UNITED ARAB EMIRATES
MINISTRY OF CLIMATE CHANGE
& ENVIRONMENT

UAE National Red List of Mammals:

Marine and Terrestrial

2019

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Marine and Terrestrial

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A report to the Ministry of Climate Change and Environment, United Arab Emirates

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Executive Summary

The United Arab Emirates contains a diversity of desert, mountain and marine habitats with 78 species of mammals (59 terrestrial, 19 marine) reported to occur. Twenty terrestrial species are either unconfirmed (6), introduced (10) or feral (4), leaving a total of 58 confirmed native species. No mammal species are endemic to the UAE, but one species (Arabian Tahr *Arabitragus jayakari*) is endemic to the Hajar Mountains of UAE and Oman and five species are endemic to the Arabian Peninsula (Arabian Oryx *Oryx leucoryx*, Arabian Gazelle *Gazella arabica*, Arabian Sand Gazelle *Gazella marica*, Wagner's Gerbil *Gerbillus dasyurus*, Arabian Jird *Meriones arimalius*). The conservation status of the mammal species was assessed at the *National Red List of Endangered Species Workshop*, held in Dubai, 23rd - 27th September 2018, through the application of the IUCN Red List Categories and Criteria at the national scale. Distribution maps were compiled for all of the species. The full dataset, comprising species assessments, supporting information and distribution maps, are available on MoCCaE website.

Fifty-eight species were assessed, and 20 species considered Not Applicable for this UAE national Red List. Three species (Grey Wolf *Canis lupus*, Leopard *Panthera pardus*, and Striped Hyena *Hyaena hyaena*) are Regionally Extinct. Fourteen species (24%) are assessed as threatened (Critically Endangered, Endangered, and Vulnerable). Twenty-five species are Data Deficient (43%) including 14 out of 19 marine species.

Habitat loss through overgrazing and hunting and persecution are the main threats to terrestrial mammals. Incidental mortality in fishing nets and pollution are the main threats to marine species.

The Red List Index (RLI) calculated for the period from 1996 to 2018 showed that the mammals of UAE are more threatened overall than the global average, but that there has been an improvement in the RLI since 1996, mainly driven by improvements to the status of three species because of direct conservation interventions. This positive trend in RLI stands in contrast to a declining trend at global level. Action to improve the status of the remaining species is essential to maintain this positive trend.

1. Introduction

1.1. The United Arab Emirates

The United Arab Emirates (UAE) is a federation of seven emirates (Abu Dhabi, Ajman, Dubai, Fujairah, Ras Al Khaimah, Sharjah, Umm Al Quwain) in the southeast of the Arabian Peninsula and on the southern side of the Arabian Gulf. The land area is approximately 71,024 km^2 including some islands in the Arabian Gulf (UAE 2019), with a marine Exclusive Economic Zone area of 52,580 km^2. The UAE lies between 22°30′ and 26°10′N and 51° and 56°25′E. It shares land borders with Oman, Saudi Arabia and Qatar and has coastlines bordering the Arabian Gulf and Gulf of Oman (Figure 1).

The Hajar Mountains run north-south along the east of the UAE, rising to almost 2,000 m, and are composed of steep rocky peaks, slopes and deeply incised wadis. The rest of the country consists of low-lying desert habitats, including extensive sand sheets and dunes, alluvial and inter-dunal gravel plains, and coastal and

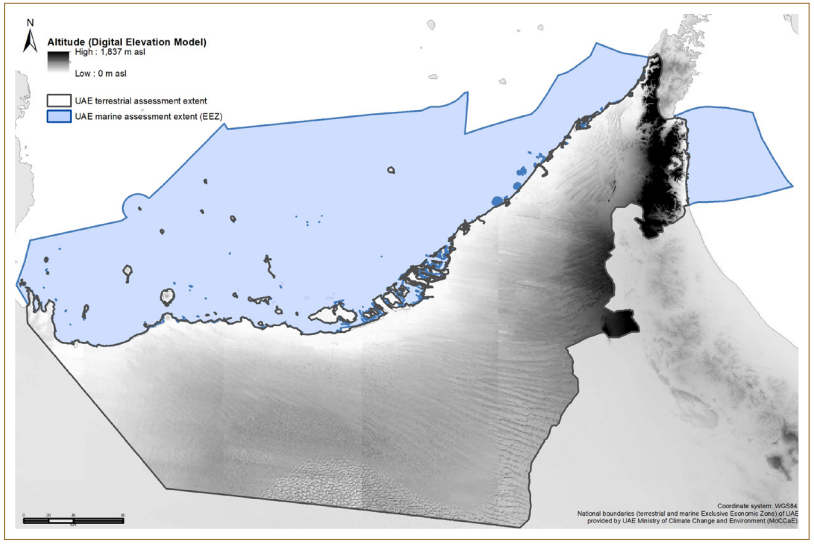

Figure 1. The United Arab Emirates and its Exclusive Economic Zone.

inland sabkha (salt flats). In the southeast, an extensive area of sand dunes forms the northern edge of the Rub al Khali (Empty Quarter). There are large oasis complexes at Liwa in the south and Buraimi-Al Ain on the UAE-Oman border. Anthropogenic habitats consist of irrigated farms, forest plantations and urban areas. Commercial, industrial and residential development has expanded greatly in the UAE during the past 30 years.

