Oceanography & Fisheries
Open access Journal
ISSN: 2476-0536

Juniper PUBLISHERS
key to the Researchers

Research Article
Volume 17 Issue 4 - September 2024
DOI: 10.19080/OFOAJ.2024.17.555970

Oceanogr Fish Open Access J

Notes on *Pyrosoma Atlanticum* Péron, 1804 with a Revision of the Deep-Sea Taxon in the Mediterranean Basin

Christina Brissimi[1], Martha Pantelidou[1], Athanasios A Kallianiotis[2], Pavlos Vidoris[2], Chryssanthi Antoniadou[1] and Chryssa Anastasiadou[2]*

[1]*Department of Zoology, School of Biology, Aristotle University, Greece*

[2]*Hellenic Agricultural Organization "Demeter", Fisheries Research Institute, Nea Peramos, Greece*

Submission: August 30, 2024; **Published**: September 17, 2024

Corresponding author: Chryssa Anastasiadou, Hellenic Agricultural Organization "Demeter", Fisheries Research Institute, GR64007, Nea Peramos, Kavala, Greece

Abstract

Pyrosomes are common in tropical and sub-tropical ocean waters, but little is known about their abundance, distribution, and trophic ecology in mid-latitude systems. Despite *Pyrosoma atlanticum* being the only species found in the Mediterranean Basin, little attention has been given so far to its biology and ecology in this region. In case the oceanographic conditions are favorable, it proceeds to the formation of large blooms, which have become more often in the last few years and have attracted the interest of the scientific community. The species displays high clearance rates, large fecal pellet production, diel vertical migration and benthic food source. Consequently, the contribution in carbon transport to the ocean bottom and benthic-pelagic coupling can be assumed, even though limited attention is given to these matters. In this current contribution, the species records in the Mediterranean basin are given, and new data regarding the species presence, abundance, colonies' length, and depth are presented.

Keywords: Pyrosomes; Pelagic tunicates; distribution; southern Aegean Sea; Eastern Mediterranean

Abbreviations: DVM: Diel Vertical Migration; S1: Station 1; S2: Station 2; CTWW: Colony Total Wet Weight; CTL: Colony Total Length; CTW: Colony Total Width; DW: Dry Weight; BS: Buccal Siphon; BB: Branchial Basket

Introduction

Pyrosoma atlanticum (Tunicata, Thaliacea) is a colonial pelagic tunicate and one of the most common species of the order *Pyrosomatida*, which consists of three genera (*Pyrostremma*, *Pyrosomella*, and *Pyrosoma*) and 8 species (*Pyrostremma spinosum, Pyrostremma agassizi, Pyrosomella verticillata, Pyrosomella operculata, Pyrosoma atlanticum, Pyrosoma aherniosum, Pyrosoma ovatum, and Pyrosoma godeauxi*) [1]. *Pyrosomatida* is the only colonial order in class *Thaliacea*, thus each colony is consisted of thousands of individual zooids encased in a common gelatinous tunic, while each zooid has a buccal and an atrial siphon [2]. P. *atlanticum* colonies are typically cylindrical and finger-shaped, having a transparent pink coloration [1]. Pyrosomes are known to produce biolumincence, which is the cause of its etymology: *pyrosoma* means fire body, derived from the greek words πύρο (pyro-)= fire and σώμα (soma) = body. Pyrosomes belong to the gelatinous zooplankton, often a neglected part of the planktonic community, resulting in a decreased scientific interest regarding these taxa, despite their worldwide distribution and their significant role in the food webs [3].

The species is considered cosmopolitan with its geographical distribution ranging from 50°N to 50°S [1], including the Atlantic Ocean, the Pacific Ocean, the Indian Ocean and the Mediterranean Basin. Among the entire order, P. *atlanticum* is the only *pyrosomatid* representative, which inhabits in the Mediterranean [4-6], although observations in this zoogeographic area are few and scattered. In the northwestern Pacific Ocean, especially in the Northern California Current, a lot of attention has been given to the species since early [7,8], while recently P. *atlanticum* blooms were found outside of the species natural geographical range [9], in northern areas of the Pacific Ocean, possibly after the large marine heat waves that occurred in the area [10,11]. The result was an increased research effort focused in investigating the ecological implications of these blooms [3,10-13].

The vertical distribution of P. *atlanticum* is quite impressive, as the colonies are found near the surface at night but migrate to deeper waters during the day, reaching even the depth of 2500 meters [14,15]. The DVM of P. *atlanticum* has been known to be quite extensive, ranging from 650m [5,14] to 2500m in the Atlantic Ocean [14,16] and from 515m [5] to 900m [17] in the Mediterranean. The species' ability to perform DVM has been a topic of interest among the scientific community, and it has been discovered that the migration depth increases with the colonies' size [5,6]. More specifically, for the small colonies (less than 3mm length) the migration depth found to be 90m while for the large colonies (more than 51 mm length) was recorded up to 760m [5,6,18]. Based on all the available references the hypothesis that P. *atlanticum* blooms occur in waters with high productivity and temperature below 18ºC was constructed [19]. The extensive DVM of the species seems to be an adaptation to a wide range of temperatures, as in warm environments it migrates in greater waters depths, to find the most suitable temperature [19]. However, another possible explanation is that pyrosomes migrate in the surface at nighttime in order to feed, like many other species of zooplankton do [20].

