

Nudibranchs from the Northern Persian Gulf

Rezai, Hamid^{1*}; Mohtarami, Seid Ali²; Dehghani, Hammed³;
Tavakoli-Kolour, Parviz⁴, Bargahi, Hamid Reza⁵; Kabiri, Keivan⁶

1- Darya Negar Pars Consulting Engineers, Tehran, IR Iran

2- Asia Aquarium, Bandar Lengeh, IR Iran

3- Islamic Azad University, Tehran, IR Iran

4- Graduate School of Engineering and Science, University of the Ryukyus, Okinawa, Japan

5- Iranian Fisheries Organization, Tehran, IR Iran

6- Iranian National Institute for Oceanography and Atmospheric Science, Tehran, IR Iran

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Abstract

Field studies were conducted in a number of intertidal and offshore islands in the Persian Gulf between 2006 to 2013. SCUBA and skin diving surveys were conducted around Larak, Hormuz, Qeshm, Hengam, Farur, Kish, Lavan, Khark and Farsi islands in the northern region of the Persian Gulf. Marine invertebrates including nudibranchs were photographed up to 32 m. Several species of nudibranchs are reported from the northern region of the Persian Gulf, over the Iranian side. In total, 32 genera of nudibranchs are recorded, which include *Fryeria rüppelii*, *Haminoea* sp., *Chromodoris annulata*, *Gymnodoris rubropapulosa*, *Cuthona yamasui*, *Hypselodoris maridadilus*, *Glossodoris pallida*, *Glossodoris* sp., *Asteronotus cespitosus*, *Marioniopsis viridescens*, *Stylocheilus striatus*, *Jorunna funebris* and *Elysia* sp. were recorded from several Iranian Island in the Persian Gulf. The most common species was *Chromodoris annulata* throughout most of the surveyed islands, but *Haminoea* sp. was highly abundant and conspicuous species only in Farsi Island. Except for *G. pallida*, *Glossodoris* sp. and *C. annulata*, all the above species are considered new records for the northern region of the Persian Gulf, but *Bursatella leachii*, *M. viridescens*, *Phestilla lugubris*, *Discodoris lilacina* and *Haminoea* sp. are new records from the Persian Gulf proper. An increase in several new records to the Iranian fauna and new records of rare species, in relatively few years results mainly from sampling effort and contributions by specialists on samples of poorly known sampled areas. Prospects for finding new and more species are promising given more diving operations are carried out.

Keywords: Nudibranchs, SCUBA, Underwater photography, Islands, Diversity, Persian Gulf

1. Introduction

Nudibranchs are shell-less gastropods. Their diverse color patterns, high diet specificity, and mechanical and

chemical defensive attributes have rendered them photographic and research targets for underwater photographers, marine biologists, and biotechnologists. Nudibranch is the largest order in the opisthobranchs, and is a highly successful group. Species in this order

* E-mail: rezaihamid1@hotmail.com

are famed amongst SCUBA-divers throughout the world because of their delicate beauty and colorful patterns. Nudibranchs can be found in all the world's oceans, and in most marine habitats, and they vary in size from 4 mm to 60 cm (Thompson, 1976). It is suggested that there are more than 3000 species worldwide (Wägele and Willan, 2000).

Although, the Persian Gulf and its islands are endowed with invaluable diversity of geological and marine habitats and fauna, its arid climate, large seasonal temperature fluctuations and relatively high salinities combined make it an extremely stressful marine environment (Sheppard et al., 1992). The Persian Gulf is inhabited by an impoverished Indo-Pacific fauna and for its relatively short history of development and the limited water exchange through the Straits of Hormuz, the diversity of nudibranch species in the Persian Gulf is expected to be lower than the Oman Sea.

Previously, Smyth (1982) identified four dorids and one aplysiid in the Persian Gulf. Later three nudibranchs were observed (Rezai et al., 1995) as a part of the ecology of marine molluscs around several Iranian islands in the Persian Gulf. Recently, Nithyanandan (2012) has recorded four new records of nudibranchs from Kuwait and one new record in the Persian Gulf.

As there are very few workers currently engaged in studying nudibranchs exclusively in the northern Persian Gulf, the record of nudibranchs from Iranian side could be added to the present checklist of marine nudibranchs in the Persian Gulf.

Under the auspices of Iranian National Center for Oceanography (INIO), several investigations were carried out on the ecology of coral reefs around Iranian Islands in the Persian Gulf between 2006 and 2013. SCUBA diving surveys were carried out on some remote islands in the northern region of the Persian Gulf, and marine invertebrates, including nudibranch were photographed and collected up to 32 m.

The present work reports the finding of new records of nudibranchs in the northern region of the Persian Gulf. The purpose of the present study is to document a checklist of nudibranch species off the coasts of some islands in the northern Persian Gulf and update on distribution of species in those islands.

