A Survey of Gastropod Species (Mollusca) in the Intertidal Zone of Hawf Coastal Area in Al-Maharah Governorate-Yemen

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Abstract: This study is considered the first exclusive study of gastropod mollusk species on the coast of Hawf, Al Mahra Governorate. It aimed to record the species of gastropod mollusks in the intertidal zone of the Hawf coast, as these species had not been previously recorded and documented. Two coastal sites were chosen in Hawf: the Ramdot coast, which is located at the following coordinates: 16°.31'.145" N, 53°.02'.890" E, and the other coast, the Gahdeb coast, is located at the following coordinates: 16°.36'.846" N, 52°.57'. 136" E. The study was conducted intermittently in 2011, 2018, and 2020, in which 300 samples were collected by hand during low tide times in the intertidal zone of the study sites from different habitats. The total number of gastropod species was 34, belonging to 23 genera, under 17 families. The dominant families were Cypraeidae with 7 species, and Neritidae, with 5 species. In terms of coastal environments, the rocky environment had the most species of gastropod mollusks.

Keywords: Gastropods; Intertidal zone; Rocky shores; Sandy shores; Hawf coast.

1. Introduction: Hawf Natural Reserve is located in the Yemeni Al-Mahra Governorate, 1,400 kilometers (870 miles) from Sana'a, adjacent to the international borders of the Sultanate of Oman, and about (120 km) from the city of Al-Ghaydah, the capital of the governorate.

The Hawf Natural Forest is located in this area, which is considered one of the most important protected forests in the Republic of Yemen, which made it the focus of attention of researchers, tourists and environmentalists, which made the Yemeni government officially seek It was approved as a nature reserve in August 2005 (Hussein *etal*.,2005& Al-Hindi *etal*., 2021). Hawf Natural Reserve was formed by the monsoon winds (Al-Mansoon) coming from the Arabian Sea and Loaded with water vapor that collides with the Hawf Mountains, forming rain clouds that fall on the Hawf Mountains throughout the Al-Mansoon period, which extends from mid-July to mid-September every year during this period, the mountains wear a green suit that pleases the onlookers (Hussein *etal*.,2005).

To the north, the reserve is bordered by a highland plateau, which descends to a desert area, to the south it is bordered by the Arabian Sea, where the main city is located, and to the east is the borders of the Sultanate of Oman, while to the west is Fatak, which is part of the Hawf District, with the beginnings of the borders of Al Ghaydah District (Al-Hindi *etal*., 2021). The Hof Nature Reserve is characterized by rare, threatened, or endemic (birds) plant and animal species that still maintain their vital nature. It is designated for the purposes of conservation and protection, as well as for scientific studies (Al-Hindi *etal*., 2021). The coasts in the south of the Arabian Peninsula at the Gulf of Aden and the Arabian Sea have not received much attention and studies in marine biodiversity field, leading to a large gap in knowledge on the fauna of marine biodiversity in this region (Sheppard et al., 1992; Saad, 1992; Apel & Spiridonov, 1998; Neumann & Spiridonov, 1999; Al-Hindi, 2010; Al-Hindi *et al*., 2012; Khvorov et al., 2012; Al-Hindi, 2019, Al-Hindi *et al*., 2023; Al-Hindi, 2024). The Hof coast is also considered one of the coasts rich in marine biodiversity, and unfortunately there are also no studies in this field. Therefore, this study is considered the first study to inventory and record gastropod species in this location, as one of the objectives of the study, and to fill the knowledge gap in the field of marine biodiversity at the southern part of the Arabian Peninsula on the Arabian Sea and the Gulf of Aden.

2. Materials and Methods

2.1: Samples: 300 different samples of gastropod mollusks were collected in the intertidal zone from different habitats in two locations on the coast of Hawf, by hand, during the low tide period, during intermittent periods in the years 2011, 2018, and 2020, due to the long distance between Aden and Hawf (1400 Km), and the scarcity of financial funding (Fig. 1 & Table 1).

2.2: Materials: Plastic containers of different sizes, nylon bags, a metric scale (20 meters), formalin, GPS device, digital camera, table showing the times of the tide and low tide of the day, and taxonomic keys of gastropod species.

2.3: Methods: The study area in the intertidal zone was divided into squares, each square measuring 5 meters in length. The samples were collected by hand during low tide times from different habitats, such as; rocky shores, rock platforms, rock pools, and sandy shores, and placed in plastic containers containing seawater and formalin at a concentration of 10% for preservation purposes. These samples were transferred to the biology department laboratories at the College of Education, Aden- University of Aden, for photographing by digital camera, and scientific classification using the taxonomic keys available to us based on the morphological characteristics of the shell and the shape of the exit opening of the foot (FAO, 2004; Richmond, 2002; Donald et al., 1995), and the measurements were taken of the shell length (SL) by digital caliper (cm).

