

RESEARCH ARTICLE

Habitat loss and small-scale fishery: A controversial issue

Chiara Silvestrini^{1,2}  | Alberto Colletti^{1,2} | Antonio Di Franco^{2,3} | Francesco Colloca⁴ | Giacomo Milisenda³ | Serena Zampardi³ | Maria Cristina Mangano^{2,3} | Giorgio Aglieri³ | Marco Ranù³ | Gianluca Liguori¹ | Roberto Danovaro^{2,5,6} | Federica Foglini^{2,7} | Valentina Grande^{2,7} | Simonetta Frascchetti^{1,2}

¹Department of Biology, University of Naples Federico II, Napoli, Italy

²NBFC, National Biodiversity Future Center, Palermo, Italy

³Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Sicily Marine Centre, Lungomare Cristoforo Colombo (complesso Roosevelt), Palermo, Italy

⁴Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Roma, Italy

⁵Department of Life and Environmental Sciences, Polytechnic University of Marche, Ancona, Italy

⁶Stazione Zoologica Anton Dohrn, Napoli, Italy

⁷National Research Council, Institute of Marine Sciences, Bologna, Italy

Correspondence

Chiara Silvestrini, Department of Biology, University of Naples Federico II, Via Vicinale Cupa Cintia 21, 80126 Napoli, Italy.

Email: chiara.silvestrini@unina.it

Funding information

European Maritime and Fisheries Fund, Grant/Award Number: FEAMP Campania 2014/2020 - DRD n. 35/2019

Abstract

Fishery is one of the most impacting human activities and is responsible for habitat loss in marine systems. While the effects of large-scale fisheries have been largely investigated, impacts of small-scale fisheries (SSF) on seafloor integrity are more often assumed than quantitatively investigated. We carried out a literature review at global scale, resulting in 19 studies with quantitative data on sessile benthic bycatch and only one documenting habitat loss driven by SSF. We also conducted a fine-scale assessment within a Mediterranean partially protected area (PPA). Results showed that 513 m² of the *Posidonia oceanica* meadow are removed annually by local SSF within the PPA, considering bycatch, fishing effort, and shoot density. Knowledge on fishing effort and fine-scale mapping is critical to assess habitat loss, suggesting the need for specific recommendations for eco-sustainable local fisheries.

KEYWORDS

benthos, bycatch, discard, habitat loss, *Posidonia oceanica*, small-scale fisheries

1 | INTRODUCTION

Pristine habitats support biodiversity and provide essential ecosystem services. Human stressors on marine ecosystems, such as pollution (Cabral & Sousa, 2019), urbanization (Airoldi &

Beck, 2007; Ding et al., 2020; Montefalcone et al., 2010), ocean warming (Layton et al., 2020; Micheli et al., 2013), and industrial fisheries are responsible for a large portion of habitat loss and fragmentation. As a consequence of multiple pressures, in the last century, seagrass meadows and mangrove forests have suffered

Chiara Silvestrini and Alberto Colletti contributed equally to this study.

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2024 The Authors. *Marine Ecology* published by Wiley-VCH GmbH.

a global loss (Duarte et al., 2020; Dunic et al., 2021; Goldberg et al., 2020) and a decline of 50% occurred in coral reefs (Eddy et al., 2021).

Fishing activities can cause severe impacts on the structure and functioning of marine ecosystems (Bevilacqua et al., 2018; Halpern et al., 2019; Kaiser et al., 2006; Mazari et al., 2019). Studies on bycatch highlighted that large-scale bottom-contact fisheries (e.g. otter trawls, dredges, and beam trawls) are responsible for habitat destruction and can cause dramatic shifts in benthic assemblages (Amoroso et al., 2018; Mangano et al., 2013, 2014; Pusceddu et al., 2014). Even worse, bottom trawling activities are still conducted in 59% of the EU marine protected areas (MPAs), depleting vulnerable species within their boundaries (Dureuil et al., 2018). Recently, a declaration of support for the prohibition of bottom trawling inside protected areas has been submitted by several marine scientists with the aim to "help restoring European marine biodiversity, replenishing European fisheries, resuscitating exhausted small-scale coastal fisheries and the livelihoods they support, and be easily financed by redirecting EU's harmful fisheries subsidies" (<https://www.enricsala.com/>).

The effects on seabed habitats driven by small-scale fisheries (SSF), representing 90% of world fisheries, contributing about half of global fish catches and operating mostly in coastal areas, are poorly investigated (Calò et al., 2022; Di Lorenzo et al., 2022; FAO, 2015; Grati et al., 2022), with direct and indirect ecological and economic consequences (Hoagland et al., 2013; Ofiara & Seneca, 2006) still largely unknown. Indeed, fixed gears, the most used gear in SSF, have been generally acknowledged as potentially less impacting on marine ecosystems compared to other forms of fishing (e.g. large-scale fisheries, Catanese et al., 2018; Jacquet & Pauly, 2008). SSF is characterized by relatively small vessels (<12m total length, with low-power engine) fishing on the continental shelf (0–200m deep) not using towed gear and exploiting areas located within a few hours from the ports or where the fishers are based (Colloca et al., 2003; Guyader et al., 2013). They are highly multi-specific and multi-métier, using a broad range of gears and techniques selected according to seasonal availability of target species to optimize the catch and maximize profitability (Calò et al., 2022; Grati et al., 2022; Tzanatos et al., 2006). These characteristics increase the heterogeneity of the fisheries, making the assessment, monitoring, and management of the sector challenging. Few attempts have been carried out to increase the selectivity and reduce fish discard by developing experimental bottom nets for SSF (Briggs, 2010; Kalayci & Yeşilçiçek, 2014; Lucchetti et al., 2020; Priester et al., 2021). However, the very limited evidences focusing on bycatch composition of unmarketable invertebrates show that fishing activities can determine significant impacts on the benthic communities (FAO, 2018) directly removing habitat-forming species (Enrichetti et al., 2019; Eryasar et al., 2020; Gil et al., 2018; Gonçalves et al., 2008; Montseny et al., 2021) or losing the nets and fishing gears on the bottom (i.e., ghost net: Bo et al., 2014; Ferrigno et al., 2018; Betti et al., 2020) mainly due to bad weather conditions (Ozyurt et al., 2012).

Understanding the potential impact of SSF on the structure and functioning of coastal ecosystems is crucial for improving the efficacy of biodiversity management and protection. Here, we combined a literature review on the effects of SSF on benthic habitats at the global scale, with in situ quantitative assessments in a Mediterranean partially protected area (PPA) to shed new light on the role of SSF as a driver of habitat loss.

2 | MATERIALS AND METHODS

2.1 | Literature review

We conducted a literature search to collect all scientific papers assessing the effects of SSF on marine habitats. A search string was run on the Web of Science (<https://www.webofscience.com/>) and Scopus (<https://www.scopus.com>) literature databases without applying any temporal- or spatial-scale restriction (1985–2022). The final search was run on 13/04/22.

Search string:

("artisanal fish*" OR "small-scale fish*" OR "Small Scale Fish*" OR "Small-Scale Fish*") AND ("habitat*" OR "discard*" OR "bycatch*" OR "by-catch")

The search resulted in 1042 studies on Web of Science and 960 on Scopus, which were further screened, leading to a total of 19 eligible studies (Table S1; Figure S1 reporting the adapted PRISMA flow diagram; Moher, 2009) reflecting the settled selection criteria: studies that included quantitative data on sessile benthic bycatch taxa (i.e., habitat-forming algae, seagrasses, and invertebrates) or on the interaction between sessile benthic species and fishing gears.

