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Check List of Iran marine Cnidarians (Animalia, Cnidaria)

Maghsoudlou, A.

Iranian National Institute for Oceanography and Atmospheric Science (INIOAS), Tehran, Iran.

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Abstract
There is an urgent need for quality control of marine species data published in domestic journals and open access databases. We extracted 149 accepted Cnidarian species after the quality control process on available published records on the OBIS data scheme. In total, 75 species belong to the hard corals (Scleractinia); 16 species belong to soft corals (Alcyonacea); 4 species of sea anemones (Actiniaria); 7 species of colonial anemones (Zoantharia); 24 species of thecate hydroids (Leptothecata); 2 species of athecate hydroids (Anthoathecata); 4 species of sea pens (Pennatulacea); 14 species of Siphonophora hydra, 2 species for Trachymedusae hydra and only one species for Narcomedusae. Our checklist can be considered as a reliable Cnidarian species list in future research and making a decision for biodiversity and conservation of corals in the country. We also updated species richness data on Iran hard corals to 75 species (Scleractinia).

Key words: *Occurrence, Observation, Cnidaria, Darwin core format, OBIS.*

INTRODUCTION

The available Iran marine species richness data are scattered in non-database information sources (i.e. research reports, scientific literature, university theses, books, and museum archives). These data are not readily available and lack of continuity between survey methodology and data reporting based on a unique and standard format, have made the resulting data vary in their quality and inefficient for providing meaningful information. Therefore, there is an urgent need to extract, standardize, and evaluate these marine occurrence records based on acceptable international format and standard (Maghsoudlou *et al*., 2019). The next step is creating a reliable marine biodiversity database, with particularattention on the Persian Gulf and the Gulf of Oman where high maritime activities, as the major waterways for oil and gas transport (Pak & Farajzadeh, 2007), threaten the biodiversity of these environments.

Ocean Biogeographic Information System (OBIS) provides the world's largest scientific knowledge base on the diversity, distribution and abundance of all marine organisms in an integrated and standardized format that is called the OBIS scheme. Iranian National Institute for Oceanography and Atmospheric Science (INIOAS) joined to the OBIS (PEGO-OBIS) in 2013, to provide and publish occurrence data of the Iranian parts of the Persian Gulf and the Gulf of Oman biota. The present review data paper provides a first Cnidarian checklist which is processed based on the OBIS species data format. Due to lack of the eight occurrence OBIS terms in some records (e.g. GPS coordinates, event date, etc.), we ignore data before 2006, so the temporal range of the occurrence data is from 2006-2016.

*Corresponding Author: wahabbio@gmail.com

MATERIAL AND METHODS

The presence of Cnidarian occurrence data is part of a big project co-funded by the Iran National Science Foundation and Iranian National Institute for Oceanography and Atmospheric Science (project grant number: INIOAS: 392-011-05 & INSF: 97004513). Through the project, the available occurrence data for Iranian parts of the Persian Gulf and the Gulf of Oman were extracted from reliable information sources up to 2016. The extracted data were standardized based on the OBIS data format, which is an international body of standards for species richness data, to create a reliable species checklist. Finally, 149 accepted Cnidarian species were retrieved from 555 standardized occurrence records.

Geographic coverage

The geographic range of our extracted data is from the Iranian coasts of the Persian Gulf and the Gulf of Oman (25.324 and 30.145 Latitude; 49.175 and 60.908 Longitude, Fig. 1).

