also being of very high value (at approximately 35,000 Lit per

² The artisanal vessels are actually only allowed to fish no more than 3 miles from the shore (as stipulated within their licence conditions).

³ These include extra tax payments and insurance payments by the vessel owner in relation to crew

⁴ Rather than being a license requirement, this action is needed to ensure payment of certain subsidies which have been available, which are based on the activity of the vessel and the fishermen in the previous year

kilo it is one of the most valuable products to be caught), the fry fishery contributes significantly to many fishermen's annual income. Articles 126 and 127 of DPR 1639/1968 indicate that fishing for the fry of certain species may be carried out for a maximum of 60 days each year between 1st December and 30th April. There are no restrictions on the quantities that can be caught during this period, and accordingly the fishermen's activity increases substantially at these times; indeed it is not unusual for an artisanal vessels to be at sea for between 15 and 18 hours per day during the fry catching period. Failure to comply with these regulations can lead to the revocation of the fishing license. The fry fishery is one of the areas of major concern to fishermen in the Gulf, with many stating that they fish for fry in excess of 60 days and also take species other than those allowed within the license. This issue is discussed in greater detail later in section 4.

There are major incentives available to the artisanal fishermen, and they are eligible for several grants and low interest loans for assistance/ improvements to their fishing operations. The criteria for qualification are simple, just requiring the fisherman to be a resident of the region for at least three years prior to the application. At the most basic level, the fishermen are eligible for financial assistance (a grant) of up to 30 percent of the capital value and low cost finance for up to 35 percent of the value, for the purchase and / or upgrading of certain vessels, particularly vessels under 9m in length and where there is significant technical innovation involved. For members of co-operatives the financial contributions can be increased up to 55 percent of the capital cost (art. 3 LR26/1987 (as amended by art. 3 LR25/1990), art. 44 LR33/1996 and art. 6 LR1/1980). In addition to these general funds there is also a dedicated fund for support of artisanal fisheries worth 15 billion lire (art. 2(6) L164/1998). One of several new initiatives for encouraging the development of commercial fisheries is the encouragement given to fishing tourism, and funds are now available for the conversion of existing vessels and safety equipment for this purpose.

Unfortunately access to these funds is limited to only a few fishermen, and in general the level of paperwork required and the small amounts of money being requested are prohibitive to the average artisanal fisherman in the Gulf. Perhaps the most important financial tool available directly to the artisanal fishermen has been the Biological Rest payment (art. 14(1) LR26/1987), made each year between 1987 and 1997 for a 45-day tie up period and cessation of fishing. There are, of course, criteria attached to eligibility⁵, though most artisanal fishermen in the Gulf fulfil them. The rewards were fairly substantial and the average artisanal vessel owner could be expected to receive nearly 9 million lire in compensation. When compared to 1998 average financial performance figures (section 4.) we see that this is a considerable amount, representing nearly one third of total sales revenue and of similar order of magnitude to the income (net financial profit) of the average vessel.

The regulatory framework therefore represents an important influence over the fisheries within the Gulf, influencing the activities of the fishermen and shaping the development of the fleet. The controls have had a demonstrable impact on the fishing effort exerted by established vessels in the fishery, most visibly through the technical conservation measures and the temporary fishing bans linked with the 'biological rest payments'. Conversely, however, there would appear to be very little *de facto* limitation on vessel numbers. Registration as a professional fisherman incurs no fee, the MAGP capacity replacement rules are not relevant, and even though the law makes provision for the suspension of new licence issues, the practice of recent years has effectively been to grant licences *ad lib* to eligible applicants. Indeed, structures are in place, which if anything seem designed to encourage the active expansion of the artisanal fishery, notably through the financial assistance given to capital investment. Given this, there are at the present time seemingly few if any institutional barriers to entry into the artisanal fishery. If we are seeking a reason why there has not been a more rapid expansion in the number of artisanal vessels since the implementation of the trawl ban, the explanation will need to be found elsewhere.

⁵ Such as the requirement for being active for 120 days the previous year, and the cessation of fishing for at least 45 days

2 FISHING AND MARKETING CHARACTERISTICS OF THE ARTISANAL FISHERIES OF THE GULF

2.1 The artisanal fishing fleet of the Gulf

During the Summer of 1999 a survey was carried out, in conjunction with the landing surveys, to determine and identify the main characteristics of the artisanal fisheries of the Gulf. The results of the survey are useful from a characterisation viewpoint and also for determining why there may be differences between the performance of the fishermen in different ports.

The survey was conducted on a census basis and was done in conjunction with the Motivation Survey. The response rate was high in all ports within the Gulf, attracting 70 % of registered fishermen in Balestrate, 64 % in Trappeto and 38% in Castellammare. This is somewhat misleading, as only 24 of the 34 registered vessels in Castellammare are active in fishing, in which case the sample covers 55% of the active population. In Terrasini, however, only three fishermen were persuaded to participate and so their activity can only be described based on anecdotal evidence and from the information given by the three respondents. There is no reason, however, to suspect that this information is inaccurate or incorrect as informal discussions with the fishermen at the port have taken place on numerous occasions and the staff at CNR-IRMA are familiar with the fishermen in the port and their activities.

2.1.1 Vessel Characteristics

Currently there are 147 fishing vessels registered to fish from the four ports in the Gulf of Castellammare. Of these, 96 are registered artisanal fishing boats, 13 trawlers (10 in Trappeto and 3 that fish out of Castellammare), 29 purse seine vessels (26 in Terrasini and 3 in Trappeto), and 9 unlicensed artisanal boats (however they are still registered as active on the coast guard register). For fishing to be undertaken as a professional enterprise, the fishermen must themselves be registered as such, and so must the boat. Legally fishermen can register as a professional fisherman at the age of 14 years, though almost all assist in fishing before this age. Once registered the fishermen are then able to catch and sell fish for a living. Any person not registered as a professional fisherman is not allowed, by law, to sell his fish. The vessel must also be registered as a professional fishing boat before fish can be sold from it, and in fact most of the fishing activities and restrictions thereto apply to the vessel rather than to the fisherman himself. For instance, vessels can only be registered to carry and utilise a maximum of four gear types, any activities in excess of this will incur penalties. The maximum distance that an artisanal vessel may fish from the shore is 3 miles, which of course has implications for certain types of fishing. In addition the boats must fly the flag of Italy, carry on board safety equipment such as life rafts and be easily identifiable as a fishing boat.

Table 2.1 *Average vessel characteristics of the artisanal vessels in the four ports of the Gulf.*

	No. Of vessels	Mean Length (m)	Mean Engine size (kW)	Mean Age	Mean Gross Tonnes
Terrasini	25	6.39	14.57	17.5	2.10
Trappeto	22	5.26	13.68	18.4	1.84
Balestrate	15	5.50	13.82	18.3	1.71
Castellammare	34	5.88	16.36	26.7	1.89
Overall	96	5.81	14.88	21.1	1.90

As we can see, the vessels exhibit very similar physical characteristics, and there are no significant inter-port differences in length or engine power. This is, as we would expect, as there is only one boat builder in the Gulf who supplies the artisanal fishery. It is interesting to note that there is one overt difference, however, and that is with regard to the age of the vessels; that the vessels in Castellammare are significantly older than those operating in the three other ports.

There is no obvious reason for this observation, though possible explanations may include the fact that 45% of fishermen have been active in the port for more than 15 years, or that 11 boats have been purchased by fishermen in Castellammare from other ports since 1990. Four vessels came from Balestrate, 2 from Trapani, 2 from San Vito lo Capo and the rest were from other ports in the vicinity. This high proportion of second-hand boats may reflect the fact that several fishermen's fathers are still active in the port and that whereas in other ports vessels are handed from father to son, in Castellammare the fathers are still using their own boats.

With regards to the physical characteristics of the boats, the survey asked whether the boats had net hauling gear, and if so, whether it was mechanical or hydraulic, hydraulic being the preferred choice. The results can be seen below in table 2.2.

The type of hauling gear is also indicative of the levels of wealth or activity of the fishermen, hydraulic gear is more expensive at a cost of approximately 4,000,000 Lira. It is quicker to use and is more powerful, however, thus reducing fishing time. Mechanic gear on the other hand cost approximately 2- 3,000,000 Lira.

Table 2.2 *Net hauling gear characteristics*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Mechanic	60%	57%	50%	17%	62%
Hydraulic	40%	43%	50%	83%	38%

We can see that the distribution is fairly similar between the ports, apart from in Castellammare where there is a predominance of hydraulic hauling gear, which is due to recent upgrading and repair work undertaken to many vessels in the port, as would be expected on older vessels.

All of the professional artisanal vessels had internal engines, whilst the majority of smaller semi-professional, part time and recreational vessels were powered by outboard motors.

It has been shown that there are no physical differences between the vessels used in the four ports, hence any differences in effort applied must be down to number of days fished, or to the number of hours fished per day.

Table 2.3 shows the average days fished by fishermen in each port, and the average number of hours fishing time⁶ per day.

Table 2.3 *Average fishing time characteristics*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Average Days Fished	167	179	214	233	198
Range	120 – 210	60 – 230	200 - 240	180 - 300	120 – 240
Fishing Time per	8	8	5	8	7

⁶ Fishing time is described as the actual time spent at sea by the fisherman, hauling, setting or clearing nets, in addition to this we must add steaming time, although this has no effect on fishing time, rather just working hours.

Day					
Range	5 – 12	3 – 11	4 - 8	3 – 11	3 - 12

As we can see there is considerable variation between the average number of days fished between the ports, the distribution of frequencies of days fished in the ports being shown in figure 1. Terrasini has the lowest average days fished in the Gulf, and in addition it also has the lowest maximum number of days. From the Motivation Survey it was shown that the reason for this low level of activity might be linked with the pessimistic outlook prevalent in the majority of artisanal fishermen in the port. When the days lost to bad weather are examined however, we see that the fishermen in Terrasini lose no more than in other ports. A possible explanation for this low level of activity is due to the conflict with the trawlers displaced from within the trawl ban area that now compete directly for space with the artisanal fishermen in Terrasini. Castellammare had the lowest with only 3.3 months being lost per year (approximately 100 days), Trappeto fishermen lost the most at 4.5 months (approximately 135 days), the fishermen in Terrasini and Balestrate were somewhere in between these two. It is apparent that in Terrasini the fishermen choose not to fish at certain times of the year when they envisage low catches; for instance, many fishermen choose the Summer months to carry out vessel maintenance, which coincides with the highest incidence of recreational fishing competition. In the other ports it is predominantly the Winter months that are chosen for vessel maintenance to avoid losing fishing time throughout the year.

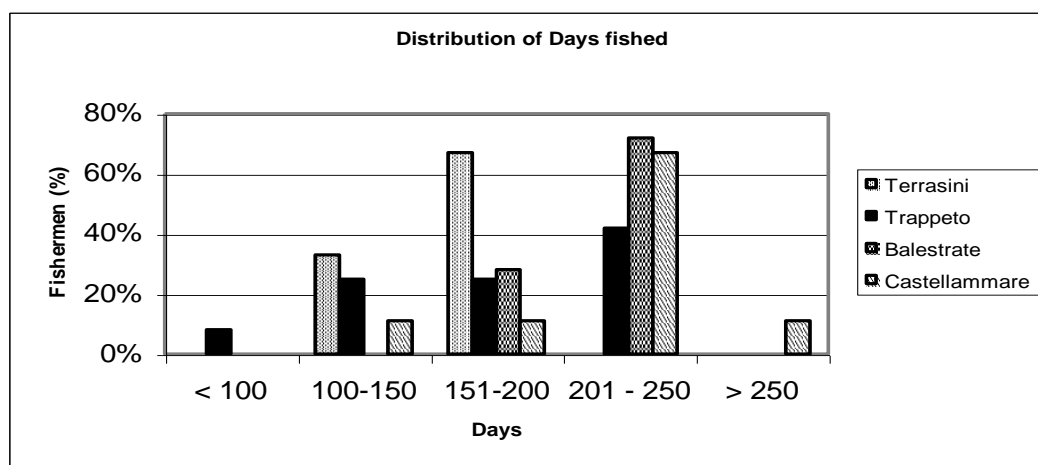
The fishermen from Castellammare spend the most time fishing, with the most days at sea (one fisherman claimed to fish for 300 days per year). The reason given during the survey was that the fishermen in the port couldn't afford not to fish for any period of time.

However, from figure 1 we can see that 51% fishermen in the Gulf fish for between 201 and 250 days per year. Thirty percent of fishermen claimed to fish for between 151 and 200 days per year, of these, however, 78 % said that they fished for 200 days per year. Overall 77% of fishermen in the Gulf fish for 200 or more days per year.

Time spent fishing effectively measures the rate of vessel utilisation, and is one of the critical factors determining profitability of the vessels (Whitmarsh et al, 2000). There are several reasons for the differences between the ports, but the evidence strongly suggests that most are concerned with the attitudes of the fishermen towards the trawl ban and issues that affect their fishing activities, such as recreational fishing and illegal trawling. These issues are covered in more detail in section B 4.

If we look at time spent actually fishing per day, we can see that there are very few differences, with only Balestrate fishermen fishing for significantly less time per day. In fact the average time spent each day for Terrasini, Trappeto and Castellammare are the same. It is interesting to note that the fishermen in Balestrate fish for less time and have a much smaller range than the other ports, only fishing for an average of 5 hours per day, with a variation of only 4 hours between all fishermen. Other things being equal fishing time will impact on profitability, though the effects can be offset by efficiency gains, which appear to have occurred in Balestrate. This issue will be discussed when the financial performance of the fleet is examined in section B 3. In addition to efficiency gains there may be other factors influencing catches and revenues such as the areas fished or different species and gear types that may be targeted or used.

Figure 2.1 *Distribution of fishing activity of the artisanal fleet in the Gulf of Castellammare*



2.1.2 Fishing Characteristics

The main bulk of the survey is aimed at determining the types of gear used by the artisanal fleet, the areas that are fished, and for what species. The first question asked was to determine the time allocation throughout the year to different gear types, or methods of fishing. There are six basic gear types used within the Gulf. These are fairly well used in all of the ports and are quite similar in characteristics. This fact is not surprising given that there are only three manufacturers / retailers making three different gear types which supply all vessels in the Gulf. The lack of competition ensures that all fishermen buy their gear from these three men. The main gear types are, Gill nets, Trammel nets, miniature purse seine for fish fry (Tartarone), encircling seine for fishing around FAD's (Raustina), long lines and jigs specifically for squid.

The first question was to determine the amount of time dedicated throughout the year to these different fishing methods. Gill net and trammel nets are usually used in conjunction with one another as a mixed net, trammel being the lower 2 metres and gill net comprising the upper part of the net. Because these methods are fairly similar, even where separate nets are used, for the purpose of analysis it was decided to classify them as one. Drifting gill nets⁷ and seine have also been put together to cover the fish fry fishing and the FAD fishing. This protects the fishermen who often illegally fish for fry outside of the recognised seasons for doing so. The results for each of the ports can be seen below.

Table 2.4. *Percentage time usage of different gears in the Gulf*

	Gill / Trammel	Seine	Long Line	Other
Balestrate	82.5	15.6	1.3	0.6
Trappeto	85.3	7.0	1.0	6.7
Castellammare	84.6	3.8	7.5	4.1
Overall	84.1	8.8	3.3	3.8

Due to lack of data, Terrasini has been excluded from the table. It is reasonable to assume, however, that the fishing patterns in Terrasini are the same as those in Trappeto⁸. From the results it can be seen that the approximate amount of effort dedicated to trammel / gill net fishing in all ports is about 85%, regardless of the number of days fished. It is the most commonly used

⁷ Strictly speaking the large mesh gill net used in association with FAD's is not a drift net, however it is not anchored to the sea floor and so for these purposes has been classified as such.

⁸ This information has been made available through informal interviews in both ports.

gear type and all artisanal fishermen in the Gulf use the gear. The nets are usually used as a mixed trammel and gill net, the lower half of the net comprising trammel and the upper using just gill net. The trammel net is a cotton built net, inner mesh size varying between 7 to 12 knots per 25 cm (approximately 45mm to 70mm). The smaller mesh size nets are used primarily for catching smaller species such as re and striped mullets. The outer mesh of the trammel net has a mesh size of approximately 150mm. The advantage of using the two meshes is that fish too small to be caught in the smaller inner mesh, may be entangled in the larger outer mesh. The upper part of the net is usually cotton monofilament gill net, single mesh of size 60mm to 90mm. Commonly bottom dwelling species such as seabreams, lobster, cuttlefish etc will be caught in the lower trammel net and species such as small tunas, mackerels and jacks will be caught in the upper gill net.

As can be seen from the table, the other gear types only account for a small percentage of the total effort applied, however, at different periods throughout the year they may be of great importance. The Drift / seine net is of importance within the Gulf, and indeed, most fishermen own one of these nets. Primarily the miniature seine net is used for the fish fry fishery. This technique is used in all of the ports in the Gulf to varying degrees, the main period for its use being during the late Winter and early spring when there is a dedicated fishery for the fry of pelagic species, such as sardines and anchovies. The mesh size on the nets is very small, being only 1-2 mm. The fry caught are in fact only several mm long themselves. The catch is very high value⁹ and highly prized, which encourages several fishermen to continue the fishery beyond its 35-day legal season. There is a second period of fry fishing that takes place in June, which is wholly illegal and targets the fry of the picarel (*Spicara flexuosa*). The main ports for this activity are Balestrate and to a lesser extent Castellammare. The activity causes much confrontation in the Gulf as the mature picarel also attract a moderate value (which is offset by its abundance). Several fishermen stated that they thought the fishery for the fry should be stopped as it damages the adult populations. There is some value in this comment as the pelagic species are large scale spawners, producing huge quantities of fry, that would in the wild have a very high rate of natural mortality, also the adult pelagic species are all low in value. Therefore the prosecution of the fry fishery has little impact upon the adult populations. The picarel however, breeds in a fairly limited area in the Gulf¹⁰ (D'Anna and Badalamenti, 1995) and, as an adult, forms a major part of the Summer fisheries for the artisanal fishermen in the Gulf.

Balestrate shows the highest use of (drift / seine nets). This is because, as well as prosecuting the fry fishery, the fishermen in Balestrate also use FAD's to attract Amberjack (*Seriola dumerili*) and Dolphinfish (*Coryphaena hippurus*), both of which are high value species. This is predominantly a late-summer / autumn fishery and is based on setting FAD's made of palm leaves, and then purse seine fishing around them. It is surprising that it is only really the fishermen from Balestrate that use this gear as the information is widely spread throughout the ports with regards to the technique. There are one or two in Castellammare and Trappeto that also use it, but here it is really only the more adventurous fishermen, whereas in Balestrate all fishermen partake, often pairing up to fish more efficiently. This is a common feature of the Gulf, the fishermen in Balestrate appearing to be the most experimental and pioneering in their use of fishing techniques. The fishermen in the other ports, on the whole, stay fairly close to port and use long used gear and techniques. However, the FAD fishery has been active for four years now and indications are that gradually other fishermen are starting to use them.

If we examine long line fishing in the Gulf, we can see that it is only really the fishermen in Castellammare that use them with any frequency, operating them for 7.5% of the time. The long lines used in Castellammare differ from those used elsewhere in the Gulf. Primarily they are set in deep water and used to catch bottom dwelling species such as Hake (*Merluccius merluccius*). The fishermen set between four and ten longlines each with approximately 1000 hooks on, set at 1m intervals. These are set in deep water and left to fish for 12 hours. Predominantly long line fishing is a Summer pastime, the main reason being that it avoids conflict with the recreational

⁹ Fish fry is the most high value species in the Gulf, commonly the fishermen will be paid between 30,000 to 35,000 L per kilo. This is two to three times as much as for other high value species, such as cuttlefish.

¹⁰ Information given by the fishermen themselves

fishers that come into the port during the Summer. Also by fishing in deep water (> 100m) the fishermen are able to take fish during the Summer that they may not be able to catch with gill and trammel nets.

Long lines are used in the other ports of the Gulf but instead of being bottom set, they are surface floating, drifting lines used to catch swordfish. The average length is approximately 1000 to 1500 m and they carry approximately 300 to 350 hooks. The fishermen in these ports tend to set their long lines when fishing is poor for other species only.

The final fishing technique of any consequence is that of jigging for squid. This activity is undertaken in all of the ports, but it can be seen that it is of more importance in Trappeto and Castellammare than in Balestrate. The method is used only during the Summer and comprises of a single line with a multiple hooked jig that is used on a hand line. The fishing takes place after nightfall when the squid are most active, often the artisanal fishermen will set their trammel nets early evening and then spend the night jigging before hauling their nets the following morning. The squid form an important and major part of the catches during the Summer and it is usual to see the lights from one hundred or more boats at sea at any one time. There is strong competition with the recreational vessels in this fishery, as the gear type used is restricted by law. However, there are seldom checks of the recreational boats and local sport fishing tackle shops sell several illegal gear types, such as flashing jigs, which are much more productive than the jigs used by the artisanal fishermen.

Cane fish traps are still used by a small number of fishermen in the Gulf, though only by older, semi-retired fishermen who use them to catch fish for personal consumption.

As shown above it is common for the fishermen to change between several gears throughout the course of a year, the only reason given for these changes being their ability to target different species. The fishermen were asked to identify the main gears that they used and the species that they targeted at different times through the year. Although the majority of fishermen stated that they would take whatever they could catch, most were able to say which species they targeted at different times of year. As expected the species targeted depends on its abundance and price on the market at the time.

Once the gear types had been identified we were interested to determine the patterns of their deployment and the conditions of their use. With these points in mind questions were asked with regards to distance to fishing grounds, areas fished in, usual depth of water and of course questions related to gear replacement and the size of gear used.

Distance to fishing ground was considered to be one of the important factors in determining catches, and therefore influencing profitability. It was assumed that the further away from port the better the catches would be due to reduced pressure of fishing. In addition to this question, the fishermen were also asked if they had always fished in the same spots. The reasoning behind this is that the fishermen may feel bound to fish a particular area, just because they have always caught fish there and their fathers may have fished there before them.

The fishermen were asked whether they had always fished in the same areas, the results being seen in Table 2.5.

Table 2.5 *Are fishing areas the same as always?*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
YES		93%	100%	58%	63%
NO	100%	7%		42%	37%

The results of this question are interesting, in that they indicate that in the central parts of the Gulf (grounds mainly prosecuted by fishermen from Balestrate and Trappeto) exploitation of specific grounds has not changed much since the trawl ban was implemented. In both the eastern and western parts of the Gulf, however, the story is quite different. The situation in

Terrasini is entirely due to the trawl ban, with the fishermen moving to new grounds to escape the influence of the trawlers, which since 1990 have been applying increasing pressure on the artisanal fishermen's traditional grounds. In Castellammare the change has come about, not because of the trawl ban, but instead due to the growing numbers of recreational fishermen operating in the western parts of the Gulf. Due to the scale of the recreational fishing activities the artisanal fishermen in Castellammare have been forced to move to new grounds and have been forced to diversify their fishing techniques. In fact, were it not for the recreational fishing pressure the fishermen in Castellammare may not have started prosecuting the fish fry fishery or target amberjack and dolphinfish.

In addition, the question of normal depth of water fished in was deemed to be important, once again due to the effect of water depth on the abundance of different species.

Table 2.6 *Average distance to fishing grounds and depth of water fished in.*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Distance to fishing grounds (km)	3.67	1.96	1.16	1.89	2.17
Normal depth of water fished in (m)	56.67	33.33	50.00	43.89	45.97
Range	10 – 80	10 – 50	10 - 100	25 - 100	10 - 100

It can be seen that the fishermen within the trawl ban area have very similar patterns of fishing activity, all fishing, on average, between 1 and 2 miles from their home port and fishing in 50 metres or less of water. With the exception of the fishermen from Trappeto, the range of depth of water fished varies from 10 to 100 metres for all fishermen in the Gulf, with the fishermen moving to different areas depending upon the abundance of fish and according to the weather. Although the average distance to fishing grounds is between 1 to 2 miles the fishermen from Castellammare, Balestrate and Trappeto fish from within about half a mile of their home port when weather is poor to over 4 miles when fishing FAD's for Amberjack and Dolphinfish.

It is interesting to note that the fishermen who travel the furthest to the fishing grounds are those from Terrasini. Until the trawl ban was implemented, they like the fishermen in the other ports of the Gulf would fish fairly close to port. However, the concentration of effort on the traditional fishing grounds since the trawl ban has meant that they have to travel further afield to combat the influence of the trawlers. Anecdotal evidence also suggests that with the increase of illegal trawling in the eastern part of the Gulf, this distance is increasing. This fact must have implications for the cost of fishing and therefore upon the profitability of the fishermen in Terrasini.

Table 2.7 *Time spent working in fishing*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Time to Grounds (hrs)	1.33	0.51	0.66	0.87	0.84
Gear repairs per day (hrs)	4.33	2.42	2.86	1.78	2.85
Fishing time (hrs)	8	8	5	8	7.25
Total (hrs per day)	15.00	11.43	9.18	11.52	11.78
Days fished per week	5.2	6.2	6.8	6.95	6.29

From table 2.7 it can be seen that not only do the fishermen in Terrasini fish further afield than those in other ports, but also their travelling time each day is considerably longer. Terrasini fishermen spend 53% more time steaming to and from grounds than the fishermen in Castellammare and almost three times as long as the fishermen in Trappeto. Of course this will have knock on effects for fishing costs, the most important being that of fuel costs.

In addition to this fact we can see that fishermen in Terrasini spend significantly more time each day repairing gear than the fishermen in the three other ports, all of whom spend between 2 and 3 hours per day on average. The fishermen in Terrasini also have the highest gear repair costs, on average, of all the artisanal fishermen in the Gulf. Once again it is probable that this can be attributed to the increased competition and gear conflict from the trawlers in the port.

If we examine total working time, though, we can see that the fishermen of Balestrate work the least hours per week, with an average working week of 62 hours, in Trappeto the average is 71 hours. In Terrasini the fishermen, although only fishing for 5.2 days per week, manage to work 78 hours in total and in Castellammare the fishermen work on average 6.95 days and a total of 80 hours of work each week.

2.1.3 Gear configurations

The general gear configurations do not vary greatly between the fishermen in the Gulf, which is not a surprising fact given that there is only one supplier of trammel and gill nets to all the artisanal fishermen in the area. Ninety two percent of artisanal fishermen in the Gulf carry and deploy only one net at a time. The exception to this was found in Trappeto, where almost one third (30%) of fishermen carry and deploy two nets per day. To a large extent the gear carried is restricted by the size of the boats in the artisanal fleet. In Trappeto the fishermen maximise the gear that they are able to carry, by taking one cotton trammel net and one lightweight nylon monofilament gill net. The gill net takes up very little space and is very lightweight. Often in addition to carrying the main trammel net the fishermen will have on board a selection of jig lines and hand lines, especially during the summer months.

When purchased as raw materials the nets come in two lengths, either 40 metres or 90 metre segments, which can then be joined to make nets of considerable length. By having the nets made in sections in this way, it is possible, if a tear or damage occurs, just to replace a single segment, rather than a whole net. Table 2.8 shows the main characteristics of the nets used in the different ports in the Gulf.

Table 2.8

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Average length of net (m)	1800	1100	1400	1500	1450
Average depth of net (m)	3.00	2.40	3.75	4.30	3.36
Soak time (hrs)	9.00	10.83	13.29	13.78	11.72

As can be seen, there are no significant differences between the nets used in the different ports, but there are differences between the lengths of the nets used with the fishermen in Terrasini using the longest. It was expected that this would be a determining factor effecting catches, and although net length was positively correlated with catch per unit of effort (CPUE), it was not found to be significant. The advantage of using long nets in Terrasini is probably offset by the short soak time, which has the effect of reducing effective fishing effort for the fishermen from the port.

It is interesting to compare the actual surface area that is actively fishing for each of these nets. The fishermen from Castellammare use the biggest gear with their nets having a surface area of 6450 m². In Balestrate and Terrasini the nets are between 5200 and 5400 m² (although they

cannot really be compared directly as the Terrasini nets are only fished for $\frac{3}{4}$ of the amount of time of those from Balestrate. In Trappeto we see that the average trammel net only has a surface area of 2640 m², which may seem very inefficient compared to the other ports, though several fishermen from Trappeto do fish with multiple gears which may compensate for this fact.

The fishermen were asked how frequently they changed or replaced their fishing gear and also about the frequency of work undertaken to their vessels. Once again the reasoning behind this was to determine relative levels of wealth, it being supposed that the more wealthy fishermen would update their vessels and gear more frequently.

The results were surprising. It was discovered that all fishermen replace a complete trammel net every 1 to 1.5 years, most commonly being replaced in sections. Repairs are ongoing and everyday there is some work that needs to be done. Other gear types were also replaced with equal frequency in the different ports, the fish fry seine being replaced completely every 3 to 5 years. Normally a wing is replaced once per year and the main body of the net every 2 to 3 years. Long lines are replaced frequently and it is normal for the fishermen to use 3 or 4 in a year, hooks are replaced as needed.

Electronic and mechanical equipment is replaced much less frequently. The average lifespan of an echo sounder is approximately 5 years; a net hauler has a similar lifespan regardless of whether it is mechanic or hydraulic.

It was discovered that most fishermen would prefer to replace their engines about once every ten to fifteen years, even though it will need considerable work before such times as it is replaced.

By far the most durable piece of equipment is unsurprisingly the vessel itself. An average wooden hulled artisanal fishing boat can be expected to last for more than twenty years and there are vessels operating in the Gulf that are in excess of 50 years.

No matter what the expected lifespan of the components, there are always pieces of work that need doing, and for this very reason the fishermen all have an annual tie up period when they carry out vessel maintenance and repairs. This is very much down to the individual fishermen, but there are two periods that can be identified for peak activity. Eighty two percent of respondents stated that they undertook vessel maintenance during bad weather, winter or during the biological rest period, all of which coincide usually. Eighteen percent of fishermen said that they undertook vessel maintenance during the summer months whilst the fishing was poor. Several fishermen did, however state that they undertook work on a two or three monthly basis, rather than leaving it all until the repair period.

2.1.4 Patterns of exploitation in the Gulf fishery

Tables 2.9 to 2.11 show the distribution of fishing gear use throughout the year, the results having been broken down for each port in the Gulf. Although Terrasini is not represented here, the evidence suggests that fishermen in Terrasini change gears less often and use less diverse gear than fishermen in the other ports in the Gulf. In fact, all of the respondents to the survey stated that they fished with trammel net only throughout the whole year, and in general fished for whatever they caught. The main reason given for this pattern of exploitation was that of gear conflict with the trawlers, which restricts greatly their ability to utilise different gear types.

Table 2.9 *Target species and gear used throughout the year in Balestrate*

Balestrate								
	Spring		Summer		Autumn		Winter	
	Target species	% usage	Target species	% usage	Target species	% usage	Target species	% usage
Trammel	Red Mullet and Cuttlefish	100%	Red Mullet	88%	mixed species	40%	Cuttlefish	50%

Gill Net								
Fry Seine			Juvenile Picarel	50%			Pelagic fry	60%
Seine			Amberjack	24%	Dolphin fish, Large Amberjack	60%		
Long line								
Jig								

Table 2.10 *Target species and gear used throughout the year in Trappeto*

Trappeto								
	Spring		Summer		Autumn		Winter	
	Target species	% usage	Target species	% usage	Target species	% usage	Target species	% usage
Trammel	Red mullet and Cuttlefish	100%	Red mullet	70%	Hake, Bream and mixed small fish	85%	Cuttlefish, sole and mixed fish	55%
Gill Net			Amberjack	10%	Bonito	20%		
Fry Seine					Picarel fry	20%	Pelagic fry	40%
Seine			Amberjack	10%				
Long line			Swordfish	10%				
Jig			Squid	20%			Octopus	15%

Table 2.11 *Target species and gear used throughout the year in Castellammare*

Castellammare								
	Spring		Summer		Autumn		Winter	
	Target species	% usage	Target species	% usage	Target species	% usage	Target species	% usage
Trammel	Boops, Cuttlefish, horse mackerel and hake	100%	Mixed species	65%	Amberjack and Hake	35%	Mixed	80%
Gill Net	Hake and Boops	20%	Bream and Hake	20%	Amberjack and Bonito	65%	Boops	25%
Fry Seine							Pelagic fry	25%
Seine					Amberjack	35%		
Long line			Hake, Scabbardfish, Bass and Gurnard	35%				
Jig			Squid	40%	Squid	10%		

It can be seen that the trammel net is by far the most widely used gear within the Gulf. Although it is used to target specific species at certain times of year and the fishermen often use several different mesh sizes, it is the most versatile of gear types and accounts for the majority of fish caught. We will now examine the seasonal pattern of gear use in closer detail.

Firstly the gears used in Spring will be examined. All fishermen in the Gulf stated that they used trammel nets in Spring, though the weather is unpredictable and sometimes the gear has to be left for longer periods if there are particularly rough seas. It can be seen that in Balestrate and Trappeto, only trammel nets are used at this time of year, the predominant species in the catches being cuttlefish (*Sepia officinalis*) and red mullet (*Mullus barbatus*). In Castellammare, however, as well as trammel nets, monofilament gill nets are also used. Although cuttlefish and red mullet do appear as target species, the fishermen also target in addition, bogue (*Boops boops*), hake and horse mackerel (*Trachurus spp.*). The reason for this difference can be explained if we look at the habitats in which the fishermen operate. For the fishermen from Balestrate and Trappeto the predominant habitat fished is that of sandy sea floor, the fishermen from Castellammare fish a mixture of both sandy and rocky bottoms, thus accounting for the different species.

