

*Small-scale fishing
in Cap de Creus:
a look into the future*



SÍLVIA GÓMEZ MESTRES
JOSEP LLORET ROMAÑACH

***Small-scale fishing
in Cap de Creus:
a look into the future***

SÍLVIA GÓMEZ MESTRES
JOSEP LLORET ROMAÑACH

Gómez Mestres, Sílvia, author

Small-scale fishing in Cap de Creus:
a look into the future Bibliography

ISBN 978-84-393-9511-9

I. Lloret Romañach, Josep, author II. Cap de Creus Natural Park
(Catalonia) III. Universitat de Girona IV. Title

1. Small-scale fishing – Catalonia – Creus, Cap de
639.2.81 (210.2:460.23 EmA)



Small-scale fishing in Cap de Creus: a look into the future

Sílvia Gómez Mestres and Josep Lloret Romañach

Photographs: Maria Velasco, Lluís Mas Blanch, Toni Font and Josep Lloret

Cover photograph: Maria Velasco

Illustrations: Jordi Rodon

Design, layout and printing: ROGER DIGITAL

Legal deposit: B 26795-2016

Date of first edition: 2019

Funded by Parc Natural de Cap de Creus and Social Council of the Universitat de Girona

*For Sibil·la and Tomàs,
so that in the future they can carry
on loving Cap de Creus,
just like their grandparents and great-grandparents did.*

*And for the grandparents and great-grandparents
who spent part of their lives
passing down this legacy to future generations.*



Table of Contents

Table of Contents

	<u>Pàgina</u>
Acknowledgements	9
Prologue	11
What is small-scale fishing?	14
What does small-scale fishing mean in Cap de Creus?	16
The diversity of small-scale fishing in Cap de Creus	20
The challenges faced by small-scale fishing today	20
Will small-scale fishermen end up disappearing in Cap de Creus?	26
Small-scale fishing and the 'return to the future'	28
What do we learn from studies?	30
What is the state of fishery resources in Cap de Creus?	40
Is small-scale fishing really sustainable	42
Does the Natural Park help recover fishery resources	48
Natural Park improve the yield of the fishing sector?	50
How can we change the course?	52
Conclusion	58
Bibliography (selection)	63
Small-scale fishing modalities in Cap de Creus	69
Common and scientific names of fish and invertebrates cited in the book	82



Photo: JOSEP LLORET

Acknowledgments

We would like to thank fishermen's guilds in general and especially all the small-scale fishermen in Cap de Creus who have collaborated in writing this book by sharing their experiences and offering their help. Although they were not all born in Cap de Creus, they love fishing, Cap de Creus and the sea. We are particularly grateful to Salva Manera and *Machín* from Port de la Selva, Agustí Fonolleras (*Regalat*) and Joaquim Fonolleras from Roses, and Rafel and Vicente Linares, and Iscla from Cadaqués, for their participation in the biological studies that the Universitat de Girona has been carrying out since 2008 in the waters of the Park, as well as the social-anthropological studies performed at the Universitat Autònoma de Barcelona. Thanks to these people's knowledge of the culture of fishing, the seabed and fish, we have been able to increase our knowledge of small-scale fishing in Cap de Creus. Together, they offer a good example that future generations will have to follow if they want to achieve sustainable fishing. We would also like to give our thanks to the photographer from Roses, Maria Velasco, and Toni Font and Lluís Mas Blanch for letting us use their photographs, as well as Jordi Rodon, head of the Fishery and Shellfish division of the Catalan Ministry of Agriculture, Livestock, Fisheries and Food for the drawings of fishing techniques. We likewise wish to thank Victòria Riera, director of the Parc Natural de Cap de Creus, for her continuous support in small-scale fishing studies in Cap de Creus, and without whom it would not have been possible to write this book. And, finally, the Catalan Directorate-General for Maritime Affairs and Fisheries for its help with data collection.



Foreword

Foreword

The book you are holding is about small-scale fishing in Cap de Creus, but its content is different to anything published to date, since it does not only describe the activity of small-scale fishing as we understand it, with the different fishing techniques, fishermen, captured species and fishing methods, it also covers everything related to the activity, such as its cultural legacy and historical tradition. It is precisely the dual perspective of small-scale fishing that makes such interesting reading.

Everyone in the Natural Park is aware of the crisis in the sector, which has been caused by both the social and economic changes of recent years and the low yield obtained nowadays as the result of excessive fishing and a degradation of essential habitats for coastal species. Current social and economic transformations have imposed new demands on the activity that challenge its continuity as small-scale fishing.

For this reason, in 2003 we conducted the first study in the Natural Park on the socio-cultural value of small-scale fishing in Cap de Creus, a study that we repeated in 2015. It brought to light that the tradition is not being passed down to younger generations, as the number of fishermen has dropped in recent years from about thirty to the region of twenty. There are many factors that could have caused this drop and we can name some of them, such as the fact that small-scale fishing has been included in a market system that increasingly depends on global economy and the progressive commodification of production factors, or the difficulty to market a product that is becoming more and more scarce and is faced by increased competition. Nowadays, anyone who wants to make their living exclusively from small-scale fishing has to respond to increasingly competitive market demands, as well as the difficulty

to satisfy modern-day requirements. Current social and economic transformations have imposed new demands on the activity that threaten its continuity as small-scale fishing. In conclusion, the necessary information has been obtained through these social and cultural studies to understand the way the sector has evolved and transformed, and they show the social reality experienced by small-scale fishermen in Cap de Creus, its socio-cultural value, its evolution in recent years, the social reasons that have caused it to fall in decline and the way fishermen adapt to the new situation.

Furthermore, biological studies have been conducted in the Natural Park that have provided us with valuable information about the impacts of the different fishing techniques that affect the Park's marine resources. Since 2008, nearly 600 samplings have been carried out aboard boats, working in collaboration with fishermen in the area. The results of the monitoring have not only been used to assess the effects of small-scale fishing on the marine resources of Cap de Creus, but also to assess its state throughout the years. Results show that the fishing resources of Cap de Creus have suffered a downward trend, with negative yields as regards the two main fishing techniques (trammel net and longline) which has reduced the medium size of some species, leading to overfishing. Looking at these results, we ask ourselves how the Natural Park can improve the yield of the fishery sector. Do we need to regulate fishing efforts in a responsible manner, in order to prevent overfishing of vulnerable coastal species, thus stopping them from disappearing? Measures need to be established that facilitate selling catches as own, locally sourced products.

However, not everything is negative for small-scale fishing, as nowadays this activity must be considered to be an option for the future. In recent years, it has been playing a major role in local, national and international research and management strategies. In this regard, marine reserves are a very important part of actions carried out in favour of small-scale fishing. Studies show that this kind of fishing is more 'ecological' than so-called industrial fishing, as it requires less effort. It is also necessary to bear in mind that over 90% of fishermen all over the world are dedicated to small-scale fishing. This kind of activity

is especially important from a socio-cultural perspective and for local economy. Small-scale fishing in the Mediterranean has played a fundamental role in both economy and society, and is one of the pillars of the culture and identity of many coastal villages, despite the fact that few studies have been conducted and there are still many gaps that need to be filled in about environmental, social and economic challenges. In this regard, Cap de Creus Natural Park has become involved in different international small-scale fishing management actions, such as those promoted by the network of Marine Protected Areas in the Mediterranean, known as MedPAN, which address the problems faced by French, Italian, Catalan, Spanish and Greek marine reserves, among others. The studies included in this book have provided an excellent opportunity to place Cap de Creus within a contemporary international framework for small-scale fishing management, often forgotten when considering other fishery systems like trawling or the use of surrounding nets.

Lastly, how can we change the course? Perhaps we could make small-scale fishing a cultural legacy and work together to conserve natural resources, to turn small-scale fishing into an activity that implies a close relationship with the environment and needs to be carried out with care and reciprocity.

Thanks to the knowledge, enthusiasm and consistent work performed with the selfless collaboration of local fishermen, the authors of this book, Josep Lloret and Sílvia Gómez, propose a series of management measures to make small-scale fishing sustainable in the long term, with a responsible use of the resources, which is economically profitable and from a social angle, it may maintain employment, in accordance with the cultural legacy and knowledge of its patrimonial, historical and identifying values.

Victòria Riera

Directora del Parc Natural de Cap de Creus

What is small-scale fishing?

Small-scale fishing, also known as artisanal fishing, is not defined the same way in all European countries. Generally speaking, it is a difficult question to answer, since everything that defines small-scale fishing varies according to history and the place. However, it is worth pointing out that over the years this type of fishing has moulded the challenges contemporary society faces today, marked by modernisation and social and economic transformations. For example, it has incorporated technological advances while readapting to the transformations of the home and the family as a traditional production unit. These transformations mean that it is difficult to distinguish it from industrial fishing. Modernisation and the increased use of technology is one of the most controversial aspects of small-scale fishing, as it encourages an intensification of the work. Though what characterises small-scale fishing? What really distinguishes small-scale fishing from other types? Simple technology? It is small-scale and presumedly low effort fishing? It is supported by a workforce (crew) of one or two people? Or because the production organisation is traditionally family-based? Insofar as all these aspects do not exist in the same degree everywhere and, furthermore, they have gradually changed over the years and do not appear at the same time in all small-scale fisheries, it is consequently difficult to define small-scale fishing.

