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New stranding records of *Janthina janthina* (Linnaeus, 1758) (Gastropoda Epitoniidae) in the central Mediterranean Sea (Strait of Messina, Italy) and observations on its behaviour

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ABSTRACT An unusual occurrence and massive stranding of the pelagic snail *Janthina janthina* (Linnaeus, 1758) (Gastropoda Epitoniidae*)* is reported along the Sicilian coast of the Strait of Messina (Italy). The diet of the Mediterranean species consisting of *Porpita porpita* (Linnaeus, 1758) and *Velella velella* (Hydrozoa) is reported. Further information on the genus *Janthina* Röding, 1798 are provided. Charts, photographs and a video clip on the construction of the 'raft' by the mollusc and its predatory behaviour are attached.

KEY WORDS Pelagic Molluscs; *Janthina*; behaviour.

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INTRODUCTION

The importance of the Strait of Messina (central Mediterranean, Italy) for marine biology studies is well known in the literature (Longo, 1882; Mazzarelli, 1936; Berdar et al., 1983; Battaglia et al., 2017; Cavallaro et al., 2021) and it is due to the high biodiversity of this area and to the peculiar rising currents that favours the beaching of the pelagic and deep fauna, belonging to different phyla (Berdar et al., 1983; Battaglia et al., 2017). In several cases, rare species are also reported, with first records in Mediterranean waters or notices on the presence of taxa previously not recorded for long periods, i.e. about a century (Berdar et al., 1982; Villari & Ammendolia, 2009; Battaglia et al., 2012; Cavallaro et al., 2016). The constant monitoring of the stranding phenomenon carried out in recent decades (Berdar et al., 1983; Battaglia et al., 2017) has made it possible to collect valuable information on the biodiversity of this area.

The monitoring carried out in the Strait of Messina in the years 2003, 2007 and 2021 allowed to record unusual stranding of the mollusc *Janthina janthina* (Linnaeus, 1758). The stranded individuals were all alive and this allowed us to observe some behaviours of the species.

Ever since Colonna (1616) discovered and described for the first time the "*Coclea ianthina*", the interest of naturalists and collectors for molluscs belonging to the genus *Janthina* Röding, 1798 has been remarkable, both for strictly scientific reasons and for the intrinsic beauty and uniqueness of their shell.

Molluscs of the genus *Janthina* are holoplanktonic, neustonic animals, whose dimensions place them in the macroplankton category. They live on

the surface of nearly all seas along with their prey, supporting their bodies afloat by means of a raft of air bubbles they build themselves. They are unable to swim and are therefore constantly at the mercy of winds and sea currents (Lalli & Gilmer, 1989). A review of the genus was published by Lalli & Gilmer (1989) in their comprehensive book on the biology of holoplanktonic gastropod molluscs.

There are not many reports of *J. janthina* for the Mediterranean Sea. A first historical report is that of Brusina (1872), which indicates the species with the synonym *Janthina costae* Mörch, 1860 in the Adriatic Sea. Gofas (2011) reports it in one of his lists for Tangier and recently Crncevic & Cetinic (2016) for a single specimen, only shell without animal, in Croatia.

A report for the Mediterranean Sea as *J. globosa* Swainson, 1822, with the synonym of *Janthina nitens* Menke, 1828, is provided by Repetto (1989) for the Tuscan Sea. Teker et al. (2017) report *J. globosa* for Turkey. There are also more numerous reports of *J. pallida*, certainly the most common species in the Mediterranean. Among the latest reports we cite Betti et al. (2017) for the Ligurian Sea.

Certainly the rarest in the Mediterranean Sea is *J. exigua*. The taxon includes 12 synonyms and almost all referable to oceanic finds. Philippi (1848) mentions it for the Mediterranean with the synonym of *Janthina incisa*. Although we have carried out research in the literature that dealt with "modern" reports of this species for the Mediterranean Sea, we have only found one by naturalistic site (Natura Mediterraneo-Forum naturalistico) which reports it for Gavdos Island, Greece (see Sitology).

All the findings in the Strait of Messina of *J. janthina* are very rare, just for the empty shell alone. Granata-Grillo (1877) reports it for the first time as *Janthina bicolor* Menke, 1828, with more recent reports by Micali & Giovine (1983).

No reports are available for the Strait of Messina for *J. exigua*, while *J. globosa* and *J. pallida* are abundant and are frequently found on beaches, especially in the winter and spring months. They are associated with their favourite prey, the Hidrozoa *Velella velella* Linnaeus, 1758 and *Porpita porpita* Linnaeus, 1758. They both pile up due to the currents near the coast, sometimes producing massive and spectacular strandings due to their intrinsic chromatic characteristics (Vazzana, 2020).