The species functions as an important part of the marine food webs [9,21], because of its role as a filter feeder and its extensive DVM, by transfering substantial amounts of carbon to the sea bottom through fecal pellets [22] and carcasses [21]. *Pyrosoma atlanticum* constitutes a valuable prey for benthic, as well as, for pelagic marine organisms [16,23]. Thirty-three benthic species, belonging to Cnidaria, Arthropoda, Echinodermata and Chordata, have been documented to consume the dead colonies of P. *atlanticum* that fall on the sea bottom, also known as jelly-falls [23]. In addition, five pelagic species, belonging to Cnidaria, Mollusca, and Arthropoda, were repeatedly observed to feed on it, while passively drifting or weakly swimming on the water column [16]. Even though it is a gelatinous organism, therefore having a remarkably high-water content, its carbon content is also unusually high, almost reaching 35% of DW [21]. Thus, its role in the carbon transport to the deep sea is detrimental, despite what was previously believed.

The mechanism causing pyrosomes' bioluminescence has not been fully elucidated yet [24], although the scientific interest concerning this subject has increased. The source of light production is located in each zooid of the colony, as it contains two spherical luminescent organs near the buccal siphon [2]. The hypothesis that the origin of bioluminescence is bacterial was supported since early [25-27]. Bacterial luciferase activity caused by Photobacterium in *Pyrosoma* sp. and was first discovered by [26]. Additional observations of numerous luminous organelles clearly seen inside the luminescent organs, were believed to be intracellular luminescent bacteria [25,27]. Further evidence supporting this hypothesis was recently published [24], contributing to the conclusion that the luminescence of P. *atlanticum* is of bacterial origin. However, around the same time, it was discovered that P. *atlanticum* bears a luciferase gene similar to the luciferase gene of Renilla reniformis [28]. Thus, the hypothesis that P. *atlanticum* is capable of producing light of its own was assessed using transcriptomics, phylogenetics, protein expression, and immunohistochemistry data [28]. Due to these contradictory findings, a certain conclusion about the mechanism of bioluminescence cannot be made yet, and hopefully new studies will be published to shed light on this matter. The aim of this study is to review the existing references on P. *atlanticum* in the Mediterranean Basin and contribute to the knowledge of the species distribution, biology and ecology.

Methods

On 24-25 August 2023, in total, twenty-five specimens of P. *atlanticum* were caught during an experimental bottom trawl survey (Fisheries & Sea Operational Program 2014 - 2020, «Innovation in Fisheries» project) at two locations of southern Aegean Sea: S1, at 664.8m of mean depth in the eastern Karpathian Sea; coordinates: 35°51.431'N, 027°34.879'E and S2, at 653.6 m of mean depth in the northern Sea of Kastelorizo, near Rhodes Is.; coordinates: 36°29.315'N, 028°24.361'E. Sampling was conducted by means of the scientific bottom otter trawl net MedITS, following a consistent and standardized protocol which is described by [29-31] and the MEDITS Handbook [32] approved by international authorities (EU). Individuals were preserved in 98% ethanol and kept at -20°C on board fishing vessel prior to examination. In the laboratory, morphometric measurements were taken to the nearest 0.01mm using digital calipers. Colony Total Wet Weight was measured to the nearest 0.01 g, using an electronic balance PIONEER PX124/E. The list of morphometric measurements includes CTWW: Colony Total Wet Weight; CTL: Colony Total Length; CTW: Colony Total Width. All specimens were photographed and stored in the marine fauna collection of Dr Anastasiadou in the FRI's premises (Catalogue No: PyrATL1 and PyrATL2. Species identified by means of specialized key [1]. Specimens were assessed and photographed (Figure 1(a-f)) in micro-stereoscope NIKON SMZ800N system and in the microscope KERN OBN135.

Results and Discussion

Extensive surveys in the Mediterranean Basin that focus on P. *atlanticum* are few (Figure 2) with the exceptions of [17,18,33] in the Ligurian Sea (north-western Mediterranean). On the contrary, in the eastern Mediterranean, only scattered records of P. *atlanticum* presence are available, often given without exact locations e.g., [34] in the Levantine Sea (around Cyprus) and [4] somewhere between Malta and Crete. The species was considered absent until [4] recorded its existence. Recently, [35] report the species from the northeastern Levantine Sea and the northeastern Aegean Sea. It should be noted that little information is provided about the species biology and/or ecology in these studies, leading to a large gap of knowledge on P. *atlanticum* in this region (Figure 2).