2. Materials and Methods

Materials for the general study were conducted in the field at a number of intertidal and offshore islands in the northern region of the Persian Gulf (Figure 1) from 2006 to 2012. SCUBA and skin diving surveys were conducted around Larak, Hormuz, Qeshm, Hengam, Farur, Kish, Lavan, Khark and Farsi islands in the northern region of the Persian Gulf. The hard bottom seabed around the islands provides an environment that supports the growth of corals and nudibranchs.

The nudibranchs were photographed up to 32 m. This effort has revealed several new records of nudibranch species not previously recorded from the study area. At each location, details of the habitat type and water depth were recorded. In some cases, divers have brought back live specimens for study in a field laboratory.

All the sites have been visited on one or more occasions during the course of the study, though many of the photographs were taken on subtidal rocky seabeds and major reefs associated around Farur and Kish islands. All underwater photographs were taken *in situ*. Specimens were photographed in the field and then released. No attempt was made to preserve the sample in the field. Specimens were identified using descriptions by Rudman (1973), Yonow (1989), Debelius (1998), Debelius and Kuitert (2007), and internet sources (<http://www.nudi-pixel.net>, and <http://www.seaslugforum.net>). Nudibranchs are notoriously difficult to identify from preserved material (Jensen, 2005). Also, taxonomy is unsettled for some genera.

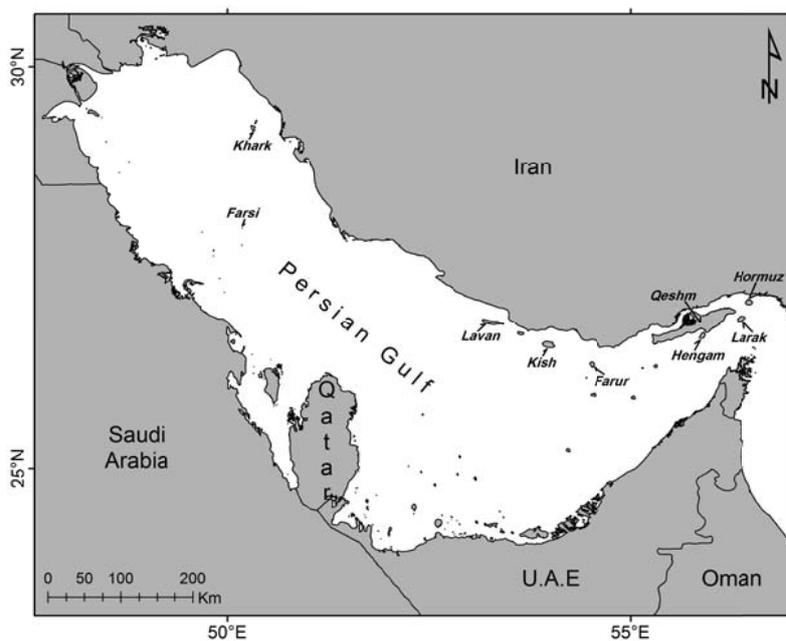


Fig. 1: The location of study areas

For statistical analysis, PRIMER (Plymouth Routines in Multivariate Ecological Research) (Clarke and Warwick, 1994) was used. Multidimensional scaling (MDS) analysis in conjunction with the Bray and Curtis similarity index (Bray and Curtis, 1957) using the group average strategy (Ludwig and Reynolds, 1988) and presence/absence transformation were applied to the species matrix data to determine similarities among stations. A measure of goodness-of-fit of the MDS ordination was given by the stress value.

3. Results and Discussion

The records on nudibranchs are some additions to the Iranian mega biodiversity. Comparison of the species in different islands shows a total of 31 nudibranchs belonging to 17 families (Table 1). The nudibranchs *Fryeria rüppelii*, *Haminoea* sp., *Chromodoris annulata*, *Gymnodoris rubropapulosa*, *Cuthona yamasui*, *Hypselodoris maridadilus*, *Glossodoris pallida*, *Glossodoris* sp., *Asteronotus cespitosus*, *Marioniopsis viridescens*, *Stylocheilus striatus*, *Jorunna funebris* and *Elysia* sp. were recorded from several Iranian Island in the Persian Gulf.

The most common and abundant species is

Chromodoris annulata throughout most of the surveyed islands, but *Haminoea* sp. and *Cuthona yamasui* were rare. The presence of *Haminoea* sp. (Haminoeidae) in Farsi Island is significant as it has never been observed in other islands in the Persian Gulf thus far. *Haminoe* sp. was the only conspicuous nudibranch present in Farsi Island, and abundant only on the patch reefs in the eastern part of the island.