During the summer the same can be seen, with trammel nets being the dominant gear type, although its use is less widespread with several fishermen using different gear types. In Balestrate 50% of fishermen fish illegally for juvenile picarel using mini-seine gear, and rather than be landed at the port the catches are sold to wholesalers at sea, who transship the catches from several boats and then sell the total catch in larger ports such as Palermo or Trapani.

Fishermen in both Balestrate and Trappeto prosecute the FAD fishery for Amberjack during the summer using two types of gear, a large mesh seine or a large mesh monofilament gill net. The seine technique is used in Balestrate and the gill net in Trappeto. In Castellammare large mesh gill nets are also used, but instead for bream and hake. Long lines are also used during the summer, and here we can see the difference between Castellammare and the other ports of the Gulf. In Castellammare long lines are bottom set and used for hake, scabbardfish and bass, the importance of this method being seen by the fact that 35% of fishermen in Castellammare use it during the Summer months. In Trappeto only 10% of fishermen stated that they used long lines and these were surface set lines for swordfish.

In both Trappeto and Castellammare jigging for squid is important during the summer with 20% of fishermen in Trappeto using the method and 40% in Castellammare. Here it provides an important source of income during the summer. Once again the difference between uses of gear is attributable to the different seabed types, rocky bottoms attracting spawning squid.

During the Autumn trammel net fishing becomes less important, with only 40% of fishermen in Balestrate and 35% of fishermen in Castellammare using the method. Instead they concentrate on using seine and large mesh gill nets for catching large Amberjack. In Trappeto, however, 85% of fishermen claim to use trammel nets during the autumn. An interesting point to note is that although the fishermen in Trappeto do not target juvenile picarel fry during the Summer, in early Autumn 20% of fishermen in the port use mini seines to capture these fish. During this time it is usual to see in the fish retailers of Trappeto picarel fry of between 15 to 25mm in length. It would appear though, that in the other towns in the Gulf the main market is for picarel fry of less than 15 mm.

During the winter months, between January and March, the most important fishing method is the fish fry seine. There is a short season of 35 days in which the fishermen of the Gulf are allowed to catch the fry of pilchard. In all three ports fishermen take advantage of this fishery to varying extents. The fishermen of Balestrate and Trappeto are the most active, often pairing up to maximise efficiency. In Castellammare the fishery is still very important at this time of year, with 25% of fishermen taking part. The fishery is particularly lucrative, with fish fry having a retail price of on average 35,000 L per kilo, which is nearly double the price of other high value species such as amberjack and dolphinfish.

Fishing patterns change during this period, with almost all of the fishermen involved in this fishery increase their working hours for the season, in Balestrate for instance fishermen increase their fishing time from 5 hours per day to an average of 14 hours. In Castellammare and Trappeto the increase is less marked but the fishermen still fish for an average of 12 hours.

It is easy to see why several fishermen in all ports in the Gulf continue with the fishery after the end of the season, also directly targeting other pelagic species such as anchovy. Currently there is no regulation of this activity and the fish are all transhipped at sea, thus ensuring that no-one fisherman's catch can be identified. However, most fishermen interviewed agreed that continuing past the end of the season was not good for the maintenance of healthy fish stocks in the future, and several commented that if there was good enforcement that restricted everybody, then they would be happy to stop the illegal fishing.

Another fishery of note during the winter is the trammel net fishery for cuttlefish, this being most conspicuous in Trappeto and Balestrate, but fishermen in Castellammare do target them as well. Generally the winter months are seen as a time for a mixed fishery, with species such as breams, hake, cuttlefish, boops and sole all being caught frequently.

Table 2.12 shows the different gear types that are used for the different species, the mesh size measurements are all in knots per 25cm.

Table 2.12 *Main mesh size of trammel nets used to target specific species*

	Mullet	Sole	Bream	Hake	Amberjack	Other
Balestrate	12	10	10	10	8	11
Trappeto	13	10	10	10	8	15
Castellammare	11	10	10	10	10	8

The gear types for the most common species are the same throughout the Gulf, the only exception being in Castellammare where the nets used to target amberjack have a smaller mesh size than those in neighbouring ports reflecting the fact that the fishermen in Castellammare target smaller amberjack.

Respondents were also asked how many crew operated the vessels. In all cases the average was less than 2 fishermen. Balestrate and Trappeto had the highest at 1.63 and 1.64 crew per boat; in these ports 63 % and 57 % of vessels respectively had more than one crew. In Castellammare and Terrasini we see much lower crew numbers with average figures of 1.25 and 1.3 crew per vessel. In Castellammare only 25% of boats took more than one crew and in Terrasini one third of boats did likewise.

Finally the survey also asked what quantity of fish was taken from the catch for home consumption. Table 2.13 shows the percentage of fish that are taken per trip. The quantities vary according to season and the availability of fish in general, but also to the species caught. Almost all fishermen take home the damaged fish that cannot be sold easily, and the undersize or undesirable species.

Table 2.13 *Percentage of fishermen in each port taking fish for home consumption per trip*

Percent of catch taken	Terrasini	Trappeto	Balestrate	Castellammare
< 10		79%	88%	42%
10 – 20	100%	21%	12%	33%
20 – 30				8%
30 – 40				
40 – 50				17%

In three of the ports in the Gulf, fishermen only take less than 20% of the days catch for their home consumption, which in absolute terms represents only 1 to 2 kilos of fish per day. The majority of these will be 'soup fish' which will be damaged or non-marketable species. Many the fishermen have a helper who assists in the clearing, cleaning and in some cases the repairing of the gear; these are commonly retired fishermen or older relatives. These are usually paid in fish, once again being the lower quality species.

In Castellammare 75% of the fishermen take home less than 20% of the catch, though there are several fishermen who take considerably more, with 17% taking more than 40% of the days catch for home consumption. It was expected that there would be a correlation between the amount of fish taken home and levels of activity. To a certain extent this was borne out by two of the fishermen in Castellammare, both of whom are in their 60's and fish for less days each year than the average. The main reason stated during interviews, for taking home so much of the catch was that they like to eat fish.

2.2 Market structure for the artisanal fishermen in the Gulf

2.2.1 Markets

The sales path for fish within the Gulf of Castellammare is quite complicated with many different paths depending upon the fish, the port and the fisherman. As has been seen before, there were some 96 individual species recorded during the landings surveys, though obviously not all of these fish are sold on the open market. Species such as small scorpion fish, eels and various other very low value species are typically kept for home consumption. However the majority of fish are sold commercially.

We have seen in the gear characteristic analysis that the most commonly used gear type, the trammel net, is a fairly unselective fishing method. The landings survey showed that although the fishermen do target different species at different times throughout the year, they still land mixed catches.

The fish are removed from the nets at sea as they are hauled from the fishing grounds. On board the fish are stored in seawater, in buckets or in wooden crates. Upon landing at the quayside, the fish are transferred to wooden crates. No ice is used at sea or at the quayside. The fish are seldom exposed to the air for more than 3 hours before being landed to shore.

The fish are therefore sold most often as a 'mixed bag', with only the highest value species having an individual price. These include, the seabreams, tuna, cuttlefish, dolphin fish, shrimp, lobster, amberjack and a few others. The rest of the fish are sold as 'Soup fish', which comprises mixed low value species. Of course in the fish retailers these 'soup fish' may be added to others and separated out by species. The fishermen pay a penalty for this in that their fish are purchased, most frequently, as a mixed bag, with a price being given for the whole catch. Single species boxes achieve consistently higher prices, but the artisanal fishers are seldom lucky enough to land sufficient quantities of single species to fill a box. It is not surprising, therefore, that the fishermen single out the large or high value species and sell them individually to hotels and restaurants.

There is a great deal of variability between the ports of the Gulf as to the sales path for the fish that is landed, and accordingly each port will be considered separately.

Castellammare

There is a poor market structure in Castellammare, a fact that was highlighted as one of the key issues concerning the fishermen in the port during the motivation survey. In Castellammare only two wholesalers, who in turn sell to the local retailers, or are retailers themselves, dominate the sales of fish. It is interesting to note that when particularly high value species are landed, such as lobsters or large catches of sea breams, the fishermen tend to sell them directly to restaurants and hotels.

It is common to see in Castellammare, heated exchanges occurring and physical violence has occurred where one fisherman receives a higher price for his fish than another landing at the same time. The feeling is that the wholesalers' antagonise the situation by playing one fisherman off against the other. All fishermen stated that they had no respect for the wholesalers. The

problems are exacerbated during the summer months when the recreational fishermen are in abundance.

The only wholesale fish market in the Gulf is found in Terrasini, the distance of Castellammare from which makes it prohibitive for the wholesalers to travel to buy the Castellammare fishermen's catches, especially given the small quantities.

In Castellammare there is no loyalty from the four fishmongers to buy from local artisanal fishermen, instead the major supply of fish comes from the fish markets of Palermo and Mazara del Vallo.

Until 1994 there was a wholesale fish market in operation in Castellammare, which took all of the landings from local artisanal vessels and also attracted trawlers from around and outside of the Gulf. Unfortunately it was closed down for health and safety reasons. Since this time, however, the fishermen claim that the prices they receive for their fish has been steadily falling.

While that may be true, the evidence from the landing survey suggests, that in 1998/99 the fishermen in Castellammare, receive on average the highest prices (albeit only a minimal difference) for their fish of all the fishermen in the Gulf.

The main sales path for locally caught fish is via the fishermen themselves. Many fishermen stay on the quayside and sell their catches from the back of their cars, to locals and tourists. The artisanal fishing vessel wharfing area is ideally situated along the main promenade of the port. As such there are many tourists or local residents using the waterside cafes and bars or who stroll along the quayside. In this way they can achieve higher prices than would be achieved by selling through the wholesalers.

Balestrate

The fishermen in Balestrate also raised concerns over the weak market for their fish. If anything the situation in Balestrate is worse than that in Castellammare. There is only one fishmonger (retailer) in the town and only one wholesaler from Terrasini that buy the artisanal fishermen's catches. The majority of fishermen in the port take it upon themselves to sell their own fish. This is done from the back of their cars or from hand pulled carts.

There are several problems associated with this. The first is that, unlike Castellammare there are no proper port facilities; instead there is only the most rudimentary of harbours, enclosed by a breakwater and a rock groyne. There is one single-track road that serves as the only entrance and exit to the port. There is no proper road, instead being a rough concrete cover to sand. There is a sewage outfall that spills its contents directly onto the road, and onto anything passing along it, including catches of fish on the open backs of the vans used frequently to transport fish in the town.

The fishermen do not have the same access to tourists or to locals as the fishermen in Castellammare, due to the fact that very few people will actually venture down to the port. In fact the fishermen in Balestrate receive the lowest price for their fish of any of the ports in the Gulf.

There is one advantage that the fishermen have in Balestrate over those in Castellammare and that is that they are only competing with one fishmonger, this means that they may be able to achieve higher prices for their fish selling them directly to the public than they would otherwise.

Trappeto

For the fishermen of Trappeto the sales path is either via wholesalers from Terrasini or via the back of their cars. Like Balestrate, Trappeto does not have a well-developed harbour area to attract locals or tourists. There are several fishmongers in the town that compete with the artisanal fishermen by mainly sourcing their fish from outside of the Gulf. However, there is a

wholesaler from Terrasini that purchases a large proportion of the Trappeto fishermen's catches, with anything not taken being sold direct to the public via the fishermen's cars.

Terrasini

Terrasini is the only port in the Gulf region that has a wholesale fish market, which functions to take fish, primarily, from the trawlers and purse seine vessels that fish out of the port. In addition to this, it also takes nearly all of the fish landed by the artisanal fleet in Terrasini.

The fish market ensures that the fishermen do not have to worry about selling their catch, but due to their reliance on the fish market their fishing patterns have to be adjusted to accommodate. The fish market is open only six days per week. This means that the artisanal fishermen cannot set their gear on a Saturday, as they would not be able to sell it on a Sunday, which of course has implications for total catches and therefore revenues. These are discussed in part 3.

The fishermen in Terrasini are lucky that they have access to the fish market and it has helped to ensure that, after Castellammare, the fishermen in Terrasini receive the second highest average price for their catches. There is a disadvantage however which is that the artisanal fishermen are expected, like the trawlers and the seiners to pay a commission sum of 7% of total gross value of catches to the market. In addition to this fee, the fishermen pay a wharfage charge of 50,000L per annum for having access to the port facilities. These factors combine to mean that the fishermen in Terrasini actually receive the lowest average price for their fish in the Gulf.

3 FINANCIAL PERFORMANCE OF THE FISHERMEN IN THE GULF

3.1 Financial Performance in 1998/1999

Costs and earnings figures were obtained for the artisanal fishermen of the Gulf. In both Castellammare and Balestrate the sample sizes represent approximately 50 per cent of the active fishermen, while in Trappeto and Terrasini they represent approximately 1/3 of the active artisanal vessels.

Due to the lack of officially recorded financial information, the project team had to develop novel methods of data collection. The method decided upon in the end was to combine both the biological landing survey and a financial costs and earnings survey (see sample questionnaire in Appendix I). In this way it was possible to collect cost and earnings data throughout the course of the whole year rather than, as is usually the case, just as a one off collecting aggregate annual data. On the whole fishermen were helpful in providing data, with very few exceptions, though in some cases the inconsistent fishing patterns meant that it was not possible to collect a complete years data. These vessels have been omitted from the analysis.

To measure the financial performance of the artisanal vessels in the fleet common accounting practice was followed and the initial results are presented as Profit and Loss accounts. Information was recorded, in common with most cost and earning studies of fishing enterprises, regarding fishing costs (i.e. Variable or operating expenses) and vessel fixed costs.

We can describe fishing costs as those that are directly related to fishing activities, these include, fuel, ice, bait, garage and loft expenses, wharfage and commission to wholesaler fees and other associated fishing costs. Vessel costs can be classified as fixed costs that would be incurred regardless of the amount of fishing activity¹¹, these include; accountants fees, insurance, tax and depreciation, capital expenditure and gear replacement and vessel and gear repairs.

¹¹ The one arguable exception may be that of repairs, however it is expected that there will need to be some form of gear replacement and vessel maintenance and repair associated with even an inactive vessel

There is an additional cost that has not been covered in the above and that is of crew and labour costs. Due to the 'share' nature of most fishermen, whereby they receive a share of the catch (or its value) as payment for their services, it could be considered that labour expenses are a variable cost, similar to other operating expenses. There is an important difference, however, which is that whereas the items listed above (e.g. fuel) can be expected to vary with the level of economic input, such as 'time spent fishing'; labour expenses can be expected to vary with vessel output.

The data collected are robust and have been corroborated by the logbooks that have been collected and through interviews with gear manufacturers, fish wholesalers and retailers. The fishermen were able to accurately give information on costs of fishing, though many were reluctant at first to give information on revenues. Were this data has not been directly given by the fishermen the revenues have been derived by imputed fish prices.

There is considerable variability between the vessels fishing within the Gulf, both within ports and perhaps more importantly between the ports, for instance vessels in Balestrate are making considerable profits on average whilst the vessels in Trappeto (the closest port to Balestrate) are in fact, on average, making losses. The reasons for this variability are explained later. The four ports in the Gulf will be considered separately in this section. Figure 3.1 shows the differences in percent of fishermen in each port achieving certain levels of boat income (net profit).

Figure 3.1 *Distribution of boat income in the four ports of the Gulf*

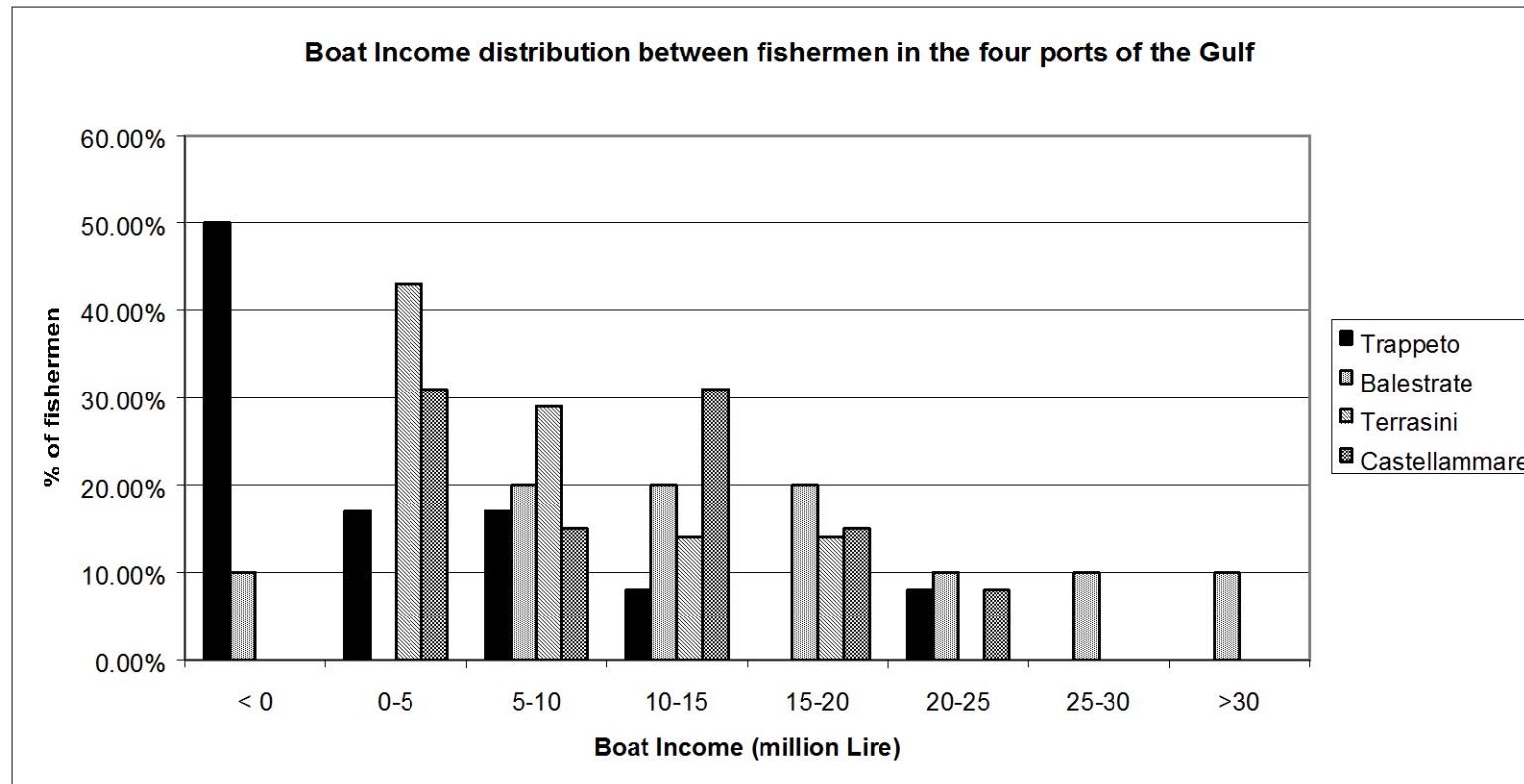


Figure 3.1 demonstrates the remarkable differences between the distribution of boat income in each of the ports. We can see that in both Terrasini and Trappeto there is a marked skewed distribution towards the lowest profits and even losses, whilst in Castellammare there is a fairly even distribution and in Balestrate a normal distribution is displayed.

Castellammare

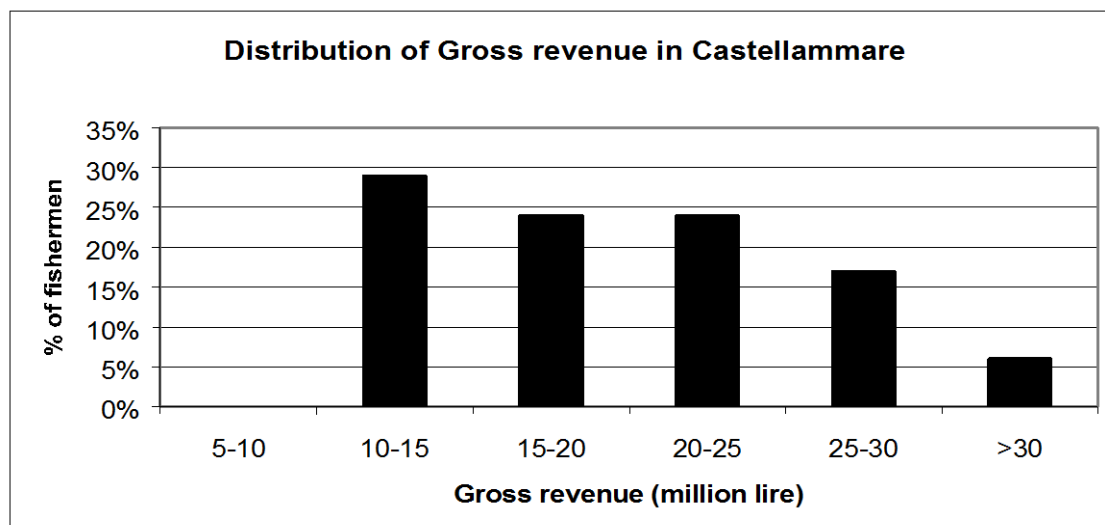
Table 3.1 below shows the average financial operating conditions for vessels in Castellammare.

Table 3.1 *Average financial operating conditions for an artisanal vessel in Castellammare*

Total sales Revenue		£20,335,324.88	
Expenses			
<i>Fishing Costs</i>		<i>Vessel Costs</i>	
Fuel	£1,033,551.89	Repairs	
Oil	£0.00	Gear	£124,117.65
Garage	£72,352.94	Boat	£323,529.41
Wharfage	£0.00	Motor	£94,117.65
Commission	£0.00	Gear replacement	
Bait	£0.00	Nets	£1,389,411.76
Other fishing	£21,117.65	Motor	£1,707,117.65
Crew	£1,052,620.32	Accountant	£560,000.00
		Chamber of Com.	£145,000.00
		Other fixed	£59,705.88
		Total	£4,403,000.00
		Tax	
		INPS	£1,272,000.00
		INAIL	£533,280.00
Total	£2,179,642.79	Total	£6,208,280.00
		Boat income	£11,947,402.00

Figure 3.2 shows the distribution of Total Sales Revenue to the fishermen in the port. It can be seen that nearly 50% of fishermen in the port achieve Total Sales Revenues greater than 20 million lira per annum, however, almost 30% receive only between 10 to 15 million lira. There are several reasons for these differences, perhaps the most obvious is that of days fished. Although the average days fished per year in the port is 233 (which coincidentally is the highest value for any of the ports of the Gulf), the range of days is actually between 180 to 300 days per year. For this reason Total Sales Revenue is perhaps not the best measure of the fishermen's well-being. A more suitable measure is that of boat income, which indicates the amount left for the vessel owner after covering all vessel costs, crew costs and fishing expenses.

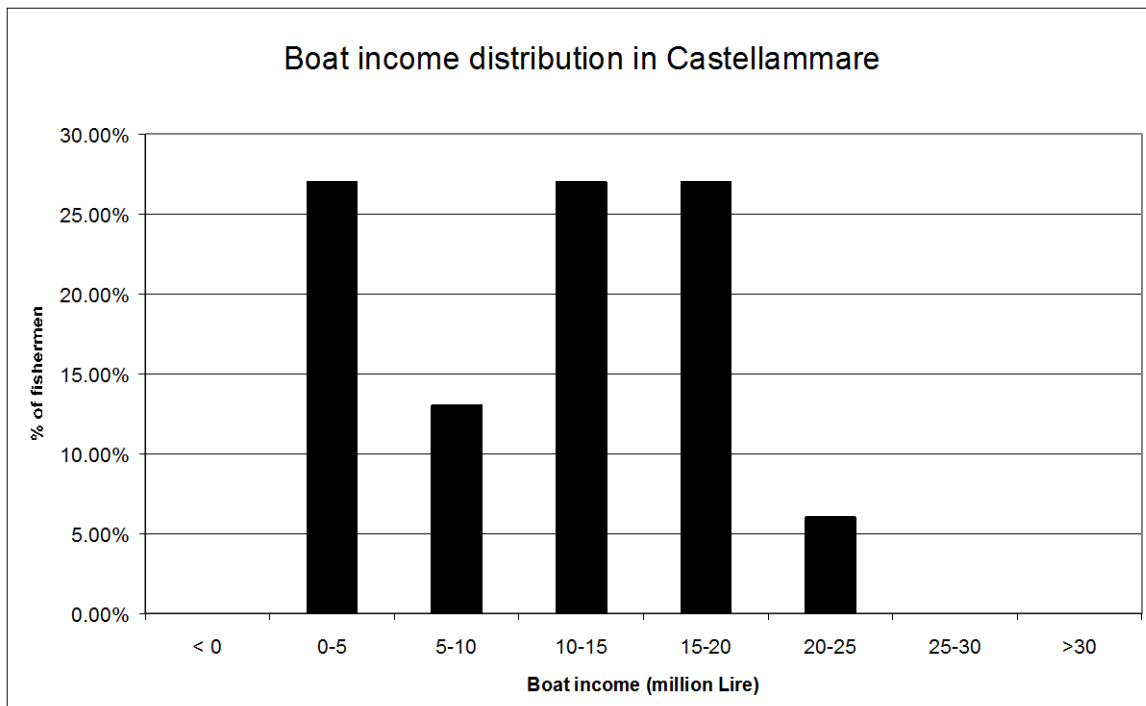
Figure 3.2 *Total Sales Revenue distribution in Castellammare*



If we consider boat income as our indicator of wealth, the vessels in Castellammare exhibit quite a profitable financial situation with average boat income (net profit before depreciation) in excess of 50% of Total Sales Revenue. In addition the vessels have fairly low crew costs at a little over 5%. Fuel costs are also a little over 5% of the Total Sales Revenue. The explanation for these two factors is given by the fact that the fishermen from Castellammare tend to fish quite close to shore and therefore have very small steaming distances. Most of the boats are also skipper operated only, taking and extra crew man at particularly productive times.

Figure 3.3 shows the distribution of profits in the port and we can see that there is quite a range of profitability. More than 25 % of fishermen earn a boat income of between 0 and 5 million lira, while >50% earn more than 10 million and less than 5% earn more than 20 million lira per year. All of the vessels in Castellammare were seen to be profitable during the year, even though there was a considerable range of profits, the lowest being less than 2 million lira, the highest being 26 million lira. The differences between the vessel performance will be discussed subsequently, though the differences, given the similarity in cost structure, are probably due to the different levels of effort exerted, measured as days fished. For most of the vessels the marginal cost of spending more days at sea is minimal, impacting mainly upon fuel costs, and to a lesser extent on gear repairs.

Figure 3.3 *Distribution of boat income in Castellammare*



Balestrate

The vessels in Balestrate exhibit many features in common with those in Castellammare, although we have shown in section B.1 that the average days fished per year are considerably less, at only 214. It is surprising, therefore to see that the boats in Balestrate actually show higher levels of profitability, shown by an average boat income in excess of 14 million lira per annum. This can be seen in Table 3.2.

The distribution of boat income is shown in Figure 3.4, we can see that there is actually a normal distribution, with most fishermen (60%) earning a net profit of between 5 and 20 million lira per annum. Of course there are a few boats earning more (30%) and some less (10%). Unlike Castellammare, in Balestrate there is very little variation in Total Sales Revenue, with only 2 vessels earning less than 30 million lira per annum. There are several reasons for this, which have been discussed elsewhere, but it should be noted that the fishermen in Balestrate exhibit a more entrepreneurial attitude and are more willing to exploit different fishing grounds and methods. This is demonstrated by examining fuel costs, for instance, for an average vessel in Balestrate, at more than 2 million lira per annum it is the highest of the Gulf ports.

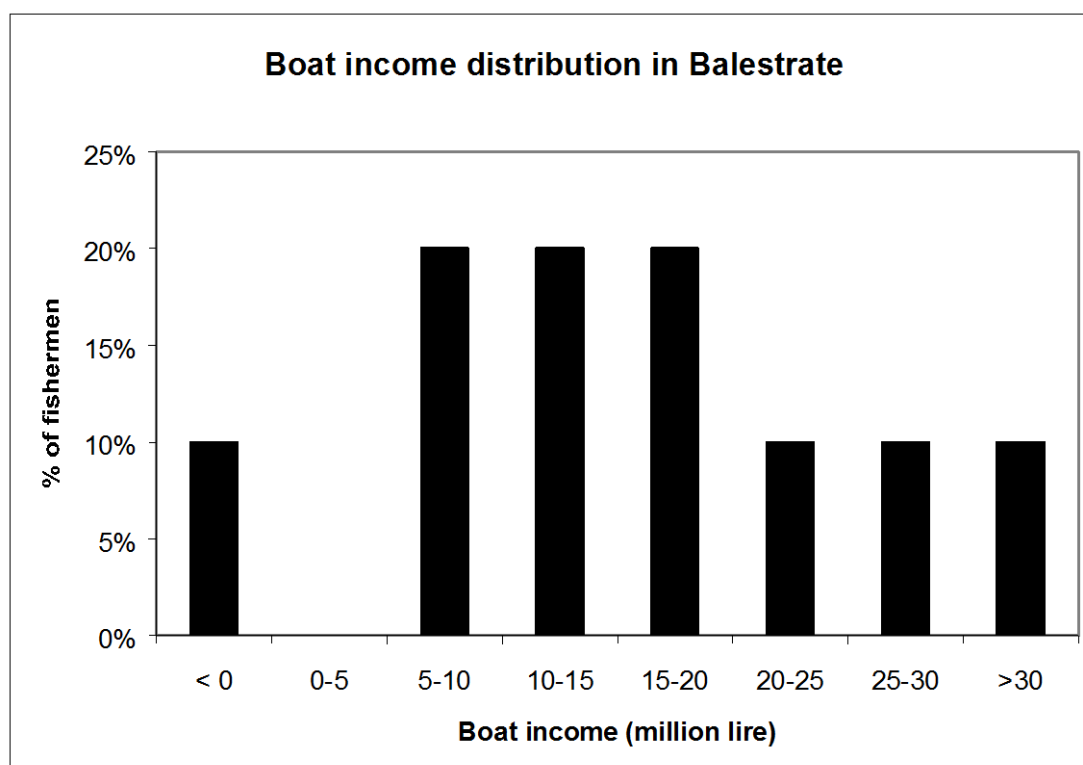
It is interesting to note that although the vessels in Balestrate earn Total Sales Revenue somewhere in the region of 50% more than the next best in Castellammare, the vessels boat income is only approximately 17 % higher. The difference is accounted for by the fact that the vessels in Balestrate have extremely high crew costs, at approximately 6.5 million lira. It is interesting, therefore, to question the true value of taking an extra crew man. Of course the payment to the crew man may not actually be a real physical payment, since often the crew are family members, most commonly a son. The vessel owner, although recording crew payments, may actually take the money as payment for board and lodgings. While this does not mean that the vessel owner has genuinely 'free' labour, it is clear that the circumstances under which the extra crew are obtained is rather different from those which would prevail in a normal labour market.

One item that can be seen in table 3.2, when compared to the financial performance of the vessels in the other three ports is that the vessels in Balestrate actually pay lower tax contributions, some 25% of the INPS contributions of vessels in the other ports, although they do pay, on average, marginally more INAIL 160,000 L. In addition the fishermen in Balestrate also have the highest accountants charges, although the tax saving more than compensates. The reason for the differences in tax payments is due to the tax relief given to co-operatives, instead of each fisherman paying his INPS contributions individually, the co-operative is treated as an individual and the cost divided by the members.

Table 3.2 *Average financial performance for vessels in Balestrate.*

Balestrate			
Total Sales Revenue		£31,217,589.76	
Expenses			
<i>Fishing Costs</i>		<i>Vessel Costs</i>	
Fuel	£2,382,790.74	Repairs	
Oil	£0.00	Gear	£357,400.00
Garage	£113,500.00	Boat	£495,000.00
Wharfage	£0.00	Motor	£28,500.00
Commission	£0.00	Gear replacement	
Bait	£0.00	Nets	£1,941,500.00
Other fishing	£121,300.00	Motor	£2,462,300.00
		Other	£0.00
Crew	£6,596,575.45	Accountant	£596,000.00
		Chamber of Com.	£145,000.00
		Other fixed	£317,300.00
		Total	£6,343,000.00
		Tax	
		INPS	£328,800.00
		INAIL	£639,952.00
Total	£9,214,166.20	Total	£7,311,752.00
		Boat Income	£14,691,671.56

Figure 3.4 *Boat income distribution in Balestrate*



Trappeto

Table 3.3 shows the financial performance of the vessels operating in Trappeto. The first thing to note is the low Total Sales Revenue figure, vessels in the port demonstrate the lowest Total Sales Revenue figures for any of the ports in the Gulf with many vessels receiving less than 10 million lira per annum. In part this low Total Sales Revenue figure can be explained by the low number of days fished each year, with an average of only 179, and a range of 60 to 230 (which is lower than the average in Castellammare).

The second item of note is the high fuel costs, second only to the vessels in Balestrate, which is partly explained by the fact that the vessels from Trappeto fish, on average, 2km from port. The other explanation is that the vessels in Trappeto do not have easy access to a marine fuel supplier, instead many choose to buy fuel from road side service stations, in effect they are paying up to three times as much for their fuel as the fishermen in other ports.

The third point is the high crew costs, also second only to Balestrate, and in this case the value of the extra crewman must be questioned.