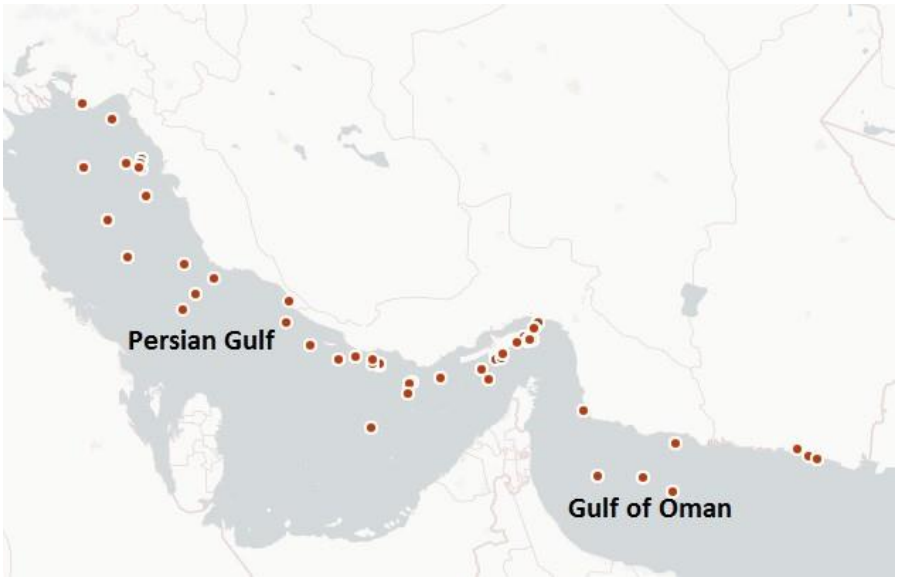

FIGURE 1. Distribution of Cnidarian occurrence records along the Iranian waters of the Persian Gulf and the Gulf of Oman.

The following three steps are taken in the present study:

- Data extraction
- Data standardization based on the OBIS occurrence data scheme.
- WORMS taxon match and Quality control

Data extraction

Available occurrence data were extracted from national and international scientific open access databases including Iranian Research Institute for Information Science and Technology (2012), Data bank of Iranian magazines (2011), Scientific Information Database (2011), Iranian Conferences Specialized Publisher (2012), Global Biodiversity Information Facility, GBIF (2012), Google Scholar (2011), Ocean Biogeographic Information System, OBIS, (2012), ScienceDirect (2012), SeSam - Collection Management Database of the Senckenberg Museum (2012), LinkedIn (2013), ResearchGate (2013) and The Biodiversity Heritage Library (2013). Academic libraries were also directly visited and relevant information was recorded.

Data standardization

The OBIS (2016) data scheme was used as a platform to organize our extracted Cnidarian data. The OBIS data scheme is based on the ratified Darwin core terms (DwC) which are a body of standards to create a common language for documenting and publishing data about species registers. DwC terms correspond to the column names of your dataset, and OBIS currently has eight required DwC terms. These terms and their definitions are listed in table 1 (Darwin Core Occurrence terms 2013). To create a reliable checklist data, we ignored those data which have not the entire eight mandatory OBIS-DwC occurrence terms (e.g. GPS coordinates, event date, etc.). Therefore, the presented Cnidarian occurrence data is limited to 2006-2016.

TABLE 1. OBIS-DwC terms and definitions (https://dwc.tdwg.org/terms/).

OBIS-DwC term	Definition
ScientificName	Contain the originally recorded scientific name, even if the name is currently a synonym.
ScientificNameID	An identifier for the nomenclatural (not taxonomic) details of a scientific name. the ID is given from WoRMS LSID
BasisOfRecord	The specific nature of the data record and include: *PreservedSpecimen:* when specimen is deposited in a collection (add institution Code, collectionCode and CatalogNumber) *FossilSpecimen:* for fossil materials *LivingSpecimen:* an intentionally kept/cultivated living specimen e.g. in an aquarium or culture collection *HumanObservation:* e.g. bird sighting, benthic sample but specimens were discarded after counting. *MachineObservation:* sensors, e.g. DNA sequencers, image recognition.
OccurrenceID	Globally unique based on the below format: urn:catalog:[institutionCode]:[collectionCode]:[catalogNumber or autonumber in the absence of a catalogNumber
OccurrenceStatus	A statement about the presence or absence of a taxon at a Location.
DecimalLongitude	The geographic longitude (in decimal degrees, using the spatial Reference system given in geodeticDatum) of the geographic center of a Location. OBIS recommended practice: EPSG:4326
DecimalLatitude	The geographic latitude (in decimal degrees, using the spatial Reference system given in geodeticDatum) of the geographic center of a Location.
EventDate	The date-time or interval during which an Event occurred. VerbatimEventDate (not recommended).OBIS recommended ISO 8601format for date recording.

Quality control and data cleaning

Quality of the extracted Occurrence data was controlled by the WORMS's taxon match system (WORMS Taxon Match 2013) and DwC terms (Darwin Core Occurrence terms 2013). Only 555 occurrence records from various information sources had all mandatory OBIS fields. As a result, the temporal range is from 2006 to 2016 due to a lack of reliable occurrences (Suppl. material 1).