The Arabian Gulf coastline extends for about 650 km and is mainly low lying with some rocky headlands and numerous small offshore Islands. There is a range of sandy, sabkha and beach rock habitats, with areas of mangrove forest dominated by *Avicennia marina*, with *Rhizospora mucronata* present in some areas. There are extensive sea grass beds in the subtidal zone and some coral reefs offshore. The coastal waters of the Gulf are relatively shallow. The east coast of the UAE, on the Gulf of Oman, is about 70 km in length and is more rugged, with deep water lying much closer to the shore. The climate of the UAE is characterised by hot summers and warm winters. Maximum temperatures in July and August may exceed 45°C on the coastal plain, while mean minimum temperatures are 10–14°C in January and February. Temperatures in the Hajar Mountains are lower and decrease with elevation. Precipitation averages less than 120 mm in the lowlands but may reach 350 mm in the Hajar. However, there is wide annual variation in the amounts (Figure 2).

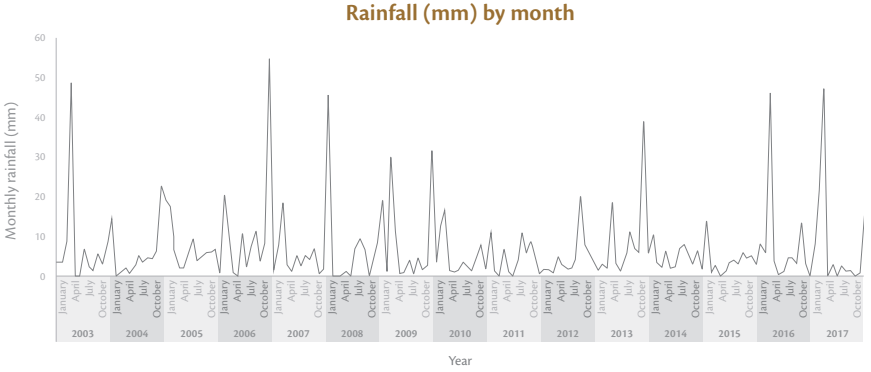

Figure 2: Monthly rainfall (mm), 2003 to 2017. Source: UAE 2019. Open Data Portal of the UAE Government.

The UAE's total human population (nationals and expatriate residents) was 9,304,277 in 2017, as compared to 9,121,167 in 2016, with the population showing significant growth in recent years (Figure 3).

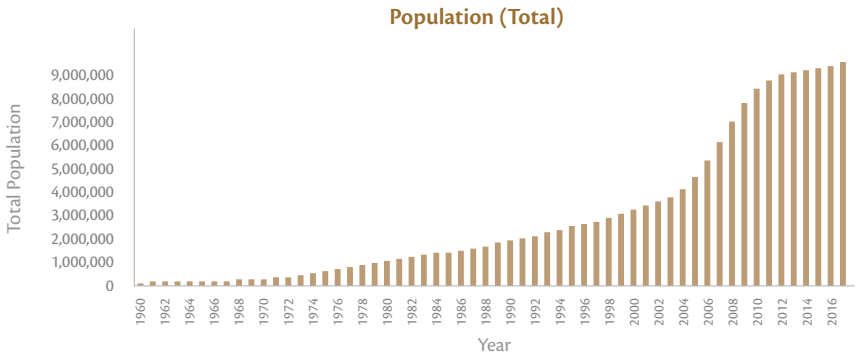

Figure 3: Total population of the UAE, 1960 to 2017 (Source: World Bank. 2018. World Development Indicators, UAE).

1.2. Mammals of the United Arab Emirates

The standard text on terrestrial mammals of the region is the three-volume *Mammals of Arabia* (Harrison 1964-1972) and the updated revised edition (Harrison and Bates 1991). Sources of information on mammals of the UAE include Gross (1987), Cunningham (2002), Drew and Tourenq (2005), Environment Agency – Abu Dhabi (2005), as well as numerous articles on individual species and reports of studies in *Tribulus*, *Zoology in the Middle East* and other journals. For marine mammals, status summaries were provided for the seas of the Arabian region by Baldwin (1999) and for UAE specifically (Baldwin 2005).

