Economic effects of marine protected areas on small-scale fisheries: a case study of the trawl ban in the Gulf of Castellammare, Sicily

by

David Whitmarsh, Carl James & Helen Pickering (CEMARE)[1]

Carlo Pipitone, Fabio Badalamenti & Giovanni D'Anna (CNR-IRMA)[2]

[1] CEMARE, Department of Economics, University of Portsmouth, Locksway Road, PORTSMOUTH, PO4 8JF, UK
Email: david.whitmarsh@port.ac.uk

[2]CNR-IRMA, Laboratorio di Biologia Marina, via G. da Verrazzano 17, 91014, Castellammare del Golfo (TP), Italy
Email: pipitone@irma.pa.cnr.it

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Abstract**:** Despite growing interest in Marine Protected Areas, relatively little is still known in practice about their economic impact or their distributional consequences for stakeholders. The present paper, based on an EU-funded project, attempts to shed light on this issue by examining the economics of an artisanal fishery operating in an area of NW Sicily from which trawlers have been excluded. The main issues examined relate to the financial performance of trammel net vessels, focussing especially on (i) current profitability levels, (ii) financial implications of changes in catch rates, (iii) financial viability of capital investment and (iv) comparative performance of vessels inside and outside the trawl ban area.

Keywords: artisanal fishery; marine protected area; trawl ban; financial performance

1. BACKGROUND TO THE STUDY

In recent years the use of marine protected areas (MPAs) as a method of managing coastal fisheries has gained popularity, and increasing numbers of MPAs are being established throughout the World. Though arguably not a 'first best' management strategy, MPAs offer a number of advantages over other management measures (Holland and Brazee, 1996). In particular they may have a useful role in situations where there is less than perfect information on fish stocks and harvests (Hall, 1998; Hannesson, 1998), such data being the underpinning of regulations based on the direct control of catches or fishing effort. Specific benefits attributable to MPAs include reduced risk of stock collapse, increased sustainable yield via 'spillover' effects, protection of vulnerable habitats and the elimination of user conflict through the separation of incompatible activities (Bohnsack, 1993 and 1996). However, while considerable progress has lately been made in understanding the bioeconomic implications of establishing 'no take' fishing zones (Holland and Brazee, 1996; Hannesson, 1998, Sanchirico and Wilen, 1999; Conrad, 1999; Pezzey, Roberts and Urdal, 2000; Milon, 2000), relatively little is still known about their economic effects in practice; specifically, about the way in which MPAs affect the economic condition of fisheries or how gains and losses may be distributed amongst the various participants. Without such information it may be difficult to make a rational assessment of the effectiveness of MPAs alongside other fisheries management measures.

The present paper, based on an EU-funded study undertaken jointly by CEMARE and CNR-IRMA, hopes to shed light on this issue by examining the economic effects of one particular MPA currently in existence in NW Sicily (Figure 1).