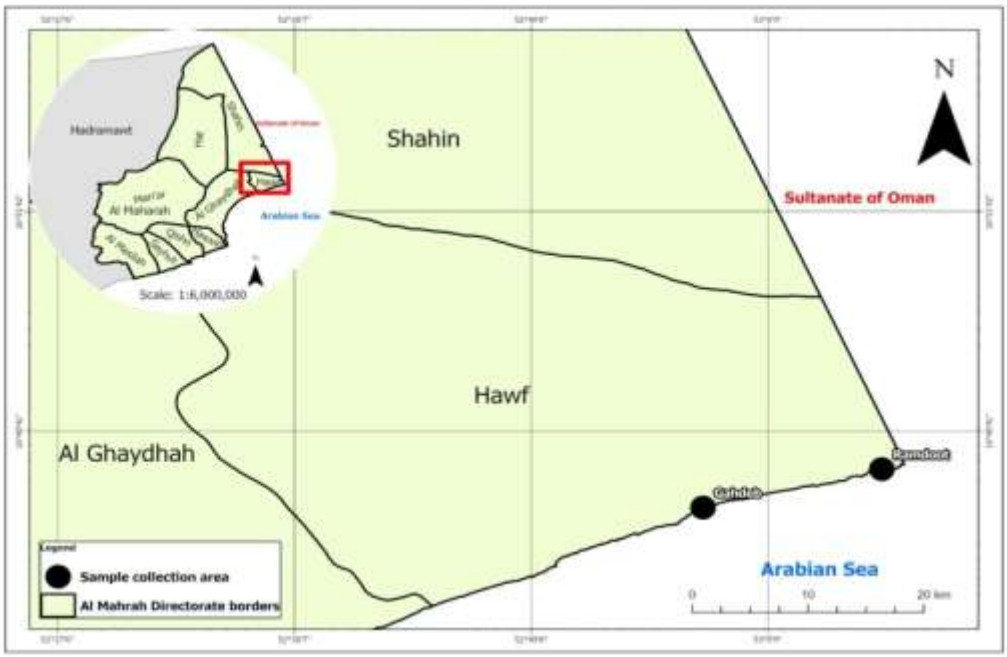

Fig. 1: Sampling sites in Hawf coasts.

Table 1. Names of the 2 sites on Hawf coasts, coordinates and description the habitats in these sites:

No	Name of site	Coordinates	Habitats	Description
1	Ramdoot	16°.31'.145" N 53°.02'.890" E	Sand; sand, rock; rock; subtidal sand.	Exposed shore with sandy shore and rocks.
2	Gahdeb	16°.36'.846" N 52°.57'.136" E	Sand; sand, rock; rock; subtidal sand; corals.	Exposed shore with two rocky headlands and sandy rocky shore.

3. Results: The number of samples collected from different gastropod species in the study area reached 300 samples, which were classified into 34 species belonging to 23 genera falling under 17 families. All of these families under the subclass: Prosobranchia, with the exception of one family, which is the Onchidiidae family (Sea slugs), which under the subclass: Opisthobranchia, with one species was recorded; *Peronia peronei* (Fig. 2 & Table. 2).

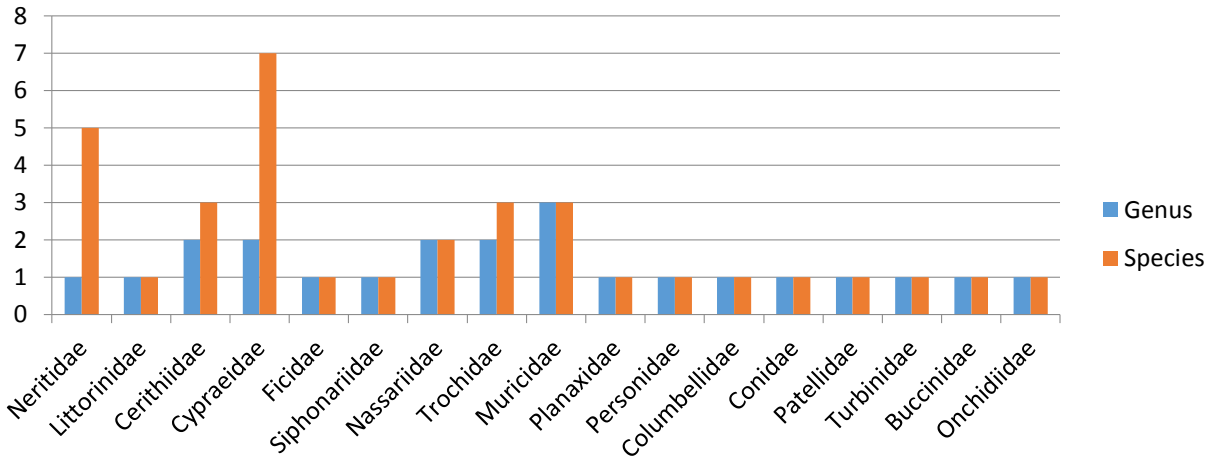

Fig. 2: Comparison between the number of families, genera, and species of gastropods in Hawf coasts.