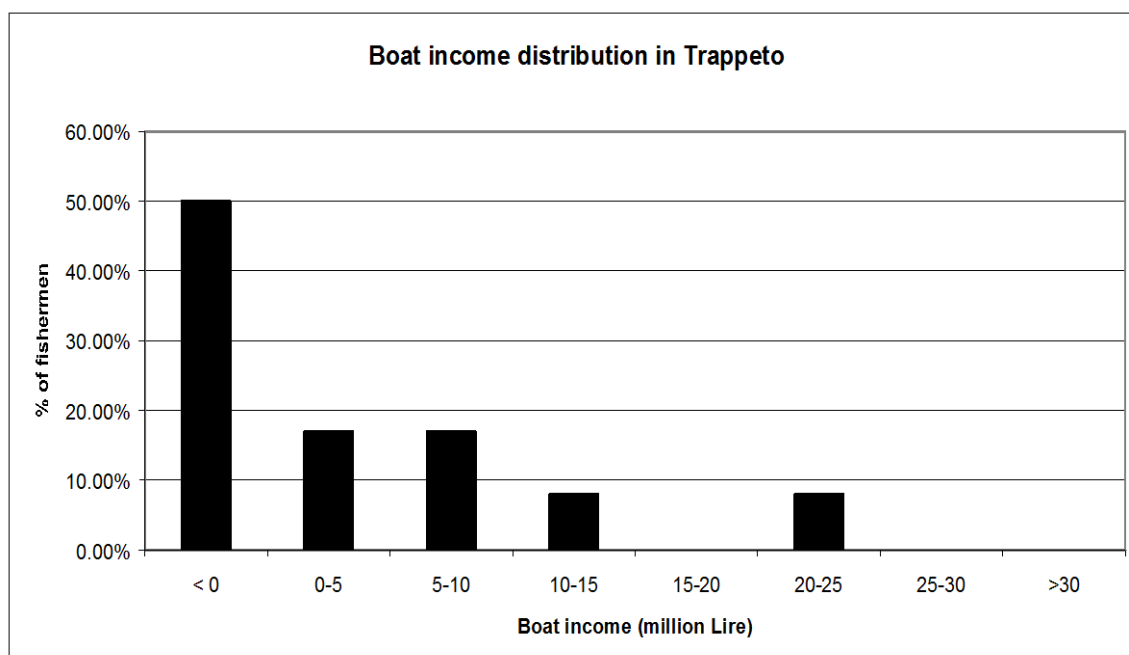
Gear and motor replacement costs in the port are very high, almost twice as much as in the other ports in the Gulf. Many fishermen had taken advantage of the last payment for biological rest to upgrade their boats, with many having engine overhauls, or extensive work done to the hull. Gear and vessel repair values were also very high.

Table 3.3 also shows, more importantly perhaps, that for the average vessel working from Trappeto fishing is not profitable, indeed the average boat income figure was just below zero. In effect the boats on average were making a loss. Figure 3.5 shows the distribution of boat income to fishermen in the port. It can be seen that more than 50% of the fishermen were making negative boat incomes.

Table 3.3 Average financial performance for vessels in Trappeto

Total Sales Revenue		£15,813,227.87	
Expenses			
Fishing Costs		Vessel Costs	
Fuel	£1,760,730.82	Repairs	
Oil	£0.00	Gear	£292,083.33
Garage	£11,666.67	Boat	£1,175,000.00
Wharfage	£0.00	Motor	£183,333.33
Commission	£0.00	Gear replacement	
Bait	£0.00	Nets	£2,783,333.33
Other fishing	£10,416.67	Motor	£3,810,833.33
Crew	£3,415,913.93	Accountant	£439,166.67
		Chamber of Com.	£145,000.00
		Other fixed	£100,833.33
		Total	£8,929,583.33
		Tax	
		INPS	£1,272,000.00
		INAIL	£533,280.00
Total	£5,198,728.08	Total	£10,734,863.33
		Boat Income	-£120,363.54

Figure 3.5 *Boat income distribution in Trappeto*



Terrasini

It is interesting to represent the vessels from Terrasini, because to a large extent, it is they who have perhaps been affected most adversely by the trawl ban. The attitudes of the fishermen from Terrasini are discussed in section 4, but the general opinion is that the fishing conditions in the port have become much worse since the trawl ban was introduced, the vessels have to go further afield in order to avoid conflict with the displaced trawlers. In addition to this, those vessels that fish on the margins of the ban area face losing gear to the trawlers. These two factors contribute to the high fuel, gear replacement and repair costs.

Table 3.4 shows the financial performance of the average vessel in Terrasini. It is interesting to note, however that the vessels in Terrasini although fishing for the least number of days on average, each year (only 160, with a range between 120 and 210) still earn higher Total Sales Revenues than those in Trappeto. This is explained by the fact that the fishermen in Terrasini benefit by being able to sell their catches on the only wholesale fish market in the Gulf area.

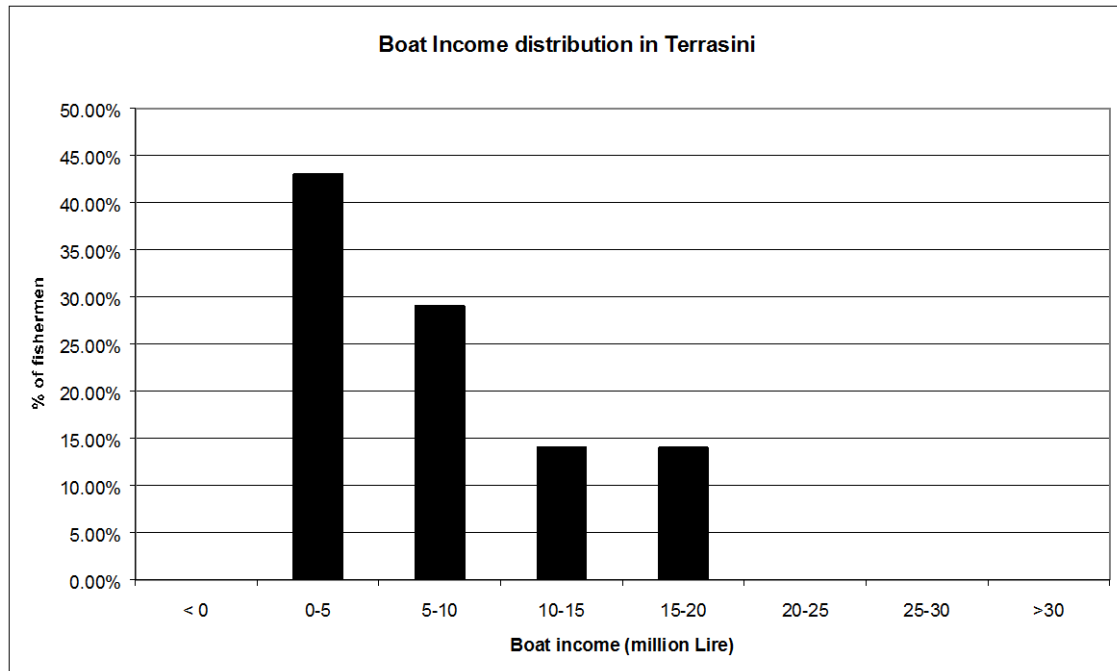
Table 3.4 shows that the vessels in Terrasini have only the third highest fuel costs, when compared to the other ports. This is surprising given that their fishing grounds are, on average, more than twice the distance of the fishing grounds for fishermen in other ports, at nearly 4 km. Again this is probably explained by the size of the port, and by the presence of the large purse seine and trawl fleet in Terrasini, and the large-scale fuel suppliers present who compete for this market.

Figure 3.6 shows the distribution of boat income in the port. While the average vessel in the port is making a profit on the whole, the actual level is very low, with more than 40% of fishermen earning a boat income of less than 5 million lira and more than 70 % earning less than 10 million lira. It is reasonable to assume therefore that the fishermen in Terrasini must be quite susceptible to any, even small, changes to the costs of their fishing activities, or to fluctuations in catch levels. This point is investigated in greater detail later, where sensitivity analysis is applied to the artisanal vessel operations.

Table 3.4 Average financial performance for vessels in Terrasini

	Average	Revenue	£17,356,216.33
Expenses			
<i>Fishing Costs</i>		<i>Vessel Costs</i>	
Fuel	£1,741,683.67	Repairs	
Oil	£0.00	Gear	£370,000.00
Garage	£0.00	Boat	£614,285.71
Wharfage	£50,000.00	Motor	£114,285.71
Commission	£1,214,935.14	Gear replacement	
Bait	£89,714.29	Nets	£1,838,571.43
Other fishing	£21,428.57	Motor	£1,285,714.29
Crew	£213,562.76	Accountant	£400,000.00
		Chamber of Com.	£145,000.00
		Other fixed	£12,857.14
		Total	£4,780,714.29
		Tax	
		INPS	£1,272,000.00
		INAIL	£533,280.00
Total	£3,331,324.43	Total	£6,585,994.29
		Boat Income	£7,438,897.61

Figure 3.6 Distribution of boat income in Terrasini



3.2 Economic Analysis

In this section we explore in greater detail the financial performance of artisanal fishing vessels operating in the Gulf, focussing on four main areas: the degree of inter-vessel variation in performance; the comparative performance of vessels inside and outside the trawl ban area; the implications of changes in catch rates and vessel utilisation rates; and the financial viability of capital investment.

3.2.1 Accounting for variations in performance

The previous section, which presented the basic results of the costs and earnings data, highlighted the very substantial variations in performance between individual operators as well as between the four main ports. For the purposes of discussion the measures of financial surplus which are relevant are:

Net revenue: total sales revenue *minus* total running costs

Value added: Net revenue *minus* total vessel fixed costs

Boat income: Value added *minus* total labour costs

The term 'profit' as commonly used in this instance corresponds to boat income, since it represents the surplus over and above all cash outgoings that is earned by the vessel owner. Where the owner is also the skipper of the vessel this surplus thus represents the reward for his labour as well as the return on the capital invested in the boat.

For each of these measures of financial surplus we have assessed the extent of inter-vessel variation, using data from the landings survey, in terms of the standard deviation (SD) and coefficient of variation (CV). These are given in Table 3.2.1 Focussing on boat income, the very considerable variation in performance becomes clearer from the histogram given in Figure 3.2.1.

In 1998/99 some trammel netters made losses while some earned profits substantially above the mean (8.7m lira) for all vessels operating in the Gulf. Table 3.2.2 gives a clue as to the source of this divergent performance, since it is clear that there were inter-vessel differences in respect of utilisation rates, catch rates, average prices, running costs, labour costs and fixed costs. Some of this variation can be explained relatively easily, as in the case of labour costs (CV= 1.55) where it is due to the inclusion in the sample of vessels employing no extra crew (hence zero labour costs) alongside vessels employing 1 or more additional crewmen. We may also account for the comparatively high variation in fixed costs (CV = 0.98) by the fact that in 1998/99 some vessels had incurred quite major repair or gear replacement expenses which could be regarded as atypical of normal operating conditions. Differences in average prices received from the sale of fish (CV = 0.46) are attributable partly to differences in the mixture of species caught and partly to inter-port differences in the market prices of each species, while variations in running costs between one vessel and another (CV= 0.5) may be explained to a large degree by different activity levels and use of inputs (fuel, etc.). Utilisation rates (days fishing per year) exhibited relatively low inter-vessel variation (CV= 0.2), which is understandable when we consider that for each fisherman the time allocated to fishing is circumscribed by an upper and lower limit: on the one hand, by the need to devote a minimum number of days to fishing in order to remain commercially viable, and on the other by the obligation to respect the 45 day biological rest period. Variations in vessel catch rates (CV= 0.5) are less easy to explain, but in general terms we can point to two main influences: (i) differences in the density of fish stocks targeted by vessels, (ii) differences in fishing skill. Both these sets of factors seem to be important in accounting for inter-port differences in vessel productivity, given that some ports in the Gulf have more favourable access to the better fishing grounds, and also that attitudes amongst fishermen at certain ports appear to be markedly more 'entrepreneurial' than at others.

3.2.2 Comparative performance of vessels inside and outside the trawl ban area

A specific question which follows from the previous analysis is whether there are any observable differences in the performance of trammel netters based at the three ports inside the trawl ban area (Castellammare, Balestrate and Trappeto) compared with those based at the port immediately outside the area (Terrasini). The comparison is limited by the fact that in the year of the landings survey relatively few trammel netters (7) were operating from Terrasini, implying that particular care needs to be taken to ensure that any observed differences are statistically significant. The initial comparison of group averages is presented in Table 3.2.3 while the differences in the means are evaluated (using an independent samples t-test) in Table 3.2.4. Statistically significant differences are found with respect to vessel utilisation rate (lower outside), total running costs (higher outside) and total labour costs (lower outside). In the context of this study it is the first two variables which are of most relevance, since the result corresponds with what we would expect to happen *a priori* as a result of the trawl ban and also with what we know of the actual fishing patterns of fishermen. Specifically, the fact that fishermen outside the ban area fished significantly fewer days per year compared to vessels inside can be rationalised as a response to the congestion externalities caused by the presence of trawlers (i.e. a 'crowding out' effect), while the fact that they incurred significantly higher total running costs can be explained in terms of the need to compensate for this problem by fishing further afield. Differences in labour costs, though statistically significant, are not thought to be related to the trawl ban *per se* and are more likely to be a reflection of the predominance of skipper-only vessels at Terrasini.

What is surprising, however, is that the difference in catch rates between the two groups of vessels is not more pronounced, since the theoretical results derived from bioeconomic modelling studies of marine reserves (Hannesson, 1998; Sanchirico and Wilen, 1999; Conrad, 2000) lead us to expect that stock density within a zone where fishing is restricted would be higher than in an adjacent area where fishing is uncontrolled. Catch rates of trammel netters within the trawl ban area were indeed higher than those outside (6.63 kg/day as compared with 5.76 kg/day) but as Table 3.2.4 shows the difference was not statistically significant. Several explanations for this result can be advanced. To start with, it may simply be due to the fact that the vessels in each sample were not identical in terms of fishing power (i.e. catchability), meaning that their comparative catch rates would not have truly reflected differences in stock density inside and outside the trawl ban area. Alternatively, the reason may be that the port of Terrasini was close enough to the edge of the exclusion zone to benefit from the conservation effects of the trawl ban (i.e. in terms of enhanced biomass). A quite different explanation may be put forward, however, which if correct has rather more ominous implications: that the trawl ban has proved ineffective and that the pressure of fishing is *de facto* as great inside the exclusion zone as outside. This suggestion is not without foundation, since we know from interviews with fishermen that illegal trawling within the ban area does take place. That being so, any differences in relative stock density between the trawl ban area and the area outside would tend to be eliminated.

It is clearly important to examine this issue more closely, because if it proves to be the case that the exclusion zone has had no observable effect on stock density then an important economic argument for its retention collapses. This can only be done satisfactorily by reference to the data obtained from the biological part of the project, specifically the experimental trawl survey and trammel survey results which enable a comparison to be made between CPUE inside and outside the trawl ban area. A summary of the trawl survey data is presented in Table 3.2.5, from which it becomes immediately apparent that, in each of the four seasons of 1998, CPUE within the trawl ban area was higher than in the corresponding season outside the area. The differential ranged from +41% in the Spring of 1998 to the +183% in the Winter of that year. There can be little doubt, therefore, that despite the ambiguous results of the landings survey, the scientific evidence supports the hypothesis that the trawl ban has increased fish stock abundance and catch rates. If that is accepted then it follows that, since catch rates are an important determinant of vessel profits, the trawl ban must necessarily have impacted positively on the financial performance of the artisanal fleet.

3.2.3 Implications changes in catch rates and utilisation rates on financial performance

The data from the landings survey on the costs and earnings of the artisanal fleet provides the basis for asking 'what-if ?' questions concerning how financial performance would be affected if operating conditions were to change. Essentially this is a simulation exercise, for which purpose we have constructed a simple financial model based on the known characteristics of the fishery which is then used to examine the sensitivity of profit (boat income) to changes in vessel catch rates and utilisation rates. While these represent only two of the factors which affect profits, they are of particular significance since catch rates represent an important target of fisheries management and utilisation rates are a key decision variable which is under the control of fishermen.

To establish the empirical basis of the model we start by demonstrating the statistical association between the financial performance of trammel netters operating in the Gulf in 1998/99 and their operating performance in terms vessel catch rates and utilisation rates. This is shown in Tables 3.2.6 and 3.2.7, which give partial correlation coefficients between CPUE and days fishing, respectively, and the three measures of financial surplus (net revenue, value added and boat income). In each case the other determinants affecting financial performance have been held constant, so that the correlation coefficients represent the linear association between only the variable in question (i.e CPUE or utilisation rate) and each measure of financial surplus. From Table 3.2.6 it is clear that, controlling for the other factors affecting performance (price, days, total cost), higher catch rates were positively associated with higher net revenue, value added and boat income. In Table 3.2.7 the analysis is repeated except that here the partial effects of vessel utilisation are examined, controlling for price, CPUE and total cost. The result shows that, holding these other factors constant, higher utilisation rates are likewise associated with higher levels of financial surplus.

While this helps to confirm empirically the important influence of vessel catch rates and utilisation rates on financial performance, our principal concern is to see by how much performance would change if either or both of these variables deviated from their baseline levels by a specified amount. To answer this question we start with the actual distribution of boat income as depicted in Figure 3.2.1 and consider how this might look if all vessels in the sample were to suffer a 25% fall in catch rates. To do this it is necessary to make a number of assumptions about the relationship between profit, revenue and costs. The model we use is based on Whitmarsh et al. (2000) though here we distinguish between one-man (skipper-only) vessels those which employ extra crewmen and as such incur labour costs. The key assumptions are (i) that total running costs are a linear function of the vessel utilisation rate (i.e days fishing) and (ii) for boats which employ extra crew, labour costs are based on an agreed share of net revenue which in the short-run remains constant. Accordingly, the profit function may be written:

Profit = Total sales revenue *minus* running costs *minus* labour costs *minus* fixed costs

$$= pEK - cE - w(pEK - cE) - F$$

where:

- p = price
- E = fishing effort (utilisation rate)
- K = catch rate
- c = average running cost
- w = crew share rate
- F = vessel fixed costs

In the analysis which follows we allow catch rate (K) and utilisation rate (E) to vary, keeping the other components constant.

The results are given in the following graphs. In the first two (Figures 3.2.2 and 3.2.3) we simulate the effects of a 25% fall and 25% rise in vessel catch rates on boat income. In the former case it is clear that the distribution of boat incomes is shifted to the left, resulting in a fall in the mean profit level from 8.71 million lira to 4.2 million lira. In the latter case the distribution of boat incomes is shifted to the right, the mean profit figure rising to 13.22 million lira. The next two sets of Figures (5.4 and 5.5) repeat this analysis except here the variable is the utilisation rate, again with a 25% fall contrasted with a 25% rise. The results are similar to those before, with the fall in utilisation rate leading to a drop in average profits to 4.61 million lira and the rise in utilisation rates causing average profits to increase to 12.81 million lira. The important point to emerge from this analysis is that, starting at the current (1998/99) operating levels, a given percentage change in either catch rates or vessel utilisation rates results in a *proportionately greater change in financial profits*.

The same financial model may be used to calculate the break-even operating levels and to compare them with the levels actually achieved in 1998/99. The results are presented in Figures 3.2.6 and 3.2.7, which show the effect of varying catch rate and utilisation rate on total revenue and boat income. In the survey year the 'representative' operator (for illustration, here taken to be a one-man trammel netter based at one of the three interior Gulf ports) had a catch rate of 6.354 kg per day and fished 224 days per year. Total revenue was 22.61 million lira per year and boat income 12.65 million lira per year. The structure of the financial model is such that there is a linear relationship between boat income and catch rate, and similarly between boat income and utilisation rate, and given the parameters of the model (derived from the landings survey) it is possible to simulate the effects of changes in either catch rates or utilisation rate and also to derive threshold (break-even) operating levels below which boat income switches from positive to negative. Figure 3.2.6 shows that vessels of this type would have incurred losses if catch rates had fallen below 2.8 kg/day, while Figure 3.2.7 shows that the corresponding figure for the utilisation rate would have been 89 days/year.

3.2.4 The financial viability of capital investment

To answer the question of whether it would be financially worthwhile to re-invest capital in the fishery, a capital budgeting model was constructed based on the returns expected from a representative trammel net vessel. Data for the model were based on the costs and earnings survey and from information supplied by manufacturers regarding the costs of a boat, gear and equipment. The assumptions of this model were: (i) the vessel would have the same performance characteristics as one that was operating within the Gulf in 1998/99 and which employed one crewman i.e. skipper-only (ii) running costs are proportional to vessel utilisation rate (iii) the project planning horizon is 20 years. (iv) items of capital equipment are replaced at the following periodicity: (a) vessel replaced every 20 years (b) engine replaced every 10 years (c) headline and rope replaced every 5 years (d) net replaced every year.

The criterion of financial worth is *net present value* (NPV), which can be expressed as:

$$NPV = \frac{B_0 - C_0}{(1+r)^0} + \frac{B_1 - C_1}{(1+r)^1} + \frac{B_2 - C_2}{(1+r)^2} + \dots + \frac{B_n - C_n}{(1+r)^n}$$

Where:

$B_0 \dots B_n$ = financial benefit expected in each year 0 to n
 $C_0 \dots C_n$ = financial cost expected in each year 0 to n

r = discount rate

In this expression the financial benefits are taken to be the annual total revenue from fishing, while the financial costs includes the expenses assumed to occur at the same rate each year (running costs, repairs, taxes and other fixed costs) plus capital expenses (vessel, engine, gear, etc.) which are incurred intermittently.

The results are summarised in the accompanying Figure 3.2.8 and Table 3.2.8. Using a discount rate of 6% in real terms as an indicative figure for the opportunity cost of capital, the investment can be shown to produce a positive net present value (NPV), implying that it would be a worthwhile use of funds. The internal rate of return (IRR) of the project is 30%, confirming that if the cost of capital is indeed 6% then investment in the fishery must logically be a better use of funds than the next best alternative. Increases in the discount rate will reduce the NPV of the project, a result which is demonstrated in Figure 3.2.8. To test the sensitivity of the project to the various factors which can affect its profitability we have adopted the standard procedure (Kohli, 1992) of measuring the percentage change in NPV as a consequence of a 1% change in each of the specified parameters from their baseline levels. These sensitivity indicators are reported in Table 3.2.8, and demonstrate the important influence of price, vessel utilisation rate and catch rate on the expected financial worth of the project. Specifically, the Table shows that a 1% rise in price would produce a 2.35% increase in NPV, other things being equal, while a 1% rise in catch rates (CPUE) would have a comparable effect. The sensitivity indicator for vessel utilisation is slightly lower at 2.19%, the reason being that though a greater number of days fishing per year would increase total revenue it would also incur additional running costs (fuel, etc.). Conversely, increased price or catch rate is assumed to affect only revenue and not costs, and accordingly the responsiveness of NPV to changes in either of these parameters is somewhat greater than with vessel utilisation. It needs to be stressed that this sensitivity analysis does not fully account for the risks of investing in the fishery, since it in itself it says nothing about the likelihood of any of the parameters deviating from their expected values. At present we have only very limited information on the year-to-year fluctuations in the various revenue and cost components which affect NPV, and until that knowledge gap is filled it will not be possible to undertake a fully comprehensive risk analysis of capital investment.

The fact that NPV is expected to be positive is an important result, because it implies that if the operating conditions which prevailed in the survey year (1998/99) were to be maintained in perpetuity then it would be rational to invest capital in the artisanal fishery (specifically, one-crewman trammel net fishing) rather than in the next best alternative use of funds. If investment is indeed financially viable then it could be argued that *the fishery has the potential to be economically sustainable* since the capital necessary for its long-term continuation would be expected to earn a competitive return. However, whether such investment is in fact undertaken obviously depends on whether vessel operators take a favourable view the prospects for the fishery, and here the evidence is rather more ambivalent. On the one hand, the fact that established fishermen have been shown to spend money on replacement of gear and equipment testifies to a willingness to maintain their existing stock of capital and a desire to stay in business as professional operators. Against that, however, we now have the evidence of the motivation survey (see next section) which indicates that fishermen taking a pessimistic view of fishing prospects outnumber those taking an optimistic view. Asked about the future, 24% believed fishing in the Gulf would be 'better' or 'much better' as against 55% who believed that fishing would be 'worse' or 'much worse'. Despite that, the overwhelming majority (86%) of fishermen signalled their intention of carrying on fishing in the Gulf in the future, which if true presumably indicates some confidence in the ability of the fishery to return a profit. Our analysis suggests that this confidence may not be misplaced.

3.2.5 The Gulf of Castellammare in the context of Sicilian artisanal fisheries as a whole

It is appropriate to finish this section of the report by seeing to what extent the artisanal fisheries in the Gulf of Castellammare are representative or typical of those elsewhere. Fortunately the recent publication of a report by IREPA on the economic performance of Italian marine fisheries in 1998 (IREPA, 2000) enables us to make an approximate comparison between artisanal

vessels operating in the Gulf and those throughout Sicily as a whole, and the relevant data are summarised in Table 3.2.9. It should be noted that an exact like-with-like comparison is not possible, since the IREPA survey covers several gear types within their grouping of 'small fishing vessels' (*piccola pesca*), notably boats which can be switched to purse seining, whereas the survey of artisanal vessels in the Gulf includes only trammel netters. Notwithstanding this limitation, a number of inferences can be drawn.

To start with, artisanal vessels in the Gulf are typically smaller than the average for Sicily as a whole, with lower tonnage and engine power, and their complement of crew is correspondingly less. Vessels in the Gulf nevertheless had somewhat higher activity levels than the average for all Sicily, with a utilisation rate of 203 compared with 159 days at sea per year. However, there is an interesting contrast in terms of the revenue per unit of fish landed and the relative importance of different cost components. The unit value (i.e. average price) of fish landed in the Gulf was 15,711 lira/kg compared with 8,303 lira/kg generally, a difference which can be explained in terms of species composition (i.e. a higher proportion of commercially more valuable species) rather than greater market power *per se*. Variable costs per unit were similar (1,436 lira/kg compared with 1,474 lira/kg), but a very marked difference appears in terms of fixed costs per unit which for Gulf fishermen were 5,732 lira/kg whereas for Sicilian small boats in total were only 438 lira/kg. The most likely explanation for this is the inclusion of maintenance and gear replacement expenses in fixed costs, which for several Gulf operators were known to be quite high in 1998/99, while the production levels (i.e. catches) over which those fixed costs were spread was for Gulf vessels substantially less than vessels in the IREPA survey. The upshot of this therefore was that the typical artisanal vessel in the Gulf was landing a higher unit value catch but incurring higher total operating costs (variable plus fixed) per kg. In fact, the higher unit value more than offset the higher unit cost, with the result that the value added per unit for Gulf vessels (8,543 lira/kg) was actually slightly greater than for artisanal vessels in Sicily as a whole (6,391 lira/kg). Inevitably, however, the much smaller volume of landings by artisanal vessels in the Gulf compared with the average elsewhere meant that the economic productivity of labour was relatively low; in terms of value added the figures were 8.11 million lira per fisherman compared with 27.6 million lira per fishermen across the whole of Sicily.

Table 3.2.1: Variations in financial performance between trammel netters operating in the Gulf of Castellammare in 1998/99

Measure of surplus (lira per vessel per year)	Mean (n = 46)	SD	CV
Total revenue	21,068,015	9,016,665	0.43
Net revenue	19,142,941	8,584,676	0.45
Value added	11,456,450	11,681,311	1.02
Boat income	8,709,793	11,501,851	1.32

Table 3.2.2: Variations in main revenue and cost components of trammel netters operating in the Gulf of Castellammare, 1998/99

Revenue or cost component	Units	Mean (n = 46)	SD	CV
Utilisation rate	Days fishing per year	203.26	41.3	0.2
Catch rate	Kg per day fishing	6.501	3.26	0.5
Average price	Lira per kg	17,493	8,119	0.46
Running costs	Lira per boat	1,925,074	958,805	0.5
Labour costs	Lira per boat	2,746,657	4,252,877	1.55

Fixed costs	Lira per boat	7,686,491	7,557,583	0.98
<p>Note: (i) The figure for catch rate (6.501) and average price (17,493) are unweighted arithmetic means for all boats in the sample. The corresponding weighted averages, which more truly reflect physical productivity of the 'representative' vessel and the market conditions for selling the catch, are as follows: catch rate = 6.5974 kg/day; price = 15,711 lira /kg. These figures, taken together with the utilisation rate (203.26), will give the average total revenue per vessel of 21 million lira per boat per year.</p> <p>(ii) The sample includes both one-man (skipper-only) vessels and those employing additional crewmen. Their operating performance differs, and for comparison we can give the relevant weighted averages for one-man and two-man vessels operating from the 3 ports inside the Gulf. One-man boats: 224 days/year; 6.354 kg/day; 15,912 lira/kg. Two-man boats: 194 days/year; 7.134 kg/day; 15,155 lira/kg</p>				

Table 3.2.3: Comparison of group statistics relating to the performance of trammel netters based inside the trawl ban area (portcode 1) and outside (portcode 2)

	PORTCODE	N	Mean	Std. Deviation	Std. Error Mean
DAYS	1	39	209.49	40.71	6.52
	0	7	168.57	25.45	9.62
CPUE	1	39	6.63349	3.43576	.55016
	0	7	5.76386	2.07828	.78552
PRICE	1	39	17,488	8,747	1,401
	0	7	17,519	3,138	1,186
TOTRUN	1	39	1,711,002	823,510	131,867
	0	7	3,117,762	801,412	302,905
TOTLAB	1	39	3,201,315	4,469,252	715,653
	0	7	213,563	565,034	213,563
TOTFIX	1	39	7,884,016	7,901,597	1,265,268
	0	7	6,585,994	5,593,585	2,114,176
TOTREV	1	39	21,734,235	9,021,570	1,444,607
	0	7	17,356,216	8,679,356	3,280,488

Definition of Variables:

Days = days fishing per year (utilisation rate)

CPUE = kg per day fishing (catch rate)

PRICE = lira per kg (price of fish)

TOTRUN = lira per boat (total running costs)

TOTLAB = lira per boat (total labour costs)

TOTFIX = lira per boat (total fixed costs)

TOTREV = lira per boat (total sales revenue)

Table 3.2.4: Independent samples t-test of the differences in group averages of the performance of trammel netters based inside and outside the trawl ban area

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Interval Difference	Confidence of the
									Lower	Upper
DAYS	Equal variances assumed	.236	.630	2.557	44	.014	40.92	16.00	8.66	73.17
	Equal variances not assumed			3.521	12.367	.004	40.92	11.62	15.68	66.15
CPUE	Equal variances assumed	1.872	.178	.645	44	.522	.86963	1.34797	-1.84703	3.58629
	Equal variances not assumed			.907	12.842	.381	.86963	.95902	-1.20479	2.94405
PRICE	Equal variances assumed	.290	.593	-.009	44	.993	-30.65	3,370.29	-6,823.03	6,761.72
	Equal variances not assumed			-.017	26.320	.987	-30.65	1,835.27	-3,800.87	3,739.57
TOTAL UN	Equal variances	.245	.623	-4.177	44	.000	-1,406,760	336,816	-2,085,569	-727,951

	assumed									
	Equal variances not assumed			- 4.258	8.442	.002	-1,406,760	330,364	-2,161,695	-651,825
TOTL AB	Equal variances assumed	14.568	.000	1.750	44	.087	2,987,752	1,707,046	-452,573	6,428,077
	Equal variances not assumed			4.001	42.91 4	.000	2,987,752	746,839	1,481,520	4,493,983
TOTF IX	Equal variances assumed	.035	.853	.415	44	.680	1,298,022	3,131,223	-5,012,543	7,608,587
	Equal variances not assumed			.527	10.84 8	.609	1,298,022	2,463,868	-4,134,204	6,730,248
TOTR EV	Equal variances assumed	.489	.488	1.188	44	.241	4,378,018	3,684,382	-3,047,365	11,803,40 2
	Equal variances not assumed			1.221	8.502	.255	4,378,018	3,584,480	-3,803,590	12,559,62 7

Table 3.2.5: Comparative stock abundance inside and outside the trawl ban area

Date	Inside			Outside			% difference
	CPUE (kg/haul)	S.D. (kg/haul)	C.V	CPUE (kg/haul)	S.D. (kg/haul)	C.V	
Spring 1994	32.52	21.00	0.6	25.53	14.01	0.5	+ 27.3
Summer 1994	34.33	19.31	0.6	23.24	16.66	0.7	+ 20.5
Autumn 1994	33.82	21.04	0.6	24.39	20.92	0.9	+ 38.6
Winter 1994	45.16	31.42	0.7	29.88	23.62	0.8	+ 51.2
Spring 1998	39.09	22.50	0.6	26.31	18.26	0.7	+ 41.3
Summer 1998	54.93	33.77	0.6	37.40	28.71	0.8	+ 46.9
Autumn 1998	59.74	31.63	0.5	35.00	15.45	0.4	+ 70.7
Winter 1998	33.14	27.03	0.8	11.70	3.34	0.3	+ 183.2
<i>Source: based on experimental trawl surveys</i>							

Table 3.2.6: Correlation matrix describing the degree of association between catch per day (CPUE) of trammel netters and their financial performance

--- PARTIAL CORRELATION COEFFICIENTS ---

Controlling for.. PRICE DAYS TOTCOST

	NETREV	VALUEADD	BOATINC	CPUE
NETREV	1.0000	.9131	.9945	.8977
	(0)	(41)	(41)	(41)

	P=	P=.000	P=.000	P=.000
VALUEADD	.9131	1.000	.9173	.8353
	(41)	(0)	(41)	(41)
	P=.000	P=	P=.000	P=.000
BOATINC	.9945	.9173	1.000	.9030
	(41)	(41)	(0)	(41)
	P=.000	P=.000	P=	P=.000
CPUE	.8977	.8353	.9030	1.000
	(41)	(41)	(41)	(0)
	P=.000	P=.000	P=.000	P=

(Coefficient / (D.F.) / 2-tailed Significance)

" . " is printed if a coefficient cannot be computed

Table 3.2.7: Correlation matrix describing the degree of association between vessel utilisation rate (days) of trammel netters and their financial performance

--- PARTIAL CORRELATION COEFFICIENTS ---

Controlling for.. PRICE CPUE TOTCOST

	NETREV	VALUEADD	BOATING	CPUE
NETREV	1.000	.7776	.9846	.7053
	(0)	(41)	(41)	(41)
	P=	P=.000	P=.000	P=.000
VALUEADD	.7776	1.000	.7881	.5266
	(41)	(0)	(41)	(41)
	P=.000	P=	P=.000	P=.000
BOATING	.9864	.7881	1.000	.5266
	(41)	(41)	(0)	(41)
	P=.000	P=.000	P=	P=.000
DAYS	.7053	.5266	.6841	1.000
	(41)	(41)	(41)	(0)
	P=.000	P=.000	P=.000	P=

(Coefficient / (D.F.) / 2-tailed Significance)

" is printed if a coefficient cannot be computed

Table 3.2.8 Sensitivity analysis of capital investment in trammel net fishing based on the performance of skipper-only vessels in 1998/99

Parameter	Units	Base values	Sensitivity indicator (%)
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Price	Lira per kg	15,912	2.35
Utilisation rate	Days fishing per year	224	2.19
Catch rate	Kg per day fishing	6.354	2.35
Running costs	Lira per day fishing	6,811	-0.16
Repairs	Lira per boat per year	1,001,363	-0.10
Tax	Lira per boat per year	1,757,403	-0.18
Other fixed costs	Lira per boat per year	805,909	-0.08
Vessel	Lira per boat	26,000,000	-0.24
Engine	Lira per boat	15,000,000	-0.21
Headline etc.	Lira per boat	1,500,000	-0.04
Net	Lira per boat	3,000,000	-0.34

Note: The NPV in the base case was 110,509,030 lira. The sensitivity indicator shows the percentage change in NPV as a consequence of a 1% change in any given parameter from its base level, assuming all parameters remain unchanged.

