Chapter 1
A Natural History of the Emirates: An Introduction

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1.1 Nature in the Context of a Rapidly Growing Nation

The United Arab Emirates (UAE) has witnessed exceptional growth in both its population and economy since its formation in 1971. Its rapid development and the expansion of trade, tourism, and industry have catapulted the UAE onto the world stage, earning it international recognition for its ultramodern cities and architectural marvels. This transformation has turned the country into a global hub for business, innovation, and cultural exchange, attracting millions of visitors and expatriates from around the world.

While the country's achievements in infrastructure, industry and commerce are truly remarkable, it is equally important for residents and visitors alike to appreciate and gain a deeper understanding of the UAE's nature and natural history. The unique ecosystems, and diverse flora and fauna that call the UAE home, not only provide the foundation for the nation's rich cultural heritage, but also serve as a testament to the resilience and adaptability of life in this arid region. From the majestic sand dunes of the Rub' al Khali to the vibrant marine life in the Arabian Gulf, the UAE's natural landscapes offer a fascinating window into the complex interplay between humans and their environment throughout history.

Natural history research in the UAE has played a pivotal role in deepening public awareness and appreciation for the country's diverse ecosystems and its unique biodiversity. Over the years, dedicated researchers and institutions have endeavored to uncover the distinctive biodiversity and complex dynamics of the UAE's natural environments. This continuing pursuit of knowledge has led to important discoveries and insights that have not only enriched our understanding of the region's unique

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ecology, but also highlighted the need for enhanced conservation and sustainable development. As natural history research in the UAE continues to evolve, it will serve as a powerful tool to support growing public awareness, instilling a sense of pride and responsibility in the nation's natural heritage, and promoting environmentally conscious policies and practices that will ensure a sustainable future for generations to come.

1.2 The Evolution of Natural History Research in the Emirates

The early records of natural history in the Emirates originated from military and consular excursions to the region in the nineteenth century. Captain Atkins Hamerton was the first European known to have visited the area of the Al Ain oasis in 1840, while Lt Col S.B. Miles, the Muscat Consul, referred to the presence of Arabian oryx (*Oryx leucoryx*), cape hare (*Lepus capensis*), and gazelle (*Gazelle* sp.) in the desert areas of Abu Dhabi and Al Ain during a 1975 visit. A decade later, Surgeon Major A.S.G. Jayakar of the Indian Army visited the area and contributed to scientific knowledge with his discoveries of the Arabian tahr (*Hemitragus jayakari*) and two species of reptile (*Agama jayakari* and *Lacerta jayakari*), commemorated in specimens still held by the Bombay Natural History Museum and the British Natural History Museum (Hellyer and Aspinall 2005).

In the early twentieth century the famous *Gazetteer* author, J.G. Lorimer, compiled a species list of fishes found in the waters of the Arabian Gulf (Lorimer 1908), while an expedition by the Peabody Museum at Harvard University in 1954 found a total of 64 species of mollusks in the Emirates, then known as the Trucial Coast (Hellyer and Aspinall 2005). Sir Wilfred Thesiger explored much of southern Arabia after the Second World War, recording the presence of the Arabian tahr and red foxes on and around Jebel Hafit (Thesiger 1959) (Fig. 1.1).

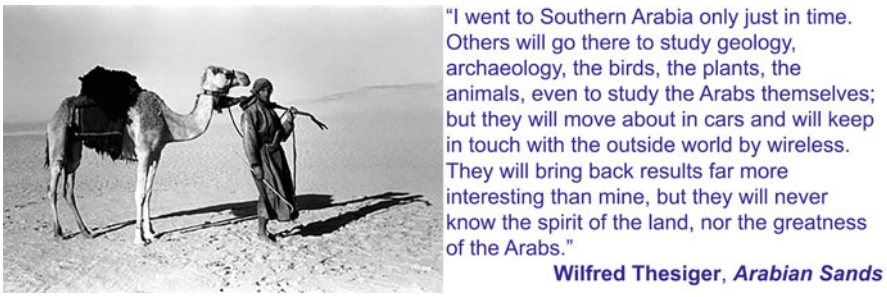

Fig. 1.1 British explorer Sir Wilfred Thesiger is best known for his book "Arabian Sands," which chronicles his journeys across the Rub' al Khali or "Empty Quarter" in the late 1940s. Image: Wilfred Thesiger by Falvialoner (CC-BY-SA-4.0). Quotation from Thesiger (1959)