RESULTS

We extracted 149 accepted Cnidarian species after the quality control process. The result shows 75 species belong to the hard corals (Scleractinia); 16 species belong to soft corals (Alcyonacea); 4 species of sea anemones (Actiniaria); 7 species of colonial anemones (Zoantharia); 24 species of thecate hydroids (Leptothecata); 2 species of athecate hydroids (Anthoathecata); 4 species of sea pens (Pennatulacea); 14 species of Siphonophora hydra, 2 species for Trachymedusae hydra and only one species for Narcomedusae.

Within the Scleractinian corals (Scleractinia order), Acroporidae and Merulinidae are the most abundant families and representatives of *Acropora* followed by *Favites* and *Porites* are the most diverse species in the studied area (Table 2, Figs. 2, 3).

TABLE 2. Iranian accepted Cnidarian species of the Persian Gulf and the Gulf of Oman (2006 to early 2017).

Actiniaria (Ansari, *et al*. 2014; Azad, 2010; Attaran *et al*. 2012; Nouri Koupaei *et al*. 2013; Moghadam *et al*., 2011)

1. *Anthothoe* spp.
2. *Stichodactyla* spp.
3. *Stichodactyla haddoni*
4. *Stichodactyla tapetum*

Alcyonacea (Azad, 2010; Tesieh *et al*., 2012; Namin & Van Ofwegen, 2009; Benayahu & McFadden, 2011)

1. *Aldersladum sodwanum*
2. *Astrogorgia fruticosa*
3. *Dendronephthya* spp.
4. *Echinogorgia* spp.
5. *Echinomuricea* spp.
6. *Euplexaura* spp.
7. *Euplexaura plana*
8. *Junceella juncea*
9. *Menella* spp.
10. *Muricella* spp.
11. *Paraplexaura* spp.
12. *Sarcophyton minusculum*
13. *Sinularia* spp.
14. *Sinularia erecta*
15. *Subergorgia suberosa*
16. *Trimuricea reticulata*

Anthoathecata (Ansari *et al*. 2014; Elkuh *et al*., 2011)

1. *Octotiara* spp.
2. *Slabberia* spp.

Leptothecata (Elkuh *et al*., 2011)

1. *Aequorea* spp.
2. *Aequorea forskalea*
3. *Aequorea parva*
4. *Clytia hemisphaerica*
5. *Cuvieria* spp.
6. *Dipleurosoma*
7. *Eirene* spp.
8. *Eirene hexanemalis*
9. *Eirene kambara*
10. *Eirene mollis*
11. *Eutima* spp.
12. *Eutima gegenbauri*
13. *Eutima gracilis*
14. *Eutima levuka*
15. *Eutima variabilis*
16. *Eutimalphes pretiosa*
17. *Halopsis ocellata*

18. *Irenium* spp.
19. *Malagazzia carolinae*
20. *Malagazzia taeniogonia*
21. *Octophialucium funerarium*
22. *Octophialucium indicum*
23. *Phialella* spp.
24. *Phialella quadrata*

Narcomedusae (Nouri Koupaei *et al*., 2013)

1. *Solmundella bitentaculata*

Pennatulacea (Elkuh *et al*. 2011; Namin & Van Ofwegen, 2009)

1. *Cavernularia* spp.
2. *Pteroeides* spp.
3. *Veretillum* spp.
4. *Virgularia* spp.

Scleractinia (Agah, 2012; Fard Yazani *et al*., 2014; Geitanchi & Mostafavi, 2011; Karimi *et al*. 2007; Kavousi *et al*. 2011; Maghsoudlou, 2008; Rahimi & Mostafavi, 2011; Rahmani & Rahimian, 2013; Sadeghi & Loghmani, 2009; Shojae *et al*., 2010; Samiei *et al*., 2013; Mostafavi *et al*., 2007)

1. *Acanthastrea echinata*
2. *Acanthastrea hemprichii*
3. *Acropora* spp.
4. *Acropora arabensis*
5. *Acropora aspera*
6. *Acropora cervicornis*
7. *Acropora clathrata*
8. *Acropora downingi*
9. *Acropora horrida*
10. *Acropora mossambica*
11. *Acropora muricata*
12. *Acropora nasuta*
13. *Acropora tortuosa*
14. *Acropora valida*
15. *Anomastraea* sp.
16. *Anomastraea irregularis*
17. *Coscinaraea* spp.
18. *Coscinaraea columna*
19. *Coscinaraea monile*
20. *Cyphastrea* spp.
21. *Cyphastrea chalcidicum*
22. *Cyphastrea microphthalma*
23. *Cyphastrea serailia*
24. *Dipsastraea favus*
25. *Dipsastraea matthaii*
26. *Dipsastraea pallida*
27. *Dipsastraea speciosa*
28. *Echinophyllia aspera*
29. *Echinopora gemmacea*