How to cite this article: Christina B, Martha P, Athanasios A K, Pavlos V, Chryssanthi A, et al. Notes on *Pyrosoma Atlanticum* Péron, 1804 with a Revision of the Deep-Sea Taxon in the Mediterranean Basin. Oceanogr Fish Open Access J. 2024; 17(3): 555970. DOI:10.19080/OFOAJ.2024.17.555970

Figure 1(a): Macroscopic view of five *Pyrosoma atlanticum* colonies from S1.

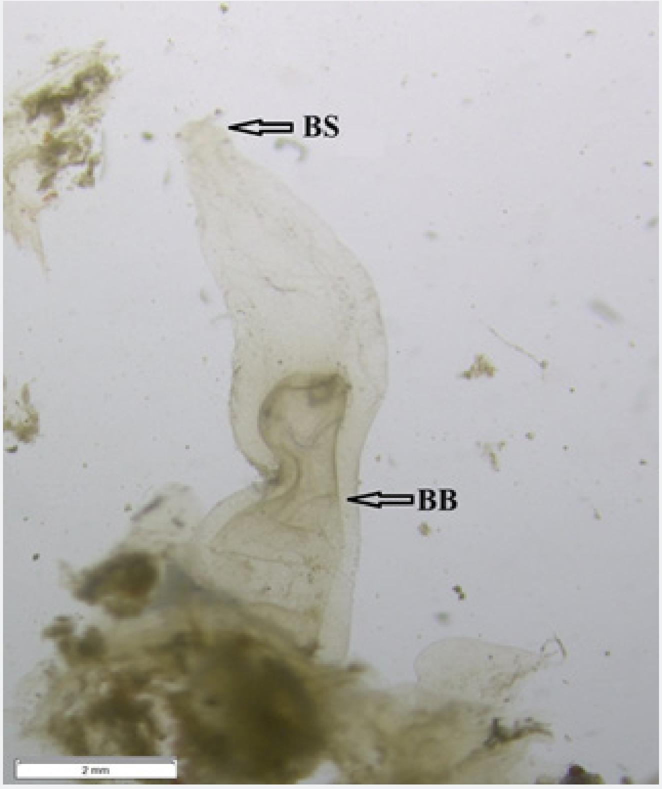

Figure 1(b): Stereoscopic view of a zooid. Arrows indicate the buccal siphon (BS) and branchial basket (BB), scale: 2mm.

How to cite this article: Christina B, Martha P, Athanasios A K, Pavlos V, Chryssanthi A, et al. Notes on *Pyrosoma Atlanticum* Péron, 1804 with a Revision of the Deep-Sea Taxon in the Mediterranean Basin. Oceanogr Fish Open Access J. 2024; 17(3): 555970. DOI:10.19080/OFOAJ.2024.17.555970

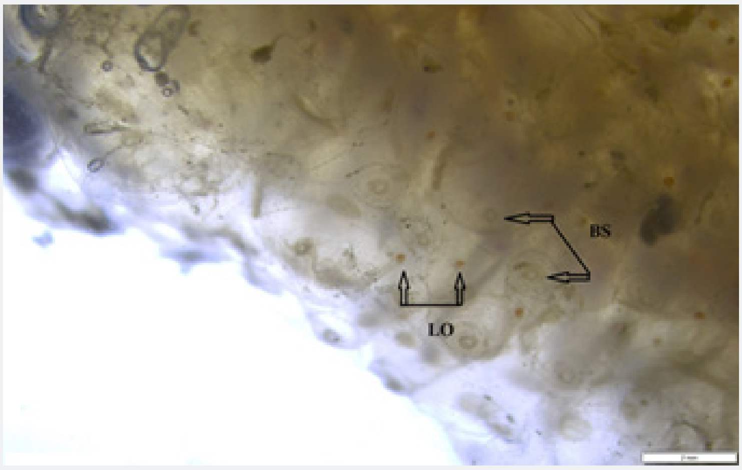

Figure 1(c): Lateral view of colonial margins. Arrows indicate buccal siphons (BS) of the zooids and possibly luminescent organs, (LO), scale: 2mm.

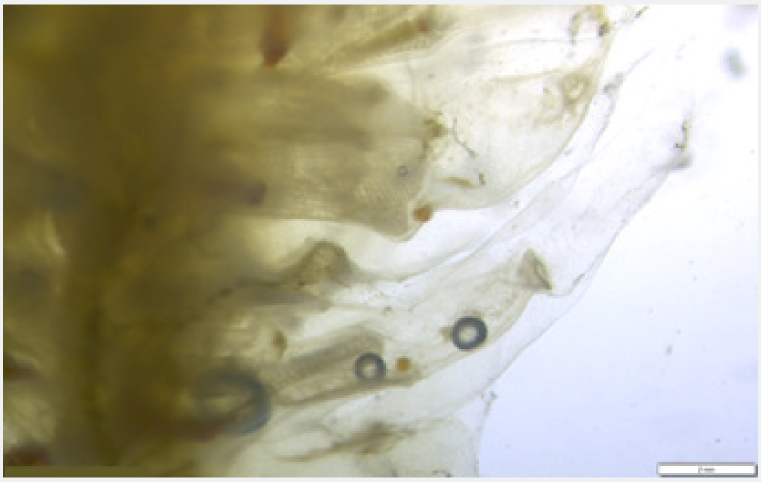

Figure 1(d): Stereoscopic detailed view of the colonial zooids, scale: 2mm.