We excluded studies that (i) were not related with SSF; (ii) did not include the bycatch analysis; (iii) did not include sessile taxa in the bycatch analysis; (iv) did not include quantitative data in the bycatch analysis; (v) did not provide species discrimination in the bycatch analysis (Figure S1).

Details of the suitable studies are reported in Table S2, while the excluded studies, with exclusion reasons, in Table S3.

Trammel nets, gill nets, traps (pots, creels, baskets), beach seines, and bottom long-lines were considered during the screening. For each eligible study we reported the following: study area, fishing gears employed, habitat (assumed from the study area and species list if not specified in the text), spatial scale of the survey, response variable (abundance, biomass, and frequency and interactions with gears), habitat characterization, and estimation of habitat loss (when available) (Table 1).

2.2 | Study area and fisher's interviews

The survey was carried out within the Santa Maria di Castellabate MPA (40°16' N, 14°55' E), in the Campania region (Southern Tyrrhenian Sea, Italy). Established in 2009, the MPA extends over a surface area of about 70.95km² from Punta Tresino to Punta

TABLE 1 List of eligible studies that provided quantitative data on bycatch composition of sessile species or their interaction with fishing gears.

| Area | Fishing gear | Habitat | Spatial scale | Habitat loss estimation | References |
|---------------------------------------|---|--------------------------------|---------------|-------------------------|--------------------------|
| Thoothukudi (India) | Trammel nets | Seagrass meadow and coral reef | 10's km | No | Anirudh et al., 2014 |
| Algarve (Portugal) | Trammel nets | Soft bottom | 10's km | No | Borges et al., 2001 |
| Florida Keys (USA) | Long poles with hooks | Coral reef | 10's km | Yes | Butler et al., 2017 |
| Mallorca Island (Spain) | Trammel net | Hard and soft bottom | 10's km | No | Catanese et al., 2018 |
| Lundy Island (UK) | Pots | Hard bottom | km's | No | Coleman et al., 2013 |
| Sagres (Portugal) | Bottom-set gill nets | Deep coral gardens | 10's km | No | Dias et al., 2020 |
| England, Scotland and Wales (UK) | Pots and creels | Hard and soft bottom | 10's km | No | Eno et al., 2001 |
| Maledetti Shoal, Ligurian Sea (Italy) | Trammel nets | Coralligenous | 10's km | No | Enrichetti et al., 2019 |
| Mallorca Island (Spain) | Trammel nets | Seagrassmeadow | 10's km | No | Gil et al., 2018 |
| Izmir Bay (Turkey) | Trammel nets | Soft bottom | 10's km | No | Gökçe & Metin, 2007 |
| Florida Keys (USA) | Traps | Coral reef | km's | No | Lewis et al., 2009 |
| Diani and Mombasa (Kenya) | Gill nets, beach seines and traps | Coral reef | 100's km | No | Mangi & Roberts, 2006 |
| North-West Adriatic Sea (Italy) | Pots, baskets, traps, trammel nets, and gill nets | Hard and soft bottom | 10's km | No | Pranovi et al., 2016 |
| Central and Southern Chile | Gill nets | Hard and soft bottom | 100's km | No | Queirolo et al., 2014 |
| Azores (Portugal) | Bottom longlines | Seamounts | 100's km | No | Sampaio et al., 2012 |
| Baja California (Mexico) | Traps and gill nets | Kelp forests and hard bottom | 10's km | No | Shester& Micheli, 2011 |
| Algarve (Portugal) | Trammel nets | Soft bottom | 10's km | No | Szynaka et al., 2018 |
| Florida Keys (USA) | Traps | Seagrassmeadow | 10's km | No | Uhrin et al., 2005 |
| ThermaikosGulf (Greece) | Trammel nets and gillnets | Soft bottom | 10's km | No | Voultsiadou et al., 2011 |

Ogliastro (Figure 1). The MPA is divided into areas with different protection regimes, where human activities are strictly regulated: the integral reserve (zone A, 1.69 km²), the partial reserve (zone B, 32.26 km²), and the general reserve (zone C, 37 km²). Zone A is a fully protected area (FPA) where extractive activities are banned, while Zones B and C are partially protected areas (PPAs) where some human uses (including SSF) are allowed but more strictly regulated than in unprotected areas. In the MPA, three main benthic habitats have been identified: *Posidonia oceanica* meadows, extending for about 28 km² and occurring both on the hard and soft substrate down to about 35 m depth (Flagella, 2010); coralligenous assemblages, covering about 9.5 km²; and frondose algae, covering about 2.5 km² (<https://amare.interreg-med.eu/>). Overall, 21 small-scale vessels, harbored within the port of San Marco di Castellabate, are authorized to operate within the PPA. Interviews were administered to 14 fishers to characterize the SSF fleet (number, size and engine power of vessels) and to assess the mean days of fishing operations per year. These set of questions were embedded in a larger survey carried out with fishers, in which a wide number of questions concerning their background, the characteristics of fishing operations, and their perceptions about different socio-ecological issue were included. Here, only the elements specifically related to our study aims were reported.

2.3 | Bycatch and quantitative estimates of habitat loss

The bycatch collection was performed between June and November 2021, in the framework of a participatory project engaging fishers, MPA managers, and researchers (<https://pofeamp.politicheagricole.it/en/il-programma/>). In particular, fishers have been involved through all the stages of the entire process in the definition of the

objectives, methods, and data collection. We distributed coastal trammel nets, gill nets, and red mullet trammel nets, respectively, 1500, 480, and 240 m long to six different vessels which operated according to their fishing behavior. The nylon multifilament nets were rigged and sized in length by the fishers to adapt them to the local fishing spots and environmental conditions. The gears provided to fishers and adopted in this study were designed based on the features of the fishing gears regularly used by local fishers (assessed during an initial phase of the project) and differed from the normally used ones only by the mesh size. More specifically, the mesh size used in this study is larger than the average used in the study area, despite falling in the entire range of the mesh size adopted. Based on this, we are confident that the estimates generated in this study are representative of the standard practices carried out in the study area.

Fishers were asked to land all benthic bycatch fraction from each fishing trip, subsequently collected by observers on the dock in the fishing harbor. Relevant data on the fishing trip (e.g., position, soak time, and depth) were also registered. In the laboratory, the benthic bycatch was analyzed for a total of 48 fishing trips (16 with trammel nets, 16 with gill nets, and 16 with red mullet trammel nets). All non-target specimens, including algae, seagrasses, and invertebrates, have been photographed, identified at the lowest possible taxonomic level, measured, and weighted.

The only habitat-forming species (sensu Ingrosso et al., 2018) that was found trapped in the gears during the survey was *P. oceanica* (conservation priority habitat under the Habitats Directive (Dir 92/43/CEE)).

