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Updated checklist of the Northern Persian Gulf and Oman Sea holothurians

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ABSTRACT

Holothurians are detritus feeder Echinoderms, live in different marine zones and play ecological roles in the marine ecosystems. The first research on the Echinoderms in the Persian Gulf took place in 1908 by Koehler and Vaney and was used as basis for further studies by Heding in 1940s. Studies in the Persian Gulf show various common species of the sea cucumbers in the Iranian waters of the Persian Gulf and the Oman Sea. This paper provides a checklist of 22 sea cucumbers identified in the Northern Persian Gulf and Oman Sea belonging to 4 orders: Holothuriida, Synallactida, Apodida and Dendrochirotida. Holothurians belong to genus Holothuria, species: *Holothuria* (*Mertensiothuria*) *leucospilota* (Brandt, 1835), *Holothuria* (*Selenkothuria*) *parva* Krauss in Lampert, 1885, *Holothuria (Thymiosycia) arenicola* Semper, 1868 and *Stichopus herrmanni* Semper, 1868 are abundant in the Northern Persian Gulf and Oman Sea, concentration of the species *Holothuria* (*Mertensiothuria*) *leucospilota* (Brandt, 1835) is the most prevalent in the area. The other species distribution is limited.

Keywords: Sea cucumber; Holothuriida; Synallactida; Apodida; Dendrochirotida.
Article type: Report.

INTRODUCTION

Sea cucumbers belong to Animalia Kingdom, Echinodermata phylum; subphylum Echinozoa, class Holothuroidea consisting of six orders: Molpadiida, Apodida, Aspidochirotida, Elasipodida, Dendrochirotida and Dactylochirotida. and 1400 species (Pawson *et al*. 2010). These benthic invertebrates are distributed wildly in all oceans and latitudes from the shoreline to abyssal plain (Purcell *et al*. 2012) and also observed in hydrothermal vent habitats (Sminrov *et al*. 2000). These invertebrates can be found on hard or soft stratums such as coral reefs, algal beds and sandy bottoms (Purcell *et al*. 2012). While being deposit feeder and suspension feeder animals, these echinoderms have an important role in marine ecosystems food web (Bruckner *et al*. 2003). Holothuroidea also have ecological impacts as: recycling nutrients, contributing to sediments health, providing high biodiversity through symbiosis associations (Purcell *et al*. 2016), and increasing productivity in sea grass systems (Wolkenhauer *et al*. 2010). The deposit feeder holothurians could balance $CaCO_3$ of coral reefs and reduce the ocean acidification impacts on these reefs (Schneider *et al*. 2011). Iranian marine coastlines are consisting of the Persian Gulf and Oman Sea. So, the marine organisms' identification and distributions are considered by the scientists. Sea cucumbers existences in Iranian coastlines were investigated previously based on islands, ports or special places but there is not a generic report in the whole Iranian coastline. All the researchers in these surveys used Scuba diving and hand collecting to collect the specimens from intertidal or sub tidal zones. Organisms were frozen before reaching the laboratory morphological features and ossicle key shape to diagnose the specimen and genus. To prepare the ossicles, 1 cm^2 of the specimen was placed in the bleaching liquid and the residue was studied under the microscope. A single research also applied histology of animal skin (Vaeznia *et al*. 2014).

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MATERIALS AND METHODS

This paper was provided by compiling the existent compilations of studies about sea cucumbers in Iranian coast of Persian Gulf and Oman Sea.