In total 78 species of mammals have been reported to occur in the UAE, 59 terrestrial and 19 marine species. Six terrestrial species are unconfirmed, leaving 72 species confirmed, but ten of these terrestrial species are introduced and four more are feral (Table 1). A small number of additional terrestrial and marine species occur in adjoining parts of Oman and in the Gulf of Oman, respectively, Table 1. Summary of mammals reported to occur in the UAE.

		No. of species
TERRESTRIAL - CONFIRMED		
Eulipotyphla	Hedgehogs and shrews	3
Chiroptera	Bats	12
Lagomorpha	Hares	1
Rodentia	Rodents	8
Carnivora	Carnivores	11
Cetartiodactyla (Artiodactyla)	Even-toed ungulates	4
Total terrestrial		39
MARINE - CONFIRMED		
Cetartiodactyla (Cetacea)	Cetaceans	18
Sirenia	Sirenians	1
Total marine		19
Total confirmed		58
OTHER TERRESTRIAL		
Unconfirmed		6
Introduced		10
Feral		4
Total other		20
Overall total		78

Table 1. Summary of mammals reported to occur in the UAE.

1.2.1. Terrestrial mammals

Bats make up 30.7% of the 39 confirmed native species, carnivores 28.2% and rodents 20.5% (Table 1). No mammal species are endemic to the UAE, but one species (Arabian Tahr *Arabitragus jayakari*) is endemic to the Hajar Mountains of UAE and Oman and five species are endemic to the Arabian Peninsula (Arabian Oryx *Oryx leucoryx*, Arabian Gazelle *Gazella arabica*, Arabian Sand Gazelle *Gazella marica*, Wagner's Gerbil *Gerbillus dasyurus*, Arabian Jird *Meriones arimalius*).

1.2.2. Marine mammals

The 19 marine mammal species comprise 18 cetaceans and one sirenian. Surveys off the east coast during the last three years have produced the first records of two species of dolphin. The marine mammal fauna is composed of inshore and deep-water species. The Gulf waters of the UAE contain important populations of at least four species: Dugong *Dugong dugon*, Indo-Pacific Humpback Dolphin *Sousa plumbea*) (believed to be the largest subpopulation in the world), Indo-Pacific Finless Porpoise *Neophocaena phocaenides* and Indo-Pacific Bottlenose Dolphin *Tursiops aduncus*. Fin Whale *Balaenoptera physalus* was formerly believed to occur in the UAE, based on strandings and skeletal material, but reanalysis of the evidence has shown that this is incorrect, and Fin Whale is not considered to occur the waters of the UAE or the Arabian region (R. Baldwin *in litt*. 2018).

1.3. Assessment of species extinction risk

The IUCN Red List of Threatened Species™ is widely considered to be the most objective system for evaluating extinction risk at global, regional and national scales (Hambler 2004, Miller *et al*. 2007). The system uses standard criteria with quantitative thresholds for population and range size, structure and trends to assign species to categories of extinction risk, ranging from Least Concern (LC) [lowest risk of extinction] through Near Threatened (NT), Vulnerable (VU), Endangered (EN) Critically Endangered (CR) [highest extinction risk], Extinct in the Wild (EW) and Extinct (EX). Those species with insufficient data to apply the Red List Criteria are listed as Data Deficient (DD) (IUCN 2001, 2012a; IUCN Standards and Petitions Subcommittee 2017). Species facing a higher risk of global extinction (i.e., those listed in the categories Critically Endangered, Endangered and Vulnerable) are collectively referred to as 'threatened'.

1.4. Red List Index

Under the Convention on Biological Diversity (CBD), Parties to the Convention adopted a strategic plan for reducing biodiversity loss, including 20 targets (the Aichi Biodiversity Targets) to be met by 2020 (Secretariat of the Convention on Biological Diversity 2010). Monitoring progress towards, and achievement of, these targets requires indicators (Balmford *et al*. 2005, Jones *et al*. 2011). Indicator sets have been adopted for the 2020 targets (Secretariat of the Convention on Biological Diversity 2010, 2014) and for the United Nations Sustainable Development Goals (SDGs; United Nations 2017). For maximum effectiveness, such indicators need to be implemented at multiple scales, including both global and national.

The Red List Index (RLI) was developed by IUCN and its partner organizations in response to the need to assess the rate of biological diversity loss (Butchart *et al*. 2004, 2005, 2007). The RLI measures trends in the overall extinction risk of species and is based on assessments done using the IUCN Red List methodology (IUCN 2001, 2012a). The RLI is used as a key indicator in both the CBD and SDG indicator sets.

