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## **CAN AN EMBLEMATIC SPECIES BECOME A PEST? THE CASE OF *ASTROSPARTUS MEDITERRANEUS* (RISSO, 1826) (ECHINODERMATA: OPHIUROIDEA) IN THE ARTISANAL FISHING GROUNDS OF THE CAP DE CREUS AREA (NW MEDITERRANEAN SEA)**

### **Abstract**

*Astrospartus mediterraneus* (Risso, 1826) (Echinodermata: Ophiuroidea) is an emblematic Mediterranean species yet, it has few reports and hasn't received much attention from the marine scientific community to date. In the framework of a project to assess how to mitigate the impact of artisanal fishing on benthic communities at the Site of Community Importance (SCI) of Cap de Creus (NW Mediterranean) (MITICAP Project), an unusually high abundance of the basket star (*A. mediterraneus*) was observed in 2018 as part of the by-catch of the local artisanal fishers. Indeed, the fishers involved in the project reported that this species had increased in abundance and expanded its distribution over the past years, ultimately interfering with their fishing activity. This work benefits from the Local Ecological Knowledge of the fishers, analyses field surveys and aims to elucidate the abundance, distribution, size, and structure of *A. mediterraneus* populations; as well as to examine the possible impact this species has on the artisanal fisheries performance. Data collection was performed through by-catch photo analysis of regular fishing events from May to August, analysis of video-transects recorded by means of Remote Operated Vehicles and conducting interviews with fishers to identify the impact. Basket stars were associated with rocky substrates with presence of gorgonians located between 50 to 80 m depth, preferentially occurring on sloping areas. Despite their high abundances ( $0.45 \pm 0.71$  ind/m<sup>2</sup>), the aggregations witnessed in the Cap de Creus area could not be determined as an outbreak due to the lack of longtime monitoring data thus, yet it seems apparent based on the LEK of the fishers that the species has been on the rise for the past years and they unanimously consider that its proliferation causes them a handicap in terms of monetary and time losses.

