Marine Biodiversity (2025) 55:82
https://doi.org/10.1007/s12526-025-01565-6

SENCKENBERG

ORIGINAL PAPER

On *Synagoga mira* Norman, 1888 (Crustacea, Ascothoracida), associated with the black coral *Parantipathes larix* (Esper, 1788)

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Received: 13 March 2025 / Revised: 26 July 2025 / Accepted: 7 August 2025

Abstract

Synagoga mira Norman, 1888 is a poorly known ascothoracidan that has never been reported since its original description in 1888, which was based on a few specimens recovered from colonies of the black coral *Parantipathes larix* (Esper, 1788) collected in the Gulf of Naples (Mediterranean Sea). A series of Remotely Operated Vehicle (ROV) campaigns conducted between 2006 and 2022 along the Italian coast (western Mediterranean Sea) identified numerous *P. larix* forests, allowing the investigation of the presence of *S. mira* on a broad geographical and bathymetric scale and the collection of twelve specimens. The first pictures of both in situ and collected specimens are reported here. The sexes seem separated and slightly skewed towards females. *Synagoga mira*, specialised in grazing the living tissue of *P. larix*, is confirmed overall as a rare species (19.2% of the sites with black coral forests between 109 and 251 m). The highest frequency of records (12 sites) and abundance of individuals (588) were confined to the Pontine Archipelago, a hot spot of occurrence of this black coral. Infestation occurred in up to 68.8% of the host colonies, with up to 46 individuals per infested colony. The health status of the coral colonies seems not to influence the infestation from *S. mira*. This study provides the first ecological data on an enigmatic and poorly known crustacean, also representing the first information for mesophotic ascothoracidans.

Keywords Synagogidae · Antipatharia · Symbioses · Mediterranean Sea · ROV

Introduction

The Subclass Ascothoracida (Crustacea: Thecostraca) includes 118 species of small ecto-, meso-, or endoparasites of Cnidaria (in particular Anthozoa) and Echinodermata (Asteroidea, Crinoidea, Echinoidea, and Ophiuroidea) throughout the world (e.g., Okada 1938; Grygier 1983, 1987, 1996; Kolbasov and Petrunina 2019; Chan et al. 2021; Kolbasov et al. 2021). Despite substantial morphological and anatomical differences in the ground plan depending on various degrees of parasitic modifications, they are characterised, among other features, by a large bivalve carapace encompassing a trunk constituted of 11 somites: 6 thoracic ones, each carrying a pair of biramous appendages, and five abdominal limbless somites including a terminal telson with a pair of furcal rami (e.g., Grygier 1983; 1996; Kolbasov and Newman 2019). Ascothoracidans are dioecious, except for Petrarcidae and Ctenosculidae, which are hermaphrodite; females are generally larger than males and incubate eggs and embryos in brood chambers protected within the valves (Grygier 1996; Kolbasov and Norman 2019).

Communicated by H. Stuckas

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Published online: 12 September 2025

Family Synagogidae, belonging to the order Laurida (the other being Dendrogastrida), is considered the most basal of the whole subclass and includes ectoparasites of anthozoans (except for the genus *Waginella*, parasitic on crinoids). Their carapace protects the entire body, and they use a pair of large, W-shaped prehensile and grasping antennules and their oral cone (with piercing and sucking mouthparts) to feed on their hosts. The first abdominal segment, or genital somite, of the males bears a forked penis, which is reduced, trunked and vestigial in females (e.g., Grygier 1983, 1996; Kolbasov and Newman 2019; Kolbasov et al. 2019, 2021).

The genus *Synagoga* includes seven valid species (reported from the Mediterranean Sea, North Atlantic Ocean, western and eastern Indian Ocean, and north-western Pacific Ocean), three of which are parasites of black corals (Anthozoa: Antipatharia) (Kolbasov et al. 2019). Descriptions of the species are often partial, based only on one sex or even one specimen, and much ecological information is lacking (e.g., Grygier 1983; Kolbasov et al. 2019). They appear more mobile than most other ascothoracidans, and few species are known only from individuals caught in plankton (Grygier and Ohtsuka 1995). The males are easily recognisable by the presence of a long, bifurcated penis; other slight differences among sexes, regarding carapace size and shape, gut diverticula shape, morphology and aspect of the appendages are also present (Kolbasov and Newman 2019).