Different international bodies and scientific studies coincide in defining it as a sector that is firmly rooted in communities, traditions and the local values that have reached our days. However, it is especially a way of understanding fishing, a culturally inherited attitude that responds to a special relationship of care and reciprocity with the environment.

What is small-scale fishing?

Small-scale fishing is a skill integrated in fishing techniques, and a way of fishing and relating with the environment, with care and reciprocity, which represents a cultural legacy.



What does small-scale fishing mean in Cap de Creus?

*'In my opinion, small-scale fishing is a boat of under nine metres with an exclusive one-person crew, where **the conditions offered by the sea, of fishing and weather, are respected at all times.** In other words, the weather is respected. **Small-scale fishing is the tradition of our grandparents'** (Fisherman from Port de la Selva, 53 years old). **'Small-scale fishing has a limited framework'** (Fisherman from Roses, 58 years old).¹*

'Small-scale fishing is a different type of product because you more or less decide what you want, there's always a part of the fish that no... that you catch although you don't want to, but depending on the kind of tool or the net you want to use, you're going to fish something specific' (Fisherman from Cadaqués, 58 years old). 'You don't always go to the same fishing ground, you also sort of follow the time of year, now one sort of fishing ground, in the summer another kind of fishing ground... you never stop varying. Since you have to do the same work every day, you set your own bans, every month you look for the fishing grounds, small or big fish' (Fisherman from Roses, 43 years old). 'The sea is like land, it produces the fruit that corresponds to the time of year' (Fisherman from Port de la Selva, 53 years old). 'The art of small-scale fishing doesn't harm the environment, I hope that in the future my children will be able to make their livings from it if they want to' (Fisherman from Port de la Selva, 41 years old).

1. 'The quotes that appear throughout the text have been extracted from fieldwork interviews and have been reproduced literally. They have been transcribed keeping the local expressions and speech, used by the people giving their accounts, so that they may be understood by readers'.

In accordance with the knowledge that has been passed down from generation to generation, small-scale fishing in Cap de Creus is defined by its limited fishing capacity, mainly due to the short boats (between six and nine metres long), and crews made up of a maximum of two people.

The fact the boats are so small makes them vulnerable to the frequent strong northerly winds, known locally as the Tramuntana which, at the same time, commands respect for adverse weather conditions. The loading capacity is also restricted, as is the workforce space (crew) and, lastly, the fishing effort is limited, without forgetting that small boats require engines with limited power.

Small-scale fishing is also understood to be a manual technique, which does not mean ignoring technological progress but, in fact, just the opposite: technological modernisation is no excuse for not knowing about weather and marine currents, fishing depths and the seasons of fish species. Knowledge that acts like a compass and tells fishermen where to go, the most appropriate technique and which nets to use, as well as letting them know what they need to fish each time.



Photo: MARIO VELASCO

Maintaining small-scale fishing as a manual technique therefore implies investing comprehensive knowledge of fishing techniques as part of a continuous interaction with carefully selected environmental resources.

By using selective fishing methods, small-scale fishing selects the species and even the size of the individuals to be caught. Fishermen are responsible for quantifying their daily fishing efforts and to calculate them in the long term if they want to carry on taking resources from the sea without exhausting them.

The hours of work are another feature of small-scale fishing that tries to avoid making the animals suffer when they are trapped by the fishing nets. This is a premise that furthermore ensures the quality of the product. Fish that have not suffered excessively are fresher, they have a better appearance and colour, and their flesh is firmer.

Definition of small-scale fishing in Cap de Creus

Small-scale fishing in Cap de Creus corresponds to fishing activities carried out with small boats (usually under nine metres long) that are sailed by one fisherman. Fishing takes place near the coast, using traditional small-scale techniques, known as '*arts menors*' (trammel nets, gill nets, longlines, etc.). Small-scale fishing in Cap de Creus has been going on for centuries and is a clear example of the complex relationship that has been created between man and nature. Most small-scale fishermen that fish in the Park's waters are from the four municipalities of the Park with a coastline (Roses, Cadaqués, Port de la Selva and Llançà) and, as professional fishermen, they have to sell their catches to their respective guilds. Ever since the Natural Park was created in 1998, small-scale fishing is the only professional fishing allowed in Cap de Creus.



The diversity of small-scale fishing in Cap de Creus

One of the most important features of small-scale fishing in Cap de Creus is its diversity: the different types of fishing techniques, fishermen, depths, caught species and fishing seasons. This is because Cap de Creus is a complex area from a biological and environmental perspective, where there are different kinds of seabeds and oceanographic and climatological situations. Small-scale fishermen in Cap de Creus have traditionally used up to 14 different fishing techniques. The most commonly used fishing gear are gill nets, trammel nets, *palangró* (small longlines) that are similar to the longer *palangre* (longline), *nanses* (basket traps) to catch common octopus and the *bolitxa* or *solta bonitolera* (stationary uncovered pound nets designed to catch bonito). Other fishing techniques, such as *poteres* (squid hooks), are used by a few fishermen in certain places and months of the year, whereas the nets for fishing big-scale sand smelts, white seabream using the *l'amagada* technique (from a hidden point), and catching squid 'making the female run' have practically disappeared from small-scale fishing. At present we do not know of any small-scale fisherman who uses these three methods, meaning we can affirm that there are techniques that are no longer used and, therefore, the diversity of fishing techniques employed has diminished over the years. The complexity of environments has obliged the fishermen in each village to adapt to the specific conditions of each place. Parents have passed this knowledge down to their children for many generations, which has led to a unique 'fishing culture'.

The challenges faced by small-scale fishing today

Current social and economic transformations have imposed new demands on small-scale fishing that challenge its continuity in this category. Higher production costs, as well as a drop in yield, are the main reasons. Both are the direct consequence of the commodification process upon which fishing



'Years ago, it was a world where the man worked and the woman stayed behind mending the net. This doesn't exist anymore. You have to do it yourself and hire services, and this is more expensive' (Fisherman from Roses, 58 years old). 'The price of the net and the money spent on repairs if you can't do it yourself, means you lose everything!' (Fisherman from Roses, 67 years old). 'To be able to make your living from fishing, you need to dedicate a lot of time. Here in Port de la Selva there are people who only live off fishing but, of course, they've got their grandparents who still repair the net' (Fisherman from Port de la Selva, 51 years old).

'However, within the world of small-scale fishing, seven to eight-metre boats are vessels that if you want to earn your living, you need to go alone. If you take someone else, it's very difficult to make your living(...) Can it be done? Yes! But, without exaggerating, you have to work 13 or 14 hours a day; otherwise... it's impossible! And that's only if you don't have many breakdowns... It's very difficult!' (Fisherman from Roses, 58 years old).

permanently depends. As a result, for example, the absence of families willing to do the work has implied having to outsource manpower. An additional cost that is difficult to sustain with fishing activities that do not produce sufficient profit to pay salaries.

Outsourcing fishing net maintenance and repair outside the family reduces production efficiency, and going out to fish has turned into a one-man crew activity.

Consequently, this progressive commodification of the production factors (boat, fishing gear maintenance and repair, and the workforce), due to the disappearance of the family as a fundamental production unit, has caused fishing to increasingly depend on relationship marketing. At the same time, fishing no longer ensures the reproduction of families that mainly base their economy on other sectors. Therefore, 'pluriactivity' or 'additional income' is now more than ever the economic basis of small-scale fishermen's households.

As part of the same commodification process, small-scale fishing has gradually seen itself dragged into a market

system that is steadily becoming a global economy.

This means that not only is it necessary to deal with competition with other fishing systems in local markets, but also the fish that arrives from outside the European Community that is better adapted to



normal consumers' purchasing capacity. This competition from foreign produce, added to the change of consumers' habits and the specialisation of fisheries in species that are more appreciated in the market, contributes to further reducing the diversity of fish available to consumers, clearly influencing the price of the end product.

However, if a person wants to live exclusively from small-scale fishing, it implies meeting market demands and responding to the complexity of covering the current needs of modern-day society's way of life. As soon as small-scale fishing stops being an activity based on a family's work effort, and it has to face an increasingly competitive market system, it becomes an activity where the traditional

'As said by [anonymous]: every time an old person from the village dies, it means that one of our customers has died! And it's true, people used to know much more about fish than they do today' (Confraria de Cadaqués – "Cadaqués Fishermen's Guild").

investment in effort and time means making a great sacrifice to maintain current standards of living. Moreover, it must be remembered that small-scale fishing had never been the exclusive financial basis for family economies, but was always either combined with other activities carried out on land, or was part of an economy that integrated fishing and agriculture. Therefore, by definition, to be able to live exclusively from small-scale

fishing, the activity needs to undergo a significant transformation.