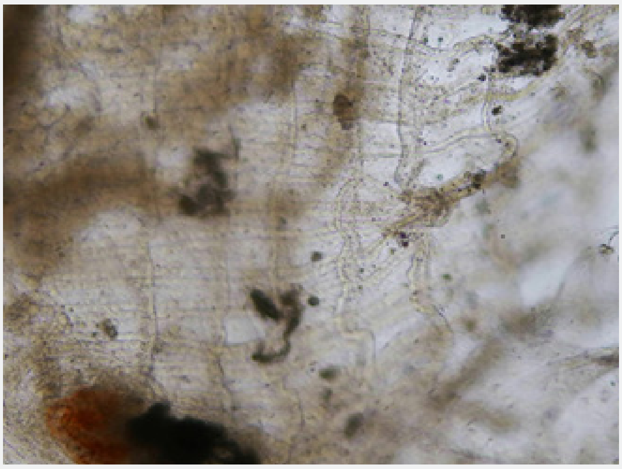

Figure 1(e): Microscopic view of the branchial basket, X100.

How to cite this article: Christina B, Martha P, Athanasios A K, Pavlos V, Chryssanthi A, et al. Notes on *Pyrosoma Atlanticum* Péron, 1804 with a Revision of the Deep-Sea Taxon in the Mediterranean Basin. Oceanogr Fish Open Access J. 2024; 17(3): 555970. DOI:10.19080/OFOAJ.2024.17.555970

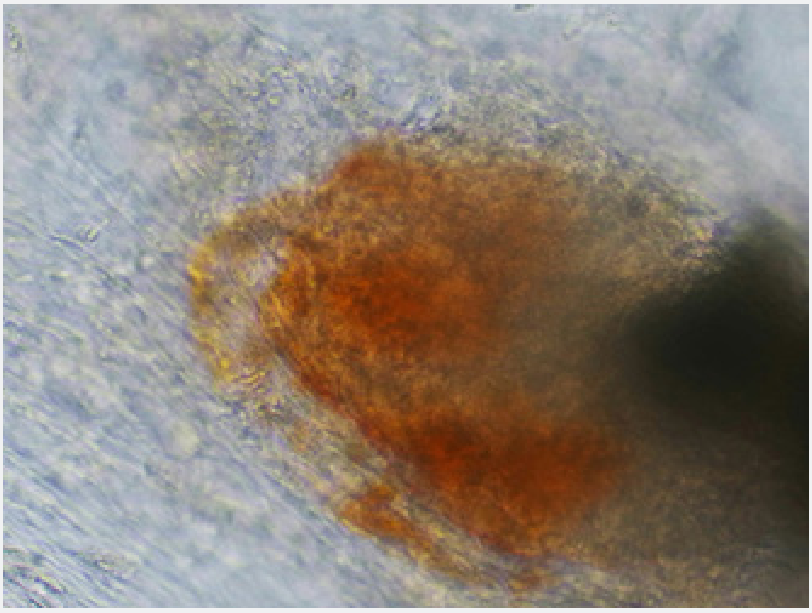

Figure 1(f): Microscopic view of the luminescent organ, x400.