Therefore, we used the bycatch of this species to estimate the loss of habitat in the study area (HL) in relation to the SSF fishing effort by the equation:

$$HL = \frac{s \times fe}{d}$$

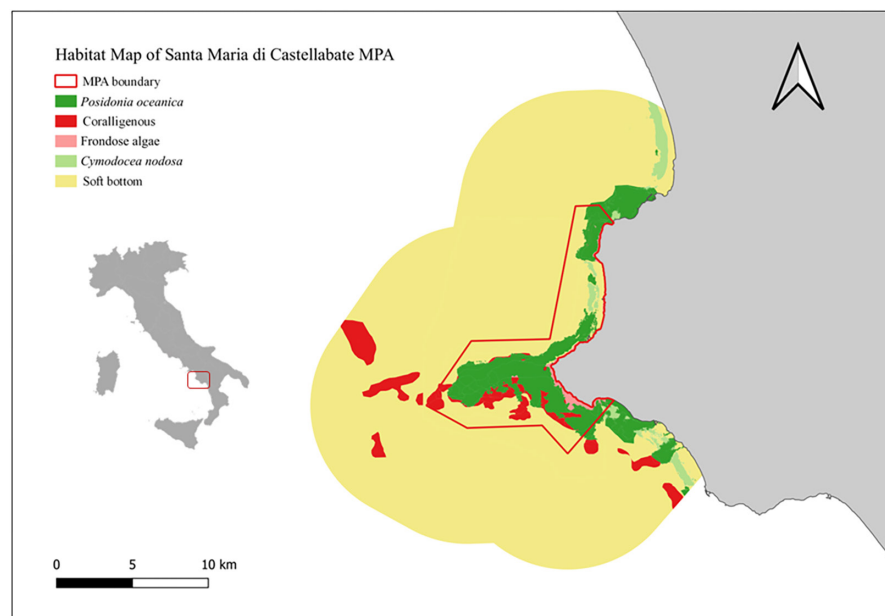


FIGURE 1 Map of the habitat distribution inside the Santa Maria di Castellabate MPA (<https://amare.interreg-med.eu/>) (Print in color).

where s is the mean number of shoots collected in the survey standardized per meter of net; fe (fishing effort) is calculated as the product of the mean net length per fishing operation and the total number of fishing operations per year; d is the mean shoot density within the study area (163.6 ± 6.57 shoots/m²; Flagella, 2010).

3 | RESULTS

3.1 | Literature search on habitat loss

The 19 eligible studies were distributed worldwide, most of them occurring in European seas (Figure 2). Among the fishing gears considered in the screening, the studies mainly focused on trammel nets and traps (nine and seven studies, respectively), followed by gillnets (six studies) (Figure 3a). The main response variables measured were abundance and biomass (12 and seven studies) (Figure 3b). When considering fishing gears and response variables, the overall number of studies exceeds the number of eligible studies (19) because some studies addressed multiple types of gears and more than one response variable. The spatial scale of surveys was mostly of 10's km (14 studies) with few exceptions of studies carried out at km's and at 100s km (two and three studies) (Figure 3c). We found a total of six habitats assessed among the eligible studies, with soft bottom (eight studies), hard bottom (six studies), and coralligenous (five studies, coralligenous and coral reef) being the most represented (Figure 3d). The habitat characterization was provided in six articles, while one study carried out an estimation of habitat loss due to SSF activity.

3.2 | Small-scale fleet and fishing effort

Fishers' interviews revealed that the size of the SSF vessels operating inside the Santa Maria Castellabate MPA ranges between 6.5 and 9 m in length and the engine power between 13 and 70 kW (kilowatt). The main deployed small-scale gears are trammel net, gill nets (fixed nets), and traps, with an average net length per fishing operation of 2000 m. On average, each vessel operates 125 days per year. To estimate the habitat loss, we assume the scenario where all the 21 SSF fishing vessels deploy fixed nets for the average number of yearly working days, resulting in 2625 fishing operations per year.

3.3 | Total bycatch and estimates of habitat loss

All fishing activities were carried out inside the PPA, on sandbanks and *P. oceanica* meadows, within a depth range between 5 and 40 m. The nets were soaked for an average time of 15 h. The total catch consisted of 154 invertebrate specimens, encompassing 25 taxa and 260 shoots of *P. oceanica*, which represented 62.8% of the total catch (expressed as number of shoots). Crustaceans included eight

species/taxa out of 86 individuals, while Echinoderms included seven species/taxa from 35 individuals. Other taxa included Gastropods with five species/taxa out of 19 individuals and four taxa of algae from 14 thalli. The list of benthic bycatch species/taxa is available in the Table S4. The average number of *P. oceanica* shoots collected during the survey was 0.016 (± 0.0039) per meter of net. We estimated that a total of 84,000 shoots (0.016 shoots/m net $\times 2000$ m net $\times 21$ fishers $\times 125$ fishing operations/year) are potentially extirpated every year by the entire small-scale fleet inside the Santa Maria di Castellabate PPA. Based on the shoot density in the study area (163.6 ± 6.57 shoots/m²), we calculated that about 513 m² of *P. oceanica* could be removed each year (HL).

4 | DISCUSSION

Our literature analysis pointed out a general lack of quantitative information about the impact of SSF on benthic habitats. The only study quantifying habitat loss reported that artisanal sponge fishery removed sponge species of commercial interest at a rate of 3.5% per month and non-commercial large sponges at a rate of 4.3% per month (i.e., Butler et al., 2017). SSF are generally considered more sustainable than other forms of fishing (Kelleher, 2005; Lloret et al., 2018; Tsagarakis et al., 2014), but there are evidences that SSF can contribute to the removal of vulnerable species (Di Lorenzo et al., 2022; Dimitriadis et al., 2016; Lloret et al., 2020; Voultsiadou et al., 2011). Our review has revealed that, when considering the contacts with gear as the response variable, most studies have focused only on the interaction between seafloor and traps, whereas just one article (Shester & Micheli, 2011) also included fixed gears (gill net) in its assessment. Shester and Micheli (2011) showed that, in contrast with traps that did not cause any species detachment from the seafloor, gill nets entangled and removed habitat formers (*Eisenia* kelps plants and gorgonian corals). The branched nature of the kelps and corals damaged by gill nets suggests that fixed gears could have similar impacts in other habitats with similar features. Therefore, when assessing ecological impacts of SSF gears, it is important to consider the vulnerability of habitat-forming species, as well as the nature of seafloor interactions with all the SSF gears employed.

Our field data suggest that the SSF can affect benthic habitats, despite the presence of a PPA. In particular, we estimated an annual loss of about 513 m² of the protected *P. oceanica* meadows driven by SSF. Rather than the loss of an entire area, the result should be interpreted as a rarefaction of shoot density. However, it is important to note that habitat fragmentation increases the meadow vulnerability, compromising the resistance of the seagrass to other impacts (Barcelona et al., 2021). Indeed, seagrass meadows tend to be exposed to several threats derived from mixed fishing activities to other multiple stressors, such as deterioration of water quality or coastal development (Herrera et al., 2022). A declining trend resulted from the comparison of the meadow extension recorded in 2003 and 2019 in a sector of our study area, with a net loss of 150,000 m² of *P. oceanica* habitat (<https://www.seaforestlife.eu/it/>).