As oil exploration grew in the wake of the Second World War, studies of the UAE's natural history evolved from occasional opportunistic reports to more focused studies as the nascent oil companies recruited international scientific expertise to study the region (Hellyer and Aspinall 2005). While the main thrust was in geology and geomorphology, many research teams included specialists in mammals, birds, marine ecosystems, and other elements of natural history, many of which left their mark by publishing some of the first comprehensive records for the area. For example, Kinsman (1964) published the first records of the unusual heat-tolerance of Abu Dhabi corals in the preeminent scientific journal, *Nature*, in 1964, and others followed with deeper and more comprehensive reef descriptions in the following decade (Kendall and Skipwith 1969; Evans et al. 1973; Shinn 1976) (see Chap. 4).

While growing research by international experts was adding to the corpus of knowledge about the natural history of the Emirates, it was often collected by transient foreign visitors, with records published in international journals and collections kept in overseas museums that were largely inaccessible to residents of the UAE (Hellyer and Aspinall 2005). Additionally, while much local ecological knowledge existed within the citizenry of the nascent UAE (e.g. timing and location for fishing or hunting), it was typically only shared through oral history between people for whom it had practical value, making it vulnerable to loss as the economy evolved (Hellyer and Aspinall 2005).

The establishment of the Emirates Natural History Group (ENHG) in Abu Dhabi in 1977 shifted this perspective (Hellyer n.d.). As the Emirates' economy developed, the number of expatriates taking up residence in the UAE grew rapidly, coinciding with explosive growth of interest in the ecosystems and organisms living in the newly adopted home of these international travelers. Many of these individuals were keen amateur naturalists rather than professional scientists, yet their group became the leading producers of scientific knowledge in the Emirates over the coming decades. The group conducted regular field trips to remote parts of the UAE, sharing their observations through public seminars and documenting their records in the ENHG *Bulletin*, which published 42 issues between 1977 and 1991 alone. By 1979 a new ENHG chapter was established in Al Ain, followed by the Dubai chapter in 1984 (Jongbloed 2003; Hellyer and Aspinall 2005). The outings by ENHG members have led to numerous discoveries over the years, such as the re-discovery of the Arabia tahr (*Hemitragus jayakari*) in March 1997 on Jebel Hafit by members of an ENHG bird-watching group. This mammal was previously considered extinct, as it was last seen over 15 years earlier and it had gone unobserved during two extensive official surveys in 1986 and 1990 (Jongbloed 2003).

As records and reporting grew more extensive in the *Bulletin* and its sister publication of the Dubai ENHG, the *Gazelle*, the peer-reviewed scientific journal *Tribulus* was established in 1991 and continues to be published today (named after the national flower of the UAE, *Tribulus omanense*, Fig. 1.2). *Tribulus* has become the journal of record for the UAE's natural history, and includes numerous highly impactful articles describing new records of species' occurrence in the Emirates, species new to science, unique methods used by organisms to cope with the environmental extremes of the area, and approaches for conservation and

Fig. 1.2 *Tribulus omanense* is the national flower of the United Arab Emirates, inspiring the title *Tribulus* for the long-running peer-reviewed scientific journal of the Emirates Natural History Group. Image credit: Gary Brown

management of local organisms and ecosystems (Hellyer and Aspinall 2005). All ENHG groups are non-profit, volunteer-led organizations, with the purpose "to give encouragement and assistance towards the appreciation and study of the natural history, natural sciences and history of the United Arab Emirates and neighbouring states" (Jongbloed 2003), and readers of this book are encouraged to join their local chapter.

