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**Spiny lobster fishery on the southwest coast of
Portugal: Conciliating fisheries and conservation.**

A pesca da lagosta na costa sudoeste de Portugal: Conciliar a
pesca e a conservação.

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*“Personally, I'd like to go on
for a hundred years...
Think of all the things
that are bound to
happen!”*

Virginia Woolf

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Although this thesis has in its cover only the author's name, none of this work would have been even possible to accomplish without the hefty support of some people, that I fear I may unintentionally forget her. If that is the case, please accept my sincere apologies.

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ABSTRACT

The European spiny lobster, *Palinurus elephas* is an important commercial spiny species in north-eastern Atlantic and Mediterranean and it has been traditionally targeted by artisanal fisheries throughout its range. In Portugal, the most important port is Sagres, where over half of the catches are landed

Spiny lobsters were caught with baited traps until the 1970s, when fixed nets were introduced leading to the virtual disappearance of the traps. As a direct consequence, fishing effort increased and lobster populations in the north-eastern Atlantic were severely depleted. Nowadays, *Palinurus elephas* is a by-catch species of net fishing and in 2008, during this work it represented only 12% of the catch.

A comparison between nets and traps was made, assessing the catchability and selectivity of both gears in order to evaluate the environmental impacts of both gears and assess the viability of the reintroduction of traps in lobster fishery.

The catch and effort data available for the *P. elephas* fishery is poor due to widespread commercialization of lobster outside the legal circuit. The management for this species is based on a few technical measures: minimum landing size of 95 mm carapace length and prohibition of landing berried females.

However, these measures are controversial (i.e. very few lobsters above minimum landing size are caught) and are frequently ignored. Therefore, in order to conciliate fishing management with conservation practices towards the recovery of European spiny lobster population, it is necessary to enhance fisher's compliance. One way of achieving this objective is to incorporate fisher's knowledge into the management, a task made easier by the fact that, in Sagres, the fishing community is highly cohesive and compromised with their activity.

Provided with knowledge and experience about important aspects of the system, fisher's participation are crucial to implement acceptable management measures. In this way, stakeholder analysis is proposed in this work as a tool to reverse the decadence of the spiny lobster stock and include community participation in the definition of regulatory measures, considering ecosystem and socio-economic factors.

Key-Words: *Palinurus elephas*; Artisanal fisheries; Sagres; Management measures; Stakeholder analysis; Q methodology.

RESUMO

A lagosta *Palinurus elephas* é uma das espécies com maior relevância comercial no Atlântico Nordeste e no Mediterrâneo sendo, tradicionalmente, um dos alvos da pesca artesanal. Em Portugal, o porto de Sagres é o mais importante, onde cerca de metade das capturas são desembarcadas.

Até ao final dos anos 70, a lagosta era comumente capturada com armadilhas iscadas, quando se deu a introdução de redes fixas, como as redes de tresmalho conduzindo, virtualmente, a um aumento do esforço de pesca ficando, conseqüentemente, a população de lagosta seriamente esgotada. Actualmente, a *Palinurus elephas* constitui um *by-catch* das pescas dirigidas a peixes representando, em 2008, no decorrer deste estudo, 12% das capturas totais.

Foi efectuada uma comparação entre redes e armadilhas, de forma a avaliar a capturabilidade e selectividade de ambas as artes, avaliando os efeitos de uma possível reintrodução de armadilhas na pesca da lagosta.

Dados acerca da captura e esforço são fracamente consistentes, devido a uma vasta comercialização da lagosta fora do circuito legal. A gestão desta espécie tem, por base, algumas medidas técnicas: tamanho mínimo de captura de 95 mm de comprimento de carapaça e a proibição de desembarque de fêmeas ovadas.

Porém, estas medidas são controversas (i.e. são capturadas poucas lagostas com tamanho acima do permitido) sendo, frequentemente ignoradas. Assim, de forma a ser possível conciliar as pescas com medidas de conservação, que visem a recuperação da população de lagosta, é necessário fomentar o envolvimento de pescadores. Um modo de alcançar este objectivo consiste na incorporação do conhecimento dos pescadores nas medidas de gestão, uma tarefa facilitada pelo facto de a comunidade pesqueira de Sagres ser altamente coesa e comprometida com a sua actividade.

A participação dos pescadores que, por deterem experiência e conhecimentos relevantes acerca de aspectos do sistema, é crucial para a implementação de medidas de gestão aceitáveis. Desta forma, uma análise de stakeholder's é proposta neste trabalho, como uma ferramenta para reverter o estado decrépito do stock de lagosta, incluindo a participação da comunidade na

definição de medidas de regulamentação, considerando o ecossistema e factores socioeconómicos.

Palavras-chave: *Palinurus elephas*; Pesca artesanal; Sagres; Medidas de gestão; Análise de stakeholder's; Metodologia Q.

LIST OF FIGURES

PAGE

- Figure 1.**European Spiny Lobster, *Palinurus elephas* (Fabricius, 1787). Source: www.faocopemed.org, assessed on March 2011.....**2**
- Figure 2.**Location of European spiny lobster, *Palinurus elephas*, fishing grounds off the Southwest (SW) coast of Portugal. The squares indicate the fishing grounds and the dots indicate the position of individual nets: 1-Arrifana, 2-Carrapateira, 3-Ponta Ruiva and Pedra do Cajado, 4-Cabo de São Vicente, 5-Tonel, 6-Fortaleza, 7-Legítimo and 8-Barranco (adapted from Galhardo 2006) The main fishing areas for the European spiny lobster are: 1 – Arrifana, 2 – Carrapateira, 4- Cabo de São Vicente, 5- Sagres.....**7**
- Figure 3.**Scheme of the experimental trap used in the current study, adapted from (Gristina 2004).....**16**
- Figure 4.**Details of the experimental network: a) trap, b) network construction at port of Sagres, c) detail of the base of the signaling poles d) detail of the terminal branch line (photos by A. Leocádio and M. Inácio).....**17**
- Figure 5.**Trammel net gear, with specifications for this study. Source: www.fao.org, assessed on April 2011.....**18**
- Figure 6.**Q-sorting grid for 23 statements with a seven-point scale: -3 (most disagree) -2 -1 0 +1 +2 +3 (most agree), based on (Guimarães 2009).....**24**
- Figure 7.**Size structure of the catch of *Palinurus elephas* sampled in the port of Sagres between May and September of 2008. Frequencies are grouped by 5mm classes and sex. The red arrow indicates the minimum landing size of 95 mm Carapace Length.....**29**

Figure 8. Catches, in kg, of *Palinurus elephas* (Spiny Lobster) in port of Sagres from 1998 to 2007 and catches, in kg, of *Nephrops norvegicus* (Norway Lobster) in ports of Sagres and Vila Real de Santo António from 1998 to 2007 (Source: General Directorate of Fisheries and Aquaculture.....**30**

Figure 9. Number of vessels targeting *Palinurus elephas* (Spiny Lobster) in port of Sagres from 1998 to 2007 and *Nephrops norvegicus* (Norway Lobster) in ports of Sagres and Vila Real de Santo António from 1998 to 2007 (Source: General Directorate of Fisheries and Aquaculture.....**31**

Figure 10. Economic importance variation of *Palinurus elephas* (Spiny Lobster) in port of Sagres from 1998 to 2007 and economic importance variation *Nephrops norvegicus* (Norway Lobster) in ports of Sagres and Vila Real de Santo António from 1998 to 2007 (Source: General Directorate of Fisheries and Aquaculture).....**34**

Figure 11. Relation price, in Euros, per kg of *Palinurus elephas* (Spiny Lobster) in port of Sagres from 1998 to 2007 and relation price, in Euros, per kg of *Nephrops norvegicus* (Norway Lobster) in ports of Sagres and Vila Real de Santo António from 1998 to 2007 (Source: General Directorate of Fisheries and Aquaculture).....**34**

Figure 12. Percentage representation of each taxonomic group caught in the lobster fishery for 2008**35**

LIST OF TABLES

PAGE

Table1. Statements referred to the most common discourses among stakeholders (Q-set ₁).....	21
Table2. Statements used in Q-sort questionnaire (Q-set ₂) referred to management measures.....	22
Table3. Number of statements that had to be allocated in each scales score.....	25
Table4. Classification of the fishing fleet registered in Port of Sagres by vessel size (LOA = length overall) and licensed main fishing gears (FPO = Pots and traps; GNS = Gillnets and Entangling nets – anchored nets; GTR = Trammel nets; LHP = Hand-lines and Pole-lines; LLS = Set longlines; LTL = Trolling lines; PS = Purse seiners). Source: MARE Fleet's Register of U.S. fishing vessels.....	32
Table5. Classification of the fishing fleet registered in Port of Sagres by vessel size (LOA = length overall) and licensed secondary fishing gears (FPO = Pots and traps; GNS = Gillnets and Entangling nets – anchored nets; GTR = Trammel nets; LHP = Hand-lines and Pole-lines; LLS = Set longlines; NO = No secondary gear). Source: MARE Fleet's Register of U.S. fishing vessels.....	32
Table6. Catches by number obtained with traps and trammel nets in the port of Sagres in the period from May to September of 2008.....	36
Table7. Most important points of view expressed by fishermen during the questionnaire (sentences from Q-set ₁).....	38

Table8. Factor matrix with an **X** indicating a defining sort. % Expl.Var. = percentage of explained variability; %Cum. Var. = percentage of cumulative variability.....**40**

Table9. Correlation between factor scores.....**40**

Table10. Factor characteristics for respondents.....**43**

INDEX

ACKNOWLEDGEMENTS.....	i
ABSTRACT	ii
RESUMO.....	iv
LIST OF FIGURES.....	vi
LIST OF TABLES.....	viii
INTRODUCTION	1
<i>Palinurus elephas – Biology and Ecology</i>	1
<i>Importance of Lobster Fisheries – The case of Palinurus elephas</i>	3
<i>Artisanal Lobster Fishery in Portugal</i>	3
<i>Fishing Methods</i>	4
<i>Main Fishing Areas for Palinurus elephas</i>	6
<i>Fishing Fleet</i>	7
<i>Management Measures of Palinurus elephas Fishery in the sw Coast</i>	8
<i>Need for new management measures – Participative Methodology in Fisheries</i>	9
<i>Participative Methodology: Q – method</i>	10
OBJECTIVES.....	13
MATERIAL AND METHODS.....	14
<i>Statistical Data Collection</i>	14
<i>Sampling</i>	14
<i>Selectivity between nets and traps</i>	16
<i>Stakeholder Analysis - Q Methodology</i>	18
Background.....	18
The communication concourse and Q-sets	20
Participants Selection.....	23
Q sorting	23
Analyzing the Q-sorts	25
Factor interpretation and construction of the discourse.....	28
RESULTS	29
<i>Fisheries data</i>	29
<i>Q - methodology</i>	37

DISCUSSION	50
FINAL CONSIDERATIONS.....	58
REFERENCES.....	61
ANNEX I - Legislation	A
ANNEX II - Questionnaire used in this work to determine the social profile of Sagres Fishing Community.	C
ANNEX III – Sampling schedule	K
ANNEX IV – Most valuable affirmations (+3) expressed by fishermen during the sorting of Q-set ₂	M
ANNEX V - Less valuable affirmations (-3) expressed by fishermen during the sorting of Q-set ₂	O
ANNEX VI – Normalized Factor Scores for Factor A.....	Q
ANNEX VII – Normalized Factor Scores for Factor B	R
ANNEX VIII – Normalized Factor Scores for Factor C.....	S
ANNEX IX – Normalized Factor Scores for Factor D.....	T
ANNEX X - Statements of Q-set ₂ with scores for each of the four extracted discourses.....	L
ANNEX XI – Distinguishing and consensus statements for discourses A, B, C and D.	M
ANNEX XII – Discourse A: major and minor concerns	O
ANNEX XIII – Discourse B: major and minor concerns	P
ANNEX XIV – Discourse C: major and minor concerns	Q
ANNEX XV – Discourse D: major and minor concerns	R

INTRODUCTION

***Palinurus elephas* – Biology and Ecology**

The European spiny lobster *Palinurus elephas* (figure 1) (Fabricius, 1787), previously known as *Palinurus vulgaris* (Holthuis 1991) is a widespread large benthic decapod crustacean (Quetglas 2004) that inhabits temperate waters, occurring in the Eastern Atlantic from Norway to Morocco and in the Mediterranean Sea (Holthuis 1991) . According with its distribution pattern, this species is most accessible and a main target of fisheries off Ireland, the UK, France, Portugal, Spain, Italy, Greece, Tunisia, Morocco and adjacent Mediterranean waters (Goñi 2005).

P.elephas is a characteristic specie of rocky and coralligenous substrates (Saldanha 1997; Díaz 2001), where natural protective holes are numerous (Goñi 2005; Groeneveld 2006), being present from close inshore to depths of – nearly - 200 meters (Goñi 2003 (b)). The younger lobsters stay closer to the coast, off the Southwest coast of Portugal, concentrations are higher between 10 and 70 meters depth (Galhardo 2006).

Migration activity is an important characteristic of this species behaviour and, *Palinurus elephas* undertakes a pre-reproductive spring onshore migration and a reverse post-reproductive offshore migration in late autumn (Hunter 1999). Tag and recapture studies revealed (Hunter 1999; Goñi 2005) that the movements of adult individuals are restricted. Seasonal migrations are associated with sea temperature and dial movements with feeding patterns (Hunter 1999).



Figure 1. European Spiny Lobster, *Palinurus elephas* (Fabricius, 1787).

Source: www.faocopemed.org, assessed on March 2011.

Adult individuals are solitary and, like the juveniles they are mainly active at night (Goñi 2005). According to Hunter (1999), *Palinurus elephas* have a typically gregarious social behaviour, in which adults prefer neighbouring individual shelters, even though up to ten individuals may share a shelter. Juveniles (carapace length below 50 mm), are always gregarious inhabiting shelters more than 20 meters deep, rarely leaving the refuge, while larger males (more than 165 mm carapace length) inhabit solitary shelters at depths greater than 15 m. The same author suggests that in the summer, the two sexes live in separate areas, with the catch being frequently composed of individuals of the same sex; occasionally, all females are berried, since the ovigerous period extends from mid-autumn to late spring, followed by moulting of females (June-August) and mating (Goñi 2005).

This species is omnivorous and preys on hard-shelled bottom dwelling organisms such as molluscs, echinoderms and crustaceans, being a

opportunistic and generalist feeder that changes its food preferences as function of the abundance of benthic organisms (Goñi 2005).

Importance of Lobster Fisheries – The case of *Palinurus elephas*

Fisheries targeting crustaceans are important worldwide, mainly due to their unit value, as they account for nearly 30% of all fish and shellfish landings by value (Smith 2003). Many crustacean fisheries are artisanal and they have, therefore, an increased socio-economic importance.

From all crustaceans, lobsters constitute one of the most globally exploited resources, ((Galhardo 1994) and (Galhardo 2006)) the European spiny lobster being an example of this situation. *Palinurus elephas* constitutes the most important non-clawed lobster resource in Europe, being one of the most economically important targets of the small-scale fisheries ((Tidu 2004) (Gristina 2009)) and is considered an emblematic species.

Artisanal Lobster Fishery in Portugal

Portugal is a historical fishing nation, with an extended coastline, a multitude of fishing ports and, therefore, fishing has always been an economically important activity for many coastal communities (Pereira 1999).

Artisanal fisheries are important worldwide as they account for more than a quarter of the overall marine catches (Batista 2009). This activity involves a traditional fleet made up of vessels with low tonnage (Battaglia 2010), relies on small capital investments and is recognized and characterized by the use of several and diversified fishing gears (Battaglia 2010), targeting a great variety of species.

An artisanal fishing activity exhibit great variations in space and time, and depends on biological and environmental conditions. In Portugal it constitutes an important subsystem of fishing practices, in the way that small-scale fishing

has a long tradition and high socio-economic importance (Pereira 1999; Batista 2009), employing a great fraction of the fishing community (Gómez 2006).

The considerable heterogeneity of this fishing sector implies differences in a number of factors, namely: duration of fishing trips, time and place of landings (due to the multitude of ports along the coast line) and different destination of products (restaurants, retail, markets and fishmonger's shops) (Battaglia 2010), which represents an additional difficulty in collecting information.

Nevertheless, fishery managers are giving more attention to socio-economic aspects of artisanal fisheries so that they can save the cultural heritage of fishing traditions.