Synagoga mira Norman, 1888 is the first described species of the family Synagogidae: it was briefly reported in 1888 from specimens previously collected by Salvatore Lo Bianco on colonies of the black coral *Parantipathes larix* (Esper, 1788) from the Gulf of Naples (western Mediterranean Sea) (Norman 1888, 1913). Norman completed the description only in 1913, stating that he '*delayed doing this in the hope of being able to procure the earlier stages of development, which I had requested Signor Lo Bianco to kindly look out for me; these, however, he was unable to procure … I wrote to Dr. Giesbrecht to ask him if he could procure for me some further, and fresh, specimens of the species. He has now written me to say that … he has not been able to meet with* Synagoga *… he adds that ''*Synagoga *has not been found in the Bay of Naples since the time that you described it." It would seem, therefore, that the species must be extremely rare*' (Norman 1913). Despite the scarcity of specimens, the morphological and anatomical description of the species is relatively clear and exhaustive.

Nevertheless, Okada (1938), after examining Norman's samples preserved at the British Museum, concluded that his taxonomical description of *S. mira* was based mainly or entirely on male specimens (even if Norman described and depicted also ovigerous females) and his observation was subsequently reported by later authors (e.g., Newman 1974; Grygier 1983; Kolbasov and Newman 2019; Kolbasov et al. 2019). No ecological information regarding *S. mira* was available except for the host preference (Norman 1913; Grygier 1983). While *S. mira* has been later cited in other papers revising Synagogidae or describing new species added to the family (e.g., Newman 1974; Grygier 1983, 1990; Kolbasov and Newman 2019; Kolbasov et al. 2019), no other specimens of *S. mira* have ever been reported or collected since 1888. In 2014, Bo et al. recorded for the first time in situ living individuals of *S. mira* on *P. larix* colonies during a Remotely Operated Vehicle (ROV) scientific campaign in the Tuscan Archipelago (Tyrrhenian Sea), but since no samples were collected, the organisms were mistakenly identified as ostracods from the ROV footage. Since then, subsequent ROV campaigns identified numerous *P. larix* forests along the Italian coast, allowing the investigation of the presence of *S. mira* on a broad geographical scale and the collection of specimens. The present work reports the first observation of the ascothoracidan *Synagoga mira* since its original description in 1888. It aims to update the knowledge on this enigmatic and poorly known species, specifically adding morphological and ecological observations (distribution, extent of the infestation, and rarity) and showing the first pictures of both in situ and collected specimens. This is also the first ecological information regarding a mesophotic *Synagoga* species.

Materials & methods

On 27th June 2012, during a ROV campaign conducted in the South Tyrrhenian Sea, a colony of *Parantipathes larix* hosting at least 12 unidentified ascothoracidans was collected at 131 m near the town of Acciaroli (Candelieri Shoal, 40.074° N, 14.876° E); the organisms were photographed before preservation in ethanol 95° (sample code CAMPANIA 11a) (Fig. 1a). For this study, the collected specimens were dissected and analysed with a Leica Stereozoom S9i stereomicroscope and a Leica DM2000 LED transmitted light microscope to allow species identification. In particular, the taxonomical characters identified by Kolbasov et al. (2019) were checked, including the shape and ornamentation of the antennules, the number of setae on Both the 2nd exopodal segment of the first thoracic appendage and the inner face of each furcal ramus, as well as the shape of the gut diverticula.

Furthermore, the total length (± SD) of the carapace was measured for each specimen, and the sex was checked by verifying the presence of a fully formed penis or a rudimentary one on the 1st abdominal somite; the penis was measured under a transmitted light microscope. The presence of eggs in females was noted, and the number of eggs per specimen was estimated.

Pictures of each specimen were taken with a Nikon D780 camera equipped with a Nikon 105 mm macro lens and two Neewer Speedlight NW562 external strobes and with the microscopes equipped with a Leica ICC50W camera via Leica Acquire software.

In addition, an extensive dataset of ROV footage was analysed for the present study. The dataset, accounting for 637 ROV videos and about 29,000 pictures, was collected during a series of scientific campaigns carried out between 2006 and 2022 along the Italian coast (western Mediterranean Sea), from the Ligurian Sea to the Sicily Channel, at mesophotic and bathyal depths down to 2000 m. Fifty-five wrecks and twelve offshore seamounts up to 70 miles from the coasts (six in the Ligurian basin, four in the central Tyrrhenian Sea, and two in the southern Tyrrhenian Sea) were included in the analysis.