MATERIAL AND METHODS

Overall, 71 adult specimens of *J. janthina* have been collected in the years 2003, 2007 and 2021, during the monitoring activity of the stranding phenomenon carried out in the last 20 years on the shore of the Sicilian coast in the Strait of Messina (38°11'39"48 N, 15°33'1"80 E).

Each specimen was measured, recording the shell length and the shell height. Some alive specimens were transferred for a limited time in a large tank**.** They were also transferred in laboratory for biological observations, as photos and videos were taken using a stereomicroscope Zeiss Discovery V.8. coupled with Axiocam 208 colour microscope camera, using ZEN 3.1 blue Edition software. At the end of these operations, all alive specimens have been released into the sea far from the coast.

Although the copious stranding of *J. janthina* occurred on 2007, we abstained at that time from reporting the event, hoping for further observations in nature regarding this species; however, since then we have observed it only another time in 2021.

Together with *J. janthina*, some specimens of *J. globosa* were also stranded (Fig. 1), with clusters of eggs attached to the floating raft (Fig. 2). The difference between the two species is evident, regarding both the shell and the different shape of the raft (Fig. 3).

RESULTS

Length frequency

Studied specimens of *J. janthina* ranged between 5.0 and 23.5 mm of shell length (average: 13.5 mm) and 3.3–16.6 of shell height (average: 10.3 mm) (Fig. 4).

The most important stranding event was recorded on 31st October 2007, when 46 specimens were found. Analysing the measurements of these specimens, it can be observed that they were quite heterogeneous in size (both young and adult specimens). Overall, 63.4% of specimens were included in size classes between 12 and 16 mm (Table 1).

Raft construction

The construction of the float has been described

Figure 1. Beached specimens of *Janthina: J. janthina* (left) and *J. globosa* (right).

Figure 2. Eggs cluster of *Janthina globosa.*

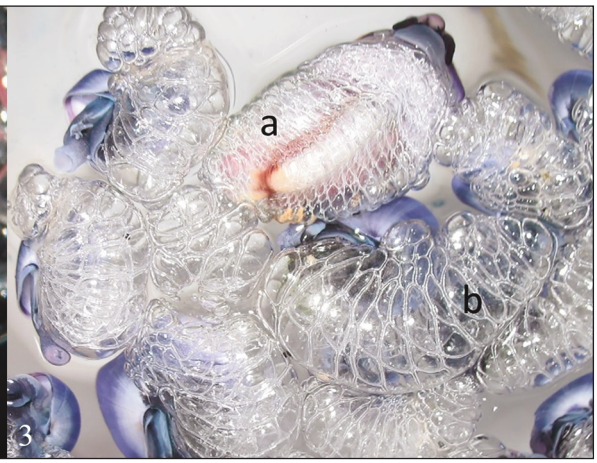


Figure 3. Rafts of *Janthina globosa* (a) and *J. janthina* (b).

by several authors and summarised by Laursen (1953).

Rafts of some specimens were destroyed when coming into contact with the substrate of the shore or were made heavier by gravels attached just after beaching. As a consequence, those specimens reconstructed their rafts or added new bubbles to gain more buoyancy. Each bubble is formed by the foot of the mollusc when it is skimming under the water surface, with the shell facing downwards. The operation begins with the extroflection of the front part of the foot (propodium), which the mollusc spreads out in shape of a spoon (Fig. 5). Then, the epidermal tissue of the foot containing glands produces a viscous mucus which, with the help of the propodium, closes itself to form a little bag-like structure (Fig. 6), which incorporates a small amount of air, shortly after shaped in form of a bubble (Fig. 7). Finally each bubble is attached to the others forming the raft (Fig. 8) and the mollusc returns to its initial position to begin the operation again (Fig. 9).

