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High bycatch rate of the coral *Cladocora caespitosa* offsets the low discards ratio in Thermaikos Gulf gillnet fishery

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Abstract

While hanging nets may have fewer overall environmental impacts than towed gears, they still catch unwanted species and sizes, which are then discarded. Gillnets are one of the most common types of nets used in Mediterranean small-scale fisheries, with commercial catches and discards containing a diverse range of fish and invertebrate species. In this study, the catch profile of gillnets in the Thermaikos Gulf (NE Mediterranean) was analyzed with a focus on the discarding of species with unfavorable conservation status, such as the Mediterranean-endemic scleractinian coral *Cladocora caespitosa*, which is listed as endangered due to declining population sizes. Our survey was conducted over two seasons (May to October in 2020 and 2021) and included 69 fishing trials under realistic fishing conditions. In general, gillnets exhibited a relatively low discards ratio (17.2%; 7.1% when only fish were considered) and a low prevalence and capture intensity of endangered or threatened species; during the entire survey, only one chondrichthyan was captured (1 specimen of *Raja radula*), while only two out of 54 fish species were of vulnerable IUCN status. These advantages were offset in part by the high catchability of *C. caespitosa* colonies, which occurred in 61% of hauls and accounted for 53% of total invertebrate biomass and 30% of total discarded biomass. The likelihood of hauling living colonies of *C. caespitosa* was higher when fishing over known coral beds (81% vs. 43%), and the overall probability of hauling *C. caespitosa* in any state was 18% higher over coral beds, suggesting that gillnets frequently detach colonies from the seafloor, which are then dispersed over a larger area as fragments with probably low survival potential. Our findings highlight the importance of identifying *C. caespitosa* beds so that fishermen avoid setting their nets in these areas, provided that they are well-informed and educated about the ecological significance of this endemic, threatened, and ecologically important species.

Keywords: Mediterranean; small-scale fisheries; discards; hanging-nets; vulnerable species; stony coral; experimental fishing.

Introduction

It is well recognized that fishing operations harm biogenic structures, such as seagrass, sponges, and corals, either directly via mechanical damage (such as the partial or total detachment of sessile organisms), or indirectly through increased sedimentation and abandoned fishing gear (Ingrosso *et al*., 2018). Corals in particular have come to the attention of policymakers because of their sensitivity to human impacts, long lifespan, and ecological importance (Shester & Michelli, 2011). Small-scale fisheries, which account for 40% of total global fisheries catch, use gears such as traps and bottom-set gillnets, which are thought to interact with marine ecosystems in a more benign manner than towed gears. The latter have a significant negative impact on seafloor habitats by reducing their complexity, diversity, and productivity (Shester & Michelli, 2011). Any direct benthic impacts from gillnet fishing operations are more likely to occur during gear retrieval, when nets and leadlines are more prone to entanglement with bottom structures (Suuronen *et al*., 2012). Nevertheless, because of the cumulative nature of these effects, environmental concerns may arise in regions or nations with intense gear operations and large small-scale fisheries (SSF) fleets.

Greece has Europe's biggest SSF fleet, with vessels operating along an extended coastline and targeting a wide range of fish and invertebrate species using a variety of fishing gear. Although hanging nets are the most often used fishing gear in the Greek SSF, there are few studies evaluating their environmental effect, with the majority of research focusing on the description of their catch profile and the assessment of their discards' ratio (e.g., Tzanatos *et al*., 2007). Villasante *et al*. (2019) reported for the gillnet fishery of Thermaikos gulf (N. Aegean Sea), one of the most important fishing grounds for the Greek SSF, a particularly low discards ratio attributable to short soak-time employed by fishermen to avoid competition with dolphins that heavily depredate their gear (e.g., Garagouni *et al*., 2022). Even though shortened soak time is an effective mitigation approach for lowering the quantity of discarded biomass (Uhlmann & Broadhurst, 2015), it is not expected to lessen the impact of fishing gear on the benthic environment, particularly during the retrieval process. Reef-forming species and other sessile epibenthic organisms commonly get entangled in gillnets and are damaged when the nets are hauled. For instance, Ganias *et al*. (2021) found a significant bycatch rate for the coral *Cladocora caespitosa* (Linnaeus, 1767) in trammel-nets operating in the eastern Thermaikos Gulf, whereas the species was missing from netting-trap operations. For the whole Thermaikos gulf, Voultsiadou *et al*. (2011) reported a 30% predominance of *C. caespitosa* in hanging-net operations (gillnets and trammel nets), whereas the species was not present in bottom-trawl hauls. These results indicate that the species is especially susceptible to hanging net operations, due to its shallower bathymetric distribution, as indicated by the difference between trawls and bottom-set nets, and to its capture mechanism with bottom-set nets, as indicated by the difference between those and netting traps.