Fishing Methods

Traditionally, this species has been targeted mainly by means of baited traps and, occasionally, by diving (Goñi 2003 (a); Goñi 2005; Groeneveld 2006). However, over the years this gear almost disappeared due to a shift in exploitation strategies, which occurred with the progressive introduction of trammel and tangling nets (Groeneveld 2006), gears with a high number of licenses attributed to the artisanal fleet and that are, at present, responsible for *P. elephas* catches (Quetglas 2004). The replacement of traps by trammel and tangling nets, was responsible for the increasing fishing pressure on the lobster population, with potential impacts on the exploited stock, due to the non-selective nature and high efficiency of the gear (Goñi 2005; Gristina 2009).

Traps have desirable features, being considered among the most versatile and effective fishing gears (Gristina 2004), producing low by-catch, retaining the target species usually alive and with minimal impacts on benthic communities (Goñi 2003 (b); Gristina 2004).

Traditional lobster traps are made of wood with one entrance or more. Generally they are placed on the bottom with or without bait, singly or in a line, usually attached by cables to buoys that signal their presence at the surface

(Leite 1991). The building of traditional traps is an art handed down through generations and it is labour intensive, making the traps very expensive. Consequently, modern traps are being assessed as alternatives to traditional traps (Gristina 2004).

Nowadays traps are built using a metal frame of rectangular or semi-circular section, with two openings and baited with sardine or mackerel (Galhardo 2006).

This fishing gear is selective, presenting a well defined bell-shape size selection patterns, with declining catchability for large and small sizes (Goñi 2003 (b)), allowing the return of undersized animals to the water unharmed (Gristina 2004). However, this gear as no longer been used in lobster fisheries due to costs and time of construction.

Trammel nets are constituted by a series of panels of three rectangular nets made up of two outer, large mesh layers and one inner, smaller mesh layer larger than the two previous ones (Leite 1991; Goñi 2003 (b)). Tangling nets, are composed by a series of panels with one single layer.

Both trammel and tangling nets are set on the bottom, between 30 and 90 meters, hauled at one to four days intervals, (Goñi 2005; Galhardo 2006) being highly efficient in capturing individuals of different sizes and shapes, since they operate by entangling, gilling or wedging the individuals (Goñi 2003 (b)). For this reason, these fishing gears are poorly selective and given the shape and spiny texture of *P. elephas* any size lobster that comes in contact with these nets will be captured (Goñi 2005; Gristina 2009).

Commercial fisheries of *P. elephas* deliver a product of high value in the local markets, making the fisheries economically attractive and feasible (Goñi 2005), imposing excessive levels of fishing effort that resulted, over the years, in an alarming decrease of the mean annual catches along its distribution area

(Goñi 2005; Palero 2008), and establishing the status of overfishing for the European spiny lobster population (Goñi 2005).

It is plausible to associate the decrease of biomass in lobster populations throughout its geographical range, to the generalized use of trammel and tangling nets.

Main Fishing Areas for *Palinurus elephas*

Palinurus elephas is exploited mainly in the southwest coast of Portugal, from Sines to Cape St Vincent on the west coast, and along the south coast from Cape St Vincent to Lagos (Galhardo 2006).

The main fishing areas (figure 2) are Arrifana, Carrapateira, Cape St Vincent and Sagres (Galhardo 1994) and according to Galhardo (2006) the most important port is Sagres, where over half of the national catch is landed.

Crustacean fisheries are among the most profitable for artisanal fisheries and the spiny lobster is an extremely important biological resource, presenting high product value, reaching high first sale prices in the national market – average value of first sale per kg was 23.04€ (DGPA 2010).

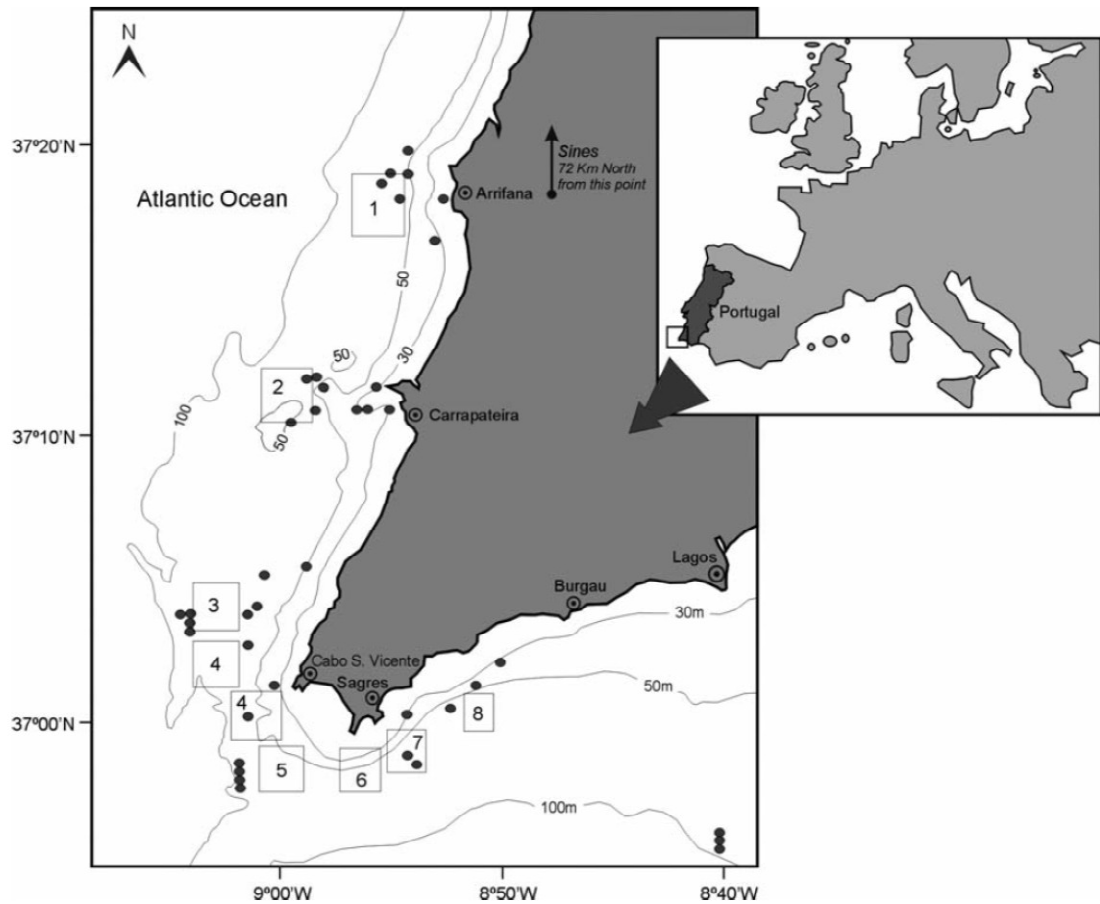


Figure 2. Location of European spiny lobster, *Palinurus elephas*, fishing grounds off the Southwest (SW) coast of Portugal. The squares indicate the fishing grounds and the dots indicate the position of individual nets: 1-Arrifana, 2-Carrapateira, 3-Ponta Ruiva and Pedra do Cajado, 4-Cabo de São Vicente, 5-Tonel, 6-Fortaleza, 7-Legítimo and 8-Barranco (adapted from Galhardo 2006)). The main fishing areas for the European spiny lobster are: 1 – Arrifana, 2 – Carrapateira, 4 – Cabo de São Vicente, 5 – Sagres.

Fishing Fleet

The artisanal fleet accounts for half of the Portuguese landings, more than 60% of the total revenues and about 80% of total fishermen (Batista 2009). Lobster fishery is undertaken by small boats, most included in the “local” segment. The artisanal fishing fleet targeting *P. elephas* has decreased from 27 to 12 vessels, between 1993 and 2007, accompanied by declines in gross tonnage and engine power (Galhardo 2006). However the average age of the vessels was

reduced to 13 years, due to investments made in modernization of the fleet and technology implementation (Galhardo 2006).

Artisanal vessels traditionally have licenses for more than one gear so, despite the fishing season being opened throughout the year (Goñi 2005), lobsters are targeted mainly during Spring and Summer (Goñi 2005; Groeneveld 2006). In other words, due to the constant poor state of the sea during the winter period, the fishermen engage in the fishing of other shellfish and fish, only occasionally catching lobster (Galhardo 2006). In this way, artisanal fisheries can be classified as multi-specific as several species of fish, gastropods, echinoderms are caught along with the target species.

Management Measures of *Palinurus elephas* Fishery in the sw Coast

The generalized use of fixed nets and multi-species catches, highlight the necessity for management and conservation plans to explicitly recognize direct and indirect impacts of these fisheries in marine ecosystems (Batista 2009).

Despite an intense exploitation of *P. elephas*, that has led to the reduction of the population, the only pieces of legislation specifically created for spiny lobster in Portugal are (annex I): minimum legal size (MLS) of 95 mm carapace length (CL), measured from the tip of the rostrum to the midpoint of the edge of the carapace (*Anexo XII do Regulamento (CE) n° 850/98* and *Portaria n° 27/2001*) and the prohibition of landing ovigerous females (*Portaria 447/2009, 28 de Abril*).

According to *Portaria 447/2009, 28 de Abril*, *Palinurus elephas* trap fishing can only be exercised between January and September and this fishery is regulated by *Portaria 270/2000, 22 Novembro*.

It also should be mentioned that permission to target lobsters within the 6 mile limit is restricted to the use of traps, but since most vessels holding the

licence are also allowed to use fixed nets, this ends up being the main gear catching lobsters.

Comparatively, in western Mediterranean, besides these measures, marine reserves were created to specifically protect this species (Goñi 2003 (a)). Lobster fishing does not involve special licensing and an unestimated fraction of the catch is sold outside any official control (Galhardo 2006).

Need for new management measures – Participative Methodology in Fisheries

The implementation of adequate measures to manage artisanal fisheries is extremely important to perpetuate this activity for the future in a biologic and socio-economic sustainable way. In Portugal, the legislation referring to participative management is *Decreto-Lei 43/2000, 10 de Dezembro [Capítulo II, Secção III, Artº 15º]* (annex I).

According to Vodden (2005), it is the duty of a population to govern their (our) interactions with socio-ecological systems in a responsible fashion. However, all have failed to carry out this duty, since inadequate paths of governance have been used, essentially because the complexity of the marine ecosystems is neither fully recognized nor understood (Vodden 2005). Indeed, the complexity of the ecosystems requires a correspondingly complex response. To guarantee a long-term sustainability in small scale fisheries, the development of alternative methods of analysis, aiming at an integrated approach to resources management, need to be considered. Rethinking the current fishery management systems requires the adoption of controversial actions (Charles 2001), once compliance has been identified as key to sustainable fisheries management (Hauck 2008).

In order to manage fisheries towards sustainability, it is crucial to get an appropriate involvement of various active participants, stakeholders (Guimarães 2009), which include fishermen, communities and the general public (Charles

2001). This point has particular importance since the public acts as holder of property rights to fish resources, having very particular perspectives regarding the fisheries and conservation measures, and therefore deserves a greater involvement in the decision making process. In this way, the general consumer should be educated in order to have a relevant role in fisheries conservation, being aware of the current status of the seas. Therefore, to proceed in such manner, the contribution of fishermen's local ecological knowledge (LEK) should be considered as a tool to improve fisheries management by providing new information about the local ecological processes and their influences on fishing resources, as well as the behavior and abundance of resources in a certain area (Silvano 2008).

Collaborative learning is of inestimable value, and is a starting point for the development of a management system towards sustainability.

Participative Methodology: Q – method

Stakeholders involvement is crucial for any effective strategy for conservation and also to reinvent fishing management, since collaborative learning is of inestimable value (Vodden 2005), representing a starting point for developing a management system.

Stakeholder perspectives can be useful in natural resources management for identifying differences in values and interests that need to be discussed, as well as creating awareness among a broad range of stakeholders and developing scenarios (Raadgever 2008).

Identification of the problem, use of theoretical analysis to find (potentially) an effective response and implement adequate policies are the three main stages of environmental policy making (Barry 1999). A vital point in environmental policy is identifying how individuals think about environmental and conservation issues. This fact is of great importance because, until stakeholder perspectives about the fisheries situation and conservation

approaches are known, it will be extremely difficult to judge what, and whether, environmental policies will be socially acceptable, and as a consequence capable of being implemented (Barry 1999).

Finding out how people understand an issue is essential to the process of problem identification (Addams 2000); each individual has a particular and subjective perception of a problem, that depends on the circumstances and is the base used to form conceptions of certain aspects of the world.

According to Raadgever (2008), a stakeholder perspective is the cognitive representation it makes of the external reality and of his/her position in that reality, including preferences concerning management options as well as the values that underlie these preferences.

One of the methodologies that has been proved adequate to elicit stakeholder perspectives is Q methodology (Webler 2009). This methodology provides the researchers with systematic and rigorous quantitative means for examining the inherent human subjectivity (Dasgupta 2005) in a structured and statistically interpretable form (Barry 1999). The outcome of a Q study is a more authentic set of factors to explain attitudes among people regarding an issue (Addams 2000; Dasgupta 2005). It does so by systematically identifying groups of individuals with a common attitude structure, considering patterns of response across individuals. In this manner, Q methodology reveals underlying social discourses regarding a certain topic (van Exel 2005).

Q methodology is a method that provides researchers a systematic and rigorously quantitative means for examining human subjectivity, that is, a person's point of view. The corollary to this conception of subjectivity, making it plausible for analysis, is that subjective points of view are communicable, and are always advanced from a position of self reference (Dasgupta 2005)

Therefore, subjective communication thus lends itself to objective analysis in the Q method (Swedeen 2006).

The strength of the method is that it does not require shared perspectives; in fact, it analyses each individual perspective as a whole. Q-methodology for stakeholder analysis aims to understand both the identities and desires of local stakeholders in their own terms (Addams 2000), considering the socio-economic aspects of the community. Thus, stakeholder analysis describes (Addams 2000; Guimarães 2009): 1) possible conflicts over any intended measures; 2) who the local stakeholders involved in the conflicts are; 3) what they believe and want, concerning the marine ecosystem and fishery conservation and 4) the trade-offs they are willing to make.

Such knowledge holds great importance if the participatory decision strategies and action plans are to respond meaningfully to the political and social realities (Guimarães 2009). Therefore, knowing these steps is critical to gain political support among the population and turn management measures into rules operating effectively.

The main purpose of stakeholder analysis in the present work, is to develop a management strategy that is agreed upon between the stakeholders and make the lobster fishery a reference in terms of sustainability. This type of analysis is called discourse analysis and it takes the statements of the stakeholders about a particular circumstance and expresses them in their own terms as an interactive process. Q-methodology is then applied in order to understand the discourse of the stakeholders with respect to the management, conservation and legislation compliance of the small-scale fishery off the southwest coast of Portugal, in particular the lobster fishery. This methodology may also be used to understand the reasons for non compliance of the existing laws, fundamentally those that further marginalize small-scale fisheries (Hauck 2008) and all their intervenients.

OBJECTIVES

The present work aims to analyze the following points:

- ✓ Update the biological information for the European spiny lobster fished of the southwest coast of Portugal, based on fisheries data collection and on-board observations
- ✓ Assess the selectivity of trammel and tangling nets and traps to catch lobsters, the environmental impacts of these gears and associated by-catch and rejection
- ✓ Discuss several scenarios for the evolution of this fishery, considering cultural and socio-economic aspects.

In short, the fundamental purpose of this work is to theoretically promote responsible fishing and sustainable management of *Palinurus elephas* artisanal fisheries of the sw coast of Portugal, in an ecosystem and socio-economic perspective.

MATERIAL AND METHODS

Data used in this thesis came from different sources:

- ✓ Statistics of fishing effort and landings, from the DGPA Statistical reports.
- ✓ Lobster biology and environmental impact of the gears (tangling nets and traps) data, collected in the framework of the project SAGRES (FCT project POCI/CTA/49248/2002).
- ✓ Socio-economic data and data to evaluate the acceptance perception and acceptance of management measures by the stakeholders – interviews.

All information was directed at assessing the situation of the lobster fishery, and providing acceptable options for its management and conservation. The work was restricted to the Port of Sagres where, at present, most of the landings occur.

Statistical Data Collection

Statistics were obtained from the series “*Os Recursos de Pesca*” for the years 1998 to 2007. The specific composition of the landings by species and vessels for the port of Sagres was obtained for the years 2007 and 2008. This data allowed the estimation of the total catch, fish fleet composition and importance of the spiny lobster in weight and value for the artisanal fleet in Sagres.

Sampling

Previous data of landings in port of Sagres for the period of 1998 to 2007 were obtained by General Directorate for Fisheries and Aquaculture (DGPA).

These data consists on daily landings for all vessels, whether registered or not in port of Sagres, which performed at least one landing of lobster (or Norway lobster) in the mentioned period, broken down by day and specie (weight and value). Therefore we could obtain information about changes in lobster fisheries during a ten years period.