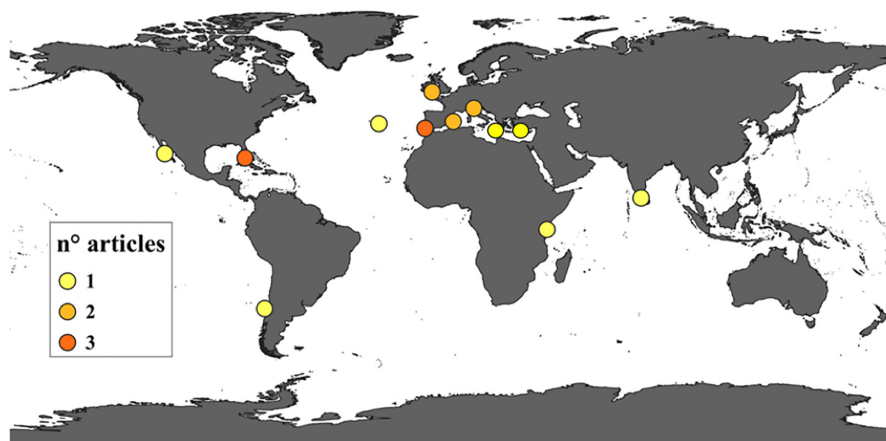


FIGURE 2 Geographical distribution of the collected studies on the assessment of the effects of SSF on marine habitats at the global scale (Print in color).

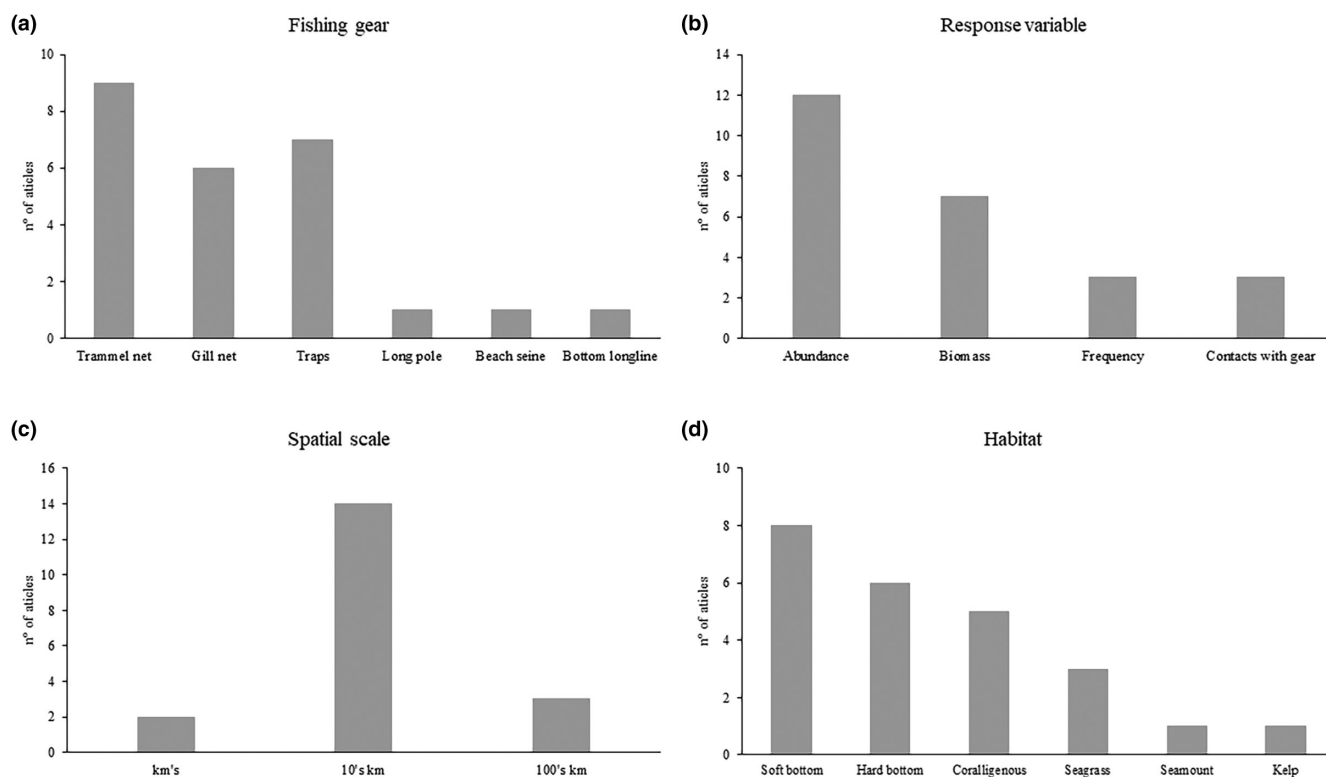


FIGURE 3 Number of articles according to (a) fishing gear employed; (b) response variable measured to assess the fishing impact; (c) spatial scale of the surveys; (d) habitat where fishing operations occurred. Note that in the case of fishing gears and response variables, the overall count of articles exceeds the number of eligible articles (19) because some studies addressed more types of gear and more than a single response variable.

According to our HL estimate, we suggest that, in the 16 years indicated (2003–2019), SSF may have contributed to the overall loss for ca 8000 m² (5% of the total loss). However, the lack of awareness about the role of SSF largely impairs our ability of teasing apart the effects of SSF from other sources of disturbance in order to identify and propose guidelines and best practices for protected and unprotected ecosystems.

Pivotal information for the assessment of the overall decline of the meadow could arise from the analyses of the relation between shoot recruitment and shoot mortality, as carried out by Marbà et al. (2005). This study demonstrates the importance of conducting

direct censuses of seagrass shoots in permanent plots to evaluate the current status of seagrass meadows and detect possible ongoing population declines. The inclusion of direct census of seagrass meadows in monitoring programs can also help provide the early warning signals to improve management decisions in the framework of conservation and restoration actions.

Even though the data collected during the survey represent an important milestone in this framework, bycatch analysis alone cannot be considered exhaustive for a comprehensive assessment of the SSF impacts. Progress in assessing the effects of SSF on habitats can be done facing the following challenges:

1. Improve our ability to gather information about SSF fishing effort. Since tracking systems, such as Vessel Monitoring System (VMS) and the Automated Identification System (AIS), are mandatory only for vessels ≥ 12 and 15 m in length, respectively (EC, 2003; EU Dir 2011/15/EU), the SSF is, as a matter of fact, untracked. Limitations in tracking systems and the lack of logbooks prevent thorough assessments of the impacts of SSF. At present, fisher interviews on gear deployments are the only available source of data. Tasseti et al. (2022) recently deployed a simple and space-saving tracking equipment on board an SSF vessel and coupled this with a serverless and cost-effective architecture to collect spatial and temporal data. The use of such low-cost technologies and machine-learning automated analyses opens the potential for more integrated platforms to support the design and development of new management actions (Kroodsmas et al., 2018). An improved regulation is especially urgent in MPAs where the potential effects of SSF on vulnerable habitats is largely underestimated, as shown in this study. Possibly, extensions and boundaries of the zones with different levels of protection should be revised considering the actual extension of habitats of EU importance.
2. Encourage a more consistent commitment. Despite collaborative conservation initiatives engaging small-scale fishers and researches can be effective tools to co-produce knowledge (Di Franco et al., 2020), the fisher's commitment may not have been always strong, leading to biased SSF impact estimates.
3. Perform fine-scale habitat mapping. In the investigated area, the distribution of *P. oceanica* has been mapped in 2002 (<https://www.emodnet-seabedhabitats.eu/>) and the only available shoot density data is at 30 m depth (Flagella, 2010). Although *P. oceanica* meadow is one of the most important habitats in the Mediterranean Sea, fine-scale data on spatial distribution and shoot densities are rarely available, making the identification of regression patterns challenging (Telesca et al., 2015). Detailed and high-resolution spatial information is a priority for implementing conservation actions and for the sustainable use of marine coastal resources.

