



Dokumentasi visual dan distribusi biotop spesies opisthobranch di Wilayah Akkum-Erdemli (Turki)

Visual documentation and biotopic distribution of opisthobranch species in the Akkum-Erdemli Region (Türkiye)

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Abstrak

Penelitian ini menyajikan penilaian awal mengenai keanekaragaman siput laut opisthobranch di perairan pesisir Erdemli-Akkum, yang terletak di Teluk Mersin (Mediterrania Timur, Türkiye). Selama penyelaman eksplorasi dengan scuba yang dilakukan antara tahun 2014 dan 2015, tujuh spesies dari berbagai kelompok opisthobranch diamati dan difoto pada beragam biotop laut, termasuk substrat berbatu, dasar berpasir, dan kumpulan makroalga. Taksa yang tercatat meliputi *Goniobranchus annulatus*, *Flabellina rubrolineata*, *Flabellina affinis*, *Cratena peregrina*, *Elysia viridis*, *Aplysia depilans*, dan *Syphonota geographica*. Spesies-spesies ini merepresentasikan keragaman ekologi dan morfologi yang luas dalam subkelas Heterobranchia. Temuan ini berkontribusi pada inventaris faunistik opisthobranch yang terus berkembang di Mediterania Timur serta menyoroti kekayaan ekologi kawasan pesisir Akkum. Penggunaan fotografi in situ terbukti bermanfaat untuk dokumentasi dan identifikasi visual, mendukung studi taksonomi dan ekologi di masa mendatang.

Kata kunci: Catatan fotografi; Mediterania Timur; Nudibranch; Opisthobranchia; Teluk Mersin

Abstract

This study presents a preliminary assessment of opisthobranch sea slug diversity in the coastal waters of Erdemli-Akkum, located in Mersin Bay (Eastern Mediterranean, Türkiye). During exploratory scuba dives conducted between 2014 and 2015, seven species belonging to different opisthobranch groups were observed and photographed across a range of marine biotopes, including rocky substrates, sandy bottoms, and macroalgal assemblages. The recorded taxa include *Goniobranchus annulatus*, *Flabellina rubrolineata*, *Flabellina affinis*, *Cratena peregrina*, *Elysia viridis*, *Aplysia depilans*, and *Syphonota geographica*. These species represent a broad ecological and morphological diversity within the subclass Heterobranchia. The findings contribute to the growing faunistic inventory of opisthobranchs in the Eastern Mediterranean and highlight the ecological richness of the Akkum coastal area. The use of in situ photography proved valuable for documentation and visual identification, supporting future taxonomic and ecological studies.

Keywords: Eastern Mediterranean; Mersin Bay; Nudibranchs; Opisthobranchia; Photographic records

1. Introduction

Opisthobranch mollusks, including nudibranchs, sacoglossans, and sea hares, represent a highly diverse group within the subclass Heterobranchia. Known for their vivid coloration, specialized feeding behaviors, and often intricate ecological relationships, these soft-bodied gastropods have attracted growing scientific interest, particularly due to their role as bioindicators in marine ecosystems (Giacobbe *et al.*, 2007; Templado, 2014).

In recent decades, the Mediterranean Sea has emerged as a hotspot for both native and alien opisthobranch species, a trend influenced by biogeographic connectivity, climate change, and anthropogenic activities (Çinar *et al.*, 2011). The Eastern Mediterranean Basin, including the coasts of Türkiye, remains

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relatively underexplored compared to its western counterpart, especially in terms of small-scale and site-specific faunistic surveys. Local studies are essential not only for biodiversity assessments but also for detecting potential bioinvasions and tracking habitat-specific species associations (Zenetos *et al.*, 2004; Yokeş and Galil, 2006).

Mersin Bay, located along the northeastern margin of the Mediterranean Sea, features a wide range of marine biotopes such as rocky reefs, sandy substrates, and macroalgal beds, all of which are suitable for hosting opisthobranch communities. However, the region's opisthobranch fauna has received limited attention in the scientific literature. Although a few general molluscan surveys have included mentions of nudibranchs and sacoglossans, detailed photographic or behavioral documentation is largely lacking.