While amateur natural historians have made the most important contributions to our knowledge of the Emirates in the past, in recent years there has been a shift towards wider engagement of professional scientists and academics as the number and size of universities has grown. Beginning with the establishment of UAE University in Al Ain in 1977, followed by Zayed University in Dubai and Abu Dhabi in 1998, and later by international institutions such as New York University Abu Dhabi in 2010, among others (Hellyer and Aspinall 2005; Burt et al. 2019), there has been substantial growth in the number of professional researchers living in the UAE, with many focusing their research on the environment and ecosystems of the Emirates (Burt 2013; Vaughan and Burt 2016; Friis and Burt 2020). This has been particularly true of the past decade, as regionally-focused environmental research centers have been established at several institutions and as recent graduates have joined local government agencies to establish and nurture research agendas at those institutions (Burt et al. 2011; Alsharari 2018). As a result, the number of historic publications related to several distinct ecosystems in the Emirates has more than doubled in just the past decade, and publications are predominantly from researchers based in the region, rather than transitory researchers visiting from other parts of the world as had often been the case in the past (Vaughan and Burt 2016; Friis and Burt 2020).

While research by amateur and professionals alike has added a phenomenal volume of knowledge on the natural history of the Emirates in the past 50 years, there is still much to learn. For example, the Bird Database of the Emirates has

Fig. 1.3 In 2022 a mesophotic coral reef was discovered in Fujairah, UAE, at 145 m depth, where organisms live in permanent darkness. Such discoveries show that we still have much to learn about the natural history of the Emirates. Image credit: Simon Nadim

grown from 20,000 records in 2003 to over 772,000 by 2022, with over 60,000 records added annually at present, expanding our knowledge of species-specific habitat use across the UAE (Jongbloed 2003; Tommy Pederson, pers. comm.). Likewise, recent surveys of insects and other arthropods identified over 2000 species not previously known to occur in the UAE, of which over 370 were species new to science (Villet 2010; Barclay 2011; Wakeham-Dawson 2015). Species revisions and additions continue for numerous other groups of organisms as well (Carranza et al. 2016; Kirchner et al. 2020). It is not only new species that are being discovered, but also whole ecosystems. Deep-water mesophotic (low light) coral reefs were not known to occur in the Emirates until 2022, when one was discovered at 145 m depth off the coast of Fujairah (Fig. 1.3), and subsequently surveyed by specialist technical divers (Dennehy 2022). These few examples demonstrate that as research continues to develop, the depth and breadth of our knowledge of ecosystems, organisms and the environment of this young nation will continue to expand.

1.3 An Overview of 'A Natural History of the Emirates'

This book represents a comprehensive summary of the current state of knowledge of the natural history of the Emirates. Building on the strong foundations laid by earlier amateur and professional natural historians alike, the contributing authors have compiled their collective knowledge of the geology, environment, ecosystems and

organisms of the Emirates into a single volume that provides readers with a comprehensive overview of the natural environment of the United Arab Emirates (UAE).

The first section of the book focuses on the physical environment of the Emirates, including an overview of the geography, geology and climate of the UAE. Gary Feulner opens the book with an introduction to the geological history and biogeographic affinity of the region (Chap. 2), emphasizing its main geographic sub-environments that foster diverse plant and animal communities across the nation. Francesco Papparella and John Burt then explore the climate of the UAE by examining the geographic processes that drive today's extreme aridity, before exploring current climate change and its implications for life (Chap. 3). The section also covers the marine environment of the Emirates (Chap. 4), which contains one of the most environmentally unique seas on earth in the Arabian Gulf as well as the diverse and productive Gulf of Oman coast.

The major terrestrial and marine ecosystems of the UAE are discussed in the second section. Gary Brown and Gary Feulner describe the vegetation of the UAE in the context of broad terrestrial habitats, and challenges related to its management in this rapidly developing nation (Chap. 5). Feulner then covers the biogeographically unique mountain region (Chap. 6), shedding light on its unique geological and climatic sub-features that drive patterns of life towards the UAE's east coast.

