



Harold Heatwole  
Indraneil Das  
Susan King *Editors*

# Status of Decline and Conservation of Amphibians of the Middle East

Amphibian Biology, Volume 11, Part 8  
Status of Conservation and Decline  
of Amphibians: Eastern Hemisphere

 Springer

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Eastern Hemisphere

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*Editors*

Harold Heatwole  
Department of Zoology  
University of New England  
Armidale, NSW, Australia

Susan King  
58 Everett Street, NSW 2365, Guyra,  
NSW, Australia

Indraneil Das  
Institute of Biodiversity  
and Environmental Conservation  
Universiti Malaysia Sarawak  
Kota Samarahan, Sarawak, Malaysia

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# Amphibian Fauna of Bahrain

# 10

Aaron M. Bauer and Indraneil Das

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## Abbreviations

*IUCN* International Union for the Conservation of Nature  
*LC* Least Concern  
*mya* millions of years ago  
*SVL* Snout-to-vent length

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A. M. Bauer (✉)  
Department of Biology and Center for Biodiversity and Ecosystem Stewardship, Villanova  
University, Villanova, PA, USA  
e-mail: [aaron.bauer@villanova.edu](mailto:aaron.bauer@villanova.edu)

I. Das  
Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak,  
Kota Samarahan, Sarawak, Malaysia  
e-mail: [idas@unimas.my](mailto:idas@unimas.my)

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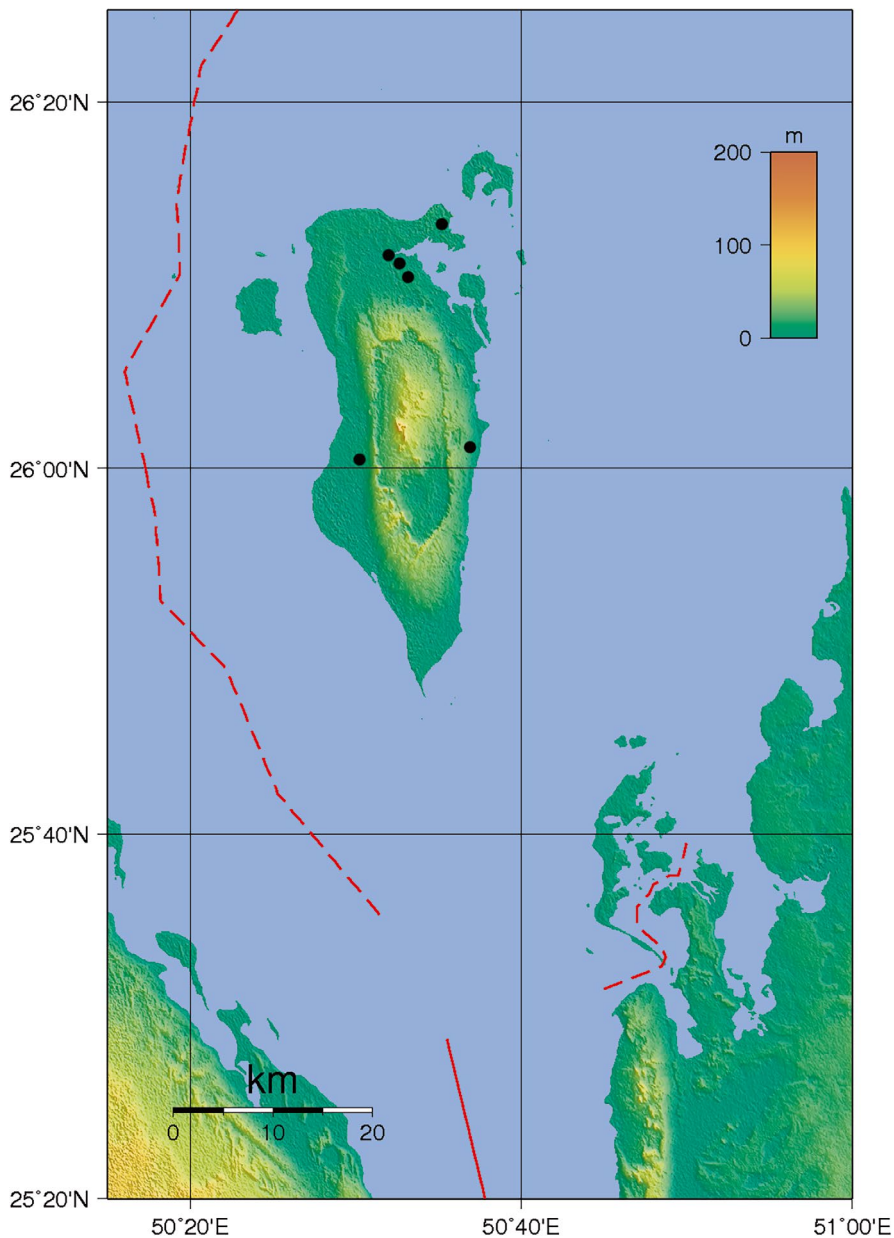
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## Introduction