30. *Echinopora hirsutissima*
31. *Favia* spp.
32. *Favites* spp.
33. *Favites chinensis*
34. *Favites complanata*
35. *Favites pentagona*
36. *Favites spinosa*
37. *Favites vasta*
38. *Goniopora* spp.
39. *Goniopora columna*
40. *Heterocyathus aequicostatus*
41. *Hydnophora pilosa*
42. *Leptastrea* spp.
43. *Leptastrea pruinosa*
44. *Leptastrea purpurea*
45. *Leptastrea transversa*
46. *Leptoria irregularis*
47. *Montipora* spp.
48. *Montipora aequituberculata*
49. *Montipora incrassate*
50. *Pavona* spp.
51. *Pavona decussate*
52. *Pavona diffluens*
53. *Pavona frondifera*
54. *Platygyra* spp.
55. *Platygyra acuta*
56. *Platygyra daedalea*
57. *Plesiastrea* spp.
58. *Plesiastrea versipora*
59. *Pocillopora damicornis*
60. *Porites* spp.
61. *Porites compressa*
62. *Porites lobata*
63. *Porites lutea*
64. *Porites solida*
65. *Psammocora* sp.
66. *Psammocora contigua*
67. *Psammocora profundacella*
68. *Psammocora stellate*
69. *Pseudosiderastrea* sp.
70. *Siderastrea* spp.
71. *Siderastrea savignyana*
72. *Stylophora pistillata*
73. *Turbinaria peltata*
74. *Turbinaria reniformis*

75. Turbinaria stellulata

Siphonophorae (Sadeghi & Loghmani, 2009)

1. *Agalma elegans*
2. *Bassia bassensis*
3. *Chelophyes appendiculata*
4. *Chelophyes contorta*
5. *Diphyes chamissonis*
6. *Diphyes dispar*
7. *Eudoxoides mitra*
8. *Lensia conoidea*
9. *Lensia subtilis*
10. *Lensia subtiloides*
11. *Muggiaea atlantica*
12. *Muggiaea kochii*
13. *Sulculeolaria biloba*
14. *Sulculeolaria quadrivalvis*

Trachymedusae (Shojae *et al*., 2010)

1. *Aglaura hemistoma*
2. *Liriope tetraphylla*

Zoantharia (Nouri Koupaei *et al*., 2013; Tesieh *et al,*. 2012)

1. *Palythoa* spp.
2. *Palythoa caribaeorum*
3. *Palythoa mutuki*
4. *Palythoa tuberculosa*
5. *Zoanthus* spp.
6. *Zoanthus sansibaricus*
7. *Zoanthus vietnamensis*

DISSCUSSION

Cnidaria Verrill, 1865 is a phylum under Kingdom Animalia with nearly 12000 accepted species. Global species richness within the reported Cnidarian orders in the present study is as follows: Scleractinia = 1610; Alcyonacea = 3410; Actiniaria = 1138; Zoantharia = 287; Leptothecata = 2076; Anthoathecata = 1300; Pennatulacea = 228; Siphonophora = 188; Trachymedusae = 53; Narcomedusae =43 (WORMS, 2019). These data indicate that Alcyonacea and Leptothecata are more species-rich orders in comparison to the hard corals. Namin and van Ofwegen (2009) reported 31 soft coral species (Alcyonacea) for the Persian Gulf. However, our data show that half of them existon the Iranian coasts.