The occurrence of *P. larix* forests was evaluated in all sites. The ROV footage of sites hosting forests was analysed to note the presence of *S. mira* specimens. When the crustacean was detected, all the black coral colonies of the site were counted. Given the small size of the target species, only the colonies suitable (i.e., sufficiently close and in focus) for a detailed investigation were considered to obtain the following additional information: depth, health status of the host colony, presence and number of crustaceans per colony. In addition, the minimum and maximum depths of the black coral colonies in the same areas were noted. These data were used to calculate the average percentage of infested colonies (± SE), the average number of individuals per infected colony (± SE), and the influence of the host health status (i.e., presence of necrotic or epibionted ramifications) in the presence of the parasite. Pictures, when present, were used to better describe the behavioural ecology of this species. The repetition of the ROV investigation at La Botte 1 site in the Pontine Archipelago gave the chance to investigate the temporal changes over seven years (2014–2021) in the occurrence of the parasitic crustacean.

Results

Analysis of the specimens

The twelve analysed specimens maintained the bright yellow colour of the valves since their collection (Fig. 1a-c). The carapace is rounded, smooth, and partially translucent, so much so that in females eggs are visible in transparency (Fig. 1b). The valves encompass the whole body of the animal (Fig. 1a-d), but when they are slightly open, thoracopods and telson stick out from the carapace (Fig. 1c). The specimens perfectly fit Norman's original description of *Synagoga mira* (1913) and the typical taxonomic characters of the species identified by Kolbasov and Newman (2019). The main observed characters regarded the antennules: the 4th segment is subtriangular, and the 5th segment is about the same length as the 6th (Fig. 1e), the two strong setae on the 4th segment are armed with many short spines (Fig. 1f), while the anterior margin of the 5th segment is ornamented with around 15 setae (Fig. 1g). In addition, around 18 setae are present on the 2nd exopodal segment of the first thoracic appendage, and around 14 setae are present on the inner face of each furcal ramus (Fig. 1h). Also, gut diverticula, W-shaped and without major ramifications, fit the type description (Fig. 1b, i).

Seven individuals out of 12 were females (recognisable by the rudimentary penises) (Fig. 1j), four of which carried eggs (estimated to be more than 120 for each individual) (Fig. 1d, k). The remaining five specimens were males, recognisable by well-developed penises (Fig. 1l); therefore, the male proportion (i.e., males/(males + females)) in the sampled group was 0.42. On average, the carapace length of non-ovigerous females was 3.3 ± 0.6 mm, ranging from 3.0 to 4.0 mm, while ovigerous females were 3.9 ± 0.4 mm long, ranging from 3.5 to 4.3 mm. Males were, on average, 2.8 ± 0.4 mm long, ranging from 2.2 to 3.3 mm. Male penises were, on average, 0.7 ± 0.1 mm, ranging from 0.5 to 0.8 mm, and deeply forked at the distal end (Fig. 1m). The shape of the carapace showed no relevant differences between sexes.

Geographical and bathymetrical distribution

Populations of *Parantipathes larix* were reported in 78 sites along the Italian coast (about 12% of the investigated sites). The ROV footage analysis allowed recording specimens of *S. mira* in 15 sites (corresponding to 19.2% of the total sites with the black coral) grouped in three areas of the Tyrrhenian Sea (Table 1), namely: i) Tuscan Archipelago (2 sites near Montecristo Island, about 350 km North-West from the northern headland of the Gulf of Naples, where the species was described). This is the area where *S. mira* was reported as an ostracod by Bo et al. (2014). ii) The Pontine Archipelago (12 sites between Ponza, Palmarola, Zannone, Botte Shoal, and Ventotene, about 80 km North-West from the northern headland of the Gulf of Naples). iii) Acciaroli (one site, Candelieri Shoal, about 80 km South-East of the southernmost headland of the Gulf of Naples).

Over 1400 colonies of *P. larix* were counted in these 15 sites, of which 320 were suitable (i.e., sufficiently close and in focus) for investigating the presence of *S. mira*. On average, suitability was 23.8 ± 2.5% of the total colonies, varying between 9.7% (Ventotene) and 44.4% (Candelieri Shoal) (Table 2). In the Tuscan Archipelago, *S. mira* specimens were recorded on 13 *P. larix* colonies, between 155