Shifting towards the coast, the mangroves of the UAE are discussed by Guillermo Friis-Montoya and Mary Killilea (Chap. 7). They highlight mangroves' importance as an 'ecosystem engineer' that support numerous resident and migratory species by providing food, shelter and spawning habitat, with mangrove forests in the Emirates making up over half of the total area of Gulf forests and continuing to grow due to local conservation and afforestation efforts. Likewise, coastal lagoons (*khors*) are addressed by Daniel Mateos-Molina and colleagues (Chap. 8), who emphasize their incredible significance to biodiversity as mosaics of ecosystems such as mangroves, mudflats and seagrass beds that are interconnected and highly productive areas supporting rich biodiversity. Moving offshore, seagrasses of the UAE are explored by Noura Al-Mansoori and Himanshu Das (Chap. 9), while David John provides an account of the regional seaweeds (Chap. 10). John Burt focuses on the coral reefs (Chap. 11), discussing their importance to biodiversity and science and the challenges of managing these systems under considerable local and global pressure. Lastly, Ivonne Bejarano and colleagues explore the oyster beds and reefs of the UAE, which are of significant ecological and cultural importance (Chap. 12).

The third section of this book delves into the diverse flora and fauna found in the UAE, showing that despite the generally extreme conditions a wide array of uniquely adapted species call the Emirates their home. Chapters provide an overview of the diversity of species within their groups, their biogeographic affinities, and explore unique features of these organisms that allow them to survive and often thrive in the UAE's environment. Gary Brown and Gary Feulner provide an account of the vascular flora (Chap. 13), while Jacky Judas covers the terrestrial mammals (Chap. 14). Oscar Campbell presents an introduction to the birds of the UAE (Chap. 15), highlighting their diversity and distribution in natural ecosystems, including both resident and migrant bird communities that utilize the Emirates as a

stopover ground on their long-distance transits. Terrestrial reptiles and amphibians are discussed by Johannes Els, Salvador Carranza and Andrew Gardner (Chap. 16), who provide insights into their ecology and conservation, while Brigitte Howarth focuses on terrestrial arthropod diversity (Chap. 17), emphasizing the importance of invertebrates in ecosystem functioning and food webs.

Moving into the marine realm, marine mammals of the Emirates, including whales, dolphins, porpoises, and dugongs, are covered by Ada Natoli and Maitha Al-Hameli (Chap. 18), while marine reptiles including turtles and snakes are discussed by Fadi Yaghmour, Johannes Els, Clara Jimena Rodríguez-Zarate and Brendan Whittington-Jones (Chap. 19), who provide insights into the ecology and conservation of these species in the UAE. Sharks and rays are addressed by Aaron Henderson and Shamsa Al-Hameli (Chap. 20), while Matthew Mitchell, Marie Seraphim and Johannes Els discuss the diverse fish species found in the Emirates, including both marine and freshwater bony fishes (Chap. 21).

The final section of the book examines the complex relationship between humans and the environment in the UAE. Tim Power provides an archaeological perspective on human-environment interactions (Chap. 22), highlighting the changes that have occurred over time. John Burt, Oscar Campbell and Jacky Judas then discuss how today's cities serve as unique ecosystems in their own right, and explore the ways in which urbanization has impacted the natural environment and how commensal organisms are taking advantage of the unique artificial microclimates and habitats that incidentally arise from development (Chap. 23). The book concludes with a forward-looking chapter titled The Emirates at 2050 (Chap. 24) which explores what nature in the UAE may look like in the coming decades if bold steps are taken by decision-makers to enhance public awareness, understanding and appreciation of the distinctive ecosystems and organisms that reside here, as well as to enhance their conservation for the enjoyment of future generations.

Overall, this book provides a comprehensive understanding of the natural environment of the United Arab Emirates, with a focus on its unique ecosystems, diverse flora and fauna, and the human impacts on these fragile habitats. It is a valuable resource for researchers, students or others interested in the ecology and environment of the UAE and its natural history. By acknowledging the significance of the UAE's natural resources, it is our hope that readers will walk away from this book with a deepened appreciation for the importance of nature in the UAE and a newfound commitment to preserving and protecting its ecological wonders. Through increased awareness and appreciation of the UAE's natural history, we can better understand the intricate relationships between humans and their environment, and work together to strike a balance between development and conservation. This book serves as an essential foundation for those seeking to contribute to this vital mission, fostering an informed and proactive community that is dedicated to safeguarding the rich natural heritage of the United Arab Emirates for future generations to enjoy.

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