Table 3.2.9 Characteristics and performance of artisanal vessels in the Gulf of Castellammare compared with Sicily as a whole, 1998

Parameter	Units	Gulf of Castellammare		All Sicily	
		Mean	No. of vessels	Mean	No. of vessels
Vessel length	Metres	5.81	96	6.80	3029
Vessel capacity	Tonnes	1.91	96	2.86	3029
Engine power	KW	14.88	96	22.44	3029
Vessel age	Years	21	96	24	3029
Fishermen per vessel	Number	1.41	46	2.58	3029
Vessel utilisation rate	Days	203	46	159	3029

Value of fish per kg	Lira	15,711	46	8,303	3029
Variable cost per kg	Lira	1,436	46	1,474	3029
Fixed cost per kg	Lira	5,732	46	438	3029
Operating cost per kg	Lira	7,168	46	1,912	3029
Value added per kg	Lira	8,543	46	6,391	3029
Value added per man	Mill. lira	8.11	46	27.55	3029

Figure 3.2.1

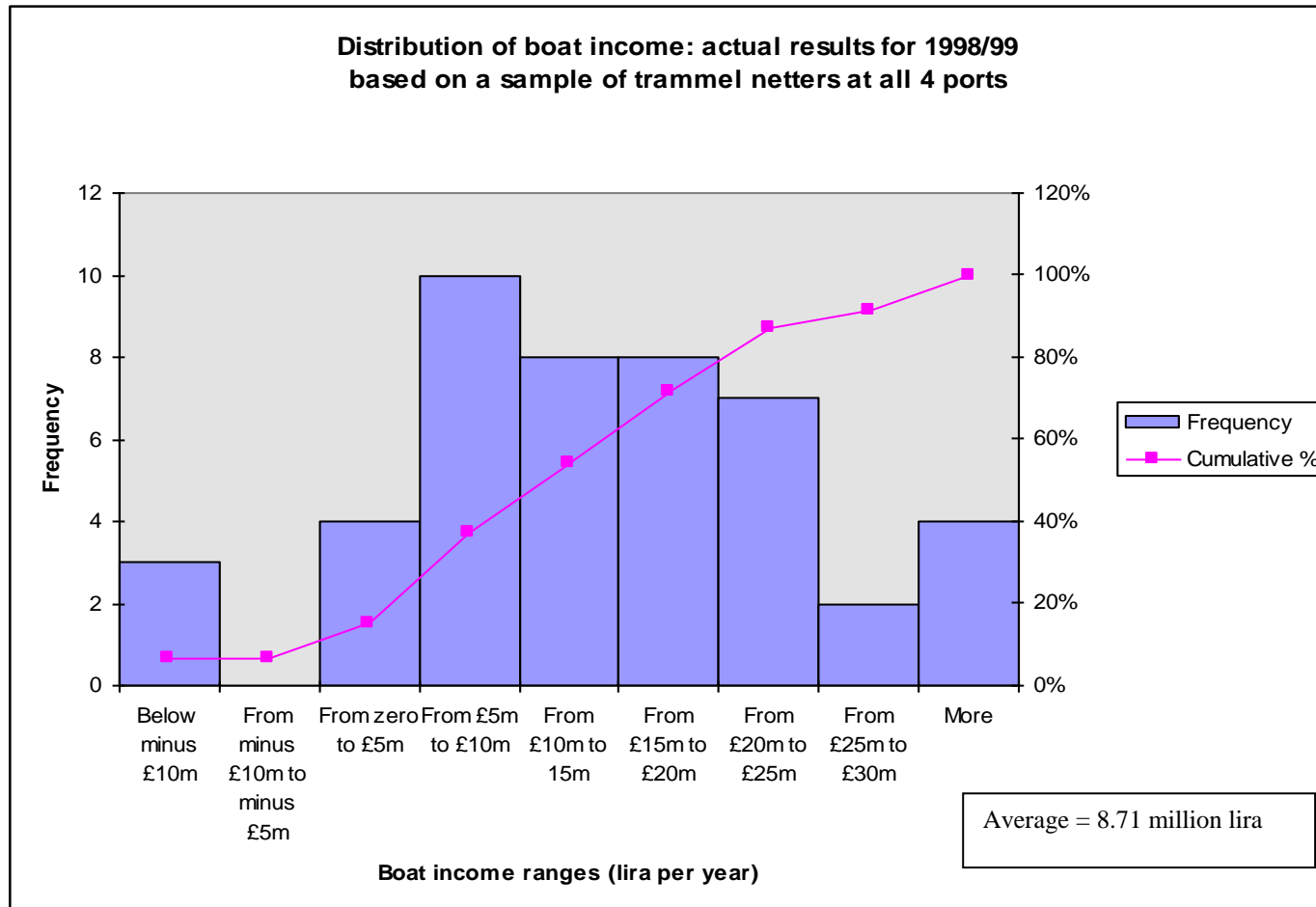


Figure 3.2.2

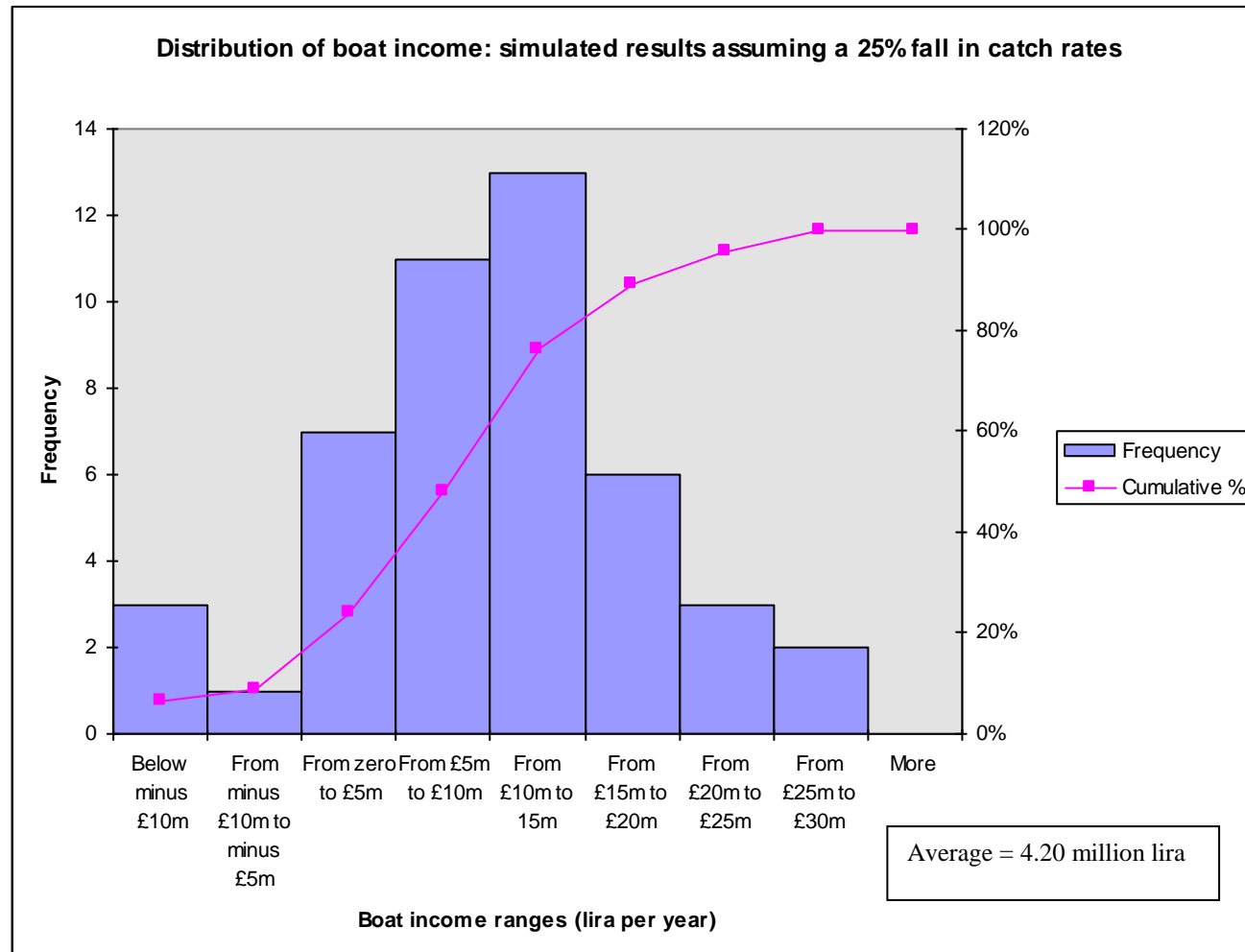


Figure 3.2.3

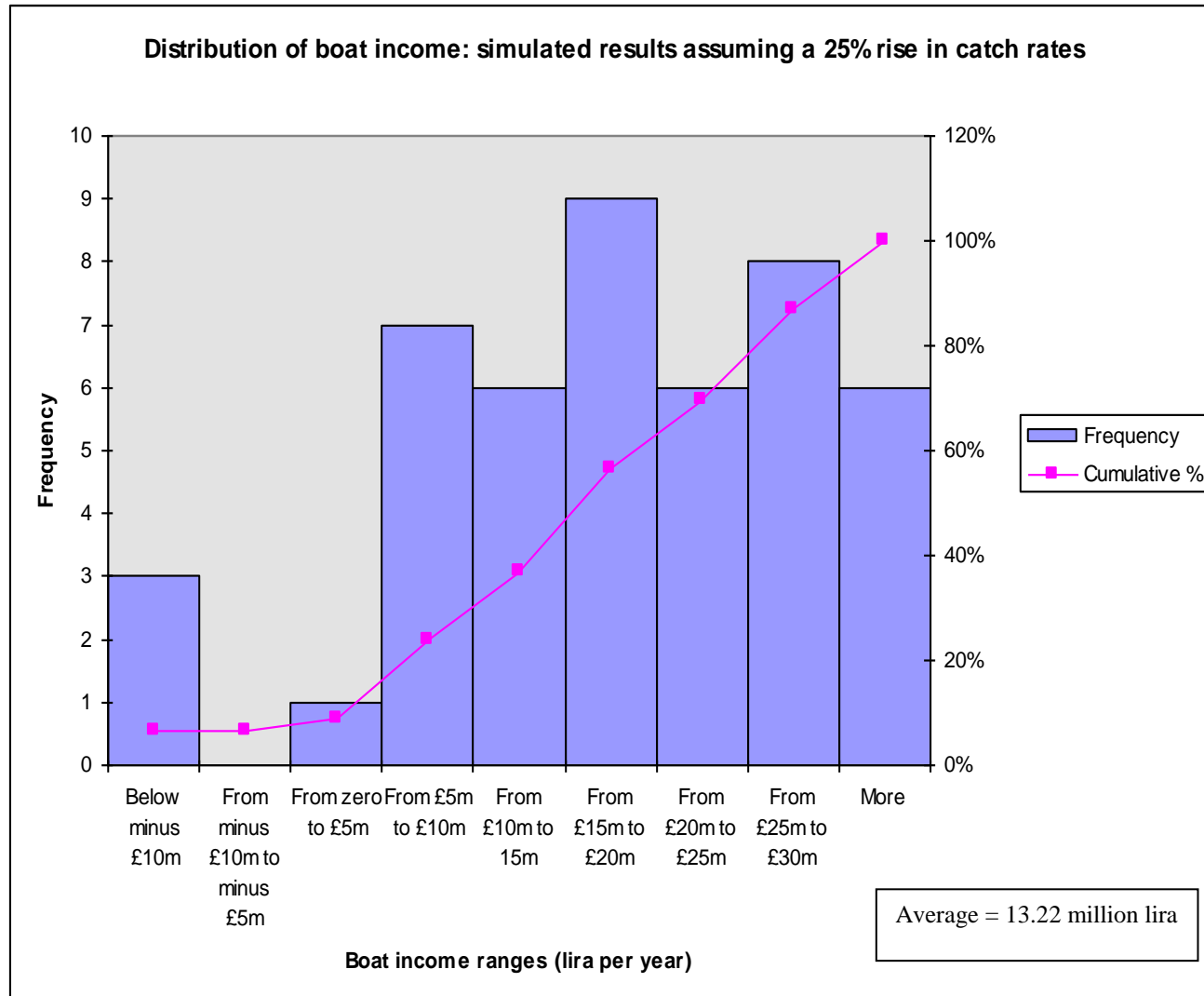


Figure 3.2.4

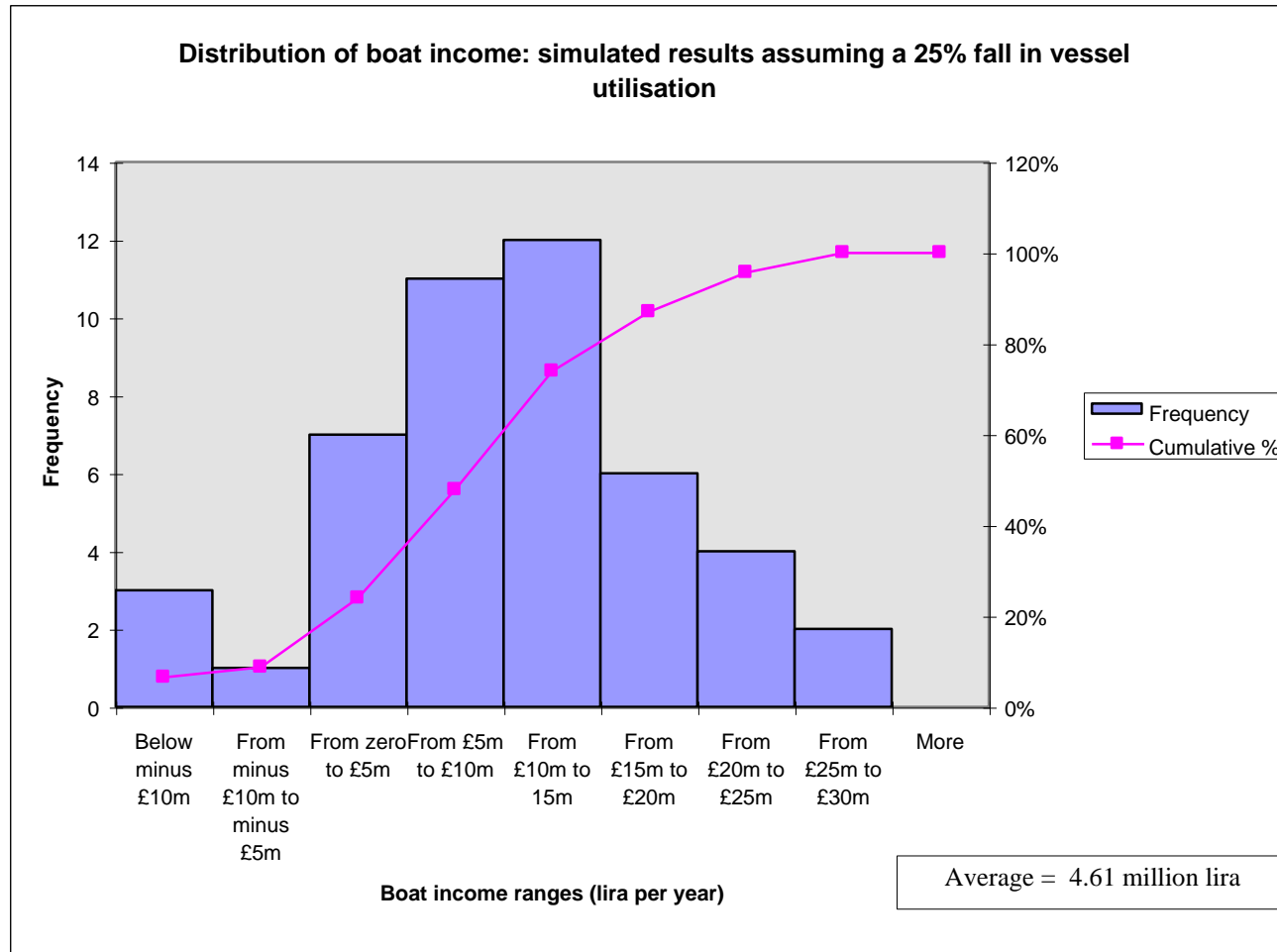
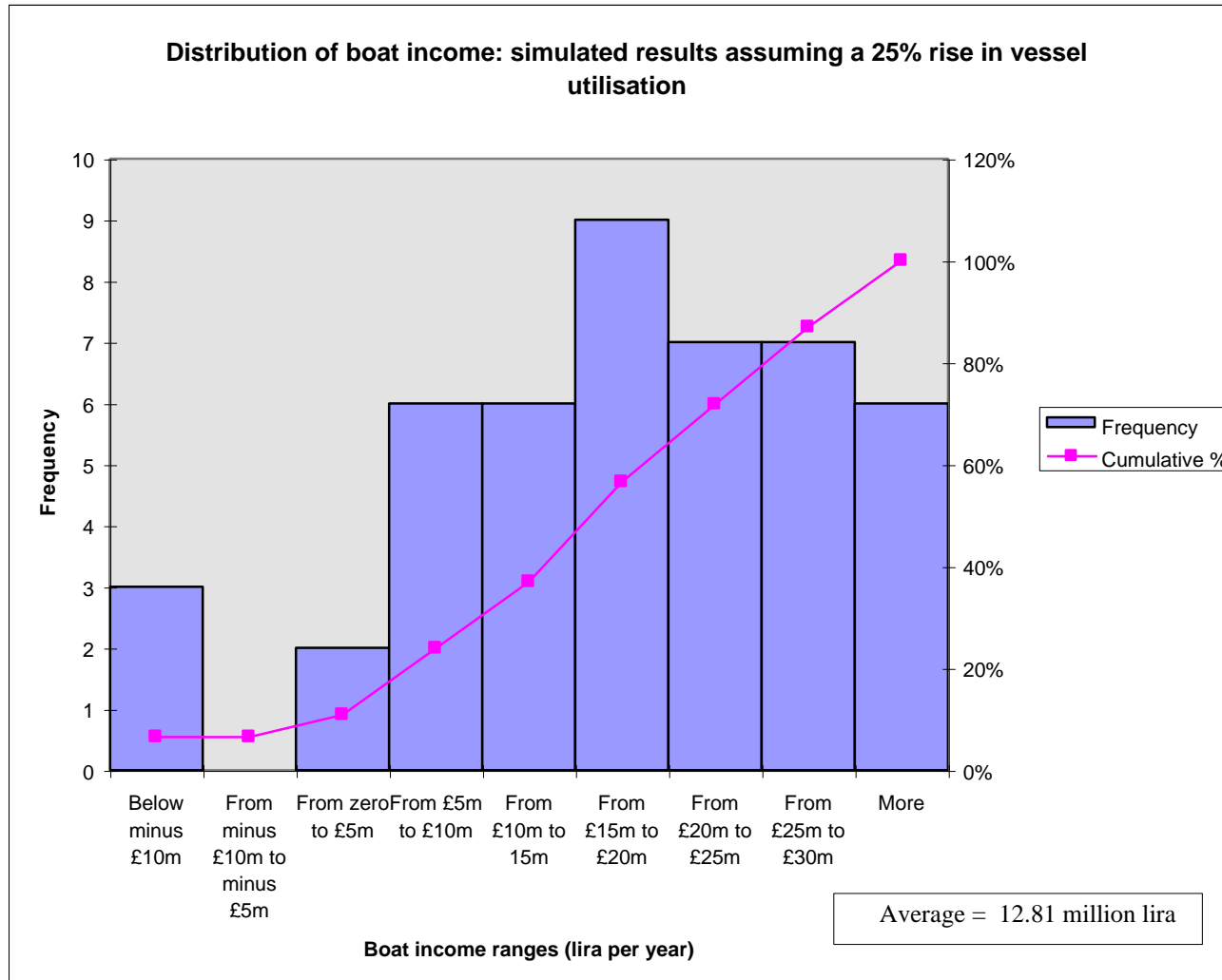


Figure 3.2.5



Financial performance of trammel net fishing in the Gulf of Castellammare, Sicily: effect of varying catch rate on annual revenue and income

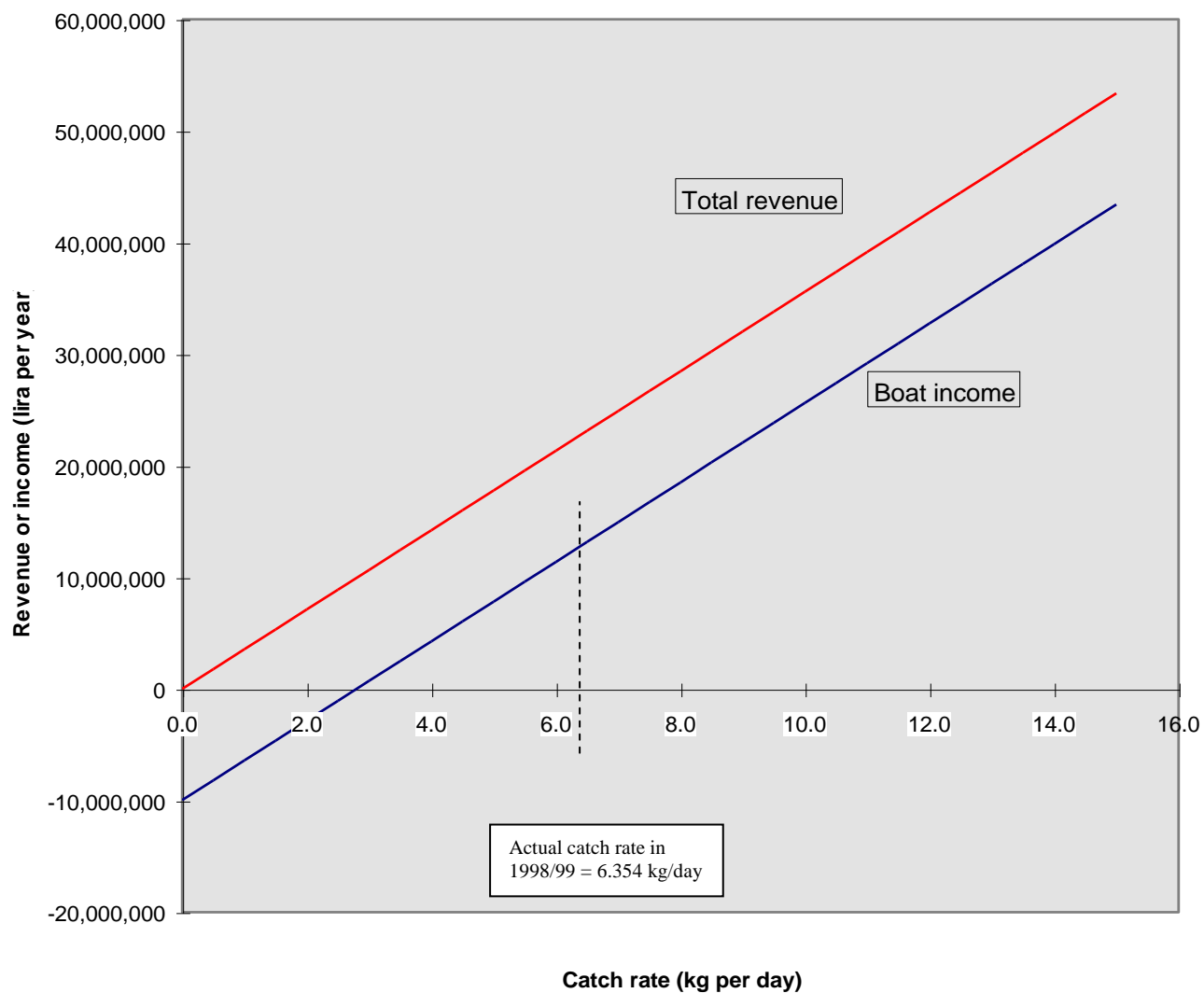


Figure 3.2.7

**Financial performance of trammel net fishing in the Gulf of Castellammare,
Sicily: effect of varying vessel utilisation rate on annual revenue and
income**

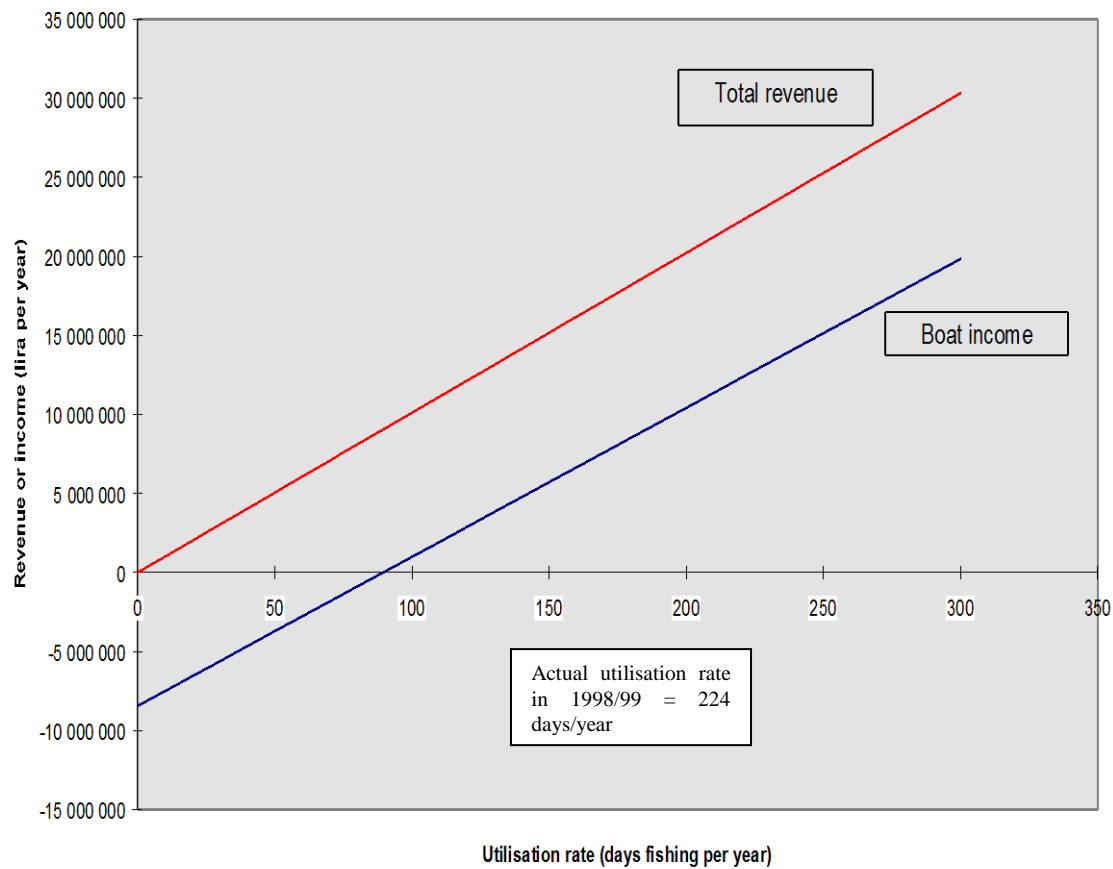
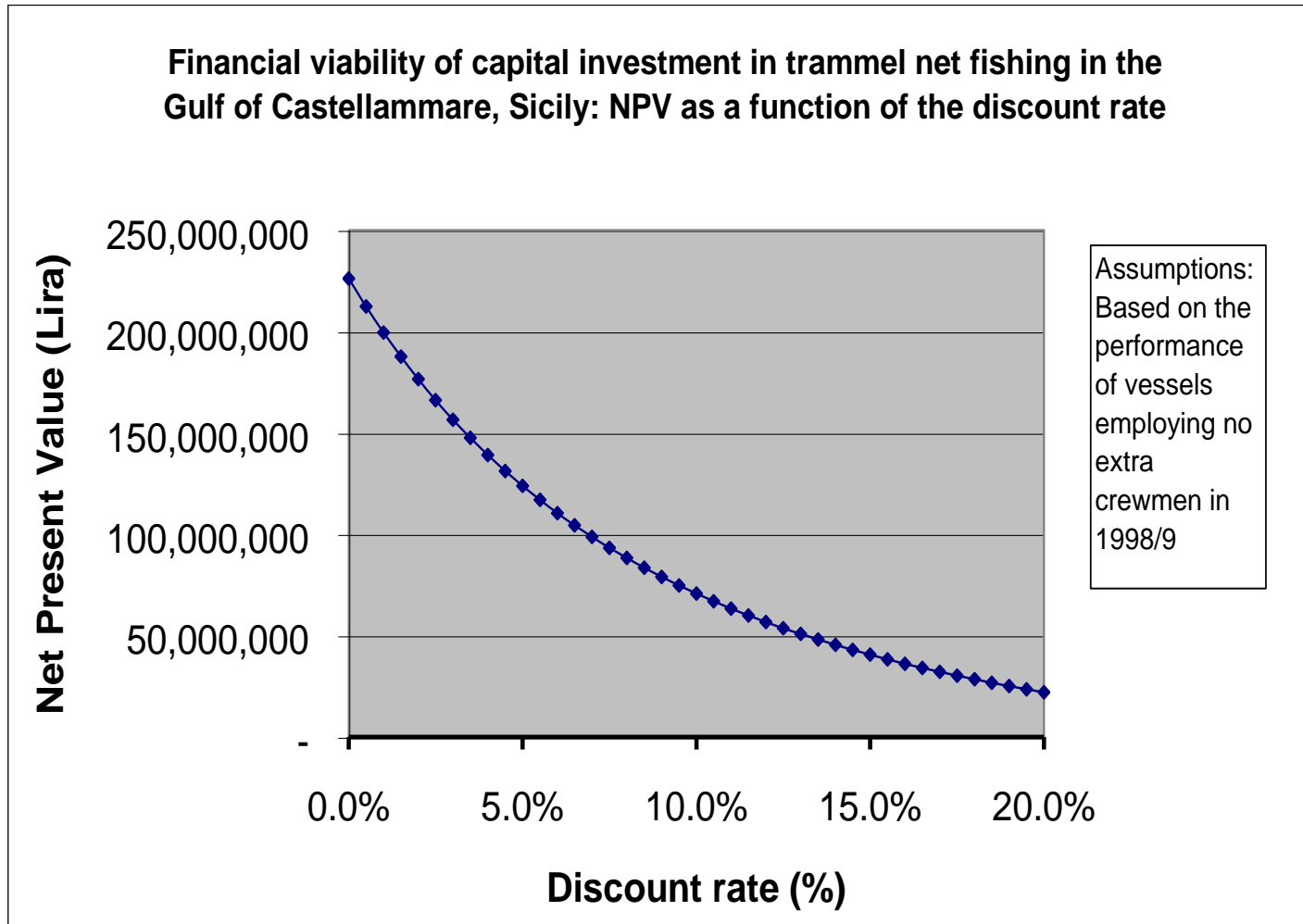


Figure 3.2.8



4 FISHERMEN'S ATTITUDES AND MOTIVATION

A survey was carried out during July 1999 in the Gulf to determine the effects of the trawling ban from the perspectives of the fishermen themselves. The results of the survey have been used to corroborate the results of the biological sampling and landing surveys.

The aim of the Motivation survey was to ascertain the opinion of the fishermen, concerning the current state of the Gulf fisheries, the usefulness of the trawling ban as a management tool and to ask questions with regard to their views on the future prospects for fishing in the area.