5 | CONCLUSIONS

Although SSF represents a significant contributor in securing food and livelihoods for coastal communities (FAO, 2018), the impact of SSF on benthic habitats has received, so far, a limited attention. The results of our study suggest that SSF is a non-negligible source of impact on the *Posidonia* meadow. This habitat is important for the productivity of commercial species also due to its role as nursery. Its good health status translates into an increase in the catch revenue, benefitting the profits of the SSF sector. Our findings document that SSF affects the seafloor integrity but, at the same time, highlight the need to gather high-resolution data about habitat distribution and detailed catch and effort data of SSF. The lack of standardized methodologies and

protocols to monitor the SSF effort hampers a fully quantitative understanding of the status and the impact of fixed gears on the seascape and limit the potential of concrete application of the ecosystem-based fisheries management (EBFM) approaches (Patrick & Link, 2015) required by the European Common Fishery Policy (CFP).

The achievement of the 30% target of the EU's Biodiversity Strategy will not be reached in the absence of a careful monitoring and assessment of SSF under protected and not protected conditions.

AUTHOR CONTRIBUTIONS

Silvestrini C.: Investigation, Data curation, Writing – Original draft, Writing – Review & Editing, and Visualization. Colletti A.: Investigation, Writing – Original draft, and Writing – Review & Editing. Di Franco A.: Writing – Review & Editing, Supervision, and Project administration. Colloca F.: Writing – Review & Editing, Supervision, Project administration, and Funding acquisition. Milisenda G.: Supervision and Project administration. Zampardi S.: Investigation, Data Curation, and Writing – Review & Editing. Mangano M.C.: Methodology and Writing – Review & Editing. Aglieri G.: Investigation and Supervision. Ranù M.: Investigation. Liguori G.: Investigation. Danovaro R.: Writing – Review & Editing and Supervision. Foglini F.: Resources. Grande V.: Resources. Frascchetti S.: Conceptualization, Writing – Original draft, Writing – Review & Editing, Supervision, Project administration, and Funding acquisition.

ACKNOWLEDGMENTS

We acknowledge the European Union's Horizon Europe Research and Innovation Programme ACTNOW (Advancing understanding of cumulative impacts on European marine biodiversity, ecosystem functions and services for human wellbeing), grant agreement N. 101060072, to provide financial support for the publication of this article. We also acknowledge the project "National Biodiversity Future Center - NBFC", project code CN_00000033, Concession Decree No. 1034 of 17 June 2022 adopted by the Italian Ministry of University and Research.

FUNDING INFORMATION

This research was funded by the project ISSPA "Innovazione, Sviluppo e Sostenibilità nel settore della Pesca e dell'Acquacoltura per la Regione Campania", European Maritime and Fisheries Fund, PO FEAMP Campania 2014/2020 – DRD n. 35/2019.

CONFLICT OF INTEREST STATEMENT

There are no relationships/conditions/circumstances that present a potential conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Chiara Silvestrini  <https://orcid.org/0000-0002-6708-9711>

