

Original Article

More than a mountain in the Arabian Peninsula: Inland fish diversity in Dhofar Region, Oman: An annotated checklist, taxonomy, short description, distribution and conservation

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Abstract: Oman, a country in Southwest Asia, situated on the south-eastern quarter of the Arabian Peninsula presents a high level of biodiversity especially marine elements. Although arid habitats cover most parts of Oman (82%), the region has mountainous area including the Dhofar region located in the Southwestern Arabian Coast ecoregion supporting several inland/freshwater systems that are vital for the survival of people as well as for different groups of animals and plants. The current checklist provides for each species of inland waters of the Dhofar region all recognized and named taxa, documenting recent changes and controversies in nomenclature, its records, taxonomic status, synonyms, etymology, common English name, short description, range expansion, conservation status, and detailed distribution map based on several field investigations throughout the region. We also provide native, endemic, and introduced species. The diversity of inland fishes of the Dhofar region included in this annotated checklist consists of 12 recognized species in 12 genera, nine families, seven orders, and a class. The most diverse order is Gobiiformes with five species (41.7%), followed by Cichliformes (two species, 16.7%), Cypriniformes, Cyprinodontiformes, Centrarchiformes, Gonorynchiformes and Mugiliformes (one species, 8.3% each). A total of 11 native species (84.15%) in eight families and one exotic species (15.85%) in one family are listed here. Out of 11 native species, one species (9.1%) in one family is endemic element that is restricted to the Dhofar territory only. It seems that Dhofar comprises more than 29.3% of the recorded inland fish species of the Arabian Peninsula, and about 52.2% of the inland fishes of Oman. Hence, Dhofar is one of the most diverse areas in the Arabian Peninsula and Oman in terms of inland ichthyodiversity. Identification of all recognized species was confirmed by DNA barcoding (mitochondrial COI). The Dhofar region also harbours 867 plant species (63% of all known plant species of Oman) including 41 endemic plants one species of endemic toad of the Arabian Peninsula, the Dhofar toad, *Duttaphrynus dhofarensis* (Bufonidae), 60 species of terrestrial reptiles (59.41% of all known species of Omani terrestrial reptiles), 475 bird species, 67 species of wild mammals (49 terrestrials and 18 marine mammals) including the critically endangered Arabian leopard (*Panthera pardus nimr*). Dhofar is renowned for its biological diversity but they are under natural and anthropological pressures particularly climate change, overgrazing of rangelands, habitat destruction, pollution, water abstraction, exotic introduction, and also some fisheries and shipping activities at the Arabian Sea. Due to its high biodiversity, needs to be taken to ensure that the wild life and their habitats are managed in a sustainable way.

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Introduction

Fishes represent the world's most diverse group of vertebrates, comprising about 36,450 species with about 18,360 freshwater species (Fricke et al., 2023) and are a major component of global biodiversity, noteworthy from an evolutionary and ecological point of view. Freshwater/inland, or collectively wetlands, fishes represent a significant component of the aquatic ecosystem and are particularly valued for their

economic, social, and aesthetic standing in many countries (Nelson et al., 2016; FAO, 2022). Fishes are already involved in environmental policies as biological diversity and ecological quality indicators and have been used successfully in biogeographical and evolutionary studies, ecoregion delineations, conservation evaluations, and assessments of ecologically acceptable water regime management plans (Economou et al., 2007). Hence, gaining

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knowledge of the diversity, distribution, and conservation of freshwater fish species in different water bodies, especially in not yet fully investigated areas such as southern Oman (Dhofar region), is necessary.

Oman is home to two areas of great diversity, each with significant levels of endemic species, namely (1) the Hajar Mountains (HMs) in the north and (2) the Dhofar Mountains (DMs) in the south. The HMs, the highest in eastern Arabia, stretch for 650 km in an arc parallel to the Oman and United Arab Emirates (UAE) coastlines of the Gulf of Oman and are bordered on the west by a vast desert (Edgell, 2006). The HMs are the sole region in eastern Arabia with habitats above 2000 m in elevation (Fig. 1) and an annual mean temperature of 13°C at the highest peaks (Edgell, 2006; Carranza et al., 2018). Despite the altitude, annual rainfall is low (between 250±300 mm), evapotranspiration is high, and the lack of trees has led some to describe the Hajars as a mountain desert (Edgell, 2006; Carranza et al., 2018).

The Dhofar Mountains (DMs) are a part of Dhofar Province in southern Oman. The DMs of southern Oman, is bounded to the north by the Rub al Khali (also known as the Empty Quarter), the largest desert in the Arabian Peninsula, to the south by the Arabian Sea, and separated from the rest of Oman in the northeast by a desert steppe known as Jiddat al Harasis (Sale, 1980) (Fig. 1). The summit of the mountain range is a somewhat wide (10±25 km) flat plateau that runs for approximately 150 km mostly between 700 and 900 m in elevation, from the Jebel Qamar in the west, through the Jebel Qara in the central part, to the Jebel Samhan in the east (Fig. 1) (Sale, 1980; Carranza et al., 2018). The highest point is over 2000 m in this latter massif, where temperatures reach the lowest values in southern Oman (Sale, 1980; Carranza et al., 2018). The Dhofar Mountains lie within the monsoon belt, and the most rain falls in July and August during the summer monsoon season, causing the unique green vegetation on the south-facing (sea) side of the mountain range (Fig. 1), where the clouds form a variable belt along the coast from the Jebel Qamar to the Jebel Samhan that press against the mountain



Figure 1. Map of Oman showing topographical relief and names of the most relevant toponyms mentioned in this study (modified from Carranza et al., 2018).

ridges causing frequent fog and light rain that does not surpass 200 mm per year (Kwarteng et al., 2009). Clouds only occasionally spill over the top of the Jebel Qamar, but on the much lower Jebel Qara, they ride up to the summit (Sale, 1980). However, the northern slopes across the whole mountain range are in a rain shadow. As a result, the north-facing (inland) side of the Dhofar Mountains is much drier and less vegetated than the lush south-facing side. These climatic differences have played an important role in shaping the flora and fauna of this interesting biodiversity-rich region. In addition, 60% of the approximately 330,000 km² of Oman consists of a flat arid desert below 250 m in elevation (Carranza et al., 2018). These massive areas are mostly infertile, vegetated by infrequent areas of widely spaced low perennial shrubs, interspersed between much broader areas of bare sand,

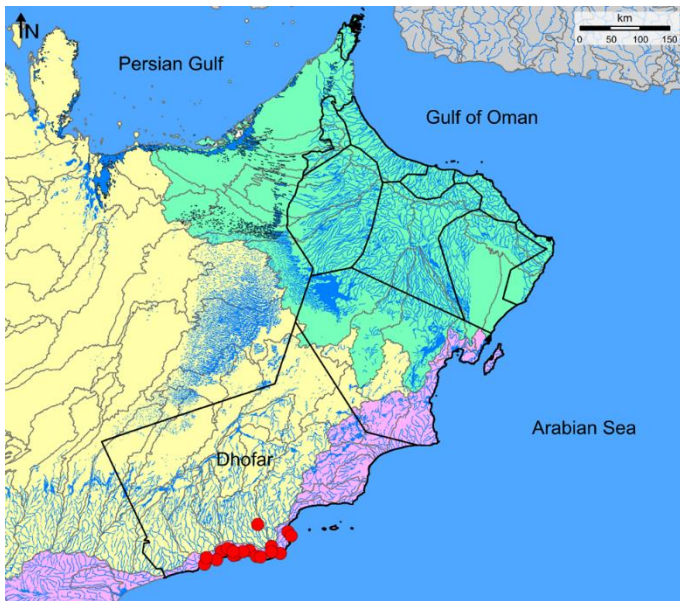


Figure 2. Collection sites in the Dhofar region, Oman.

gravel, and rocks. The mean annual temperatures are high (28°C), and annual precipitation is very low ($<150\text{ mm}$) (see Carranza et al., 2018). The mountains enclosing the western end of the plain are precipitous and unreachable, while those to the east rise steeply with many sheer cliffs and deep gorges but are capped by rolling grassy uplands and interspersed with wide park-like valleys well-wooded with groves of wild figs, tamarinds, acacias, and sycamores.