Except for *G. pallida*, *Glossodoris* sp. and *C. annulata*, all the above species are considered new records for the “northern region” of the Persian Gulf, but *Bursatella leachii*, *M. viridescens*, *Phestilla lugubris*, *Discodoris lilacina* and *Haminoea* sp. are new records from the Persian Gulf. Several individuals of *Marioniopsis viridescens* were seen and photographed on rock faces in about 5 m depth near Farur during daytime. This species has never been recorded from any other island in the Persian Gulf thus far.

Almost all of the specimens were found on or around coral reefs and on subtidal rocks. The most common nudibranch was *Chromodoris annulata* which usually spawns in the early spring in Kish Island. The common species is *C. annulata* with their peak in March with cosmopolitan distribution in the Indian Ocean. *Elysia* sp., *Aplysia* sp. and *Bursatella leachii* also reach maximum abundance in March.

Table 1: Observed Nudibranch species in the surveyed islands in the northern Persian Gulf

Taxa	Farur	Kish	Hengam	Qeshm	Khark	Larak	Farsi	Lavan	Hormuz
* <i>Fryeria rüppelii</i>	+	+				+			
<i>Phyllidia</i> sp.					+	+			
<i>Chromodoris annulata</i>	+	+		+		+		+	+
<i>Chromodoris obsoleta</i>								+	
* <i>Gymnodoris rubropapulosa</i>	+					+			
* <i>Cuthona yamasui</i>	+								
<i>Glossodoris pallida</i>	+								
<i>Glossodoris</i> sp.		+							
* <i>Asteronotus cespitosus</i>	+	+							
* <i>Hypselodoris nigrostriata</i>	+	+							
* <i>Hypselodoris whitei</i>	+								
<i>infucata</i> <i>Hypselodoris</i>						+		+	
<i>Hypselodori dolfussi</i>								+	
<i>Risbecia pulchella</i>		+	+						
√ <i>Marioniopsis viridescens</i>	+								
* <i>Jorunna funebris</i>			+						
* <i>Plakobranthus ocellatus</i>		+	+	+					
<i>Plocamopherus ocellatus</i>				+					
* <i>Elysia</i> sp.		+	+	+				+	+
√ <i>Bursatella leachii</i>			+						
<i>Stylocheilus striatus</i> *	+								
<i>Aplysia cornigera</i> .			+						
<i>Onchidium peronii</i>	+	+	+	+					
<i>Armina</i> sp.									+
√ <i>Phestilla lugubris</i>		+	+						
<i>Dendrodoris fumata</i>		+							
<i>Dendrodoris nigra</i>		+							
√ <i>Discodoris lilacina</i>			+						
<i>Aeolidiella ?alba</i>		+							
<i>Phidiana militaris</i>					+				+
√ <i>Haminoea</i> sp.							+		
<i>Doriopsilla</i> sp.									+

+ = present; * = new record for the northern region of the Persian Gulf; √ = new record for the Persian Gulf

Phestilla lugubris was only found around Hengam Island, feeding on massive corals *Porites* and well camouflaged on the host. It is considered the first record for Iran if not for the Persian Gulf. The nudibranch *Phestilla sibogae* is known to incorporate coral photosynthetic endosymbionts (dinoflagellate zooxanthellae of the genus *Symbiodinium*) (Haramaty, 1991). The corallivorous nudibranch *Phestilla* spp. has been implicated as a potential disease vector in Australia; following nudibranch grazing, coral fragments were colonized by various microbes, e.g. ciliates (*Paramecium*) and bacteria (*Beggiatoa* spp.), leading to subsequent epidermal tissue loss (Dalton and Godwin, 2006).

The low species diversity in the Persian Gulf is thought to be due largely to the stressful physical conditions which have restricting effects on the biota. The constricted and shallow entrances to the Persian Gulf are thought to be an additional barriers preventing influx of many species (Kimor, 1973). The high salinities within the Persian Gulf would also appear to be largely responsible for the reduced number of species of molluscs, or even for the absence of certain groups, reported by other authors (Kinsman, 1964; Basson et al., 1977).

Farur Island contains a large proportion of species, including nudibranchs. The island is protected and generally unaffected by tourism and construction activities. Surprisingly, only one of the nudibranch species reported here, *Marioniopsis viridescens*, is new to this area. However, seven other species which are new records for the northern region of the Persian Gulf have an Indian Ocean distribution. Thus, this location seems to be a hot spot biodiversity area, with high abundance of reef fish and invertebrates.

Because of low previous collecting efforts in the area, it comes perhaps as no surprise that species thought to be endemic in the Oman Sea are now also found in the Persian Gulf. As the nudibranch fauna is yet to be extensively studied in this region, some of the names on the list could be misidentifications or

synonyms but until a worker starts to study these animals again there is not much hope of clearing up errors.

Many nudibranchs are very small, cryptic, and nocturnal; therefore, the methods employed in this study (i.e., species sighted by the divers in the daytime) give only an incomplete and partial survey view of the total nudibranch assemblage of the sites and likely underestimated the total number of species present.