At present, even though fishing can be considered an employment option, especially when there is no work on land, its decline is quite evident. The main reason is the absence of younger generations who take over from their parents. As previously explained, small-scale fishing involves a series of closely related aspects that define a work system based on a very specific manual technique that requires knowledge that is passed down through the generations, which has gradually died out due to the lack of younger generations willing to carry on with the tradition. The technique integrates effort and spending a specific amount of time fishing (measured by the number of people making up the crew, the



size of the boat and volume of the nets, as well as the work schedule), in a permanent relationship with the environment and the resources. The activity thus involves a clearly defined complex learning process that implies being exposed to weather conditions, complying with uncommon working hours and working in a regular manner. In addition, in recent years, learning from older generations has been replaced by compulsory training by way of one-year courses. The return on all the investments is low; on the one hand, due to the costs and, on the other, the difficulty to market a product that is becoming increasingly scarce and subject to greater competition.

Will small-scale fishermen end up disappearing in Cap de Creus?

In recent decades, the number of small-scale fishermen working in the waters of the Natural Park has fallen considerably, falling from about 30 in 2003 to around 20 in 2015. Even so, the majority of fishermen carry out their activity on an occasional basis in the Park and very few (about 10) do it regularly throughout the year. At present, the fishermen population is aging (many of them are over 50 years old) and it hires very few young people. Nowadays, most fishermen combine fishing with tourist activities, or they alternate between the waters in the Park and others that are outside. The present crisis affecting the activity could cause small-scale fishing to disappear from the Park within the next 50 years. This crisis in small-scale fishing happens in many of the so-called high-income countries around the world (as opposed to countries considered to be low-income, where small-scale fishing continues to be an important source of food and income for local coastal communities).

Nevertheless, the crisis that affects small-scale fishing in Cap de Creus, like in other European countries, is not only due to the previously mentioned social and economic changes, but also the low yield obtained nowadays as the result of overfishing and the degradation of habitats considered essential for coastal species.



Small-scale fishing and the 'return to the future'

Despite the delicate situation of the fishermen in Cap de Creus, it seems that small-scale fishing in that area and around the world is an option for the future. Until a few years ago, governments focused on trawling and the surrounding net method, although in recent years the study and management of small-scale fishing plays a fundamental role within local, national and international research and management strategies. In particular, in many marine reserves around the world, actions have been carried out in favour of small-scale fishing, including the creation of marine reserve networks at an international scale, such as the MedPAN network (www.medpan.org) that put reserve managers into contact to better manage human activities within protected marine areas. Why is small-scale fishing becoming more relevant?

Firstly, there are more and more studies which demonstrate that small-scale fishing is more 'ecological' than so-called 'industrial' fishing (trawling and surrounding net methods). Small-scale fishing has a lower ecological impact than industrial fishing because the catches are normally smaller (less fishing effort is required), it affects sea habitats to a lesser extent (small-scale fishing techniques are usually passive and do not drag along the seabed like hauling), the boats consume less petrol (as they are small boats that do not need powerful engines) and not as many 'unwanted' individuals are caught (fish that are too small or there is no commercial interest in the species), in contrast to trawling. In addition, unlike trawling, small-scale fishing on the whole catches individuals that exceed the size of the species at sexual maturity and the legal minimum landing size. For these reasons, small-scale fishing is considered all over the world as a more ecological alternative to trawling and fishing with surrounding nets.

Consequently, and in second place, it is the sustainable alternative that provides sustenance and a stable livelihood to coastal towns, as it considers well-being of the resources that have to feed society. At global



level, small-scale fishermen represent over 90% and in the European Union (EU), this sector comprises around 84% of the total European fleet and gives direct employment to nearly 100,000 people.

Although compared to large-scale industrial fishing, the volume of catches and the economic significance of small-scale fishing is generally relatively low, small-scale fishing is particularly important from a socio-cultural perspective and for local economy. Therefore, it is an integral part of the Mediterranean coast. Whereas in countries like Spain, the primary sector (to which the fishery sector belongs) is not very important for the gross domestic product (making up approximately 2.5% of the total), the percentage could increase considerably at a regional and local level. This particularly applies to small-scale fishing, as the catches have a high unit value and are mainly intended for local markets and the tourist sector, besides being an activity with a high social and cultural value, insofar as it brings knowledge, history and identity.

Consequently, small-scale fishing in the Mediterranean has played a basic role in both economy and society and represents one of the essential pillars of the culture and identity of many Mediterranean coastal towns.

What do we learn from studies?

The studies conducted in Cap de Creus in recent years have revealed relatively unknown aspects of small-scale fishing. Without studies on small-scale fishing in Cap de Creus, we cannot know its social, cultural and economic value, nor the way it has changed over the years or the ecological impacts this kind of fishing has on the coast. This is especially important, given that small-scale fishing is specifically defined in each place, depending on the ecology, culture and history itself. It has particular features



Photo: LUIS MAS BLANCH

and problems that can only be known by carrying out first-hand studies in the villages where the activity is developed. Even so, small-scale fishing has hardly been studied and there are still many gaps in the knowledge of environmental, social and economic challenges. In-depth knowledge of the sector is necessary if we want to carry out integrated fish management that bears in mind both ecological and socio-cultural aspects. For this reason, in recent years the Natural Park has promoted a series of studies on this fishing activity, working in collaboration with different universities.

Biological studies of small-scale fishing (also known as 'fish monitoring') conducted in collaboration with different small-scale fishermen, have provided valuable information about the impact of the different small-scale fishing techniques on the Park's marine resources and the evolution and current status of the captured species. Despite the limitations of monitoring small-scale fishing, it is the only system that can provide comprehensive information about the majority of fish species in the Park, whether they live in shallow or deep water, they have day or night habits, benthic or pelagic, and live in different habitats (clay, *Posidonia oceanica* or 'seagrass', pre-coralline or 'maërl', etc.). These fishery studies, which are necessary to be able to assess and manage the marine resources in Cap de Creus Natural Park, complement the monitoring that is carried out by diving with autonomous diving equipment (known as 'visual census') whose aim is to study specific vulnerable species (whether or not they are exploited by fishing) which live on rocky and coralline seabeds in the natural park.

The fish monitoring in Cap de Creus has been analysing the catches of different small-scale fishermen from Roses, Cadaqués and Port de la Selva, and it has mainly been carried out on board fishing boats. Since 2008, nearly 600 samplings have been performed on board fishing boats, working in collaboration with different small-scale fishermen. During the monitoring, the catches are recorded, the sizes of the fish and invertebrates caught are measured and the fishermen are interviewed to obtain data on the



fishing effort (hours of fishing and the size of the mesh). The technique studied in greatest depth is trammel nets, as it is the method that catches the highest number of representative species that live on the rocky seabeds of Cap de Creus, such as the forkbeard, scorpionfish and spiny lobster. The information of the hours of fishing and the size of the technique (metres of trammel nets and gill nets; number of hooks on the longlines) was used to calculate the fishing effort, a measurement required to be able to calculate the so-called Catch Per Unit Effort (CPUE). The CPUE indicates the yield produced by each fishing operation of either all the species together or for one in particular, and indicates the abundance and biomass of the exploited species. By comparing the CPUE of the different operations performed over the years, we can see whether the abundance or biomass of a specific species increases, decreases or remains stable. The results of this monitoring have not only been used to assess the effects of small-scale fishing on the marine resources in Cap de Creus, but also to study the evolution of these resources throughout the years.

At the same time, social and cultural studies have gathered the necessary information to understand the evolution of the sector and its changes. The studies show the social reality of Cap de Creus' small-scale fishermen (its socio-cultural value, its evolution during recent years, the social reasons that have led to its decline and the way fishermen have adapted to the new situation). As mentioned above, the features of small-scale fishing have a basically social and cultural content that is made evident by its marked family and community character, and collects knowledge that is passed down from parents to children and/or family members. To assess the dynamics of this professional activity that is influenced by both the environment (fishing resources, oceanography and the weather), as well as society and culture (knowledge, learning, the family and also tourism), it is necessary to use study tools that are capable of interpreting this reality.



The first socio-cultural study was conducted in 2004 and after a sufficiently long period to observe the changes in the sector, in 2015 a second study was performed. These studies were performed using research methodologies and techniques associated to socio-cultural anthropology and, as a result, the studies are basically ethnographic. A total of 52 in-depth interviews were included that were obtained from fishermen from the Park who fish in its waters. The in-depth interviews were complemented with statistics obtained from data recorded in guilds and collected through questionnaires given to the fishermen. However, the statistics do not accurately reflect the reality of fishing in Cap de Creus Natural Park, nor are they explicative. It is impossible to understand the complexity of this sector, subject to constant variations and exposed to many external factors, unless we employ qualitative methodologies, such as in-depth interviews, which provide us with a more significant, accurate and detailed approach that, in the case under study, is very important.

We visited all the fishing villages in the area and personally spoke to their small-scale fishermen. The studies were conducted separately in each municipality due to particularities of fishing in each sector of the Park. The intention was to reflect the greater part of the fishing population in each municipality that work in the Park's waters, and to know the frequency and intensity of the activity. For this reason, we have studied the fishing gear employed for each occasion, the species fished, and when and where fishing is carried out. In addition, a list has been made of the most instrumental aspects of the fishing world (fishing gear), seasonal dynamics of fishing with the environmental factors that affect them. Furthermore, an analysis has been made of the socio-economic reality of fishermen, as well as the most significant social and cultural changes in the fishing world that have taken place in recent years. All existing information has been collected in this area about regulation systems for the management of fishing activities that since time immemorial have been used by fishermen's guilds, and those that still exist today.