Although the southern slopes enjoy good rainfall, the ground soil does not retain water. Underground rivers drain the waters of Jabal Aram into Wadi Dabat, the mouth of which is sealed by a sheer limestone cliff 500 feet high. The accumulated waters fill a lake two miles long, situated at a height of 1,000 feet, and overflow during the rains to form a picturesque waterfall. Other underground rivers feed perennial springs at the foot of the hills. There are six of these springs; Jarziz, the best of them, produces an estimated flow of 40,000 gallons of water an hour. These waters, if unharnessed, again disappear underground in the foothills and reappear to feed extensive freshwater creeks in the coastal belt divided from the sea only by narrow sandbars. Fresh water is easily obtainable from shallow wells at a distance of a hundred yards from the high-water mark and up to a distance of one mile inland, beyond which the increased water depth discourages prospective

cultivators.

The Dhofar forests are home to more than 750 flora species, including 50 native species, which account for more than 75% of Oman's biodiversity. Due to prevailing environmental conditions and anthropogenic activities, the inland and coastal water bodies of the Dhofar region are considered highly stressed ecosystems because they have caused a number of stressors threatening their ecological integrity and sustainability, especially on fishes.

Since the works of Boulenger (1887; 1889), which made the start of the history of the fish fauna of Oman, several scientists were involved in ichthyological investigations to study the fish of this part of the world including the Dhofar region (e.g., White and Barwani, 1971; Banister and Clarke, 1977; Krupp, 1983; Fischer and Bianchi, 1984; Al-Abdessalaam, 1995; Randall, 1995; Jawad and Al-Mamry, 2012a; 2012b; Iwatsuki et al., 2012; Al Jufaili and Esmaeili, 2022; Al Jufaili and Jawad, 2020; Al Jufaili et al., 2021a, b; Masoumi et al., 2021; Esmaeili et al., 2022; Zarei et al., 2022).

During the last century, some studies that aimed to study the freshwater fish fauna of the Arabian Peninsula have given slight attention to the freshwater fish species that inhabit the inland waters of Oman (Banister and Clarke, 1977; Krupp, 1983). Recently, non-comprehensive studies have dealt with the fish fauna of the inland waters of Oman (Freyhof et al., 2017, 2020; Al Jufaili and Jawad, 2020; Al Jufaili et al., 2021a; 2021b; Masoumi et al., 2021; Esmaeili et al., 2022). A precise inventory of the fish species diversity of any area is a necessary prerequisite for the formulation and implementation of conservation plans and actions and fishery management measures (Fig. 3), and no comprehensive and integrated data are available on ichthyodiversity of the Dhofar region. Hence, the aims of the present work are (i) to provide a complete and accurate list of known Inland fishes of Dhofar, (ii) to update nomenclature status of the Dhofar inland fishes, (iii) to give a short description of recognized species in Dhofar, (iv) to document range expansion of the majority of species recorded from Dhofar, and (v) to prepare detailed distribution map of

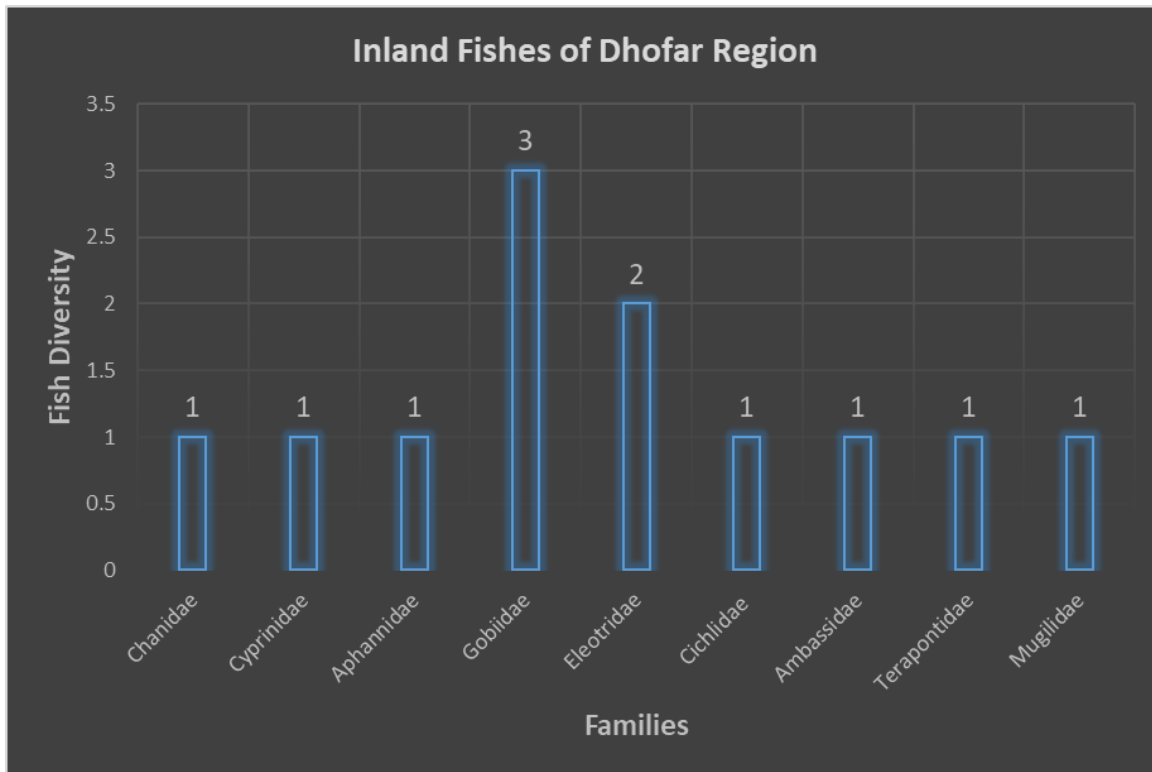


Figure 3. Species diversity in different fish families of the Dhofar inland waters.

the listed fishes of the Dhofar region based on several field surveys.

Materials and Methods

Study area. The Dhofar Governorate, situated at the western extremity of Oman's territories, is enclosed by the Indian Ocean on its southern side and by the Qara Mountain Range, a semi-circular formation of mountains running into the sea at Ras Hamar and Mirbat, which shut it off from the mountains and deserts to the north, east and west. South-west monsoon (locally referred to as Khareef) clouds driving up from the Indian Ocean are met by winds from the north and east and buffered and depressed until they are entrapped by the mountains over the Dhofar plain. Thus, Dhofar is unique on the Southern Arabian coast and it enjoys monsoon rainfall for some three months of the year.