The spiny lobster population of the southwest coast of Portugal was sampled in the port of Sagres (figure 2) during the fishing season of 2008, from May to September, on board of a commercial vessel – CATAMAR. The sampling schedule is shown in annex III and 23 throws were made in the considered sampling period.

Tangling nets (of the type regularly used in the lobster fishery in Sagres) and traps (designed according the specifications of lobster traps used in the Mediterranean) were set in the same area and hauled in the same area and days.

Based on fishing routine, on average, the vessels haul the gears once to twice a week and, for this study it was established that biological sampling would be done once a week. All fishing operations were accompanied by samplers that recorded all species in the catch, their freshness and whether they've been rejected and why.

All individuals were measured, and the sex and ovigerous conditions for females identified.

Selectivity between nets and traps

For this experiment, it was necessary to construct fishing traps, since this gear is no longer in use for lobsters in Sagres. The traps had the same dimensions and characteristics from those used in experiments in Mediterranean Sea for the same species (Gristina 2004). The traps used in this study, had a cylindrical shape of 80 cm x 52 cm, constructed of plastic mesh (2 cm mesh size) with a steel ring frame with a 21 cm diameter entrance (figure 3). Each trap was covered with a rigid plastic mesh with 40 mm side and when set they were baited with mackerel. Traps were set for 32 days.

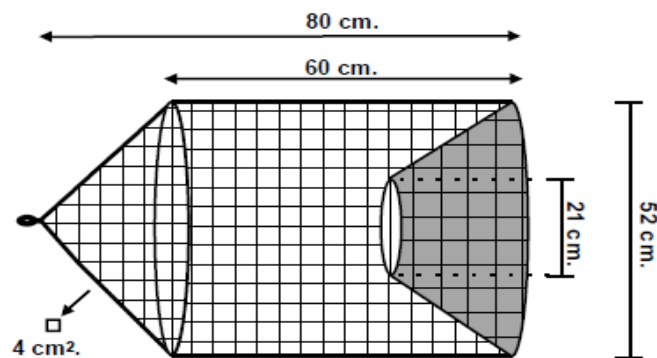


Figure 3. Scheme of the experimental trap used in the current study, adapted from (Gristina 2004)

A line of fifty traps was build according the rules applied to the lobster fishery in the Mediterranean. Dimensions, characteristics and details of the experimental gear can be seen in figure 3 and Figure 4. In each fishery the effort was maintained constant by the replacement of the damaged or lost traps.

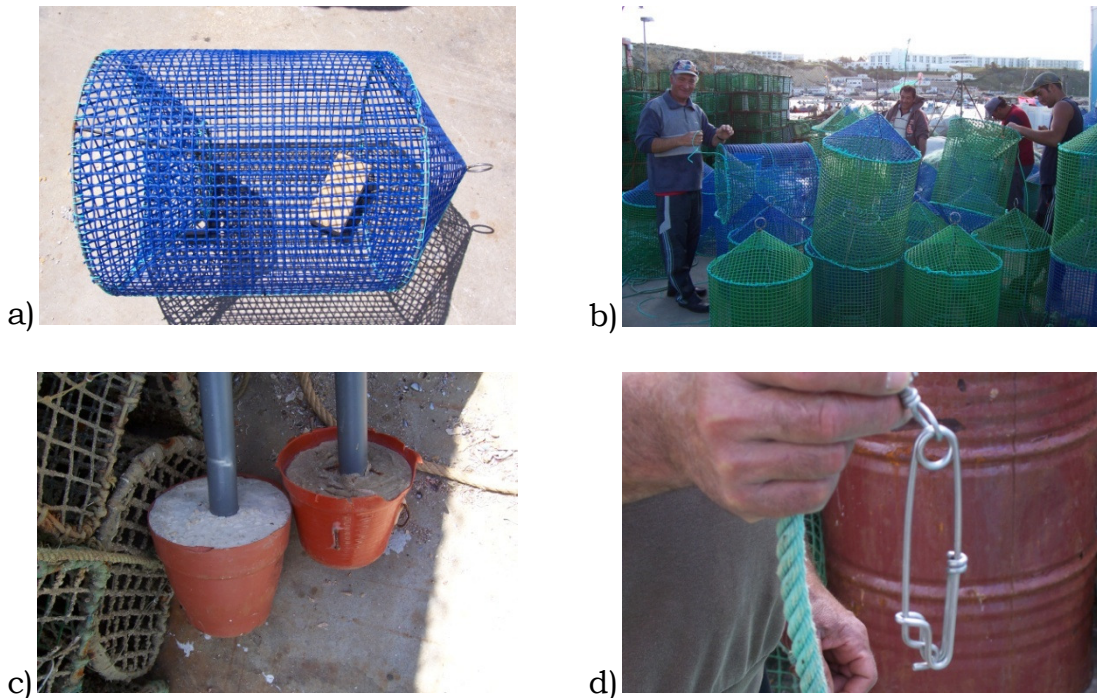


Figure 4. Details of the experimental network: a) trap, b) network construction at port of Sagres, c) detail of the base of the signaling poles d) detail of the terminal branch line (photos by A. Leocádio and M. Inácio).

Besides the construction of traps, trammel nets were also used in the fisheries to assess the selectivity of both gears. Trammel nets are constituted by panels made of gangs of two outer, large mesh layers and one inner, smaller mesh layer (figure 5). General characteristics of this gear are: panel with 2.5 to 4 meters high and 50 meters length. Usually, the number of panels is, on average, 120 but for the purpose of the present work, a net consisting of 50 panels, with meshes (diagonal with the net stretched) of 130 mm in the outside layers and 65 mm in the inner layer, was used. Nets were set for 27 days.

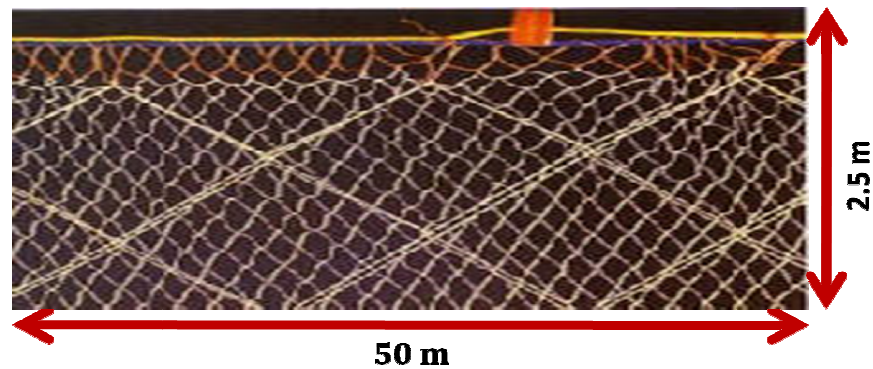


Figure 5. Trammel net gear, with specifications for this study. Source: www.fao.org, assessed in April 2011.

Stakeholder Analysis - Q Methodology

Background

Identifying individual opinions about environmental and conservation issues requires a discourse analysis in order to construct a process of problem identification.

The present study proposes a stakeholder analysis based on the implementation of Q methodology, where the main purpose is to understand what stakeholders perceive as fundamental actions towards the development and sustainability of lobster fisheries in Sagres.

A respondent, or *subject*, in a Q study, models his/hers viewpoints on a matter of subjective importance. For this purpose, a set of sample stimuli ¹⁾ designated as a *Q sample* or *Q set* is at first presented to the respondents. The respondents then systematically *rank* these statements according to specific instructions ²⁾ (Webler 2009)

The set of ordered (ranked) statements constitutes the *Q-sort* and, from the entire set of *Q*-sorts, each done by a different respondent, methods of statistical analysis are applied for extraction of a few typical *Q*-sorts, capturing the common perspectives of all the individual *Q*-sorts. Finally, these typical *Q*-sorts are interpreted, to arrive at the social discourses within the data (Dasgupta 2005).

Considering the aforementioned, performing a *Q* methodology study involves the following steps (Barry 1999; Swedeen 2006):

(1) Identification of a discourse area of interest which one wishes to explore and the relevant population (for example: fishermen, port authorities, fish buyer, consumers, fishing vessel owner)

(2) Conduction of structured interviews with a relevant sample of the population to obtain series of statements about the topic of interest;

(3) Selection of a representative set of statements from the full concourse, which indicates the diversity of communication in the topic (*Q*-set₁ and *Q*-set, presented in table 1 and table 2 respectively);

(4) Selection of participants, which holds the largest possible diversity of opinions, asked to rank the statements (obtained in step 3) in a structured way. Typically the statements are ranked in a scale from “most agree” to “most disagree”. The set of ranked statements constitutes the *Q*-sort, which models each individual perspective;

(5) From the *Q*-sorts, a statistical analysis is conducted (factor analysis) allowing the extraction of a few *Q*-sorts, representing distinctive and collective understanding of the topic;

(6) Interpretation and explanation of the discourses in terms of commonly shared perspectives.

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- 1) Most commonly presented to the participants in the form of a set of statements relating to the problem that the researcher is interested in studying.
 - 2) The respondents may be asked to order the statements in terms of those that are most agreed with to those that are most disagreed with.

The communication concourse and Q-sets

In Q, concourse refers to the flow of communicability concerning a certain topic. The concourse is a very useful technique for the collection of all possible statements the respondents can make about the subject at hand (Dasgupta 2005) and therefore, the concourse is thus supposed to contain all the relevant aspects of all concourses.

In order to apply this methodology, open, semi-structured interviews were conducted to three representatives of stakeholders, namely: fisherman, director of the fish auction operations, buyer in the Sagres port. These three people were all identified as having a lifetime experience associated with the artisanal fishery, particularly the lobster fishery in Sagres. A fourth key element was considered, the research community.

It should be considered that statements are naturally rendered, usually during the course of an interview in order to minimize the introduction of external meanings. The aim of the interview is to generate statements of opinion using the participants' own words on the topic. Interviews were conducted until no new points of view were encountered and the same comments were being repeated – theory of limited independent variety (Hauck 2008)

The resultant subset of statements (Q-set), therefore provides a reasonable representation of viewpoints on the issue of fisheries management and conservation.

Because all the work with spiny lobster in the area of interest has been conducted by the same team undertaking this work, and to avoid bias due to previously acquired perceptions, the information from the research community was obtained with a different methodology. The management options were identified from a literature review focusing on lobster management issues worldwide.

Therefore, two sets of statements were generated for the present study. One set was composed by statements referred to the most common discourses among stakeholders, obtained from interviews (Q-set₁). The second set (Q-set₂) was composed by statements referred to hypothetical management measures.

Table 1. Statements referred to the most common discourses among stakeholders (Q-set₁).

1	Climate changes
2	Captures of berried females
3	Lack of supervision
4	Non-compliance with respect to closed seasons for lobster
5	Use of too many nets
6	Too many licenses
7	Lobster catch by divers
8	Too many species that prey on lobster
9	Lobster selling outside fish auction (Illegal sale)
10	Lack of shelters for small lobsters
11	Lack of food for lobsters
12	Setting the gears in banned sites
13	Introduction of fishing nets
14	Algae harvesting
15	Non-compliance with minimum legal size (MLS)
16	Excessive fishing effort
17	Pollution

Table 2. Statements used in Q-sort questionnaire (Q-set₂) referred to management measures.

1	Supervision to enforce first sale in fish auction
2	Supervision of Minimum Landing Sizes (MLS) in restaurants
3	Creation of no fishing protected areas
4	Restocking with young lobsters reared in nurseries
5	Allow lobster fishing only with traps
6	Creation of protected areas where gears that catch lobsters cannot be used
7	Reduction of the number of fishing licenses
8	Reservation of areas for fishing lobsters only with traps
9	Increase the frequency of hauling nets
10	Closure of the fishery in alternative years
11	Obligation to return berried lobsters to the sea
12	Construction of maintenance facilities that allows direct sale of live lobsters to the public
13	Establish a minimum number of lobsters per vessel and fishing season
14	Positive discrimination of fishers living in Sagres
15	Establishment of a closed season for the lobster
16	Increase the minimum landing size
17	Prohibitions of fishing nets in lobster areas
18	Attribution of specific licenses for crustacean fisheries
19	Creation of artificial shelters for small lobsters
20	Construction of traps with windows to allow the escapement of small lobsters
21	Selective fishing for octopus (lobster main predator) in lobster growth areas
22	Control of algae harvest
23	Closure of the fishery until lobster population recovers

Participants Selection

A Q methodological study requires only a limited number of respondents and they should hold the full diversity of opinions present in the discourse (Addams 2000). It is required that these should be deliberately selected to reflect the widest range of potential types of opinions in order to identify all factors that exist in relation to the topic of research (Addams 2000). For the purpose of the present study, 19 individuals, related to the stakeholder group, were selected. Target stakeholders were captains, crew members of fishing vessels representing the diversity of vessels and gears present in the port of Sagres.

It is worth noting that in Q Method, the variables are the people performing the sorts and not the Q-set statements.

Q sorting

A questionnaire (annex II) was given to 19 individuals, related to the group of stakeholders previously mentioned, and its main purpose was to determine the social profile of the participants in Sagres and also hold the full diversity of opinion. Participants' personal data (birth place, age, level of education, number of sons and their involvement in fishing activity, etc) and socio-economic data were collected by means of questionnaire in order to get the social structure of the whole fishing community.

Additional information concerning the level of association in fishing cooperatives was also obtained. Furthermore, all individuals were asked about the costs and revenues of their activity (Battaglia 2010) and the most often employed fishing gear. Information about fixed costs (boat maintenance, taxes, and vessel's insurance), production costs (fuel consumption, lubricants, baits use, purchase of gear equipment and repair, ropes) and commercialization costs (compensation and government assistance) was obtained.

disagree” and +3 to “Strongly agree”. The sentences in the same column all get the same points. An indifference point is the center of the “pyramid” (0 points), this means that a participant is assumed to assign no importance to statements that are sorted in the zero categories, and neither agrees nor disagrees with the statement.

The ranking of statements by an individual is designed as an individual “Q-sort” and reflects the significance of each statement to that individual. The participant was free to alter the placement of statements at any stage, until the distribution best reflect his/her views and opinions.

Participants were forced to make choices because there was a limited number of cards on a given column i.e., the structure of the “pyramid” is rigid (table 3). The pyramidal structure of this Q sort is used to encourage the participants to give careful consideration to the ranking they want to attribute to each sentence.

Table 3.Number of statements that had to be allocated in each scale score.

Scale score	-3	-2	-1	0	+1	+2	+3
No. of statements	2	3	4	5	4	3	2

Analyzing the Q-sorts

The structure of the pyramid implies an approximately normal frequency distribution for the variables, allowing the use of multivariate techniques that assumes normally distributed variables. The analysis of the Q-sorts is a purely technical and objective procedure used to identify the various discourses within the survey (Guimarães 2009) and involves the application of three statistical procedures (Addams 2000):

1) Calculation of a correlation matrix; (multiply the number of the scores attributed by each individual interviewed, size of the matrix **$n \times n$**)

- 2) Extraction and rotation of significant factors to an acceptable solution
- 3) Computation of a set of factor scores for each factor.

To analyze the Q-sorts, and extract the causal “ideal type” Q-sort, the PQ method version 2.11 was used. This software package is freeware programs specifically designed for Q methodology ³⁾.

Each Q-sort in the study is entered as a data into the program, which intercorrelates each Q-sort with every other sort. The inter-correlation matrix produced is then factor analyzed using a Principal Components Factor Analysis - PCA (Addams 2000). This technique is commonly used to manipulate data so that the separation factors to be optimized without changing the underlying relationship. The resultant factor analysis is rotated to a simple structure, using VARIMAX rotation (orthogonal rotation), to extract significant factors.

In the following paragraphs the statistical analysis is explained.

The first step in the analysis is the construction of the correlation matrix between sorts and the matrix gives the inter-correlations among all the Q-sorts. At the next phase, factor analysis itself is performed by using Principal Components Analysis (PCA) which considers both commonality and specificity (Webler 2009). Here, factor analysis is performed on the correlation matrix in order to systematically condense the information and search for similarities among the Q-sorts. Thus, factor analysis seeks correlations between variables (participants performing the Q-sorts) in the data attempting to reduce multivariate data to a small number of factors.

³⁾ Available at: <http://www.rz.unibw-muenchen.de/~p41bsmk/qmethod/pqmanual.htm> (consulted at August, 2010)

Factor analysis is performed in order to condense further information and search for more general family resemblances (Addams 2000). The aim of factor analysis is to find a limited number of uncorrelated factors that can adequately account for the observed correlations. Any number of factors will give some insight into how people think about a certain issue, in the present case the adequate management measures for the spiny lobster fishery in the SW coast of Portugal, is doing an adequate number of discourses that one wishes to extract from the data.