Photo: MARIA VELASCO

Likewise, we considered it was important to hold an informal interview with the president of each fishermen's guild, about the relationship of the institution with fishing regulation and management. The most recent study included holding key interviews with different social actors of the fishing world who work on designing alternative solutions to improve profitability and promote the local product. We specifically interviewed the people responsible for new initiatives to designate heritage and promote fishing and its products in the municipalities of Cap de Creus. Elderly fishermen with a good wealth of knowledge (unfortunately not many of them survive) were also interviewed. These men have transmitted their know-how and experience, which we found very useful for clarifying isolated concepts and aspects related to the fishing world, and the historical perspective offered by these fishermen helped us contextualise and improve our understanding of fishing today.

In addition, we collected the fishermen's proposals, suggestions, perceptions and evaluations of Cap de Creus Natural Park. The comparison between the times when the studies were conducted (2004 and 2015) include aspects such as the economic crisis that has also affected fisheries since 2008, added to the crisis that had already affected the sector since 2000. Other aspects were also included, such as disputes for competence over the resources with other extractive activities (recreational fishing); the effects of applying and/or including new legislation and measures referred to fishing, considering all the approaches: environmental, commercial and tourist; documentary information about the applicable legislation that regulates the exercise of small-scale fishing; the legislation which covers anyone developing initiatives aimed towards adapting fishing to new social, economic and environmental frameworks to tackle the current critical situation.

Finally, the studies propose providing knowledge about the social and cultural bases that could re-evaluate small-scale fishing in order to encourage its development and promote it as sustainable, locally-sourced and native fishing.



What is the state of fishery resources in Cap de Creus?

Not very good –in fact, not very good at all. The results of fish monitoring carried out since 2008 have detected that the yield or Catch Per Unit Effort (CPUE) of the species as a whole caught by the two main techniques (trammel nets and longlines) has undergone a downwards trend, which indicates that the abundance of species caught is also getting smaller. A detailed analysis of data has been carried out on two species that represent the rocky seabed of Cap de Creus because they are sedentary (that is, they are associated with the seabed in Cap de Creus) and are caught with trammel nets: red scorpionfish and forkbeard. The results show that over the years the yield (CPUE) of these two emblematic species of the Natural Park has been falling. A negative trend has also been observed in the average landing size of these fish, which indicates that smaller and smaller individuals are caught. The negative trend of the yield and the average size of forkbeard and scorpionfish indicate that the status of their populations in Cap de Creus is becoming worse. Even though the analyses have been carried out using data from six years of sampling, the results are worrying as they indicate symptoms of overfishing. The crisis affecting small-scale fishing in Cap de Creus is not only made evident by the drop in the number of fishermen and the fishing techniques employed, but also by the reduction of the Park's most representative fishing resources.

***Symptoms that show the fishing resources in
Cap de Creus Natural Park have worsened in recent years (2008-2015)***



- Lower yield from trammel nets (kg caught by metres of net and hours of fishing)
- Lower yield from longlines (kg caught by hook and hours of fishing)
- Smaller average size of scorpion fish caught
- Smaller average size of the forkbeard caught



Is small-scale fishing really sustainable?

It is said that traditionally small-scale fishermen maintain a careful relationship integrated in the environment through knowledge and culture. (...) As the result of this careful relationship, fishermen have the responsibility of measuring the fishing effort every day.

When we talk about sustainable small-scale fishing, we are referring to a culturally inherited type of fishing with specific features that, as we have previously defined, respond to an attitude and relationship that is respectful with the environment. It is said that traditionally, small-scale fishermen maintain a careful relationship integrated in the environment, based on knowledge and culture. It is through this relationship that the fishing and fishery

season is designed by supposedly following accurate criteria for selecting the species that have to be caught. This careful relationship obliges the fishermen to measure the fishing effort every day.

The value of small-scale fishing is based on the fact it strengthens the relationship of respect between fishermen and the environment. Nevertheless, insofar as small-scale fishing is not unrelated to the changes in global economy, the criteria are conditioned by market criteria, which affects the selective aspect of small-scale fishing.

As mentioned above, despite the fact that, from an environmental point of view, small-scale fishing is the kind of fishing that could be the most sustainable in comparison to trawling and surrounding nets, it is worth noting that if it is not done properly or done excessively, it could have negative consequences for the populations of coastal species, particularly because small-scale fishing mostly catches breeders, many of which are young, and this could threaten the reproductive stock and subsequent recruitment.

As we have already commented, small-scale fishing is understood to be mainly selective: large, breeder individuals are often selected, which are the most appreciated fish in the market. Nevertheless, that on its own does not imply it is sustainable. Why? Firstly, because when the largest individuals are caught, it means



that the largest breeders are caught, which usually produce a higher number of eggs and are of better quality. Secondly, that fact that small-scale fishing often selects the largest sizes of specific fish that change their sex when they reach a certain size (the so-called 'hermaphrodite species') means that mostly examples of one sex are caught, which threatens the sexual balance within the population. Consequently, as small-scale fishing is often selective in terms of sizes, it could make small-scale fishing affect the populations of hermaphrodite fish. According to the studies conducted in Cap de Creus, the presence of hermaphrodite fish in the catches of small-scale fishing is recurrent. There are specifically 11 hermaphrodite species that represent up to 20% of the total catch, although in some fishing techniques, such as gill nets, hermaphrodite fish make up 60% of the total catch. It was observed that in five of these hermaphrodite species the majority of individuals caught were of only one sex (male or female). Thus, in the case of the gilthead seabream, zebra seabream and common pandora, over 80% of the catch obtained in Cap de Creus was made up of males. However, as regards Axillary seabream and groupers, over 90% of the catch was made up of females.

What are hermaphrodite species?

Unlike the majority of species, which are born with a sex (male or female) that they keep for their entire lives (like humans), hermaphrodite species start out as one sex and switch to the other sex later in life. There are hermaphrodite species that are born male and when they reach a certain size, they become females, like the gilthead seabream and seabream, and there are fish that are born female and when they reach a certain size, they turn into males, like the grouper and pandora. There are also species that have both male and female reproductive organs, like the comber and painted comber. As regards the species that change their sex when they reach a certain size, it is evident that if the catch is mainly focused on a single size range, the fishing activity mostly affects one sex, meaning that these fish are left without a mate to be able to reproduce, which negatively affects the population.



Photo: MARIA VELASCO

It is also necessary to bear in mind the possible impact caused by trammel nets, especially those used to catch lobsters, on the coralline areas (which fishermen often call 'rocky seabeds'). Coralline is a fragile and emblematic Mediterranean habitat, similar to the coral reefs found in tropical seas, made up of different animal species, many of which are sessile and fragile invertebrates, such as gorgonians and bryozoans, which are sometimes dragged by the net when the weights (the part of the trammel net that touches the seabed) enters into contact with these invertebrates. The same thing happens with longlines and sessile organisms: this has been observed with large longliners (that cannot be considered small-scale fishing boats) when they fish in the so-called 'rec de Cap de Creus', an underwater canyon located at a great depth outside the Park, home to very vulnerable white cold-water coral.

Another feature to be considered are the discards (species with no commercial interest or individuals that do not reach the legal landing size and are consequently returned to the sea after being caught). Unlike trawling, which discards a significant part of the catch (sometimes over 40% of the total amount caught), the discards from small-scale fishing are very low (frequently less than 10% of the catch). However, this does not mean that they do not exist, neither are they something we should forget, especially when the discarded species are considered vulnerable. During the studies carried out in Cap de Creus, it was basically observed that cartilaginous fish are discarded (mostly rays), which generally have a low commercial value, as well as small fish and invertebrates. In most cases, these animals are released alive into the sea (unlike fish caught by trawling, which are often dead or dying when they are returned). The fish released into the sea alive include the common eagle ray, electric ray, ocean sunfish and flying fish. Good small-scale fishermen are careful to release these animals immediately after they have been caught. During the studies, we observed that no bird, turtle or dolphin was caught, unlike other fishery activities of a more industrial nature.



Finally, it is necessary to mention that sometimes fishermen lose their gear in the sea when it gets tangled with the rocks on the seabed, or 'someone' has cut the ropes that fastened the gear to the seabed or it is lost in storms. Lost nets are known as 'ghost nets' because they carry on catching fish and crustaceans for some time, and no one will obtain any profit from them. It must be remembered that fishing nets and longlines are made of very resistant materials and their degradation takes several years. As a result, if we want to avoid this problem, we need to prevent gear from getting lost and every so often, carry out retrieval tasks with fishermen's collaboration, in the same way as has been done in some places along the Catalan coast.

Does the Natural Park help recover fishery resources?

The establishment of a marine reserve often increases biomass, abundance, average size and breeding potential of the species exploited in a marine reserve or natural park, which ought to favour the long-term fishing yield, in both the park and nearby areas. This benefit is due to the fact that fishing in a natural park is restricted and controlled, which ends up having a positive impact on the species that live there, especially the most sedentary ones. The advantages of fully protecting the populations of fish inside a reserve usually affect surrounding areas, as the adults in the reserve and/or their eggs or larvae can move outside the limits, whether by swimming (in the case of adults) or carried by marine currents (in the case of eggs and fish larvae).