From the survey it became possible to build up a picture of the patterns of exploitation and development in the life of the fishermen, and the relationships between fishermen and between the ports of the Gulf. We also asked questions about what issues the fishermen felt were of most importance to themselves. Finally questions were asked about the future of the Gulf fisheries and attitudes to certain hypothetical scenarios that were put forward with regards to potential changes in the Gulf.

A copy of the questionnaire can be found in Appendix

4.1 Historical information

Questions 1 through to 7 were used to determine the physical characteristics of the fishermen their past activities and also to determine the relationships between fishermen in and between the ports of the Gulf.

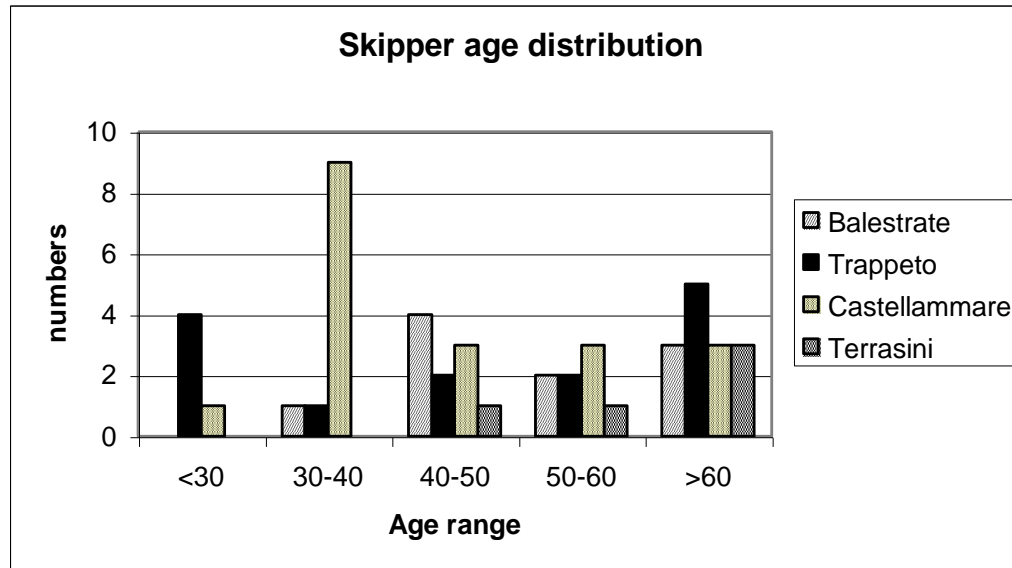
Table 4.1 and Figure 4.1 present information on the age distribution of the fishermen.

Table 4.1 *Average skipper age*

Port	Average age (years)	Highest	Lowest
Terrasini	58.4	69	47
Trappeto	47.3	66	27
Balestrate	50.7	68	21
Castellammare	43.9	62	29

Figure 4.1 *Skipper age distribution between the four ports of the Gulf*

Table 4.2 Skipper age distribution within the ports



Age (years)	Balestrate	Trappeto	Castellammare	Terrasini
<30	0	4	1	0
30-40	1	1	9	0
40-50	4	2	3	1
50-60	2	2	3	1
>60	3	5	3	3

If we look at these age distributions we can see that, although there are no marked differences between the average age of skipper between the ports¹, there are noticeable differences between the distributions.

¹ It should be noted that the figures for Balestrate may be slightly biased due to the fact that there are 4 other fishermen in the port who declined to be interviewed, they are all aged in their mid twenties. This of course would have the effect of decreasing the mean.

In Terrasini, we can see that the majority of active fishermen are over 60 years old with very few below the age of 50. In fact in our sample the youngest was 47, and though a small sample it is representative of the port as a whole which demonstrates an aged population. Anecdotal evidence from interviews suggests that the numbers of artisanal fishermen vessels operating from the port have declined during the past ten years and, that unlike the other ports in the Gulf there have been no new entrants to the fishery from younger generations. It should also be noted that the port has the oldest fisherman at the age of 69.

In Trappeto we see a different situation, whereby there are two distinct pockets of fishermen, one of less than 30 years and one of older than 60 years. The explanation for this comes from the fact that there are several large purse seine vessels operating from the port. The younger fishermen tend to start fishing on the artisanal boats and do that for a few years, then fish the Summer on purse seine vessels and throughout the Winter on artisanal boats. After gaining a certain amount of experience the fishermen tend to move onto the purse seine vessels, where they stay until too old. After leaving the purse seine vessels the older fishermen tend to then re-join the artisanal fleet.

In Balestrate there is an even distribution of ages, although the sample underestimates the youngest age group, the <30-year-olds. During the sampling 4 fishermen declined to respond, all of whom were in their twenties.

In Castellammare we see a surprising result and that is that the majority (47%) of the fishermen fall into the 30 – 40 year age group. There are very few fishermen in the <30 age group and then even distribution in the other age groups. Of the sample 40% had also been fishing in the Gulf for between 10-15 years, indicating that they had returned to Castellammare before the trawl ban was implemented. An explanation for this is given by the fact that almost all fishermen in Castellammare start their working careers on merchant wine vessels operating throughout the Mediterranean. They return to the Gulf ports later, usually after about 10 years, to take up fishing. This point will be discussed in more detail later.

The aim of questions 2 to 5 was to determine when the fishermen started fishing and the path of their fishing activities since they started. All of the fishermen in the Gulf, with only one exception, officially started fishing at the age of 14 when they could legally register as professional artisanal fishermen. However all stated that from a very early age they had accompanied their fathers on fishing trips, typically starting between the ages of 3 and 5, and actively assisted in the fishing operation from about the age of ten years. The one exception was in Castellammare, one fisherman stated that he started fishing at the age of 35, he had previously been a teacher in the town.

It was important to discover the motivation for becoming a fisherman in the first instance, and to this end we asked the respondents to rank according to the criteria in Table 4.3 why they took up fishing. The top 4 responses for each port can be seen in table 4.3.1.

Table 4.3 *Reasons for taking up fishing for an occupation*

Why did you become a fisherman
Father a fisherman
Other Family members in fishing

Inherited boat
No other employment opportunities
Better opportunities in fishing
Moved to Area
Love of fishing

Table 4.3.1 *The four most frequent responses in each port*

	Terrasini	Trappeto	Balestrate	Castellammare
1 st reason	Father a fisherman	Father a fisherman	Father a fisherman	Father a fisherman
2 nd reason	No other employment opportunities	Other Family members in fishing	Other Family members in fishing	Other Family members in fishing
3 rd reason	Other Family members in fishing	Inherited boat	Inherited boat	No other employment opportunities
4 th reason	/	Better opportunities in fishing	Love of fishing	Inherited boat

As can be seen from the above tables, the main motivation for becoming a fisherman comes from the family connection with fishing. In all of the four ports, the prime reason stated was that of Father being a fisherman.

The next most common response was that of other family members in fishing, leading us to assume that is a very family oriented industry. In fact whilst conducting interviews it became apparent that most of the fishermen within a port are related to one another in some way. This fact may well have implications when looking at the potential to expand the fishery with new unrelated entrants.

The one port where this was not the case was Terrasini, since here the second most important reason for becoming a fisherman was due to a lack of alternative employment. This is very true throughout the Gulf region, where fishing and farming are the primary employers, and where the only other possible sector would be that of retail, an area which now appears to be manpower saturated. It is possible that this factor is masked in the other ports due to the strong family pressure to join the fishery, and it is highly likely that if the young men looked elsewhere for employment that it would be difficult to obtain.

When we look at the third ranked reason we can see that the employment factor is apparent in Castellammare and that 'other family' features in Terrasini, an interesting finding in both Trappeto and Balestrate is that the fishermen inherited a boat. This strengthens the case for the explanation that the fishermen are, to a certain extent, pushed into fishing through family pressure.

When we examine other reasons for taking up fishing as a profession we see that in both Castellammare and Balestrate 'passion for the sea' was expressed by nearly half of the respondents. In the ports of Trappeto and Terrasini, however, no such passion was expressed. Once again these results could be interesting from a management perspective.

Question 3 examined how long the fishermen had been active in the Gulf, while question 4 and 4a examined whether this had been continuous or whether there had been a break for any reason.

Table 4.4 shows the percentage of fishermen at each port according to the length of time that the fishermen have been actively fishing in the Gulf .

Table 4.4 *Years of active fishing in the Gulf*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
<5	0%	0%	0%	5%	2%
5-10	20%	43%	30%	10%	24%
10-15	0%	29%	40%	40%	34%
15-20	20%	14%	10%	20%	16%
20-30	40%	14%	10%	15%	16%
>30	20%	0%	10%	10%	8%

As can be seen in table 4.4, the majority of fishermen have been active in the Gulf of Castellammare for more than ten years, 80 % in Terrasini, 57% in Trappeto, 70% in Balestrate and 85 % in Castellammare. Overall 74% of the artisanal fishermen in the Gulf have been active for greater than 10 years. This may give some indication as to how much of an effect the trawl ban has had on encouraging fishermen to return to the Gulf. It is interesting to note that in only one port that there are fishermen who have been active for less that 5 years. There are however, significant percentages of fishermen in all ports, except Castellammare, that have been active for between five and ten years.

In order to establish whether this movement to the fishery was due to the trawling ban giving better prospects we asked the fishermen why they had left the Gulf and why they had then returned. As was stated previously almost all fishermen (70% of the sample) in the Gulf leave at some time to work on merchant vessels, or to work on purse seine vessels elsewhere in the Mediterranean. The most common destination being Tuscany, and in particular the Port of Veragio or the island of Elbe. Other destinations include Sardinia and Tunisia. Table 4.5 shows the responses achieved in each port.

Table 4.5 *Alternate employment undertaken by the artisanal fishermen prior to returning to the Gulf*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Purse seines in Tuscany	3	8	8	2	21
Engineer in Germany	2	2	5	0	9
Merchant vessels and Tank ships	3	0	0	9	12
America	0	2	0	2	4
Other Mediterranean purse seine	0	0	0	1	1
Stayed in Gulf	2	1	2	6	11
Average Duration of absence (years)	11	20	17	9	14.25

It can be seen from the table that only in Castellammare do a significant number of fishermen stay at home and fish only in the Gulf. Even here, however, there is a strong tradition of working away for a period of time, the average duration of which is 9 years. It is interesting to see the average periods of absence from the Gulf. In Trappeto and Balestrate the fishermen tended to be away for the whole period, moving from Sicily to Tuscany and then onto Germany before moving back to Sicily. In both Castellammare and Terrasini, however, the fishermen tended to go away for relatively short periods, of between 1 and 7 years, return home, stay for maybe 5 or so years and then leave again.

Most of the fishermen interviewed left during, the mid to late 1960's through to the late 1970's and early 1980's, returning in the mid to late 1980's. The period between the late 1950's to the early 1980's is well recognised as a particularly difficult time for rural Sicily. The absence of fishermen in the 20 to 30 year old age group, prevented us from ascertaining whether the activity was restricted to the older fishermen in the Gulf. Anecdotal evidence does, however, suggest that the younger fishermen still leave the Gulf to work on merchant vessels or to live abroad for some period, and that the activity plays a crucial role in their training.

Question 4a asked why the fishermen returned to Sicily. Overwhelmingly one factor stood out as the driving factor in the fishermen's decision to return. 56% of the sample stated that they returned for family reasons, or to be closer to their family, (if we add to these, those who returned for ill health, 73% of the sample have been accounted for already). Of the remainder, 2 fishermen in Trappeto stated that they returned due to low incomes as crew on purse seine vessels and that the biological rest payments meant they could equal earnings, but work less hard and be nearer their families. Three fishermen in Castellammare stated that they had enough money to buy their own artisanal boats, 1 was tired of sailing and 1 hoped for better opportunities. Only one fisherman, in Balestrate, cited the trawl ban as being influential in his decision to return to the Gulf.

Finally we have determined the relationships between the fishermen within and between the ports of the Gulf. Of the entire sample only 9 fishermen said that they had no other relatives in fishing, 4 in Trappeto, 3 in Castellammare and 2 in Balestrate. With the exception of Castellammare the age of these fishermen was between 59 and 68 years. Castellammare presents us with something of an anomaly in that the ages of the fishermen are between 30 and 38 years. Of these only one stated that his father was a fisherman, one had other family members in fishing, but his father was not, and the third inherited his boat.

By far the most common relationship between the fishermen was that of brothers. Most commonly they fish in the same port. Cousins were also very common, indicating that older brothers had fished together also. There were very few instances where cousins fished in different ports within the Gulf, instead most were operating from the same port. In Castellammare 5 fishermen said they had relatives fishing in 'other Gulf' ports, the only other was in Terrasini. There were 9 fishermen in the Gulf who had relatives fishing overseas, 7 were fishing in Tuscany, 1 in the Adriatic Sea and 1 in the United States of America.

4.2 The current situation

Given that it would appear that the trawl ban did not encourage any of the existing fishermen, except one, to join the fishery, the following section was aimed at determining the existing fishermen's attitudes to the trawl ban, and appraise the current fishing climate within the Gulf. Within this context we questioned the fishermen as to what the biggest problems are that they face in the fishery. We also investigated gear replacement times and general fishing practices, however, these have been covered in previous sections of the report.

The first and probably the most straightforward question(No. 10) asked the fishermen to rank how their fishing had been since the trawling ban according to the responses in the table below.

Table 4.6 Responses to question 10 ranked on a scale of 1 to 5

Response	Score
Much Better	5
Better	4
Same	3
Worse	2
Much Worse	1

The results can be seen in Table 4.6.1

Table 4.6.1 Fishermen's perception of fishing conditions in the Gulf since the Trawl ban

Response	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Much Better	0%	21%	40%	20%	23%
Better	0%	71%	50%	65%	58%
Same	0%	0%	10%	10%	6%
Worse	80%	8%	0%	5%	12%

Much Worse	20%	0%	0%	0%	1%
------------	-----	----	----	----	----

Overall 87.5% of fishermen thought that fishing since the ban is at least the same as it was before the ban, 81.25% consider the fishing to be better than before the trawl ban, and 23% consider the fishing to be much better since the trawl ban. There were, however, 12.5% of fishermen, including all the fishermen from Terrasini, that thought the fishing had deteriorated since the trawl ban was introduced. We can corroborate this data with the financial returns presented in part 3, where we can see that those fishermen performing well tend to be predominantly in Balestrate. The results above also recognise other 'highliners' operating in Trappeto and Castellammare, compared to Terrasini that shows the lowest average return to the fishermen.

On the whole then we can see that there is a considerable feeling of well being with regards to the fisheries of the Gulf. Question 11 then asked specifically if the fishermen thought that the changes in the fishery were due to the trawl ban alone. The responses are shown in table 4.7.

Table 4.7 *Are the changes to the fisheries of the Gulf due to the trawl ban?*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
YES	100%	93%	90%	80%	90%
NO	0%	7%	10%	20%	10%

As can be seen from the above table, 90% of all fishermen thought that the changes (both for the better and the worse) were due directly to the trawl ban. Where fishermen rejected the idea of change due to the trawl ban we asked what they thought the likely cause was. The responses mainly focused on increased pollution in the Gulf causing depletion of certain species. Gear innovation was highlighted as contributing to the increase in catches as well.

Question 12 investigated the fishermen's perceptions of the number of other fishers in the Gulf, which given the very limited amount of travel between the ports is an interesting issue. Once again the fishermen were asked to rank according to the table below, whether they thought that there were more or less professional artisanal fishermen in the Gulf now, than there were prior to the trawl ban.

Table 4.8

Response	Score
Many More	5
More	4
Same	3

Less	2
Many Less	1

The responses can be seen below.

Table 4.8.1 Fishermen's perception of the number of fishermen in the Gulf, compared to the pre – ban situation.

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Many More	0%*	0%	10%	15%	8%
More	60%	43%	30%	70%	54%
Same	0%	7%	40%	15%	16%
Less	40%	50%	20%	0%	22%
Many Less	0%	0%	0%	0%	0%

* percentage of fishermen in each port giving this response

We can see that 78% of the fishermen in the Gulf think that there are at least as many professional artisanal fishermen in the Gulf today as there were before the trawl ban, 62% think that there are more and 8% think there are many more. It is interesting to note, though, that nearly a quarter (22%) of the fishermen interviewed think that there are less artisanal fishermen now than were operating before the trawl ban, while nobody thought that there were many less.

Given that the general consensus is that there are more fishermen in the Gulf now, it is surprising that there is not more conflict. Indeed we found that when asked if the extra fishermen caused problems, 100 % of the fishermen in the ports of Balestrate, Trappeto and Terrasini and 25% of fishermen in Castellammare stated that there were no problems.

However, the 75% of respondents in Castellammare that said there were problems highlighted the main problem area as one of competition for space on the fishing grounds. The majority of these fishermen pointed out that the placement of the artificial reefs was on traditional fishing grounds that were now out of bounds. Also due to the positioning of Castellammare at the Western end of the Gulf the fishermen are constrained by the Zingaro national parks' boundaries. To a certain extent this reaction may have been more to do with the expansion of recreational fishing rather than the expansion in numbers of artisanal professional fishermen, more will be said on this point later. Of particular importance were the responses indicating that prices had fallen in recent years. Most fishermen attribute this to the closure of the fish market in Castellammare. The market closed in 1994 and since this time almost all fish is sold either privately or via two or three wholesalers who buy on the quayside. The fishermen feel that their competitive edge has been lost and now they are at the mercy of a few wholesalers, also they compete directly with the recreational fishers that illegally sell their fish to the restaurants and hotels.

To follow this question it was put to the fishermen to describe and rank those issues that they felt to be of most importance to their fishing activities in the Gulf. The pilot survey identified a number of probable responses and with few exceptions most fishermen answered in relation to these. The table below shows the issues that were identified as being key during the pilot survey.

Table 4.9 the most important issues identified for the artisanal fishermen in the Gulf

Fishing policy and management
Political Representation
Enforcement
Waste water and Pollution
Decreased fish stocks
Market structure
Co-operative
Port facilities
Illegal trawling
Conflict artisanal / trawlers
Recreational Fishers

Table 4.9.1 *The most important issues to the Artisanal fishermen in the Gulf*

	Terrasini		Trappeto		Balestrate		Castellammare		Overall
	Total Score	RANK	Total Score	RANK	Total Score	RANK	Total Score	RANK	Rank
Fishing policy and management	7	3	7	8	4	8	22	6	
Political Representation	0	0	5	9	3	9	1	11	
Enforcement	4	5	32	2	16	5	12	7	5
Waste water and Pollution	4	5	21	5	5	7	36	4	
Decreased fish stocks	5	4	0	0	0	0	5	8	

Market structure	0	0	8	7	22	4	50	3	4
Co-operative	0	0	1	11	1	0	0	0	
Port facilities	0	0	22	4	23	3	74	1	3
Illegal trawling	10	2	27	3	34	1	32	5	2
Conflict artisanal trawlers	7	3	4	10	9	6	3	10	
Recreational Fishers	21	1	58	1	25	2	70	2	1
Other	0	0	10	6	0	0	5	8	

Table 4.9.2 *The five most important issues to the fishermen in the different ports in the Gulf*

	Terrasini		Trappeto		Balestrate		Castellammare		
	Total Score	RANK	Total Score	RANK	Total Score	RANK	Total Score	RANK	
Recreational Fishers	21	1	58	1	25	2	70	2	
Port facilities			22	4	23	3	74	1	
Illegal trawling	10	2	27	3	34	1	32	5	
Enforcement			32	2	16	5			
Market structure					22	4	50	3	
Fishing policy and management	7	3							
Waste water and Pollution	4	5	21	5				36	4
Decreased fish stocks	5	4							

The fishermen were asked to score, 1 to 5, the problems that were most important to them, 5 being most important and 1 being the least important. Following from that, the scores have been summed to give us a total score for each issue. We have been able to determine from this, for each port the most pressing issues. The results have been ranked from 1 to 11, with 1 carrying the most weight through to 11 for those issues that had very small responses. The difference between the total scores in the different ports is a reflection of the different sample sizes. However the ranking has taken account of this.

Table 4.9.2 represents the five most important issues only, in each of the ports. It is fairly obvious that there is one issue that presents itself as probably the most important issue in the Gulf, and that is recreational fishing. This issue scored as the main problem in both Trappeto and Terrasini and as the second biggest problem in both Balestrate and Castellammare.

Recreational fishing in the Gulf

There are currently more than one thousand recreational boats operating in the Gulf, which predominantly operate during the Summer months, usually from about April to the end of September. However, there are a small number that operate throughout the Winter as well.

The problem of recreational fishing in the Gulf is something of a recent occurrence, and up until about 5 years ago there were very few recreational boats. However, lifestyle changes have meant that more people are travelling from main centres, such as Palermo, to holiday homes in coastal regions such as the Gulf towns. There are holiday homes situated all along the Gulf coast, from Punta Raisi in the east to Scopello at the edge of the Zingaro nature reserve in the western Gulf. At the very western tip of the Gulf San Vito lo Capo is situated which is the main tourist town in the area. The majority of these homes have weekend and Summer holiday use, being less than 1 hour's drive from Palermo. Although not quantified, anecdotal evidence suggests that almost all of these houses have a boat, and the majority of people with a boat will partake in some form of fishing activity.

Recreational sea fishing in and around Sicily (and indeed all Italy) is bound and regulated by several Acts and Articles of both National and Regional legislation (see Appendix 2). The legislation relates mainly to gear and vessel restrictions, bag limits and after catch processing and disposal restrictions. However, there is no requirement for a licence to fish or to record catches or on the amount of effort that may be asserted (i.e. in limits to the total number of vessels).

As can be seen, the number of recreational vessels far outnumbers the professional artisanal fleet in the Gulf by more than 14 times. Obviously this will have an impact on the catches of the artisanal fleet, and in fact all fishermen stated that the Summer was the worst time of year for catches and the period when they struggled most.

The law states that recreational vessels must use not more than 200 metres of trammel / gill net at any one time, and indeed recreational fishers are bound by the same gear restrictions for squid jigging as the professional fishermen and that it is illegal for recreational fishermen to sell their catch. (see Appendix 2). Despite these restrictions, however, the sheer number of recreational craft clearly pose a problem to professional operations.

To re-cap, the artisanal vessels are all wooden hulled, open deck vessels of approximately 6.9m average length with an engine size of approximately 20 Hp. The recreational vessels on the other hand tend on the whole to be fibre-glass hulled and have varying engine sizes, many of which have single or twin outboard motors in excess of 75 Hp. These vessels then are much quicker and lighter than the artisanal ones. As for gear use, because the recreational fishery is unregulated most tend to use the same gear as the professional fishermen. Recreational fishermen can often be seen using long line gear several hundreds of metres in length and carrying several thousand hooks. With regards to the fishing of squids, which forms a substantial portion of the Summer revenues for the artisanal fishermen, some recreational fishermen are known to use flashing jigs (incorporating a battery operated flashing light) that are outlawed in Sicily.

The recreational vessels in most cases tend to be more technically sophisticated than the artisanal vessels, sporting an array of electronic fish finding equipment and having up to date hauling gear which is often missing on all but the most advanced artisanal boat.

It is interesting to note that the Summer peak recreational fishery coincides with the period of greatest gear losses for the artisanal fishermen. Many of the survey respondents quoted times when nets and gear had gone missing throughout, predominantly, the Summer when weather conditions were good and losses should have been minimal. The anecdotal evidence suggests that the recreational will lift nets if they find them at sea¹. The cost to fishermen of this action can be several million Lira with a complete trammel net of 1800 metres costing approximately 3,000,000 L, which in most cases represents more than ten percent of the annual Total Sales Revenue for the fishing operations.

One very important issue and probably one of the main ones related to recreational fishermen, is that of selling their catch. Obviously, using the gear that they are, the recreational fishermen are, in some cases landing substantial catches, at least equal to, and often larger than the artisanal fishermen's. It is common to see recreational fishermen calling on hotels after a day's fishing trying to sell their catch, and in most cases they are successful. The prices that the fish is sold at is lower than that which the hotels could buy it for from the retailers or wholesalers, and therefore there is a knock on effect that causes prices to fall for the artisanal fishermen. Question 7 of the survey addressed this issue and 73% of the fishermen in the Gulf said that prices were lower, which coincides with the period when the artisanal fishermen say that the fishing is the worst.

Pollution

Although not a major concern, pollution features in the top 5 problems in Terrasini, Trappeto and Castellammare. Several fishermen attribute this, in part, to the growing amounts of rubbish that are disposed of at sea by the recreational fishermen. During the Summer months litter washes up on the beaches constantly, it is mainly comprised of plastics, plastic bags and waste items.

Other forms of pollution that have been a problem are the tannin run off water from the wine producers and alcohol distilleries (the Gulf region is one of the main producers of pure alcohol in Europe). Both of these have had adverse effects on the fish production in the Gulf in the past, though recently, the production in the region has fallen and become cleaner, thus reducing the environmental impact.

In addition to these physical pollutants there also appears to be confusion with the fishermen with regards to what is anthropogenic pollution and what is not. One of the major complaints regarding this issue is that nowadays the fishermen see that the sea floor is 'unhealthy' and often the nets are hauled with black sludge coating the footropes where they have been buried in the sediments. This is a recent condition in the sea floor sediments that has only occurred since the trawl ban was implemented. The fishermen claim that these anoxic sediments deter fish from feeding and they stay away from the area.

In actual fact the sea floor structure is now typical of one that is undisturbed. Whilst there was constant trawler action the upper surface of the sea floor sediments were constantly being turned over and mixed, which led to a thorough and even distribution of oxygen well down into the sediment. Normally in an undisturbed environment there will only be very limited mixing of the upper surface sediments. In fact under normal conditions oxygen rich sediments will only be found down to about a depth of 100mm, which is greatly increased by any action that frequently stirs the upper levels. Below 100mm anoxia occurs as bacteria break down organic matter, thus causing the black sludge.

¹ Each artisanal fisherman marks his own nets on the buoys so that all other fishermen know who's they are, also the relationships between the professional fishermen are such that it is highly unlikely that one would lift another's nets.

Accordingly, what the fishermen are calling 'pollution' is in fact an indication that the Gulf sea floor is returning to the undisturbed biotype. However, this is not to say that this may necessarily be best for fish production, and in fact there is evidence that the fishermen are correct with their observations that certain species that used to be commonplace are now scarce.

Illegal Trawling

Illegal trawling has been highlighted as the second biggest problem faced by the artisanal fishermen in the Gulf at this time. We can see from table 4.9.1 that it ranks as the biggest single problem for the fishermen of Balestrate, it is ranked 2nd in Terrasini and is a significant problem for the fishermen of Trappeto scoring third. However it is very closely related to the second biggest problem in Trappeto, lack of enforcement, and we can see that there are only 5 points difference between 2nd and 3rd ranked problems.

Illegal trawling is something that is of growing concern in the Gulf. During the early part of the trawl ban the trawlers stayed outside of the banned area, fishing the deeper waters offshore. The trawler activity was fairly strictly controlled and, to a certain extent, there was nothing to be gained by continuing to fish illegally within the Gulf.

The improvements in the Gulf fish stock biomass, as a result of the trawl ban, have been widely announced in the scientific and popular, local press, the trawlers meanwhile continue to fish outside of the fish rich waters. During the past three years the trawlers have started to encroach into the closed area, albeit initially only one or two vessels crossed the boundary during the night. Now, however, artisanal fishermen report that the trawlers blatantly fish within the banned area even during the day sometimes, especially when bad weather makes less likely police controls.

As can be seen from table 4.8.2 the impact of this is felt mainly in the eastern parts of the Gulf between Terrasini to Balestrate². For the fishermen in Castellammare illegal trawling is a minor nuisance, only infrequently affecting their fishing gear.

The problems of illegal trawling are many and varied. In Terrasini, for instance, the main problem is with competition, and all of the fishermen here stated that the concentration of fishing effort in the small area around Terrasini has all but devastated fish stock.

In Trappeto and Balestrate the problems are slightly different. Although still facing the 'competition' aspect, the fishermen here tend to see less of the concentration of effort aspect. Instead their biggest concern is related to gear conflicts, such that it is not unusual for a fisherman in Trappeto to lose an entire trammel net to a trawler, either towed away completely or be so damaged as to be useless and irreparable.

According to sources in Trappeto and Terrasini conflict between the trawlers and the artisanal fishermen has reached such a level that physical violence has occurred.

Lack of Enforcement

Related to illegal trawling is the subject of fisheries enforcement. This ranked fourth and was a feature of responses in all ports. It is apparent that the enforcement issue is not only related to the activity of the trawlers, but also to the recreational and professional artisanal fishermen as well. In addition it was seen as a problem within ports and between the ports of the Gulf.

² The trawlers are unable to work the areas around Balestrate and to the West of Trappeto due to the placement of the artificial reefs. Also they do not fish on the rocky bottoms of the Western part of the Gulf outside Castellammare for fear of losing gear. Also the likelihood of interception would be greater for such a blatant disregard for the trawl ban.

Let us consider the first of these areas: the lack of enforcement of the trawling ban. In all ports the fishermen recognised the fact that currently there is very little enforcement of the ban. In the early days of the ban the coast guard operated 1 surveillance helicopter and several small launches to monitor fishing operations. Gradually the level of surveillance has diminished and currently it is very unusual to see any sort of coast guard vessel patrolling the Gulf. Anecdotal evidence suggests also that when offences are detected there is very little done in the way of prosecution or punishments to act as deterrents.

Several fishermen reported that the fisheries enforcement activities that are undertaken are mis-directed. For instance it is common to see the Finance Police checking sales notes and receipts at the quayside, or the coast guard carrying out safety checks on the artisanal vessels when they are tied up in port. There are seldom checks at sea, and never checks on size limits of the catch or checks on the gear used.

If we consider the next group: the recreational fishermen. As has already been stated, the recreational fishery is largely unregulated, with no active restrictions on fishing methods, catches etc. The professional fishermen's main concern is with the use of illegal gear and the selling of fish at unregulated prices that undermine the local market for fish.

The third problem with enforcement is that concerned with the artisanal fishermen themselves, more specifically with the fish fry fishery that is conducted. There is a legal pelagic species fry (*neonata* – Sicilian name) fishery that operates for four weeks during the month of March. The fish fry are probably one of the most valuable catches that the fishermen land with a value in the region of 35,000 L per kilo. There are no restrictions on the quantities that can be landed, only on the season. The fishermen that prosecute this fishery are predominantly those from Balestrate and Trappeto, whereas by contrast in Castellammare there are only three or four and very few in Terrasini. During this period the fishermen extend their fishing activities to fish for up to 16 hours per day. The sales path for the fish changes and rather than the fish being landed at the port it is most often transhipped at sea to mobile wholesalers, who then distribute through the markets.

While this activity, in itself, causes no great concern, problems occur because many fishermen extend their period of fry fishing. The demand for fish fry is such that, the species caught is irrelevant; the size varies from several millimetres to 1 to 2 centimetres, the smallest sizes realising the highest prices. There is one particular fry fishery that occurs later in the year (May and June) for juvenile Picarel (*Spicara flexuosa*) (*Macarruneddu* – Sicilian name), other species are also taken. The concern is that this constant fry fishery is undermining the potential adult stocks of certain species. The pelagic fry fishery is endorsed by all, as the juvenile stage has a very high value, but the adult pelagics are low value species, with a price of only 1,000 to 2,000 Lira per kilo. The adult picarel, however, has a medium value as an adult fish, with prices between 8,000 to 10,000 lira per kilo common, the price being compensated for by the abundance of adult fishes.

The main participants in the fry fishery are the fishermen from Balestrate and Trappeto. When surveyed, however, most respondents stated that if there were sufficient enforcement activity to stop the fishery for all, then they would gladly stop, as they realise that the fishery can only harm the fishery for adult life stages of several species. They feel though that they will not stop until all fishermen stop.

A more recent problem that has become apparent is that of illegal mini-trawling, a practise which is only found in the Ports of Balestrate and Castellammare and in which only four boats participate. The method involves using a mini 'pair trawl' set up between two artisanal boats, with the fishermen then sharing the proceeds. During the survey work, several incidents were observed and the catches were significant, usually between 50 to 100 Kilos per day. Though there is significant objection to this practise, the fishermen justify it by saying that they cannot make a decent living by artisanal fishing alone, especially now that the biological rest payments have ceased. The practise currently goes unnoticed by the coast guard, the artisanal fishermen arguing that since they have to compete with the illegal trawlers from Terrasini (that are not

restricted), there is no justifiable reason why should they forgo the opportunity to increase catches.

One common response to the subject of lack of enforcement, was that the fishermen would conform to the regulations if 'all' fishermen, artisanal, recreational and trawlers were regulated efficiently.

Port Facilities

Lack of adequate port facilities ranked 3rd of problems for the fishermen. The only port where it did not even get a mention was in Terrasini, which is not surprising as it is the main purse seining port in the region and is the only port in the Gulf area with a fish market.

In Castellammare the fishermen ranked that port facilities were their main concern. This is a surprising result given that Castellammare has a well developed break water, has deep water birthing, a separate artisanal fishing boat tie up area, floating pontoons for the recreational vessels and is one of only two ports where fuel can be purchased. The motivation behind their response may be due to the fact that general conditions appear to have deteriorated since the closure of the fish market.

It is easy to see why port facilities rank highly in both Balestrate and Trappeto. Trappeto has no fuel station, no market and little in the way of developed port facilities. They do have an extensive breakwater and separate harbours for the purse seine and artisanal vessels. In addition they also have a concrete slipway and hard standing for the boats.