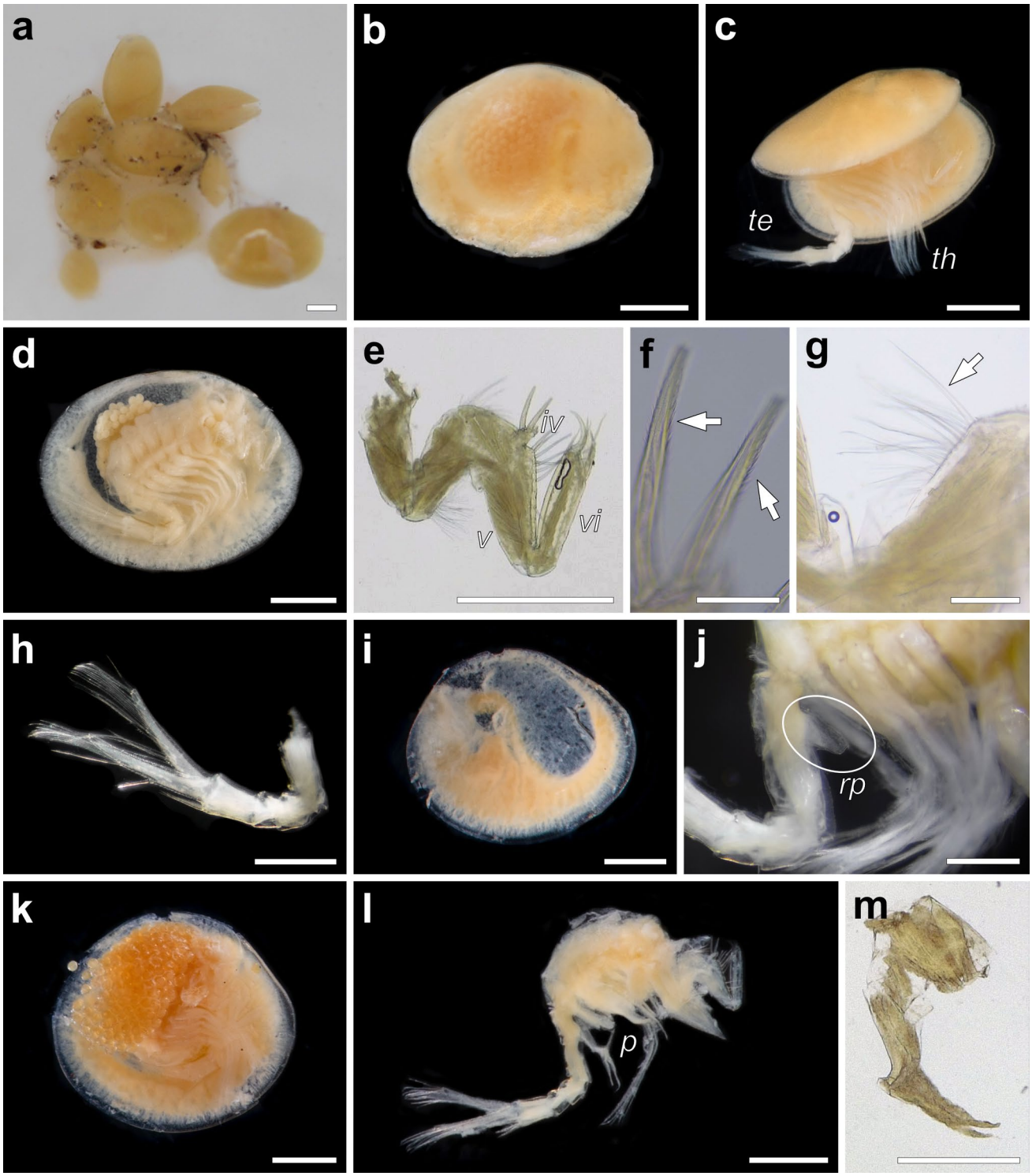

Fig. 1 *Synagoga mira* collected specimens: a, some living, freshly collected individuals; b, a large preserved ovigerous female encompassed in its carapace (eggs are visible in transparency); c, thoracopods and telson protrude from the carapace; d, an ovigerous preserved female in its position (right valve and most of the eggs removed); e, antennule (4th, 5th and 6th segments indicated by roman numbers); f, detail of the many short spines on the two strong setae of the 4th segment of the antennule, also indicated by arrows; g, details of the long and thin setae on the 5th segment of the antennule, indicated by the arrow; h, dissected abdomen showing the telson ornated with around 14 setae on the inner face of each furcal ramus; i, gut diverticula visible on a right valve; j, detail of the rudimentary penis of a female specimen; k, the ovigerous female (right valve removed) with the highest number of counted eggs (122); l, a male removed from its carapace, showing the penis; m, the extracted penis. Legend: *p, penis, rp, rudimentary penis; te, telson; th, thoracopods*. Scale bars: a—d, i, k, l: 1 mm; e, h, j, m: 0.5 mm; f: 0.05 mm; g: 0.1 mm