REFERENCES

- Airolidi, L., & Beck, M. (2007). Loss, status and trends for coastal marine habitats of Europe. In R. Gibson, R. Atkinson, & J. Gordon (Eds.), *Oceanography and marine biology, oceanography and marine biology – an annual review* (pp. 345–405). CRC Press. <https://doi.org/10.1201/9781420050943.ch7>
- Amoroso, R. O., Pitcher, C. R., Rijnsdorp, A. D., McConnaughey, R. A., Parma, A. M., Suuronen, P., Eigaard, O. R., Bastardie, F., Hintzen, N. T., Althaus, F., Baird, S. J., Black, J., Buhl-Mortensen, L., Campbell, A. B., Catarino, R., Collie, J., Cowan, J. H., Durholtz, D., Engstrom, N., ... Jennings, S. (2018). Bottom trawl fishing footprints on the world's continental shelves. *Proceedings of the National Academy of Sciences, USA*, 115, E10275–E10282. <https://doi.org/10.1073/pnas.1802379115>
- Anirudh, K., Jakhar, J. K., & Vardia, H. K. (2014). Bycatch analysis of trammel net along Thoothukudi (Tuticorin) coast, India. *The Ecoscan*, 8(3–4), 339–343.
- Barcelona, A., Colomer, J., Soler, M., Gracias, N., & Serra, T. (2021). Meadow fragmentation influences *Posidonia oceanica* density at the edge of nearby gaps. *Estuarine, Coastal and Shelf Science*, 249, 107106. <https://doi.org/10.1016/j.ecss.2020.107106>
- Betti, F., Bavestrello, G., Bo, M., Ravanetti, G., Enrichetti, F., Coppari, M., Capanera, V., Venturini, S., & Cattaneo-Vietti, R. (2020). Evidences of fishing impact on the coastal gorgonian forests inside the Portofino MPA (NW Mediterranean Sea). *Ocean and Coastal Management*, 187, 105105. <https://doi.org/10.1016/j.ocecoaman.2020.105105>
- Bevilacqua, S., Guarnieri, G., Farella, G., Terlizzi, A., & Fraschetti, S. (2018). A regional assessment of cumulative impact mapping on Mediterranean coralligenous outcrops. *Scientific Reports*, 8, 1757. <https://doi.org/10.1038/s41598-018-20297-1>
- Bo, M., Bava, S., Canese, S., Angiolillo, M., Cattaneo-Vietti, R., & Bavestrello, G. (2014). Fishing impact on deep Mediterranean rocky habitats as revealed by ROV investigation. *Biological Conservation*, 171, 167–176. <https://doi.org/10.1016/j.biocon.2014.01.011>
- Borges, E., Bentes, C., Gonçalves, L., & Pais, R. (2001). By-catch and discarding practices in five Algarve (southern Portugal) métiers: By-catch and discarding practices in Portugal. *Journal of Applied Ichthyology*, 17, 104–114. <https://doi.org/10.1111/j.1439-0426.2001.00283.x>
- Briggs, R. P. (2010). A novel escape panel for trawl nets used in the Irish Sea Nephrops fishery. *Fisheries Research*, 105, 118–124. <https://doi.org/10.1016/j.fishres.2010.03.012>
- Butler, M. J., Behringer, D. C., & Valentine, M. M. (2017). Commercial sponge fishery impacts on the population dynamics of sponges in the Florida keys, FL (USA). *Fisheries Research*, 190, 113–121. <https://doi.org/10.1016/j.fishres.2017.02.007>
- Cabral, F., & Sousa, C. L. (2019). Synergistic effects of climate change and marine pollution: An overlooked interaction in coastal and estuarine areas. *International Journal of Environmental Research and Public Health*, 16, 2737. <https://doi.org/10.3390/ijerph16152737>
- Calò, A., Di Franco, A., Quattrocchi, F., Dimitriadis, C., Ventura, P., Milazzo, M., & Guidetti, P. (2022). Multi-specific small-scale fisheries rely on few, locally essential, species: Evidence from a multi-area study in the Mediterranean. *Fish and Fisheries*, 12689, 1299–1312. <https://doi.org/10.1111/faf.12689>
- Catanese, G., Hinz, H., Gil, M., Palmer, M., Breen, M., Mira, A., Pastor, E., Grau, A., Campos-Candela, A., Koleva, E., Grau, A. M., & Morales-Nin, B. (2018). Comparing the catch composition, profitability and discard survival from different trammel net designs targeting common spiny lobster (*Palinurus elephas*) in a Mediterranean fishery. *PeerJ*, 6, e4707. <https://doi.org/10.7717/peerj.4707>
- Coleman, R. A., Hoskin, M. G., von Carlshausen, E., & Davis, C. M. (2013). Using a no-take zone to assess the impacts of fishing: Sessile epifauna appear insensitive to environmental disturbances from commercial potting. *Journal of Experimental Marine Biology and Ecology*, 440, 100–107. <https://doi.org/10.1016/j.jembe.2012.12.005>
- Colloca, F., Crespi, V., Cerasi, S., & Coppola, S. R. (2003). *Evolution of the artisanal fishery in Cilento, Italy – Case study*. Food and Agriculture Organization of the United Nations.
- Di Franco, A., Hogg, K. E., Calò, A., Bennett, N. J., Sévin-Allouet, M.-A., Esparza Alaminos, O., Lang, M., Koutsoubas, D., Prvan, M., Santarossa, L., Niccolini, F., Milazzo, M., & Guidetti, P. (2020). Improving marine protected area governance through collaboration and co-production. *Journal of Environmental Management*, 269, 110757. <https://doi.org/10.1016/j.jenvman.2020.110757>
- Di Lorenzo, M., Calò, A., Di Franco, A., Milisenda, G., Aglieri, G., Cattano, C., Milazzo, M., & Guidetti, P. (2022). Small-scale fisheries catch more threatened elasmobranchs inside partially protected areas than in unprotected areas. *Nature Communications*, 13, 4381. <https://doi.org/10.1038/s41467-022-32035-3>
- Dias, V., Oliveira, F., Boavida, J., Serrão, E. A., Gonçalves, J. M. S., & Coelho, M. A. G. (2020). High coral bycatch in bottom-set gillnet coastal fisheries reveals rich coral habitats in southern Portugal. *Frontiers in Marine Science*, 7, 603438. <https://doi.org/10.3389/fmars.2020.603438>
- Dimitriadis, C., Borthagaray, A. I., Vilela, R., Casadevall, M., & Carranza, A. (2016). A network approach to by-catch in a multi-species Mediterranean small-scale fishery. *Fisheries Research*, 173, 273–281. <https://doi.org/10.1016/j.fishres.2015.07.036>
- Ding, X., Shan, X., Chen, Y., Li, M., Li, J., & Jin, X. (2020). Variations in fish habitat fragmentation caused by marine reclamation activities in the Bohai coastal region. *China. Ocean & Coastal Management*, 184, 105038. <https://doi.org/10.1016/j.ocecoaman.2019.105038>
- Duarte, C. M., Agustí, S., Barbier, E., Britten, G. L., Castilla, J. C., Gattuso, J.-P., Fulweiler, R. W., Hughes, T. P., Knowlton, N., Lovelock, C. E., Lotze, H. K., Predragovic, M., Poloczanska, E., Roberts, C., & Worm, B. (2020). Rebuilding marine life. *Nature*, 580, 39–51. <https://doi.org/10.1038/s41586-020-2146-7>
- Dunic, J. C., Brown, C. J., Connolly, R. M., Turschwell, M. P., & Côté, I. M. (2021). Long-term declines and recovery of meadow area across the world's seagrass bioregions. *Global Change Biology*, 27, 4096–4109. <https://doi.org/10.1111/gcb.15684>
- Dureuil, M., Boerder, K., Burnett, K. A., Froese, R., & Worm, B. (2018). Elevated trawling inside protected areas undermines conservation outcomes in a global fishing hot spot. *Science*, 362, 1403–1407. <https://doi.org/10.1126/science.aau0561>
- EC. (2003). Commission regulation (EC) No 2244/2003 of 18 December 2003 laying down detailed provisions regarding satellite-based vessel monitoring systems. *Commission Regulation*, 1999, 17–27.
- Eddy, T. D., Lam, V. W. Y., Reygondeau, G., Cisneros-Montemayor, A. M., Greer, K., Palomares, M. L. D., Bruno, J. F., Ota, Y., & Cheung, W. W. L. (2021). Global decline in capacity of coral reefs to provide ecosystem services. *One Earth*, 4, 1278–1285. <https://doi.org/10.1016/j.oneear.2021.08.016>
- Eno, N. C., MacDonald, D. S., Kinnear, J. A. M., Amos, S. C., Chapman, C. J., Clark, R. A., Bunker, F., St, P. D., & Munro, C. (2001). Effects of crustacean traps on benthic fauna. *ICES Journal of Marine Science*, 58, 11–20.
- Enrichetti, F., Bava, S., Bavestrello, G., Betti, F., Lanteri, L., & Bo, M. (2019). Artisanal fishing impact on deep coralligenous animal forests: A Mediterranean case study of marine vulnerability. *Ocean and Coastal Management*, 177, 112–126. <https://doi.org/10.1016/j.ocecoaman.2019.04.021>
- Eryasar, A. R., Ceylan, Y., Özbilgin, H., & Bozaoğlu, A. S. (2020). Are cloth tarpaulin mounted nets effective for discard reduction in trammel nets? *Turkish Journal of Fisheries and Aquatic Sciences*, 21, 63–71. https://doi.org/10.4194/1303-2712-v21_2_02
- FAO. (2015). *Voluntary guidelines for securing sustainable small-scale fisheries in the context of food security and poverty eradication*. FAO.

