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Short Communication

Observations on the ghost fishing in two species of marine heterobranchs (Mollusca Gastropoda): *Aplysia depilans* Gmelin, 1791 (Aplysidae) and *Umbraculum umbraculum* ([Lightfoot], 1786) (Umbraculidae)

Andrea Lombardo, Giuliana Marletta*[1]

Department of Biological, Geological and Environmental Sciences, University of Catania, 95124 Catania, Italy.

Abstract: The present note reports for the first time the finding of two species of marine Heterobranchia within a ghost net. The stretch of the net was repeatedly wrapped in itself and formed a large tangle of spherical shape. This created several "layers" of meshes wrapped in each other, where the following species of marine heterobranchs were found: *Aplysia depilans* and *Umbraculum umbraculum*. In particular, of the former, an alive specimen was found tied to the wire of the net, and a dead specimen floating within the ghost net. Of the second species, only the shell was found.

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Introduction

The term “ghost fishing” indicates the capability of given fishing gear to continue fishing even after the fisherman has lost control of it (Smolowitz, 1978). Such equipment can be lost in the sea due to multiple factors (Thomas and Sandhya, 2019): bad weather/sea conditions, damaged equipment, attachment of the same with natural (e.g. reefs) or artificial (e.g. wrecks) parts of the seabed, contact with other fishing equipment or for intentional causes. Lost fishing gears are indicated with the acronym A.L.D.F.G. (Abandoned Lost Discarder Fishing Gear) or ghost nets. Through the phenomenon of ghost fishing, they continue to cause extensive damage to marine biodiversity (Smolowitz, 1978; Thomas and Sandhya, 2019).

In the Mediterranean, the fishing gears mainly used in small-scale fisheries (SSFs) are passive (i.e. gillnets and trammel nets) (Lucchetti et al., 2020). A gillnet is a wall of netting that hangs in the water column (it can be fixed to the substrate or floating), typically made of monofilament or multifilament nylon (NOAA, 2022). Trammel nets are similar to the previous one, except that the wall is formed by three layers of the net (Seafish, 2022). Ghost fishing is mainly caused by such passive fishing gears (Brown et al., 2005), which continue to fish, even for years, a high number of target, non-target and threatened organisms after being lost at sea (Nakashima and Matspuka, 2004; Thomas and Sandhya, 2019). Fortunately, these ghost nets have become damaged or colonized by encrusting organisms and have lost their effectiveness (Nakashima and Matspuka, 2004). The marine organisms that are mainly threatened by ghost nets are fishes and crustaceans (Thomas and Sandhya, 2019).

In this regard, the information regarding ghost fishing related to marine heterobranchs (previously known as Opisthobranchia), a group that includes the most colorful and structurally diversified gastropods (Rudman and Willan, 1998), are practically non-existent. Consequently, this note describes observations made on a stretch of abandoned gillnet found during a scuba dive and in which two species of these marine gastropods have been found.

Materials and Methods

On 25th July 2022, during a scuba dive carried out between 9-11 AM in the site of Acque Fredde

*Correspondence: Giuliana Marletta
E-mail: giuliana.marletta@phd.unict.it

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(37°38'15.7"N, 15°10'52.1"E), a diving point located within the hamlet of Santa Tecla in the municipality of Acireale (eastern coast of Sicily, Italy), a stretch of abandoned gillnet was found at a depth of about 4-5 meters. The stretch of the net was repeatedly wrapped on itself and formed a large tangle of spherical shape. This shape created several "layers" of meshes wrapped in each other. The ghost net covered, wrapping it, a small area (about one m^2) of the seabed. The covered area was a flat boulder placed between larger rocks and a small rocky wall, nearby, there were also some pebbles. The entanglement contained many marine organisms trapped inside and, on its surface, both living and dead (see results). After releasing all the living organisms from the net, the latter was removed from the bottom and brought to the surface, where it was almost completely unrolled. When unrolled, the piece of the net had approximately a rectangular shape (about 142 cm long and 50 cm high) (Fig. 1A). Along most of the margins, there were some ropes. The side of each mesh had a length of 3 cm (Fig. 1B). At some points of the net, the meshes formed small knots (Fig. 1C).