RESULTS AND DISCUSSION

The earliest study of Holothuriians in Iranian water of the Persian Gulf was performed by two scientists: Koehler and Vaney (Heding 1940). The investigators reported six species, including *Holothuria ocellata* Jaeger, found in Bandar Abbas City. The investigators explored a region believed to be in the Persian Gulf, within Bandar Abbas and Bahrain (Heding 1940), though specific locations were not reported. A 1940 Danish scientific investigation in Iran yielded 11 new species and recorded three others (Heding 1940). The Danish team's report of *Stolus buccalis* (Stimpson, 1855), *Colochirus loppenthini*, and *Holothuria pardalis selenka* on Bahrain's coastline, formerly part of the Iranian coast, excluded these species because the study's focus did not extend to regions no longer considered Iranian territory. The reported species of the both 1908 and 1940 studies are presented in Table 1. Heding, while searching the Iranian shorelines, believed the Holothurian fauna of the Persian Gulf was poor in diversity and species numbers, identifying Holothurians in only four locations: Bushehr, Bandar Abbas, Geshm, and Hengam Islands. He reported three species: *Holothuria* (*Mertensiothuria*) *leucospilota* (Brandt, 1835), *Protankyra pseudodigitata* and *Thyone dura* koehler & vaney, 1908 as the most distributed and numerous Holothurians. *H. leucospilota* was distributed in coral reefs, and the other two had been collected on soft bottoms, *P. pseudodigitata* was identified in some locations, while *T. dura* was only collected in Geshm Island and Banndar abbas (Heding 1940). There was no evidence of research on sea cucumber in Iranian water up to 2009, though some dissertations were performed on identifying and locality of Holothuridea in the Persian Gulf and Iranian waters of the Oman Sea. Shakouri during work in the Iranian waters of the Oman Sea for Holothuridea reported 5 sea cucumbers: *H. leucospilota, Holothuria* (*Thymiosycia*) *arenicola* Semper, 1868, *Holothuria* (*Mertensiothuria*) *hilla* Lesson, 1830, *Holothuria* (*Selenkothuria*) *parva* Krauss in Lampert, 1885, and *Stichopus herrmanni* Semper, 1868 in subtidal zone of Chabahar Bay (Shakouri *et al*. 2009a,b). Following the researches in the Oman Sea, *Holothuria* (*Halodeima*) *edulis* Lesson, 1830 occurrence was reported (Daneshmand *et al*. 2010). Scientists studying environmental factors and holothurian distribution in Chabahar Bay, Eastern Oman Sea, confirmed the presence of the four species previously reported (Shakouri *et al*. 2014). Table 1 lists studies on sea cucumbers in the Persian Gulf Islands. In the Iranian waters of the Oman Sea only Chabahar Bay was examined as studying area (Daneshmand *et al*. 2010; Khaleghi 2013). Further research identified new and re-detected sea cucumber species in the Persian Gulf Islands. In 2012, for the first time, *Ohshimella ehrenbergii* (Selenka, 1868) belonging to Dendrochirotida order, and Sclerodactylidae family was found at a depth of 2.5 meters off Farour Island, amongst rock pools (Dabbagh *et al*. 2012b). *Holothuria* (*Semperothuria*) *cinerascens* (Brandt, 1835) in the Persian Gulf was documented by Fatemi *et al.* through a research done on sea cucumbers of intertidal zone of Geshm Island (Fatemi *et al*. 2011). The species was found in Geshm Island for the second time by another researcher (Nateghishahrokni 2013). Presence of the species *Holothuria* (*Metriatyla*) *scabra* Jaeger, 1833 from family Holothuriidae was reported intermittently in Geshm (Dabbagh *et al*. 2012a; Nateghishahrokni 2013), Hengam (Salarzadeh *et al*. 2013) and Hormoz Islands (Pourvali *et al*. 2014a). Some studies focused on sea cucumbers identification around Hengam Island resulted in recording new species; *Holothuria notabilis* Ludwig, 1875, that was identified in the sea grass beds on sandy substrate coast (Afkhami *et al*. 2014). *Stichopus monotuberculatus* (Quoy & Gaimard 1834) belongs to order Aspidochirotida, family Stichopodidae was observed in Hengam Island (Ehsanpour *et al*. 2012). Species *Holothuria (Lessonothuria) insignis* Ludwig, 1875 was found in Hendourabi and Kish Islands, in areas of subtidal of sand - rocky bottoms at 5 meters depth (Nateghishahrokni 2013). It was also reported from subtidal zone of Hormoz Island (Afkhami *et al*. 2015). *Holothuria* (*Selenkothuria*) *bacilla* Cherbonnier, 1988 was cited in several investigations. It was first documented by Izadi in Geshm Island (Izadi 2009). In Larak Island this species was found at a depth of 15 meters among cobblestone beds (Nateghishahrokni 2013), and again in Hengam Island (Owfi & Mehrdoost 2015). It was also reported for the first time in Hormoz Island (Afkhami *et al*. 2015) and Kish Island (Najafshad *et al*. 2019). Barzkar reported a new species: *Stichopus horrens* Selenka, 1867 of family Stichopodidae in the Persian Gulf among rocky shores of Hendourabi Island. He also reported *S. hermanni* in this Island for the first time (Barzkar *et al*. 2019). Whilst new species were found through new research, the presence of previously found species by Heding & Vaney (Heding 1940) as: *Holothuria (Halodeima) atra* Jaeger, 1833 (Tehranifard & Rahimibashar 2012; Pourvali *et al*. 2014b; Farhadi *et al*. 2014), *Holothuria* (*Thymiosycia*) *impatiens* (Forsskål 1775; Salarzadeh 2013; Ameri *et al*. 2014),