The Kingdom of Bahrain (Fig. 10.1) is an insular nation, lying between latitudes 25.6° and 26.3° N and longitudes 50.3° and 50.8° E, and is the third smallest country in Asia, covering a land area of 780 km<sup>2</sup> (including 115 km<sup>2</sup> in reclaimed land in the form of artificial islands). By far, the largest island is Bahrain, with more than 80 additional smaller islands, including Um All-Na'sān, the Ḥawār Islands, Al-Muḥharraq, and Sitrah. Bahrain lies in the Arabo-Persian Gulf, off the eastern coast of Saudi Arabia, to which it is connected by the 24-km-long King Fahd Causeway. The Ḥawār Group, comprising 36 islands, 19 km southeast of Bahrain Island, lies only about 2 km off the western coast of Qatar. In 2021, Bahrain had a population of 1.7 million people, of which 46% were Bahraini nationals. Bahrain's modern economy is based on banking, tourism, and the processing and export of oil. In the Bronze Age, it was the site of the Dilmun civilization and later was, in succession, part of the Assyrian, Babylonian, and Persian empires and it has numerous important archeological sites (Belgrave 1952; Rice 1986). Historically, it was an important trade center and pearl fishery site with links to the Greek world and the civilizations of southern Asia, in addition to the more proximal Arabian, Mesopotamian, and Persian cultures (Nizami 1994; Potts 2007; Kosmin 2013).

Bahrain was last inundated in the early Pleistocene (1.0–0.5 mya) and its current terrestrial fauna and flora would have colonized the archipelago only since that time (Fairbridge 1961; Mohammed et al. 1997). However, during subsequent glacial maxima when most of the current Arabo-Persian Gulf was exposed, it would have been contiguous with the Arabian mainland and adjacent regions (Rose 2010). Today, most of Bahrain is low-lying desert, with a high point of 134 m at Jabal Al-Dukhān on the central escarpment. Summers are hot, with high humidity and record temperatures of >48 °C and monthly average highs of ≥36° from May through September; winter months (December–March) are mild, with average lows below 18 °C. Mean rainfall is 78.3 mm, falling sporadically through winter and early spring. The flora is desertic and many species are halophytic. At least 357 species of vascular plants in 55 families have been recorded (El-Oqlah and Abbas 1994; Al-Eisawi 2001; Anonymous 2006).

Bahrain is a signatory of the Ramsar Convention, and two protected areas are recognized by the IUCN: Tubli Bay (1610 ha), an intertidal area with remnant mangroves, and the Ḥawār Islands (5200 ha), desert islands surrounded by seagrass



**Fig. 10.1** Relief map of Bahrain, showing its physiographic features and important known localities for *Pelophylax ridibundus* (dots: Jidd Hafs, 26°13'N, 50°32'E; Sihlat al Hadriya 26°12'N, 50°32'E; Ras Sanad, 26°10'N, 50°36'E; Al-Areen Wildlife Park 26° 0' 57", 50° 29' 41"; Muharraq-Insel, NE Bahrain 26° 0' 57", 50° 29' 41". m = meters above sea level)

beds. Potential habitat for frogs exists on Ḥawār Island, but no amphibians have been recorded from there (Bray 1978).

Bahrain lies within a water-deficit region with only ~2% arable land and relies on desalination of seawater as a primary source of freshwater for drinking and domestic purposes, supplemented by groundwater from the Dammam Aquifer and, to a lesser extent, the Rus-Umm er Radhuma Aquifer, and from treated wastewater (Zubari and Lori 2006). There are no permanent rivers and Bahrain's natural non-marine wetland biodiversity is concentrated around springs or artesian wells, although because of the depletion of the Dammam Aquifer, natural springs have ceased to flow.

