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Checklist of the opisthobranchs (Heterobranchia: Gastropoda) along the Iranian coasts of the Gulf of Oman

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Abstract

This is the first paper describing the heterobranch fauna of the coasts of Iran. A total of 25 species belonging to 14 families is recorded from the Iranian coasts of the Gulf of Oman. Except for *Chromodoris annulata,* the remainder are all new records for the area. The families Chromodorididae and Aplysiidae have the highest diversity in the Gulf of Oman at present. A preliminary checklist of heterobranchs occurring in Iran is provided, based on current and literature records.

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Introduction

The Nudibranchia is a large group of marine molluscs (Gosliner *et al*., 2008). They are often colourful and display several forms of crypsis, special resemblance, aposematic coloration and mimicry (Gosliner & Behrens, 1990; Tullrot, 1998). The Gulf of Oman has very diverse habitats and is therefore a good region for finding nudibranchs. However, the study of nudibranchs is non-existent for the Iranian coasts, and this paper goes some way towards remedying this. Yonow (2008, 2012) reported some opisthobranchs from the Gulf of Oman (see Table 1), as did Gosliner & Behrens (2004). Nithyanandan (2012) reported seven nudibranch species (*Doriopsilla* cf. *miniata, Flabellina bicolor, Phyllidia (Fryeria) rueppelii, Plocamopherus ocellatus, Chromodoris obsoleta and Glossodoris* cf. *pallida*) from the northern Persian Gulf, but there has been no sampling along the Iranian coasts of either the Persian Gulf or the Gulf of Oman.

No studies are available on the opisthobranchs of the Iranian coasts; therefore the present attempt has been made to compile a list on the occurrence of this group of animals based on the field surveys conducted from March 2012 to July 2013. The non-nudibranchs have not been studied at all from the region; only two Aplysiidae were recorded by photographs only from the Gulf of Oman (Yonow, 2012): these two species are *Dolabella auricularia* and *Stylocheilus longicauda*. Clearly much more fieldwork is needed to provide a comprehensive list of all the sea slugs found in this region; in an effort to rectify this, twenty-five species are reported in this study.

The Aplysiidae and Chromodorididae, both with five species in each, are the most frequently encountered in this region and the Pleurobranchidae, Dorididae, Aegiridae, Triophidae, Tethyidae, Halgerdidae, Aeolidiidae, and Arminidae have the lowest diversity. A preliminary checklist of sea slugs along the Iranian coasts of the Gulf of Oman has been prepared based on the current records and previous literature records with revised nomenclature.

Materials and methods

Sampling

Sampling was carried out from March 2012 to July 2013 in the intertidal zones of the Iranian coasts because these sites contain many types of habitats and cover the Iranian coastline of the Gulf of Oman. Three sites, Jask (25° 35'N, 58° 02'E), Chabahar Bay (25° 16'N, 60° 40'E), and Gowatr Bay (25° 13'N, 61° 48'E) were chosen for sampling sites (fig 1). The samples were transported to the laboratory in Chabahar Maritime University for further identification.

Treatment of samples

All specimens were photographed using digital camera (model: Nikon D3100) in dishes in the laboratory, and measured to the nearest millimetre. Before placement in the fixative solution the animals were narcotised with a solution consisting of 72g/l of $MgCl_2$ (Apte, 2009; Gosliner and Behrens, 2008). Animals were fixed in a solution of 5% formaldehyde and seawater. The formaldehyde-fixed animals were subsequently transferred to 95% ethanol for long-term preservation. Identification was carried out based on the external morphology only and using following literature: Rudman (1982, 1984, 1987), Eales (1994), Yonow (1989, 1990, 2001, 2008, 2012), Apte *et al.* (2010), and Dayrat (2010).

Fig. 1. Map providing the general location of the three sampling sites.

Results

A total of 25 species of heterobranchs, representing 14 families, have been recorded from Iranian coastline of the Gulf of Oman and identified to species level, with

