

## 2.13. Fishermen and scientists: synergies for the exploration, conservation and sustainability of the marine environment

Andreu Santín, Jordi Grinyó, Stefano Ambroso, Patricia Baena, Marina Biel, Guillem Corbera, Janire Salazar, Maria Montseny, Josep-Maria Gili

During the 20th and 21st centuries, the growing demand for marine resources by Mediterranean countries has led to a gradual increase in fishing pressure. As a result, both coastal and continental Mediterranean waters have suffered from the impacts of trawling and, to a lesser extent, of artisanal fishing with longlines, trammel nets and other minor fishing gear (Grinyó *et al.* 2022, Demestre *et al.* 2022). Following the indications proposed by the European Marine Strategy, a set of particularly vulnerable areas has begun to be delimited, and protection measures are to be implemented for their conservation (Law 41/2010, of 29 December, on marine protection; <https://www.boe.es/eli/s/l/2010/12/29/41>). These areas seek to develop integrated policies to promote sustainable fishing practices that prevent the over-exploitation of natural resources while at the same time mitigating the impacts that may occur on benthic habitats, which are those found directly on the seafloor. Although fisher's guilds are still operative in most marine protected areas, only a minority of scientific studies and management plans have integrated the experience and knowledge of fishers in such areas. This scant involvement of fishers in drawing up the management measures often results in their opposition to them, as well as a lack of motivation regarding proposals for a more sustainable exploitation and preservation of the marine environment.

### First experiences: the artisanal fisheries of the Menorca Channel

In this regard, the research group on Ecology and Resilience of Benthic Ecosystems in a Changing Ocean of the Institut de Ciències del Mar has been working for years to achieve greater involvement and integration of fishers in scientific projects and management activities. As an example, during the exploration of the Menorca Channel, artisanal fishers in the area helped identify areas of high diversity on the limit of the continental platform, which have been unexplored so far but have been known for decades by the fishers. These areas contain dense communities of sponges and gorgonians, sometimes extending for kilometres, which could be listed among the best preserved in the northwestern Mediterranean (Grinyó *et al.* 2018, Santín *et al.* 2018), and which harbour several new species to science. In the Channel, specimens of various species of gorgonians (colonial organisms related to corals and without commercial interest) often get entangled in small-scale fishing nets and are systematically returned to the sea by the fishers. The colonies that are accidentally caught include some that are completely removed from their substrate and some that are still fixed to pebbles. Following a joint investigation with the fishers, it was noted that the survival of the ones attached to pebbles is much higher when they are returned to the sea. Therefore, on the basis of the knowledge acquired by these Minorcan fishers, we devel-