Cladocora caespitosa is an indigenous scleractinian coral of the Mediterranean. It is widely distributed over the whole basin, spreading throughout the Iberian-Moroccan Gulf (Kružić & Požar-Domac, 2003) and entering the adjacent eastern Atlantic coasts of Morocco and Portugal (Otero *et al*., 2017). However, its presence in the latter area is only sporadic, as prevailing environmental conditions might be preventing further expansion (Chefaoui *et al*., 2017) and accordingly, it is considered as Mediterranean-endemic. The species thrives in shallow depths, often between 5 and 15 meters, in both sheltered and exposed biotopes, though it may be found at much greater depths and in dim light conditions (Kersting *et al*., 2013, 2022; Jiménez *et al*., 2016). *Cladocora caespitosa* has been included in the IUCN red list since 2008, and assigned as endangered since 2015 (Otero *et al*., 2017) owing to increasing evidence of population declines in the Mediterranean. Ocean warming and marine heatwaves are among the biggest threats for the species (Garrabou *et al*., 2009, 2022; Jiménez *et al*., 2016). Together with the expansion of invasive algal species, and the overall deterioration of coastal ecosystems due to eutrophication and fishing, they are the primary concerns (Kersting *et al*., 2013; Otero *et al*., 2017). However, despite its ecological significance, the status of its populations and their resilience towards human pressures have not been adequately examined (Pitacco *et al*., 2021). Focusing on the North Aegean Sea, *C. caespitosa* is among the most widespread coral species (Vafidis *et al*., 1997; Koukouras *et al*., 1998; Chefaoui *et al*., 2017), including the Thermaikos Gulf, where it is listed among SSF discarded species by Voultsiadou *et al*. (2011) and Ganias *et al*. (2021). However, neither of these two studies give any information about the size, the condition, and the precise frequency of the coral's colonies in the captures, to comprehend the magnitude of the effect of fishing activities on its populations.

The objective of this study was to examine the capture profile of gillnets in the Thermaikos Gulf, with emphasis on the discarding of species with unfavorable conservation status, such as *C. caespitosa*. Tzanatos *et al*. (2020) highlighted the environmental advantages of gillnets targeting striped red mullet (*Mullus surmuletus*) throughout the summer – i.e., the métier surveyed in this research – since the gear operates beyond the population spawning peak and does not capture juveniles (see also Mouchlianitis *et al*., 2022). However, to ensure the ecological sustainability of a gear, its impacts on the benthic ecosystem must be documented as negligible, as well. Therefore, this work aims to assess the impacts of bottom set gillnets on *C. caespitosa* by estimating the frequency of occurrence of the species in comparison to other taxa, the existence of damaged *C. caespitosa* colonies, and their association with fishing and discarding practices within the local small-scale fishery. This work provides the first comprehensive evaluation of the catchability of *C. caespitosa* using static nets, revealing the significant information gap regarding the potential effects of artisanal and small-scale fisheries on endangered species.

Materials and Methods

The study took place in the Thermaikos Gulf (North Aegean Sea, Greece), in a shallow (5-20 m) soft substratum fishery ground extending between Nea Michaniona and Aggelohori (Fig. 1). The sea bottom consists of mixed soft substrata (muddy sediments with detritic and shell fragments) and scattered *Posidonia oceanica* meadow patches, sponges (e.g., *Aplysina aerophoba*, *Chondrosia reniformis*, *Chondrilla nucula*), the corals *Balanophyllia europaea* and *Cladocora caespitosa*, and shells of the Mediterranean fan mussel *Pinna nobilis* (data obtained from four qualitative visual censuses by means of scuba diving along the deployed gillnets). *Cladocora caespitosa* colonies occur on both vegetated (algal-covered sedimentary bottom) and unvegetated seabed (Fig. 2). Between 7 and 10 small coastal vessels (<12 m long) operate from the port of Nea Michaniona on a regular basis throughout the year. The predominant fishing gears used are gillnets and trammel nets, with some fishers using only one of the two and others using both, depending on the season. Gillnets target mainly the striped red mullet (*Mullus surmuletus*) and surmullet (*M. barbatus*), while trammel nets target flatfish and scorpaenids, prawns, or cuttlefish.