some specimens cited only to genus level. The cumulative list of opisthobranchs species from the Gulf of Oman, resulting from a critical analysis of literature records and new material examined herein is reported in Table 1. Of this list of 25 species, 24 are new records to the Gulf of Oman and all of them are new records for the Iranian coasts (Table 1). The families Aplysiidae and Chromodorididae, both with five species each, are the most species along the Iranian coasts at present. The families Pleurobranchidae, Doridiidae, Aegiridae, Triophidae, Tethyidae, Halgerdidae Aeolidiidae, and Arminidae, with only one species each, are the poorest families recorded in this area. The species with the highest frequency of encounters was *Dendrodoris fumata* (33 specimens); the next most frequently recorded species were *Discodoris fragilis* (21 specimens), *Sebadoris nubilosa* (16 specimens), *Elysia ornata* (14 specimens), and *Chromodoris annulata* (10 specimens). *Dendrodoris fumata* was recorded at all three sites but the abundance was varied. *Elysiella pusilla*, *Chromodoris annulata* , *Phyllaplysia* sp , *Melibe rangii*, *Dermatobranchus piperoides*, *Atagema spongiosa*, *Plocamopherus indicus*, *Asteronotus cespitosus*, *Chromodoris* cf. *albonares*, *Chromodoris sinensis* and *Chromodoris decora* were recorded only once. The Aplysiidae (n = 5) and Chromodorididae (n = 5) accounted for 19.2 % of the total number of species, followed by Dendrodorididae (n = 2), and Discodorididae (n = 2), respectively with 7.6 % (Table 1). The majority of the specimens (25 species) were found in Chabahar Bay; the site with the lowest diversity in this study was the Gulf of Gowatr, with only six species recorded during the 16-month collecting period.

Table 1. Checklist of the nudibranchs (Heterobranchia: Nudibranchia) from the Gulf of Oman.

Species	References	This study	numbers	Station
Order Anaspidea				
Family Aplysiidae				
Aplysia dactylomela		▲	6	Ch,J
Aplysia juliana		▲	6	Ch, G
Aplysia oculifera		▲	4	Ch, J
Aplysia parvula		▲	8	Ch, J
Dolabella auricularia	•			
Phyllaplysia sp		▲	3	Ch
Stylocheilus longicauda	•			
Order Sacoglossa				
Family Plakobranchidae				
Elysia ornaa		▲	14	Ch, J, G
Elysiella pusilla		▲	4	Ch
Order Pleurobranchida				
Family Pleurobranchidae				
Pleurobranchus forskalii		▲	2	Ch,G
Order Nudibranchia				
Suborder Aeolidina				
Family Aeolidiidae				
Phidiana militaris		▲	2	Ch, J
Suborder Arminina				
Family Arminidae				
Dermatobranchus piperoides		▲	3	Ch
Suborder Dendronotina				
Family Tethyidae				
Melibe rangii		▲	1	Ch
Suborder Doridina				
Family Aegiridae				
Aegires villosus		▲	2	Ch, J
Family Chromodorididae				
Cadlinella ornatissima	•			
Chromodoris africana	•			
Chromodoris annulata	•	▲	10	Ch
Chromodoris cavae	•			
Chromodoris cazae	■			

Species	References	This study	numbers	Station
Chromodoris cf. *albonares*		▲	2	Ch
Chromodoris decora	●	▲	1	Ch
Chromodoris sinensis		▲	4	Ch
Chromodoris sp.		▲	2	Ch,J
Chromodoris tinctoria	●			
Glossodoris pallida	●			
Glossodoris undaurum	●			
Hypselodoris dollfusi	●			
Hypselodoris nigrostriata	●			
Risbecia pulchella	●			
Family Dendrodorididae				
Dendrodoris fumata		▲	33	Ch, J, G
Dendrodoris nigra		▲	6	Ch, J,
Family Discodorididae				
Discodoris fragilis		▲	21	Ch, J, G
Sebadoris nubilosa		▲	16	Ch, J, G
Family Doridiidae				
Atagema spongiosa		▲	2	Ch
Family Gymnodorididae				
Gymnodoris alba		▲	4	Ch, J
Gymnodoris impudica	●			
Gymnodoris inornata	●			
Family Halgerdidae				
Asteronotus cespitosus		▲	2	Ch
Family Triophidae				
Plocamopherus indicus		▲	2	Ch

Key to sites: Ch: Chabahar; J: Jask; G: Gowatr. ▲ Present study.● Yonow (2008, 2011).■ Gosliner & Behrens (2004).

Discussion

This is the first comprehensive study describing the diversity of sea slugs along the Iranian coasts of the Gulf of Oman. Due to an insufficient number of sampling dives, lack of night sampling and lack of dredge sampling as well as inspections of intertidal areas, the total number of the species was not as high as expected. However, these records form a solid baseline for further work, recording four of the six orders of Heterobranchia.