Table 2: Gastropod families and species with their distributions in study area; Present (+), Absent (-).

In the following, all the gastropods species recorded in this study are presented including species names, state, habitats, material examined, distribution of the species, and some remarks.

Family	Species	Habitat			
		Sandy shore	Rocky shore		
			Under rocks	On the rocks	rock pools
Neritidae	***Nerita adenensis***	-	+	+	+
	Nerita albicilla	-	+	+	+
	Nerita textiles	-	+	+	+
	Nerita orbignyana	-	+	+	+
	Nerita longii	-	+	+	+
Littorinidae	***Littoraria glabrata***	-	-	+	-
Cerithiidae	***Cerithum scabridum***	+	-	-	-
	Cerithum rueppelia	+	-	-	-
	Rhinoclavis sinensis	-	+	-	-
Cypraeidae	***Naria turdus***	-	+	-	-
	Naria lamarckii	-	+	-	-
	Naria nebrites	-	+	-	-
	Naria marginalis	-	+	-	-
	Naria ocellata	-	+	-	-
	Mauritia histrio	-	+	-	+
	Mauritia mauritiana	-	+	-	-
Ficidae	***Ficus variegate***	+	-	-	-
Siphonariidae	***Siphonaria savignyi***	-	-	+	-
Nassariidae	***Nassarius deshayesianus***	-	+	-	-
	Bullia mauritiana	+		-	-
Trochidae	***Trochus kochi***	-	+	-	-
	Trochus firmus	-	+	-	-
	Monodonta nebulosa	-	+	+	-
Muricidae	***Tylothais savignyi***	-	+	+	-
	Purpura persica	-	+	+	-
	Drupella rugosa	-	+	-	-
Planaxidae	***Planaxis sulcatus***	-	+	-	-
Bursidae	***Dulcerana granularis***	-	+	-	+
Columbellidae	***Pardalinops aspersus***	-	+	-	+
Conidae	***Conus achatinus***	-	+	-	-
Patellidae	***Cellana rota***	-	-	+	-
Turbinidae	***Lunella coronate***	-	-	+	-
Pisaniidae	***Engina mendicaria***	-	+	-	+
Onchidiidae	***Peronia peronii***	-	-	+	+

Family: Neritidae Rafinesque, 1815

***Nerita adenensis* Mienis, 1978**

Plate 1 A

State: Recorded in Hawf coasts, sample localities 1, 2; from supralittoral zone of rocky shores.

Materials examined: 4 specimens (SL 1.5-2 cm), 9/3/2011, **Site 1**. 3 specimens (SL 2-2.2 cm), 17/7/2018, **Site 2**.

Distribution: Red Sea, Gulf of Aden, Socotra, North Coast of Somalia, Arabian Sea, Gulf of Oman, Arabian Gulf, Pakistan.

***Nerita albicilla* Linnaeus, 1758**

Plate 1 B

State: Recorded in Hawf coasts, sample localities 1, 2; from supralittoral zone of rocky shores.

Materials examined: 5 specimens (SL 1.2-3 cm), 17/7/2018, **Site 1**. 2 specimens (SL 1.6-2.5 cm), 17/7/2018, **Site 2**. 7 specimens (SL 1.4-3.2 cm), 25/8/2020, **Site 1.**

Distribution: Indo-Pacific area including the Red Sea, Gulf of Aden, Arabian Sea, Oman, India, Arabian Gulf, East African, Thailand, Indonesia, Philippines, and Australia.

***Nerita textilis* Gmelin, 1791**

Plate 1 C

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Materials examined: 3 specimens (SL 2-3.7 cm), 10/3/20211, **Site 1**. 6 specimens (SL 1.8-4 cm), 10/3/2011, **Site 2**. 7 specimens (SL 3-3.5 cm), 25/8/2020, **Site 2**.

Distribution: Indo-Pacific area including the Red Sea, Gulf of Aden, Arabian Sea, East African, Thailand, Indonesia, Philippines, and Australia.

***Nerita orbignyana* Récluz, 1841**

Plate 1 D

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Remarks: Shell has different colors.

Materials examined: 7 specimens (SL 1.5-2 cm), 9/3/2011, **Site 1**. 2 specimens (SL 1.3-1.9 cm), 9/3/2011, **Site 2**. 2 specimens (SL 1.3-2 cm), 25/8/2020, **Site 2**.