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## The Amphibian Species

Amphibians are mentioned in general accounts of the wildlife (e.g., Hill and Webb n.d. [no date]; Smith 1978; Samour 1990; Hill 2003) or reports on herpetological surveys (e.g., Loveridge 1955; Gallagher 1971; Cornes 1984) in Bahrain, and in more general treatments of the amphibian fauna of Arabia *sensu lato* and the Middle East (e.g., Arnold 1980; Balleto et al. 1985; Leviton et al. 1992; Borkin and Litvinchuk 2013).

Although “a toad” was noted from Awali (I.W. Hanwell in Gallagher 1971), this record is unconfirmed and only a single amphibian species, the Marsh Frog, is documented from Bahrain. Originally described as *Rana ridibunda* Pallas, 1771 from areas in Russia and Kazakhstan, it was first placed in *Pelophylax* by Fei et al. (1990), and subsequently in *Hylarana* by Chen et al. (2005), but since 2006, has been consistently treated as *Pelophylax ridibundus*, following Frost et al. (2006). The species is widespread from much of Western and Central Europe to trans-Ural Russia and south to Afghanistan and parts of Iran. Scattered areas in Saudi Arabia represent the southernmost extent of the species (Mohammadi et al. 2015; Frost 2021) and include the nearest mainland locality to Bahrain at a distance of approximately 25 km (Mohammed et al. 1997).

*Pelophylax ridibundus* (Fig. 10.2) is a predominantly brownish or greenish aquatic frog with a pair of dorsolateral folds, long legs, and partly webbed hindfeet. In neighboring Saudi populations, metamorphosis is completed at 22–34 mm SVL and minimum size at reproduction is about 40-mm SVL. Males reach 58 mm SVL, whereas females reach at least 87.5 mm SVL (Gallagher 1971; Briggs 1981; Balleto et al. 1985; Leviton et al. 1992). Males call in choruses and breeding takes place chiefly during the cooler winter and spring months; tadpoles have been found from January to May (Hill and Webb n.d. [no date]; Gallagher 1971; Cornes 1984; Hill 2003).

Although Bahraini specimens have not been included in phylogenetic analyses, a karyotypic study including frogs from Bahrain as well as eastern Saudi Arabia and Egypt (Mohammed et al. 1997) found no evidence for either sexual dimorphism or specific differentiation. Eiselt and Schmidler (1973) compared Bahraini *P. ridibundus* with specimens from Iran morphologically and morphometrically and found



**Fig. 10.2** *Pelophylax ridibundus* from Ha'il region, Saudi Arabia. (Photograph by Adel Ibrahim)



differences, but nothing they considered to be taxonomically relevant. Balleto et al. (1985) reported that Bahraini and central Saudi Arabian populations differed morphologically from isolated high-elevation populations from the Asir region of Saudi Arabia.

Population structure, breeding, and growth of the species were studied by Briggs (1981) at Al Qatif, about 60 km from Bahrain on the Saudi Arabian mainland. There, at least some males reach breeding size by the breeding period in their first winter after metamorphosis, whereas females likely breed only in their second post-metamorphic year. Oviposition takes place from November to March, with a peak in January, whereas metamorphosis extends from late December to early summer. Adults migrate to the breeding sites and disperse after mating and the metamorphs disperse by early September.

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## Threats and Conservation

The only terrestrial protected area in Bahrain is the Al Areen Wildlife Park and Reserve (8 km<sup>2</sup>), which includes two surface reservoirs and other artificial habitats occupied by Marsh Frogs (Samour et al. 1989; Samour 1990). Al Areen is a nature reserve and zoological gardens located in Sakhir and established in 1976. One of the ten protected areas in Bahrain (the others chiefly marine), it is home to over 90 species of birds and 50 species of mammals, including several exotic taxa. In Saudi Arabia, *P. ridibundus* occupies irrigated palm farms and treated sewage ponds (Al-Johany et al. 2014) and in this region, the species may be tolerant of polluted water, although in the Ha'il region of Saudi Arabia, they prefer permanent streams (Alshammari and Ibrahim 2018), a habitat lacking in Bahrain. In Bahrain, oases, irrigated ditches, hand-dug wells and cisterns, ponds, and reed beds are used

by this species and areas with thick algal mats are particularly preferred (Hill and Webb *n.d.* [no date]; Gallagher 1971; Cornes 1984; Balleto et al. 1985; Hill 2003).