We have observed these positive aspects in different studies carried out in marine reserves in France, the US and Australia. However, since the creation of Cap de Creus Natural Park in 1998, the fishing resources in general do not appear to have improved. As explained in the previous section, the situation is quite the opposite given the negative trend in recent years.



In the case of one study in particular, on the forkbeard in Cap de Creus, it was observed that the creation of the Park has not helped to recover the populations of this species. It is probably necessary to wait for the approval of new fishing management and regulation measures (small-scale and recreational) within the framework of the *Pla Rector d'Ús i Gestió* (Use and Management Master Plan -PRUG) a basic document for managing a protected area that has to provide new tools to improve conservation of the park's marine resources. At present (without the approval of the PRUG) the only restriction on small-scale and recreational fishing is the prohibition to fish using any technique in the small integral nature reserve of S'Encalladora (20 hectares) and diving is prohibited in the three partial nature reserves (in addition, trawling and fishing with surrounding nets are prohibited throughout the whole park).

It must also be considered that according to studies performed in Cap de Creus, recreational fishermen in the Park catch nearly the same amount of fish in one year as small-scale fishermen. Even though studies on small-scale fishing do not show any improvement in the Park's resources, other studies performed with divers (with the so-called visual censuses) show symptoms of recovery of some vulnerable species, such as the grouper, meaning that the Park is indeed contributing towards the recovery of some species. Nevertheless, the recovery of these species is still insignificant for small-scale fishing, in terms of volume of catches and sales.

How can the Natural Park improve the yield of the fishing sector?

It is clear that although the populations of fish and crustaceans caught by small-scale fisheries can be recovered, it does not imply an improvement of the profitability of small-scale fishing. To start off, regular fishing has to ensure a responsible fishing effort to avoid overfishing of vulnerable coastal species and thus prevent them from disappearing.



However, measures should be established that make it easier to market the catches of small-scale fishing as own, locally sourced products, looking to increase the knowledge of local marine biodiversity with a gastronomical value for consumers. This would ensure excessive fishing of some of the coastal species that are precisely the most vulnerable. At the same time, it would lower the cost of the product and be more accessible to consumers.

How can we change the course?

If we want small-scale fishing to be sustainable in the long term, we need to find a suitable balance in a responsible exploitation of the resources, which should be financially profitable, that from a social perspective, should allow employment to be maintained and that, in cultural terms, should respect knowledge and natural, historical and identifying patrimonial values. To make this possible, the main deficiencies detected previously should be corrected urgently by implementing different management measures. The most important are listed below:

- (1) **Fishery regulations in the Park need to adopt a lower fishing effort than the one set forth by the general regulations in Catalonia**, though they would have to adjust to the regulations followed today and used by the majority of small-scale fishermen in the Park.
- (2) **Place priority on traditional knowledge related to anything that defines fishing as small-scale** and include it in the regulations established by the Park. This would not only enable us to clearly distinguish between small-scale and industrial fishing, but also adapt the regulations according to the established definition
- (3) **Reduce the impact on vulnerable species** (complex breeding species, including hermaphrodites, slow growing fish and species with a long lifespan) so as to ensure their recovery.



Photo: JOSEP LLORET

- (4) **Increase surveillance** to tackle illegal fishing, both commercial (including trawling) and recreational.
- (5) **Implement systems to retrieve nets lost at sea** ('ghost' nets), working in cooperation with fishermen, divers and other groups, and hold campaigns to prevent losing fishing nets in the sea.
- (6) **Periodic monitoring of both small-scale and recreational fishing**, an activity that is becoming more and more popular. It has a growing number of users and the impacts on coastal resources are increasing.
- (7) **Fishermen should actively participate in the management** of the fishing resources in the Park (the so-called 'co-management').
- (8) **It is necessary to give value to the local product** and increase knowledge of marine biodiversity.
- (9) **Establish marketing measures** based on what studies have recently named '**short food supply chain**'. The volume of fish caught by small-scale fishing in Cap de Creus is much lower than that of industrial fishing and is therefore unable to compete with it. However, a short circuit marketing system would enable small-scale fishing to better adapt to a market that, in addition, is addressed to a very specific consumer. Measures of this kind have been implemented in other ports, which sold fixed-price baskets to cooperatives that sell to environmentally and socially committed consumers..
- (10) Integrate short circuit marketing measures in other initiatives aimed towards **disseminating small-scale fishing as sustainable fishing** so as to make it known, for example, through fishing-tourist initiatives as part of the cultural tourism in Cap de Creus..
- (11) One of the Park's measures was the establishment of **integrated collaborations between small-scale fishermen and the Natural Park** to conserve natural resources; this paper proposes going a step further and to implement marine stewardship. There is a network in Catalonia (*Xarxa de Custòdia*



del Territori - Land Stewardship Network: <http://custodiaterritori.org>) that sees to establishing this kind of collaboration relationships in both the rural and marine environment. Stewardship is a verbal agreement in which the producer guarantees it will act under criteria for ecological, social and environmental sustainability. However, the stewardship, entities and councils guarantee they will support the commercial outlet of the products that come from a sustainable activity..

- (12) Marine stewardship declarations must include the commitment to maintain the inheritance passed down through cultural legacy, to **take care of the marine environment** and include it as part of the conservation of **natural and cultural heritage**.
- (13) Considering that small-scale fishing is the only modality of commercial fishing permitted in Cap de Creus Natural Park, it would be appropriate to **continue with the studies of small-scale fishing from a socio-cultural, biological and economic perspective**. This would give us a broader and more comprehensive view of the sector's evolution and provide us with more decisive factors to create management plans adapted to the real circumstances of small-scale fishing.
- (14) As this situation is the same along the entire Catalan coast and small-scale fishing is a minority activity that with a low representation in the sector and Catalonia as a whole, **it would be advisable to establish coordinated measures and alliances with other ports and small-scale fishermen with the aim of acquiring greater efficiency and weight** by way of marine reserve networks, such as the MedPAN network (www.medpan.org) and initiatives carried out by NGOs, like the small-scale fishermen's platform, LIFE (<http://lifepatform.eu/>).



Photo: LUIS MAS BLANCH

Conclusion

Small-scale fishing requires in-depth study because it is socially and economically important from a local perspective (for the municipalities of the Natural Park) and although is not as deleterious for the marine environment compared to trawling and fishing with surrounding nets, it also affects ecosystems and marine resources. From a biological perspective, it is particularly necessary to study and manage the pressure caused by small-scale fishing through its multiple modalities and fishing techniques, especially the pressure on species and coastal habitats, with emphasis on the most vulnerable. Likewise, a full assessment is required of the social and economic challenges that small-scale fishing is going to face in the immediate future. This is the only way to ensure small-scale fishing is compatible with the conservation of Cap de Creus' natural heritage and maintain the basic understanding of small-scale fishing in terms of attitude and its respectful relationship with the environment, undoubtedly a cultural legacy with all the value this implies. It is therefore necessary to recover the cultural heritage of small-scale fishing.

Small-scale fishing ought to become an example of fishing management. The activity should be promoted as it is evident that if small-scale fishing is done properly it ends up finding a balance between fishermen and fish. Governments have often granted different subsidies to promote large-scale fishing (with big ships, big engines, big nets that catch high volumes of fish). This strategy has been a financial and ecological failure, meaning that we must head towards a future where small-scale fishing has a role with greater relevance. This book has shown that small-scale fishing is not free from ecological impacts, though with good management that includes institutional support and fishermen's awareness, as well as the recovery of the cultural legacy, this type of fishing could be fully sustainable. Consequently, the challenge is to make the environmental impact of small-scale fishing as low as



possible so it may become 100% sustainable, and a model for fishing in general. This book has been written with the aim of contributing to this idea. Many small-scale fishermen have already abandoned their boats and the number is rising. With the loss of these fishermen, not only will the profession disappear but also traditional knowledge about marine ecosystems that these people know well, and an example will be lost of how to make fishing compatible with the sea and its resources. We hope this book arrives before it is too late.





Bibliography (selection)

BOIX, L. (2016). *Arts i ormejis de pesca*. Edicions Brau.

BUSELIC, Y.; STAGLICIC, N.; LLORET, J.; MATIC-SKOKO, S. (2015) "Can restrictions in Mediterranean artisanal fisheries be beneficial for target species?" *Acta Ichthyologica et piscatoria* 45(1):31-38

CBBA (2011). *Seguiment del medi marí del Parc Natural de Cap de Creus-Illes Medes-Montgrí*. Government of Catalonia.

FAO (2015). *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication*. Fao (Rome). 18 p. <http://www.fao.org/3/a-i4356e.pdf>

GARCÍA-RUBIES, A. (2008). "Els peixos vulnerables de Cap de Creus". Included in: *Actes de les primers i segones jornades del medi natural de Cap de Creus* (ed. per RIERA, V.; LLORET, J.; FELIU, P.), 131 p.

GARRIDO, A. (2012). *La pesca al Cap de Creus en l'època moderna. Organització, gestió i conflictes per l'accés als recursos pesquers (segles XVI-XVIII)*. Doctoral Thesis. Universitat de Girona.