Holothuria hilla (Dabbagh & Kamrani 2011; Afkhami *et al*. 2012b; Ameri *et al*. 2014), *H. parva* (Salarzadeh *et al*. 2012), *Holothuria (Theelothuria) spinifera* Théel, 1886 (Nateghishahrokni 2013) and *S. hermanni* (Afkhami *et al*. 2012a; Bastami *et al*. 2012; Nateghishahrokni 2013; Salarzadeh *et al.* 2013) were also reported. Sea cucumbers of the Persian Gulf and the Oman Sea are listed in Table 1 alphabetically. Sea Cucumber are used as food and commodity and are harvested and traded worldwide. The most commonly harvested sea cucumber species worldwide belong to order Aspidochirotida, families: Holothuriidae and Stichopodidae. Purcell reported 58 commercially important sea cucumber species (Purcell 2012). There are 14 species among 58 prevalently used species of sea cucumber in the Iranian shoreline: *H. arenicola, H. atra, H. cinerascens, H. edulis, H. hilla, H. impatiens, H. leucospilota, H. notabilis, H. pardalis, H. pervicax, H. scabra, H. spinifera, Stichopus cf. monotuberculatus, S. hermanni* and *S. horrens*. However, due to religious believes local people have not harvested these aquatics. International Union for conversation of Nature (IUCN) presents threatened species annually. The species: *H. lessoni* and *H. scabra,* are listed in IUCN red list (Conand *et al*. 2013: Hamel *et al*. 2013).

Table 1. Sea cucumbers of the Persian Gulf and the Oman Sea.

Species	Area	Location	References
Acaudina leucoprocta (HL Clark 1938)		Hengam*	Heding (1940)
Holothuria (*Thymiosycia*) *arenicola* Semper, 1868	Oman Sea	Chabahar♦	Shakouri *et al.* (2009a)
			Khaleghi (2013)
			Shakouri *et al.* (2014)
	Persian Gulf	Bostaneh#	Dabbagh & Keshavarz (2011)
		Lengeh#	Salarzadeh *et al.* (2012)
		Bushehr#	Salarialiabadi *et al.* (2015)
		Nayband#	
		Dayyer#	Keshavarz & Mohammadikia (2015)
		Geshm*	Fatemi *et al.* (2011)
			Vaeznia *et al.* (2014)
		Hormoz*	Pourvali *et al.* (2014)
		Hengam*	Owfi & Mehrdoost (2015)
		Hendourabi*	Barzkar *et al.* (2019)
Holothuria (*Halodeima*) *atra* Jaeger, 1833	Oman Sea	Chabahar♦	Shakouri *et al.* (2014)
	Persian Gulf	Hengam*	Heding (1940)
		Hormoz*	Pourvali *et al.* (2014)
			Vaeznia *et al.* (2014)
		Khark*	Farhadi *et al.* (2014)
		Kish*	Tehranifard *et al.* (2011)
Holothuria (*Selenkothuria*) *bacilla* Cherbonnier, 1988		Hengam*	Owfi & Mehrdoost (2015)
		Hormoz*	Pourvali *et al.* (2014)