The study area comprises parts of two freshwater ecoregions of Oman (Fig. 2): (1) Southwestern Arabian Coast, ID 439, major habitat type, xeric freshwater and endorheic (closed) basins (Fig. 2). This ecoregion runs along the southern and western fringes of the Arabian Peninsula, bounded by the Red Sea to

the west, the Gulf of Aden to the south and the An-Nafud and Rub' al-Khali deserts of the Arabian interior to the east and north. It includes the narrow coastal plain called the Tihamah, which extends along the Red Sea escarpment. Tihamah is a narrow coastal plain backed by the Hijaz Mountains in the north and the Asir Mountains in southwest Arabia. The elevation reaches 3,760 m near San'a in the Asir Mountains. Small streams are subject to intermittent flow and flash floods. The water table of many natural streams is being lowered by groundwater pumping for irrigation. (2) Arabian Interior, ID 440, major habitat type of xeric freshwater and endorheic (closed) (Fig. 2). In general, the whole ecoregion includes the internal basins of the Arabian Peninsula. It is bounded to the east by the Oman Mountains ecoregion (443), the Persian Gulf, and the Lower Tigris and Euphrates ecoregion (441); to the north by the Upper Tigris-Euphrates ecoregion (443); to the northwest by a small section of Coastal Levant (436), Orontes (447), and Jordan River (438) ecoregions; and to the west and south by the Southwest Arabian Coast ecoregion (439). A large portion of the ecoregion is a plateau called the Najd that slopes from the Red Sea

escarpment at over 2,850 m in the west to 750 meters in the east. There are mountain ranges in the southwest but mostly isolated wadis draining to deserts. The Jabal Tuwayq is an escarpment with limestone cliffs, plateaus, and canyons that rise in the middle of the Najd. There are few freshwater habitats over most of this basin. Streams occur near Damascus and Azraq in the north and along the inner slope of the Asir Mountains in the southwest. However, those near population centers, such as Damascus, are heavily polluted. Many streams are intermittent and subject to flash floods. Brackish salt flats exist in some areas, the most famous being the quicksands of Umm al Samim. The Azraq Oasis in Jordan is heavily affected by groundwater extraction for irrigation and water diversion to Amman. The oasis occupies about five km² of permanent pools fed by springs at 600 m altitude.

The fishes were collected from several main water bodies in these two ecoregions, including aflaj, subterranean water systems / sinkhole, and brackish salt flats. Overall, more than 22 sampling sites from two ecoregions in the Dhofar region were investigated (Fig. 2).

Data collection and analysis. Fishes were collected between 2021-2022 using foldable shrimp and crab fishing traps (mesh size of 3*3mm) and scoop nets (mesh size 1*1mm), from several sampling sites (Fig. 2). After anesthesia, fish specimens were fixed in 10% formaldehyde or absolute alcohol and transferred to the laboratory for further identification. Fixed specimens were deposited at ZM-CBSU (Zoological Museum and Collection of Biology Department, Shiraz). Species-level identification of the specimens was carried out using major taxonomic keys and primary taxonomic literature, e.g. Freyhof et al. (2020), Al Jufaili et al. (2021a), and Esmaeili et al. (2022). Morphological identifications were confirmed by morphological characters and DNA barcoding (mitochondrial COI; unpubl. data). Esmaeili et al. (2018) and Eagderi et al. (2019) were followed to arrange species in orders and families. All species were arranged alphabetically within their own families. The taxonomic classification mainly follows

Fricke et al. (2023); in other cases, the source of the classification is provided as a comment. Most of the common names of the species originate from FishBase (Froese and Pauly, 2023). For each species, both taxonomic comments and synonyms are provided. The type materials are also given the following original description by Fricke et al. (2023).

Results

Species accounts

The diversity of inland fishes of the Dhofar region included in this annotated checklist consists of 12 recognized species in 12 genera, nine families, seven orders, and one class. The most diverse order is Gobiiformes, with five species (41.7%), followed by Cichliformes (two species, 16.7%), Cypriniformes, Cyprinodontiformes, Centrarchiformes, Gonorynchiformes and Mugiliformes (one species, 8.3% each). A total of 11 native species (84.15%) in eight families and one exotic species (15.85%) in one family are listed here. Out of 11 native species, one species (9%) in one family is endemic and is restricted to the Dhofar territory only (Table 1). The southwestern Arabian Coast Ecoregion (SACE) and the Arabian Interior Ecoregion (AIE) of the Dhofar region harbor 13, and one species, respectively (Figs. 4).

Class Actinopterygii

Gonorynchiformes (one family, one genus, one species)

Chanidae

Chanos Lacepède, 1803

1. *Chanos chanos* (Forsskål, 1775), Native

Etymology: *Chanos*: Greek, *chanos*, *-eos*, *ous*, and *chasma*, *-atos*= *abyss*, mouth opened, inmensity.

Common name: Milkfish.

Taxonomy: *Mugil chanos* was described by Fabricius [J.C.] in Niebuhr (ex Forsskål) 1775:74, xiv [Descriptiones animalium (Forsskål)] Jeddah, Saudi Arabia, Red Sea [not Mediterranean Sea].

Holotype: ZMUC P17154 (dry skin).

Synonyms: *Chanos arabicus* Lacepède [B. G. E.] (ex Forsskål, ex Fabricius) 1803:395, 396 [Histoire naturelle des poissons (Lacepède) v. 5].

Table 1. Species diversity in Oman and Dhofar Region. SACE, Southwestern Arabian Coast Ecoregion; AIE, Arabian Interior Ecoregion, OME, Oman Mountain Ecoregion; * endemic fishes of Dhofar region, LC, Least Concern; EN, Endangered; NT, Nera Threatened.

No	Order	Family	Inland fishes of Oman	Dhofar	OME	SACE	AIE	Status in Oman	IUCN status
1	Gonorynchiformes	Chanidae	<i>Chanos chanos</i>	✓	—	✓	—	Native	LC
2	Cypriniformes	Cyprinidae	<i>Cyprinion muscatense</i>	—	✓	—	—	Native	LC
3	Cypriniformes	Cyprinidae	<i>Garra barreimiae</i>	—	✓	—	—	Native	LC
4	Cypriniformes	Cyprinidae	<i>Garra dunsirei</i> *	✓	✓	—	—	Endemic	EN
5	Cypriniformes	Cyprinidae	<i>Garra gallagheri</i>	—	✓	—	—	Endemic	EN
6	Cypriniformes	Cyprinidae	<i>Garra longipinnis</i>	—	✓	—	—	Endemic	EN
7	Cypriniformes	Cyprinidae	<i>Garra shamal</i>	—	✓	—	—	Endemic	VU
8	Cypriniformes	Cyprinidae	<i>Garra sharq</i>	—	✓	—	—	Endemic	EN
9	Gobiiformes	Eleotridae	<i>Eleotris acanthopomus</i>	✓	—	✓	—	Native	LC
10	Gobiiformes	Eleotridae	<i>Ophiocara porocephala</i>	✓	—	✓	—	Native	LC
11	Gobiiformes	Gobiidae	<i>Awaous jayakari</i>	✓	✓	✓	—	Native	LC
12	Gobiiformes	Gobiidae	<i>Cryptocentroides arabicus</i>	✓	✓	✓	—	Native	LC
13	Gobiiformes	Gobiidae	<i>Favonigobius melanobranchus</i>	—	✓	—	—	Native	LC
14	Gobiiformes	Gobiidae	<i>Glossogobius tenuiformis</i>	✓	✓	✓	—	Native	NT
15	Mugiliformes	Mugilidae	<i>Planiliza macrolepis</i>	✓	—	✓	—	Native	LC
16	Cichliformes	Ambassidae	<i>Ambassis dussumieri</i>	✓	—	✓	—	Native	LC
17	Cichliformes	Ambassidae	<i>Ambassis gymnocephalus</i>	—	✓	—	—	Native	LC
18	Cichliformes	Cichlidae	<i>Oreochromis niloticus</i>	✓	✓	✓	—	Exotic	LC
19	Cyprinodontiformes	Aphaniidae	<i>Aphaniops kruppi</i>	✓	✓	✓	—	Endemic	LC
20	Cyprinodontiformes	Aphaniidae	<i>Aphaniops stoliczkanus</i>	—	✓	—	—	Native	LC
21	Cyprinodontiformes	Poeciliidae	<i>Poecilia latipinna</i>	—	✓	—	—	Exotic	LC
22	Centrarchiformes	Terapontidae	<i>Terapon jarbua</i>	✓	✓	✓	—	Native	LC

* *Garra sindhae* Lyon, Geiger and Freyhof, 2016 from Wadi Andhur; and *G. smartae* Krupp and Budd, 2009, from Wadi Hasik are synonyms of *Garra dunsirei*.