Table 1 Summary of the sites where *Synagoga mira* was observed

Area	Site	Dive Code	Latitude (°)	Longitude (°)	Dive min–max depth (m)	*P. larix* min–max depth (m)
Tuscan Archipelago	Cassaforte Shoal	Dive 31 MIPAAF 2012	42.243	10.034	160–170	160–170
	Panozzo Shoal	Dive 35 MIPAAF 2012	42.171	10.177	145–200	150–190
Pontine Archipelago	Zannone N 1	Dive 15 MSFD 2021	41.017	13.046	137–147	141–146
	Zannone N 2	Dive 5 MSFD 2021	41.009	12.996	132–148	132–147
	Zannone N 3	Dive 4 MSFD 2021	41.008	12.997	135–167	138–163
	Zannone E	Dive 22 MSFD 2021	40.918	13.056	171–262	171–251
	Palmarola 1	Dive 11 MSFD 2021	40.988	12.814	125–152	136–150
	Palmarola 2	Dive 10 MSFD 2021	40.984	12.836	115–148	140–147
	Palmarola 3	Dive 6 EU-ENPI 2014	40.933	12.755	155–162	155–162
	Ponza 1	Dive 5 EU-ENPI 2014	40.957	12.987	100–120	108–118
	Ponza 2	Dive 8 EU-ENPI 2014	40.933	12.957	100–120	108–117
	La Botte 1	Dive 13 EU-ENPI 2014	40.844	13.083	70–165	139–164
	La Botte 2	Dive 7 MSFD 2021	40.834	13.096	115–141	123–141
	Ventotene	Dive 20 MSFD 2021	40.793	13.368	139–159	144–151
Acciaroli	Candelieri Shoal	Dive 3 MIPAAF 2012	40.074	14.876	130–135	130–135

Table 2 Summary of the records of *Synagoga mira* on host colonies of *Parantipathes larix.*

Area	Site	Total n. of host colonies	Total n. of suitable host colonies	Total n. of infected colonies	Total n. of unhealthy colonies	N. of unhealthy colonies with *S. mira*
Tuscan Archipelago	Cassaforte Shoal	128	24	5	0	0
	Panozzo Shoal	130	27	8	0	0
Pontine Archipelago	Zannone N 1	53	10	4	2	1
	Zannone N 2	97	13	6	3	1
	Zannone N 3	49	10	4	2	2
	Zannone E	194	35	14	0	0
	Palmarola 1	107	19	9	2	1
	Palmarola 2	34	11	5	0	0
	Palmarola 3	41	16	5	0	0
	Ponza 1	120	37	13	2	1
	Ponza 2	132	24	6	1	0
	La Botte 1	160	53	33	4	2
	La Botte 2	83	18	9	1	1
	Ventotene	72	7	4	1	1
Acciaroli	Candelieri Shoal	36	16	11	0	0

and 170 m depth (Fig. 2a). In the Pontine Archipelago, individuals were observed on 112 colonies, between 109 and 251 m (Fig. 2b), and in Acciaroli they were observed on 11 colonies, between 131 and 134 m depth (Fig. 2c). *Parantipathes larix* forests depth ranges were 150–190, 108–251, and 130–135 m in the Tuscan Archipelago, the Pontine Archipelago, and Acciaroli, respectively. The percentage of infested colonies was, on average, 42.6 ± 3.4% of the suitable colonies, varying between 20.8% (Cassaforte Shoal) and 68.8% (Candelieri Shoal) (Table 2). In the Pontine Archipelago, the infestation was observed in 25.0% to 62.3% of the suitable colonies (on average, 43.0 ± 3.0%), with La Botte 1, 2 and Ventotene showing the highest values (Table 2). At the site of La Botte 1, the percentage of infestation showed no evident changes in the considered period (62.3% in 2014 and 61.5% in 2021).

In situ *observations*

Overall, 666 individuals were counted in the ROV footage, of which 588 (88.3%) were recorded in the Pontine Archipelago, followed by Acciaroli (8.2%) and the Tuscan

Archipelago (3.4%). On average, an infested *P. larix* colony hosted at least 4.9 ± 0.2 crustaceans. Some differences were observed on a regional basis. A maximum of three individuals (on average, 1.8 ± 0.2) per colony were recorded in the Tuscan Archipelago. In contrast, up to 46 (on average, 5.3 ± 0.5) (Fig. 2 d) and nine (on average, 5.0 ± 0.7) individuals were recorded in the Pontine Archipelago and Acciaroli, respectively. In the site of La Botte 1, the number of individuals per infested colonies varied between 3.7 ± 0.5 in 2014 and 5.9 ± 1.4 in 2021.