Distribution: Indo-Pacific area including the Red Sea, Gulf of Aden, Arabian Sea, East African, Thailand, Indonesia, Philippines, and Australia.

***Nerita longii* Récluz, 1842**

Plate 1 E

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Remarks: Common species in all rocky coasts of Hawf.

Materials examined: 5 specimens (SL 1.5-2.4 cm), 10/3/2011, **Site 1**. 10 specimens (SL 2-2.5 cm), 10/3/2011, **Site 2**. 4 specimens (SL 1.8-2.2 cm), 17/7/2018, **Site 2**. 6 specimens (SL 1.5-2.5 cm), 25/8/2020, **Site 2**.

Distribution: East Africa, Red Sea, Gulf of Aden, South Arabian Coast, Gulf of Oman, Arabian Gulf.

Family: Littorinidae Children, 1834

***Littoraria coccinea glabrata* (R. A. Philippi, 1846)**

Plate 1 F

State: Recorded in Hawf coasts, sample localities 1, 2; from supralittoral zone of rocky shores.

Materials examined: 6 specimens (SL 2-2.5 cm), 9/3/2011, **Site 1**. 8 specimens (SL 1.9-2.6 cm), 9/3/2011, **Site 2**. 6 specimens (SL 2-2.3 cm), 25/8/2020, **Site 2**.

Distribution: Gulf of Aden, Somalia, South Arabian Coast, Gulf of Oman, Arabian Gulf.

Family: Cerithiidae J. Fleming, 1822

***Cerithium scabridum* R. A. Philippi, 1848**

Plate 1 G

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of sandy shores.

Materials examined: 5 specimens (SL 2.5-3 cm), 9/3/2011, **Site 1**. 5 specimens (SL 2-3.5 cm), 9/3/2011, **Site 2**. 3 specimens (SL 2.3-3.7 cm), 25/8/2020, **Site 2**.
Distribution: Red Sea, Gulf of Aden, Socotra, North Coast of Somalia, Arabian Sea, Gulf of Oman, and Arabian Gulf.

***Cerithium rueppelli* R. A. Philippi, 1848**

Plate 1 H

State: Recorded in Hawf coasts, sample locality 2; from intertidal zone of sandy shores.
Materials examined: 5 specimens (SL 3-3.9 cm), 9/3/2011, **Site 2**.

Distribution: Western Indian Ocean including the Red Sea, Gulf of Aden, Socotra, North Coast of Somalia, Arabian Sea, Gulf of Oman, Arabian Gulf, Pakistan.

***Rhinoclavis sinensis* (Gmelin, 1791)**

Plate 1 I

State: Recorded in Hawf coasts, sample locality 2; from intertidal zone of rocky shores.
Materials examined: 2 specimens (SL 1.3-1.9 cm), 9/3/2011, **Site 2**.
Distribution: Gulf of Aden, Socotra, Somalia, Arabian Sea, Gulf of Oman, Arabian Gulf.

Plate 1: A. *Nerita (Adenerita) adenensis* , SL 2.2 cm; **B**. *Nerita albicilla*, SL 2.5 cm; **C**. *Nerita textiles*, SL 3.5 cm; **D**. *Nerita orbignyana* , SL 2 cm; **E**. *Nerita longii*, SL 2.4 cm; **F**. *Littoraria glabrata*, SL 2 cm; **G**. *Cerithum scabridum*, SL 3.5 cm; **H**. *Cerithum rueppelia*, SL 3.9 cm; **I**. *Rhinoclavis sinensis*, SL 1.9 cm; **J**. *Naria turdus*, SL 4 cm; **K**. *Naria lamarckii*, SL 3 cm; **L**. *Naria nebrites*, SL 3 cm.

Family: Cypraeidae Rafinesque, 1815

***Naria turdus* (Lamarck, 1810)**

Plate 1 J

State: Recorded in Hawf coasts, sample locality 1; from intertidal zone of rocky shores.
Materials examined: 3 specimens (SL 3-4 cm), 9/3/2011, **Site 1**.
Distribution: North West of the Indian Ocean in clouding Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, East Africa (Eritrea, Kenya, Madagascar, Mozambique, Somalia, Tanzania), Mediterranean Sea (Palestine, Tunisia, Libya, Egypt).

***Naria lamarckii* (J. E. Gray, 1825)**

Plate 1 K

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Materials examined: 5 specimens (SL 3-3.8 cm), 9/3/2011, **Site 1**. 4 specimens (SL 3.5-3.8 cm), 25/8/2020, **Site 2**.

Distribution: Indian Ocean in clouding Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, East Africa (Kenya, Madagascar, the Mascarene Basin, Mauritius, Mozambique, Zanzibar), Seychelles, Tanzania, India, Thailand, Singapore, Indonesia and Philippines.