**Key-words:** Ophiuroid blooms, artisanal fishing, Local Ecological Knowledge, ROV, Mediterranean Sea

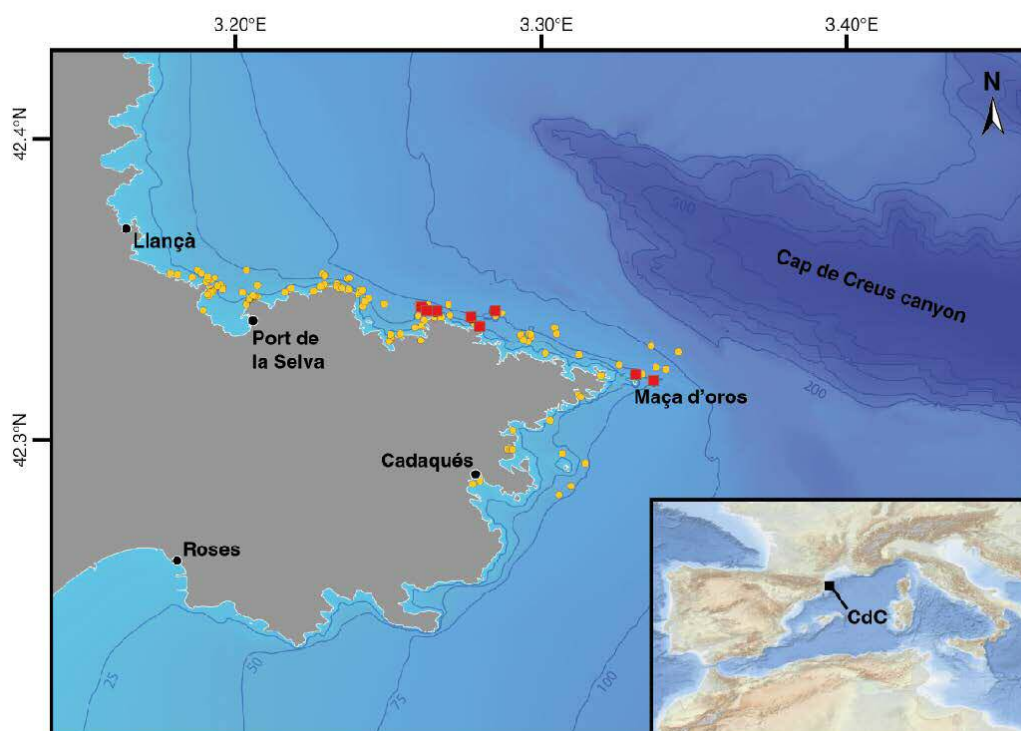
### **Introduction**

The basket star *Astrospartus mediterraneus* (Risso, 1826) is the sole representative of the Gorgonocephalidae family in the Mediterranean Sea (Ocaña & Pérez-Ruzafa, 2004), where it is considered as a rare and emblematic species (Fitori *et al.*, 2022; Mallol, 2010; Zibrowius, 1978) in need of conservation and protection (Cocito *et al.*, 2015; Fitori *et al.*, 2022). Yet with almost no information regarding its biology or ecology (Zibrowius, 1978). In 2018, within the frame of the MITICAP Project which aimed to reduce the impacts derived from artisanal fishing in the Cap de Creus Natural Park and SCI, fishers from the guilds of Port de la Selva and Cadaqués (Alt Empordà, Catalonia)

stated that over the past 5 years they noticed a substantial increase in *A. mediterraneus* abundances. Indeed, after assessing the fishing by-catch generated by different gears it was evident that *A. mediterraneus* represented a large proportion of captured organisms (Santin *et al.*, 2022). This situation started to be perceived by fishers from both guilds as a problem. In this context, this research aims to gain insight on these topics and determine their relation and affectation to artisanal fisher's performance.

### Materials and methods

This study was conducted on the fishing grounds shared by both collaborating guilds which are mostly located in the north side of the Cap de Creus (CdC) area (42°19'12" N, 03°19'34" E) located in the north-western region of the Mediterranean Sea (Fig 1.).



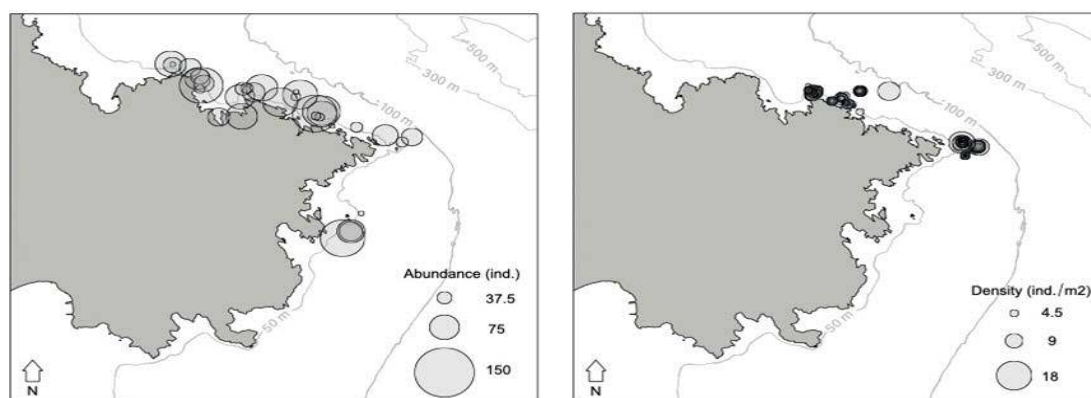
**Fig. 1 : Cap de Creus marine area. The yellow circles indicate the survey stations with presence of *A. mediterraneus*. Red squares Indicates where videotranssects took place**