Our systematic survey took place by means of experimental fishing trials over two seasons, from May to October in 2020 and 2021, using a chartered 8 m coastal fishing vessel (2.3 GT, 43 hp) and nylon gillnets with a stretched mesh size of 36 mm, which is the most common fishing gear deployed in the study area. Three net panels (100 m x 1.8 m each, attached to a head rope equipped with floaters and a ground rope with a lead core) were connected in line to form a 300 m long fleet, at either end of which a 50 m rope leading to a surface marker was attached. A total of 69 fishing trials were carried out during the 2y survey: 25 in 2020 and 44 in 2021. During each

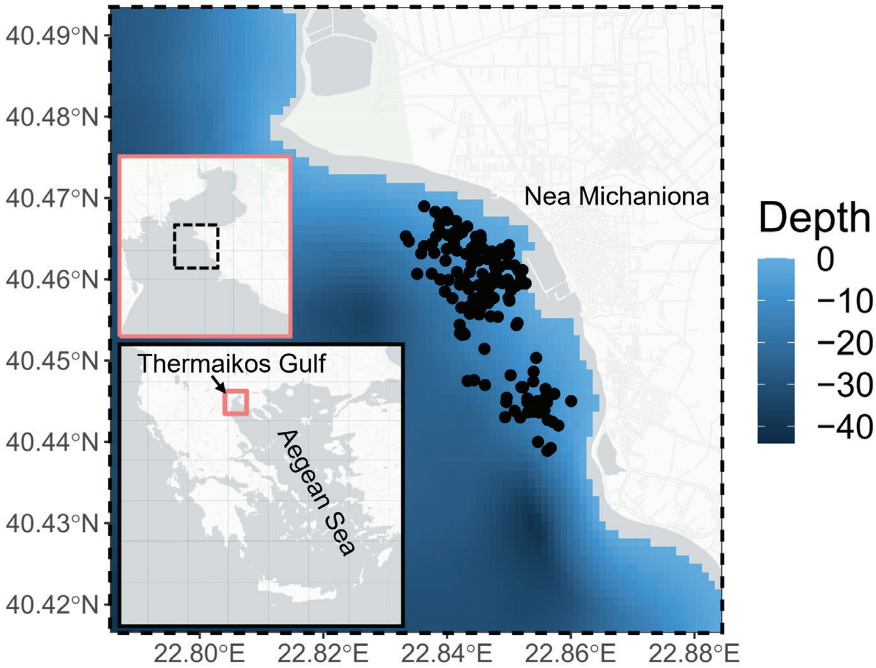

Fig. 1: Study area showing locations of each gillnet fleet deployed during two seasons of fishing effort. Insets show the location of the study area within the Thermaikos Gulf (dashed line), and the Thermaikos in relation to Greece (solid line).