***Naria nebrites* (Melvill, 1888)**

Plate 1 L

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Materials examined: 4 specimens (SL 3-3.3 cm), 9/3/2011, **Site 1**. 2 specimens (SL 2.8-3 cm), 9/3/2011, **Site 2**.

Distribution: Gulf of Aden, Red Sea, Somalia, Arabian Sea, Gulf of Oman, Arabian Gulf.

***Naria marginalis* (Dillwyn, 1827)**

Plate 2 A

State: Recorded in Hawf coasts, sample locality 2; from intertidal zone of rocky shores.

Materials examined: 1 specimen (SL 3 cm), 25/8/2020, **Site 2**.

Distribution: Red Sea, Gulf of Aden, Arabian Sea, Indian Ocean along Kenya, Mozambique, Somalia, South Africa and Tanzania.

***Naria ocellata* (Linnaeus, 1758)**

Plate 2 B

State: Recorded in Hawf coasts, sample locality 1; from intertidal zone of rocky shores.

Materials examined: 1 specimen (SL 3 cm), 9/3/2011, **Site 1.**

Distribution: Red Sea, Gulf of Aden, Socotra, North Coast of Somalia, South Arabian Coast, Gulf of Oman, Arabian Gulf, Pakistan.

Plate 2: A. *Naria marginalis*, SL 3 cm; **B**. *Naria ocellata*, SL 3 cm; **C**. *Mauritia histrio*, SL 6 cm; **D**& **E**. *Mauritia mauritiana*, SL 7.3 cm; **F**. *Ficus variegata*, SL 5 cm; **G**. *Siphonaria savignyi*, SL 1.7 cm; **H**. *Nassarius deshayesianus*, SL 2 cm; **I**. *Bullia mauritiana*, SL 4.2 cm; **J**. *Trochus kochii*, SL 3.5 cm; **K**. *Trochus firmus*, SL 2.2 cm; **L**. *Monodonta nebulosa*, SL 3.5 cm.

***Mauritia histrio* (Gmelin, 1791)**

Plate 2 C

State: Recorded in Hawf coasts, sample locality 1; from intertidal zone of rocky shores.

Remarks: Common and widespread species in all sandy coasts of Aden.

Materials examined: 1 specimens (SL 6 cm), 9/3/2011, **Site 1.**

Distribution: Indian Ocean clouding, Red Sea, Gulf of Aden, Arabian Sea, East Africa, Kenya, Mauritius, Mozambique, Seychelles, Tanzania, North West Australia and Philippines.

***Mauritia mauritiana* (Linnaeus, 1758)**

Plate 2 D& E

State: Recorded in Hawf coasts, sample locality 2; from intertidal zone of rocky shores.

Remarks: Rare species in the Yemeni coasts at Gulf of Aden and Arabian Sea.

Materials examined: 1 specimen (SL 7.3 cm), 9/3/2011, **Site 2.**

Distribution: Indian Ocean including Red Sea, Gulf of Aden, Arabian Sea, and along South-East Africa and in the western Pacific Ocean (western and northern Australia, Malaysia, Philippines and Hawaii).

Family: Ficidae Meek, 1864 (1840)

***Ficus variegata* Röding, 1798**

Plate 2 F

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of sandy shores.

Materials examined: 1 specimen (SL 5 cm), 9/3/2011, **Site 1**. 1 specimen (SL 5.2 cm), 9/3/2011, **Site 2**.

Distribution: Indian Ocean in clouding, Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, Arabian Gulf, and in the Pacific Ocean off Japan.

Family: Siphonariidae J. E. Gray, 1827

***Siphonaria savignyi* Krauss, 1848**

Plate 2 G

State: Recorded in Hawf coasts, sample localities 1, 2; from intrtidal zone of rocky shores.

Materials examined: 4 specimens (SL 1-1.5 cm), 9/3/2011, **Site 1**. 1 specimen (SL 1.2 cm), 9/3/2011, **Site 2**. 3 specimens (SL 1-1.7 cm), 24/7/2018, **Site 2**.

Distribution: Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, Arabian Gulf, and West Pacific.

Family: Nassariidae Iredale, 1916 (1835)

***Nassarius deshayesianus* (Issel, 1865)**

Plate 2 H

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Materials examined: 5 specimens (SL 1.9-2.1 cm), 9/3/2011, **Site 1**. 2 specimens (SL 1.5-2 cm), 9/3/2011, **Site 2**.

Distribution: Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, Arabian Gulf.

***Bullia mauritiana* J. E. Gray, 1839**

Plate 2 I

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Remarks: Common species in sandy coasts of Hawf.

Materials examined: 3 specimens (SL 3-4 cm), 9/3/2011, **Site 1**. 6 specimens (SL 3.3-3.9 cm), 9/3/2011, **Site 2**. 6 specimens (SL 2.8-4.2 cm), 25/8/2020, **Site 2**.