The outcome of factor analysis reveals underlying explanations for patterns among the Q-sorts (Webler 2009); it rearranges the initial information (variables corresponding to the points each sentence obtained for each interviewee) and extracts new linear combinations of these, new variables or factors, that re-express idealized patterns of Q-sorts (Addams 2000; van Exel 2005).

There are several criteria that should be considered when deciding between different numbers of factors (Webler 2009):

- (1) **Simplicity:** fewer factors are better, as it makes viewpoints easier to understand
- (2) **Clarity:** the best factor solution is one in which each sorter loads highly on one, and only one, factor
- (3) **Distinctness:** lower initial correlation is better, as high correlation bring no improvement in the explanation obtained by the factors when compared to the initial interviewees.
- (4) **Stability:** preservation of stable clusters of interviewees in as many factors as possible, since it is an indicator that individuals really do think similarly.

The significance of a factor can be determined statistically by employing the eigenvalue criterion (Barry 1999). The eigenvalues of correlation matrix determine the Q methodologists judgement of practical significance and by

convention, factors with eigenvalues – idiosyncratic value - greater than 1.00 are considered to be practically significant, that is, as explaining an important amount of variability in the data (Barry 1999).

Factor interpretation and construction of the discourse

During the factor interpretation process, each factor was analyzed individually and compared with other factors for the purpose of illustrating the differences and characteristics of the various discourses, as well as the points of agreement and disagreement represented, respectively, by the questions with high positive and lower negative loads in that factor.

The interpretative task in Q methodology involves the introduction of summarizing accounts, each of which explains the opinion being expressed by a certain factor (Webler 2009). Factor interpretation is done by examining the overall patterns and interrelationships of items in the reconstructed Q-sort, representing each distinct attitude, attempting to explain the comparative positioning of items (Addams 2000). Thus, the interpretation proceeds by continuously putting up possible explanations for the factor array until the best explanation is developed.

Finally, the interpretation of each factor's discourse is generally presented in terms of a label intended to present a particular important characteristic or narrative of the factor (Webler 2007).

RESULTS

Fisheries data

In Portugal, the lobster fishing season is established from March to September and, the samples were collected in a period between May and September of 2008 in port of Sagres. The sampling schedule on board is presented in annex III and 23 throws were made during this period.

Eighty three spiny lobsters were sampled in which 38 were females (6 were in the ovigerous period) and 45 were males. The length distributions for males and females for the considered period are presented in figure 7.

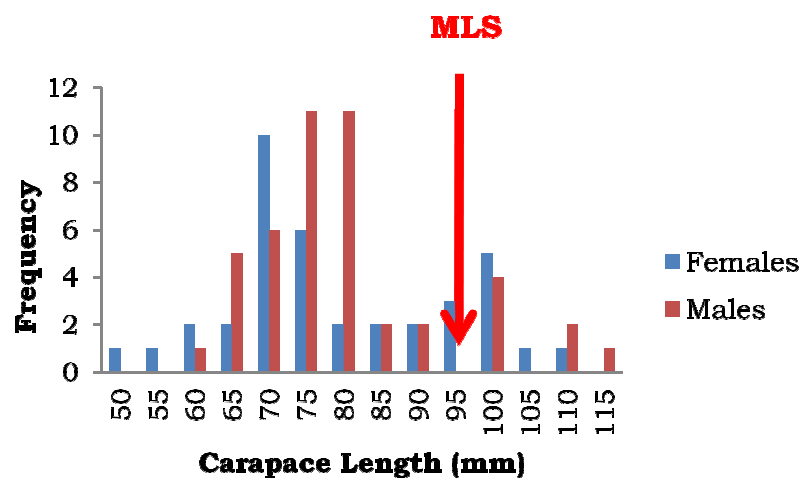


Figure 7. Size structure of the catch of *Palinurus elephas* sampled in the port of Sagres between May and September of 2008. Frequencies are grouped by 5 mm classes and sex. The red arrow indicates the minimum landing size (MLS) of 95 mm Carapace length.

In all sampling period, the length distribution shows a well represented group with lengths from 51.55 mm to 115.53 mm carapace length (CL). The minimum and maximum sizes caught (CL) for males were, respectively, 61.72 mm and 115.53 mm and, for females the minimum and maximum size caught (CL) were, respectively 51.55 mm and 114 mm. In these samples larger classes are notoriously dominated by males. The distributions reveal a total disregard for compliance with the minimum landing size (MLS) regulation of 95 mm and corroborate the fact that most individuals caught are below MLS.

The decrease in catches is the revealing point that the lobster population is severely depleted and that this specie has lost importance in recent years. Alongside with this a diversification on target species occurred emerging the crayfish (*Nephrops norvegicus*) as a potential commercial resource for crustacean fisheries (figure 8).

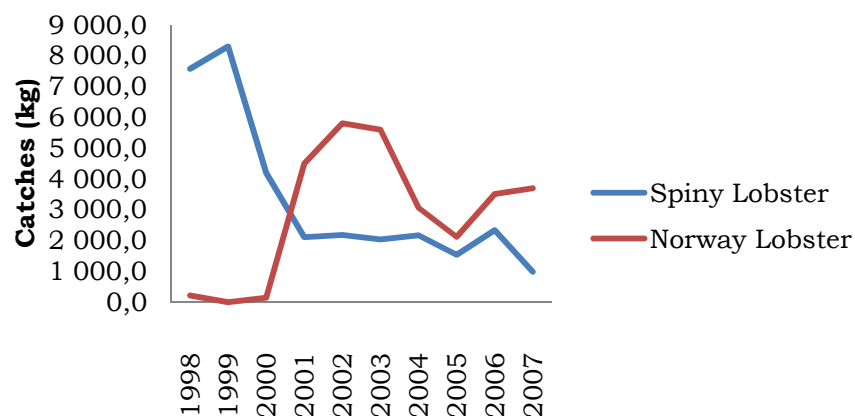


Figure 8. Catches, in kg, of *Palinurus elephas* (Spiny Lobster) in port of Sagres from 1998 to 2007 and catches, in kg, of *Nephrops norvegicus* (Norway Lobster) in ports of Sagres and Vila Real de Santo António from 1998 to 2007 (Source: General Directorate of Fisheries and Aquaculture).

According with figure 8 it is possible to verify that the *P. elephas* catches decreases from an average of 8 000 kg in 1998-1999 to 988.2 kg in 2007, which supports the hypothesis that in 2008 the fisheries followed the same decreasing pattern. On the other side, *N. norvegicus* catches suffer an increase from 219.3

kg in 1998 to 3699.1 kg in 2007 revealing a swell in this fishery coupled to the fact that the number of vessels is also higher (figure 8 and figure 9).

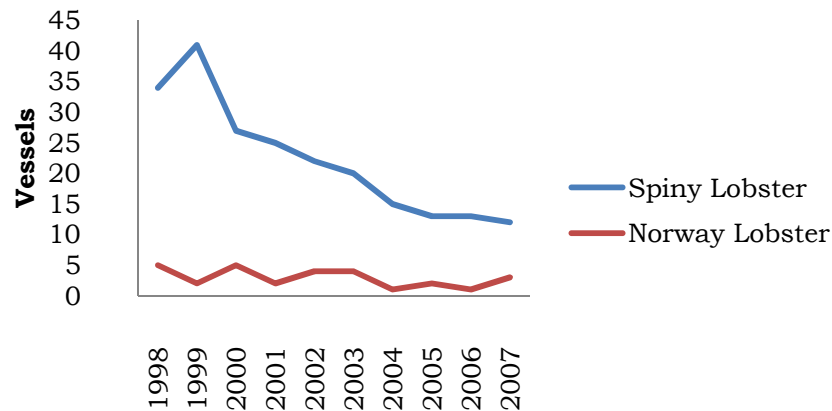


Figure 9. Number of vessels targeting *Palinurus elephas* (Spiny Lobster) in port of Sagres from 1998 to 2007 and *Nephrops norvegicus* (Norway Lobster) in ports of Sagres and Vila Real de Santo António from 1998 to 2007 (Source: General Directorate of Fisheries and Aquaculture).

Figure 9 shows the progressively diminished number of vessels in a range of a decade, which is consistent with the lower catches, explaining the reduction in fishing effort. It is also patent in figure 9 that for *N. norvegicus*, the number of vessels has remained (relatively) constant through the considered period, sustaining the increasingly frequent catches of Norway lobster.

In the past decades a constant decrease in the number of vessels targeting lobster has occurred, from 35 to, approximately 12. The values given below were based on the database of the EU fleet (DG MARE Fleet's Register of U.S. fishing vessels ⁴). Contained in the database, as being operational on the date of the consultation, 473 vessels are registered in Port of Sagres and, classified in the "Local" segment. Only 107 vessels have licenses for fishing in those waters. The types of gears used in Sagres are diverse and, for the total number of vessels mentioned before, they account for seven main gears and six secondary ones. Tables 4 and 5 shows the structure of the fleet by vessel size and licensed fishing main and secondary gear, respectively.

⁴ Available at: <http://ec.europa.eu/fisheries/fleet/index.cfm?method=Download.menu> (consulted in August, 2010).

Table4. Classification of the fishing fleet registered in Port of Sagres by vessel size (LOA = length overall) and licensed main fishing gears (FPO = Pots and traps; GNS = Gillnets and Entangling nets – anchored nets; GTR = Trammel nets; LHP = Hand-lines and Pole-lines; LLS = Set long lines; LTL = Trolling lines; PS = Purse seiners). Source: MARE Fleet's Register of U.S. fishing vessels.

LOA (meters)	Main Gear Code							TOTAL
	FPO	GNS	GTR	LHP	LLS	LTL	PS	
00≤LOA<06	12	8	4	10	3	1		38
06≤LOA<10	8	33	6	2	8	1		58
10≤LOA<12		4	1					5
12≤LOA<18		1						1
18≤LOA<24		1			1		2	4
24≤LOA<30	1							1
Total	21	47	11	12	12	2	2	107

Table5. Classification of the fishing fleet registered in Port of Sagres by vessel size (LOA = length overall) and licensed secondary fishing gears (FPO = Pots and traps; GNS = Gillnets and Entangling nets – anchored nets; GTR = Trammel nets; LHP = Hand-lines and Pole-lines; LLS = Set long lines; NO = No secondary gear). Source: MARE Fleet's Register of U.S. fishing vessels.

LOA (meters)	Secondary Gear Code						TOTAL
	FPO	GNS	GTR	LHP	LLS	NO	
00≤LOA<06	5		5	21	4	3	38
06≤LOA<10	15		22	5	5	1	48
10≤LOA<12	1		4		1		6
12≤LOA<18			1				1
18≤LOA<24	1	1				2	4
24≤LOA<30					1		1
Total	22	1	32	26	11	6	98

From the tables 4 and 5, it is possible to affirm that 107 vessels have licenses for fishing in the Southwest coast waters with 79 licensed main fishing gears and 98 vessels also present a secondary fishing gear with 55 licensed secondary fishing gears.

Gears of interest for the lobster fishery, as the scope of the present work, are traps (FPO), gillnets and entangling nets (GNS) and trammel nets (GTR). Vessels with $00 \leq LOA \leq 06$ have traps as the main fishing gear and vessels with $06 \leq LOA \leq 10$ have gillnets and entangling nets as principal gears, and have trammel nets as a secondary gear. From both tables, we can conclude that the majority of vessels have gillnets and entangling nets as the main gear and trammel nets as a secondary one.

However, for all the vessels, the crustaceans aren't the only target species and, as shown in table 6, this fishery is highly diversified and in the same trip more than one gear can be used, such as trammel nets and traps.

According with figure 10 the economic importance of lobster presents a diminishing role, as oppose to crayfish, other noble crustacean, fishery that shows an incremental progress in the decade of 1998-2008.

In terms of values, the economic value (figure 10) of lobster fishery in Sagres decreased from 180 398, 44 € in 1998 to 43 407, 75 € in 2007. For crayfish fishery, the economic value of the specie increased from 6 363, 70 € to 299 786, 14€ from 1998 to 2007.

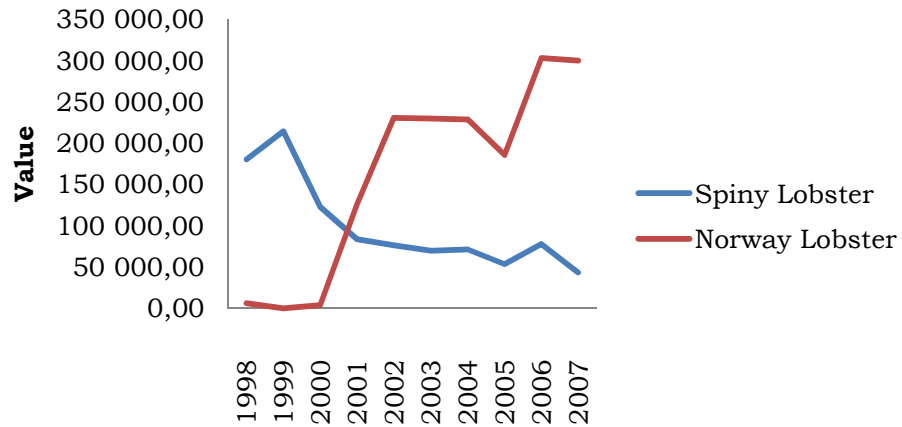


Figure 10. Economic importance variation of *Palinurus elephas* (Spiny Lobster) in port of Sagres from 1998 to 2007 and economic importance variation *Nephrops norvegicus* (Norway Lobster) in ports of Sagres and Vila Real de Santo António from 1998 to 2007 (Source: General Directorate of Fisheries and Aquaculture).

Also, figure 11 indicates that the relation Euros per kg for both species has suffered visible oscillations with crayfish being more representatives, which reveals that crayfish is, actually, the most fished crustacean.

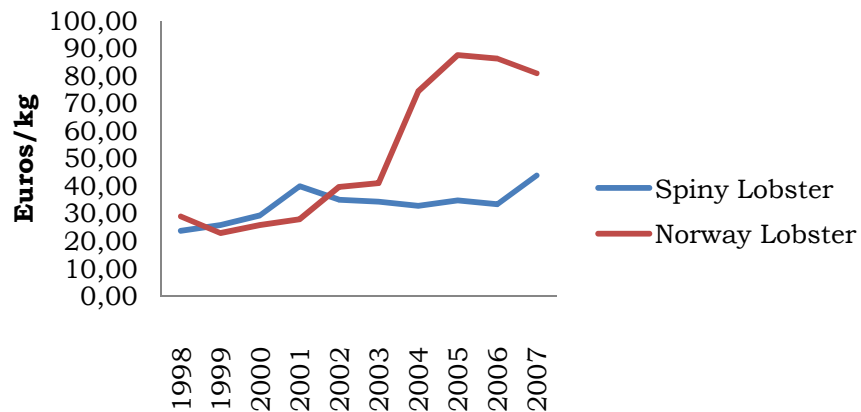


Figure 11. Relation price, in Euros, per kg of *Palinurus elephas* (Spiny Lobster) in port of Sagres from 1998 to 2007 and relation price, in Euros, per kg of *Nephrops norvegicus* (Norway Lobster) in ports of Sagres and Vila Real de Santo António from 1998 to 2007 (Source: General Directorate of Fisheries and Aquaculture).

The present study reveals that traps aren't efficient catching crustaceans since for the lobster fishery in Sagres only one individual was caught by this

gear (male with 85.05 mm CL) in contrast with the 76 individuals of *Palinurus elephas* caught by trammel nets.

Since there were used two fishing gears and due to the previous knowledge that the trammel nets presents low selectivity, the figure 12 shows the percentage representation of each taxonomic group in the lobster fisheries with this gear for 2008. The results demonstrate that fishes have the highest representation, 21%, in the catches, followed by cnidarians. Lobsters represent only 12% of the total catch obtained in 2008. Therefore, trammel nets catches may be representative of the lobster population due to the low selectivity of the gear.

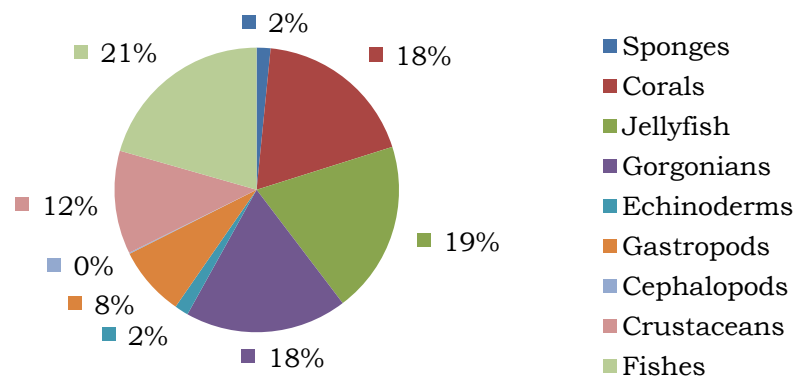


Figure 12. Percentage representation of each taxonomic group caught in the lobster fishery for 2008.

