



- **SHORT COMMUNICATION** -

The New Intertidal Record of *Goniobranchus annulatus* (Eliot, 1904) (Chromodorididae) from Mersin Bay, Northeastern Mediterranean, Turkey

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Abstract

One individual of *Goniobranchus annulatus* (Eliot, 1904), which is known as a tropical species, was found at the intertidal zone among the rocks near the Taşucu Bay. It was 3 cm in length and remarkable with its bright colors. After it was photographed and measured, the specimen was released back to the sea. This Heterobranchs are widely distributed in the Indian Ocean and is also being found in the Red Sea. It was first listed as “casual” alien species in CIESM in 2005, but today, it is established in the Levantine Basin.

Keywords:

Intertidal Record, *Goniobranchus annulatus*, Heterobranchia, Taşucu, Mersin Bay

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Introduction

Goniobranchus annulatus (Eliot, 1904) was first described in 1904 as “*Chromodoris annulata*”. In a study conducted in 2012, the name of the species was accepted as “*Goniobranchus annulatus*”, and it was included in the Heterobranchia subclass (Johnson & Gosliner, 2012; Schrödl & Stöger, 2014). *G. annulatus* is a gastropod that belongs to the order Nudibranchia. Nudibranchs are brightly colored mollusks. They are widely distributed in seagrass beds, coral reefs, mangroves, rocky, muddy, and sandy regions (Carpenter et al., 1997). *G. annulatus*, known as a tropical species, is found mostly in the Red Sea and the Indian Ocean (Daskos & Zenetos, 2007; Rudman, 1987). It is also listed as casual alien species in CIESM 2005 (Zenetos et al., 2005). Some researchers see the

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presence of *G. annulatus* in shallow and tidal areas as a strategy to reduce the pressure of predators on them. However, it is also thought that other Nudibranchs are a more significant threat to *G. annulatus* than predator fish (Lüttmann et al., 2006).

It has a white body covered with yellowish-orange dots. Rhinophores and gills are located in two purple rings. Also, a purple-continuous line surrounds the body from the sides. Rhinophores and gills are white, the tip and base parts are purple (Rudman, 1987; Nithyanandan, 2012). Species belonging to the family Chromodorididae are known to feed on sponges (Rudman, 1987; Sachidhanandam et al., 2000).

G. annulatus was first reported in the Mediterranean on the island of Salamina in Greece (Daskos & Zenetos, 2007; Zenetos et al., 2008). Afterward, it was recorded in Antalya Bay (Gokoglu and Ozgur, 2008), Iskenderun (Çevik et al., 2008), Kaş and İskenderun (Yokes et al., 2009), İskenderun (Özcan et al., 2010), Larnaka, Cyprus (Tsiakkiros & Zenetos, 2011) and Israel (Pasternak et al., 2011).

In this study, a specimen of *G. annulatus* was photographed in a rocky area containing some algae species (*Ulva* spp. and *Enteromorpha* spp.) at 1 m depth in Mersin Bay.

Material and Methods

One specimen of *Goniobranchus annulatus* was photographed at the intertidal zone of the Taşucu Bay ($36^{\circ}09'34.2''\text{N}$ $33^{\circ}41'14.4''\text{E}$) on 04 June 2019, at a depth of 1 m among rocks together with *Ulva* spp., *Enteromorpha* spp. and other algae on the shore (Figure1). Species identified according to Rudman (1987).