The crustaceans were vagile and active, moving freely on the black corals' pinnules and branches (Fig. 2e-f); pinnules

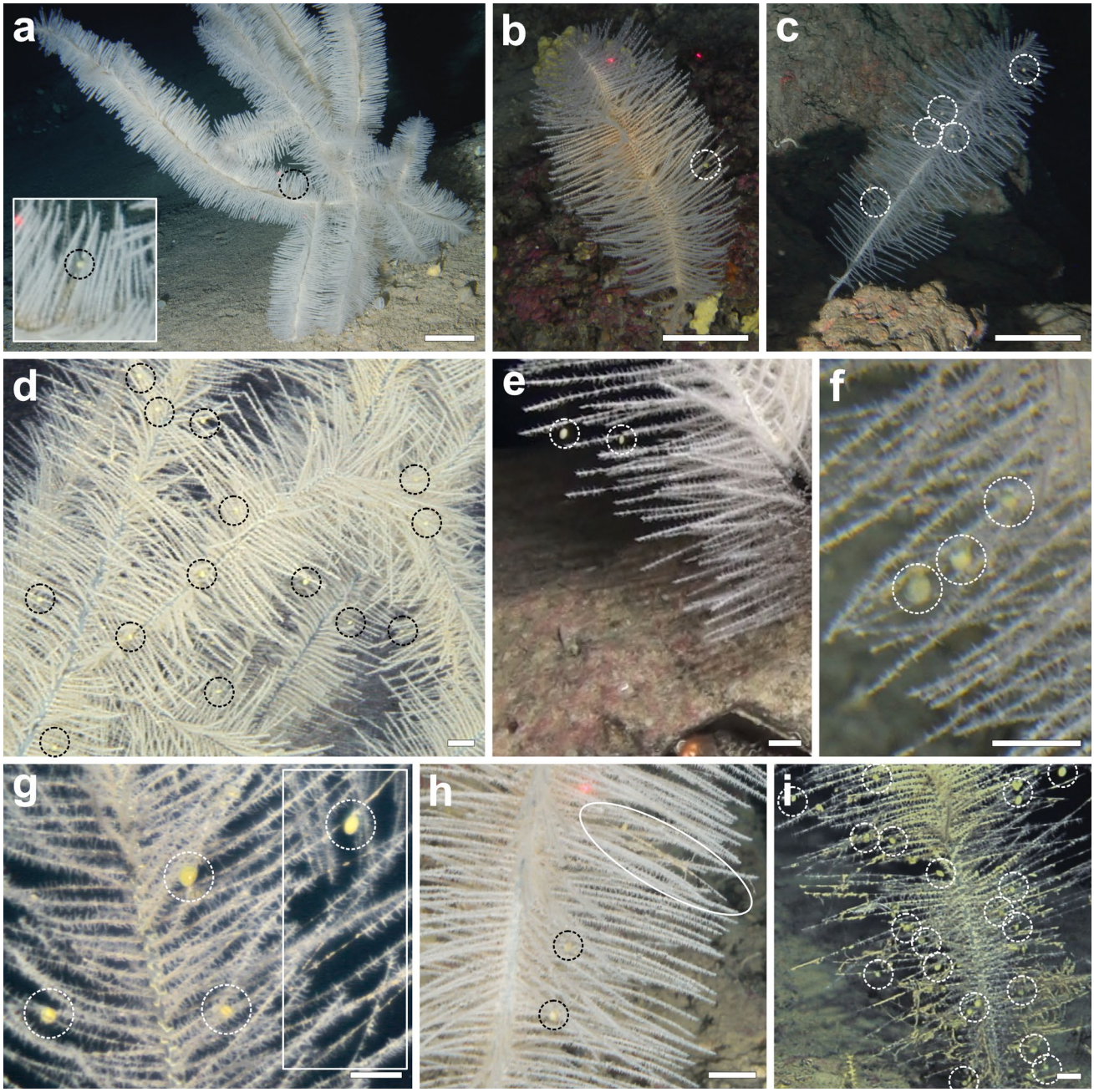

Fig. 2 *Synagoga mira* on *Parantipathes larix* colonies: a, an individual on a large coral in the Tuscan Archipelago (zoom in the inset); b, a fertile *P. larix* colony with one visible parasite in the Pontine Archipelago; c, an infested colony in Acciaroli; d, numerous individuals on a portion of a large colony; e, two individuals freely moving along the pinnules; f, three crustaceans on the same pinnule; g and h, two infested colonies showing the possible effect of *S. mira* grazing; i, an epibionted colony showing high levels of infestation and grazing damages. Pictures d—i from the Pontine Archipelago. Dotted circles indicate the most visible individuals; oval and square indicate grazed pinnules. Scale bars: a—c: 10 cm; d—i: 1 cm

with parasites often appeared partially devoid of coenenchyme (Fig. 2g, h).