The samples were collected by means of trammel nets and traps and the yields obtained for both gears, summarized in table 6, corresponded to the total catch by the line of 50 traps or 50 net panels in a same immersion period.

It is useful to consider that trammel nets are more efficient catching fish and, on the other side traps presents a greater capacity catching crustaceans however, the total yields are similar for both gears, that is, 448 individuals were caught by traps and 534 individuals were caught by trammel nets.

The main fish, crustaceans and mollusks with commercial interest, caught in the SW coast, under the same grounds as lobsters, are presented in table 6. The

reduced percentage of crustaceans caught in these fisheries can also be shown in figure 12 and table 6 that presents the *Palinurus elephas* catches in 2008.

Table 6. Catches by number obtained with traps and trammel nets in the port of Sagres in the period from May to September of 2008.

Taxonomic Group (1)	Scientific Name	Common Name	Traps	Trammel Nets
Fishes	<i>Conger conger</i>	Safio	8	1
	<i>Diplodus spp</i>	Sargo		1
	<i>Diplodus vulgaris</i>	Safia		2
	<i>Helicolenus dactylopterus dactylopterus</i>	Boca negra	28	5
	<i>Lepidotrigla cavillone</i>	Ruiivo		1
	<i>Lophius spp</i>	Tamboril		2
	<i>Merluccius merluccius</i>	Pescada		27
	<i>Mullus surmuletus</i>	Salmonete		1
	. (2)	Teleósteo		49
	<i>Pagellus acarne</i>	Besugo		20
	<i>Pagrus Pagrus</i>	Pargo		5
	<i>Phycis blennoides</i>	Abrótea	3	40
	<i>Raja spp</i>	Raia		3
	<i>Spondyliosoma cantharus</i>	Choupa		5
	<i>Synaptura lusitanica lusitanica</i>	Linguado		1
	<i>Trisopterus Luscus</i>	Faneca	5	5
	<i>Zeus faber</i>	Peixe galo		2
	<i>Serranus hepatus</i>	Serrano ferreiro	2	
Total Vertebrates			46	170
Sponges	Spongidae (Family)	Espanja		14
Cnidarians	<i>Astropartus mediterraneus</i>	Medusa		162
Echinoderms	.	Ouriço do mar	3	
	<i>Centrostephanus longispinus</i>	Ouriço do mar	4	
	.	Estrela do mar		1
Gastropods	<i>Holoturidae</i>	Holotúria	11	17
	.	Gastrópode	8	0
	<i>Charonia lampas</i>	Buzina	22	62
	<i>Cymbium olla</i>	Ferro de engomar		2
Cephalopods	<i>Ranella olearium</i>	Búzio gigante	32	
	<i>Octopus vulgaris</i>	Polvo	6	
Crustaceans	<i>Sepia spp</i>	Choco		1
	<i>Palinurus elephas</i>	Lagosta	1	76
	<i>Hommarus gammarus</i>	Lavagante	3	3
	<i>Maja brachydactyla</i>	Santola		6
	<i>Plesionika narval</i>	Camarão narval	254	
	<i>Dardanus arrosor</i>	Paguro	26	1
	<i>Calappa granulata</i>	Freirinha real	0	18
	.	Caranguejo	3	2
	.	Caranguejo eremita	29	
Total Decapods			316	106
Total Invertebrates			402	365
Total			448	535

- (1) Corals and gorgonians are not included since in most cases the counting only refers to fragments of individuals
- (2) Unidentified fish due to their state of degradation

Tables 4 to 6 shows that for the reduced number of vessels in port of Sagres, there are an increased number of licenses for fishing gears.

Q - methodology

The increasing devaluation oh *Palinurus elephas* in both biological and economic terms stands up the need to incorporate new management measures.

To evaluate what fishermen perceive as fundamental management measures for lobster fishery in Sagres, open semi-structured interviews (interviews with a pre-defined script but with a degree of freedom that allows the inclusion of new issues and other deviations from the script) were conducted and, according to them, the main contributions identified, as major contributors for the decrease of the spiny lobster stock in the sw coast of Portugal are presented in table 7. The sentences were drawn from the results of interviews and represent common discourses among the interviewees or ideas that were found interesting to use in the next phase of the method. These sentences derived from the Q-set₁ and represent the sentences that collected the highest degree of accordance: agree and strongly agree.

Table 7. Most important points of view expressed by fishermen during the questionnaire (sentences from Q-set₁).

Pollution
Selling off fish auction
Non-compliance with the minimum landing sizes (MLS)
Non-compliance with respect to the closed season for lobster
Climate changes
Capture of berried females
High number of species that preys on lobster
Introduction of fishing nets
Increasing number of fishing nets
Too many licenses
Harvesting of lobsters by divers
Allocation of gears in forbidden areas
Lack of fiscalization
Lack of shelter for small lobsters
Too many fishing nets

During the Q-sorting, each respondent was designated by the code *lobs01* to *lobs19* (annex IV and annex V).

Table 8 presents the factor matrix after the varimax rotation procedure. The entries in the table are called factor loadings and are, effectively, correlation coefficients indicating the degree to which each participant Q-sort correlates with each factor. From the analysis of table 8, one could said that discourse A explains 18% of the total variance, discourse B explains 14% and 15% and 13% of the total variance are explained by discourse C and D, respectively. The four discourses represent 60% of the total variability and correlations between factor scores are presented in table 9

The sorts which load significantly are marked by an **X⁵⁾** and, in the present study, four factors were extracted and all these factors had, at least two participants giving them significant loading. This means that six participants had significant pure loadings on factor A, four participants had significant pure

loadings on factor B, five participants had significant pure loadings on factor C and three participants had significant pure loadings on factor D. Since none of the participants contribute to more than one factor, perspectives have a high degree of uniqueness. From table 9 we observed that the perspective with the highest similarities are A and D. While the more distinct are B and D. The degree of similarity in the discourses denotes consensus between individuals' points of view. These individuals represent unique factor types, corresponding to unique attitudes or points of view.

⁵⁾ Loadings may, in theory, range from +1 to -1 and represent the amount of variation of commonality that is accounted for by each factor

Table 8. Factor matrix with an **X** indicating a defining sort. % Expl. Var. = Percentage of explained variability; % Cum. Var. = Percentage of cumulative variability.

Participant Code	Discourse A	Discourse B	Discourse C	Discourse D
Lobs01	0.0512	0.7053 X	-0.1089	0.0542
Lobs02	0.3118	-0.3542	0.6480 X	0.2137
Lobs03	0.1083	-0.2556	0.6339 X	0.0781
Lobs04	0.0122	-0.0729	0.2016	0.8594 X
Lobs05	0.1785	0.2852	-0.0715	0.8288 X
Lobs06	0.6482 X	0.2778	0.4860	-0.0974
Lobs07	0.2503	-0.1293	-0.0052	0.6534 X
Lobs08	-0.3580	0.2629	0.7985 X	0.0246
Lobs09	0.2314	-0.6611 X	0.0392	-0.0003
Lobs10	0.7313 X	0.0126	0.1240	0.2375
Lobs11	0.0488	0.5292	0.3223	0.5058
Lobs12	-0.0042	0.2318	0.7886 X	-0.1351
Lobs13	0.7782 X	-0.0247	-0.1039	0.3207
Lobs14	0.1574	-0.0850	0.5991 X	0.1336
Lobs15	0.6506 X	-0.1726	-0.0014	0.1461
Lobs16	-0.1392	-0.6400 X	-0.0182	-0.0496
Lobs17	0.3215	0.6457 X	0.0365	-0.1365
Lobs18	0.7913 X	0.1509	0.1329	-0.1610
Lobs19	0.4930 X	0.2266	0.0118	0.1229
% Expl. Var.	18	14	15	13
% Cum. Var.	22	36	49	60
Participants	6	4	5	3

Table 9. Correlation between factors scores.

	A	B	C	D
A	1.0000	0.1212	0.0982	0.0268
B	0.1212	1.0000	0.0268	0.0454
C	0.0982	0.0268	1.0000	0.0974
D	0.2608	0.0454	0.0974	1.0000

For determining the significance of loadings, the rule of thumb is that some elements of the correlation matrix should exceed 0.30 while none should exceed 0.90 (van Exel 2005).

Individuals which have a positively significantly loaded on a factor are assumed to share a common perspective with one another, while having opposite views from the ones with negative loads on the same factor. This can be seen in factor B (table 8), where participants Lobs01 and Lobs 17 have positive loads while Lobs09 and lobs16 have negative loads. Participants Lobs01 and Lobs17 considered that the creation of artificial shelters is extremely important. Also, participant Lobs17 also believes that controlling the harvesting of algae is an activity that requires a strong weighting. However, participant Lobs09 holds an opposite point of view, since he considered the above measures of reduced importance. Participants Lobs01 and Lobs16 also shows opposites points of view regarding the issue of reducing fishing licenses, since participant Lobs 01 considered that this is an irrelevant measure, unlike the participant Lobs16 (annex IV and annex V).

Before describing and interpreting the factors, factor scores were calculated (annex VI to annex IX) for each of the four factors. A statements' factor score is the normalized weighted average of scores of respondents that define that factor. In this process, more weight is given to the Q-sorts scores of those participants who have higher loadings, indicating that they are more representative of the factor type. The result is a table of factor scores arranged as factor arrays (annex X) showing the scores obtained by each statement for each factor. Each factor array represents the best available description of opinions and Q interpretations are, generally, based on these factor scores and factor arrays.

All the extracted discourses express a point of view that emphasizes what stakeholders' aims and perceive as conservation and management strategies.

Discourse A is the only one that put the increase of supervision of minimum landing size in restaurants as priority (+3), whereas in all the other discourses negative values were attributed to this issue, meaning that this measure isn't a priority for the majority of the participants. Also, both discourses A and C present a more positive (+2) view with respect to introduce measures to mitigate lobsters selling outside the fish auction, indicating the importance of role of consumer in this perspective-

Discourse C and D present a shared concern with the obligation to return berried lobsters to the sea). To compensate the excessive impact of fishing on *Palinurus elephas* stock, measures such as construction of maintenance facilities (+3 in discourse A and +2 in discourse B), establishment of a closed season for this species (+3 in discourse C) and creation of artificial shelters for small individuals (+3 in both discourses B and D) are considered.

All of the above opinions suggest a concern for ecological aspects. These results suggest there is found a global sense of environmental responsibility, with expectations that the administration should have a large part to play in enforcing protective measures. Positive questions among the four discourses are concerning supervision to avoid illegal selling; closure of the lobster fishery in alternative years; construction of maintenance facilities to allow direct sale to the public; increase the frequency of hauling the nets; creation of artificial shelters for small lobsters and the obligation to return berried lobsters to the sea.

The more persons defining a factor, the higher the reliability and lower the magnitude of errors associated with that factor (table 10).

Table 10.Factor characteristics for respondents.

	FACTORS			
	A	B	C	D
Defining Variables	6	4	5	3
Average Reliability Coefficient	0.800	0.800	0.800	0.800
Composite reliability	0.960	0.941	0.952	0.923
Standard Error of Factor Scores	0.200	0.243	0.218	0.277

According with table 10, factor A shows the highest reliability, 0.960, and the lowest error, 0.200. On the other hand, factor D presents the lowest reliability, 0.923 and consequently the highest error, 0.277. The total factor variance was 2.957 and standard deviation of 1.719.

For factor interpretation, two statistical aspects may be considered:

- 1) Normalized factor scores which are significant at the 99% level of confidence for a factor ($P < 0.01$) and at 95 level of confidence for a factor ($P < 0.05$);
- 2) Statements which have high scores for a particular factor, that is, -3 and +3.

For the four factors extracted in this study, nine statements were extracted for factor A, five for factor B, six for factor C and five for factor D. Annex XI lists the distinguishing statements along with factor scores, those with significantly differences among the four discourses. Also, consensus statements were identified as those that do not distinguish between any pair of factors or discourses. The identified consensus statements are also presented in annex XI.

A careful and rigorous selection was made in order to arrive at a description of the points of view that best integrates all the distinguishing statements associated with a particular type. In this way, major and minor concerns related to the four factor/discourse types are presented in annex XII to annex XV.

Discourse A explains 18% of the total variance (table 8). This discourse (annex XII) displays a strong concern about the current status of the lobster stock in the sw coast of Portugal. There is a strong agreement with regard to supervision in restaurants and for sale outside the fishing auction. The data presents in the same way, an agreement on the construction of maintenance structures and artificial shelters that, could improve the biomass of this species in the considered area. The perspective pointed out by discourse A understands the potential threats that lack of control represents for marine biodiversity. The focus on contingent valuation is also demonstrated by the emphasis given to the support for the construction of structures that could improve the *Palinurus elephas* condition.

According to this perspective, the value of preservation of lobster population is not fully recognized for all users and, therefore, it emphasizes the need to increase investment in information and environmental education.

However, reducing the number of fishing licenses and closing the fishery until lobster population recovers are not regarded as important. The majority of the respondents considered that the numbers of fishing licenses are already reduced and, even when the fishery is closed there is an occasional capture of lobsters. Also, the creation of protected areas where gears that catch lobsters cannot be used, the prohibition of fishing nets in lobster areas are not considered relevant in this discourse.

Information, education and cooperation between fishermen and administration authorities seem to be the main vehicle of change in Sagres fishing community. Considering the contingent nature of the present

perspectives', one could surmise that environmental education would be a logical investment, as it is a way to achieve future behavior attitudes in what concerns conservation of the resources. Discourse A focuses, to a certain extent, in the dissemination of information and cooperation among stakeholders'. From this analysis, it is plausible to call discourse A as **Information exchange and cooperation among stakeholders'**.

Discourse B explains 14% of the total variance (table 8). This discourse (annex XIII) emphasizes that measures that potentiate the recovery of lobster population should be implemented, revealing awareness that conservation and sustainability in fisheries are needed. This discourse is very concerned with the exploitation of marine resources in a sustainable way. These respondents are strongly aware of environmental issues, which they identify as being the root of the present fishery crisis. In addition, discourse B shows up a strong belief that the construction of maintenance facilities and the creation of protected areas with restricted fishing gears will improve the resource conservation, and also reveals the need for changing the current legislation regime, so that the fishery can continue, considering the conservation aspects.

The root of this fishery crisis is the excessive fishing effort on lobster population, which resulted in a serious stock depletion. Besides all respondents have pointed towards the need for new management strategies, measures such as reduction of the number of fishing licenses and closure of the fishery until lobster population recovers are seen as having a minor importance in discourse B. All the respondents share this point of view since, in their opinion, fishing licenses are currently reduced and that the closure of lobster fishery will not solve the problem, in a way that lobster catches are occasional and by-catch of other target species.

Common disagreements are considered for the implementation of other management measures such as reservation of fishing areas for catching lobsters only with traps since this gear is no longer in use, due to its low durability and reduced catchability and, due to the fact that is a very expensive gear to

produce. Increasing the frequency of hauling the nets is also a measure of minor concern mainly because it is a matter of conscience and ethics in fishing practices.

From this analysis, discourse B strongly agrees with the implementation of measures that can potentiate the conservation and recovery of the lobster population by the creation/construction of maintenance facilities rather than the introduction of more drastic measures that includes modification of fishing practices. For this reason, this discourse is called **Management and conservation by creation of infrastructures**.

Discourse C explains 15% of the total variance (table 8) and the most influential statements for this discourse can be seen on annex XIV. This discourse focuses primarily on changing mentalities and ethic implementation during fishing practices and, secondly it focuses on management measures itself. Discourse C gives greater importance to issues related to fishermen behavior and their relationship with the marine system. Obligation to return egg-berried lobsters to the sea as well as the establishment of a closed season for lobster are identified as the fundamental issues, which may be related to the fact that fishermen circumvent those measures. Besides, there is a closed season already established (from October 1st until January 1st), but the high rank attributed to this statement indicates that there is a need to reinforce that measure. This situation leads, as also shown in discourse A, to the implementation of environmental education towards sustainability on those who exerts their activity in the considered area. Increase control on fishermen behavior is the fundamental point in the present discourse and an example of change in mentalities is the importance given to restocking with young lobsters reared in nurseries.