The Erdemli-Akkum region in particular, although ecologically rich and frequently visited by divers, has not been the subject of any published opisthobranch-specific studies. Recognizing the need for fine-scale biodiversity data, this study was initiated as part of exploratory dives conducted between 2014 and 2015 and aimed to visually document opisthobranch taxa in different microhabitats in the region. This paper presents photographic records of seven opisthobranch species encountered during these surveys, providing new regional data and expanding the existing faunistic inventory.

2. Materials and Methods

The study was conducted along the Erdemli-Akkum coastline within the Mersin Bay, in the northeastern part of the Mediterranean Sea (Türkiye) (Fig. 1). This area is characterized by a range of marine biotopes, including shallow rocky reefs, sandy bottoms and patches of macroalgal vegetation, which are typical habitats for opisthobranch molluscs. The area is subject to seasonal environmental fluctuations and anthropogenic pressures due to its proximity to urban and tourist areas.

Field observations were carried out between 2014 and 2015 during exploratory scuba dives at depths ranging from 1 to 10 meters. The dives were conducted in calm sea conditions, mostly during daylight hours to ensure optimal visibility. No specimens were collected; instead, in situ photography was used as a non-invasive method to document the presence and identity of opisthobranch species.

Each dive focused on different substrate types (e.g. rocky outcrops, seagrass beds, and soft sediment zones) to capture habitat diversity and associated fauna. All photographs were taken using underwater digital cameras, and GPS points were manually recorded via surface coordinates for each surveyed area.

Species identification was based on visible morphological features such as color patterns, body shape, rhinophore structure, cerata arrangement, and other diagnostic characters observable from photographs (Fig. 2). Identification followed established regional field guides and taxonomic keys (e.g. Debelius and Kuitert, 2007; Trainito and Doneddu, 2014). In cases of uncertainty, comparative cross-checks were made using online repositories and current taxonomic literature.

All data, including photographic records and habitat notes, were compiled into a georeferenced species list. Observations were compared with previous literature from the eastern Mediterranean to assess whether records represented common, rare, or potentially new local occurrences.

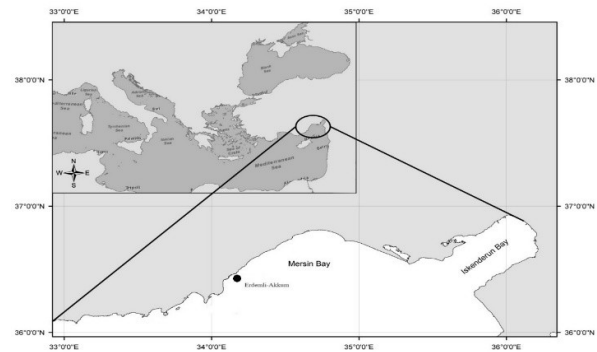


Figure 1. Map of the sampling site in Mersin Bay where (●) the sea slugs were observed from different biotopes.



Figure 2. Representative opisthobranch sea slug species observed and photographed during biodiversity surveys conducted in 2014–2015 at various biotopes around Erdemli–Akkum (Mersin Bay, Eastern Mediterranean). 1. *Goniobranchus annulatus*, 2. *Flabellina rubrolineata*, 3. *Flabellina rubrolineata* (color variant), 4. *Flabellina affinis*, 5. *Elysia viridis*, 6. *Cratena peregrina*, 7. *Aplysia depilans*, 8. *Syphonota geographica*.

3. Results

A total of seven opisthobranch species belonging to different families within the subclass *Heterobranchia* were visually documented in the coastal area between Erdemli and Akkum (Mersin Bay) during scuba surveys conducted in 2014 and 2015.

All observations were made in situ through underwater photography, and species were identified based on external morphological features. The recorded taxa included *Goniobranchus annulatus*, *Flabellina rubrolineata* (two individuals showing color variation), *Flabellina affinis*, *Elysia viridis*, *Cratena peregrina*, *Aplysia depilans*, and *Syphonota geographica*. These species were distributed across three main habitat types: rocky substrates with macroalgae (*Flabellina affinis*, *Cratena peregrina*, *Flabellina rubrolineata*), seagrass and algal patches (*Elysia viridis*, *Syphonota geographica*), and sandy-bottomed or open areas (*Aplysia depilans*, *Goniobranchus annulatus*).