*Pelophylax ridibundus* has been assessed as Least Concern at the global level on the IUCN Red List (Kuzmin et al. 2009). Marsh frogs were abundant in Bahrain until the early 1970s in freshwater springs and agricultural water channels in the north, east, and west of the country. However, over-exploitation of the Damman Aquifer (Edmunds and Droubi 1998) has resulted in both salinization and loss of freshwater springs. At present, no freshwater springs are viable, and agricultural areas with flood-irrigation systems have decreased. The resulting loss of habitat has been considered a potential threat to *P. ridibundus* in Bahrain (Anonymous 2006) and anecdotal reports of population decline were noted 20 years ago (Hill 2003). In Bahrain's National Red-List Category, based on assessments made in 2015, the species is listed as Vulnerable, under category B1ab(i), showing a 25–50% decline (Naser et al. 2017). Threats resulting from the extraction of water, the indiscriminate use of pesticides and herbicides, and pollution of the ponds and other bodies of water have been implicated in regional declines of *P. ridibundus* (Balleto et al. 1985). Pollution through compounds of zinc in urban environments, most likely from automobiles' exhausts, in Bahrain has been documented by Madany et al. (1994). Sources elsewhere have been attributed to the wear of tires and brake linings, and corrosion from galvanized steel barriers; pollution by zinc can negatively impact amphibians and may significantly increase mortality of larval stages (Croteau et al. 2008). Climatic change has recently been considered a threat to the species in adjacent Saudi Arabia (Aloufi et al. 2019) and this is probably also the case in Bahrain, where recent years have seen record-setting high temperatures (<https://www.mtt.gov.bh/meteorological-services>).

Bahrain's Royal Decree No. (2) of 1995 on Wildlife Protection as amended by Legislative Decree No. 12 of 2000, prohibits the capture, killing, or transportation of wildlife and marine organisms under the auspices of the National Authority for Wildlife Protection. While amphibians are not specifically covered, the frog motif has been recognized postally as relevant to environmental conservation: on 16 September 1997, Bahrain Post issued 80 fil, 100 fil, 200 fil, and 250 fil stamps (Stanley Gibbons catalogue numbers 620–623) depicting stylized frogs as part of an image representing the earth's biota in commemoration of the tenth Anniversary of the Montreal Protocol (on reduction of use of chlorofluorocarbons). A similar design was issued by the State of Kuwait to commemorate the event (see Fig. 7.3 in Chap. 7). Captive breeding of the marsh frog has been undertaken at Al Areen Wildlife Park and Reserve (Anonymous 2006).