			Afkhami *et al.* (2015)
		Geshm*	Izadi (2009)
		Kish*	Najafshad *et al.* (2019)
		Larak*	Nateghishahrokni (2013)
Holothuria (*Semperothuria*) *cinerascens* (Brandt 1835)		Geshm*	Fatemi *et al.* (2011)
			Nateghishahrokni (2013)
		Hormoz*	Pourvali *et al.* (2014)
Holothuria (*Thymiosycia*) *conusalba* Cherbonnier & Féral, 1984			
	Oman Sea	Chabahar♦	Daneshmand *et al.* (2010)
Holothuria (*Halodeima*) *edulis* Lesson, 1830			
Holothuria (*Mertensiothuria*) *hilla* Lesson, 1830			Shakouri *et al.* (2009b) & Shakouri *et al.* (2014)
			Daneshmand *et al.* (2010)
	Persian Gulf	-	Koehler & Vaney (1908)
		Farour*	Dabbagh & Kamrani (2011)
		Geshm*	Fatemi *et al.* (2011)
			Vaeznia *et al.* (2014)
		Hendourabi*	Ameri *et al.* (2014)
		Hengam*	Salarzadeh *et al.* (2013)
		Hormoz*	Vaeznia *et al.* (2014)
		Larak*	Afkhami *et al.* (2012)
Holothuria (*Thymiosycia*) *impatiens* (Forsskål 1775)		Farour*	Heding (1940)
		Hendourabi*	Ameri *et al.* (2014)
		Hengam*	Salarzadeh *et al.* (2013)
			Owfi & Mehrdoost (2015)
		Larak*	Afkhami *et al.* (2012)
Holothuria (*Lessonothuria*) *insignis* Ludwig, 1875	Oman Sea	Chabahar♦	Khaleghi (2013)
	Persian Gulf	Hormoz*	Afkhami *et al.* (2015)
Holothuria (*Mertensiothuria*) *leucospilota* (Brandt 1835)	Oman Sea	Chabahar♦	Shakouri *et al.* (2009a)
			Daneshmand *et al.* (2010)
			Khaleghi (2013)

			Shakouri *et al.* (2014)
	Persian Gulf	-	Koehler & Vaney (1908)
		Khark*	Heding (1940)
		Shidvar*	Heding (1940)
		Aboumousa*	Afkhami *et al.* (2012)
		Bostaneh#	Dbbagh & Keshavarz (2011)
		Dayyer#	Keshavarz & Mohammadikia (2015)
		Geshm*	Fatemi *et al.* (2011)
			Vaeznia *et al.* (2014)
		Hendourabi*	Ameri *et al.* (2014)
		Hengam*	Salarzadeh *et al.* (2013)
			Owfi & Mehrdoost (2015)
		Hormoz*	Pourvali *et al.* (2014)
		Kish*	Najafshad *et al.* (2019)
Holothuria (*Theelothuria*) *notabilis* Ludwig, 1875		Hengam*	Afkhami *et al.* (2014)
Holothuria ocellata Jaeger		-	Koehler & Vaney (1908)
		Bandarabbas	Heding (1940)
Holothuria (*Lessonothuria*) *pardalis* Selenka, 1867		Hormoz*	Pourvali *et al.* (2014)
		Geshm*	Fatemi *et al.* (2011)
Holothuria (*Selenkothuria*) *parva* Krauss in Lampert, 1885		-	Koehler & Vaney (1908)
		Hendourabi*	Barzkar *et al.* (2019)
		Hengam*	
			Owfi & Mehrdoost (2015)
		Hormoz*	Pourvali *et al.* (2014)
		Geshm*	Heding (1940)
			Fatemi *et al.* (2011)
			Vaeznia *et al.* (2014)
		Bostaneh#	Dabbagh & Keshavarz (2011)
			Salarialiabadi *et al.* (2015)
		Dayyer#	Keshavarz & Mohammadikia (2015)
			Salarialiabadi *et al.* (2015)
		Bushehr#	Heding (1940)
			Salarialiabadi *et al.* (2015)