GIOVANNI, V.; ALEGRET, J.L.; BALDI, A.; DEGAGE, A. (1996). *Anthropologie et droit comparé des pêches en Méditerranée nord-occidentale. Les propriétés de résistance des systèmes de gestion*. Contrat TR/MED 92/017 commission des communautés européennes DG XIV. 138 p.

GÓMEZ, S.; LLORET, J.; ZARAGOZA, N. (2003). *La pesca artesanal al Parc Natural de Cap de Creus*. Cap de Creus Natural Park.

GÓMEZ, S.; LLORET, J.; RIERA, V.; DEMESTRE, M. (2006). "The decline of the artisanal fisheries in mediterranean coastal areas: the case of Cap de Creus (Cape Creus)". *Coastal Management* 34:217-232.

- GÓMEZ, S.; RIERA, V. (2007). "Paisatge, pescadors i peixos: la pesca artesanal al Cap de Creus". Acts of Congress: *El paisatge, element vertebrador de la identitat empordanesa*. Institut d'Estudis Empordanesos. Vol II, 473-491 p.
- GÓMEZ, S.; RIERA, V. (2007). *La pesca artesanal al Cap de Creus*. Magazine for the Dissemination of Catalan Ethnology. Centre de Promoció de la Cultura Popular i Tradicional Catalana. Government of Catalonia.
- GÓMEZ, S. (2015). *Estudi social de la pesca artesanal a Cap de Creus*. Cap de Creus Natural Park.
- GÓMEZ, S.; LLORET, J. (2016). "The SSF Guidelines as a tool for marine stewardship in the Mediterranean: the case of Cap de Creus Marine Protected Area". Included in: JENTOFT, S.; CHUENPAGDEE, R. (ed.) *Unpacking the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries: From Rhetoric to Action*. Part 4, Springer (in press).
- GÓMEZ, S. (2016). "El patrimonio de la pesca artesanal y la gestión sostenible de los recursos en las áreas marinas protegidas: el caso de Cabo de Creus". Included in: BELTRÁN, O.; SANTAMARÍA, B. (eds). *Antropología Ambiental* (in press).
- GRIFFITHS, R.C.; ROBLES, R.; COPPOLA, S.R.; CAMIÑAS, J.A. (2007). *Is there a future for artisanal fisheries in the Western Mediterranean?* Rome FAO, Copemed. 106 p.
- GUYADER, O.; BERTHOU, P.; KOUTSIKOPOULOS, K.; ALBAND, F.; DEMANÈCHE, S. et al. (2007). *Small-Scale Coastal Fisheries in Europe*. Final report of the contract no. FISH/2005/10. <http://ec.europa.eu/fisheries/publications/studies/reports/en.htm>

- HEREU B.; ROMERO J.; DÍAZ D.; ASPILLAGA E.; CAPDEVILA P.; GARCÍA-RUBIES A. *et al.* (2014). *Seguiment de la biodiversitat marina al Parc Natural de Cap de Creus i al Parc Natural del Montgrí, les Illes Medes i el Baix Ter*. 2014 Report. Contract number AG-2014-654 with the Government of Catalonia. Ministry of Agriculture, Livestock, Fisheries, Food and Environment. Service for Protected Natural Areas.
- JACQUET, J.; PAULY, D. (2008). "Funding priorities: big barriers to small-scale fisheries". *Conservation Biology* 22, 832-835.
- KELLEHER, K. (2005). *Discards in the world's marine fisheries*. An update. FAO Fisheries Technical Paper 470, 131 p. <ftp://ftp.fao.org/docrep/fao/008/y5936e/y5936e00>.
- LLORET, J. (2008-2015). *Informes anuals dels seguiments de la pesca artesanal a Cap de Creus*. Cap de Creus Natural Park.
- LLORET, J.; RIERA, V. (2008). "Evolution of a Mediterranean coastal zone: human impacts on the marine environment of Cape Creus". *Environmental Management* 42, 977-988.
- LLORET, J.; MUÑOZ, M.; CASADEVALL, M. (2012). "Threats posed by artisanal fisheries to the reproduction of coastal fish species in a Mediterranean marine protected area". *Estuarine, Coastal and Shelf Science* 113: 133-140.
- LLORET, J.; FONT, T. (2013). "A comparative analysis between recreational and artisanal fisheries in a Mediterranean coastal area". *Fisheries Management and Ecology*, 2013, 20, 148-160.
- LLORET, J.; COWX, I.; CABRAL, H.; CASTRO, M.; FONT, T. *et al.* (2016). "Small-scale coastal fisheries in European Seas are not what they were: ecological, social and economic changes". *Marine Policy* (in press) <http://dx.doi.org/10.1016/j.marpol.2016.11.007>

- MACFADYEN, G.; SALZ, P.; CAPPELL, R. (2011). *Characteristics of small-scale coastal fisheries in Europe*. Brussels: European Parliament's Committee on Fisheries. [http://www.europarl.europa.eu/RegData/etudes/etudes/Join/2011/460059/IPOL-PECH_ET\(2011\)460059_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/etudes/Join/2011/460059/IPOL-PECH_ET(2011)460059_EN.pdf)
- MALLOL, S. (2010). "La col·lecció zoològica de Joan Ortensi de Roses: procés de revisió i recuperació". *Annals de l'Institut d'Estudis Empordanesos*, 41, 183-212.
- MOLLOY P.P.; REYNOLDS J.D.; GAGE M.J.G.; MOSQUEIRA I.; CÔTÉ I.M. (2008). "Links between sex change and fish densities in marine protected areas". *Biological Conservation* 141, 187-197.
- MUÑOZ, M.; LLORET, J.; VILA, S. (2013). "Effects of artisanal fisheries on the scorpaenids (*Scorpaena* spp.) reproduction in the marine protected area of Cap de Creus (NW Mediterranean)". *Fisheries Research* 138: 146-151.
- NADAL, J. (1981). *Els nostres peixos* (ed. Diputació de Girona), 255 p.
- PAULY, D. (2006). "Major trends in small-scale marine fisheries, with emphasis on developing countries, and some implications for the social sciences". *Maritime Studies* 4, 7-22.



SMALL-SCALE FISHING MODALITIES

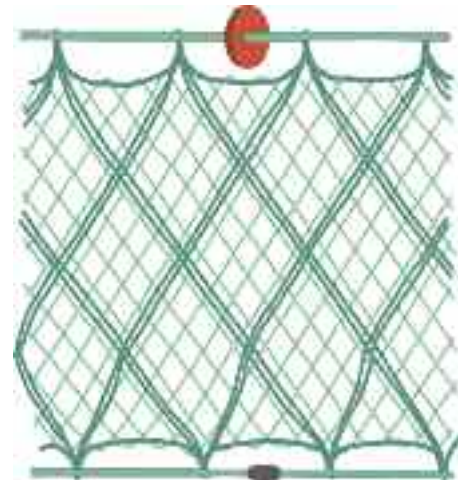
in Cap de Creus



FISHING WITH TRAMMEL NETS

- ✓ Trammel nets consist of a central net that is between two layers of netting (called *armallades* or *armalls* in Catalan), which enmesh fish (scorpionfish, groupers, etc.) and invertebrates (spiny lobsters, lobsters, squid, etc.). Most trammel nets are made of nylon.
- ✓ At present, fishing with trammel nets is the method most employed by fishermen in Cap de Creus, although the use of gill nets (another type of net described in the following section) has proliferated in recent years. Many years ago, before the appearance of trammel nets, basket traps were used to catch fish and invertebrates (nowadays basket traps are only used to catch the common octopus).
- ✓ Trammel nets are normally between 1.3 and 2.5 metres high and between 150 and 2500 metres long (with netting panels measuring 50 or 100 metres distributed throughout the length and stringed together). The average length of each net is 800 metres, which is the usual length immersed by each fisherman.
- ✓ Trammel nets are immersed all year long, but there is a very clear seasonal pattern: fishing is very intensive in spring, summer and autumn. This is the strategy traditionally followed by the majority of small-scale fishermen in Cap de Creus. However, despite everything, in recent years this seasonality has become unclear.
- ✓ Trammel nets are immersed at a depth of between 5 and 100 metres (average depth: 30 metres) in about 30 different fishing areas along the coast of Cap de Creus. Trammel nets used to catch lobsters, are usually immersed at greater depth.