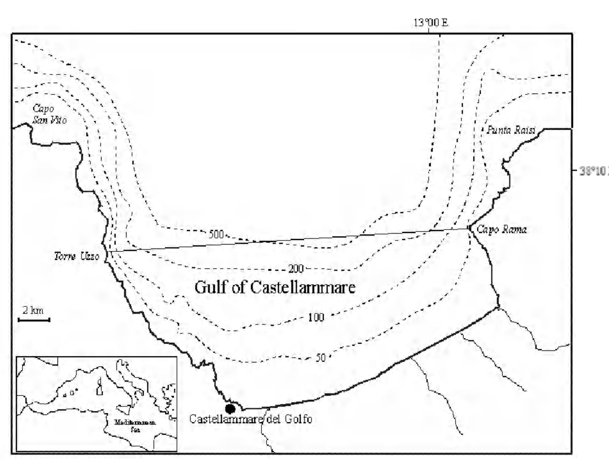


Figure 1: The Gulf of Castellammare, NW Sicily

In 1990 the Sicilian Regional Government imposed a year-round trawl ban in the Gulf of Castellammare, aimed at rebuilding the severely depleted demersal stocks and eliminating the conflict between the trawlers and the small-scale artisanal vessels operating in the Gulf. Currently, fishing within the trawl ban area is restricted to artisanal and recreational vessels. A study funded by the European Commission (MED 92/011) and undertaken by CNR-IRMA between 1993-5 assessed the state of the fish resources in the Gulf and the effects of the trawl ban on their abundance. The study demonstrated an 8-fold increase in biomass of the whole fish assemblage within the prohibited zone four years after the implementation of the ban (Pipitone et al., 1996), raising the question of how far the biological improvements had been translated into economic gains for the artisanal fleet. The current project aims to investigate this particular issue, given the recent biological evidence on the state of the fish stocks, as well as looking more generally at the major economic consequences of the trawl ban for the artisanal fisheries of the Gulf.

2. CHARACTERISTICS OF THE ARTISANAL FISHERY

The Gulf of Castellammare has a perimeter of approximately 70 km and is one of the widest bays of the Island of Sicily. 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, 29 purse seine vessels and 9 unlicensed artisanal boats (which, however, are still registered as active on the coast guard register). Within the artisanal fleet the main gear types and fishing methods are trammel nets, set gillnets, FAD seine and squid jigging. For fishing to be undertaken as a professional enterprise, the fishermen must themselves be registered as such, and so must the boat.

Over 80 commercial varieties of fish are caught and sold locally, some of the more important being Red Mullet *(Mullus barbatus),* Picarel *(Spicara flexuosa),* Sea Breams *(Diplodus sargus, D. vulgaris and Pagellus spp.),* Hake *(Merluccius merluccius),* Amberjack *(Seriola dumerili)* and Dolphinfish *(Coryphaena hippurus).* The sales path for fish within the Gulf of Castellammare is quite complicated with different distribution channels depending upon the fish, the port and the fisherman. 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. The fish are sold most often as a 'mixed bag', with only the highest value species having an individual price. These include the Seabreams, Tunas, Cuttlefish, Dolphinfish, Shrimp, Lobster, Amberjack and a few others. The rest are sold as 'Soup fish', which is mixed low value species.

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. Recreational boats in the Gulf now outnumber artisanal vessels by 14 to 1. (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.

3. METHODOLOGY AND DATA COLLECTION

Economic assessment of the artisanal fishery required the collection of primary data, the main sources of which were fishermen, fish wholesalers and retailers, and equipment suppliers. Data collection during 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.

The landings survey was the principal source of costs and earnings data on the artisanal fisheries, and given its importance in the present context it is necessary to explain the way it was carried out. The structure and methodology broadly followed the conventional categories and definitions of fishing expenses used in similar financial surveys (Davidse et al., 1993; Pascoe et al., 1997; European Commission., 1998; Whitmarsh et al., 2000), although in this case fishermen were not required to supply separate information on items such as depreciation. However, there were two features of the survey which made it distinctive. Firstly, unlike most costs and earnings surveys which typically involve the 'one-off' collection of annual data at a specific point in time, the approach used here was to collect data at regular (fortnightly) intervals over a 12 month period. This had the advantage of allowing us to monitor the activity and performance of the fleet throughout the year as well as giving aggregate performance data once it was completed. The surveys were undertaken on a census basis, with all active fishermen on any given day being surveyed, while those fishermen not active were also surveyed and the reason for their inactivity recorded. Secondly, given the reluctance of fishermen to supply information on their sales revenue, the monetary value of production (and hence earnings) was assessed using imputed values for the main fish species. These were derived by asking wholesalers how much they were buying the fish for, with prices being recorded for all major species purchased on the day of the landings survey. Where the full co-operation of the wholesalers was not forthcoming, fish price data was obtained on a fortnightly basis from retailers.

Supplementary financial information was obtained from interviews held with the main gear manufacturer/supplier in the area. 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 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. Costs and earnings data derived from fishermen via the landings surveys were corroborated by 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 one based in Terrasini who represents fishermen from Balestrate, Trappeto and Terrasini. The accountants were also instrumental in describing the conditions under which the fishermen operate, one particularly important aspect of which relates to membership of co-operatives. From an expenditure point of view, membership of a co-operative can have considerable tax advantages, and while it might also have been expected to have marketing advantages this proved not to be the case in practise.