		Nayband[#]	Salarialiabadi *et al.* (2015)
		Lengeh[#]	Vaeznia *et al.* (2014)
			Salarzadeh *et al.* (2012)
Holothuria (*Stauropora*) *pervicax* Selenka, 1867	Oman Sea	Chabahar[♦]	Shakouri *et al.* (2014)
Holothuria (*Metriatyla*) *scabra* Jaeger, 1833	Persian Gulf	Hengam*	Salarzadeh *et al.* (2013)
		Hormoz*	Pourvali *et al.* (2014)
		Geshm*	Darvish Bastami *et al.* (2012)
Holothuria (*Theelothuria*) *spinifera* Théel, 1886		Khark*	Heding (1940)
		Hendourabi*	Nateghishahrokni (2013)
Ohshimella ehrenbergii (Selenke 1868)		Farour*	Dabbagh *et al.* (2012)
		Khark*	Heding (1940)
Protankyra magnihamula Heding, 1928			
Protankyra pseudodigitata (Semper 1867)		Bushehr[#]	Heding (1940)
			Peyghan *et al.* (2018)
		Bandar abbas	Heding (1940)
		Geshm*	Vaeznia *et al.* (2014)
		Farour*	Heding (1940)
		Hendourabi*	Barzkar *et al.* (2019)
Stichopus monotuberculatus (Quoy & Gaimard 1834)		Hengam*	Ehsanpour *et al.* (2012)
			Salarzadeh *et al.* (2013)
Stichopus herrmanni Semper, 1868	Oman Sea	Chabahar[♦]	Shakouri *et al.* (2009a)
			Daneshmand *et al.* (2010)
			Shakouri *et al.* (2014)
	Persian Gulf	-	Koehler & Vaney (1908)
		Lavan*	Heding (1940)
		Aboumousa*	Afkhami *et al.* (2012)
		Hendourabi*	Ameri *et al.* (2014)
		Hengam*	Salarzadeh *et al.* (2013)
		Geshm*	DarvishBastami *et al.* (2012)
		Kish*	Tehranifard *et al.* (2011)

	Hendourabi*	Barzkar *et al.* (2019)
Stichopus horrens Selenka, 1867		
Thorsonia fusiformis Heding, 1940	Bushehr#	Heding (1940)
Havelockia festina (Koehler & Vaney 1908)	-	Koehler & Vaney (1908)
	Hormoz Strait	Heding (1940)
	Geshm*	Vaeznia *et al.* (2014)

Note: *Island, #Port, *Bay.

CONCLUSION

Compare to Heding results in the Persian Gulf, *T. dura* and *P. pseudodigitata* were identified in Qeshm Island (Vaeznia *et al*. 2015), but *T. dura* is not known to be the dominant species in this region as Heding reported, and *P. pseudodigitata* also found in Bushehr Port (Peyghan *et al*. 2018) had not been documented in this area for more than fifty years. Five species: *Havelockia festina* (Koehler & Vaney 1908), *Acaudina leucoprocta* (HL Clark 1938), *Holothuria ocellata* Jaeger, *Protankyra magnihamula* Heding, 1928 and *Thorsonia fusiformis* Heding, were recorded only by the first two investigations in the Persian Gulf. There has been no further evidence of these species in Iranian waters since. In total 27 sea cucumber species in Iranian coast line have been identified, although there is no evidence of recording the five species. Studies indicate the presence of 22 species in the Northern Persian Gulf and the Oman Sea. Among these *O. ehrenbergii* and *T. dura* belong to order Dendrochirotida, family: Sclerodactylidae and Phylophoridae, genus: Protankyra and *Thyone* respectively. *S. hermanni*, *S.* cf. *monotuberculatus* (Quoy & Gaimard 1833) and *S. horrens* are belonged to order Synallactida, family Stichopodidea and genus *Stichopus*. *P. pseudodigitata* (Semper 1867) belongs to order Apodida, family Synaptidae, genus *Protankyra*. The other 15 identified species belonged to order Holothuriida, family Holothuriidae, genus *Holothuria.* All *H. leucospilota, H. parva*, *H. arenicola* and *S. hermanni* are the most common sea cucumbers species in the abovementioned regions while the atypical uncommon sea cucumber species in Iranian shoreline are: *H. cinerascens, H. edulis, H. notabilis, H. Pardalis, H. pervicax, H. spinifera, P. Pseudodigitata, S. monotuberculatus, S. horrens, T. dura* and *O. Ehrenbergii* and have been reported in specific locations. *H. leucospilota* is the most commonly found holothurians species in Iranian Shore line and is represented as more established. The authors of this paper recommend using molecular techniques for new investigations in this area so more detailed information would be accessible.

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