Members of the research team joined the artisanal fishers' fleet from Port de la Selva and Cadaqués guilds (Alt Empordà, Catalonia, Spain) during regular fishing journeys. The fishing events took place coinciding with the spiny lobster (*Palinurus elephas* J. C. Fabricius, 1787) and scorpion fish (*Scorpaena scrofa* (Linnaeus, 1758)) fishing season. For each fishing event data about sea conditions, type of gear used, setting and collection time of fishing gear data, gear depth, and coordinates were gathered (Montseny *et al.*, 2019). *Astrospartus mediterraneus* caught in trammel nets were untangled and photographed with a graduated grid in centimetric units for scale. To characterize the artisanal fishing grounds in the Cap de Creus area, a total of 19 video transects were recorded onboard the vessel 'Atlantic Explorer' using a Perseo ROV. For every individual of *A. mediterraneus* observed during the transect, the following information was compiled: elapsed time since the beginning of the video, universal time

coordinates, depth, associated substrate type (including epiphyted organisms, if any), and the geographical coordinates. Moreover, each sampling unit's substrate type and slope were also registered, following the categories in Santín *et al.* (2018). To accurately estimate the impact of the basket star' possible outbreak, fishers completed a survey about this issue. In order to be eligible to take the survey, the selection criteria were: (i) being an active artisanal fisher and (ii) working on the Catalan coast.

## Results

The average disc diameter size was  $2.67 \pm 0.97$  cm, ranging between 0.19 – 6.67 cm. Most aggregations from cluster analyses showed 60% of individuals with a size-frequency between 2 and 3 cm, followed by classes of 1 to 2 cm (20–30%) and 3 to 4 cm (10%). Statistical analysis showed populations with a dominance of small to medium size classes (1 to 5 cm) and a prevalence of 2–3 cm individuals. Results show a species' prevalence in the northern and eastern parts of the Cap de Creus area. However, largest densities are found at the northwest flank of the study area where the species showed its densest aggregations (Fig.2b). Even so, the greatest abundances (over 150 individuals) occurred in just a few points, spread along the entire sampled area (Fig.2a).



**Fig. 2: Geographic distribution of *A. mediterraneus* in the study area, based on by-catch (abundance (a) and videotranssect (density) (b) data.**

Both data from video analyses and fishing events showed a similar bathymetrical distribution for the species, with an overall distribution between 35 — 85 m, but with a high incidence of *A. mediterraneus* restricted between 50 and 80 m depth. In this regard, there is a clear density increase for *A. mediterraneus* in the continental shelf below 50 m depth. Regarding the relationship between species' density and the presence of ecosystem engineers, there was an evident preference of the basket star for gorgonian forests. *A. mediterraneus* was also associated with sloping areas, showing a prevalence for this type of habitat.

Regarding the survey's analysis, 26 fishers answered the questionnaire, from 9 different fishers' guilds located on the Catalan coast. The answers were stated as follows: 69.2% of surveyed fishers believe that there is an abundance increase of basket star individuals on the Catalan coast. Among them, 42.1% answered that between 40 and over 50 baskets stars get entangled daily in their fishing gear and 47.6% devoted 1-3 hours to clean the fishing gear from the species. Yet all of them agreed that it constitutes an obstacle to their job performance. About the economic cost of this bycatch on their fishing gear, they estimate a monetary loss of 30-100€ per week in bycatch cleaning and

fixing damaged gears provoked by this species, but all of them coincide in the difficulty to assess a specific quantity.