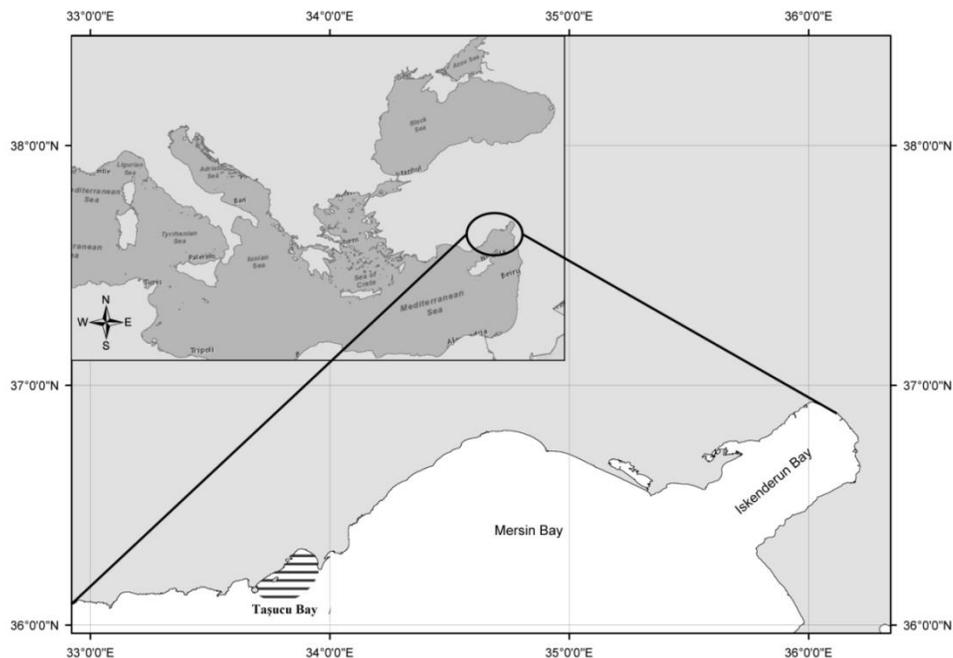


Figure 1. The shaded area indicates the location where the specimen observed.



Figure 2. *Goniobranchus annulatus* from Taşucu Bay (3 cm in length).

Results

In this study, a 3 cm long *G. annulatus* was observed at a depth of 1 m. In this example, typical *G. annulatus* morphological characteristics were found. Body-color was bright white and body surface covered with orange-yellowish spots. The trunk was covered with a continuous line in dark purple on the sides. The base and tips of rhinophores and gills were dark purple. Table 1 shows the recordings, lengths, and depths of *G. annulatus* in the Mediterranean.

Table 1. Comparison of Mediterranean records of *G. annulatus*

Reference	Region	Depth	Length
Daskos & Zenetos (2007)	Salamina Island/Greece	12 m	N/A
Gökoğul & Özgür (2008)	Antalya Bay/Turkey	2.5 m	4 cm
Çevik et al. (2008)	Gulf of İskenderun	7 m	N/A
Yokeş et al. (2009)	Kaş	N/A	1 cm
Özcan et al. (2010)	Gulf of İskenderun	0-15 m	14-20 cm
Tsiakkios & Zenetos (2011)	Larnaka/Cyprus	5 m	N/A
Pasternak et al. (2011)	Israel	1-5 m	4 cm
This study	Gulf of Mersin	1 m	3 cm

Discussion

For the Mediterranean, *G. annulatus* was first recorded in Greece in 2004, which was observed at a depth of 12 m and in a rocky environment. It was carrying the coloration seen in Arabian waters. A purple line interconnected the purple rings surrounding the rhinophores and gills and the body covered with only a few yellow spots (Daskos & Zenetos, 2007). The records from Antalya and Iskenderun were the samples with Lessepsian coloration (there is no connection between

rhinophores and gills) on the rocky ground at a depth of 2.5 - 15 m (Gokoglu & Ozgur, 2008; Çevik et al., 2008; Özcan et al., 2010).

Table 1 shows that the largest specimens of *G. annulatus* (14-20 cm) were found in the Gulf of Iskenderun up to a depth of 15 m (Özcan et al., 2010). The second-largest record given in the same table was Antalya (Gökoğul & Özgür, 2008) and Israel (Pasternak et al., 2011) with a length of 4 cm between 1-5 m depth. The smallest sample recorded is 1 cm long and is from the Kaş region (Yokeş et al., 2009).

The absence of direct geography to allow the migration of *G. annulatus* between Greece and the Arabian Peninsula supports the idea that the migration was by transport rather than the Lessepsian migration mentioned in Daskos & Zenetos (2007). In all other records in the Mediterranean and the Suez Canal, it is understood that *G. annulatus* prefers the relatively coastal and rocky areas as habitats. Thus, it can be said that there is a possible dispersion pathway for *G. annulatus* on the continental shelf on the mainland.

G. annulatus individuals have been previously reported from Antalya and İskenderun. The specimen observed in this study shows a color pattern similar to the pattern of the Red Sea population. Although the sample reported in Daskos & Zenetos (2007) shows a different feature like having an interconnection between rhinophores and gills, our finding supports the idea of the Lessepsian migration path for this species. This study is the new intertidal record of *G. annulatus* for the Levantine basin and the first record for the Mersin Bay.

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Conflict of Interest: The authors declare that they have no conflict of interest.