On the other hand, measures such as increasing the frequency of hauling the nets, construction of traps with small windows in order to allow the escapement of small lobsters and also selective fishing for octopus are not well viewed by the respondents, who also consider the reduction of fishing licenses a

major inconvenience which denotes a lack of confidence and disagreement with the political structure and law enforcement on fishing sector. From this discourse's point of view, issues related with law enforcement and management institutions are an enormous obstacle in fisheries conservation and its future development, which reinforce the importance given to short-term actions rather than long-term actions. Institutional issues were a common topic discussed in the interviews and from the perspective pointed by discourse C, it should be designated as **Behavior and ethic – fishermen awareness**.

Discourse D explains 13% of the total variance (table 8) and for this discourse the most important statements are presented in annex XV. Discourse D can be characterized by a strong concern for the well-being and conservation of *Palinurus elephas* stock. The present discourse shows a greater appreciation for management actions and it is distinguished from other discourses by its agreement with the idea that the spiny lobster is seriously threatened, emphasizing the need of closing the lobster fishery in alternative years to increase its recovery.

The obligation to return egg-berried lobsters to the sea and the creation of artificial shelters for small lobsters are a primary concern in the present discourse. However, apart from the conservation point of view presented by the respondents, political measures that influence management procedures are severely contested, especially when referring the reduction of the number of fishing licenses and control of algae harvest, considered obsolete since this activity is no longer practiced. The establishment of a minimum number of lobsters per vessel and fishing season are considered impracticable and, also the respondents had considered the issue of increase the minimum landing size as a matter of minor importance. Conservation conscience and fisheries policy are the main topic in discourse D and, by that, it is designated **Pro-political conservation measures**.

The number of stakeholder group loadings on each factor is summarized on table 8 and it is important to note that all stakeholder groups loaded on one of the factors and none loaded on two or more factors (distinct perceptions

associated with each factor). All stakeholders are related to the fishery industry: fishermen engaged in the activity for an average period of twenty years. For most of the participants, fishing is their only source of income and represents a lifetime work. The **Information exchange and cooperation among stakeholders** discourse is defined by a total of six stakeholders; the **Management and conservation by creation of infrastructures** discourse represents the opinion of four stakeholders; the **Behavior and ethic – fishermen awareness** discourse is supported by a group of five stakeholders and, finally the **Pro-political conservation measures** discourse is associated with three stakeholders’.

From the loadings described, it can be seen that there are distinct patterns in relationships of subgroups to each discourse. Discourses are loaded with individuals that can be recognized with the defined discourses. Discourse A is associated with participants linked with education, discourse B with participants favoring business and facilities construction, discourse C includes participants valuing environmental protection and education and also political activity, as does discourse D.

Areas of consensus were revealed in this study among all discourses and participants and those areas act as a basis for future work in development of management scenarios that are sustainable and consented by all stakeholders. Two, of the 23 set of statements, had high level of agreement among all discourses (all participants gave them “strongly disagree” scores)) and received statistically indistinguishable scores (annex XI). The statement “Allow lobster fishery only with traps” was non-significant at $P>0.01$ and at $P>0.05$ and statement “Reduction of the number of fishing licenses” was non-significant at $P>0.01$. Therefore, the statements mentioned above are those that do not distinguish between any pair of factors. There was a general disagreement with the ideas of closing the fishery until lobster population recovers and also with the idea of create protected areas for fishing only with traps, though the relative intensity of disagreement was low (annex X) .

More subtle interpretations of the potential of common grounds can be developed by looking beyond just those statements that failed to distinguish statistically among the four factors (Swedeen 2006). For instance, a statement that had +3 on one discourse (discourse A) and +2 on another (discourse B) are statistically different as in statement “Establish a minimum number of lobsters per vessel and fishing season” (annex X), with a score difference of +1. However, both discourses are on the “agree side” of the scale. While they do reflect a different order of importance in the context of the other statements, they represent an idea that people could likely talk about an issue without a great deal of conflict. These statements could act as a departure point for consensus among groups represented by different discourses (Swedeen 2006).

Applying the above principle to statement “Establishment of a closed season for lobster” (annex X), it is possible to verify that this is a nearly consensual statement, given that it received positive scores of +1, +1, +3 and +1 in discourses A, B, C and D respectively. The statement “Obligation to return egg-berried lobsters to the sea” (annex X) had scores that were further apart for the four discourses: 0, 0, +3 and +3 to discourses A, B, C and D respectively, suggesting that it is associated with indifference in discourses A and B being, on the other hand, of extreme importance for discourses C and D. A similar pattern is found on statement “Supervision to avoid selling outside fish auction” (annex X) that had the scores +2, 0, +2 and 0 for discourses A, B, C and D respectively. The score 0 among high scores, +2 and +3, on a sentence suggests an area in which discussion and collaborative learning could lead to a strong agreement. In cases such as those previously mentioned, individuals can openly discuss facts and values, elaborate and defend their ideas and seek clarification and the reasons for other ideals, in order to reach mutual understanding.

DISCUSSION

The exploitation pattern of *Palinurus elephas* has changed over time. The increasing lobster demands and fishing effort served as a motto for a shift in exploitation strategies for this species (Groeneveld 2006) as traps were replaced by fixed nets, such as trammel nets (Goñi 2005).

To assess the main threats to the sustainability of these fisheries the following aspects should not be neglected: the regulatory framework, the adequacy of the minimum landing size for protecting the reproductive potential of the populations, the current exploitation pattern and the potential impact of trammel nets fishing on the lobster habitat (Goñi 2003 (c)). The use of fixed nets to catch spiny lobster results from the fact that vessels make licenses for several gear types (Galhardo 2006) and all circumstantial evidence points to a greater efficiency of nets in catching lobsters, excessive fishing effort and to the poor selectivity of fixed nets compared with traps (Goñi 2005).

Despite modest catches, the past importance of the spiny lobster fishery in the economy and tradition of the region (Campillo and Amadei 1978; Kittaka and Ikegami 1988), the possibility of a decent catch has been a sufficient incentive for the exploitation of this resource (Díaz 2001; Gristina 2009)

The results obtained in the present work showed that yields for both gears were approximately the same, even if the major efficiency in capturing fish is found in nets whilst traps are more efficient capturing crustaceans. This confirms the extremely low selectivity of trammel nets presented in the results (76 species caught with trammel nets).

The analysis of the landings indicated that another species has emerged, both in landings and value. The landings of the Norway lobster, *Nephrops*

norvegicus, could represent a new fishery, extremely profitable, although conducted by a small number of vessels.

In Portugal, the current measures for management and regulation of spiny lobster fisheries focus only on a minimum legal size (MLS) of 95 mm carapace length (CL), ban on landing of berried females and establishment of a closed season (October to April) (annex I). Considering the legislation applied for spiny lobster artisanal fisheries, the results hitherto show that regulation measures are circumvented because all individuals caught, even those below MLS are kept either for sale outside the legal circuit or for consumption by the vessel crew. Some of the undersized lobsters are sold legally because port authorities do not enforce the MLS since, according with the fishing community, the limit established is not considered suitable for lobsters present in SW coast.

According to Galhardo (2006), for the years of 1993-94 maximum sizes in monthly samples of *Palinurus elephas*, varied from 151 mm to 180 mm for females and 165 mm to 193 mm for males. In the range of a decade, i.e., the data obtained for 2003 showed that the maximum size reported for males was 141 mm of carapace length (Galhardo 2006). In this study, the maximum sizes for males and females were 115 mm and 114 mm CL respectively thus highlighting the perilous state of this population. Also, at the same time, the unit value of first sale has decreased.

Currently, most of the individuals caught in the sw coast are below 95 mm CL and, even though the lobster fishery is allowed only between May and September, vessels catch and keep it during the closed season. The fact that vessels have licenses for more than one gear makes the lobster catches a stark possibility. All of the above considerations indicate that lobster management laws are unsustainable and authorities must reinterpret the state of marine artisanal fisheries (Groeneveld 2000).

Given the condition of the resource, from the point of view of conservation, the reintroduction of fishing gears with less environmental impacts was

proposed in this work as a possible management measure, in order to allow the recovery of the *P. elephas* in the SW coast of Portugal – Sagres.

Traps have been considered among the most versatile and effective fishing gears and moreover, they represent a useful tool for sustainable harvest, being selective and also producing a negligible by-catch, having a minimal impact on benthic communities. Fishing with traps is preferable to trammel nets because they retain a smaller proportion of juveniles and because larger lobster are either too large to enter traps or are able to feed without entering (Goñi 2003 (c)).

In cases such as spiny lobster fishery, the re-introduction of selective traps represents an important opportunity for the re-launching of local artisanal fisheries in accordance with sustainable management practices (Gristina 2004).

Since traditional wood traps were very expensive to produce, modern plastic traps were assessed as a consistent alternative (Goñi 2003 (a); Gristina 2004) for spiny lobster fisheries. However, results show that alternative models haven't obtained satisfactory results since they were not robust enough for fishing in the SW coast waters. The gears were often found completely twisted due to the intensity of the currents due to turbulence generated from the surface wind regime in that area.

To add to the above situation, the catchability exerted by the line of fifty traps was not the one expected. The type of material used in their construction could affect their attractiveness to lobsters in a way that catch performance of the gear is conditioned and influenced by several factors, namely: material, mesh size, trap size, design, soak time, bait and life cycle stage of the target species (Krouse 1989; Gristina 2004). Thus, it could be said that, according to Krouse (1989), whether a crustacean is attracted to, enters, and is retained by a trap depends on a series of environmental, behavior and physiological factors along with the mechanical characteristics of the gear. Therefore, an understanding of the multifaceted capture process is essential and beneficial to the fishermen in allowing a more efficient gear design and effective fishing

strategies (Krouse 1989). The artisanal fishery for spiny lobster is extremely complex due to the strong human component and also due to the inherent characteristics of the system (Allison 2001), such as the use of multiple fishing gears and unreliable fisheries information which, coupled to the fact that fishing areas have remained the same throughout time (Galhardo 2006), resulted in progressively diminished catches, culminating in ineffective management strategies.

Artisanal fisheries occur on coastal ground so the feasibility of implementing management options is far greater and the basic tools for that purpose are access controls in time, space, and vessel number, and technical measures such as gear and MLS (Mardle 2002), while the information required for adequate management plan covers a spectrum of scientific disciplines: biology, fishery science, sociology, biometrics, ecology and economics (Zuboy, Jones et al. 1980; Phillips 2007).

The crisis in fisheries is increased by a strong complexity and presents different symptoms of a general state of overexploitation derived from the mismatch between the socio-economic and biological context (Freire and García 2000; Pauly 2003), which means that all of the idiosyncrasies mentioned before change between types of fisheries and therefore, key priorities for fisheries management include environmental sustainability, economic viability and the inclusion of stakeholders in the decision making process.

Change has been a constant throughout the history of fisheries, although major driving forces have been technology and competition rather than fisheries management (Hilborn 2007). The ease with which such innovations have been accepted cannot help and instead make the fishery management impracticable (Groeneveld 2006). Management changes requires simultaneous acceptance by many participants and, the constant battles over the decisions about optimal minimal sizes, seasons and access to fishing grounds, as well as other measures, have only led to slow or no progress in management. In order for this management to be efficient, full compliance is required. Good catch and landing

statistics are also fundamental, since scarce and unreliable fisheries information will further create ineffective management plans and stock assessment (Groeneveld 2006).

Small-scale fisheries are an activity that assumes growing importance (Costa 2008; Batista 2009; Battaglia 2010) due among other factors, to:

- strong implementation along the whole coast
- great diversity of fishing gears and a large number of small vessels exploiting a large variety of species
- high commercial value of the captured resources
- great number of fishermen and other involved agents
- socio-economic and cultural importance in the fishing communities
- reduction of the importance of the traditional fishing grounds explored by the distant fleet.

As a subsystem of fishing, artisanal fisheries is managed within a specific legal and administrative framework and is practiced by vessels with small and medium dimension, that operate with great diversity of gears near the coast (Costa 2008), and involves traditional forms of organization such as remunerative systems entirely based on the profits of fishing.

The reason why traditional regulations have not been adequate is traced back to political control of fisheries management that caters special interests at the expense of economic efficiency and a management system that stimulates a perfect market need to be allied to a more efficient fiscalization. It is important to consider that, if marine fisheries are to be sustained, increased public support and consumer power must be used to create social, economical and political incentives and opportunities for fisheries that are both sustainable and with minimum environmental impacts (Sutton 2001).

Rethinking fishery management for small-scale fisheries poses challenges that do not lie in obtaining new data or developing new techniques, but rather in rethinking the philosophy towards sustainability. Reversing the current fishery crisis will require a major overhaul of the contemporary fisheries management (Sutton 2001). Only this, coupled with public interest and motivation and also powerful economic incentives, has the ability to stop overfishing and to shift the focus of fisheries management from development and exploitation to conservation and sustainability (McGuire 2001). Greater public involvement in fisheries management process is required because community participation is beneficial despite its inherent complexity. A critical feedback to the management process is, by far, necessary (Jentoft 2001) but it should be stressed that the approach to a fishing community must be extremely careful, since fishermen are, by its own nature, very suspicious, showing reluctance in accepting new projects or measures of management.

In community participation, it is required to know which community members will participate in the management process. This expanded view emphasizes the need for involvement of various stakeholders at various levels : global level (biodiversity), society level (national resource), citizen level (food security), fishers (boat owners, operators, and crew), industrial realm (marketers) and family level (employment) (Charles 2001; Harris 2001). Also, community participation must be seen as a developmental process and it is important that the stakeholders have some party in authority so that one could establish a basis of truth and verity.

The implementation of a bottom-up fishery management actions for the rational use of coastal resources, where users can be directly incorporated at an early stage, into management process (McClanahan 2007), could be an interesting strategy, mainly because an important part of the success regarding long-term sustainability of resources lies in the implementation of co-management actions. Participation of fishers in the management process is perceived as desirable due to they're important empirical knowledge concerning important aspects of the system, and their participation is essential to interpret

that information (Orensanz and Jamieson 1998). Besides, effective implementation of management requires compliance and support, which in turn requires understanding and trust (Hauck 2008). The interconnectivity of concerns embracing ecosystem health, social justice and livelihood is the core to understanding and ultimately develop fishing strategies that ensure sustainability (Hauck 2008).

In artisanal fisheries the scope for community participation is high, mainly due to the marginalization aggravated by conventional top-down decision making process (Berkes 2001) which supports the hypothesis that artisanal fisheries are unmanageable without the input and cooperation of stakeholders. Community participation in fisheries management requires collaboration, transparency and accountability (Berkes 2001) and, the groups of stakeholders must be treated as equals in their claims to legitimacy (Harris 2001).

Artisanal fisheries have an important role in keeping economic and social cohesiveness in coastal communities and it is this connection that explains the emotive power associated to this activity (Johnson 2006). Therefore, it is plausible to affirm that, in small scale fisheries, resource management is in fact, people's management and fishers are one of key actors in the management process (McClanahan 2007).

Given all the above, engaging communities in management is an essential management strategy as it is most likely that it creates incentives for compliance (McClanahan 2007). The application of the precautionary approach, should be considered, to deal with the uncertainty inherent in fishery science and with the negative consequences for conservation of the lack of compliance with control measures (Charles 2001). In this way, it is important to shift from a fractional view in which the fishery is treated in isolation, to an integrated systems view with the fishery recognized as part of a coastal and regional economy.

New perspectives for solutions for artisanal fisheries require more holism and shifts in management focus, namely in sharing of management roles and

responsibilities. In other words, a shift should take place to ask how the harm could be minimised, changing fisheries policies to an integrated approach that recognizes the importance of formulating integrated regulations measures. A code of conduct for responsible fisheries should be adopted in order to resolve the conflicting short term interests of individuals with long terms interests of the society (McClanahan 2007), also considering an ethical point of view of depleting species and processes to levels where their survival is jeopardized (FAO 2005). In spite of this consideration being socially rational and appealing, it requires active management and agreement among stakeholders. It must be emphasized that ethical standards should not be imposed but should be understood and accepted by all, without the need for complex explanatory mediations and aggressive enforcement actions.

FINAL CONSIDERATIONS

The persistent ecological and biological collapse of marine stocks has prompted to a steady stream of preoccupations and studies regarding management and ethical issues in fisheries.

In a situation of failure of management systems, we must go beyond the most common solution, which is to give fishers a supplemental livelihood, toward more innovative approaches involving development of skills. New management directions need to address in coastal communities, the challenges including: employment and income, food security, and better quality of living.

To mitigate the current status of crisis in artisanal fisheries it is important to consider several aspects not only environmental sustainability but also social and economic viability and the inclusion of stakeholders.

All social and biological systems must be balanced and ethically structured. The artisanal fishing system needs a brand new reconstruction since it became obvious that the current top-down management procedure isn't accurate and fair. From the present work the main conclusion that emerged was the need of community participation in management strategies, all fisher's claims for an opportunity to give their opinion regarding the implementation of legislation, fishing gears, i.e., introduce a bottom-up management procedure.