Distribution: Indian Ocean clouding, Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, along Madagascar and South Africa.

Family: Trochidae Rafinesque, 1815

***Trochus kochii* R. A. Philippi, 1844**

Plate 2 J

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Materials examined: 6 specimens (SL 3-3.2 cm), 9/3/2011, **Site 1**. 3 specimens (SL 3.1-3.5 cm), 9/3/2011, **Site 2**.

Distribution: Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, Arabian Gulf, and South Africa.

***Trochus firmus* R. A. Philippi, 1850**

Plate 2 K

State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Materials examined: 3 specimens (SL 2-3 cm), 9/3/2011, **Site 1**. 3 specimens (SL 2.2-3.5 cm), 9/3/2011, **Site 2**. 5 specimens (SL 2-3.3 cm), 24/7/2018, **Site 2**.
Distribution: Gulf of Aden, Arabian Sea, Gulf of Oman, and Arabian Gulf.
***Monodonta nebulosa* (Forsskål, 1775)**
Plate 2 L
State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.
Materials examined: 2 specimens (SL 2.5-3.5 cm), 9/3/2011, **Site 1**. 7 specimens (SL 2-3.3 cm), 9/3/2011, **Site 2**.
Distribution: Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, Arabian Gulf, and Eastern Indian Ocean.
Family: Muricidae Rafinesque, 1815
***Tylothais savignyi* (Deshayes, 1844)**
Plate 3 A
State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.
Remarks: Common and widespread species in the rocky coasts of Hawf.
Materials examined: 6 specimens (SL 2-4 cm), 9/3/2011, **Site 1**. 6 specimens (SL 3-3.5 cm), 9/3/2011, **Site 2**. 4 specimens (SL 2.5-3.3 cm), 24/7/2018, **Site 2**. 4 specimens (SL 2-3 cm), 25/8/2020, **Site 2**.
Distribution: Red Sea, Gulf of Aden, Socotra, Arabian Sea, Gulf of Oman, Arabian Gulf.
***Purpura persica* (Linnaeus, 1758)**
Plate 3 B
State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.
Materials examined: 9 specimens (SL 3.2-6 cm), 9/3/2011, **Site 1**. 4 specimens (SL 2.3-4.3 cm), 9/3/2011, **Site 2**. 4 specimens (SL 4-4.5 cm), 25/8/2020, **Site 2**.
Distribution: Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, Arabian Gulf, Indian Ocean along Madagascar, Mauritius, Mozambique, Tanzania and the East Coast of South Africa, in the Southwest Pacific.
***Drupella rugosa* (Born, 1778)**
Plate 3 C
State: Recorded in Hawf coasts, sample locality 1; from intertidal zone of rocky shores.
Materials examined: 3 specimens (SL 2-2.5 cm), 9/3/2011, **Site 1**.
Distribution: Red Sea, Gulf of Aden, Indian Ocean along Aldabra, Chagos, Madagascar, the Mascarene Basin, the Gulf of Thailand, and in the Western Pacific.
Family: Planaxidae J. E. Gray, 1850
***Planaxis sulcatus* (Born, 1778)**
Plate 3 D
State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.
Materials examined: 5 specimens (SL 1.5-1.7 cm), 9/3/2011, **Site 1**. 6 specimens (SL 1.7-1.9 cm), 9/3/2011, **Site 2**. 5 specimens (SL 1.5-1.9 cm), 24/7/2028, **Site 2**.
Distribution: Red Sea, Gulf of Aden, Arabian Sea, East Africa.
Family: Bursidae Thiele, 1925
***Dulcerana granularis* (Röding, 1798)**
Plate 3 E
State: Recorded in Hawf coasts, sample locality 2; from intertidal zone of rocky shores.
Materials examined: 3 specimens (SL 3.5-4 cm), 25/8/2020, **Site 2**.
Distribution: Red Sea, Gulf of Aden, Socotra, Indo-West Pacific.
Family: Columbellidae Swainson, 1840
***Pardalinops aspersus* (G. B. Sowerby I, 1844)**
Plate 3 F
State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.