Short description: Body elongated and moderately compressed, mouth small, terminal, and without teeth, eye covered by adipose tissue, branchiostegal rays 4, gill rakers fine and numerous (more than 250), fins without spines, dorsal fin about midpoint of body, dorsal-fin rays 13–17, anal fin short, close to caudal fin, anal-fin rays 9–11, caudal fin deeply forked and large, scales small and ctenoid, lateral line scales 75–91. Body silvery on belly and sides, grading to olive-green or blue on back; dorsal, anal, and caudal fins with dark margin; peritoneum black.

Habitat: Freshwater, brackish, marine.

Distribution in Dhofar region: Wadi Hasik, Dhofar Governorate.

Examined material: ZM-CBSU: O001.Cc101, 2, Oman: Dhofar Governorate, Salalah, Wadi Hasik, at Hasik, 17°22'01.2"N, 55°16'58.8"E, H.R. Esmaeili, S.M. Al Jufaili, A.H Masoumi, 04 Jan. 2022.

Cypriniformes (one family, one genus, one species)

Cyprinidae

The family Cyprinidae is represented by the labeonines genus of *Garra* and one species. Members of the genus *Garra* are distinguished by having a modified complex mouth structure (including a disk-like structure, which is a specialized mental lobe behind the lower jaw) and a smooth posterior margin of the last unbranched dorsal-fin ray.

Garra Hamilton, 1822

2. *Garra dunsirei* Banister, 1987, Endemic

Etymology: *Garra*: named based on a vernacular Indian name, a fish living in mud; *dunsirei*: named after Mr. A. Dunsirei who collected the fishes.

Common name: Tawi Atair Garra.

Taxonomy: *Garra dunsirei* was originally described by Banister 1987:59, Figures. 1, 2a, 3-5 [Bulletin of the British Museum (Natural History) Zoology v. 52 (no. 1) from a Sinkhole, Tawi Atair [or Attair], 17°06'N, 54°34'E, in the Jabal Qara (Jabal Samhan) mountains, Dhofar, Oman.

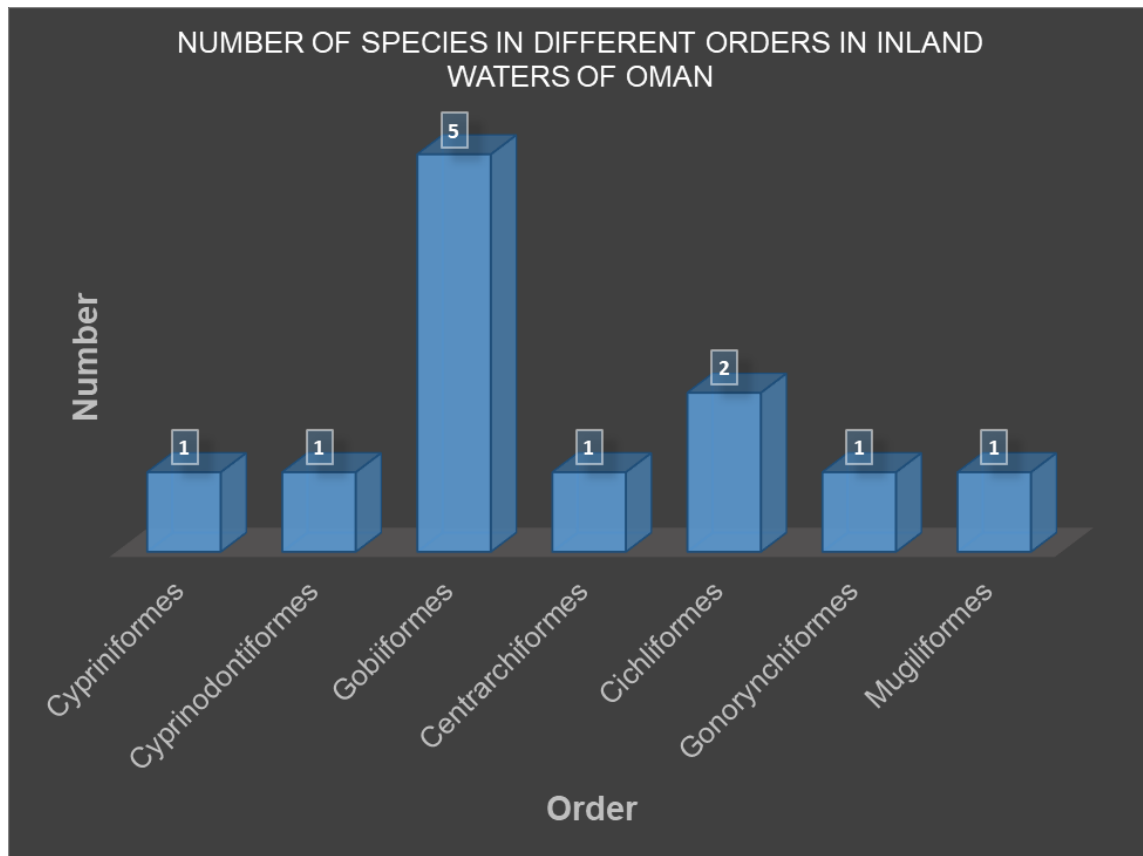


Figure 4. Number of fish species in different orders in the inland waters of Dhofar.

Holotype: BMNH 1984.3.6.571. **Paratypes:** BMNH 1984.3.6.572-576 (6).

Short description: It is distinguished from the other *Garra* species in the region by having highly unusual shape of neural spines below dorsal fin, being very short and not penetrating between dorsal pterygiophores, whitish or pink body, very small eye, absence or reduction of scales on breast and abdomen.

Distribution in Dhofar region: *Garra dunsirei* is restricted to a sinkhole at Tawi Attair, in the Jabal Qara (Jabal Samhan) mountains, Dhofar, Oman. Tawi Atair is a very impressive limestone formation at the surface level (680 m above sea level) with a depth of about 211 m.

Examined material: Based on holotype and paratypes; ZM-CBSU: O016.Ga183-Ga197 Wadi Hadhabram; ZM-CBSU: O017.Gi 101- Gi 144, Wadi Andhur.

Remarks: Three endemic species of the genus *Garra* were reported from the Dhofar region: *Garra dunsirei* Banister, 1987 from the Tawi Atair Sinkhole; *Garra sindhae* Lyon, Geiger and Freyhof, 2016 from

the Wadi Andhur; and *G. smartae* Krupp and Budd, 2009, from the Wadi Hasik (Freyhof et al., 2020; Esmaeili et al., 2022). Sayyadzadeh et al. (2023) used a total of 18 meristic and 24 morphometric parameters, including all those given in the original descriptions of *G. sindhae* and *G. smartae*, to study *Garra* from the Dhofar region, collected from the type localities, and a new population from Wadi Laggashalyon. According to them, no morphometric or meristic diagnostic features were found to distinguish *G. sindhae* and *G. smartae*, as all features overlapped. According to Lyon et al. (2016, pp. 80-81), *G. sindhae* is distinguished from *G. smartae* by: “having the belly and breast behind the pectoral fin origin fully covered with deeply embedded scales (vs. scales absent in front of the posterior pectoral fin base), 8–12 gill rakers on lower limb of first-gill arch (vs. 13–15), a prominent hump on the dorsum in some individuals (vs. no hump), and the oral disc being wider than long (vs. longer than wide).” Based on Sayyadzadeh et al. (2023), the two populations examined from the type localities of *G. sindhae* and

G. smartae, had the belly and breast fully covered by deeply embedded scales; the mode of 12 gill rakers on lower limb of first gill arch (10–13 vs. 12–14); size of oral disc varies between individuals in two populations of *G. sindhae* and *G. smartae*, in some with developed disc is wider than long and some with weak disc longer than wide or equal. The only diagnosis mentioned by Lyon et al., (2016, p. 81), “a prominent hump on back in some individuals,” is confirmed based on Sayyadzadeh et al. (2023), but this does not apply to all individuals of *G. sindhae*. Morpho-molecular characters also show that the Laggashalyon population belongs to *G. smartae* (Sayyadzadeh et al., 2023). Therefore, based on the absence of diagnostic characters, low genetic distance, molecular species delimitation approach, and the presence of morphological variations between hypogean and epigeal fish populations especially among *Garra* species, Sayyadzadeh et al. (2023), treated *G. sindhae* and *G. smartae* as junior synonyms of *G. dunsirei*. Here, we follow Sayyadzadeh et al. (2023) and Fricke et al. (2023).