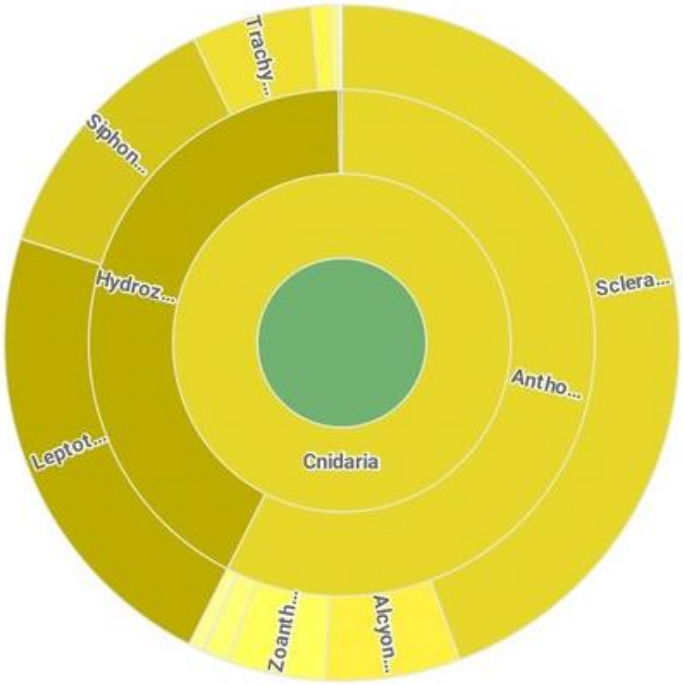

FIGURE 2. Taxonomic distribution of Cnidarian orders, extracted from reliable resources mentioned in table. 2 and the reference section of this study

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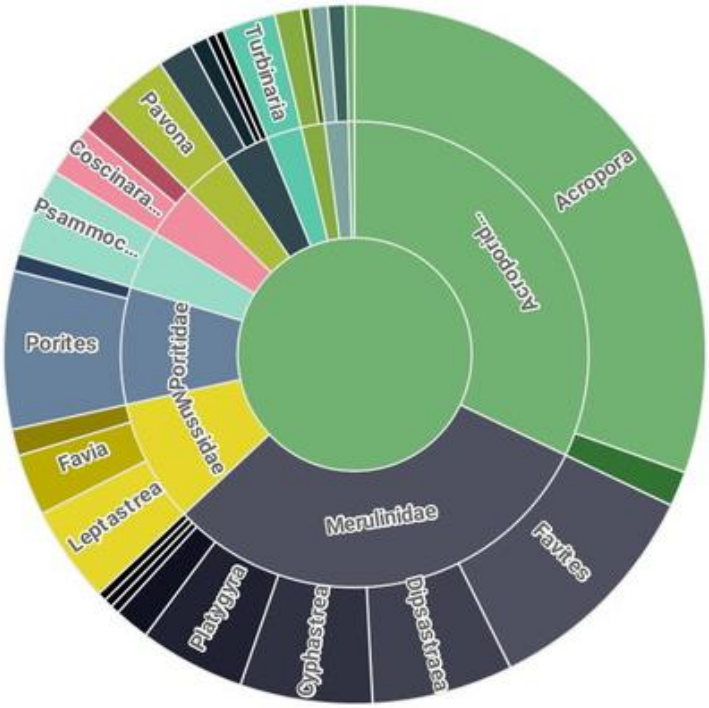

FIGURE 3. Taxonomic distribution of hard corals (Scleractinia), extracted from reliable resources mentioned in table 2 and the reference section of this study.

Half of the Cnidarian species represented here belong to hard corals. It reveals thathard corals, because of easier identification in comparison to other groups, and also for their vast distribution on 14 Iranian coast and Islands intertidal zone, are the favorite group to study among Iranian scientists, our hard corals species list confirms Riegl & Purkis (2012) remarks who stated that Iran has a rich coral fauna compared to Arabian neighbor countries of the Persian Gulf, probably the richest fauna in the Persian Gulf. Our data also updated species richness on whole Persian Gulf hard corals, has already been reported (Maghsoudlou, 2008; Maghsoudlou *et al*., 2008; Riegl & Purkis, 2012) up to 75 species. Nevertheless, the species richness in the Persian Gulf is almost 5 times lesser than the Red Sea, as DiBattista *et al*. (2016) recorded 365 scleractinian coral species from the Red Sea. Based on the IUCN (2020) 24 species of the presented hard corals are in the IUCN red list which emphasizes on the urgent need for more attention to Iranian coral ecosystems. Regular monitoring and creating a robust coral database not only for Iran, but also for the region can help us to conserve these valuable resources (Maghsoudlou et al., 2019). Moreover, establishing a robust open-access species database not only increase the accessibility and usability of data in science, but also can vastly improve our knowledge and also enable us to make more effective decisions about biological resource management (Costello & Wieczorek, 2014; Palacio, 2008). Among the countries surrounding the Indian Ocean, India is the only country that has a consistent marine biodiversity database (Wafar *et al*., 2011). Lack of skilled people, institutional, and technical capabilities are mentioned as the reason for asymmetric growth of marine biodiversity knowledge among Indian Ocean countries (Richmond, 2001, Wafar *et al*., 2011).

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