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## References

- Al-Eisawi, D.M., 2001. Notes on the flora of Bahrain: new families, genera and species to the flora of Bahrain. *Arab Gulf Journal of Scientific Research* **19**: 1–6.
- Al-Johany, A.M., Al-Qarni, S.S. and Hasayen, K.A., 2014. Distribution and habitats of amphibians in the central region of Saudi Arabia. *Herpetological Conservation and Biology* **9**: 601–608.
- Aloufi, A.A., Amr, Z.S., Abu Baker, M.A. and Hamidan, N., 2019. Diversity and conservation of terrestrial, freshwater, and marine reptiles and amphibians in Saudi Arabia. *Amphibian and Reptile Conservation* **13**: 181–202.
- Alshammari, A.M. and Ibrahim, A.A., 2018. Amphibians of the Ha'il region, Saudi Arabia, with special reference to their habitat and distribution. *Advances in BioResearch* **9**: 165–172.
- Anonymous, 2006. *Bahrain First National Report to the Convention on Biological Diversity*. Public Commission for the Protection of Marine Resources, Environment and Wildlife, General Directorate for Environment and Wildlife Protection, Isa Town, Bahrain. 102 pp.
- Arnold, E.N., 1980. The reptiles and amphibians of Dhofar, southern Arabia. *Journal of Oman Studies Special Report* **2**: 273–332.
- Balleto, E., Cherchi, M.A. and Gasperetti, J., 1985. Amphibians of the Arabian Peninsula. *Fauna of Saudi Arabia* **7**: 318–392.
- Belgrave, J.H.D., 1952. A brief survey of the history of the Bahrain Islands. *Journal of the Royal Central Asian Society* **39**: 57–68.
- Borkin, L.J. and Litvinchuk, S.N., 2013. Amphibians of the Palearctic: taxonomic composition [in Russian]. *Proceedings of the Zoological Institute of the Russian Academy of Sciences* **317**: 494–541.
- Bray, D., 1978. The natural history of the Hawar Islands. Reptiles and amphibians. *Wildlife in Bahrain (Bahrain Natural History Society Annual Report)* **1977**: 50–51.
- Briggs, J., 1981. Population structure of *Rana ridibunda* in the Al Qatif Oasis. *Proceedings of the Saudi Biological Society* **5**: 333–345.
- Chen, L.-Q., Murphy, R.W., Lathrop, A., Ngo, A., Orlov, N.L., Ho, C.T. and Somorjai, I., 2005. Taxonomic chaos in Asian ranid frogs: an initial phylogenetic resolution. *The Herpetological Journal* **15**: 231–243.
- Cornes, C., 1984. Reptiles and amphibians found in the desert areas of Bahrain. *Wildlife in Bahrain (Bahrain Natural History Society Annual Report)* **1984**: 107–119.
- Croteau, M.C., Hogan, N., Gibson, J.C., Lean, D. and Trudeau, V.L., 2008. Toxicological threats to amphibians and reptiles in urban environments. Pp. 197–209 In: Mitchell, J.C., Jung Brown, R.E. and Bartholomew, B. (eds.), *Urban Herpetology*. Society for the Study of Amphibians and Reptiles. *Herpetological Conservation* **3**.
- Edmunds, W.M. and Droubi, A., 1998. Groundwater salinity and environmental change. Pp. 503–518. In: *Isotope Techniques in the Study of Past and Current Environmental Changes in the Hydrosphere and Atmosphere*. International Atomic Energy Agency, Vienna.
- Eiselt, J. and Schmidler, J.F., 1973. Froschlurche aus dem Iran unter Berücksichtigung außeriranischer Populationsgruppen. *Annalen des Naturhistorischen Museums Wien* **77**: 181–243, pls. 1–4.
- El-Oqlah, A.A. and Abbas, J.A., 1994. A checklist of the vascular plants of Bahrain. *Dirasat Journal* **21B**: 95–118.
- Fairbridge, R.W., 1961. Eustatic changes in sea level. pp. 99–185. In: Ahrens, L.H., Press, F., Rankama, K. and Runcorn, S.K. (eds.), *Physics and Chemistry of the Earth*, Vol. 4. Pergamon Press, Oxford.
- Fei, L., Ye, C.-Y. and Huang, Y.-Z., 1990. *Key to Chinese Amphibians* [in Chinese]. Publishing House for Scientific and Technological Literature, Chongqing. 364 pp.
- Frost, D.R., 2021. *Amphibian Species of the World: An Online Reference*. Version 6.1 (15 December 2021). Electronic Database accessible at <https://amphibiansoftheworld.amnh.org/index.php>. American Museum of Natural History, New York, USA. <https://doi.org/10.5531/db.vz.0001>