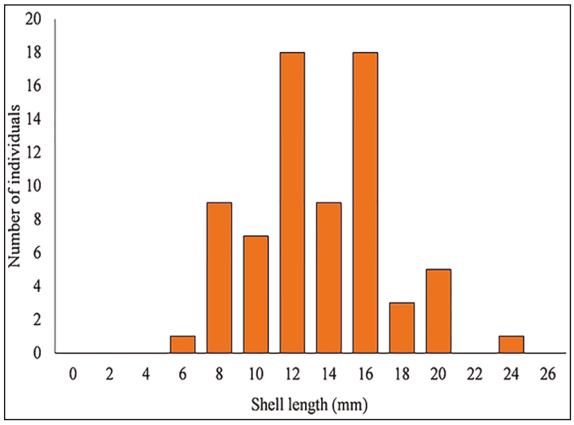


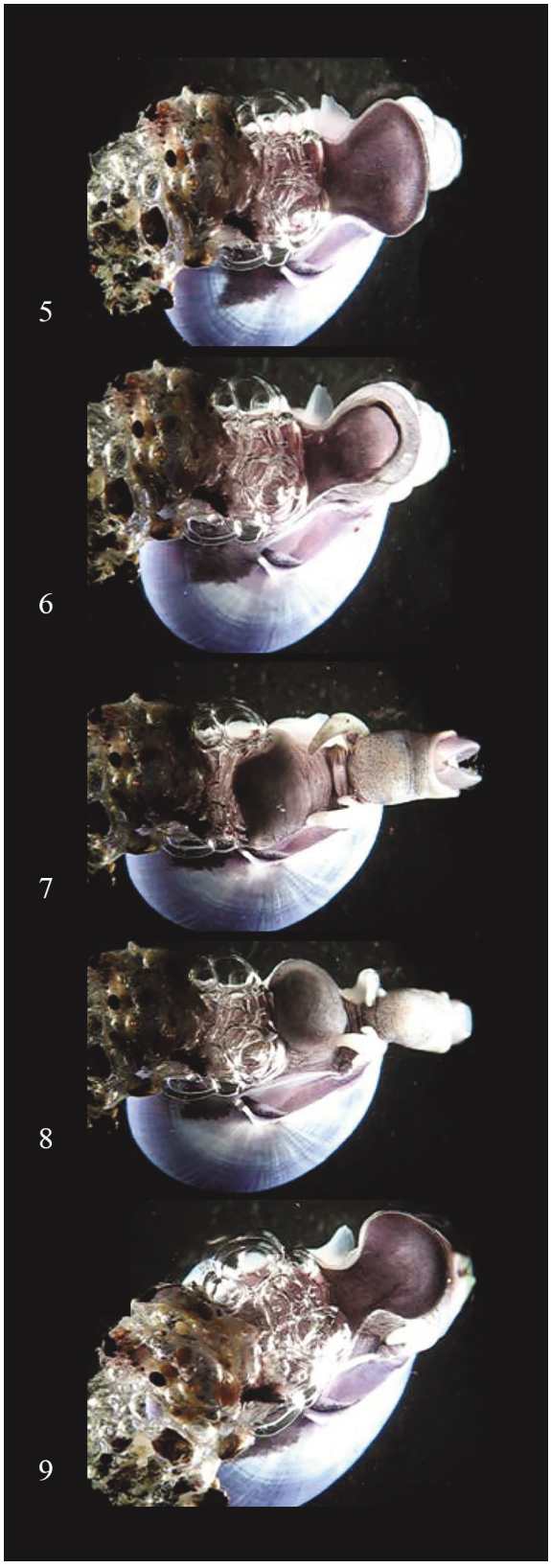
Figure 4. Length frequency distribution of specimens of *Janthina* found stranded in the Strait of Messina.

Each operation lasted an average of 20 to 30 seconds and was repeated about 10 to 11 times, until the mollusc became relatively buoyant. The whole operation was filmed and photographed. See Figs. 5–9 for the whole cycle of steps to make a bubble). The entire video clip is available at the link in "Additional files".

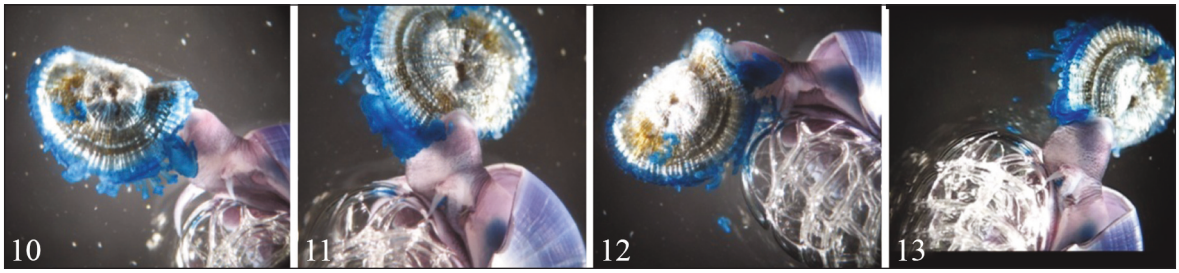
Predation

The diet of the genus *Janthina* mainly consists of pelagic Cnidaria, mostly Siphonophorae and Anthoathecata Porpitidae (Lalli & Gilmer, 1987), which they capture using a sort of proboscis equipped with the radula, whose conformation is similar to that of typical species of Epitoniidae: for this reason, as supported by molecular data, the genus *Janthina* has been recently ascribed to the latter family (Klussmann-Kolb & Dinapoli, 2006).