Seven opisthobranch species were photographed at shallow depths (1–10 meters), often in areas with low to moderate wave energy, and the highest number of individuals was recorded in algal-dominated microhabitats. The systematic classification and biotope preferences of opisthobranch sea slug species are listed with their respective taxonomic ranks (Class, Subclass, Order, Family, Genus), along with observed habitat associations based on in situ underwater photography. Biotope types include rocky substrates with macroalgae, seagrass, and algal patches, and sandy-bottom or open areas (Table 1).

Table 1

Systematic classification and biotope preferences of observed Opisthobranch species from the Erdemli-Akkum Coastal Zone (Mersin Bay).

No	Species Name	Class	Subclass	Order	Family	Biotope Preference	Depth (m)
1	<i>Goniobranchus annulatus</i>	Gastropoda	Heterobranchia	Nudibranchia	Chromodorididae	Rock area/ Among brown algae	3
2	<i>Flabellina rubrolineata</i>	Gastropoda	Heterobranchia	Nudibranchia	Flabellinidae	Sand rock junction/ On top of the ghost fishing net	12
3	<i>Flabellina rubrolineata</i> (color variant)	Gastropoda	Heterobranchia	Nudibranchia	Flabellinidae	Rock area/ On a hydroid colony	8
4	<i>Flabellina affinis</i>	Gastropoda	Heterobranchia	Nudibranchia	Flabellinidae	Rock area/ On a hydroid colony	7
5	<i>Cratena peregrina</i>	Gastropoda	Heterobranchia	Nudibranchia	Facelinidae	Rocky area/ On a hydroid colony	10
6	<i>Elysia viridis</i>	Gastropoda	Heterobranchia	Sacoglossa	Plakobranchidae	Sandy area/ On top of <i>Penicillus capitatus</i> (calcareous green algae)	6
7	<i>Aplysia depilans</i>	Gastropoda	Heterobranchia	Aplysiida	Aplysiidae	Sandy area/ Among detached algal mats or wrack	8
8	<i>Syphonota geographica</i>	Gastropoda	Heterobranchia	Aplysiida	Aplysiidae	Sandy area	9

4. Discussion

In this study, the seven species were recorded from distinct marine biotopes, including sandy bottoms, rocky substrates, and macroalgal habitats. The documented taxa reflect the high diversity of opisthobranch mollusks in the Mersin Bay region and contribute to the faunistic inventory of the Eastern Mediterranean Sea.

The results of this study highlight the remarkable opisthobranch diversity present in the shallow marine habitats of Mersin Bay, a region that has historically been underrepresented in molluscan biodiversity literature (Çinar *et al.*, 2011; Yokeş and Galil, 2006). The seven recorded species represent a variety of ecological niches and morphological adaptations, reflecting the habitat heterogeneity of the study area.

The presence of visually striking nudibranchs such as *Flabellina affinis* and *Goniobranchus annulatus* confirms the suitability of rocky and coralline algal substrates for these taxa, which are often associated with hydroid colonies (Debelius and Kuitert, 2007). Meanwhile, *Elysia viridis*, a sacoglossan species with photosynthetic capabilities, was commonly observed in algal-covered areas, indicating its reliance on specific macroalgal hosts. The sea hares *Aplysia depilans* and *Syphonota geographica* were found in more open and sandy substrates, consistent with previous reports from the Mediterranean (Trainito and Doneddu, 2014).

Interestingly, the observation of two color morphs of *Flabellina rubrolineata* may reflect intraspecific variability or the presence of closely related cryptic species—an issue that has been previously discussed in opisthobranch taxonomy (Templado, 2014). Consequently, these visual records, in combination with biotope context, contribute to a better understanding of the habitat preferences, species richness, and potential ecological roles of opisthobranchs in the Eastern Mediterranean (Templado, 2014). Furthermore, the study aligns with broader efforts to establish baseline biodiversity data, which is critical for long-term monitoring and conservation planning in the face of ongoing environmental change.

5. Conclusion

Despite the small spatial and temporal scale of the study, the diversity observed supports the hypothesis that the Erdemli-Akkum region functions as a microbial diversity hotspot. These findings contribute to the baseline knowledge of the region's opisthobranch fauna and suggest that broader, seasonal studies would likely reveal additional species. Moreover as mentioned by Giacobbe *et al.* (2007) the use of non-invasive photographic surveys proved effective for faunistic documentation and can be expanded into citizen science and long-term monitoring programs.

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