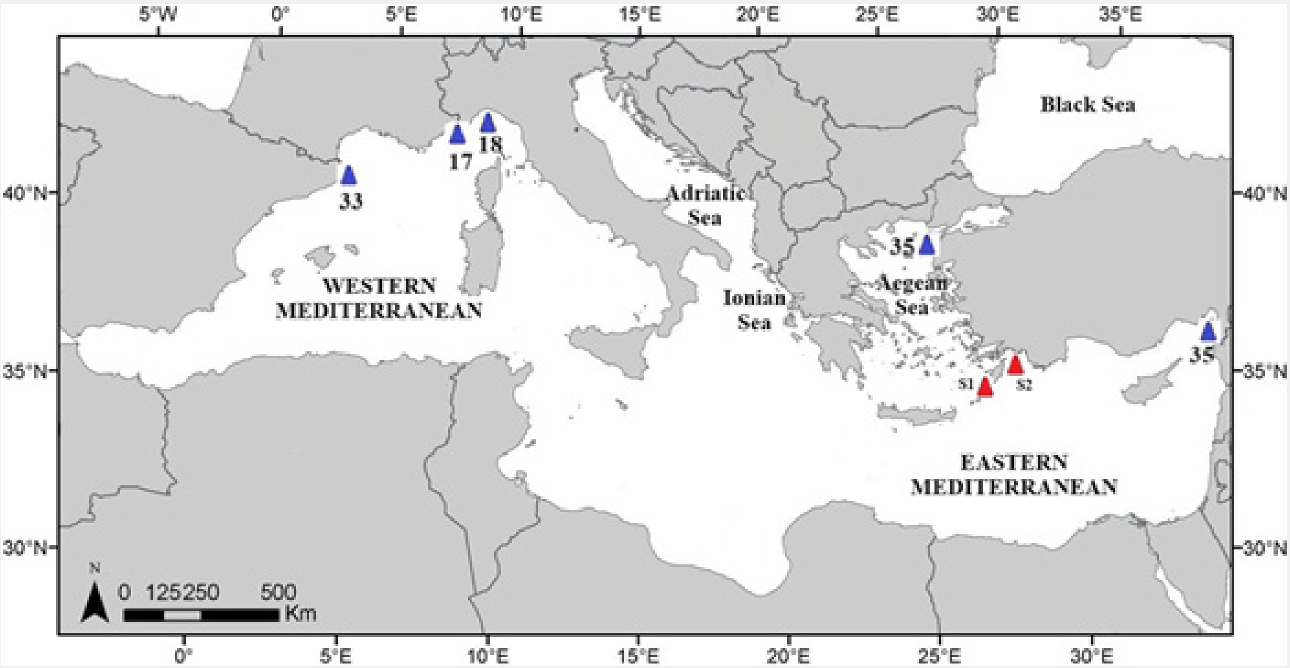

Figure 2: Pyrosoma atlanticum in the Mediterranean Basin according to published records (blue triangles) and to present study (red triangles). Numbers correspond to references. S1, S2: sampling locations of the present study. The map was gener-ated with ArcGIS (http:// desktop.arcgis.com/en/) (version 10.8.2).

The varimetric measurements of the 25 colonies of P. *atlanticum* that were captured during the bottom-trawl survey in the southern Aegean Sea are given in (Table 1). For S1, mean Colony Total Wet Weight was 2.69gr, mean Colony Total Length was 61.41mm and mean Colony Total Width was 16.58mm. For S2, mean Colony Total Wet Weight was 3.16gr, mean Colony Total Length was 55.23mm and mean Colony Total Width was 17.27mm. The varimetric measurements did not differ between stations,

How to cite this article: Christina B, Martha P, Athanasios A K, Pavlos V, Chryssanthi A, et al. Notes on *Pyrosoma Atlanticum* Péron, 1804 with a Revision of the Deep-Sea Taxon in the Mediterranean Basin. Oceanogr Fish Open Access J. 2024; 17(3): 555970. DOI:10.19080/OFOAJ.2024.17.555970

although S1 was located in the eastern Karpathian Sea and S2 was located in the northern Sea of Kastelorizo. The majority of the colonies in this study (84%) were sexually mature, as they were above 40 mm, which is the reproductive size of P. *atlanticum* [1].

Table 1: Varimetric measurements of P. atlanticum colonies from the two sampling locations: S1, eastern Karpathian Sea and S2, northern Sea of Kastelorizo. Mean values are also given per station.

Station	Colony Total Wet Weight (gr)	Colony Total Length (mm)	Colony Total Width (mm)
S1	4.5	73.9	24.36
S1	-3.13	54.34	20.6
S1	3.01	81.76	12.81
S1	1.73	48.74	12.89
S1	1.11	48.33	12.24
Mean (S1)	2.696	61.414	16.58
S2	7.4	100.76	26.72
S2	8.9	83.18	24.92
S2	4.4	79.13	17.25
S2	5.75	77.73	21.39
S2	5.01	55.92	24.59
S2	2.87	66.75	14.29
S2	3.57	65.38	16.36
S2	3.47	56.78	17.48
S2	1.89	56.37	12.99
S2	3.38	50.76	17.7
S2	3.03	44.57	21.57
S2	3.56	50.26	21.99
S2	2.36	53.35	17.72
S2	1.12	47.66	11.55
S2	1.42	41.51	14.07
S2	2.07	40.01	18.91
S2	1.25	34.41	13.34
S2	0.95	32.54	14.11
S2	0.49	37.31	8.81
S2	0.5	30.37	9.65
Mean (S2)	3.1695	55.2375	17.2705

In general, colony abundance and size vary greatly among areas and studies (Table 2). *Pyrosoma atlanticum* has been reported to reach a maximum of 41000 colonies / 1000m^3 [22] or 110510 colonies / 1000m^2 [16] and 780mm in length [13]. Although colony abundance is reported from most studies, the use of arbitrary measurement units, such as colonies / 1000m^3 or colonies / 1000m^2 (due to different sampling methods), by every author and the lack of an accepted definition of pyrosome bloom, make it difficult to compare results from different studies [19]. Subsequently, it was suggested that that in order to classify an aggregation as 'bloom' it should reach a minimum of 100 colonies / 1000m^3 if the length is above 100mm, and a minimum of 1000 / 1000m^3 if the length is below 10mm [19]. In our case the abundance estimated for the S1 to be 1,41 colonies / 1000m^2 and for S2 to be 0,088 colonies / 1000m^2. In our case, the low abundances cannot justify the characterization 'bloom'. It is the lowest abundance recorded (regarding this particular measurement unit: colonies per 1000m^2), as the rest of the studies reported much larger abundances e.g., es, such as 111 colonies / 1000m^2 [17], 400 colonies / 1000m^2 [12], 98000 colonies / 1000m^2 [18], and 110510 colonies / 1000m^2 [16].