Gobiiformes (two families, five genera, five species)

Eleotridae (two genera and two species)

Eleotris Bloch and Schneider, 1801

3. *Eleotris acanthopomus* Bleeker, 1853, Native

Etymology: *Eleotris*: The name of a Nile fish, eleotris; *acanthopomus*: refers to the downward-pointing spine at the posterior margin of the preoperculum.

Common name: Spine-cheek Gudgeon.

Taxonomy: *Eleotris acanthopomus* was described by Bleeker [P.] 1853:275 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 4 (no. 2)] from Western Sumatra, Indonesia.

Holotype (unique): RMNH 25934.

Short description: D VI–I, 8; A I, 8; Pt 16; P2 I, 5; LR 51; TR 16; Pred. S 41; P-V 3/1 II II 1/8; V 10+15=25. The species of this genus have a downward-pointing spine at the posterior margin of the preoperculum, which is covered with skin. The species are distinguished by the differences in the sensory papillae. *Eleotris acanthopomus* has 5

transverse rows of papillae below the eyes. The 2nd and 4th transverse rows extend downwards beyond the longitudinal row below them, but the 3rd and 5th do not. Two longitudinal rows on the operculum do not touch at the posterior ends. Inhabits mainly brackish water. Takes up life at the bottom before it reaches 2 cm SL.

Habitat: freshwater, brackish, marine.

Distribution in Dhofar region: We collected it from one locality (Wadi Hasik) in the Dhofar region, an inland water body of Oman adjacent to the shore of the Arabian Sea.

Examined material: ZM-CBSU: S103-1, 2, Oman: Dhofar Governorate, Salalah, Wadi Hasik, at Hasik Village, 17°22'01.2"N, 55°16'58.8"E, H.R. Esmaili, S.M. Al Jufaili, A.H. Masoumi, 04 Jan. 2022.

Ophiocara Gill, 1863

4. *Ophiocara porocephala* (Valenciennes, 1837),

Native

Etymology: The Greek, *ophis*= serpent, *kara*= face; *porocephala*: refers to the snout shape.

Common name: Spangled Gudgeon, Northern Mud Gudgeon.

Taxonomy: *Eleotris porocephala* was originally described by Valenciennes [A.] in Cuvier and Valenciennes 1837:237 [Histoire naturelle des poissons v. 12] from Seychelles.

Lectotype: MNHN 2020-0477. Paralectotypes: MNHN A-1573 (4) Seychelles, MNHN A-1574 (2) New Ireland.

Synonyms: *Eleotris porocephala* Valenciennes in Cuvier and Valenciennes 1837, Hist. Nat. Poiss., v. 12: 237. *Eleotris ophicephalus* Valenciennes (ex Kuhl and Van Hasselt) in Cuvier and Valenciennes 1837, Hist. Nat. Poiss., v. 12: 239. *Eleotris madagascariensis* Valenciennes in Cuvier and Valenciennes 1837, Hist. Nat. Poiss., v. 12: 240. *Eleotris viridis* Bleeker 1849, Verh. Batav. Genootsch. Kunst. Wet., v. 22: 22. *Eleotris kuak* Montrouzier 1857, Ann. Soc. Imp. Agric. Hist. Nat. Lyon, v. 8 (1856): 465.

Short description: Body stout, cylindrical; head dorsally flattened; anterior nostril long reaching lower margin of upper lip; mouth large, length of upper jaw

12.3–15.8% SL; posterior end of maxillary extending to below central to posterior part of eye; gill opening extending beyond the posterior end of urohyal; teeth inwardly curved, thickly set on both jaws, large on outer row and anterior part of inner row of upper jaw, and large on anterior part of outer row and posterior part of inner row of lower jaw; two separate dorsal fins (D VI, I 8–9); pectoral fins rounded (P 14–16); ventral fins separate; anal fin (A I, 7–8); caudal fin rounded (C 17); scales large, cycloid from snout to posterior part of head, mixed with ctenoid posteriorly to beginning of dorsal fin; ctenoid to eye on lateral side of head and to base of pelvic fins; lateral line absent; 33–37 mid-lateral scales; 12–14 horizontal scale rows; 18–26 predorsal scales; gill rakers 11–13; vertebrae 26 (rarely 27).

Distribution in Dhofar region: Janouf, Dhofar Governorate.

Examined material: ZM-CBSU: O015.Op101, 4, Oman: Janouf, 17°02'03"N, 54°16'59"E, Al Jufaili, Nov. 2020.

Gobiidae (three genera, three species)

Awaous Valenciennes, 1837

5. *Awaous jayakari* (Boulenger, 1888), Native

Etymology: *jayakari*: named after Atmaram Sadashiv Grandin/Grovindin Jayakar (1844–1911), known also as Muscati, Indian naturalist, military physician, and colonial administrator, sent to Muscat by the Indian Medical Service.

Common name: Longnose Goby, Arabian Freshwater Goby, Jayakar's Goby.

Taxonomy: *Gobius jayakari* was described by Boulenger [G. A.] 1888:663, Pl. 54 (Fig. 2) [Proceedings of the Zoological Society of London 1887 (pt 4)] from a freshwater body near Muscat, Oman.

Syntypes: BMNH 1887.11.11.234-237 (4).

Synonym: *Gobius percivali* Boulenger, 1901, Proc. Zool. Soc. Lond., 1901, v. 1 (pt 1): 152, Figure 9 (Stream near Lahej [Al-houta], Yemen).

Short description: *Awaous jayakari* belongs to the *A. commersoni* group (western Indian Ocean species-group), which is characterized by the absence of scales

on the opercle and preopercle). It is clearly distinguished from its closely related species from Africa, *A. aeneofuscus*, by the following characters: breast and pectoral base naked, pectoral base with 1–3 scales in adults (vs. pectoral base usually fully scaled), and the first dorsal fin with small brown spots and no distinct black spot in young or adults (vs. with marbling of small black spots and blotches, especially pronounced posteriorly, but no distinct white-edged black spot).

Distribution in Dhofar region: Hasik, Mugsil, A Sheer, and probably other wadis adjacent to the coastal area of the Arabian Sea, Dhofar region.

Examined material: ZM-CBSU: AJ1-24, 45, Oman: Dar Sait, 23°36'45"N, 58°32'41"E, S.M. Al Jufaili.

Cryptocentroides Popta, 1922

6. *Cryptocentroides arabicus* (Gmelin, 1789), Native
Etymology: *Cryptocentroides*: the Greek, *kryptos*=hidden, *kentron*=sting; *arabicus*: refers to the Arabian Peninsula.

Common name: Arabian Goby.

Taxonomy: *Gobius arabicus* was originally described by Gmelin [J. F.] (ex Forsskål) 1789:1198 [Caroli a Linné ... Systema Naturae per regna tria naturae v. 1 (pt 3)] from Jeddah, Saudi Arabia, Red Sea. No types known. Based on *Gobius anguillaris* (non Linnaeus 1758) of Forsskål 1775:x, 23.