### Discussion

According to the data obtained, *Astrospartus mediterraneus* abundance and density higher values do occur in the studied area and present a high relation with deep rocky substrates with presence of gorgonian assemblages, preferentially occurring on sloping areas. Results show, as the fishers had suspected, the presence of unusual *A. mediterraneus*' aggregations in the area appears to be proven, with up to 150 individuals caught in a single fishing event, and density values far above those of other Mediterranean areas (Terribile *et al.*, 2016). Nevertheless, although the mean number of individuals in the video transects was  $0.45 \pm 0.71$  ind/m<sup>2</sup>, basket stars' density values were not homogeneous with the Cap de Creus area, with dense aggregations ( $1.07 \pm 2.51$  ind/m<sup>2</sup>) occurring within a well-defined bathymetric range, between 55 to 80 m depth. The highest densities mainly occurred on sloping rocky outcrops, where they frequently occurred atop gorgonians. The average disc diameter ( $2.67 \pm 0.34$  cm) might suggest that present-day aggregations in the study area have appeared quite recently, pointing towards a recent outburst mainly formed by relatively young individuals. A plausible cause for the spectacular population outbreaks registered for these species could be linked to an increment both in quantity and quality of their food source due to water eutrophication (Duineveld *et al.*, 1987; Josefson *et al.*, 1993), increased water temperatures derived from climate change (Billett *et al.*, 2001; Wigham *et al.*, 2003), or lack of predators in the area (Cheser, 1969; Duineveld *et al.*, 1987). Nevertheless, while several factors or combination of factors could explain the recorded outburst of *A. mediterraneus* in the studied area, the lack of long-term data and the scarcity of information regarding the ecology of the studied species only allow for speculative hypothesis on the matter, with the exact causes that have triggered the population outburst remaining unknown. As a result of the surveys conducted, it is clear that basket stars are perceived negatively by the fisher's communities as their increase in abundance is associated with an economic loss for artisanal fishers and constitutes an obstacle to their job performance. A possible solution for the fishers affected by this problem in the area would be to modify their fishing habits in order to avoid, or at least reduce, the basket star bycatch incidence on their fishing gear. Nevertheless, this might not be a solution for artisanal fishers in the area, as their main targeted species (spiny lobster and scorpion fish) are strongly associated with mid-deep rocky outcrops (Díaz *et al.*, 2001), as it is the case of *A. mediterraneus*, which points towards a problem without a near solution.

### Conclusions

The ecological traits and habitat preference for the Cap de Creus *Astrospartus mediterraneus* aggregations have been stipulated. Basket stars have a habitat preference for sloping rocky substrates with the presence of gorgonians in a depth range between 50 to 80 m depth, preferentially occurring on sloping areas. Cap de Creus' aggregations could not be determined as an outbreak because of the lack of long time-sensitive data. Nevertheless, comparing the central disc size among other Mediterranean regions, they are considered aggregations of young individuals. On the socio-economic impact and concerning fishers' perception on this topic, there is unanimity about the existence of a problem on this issue. They consider that the basket star's increase causes them a

handicap in terms of monetary and time losses. Despite the new ecological insights provided by this study, there is still a massive gap in knowledge regarding the biology of *A. mediterraneus*. To properly assess this issue, additional biological studies are further needed as they will be of paramount importance to improve our knowledge and better understand the outbreak origin of *A. mediterraneus* in the Cap de Creus marine area.

### Acknowledgments

The authors would like to thank the crew of the R/V “Atlantic Explorer”, the artisanal fishermen from Port de la Selva and Cadaqués and the Cap de Creus Natural Park for their aid. Their work was performed under the MitiCap and ResCap projects, which are founded by the Fundació Biodiversidad from the Ministerio para la Transición Ecológica, through the Pleamar Program, co-funded by the European Maritime and Fisheries Fund.