The health status of the colonies hosting *S. mira* varied in the three considered areas. In the Tuscan Archipelago, *S. mira* was recorded only on healthy colonies since the population of *P. larix* showed no traces of necrosis or epibiosis (Tab. 2; Fig. 2a). In the Pontine Archipelago, about 7.1% of the investigated *P. larix* colonies were unhealthy, of which 55.6% hosted the parasite (Tab. 2). Some of these colonies could be heavily infested (Fig. 2i), with the grazing traces partially mixing up with the necrotic portions. About 92.9% of the colonies were healthy, of which 42.6% hosted the parasite. Finally, in Acciaroli, all colonies, with or without parasites, were healthy (Tab. 2).

Discussion

The dissection of the collected specimens confirms, beyond any doubt, that they belong to *S. mira*. Thoracopods' and telson's ability to stick out from the carapace, as well as observations from ROV images, confirm that *S. mira*, like the congeneric *Synagoga arabesque* Kolbasov, Petrunina, Ho & Chan, 2019 and *Synagoga grygieri* Kolbasov & Newman 2018, can freely move on the coral branches, and they can all be considered micropredators more than true parasites (Kolbasov and Newman 2019; Kolbasov et al. 2019). The marks of the feeding activity of the crustaceans are often visible in infested colonies and can add up to other stressors, inducing necrosis in some portions of the hosts. It is interesting to note that specialised predators of Antipatharia are rare (Wagner et al. 2012; Bo et al. 2019a, b), probably because of the poor nutritive quality of the coral, as well as the presence of stinging cells, acontias, defensive mucous, and spines on the chitinous skeleton. Therefore, the genus *Synagoga*, with at least three species of specialised Antipatharia feeders, appears to have specifically evolved to take advantage of a poorly exploited feeding niche. Interestingly, in the Mediterranean Sea, only two out of the four more common black coral species were observed to suffer from more or less specialised feeders. *Antipathella subpinnata* (Ellis & Solander, 1786) commonly hosts the strictly symbiotic flatworm *Anthoplana antipathellae* Bo & Betti, 2019 (Bo et al. 2019a), while *P. larix* is subjected to the feeding activity of *S. mira* and, more occasionally, that of the goniasterid sea star *Peltaster placenta* (Müller & Troschel 1842) (Bo et al. 2019b).

No information was previously available regarding the sex ratio of the species. Despite the very small number of examined specimens, the present study might suggest a sex ratio close to 1:1. These latters are easily recognisable by the larger size, the vestigial penis and, when ovigerous, by the eggs visible in transparency, as it happens in the congeneric *S. arabesque* and *S. grygieri*, but no clear differences in the carapace and gut diverticula, as reported for the Atlantic species, were observed (Kolbasov and Newman 2019; Kolbasov et al. 2019). Sexual dimorphism in the appendages was not investigated.

ROV investigations confirm the strict association between *S. mira* and *P. larix*. No specimens of *S. mira* were ever reported on the other three common Mediterranean black coral species (*A. subpinnata*, *Antipathes dichotoma* Pallas 1766, and *Leiopathes glaberrima* (Esper, 1792)) analysed in the ROV archive and accounting for more than 250 investigated populations (Bo, pers. comm.). Therefore, the host specificity of *Synagoga* species is confirmed, at least for those with a known benthic host (Kolbasov and Newman 2019).

The large number of analysed *P. larix* populations (78) and the limited number of sites with *S. mira* (19.2%) suggest that the species is overall, on a large geographical scale, rare (as supposed by Norman 1913). *Parantipathes larix* forests are found all along the western Italian coasts, from the Ligurian Sea to the Sicily Channel, but *S. mira* observations are limited to the Tyrrhenian Sea, in relative proximity to the area where this species was collected for the first time in 1888. This could be related to the fact that *P. larix* forests are more frequent and denser in this basin (Bo et al. 2014; Ingrassia et al. 2016). In particular, the Pontine Archipelago hosts the highest number of forests of the entire Italian coast and also the densest ones (Bo, pers. comm.). In this area were reported i) the highest number of infested colonies (82.4%), ii) infestation rates almost always higher that 40%, and iii) the highest number of individuals (88.3% of the total), supporting the idea that this highly specialised parasite follows its host in the sites with higher colonies' occurrence, becoming locally very frequent and abundant. Moreover, it must be considered that the number of individuals and the maximum number of crustaceans per suitable colony (here reported to be 46 individuals) are plausibly underestimated due to the fact that the ROV usually frames only portions (and one side) of the long bottle-brush colonies, hence supporting much higher values.