Synonyms: *Gobius anguillaris* Forsskål (nec Linnaeus) 1775, Descr. Animalium: 23 (Jidda, Saudi Arabia, Red Sea). Misidentification of *Gobius anguillaris* Linnaeus 1758. *Gobius djiddensis* Bonnaterre 1788, Tabl. Encyclop. Méthod. Ichthyol. 64 (Red Sea). *Gobius arabicus* Gmelin 1789, Systema Naturae Linné, v. 1 (pt 3): 1198. Nomen novum, replacement name for *Gobius anguillaris* Forsskål, 1775.

Short description: Comparing with eastern Australian species, *C. arabicus* is distinguished from its congener *C. insignis* by having upper edge of operculum level with that of eye (vs. upper edge of eye above that of operculum), distance between lower edge of eye and upper jaw long and curved (vs. short and straight), posterior edge of preoperculum bent

forward (vs. straight), soft and spinous parts of dorsal fin slightly separated (vs. closely connected), caudal fin pointed (vs. rounded), dorsal, pectoral and caudal fins yellowish, head and body with no spots, double dark bands on body, with zigzag shape (vs all fins with blueish colour, different sizes of blue spots distributed over head and body, dark bars on body straight and obliquely located) (Seale, 1910; Jawad et al., 2021).

Distribution in Dhofar region: We confirm its presence in four localities (Hasik, Taqa, Janouf, and Mugh sail) in the inland water bodies of Oman adjacent to the shore of the Arabian Sea.

Examined material: ZM-CBSU: O003.Ca101, 66, Oman: Al Bahayes, 23°40'38"N, 58°11'34"E, S.M. AlJufaili, Nov. 2020.

Glossogobius Gill, 1859

7. *Glossogobius tenuiformis* Fowler, 1934, Native

Etymology: *Glossogobius*: the Greek, *glossa*= tongue, *gobius*= gudgeon.

Common name: Oman Freshwater Goby.

Taxonomy: *Glossogobius tenuiformis* was described by Fowler [H. W.] 1934:496, Figure 49 [Proceedings of the Academy of Natural Sciences of Philadelphia v. 86] from the St. Lucia Lake, 20 miles up, northern Zululand, KwaZulu-Natal, South Africa.

Holotype: ANSP 60250. Paratypes: ANSP 60248-49 (1, 1).

Short description: *Glossogobius tenuiformis* belongs to the *G. giuris* complex and is distinguished from *G. giuris* sensu stricto by each of the sensory papilla lines being composed of single rows (vs. 2–3 rows or more in several lines), the absence or very short (and often only a few papillae long) sensory papilla line 6 (vs. row 6 always distinctly present and long); lower pre-dorsal scale counts (7–16 vs. 15–24) and gill rakers on outer face of first arch 1+1+9–11 usually 1+1+10 (vs. 1–2+1+6–9, usually 1–2+1+7–8). Dorsal-fin rays VI, second dorsal-fin rays I, 9, anal-fin rays I, 8–9, pectoral-fin rays 17–21, caudal-fin rays 17, with 12–14 branched rays, pelvic-fins rays I, 5, lateral scales 28–32, transverse backward scales 8.5–10.5, predorsal scales 7–16, vertebrae 10+17=27.

Distribution in Dhofar region: *Glossogobius*

tenuiformis is currently known from Wadi Hasik and Wadi Mugseil.

Examined material: ZM-CBSU: O001.Gt101, 21, Oman: Dhofar Governorate, Salalah, Wadi Hasik, at Hasik, 17°22'01.2"N, 55°16'58.8"E, H.R. Esmaeili, S.M. Al Jufaili, A.H. Masoumi, 04 Jan. 2022.

Mugiliformes (one family, one genus, one species)

Mugilidae

8. *Planiliza macrolepis* (Smith, 1846), Native, New record

Etymology: *Planiliza* refers to flattened head; *macrolepis*: large scale.

Common name: Largescale Mullet.

Taxonomy: *Mugil macrolepis* was described by Smith [A.] 1846: no pagination, Pl. 28 (Fig. 2) [Illustrations of the zoology of South Africa v. 4] from Rivers and freshwater lakes, South Africa.

Holotype (unique): BMNH 1859.5.7.56 (dry).

Synonyms: *Mugil adustus* Bleeker [P.] 1854:503 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 5 (no. 3)]. *Mugil borneensis* Bleeker [P.] 1851:201 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 2 (no. 2)]. *Mugil crenilepis* Castelnau [F. L.] 1861:49 [Mémoire sur les poissons de l'Afrique austral]. *Mugil cunnumboo* Day [F.] 1865:141, fig. The fishes of Malabar. *Liza macrolepis* (Smith 1846), Dor 1984:191. *Chelon macrolepis* (Smith 1846), Randall 1995:235.

Short description: Body moderately robust, head depth equal to or greater than width, head flattened dorsally, snout length less than or equal to eye diameter, moderately pointed, upper lip with outer row of very close-set, small, peg-like unicuspid teeth, forming fine comb; 1 or 2 irregular rows of smaller, more wide-set teeth; inner rows well-spaced from outer row, lower lip directed forwards with small villiform teeth present or absent, vomer toothed, adipose eyefold poorly developed as rim around eye or absent, 35–78 gill rakers on lower limb of first gill arch, shorter than longest gill filament, dorsal-fin origin (first) closer to caudal- fin base than snout tip, anal-fin spines III, anal-fin soft rays 9, caudal fin emarginate, scales ctenoid, longitudinal series 32 or

33; transverse series 10 or 11; longitudinal series anterior to tip of pectoral fins 7 to 9, 21 or 22 anterior to origin of second dorsal fin, 16 scales in transverse series entirely around caudal peduncle, body greenish grey dorsally; flanks and abdomen silvery; fins grey or bluish with dusky margins and may appear yellowish at base; pectoral fins with golden base.

Habitat: Freshwater, brackish, marine.

Distribution in Dhofar region: Wadi Hasik.

Examined material: ZM-CBSU: O001.Pm101, 3, Oman: Dhofar Governorate, Salalah, Wadi Hasik, at Hasik, 17°22'01.2"N, 55°16'58.8"E, H.R. Esmaeili, S.M. Al Jufaili, A.H. Masoumi, 04 Jan. 2022.

Cichliformes (two families, two genera, two species)

Ambassidae (one genus, one species)

Ambassis Cuvier, 1828

9. *Ambassis dussumieri* Cuvier 1828, Native

Etymology: *Ambassis*: derived from Greek, *anabasis*= climbing up; *dussumieri*: for Dussumier.

Common name: Barehead glassfish, Malabar glassy perchlet.

Taxonomy: *Ambassis dussumieri* was described by Cuvier [G.] in Cuvier and Valenciennes 1828:181 [Histoire naturelle des poissons v. 2] from Malabar, India. Lectotype: MNHN 0000-9335 (1). Syntypes: MNHN 0000-9335 (2), SMF 1325 [ex MNHN in 1830] (1).

Synonyms: *Ambassis dussumieri* Cuvier, in Cuvier and Valenciennes 1828: 181 (type locality: SW India). *Ambassis denticulata* Klunzinger 1870: 719 (type locality: Red Sea). *Ambassis gymnocephalus* (non Lacépède, 1802): Bleeker, 1874: 99. *Ambassis urotaenia* (non Bleeker, 1852): Pellegrin 1933: 88. *Chanda gymnocephalus* Dor 1984: 94.

Short description: A species of *Ambassis* with the following combination of characters: Dorsal fin VI-VII/I, 8-10; Anal fin III, 8-11; Pectoral fin 14-16; Lateral line discontinuous, 12-14 + 10-16 scales, interrupted below base of soft dorsal-fin rays by 1-3 (usually two) tubeless scales; Vertical scale rows 27-28; Horizontal scale rows 9-10; Cheek scale rows 2; Predorsal scales 13-16 (11 or 12 in some early juveniles); Gill rakers 8-10 + 22-25 (7+17 in a 17 mm

SL early juvenile); Supraorbital spines 1-5, usually 3-4; rostral spine. Supraorbital spines 1-4, more numerous and more pronounced in larger specimens. Preorbital ridge smooth or with 2-3 small serrae; preorbital edge with 4-6 serrae (two in 17 mm juvenile); retrorse rostral spine present at all sizes. Preopercle ridge with 3-13 serrae; lower edge of preopercle with 6-31 serrae, these extending dorsally along rear margin of preopercle to about one-third its height in larger specimens. Interopercle smooth except for 1-2 tiny spines near posterior angle. (Anderson and Heemstra 2003). Habitat: brackish, marine.