- Frost, D. R., Grant, T., Faivovich, J., Bain, R.H., Haas, A., Haddad, C.F.B., de Sá, R.O., Channing, A., Wilkinson, M., Donnellan, S.C., Raxworthy, C.J., Campbell, J.A., Blotto, B.L., Moler, P.E., Drewes, R.C., Nussbaum, R.A., Lynch, J.D., Green, D.M. and Wheeler, W.C., 2006. The amphibian tree of life. *Bulletin of the American Museum of Natural History* **297**: 1–370. <https://digitallibrary.amnh.org/handle/2246/5781>
- Gallagher, M.D., 1971. *The Amphibians and Reptiles of Bahrain*. Privately printed by author, Bahrain. [ii] + ii + 40 pp.
- Hill, M., 2003. *Wildlife of Bahrain*. Miracle Publishing, Manama, Bahrain. viii [sic, iv] + 191 pp.
- Hill, M. and Webb, P., n.d. [no date] *An Introduction to the Wildlife of Bahrain*. Ministry of Information, State of Bahrain. 176 pp.
- Kosmin, P., 2013. Rethinking the Hellenistic Gulf: the new Greek inscription from Bahrain. *Journal of Hellenistic Studies* **133**: 61–79.
- Kuzmin, S., Tarkhnishvili, D., Ischenko, V., Dujaebayeva, T., Tuniyev, B., Papenfuss, T., Beebee, T., Ugurtus, I.H., Sparreboom, M., Rastegar-Poutani, N., Disi, A.M.M., Anderson, S., Denoël, M. and Andreone, F., 2009. *Pelophylax ridibundus*. The IUCN Red List of Threatened Species 2009: e.T58705A11825745. <https://doi.org/10.2305/IUCN.UK.2009.RLTS.T58705A11825745.en>. Accessed on 13 January 2022.
- Leviton, A.E., Anderson, S.C., Adler, K. and Minton, S.A., 1992. *Handbook to Middle East Amphibians and Reptiles* (SSAR Contributions to Herpetology, Number 8). Society for the Study of Amphibians and Reptiles, Oxford, Ohio, USA. viii + 252 pp.
- Loveridge, A., 1955. Reptiles and amphibians from Bahrain Island and Saudi Arabia collected by Henry Field, 1950. *American Documentation Institute* **4612**: 47.
- Madany, I.M., Akhter, M.S. and Al Jowder, O.A., 1994. The correlations between heavy metals in residential indoor dust and outdoor street dust in Bahrain. *Environment International* **20**: 483–492.
- Mohammadi, Z., Khajeh, A., Ghorbani, F. and Kami, H.G., 2015. A biosystematics study of new records of the marsh frog *Pelophylax ridibundus* (Pallas, 1771) (Amphibia: Ranidae) from the southeast of Iran. *Journal of Asia-Pacific Diversity* **8**: 178–182.
- Mohammed, S.A., Gamal El-Din, A.E., El-Dawi, H., Al-Maskati, H.A. and Saleh, M., 1997. Karyological comparison of water frog (*Rana cf. ridibunda*) populations from Bahrain, eastern Saudi Arabia and Egypt. *Zoology in the Middle East* **15**: 41–49.
- Naser, H.A., Mohamed, A.M.A., Al-Wasmi, N.A.A.M., Al Mealla, R., Khamis, A., Al-Shuwaikh, B., Al-Khalifa, K.B.A., Abdulhalim, H., Salim, M.A. and El Moghrabi, L., 2017. *The First Regional Red List Assessment of Selected Species in the Kingdom of Bahrain*. United Nations Educational, Scientific and Cultural Organization, Arab Regional Centre for World Heritage and the Supreme Council for Environment, Manama. 76 pp.
- Nizami, K.A., 1994. Early Arab contact with South Asia. *Journal of Islamic Studies* **5**: 52–69.
- Pallas, P.S., 1771. *Reise durch verschiedene Provinzen des Russischen Reichs*. Theil 1. St. Pétersbourg: Gedruckt bey der Kayserlichen Academie der Wissenschaften. 12 + 504 pp; 6 plates.
- Potts, D.T., 2007. Revisiting the snake burials of the Late Dilmun building complex on Bahrain. *Arabian Archaeology and Epigraphy* **18**: 55–74
- Rice, M., 1986. “Dilmun discovered”—the archaeology of Bahrain to the early second millennium BC. *Asian Affairs* **17**: 252–263.
- Rose, J.I., 2010. New light on human prehistory in the Arabo-Persian Gulf Oasis. *Current Anthropology* **51**: 849–883.
- Samour, J.H., 1990. Checklist of animals in the collection [of] Al Areen Wildlife Park and Reserve. *Wildlife in Bahrain (Bahrain Natural History Society Annual Report)* **1990**: 3–6.
- Samour, J.H., Irwin-Davies, J., Mohanna, M. and Faraj, E., 1989. Conservation at Al-Areen Wildlife Park, Bahrain. *Oryx* **23**: 142–145.
- Smith, G.B., 1978. Al-Areen Wildlife Sanctuary. *Wildlife in Bahrain (Bahrain Natural History Society Annual Report)* **1977**: 38–42.
- Zubari, W.K. and Lori, I.J., 2006. Management and Sustainability of Groundwater Resources in Bahrain. *Water Policy Journal* **8**: 127–145.