Taxonomic composition of the Nudibranchia is comparable to that reported for other sites in the western Indian Ocean (Yonow, 1984, 2012, Yonow & Hayward 1991, Nithyanandan, 2012), although the orders Cephalaspidea and Umbraculida are not yet recorded. Some of these species are commonly recorded from the western Indian Ocean, but other species, such as *Dermatobranchus piperoides, Plocamopherus indicus, Elysiella pusilla,* and *Phyllaplysia* sp. are very rare. Yonow (2008, 2012) reported only 15 heterobranchs from the Gulf of Oman (table 1), of which only one species (*Chromodoris annulata*) was also recorded by us. This minimal overlap indicates a rich faun along the Iranian coastlines, and deserving of further study. In the present study 25 species are reported for the first time from this coastline; this is the first ever specialized study on the Iranian sea slug fauna.

Four species, *Dendrodoris fumata*, *Sebadoris nubilosa*, *Discodoris fragilis* and *Elysia ornata* were found at all sampling sites. *Chromodoris annulata*, *Elysiella pusilla*, *Melibe rangii*, *Dermatobranchus piperoides*, *Plocamopherus indicus*, *Asteronotus cespitosus*, *Phyllaplysia* sp., *Chromodoris* cf. *albonares*, *Chromodoris sinensis*, *Chromodoris decora,* and *Atagema spongiosa* were found only in Chabahar Bay. Considering all records, the Chromodorididae (15 species) and Aplysiidae (7 species) were the most frequently encountered families in the Gulf of Oman. Chromodorididae (5 species), Aplysiidae (5 species), Discodorididae (2 species), Plakobranchidae (2 species) and Dendrodorididae (2 species) show the highest diversity along the Iranian coasts of Gulf of Oman in

this first study. Every species was found in Chabahar Bay, probably because most of habitats (coral reef, sandy shore, algal bed, stony beach, wavy area, etc.) can be found in this area. Most areas of Gowatr Bay include sandy sediments and for this reason it has the poorest diversity among the sampling areas (Kardavani, 1995).

Dendrodoris fumata was the most frequently recorded and abundant species in this study; it is originally described from the Red Sea. It is variable in colour with two forms occurring in the Red Sea (Yonow, 2008; Brodie *et al*., 1997). In this study grey form were also recorded; the grey form was more common in all stations (especially in Chabahar Bay).

The high diversity of Chromodorididae and Aplysiidae recorded in Iranian waters of the Gulf of Oman is in accordance with previous studies in the Indian Ocean (Yonow, 1984, Yonow & Hayward 1991, Yonow, 1994, Yonow *et al*. 2002, Yonow 2008, 2012). The common occurrence of Doridoidea species can be attributed to the high abundance of sponges, diverse habitats with high diversity of species, on which the doridsprey. Thus, the availability of food may be reflected in the distribution of nudibranchs (Darumas *et al*. 2007).

Zoogeographical analysis revealed that about more than 90% of the Gulf of Oman opisthobranchs have wide distributions in the western Indian Ocean. Therefore it can be concluded that opisthobranch fauna of the Gulf of Oman are more influenced by the Western Indian Ocean including the Red Sea and East Africa. Our knowledge on Gulf of Oman nudibranchs is yet very poor. Much of the present study on Iranian opisthobranchs was confined to intertidal habitats. Although these areas showed high diversity in Aplysiidae and Chromodorididae species; one need to look at rest of the marine intertidal habitats such as coral reefs, mangroves, sea grass beds, and soft sediment habitats. Based on the findings of present study, it is clearly suggested that the Iranian coasts of Oman Gulf are indeed a region of high opisthobranch diversity. It should be noted that nudibranch species are small, camouflaged, or simly rare. They have a cryptic lifestyle or a short-life history, or they are only nocturnally active (Gosliner & Behrens, 1990; Tullrot, 1998).Therefore, it is highly likely that the present number of Iranian nudibranchs is an underestimation and that many additional species will be discovered in the future.

The lack of comprehensive studies creates large gaps in our knowledge on the distribution of nudibranchs, in the Persian Gulf and Gulf of Oman, as well as in the western Indian Ocean more generally. At least one species, Chromodoris cazae, is endemic to this area, which suggests the possibility of more endemic species. More intensive surveys will surely improve our species inventory for the area.

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References

Apte D, Bhave V, Parasharya D. 2010. An annotated and illustrated checklist of the opisthobranch fauna of Gulf of Kutch, Gujarat, India with 21 new records for Gujarat and 13 new records for India: part 1. Journal Bombay Natural History Society **107 (1)**, 14–23.

Apte D. 2009. Opisthobranch fauna of Lakshadweep Islands, India, with 52 new records to Lakshadweep and 40 new records to India: part 1. Journal Bombay Natural History Society **106 (2)**, 162–175.