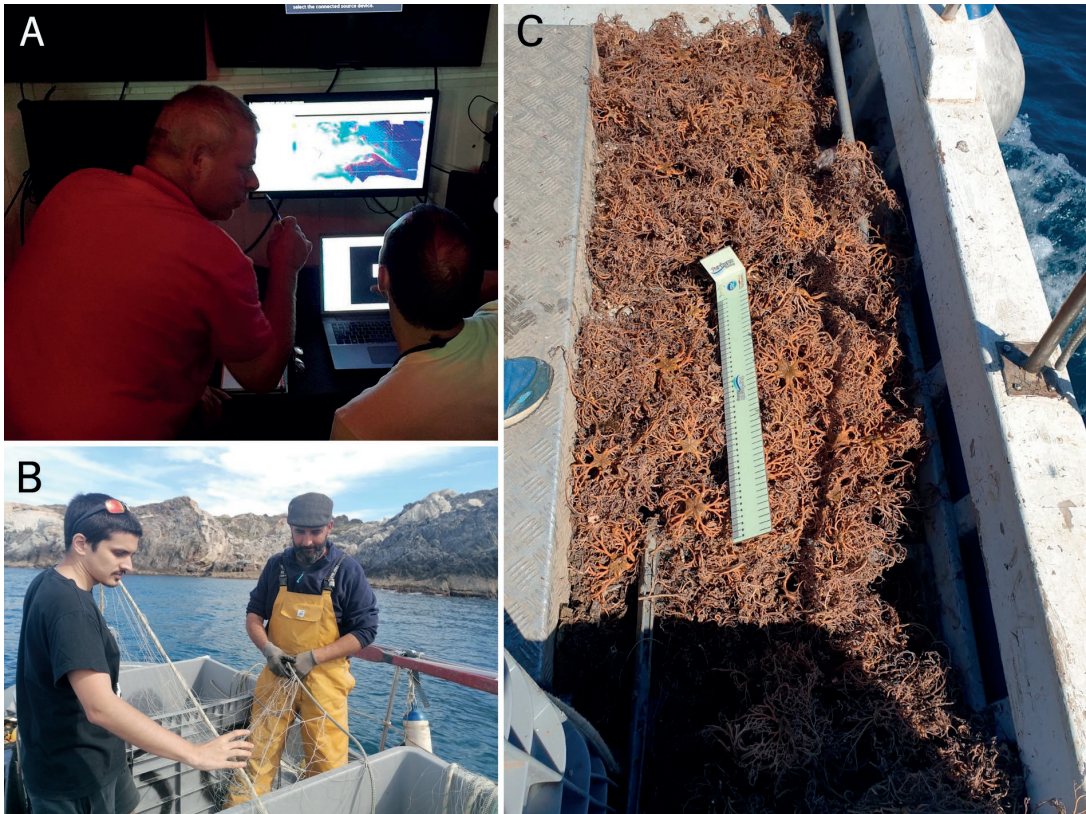


Figure 1. A, advice by artisanal fisherman from Port de la Selva to the scientific team of the MITICAP project during the exploration of the artisanal fishing grounds of the Cap de Creus by means of a remotely operated vehicle. B, collaboration between artisanal fishermen and scientists in the preparation of experimental artisanal trammel nets on board a fishing boat. C, hundreds of *Astrospartus mediterraneus* specimens accidentally caught by artisan trammel nets in a single fishing event.

oped a method for restoring gorgonians that has been successfully applied for years in the Cap de Creus area (Grinyó *et al.* 2022, Montseny *et al.* 2021).

### Nowadays: Towards a co-management model and conservation of marine resources

It is precisely in the area of the Cap de Creus (the first maritime-terrestrial national park in the Spanish state, recently included in the Natura 2000 Network) that the research group's efforts are currently focused. During the course of the Life+ INDEMARES project, it was found that, in the Cap de Creus marine area, as in the Menorca Channel, the best preserved areas were those inaccessible to trawling and only frequen-

ed by artisanal fishing boats (Gili *et al.* 2011). However, although the impact of small-scale fishing on the environment is lower, it still exists. Therefore, a close cooperation was initiated with artisanal fishers of Port de la Selva and Cadaqués with the aim of better understanding their techniques, promoting this type of fishing against more destructive ones and mitigating the impacts that it has in the area (Figure 1A). This mitigation has so far consisted in the modification of the fished areas, the selection of different fishing gear based on the habitats that each fishing area hosts, and measures to reduce ghost fishing (capture of marine organisms by lost and/or derelict fishing gear; Figure 1B). The fishers of this area accidentally catch species of high scientific interest, and they have helped to detect for the first time the presence of the gorgonian *Spini-*

*muricea klavereni* on the Catalan coasts (Yokeş *et al.* 2018). Another important contribution by the fishers was the detection of an increase in the population of *Astrospartus mediterraneus* (an emblematic ophiuroid of the Mediterranean region considered rather rare or scarce) that had gone unnoticed by the scientific community (Figure 1C). The significant increase in populations of this echinoderm has had a negative effect on artisanal fisheries, resulting in a considerable increase in net clearance times. However, communication between fishers and scientists enabled the problem to be analysed from an ecological point of view, helping to increase the confidence of fishers and their willingness to work along instead of with scientific staff.

The scientific community is making great efforts to bring science closer to society. In order to reverse the unsustainable extractive fishing model that prevails in today's society, all stakeholders need to be involved. Therefore, creating a model of close cooperation between scientific staff and fishers is essential in order to achieve a paradigm shift in the exploitation of fish stocks that will lead to more sustainable practices and allow artisanal fisheries to be supported and enhanced.

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