This study also investigated the possibility of considering *S. mira* as a proxy of the health status of *P. larix*, an important structuring species at mesophotic depths. This was, for example, hypothesised for *P. placenta* (Bo et al. 2019b; Toma et al. 2024), the other known predator of this black coral. Indeed, mesophotic megabenthic communities, including *P. larix*, in the southern Tyrrhenian area (Pontine Archipelago and Campanian coast) are highly damaged by sedimentation and fishing activities (Bavestrello et al. 2014; Bo et al. 2014; Ingrassia et al. 2016; Angiolillo and Fortibuoni 2020). However, no clear patterns of preference of *S. mira* were reported for healthy and unhealthy coral colonies. Only in the Pontine Archipelago could a slightly

higher preference for epibionted and necrotic colonies be highlighted.

Although only one temporal replica was considered, the comparative data for 2014–2021, in the La Botte 1 site, suggest that the infestation is temporally stable and does not reflect explosive and stochastic blooms of the parasite.

The three species described as exclusively associated with antipatharians are *S. mira* on *P. larix* (currently reported only in the Mediterranean Sea at mesophotic depths), *S. grygieri* on *Antipathella wollastoni* (Gray, 1857) from the Macaronesian Archipelago at shallow depths, and *S. arabesque* on *Myriopathes* cf. *japonica* (Brook, 1889) from Taiwan shallow waters (Kolbasov and Newman 2019; Kolbasov et al. 2019). The occurrence of related parasitic species on Atlantic-Mediterranean and Indo-Pacific black corals supports the Tetian distribution of the involved genera, as also suggested in the case of the polyclad *A. antipathellae* (Bo et al. 2019a) and the genus *Antipathella* itself (Bo et al. 2008), highlighting the intriguing origin of part of the Atlantic-Mediterranean fauna.

Funding Open access funding provided by Università degli Studi di Genova within the CRUI-CARE Agreement. The large ROV dataset employed in the present study was built including observations conducted along the Italian coast during several ROV campaigns. These campaigns were financed by: Ministero dell'Ambiente e della Tutela del Territorio e del Mare (Project 2010, Red Coral); Ministero delle Politiche Agricole, Alimentari e Forestali (Project 2012, "Use of ROV in the management of deep *Corallium rubrum* populations"; L.R. 7 Agosto 2007, no. 7. "Struttura spaziale, di popolazione e genetica dei banchi di *Corallium rubrum* del Mediterraneo centro occidentale"); Istituto Superiore per la Ricerca e la Protezione Ambientale (ISPRA) and Calabrian Regional Council for Environment ("Monitoraggio della Biodiversità Marina in Calabria", grant no. 327 MoBioMarCal); Ministry of Instruction, University and Research (MIUR) (grant no. 2010Z8HJ5M_011 PRIN 2010–2011); Autonomous Region of Sardinia (RAS); Agenzia Regionale per la Protezione dell'Ambiente Ligure (grant no. 127/2015, 109/2016, 110/2017, within the Marine Strategy Framework Monitoring Program, ARPAL n. 177/2014); EU-ENPI CBC MED 2007–2013, "Ecosystem conservation and sustainable artisanal fisheries in the Mediterranean basin" (ECOSAFIMED) (grant no. II-B/2.1/1073); Greenpeace-ISPRA, 2012 "I tesori sommersi del Canale di Sicilia"; D.R.A. Assessorato Territorio Ambiente Regione Siciliana-Asse 3 Linea di intervento 3.2.1.2 of POR FESR Sicilia 2007–2013; Local Management Plan of the Unit Management between Calavà Cape and Milazzo Cape-P0044509, ISPRA-Regione Sicilia; SIA-SIC "Study of the impact on fishing from war and merchant ships wrecks in the Strait of Sicily and in other Sicilian seas"-2010–2012–ISPRA-Regione Sicilia; PRIN (Progetti di Rilevante Interesse Nazionale) project "Tyrrhenian Seamounts ecosystems: an Integrated Study (TySEc)" financed by the Italian Ministry of Research and Instruction and by the Global Census of Marine Life on Seamounts (CenSeam, New Zealand); SIR-MIUR_BIOMOUNT Project (Biodiversity Patterns of the Tyrrhenian Seamounts) (grant no. RBSI14HC9O); Curiosity Driven Project "Lost coral reefs: ancient deep-sea bioherms in a modern world" (2021–2022); "National Biodiversity Future Center–NBFC project", CN_00000033, project funded under the National Recovery and Resilience Plan (NRRP); Marine Strategy DEEP 2021–2023 (ISPRA and CONISMA), monitoring and health status assessment of bathyal cold-water coral reefs and roche du large communities.

Declarations

Competing interests The authors have no relevant financial or non-financial interests to disclose.

Data availability Data related to *Synagoga mira* may be available upon request.

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