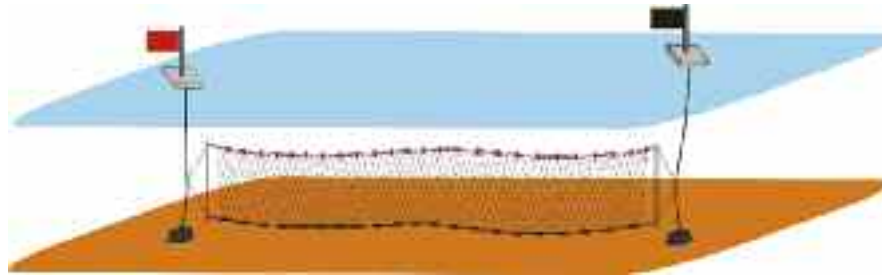
- ✓ Each trammel net is usually immersed between 12 and 24 hours. Only in the case of lobster fishing may the nets be in the water for longer than 24 hours.
- ✓ Trammel nets are mainly used in fishing areas with a rocky/coralligenous seabed (70% of the observations) and to a lesser extent on seabeds of maërl, *Posidonia oceanica* or sand/clay (the remaining 30%, particularly when fishing striped red mullet on maërl). It is worth mentioning that when a trammel net is immersed over a rocky seabed, fishermen try to avoid the rocks so the net will not get torn, though on occasions, when catching small red scorpionfish, and small European locust lobsters, the nets are set on the rock itself. Trammel nets for lobsters are set after specifically searching for coralline seabeds at a greater depth (40-60 metres).
- ✓ Trammel nets catch many species; it is actually the technique that catches the most species: about 70, of which a dozen are totally discarded because they have no commercial value. The majority of species caught are benthic that hardly move, or territorial, such as scorpionfish (even the red scorpionfish and black scorpionfish), forkbeard and striped red mullet; large decapoda, such as the lobster, European lobster and Mediterranean slipper lobster and cephalopods, like the common octopus.



Drawing of a trammel net

FISHING WITH GILL NETS

- ✓ Gill nets look similar to trammel nets but they consist of a single net, where the fish are caught by their gills. The majority of gill nets are made of monofilament material and they triple the height of trammel nets (they are usually about 5-7 metres high, although some have a height of up to 12 metres).
- ✓ Gill nets have become more popular in recent years (traditionally, trammel nets were used) and they are currently the second most popular technique used by small-scale fishermen in Cap de Creus. However, there is one type of gill net that has been used for many years: the *solta bonitolera*, *bolitx* or *bolitxa*, which is described below due to the uniqueness of this fishing technique.



Drawing: Josep Robon

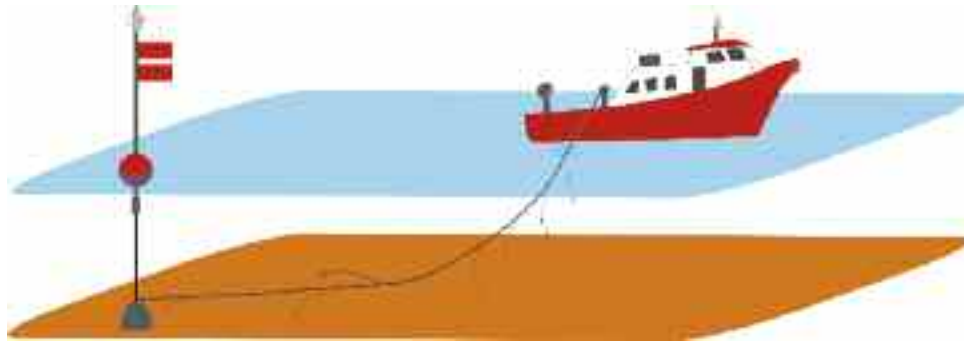
A gill net immersed on the seabed, with the two flag buoys.

- ✓ The total length of gill nets set by each fisherman is between 200 and 1600 metres, with an average of approximately 700 metres. They are immersed during the entire year but more intensively in spring and autumn, at depths of up to 90 metres. The total number of fishing hours (the number of hours during which the net is immersed) is nearly always about 15.
- ✓ Unlike trammel nets, gill nets are immersed equally between the different types of habitats and never on rocks, so as not to tear the net, which is fragile (monofilament).
- ✓ Fishermen use gill nets with the aim of catching species they call 'fish that are passing': species with greater mobility than those caught by trammel nets (in other words, they are not so sedentary, not as 'rooted' to the Cap de Creus seabed). They include the gilthead seabream, European seabass, common pandora, axillary seabream, greater amberjack and European hake. Gill nets catch a total of about 50 different species of which four are discarded (returned to the sea).

FISHING WITH LONGLINES

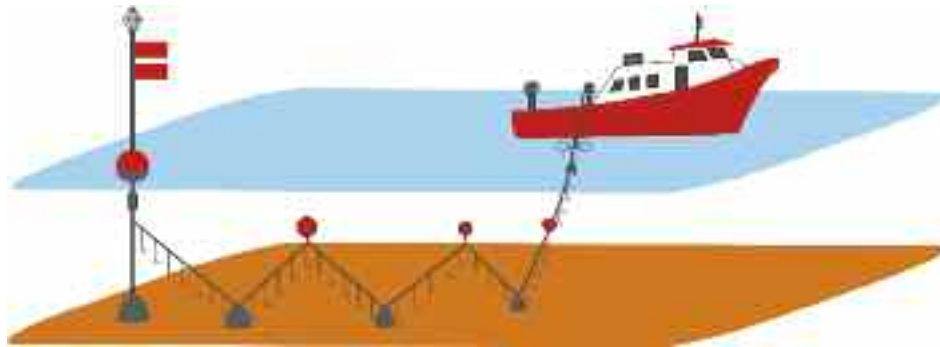
- ✓ Longlines are fishing gear with numerous hooks that are immersed with snoods joining them together. Those used in Cap de Creus are basically the so-called bottom-set longlines and drifting longlines. They have between 90 and 560 hooks (the average is 200 hooks) and for this reason, the longlines used today in Cap de Creus can be compared with those used in olden days, and are nothing like the huge longlines used by longliners from Roses, Llançà and Port de la Selva when they fish in the Gulf of Lion.

- ✓ Although it is common to alternate between nets and longline techniques, there are some fishermen who never use longlines, and others that use them exclusively all year.
- ✓ Longline fishing requires quite specific skills, because a certain type of longline is necessary to catch a specific species, in a certain season of the year and on a particular type of seabed. Not everyone knows how to do it!
- ✓ Longlines can be found all year, although they are immersed more during the summer and autumn. The number of immersion hours is lower than fishing with trammel nets or gill nets, as longline are immersed from between two and 14 hours. In Cap de Creus, longlines are immersed at depths of between six and 60 metres approximately.



Bottom-set longlines.

- ✓ Longlines are mostly immersed on rocky or coralline seabeds (60% of the cases) and seagrass (seabeds of *Posidonia oceanica* in 20% of the cases) and to a lesser extent on maërl and sand/clay. In this case, whenever someone says 'rock', they mean that the longline is set on the rocks themselves.
- ✓ The target species depend on the modality of the technique and often the type of longline is given the name of the target species (conger longline, grouper longline, hake longline, etc.). The bait used to attract the fish to the hook is also specific to each longline and depends on the target species. Some fish are 'gourmets' and the fishermen are well aware of the fact!
- ✓ Longlines catch a total of about 30 different species, of which none are discarded (released into the sea). Mostly European conger and axillary seabream are caught.

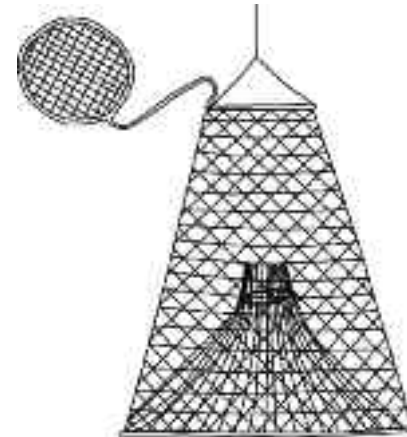


Drifting longline.

Drawing: Joëli Robson

FISHING WITH BASKET TRAPS TO CATCH THE COMMON OCTOPUS

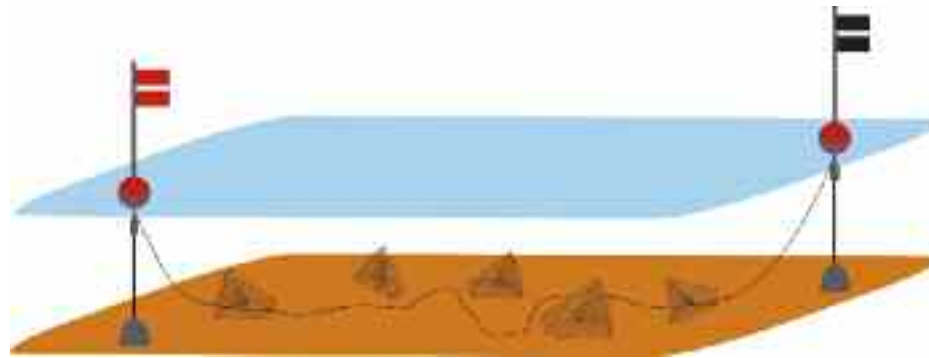
- ✓ Basket traps to catch the common octopus are an adaptation of the old traps that were used by fishermen to catch certain fish and lobsters (they are no longer used). Basket traps today are used exclusively to catch the common octopus. However, many years ago, people did not appreciate it and therefore it was not caught in Cap de Creus: the popular 'Galician-style octopus' dish served today in many restaurants has undoubtedly played an important role in this species' popularity.
- ✓ Basket traps today are built of synthetic materials and the bait, which is placed inside to attract the common octopus, is made up of either fish –without commercial value, such as bogue or mackerel, which are previously salted– or terrestrial animal remains obtained from slaughterhouses.
- ✓ Each fisherman sets an average of 45 traps at a depth of between 14 and 45 metres. There is a separation of approximately 10 metres between each trap and they are all joined together by a rope. The traps are immersed between January and June and they are often left under the water for about six days (the traps are always immersed and the fisherman lifts them, removes the catch, adds more bait and then returns them to the sea again).