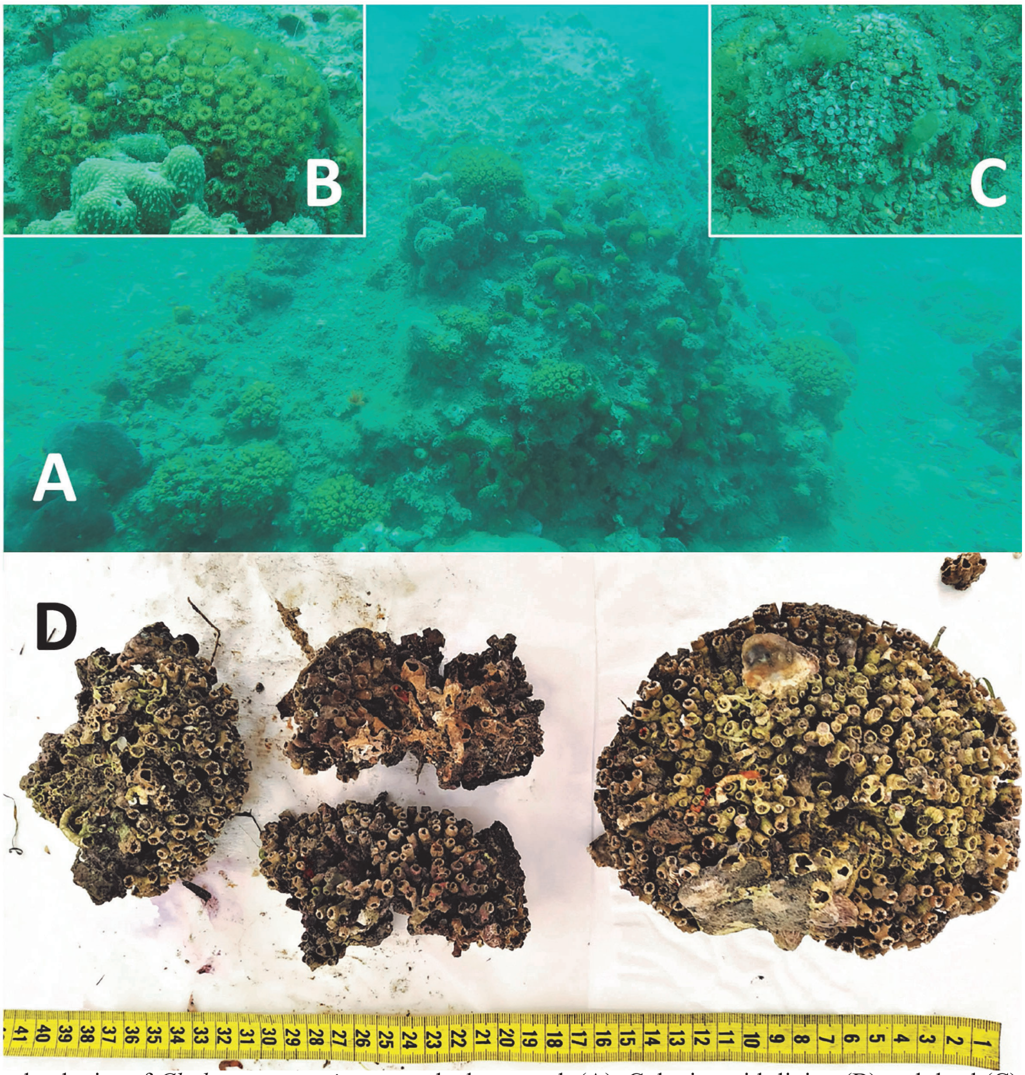

Fig. 2: Scattered colonies of *Cladocora caespitosa* attached to a rock (A). Colonies with living (B) and dead (C) polyps. Intact (right) or fragmented *C. caespitosa* colonies caught with static nets (D).

fishing trial, three fleets were deployed, that is a total of 900 m of fishing gear, and then the vessel drifted nearby with the engines off. As the purpose of the study was to assess the catch profile under realistic conditions, experimental fishing effort was conducted simulating the prevailing gillnet-fishing tactics in the area. That is, gillnets were set before sunrise and allowed to soak for approximately 1.5 hours, in locations where this gear is regularly deployed by fishers (Fig. 1). All trials took place within the 20 m isobath and in <4 Beaufort scale. The substrate type of each fleet was also recorded according to the fisher's characterization, who, based on local knowledge, indicated the areas where *C. caespitosa* is distributed, hereafter referred to as coral beds (i.e., presence of several coral colonies). We collected this information at the per-fleet level because the sea bottom is quite heterogeneous in the survey area and substrate type often differed among fleets of the same haul.