Results and Discussions

In the found ghost net, three different groups of animals were found. The most numerous groups of trapped animals were that of crustaceans, with about ten live specimens, including 5 *Maja squinado* (Herbst, 1788); 3 *Herbstia condyliata* (Fabricius, 1787); 1 *Dromia personata* (Linnaeus, 1758); 1 *Carcinus* sp. and portions of the exoskeleton of *Scyllarus arctus* (Linnaeus, 1758). In the net, there were also two specimens of *Stramonita haemastoma* (Linnaeus, 1767) (Mollusca, Gastropoda) and an individual of *Symphodus tinca* (Linnaeus, 1758) (Chordata, Actinopteri). Two species of marine heterobranchs were also found in the net stretch: 2 specimens of *Aplysia depilans* Gmelin, 1791 and a shell of *Umbraculum umbraculum* ([Lightfoot], 1786). As for the 2 individuals of *A. depilans*, one was alive and quite active, while the other specimen was dead, and its body was in a state of decomposition (with a yellowish-gray body and unrecognizable extremities of the head). Both individuals were about the same size (about 5 cm long). The live specimen (Fig. 1D) had the final part of the foot tied to a small knot formed by the wire of the net. This knot created an obvious bottleneck between the animal's tail and the rest of the body. This specimen also had an evident oblique groove on the tegument of both sides of the visceral mass. In addition, the mantle, usually found between the parapodia (and therefore relatively hidden), was located higher and beyond the margin of the latter. During the attempts made to free the animal (i.e. cutting gently the knot that choked the tail), the latter, whenever it was slightly pressed by one of the authors, secreted the purple ink. Instead, the deceased specimen was free (not tied or embedded) within the agglomeration formed by the net. Inside the net was also found a shell of *U. umbraculum* (Fig 1D-E) with some organic parts still attached to the margins of the ventral side.

The observations reported here on the finding of 2 species of marine heterobranchs within a ghost net would seem to be, to our knowledge, the first concerning this group of animals regarding the issue of ghost fishing. In fact, in literature, the only studies that have reported the finding of marine heterobranchs in fishing nets exclusively concern cases of "bycatch" [generally defined as the incidental capture of non-target species during fishing activities (Alverson et al., 1994; Kumar and Deepthi, 2006)] in the course of trawling [*Aplysia brasiliana* Rang, 1828 (Branco et al., 2015) and *Aplysia* sp. (Mendonça et al., 2019)] or fishing with nets placed parallel to the seabed [*Bulla ampulla* Linnaeus, 1758 (Samuel et al., 2018)] and therefore not through ghost nets.

Interestingly, both specimens of *A. depilans* found inside the net had a diameter of the body that would have quietly allowed it to cross the net's meshes (3 cm per side) (unlike all other organisms found in it, even *U. umbraculum*). Nevertheless, both animals were found inside the agglomeration formed by the net. This probably happened because the piece of the net was wrapped several times on itself, forming a spherical agglomerate composed of several "layers". As a result, the two animals, after entering the net,