- FAO. (2018). The State of World Fisheries and Aquaculture 2018. In *Meeting the Sustainable Development Goals*. FAO.
- Ferrigno, F., Appolloni, L., Russo, G. F., & Sandulli, R. (2018). Impact of fishing activities on different coralligenous assemblages of gulf of Naples (Italy). *Journal of the Marine Biological Association of the United Kingdom*, 98, 41–50. <https://doi.org/10.1017/S0025315417001096>
- Flagella, S. (2010). *Interpretazione dei pattern di crescita della fanerogama marina Posidonia oceanica (L.) Delile*. PhD thesis. Università degli Studi di Napoli Federico II.
- Gil, M. D. M., Catanese, G., Palmer, M., Hinz, H., Pastor, E., Mira, A., Grau, A., Koleva, E., Maria Grau, A., & Morales-Nin, B. (2018). Commercial catches and discards of a Mediterranean small-scale cuttlefish fishery: Implications of the new EU discard policy. *Scientia Marina*, 82, 155. <https://doi.org/10.3989/scimar.04735.03B>
- Gökçe, G., & Metin, C. (2007). Landed and discarded catches from commercial prawn trammel net fishery. *Journal of Applied Ichthyology*, 23, 543–546. <https://doi.org/10.1111/j.1439-0426.2007.00832.x>
- Goldberg, L., Lagomasino, D., Thomas, N., & Fatoyinbo, T. (2020). Global declines in human-driven mangrove loss. *Global Change Biology*, 26, 5844–5855. <https://doi.org/10.1111/gcb.15275>
- Gonçalves, J. M. S., Bentes, L., Coelho, R., Monteiro, P., Ribeiro, J., Correia, C., Lino, P. G., & Erzini, K. (2008). Non-commercial invertebrate discards in an experimental trammel net fishery. *Fisheries Management*, 15, 199–210. <https://doi.org/10.1111/j.1365-2400.2008.00607.x>
- Grati, F., Azzurro, E., Scanu, M., Tasseti, A. N., Bolognini, L., Guicciardi, S., Vitale, S., Scannella, D., Carbonara, P., Dragičević, B., Ikica, Z., Palluqi, A., Marčeta, B., Ghamati, H., Turki, A., Cherif, M., Bdioui, M., Jarbouli, O., Benhadjhamida, N., ... Arneri, E. (2022). Mapping small-scale fisheries through a coordinated participatory strategy. *Fish and Fisheries*, 23, 773–785. <https://doi.org/10.1111/faf.12644>
- Guyader, O., Berthou, P., Koutsikopoulos, C., Alban, F., Demanèche, S., Gaspar, M. B., Eschbaum, R., Fahy, E., Tully, O., Reynal, L., Curttil, O., Frangoudes, K., & Maynou, F. (2013). Small scale fisheries in Europe: A comparative analysis based on a selection of case studies. *Fisheries Research*, 140, 1–13. <https://doi.org/10.1016/j.fishres.2012.11.008>
- Halpern, B. S., Frazier, M., Afflerbach, J., Lowndes, J. S., Micheli, F., O'Hara, C., Scarborough, C., & Selkoe, K. A. (2019). Recent pace of change in human impact on the world's ocean. *Scientific Reports*, 9, 11609. <https://doi.org/10.1038/s41598-019-47201-9>
- Herrera, M., Tubío, A., Pita, P., Vázquez, E., Olabarria, C., Duarte, C. M., & Villasante, S. (2022). Trade-offs and synergies between seagrass ecosystems and fishing activities: A global literature review. *Frontiers in Marine Science*, 9, 781713. <https://doi.org/10.3389/fmars.2022.781713>
- Hoagland, P., Kite-Powell, H. L., Jin, D., & Solow, A. R. (2013). Supply-side approaches to the economic valuation of coastal and marine habitat in the Red Sea. *Journal of King Saud University, Science*, 25, 217–228. doi:10.1016/j.jksus.2013.02.006
- Ingrassio, G., Abbiati, M., Badalamenti, F., Bavestrello, G., Belmonte, G., Cannas, R., Benedetti-Cecchi, L., Bertolino, M., Bevilacqua, S., Bianchi, C. N., Bo, M., Boscari, E., Cardone, F., Cattaneo-Vietti, R., Cau, A., Cerrano, C., Chemello, R., Chimienti, G., Congiu, L., ... Boero, F. (2018). Mediterranean bioconstructions along the Italian coast. In *Advances in marine biology* (pp. 61–136). Elsevier. <https://doi.org/10.1016/bs.amb.2018.05.001>
- Jacquet, J., & Pauly, D. (2008). Funding priorities: Big barriers to small-scale fisheries: Funding for fisheries. *Conservation Biology*, 22, 832–835. <https://doi.org/10.1111/j.1523-1739.2008.00978.x>
- Kaiser, M., Clarke, K., Hinz, H., Austen, M., Somerfield, P., & Karakassis, I. (2006). Global analysis of response and recovery of benthic biota to fishing. *Marine Ecology Progress Series*, 311, 1–14. <https://doi.org/10.3354/meps311001>
- Kalayci, F., & Yeşilççek, T. (2014). Influence of season, depth and mesh size on the trammel nets catch composition and discard in the southern Black Sea, Turkey. *Marine Biology Research*, 10, 824–832. <https://doi.org/10.1080/17451000.2013.853126>
- Kelleher, K. (2005). *Discards in the world's marine fisheries: An update*. FAO fisheries technical paper.
- Kroodsma, D. A., Mayorga, J., Hochberg, T., Miller, N. A., Boerder, K., Ferretti, F., Wilson, A., Bergman, B., White, T. D., Block, B. A., Woods, P., Sullivan, B., Costello, C., & Worm, B. (2018). Tracking the global footprint of fisheries. *Science*, 359, 904–908. <https://doi.org/10.1126/science.aao5646>
- Layton, C., Cameron, M., Tatsumi, M., Shelamoff, V., Wright, J., & Johnson, C. (2020). Habitat fragmentation causes collapse of kelp recruitment. *Marine Ecology Progress Series*, 648, 111–123. <https://doi.org/10.3354/meps13422>
- Lewis, C. F., Slade, S. L., Maxwell, K. E., & Matthews, T. R. (2009). Lobster trap impact on coral reefs: Effects of wind-driven trap movement. *New Zealand Journal of Marine and Freshwater Research*, 43, 271–282. <https://doi.org/10.1080/00288330909510000>
- Lloret, J., Biton-Porsmoguer, S., Carreño, A., Di Franco, A., Sahyoun, R., Melià, P., Claudet, J., Sève, C., Ligas, A., Belharet, M., Calò, A., Carbonara, P., Coll, M., Corrales, X., Lembo, G., Sartor, P., Bitetto, I., Vilas, D., Piroddi, C., ... Font, T. (2020). Recreational and small-scale fisheries may pose a threat to vulnerable species in coastal and off-shore waters of the western Mediterranean. *ICES Journal of Marine Science*, 77, 2255–2264. <https://doi.org/10.1093/icesjms/fsz071>
- Lloret, J., Cowx, I. G., Cabral, H., Castro, M., Font, T., Gonçalves, J. M. S., Gordoa, A., Hoefnagel, E., Matić-Skoko, S., Mikkelsen, E., Morales-Nin, B., Moutopoulos, D. K., Muñoz, M., dos Santos, M. N., Pintassilgo, P., Pita, C., Stergiou, K. I., Ünal, V., Veiga, P., & Erzini, K. (2018). Small-scale coastal fisheries in European seas are not what they were: Ecological, social and economic changes. *Marine Policy*, 98, 176–186. <https://doi.org/10.1016/j.marpol.2016.11.007>
- Lucchetti, A., Virgili, M., Petetta, A., & Sartor, P. (2020). An overview of gill net and trammel net size selectivity in the Mediterranean Sea. *Fisheries Research*, 230, 105677. <https://doi.org/10.1016/j.fishres.2020.105677>
- Mangano, M., Kaiser, M., Porporato, E., & Spanò, N. (2013). Evidence of trawl disturbance on mega-epibenthic communities in the southern Tyrrhenian Sea. *Marine Ecology Progress Series*, 475, 101–117. <https://doi.org/10.3354/meps10115>
- Mangano, M. C., Kaiser, M. J., Porporato, E. M. D., Lambert, G. I., Rinelli, P., & Spanò, N. (2014). Infaunal community responses to a gradient of trawling disturbance and a long-term fishery exclusion zone in the southern Tyrrhenian Sea. *Continental Shelf Research*, 76, 25–35. <https://doi.org/10.1016/j.csr.2013.12.014>
- Mangi, S. C., & Roberts, C. M. (2006). Quantifying the environmental impacts of artisanal fishing gear on Kenya's coral reef ecosystems. *Marine Pollution Bulletin*, 52, 1646–1660. <https://doi.org/10.1016/j.marpolbul.2006.06.006>
- Marbà, N., Duarte, C. M., Díaz-Almela, E., Terrados, J., Álvarez, E., Martínez, R., Santiago, R., Gacia, E., & Grau, A. M. (2005). Direct evidence of imbalanced seagrass (*Posidonia oceanica*) shoot population dynamics in the Spanish Mediterranean. *Estuaries*, 28, 53–62. <https://doi.org/10.1007/BF02732753>
- Mazaris, A. D., Kallimanis, A., Gissi, E., Pipitone, C., Danovaro, R., Claudet, J., Badalamenti, F., Stelzenmüller, V., Thiault, L., Benedetti-Cecchi, L., Goriup, P., Katsanevakis, S., & Fraschetti, S. (2019). Threats to marine biodiversity in European protected areas. *Science of the Total Environment*, 677, 418–426.
- Micheli, F., Halpern, B. S., Walbridge, S., Ciriaco, S., Ferretti, F., Fraschetti, S., Lewison, R., Nykjaer, L., & Rosenberg, A. A. (2013). Cumulative human impacts on Mediterranean and Black Sea marine ecosystems: Assessing current pressures and opportunities. *PLoS One*, 8, e79889. <https://doi.org/10.1371/journal.pone.0079889>