Ethical approval: All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

References

- Carpenter, Kent, E., Harrison, P. L., Hodgson, G., Alsaffar, A. H., Alhazeem, S.H., 1997. *The Corals and Coral Reef Fishes of Kuwait*, Biological. ed. Kuwait Institute for Scientific Research, Safat, Kuwait.
- Çevik, C., Ergüden, D., 2008. İskenderun Körfezinde Dağılım Gösteren Bazı Opisthobranchia Türleri., in: II. Ulusal Malakoloji Kongresi Bildiriler Kitabı. 08-10 Ekim 2008. Adana (Türkiye).
- Daskos, A., Zenetos, A., 2007. Additions to the knowledge of alien Opisthobranchia of Greece. *Aquatic Invasions*, 2(3), 258-260. <https://doi.org/10.3391/ai.2007.2.3.10>
- Gokoglu, M., Ozgur, E., 2008. First report of *Chromodoris annulata* Eliot, 1904 (Mollusca, Opisthobranchia, Chromodoididae) on the Levantine coast of Turkey, *Eastern Mediterranean Aquatic Invasions*, 3, 435–437.

- Johnson, R.F., Gosliner, T.M., 2012. Traditional taxonomic groupings mask evolutionary history: A molecular phylogeny and new classification of the chromodorid nudibranchs. *PLoS One*, 7(4), e33479. <https://doi.org/10.1371/journal.pone.0033479>
- Lüttmann, K., Anthes, N., D'Souza, T.G., Riss, S., Michiels, N.K., 2006. Population size estimate of a reef-flat aggregation of *Chromodoris annulata* (Opisthobranchia, Chromodoridae). *Journal of Molluscan Study*, 72(2), 214. <https://doi.org/10.1093/mollus/eyi065>
- Nithyanandan, M., 2012. New and rare nudibranch records from Kuwait, Arabian Gulf (Mollusca: Opisthobranchia). *Marine Biodiversity Records* 5, 1–7. <https://doi.org/10.1017/S1755267212000954>
- Özcan, T., Ergüden, D., Turan, C., Çevik, C., 2010. Distribution of alien nudibranch *Chromodoris annulata* Eliot, 1904 (Opisthobranch; Chromodorididae) in the Gulf of Iskenderun, Turkey. *Biharean Biologist*, 4(1), 89-90.
- Pasternak, G., Ziv, R., Eyal, G., Shefer, S., Mienis, H.K., Rittner, O., Galil, B.S., 2011. On the population of *Chromodoris annulata* eliot, 1904 (Mollusca: Opisthobranchia: Chromodorididae) off the Mediterranean coast of Israel. *Aquatic Invasions*, 6(1), 91-93. <https://doi.org/10.3391/ai.2011.6.S1.021>
- Rudman, W.B., 1987. The Chromodorididae (Opisthobranchia: Mollusca) of the Indo-West Pacific: *Chromodoris epicuria*, *C. aureopurpurea*, *C. annulata*, *C. coi* and *Risbecia tryoni* colour groups. *Zoological Journal of the Linnean Society*, 90, 305-407. <https://doi.org/10.1111/j.1096-3642.1987.tb01357.x>
- Sachidhanandam, U., Willan, R.C., Chou, L.M., 2000. Checklist of the nudibranchs (Opisthobranchia: Nudibranchia) of the South China Sea. *Raffles Bulletin of Zoology*, 48, 513–537.
- Schrödl, M., Stöger, I., 2014. A review on deep molluscan phylogeny: old markers, integrative approaches, persistent problems. *Journal of Natural History*, 48(45-48), 2773-2804. <https://doi.org/10.1080/00222933.2014.963184>.
- Tsiakkuros, L., Zenetos, A., 2011. Novi prilozi poznavanju alohtone faune mekušaca uzduž ciparske obale: Novi stražnjoškržnjaši u ciparskoj fauni. *Acta Adriatica*, 52(1), 115-123.
- Yokes, M.B., Balikci, Ö., Karhan, Ü.S., Dalyan, C., 2009. An established population of *Chromodoris annulata* on the Mediterranean coast of Turkey (Opisthobranchia, Gastropoda). *Triton*, 19, 12–14.
- Zenetos, A., Çınar, M.E., Pancucci-Papadopoulou, M.A., Harmelin, J.G., Furnari, G., Andaloro, F., Bellou, N., Streftaris, N., Rowius, H.Z., 2005. Annotated list of marine alien species in the Mediterranean with records of the worst invasive species. *Mediterranean Marine Science*, 6(2), 63-118.
- Zenetos, A., Vassilopoulou, V., Salomidi, M., Poursanidis, D., 2008. Additions to the marine alien fauna of Greek waters (2007 update). *Marine Biodiversity Records*, e91. <https://doi.org/10.1017/s1755267207009281>