After each haul, the catch was placed in a portable cooler and transferred to the laboratory for processing. Each specimen in the catch was identified to the lowest possible taxonomic level, weighed for total wet-weight (TW, g) and classified as "commercial" or "self-consumed" or "discarded" according to fisher's use of the species. The latter category was sub-classified to highlight the reasons for discarding, i.e., undersized specimens of commercial species (e.g., belonging to species included in Annex III of EU Reg. 1967/2006 and therefore included in the Landing Obligation provisions), damaged specimens of commercial species of legal size, or non-commercial species. The colonies of *C. caespitosa* were further processed to evaluate their state by examining the condition of the polyps (alive or dead) and weighing all fragments (Fig. 2). Fragments having more than 80% of their polyps alive were assessed as living, whereas fragments with less alive polyps and eroded septa on their white corallites were assessed as dead. Subsequently, the frequency of occurrence of *C. caespitosa* in every state was assessed by estimating its prevalence in fleets deployed over the different substrate types (i.e., *Cladocora* bed or other soft substrata).

Results

Because the objective of this study was to assess the capture profile of bottom set gillnets based on local fishing practices and not to analyze spatiotemporal patterns, data from both survey years were aggregated. The total biomass captured from the 69 hauls was 276.9 kg. Dead *C. caespitosa* colonies (6.08 kg), unidentifiable organic material (1.16 kg) and the jellyfish *Cotylorhiza tuberculata* (16.2 kg, 83% of which were caught in three hauls) were excluded from the above calculation. Gillnets were highly selective for fish, which comprised 242.4 kg (87.6%) of total biomass, with invertebrates composing the remaining 12.4%. The most abundant fish caught was the round sardinella, *Sardinella aurita*, which comprised 35.8% of total fish biomass, the striped red mullet *Mullus surmuletus* (17.6%), the European barracuda *Sphyraena sphyraena* (9.5%), the red pandora *Pagellus erythrinus* (7.2%), and the annular sea-bream *Diplodus annularis* (5.9%) (Table 1). Among invertebrates, by far the most important species in terms of biomass was *C. caespitosa*, which made up 21.4 kg (53% of the total biomass of invertebrates), followed by the gastropod *Hexaplex trunculus* (10.4%), the sponge *Aplysina aerophoba* (7.1%), the cuttlefish *Sepia officinalis* (6.3%), and the octopus *Octopus vulgaris* (5.2%) (Table 1). In total, these species accounted for 76% and 82% of total biomass of fish and invertebrates caught, respectively.

Of the total biomass captured, 30.8 kg (10.9%) was "self-consumed" and 47.5 kg was "discarded"; thus, the total discard ratio estimated for gillnets was 17.2%. When considering only fish in the calculation, the discard ratio was 7.1%. The annular seabream, the black seabream and the red pandora were the most discarded species, as undersized individuals were frequently caught, even though a high proportion (44-89%) of the above species was self-consumed by the fisher. The discard ratio in the remaining fishes was quite low, having an average of 9.5%; body-damage was practically the sole reason for discarding any of these fishes. Amongst the 54 fish species captured during the entire survey, all were classified as commercial or potentially commercial except for the damselfish *Chromis chromis*, which was represented by only one individual in both years.

In contrast with fishes, almost all invertebrates were discarded, except for cuttlefish (15 individuals, 6.3% of total invertebrate biomass) and one specimen of the musky octopus *Eledone moschata*. All octopuses *Octopus vulgaris* caught (n=11, 5.2% of total invertebrate biomass) were undersized and therefore returned to the sea upon hauling. As a result, the discards ratio for invertebrates was 92.8%, as very few specimens of the gastropods *Hexaplex trunculus* and *Bolinus brandaris* were kept by the fisher for self-consumption. *Cladocora caespitosa* was by far the most dominant discarded species, comprising 59% of the biomass of discarded invertebrates and 40% of the total discarded biomass.

The prevalence of *C. caespitosa* was very high, occurring in ~60% of all hauls (42 out of the 69 hauls). However, the number of coral specimens per haul was limited and, in most cases (57%), only one or two fragments were found (Fig. 3A). Moreover, the individual fragments were again small, with >65% ranging between 10–100 g, and colonies larger than 1 kg captured in only two hauls (Fig. 3B). A total of 65.6% of all fragments were classified as living while there was no statistical difference in the weight of fragments between coral beds and other substrates (*t*-test on log-transformed values: $P>0.1$).