Co-management"; is among several slogans used to indicate a dissatisfaction with present systems and a movement to more decentralized systems of marine resource management. Participatory management and community-based resource management strategies can provide support for development and management initiatives – a mechanism not only for resource management but also for social, community and economic development by promoting participation and empowerment of people to solve problems and address community needs.

The low catches and landings of lobster in Sagres reveal the decrepit state of the population and all the work leads us to the following question: From the fisher's perspectives, which conservation and management measures can be adopted?

Several suggestions are proposed, namely:

- Modification of the current MLS, from 95 mm carapace length to 20 mm total length, according to an accurate biological research about the species in the referred area,
- Enhancement – human interventions designed to increase population productivity, feasible at a small-scale. Interventions may include habitat improvement, creation of artificial reefs and control of predators,
- Designate protected areas, in order to play a significant role in marine resources conservation,
- Restoration of coastal habitats susceptible to human-caused pollution
- Enhancing lobster populations by restocking with young individuals, practices leading ultimately to aquaculture,
- Establishment of a closure period for *Palinurus elephas* and gear restrictions,
- Establishment of a digital tagging system that determine whether the individuals went through auction,
- Economic analysis of fishing effort-yield relationship and the associated costs and returns.

Given all considerations presented in this work, small-scale fisheries need a radically different approach towards enforcement and compliance, considering socio-economic levels: stakeholder consensus and involvement in management. The fishing communities have barriers hard to overcome and this process requires new skills by the managers who, in addition to having technical capabilities, must also be a mediator, facilitator and educator.



The assumption underneath this approach is that when stakeholders understand the problems and the benefits of taking action, and (mostly) agree upon the actions to be taken, they will take part in the enforcement.

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ANNEX I - Legislation

Decreto-Lei n° 43/2003, 10 de Dezembro [Capítulo II, secção III, Art° 15°]

Regulamento Geral da Pesca Marítima

Secção III Gestão participativa

ARTIGO 15

(Sistema de gestão participativa)

1. O Ministério das Pescas adoptará a gestão participativa como modelo preferencial para assegurar a gestão das pescarias.
2. O modelo de gestão participativa constitui um sistema que prossegue os seguintes objectivos principais:
 - a) Garantir uma gestão responsável das pescarias;
 - b) Assegurar o direito de acesso às pescarias das comunidades pesqueiras tendo em vista a protecção e a promoção do seu bem estar;
 - c) A promoção da participação das comunidades pesqueiras na planificação e aplicação das medidas de ordenamento pesqueiro;
 - d) O fomento de actividades de formação através da extensão pesqueira;
 - e) A criação de um ambiente favorável à coexistência de pescadores artesanais, armadores de pesca semi-industrial e de pesca industrial.
3. A Comissão de Administração Pesqueira e o Comité de Co-Gestão são o fórum do sistema de gestão participativa onde todos os grupos de interesse se encontram representados.

Regulamento (CE) n° 850/98 [Art° 48°, n° 3 do Decreto Regulamentar n° 43/87] e Portaria 27/200

*Tamanhos Mínimos Legais das Espécies – Crustáceos – *Palinurus elephas**

Decreto-Lei 270/2000, 22 de Novembro [Portaria n° 1102-D/2000, 22 Novembro]

Regulamento da pesca por arte de armadilha

Artigo 11.º

Pesca da lagosta e do lavagante

1 — A pesca de lagosta (*Palinurus elephas* e *P. mauritanicus*) e de lavagante (*Homarus gammarus*) com armadilhas só pode ser exercida entre 1 de Janeiro e 30 de Setembro, sem prejuízo do disposto no n.º 2.

2 — Nas águas da subárea dos Açores da zona económica exclusiva nacional é proibida a pesca de exemplares fêmeas entre 1 de Janeiro e 31 de Março.

3 — Nas armadilhas destinadas à captura das espécies referidas no presente artigo, quando construídas com ripas de madeira ou outro material, a distância entre estas deve permitir a introdução sem oposição e em qualquer sentido de uma bitola de 40 mm.

4 — Durante o período referido no n.º 1, todos os exemplares ovados que forem capturados devem ser rejeitados e devolvidos ao mar, não podendo ser mantidos a bordo, transbordados, desembarcados, transportados, armazenados, expostos ou vendidos.

ANNEX II - Questionnaire used in this work to determine the social profile of Sagres Fishing Community.

Spiny Lobster Fisheries in the Southwest Coast of Portugal – Conciliating Fisheries with Conservation Measures

This questionnaire is entered into the Masters final work. Responses are anonymous and confidential. Its completion is voluntary. I appreciate your cooperation.

Date: _____

Time Beginning/Time End of the interview: _____/_____

I: Relation to Fishing

1. Type of activity (fisherman, buyer's auction, tax, etc):

2. Years in this activity: _____

3. Have you ever had other activity related to fishing? (Yes or No)

4. If yes, which? _____ and for how long? _____

II: Personal Data

1. Gender

Female Male

2. Age _____

3. Household _____

4. Marital status

Single

Married

Widower

Divorced

5. Educational Qualifications _____

6. Attended courses related to fishing?

Yes

No

If yes, which?

Course designation/Year

_____	/	_____
_____	/	_____
_____	/	_____
_____	/	_____
_____	/	_____

II. Relation with Sagres community

7. Are you from Sagres?

Yes

No

If not, from which coucil? _____

Are you resident in Sagres?

Yes

No

III. Fishing History

8. Who started you in fishing activity?

9. Who taught more about fishing?

10. Who in your family has been fishing professionally or fishing?

11. Do you encourage your family to dedicate themselves to fishing activity?

Yes

No

Justification _____

12. Currently full-time fishing (1) or do you have a parallel activity (2)?

Yes (1)

No (2)

Other activities? _____

13. Do you engage a directed fishery to lobster?

Yes

No

14. Years in lobster fishery _____

15. Months for lobster fishery _____

16. On a monthly basis, how often do you fish lobsters? (fishing effort dedicated to lobster fishery)

1 – 3 times 3 – 6 times 6 – 9 times 9 – 12 times > 12 times

17. Number of lobsters for fishing season (minimum and maximum)?

< 10 10 – 20 20 – 30 30 – 40 > 50

18. Fishing revenues (total for month)

<500 € 500 - 1000 € 1000 - 1500 € 1500 - 2000 € >2000 €

19. Revenues of lobster fishery (per month)

<50 € 50 - 100 € 100 - 150 € 150 - 200 € >200 €

20. The returns obtained by lobster fishery are relevant for your income?

Yes No

IV: Fishing Organization

21. Are you the owner of the fishing vessel that you currently use?

Yes No

22. Do you have more than one vessel?

Yes No

23. Vessels characteristics

Size _____

Engine Power _____

Year _____

Crew _____

Fishing gear(s) _____

24. Are you associated to any fishery organization?

Yes No

25. How often do you attend the meetings?

Always Sometimes Rarely Never

V: Q – sort

Regarding the current state of the lobster fishery, in your opinion what happened in the last 10 years?

26. There was a decrease of some species?

Yes No

If yes, which? _____

27. There was an increase of some species?

Yes No

If yes, which? _____

28. About the lobster?

Increased

Remained at the same level

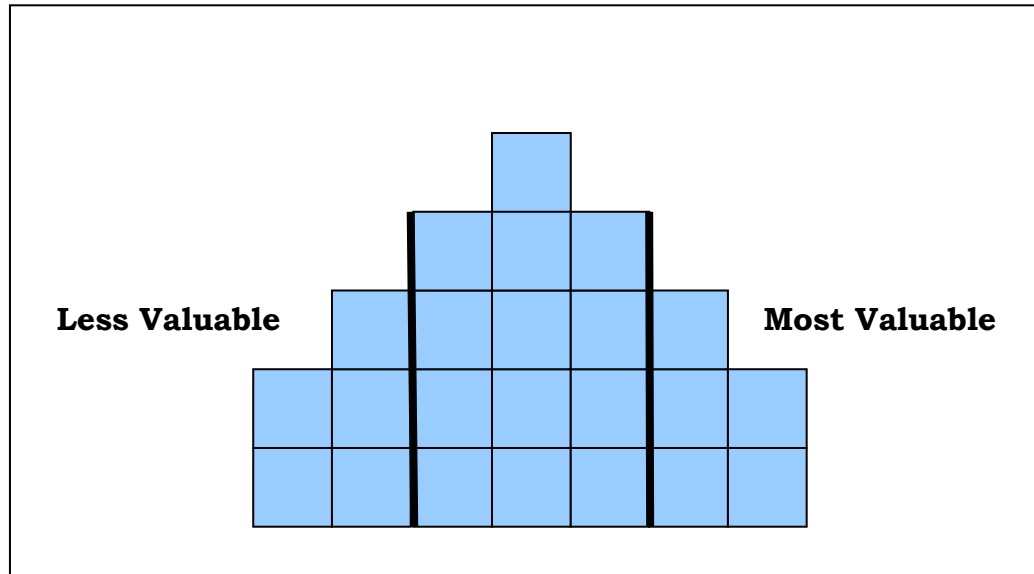
Decreased

29. From the following statements which, in your opinion, contributed to the reduction of the lobster population?

Read each statement and indicate with a circle, the one that best describes your opinion using the following rating scale:

	Totally Disagree	Disagree	Indifferent	Agree	Totally Agree
Climate changes	1	2	3	4	5
Landing of berried females	1	2	3	4	5
Lack of fiscalization	1	2	3	4	5
Failure to comply with the closure season	1	2	3	4	5
Too many nets	1	2	3	4	5
Too many licenses	1	2	3	4	5
Lobster catches by divers	1	2	3	4	5
High number of species that preys on lobster	1	2	3	4	5
Sale outside the fish auction	1	2	3	4	5
Absence of shelters for small lobsters	1	2	3	4	5
Excessive lobster fishery	1	2	3	4	5
Lack of food for lobsters	1	2	3	4	5
Setting of the gears in prohibited areas	1	2	3	4	5
Introduction of nets	1	2	3	4	5
Harvesting of algae	1	2	3	4	5
Non compliance with Minimum Legal Size	1	2	3	4	5
Pollution	1	2	3	4	5
Other causes for lobster decrease					

30. Please rank the statements made in these 23 cards in three levels of valuation: less valuable, moderately valuable and more valuable. The less valuable, may represent the phrases less agreed. In the case of the most valuable, may represent the phrases most agreed.



31. Why did you choose these two cards as the most valuable?

32. Why did you choose these two cards as the less valuable?

ANNEX III – Sampling schedule

Sampling schedule in Port of Sagres (1 meter = 1.83 fathoms; Wind scale: 0-no wind, 1-slight, 2- moderate, 3- strong; Vessel: CATAMAR. Throws 12 and 15 refer to nets that weren't near traps allowing the assessment of net impacts.

Throw	Fishing Gear	Setting			Hauling			Wheater Conditions - Hauling		
		Date	Time_Beginning	Time_End	Date	Time_Beginning	Time_End	Condition of the Sea (m)	Wind	Visibility
1	Traps	12-05-08	06:00	06:15	15-05-08	06:30	07:30	1	1	Good
2	Net	07-05-08	16:00	16:15	15-05-08	08:00	10:00	1	1	Good
3	Traps	15-05-08	10:30	10:45	24-05-08	08:05	08:52	1,5	2	Good
4	Net	15-05-08	10:00	10:15	24-05-08	06:22	07:44	1,5	2	Good
5	Traps	24-05-08	10:00	10:15	20-06-08	.	.	.	.	.
6	Net	24-05-08	10:30	10:45	20-06-08	.	.	.	.	.
7	Traps	20-06-08	.	.	22-07-08	12:30	13:15	0,5	1	Reduced
8	Net	20-06-08	.	.	16-07-08	14:06	15:00	0,5	1	Reduced
9	Net	20-07-08	.	.	22-07-08	11:00	12:10	.	.	.
10	Net	22-07-08	15:00	15:15	12-08-08	10:00	10:50	0,5	1	Reduced
11	Traps	22-07-08	15:20	15:35	12-08-08	11:00	11:50	0,5	1	Reduced
15	Net_2	22-07-08	.	.	12-08-08	12:15	13:00	0,5	1	Reduced
12	Net_2	12-08-08	12:00	12:15	.	.	.	.	.	.
13	Traps	12-08-08	12:30	12:45	20-08-08	08:15	09:00	3	2	Good
14	Net	12-08-08	12:50	13:05	20-08-08	07:00	08:00	3	2	Good
16	Net	20-08-08	.	.	27-08-08	11:15	12:30	1,5	2	Good
17	Traps	20-08-08	.	.	27-08-08	12:45	13:30	1,5	2	Good
18	Net	27-08-08	13:30	13:45	09-09-08	12:50	13:30	0,5	1	Good
19	Traps	27-08-08	13:50	14:05	09-09-08	13:40	14:20	0,5	1	Good
20	Traps	09-09-08	14:30	14:45	25-09-08	13:45	14:30	0,5	0	Good
21	Net	09-09-08	14:50	15:05	25-09-08	13:00	13:35	0,5	0	Good
22	Traps	25-09-08	15:00	15:15	30-09-08	14:40	15:15	1	0	Good
23	Net	25-09-08	15:20	15:35	30-09-08	14:00	14:30	1	0	Good

Throw	Fishing Gear	Positioning				Depth		Immersion Time (days)
		Buoy_South_Lat	Buoy_South_Long	Buoy_North_Lat	Buoy_North_Long	Fathoms	Meters	
1	Traps	3703510	904618	3704096	904704	52	95,16	3
2	Net	3704750	905243	3704833	905502	52	95,16	8
3	Traps	3704069	904552	3704740	904739	52	95,16	9
4	Net	3703330	904881	3704793	904900	52	95,16	9
5	Traps	3701218	901449	3701860	901495	38	69,54	27
6	Net	3659831	901399	3701369	901572	38	69,54	27
7	Traps	3700450	901890	3701060	901999	36	65,88	32
8	Net	3659820	901640	3701200	901800	36	65,88	26
9	Net	3659820	901640	3701200	901800	36	65,88	2
10	Net	3702069	901369	3702650	901410	36	65,88	21
11	Traps	3702069	901369	3702900	901539	36	65,88	21
15	Net_2	3701580	903791	3702520	904060	46	84,18	21
12	Net_2	3702169	901527	3702769	901561	39	71,37	
13	Traps	3702090	901536	3702592	901659	39	71,37	8
14	Net	3701550	901446	3702390	901396	36	65,88	8
16	Net	3701969	901396	3702583	901504	37	67,71	7
17	Traps	3702069	901473	3702569	901660	37	67,71	7
18	Net	3700869	901912	3701290	901697	36	65,88	13
19	Traps	3701190	901424	3701556	901572	36	65,88	13
20	Traps	3702131	901360	3702589	901469	34	62,22	16
21	Net	3702215	901372	3702704	901443	34	62,22	16
22	Traps	3702002	901329	3702505	901428	35	64,05	5
23	Net	3701969	901261	3702459	901297	24	43,92	5

ANNEX IV – Most valuable affirmations (+3) expressed by fishermen during the sorting of Q-set₂

Respondent Code	Sentence Nr.	Sentence
Lobs01	15	Establishment of a closed season for lobster
	19	Creation of artificial shelters for small lobsters
Lobs02	15	Establishment of a closed season for lobster
	4	Restocking with young lobsters reared in nurseries
Lobs03	1	Supervision to avoid selling off fish auction
	11	Obligation to return egg-berried females
Lobs04	11	Obligation to return egg-berried females
	10	Closure of the fishery in alternative years
Lobs05	17	Prohibition of fishing nets in lobster areas
	19	Creation of artificial shelters for small lobsters
Lobs06	13	Establish a minimum number of lobsters per vessel and fishing season
	16	Increase the Minimum Landing Size (MLS)
Lobs07	2	Supervision of MLS in restaurants
	19	Creation of artificial shelters for small lobsters
Lobs08	11	Obligation to return egg-berried females
	15	Establishment of a closed season for lobster
Lobs09	17	Prohibition of fishing nets in lobster areas
	20	Construction of traps with windows to allow the escapement of small lobsters
Lobs10	10	Closure of the fishery in alternative years
	19	Creation of artificial shelters for small lobsters