### Bibliography

- BILLETT D. S. M., BETT B. J., RICE A. L., THURSTON M. H., GALÉRON J., SIBUET M., WOLFF G. A. (2001) - Long-term change in the megabenthos of the Porcupine Abyssal Plain (NE Atlantic). In *Progress in Oceanography* (50) 324-348.
- CHESER R. H. (1969) - Destruction of pacific corals by the sea star *Acanthaster planci*. *Science*, 165: 280–283.
- COCITO S., DELBONO I., BARSANTI M., DI NALLO G., LOMBARDI C., PEIRANO A. (2015) - Underwater itineraries at Egadi Islands: Marine biodiversity protection through actions for sustainable tourism. *Energia, Ambiente e Innovazione*, 69–75.
- DÍAZ D., MARÍ M., ABELLÓ P., DEMESTRE M. (2001) - Settlement and juvenile habitat of the European spiny lobster *Palinurus elephas* (Crustacea: Decapoda: Palinuridae) in the western Mediterranean Sea. *Scientia Marina*, 65(4): 347–356.
- DUINEVELD G. C. A., KONITZER A., HEYMAN R. P. (1987) - *Amphiura filiformis* (Ophiuroidea: Echinodermata) in the North Sea. Distribution, present and former abundance and size composition. *Netherlands Journal of Sea Research*, 21(4): 317–329.
- FITORI A., FITURI A. EL BADREDDINE A., AGUILAR R. (2022) - First Record of the Basket Star *Astrospartus Mediterraneus* (Risso, 1826) (Echinodermata: Ophiuroidea) in the Libyan Waters. *International Journal of Agriculture & Environmental Science*, 9(1): 49–50.
- JOSEFSON A. B., JENSEN J. N., ERTEBJERG G. (1993) - The benthos community structure anomaly in the late 1970s and early 1980s-a result of a major food pulse? In *Mar. Biol. EC&* (Vol. 172).
- MALLOL S. (2010) - La col·lecció zoològica Joan Ortensi de Roses: procés de revisió i recuperació. *Annals de l'Institut d'Estudis Empordanesos*, 41: 183–212.
- MONTSENY M., LINARES C., VILADRICH N., OLARIAGA A., CARRERAS M., PALOMERAS N., GRACIAS N., ISTENIČ K., GARCIA R., AMBROSO S., SANTÍN A., GRINYÓ J., GILI J. M., GORI A. (2019) - First attempts towards the restoration of gorgonian populations on the Mediterranean continental shelf. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 29(8): 1278–1284.
- OCAÑA A., PÉREZ-RUZAF A. (2004) - Andalusian coast echinoderms. *Acta Granatense*, 3: 83–136.
- SANTIN A., GRINYÓ J., AMBROSO S., BAENA P., BIEL-CABANELAS M., CORBERA G., SALAZAR J., MONTSENY M., GILI J.-M. (2022) - Fishermen and scientists: synergies for the exploration, conservation and sustainability of the marine environment. In M. V. Martínez de Albéniz (Ed.), *The ocean we want: inclusive and transformative ocean science* (pp. 77–79). Institut de Ciències del Mar, CSIC.
- SANTÍN A., GRINYÓ J., AMBROSO S., URIZ M. J., GORI A., DOMINGUEZ-CARRIÓ C., GILI J. M. (2018) - Sponge assemblages on the deep Mediterranean continental shelf and

- slope (Menorca Channel, Western Mediterranean Sea). *Deep Sea Research Part I: Oceanographic Research Papers*, 131: 75–86.
- TERRIBILE K., EVANS J., KNITTWEIS L., SCHEMBRI P. J. (2016) - Maximizing MEDITS: Using data collected from trawl surveys to characterize the benthic and demersal assemblages of the circalittoral and deeper waters around the Maltese Islands (Central Mediterranean). *Regional Studies in Marine Science*, 3: 163–175.
- WIGHAM B. D., TYLER P. A., BILLET D. S. M. (2003) - Reproductive biology of the abyssal holothurian *Amperima rosea*: An opportunistic response to variable flux of surface derived organic matter? *Journal of the Marine Biological Association of the United Kingdom*, 83(1): 175–188.
- ZIBROWIUS H. (1978) - Nouvelles observations de l'ophiure gorgonocéphale *Astrospartus mediterraneus* sur la cote méditerranéenne de France. Bibliographie annotée et répartition. *Station Marine D'Endourne*, Marseille (4) 157 -169.