How to cite this article: Christina B, Martha P, Athanasios A K, Pavlos V, Chryssanthi A, et al. Notes on *Pyrosoma Atlanticum* Péron, 1804 with a Revision of the Deep-Sea Taxon in the Mediterranean Basin. Oceanogr Fish Open Access J. 2024; 17(3): 555970. DOI:10.19080/OFOAJ.2024.17.555970

Table 2: *Pyrosoma atlanticum* maximum colony abundance, colony length range, colony mean length, and maximum depth from different regions, according to the reference review.

Colony Abundance (Colonies / 1000m³ or Colonies / 1000 m*2*	Colony Mean Length (mm)	Maximum Depth (m)	Zoogeographic Regions/Unities	Area	Reference
-	-	125	E Mediterranean	between Malta and Crete	[4]
41000 / 1000m³ (day) 9500 / 1000m³ (night)	-	-	SE Atlantic	450 miles off Congo river mouth	22
111 / 1000m² (day) 75 / 1000m² (night)	-	900 (day) 700 (night)	NW Mediterranean	Ligurian Sea	[17]
14200 / 1000m² (day)	179	-	South Indian	Agulhas Front	[20]
3000 / 1000m³	-	60	NW Pacific	From California to British Columbia	[3,10]
2.85 ± 4.74 / 1000m³	107.92	400 (day) 100 (night)	SW Pacific	Tasman sea	[9]
5000 / 1000m³	136	-	NW Pacific	Northern California Current	[13]
400 / 1000m²	-	-	NW Pacific	Northern California Current	[12]
98000 / 1000m² (day) 12300 / 1000m² (night)	-	600	NW Mediterranean	Ligurian Sea	[18]
110510 / 1000m² (day) 8370 / 1000m² (night)	-	700 (day) 350 (night)	NE Atlantic	Cabo Verde	[16]
2.06 ± 2.09 / 1000m³	-	>600 (day) >600 (night)	SW Atlantic	Northeastern Brazil	[36]
228.7 / 1000m³	-	550	NW Mediterranean	Ligurian Sea	[33]
1,41 0,88	61.41 (S1) 55.23 (S2)	664.8 (S1) 653.6 (S2)	E Mediterranean	Southern Aegean Sea	Present study

In our samples, colonies' mean length (56.47mm) was smaller in comparison to other studies (Table 2), as most of them recorded greater for example 107.92mm [9], 136mm [13], 179mm [20]. Our data revealed that colonies of P. *atlanticum* from southern Aegean Sea were found in 653,6 m (S2) and 664,8 m (S1) mean depths during the day, which falls within the normal range of the species' daytime distribution. Alike, other research efforts located the species during daytime samplings at similar depths, such as 550m [33], 600m [18], 600m or more [36], 700m [16].

The rare records of P. *atlanticum* in the eastern Mediterranean Sea and its limited research could be attributed to several causes: sampling bias, insufficient interest of the scientific community combined with insufficient funding, the difficulty to identify taxa belonging to gelatinous zooplankton, the sensitivity of colonies to maintain alive for laboratory experiments more than a few hours. Excluding Mediterranean Sea, in other areas such as

How to cite this article: Christina B, Martha P, Athanasios A K, Pavlos V, Chryssanthi A, et al. Notes on *Pyrosoma Atlanticum* Péron, 1804 with a Revision of the Deep-Sea Taxon in the Mediterranean Basin. Oceanogr Fish Open Access J. 2024; 17(3): 555970. DOI:10.19080/OFOAJ.2024.17.555970

North California Current, the species blooms are quite common, so that that research vessels come across it, during samplings. It can be concluded that the species might be less rare than previously thought and its presence may be underestimated in the Mediterranean Basin. Although the species has a vital role in the benthic marine food webs and is harmless both for humans and for other marine organisms, blooms could become a problem for fisheries and harbor unpredicted ecological and economic consequences [10].

Conclusion

The present study reviews all the available existing information on *Pyrosoma atlanticum* in the Mediterranean Basin. Additionally, it gives valuable information of the species colonies sampled from the deep-sea bottom trawling in southern Aegean Sea. The species has been recorded in two locations (E. Karpathian Sea and N. Sea of Kastelorizo) in 653.6m and 664.8m mean depths. Species' abundance was relatively low, in comparison to most of the studies. The majority of P. *atlanticum* colonies was sexually mature although the mean colony length was smaller than typically found. However, further research is needed to investigate many aspects of the biology and ecology of the species and its subsequent implications.