In Balestrate there are only the most rudimentary of facilities, extending to a breakwater and a small rock groyne that closes off the small harbour, which only has space for no more than 15 boats at any one time. There are no facilities for removing the boats from the water and all are hauled by hand onto the sand. There is a single entrance and exit road to the harbour that is in disrepair and is splashed by a sewage outfall, and all fish being taken away from the harbour have to travel up this road, mostly on open back trucks. There is no slipway, but instead there is a rough patch of poured concrete that the boats are hauled up. Work is currently being undertaken, however, to rectify this situation and a new breakwater is being built, with completion expected during Summer 2000.

The nearest fuelling point for the boats from Balestrate is Castellammare, which is a one-hour journey away. Trappeto is equidistant from both Castellammare and Terrasini, both being about 1.5 hours steaming time. Often the boats from Trappeto choose to pay extra and buy their fuel from roadside fuelling stations, though obviously this proves to be very expensive with fuel costing up to 1,000 L more per litre. It does mean, however, that the fishermen do not lose a day fishing just for refuelling.

Market Structure

As has been seen in previous sections, there is a complex and varied sales path for the fish caught by the artisanal fishermen. The poor market structure was highlighted in both Castellammare and Balestrate. In Trappeto and Terrasini the lack of complaint was expected as the wholesale market in Terrasini takes all the fish from local fishermen and a large proportion of the fish from Trappeto also. The distance of Balestrate and Castellammare does make it prohibitive for the wholesalers to journey to these ports to buy fish, especially given the small landings. In Castellammare the sales of fish are dominated by only two wholesalers, who in turn sell to the local retailers, or are retailers themselves. It is interesting to note that when particularly high value species are landed, such as lobsters or large catches of sea breams, the fishermen tend to sell them directly to restaurants. In addition to these sales, many fishermen will stay on the quayside and sell their catches from the back of their cars, to locals and tourists. In this way they can achieve higher prices than would be got selling to the wholesalers.

It is common to see in Castellammare, heated exchanges occurring and physical violence has occurred when one fisherman got a higher price for his fish than another. The feeling is that the wholesalers do play one fisherman off against the other. All fishermen stated that they had no respect for the wholesalers. The problems are exacerbated during the Summer months when the recreational fishermen are in abundance.

In Balestrate the situation is different, and there is only one fish retailer and one wholesaler who comes from Terrasini. The majority of fishermen, therefore, take it upon themselves to sell their fish, either from hand pushed carts or from the back of cars, whilst several fishermen sell to individual restaurants and hotels.

The problem it seems is that the fishermen feel that they cannot be competitive, always having to accept low prices for their fish due to a lack of loyalty, on the parts of the retailers or wholesalers, to local fishermen. Indeed the retailers in Castellammare source most of their fish from outside the Gulf, some coming from Terrasini, but the majority coming from Mazzara de Valo or from Palermo.

Other issues

Two other issues have been highlighted as being of importance and both apply only to Terrasini. Not surprisingly the first concerns the problem of decreased fish stocks since the implementation of the trawl ban. This is exactly what we would expect to occur around Terrasini given its position as the first port outside the ban area. The concentration of effort in waters immediately adjacent to the trawl ban, the traditional waters of the artisanal fishers, has depleted fish stocks to minimal levels. The average daily catch for an artisanal vessel from Terrasini is less than 5 kilos, this impacts upon the amount of time that the fishermen fish for. In fact motivation in Terrasini is very low, with most fishermen refusing to fish throughout most of the Summer and during bad weather. The average amount of time spent at sea is in fact less than 160, which compares to 184 in Trappeto, 223 in Balestrate and 232 in Castellammare. The fishermen in Terrasini claim that under these conditions it is not worth their while expending fuel and gear costs due to the very low returns. A more detailed account of the differences between catches inside and outside the Gulf can be found in Section 3.

The other issue raised was that of poor political representation and fisheries management. Indeed, the last fisheries management act expired in December 1997. Since that time an update has been in development and is expected to be implemented during 2000. Within these pieces of legislation are crucial elements, such as with regards to the Biological rest payments, and regulations concerning recreational fishermen and development of fishing tourism opportunities. The artisanal fishermen feel that they are ignored on fisheries management issues, especially in a port such as Terrasini where the majority of fishermen are large-scale purse seine pelagic fishermen. The only port in the Gulf where political representation is particularly strong is in Balestrate, where there is a very strong co-operative in operation and a fisheries politician who is interested in taking the arguments of the local small-scale fishermen further afield. In the other ports there exists a feeling of defeat, complacency or ignorance with regards to such management matters.

4.3 The future of fisheries in the Gulf

The remainder of the questionnaire was designed to determine how the fishermen felt about the future of the fisheries in the Gulf. The questions asked determined their own attitudes to continuing fishing as well as examining their feelings as to what would happen in the future. In addition we put forward a series of hypothetical situations looking at how the fishermen would react to potential changes in the fishery.

In the first instance we asked how the fishermen saw the future of the Gulf fisheries, whether they would become, better, remain the same or whether in fact conditions would worsen. The results can be seen below in table 4.10.

We can see that, unfortunately, on the whole the picture is quite bleak with 60% of fishermen feeling that general conditions in the future will be worse. The ports with the most pessimistic outlook are, not surprisingly, Terrasini and Trappeto, in which 79% of fishermen believed that conditions would be worse in future years, and even in Castellammare more than half (55%) thought that things would worsen.

Twenty percent of fishermen did, however, think that conditions would remain fairly constant or would remain the same. Of these three ports, only in Castellammare were there a few fishermen who thought that things may be better.

Table 4.10 *Artisanal fishermen's expectations for future conditions in the Gulf*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Much Better	0%	0%	10%	0%	3%
Better	0%	0%	60%	25%	21%
Same	0%	29%	20%	20%	17%
Worse	80%	71%	10%	45%	52%
Much Worse	20%	0%	0%	10%	8%

The only port where there was an overriding sense of optimism was Balestrate, where 90% of fishermen thought that conditions would be as good or better in the future, only one respondent thought that things may get worse.

To follow on from this question, question 16 asked whether the fishermen would continue to fish for the foreseeable future. The results are very interesting and can be seen in table x4.11

Table 4.11 *Fishermen's intention to continue fishing in the future*

	Yes	No
Terrasini	60%	40%
Trappeto	93%	7%
Balestrate	100%	0%
Castellammare	80%	20%
Overall	83%	17%

We can see that, even given the pessimistic outlook of the majority of fishermen, almost all intend on continuing to fish for the foreseeable future. Only 17% of fishermen interviewed stated that they were intending to leave fishing. Of these it was mostly the very old fishermen (older than 60 years) that said they were planning on retiring. The main exception was one fisherman from Terrasini, aged only 23 years who was planning on becoming a wholesaler, and who said that he could not earn enough to keep his family as a fisherman.

The result of these answers can easily be explained given the lack of alternative employment in the area. Most of the artisanal fishermen are skilled only in fishing and engineering. Most have families and children and do not want to move away from the Gulf. There is an attitude prevalent that is resistant to change and most fishermen derive a large amount of pleasure from fishing for a living.

We also surveyed the fishermen's opinion as to whether fish prices, fishing costs and catches would vary during the next year. The results are shown below in table 4.12.

Table 4.12 *Fishermen's opinions of future costs and prices in the local area*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
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Fishing Costs	Worse	Worse	Worse	Worse	Worse
Catches	Worse	Same	Better	Same	Same
Fish Prices	Same	Same	Same	Worse	Same

As can be seen, the general consensus is that during the next fishing year fishing costs are likely to be worse, an opinion which is borne out by the gear retailer in Terrasini who also says that prices are likely to rise for gear. Also as new different types of gear become available, they are often more expensive, an example of which is Japanese nylon monofilament line that is used for making gill nets. To a large extent this has replaced the traditional cotton even though it is more than twice the price, it is however, more durable and easier to work.

Within the trawl ban area it can be seen that the fishermen think that on the whole catches will remain about the same. This is indeed corroborated by the biological data, which indicates that fish populations have now stabilised within the Gulf. Outside of the ban area the fishermen are expecting catches to fall. This is a valid assumption given the increasing competition from the trawlers, especially as they start to encroach more into the eastern parts of the Gulf within the ban area where many fishermen from Terrasini do find some extra fish.

Finally we asked opinions on fish prices. On the whole the fishermen considered that prices would remain at about the same level, the only exception being Castellammare where there was an overwhelming opinion that fish prices would be lower. This attitude is brought about as the fishermen are faced with still growing numbers of recreational fishermen. Also they see no way of increasing prices for their fish, given that they operate in a very limited market. Most of the comments from the fishermen on this subject were with regard to the closure of the fish market in Castellammare in 1994. The fishermen strongly believe that if there were a market once again in Castellammare that they would achieve better prices. With regard to this issue the point was raised that with only the artisanal boats landing the market would not have a large enough supply to be valid. The response to this was that some limited trawling should be allowed within the ban area, at certain times of year to persuade the trawlers also to land at Castellammare.

Hypothetical scenarios

The final part of the motivation survey put forward several hypothetical scenarios to the fishermen to examine their reaction to potential changes in the fishery. Given the importance of the biological rest subsidy to the fishermen, we asked how the fishermen would behave if changes took place to the price of fish. The idea put forward was one of a 20% rise or fall in price, with the biological rest payments still being paid and if they were stopped. We asked if the fishermen would fish for longer, less time or the same under different scenarios. In addition, we asked by how many hours they would change their activities each day and we gave the respondents room for comments.

Firstly we will consider the results from Terrasini. Question 18 asked whether the fishermen would fish, more, same or less if fish prices rose by 20%, given that they would also receive the biological rest payment should they choose to take it. We also asked the fishermen to state how many hours per day they would increase or decrease their fishing by. Question 19 was as 18, though here we asked the fishermen instead to consider a 20% fall in fish prices. Questions 20 and 21 put forward the same rise and fall in fish prices, but this time the fishermen were asked to give their responses assuming that there would be no biological rest payment. In addition to these questions we asked the fishermen for their comments as well. The results are shown below in Table x.

If we address the question, regarding what the fishermen would do given a 20% rise in fish prices it is interesting to note that fishermen in both Terrasini and Castellammare have the same outlook, as do the fishermen of Trappeto and Balestrate. Under these conditions all of the fishermen in Terrasini and 95% of those in Castellammare would fish for only the same amount, or less time than they do currently. This result seems to contradict any assumption that fishermen are profit maximisers, and indeed these respondents are demonstrating a *satisficing* attitude. The comments that accompanied these responses were largely related to being able to

spend more time on leisure and with the family. If we look at Balestrate and Trappeto we can see that more than half of the fishermen demonstrate a profit maximising mentality, with 50% in Trappeto and 60% of fishermen in Balestrate stating that they would fish for more time should prices rise. In Balestrate the average response was that they would fish for approximately 2.5 hours extra per day, in Trappeto the response was an extra 3 hours per day. In Castellammare only one fisherman stated that he would fish for more time, an astounding 5 hours extra per day, and he also stated that he would fish for more days per year and then would be able to afford to retire sooner. Even in Trappeto and Balestrate, however, we do see *satisficing* behaviour in that almost half the fishermen in these two ports also stated that they would fish for the same amount or less time if fish prices rose by 20%.

Table 4.13 Responses to hypothetical changes in the fisheries of the Gulf

Terrasini	With things remaining constant, If prices were subject to.....				If the Biological rest money were stopped and, If prices were subject to.....			
	20% increase	Hrs day	per 20% decrease	Hrs day	per 20% increase	Hrs day	per 20% decrease	Hrs day
	18a	b	19a	B	20a	B	21a	b
MORE	0%		20%	2 hr				
SAME	80%		40%		100%		40%	
LESS	20%	2 hr	40%				60%	

Trappeto

	18a	b	19a	B	20a	b	21a	b
MORE	50%	3	14%	3	71%	3	14%	3
SAME	36%		22%		22%		7%	
LESS	14%	3	64%		7%	1	79%	2

Balestrate

	18a	b	19a	B	20a	b	21a	b
MORE	60%	2.5	40%	3	40%	3	30%	3.5
SAME	20%		40%		30%		10%	
LESS	20%	1	20%	2.5	30%	3	60%	

Castellammare

	18a	B	19a	B	20a	b	21a	b
MORE	5%	5	65%	2.5	30%	2	65%	2
SAME	50%		25%		60%		15%	
LESS	45%	2	10%		10%	2	20%	

Overall

	18a	B	19a	B	20a	b	21a	b
MORE	29%	4	35%	3	47%	3	27%	3
SAME	47%		32%		53%		18%	
LESS	25%	2	34%	2	16%	2	55%	2

Question 19 put forward the idea that fish prices would fall by 20%, although the fishermen would still be in receipt of the biological rest money. The responses to this question are surprising. Only in Castellammare did the fishermen state the expected response, that of fishing for more time, given the very limited alternate employment opportunities available. Here 65% of the fishermen stated that they would have to fish for longer (an average of 2.5 hours extra per

day, although the range was between 2 and 4 hours) to realise the same revenues. One quarter stated that they would fish for the same amount of time and hope that fish prices would rise again, and 10% said that they would leave the fishery and retire.

In both Terrasini and Trappeto the majority of fishermen stated that under such conditions, they would fish for only the same amount or less time. In Trappeto 35 % of respondents said that they would leave the fishery, and those that stated that they would remain in the fishery would fish for only 1 hour less per day or maybe one day less per week. In Terrasini 40% of fishermen said that under such conditions they would leave the fishery. Only a very small percentage in both ports stated that they would fish for more time to compensate.

In Balestrate there was an even distribution of fishermen who would fish for more time, less time and the same amount. It is interesting to note that the increased time allocation on the part of those who stated they would fish for longer was greater than the reduced time allocation on the part of those who said they would fish less. The only comment in Balestrate with regards to this question was one fisherman who stated that he would fish for as many hours extra that he could physically stand, his estimate being that it would be no more than 3 hours extra per day.

In questions 20 and 21, we presented the price changes but also removed the biological rest payments, and again the responses were once again very interesting. For a rise in prices 41% of all fishermen in the sample stated that they would fish for more time, the main motivation being to compensate for lost income. Only 12% of fishermen in the Gulf said that they would fish for less time if prices rose, these fishermen all stating that without the biological rest payment they would leave the fishery and retire. In Terrasini we can see that all fishermen interviewed stated that they would continue with their current fishing practices if the biological rest money were stopped, and in Castellammare 60% of fishermen said likewise. In Trappeto and Balestrate less than one third of fishermen said that stopping the biological rest payments would not change their fishing practices. We can see that where fishermen stated that they would fish for more time, the maximum that they would fish for is similar in all of the ports. In Trappeto and Balestrate fishermen stated that they would fish for an extra 3 hours per day, the range was fairly small with all fishermen quoting figures of between 2 and 4 hours extra per day. In Castellammare we can see that the average extra is 2 hours, the spread here was between 1 and 3 hours³.

Question 21 asked finally what the reaction would be to a fall in fish prices combined with withdrawal of the biological rest payments. The results are, as we would expect. Almost all fishermen in the ports of Terrasini, Trappeto and Balestrate (83%) stated that they would fish for less time, in fact almost all with only 2 exceptions in Balestrate, said that they would retire from fishing altogether. Only three fishermen in Balestrate and two in Trappeto said that they would increase their fishing effort, whilst two stated that they would continue with current practices.

In Castellammare the situation was somewhat different. Sixty five percent of fishermen said that they would increase their fishing effort by 2 hours extra per day. Only two fishermen said that they would retire.

Given the lack of alternative employment this would seem to be a logical step. Indeed it would be interesting to see what would actually happen in the three remaining ports should this situation arise. Already the biological rest payments have been stopped, however, during the Winter / spring 1999 / 2000 almost all artisanal fishermen in the Gulf stopped fishing for the 45 day period and thus far there has been no indication of fishermen leaving the fishery.

Two final questions were asked regarding whether the fishermen themselves thought that the biological rest payments and, indeed, the trawl ban itself should remain in place. Also we asked what the fishermen would do if either were removed.

³ One outstanding point is that, it would appear as though the maximum extra work that the fishermen could achieve would be approximately an extra 3 hours per day. For all of the questions where fishermen stated that they would fish for longer, 3 hours was the maximum, with only one exception.

Table 4.14 *Fishermen's responses to the question, Should the trawl ban / biological rest payments remain in place?*

		Terrasini	Trappeto	Balestrate	Castellammare	Overall
Trawl Ban	YES	20%	93%	100%	100%	78%
	NO	80%	7%	0%		22%
Biological rest payments	YES	100%	100%	100%	95%	99%
	NO	0%	0%	0%	5%	1%

We can see that there are two opposing views to the trawl ban. Within the ban area all fishermen (with one exception in Trappeto) think that the trawl ban should remain in place indefinitely, whilst outside the Gulf the fishermen are generally opposed to the ban. The obvious explanation for this is the concentration of fishing effort outside the ban area, in the waters traditionally exploited by the artisanal fishermen from Terrasini. Within the ban area the remaining fishermen continue to reap the considerable benefits that the protection has provided. Indeed, many fishermen stated that if the ban were lifted that they would have to give up fishing. Increased competition for fish, gear conflict and various costs associated with gear replacement are the main reasons given. On the whole though, the majority of fishermen 51 percent said that they would have to carry on fishing if the ban were lifted, as there are no alternative sources of employment. Several younger fishermen thought that they would emigrate overseas and take up various forms of employment.

As with the previous question, there was a general consensus concerning the biological rest payments, and only one fisherman in Castellammare considered that they should be removed⁴. When asked what they would do should the payments stop, there was a range of responses.

Table 4.15 *Proposed fishermen's actions should the biological rest payments cease*

	Terrasini	Trappeto	Balestrate	Castellammare	Overall
Stop Fishing	20%	86%	30%	25%	40%
Continue Fishing	80%	14%	70%	75%	60%

As can be seen from the table the majority of fishermen stated that they would continue to fish if the biological rest payments were removed. The survey suggested, however, that up to 40 percent of the artisanal fishing population could have been lost through ceasing the biological rest payments. In actual fact no fishermen have been seen to leave since the beginning of 1999 other than through old age.

The respondents were also asked for their general comments on the fisheries and state of the Gulf. These have been compiled by port and can be found in Appendix 3.

5 CONCLUSIONS

Financial results derived from the landings survey undertaken in the Gulf of Castellammare in 1998/99 indicate that artisanal fishing vessels on average earned positive net profits, albeit with a very wide dispersion around the mean. Boat income, defined as total sales revenue minus total fixed and variable costs, averaged 8.7 million lira (= 4,493 EURO) for trammel netters operating in the Gulf in 1998/99. Fewer than 7% made financial losses while the top 13% earned profits of 25 million lira (= 12,911 EURO) or more. Capital investment appraisal indicates that the

⁴ As indeed they have, as of Winter 1998 there were no more biological rest payments made to the artisanal fishermen of the Gulf.

average level of profitability would appear to be sufficient to generate a positive return on investment, suggesting that the artisanal fishery has the potential to retain capital and hence to be economically sustainable so long as current operating conditions (i.e. resource productivity, market conditions, vessel utilisation rate, etc.) are maintained. Such a proviso is clearly relevant to any policy discussion relating to the trawl ban, since a radical relaxation or abandonment of that prohibition can be expected to jeopardise the performance of artisanal vessels within the current exclusion zone. This would happen if an expansion of trawler effort resulted in a reduction in demersal stocks currently exploited by artisanal vessels, leading in turn to lower CPUE and profits. In such circumstances the financial viability of the artisanal fishery would be compromised. While the trawl ban continues, there is a reasonable prospect that the stocks will remain strong enough for the artisanal fishery to be financially viable and thus economically sustainable.

There can be little doubt that artisanal fishermen based in the Gulf have benefited financially from the trawl ban, and the evidence for this comes from two sources. Firstly, there are the biological survey results which have demonstrated a large increase in demersal biomass since the ban was imposed. Of particular significance is the fact that the abundance of shallow water species caught with trammel nets increased by 77% between 1990 and 1999. This increase in biomass can be expected to have been translated into higher catch rate, which as the report has demonstrated is an important parameter in the profit function of artisanal vessels. This conclusion should be qualified, however, by noting that over this period the species composition has changed, with most of the biomass increase being for varieties of fish classed as only 'moderately' commercial. What this means, in effect, is that the increase in the *economic abundance* of the stocks has been less pronounced than the increase in *physical abundance*, and as such the financial gains to artisanal fishermen (though positive) will have been partially attenuated. The second main source of evidence suggesting that the trawl ban has benefited artisanal fishermen financially derives from the comparative operating performance of trammel netters inside and outside the trawl ban area. Trammel net fishermen operating from a port outside the trawl ban area fished fewer days per year (possibly due to 'crowding out' by trawlers) and incurred higher running costs (possibly because of the need to travel further afield so as to minimise gear conflict) compared to similar vessels operating from ports inside the area. Such vessels may also have been disadvantaged by lower catch rates, since the experimental trawl and trammel net surveys have demonstrated that stock density is markedly lower on fishing grounds presently outside the prohibited zone.

Clearly there are policy lessons to be learned from these results which are of relevance in other situations where prohibitions on trawling are being considered as a fisheries management tool. Specifically, the results suggest that trawl bans may not only play an important role in rebuilding seriously depleted stocks but also that these biological improvements will have a positive impact on the financial performance of fishermen (in this case, small-scale operators) who are permitted to remain. It needs to be stressed, however, that there are several economic issues which are likely to be relevant to policy but which are outside the scope of the present project. Indeed, this particular case study addresses only a sub-set of the questions now considered central to the current debate surrounding the use of MPAs as a fisheries management tool, and a number of important lines of enquiry (such as the effects of displaced trawling effort on adjacent fishing grounds) remain unexplored. To investigate these comprehensively, however, requires the development of an analytical framework (specifically, a bio-economic model) which can be used to examine different scenarios and simulate alternative policy options. This we recommend as an avenue for future research.

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APPENDIX I

Sample Landings Survey

Vessel ID _____ Date _____

Length of trip _____ No. trips _____

Fishing Area _____

Gear Net Seine Pots Longline

No. of nets / hooks / pots _____

Soak Time _____

Mesh size _____

Number of Crew _____

Catches Number of boxes / Kg

Hake	_____	Seabream	_____
Red Mullet	_____	Scabard fish	_____
Gurnard	_____	Flounder	_____
Sole	_____	Pickarel	_____
Octopus	_____	Other	_____
Cuttlefish	_____		_____
Grey Mullet	_____		_____

Sales _____ Lit.

Expenses

Fuel _____
Crew _____
Gear _____
Repairs _____
Accountant _____
Other _____

APPENDIX II

Sample Fishing Characteristics Survey

No.
Interviewer
Date

Confidential

Survey of fishing characteristics; Gulf of Castellammare, North west Sicily May 1999

cemare

Centre for the Economics and Management of Aquatic Resources

CEMARE
University of Portsmouth
Locksway Road
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Fishing Characteristics

Skipper Name _____

Vessel ID (No.) _____ Vessel Name _____

Age of Vessel _____

Days fished _____

Time lost due to weather etc. _____

Inboard / Outboard Engine _____

Size Output (Hp/ kW) _____

Do you have Hauling gear

Yes	No
-----	----

Main Fishing method

Season	Method	Species
Spring		
Summer		
Autumn		
Winter		

Time given to different Methods (per cent) ?

Method	Amount of Time (per cent)
Gill / Trammel net	
Drift / Seine	
Long Line	
Pots	
Other	

Why do you change gears / methods?

Where do you usually fish? *(Please mark on map)*

Distance to fishing grounds _____

Have you always fished in the same areas? Yes / No

Normal depth of water fished in? _____

What determines when you move to other areas ?

How long does it take to get to the fishing grounds? _____

Fishing time _____

Average fishing trip length (hours / days) _____

Fuel consumption, per trip _____ @ _____ Lr/ltr

Gear Characteristics

What gear is carried each trip ? _____

Number of nets deployed per trip _____

Average length of net _____

Mesh size ?

Mesh size (mm)	Species
	Mullet
	Sole
	Bream
	Hake
	Lobster
	Other

Depth of net? ft _____ m _____

Length of time nets are deployed (soak time)

Number of lines? _____

Number Hooks per line _____

Time spent repairing gear per day _____

Gear replacement, How often?

Gear type	Frequency of replacement
Gill / Trammel net	
Drift / Seine	
Long Line	
Hooks	
Pots	
Other (ie, net haulers)	

Do you have an annual repair period?

When ? _____

Crew Characteristics

Number of crew ? _____

Relationships between crew _____

Share system?

Skipper / Owner _____

Crew _____

Vessel share _____

Age of crew members ? _____

Catch Characteristics

Main target species

Species	Month when caught	Species	Month when caught
<i>Hake</i>		<i>Seabream</i>	
<i>Red Mullet</i>		<i>Dolphin fish</i>	
<i>Striped Mullet</i>		<i>Pickarel</i>	
<i>Amberjack</i>		<i>Octopus</i>	
<i>Boops</i>		<i>Cuttlefish</i>	
<i>Sole</i>		<i>Other</i>	

What is the minimum quantity / revenue that you need per trip to remain viable?

_____ Kg _____ L

How much of the catch is taken for the crew household consumption?

<10 %		20-30		40-50		60-70		80-90	
10-20		30-40		50-60		70-80		90-100	

APPENDIX III

Sample Fishermen Motivation Survey

No.
Interviewer
Date

Confidential

Survey of fishermen's motivations; Gulf of Castellammare, North west Sicily May 1999

cemare

Centre for the Economics and Management of Aquatic Resources

CNR - IRMA

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Artisanal Fisheries in the Gulf of Castellammare, Sicily
Survey of Fishermen's Opinions and Motivations

ID No. _____

Age _____

Historical Information

- 1) In what year did you become a fisherman?

19 - _____

- 2) Why did you become a fisherman?

Father a fisherman	
Other family members fishermen	
Inherited a boat	
No other employment opportunities	
Saw better opportunities in fishing	
Moved to area	
Other	

- 3) How long have you been fishing in the Gulf

Less than 5 years	5 to 10	10 to 15	15 to 20	20 to 30	More than 30
-------------------	---------	----------	----------	----------	--------------

- 4) Has this been continuous, or have you moved away at any time?

- 4a) Why did you move back to the area?

- 5) How long do you spend fishing? Hours per day _____
 Days per week _____
 Days per year _____

- 6) Do other family members work in fishing? Where? and with what method?

Area / Region / Country	Gear Type

Current Situation

- 7) When is the best time of year for fishing? With regards to:
(month / season)

Prices _____ Catches _____

- 7a) Are prices for locally caught fish generally lower when landings are high?

Yes	No
-----	----

- 8) When did you last refit your boat?

19 -

- 9) Have you bought new gear recently?
(quantity and when)

Nets	
Lines	
Buoys	
Net Hauler	
Engine	
Electronics	

- I now have a few questions on your views of the current trawling ban

- 10) Since the trawling ban has your fishing become?

(prompt for interviewer)		(response)		
Much better	Better	Same	Worse	Much worse

- 11) Do you think this change is due to the ban?

Yes	No
-----	----

- 11a) If No, then what? _____

On a Scale of 1 to 5 please answer the following question.

5 = many more, 4 = more, 3 = same, 2 = less, 1 = a lot less

- 12) Do you think there are more or fewer professional artisanal boats in the gulf now than there were 10 years ago?

(prompt for interviewer)			(response)	
Many more	More	Same	Less	A lot less

- 13) If More, does this cause problems for you?

Yes	No
-----	----

- 13b) If yes, how?

- 13c) Could you rank these in order of significance? Tick Rank

For space on fishing grounds		
Prices		
Other		

Specify Other

- 14) a) What are the other main problems you face in the Gulf?
 b) And are they being addressed?
 c) Could you *Rank in order of importance? (scale of response, 5 most important, 1 least)*

Fisheries management

Tick Rank Yes No

Fishing Policy				
Management regime				
Political representation				

Environmental

Waste water and pollution				
Decreased fish stocks				

Markets

Lack of fish market				
Wholesalers monopoly				
Co-operative				
Port / harbour facilities				

Conflict

Illegal trawler activity				
--------------------------	--	--	--	--

Conflict between Artisanal / trawler fishers				
Recreational fishermen				
Other				

The Future

Using the scale on the card please rank the following question.

5 = much better, **4** = better, **3** = same, **2** = worse, **1** = much worse

- 15) Do you see the fisheries of the Gulf becoming?

- 16) Will you carry on fishing in the Gulf in the future?

YES	NO
-----	----

- 16a) If No, what will you do?

Using the scale on the card please score the following question.

5 = much better, **4** = better, **3** = same, **2** = worse, **1** = much worse

- 17) In the next year do you think that the following will be :

Fishing costs	
Catches	
Prices	

The following are purely hypothetical questions to enable us to judge the importance of certain factors for the artisanal fishermen in the Gulf.

- 18) As things are at the moment, If Catch / Prices rose by, say, 20 percent would you:

Fish for more time	Same amount of time	Fish for less time

- 18a) By how much per day?

1 hour	2 hours	3 hours	4 hours	5 hours
--------	---------	---------	---------	---------

Or days per year

--

19) As things are at the moment, If Catch / Prices fell by, say, 20 percent would you:

Fish for more time	Same amount of time	Fish for less time

19a) By how much per day?

1 hour	2 hours	3 hours	4 hours	5 hours
--------	---------	---------	---------	---------

Or days per year

--

20) If the Biological rest money were stopped and Catch / Prices rose by, say, 20 percent would you:

Fish for more time	Same amount of time	Fish for less time

20a) By how much per day?

1 hour	2 hours	3 hours	4 hours	5 hours
--------	---------	---------	---------	---------

Or days per year

--

21) If the Biological rest money were stopped and Catch / Prices fell by, say, 20 percent would you:

Fish for more time	Same amount of time	Fish for less time

21a) By how much per day?

1 hour	2 hours	3 hours	4 hours	5 hours
--------	---------	---------	---------	---------

Or days per year

--

22) Do you earn money from any other activities?

YES	NO
-----	----

23) If Yes and you don't mind telling me, what are they?

Activity

24) How much of your household income comes from fishing?

Fishing	
Other Occupations (<i>Please specify</i>)	

25) Do you think the Trawl ban should remain in Place

YES	NO
-----	----

26) What would you do if the ban on trawlers be lifted?

And Finally

27) Do you think the Biological rest payments should continue?

YES	NO
-----	----

--	--

28) What will you do if the subsidy is stopped?

Thank you very much for your time.

APPENDIX IV

Regulatory Framework Governing Fisheries in the Gulf of Castellammare

The regulatory framework governing fisheries within the Gulf of Castellammare consists of the respective actions of Community, national and regional legislative bodies. The division of responsibilities between these bodies has its basis in the Italian Constitution, Italy's membership of the European Community, the Treaties of the European Community, the derogation of responsibility for fisheries to the Regions and the status of Sicily as a 'Region with special autonomy' within Italy.

Given the coastal, local nature of the fisheries in question, the regulatory frameworks that prescribe their management, and the vertical position within the regional-national-Community hierarchy at which the directly applicable legislation has been created, the actions of national and regional legislative bodies are the focus of this review.

The review initially addresses the legally defined institutional structure governing fisheries within Italy, Sicily and the Gulf of Castellammare. It addresses the division of responsibilities and the spatial hierarchy, providing essential context for the more detailed review of the legal framework governing fisheries in the Gulf of Castellammare. As further context, the review then highlights the legally defined objectives and priorities of fisheries management in Italy and Sicily and the chosen means of achieving them. The main component of the review then follows: the regulatory framework governing fisheries within the Gulf of Castellammare. Within this section, attention is afforded to both the provisions for the trawling ban and the wider regulatory framework within which the artisanal fisheries and the trawlers operate.

Institutional Framework, National and Regional

The State (Ministry for Agricultural Policies) versus the Regions

Responsibility for fisheries management is split between the State and the Regions. This division derives from article 5 of the Italian Constitution, which lays down rules for the decentralisation of both organisation and autonomy within the State, and Legislative Decree DL143/1997, which restructured the administration of fisheries in Italy.

Under the Italian Constitution, the State is obliged in the exercise of its duties to open up to its citizens and derogate those interests not considered to be of national importance, competency being distributed among the necessary administrative entities: State, Region, Province¹ and Commune. Articles 177 and 118 of the Constitution enumerate the competencies of the Regions, laying out their minimum responsibilities. The remaining responsibilities are reserved for the State, who can allocate them through general laws to the Provinces and Communes (Art.128 of the Constitution) or, in terms of particular functions, to the Regions (Art. 118 of the Constitution).

The responsibilities reserved for the State by the Italian Constitution and executed through the State's central, executive agencies, include:

- General, national level policies for, *inter alia*, economic planning, budgetary control, international relations and the direction and co-ordination of the Regions in specified matters.
- Financial policies, including public finance and taxation.
- Policies for matters of political economy, covering industry and commerce, the merchant marine, international trade, employment and social security, and the direction and investment of national funds in industry, agriculture and commerce.
- Policies on the provision of public services, including education and scientific research.

¹ The Province and Commune have only indirect relevance to marine fisheries and are, therefore, not covered in this review.

The agencies of the State discharge their responsibilities through administrative acts, consisting of decrees, resolutions of collective agencies or decisions requiring the issue of a decree by the President of the Republic.