Materials examined: 3 specimens (SL 2-2.5 cm), 9/3/2011, **Site 1**. 2 specimens (SL 2.3-2.6 cm), 9/3/2011, **Site 2**.
Distribution: Gulf of Aden, Somalia, South Arabian Coast, Gulf of Oman, Arabian Gulf.
Family: Conidae J. Fleming, 1822
***Conus achatinus* Gmelin, 1791**
Plate 3 G
State: Recorded in Hawf coasts, sample locality 1; from intertidal zone of rocky shores.
Materials examined: 4 specimens (SL 4-4.5 cm), 9/3/2011, **Site 1**.
Distribution: Red Sea, Gulf of Aden, Arabian Sea, East Africa, and Western Australia.
Family: Patellidae Rafinesque, 1815
***Cellana rota* (Gmelin, 1791)**
Plate 3 H
State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.
Materials examined: 3 specimens (SL 2.5-2.7 cm), 9/3/2011, **Site 1**. 1 specimen (SL 2 cm), 9/3/2011, **Site 2**.
Distribution: Red Sea, Gulf of Aden, Socotra, North Coast of Somalia, Arabian Sea, Gulf of Oman, Arabian Gulf, and Western Australia.
Family: Turbinidae Rafinesque, 1815
***Lunella coronata* (Gmelin, 1791)**
Plate 3 I
State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.
Materials examined: 5 specimens (SL 2.3-2.6 cm), 9/3/2011, **Site 1**. 2 specimens (SL 2-2.5 cm), 9/3/2011, **Site 2**.
Distribution: Red Sea, Gulf of Aden, Arabian Sea, Southeast Africa, and in the Indo-Pacific.
Family: Pisaniidae J. E. Gray, 1857
***Engina mendicaria* (Linnaeus, 1758)**
Plate 3 J
State: Recorded in Hawf coasts, sample localities 1, 2; from intertidal zone of rocky shores.
Materials examined: 2 specimens (SL 1.3-1.7 cm), 9/3/2011, **Site 1**. 2 specimens (SL 1.5-1.9 cm), 9/3/2011, **Site 2**.
Distribution: Tropical Indo-Pacific, including Red Sea, Gulf of Aden, Arabian Sea, Arabian Gulf, East Africa and Australia.

Plate 3: A. *Tylothais savignyi*, SL 3.5 cm; **B**. *Purpura persica*, SL 4.5 cm; **C**. *Drupella rugosa*, SL 2.5 cm; **D**. *Planaxis sulcatus*, SL 1.9 cm; **E**. *Dulcerana granularis*, SL 4 cm; **F**. *Pardalinops aspersus*, SL 2.5 cm; **G**. *Conus achatinus*, SL 4.5 cm; **H**. *Cellana rota*, SL 2.7 cm; **I**. *Lunella coronata*, SL 2.6 cm; **J**. *Engina mendicaria*, SL 1.9 cm; **K**& **L**. *Peronia peronii*, SL 6 cm.

Family: Onchidiidae Rafinesque, 1815

***Peronia peronii* (Cuvier, 1804)**

Plate 3 K& L

State: Recorded in Hawf coasts, sample locality 1; from intertidal zone of rocky shores.

Materials examined: 1 specimen (SL 6 cm), 9/3/2011, **Site 1**.

Distribution: Indian Ocean including Gulf of Aden, Arabian Sea, Arabian Gulf, East Africa.

4. Discussion

Due to the lack of previous studies, this is considered the first study to record gastropod mollusks on the coasts of Hawf in Al-Mahra Governorate, eastern Yemen.

This study clearly shows that most of the gastropod mollusks counted and recorded in the study area were on the coasts of rocky shores, including rock platforms and rock pools. Of the total species obtained, 30 were monitored and recorded, while only 4 species of gastropod mollusks on sandy shores were observed and recorded (Fig. 3), and this is confirmed by previous studies, that rocky coasts are richer and more diverse in marine organisms (Barry *et al*., 1995; Kohan *et al*., 2012; Yekta *et al*., 2019).

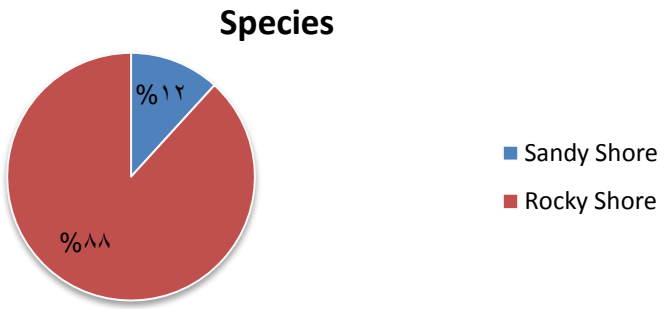

Fig. 3: Percentage of gastropod species in the rocky and sandy environment in the study area

The most abundant species in this study on the sandy coasts that permeate the study area was *Bullia mauritiana*. This is due to the nature of this species' feeding, as it has a scavenger food nature and feeds on dead marine organisms that are abundant on the sandy coast of the study area, and this is consistent with what was mentioned by Bosch et al (1995), while the least abundant species was *Ficus variegate*.