Lobs11	15	Establishment of a closed season for lobster
	14	Positive discrimination of fishers of that area
Lobs12	13	Establish a minimum number of lobsters per vessel and fishing season
	18	Attribution of specific licenses for crustacean fisheries
Lobs13	2	Supervision of MLS in restaurants
	12	Construction of maintenance facilities that allows direct sale to the public
Lobs14	4	Restocking with young lobsters reared in nurseries
	15	Establishment of a closed season for lobster
Lobs15	12	Construction of maintenance facilities that allows direct sale to the public
	20	Construction of traps with windows that allows the escapement of small lobsters
Lobs16	7	Reduction of the number of fishing licenses
	10	Closure of the fishery in alternative years
Lobs17	19	Creation of artificial shelters for small lobsters
	22	Control of algae harvest
Lobs18	1	Supervision to avoid selling off fish auction
	2	Supervision of MLS in restaurants
Lobs19	10	Closure of the fishery in alternative years
	19	Creation of artificial shelters for small lobsters

ANNEX V - Less valuable affirmations (-3) expressed by fishermen during the sorting of Q-set₂

Respondent Code	Sentence Nr	Sentence
Lob01	7	Reduction of the number of fishing licenses
	8	Reservation of areas for fishing lobster only with traps
Lobs02	7	Reduction of the number of fishing licenses
	22	Control of algae harvest
Lobs03	4	Restocking with young lobsters reared in nurseries
	19	Creation of artificial shelters for small lobsters
Lobs04	12	Construction of maintenance facilities that allows direct sale to the public
	22	Control of algae harvest
Lobs05	8	Reservation of areas for fishing lobster only with traps
	16	Increase the Minimum Landing Size
Lobs06	8	Reservation of areas for fishing lobster only with traps
	23	Closure of the fishery until lobster population recovers
Lobs07	18	Attribution of specific licenses for crustacean fisheries
	7	Reduction of fishing licenses
Lobs08	20	Construction of traps with windows to allow the escapement of small lobsters
	21	Selective fishing for octopus in lobster growth areas
Lobs09	19	Creation of artificial shelters for small lobsters
	22	Control of algae harvest
Lobs10	22	Control of algae harvest

	23	Closure of the fishery until lobster population recovers
Lobs11	8	Reservation of areas for fishing only with traps
	23	Closure of the fishery until the lobster population recovers
Lobs12	19	Creation of artificial shelters for small lobsters
	21	Selective fishing for octopus in lobster growth areas
Lobs13	7	Reduction of fishing licenses
	22	Control of algae harvest
Lobs14	17	Prohibition of fishing in lobster areas
	22	Control of algae harvest
Lobs15	3	Creation of no fishing protected areas
	7	Reduction of fishing licenses
Lobs16	12	Construction of maintenance facilities that allows direct sale to the public
	16	Increase the Minimum Landing Size
Lobs17	21	Selective fishing for octopus in lobster growth areas
	23	Closure of the fishery until the lobster population recovers
Lobs18	7	Reduction of fishing licenses
	14	Positive discrimination of fishers of that area
Lobs19	7	Reduction of fishing licenses
	14	Positive discrimination of fishers of that area

ANNEX VI – Normalized Factor Scores for Factor A

Nr	Statement	Z-score
2	Supervision of minimum landing sizes (MLS) in restaurants	1.646
12	Construction of maintenance facilities that allow direct sale to the public	1.436
19	Creation of artificial shelters for small lobsters	1.132
1	Supervision to avoid selling off fish auction	1.091
10	Closure of the fishery in alternative years	1.069
13	Establish a minimum number per vessel and fishing season	0.867
21	Selective fishing for octopus in lobster growth areas	0.812
20	Construction of traps with windows to allow the escapement of small lobsters	0.517
15	Establishment of a closed season for lobster	0.398
4	Restocking with young lobsters reared in nurseries	0.360
11	Obligation to return egg-berried lobsters to the sea	0.304
9	Increase the frequency of hauling the nets	0.185
18	Attribution of specific licenses to crustacean fisheries	-0.187
16	Increase the minimum landing size	-0.393
5	Allow lobster fishery only with traps	-0.576
14	Positive discrimination of fishers of that area	-0.678
3	Creation of no fishing protected areas	-0.692
8	Reservation of areas for fishing lobsters only with traps	-0.708
17	Prohibition of fishing nets in lobster areas	-0.739
6	Creation of protected areas where gears that catches lobsters cannot be used	-0.961
22	Control of algae harvest	-1.375
23	Closure of the fishery until lobster population recovers	-1.604
7	Reduction of the number of fishing licenses	-1.905

ANNEX VII – Normalized Factor Scores for Factor B

Nr	Statement	Z-score
19	Creation of artificial shelters for small lobsters	2.214
22	Control of algae harvest	1.798
16	Increase the minimum landing size	1.385
6	Creation of protected areas where gears that catches lobsters cannot be used	1.181
12	Construction of maintenance facilities that allows direct sale to the public	0.780
18	Attribution of specific licenses for crustacean fisheries	0.564
15	Establishment of a closed season for lobster	0.519
14	Positive discrimination of fishers of that area	0.393
3	Creation of no fishing protected areas	0.208
20	Construction of traps with windows to allow the escapement of small lobsters	-0.041
11	Obligation to return egg-berried lobsters to the sea	-0.092
4	Restocking with young lobsters reared in nurseries	-0.117
1	Supervision to avoid selling off fish auction	-0.220
5	Allow lobster fishery only with traps	-0.294
13	Establish a minimum number of lobsters per vessel and fishing season	-0.439
2	Supervision of Minimum Landing Sizes (MLS) in restaurants	-0.481
17	Prohibitions of fishing nets in lobster areas	-0.598
21	Selective fishing for octopus in lobster growth areas	-0.684
9	Increase the frequency of hauling the nets	-0.859
10	Closure of the fishery in alternative years	-0.976
8	Reservation of areas for fishing lobsters only with traps	-1.269
23	Closure of the fishery until lobster population recovers	-1.351
7	Reduction of the number of fishing licenses	-1.620

ANNEX VIII – Normalized Factor Scores for Factor C

Nr	Statement	Z-Score
15	Establishment of a closed season for lobster	1.999
11	Obligation to return egg-berried lobsters to the sea	1.578
1	Supervision to avoid selling off fish auction	1.021
9	Increase the frequency of hauling the nets	0.998
4	Restocking with young lobsters reared in nurseries	0.993
16	Increase the minimum landing size	0.988
18	Attribution of specific licenses for crustacean fisheries	0.561
13	Establish a minimum number of lobsters per vessel and fishing season	0.536
6	Creation of protected areas where gears that catches lobster	0.199
14	Positive discrimination of fishers of that area	0.130
12	Construction of maintenance facilities that allows direct sale to the public	0.000
3	Creation of no fishing protected areas	-0.012
8	Reservation of areas for fishing lobsters only with traps	-0.117
23	Closure of the fishery until lobster population recovers	-0.241
5	Allow lobster fishery only with traps	-0.292
2	Supervision of minimum landing size (MLS) in restaurants	-0.345
17	Prohibition of fishing nets in lobster areas	-0.430
10	Closure of the fishery in alternative years	-0.662
22	Control of algae harvest	-1.087
20	Construction of traps with windows to allow the escapement of small lobsters	-1.150
7	Reduction of the number of fishing licenses	-1.208
19	Creation of artificial shelters for small lobsters	-1.686
21	Selective fishing for octopus in lobster growth areas	-1.774

ANNEX IX – Normalized Factor Scores for Factor D

Nr	Statement	Z-Score
19	Creation of artificial shelters for small lobsters	1.690
11	Obligation to return egg-berried lobsters to the sea	1.536
17	Prohibition of fishing nets in lobster areas	1.368
9	Increase the frequency of hauling the nets	1.226
10	Closure of the fishery in alternative years	1.071
14	Positive discrimination of fishers of that area	1.023
15	Establishment of a closed season for lobster	0.559
6	Creation of protected areas where gears that catches lobster	0.417
4	Restocking with young lobsters reared in nurseries	0.249
20	Construction of traps with windows to allow the escapement of	0.215
3	Creation of no fishing protected areas	0.202
2	Supervision of minimum landing size (MLS) in restaurants	0.012
1	Supervision to avoid selling off fish auction	-0.249
5	Allow lobster fishery only with traps	-0.249
21	Selective fishing for octopus in lobster growth areas	-0.275
8	Reservation of areas for fishing lobsters only with traps	-0.533
23	Closure of the fishery until lobster population recovers	-0.701
12	Construction of maintenance facilities that allows direct sale to the public	-1.144
16	Increase the minimum landing size	-1.165
18	Attribution of specific licenses for crustacean fisheries	-1.191
13	Establish a minimum number of lobsters per vessel and fishing season	-1.226
22	Control of algae harvest	-1.394
7	Reduction of the number of fishing licenses	-1.441

ANNEX X - Statements of Q-set2 with scores for each of the four extracted discourses

Nr	Statement	Factor Arrays			
		A	B	C	D
1	Supervision to avoid selling off fish auction	+2	0	+2	0
2	Supervision of minimum landing size (MLS) in restaurants	+3	-1	-1	0
3	Creation of no fishing protected areas	-1	+1	0	0
4	Restocking with young lobsters reared in nurseries	0	0	+2	+1
5	Allow lobster fishery only with traps	-1	0	-1	0
6	Creation of protected areas where gears that catches lobsters cannot be used	-2	+2	+1	+1
7	Reduction of the number of fishing licenses	-3	-3	-2	-2
8	Reservation of areas for fishing lobsters only with traps	-1	-2	0	-1
9	Increase the frequency of hauling the nets	0	-2	+2	+2
10	Closure of the fishery in alternative years	+2	-2	-1	+2
12	Obligation to return egg-berried females to the sea	+3	+2	0	-1
13	Establish a minimum number of lobsters per vessel and fishing season	+1	-1	+1	-2
14	Positive discrimination of fishers of that area	-1	+1	0	+1
15	Establishment of a closed season for lobster	+1	+1	+3	+1
16	Increase the minimum landing size	0	+2	+1	-2
17	Prohibition of fishing nets in lobster areas	-2	-1	-1	+2
18	Attribution of specific licenses for crustacean fisheries	0	+1	+1	-2
19	Creation of artificial shelters for small lobsters	+2	+3	-3	+3
20	Construction of traps with windows to allow the escapement of small lobsters	+1	0	-2	0
21	Selective fishing for octopus in lobster growth areas	+1	-1	-3	-1
22	Control of algae harvest	-2	+3	-2	-3
23	Closure of the fishery until lobster population recovers	-3	-3	0	-1

ANNEX XI – Distinguishing and consensus statements for discourses A, B, C and D.

($P < 0.05$ and asterisk (*) indicates significance at $P < 0.01$).

Discourse	Distinguishing Statements	Rank
A		
	Supervision of minimum landing sizes (MLS) in restaurants	+3(*)
	Construction of maintenance facilities that allows direct sale to the public	+3
	Selective fishing for octopus in lobster growth areas	+1(*)
	Increase the frequency of hauling the nets	0(*)
	Attribution of specific licenses for crustacean fisheries	0
	Increase the minimum landing size	0
	Positive discrimination of fishers of that area	-1(*)
	Creation of no fishing protected areas	-1
	Creation of protected areas where gears that catches lobsters cannot be used	-2(*)
B		
	Control of algae harvest	+3(*)
	Creation of protected areas where gears that catches lobsters cannot be used	+2
	Construction of maintenance facilities that allows direct sale to the public	+2
	Establish a minimum number of lobsters per vessel and fishing season	-1
	Increase the frequency of hauling the nets	-2(*)
C		
	Establishment of a closed season for lobster	+3(*)
	Restocking with young lobsters reared in nurseries	+2
	Construction of maintenance facilities that allows direct sale to the public	0
	Construction of traps with windows that allows the escapement of small lobsters	-2(*)

	Selective fishing for octopus in lobster growth areas	-3(*)
D		
	Prohibition of fishing nets in lobster growth areas	+2(*)
	Construction of maintenance facilities that allows direct sale to the public	-1(*)
	Increase the minimum landing size	-2
	Attribution of specific licenses for crustacean fisheries	-2(*)
	Establish a minimum number of lobsters per vessel and fishing season	-2

All listed statements are non-significant at $P > 0.01$ and those flagged with an asterisk (*) are also non-significant at $P > 0.05$.

Consensus Statements	Discourse Rank			
	A	B	C	D
Allow lobster fishery only with traps(*)	-1	0	-1	0
Reduction of the number of fishing licenses	-3	-3	-2	-3

ANNEX XII – Discourse A: major and minor concerns

Discourse A – major concerns about the present status of *Palinurus elephas* population and implementation of management measures.

Number	Statements defining discourse A major concerns	Factor Score			
		A	B	C	D
1	Supervision to avoid selling off fish auction	2	0	2	0
2	Supervision of minimum landing sizes (MLS) in restaurants	3	-1	-1	0
10	Closure of the fishery in alternative years	2	-2	-2	2
12	Construction of maintenance facilities that allows direct sale to the public	3	2	0	-1
19	Creation of artificial shelters for small lobsters	2	3	-3	3

Discourse A – minor concerns about the present status of *Palinurus elephas* population and implementation of management measures.

Number	Statements defining discourse A minor concerns	Factor Score			
		A	B	C	D
6	Creation of protected areas where gears that catches lobsters cannot be used	-2	+2	+1	+1
7	Reduction of the number of fishing licenses	-3	-3	-2	-3
17	Prohibition of fishing nets in lobster areas	-2	-1	-1	+2
22	Control of algae harvest	-2	+3	-2	-3
23	Closure of the fishery until lobster population recovers	-3	-3	0	-1

ANNEX XIII – Discourse B: major and minor concerns

Discourse B – major concerns about the present status of *Palinurus elephas* population and implementation of management measures.

Number	Statements defining discourse B major concerns	Factor Score			
		B	C	D	A
6	Creation of protected areas where gears that catches lobsters cannot be used	+2	1	1	-2
12	Construction of maintenance facilities that allows direct sale to the public	+2	0	-1	+3
16	Increase the minimum landing size	+2	+1	-2	0
19	Creation of artificial shelters for small lobsters	+3	-3	+3	+2
22	Control of algae harvest	+3	-3	-3	-2

Discourse B – minor concerns about the present status of *Palinurus elephas* population and implementation of management measures.

Number	Statements defining discourse B minor concerns	Factor Score			
		B	C	D	A
7	Reduction of the number of fishing licenses	-3	-2	-2	-3
8	Reservation of areas for fishing lobsters only with traps	-2	0	-1	-1
9	Increase the frequency of hauling the nets	-2	+2	+2	0
10	Closure of the fishery in alternative years	-2	-1	+2	+2
23	Closure of the fishery until lobster population recovers	-3	0	-1	-3

ANNEX XIV – Discourse C: major and minor concerns

Discourse C – major concerns about the present status of *Palinurus elephas* population and implementation of management measures.

Number	Statements defining discourse C major concerns	Factor Score			
		C	D	A	B
1	Supervision to avoid selling off fish auction	+2	0	+2	0
4	Restocking with young lobsters reared in nurseries	+2	+1	0	0
9	Increase the frequency of hauling the nets	+2	+2	0	-2
11	Obligation to return egg-berried lobsters to the sea	+3	+3	0	0
15	Establishment of a closed season for lobster	+3	+1	+1	+1

Discourse C – minor concerns about the present status of *Palinurus elephas* population and implementation of management measures.

Number	Statements defining discourse C minor concerns	Factor Score			
		C	D	A	B
7	Reduction of the number of fishing licenses	-2	-3	-3	-3
19	Creation of artificial shelters for small lobsters	-3	+3	+2	+3
20	Construction of traps with windows to allow the escapement of small lobsters	-2	0	+1	0
21	Selective fishing for octopus in lobster growth areas	-3	-1	+1	-1
22	Control of algae harvest	-2	-3	-2	+3

ANNEX XV – Discourse D: major and minor concerns

Discourse D – major concerns about the present status of *Palinurus elephas* population and implementation of management measures.

Number	Statements defining discourse D major concerns	Factor Score			
		D	A	B	C
9	Increase the frequency of hauling the nets	+2	0	-2	+2
10	Closure of the fishery in alternative years	+2	+2	-2	-1
11	Obligation to return egg-berried lobsters to the sea	+3	0	0	+3
17	Prohibition of fishing nets in lobster areas	+2	-2	-1	-1
19	Creation of artificial shelters for small lobsters	+3	+2	+3	-3

Discourse D – minor concerns about the present status of *Palinurus elephas* population and implementation of management measures.

Number	Statements defining discourse D minor concerns	Factor Score			
		D	A	B	C
7	Reduction of the number of fishing licenses	-3	-3	-3	-2
13	Establish a minimum number of lobsters per vessel and fishing season	-2	+1	-1	+1
16	Increase the minimum landing size	-2	0	+2	+1
18	Attribution of specific licenses for crustacean fisheries	-2	0	+1	+1
22	Control of algae harvest	-3	-2	+3	-2