Distribution in Dhofar region: Janouf estuary.

Examined material: ZM-CBSU: O015.Ad101-Ad1033, Oman: Dhofar Governorate, Salalah, Janouf, 17°02'03"N, 54°16'59"E, H.R. Esmaeili, S.M. Al Jufaili, A.H. Masoumi, 04 Jan. 2022.

Cichlidae (one genus, one species)

Oreochromis Günther, 1889

10. *Oreochromis niloticus* (Linnaeus, 1758), Exotic

Etymology: *Oreochromis*: Latin, *aurum*= gold + Greek, *chromis*= a fish, perhaps a perch; *niloticus*: refers to the Nile River.

Common name: Nile Tilapia.

Taxonomy: *Perca nilotica* was described by Linnaeus [C.] 1758:290 [Systema Naturae, Ed. X v. 1] from Nile River.

Holotype:? NRM LP 10.

Synonyms: *Chromis triacantha* Bowdich [S. L.] 1825:235, figure 52 [Fishes of Madeira; ref. 590] Gambia River. *Tilapia calciati* Gianferrari [L.] 1924:242, figure [Atti della Società Italiana di Scienze Naturali di Milano v. 63. *Tilapia regani*, Poll [M.] 1932:32, Pls. 1 (Fig. 2), 2 (Fig. 2) [Revue de Zoologie et de Botanique Africaines v. 23 (no. 1). *Tilapia vulcani* Trewavas [E.] 1933:315, figure 1 [The Journal of the Linnaean Society of London. Zoology v. 38 (no. 259). *Tilapia inducta* Trewavas [E.] 1933:317, figure 2 [The Journal of the Linnaean Society of London. Zoology v. 38 (no. 259).

Short description: Dorsal-fin spines 15–18, dorsal-fin soft rays 11–13, anal-fin rays III, 9–11, vertebrae

30–32. *Oreochromis niloticus* differs from *O. mossambicus* another introduced fish to the Arabian Peninsula by having 3–40 dark grey to black regularly shaped and set bars on caudal fin (increasing with fish size), all flank scales with dark-grey scale pockets, tip of membrane between dorsal-fin spine black, nuptial male whitish with pink anterior body and caudal fin.

Habitat: freshwater, brackish.

Distribution in Dhofar region: Wadi Darbat, Ain Hamran, Ain Razat, Ain Sahalnout/Sahalnoot, and Wadi Ishat.

Examined material: ZM-CBSU: O003.On101, 12, Oman: Dhofar Governorate: Wadi Darbat, 17°05'55"N, 54°27'04"E, H.R. Esmaili, S.M. Al Jufaili, A.H Masoumi, 02 Jan. 2022. ZM-CBSU: O005-On113, 17, Oman: Ain Razat, 17°07'46"N, 54°14'19"E, H.R Esmaili, S.M. Al Jufaili, A.H. Masoumi, Jan. 2022.

Cyprinodontiformes (two families, two genera, two species)

Aphaniidae (one genus, one species)

Aphaniops Hoedeman, 1951

11. *Aphaniops kruppi* (Freyhof, Weissenbacher and Geiger, 2017), Endemic

Etymology: *Aphaniops*: *Aphanius-opsis*, resembling *Aphanius*; *kruppi*: named for Dr. Fareed Krupp for his valuable contributions to the explorations of the freshwater fishes of the Middle East.

Common name: Omani Killifish, Omani Tooth-carp.

Taxonomy: *Aphanius kruppi* was described by Freyhof [J.], Weissenbacher [A.] and Geiger [M. F.] 2017:561, figures. 2-5 [Zootaxa 4338 (no. 3)] from a spring in Al Mudayrib, Oman, 22°36'46"N, 58°40'31"E.

Holotype: ZFMK-ICH 103668. Paratype: FSJF. Plus, additional non-type material.

Short description: *Aphaniops kruppi* is distinguished from the other *Aphaniops* in the Arabian Peninsula by combination of the following characters: Male with 9–14 brown or grey flank bars between pectorals, pelvic and caudal-fin bases, often associated into blotches in front of pelvic-fin base. Females with a diamond-shaped or vertically elongate black or dark brown

blotch at caudal-fin base. Dorsal-fin branched rays 6½–7½, anal-fin branched rays 7½–8½, caudal-fin branched rays 8+7–8+8, pectoral-fin rays 14–16, pelvic-fin rays 6–7. Trunk and head entirely scaled, scales large and cycloid in females, with small cteni in males, scale above pectoral-fin origin enlarged, one scale row on upper part of opercle, flank with 24–28 scales along lateral series, two or three additional rows of small scales on anterior caudal-fin base, 9, rarely 10 scale rows between dorsal- and pelvic-fin origins, caudal peduncle with 16, rarely 14, circumpeduncular scales. Lateral line incomplete, with 9–15 pores, scales pored mostly behind vertical of pelvic-fin origin. Teeth tricuspid, median tip is longer than laterals.

Distribution in Dhofar region: Wadi Darbat, Wadi Hasik, Mugsail, Raysut, Ain Razat, Sadah, Soub, Ain Jarziz, Ain Hamran, Mirbat, Wadi Anshir, Ain Sahalnout, Taqa.

Examined material: ZM-CBSU: O001.Ak101, 90, Oman: Dhofar Governorate, Salalah, Wadi Hasik, at Hasik, 17°22'01.2"N, 55°16'58.8"E, H.R. Esmaili, S.M. Al Jufaili, A.H Masoumi, 04 Jan. 2022. ZM-CBSU: O003.Ak191, 56, Oman: Dhofar Governorate, Wadi Darbat, 17°05'55"N, 54°27'04"E, H.R. Esmaili, S.M. Al Jufaili, A.H. Masoumi, 02 Jan. 2022.

Centrarchiformes (one family, one genus, one species)

Terapontidae

Terapon Cuvier, 1816

12. *Terapon jarbua* (Forsskål, 1775), Native

Etymology: Its deprecated junior homonym is *Therapon*. It was introduced since "*Terapon*" was perceived as an incorrect rendering of the Greek word *therapon*. In fact, the intended etymology was Greek: *teras*= "strange thing, monster, wonder" (cf. *teratosaurus*) + Greek: *pontios*= "marine", pertaining to the sea. *jarbua*: first named using the Arabic name "Djarbua" in a draft by Peter Forsskål.

Common Name: Jarbua Terapon.

Taxonomy: *Sciaena jarbua* was described by Fabricius [J. C.] in Niebuhr (ex Forsskål) 1775: xii,

44, 50 [Descriptiones animalium (Forsskål)] from Djidda (Jeddah, Saudi Arabia, Red Sea).

Lectotype: ZMUC P43571 (dry skin). Paralectotypes: ZMUC P43572 (1, dry skin).

Short description: Body oblong moderately and laterally compressed, dorsal-fin rays XI-XII, 9–11; anal-fin rays III, 7–10; pectoral-fin rays 13–14; gill rakers 6–8+13–16 = 19–24, pored lateral line scales 75–100; horizontal scale rows above lateral line 13–17; caudal fin emarginate. Lower opercular spine very large extending well beyond the opercular flap. Post temporal bone exposed posteriorly and serrate. Body silvery white with 3–4 curved stripes from nape to hind part of body, the lowermost continuing across the middle of the caudal fin; spinous part of dorsal fin with a blackish blotch dorsally on membranes between third and sixth spines; caudal fin with stripes, the lobes with dark tips.