4. FINANCIAL PERFORMANCE OF THE ARTISANAL FISHERY

4.1 Profitability in 1998/99

Based on the methodology outlined above we were therefore able to obtain costs and earnings figures for the artisanal fishermen of the Gulf. In both Castellammare and Balestrate the sample sizes represent approximately 50 per cent of the active fishermen, in Trappeto and Terrasini they represent approximately one-third of the active artisanal vessels. The measures of financial surplus used in the study were defined as follows:

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 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 in terms of the standard deviation (SD) and coefficient of variation (CV). Here we report the results for trammel netters, the predominant type of vessel used in the artisanal fishery. (Table 1). Focussing on boat income, the very considerable variation in performance becomes clearer from the histogram given in Figure 2.

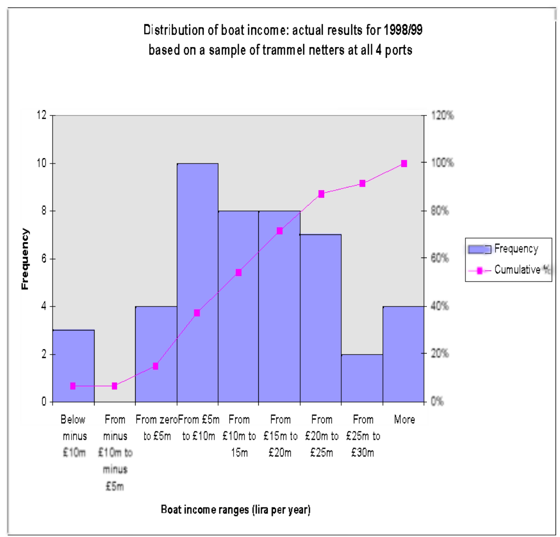


Figure 2: Profitability of trammel net fisheries in 1998/99 (mean net profit = 8.70 million lira)

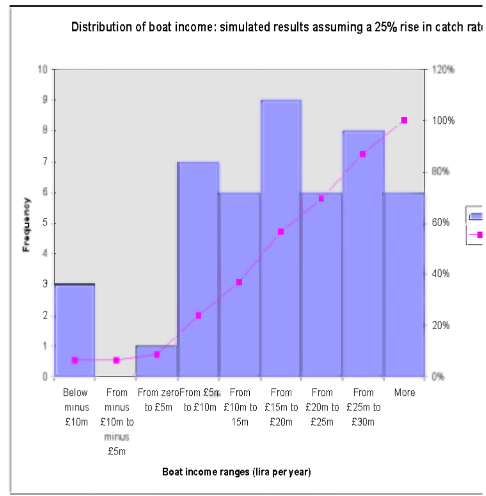
In 1998/99 some trammel netters made losses while some earned profits substantially above the mean (8.7m lira) for all vessels operating in the Gulf. Table 2 gives a clue as to the source of this divergent performance, since it is clear that there were inter-vessel differences in respect of utilisation 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.

4.2 Implications of changes in catch 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. While this is only one of the factors which affect profits, it is of particular significance since it represents an important target of fisheries management and arguably measures the success of management at maintaining harvestable fish stocks.

Our principal concern is to see by how much performance would change if vessel catch rates deviated from their baseline levels by a specified amount. We start with the actual distribution of boat income as depicted in Figure 2 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 and 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) to vary, keeping the other components constant.

The results are given in Figures 3 and 4, which simulate the effects of a 25% fall and 25% rise respectively in vessel catch rates on boat income. In the former case (Figure 3) 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 (Figure 4) the distribution of boat incomes is shifted to the right, the mean profit figure rising to 13.22 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 vessel catch rates results in a proportionately greater change in financial profits: the results suggest that a 25% change in catch rates leads to an approximately 50% change in profits in the same direction.