As we observed in the field and in the laboratory, *J. janthina* and *J. globosa* prey specimens of *Porpita* and *Velella* shortly after being introduced in the tanks. The specimens of *J. globosa* dedicated to laying eggs on of the raft ignored both *Velella* and *Porpita*, while specimens of *J. janthina* chose to attack *Porpita*. It was noticeable that the molluscs, still attached to their raft, began to feed from the external sides of the prey, wrapping the tissue of the prey with their everted proboscis, thus favoring the action of the radula. After its complete ingestion *J. janthina* starts searching for another prey, without paying atten-



Figures 5–9. Stages of the construction of the raft.



Figures 10–13. Frames of predation by *Janthina janthina* on *Porpita porpita*.

		SHELL LENGTH		SHELL HEIGHT	
Dates	**N. of specimens**	**Range**	**Average**	**Range**	**Average**
07/10/2003	2	11.5–12.0	11.8	9.0–10.2	9.6
31/10/2007	46	5.0–23.5	14.8	3.3–16.6	11.2
04/11/2007	7	8.4–20.5	12.3	6.0–16.1	9.3
09/11/2021	16	7.2–16.0	10.8	4.4–12.6	8.2
total	71	5.0–23.5	13.5	3.3–16.6	10.3

Table 1. Number of specimens of *Janthina janthina* and average shell size (length and height, mm) for each stranding date.

tion if it is *V. velella* or *P. porpita*. The stages of nutrition were filmed and photographed (Figs. 10–13).

DISCUSSION

Lalli & Gilmer (1989) reported the observations by other Authors (Fraenkel, 1927; Laursen,1953; Douglas et al., 1956; Bayer, 1983) on the formation of the 'raft' of air bubbles that allows the animal to float. Our observations regarding the construction of the raft coincide with those published by Bayer (1963), while some new aspects on the methods utilized and the diet preferences of the species were added.

Wilson & Wilson (1956) reported specimens of *Janthina* detaching itself from the raft to crawl freely under the surface of the prey to feed upon it. They also reported that some specimens preferred to attach the raft to the edge of the prey or to rebuild a new one after feeding.

Specimens of *J. janthina* we have observed both in their natural environment as well as those in the laboratory have never left the raft, even during the capture and ingestion of the prey. However, as mentioned by Wilson & Wilson (1956), they did restore the raft when necessary.

It should also be underlined that in the middle of the last century taxonomy of species of *Janthina* had not been well defined, therefore we cannot really know which species these latter Authors were observing.

It must be said that not all the species of *Janthina* have the same habits. Through observations in nature, we noticed that *J. pallida* feeds only upon *V. velella*. Sometimes, several specimens of different sizes of *Janthina* attacked the same prey, always without the presence of any raft. Bayer's observations (1963), only with animals in captivity, confirm our environmental observations. He also reported that, once the edible tissues of *Velella* were completely ingested, *J. pallida* built a new raft and switched to another prey.

Our twenty-year-long environmental monitoring of the genus *Janthina* along the Sicilian coasts of the Strait of Messina allowed us to observe differences in prey selection in different species. As a fre-

quent visitor of the Strait, *J. pallida* can be considered monotrophic: we have found it feeding only upon *V. velella*, according to observations on specimens collected at the open sea but also on beached specimens. *Janthina globosa* has also been observed feeding mainly upon *P. porpita* for decades and in only one case has been observed with large clusters of *Velella*.

As for *J. janthina*, we observed it preying on *Porpita* in open sea and on *Porpita* and *Velella* in the laboratory. *Porpita porpita* has been never reported in literature as prey of *J. janthina*, therefore our observations add further element to the knowledge of the diet composition of this species. It should also be added that *Physalia physalis*, reported by Bayer (1963) as a prey of the latter species together with *V. velella*, is extremely rare in the Mediterranean.

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Web site

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Additional files

File.avi: Phases of construction of the raft by *Janthina janthina*.