The relative frequency of *C. caespitosa* captured in fleets that were deployed over the suggested coral beds was 43%, while 34% of these fleets caught living colonies. The relative frequency of *C. caespitosa* in the remaining fleets was 25%, while living colonies were only caught in 11% of these fleets. Looking only at fleets where living colonies of *C. caespitosa* were caught, 81% were deployed over coral beds; in the remaining substrates living colonies were caught in 43% of the fleets. As the

Table 1. Summary of the most important fish and invertebrate species caught by means of gillnets during the present survey: total number (N) and total biomass (B) of captured specimens and the frequency of occurrence of each species in the hauls (F). The fraction that each species was commercialized, self-consumed or discarded and the reason for self-consumption and discarding is also provided. IUCN corresponds to the conservation status of each species: LC=least concern; VU=vulnerable; EN=endangered.

Species	N	F	B(kg)	% COMMERCIAL/SELF-CONSUMPTION/ DISCARD	REASON FOR SELF-CONSUMPTION/ DISCARDING	IUCN
PORIFERA						
Chondrilla nucula Schmidt, 1862	61	26%	0,46		- /Species	-
Aplysina aerophoba Nardo, 1833	33	30%	2,85		- /Species	-
Chondrosia reniformis Nardo, 1847	25	23%	0,46		- /Species	-
CNIDARIA						
Cladocora caespitosa Linnaeus, 1767	-	60%	21,38		- /Species	EN
Cotylorhiza tuberculata Macri, 1778	31	10%	16,29		- /Species	-
MOLLUSCA						
Hexaplex trunculus Linnaeus, 1758	396	74%	4,22		Species / Quantity	-
Bolinus brandaris Linnaeus, 1758	161	49%	1,29		Species / Quantity	-
Sepia officinalis Linnaeus, 1758	15	19%	2,54		- / -	LC
Octopus vulgaris Cuvier, 1797	11	12%	2,08		- /Size	LC
ARTHROPODA						
Paguristes eremita Linnaeus, 1767	53	29%	0,07		- /Species	-
Pagurus cuanensis Bell, 1845	18	7%	0,02		- /Species	-
Pilumnus villosissimus Rafinesque, 1814	11	7%	0,01		- /Species	-
CHORDATA						
Sardinella aurita Valenciennes, 1847	1823	28%	86,86		Quantity / Damage	LC
Mullus surmuletus Linnaeus, 1758	911	94%	42,68		Size, Damage / Damage	LC
Diplodus annularis Linnaeus, 1758	807	96%	14,43		Size, Damage / Species, Damage	LC
Pagellus erythrinus Linnaeus, 1758	590	99%	17,48		Size, Damage / Damage	LC
Serranus scriba Linnaeus, 1758	208	48%	9,78		- / Damage	LC
Symphodus tinca Linnaeus, 1758	202	38%	6,78		- / Damage	LC
Mullus barbatus Linnaeus, 1758	199	68%	7,68		- / Damage	LC
Sphyraena sphyraena Linnaeus, 1758	198	64%	23,06		Damage / Damage	LC
Boops boops Linnaeus, 1758	194	51%	8,51		- / Damage	LC
Pagellus acarne Risso, 1827	132	30%	4,05		Size / Damage	LC
Trachurus trachurus Linnaeus, 1758	100	45%	5,00		Damage / Damage	LC
Diplodus vulgaris Geoffroy Saint-Hilaire, 1817	87	41%	1,53		Size / Species, Damage	LC
Spicara flexuosa Rafinesque, 1810	57	32%	1,54		- / -	LC
Serranus cabrilla Linnaeus, 1758	53	36%	1,80		- / Damage	LC
Scorpaena porcus Linnaeus, 1758	44	12%	1,17		Size / -	LC
Dentex dentex Linnaeus, 1758	19	19%	0,68		- / Damage	VU
Raja radula Delaroche, 1809	1	1%	0,23		Size / -	EN
Sciaena umbra Linnaeus, 1758	1	1%	0,04		- / -	VU