Some invertebrates in intertidal rocky shores form their distributional pattern according to their tolerance to environmental variables such as extreme salinity and temperature. Therefore, global warming can alter the species distribution pattern in intertidal rocky shores (Barry *et al*., 1995; Harley, 2003; Yekta *et al*., 2019), and this is what we observed in the distribution of gastropods in the study sites by the zonation, where we found the vertical distribution of species in the rocky coastal areas is the presence of the species *Littoraria glabrata*, belonging to the family Littorinidae, in the upper littoral zone, which is sometimes called the spray zone. This zone is semi-dry at most times of the day, and water does not reach it except by spray or during the rising tide. This is consistent with what was found by Khafagi (1999), and Kiat& Clements (2008) added that the species *Nerita plicata* is also found in the supra-tidal range in rocky coastal areas, but we did not find it during our study. As for the intertidal zone, which is exposed to atmospheric air twice a day during the ebb process for a period of 4-6 hours, all recorded species were found in the rocky environment except for the species *Littoraria glabrata*. However, Bosch et al (1995) and Richmond (2002) mentioned that the species *Nerita adenensis*, *Nerita albicilla*, *Nerita textiles*, *Nerita orbignyana* and *Nerita longii* are found also in the sub littoral zone, which is submerged in water except during the period of very low rising tide, where it is only exposed to the air for a short period not exceeding one or two hours at irregular times.

Sea slugs only one species was observed and recorded in the study area, which is *Peronia peronei*. This species was found in the rocky sites of the study area, on rocks covered with algae and in tidal pools. This agrees with what was mentioned by Feulner& Richard (2006), but they added that this species is also found in sandy and muddy coasts, we did not find it in these locations during our current study.

Most of the species that we found in the study area in the rocky environment within the intertidal zone during the low tide period were found under rocks, between cracks, or in tide pools in order to hide from the sun's rays, which lead to dehydration and death for these organisms.

As for the species that were found in the sandy environment in the intertidal zone, they adapted to these unsuitable environmental conditions by burying themselves in the sand several centimeters deep for fear of drying out and dying due to the direct heat of the sun.

The Hawf coast exhibits a striking dominance of two gastropod genera: *Naria* (family Cypraeidae) and *Nerita* (family Neritidae), each comprising five distinct species. The *Naria* genus is represented by *Naria turdus*, *Naria lamarckii*, *Naria nebrites*, *Naria marginalis*, and *Naria ocellata*, while the *Nerita* genus includes *Nerita adenensis*, *Nerita albicilla*, *Nerita textiles*, *Nerita orbignyana*, and *Nerita longii*. This prevalence is strongly linked to the rocky nature of the coastline, which supports extensive growth of marine algae. As herbivorous grazers, these *Naria* and *Nerita* species directly benefit from this abundant food source (Bosch et al., 1995; Richmond, 2002; Kiat & Clements, 2008). Furthermore, the genus *Naria* (often referred to by its former name, *Cypraea*) is also notably abundant in or near coral reef ecosystems within the region (FAO, 2004).

The Yemeni coast along the Arabian Sea remains an under-explored frontier in marine biodiversity research. Recognizing this significant gap in our understanding, particularly concerning gastropod mollusks, this study endeavors to contribute initial insights into the diversity of this faunal group within the region.

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مسح لأنواع بطنيات القدم (رخويات) في المنطقة المدية لساحل حوف بمحافظة المهرة- اليمن

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الملخص: تعتبر هذه الدراسة أول دراسة حصرية لأنواع الرخويات بطنية القدم في ساحل حوف بمحافظة المهرة، وهدفت هذه الدراسة إلى تسجيل أنواع الرخويات بطنية القدم في المنطقة المدية لساحل حوف الذي لم تسجيل وتوثق فيه هذه الأنواع من قبل. تم اختيار موقعين ساحليين في حوف، وهما: ساحل رمدوت الذي يقع عند الإحداثيات التالية: 53°.02'.890" شرقًا، 16°.31'.145" شمالًا، والساحل الآخر ساحل جادب الذي يقع عند الإحداثيات التالية: 52°.57'.136" شرقًا، 16°.36'.846" شمالًا، وقد أجريت الدراسة بشكل متقطع في أعوام 2011، 2018، و2020. تم فيها جمع 300 عينة يدويًا، أثناء فترة الجزر المنخفض في المنطقة المدية لمواقع الدراسة، من بيئات مختلفة.

بلغ العدد الإجمالي لأنواع بطنيات القدم في منطقة الدراسة 34 نوعًا، تنتمي إلى 23 جنسًا، وتندرج تحت 17 عائلة، وكانت العائلات السائدة هي Cypraeidae بـ 7 أنواع، وNeritidae بـ 5 أنواع. ومن حيث البيئات الساحلية، كانت البيئة الصخرية تضم معظم أنواع رخويات بطنيات القدم.

الكلمات المفتاحية: بطنيات القدم؛ المنطقة المدية؛ السواحل الصخرية؛ السواحل الرملية؛ ساحل حوف.