In terms of fisheries, these State level duties are clarified as: the co-ordination of the activities of the Regions and providing at the national level for the management of fish resources (art. 2(2)). Exercised through the Ministry for Agricultural Policies and delegated to the Directorate General for Fishing and Aquaculture these specific responsibilities extend to (DL143/1997):

- The legal control of fishing and aquaculture²
- The management of fish resources of national interest, licences and temporary closures
- Research undertaken in fisheries and aquaculture
- The collection, storage and processing of statistics (with reference to L41/82)
- International relations (with the European Community, OCSA and FAO)
- Markets and related management measures
- Community technical management measures
- National and Community structural measures
- Promotional campaigns and communication (with reference to L41/82)
- The planning and management of SFOP “Strumento Finanziario Operativo per la Pesca”, a financial instrument for fisheries.

The Ministry also retains the powers, *inter alia*, to recognise national associations and for the allocation of financial resources to the regions.

In the exercise of State responsibilities, the central agencies are supported by local administrative structures, which act on behalf of the State not the Region. These usually coincide with regional or provincial boundaries, and act to implement at the local level those State laws and responsibilities not derogated to the Regions. The local agencies include the Direzioni Marittime and Capitanerie di Porto (Harbour Master's Offices), which have certain provisional responsibilities for marine traffic and the implementation of fisheries regulation. Beneath these, there are three further categories of local offices, of decreasing importance: Ufficio Circondariale Marittimo, Ufficio Locale Marittimo (Local Harbour Office) and Delegazione di Spiaggia (responsible for beach management). Those relevant to the subject of this report are detailed in subsequent sections of this Appendix.

In terms of the responsibilities of the Regions, Italy is made up of 20 Regions, 5 with special autonomy for ethnic, historical and peripheral reasons, of which Sicily is one, and 15 with ordinary autonomy. For the 15 Regions with ordinary autonomy, their responsibilities are constitutionally defined through article 117 of the Italian Constitution and their agencies, relations and procedures set by Statute³. For the 5 Regions with special autonomy their responsibilities are defined by their respective constitutional Acts, which vary from Region to Region, and their agencies, relations and procedures set by Regional Legislation. The scope of action available to those Regions with special autonomy is generally broader than that for the other regions. Notably, Regions with special autonomy have the power not only to enact secondary⁴ and effective⁵ legislation, but also to enact primary legislation (which is generally only subject to constitutional restrictions).

As a Region with special autonomy, Sicily has long had the capacity to manage its own fisheries. The scope of, and limitations on, this capacity are laid down by its Constitution (“Statuto della Regione Siciliana”, DL 455/1946) and Regional Law LR26/1987. Article 14 DL 455/1946 stipulates that the Sicilian Assembly, within the limits of the Region and within the limits of the Constitution of the State, without prejudice to the reform of agriculture and industry determined

² In practice qualified by the extent of regional powers.

³ The statutes of Regions with special autonomy are approved by constitutional laws, while those of regions with ordinary autonomy are resolved by individual Consigli Regionali and approved by parliamentary laws.

⁴ Application of the fundamental principles of State laws.

⁵ Application of specific State laws that the Region is required to apply, organise and integrate at the local level.

by the political Constituency of the Italian people, has exclusive legislative powers for, *inter alia*, fishing and hunting. This competency is potentially far reaching, although with the need to ensure compliance with Community legislation and policy and consistency between the Regions, the qualification stipulated in article 14 requires that these powers are subject to the proviso that the instruments and measures introduced are in harmony with national measures and plans, and guidelines on Community rules (art.1(2) LR26/1987). As will become evident through the later sections of this review, regional legislation largely pertains to the extrapolation of national and international provisions to fit the local scenario.

At the regional level, the *Assemblea Regionale*, composed of *Presidente* and *Consiglieri*, is the agency responsible for legislating, controlling and planning, while the *Giunta Regionale* (composed of the *Assessori* and *Presidente*) is entrusted with policy initiatives, financial proposals, principal acts of planning and administrative activities. The administrative functions are carried out through decisions of the *Assemblea Regionale* (in the form of Acts (LR) and resolutions) and *Giunta Regionale* (in the form of Decrees, circulars and resolutions).

Harbour Offices

The Harbour Masters' Offices represent the local manifestation of the Ministry. The shoreline of the Italian Republic is divided into 10 marine zones, which are further sub-divided into 48 naval districts⁶, at the centre of each is a Harbour Master's Office (L 381/1988). There is a Harbour Master's Office for each major harbour. The administrative functions of the Harbour Masters' Offices pertain to navigation, marine traffic, the registration of fishing enterprises, the supervision of fishing activities, the trade in fish products and the determination of violations of the laws and regulations entrusted to them. They may also, as necessary, go beyond the normal administrative and control functions, to impose by decree, temporal and spatial limitations on fishing and the setting of landing points for the landing of fish products.

As noted, the Harbour Master's Office has particular responsibilities for the supervision of fishing. Although article 19 L963/1965 assigns ultimate responsibility for supervision to the Ministry of Agricultural Policy, much of the groundwork surveillance of fishing and fish commerce, and the determination of contraventions⁷ of the law, is entrusted to the direction of the commanders of the Harbour Masters' Offices. The Harbour Masters' Offices are responsible for the co-ordination and direction of the actions of the various agencies that assist⁸ in surveillance:

- the civil and military staff of the central and peripheral administration of the Ministry of Agricultural Policy (including *Carabinieri* and *Capitaneria di Porto*)
- the financial police
- police officers
- the agents of public safety
- agents sworn in for the purpose⁹(art.21 L963/1965).

The Gulf of Castellammare falls within two naval districts and provinces, Palermo (including Terrasini, Trappeto and Balestrate) and Trapani (including Castellammare and San Vito). For

⁶ Determined by the Ministry for Agricultural Policies in conjunction with the Minister for the Environment.

⁷ The penalties arising from infringements of the laws and rules governing fishing are laid out in detail in various statutes and decrees, extending from fines to the withdrawal of authorisations and benefits, the seizure of the vessel or equipment and the detention of the person convicted, depending on the infringements and the benefits being received. In the event of any infringement, even on the part of an employee or dependent, the vessel owner or fishing entrepreneur is liable for the penalties associated therewith (art.30 L963/1965).

⁸ For the purpose of surveillance and assessing compliance with the rules of fishing, these agents are permitted at any time to visit any vessel, fishing plant, place of storage or sale, or means of transportation (art.23 L963/1965).

⁹ These can include regional and provincial administrators and others with certain experience and knowledge, which have received prior support from the head of the naval district (art.22 L963/1965).

administrative and legal purposes, fishermen refer to the province they belong to (hence to the Harbour Master's Office of Trapani or Palermo). For less significant authorizations or problems they refer to the smaller local offices (i.e., Ufficio Locale Marittimo of Castellammare or of Terrasini).

Regional Councillor for the Co-operation, Commerce, Handicraft and Fishing

The Regional Councillor for Co-operation, Commerce, Handicraft and Fishing (Assessore per la cooperazione, il commercio, l'artigianato e la pesca) is responsible for fisheries within the Region, in accordance with the powers afforded by the Sicilian Constitution and the Regional Law LR26/1987. Included within these powers, are duties of the supervision/ surveillance of fishing within the Gulf of Castellammare, along with the Gulfs of Catania and Patti (art. 10 LR25, 1990).

Sicilian Regional Council for Fishing

The Regional Council of Fishing was established under article 14 LR1/1980, to advise the Regional Councillor for Co-operation, Commerce, Handicraft and Fishing on matters relating to fisheries in the Region. Notably these include: general matters concerning fisheries and the management of fishing in the waters of the region, the formulation of legislation, initiatives for the protection of biological resources, and applied research on the fisheries of the region (including the financial and legislative requirements of this research)(art. 16 and 17). The membership of the Council includes, *inter alia*, the Regional Councillor for Co-operation, Commerce, Handicraft and Fishing; the leader of the "fishing" working group within the office of the Regional Councillor for Co-operation, Commerce, Handicraft and Fishing; the leader of the working group on "marine structures" within the Office of the Regional Councillor for Public Works; the Director of the "Istituto regionale per il credito alla cooperazione" (Regional Institute for Credit and Co-operation, IRCAC); and representatives of the Italian Registry of Shipping, Chamber of Commerce, labour organisations, co-operatives, National Federation of Fishing; and other experts in fisheries (art. 14 LR 1/1980 and art.7 LR26/ 1987).

Central and Local Advisory Commissions for Marine Fishing

The Central Advisory Commission for Marine Fishing was created under articles 5 and 6 of Law 963/1965 (as modified by art. 29(a) L41/1982 and art. 17 L165/1992) to advise on marine fishing issues at the national level. It includes representatives from: various Ministries, academic and research institutions, fishing co-operatives, fish markets, fish traders, fishermen and their employers, sports fishermen, fish farmers, and the Association of Commerce, Industry, Handicraft and Agriculture.

The Central Advisory Commission for Marine Fishing is also the basis of the National Committee for the Conservation and Management of the Biological Resources of the Sea, which was formed under L41/1982 (as amended) for the purposes of detailing and modernising the national plans put in place for fisheries and aquaculture. As well as members of the Central Advisory Commission for Marine Fishing, the National Committee incorporates representatives from other bodies. These include: the Minister for Scientific and Technological Research, a representative from each of Sicily, Sardinia and Friuli Venezia Giulia, one representative from each of five other regions¹⁰, a representative from the canning industry, and one from the Committee for the Co-ordination of Scientific and Technological Research. The President of the Committee also invites other interested parties as appropriate (art.3 L41/1982 (as amended by L302/1989 and L165/1992)).

Local Advisory Commissions for Marine Fishing have also been established to advise on fishing issues within their respective naval districts. Their membership draws from district level

¹⁰ As designated by the Inter-regional Commission, which was established under article 13 L281/1970 and DM 6/07/1972 and consists of the Presidents of the Committees of the Regions to determine the criteria for the division of regional development funds between the regions.

representatives of the categories of interests represented in the national, Central Advisory Commission for Marine Fishing (art.21 DPR 1639/1968).

Fishing Society

The Sicilian agency for industrial promotion (ESPI) was authorised under LR1/1980, article19 to establish a Fishing Society, a state shareholding enterprise, for the purpose of fishing, processing, preserving and trade of fish products, in which both public and private organisations can participate.

Objectives and Priorities of Fisheries Management

The objectives and priorities of fisheries management serve two key functions in Italy, notably, to guide and direct the actions of the various agencies with responsibilities for fisheries management, at the national, regional and local scale, and to guide the development and interpretation of national and regional legislation for fisheries.

The objectives of fisheries management and the fundamental means of achieving them at the national level are laid out by the National Committee for the Conservation and Management of Marine Biological Resources and the Minister of Agricultural Policy, under article1(a) L41/1982 (as amended by L302/1989 and L165/1992), in national level plans. The plans cover successive three year periods¹¹ and are targeted at promoting the rational exploitation and increase in value of marine biological resources through the balanced development of fishing (article1(a) L41/1982). The plans come in three sections. Part I covers the management of fishing activities and the development of aquaculture, promotes the exploitation, without extermination, of natural resources and provides for the fishing methods to be used in different fishing zones. Part II addresses the requirements and provisions for land-based support infrastructures. Part III provides for financial forecasting and the allocation of financial resources (art.2 L41/1982 as amended). The plans provide both the basic structure of management, along with more detailed guidance where deemed appropriate¹², and can be amended and modernised as necessary¹³.

Table 1 below identifies the key objectives for fisheries management and the principal means identified to achieve these objectives as laid out in national legislation, the national plan covering the time period of this study and as extrapolated to the regional level through Regional Law LR26/1987. The objectives at the regional level closely match those at the national level along with an additional objective of increasing fisheries related employment, particularly of young people. The means of obtaining these objectives however differ slightly at the national and regional level.

Table 1 Objectives of fisheries management and the means of achieving them

Objectives
a. The rational management of marine biological resources
b. To increase the production and value of the products of Sicilian marine fishing
c. To diversify, expand and rationalise the markets for Sicilian fish products as well as to increase the production of Sicilian fish products
d. To increase the value added of fish products and related employment
e. To improve the onboard working conditions of fishermen
f. To improve the balance of trade in fish products

¹¹ These can be updated as necessary to account for technological innovation and the state of the resource and the industry (art.1(a) L41/1982 as modified).

¹² As in the case of licensing (see the section ‘Licensing’ below).

¹³ Article 1 L164/1998 authorised the Minister for Agricultural Policy to modernise the national plan for fishing and aquaculture for the years 1997 to 1999, in 1998, to take on board what was seen as a ‘serious crisis facing the fishing sector’.

Means of Achieving the Objectives - National	
a.	The development of scientific and technological research in fisheries and aquaculture, both marine and estuarine
b.	The conservation of the biological resources of the sea
c.	The regulation of fishing effort in relation to the productive capacity of the sea
d.	The restructuring and modernisation of the fishing fleet and means of production
e.	Supporting co-operation, co-operatives and producers associations
f.	The development of marine and estuarine aquaculture
g.	The implementation of zones of biological rest and active re-population (including the use of artificial structures)
h.	The modernisation, expansion and rationalisation of the shore based infrastructure
i.	The re-organisation and development of the distribution and preservation of marine and aquaculture products (as amended by L164/1998, art.1(2))
j.	The development of central and peripheral institutional structures necessary for prevention, control and surveillance and the regulation of fishing effort
k.	The provision of loans to assist with achieving these tasks (subject to public competition and the payment of interest (amended by art.7 L302/1989)).
Means of Achieving the Objectives – Sicily	
a.	The development of scientific and technological research in fisheries and aquaculture, both estuarine and marine
b.	The conservation of the biological resources of the sea
c.	The study and control of pollution, so not to prejudice fishing and aquaculture within the coastal zone
d.	The development of aquaculture and mariculture
e.	The regulation of fishing effort in relation to the capacity of marine resources
f.	The restructuring and equipping of the fishing fleet and means of production
g.	The promotion of co-operatives, consortia of co-operatives and producers' associations
h.	The institution of zones of biological rest and active repopulation
i.	The modernisation and expansion of the shore-based infrastructure
j.	The reorganisation and development of fish preservation and the transport network for marine products
k.	The improvement of the image of Sicilian products
l.	The recovery and utilisation of under-utilised or discarded resources
m.	The recovery and protection of artisanal fisheries (LR 26/1987).

Regulatory Framework Governing Fisheries with the Gulf of Castellammare

The regulatory framework governing fisheries within the Gulf of Castellammare has a number of components. These components fall within, and are described below in terms of, the following categories:

- Registration
- Licensing
- Technical management measures
- Economic instruments

Provisions for:

- Sport fishing
- Fishing tourism

Registration

Prior to engaging in professional fishing activities, the fishermen, their vessels and any fishing enterprises must be registered, including artisanal.

Professional fishing is defined in terms of the classifications given in the section 'Register of Fishing Vessels', below, and also includes fishing using any fixed or mobile equipment, both temporary and permanent, designed (a) to capture mobile species, (b) for fish culture, (c) mollusc culture, and (d) for the exploitation of artificial reefs (art.10 DPR 1639/1968). Here the key distinction is between professional fishing and sport fishing.

Register of Fishing Vessels

All professional-fishing vessels must be registered with the Ministry of Agricultural Policy, via its provisional officer – in this case, the Controllers of the respective Naval Districts for the Gulf (refer to 'Harbour Offices' section). Each application is assessed against the objectives of the triennial plan (arts.1, 2 and 3 DM 31/07/1997) and issued or not, accordingly. Each vessel is registered within one of a number of categories, which determines the type of fishing activities it can subsequently undertake. The Head of the Naval District is responsible for determining the allocation of vessels and operations to the respective categories. The categories are:

- Pesca oceanica: vessels that are suitable and equipped with appropriate gear and processing equipment for fishing outside the Mediterranean
- Pesca d'altura: vessels that are suitable and equipped with appropriate gear and refrigeration and processing equipment for fishing in the Mediterranean
- Pesca ravvicinata: vessels that are suitable and equipped with suitable gear for inshore fishing[≡], up to 20 miles from the coast
- Pesca locale: vessels that are suitable and equipped with gears for local coastal fishing[≡], up to 6 miles from the coast
- Vessels used in support of fixed fishing systems (arts.8 and 9, DPR 1639/1968).

([≡] Classified as coastal fishing)

The artisanal vessels in the Gulf would fall within the last but one category. The registration is particular and exclusive to the naval district of residence. The registration of a fishing vessel in another naval district or participation in a different category of commercial fishing to that authorised would be subject to the granting of authorisation by the appropriate department of the Ministry of Agricultural Policy upon application.

Register of Marine Fishermen

All fishermen prior to fishing are also required to register at the Harbour Master's Office of the naval district in which they live (art.9 L963/1965). Registration is free (art.10), but for certain categories of fishing requires the fishermen to have previously completed certain qualifications, from the "Matricole della gente di Mare"¹⁴, and for fishing to be the sole or prevailing activity of the applicant. The fishermen are registered in accordance with these qualifications and for the specific categories of fishing listed in the section 'Register of Fishing Vessels', above¹⁵. The artisanal fishermen, falling within the local coastal fishing category (<6 miles from the coast), are, however, exempt from the various certificates and tests, although still required to undertake fishing as the sole and prevailing activity (arts.49-53 DPR 1639/1968).

Registration is specific to the naval district, and is lost within a district upon either: the transfer of registration to another district or country, loss of citizenship, failure to meet the requirements of article 35 (as noted in footnote 15), the voluntary cessation of fishing, the discontinuation of fishing for a period of three years or more, or death (art.45 DPR 1639/1968). Where appropriate, however, there is an opportunity to re-register if the cause of the original loss of registration is

¹⁴ Article 39, DPR 1639/1968.

¹⁵ Fishermen cannot be registered if they have been: declared or have a tendency towards being a habitual criminal (unless rehabilitated), condemned for one or more previous infringements of the laws governing fisheries amounting to a custodial sentence of greater than one year or condemned for more than 5 infringements of the laws governing fisheries (unless rehabilitated) (art.35 DPR 1639/1968 as amended by D219/1983, art.2).

addressed within a period of five years. Alternatively, a fisherman so affected can initiate a new application (art.46 DPR 1639/1968).

Register of Fishing Enterprises

Fishing enterprises are also required to register with the Harbour Master's Office (art.11 L963/1965). The registration requires details of, *inter alia*, the enterprise, its owners, the location and categories of the vessels used (including their characteristics) and the type and category of fishing undertaken (arts. 63 and 66, DPR 1639/1968, as amended by art.4 DPR 219/1983). The enterprises are also classified in terms of the type of fishing undertaken, as described in the section 'Register of Fishing Vessels', above (arts.9, 10 and 63 DPR 1639/1968).

The registration of fishing enterprises, albeit specific to a district can, however, be transferred between the Harbour Master's Offices of different districts (art.69 DPR 1639/1968). Registration, however, ceases in the district once transferred out. Similarly, registration is lost upon the death of the entrepreneur, the collapse of the enterprise, the cessation of fishing, either voluntarily or involuntary, or where fishing has not been undertaken for a period of three years (art.70 DPR 1639/1968). In the event of the withdrawal of registration being for one of the last three reasons, the entrepreneur can apply to be re-admitted once the cause has been addressed.

Licensing

The framework of licences to fish is provided by DM 26/07/1995 (implementing article 4 of L41/1982), which makes provisions for the granting of fishing licences, repealing all previous legislation on this issue. The Decree establishes the procedure to be followed, the requirements for the application, award and renewal of licences and the duration of the licences.

Fishing licences are issued by the Ministry for Agricultural Policy on the basis of a number of conditions being satisfied. Notably, the vessels must be registered¹⁶ and the applicants must have obtained certification authorising the category of fishing and the fishing gears applying for¹⁷, as described in the section 'Register of Fishing Vessels', above (art.2 DM 26/07/1995). For vessels being built, acquired without a licence, or being modified in terms of their technical characteristics, prior certificated authorisation is required from the Ministry of Agricultural Policy. The authorisation is limited to one certificate per entrepreneur or fisherman (where not associated with a co-operative or fishing enterprise) and three per fishing co-operative. The certificates are not transferable or alienable (art.3 DM 26/07/1995). All vessels are also required to satisfy article 149 of the Navigation Code and art 332 D328/1952 (as amended by DPR445/1998), which stipulates a requirement for a navigation licence, which is subject to renewal on a three yearly basis, for the purpose of assessing the safety of the vessel.

A new fishing licence is only issued for a vessel once it has been constructed or acquired (art.13 DM 26/07/1995) and only then in accordance with the requirements of the three-year plan currently in operation (refer to the section 'Objectives and Priorities of Fisheries Management' above). Within the national plan, the Minister for Agricultural Policy can, *inter alia*, establish, direct and limit the maximum number of fishing licenses that are to be issued¹⁸. The plan also specifies the subdivision of this number according to the different fishing zones, different gears types and species targeted, the vessel categories listed in the Section 'Register of Fishing Vessels' and the engine power of the vessel (art.4 L41/1982 as modified by art.3 L165/1992 and art.12 L963/1965). The issue of new licences was restricted over the study period, only being permitted without the withdrawal of another vessel in select circumstances. *Inter alia*, these included:

Small-scale fishing with boats of 2.5 tsl

¹⁶ Art.11 L963/1965.

¹⁷ Arts. 8 and 9 DPR1639/1968.

¹⁸ The Ministry reserves the right to suspend the release of new licences in the event of the issue being incompatible with the attainment of the objectives of the national fisheries plan and European Community legislation.

Inshore fishing up to 0.8 tsl

Modifications of vessels of tonnage 2.6 tsl and power 20 Kw (art.21(1) DM 26/07/1995).

Priorities were also set in terms of the preferred recipients of new licences. In the award of new licences, priority was given to co-operatives of young fishermen; vessel-owners' co-operatives; young fishermen (up to 36 years) not in co-operatives; and the replacement of rowing and/or sailing vessels¹⁹ with motorised vessels (art.23(2) DM 26/07/1995).

For vessels being modified, the award of a new licence requires the vessel to already be in possession of a valid licence, the applicant to have been registered in the registry of fishing enterprises for at least 3 years and the modifications to fall within the following maximum limits (art.24 DM 26/07/1995):

Local coastal fishing, up to 10 tsl and 150 Kw

Inshore fishing, up to 50 tsl and <350 Kw

The licence, if awarded, is valid for 8 years initially²⁰ and renewable upon request (art.2 DM 26/07/1995). It specifies the type of fishing that can be undertaken, the geographical limits and the gears used²¹ (art.10 DM 26/07/1995). Along with the original application, requests for renewals are made either directly to the Ministry or by the means specified by the Ministry: the renewal of licences may be delegated to the peripheral, local agencies of the Ministry (art.4 L41/1982 (as modified by art.3 L165/1992) and art.12 L963/1965). Requests can also be made to the Ministry for variations in the gears authorised by the licence, within limits. If the applicant has not supplied details of the technical characteristics of the vessel in accordance with article 27 DM 26/07/1995, a non-renewable certificate of six months duration temporarily authorising fishing is issued, rather than a licence²².

The form of the licence varies in terms of the type of fishing it authorises. For vessels of 10 tsl or 150Kw or less, such as those used by the artisanal fleet in the Gulf of Castellammare, the licences issued restrict the vessels' operational scope to local coastal fishing and to the district within which the vessel is registered and the districts immediately adjacent to it (arts.10 and 23(1) DM 26/07/1995). For vessels of 10 tsl or less, the gears permitted are also restricted, to one or more of those in Table 2:

Table 2 Gears available to vessels of 10 tsl or 150Kw or less

Gear Category		Gears	
Set gear	Attrezzi da posta	Gillnet	Imbrocco
		Trammelnet	tramaglio
		Pot	nasse
		Trap (similar to pots)	cestelli
		Fyke net	cogolli
			bertorelli
		Encircling net	rete circuitante
		Stationary net	rete da posta fissa
		Encircling gillnet	rete da posta a circuizione

¹⁹ To be removed completely from use.

²⁰ The licence is revoked if the legal entity it is awarded to ceases to exist, fishing is voluntarily abandoned or cessation of fishing activities is deduced from either: a failure to renew a licence up to six months after it ceases to be valid, the vessel having been laid-up for 3 years, or the physical loss of the vessel (art.6 DM 26/07/1995). Similarly, the licence is revoked if there is transfer of ownership of the vessel within 5 years of the licence being awarded or if the Ministry has not been informed within a certain time period of the death of the beneficiary, the transfer between districts of the registration of the vessel or fishing enterprise, or of the technical details of the vessel (art.6 DM 26/07/1995).

²¹ The documents issued must be kept onboard and available for inspection (art.9 DM 26/07/1995).

²² Also used in the event of a delay in issuing the renewal of a licence.

Driftnet	Ferrettara	Species specific driftnets of specified mesh size. For targeting small- and medium-sized pelagic species: Sardine, round sardinella, mackerel, bogue, saddled seabream, bullet tuna, little tunny, skipjack tuna & bonito	piccola derivante menaide sanguisara bisantonara alacciara bisara bogara sgomberara occhiata palamitara
Longline	Palangari	Bottom longline Drifting longline	palangari fissi palangari derivant
Line	Lenze	Hand line Pole and line Trolling line	lenze a mano lenze a canna lenze trainate
Harpoon	Arpione	Harpoon Multiple tipped harpoon Urchin pole Urchin dredge	arpione fiocina asta e specchio per ricci rastrello per ricci

(art.19(2), DM 26/07/1995)

Which of these gears a vessel can use depends largely on the age of the vessel (ie. if it was licensed prior to 1995 or received its first licence after this date) and what gears it was previously authorised to use. Where a vessel was already authorised to use four or five of these gear categories, the licence under DM 26/07/1995 continued to permit their use. For vessels which were only authorised to use lines or harpoons, the new legislation permitted the addition of a further category from the first three categories. For vessels previously authorised to undertake one of the first three categories, they could add a further system from the first three categories with the exception of driftnets, plus one of the last two categories. For these latter vessels, applications could also be made to the Ministry to substitute between the first three categories, excluding driftnets (art.19(3-6) DM 26/07/1995). In relation to any changes made, a new licence is required from the Ministry (art.20, DM 26/07/1995).

Under DM26/07/1995 a mechanism is provided for the transfer of licences between vessels. However, this is only in very limited circumstances, relating to the replacement of vessels. Notably, where a vessel of equal tonnage and power with an active licence is withdrawn from fishing activities or another vessel of the applicant has been wrecked within the 3 years preceding the application for the certified authorisation covered in the paragraph 2 of this section (art.13, DM 26/07/1995). The transfer or sale of a vessel does not constitute eligibility for the transfer of a licence (art.13).

Technical Management Measures

Under L963/1965 (art.14) and for the purposes of conserving the biological resources of the sea and ensuring that fishing is conducted in a disciplined manner, provisions are made at the national level for the setting of limits and permitted methods for fishing in Italian waters. These apply throughout the Italian Regions, including Sicily, unless regional legislation is enacted to supplement them. Notably the following have been prohibited and regulations produced at the national level to detail the species that can be caught and the fishing gears and equipment that can be used²³ (art.2 DPR 1639/1968):

To fish in zones or at times prohibited by regulation, decree or order or to possess, transport or trade the products of such fishing, and to fish in excess of any limits for species specified by regulation, decree or order.

To fish with vessels, equipment or gears prohibited or to place fixed apparatus or mobile gears without, or in contravention of authorisation, and to possess, transport or trade in the products of such fishing.

²³ Covers all Italian waters seaward of the geographical outer limit of internal waters (art.1).

To fish, possess, transport or trade in the juveniles of any marine species for which the capture of such life cycle phase is prohibited, without exempting authority from the Ministry of Agricultural Policy.

To damage marine biological resources through the use of explosives, electrical currents or toxic substances to stun, numb or kill, or to collect, transport or trade in the products of these activities.

To take, extract, free, transport or trade, without consent or entitlement to, the products of another person's fishing activities.

(art.15 L963/1965 as amended by art. 5 L381/1988)

An important limitation aimed at preserving coastal resources and habitats and reducing conflict between trawlers and artisanal fishermen is the prohibition of the use of towed gears in areas where the water depth between the surface and seabed is less than 50 metres or within 3 miles of the coastline where the water depth does not exceed 50 metres within that distance (art.111, DPR 1639/1968).

Species Restrictions

Under Presidential Decree DPR1639/1968, a national framework of minimum landing sizes has been created for the exploitation of marine resources in Italian waters, catering both for particular species and marine species in general (arts.87 and 88, DPR 1639/1968). The general provisions stipulate a minimum landing size of 7cm, unless the adult life stage of a species is smaller than this, in which case no minimum landing size is set (art.93 DPR 1639/1968). To these are added explicit provisions for certain, named species where different minimum landing sizes are deemed appropriate. These landing sizes apply throughout the spatial scale, unless more stringent minimum landing sizes are set for a particular locality. To provide for local variability in marine resources, locally specific conservation requirements and the optimisation of exploitation, the Head of the local Naval District, after consulting with the Local Advisory Commission for Marine Fishing, may propose to the Ministry the setting of more stringent landing sizes at the local level. If these recommendations are adopted, then these more stringent landing sizes will apply within the locality claimed for in preference to the national ones. Table 3 lists the minimum landing sizes of species of interest to this study, which do not fall within the general provisions, along with the source legislation.

Table 3 Minimum sizes for species caught in the Gulf of Castellammare

Species	Minimum size (cm)	Notes
Finfish		
spigola (Dicentrarchus labrax)	20	
sgombro (Scomber spp.)	15	
palamita (Sarda sarda)	25	
tonno (Thunnus thynnus)	70	
alalunga (Thunnus alalunga)	40	
tonnetto (Euthynnus alletteratus)	30	
pesca spada (Xiphias gladius)	140	
triglia (Mullus sp.)	9	Inserted by DM 3/08/1982, art.1
sogliola (Solea vulgaris)	15	
merluzzo o nasello (Merluccius merluccius)	11	
cefalo (Mugil sp)	20	Inserted by DM 5/06/1987, art.1
cernia (Epinephelus spp. and Polyprian americanum)	45	
orata (Sparus auratus)	20	
go (Gobius ophiocephalus)	12	
passera pianuzza (Platichthys flesus)	15	
Crustaceans		
aragosta (Palinurus elephas)	30	

astice (<i>Homarus gammarus</i>)	30	
scampo (<i>Nephrops norvegicus</i>)	7	

(arts.87 and 88 DPR 1639/1968)

Of each catch, not more than 10% of the specimens or 10% of the weight (and where possible of the volume) of the catch is permitted to be less than the prescribed minimum landing size, and any fish smaller than the minimum landing size are required to be discarded overboard (arts.87 and 91 DPR 1639/1968 as amended by art.1 DM 21/04/1983). Likewise, any berried female lobsters must be returned to the sea (art. 91 DPR 1639/1968).

In addition to minimum landing sizes, several species are covered by closed periods. The species of interest to this study so affected are given in Table 4.

Table 4 Temporal prohibitions on harvesting

Species	Temporal Prohibitions	Legislation
Lobster (<i>Palinurus vulgaris</i> , <i>Homarus gammarus</i>)	1 April to 30 April	Art.132, DPR 1639/1968
Swordfish	September to December	Art.134, DPR 1639/1968

Gear Restrictions

National gear specific provisions have been created to define the size and operation of specific gear types for the purpose of conserving and rationalising the exploitation of fish stocks. Table 5 sets out the national provisions governing those gears used most commonly in the Gulf of Castellammare.

In addition to these national provisions, the Head of the Naval District, upon consultation with the Local Advisory Commission for Marine Fishing and prior authorisation from the Ministry, may also create local rules relating to the size and operation of specific gear types. The purpose being to reflect the needs of local management and local customs (arts.96 and 97 DPR 1639/1968). In the Gulf of Castellammare this is manifest, in conjunction with provisions for the re-population of fish stocks, in the trawling ban (refer to the section 'Area Closures and Stock Re-population Initiatives').

Within the categories of gears and fishing types operating in the Gulf, one in particular has received specific attention in the regulatory framework: that of underwater fishing, manifest in the Gulf as spear fishing. Spear fishermen operate within the same area as the artisanal fishermen and also supply the same markets, although landings are relatively small. The rules specify that only fishermen who are specialist in and registered as underwater fishermen can participate and only those forms of diving which do not use auxiliary breathing apparatus can be used (art.128 DPR 1639/1968 as amended by art.5 DPR219/1983; art.27 LR1/1980). As with other categories of professional fishing, professional underwater fishermen are registered by the Head of the Naval District (art.1 DM 20/10/1986). The Head of the Naval District also awards the authorisation necessary to fish, the number of which are limited at any one time. Whether spear-fishermen in the Gulf comply with these requirements is open to debate. In consultation with the Local Advisory Commission for Marine Fishing, the Head of the Naval District is required, under article 8 of Ministerial Decree DM 20/10/1986, to set the maximum number of authorisations that should be given out, the maximum permitted amount fished each day, along with any periods of prohibition deemed necessary (for both professional and sport fishermen). Prior to being awarded the authorisation to fish, the fishermen must pass a medical examination, be registered in the registry of underwater fishermen and have appropriate underwater diving qualifications (art.3 DM 20/10/1986). Once authorised, they are only permitted to fish within that district authorised (art.2 DM 20/10/1986), to operate within a specified maximum depth (either 20 m or unlimited)²⁴, and to use specified gears. (arts.1, 4 DM 20/10/1986). There are also other spatial constraints, notably underwater fishing is prohibited: within 500m from bathing beaches, within

²⁴ The 20m-depth limit can be awarded to fishermen between 18 and 40 years, while the unlimited depth limit can only be awarded to fishermen between 18 and 35 years

100 from fixed fishing gear and nets, within 100m from vessels berthed outside a port; in any navigational areas around ports or anchorages so determined by the Head of the Naval District (art.129 DPR 1639/1968).