Acknowledgement

The present work is funded from the Fisheries & Sea Operational Program 2014 – 2020, "Innovation in Fisheries" article 26 & 44 par. 3, regulation 508/2014 and is under the framework of the research program "Study of the inhibition of shrimp melanosis: development of a pilot system with applications in Greek fisheries". We are also grateful to captain and staff of the trawler "Megalochari" involved in the survey in the Aegean Sea.

Author Contributions

Conceptualization, C.B., C.A.; methodology, C.A., P.V.; software, C.B., M.P.; validation All Authors; investigation, All Authors; writing—original draft preparation, C.B., M.P., Ch.A., and C.A.; writing—review and editing, C.B., M.P., Ch.A., P.V., A.A.K. and C.A.; visualization, C.B.; supervision, C.A.; project administration, C.A. All authors have read and agreed to the published version of the manuscript.

References

1. Van Soest RWM (1981) A monograph of the order Pyrosomatida (Tunicata, Thaliacea). J Plankton Res 3(4): 603-631.
2. Godeaux J (1985) The Thaliacean faunas of the mediterranean and the red sea. Proceedings "Progress in Belgian Oceanographic Research". Brussels., pp. 451-459.
3. Carvalho P, Bonecker S (2008) Tunicata, Thaliacea, Pyrosomatidae, Pyrosomella verticillata (Neumann, 1909): First record from the southwest Atlantic Ocean. Check List 4(3): 272-274.
4. Sutherland KR, Sorensen HL, Blondheim ON, Brodeur RD, Galloway AWE (2018) Range expansion of tropical pyrosomes in the northeast Pacific Ocean. Ecology 99(10): 2397-2399.
5. Andersen V, Sardou J, Nival P (1992) The diel migrations and vertical distributions of zooplankton and micronekton in the Northwestern Mediterranean Sea 2. Siphonophores, hydromedusae and pyrosomids. J Plankton Res 14(8): 1155-1169.
6. Andersen V, Sardou J (1994) Pyrosoma atlanticum (Tunicata, Thaliacea): diel migration and vertical distribution as a function of colony size. J Plankton Res 16(4): 337-349.
7. Lavaniegos BE, Ohman MD (2003) Long-term changes in pelagic tunicates of the California Current. Deep Sea Res Part II 50(14-16): 2473-2498.
8. Lavaniegos BE, Ohman MD (2007) Coherence of long-term variations of zooplankton in two sectors of the California Current System. Prog Oceanog 75(1): 42-69.
9. Henschke N, Pakhomov EA, Kwong LE, Everett JD, Laiolo L, et al. (2019) Large vertical migrations of Pyrosoma atlanticum play an important role in active carbon transport. J Geophys Res G: Biogeosciences 124(5): 1056-1070.
10. Brodeur RD, Perry I, Jennifer B, Flostrand L, Galbraith M, et.al. (2018) An unusual gelatinous plankton event in the NE Pacific: The Great Pyrosome Bloom of 2017. Technical Report, PICES Press 26(1): 22-27.
11. Miller RR, Santora JA, Auth TD, Sakuma KM, Wells BK, et al. (2019) Distribution of pelagic thaliaceans, Thetys vagina and Pyrosoma atlanticum, during a period of mass occurrence within the California Current. CalCOFI Rep 60: 1-15.
12. O'Loughlin JH, Bernard KS, Daly EA, Zeman S, Fisher JL, et al. (2020) Implications of Pyrosoma atlanticum range expansion on phytoplankton standing stocks in the Northern California Current. Prog Oceanog 188: 102424.
13. Schram JB, Sorensen HL, Brodeur RD, Galloway AWE, Sutherland KR (2020) Abundance, distribution, and feeding ecology of Pyrosoma atlanticum in the Northern California Current. Mar Ecol Prog Ser 651: 97-110.
14. Roe HSJ, Badcock J, Billett DSM, Chidgey KC, Domanski P, et al. (1987) Great Meteor East: a biological characterisation. Institute of Oceanographic Sciences Deacon Laboratory Report, 248 Wormley, UK. Institute of Oceanographic Sciences, p. 260.
15. Angel MV (1989) Vertical profiles of pelagic communities in the vicinity of the Azores Front and their implications to deep ocean ecology. Prog Oceanog 22(1): 1-46.
16. Stenvers VI, Hauss H, Osborn KJ, Neitzel P, Merten V et al. (2021) Distribution, associations and role in the biological carbon pump of Pyrosoma atlanticum (Tunicata, Thaliacea) off Cabo Verde, NE Atlantic. Scientific Reports 11(1): 9231.
17. Sardou J, Etienne M, Andersen V (1996) Seasonal abundance and vertical distributions of macroplankton and micronekton in the Northwestern Mediterranean Sea. Oceanol Acta 19(6): 645-656.
18. Granata A, Bergamasco A, Battaglia P, Milisenda G, Pansera M et.al. (2020) Vertical distribution and diel migration of zooplankton and micronekton in Polcevera submarine canyon of the Ligurian mesopelagic zone (NW Mediterranean Sea). Prog Oceanog 183: 102298.
19. Lilly LE, Suthers IM, Everett JD, Richardson AJ (2023) A global review of pyrosomes: Shedding light on the ocean's elusive gelatinous "fire-bodies". L&O Letters 8(6): 812-829.
20. Perissinotto R, Mayzaud P, Nichols PD, Labat JP (2007) Grazing by Pyrosoma atlanticum (Tunicata, Thaliacea) in the south Indian Ocean. Medio Ambiente y Comportamiento Humano. Mar Ecol Prog Ser 330: 1-11.