Synonyms: *Holocentrus servus* Bloch [M. E.] 1790:80, Pl. 238 (Fig. 1).

Terapon timoriensis Quoy [J. R. C.] and Gaimard [J. P.] 1825:341 [Voyage autour du monde.

Coius trivittatus Hamilton [F.] 1822:92, 370 [An account of the fishes found in the river Ganges.

Habitat: freshwater, brackish, marine.

Distribution in Dhofar region: Mugseil and Raysut, Dhofar Governorate.

Examined material: ZM-CBSU: O001.Tj101, 2, Oman: Dhofar Governorate, Salalah, Wadi Hasik, at Hasik, 17°22'01.2"N, 55°16'58.8"E, H.R. Esmaeili, S.M. Al Jufaili, A.H. Masoumi, 04 Jan. 2022.

Habitat Diversity: Fishes of Dhofar are found in several inland water bodies, including aflaj (qanats), wadis (streams), subterranean water systems/sinkholes, and brackish salt flats.

Discussion

Diversity: The present study revealed that the Dhofar region harbors 12 species in 12 genera, nine families, seven orders, and one class that are higher than those recorded by Esmaeili et al. (2022). *Garra dunsirei* is the only endemic fish of the Dhofar region that is distributed in the Tawi Attair Sinkhole, Wadi Andhur and, Wadi Hadhabram. *Garra sindhae* and *G. smartae*

are synonyms of *G. dunsirei*. Although we collected new samples of Wadi Andhur and Wadi Hadhabram, our attempts to collect *G. dunsirei* from the Tawi Attair Sinkhole (type locality) yielded no success due to difficulties in accessing the sinkhole. Tawi Atair/Attair Sinkhole is the most famous sinkhole in Dhofar governorate known as the 'Bird Well' gained international fame after its discovery in 1997 by a team of Slovenian explorers in collaboration with Sultan Qaboos University (SQU) as one of the largest solvent sinkholes in the world. Tawi Atair is a very impressive limestone formation, at the surface level (680 m above the sea level), it is 140 m across in the NE – SW direction and 100 m in the NW – SE direction. In the lower half, it narrows down to 60 m across. The depth of the sinkhole is 211 m., and the volume is 975,000 m³. Such size is not exceptional. Tawi Atair might be formed by a collapse of the roof of a giant cave hall but just as well as by a gradual widening of fractures in the rock. This area of Oman contains much evidence of karst processes creating numerous other smaller sinkholes and many caves. Walls of sinkhole contain multiple dripstone formations, including stalactites, stalagmites, and others. These formations are located at different heights.

The Nile tilapia, *Oreochromis niloticus*, is the only exotic species found in five sites. It is widely distributed in Oman's inland waters (Esmaeili et al., 2022) and seems to have been introduced to new localities in the Dhofar region.

The Barehead glassfish, *Ambassis dussumieri*, is a new record for the Dhofar region. It is found in estuarine and coastal waters in the Indo-West Pacific from South Africa, north to the Red Sea, and eastward around India and Australasia to the Philippines and China. Recently, it has been reported as an alien species in the Mediterranean Sea (Stern et al., 2022). Wadi Hasik with eight species, including *Aphaniops kruppi*, *Awaous jayakari*, *Cryptocentroides arabicus*, *Glossogobius tenuiformis*, *Eleotris acanthompus*, *Terapon jarbua*, *Chanos chanos*, and *Planiliza macrolepis* can be considered as a micro-hotspot in terms of having high fish diversity in comparison with

other parts of the Arabian Peninsula (see Freyhof et al., 2020) for the Dhofar region. Wadi Hasik is located in the Jebel Samhan Nature Reserve in the Dhofar Mountains, which is the largest (5,057.49 km²; 1.53% of the country) Nature Reserve of Oman (Carranza et al., 2018).

Dhofar versus Arabian Peninsula and Oman inland fish diversity: Freyhof et al. (2020) reported 41 fish species in 11 families from the entire Arabian Peninsula, and Esmaeili et al. (2022) listed 23 recognized species in 15 genera, 10 families, and seven orders from inland waters of Oman. Here, we have listed 12 species in 12 genera. It seems that Dhofar comprises more than 29.3% of the recorded species of the Arabian Peninsula and about 52.2% of the inland fishes of Oman. Hence, Dhofar is one of the diverse areas in the Arabian Peninsula and Oman in terms of inland ichthyodiversity.

Endemism: Only one inland fish species (8.3%) in one genus (*Garra*) and one family (Cyprinidae) is the endemic element that is restricted to the Dhofar territory only. The widely distributed species, *Aphaniops kruppi* is endemic to Oman.

Ichthyodiversity conservation: The inland fish species of Dhofar are characterized by a high level of native ichthyodiversity, which leads to a simultaneous need for a conservation management plan. As given in Table 1, out of 12 fish species reported from the Dhofar region, 10 species are categorized as Least Concern (LC), one Endangered (EN), and one Near Threatened (NT). Given the approximately high number (25%) of species in need of conservation (CR, EN, and NT), and the relatively poor resources available for biological diversity conservation, environmental managers and biologists are confronted with the problem of deciding which taxa warrant special protection using criteria such as the magnitude of the extinction threat, ecological value or role in the ecosystem and biological distinctiveness. Assessing 'biological distinctness' is a challenging subject for biodiversity conservation which should be fully considered in future studies.

Threats to inland fish diversity. In many parts of the world, global warming, pollution, drought, water

modifications (dam construction, water abstraction), and the introduction of exotic fishes are the main threats to the unique biodiversity, especially the ichthyodiversity of Dhofar. The provided data is necessary for increasing fish knowledge, developing competent and pragmatic management plans, and effective conservation policies to protect the native and endemic natural heritages of Dhofar.

Dhofar biodiversity: The geographical position of Dhofar, being only 600 kilometers from the Horn of Africa, combined with the climatic influence of the Khareef or Southwest Monsoon, has resulted in an exclusive flora and fauna that is amongst the most diverse of the Arabian Peninsula. The Dhofar region harbors 867 plant species (63% of all known plant species in Oman), including 41 species of plants that are not found anywhere outside Dhofar. To the north of the mountains are found species that are typical of the Arabian deserts (known as the Nubo-Sindian zone), while species occurring to the south and directly impacted by the summer monsoon, more closely resemble the flora of northeast Africa (the Somalia-Masai zone). Dhofar is also home to 12 species of inland fishes, including three endemic species, one species of endemic toad of the Arabian Peninsula, the Dhofar toad, *Duttaphrynus dhofarensis* (Bufonidae) (60 species of terrestrial reptiles (59,41% of all known species in Omani terrestrial reptiles), 475 bird species, 67 species of wild mammals (49 terrestrials and 18 marine mammals) including the critically endangered Arabian leopard (*Panthera pardus nimr*). Dhofar is renowned for its biological diversity, but they are under natural and anthropological pressures, particularly climate change, overgrazing of rangelands, habitat destruction, pollution, water abstraction, exotic introduction, and also some fisheries and shipping activities at the Arabian Sea. Due to its high biodiversity, it needs to be taken to ensure that the wildlife and their habitats are managed in a sustainable way. The provided data on ichthyodiversity will be necessary for increasing fish knowledge and the development of competent and pragmatic management plans and effective conservation

policies.

In conclusion, the data provided in this study are necessary for increasing fish knowledge, developing competent and pragmatic management plans, and effective conservation policies to protect the native and endemic fishes of the Dhofar region and its natural heritage.

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Availability of data and materials: The data generated and analyzed during the present study are available from the corresponding author. The fish specimens are available in ZM-CBSU (Zoological Museum and Collection of Biology Department, Shiraz University, Shiraz).

Ethics approval consent for participation: The research work was approved by the Sultan Qaboos University (SQU) Animal Ethics Committee (SQU/AEC/2020-21/2).

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