Table 5 National fishing gear provisions

Gear	Permitted dimensions	Prohibited accessories	Prohibited use
Set nets (Reti da posta)	Length: unlimited Mesh size: 20mm and above (no limits for sardines & anchovy)		Areas: within 200m of mouths or rivers and watercourses
Encircling nets (Rete da circuizione)	Size: unlimited Mesh size: 10mm and above	light sources in waters < 30m deep within 3 miles of the coast ¹	Areas - Purse seines ("cianciolo"): in waters <50m deep within 3 miles of the coast
Trawl nets (Reti da traino)	Size: unlimited Mesh size: 40mm and above (or smaller for species not conveniently fished with 40mm mesh, where authorised ²) Double bags: subject to size stipulations	Obstructions of the mesh to reduce gear selectivity	Areas: in waters <50m within 3 miles of the coast (unless operated from rowing boats or by hand from the shore); within 300m from buoys marking fishing gear
Lift nets (Reti da raccolta) (e.g. "trabucchi", "bilance", "quadre")	Size: unlimited Fixed or mobile Distance apart: as set by Head of Naval District Mobile versions operated from vessels: Mesh size: 10mm or more (no limit for cast nets)		
Long-lines (Palangari)	Buoyage: buoys <500m apart.		
Jigging lines (Totanara)	Accessories: luminous source only when gear is operated by hand		
Drift nets (Ferrettara)	Length: 2km or less Mesh: <150mm		Area: for certain species ²⁵ up to 31 December 2001, beyond 6 miles from the coast ²⁶

Notes: 1. With possible additional prohibitions set by the head of the local marine compartment for the purpose of protecting marine resources

2. In accordance with procedures laid down in art.32 Law 963/1965.

(arts. 103-116 DPR 1639/1968; art.1(3) DM 27/07/1998; art.1 DM 14/10/1998)

Restrictions on the exploitation of fish fry

Species and gear restrictions are supplemented during certain times of the year with provisions governing the exploitation of fish fry. The harvesting of fish fry is an important activity for artisanal fishermen within certain parts of the Gulf of Castellammare.

In addition to permitting the capture of fry for on-growing and release as part of stock replenishment initiatives (art. 125, DPR 1639/1968), the Minister for Agricultural Policy can also

²⁵ ricciola (amberjack), occiata (saddled seabream), sgombro (mackerel), palamita (skipjack tuna), lampuga (dolphin fish), boga (bogue), costardella (sauri), sardina (sardine), biso (bullet tuna), salpa (salema), alaccia (round sardinella) and acciuga (anchovy)(art.1(1) DM 14/10/1998). Violation of these provisions results on first offence to the withdrawal of the authorisation for 3 months and successive offences withdrawal for 6 months (art.3).

²⁶ From 1 January 2002 "ferrettarra" will only be permitted up to 3 miles from the coast and for ricciola (amberjack), occiata (saddled seabream), sgombro (mackerel), boga (bogue), sardina (sardine), salpa (salema), alaccia (round sardinella) and acciuga (anchovy)(art.1(1) DM 14/10/1998). The permitted mesh size will also be less than 100mm (art. 2(1) DM 14/10/1998).

authorise the exploitation of the fry of certain species by professional fishermen. Ministerial Decree DM 28/08/1996 clarifies this position, permitting certain classes of vessels in certain naval districts where fry fishing has traditionally been undertaken to fish professionally for fry of sarda (sardine), alicia (anchovy) and alaccia (round sardinella), as well as rossetto (transparent goby), notably:

vessels of 10 tsl and 100 hp (art.1(1))

vessels of higher tonnage and engine power, whose vessel owners had in previous years already obtained and used the authorisation of the Minister (art.1(2))

co-operatives that include vessels and their owners who meet the requirements of art.1(1) (art.1(5)).

The authorisation covers a period of up to 60 days between 1 December and 30 April each year. The authorised period in any year, however, may be less than this. The determination of the authorised period is the responsibility of the National Committee for the Management and Conservation of the Biological Resources of the Sea for the majority of Italian regions (art.1(3) DM 28/08/1996). Within Sicily, it is the responsibility of the Regional Councillor for Co-operation, Commerce, Handicraft and Fishing and is set by decree.

Applications for authorisation are required to be submitted to the Ministry for Agricultural Policy by 31st October each year for the following year (art 4 DM 28/08/1996). In practice this is via the Ministry's provincial offices. In Sicily, applications are submitted to the Local Harbour Offices (for the Gulf of Castellammare this is either the Ufficio Locale Marittimo of Castellammare or Terrasini).

Under national legislation, only vessel owners who have already received the relevant authorisation for a previous year are eligible for authorisation under these provisions. Similarly the authorisation can only go to the same or lesser number of boats that received the authorisation previously and if carried to a new boat, that boat must have the same tonnage and engine power as the previous vessel²⁷ (art.1 DM 28/08/1996). Once authorised, the vessel owners are permitted to fish between 0400 and 1800 during weekdays within the period, excluding festive days, and at night using lights for attraction and encircling nets (art.3 DM 28/08/1996). The gears that can be used are limited to trawl nets, seines, encircling nets and any nets used must not have a mesh size of greater than 5mm and must be lacking in teeth, chains or other artificial devices that increase penetration into seabed sediments (art.2(1) DM 28/08/1996). The right to fish awarded by the authorisation is accompanied by a right to possess, transport and trade in the fry (art.2(2) DM 28/08/1996).

As conditions of the authorisation, the fishermen are required to carry on board a written copy of their authorisation and to record the amounts, days and areas fished and submit this at the end of every month to the Local Harbour Office. Any failure to supply this record leads to the revocation of the authorisation²⁸.

Area Closures and Stock Re-population Initiatives

Alongside provisions to exploit the fry of certain marine species, there are also measures in place, at both the national and regional level, for the protection of juveniles, in the form of area closures and repopulation initiatives. The trawling ban and artificial reef complexes are the manifestation of this in the Gulf of Castellammare.

National, generic provisions for area closures for fishing pertain to measures for the protection of juveniles and the interests of fish and mollusc culture. Article 92 of DPR 1639/1968 (as amended), for example, enables the Minister of Agricultural Policy to ban or limit fishing activities within 200m of the mouths of rivers and other man-made and natural watercourses and in lagoons, estuaries or basins used for aquaculture or mariculture. Article 98 of DPR 1639/1968

²⁷ A formal request must also be made.

²⁸ None of this compromises the competence of the Regions of Special Charter (i.e. Sicily) to legislate on this matter, albeit that the latter would need to take onboard national policy and European Community commitments.

also permits the Minister for Agricultural Policy²⁹ to prohibit or limit, permanently or temporarily, fishing in the spawning³⁰ or nursery areas of marine species that are either commercially important or depleted due to over-exploitation.

At the local level, the Gulf of Castellammare, along with the Gulf of Catania and Gulf of Patti, are targeted areas for fish stock re-population. Under article 8(1) LR26/1987 the Regional Councillor for Co-operation, Commerce, Handicraft and Fishing is empowered, in consultation with the Regional Council for Fishing, to create by decree a regional plan for fish stock re-population with the aim of conserving, enhancing and managing rationally the biological resources of Sicilian coastal waters. The means available to them for use in this plan include the introduction of biological rest and re-stocking, the development of structures for control and surveillance tasks (art.1(2) LR31/1974 and art.8 LR26/1987) and monetary contributions (art 21 LR26/1987). Under earlier legislation, the regional administration also has the power to put into effect artificial reef programmes for the same purpose³¹ (arts.1, 2, 3 and 6 LR31/1974) and create zones of biological protection (art.25 LR1/1980 adopting article 98 of the Regulations approved by DPR1639/1968).

Of those measures that are specific to the Gulf of Castellammare, the principle mechanism for stock re-population is the use of zones of biological protection – the ban on trawlers and other vessels using similar gears fishing within that area of the Gulf lying landward of a line drawn between the Capo Rama and Torre Uzzo (art.9 LR25/1990).

This is supplemented by five artificial reef complexes installed between 1986 and 1997³² in the Gulf by the Consortium for Fish Re-population for the Gulf under the provisions of LR31/1974 and art. 8 of LR25/1990 (see footnote 31). The Consortium for Fish Re-population was established in the Gulf of Castellammare in 1980 under DPR 182/1980 and LR31/1974 (as amended by art.7 LR25/1990 and extended up to 1998 by art.3(1) LR33/1998)³³. Its membership includes the towns of San Vito, Castellammare, Balestrate, Trappeto, Terrasini, plus the Chamber of Commerce of Trapani and its geographical area of competence stretches between Punta Molinazzo (Terrasini), San Vito and Capo del Saraceno di Monte Cofano (art.3(4) LR33/98). The artificial structures³⁴ are aimed at performing two jobs, modifying the natural environment so as to increase the quantitative and qualitative level of fish production and preventing fishing using bottom scrapping gears (art 1(1)).

There are also a number of financial provisions. Those covering the study period are given below. The financial measures provided under the legislation, include monetary contributions of up to a maximum of Lit.200 million per annum in favour of the members of the Consortium for Fish Re-population set up in accordance with LR31/1974 (as amended). In addition, those fishing enterprises and crew members of trawl vessels affected by the trawling ban in the Gulf were eligible for financial assistance and compensation of initially up to Lit.7 million per tsl. (art.9(1, 5) LR25/1990). The amount has been revised subsequently, with the amount for 1997

²⁹ With the support of the Local Advisory Commission for Marine Fishing.

³⁰ On the basis of scientific and technical studies.

³¹ Under LR31/1974 and art. 8 of LR25/1990 the regional administration is empowered to both put into effect and finance artificial reef initiatives in zones of active re-population to exclude trawling and maintain the productivity of fish stocks (art.1(1) LR31/1974).

³² For further information refer to: Badalamenti F. & D'Anna G., 1995. Esperienze di barriere artificiali nel Golfo di Castellammare (Sicilia nord-occidentale). *Biol. Mar. Medit.*, 2 (1): 165-173; Badalamenti F., D'Anna G. & Riggio S., 2000. Artificial reefs in the Gulf of Castellammare (north-west Sicily): a case study. In: Jensen A.C., Collins K.J. & Lockwood A.P.M. (eds.), *Artificial reefs in European seas*. Kluwer Academic Publishers: 75-96; Riggio S., Badalamenti F. & D'Anna G., 2000. Artificial reefs in Sicily: an overview. In: Jensen A.C., Collins K.J. & Lockwood A.P.M. (eds.), *Artificial reefs in European seas*. Kluwer Academic Publishers: 65-73.

³³ LR70/1978 and LR33/1995 govern the constitution of consortia.

³⁴ The rules for state property concessions for the deployment of artificial reefs are prescribed by art.75 LR15/1993 in conformance with national law L41/1982 (as amended by art.21 L165/1992 and art.1 (2h) L164/1998), DM 19/07/1989 and L160/1989.

set by article 65(2) LR6/1997 and that for 1998 increased by a further 75% for 1998 by art.2 LR30/1998. The benefits are calculated on a daily basis up to a maximum of 150 working days per year³⁵. To be eligible the enterprises (both physical and legal persons) must be resident and legally based within the territory of the region, their vessels must be registered within the naval districts of Catania, Palermo, Messina, Trapani and Augusta and use trawls or similar gears. They must also have been operating within the area delimited by the trawl ban and cannot have been laid up for more than 1 year prior to the entry into force of the Law (art.9(2) LR25/1990 as clarified and amended by art.1 LR33/1995). The temporal duration of these provisions has been extended several times and under article 2 LR36/1995 now spans the duration of the ban itself. It should be noted, however, that any violation of the rules of fishing or related activities results in the loss of these benefits (art.12 LR25/1990).

Temporal Closures

In addition to area closures, there are temporal closures, “biological rest” periods, which were active within the Gulf of Castellammare during the study period.

Provisions for biological rest include the banning or limiting of access by trawlers into specified zones for up to 2 months a year under article 26 LR1/1980 and the suspension of fishing permits under article 12 LR63/1965, to aid the reproduction and regeneration of fish stocks³⁶. They also included during the study period, for a similar purpose, annual financial payments for the temporary cessation of fishing activities, under article 14(1) LR26/1987. The latter was adopted for a number of years in the Gulf of Castellammare, with the owners and crew of the artisanal vessels the beneficiaries. These payments have had a significant influence on the economic performance of the artisanal fleet during the study period.

The financial payments under article 14(1) LR26/1987 and active as from 1 January 1987 were incentive/compensation payments in support of periods of biological rest aimed at adapting fishing effort within Sicilian waters to fish stocks. The stipulated period of tie-up required to be eligible for the payment was a period of at least 45 days (either continuous or intermittent) “biological rest”, over and above an allowance of 115 days “technical rest” (when fishing is not possible due to bad weather or technical breakdowns)³⁷ (art.14(3)). To be eligible fishing enterprises/vessel owners³⁸ had to be resident and have legal status in Sicily for a minimum of 3 years, their boats had to be registered in the naval districts of Sicily and they had to be actively engaged directly in fishing, which also had to be their predominant activity (art.14(1)). In addition, the vessel had to have been fishing for at least 120 days of the current year (art. 14(3) LR26/1987 as amended by LR25/1990). Under art.43 LR33/1996, vessel owners in co-operatives (those who had passed the management of their vessels to the co-operative by 31 December 1993) were also eligible for the payments. The financial payments made were determined according to the tonnage and to the age of the vessels (see Table 6), in addition to the days of rest, both biological and technical.

Table 6 Payment to fishing enterprises and fishing societies for periods of rest, per day of biological rest

³⁵ The financial payments for both fishing enterprises and the crews of the vessels of those enterprises are issued in accordance with article 14 LR26/1987 (as amended), which provides for temporary fishing bans, “biological rest”. A specific exemption is made, however, from the minimum term of fishing activity prescribed by article 14 (art.9(2), 9(3) LR25/1990).

³⁶ Authority rests with the Regional Councillor for Co-operation, Commerce, Handicraft and Fishing, subject to the prior consultation of the Regional Council for Fishing and is subordinate to the competent Legislative Committee of the Regional Assembly (art.26 LR1/1980).

³⁷ Article 1(2) DM 16/06/1998 specifies that the relevant regional legislation and budgets of the Regions of Special Charter (including Sicily) govern socio-economic measures accompanying technical rest, as with the provisions for the temporary cessation of trawling.

³⁸ Newly formed fishing societies (although none were active in the Gulf) were also eligible for the payment, with the stipulation of 3 years under article 14(1) removed, provided that the associates of the society have resided in the region for at least 3 years (art.61(1) LR33/1996).

Tonnage of vessel	Vessel age: less than 10 years		Vessel age: 10 years or more	
<12 tsl	L60,000	Increased by 50% from 1 January 1990 (art.5(1) LR25/1990)*	L50,000	Increased by 50% from 1 January 1990 (art.5(1) LR25/1990)
12tsl < 30tsl	L120,000		L100,000	
30 tsl < 70 tsl	L290,000		L220,000	
70 tsl <100 tsl	L445,000		L370,000	
100 tsl < 200 tsl	L885,000		L590,000	
200 tsl < 300 tsl	L1,400,000		L1,035,000	
300 tsl <500 tsl	L1,775,000		L1,500,000	
500 tsl < 1,000 tsl	L2,200,000		L1,850,000	

(art.14 LR26/1987)

* Arranged by the regional councillor for co-operation, commerce, handicraft and fishing (art.5 LR25/1990)

During the periods of stoppage, the members of the crew were also eligible for a financial payment. For the number of effective days not fished during the biological rest and technical rest (calculated as 115 days each year), a daily payment of Lit.60,000 was made. This was on condition that during the solar year at least 100 or so days were spent at sea fishing in the districts of Sicily. Fishermen who had been actively fishing for at least 100 or so days during the reference year but only temporarily on vessels that undertook the 45-day biological rest were also eligible for the payment (art. 14(4) and 14(5) LR26/1987 as inserted by art.1(1) LR36/1994).

In 1998 new legislative provisions were enacted in effect replacing the aforementioned provisions. The new legislation LR 30/1998 provided for financial payments to accompany technical interruptions of marine fishing activities, extending national law (L164/1998) to the naval districts of Sicily. In accordance with article 3 of that Law, a financial payment could be given in 1998 to both the vessel owner and the crew for a technical rest of over 30 days, as determined by Minister for Agricultural Policy under article 4 of L41/1982. To which article 1(2) LR30/1998 added that fishing enterprises were permitted to benefit in 1998 from a technical interruption of up to 45 days, with the relative compensation commensurate with the days of effective suspension of fishing activities. According to article1(1) the conditions and procedures for providing these financial measures were to be fixed by decree of the President of the Region on the basis of a proposal submitted by the Councillor for Co-operation, Commerce, Handicraft and Fishing with prior consultation with the competent Legislative Committee of the Sicilian Regional Assembly and budget allocated appropriately. However, it would appear that while this regional law entered into force, it was not acted upon.

As article 3 LR30/1998 makes reference to, the financial provisions pertaining to this and other fisheries management measures are subordinate to active European community rules on the subject of state aid, as well as the definition of procedures under article 93(2),(3) of the founding Treaty of the European Community.

Economic Instruments

At both the national and regional level, there are a number of initiatives in place to support artisanal fisheries using economic instruments³⁹. Of those that apply to the artisanal fisheries in the Gulf of Castellammare, the principal mechanisms include financial assistance for the construction and modernisation of fishing vessels, equipment, institutional arrangements or support infrastructures; and 'hardship payments'. The practical accessibility by the artisanal fishermen of these financial opportunities has, however, proven extremely limited, largely due to the paperwork and bureaucracy involved and the reluctance of the banks to deal with the relatively small-scale loans applied for.

³⁹ All finance deals and payments (subsidies, loans, financial contributions to interest payments on loans) made available are subject to the subsidies and agreed maximums of aid under community rules (art17(1) LR26/1987 and other financial legal statutes).

Under Regional Law LR26/1987 (as amended by LR25/1990), LR33/1996 and LR1/1980, financial assistance is technically available to the artisanal fleet for the construction and modernisation of their vessels. Fishermen, single vessel owners, and associate owners⁴⁰ registered in the naval districts of Sicily, who actively and predominantly fish for a living and who have lived in the Region for at least 3 years, can apply for financial contributions (up to 30% of capital cost) and low cost financing (up to 35%) for the purchase and upgrading of certain vessels, *inter alia*:

The construction of motor boats or motor fishing vessels of 9m or less, without the requirement for the previous destruction of another vessel. The priority lies with vessels adopting technical innovation.

The improvement, transformation, maintenance and regeneration of existing fishing boats and the replacement of engines on operational fishing boats, irrespective of tonnage, providing that the vessel is not more than 30 years old and the vessel has been registered in Sicilian naval districts for at least 5 years before applying (art.3 LR26/1987 (as amended by art.3 LR25/1990), art.44 LR33/1996 and art.6 LR1/1980).

Fishermen's co-operatives, their consortia and fishermen's and vessel owners' societies can also apply, with financial contributions increasing for these applicants up to 55% of the capital cost (art.3 LR26/1987 as amended by art.3 LR25/1990, art.44 LR33/1996 and art.6 LR1/1980). To be eligible, the fishermen and vessel owners must demonstrate that they have actively fished for three out of the preceding five years, or two years in the case of immigrants and young people (less than approximately 20 years of age). For co-operatives and societies, at least 60% of their registered stock must originate from the financial contributions of member fishermen and vessel owners (art.2 LR26/1987). Prior to the construction and modification of a vessel, and receiving the financial award, permission to construct and modify the vessel must also be obtained in accordance with articles 3 and 4 of Ministerial Decree DM 26/07/1995 (as specified in the section 'Licensing', above). Upon satisfactory compliance with these conditions, the benefits are arranged and distributed by the Regional Councillor for Co-operation, Commerce, Handicraft and Fishing, in co-operation with the banks and after consulting with the Regional Council for Fishing.

Under the scheme, it is not permitted to convert vessels of less than 30 tons gross weight to trawling and any permission to construct new vessels is subject to the upper limits for fleet tonnage set at the national level by the Minister for Agricultural Policy (art.44 LR33/1996). Further any change in the location or use of the vessel involves the immediate forfeiture of the benefit (art.3 LR26/1987 (as amended by art.3 LR25/1990), art.44 LR33/1996 and art.6 LR1/1980).

In addition to this scheme, the Regional Councillor for Co-operation, Commerce, Handicraft and Fishing can also make in favour of fishermen and vessel owners contributions towards interest repayments on certain fishing associated loans, for periods of up to 2 years, such that the rate of interest (including all associated expenses) over that period does not exceed 6%. The size of the loan covered equates to Lit250,000 per ton of gross weight, with the total amount of the loan covered not exceeding Lit25 million per vessel (art.9 LR9/1985).

To increase the distribution and value of fish caught in Sicily, grants, loans and financial contributions towards interest repayments on loans are also available for onshore infrastructure and down-stream operations. The potential beneficiaries include, *inter alia*, registered fish traders (art.10 LR26/1987) and fish processing companies (art.11 LR26/1987). Under article 4 LR1/1980 co-operatives, associations, consortia of fishermen and vessel owners and fish traders⁴¹ are eligible for financial assistance and loans under favourable terms, up to a maximum of 40% and 60%, respectively of the cost of constructing and purchasing specified shore-based support infrastructure (buildings and equipment) for fishing, fish processing and trade:

Refrigerators and freezers

⁴⁰ Owning at least 13/24^{ths} of the vessel, unless the vessel is shared with their spouse (then 12/24^{ths})(art.2 LR26/1987).

⁴¹ Inserted by article10(4) LR26/1987.

Refrigerated vans

Local warehouses, centres of collection and sale to wholesalers

Equipment and refrigeration counters for the sale of fish products

Machinery for making fish product packaging.

In return, the systems, machinery and equipment must be used for a period of 10 years (5 years in respect of refrigerated vans)(art.4 LR1/1980) and any loans for which a contribution towards interest payments is sought, by fishermen and vessel owners, must be of 12 years duration or less (art.8 LR1/1980).

Of cross-sector applicability, there are also investment programmes aimed at small and medium sized enterprises for the purpose of developing industrial production and the service sector in Sicily (art.32 LR15/1993) and regional aid for the additional cost of transporting goods from Sicily to markets in Italy and Europe, reflecting the structural disadvantages of the region (art.1 LR33/1996).

With the aim of putting into effect measures to support small-scale, artisanal, coastal fisheries, these fisheries also became the targeted beneficiaries of another, dedicated financing initiative in 1998 (art.2(6) L164/1998). National Law 164/1998 authorised for that year, a budget of Lit15,000 million for support initiatives for this sector, with the Treasury Minister able to authorise adjustments of this budget over time (art.2(10)). This has been elaborated on and clarified by DM 14/09/1999⁴², although this decree did not come into force during the study period.

There were also other financial payments technically open to the artisanal fishermen during the study period, within the general category of 'hardship payments'. Under LR33/1998, article 1(1) the Regional Councillor for Co-operation, Commerce, Handicraft and Fishing is authorised to distribute to fishing enterprises payments for periods in which fishing activity is reduced by the incidence of a natural calamity (defined as a declared proven emergency). The list of criteria by which a reduction in fishing activity is to be determined is attached to Part IV of Community Regulation 3699/93 (Table 2) and subject to determination from time to time by the Regional Councillor after consultation with specified interested regional bodies (art.1(1),(4)). The payments under this initiative are equal to Lit60,000 for each member of the crew for each day for which the reduction is suffered, subject to their having fished for 181 days at sea on a vessel registered in the naval districts of Sicily (art.1(2) and art.2(1) LR33/1998).

The crew members of fishing vessels so affected are eligible for a fixed lump sum payment during the course of a year, which in 1998 was equal to Lit4,800,000⁴³. To be eligible for the payment, the fishermen must have fished for at least 181 days at sea on fishing boats registered within the naval districts of Sicily (art.2(1) LR33/1998). Included in the calculation of number of days at sea are days of illness or accident and enforced absence up to a maximum of 20 days.

Sport and Tourism Fishing

Sport Fishing

Alongside professional fishing in the Gulf of Castellammare, there is a growing and active sport fishery. This latter fishery is giving rise to a growing concern among the artisanal fishermen over the effect it is having both in terms of the resource and local markets for their products, given that catches appear to be both sizeable and finding their way onto the marketplace. It is,

⁴² Under article 1 DM 14/09/1999, the criteria for eligibility was in terms of boat size, gear used and operational distance from the shore:

- Vessel size – less than 12m in length and less than 10tsl and 15 gross tonnage
- Gears – set nets, drift nets, longline, line and harpoon (and other systems used locally and defined by local agencies)⁴²
- Distance from the shore – within 12 miles.

The extent of application of these provisions in internal waters is dependent on specific local rules, or in their absence, to national rules (art.1(4) DM 14/09/1999).

⁴³ The amount is to be adjusted annually on the basis of the ISTAT surveys on the cost of living.

therefore, pertinent to address the legal regime governing this 'competing' activity in this review, to establish the legal limits to this competition and the ability to manage the activity.

Sport fishing under article 7 (DPR 1639/1968) is defined as fishing undertaken for recreation and competition. As with professional fishing there are generic rules for sports fishing, and additional rules for underwater forms, and unless explicitly provided for sport fishing is subject to the legal rules governing professional fishing (art.137, DPR1639/1968). The activity is governed explicitly by L963/1965, article17, and regulations made thereunder. These establish the rules to be observed in the exercise of sport fishing and the cases in which individual gears can be used.

One of the basic provisions is the prohibition, under any form, of the sale or trade of the products of sport fishing (art.7 DPR1639/1968). To which are added limitations on what can be caught and how. Notably, sport fishermen are not permitted to catch fish, molluscs and crustaceans in excess of 5kg per day, except where an individual fish exceeds this weight, and in terms of grouper of any species, not more than 1 specimen may be caught (art.142 DPR1639/1968). The fishing gears that can be used are limited to the following:

Hand nets or liftnets of 6m or less

Cast nets (giacchio, rezzaglio or sparviero) of 16m or less

Set lines, pole and line with no more than 3 hooks, 'lenze morte', hand lines, current-driven hand-held lines (correntine) with no more than 6 hooks, lines for cephalopod and hand-operated rakes (rastrelli da usarsi a piedi). No more than 5 rods are permitted per fisherman

Trolling lines used on the seabed, surface or 'filaccioni'

'Nattelli' for surface fish, subaqua guns, hand-held harpoons and rods for cephalopod

Set or drifting longlines with less than 200 hooks per boat, irrespective of the number of people onboard

Two traps per boat

Lamps used in underwater fishing or a single lamp in conjunction with fishing by harpoon (art. 2 DM 7/01/1980, as amended by art.1 DM 6/08/1982).

Further, it is prohibited to undertake sport fishing less than 500m from a professional fishing operation (art.139, DPR1639/1968 as amended by art.4 DPR219/1983) and any vessels used for sport fishing must be pleasure craft, as distinct from a fishing vessel (art.143 DPR1639/1968).

In terms of recreational underwater fishing, as with professional underwater fishing, sport fishermen are not permitted to use auxiliary breathing apparatus. They cannot collect corals or molluscs, which are reserved for professional fishermen and they are required to comply with various safety provisions, including the limitation of their activities to day light hours (art.3 DM 7/01/1980). There are various safety provisions prescribed within the legislation, referring to, *inter alia*, the equipment and gears used, particularly the carriage of spear guns DM249/1987).

Fishing Tourism

In contrast to the competition engendered by sports fishing, tourism fishing provides an opportunity to the artisanal fleet for diversification, although one not exploited at present. With local people dominating tourism around the Gulf, many with their own boats tourism fishing opportunities at present are viewed as limited, and centred around a smaller number of tourists coming from outside the area.

The rules governing tourism fishing principally relate to the safety and comfort of the passengers and the desire to avoid the use of fishing boats to ferry passengers between locations on the coast. For the purpose of taking people to sea onboard fishing boats for recreation, a vessel has to be registered with the local Naval District and authorisation received to carry passengers in accordance with the provisions of article 27bis L41/1982 and article 117(3) L400/1988. Up to 7th September 1999, when Decree 293/1999 came into force, the following more detailed rules applied.

The Head of the Naval District was responsible for issuing the necessary authorisation, which required the evaluation of the emergency provisions onboard the vessel and its stability, and

ultimately specified the number of people allowed onboard and the requirements for additional safety provisions⁴⁴ (art.5 DM 19/06/1992). The vessel owner was also required to have a valid emergency certificate, which was to be presented at the start of operations to the registry office, along with an indication of the tariffs they intended to apply (art.8 DM 19/06/1992). Upon authorisation, the boats could then only operate in the registering District and its neighbouring districts, out to 3 miles from the coast, picking up and dropping down the passengers at the same point (art.2, 3 DM 19/06/1992). The limits of operation also stretched solely between 1st May and 30th September each year (art.1 DM 19/06/1992) and to daytime hours and to sea states not exceeding force 2 (unless exemptions to the latter were made at the start of the season by the Head of the Naval District on the grounds of local geomorphological conditions) (arts.2, 3 DM 19/06/1992). In terms of the gears used, all existing gears covered in the vessel's licence were permitted, with the exception of trawls and encircling gears⁴⁵, unless otherwise prescribed for the District (art.96 DPR 1639/1968)(art.4 DM 19/06/1992). The gears permitted for sport fishing could also be used (art.138 DPR 1639/1968).

Since 7th September 1999, under Decree 293/1999, only vessels licensed in the categories of local coastal and inshore fishing have been permitted to board persons other than the crew for the purpose of fish tourism, which has been re-defined as:

The practise of sport fishing, using sport fishing gears

The conduct of short excursions along the coast for the purpose of observing and revealing the culture of the sea and fishing, and observing the activities of professional fishermen

The carriage of persons for the purpose of familiarising them with and improving the quality of the coastal environment, coastal lagoons and where authorised by the competent region, of internal waters (art.1(2)).

For the necessary authorisation to undertake fishing tourism, applications must be made to the Head of the Naval District where the fishing vessel is registered, accompanied by the vessel's safety documentation and the tariffs that the vessel owner intends to apply. Any single, enterprise and co-operative vessel owner⁴⁶ can apply (art.1(1)). Authorisation is subject to the Head of the Naval District being satisfied with the documentation and the vessel passing the required safety tests. As previously, upon issue, the authorisation stipulates the maximum number of persons allowed onboard (up to a maximum of 12) and any additional safety provisions required. Where modifications are made to the technical characteristics of the vessel a new authorisation is required with new safety tests carried out (arts. 5 and 7 D293/1999).

The temporal limitations on fishing tourism have also been clarified by the new Decree. The activity can now be undertaken under suitable meteorological conditions during the daylight hours of weekdays and holidays, and by special arrangement⁴⁷ also during the night (art.2(1) Decree 293/1999). For the latter, however, the vessel must be equipped with accommodation for the passengers, equal to that of the crew (art.5(c) D22/06/1982). The activity may be undertaken all year round. However, to be authorised for the period 1st November to 30th April the boat must have sufficient shelter for the people onboard (art.4 D293/1999). The vessels can only operate, as before, in the district in which they are licensed and its immediate neighbours, but the vessels authorised for local coastal fishing⁴⁸ are now permitted to go up to 6 miles from the coast and vessels authorised to undertake inshore fishing permitted to go up to 20 miles from the coast (art.2(1) D293/1999). As with the previous rules, the vessels are required to return their passengers to the departure port, unless the situation requires them, out of necessity, to go into another port (art.2(2) D293/1999).

⁴⁴ Article 5 DM 19/06/1992 specifies the requirements for onboard safety equipment, including life jackets, rings and flares.

⁴⁵ If a vessel was licensed only for trawls or encircling gears, a temporary certificate could be applied for from the registry office for the use of other gears permitted under article 19 DM 16/07/1995)(art.1-bis DM 19/06/1992 as inserted by art.1 DM 1/04/1998).

⁴⁶ Fishing co-operatives and fishing enterprises may even acquire dedicated vessels for the purpose, provided that they are 10 tons gross weight or less and obtain the required certificate of vessel registration (art.4 D 293/1999).

⁴⁷ As laid out in Article 5(1c) DM 22/06/1982.

⁴⁸ Or those acquired for the purpose (see footnote 46).

In terms of the gears that may be used, the existing vessels⁴⁹ of the applicant can use the same gears as covered by their fishing licence, subject to the rules of the local District, as stipulated in article 96 DPR 1639/1968 (art.3(1) D293/1999). The use of sport fishing gear is also permitted. For safety reasons, however, the vessel owner is required to ensure that such systems do not hinder the normal activities on board the vessel during navigation (art.3(3) Decree 293/1999). This is in addition to the other health and safety provisions required onboard, which include sanitary provisions, rescue equipment (see **Table 7**), and VHF radio.

Table 7 Rescue equipment onboard boats used for fishing tourism

Equipment	Required by (vessel specification)
Rafts sufficient for all persons	Inshore fishing vessels authorised to go beyond 3 miles from the coast
Floats sufficient for all persons	Local coastal fishing vessels authorised to go beyond 3 miles from the coast
Life jacket per person	All vessels
Life rings	(except those operating within 1 mile of the coast)
1	boats of 10m or less
2 (1 of which is luminous)	boats greater than 10m
4 (2 of which are luminous)	boats over 24m

(arts.12,13 and 14 D293/1999)

Any contravention of the terms of authorisation and the rules governing fishing tourism under Decree 293/1999 results in the revocation of the authorisation for one year (art.7(2)).

⁴⁹ Where the vessel is licensed only for trawling, a temporary certificate can be applied for from the Head of the Naval District for the use of other gears permitted under article 19 of DM 26/07/1995. However, the towing systems must be removed from the vessel and secured by the local maritime authority before tourism fishing activities begin (art.3(2) D293/1999). Where a vessel is acquired solely for the purpose (see footnote 46), those gears laid out in article 19 of DM 26/07/1995 are permitted, with the exclusion of Longlines.

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