The resulted list will undoubtedly be greatly expanded when the nudibranch fauna of each area is studied in detail. In recent years, revisions of the families like *Chromodoridae* and *Phyllydidae* in the Indo-Pacific region have been carried out by Rudman (1983, 1984, 1991) and Brunckhorst (1993), respectively. They have helped to clear up much of the confusion which used to surround these important groups. A checklist such as this hints at the biodiversity of the group and will help in conservation efforts around the Persian Gulf.

As the reefs are under increasing pressure from both natural (climate change, bleaching, sedimentation, etc.) and man made causes (harbour construction, illegal fishing, military drills, etc.), and so are nudibranchs living on them. Thus, recording the present number of taxa is significant as it would establish a basis with which future surveys could be compared and assessed.

Many factors are contributing to the stressful nature of this coastal region including environmental stress, physical isolation the Persian Gulf, and high salinity. The Persian Gulf and the coasts surroundings various countries are undergoing massive construction activities and pollution. With intensive dredging and reclamation of coastal area, marine habitats and coastal ecosystems are facing serious environmental challenges.

Multidimensional scaling (MDS) of species matrix data revealed two groups of islands: one group of islands (Larak, Hormuz, Qeshm, Hengam, Farur, Kish, Lavan, Khark) which lay close to each other; and one island (Farsi) which is far apart (Figure 2)

from other island group. Habitat similarity between nearby islands might be related to higher live coral coverage (Carpenter et al., 1981), and of course the closer distance between them. Furthermore, the remoteness of Farsi Island from the mainland and from other islands and current direction could have contributed to its low diversity.

Documenting new species to coastal waters of the Persian Gulf brings the nudibranch fauna in Iranian coastal waters to a total of 32 species. With SCUBA-diving and the help of many eyes focused on spotting nudibranchs, many of these rare species can be regarded as more or less common in some of the localities where, divers have learned to look for them. The rarity of many of the nudibranchs do not seem to adhere to the definition of small populations along the coast of the Persian Gulf, but more to the fact that no one has been looking for them, or been able to observe them.

New records from Iran and increased observations and records of species compared to previously known distributions in some instances have been advocated to climate change and increased sea water temperatures.

A recent report on changes in macrobenthic organisms discuss different scenarios for changes, among them increase in sea temperature (Brattegard, 2010).

4. Conclusions

Many observations were made from different islands in the northern region of the Persian Gulf where previous authors were unable or prevented from study them either for their remoteness or for security reasons. As more diving operations are carried out in the future, the chances of finding more species would increase. Therefore, the present material does not by any means comprise an exhaustive collection of nudibranchs in the Persian Gulf. Long-term studies are required to monitor the alien species and their relation to native and endemic species, in order to examine possible competition and to document the displacement and replacement events. Special interest and monitoring studies are needed in the Persian Gulf due to prediction of the probable impacts to the native fauna and flora components. Future ecological research in the area could benefit our knowledge of the life history and population dynamics strategies utilized by nudibranch to survive stressful environment.

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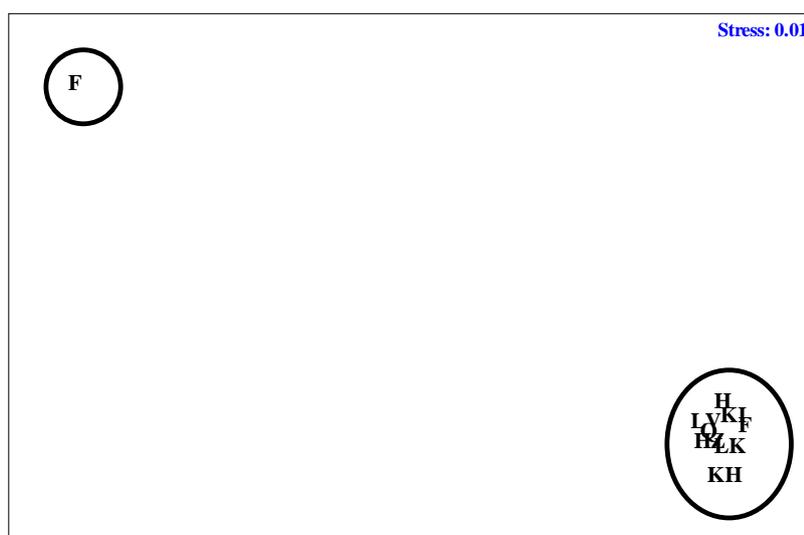


Fig. 2: MDS ordination plot of islands in the surveyed area. A measure of goodness-of-fit of the MDS ordination was given by the stress value (F= Farur; LK= Larak; KH= Khark; LV= Lavan; H= Hendourabi; Q= Qeshm; KI= Kish; HZ= Hormuz.).

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