- Moher, D. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA Statement. *Annals of Internal Medicine*, 151, 264. <https://doi.org/10.7326/0003-4819-151-4-200908180-00135>
- Montefalcone, M., Parravicini, V., Vacchi, M., Albertelli, G., Ferrari, M., Morri, C., & Bianchi, C. N. (2010). Human influence on seagrass habitat fragmentation in NW Mediterranean Sea. *Estuarine, Coastal and Shelf Science*, 86, 292–298. <https://doi.org/10.1016/j.ecss.2009.11.018>
- Montseny, M., Linares, C., Viladrich, N., Biel, M., Gracias, N., Baena, P., Quintanilla, E., Ambroso, S., Grinyó, J., Santín, A., Salazar, J., Carreras, M., Palomeras, N., Magí, L., Vallicrosa, G., Gili, J.-M., & Gori, A. (2021). Involving fishers in scaling up the restoration of cold-water coral gardens on the Mediterranean continental shelf. *Biological Conservation*, 262, 109301. <https://doi.org/10.1016/j.biocon.2021.109301>
- Ofiara, D. D., & Seneca, J. J. (2006). Biological effects and subsequent economic effects and losses from marine pollution and degradations in marine environments: Implications from the literature. *Marine Pollution Bulletin*, 52, 844–864. <https://doi.org/10.1016/j.marpolbul.2006.02.022>
- Ozyurt, C. E., Mavruk, S., & Kiyaga, V. B. (2012). The rate and causes of the loss of gill and trammel nets in Iskenderun Bay (north-eastern Mediterranean): Lost nets in Iskenderun Bay. *Journal of Applied Ichthyology*, 28, 612–616. <https://doi.org/10.1111/j.1439-0426.2012.02007.x>
- Patrick, W. S., & Link, J. S. (2015). Myths that continue to impede progress in ecosystem-based fisheries management. *Fisheries*, 40, 155–160. <https://doi.org/10.1080/03632415.2015.1024308>
- Pranovi, F., Colla, S., Valeri, P., & Anelli Monti, M. (2016). Present and future status of artisanal fisheries in the Adriatic Sea (western Mediterranean Sea). *Ocean & Coastal Management*, 122, 49–56. <https://doi.org/10.1016/j.ocecoaman.2016.01.004>
- Priester, C. R., Martínez-Ramírez, L., Erzini, K., & Abecasis, D. (2021). The impact of trammel nets as an MPA soft bottom monitoring method. *Ecological Indicators*, 120, 106877. <https://doi.org/10.1016/j.ecoli.2020.106877>
- Pusceddu, A., Bianchelli, S., Martín, J., Puig, P., Palanques, A., Masqué, P., & Danovaro, R. (2014). Chronic and intensive bottom trawling impairs deep-sea biodiversity and ecosystem functioning. *Proceedings of the National Academy of Sciences USA*, 111, 8861–8866. <https://doi.org/10.1073/pnas.1405454111>
- Queirolo, D., Merino, J., Ahumada, M., Montenegro, I., Gaete, E., & Escobar, R. (2014). Species composition in the artisanal gillnet fishery of Chilean hake *Merluccius gayigayi* in central Chile. *Revista de Biología Marina y Oceanografía*, 49, 61–69. <https://doi.org/10.4067/S0718-19572014000100007>
- Sampaio, Í., Braga-Henriques, A., Pham, C., Ocaña, O., de Matos, V., Morato, T., & Porteiro, F. M. (2012). Cold-water corals landed by bottom longline fisheries in the Azores (north-eastern Atlantic). *Journal of the Marine Biological Association of the United Kingdom*, 92, 1547–1555. <https://doi.org/10.1017/S0025315412000045>
- Shester, G. G., & Micheli, F. (2011). Conservation challenges for small-scale fisheries: Bycatch and habitat impacts of traps and gillnets. *Biological Conservation*, 144, 1673–1681. <https://doi.org/10.1016/j.biocon.2011.02.023>
- Szynaka, M. J., Bentes, L., Monteiro, P., Rangel, M., & Erzini, K. (2018). Reduction of by-catch and discards in the Algarve small-scale coastal fishery using a monofilament trammel net rigged with a guarding net. *Scientia Marina*, 82, 121. <https://doi.org/10.3989/scimar.04734.16B>
- Tasseti, A. N., Galdelli, A., Pulcinella, J., Mancini, A., & Bolognini, L. (2022). Addressing gaps in small-scale fisheries: A low-cost tracking system. *Sensors*, 22, 839. <https://doi.org/10.3390/s22030839>
- Telesca, L., Belluscio, A., Criscoli, A., Ardizzone, G., Apostolaki, E. T., Frascchetti, S., Gristina, M., Knittweis, L., Martin, C. S., Pergent, G., Alagna, A., Badalamenti, F., Garofalo, G., Gerakaris, V., Louise Pace, M., Pergent-Martini, C., & Salomidi, M. (2015). Seagrass meadows (*Posidonia oceanica*) distribution and trajectories of change. *Scientific Reports*, 5, 12505. <https://doi.org/10.1038/srep12505>
- Tsarakis, K., Palialexis, A., & Vassilopoulou, V. (2014). Mediterranean fishery discards: Review of the existing knowledge. *ICES Journal of Marine Science*, 71, 1219–1234. <https://doi.org/10.1093/icesjms/fst074>
- Tzanatos, E., Somarakis, S., Tserpes, G., & Koutsikopoulos, C. (2006). Identifying and classifying small-scale fisheries métiers in the Mediterranean: A case study in the Patraikos gulf, Greece. *Fisheries Research*, 81, 158–168. <https://doi.org/10.1016/j.fishres.2006.07.007>
- Uhrin, A. V., Fonseca, M. S., & Di Domenico, G. P. (2005). Effect of Caribbean spiny lobster traps on seagrass beds of the Florida keys National Marine Sanctuary: Damage assessment and evaluation of recovery. *American Fisheries Society Symposium*, 41, 579–588. <https://doi.org/10.47886/9781888569605.ch79>
- Voultsiadou, E., Fryganiotis, C., Porra, M., Damianidis, P., & Chintiroglou, C. C. (2011). Diversity of invertebrate discards in small and medium scale Aegean Sea fisheries. *The Open Marine Biology Journal*, 5, 73–81. <https://doi.org/10.2174/1874450801105010073>

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Silvestrini, C., Colletti, A., Di Franco, A., Colloca, F., Milisenda, G., Zampardi, S., Mangano, M. C., Aglieri, G., Ranù, M., Liguori, G., Danovaro, R., Foglini, F., Grande, V., & Frascchetti, S. (2024). Habitat loss and small-scale fishery: A controversial issue. *Marine Ecology*, 00, e12795. <https://doi.org/10.1111/maec.12795>