How to cite this article: Christina B, Martha P, Athanasios A K, Pavlos V, Chryssanthi A, et al. Notes on *Pyrosoma Atlanticum* Péron, 1804 with a Revision of the Deep-Sea Taxon in the Mediterranean Basin. Oceanogr Fish Open Access J. 2024; 17(3): 555970. DOI:10.19080/OFOAJ.2024.17.555970

21. Lebrato M, Jones DOB (2009) Mass deposition event of Pyrosoma atlanticum carcasses off Ivory Coast (West Africa). Limnol Oceanog 54(4): 1197-1209.

22. Drits AV, Arashkevich EG, Semenova TN (1992) Pyrosoma atlanticum (Tunicata, Thaliacea): grazing impact on phytoplankton standing stock and role in organic carbon J Plankton Res 14: 799-809.

23. Archer Stephanie K, Kahn AS, Leys SP, Norgard T, Girard F, et al. (2018) Pyrosome consumption by benthic organisms during blooms in the northeast Pacific and Gulf of Mexico. Ecology 99: 981-984.

24. Berger A, Blackwelder P, Frank T, Sutton TT, Pruzinsky NM, et al. (2021) Microscopic and Genetic Characterization of Bacterial Symbionts with Bioluminescent Potential in Pyrosoma atlanticum. Front Mar Sci 8: 606818.

25. Bowlby MR, Widder EA, Case JF (1990) Patterns of Stimulated Bioluminescence in Two Pyrosomes (Tunicata: Pyrosomatidae). Biol Bull 179(3): 340-350.

26. Leisman G, Cohn DH, Nealson KH (1980) Bacterial Origin of Luminescence in Marine Animals. Science 208(4449): 1271-1273.

27. Mackie GO, Bone Q (1978) Luminescence and Associated Effector Activity in Pyrosoma (Tunicata Pyrosomida). Proc R Soc Lon 202: 483-495.

28. Tessler M, Gaffney JP, Oliveira AG, Guarnaccia A, Dobi KC et.al. (2020) A putative chordate luciferase from a cosmopolitan tunicate indicates convergent bioluminescence evolution across phyla. Sci Rep 10(1): 17724.

29. Bertrand JA, Gil de Sola L, Papaconstantinou C, Relini G, Souplet A (1997) An international bottom trawl survey in the Mediterranean: the MEDITS Program. ICES CM 1997/Y: 03-16.

30. Bertrand JA, Gil de Sola L, Papaconstantinou C, Relini G, Souplet A (2002) The general specifications of the MEDITS surveys. Sci. mar 66(S2): 9-17.

31. Spedicato MT, Massutí E, Mérigot B, Tserpes G, Jadaud A, Relini G (2019) The MEDITS trawl survey specifications in an ecosystem approach to fishery management. Sci. mar 83(S1): 9-20.

32. Medits Handbook.

33. Pastor-Prieto M, Sabatés A, Raya V, Canepa A, Parraguez TI, et al. (2022) The role of oceanographic conditions and colony size in shaping the spatial structure of Pyrosoma atlanticum in the NW Mediterranean Sea. J Plankton Res 44(6): 996-1011.

34. Weikert H, Godeaux JEA (2008) Thaliacean distribution and abundance in the northern part of the Levantine Sea (Crete and Cyprus) during the eastern Mediterranean climatic transient, and a comparison with the western Mediterranean basin. Helgol Mar Res 62(4): 377-387.

35. Gönülal O, Dalyan C (2017) Bathymetric distribution of macroinvertebrates in the Northeastern Levantine Sea and the Northeastern Aegean Sea based on bottom-trawl surveys. Oceanol Hydrobiol St 46(4): 405-413.

36. Giachini Tosetto EG, Barkokébas Silva BB, Franchesca García Díaz X, Neumann Leitão S, Bertrand A (2022) Thaliacean community responses to distinct thermohaline and circulation patterns in the Western Tropical South Atlantic Ocean. Hydrobiologia 849: 4679-4692.

How to cite this article: Christina B, Martha P, Athanasios A K, Pavlos V, Chryssanthi A, et al. Notes on *Pyrosoma Atlanticum* Péron, 1804 with a Revision of the Deep-Sea Taxon in the Mediterranean Basin. Oceanogr Fish Open Access J. 2024; 17(3): 555970. DOI:10.19080/OFOAJ.2024.17.555970