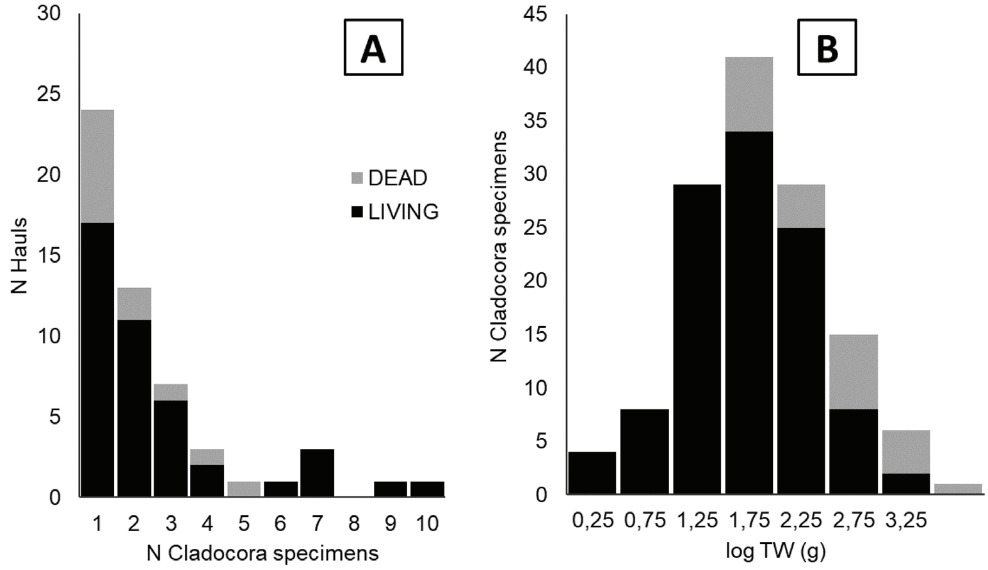

Fig. 3: Frequency distribution (A) and size (log of total wet-weight in g) frequency distribution (B) of the number of living and dead *C. caespitosa* specimens caught in systematic gillnet fishing surveys.

probability of hauling *C. caespitosa* was 18% higher over known coral beds, possible differences in target species (fish, cephalopods) biomass were examined between the two categories of substrate types (coral bed vs other). While the target catch biomass of fleets over coral beds was statistically higher (Mann–Whitney test: p-value = 0.03), the numeric difference was small (200 gr) and, in practical terms, negligible for fishers.

Discussion

In the studied fishing ground, the main reason for discarding fishes appears to be morphologically damaged individuals that could not be sold; most frequently the target species *Mullus surmuletus*, *Sphyraena sphyraena* and *Pagellus erythrinus*. Body damage is due primarily to depredation by active predators (dolphins, cormorants, sea turtles, and larger fishes; Garagouni & Ganias, 2023) and secondarily to injuries during the disentanglement process for example, dermal wounds, damaged opercula, etc. Among fishes, only the damselfish *C. chromis* was categorized as non-commercial. Only a few fishes were systematically discarded as under-sized (covered by Art. 15 of EU Reg. 1380/2013), specifically, the annular seabream, the black-sea bream and the red pandora. Accordingly, a limited number of species with a minimum conservation reference size are caught below that size by gillnets. These results support that gillnets used in southern European fisheries have a low percentage of undersize catches and so are sufficiently selective (Erzini *et al*., 2006). Moreover, very few threatened fish species were caught: in total, 19 specimens of the common dentex *Dentex dentex* (IUCN status: vulnerable), one specimen of the black meagre *Sciaena umbra* (IUCN status: vulnerable), and one specimen of the undulate ray *Raja radula* (IUCN status: endangered) (Table 1). The latter species was the only chondrichthyan caught, highlighting the particularly low catch rates of this vulnerable group of fishes by gillnets.

Among invertebrates, only three commercial species were caught, all cephalopods: the cuttlefish *S. officinalis*, the common octopus *O. vulgaris* and the musky octopus *E. moschata*. These species, however, comprised a minor portion of the commercial catch, since cuttlefish and the musky octopus were captured in small quantities and all specimens of the common octopus were undersized and returned alive to the sea. All remaining invertebrates are systematically discarded in the small-scale fishery of Thermaikos, except for the gastropods *H. trunculus* and *B. brandaris*, which are occasionally commercialized when caught in large quantities. The overall discard ratio of gillnets was 17.3%, which is lower than the one estimated for trammel nets (25%) by Ganias *et al*. (2021) for the same fishing area, using the same methodology. The smaller discard-ratio of gillnets underpins their high selectivity towards commercial species, which is essential for fishing gear to be considered sustainable.