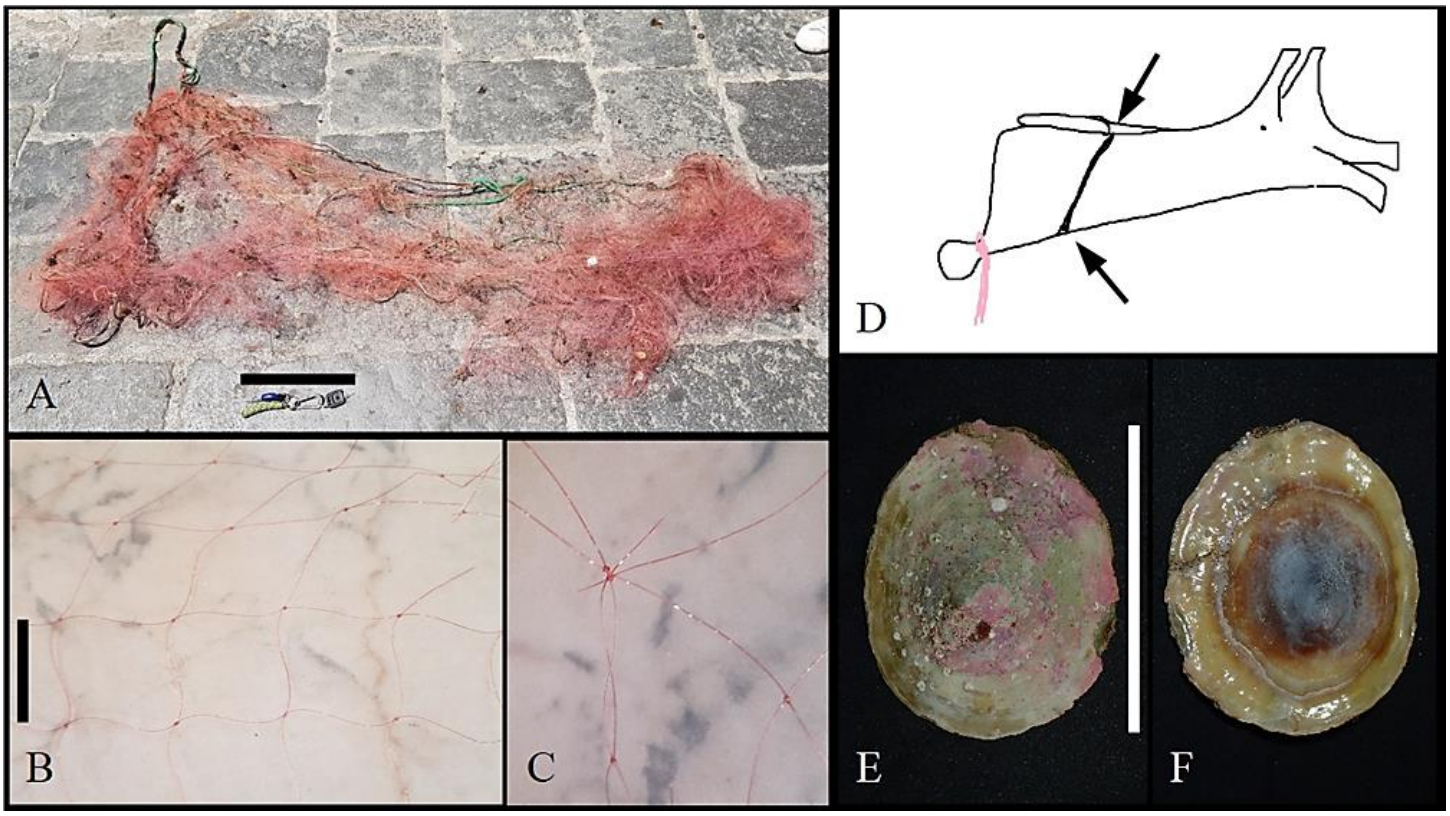

Figure 1. A: The unrolled ghost net (scale bar 22 cm); B: net meshes (scale bar 3 cm); C: small knots between the meshes; D: schematic picture of the alive *Aplysia depilans*. The lower black arrow indicates the groove on tegument; the upper arrow shows the mantle extroflextion.; E: dorsal view of *Umbraculum umbraculum* shell; F: ventral view of the shell (scale bar 4.2 cm).

found themselves in a real sensory labyrinth that made the orientation almost impossible for them. In fact, in marine heterobranchs the sense of sight is poorly developed, and they are oriented mainly through touch, chemical sensations and balance (Kandel, 1979). The hypothesis that they were "lost" within the net is confirmed by the fact that one of the two individuals was found dead and free (not stuck in the wires) inside the network. Therefore, it is likely that this individual had died of starvation, having been lost within the agglomeration for a long time. On the other hand, the other specimen of *A. depilans* was found with his tail tied to the knots of the net and, therefore, unable to escape. This same specimen had an evident groove in the tegument on both sides of the visceral mass and the mantle slightly outside parapodia. This groove and the strange position of the mantle may have been caused by the continuous unnatural rubbing and chokes that the animal's body had undergone to pass through the various layers of the net.

The finding of the shell of *U. umbraculum* inside the net suggests that even this animal was lost and could no longer get out of it. The shell had on some of the margins of the ventral side small organic parts that indicated that this organism was previously alive and probably, after being trapped in the net (since the animal was too large to get out), it was preyed upon by one of the many crustaceans found in it.

To conclude, the present observations confirm the results of Matsuoka et al. (2005) that the abandoned gillnets intertwined/wedged on a three-dimensional seabed maintain a high capacity for ghost fishing. Consequently, it is evident that the ghost nets, under certain conditions (particular entanglements of the same), in addition to representing a threat to the group of marine heterobranchs, can be real mortal traps even for invertebrates that potentially would be able to cross them for their small size.

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