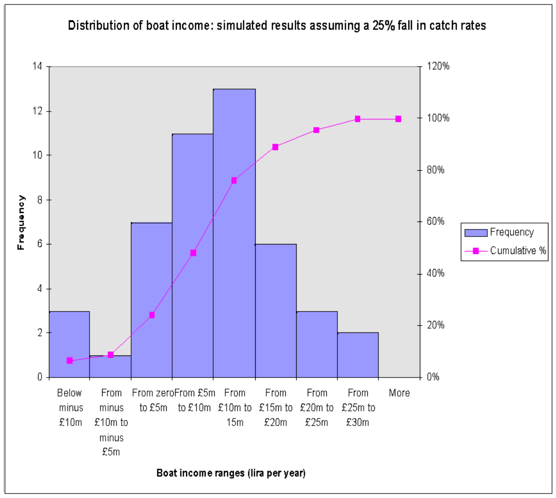


Figure 3: Profitability of trammel net fisheries assuming a 25% fall in catch rates (mean net profit = 4.20 million lira)

Figure 4: Profitability of trammel net fisheries assuming a 25% rise in catch rates (mean net profit = 13.22 million lira)

4.3 The financial viability of capital investment

To answer the question of whether it would be financially worthwhile to re-invest 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 returns 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:

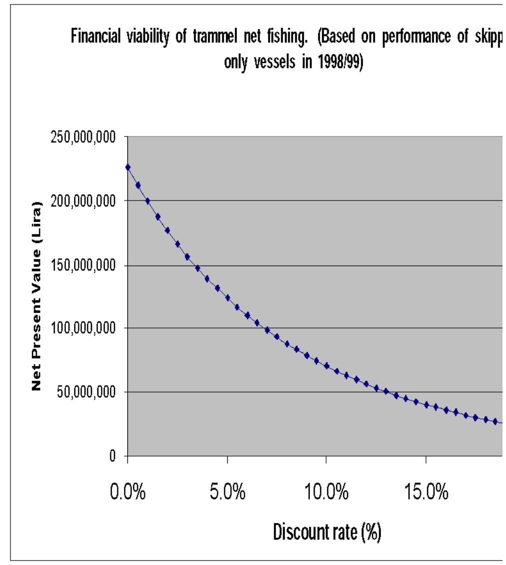
$$NPV = \frac{(B_0 - C_0)}{(1+r)^1} + \frac{(B_1 - C_1)}{} \ldots + \ldots \frac{(B_n - C_n)}{(1+r)^n} \quad (1+r)^0$$

Where:

$B_0 \ldots B_n$ = financial benefit expected in each year 0 to n

$C_0 \ldots C_n$ = 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 Figure 5 and Table 3. 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 5. To test the sensitivity of the project to the various factors which can affect its profitability we have adopted the standard procedure 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, 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 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.

Figure 5: Net Present Value as a function of the discount rate

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 have the evidence of the motivation survey 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.

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

A specific question which follows from the previous analyses 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 4 while the differences in the means are evaluated (using an independent samples t-test) in Table 5. 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 5 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 6, 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.

5. CONCLUSIONS

Results of the survey undertaken in the Gulf of Castellammare in 1998/99 indicate that artisanal fishing vessels on average earned positive net financial profits, albeit with a very wide dispersion around the mean. The 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, etc.) are maintained. Such a proviso is clearly relevant to any policy discussion relating to 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. Evidence that the artisanal fishery would indeed be adversely affected by such a move can be adduced from the generally poorer operating performance of vessels based outside the trawl ban area compared with similar vessels inside, as well as the biological survey results demonstrating that stock density is lower on fishing grounds presently outside the prohibited zone.

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Table 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 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	7,696,491	7,557,583	0.98

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.

(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

Table 3: 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 (%)
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 4: 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

Table 5: 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% Confidence Interval of the Difference	
									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
TOTRUN	Equal variances assumed	.245	.623	-4.177	44	.000	-1,406,760	336,816	-2,085,569	-727,951
	Equal variances not assumed			-4.258	8.442	.002	-1,406,760	330,364	-2,161,695	-651,825
TOTLAB	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	42.914	.000	2,987,752	746,839	1,481,520	4,493,983
TOTFIX	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	10.848	.609	1,298,022	2,463,868	-4,134,204	6,730,248
TOTREV	Equal variances assumed	.489	.488	1.188	44	.241	4,378,018	3,684,382	-3,047,365	11,803,402
	Equal variances not assumed			1.221	8.502	.255	4,378,018	3,584,480	-3,803,590	12,559,627

Table 6: 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	28.10	24.90	0.9	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	37.16	24.24	0.7	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

Source: based on experimental trawl surveys