The above environmental benefits of gillnets were offset by the increased catchability of the coral *C. caespitosa*, which was the dominant invertebrate species in terms of biomass and occurred in 60% of all fishing hauls carried out during the study. While this is a lower occurrence rate than that found by Dias *et al*. (2020) for other cold-water corals caught by gillnets in the Algarve (85%), the impact on the local coral population is likely as serious, since it is the only "reef-building" coral found in the Thermaikos (Kruzic and Benkovic, 2008). Given that the species has no commercial value, all of its biomass is discarded. Consequently, it comprised 7% and 30% of the total and discarded biomass, respectively. By disregarding *C. caespitosa*, the discard ratio of gillnets is reduced to 12.3%. It is worth mentioning that this is likely a real issue when it comes to fisheries observers since, at least locally, gillnets are usually cleared during the hauling process, and *C. caespitosa* is thrown directly overboard, so none (or very little) of it reaches the harbor to be counted. This would create a serious bias in the estimated environmental impact of gillnets, since *C. caespitosa* is an endangered and ecologically important ecosystem engineering species (Otero *et al*., 2017; Kersting *et al*., 2022); its loss, therefore, may have cascade effects at an ecosystem level (Buhl-Mortensen *et al*., 2010).

Fishing has been listed among potential threats for *C. caespitosa* (Otero *et al*., 2017) and the present study corroborates evidence for the impact, detachment, fragmentation and removal of colonies, of static gears on the species' populations. A previous study by Ganias *et al*. (2021) showed that colonies of this coral, either fragmented or intact, were highly prevalent in trammel-net catches from the same fishing area. Together, these studies show that static nets may severely affect *C. caespitosa* beds, at least in areas like the Thermaikos, where these beds are regularly exploited by small-scale fishers mainly using this type of gear.

An important finding of this study was that local fishers could quite accurately characterize substrate types, since in our hauls *C. caespitosa* was mostly prevalent over the so-called coral beds. Fishing with static nets may cause direct damage to biogenic builders, such as corals, by detaching, fragmenting and extracting pieces during hauling (Georgiadis *et al*., 2009). Given that coral colonies are quite fragile, they are usually returned fragmented back to the sea. Fishers generally discard coral colonies from on board, during the hauling process and the initial gross clearing of large pieces from nets, while smaller parts are discarded at the fishing harbor during the disentanglement process. It is thus possible that these discarded fragments are scattered over a broader marine area, and, being unattached to the seabed, may easily be recaptured in a different fishing ground. This tactic may explain the prevalence of dead colonies in the hauls outside the coral beds. The survival potential of discarded fragmented colonies is unknown. It will likely depend on their size, stress effect (e.g., time of exposure onboard, tissue damage) and the habitat into which they are discarded. Mechanically fragmented colonies due to hauling will most likely become gradually buried in sediment, especially in muddy bottoms, and small fragments returned to the sea bottom may also roll over. Both procedures may cause necrosis of alive polyps, which may be further covered by algae and mucilage, while the original colonies they broke off from are made more vulnerable to pathogens (e.g., Bavestrello *et al*., 1997). A shift towards asexual reproduction has been reported for a fragmented *C. caespitosa* population in the eastern Mediterranean (López-Marquez *et al*., 2021), as a tactic to enhance survivorship. Furthermore, Kersting and Linares (2019) presented evidence for high rejuvenescence abilities of *C. caespitosa*, which seems to follow this strategy to withstand and recover from rapid environmental changes. However, low survival of coral fragments in sedimentary habitats, such those in the studied area, has been documented for the tropical branching coral *Acropora palmata*, independent of their size (Lirman, 2000). Additional specific research is required to assess the fate of *C. caespitosa* fragments.

A sustainable practice for protecting the population of this endangered species would be to avoid gillnet deployments over coral beds –a feasible tactic, given that fishers are aware of their local distribution patterns. The finding that catches over these beds are only marginally higher compared to adjacent habitats, at least in the Thermaikos grounds, could motivate fishers to avoid setting their nets in these areas provided that they are well informed and educated on the significance of this endemic, threatened, and ecologically important species.

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