Drawing: Jordi Roca

Basket trap for catching common octopus.

- ✓ Although the target species is the common octopus, which makes up 90% of the catches, another nine species are caught, such as the spider crab (a crustacean) and some benthic fish. The 'real' spider crab is a vulnerable crustacean that lives near the coast. Decades ago it was the target of specific fishing, but it seems to have nearly disappeared from Cap de Creus.



Drawing: Jeroen Roboon

Basket traps for the common octopus, immersed on the seabed.

FISHING WITH SOLTA BONITOLERA OR BOLITXA (BOLITX) (Stationary uncovered pound nets designed to catch bonito)

- ✓ The *bolitxa* is a type of gill net used to catch bonito during its migrations, which is immersed in a special way: one of the ends is tied to a rock on the coast and the other is left in the sea. *Bolitxes* are about 250 metres long and 20 metres high and are immersed at a depth of between 20 and 30 metres approximately, always on sand and seagrass (*Posidonia oceanica*).
- ✓ Inside the Park, the nets are mostly immersed in three coves of the park of Mar d'Amunt: Prona and Taballera (Port de la Selva) and Galladera (Cadaqués). Nevertheless, years ago, when there was an abundance of bonito, the fishermen from Cadaqués also used to immerse their *bolitxa* in a cove of Mar d'Avall: Canadell (Roses). Outside the waters of the Park, the nets are also set on Pas beach (Port de la Selva). Nowadays they are used by very few fishermen from Port de la Selva and Cadaqués. In Port de la Selva, where traditionally there were more fishermen that used *bolitxes*, the fishing grounds were assigned by a draw. Now it is not necessary to hold a draw, as hardly any fishermen have a *bolitxa*.
- ✓ Traditionally, the fishing season is divided into two periods: spring and autumn/beginning of winter. The pause in summer is basically due to the fact that pleasure boats prevent the effectiveness of this type of fishing.
- ✓ The nets are immersed for about 12 hours, nearly during the day from 6.00am to 4.00pm (they are only left during the entire night when there is a full moon, when they can be left until 8.00pm: then they are usually immersed one day in the afternoon and are lifted the following afternoon). In Port de la Selva, the fishermen usually immerse and lift the *bolitxa* on the same day (they are taken home, thus leaving space for another fishermen) whereas in Cadaqués the nets are usually immersed, lifted and immersed again in the same place.

- ✓ Although the target species is bonito (approximately 80% of the catches), about 20 other species are caught, of which only one is totally discarded: the ocean sunfish which, during the spring, when it is swimming in superficial waters near the coast, searching for jellyfish to eat, gets accidentally trapped in the net (though it is released alive into the sea again, apparently unharmed). Another species that is often caught by the *bolitxa*, whose commercial value is nowhere near that of bonito, is the bullet tuna. According to recent studies, it appears that this species is favoured by climate change, specifically the warming of the sea because, unlike bonito, it likes warm water. By contrast, bonito would be harmed by the warming of the sea as it prefers colder water. Sea warming would also explain why yellowmouth barracudas are now getting trapped in *bolitxes* when years ago that never happened (it appears that only a similar species, called the European barracuda, used to be fished but it was native). A *bolitxa* has even been known to trap the occasional smooth hammerhead (shark) of a considerable size and less than 50 metres from the coast. It's a good thing swimmers don't know!
- ✓ No one knows why bonitos swim into some of the coves of Cap de Creus during their migration, where fishermen are waiting to capture them. The seasonal migrations of bonito are still unknown: in some places in the south of the Catalan coast they disappear for a few months, while others in the north, such as in Cap de Creus, do appear. Does it take bonitos by whim? We very much doubt it; there must be a biological reason, but to find out we need to carry on studying the species in Cap de Creus and its fishing.



Common and scientific names of fish and invertebrates cited in the book

Local name	English name	Scientific name
Barracuda	Yellowmouth barracuda	<i>Sphyraena viridensis</i>
Besuc	Axillary seabream	<i>Pagellus acarne</i>
Boga	Bogue	<i>Boops boops</i>
Bonítol (adult), fumadell (juvenil)	Atlantic bonito	<i>Sarda sarda</i>
Bugies	Small European locust lobster	<i>Scyllarus arctus</i>
Cabra (femella), cabrot (mascle)	Spinous spider crab	<i>Maja squinado</i>
Cabra borda	Spider crab	<i>Maja crispata</i>
Calamar	European squid	<i>Loligo vulgaris</i>
Cigala (o lluísa)	Mediterranean slipper lobster	<i>Scyllarides latus</i>
Congre	European conger	<i>Conger conger</i>
Escórpora roja (vermella), cap-roig o rascassa	Red scorpionfish	<i>Scorpaena scrofa</i>
Escórpora negra o rufí	Black scorpionfish	<i>Scorpaena porcus</i>
Escórpora de cap tinyós, capità o malanit	Small red scorpionfish	<i>Scorpaena notata</i>
Escórpores	Scorpionfish	<i>Scorpaneae scrofa</i> , <i>S. notata</i> i <i>S. porcus</i>
Espet	European barracuda	<i>Sphyraena sphyraena</i>
Joell	Big-scale sand smelt	<i>Atherina sp</i>
Llagosta	Common spiny lobster	<i>Palinurus elephas</i>
Llamàntol o sastre	European lobster	<i>Homarus gammarus</i>
Llobarro	European seabass	<i>Dicentrarchus labrax</i>
Lluç	European hake	<i>Merluccius merluccius</i>
Melva	Bullet tuna	<i>Auxis rochei</i>

Local name	English name	Scientific name
Milana	Common eagle ray	<i>Myliobatis aquila</i>
Molla de roca	Forkbeard	<i>Phycis phycis</i>
Nero (mero o anfós)	Dusky grouper	<i>Epinephelus marginatus</i>
Orada	Gilthead seabream	<i>Sparus aurata</i>
Pagell	Common pandora	<i>Pagellus erythrinus</i>
Palomida	Greater amberjack	<i>Seriola dumerili</i>
Peix lluna o bot	Ocean sunfish	<i>Mola mola</i>
Peix martell	Smooth hammerhead	<i>Sphyrna zygaena</i>
Peix volador	Flying gurnard	<i>Dactylopterus volitans</i>
Pop roquer (o pop de roca)	Common octopus	<i>Octopus vulgaris</i>
Rajades o clavellades	Thornback ray	<i>Raja spp</i>
Roger o moll de roca (o de grapissar)	Striped red mullet	<i>Mullus surmuletus</i>
Sarg	White seabream	<i>Diplodus sargus</i>
Sarg imperial	Zebra seabream	<i>Diplodus cervinus</i>
Sèpia	Common cuttlefish	<i>Sepia officinalis</i>
Serrà	Comber	<i>Serranus cabrilla</i>
Sorell blanc	Atlantic horse mackerel	<i>Trachurus trachurus i T. mediterraneus</i>
Sorell negre	Blue jack mackerel	<i>Trachurus picturatus</i>
Tremolosa	Marbled electric ray	<i>Torpedo marmorata</i>
Vaca serrana	Painted comber	<i>Serranus scriba</i>

This book is the first publication about small-scale fishing that combines studies of biology and social anthropology in a marine protected area. Its purpose is to re-evaluate and give visibility to a fishing activity that throughout history has nurtured the coastal villages of Cap de Creus and its culture. The changes these towns have undergone in recent years have imposed new social, economic and environmental challenges that need to be faced by small-scale fishing. Paradoxically, different international organisations supported by scientific studies, are currently affirming that small-scale fishing is the most sustainable option that, if carried out properly with good management, it will ensure the well-being of sea resources and the coastal livelihood. The book you are holding in your hands aims to offer a look into the future without losing the essence of the past that, as a cultural legacy, provides us with the keys to readapt small-scale fishing to the changes in the modern-day world, based on social, economic and environmental sustainability.



SÍLVIA GÓMEZ MESTRES (Barcelona, 1975) is doctor in Social Anthropology. She works as a researcher and teacher at the Universitat Autònoma de Barcelona and has also worked at the Universitat de Barcelona and the CNRS (France). She has done secondments in centres such as the Université Paris 1 and l'École d'Hautes Études en Sciences Sociales (France), the Institut Català de Recerca en Patrimoni Cultural (Girona) and University of Oslo (Norway). She has written several papers on social anthropology about nature and culture and the anthropology of fishing in Cap de Creus for its sustainable management.



JOSEP LLORET ROMAÑACH (Roses, 1971) is doctor in Marine and Fisheries Biology. He has worked in Cap de Creus Natural Park, Institut de Ciències del Mar (CSIC), CNRS (France) and the Thünen Institut (Germany) thanks to different contracts and grants awarded by the European Union, and the governments of Catalonia, Spain and Germany. He is currently a teacher and researcher at the University of Girona. He is the author of numerous publications that attempt to know and conserve fish, marine ecosystems and fishing.

PARC NATURAL DE CAP DE CREUS • CONSELL SOCIAL DE LA UNIVERSITAT DE GIRONA (UdG)