Brodie DG, Willan RC, Collins JD. 1997. Taxonomy and occurrence of *Dendrodoris nigra* and *Dendrodoris fumata* (Nudibranchia: Dendrodorididae) in the Indo-West Pacific region. Journal Molluscan Studies **63,** 407–423. doi: 10.1093/mollus/63.3.407

Darumas U, Chavanich S, Suwanborirux K. 2007. Distribution patterns of the renieramycin producing sponge *Xestospongia* sp. and its association with other reef organisms in the Gulf of Thailand. Zoological Study **46,** 695–704.

Dayrat B. 2010. A monographic revision of basal discodorid sea slugs (Mollusca: Gastropoda: Nudibranchia: Doridina). Proceedings of the California Academy Sciences ser **61 (4**), suppl. I: 1–403. http://campillos.ucmerced.edu/~bdayrat/PDF%20of%20Papers/Dayrat%202010%20PCAS%20LR.pdf

Eales NB. 1944. Aplysiids from the Indian Ocean, with a review of the family Aplysiidae. Proceedings of the Malacological Society London **26**, 1–22.

Gosliner TM, Behrens DW, Valdes A. 2008. Indo-Pacific nudibranchs and sea slugs: a field guide to the world's most diverse fauna. Sea Challengers Natural History Books and California Academy of Sciences, Gig Harbor, WA, 425 pp.

Gosliner TM, Behrens DW. 1988. A Review of the Generic Divisions Within the Phyllidiidae with the Description of a New Species of *Phyllidiopsis* (Nudibranchia: Phyllidiidae) from the Pacific Coast of North America. The Veliger **30**,305-314.

Kardavani P. 1995. Iran aqua ecosystem (Persian Gulf and the Sea of the Oman).1st edition.Ghumes , Iran, Tehran, 268pp.

Nithyanandan M. 2012. New and rare nudibranch records from Kuwait, Persian Gulf (Mollusca: Opisthobranchia). Marine Biodiversity Records **5**, 1-7. doi:10.1017/S1755267212000954

Rudman WB. 1982. The Chromodorididae (Opisthobranchia, Mollusca) of the Indo-West Pacific: *Chromodoris quadricolor, C. lineolata* and *Hypselodoris nigrolineata* colour groups. Zoological Journal Linnean Society **76 (3),** 183–241. doi: 10.1111/j.1096-3642.1982. tb02182.x

Rudman WB. 1984. The Chromodorididae (Opisthobranchia, Mollusca) of the Indo-West Pacific: a review of the genera. Zoological Journal Linnean Society **81**, 115–273. doi: 10.1111/j.1096-3642.1984.tb01174.x

Rudman WB. 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 Linnean Society **90 (4),** 305–407. doi: 10.1111/j.1096- 3642.1987.tb01357.x

Tullrot A. 1998. Evolution of warning coloration in the nudibranch *Polycera quadrilineata*. PhD Thesis, Goteborg University, Sweden, pp.

Yonow N, Hayward PJ. 1991. Opisthobranches de l'lle Maurice, avec la description de deuxéspèce-snouvelles (Mollusca: Opisthobranchia). Revue française d'aquariologie herpétologie **18 (1),** 1 - 30.

Yonow N. 1984. Doridaceannudibranchs from Sri Lanka, with descriptions of four new species. The Veliger **26 (3),** 214 -22.

Yonow N. 1989. Red Sea Opisthobranchia. 2. The family Chromodorididae (Mollusca, Nudibranchia). Fauna of Saudi Arabia **10**, 290–309.

Yonow N. 1990. Red Sea Opisthobranchia. 3. The orders Sacoglossa, Cephalaspidea, and Nudibranchia: Doridacea (Mollusca, Opisthobranchia). Fauna of Saudi Arabia **11**, 286–299.

Yonow N. 2000. Red Sea Opisthobranchia 4: The orders Cephalaspidea, Anaspidea, Notaspidea, and Nudibranchia: Dendronotacea and Aeolidacea. Fauna of Arabia **18**, 87–131.

Yonow N. 2001. Results of the Rumphius Biohistorical Expedition to Ambon (1990).Part 11.Doridacea of the families Chromodorididae and Hexabranchidae (Mollusca, Gastropoda, Opisthobranchia, Nudibranchia), including additional Molukkan material. Zoologische Mededelingen, Leiden **75 (15),** 1–50.

Yonow N. 2008. Sea Slugs of the Red Sea. Pensoft Publishers, Sofia-Moscow, 304 pp.

Yonow N. 2012. Opisthobranchs from the western Indian Ocean, with descriptions of two new species and ten new records (Mollusca, Gastropoda). ZooKeys **197**, 1–129.