The RLI is based on the number of species in each Red List Category, and the number that change categories between assessments owing to genuine improvement or deterioration in status. It excludes changes in category resulting from improved knowledge, taxonomic changes, or revisions to the Red List Criteria (Butchart *et al*. 2004, 2007). The RLI can be calculated for any set of species that has been assessed at least twice. To date, global RLIs have been published for birds (1988–2016), mammals (1996–2008), amphibians (1980–2004), reef-forming warm water corals (1998–2008) and cycads (2003–2014) (see the Red List Index page on The IUCN Red List of Threatened Species: https://www.iucnredlist.org/assessment/red-list-index).

The RLI has been used mostly to track global trends in species' status (Butchart *et al*. 2004, 2010), but it can also be used to show trends in different biogeographic realms (Hoffman *et al*. 2011); political units (Szabo *et al*. 2012); ecosystems, habitats, taxonomic groups; and in species relevant to different international agreements and treaties (Butchart *et al*. 2007, Bubb *et al*. 2009). To date, there has been limited but growing use of the index at the national or subnational levels, for example for British Columbia in Canada (Quayle *et al*. 2007), Sweden (Gärdenfors 2010), Denmark (Pihl and Flensted 2011), Australian birds (Szabo *et al*. 2012) and mammals (Woinarski *et al*. 2015), Finland (Juslén 2013), and in Spain (Moreno Saiz *et al*. 2015).

National RLIs based on national-scale assessments of extinction risk allow more sensitive tracking of biodiversity trends (because more species move between Red List categories between assessments when the categories are assigned using national rather than global extinction risk) and hence are of greater utility at the national scale, which is where the decisions are made that have greatest influence on biodiversity trends.

1.5. Assessment workshop

The national Red List assessment workshop took place in Dubai on 23-27 September 2018 and had the following objectives:

- To review the status and distribution of all mammal species occurring within the region;
- To undertake national Red List assessments of all eligible mammal species;
- To develop a national Red List Index (RLI) for mammals;
- To provide a baseline to assist in monitoring and national conservation planning.

2. Assessment methodology

2.1. Geographic scope

The assessment region comprised the whole of the United Arab Emirates land surface, including islands, and for marine species the Exclusive Economic Zone (EEZ) in the Arabian Gulf and off the east coast (Figure 1). National land and EEZ boundaries followed those provided by the UAE Ministry of Climate Change and Environment (MoCCaE).

2.2. Taxonomic scope

The Red List assessment and calculation of the Red list Index covered only the 58 confirmed, native terrestrial and marine mammal species in the UAE, in accordance with the Red List guidance; the 20 species that are introduced, feral, or whose occurrence is unconfirmed, were excluded as these species were considered Not Applicable for Red List assessment at national level (IUCN 2012a, 2012b).

2.3. Assessment protocol

For all assessments, the following data were compiled using IUCNs online database, the Species Information Service (SIS);

- Taxonomic classification and UAE-specific Taxonomic Notes.
- Geographic range within the UAE and, briefly, the global distribution of the species.
- Population information and overall population trend.
- Habitat preferences and primary ecological requirements, including pertinent biological information (e.g., generation length, maximum size and age, etc.), where available.
- Species use and trade.
- Major threats.
- Conservation measures (in place and needed).

- Research needed.
- Other general information.
- National Red List Category and Criteria and Rationale.
- Back-casted assessment to 1996 and the reasons for change in status.
- Red List Index information was recorded for species with genuine changes in status.
- Key literature references.

Draft assessments were compiled based on existing draft and published global assessments, review of available literature, and consultation with experts both within the UAE and outside. Finalisation of assessments and distribution maps (see section 2.4 Species mapping, below) followed a three-stage process. First, the draft assessments and maps were submitted to MoCCaE in June–July 2018, who circulated them to national experts and returned edits and comments to IUCN. The main review occurred through a *National Red List of Endangered Species Workshop*, held in Dubai, 23rd–27th September 2018, hosted by MoCCaE and facilitated by Dr David Mallon and IUCN staff. A large number of experts contributed their time and expertise during the workshop to review both the draft assessments and distribution maps, and to assign a final Red List Category. Post-workshop editing was undertaken by IUCN staff, and a final stage of review and commenting was undertaken, with the drafts again circulated by MoCCaE to national experts, and resulting comments and data incorporated by IUCN. Consistency in the use of IUCN Red List Criteria was checked by IUCN staff. The resulting finalised IUCN Red List assessments are a product of scientific consensus concerning species status and are supported by relevant literature and data sources.

The Red List status of the 58 native wild species was assessed by application of the IUCN Red List Categories and Criteria, version 3.1 (IUCN 2001, IUCN 2012a) and guidelines for their application (IUCN Standards and Petitions Subcommittee 2017). The initial assessments were then reviewed following the Guidelines for Application of IUCN Criteria at Regional Levels (IUCN 2012b) and a final category assigned. Figure 4 shows the structure of the categories used for the national assessment. A limited post-workshop review was carried out to solicit views from experts who had been unable to attend.

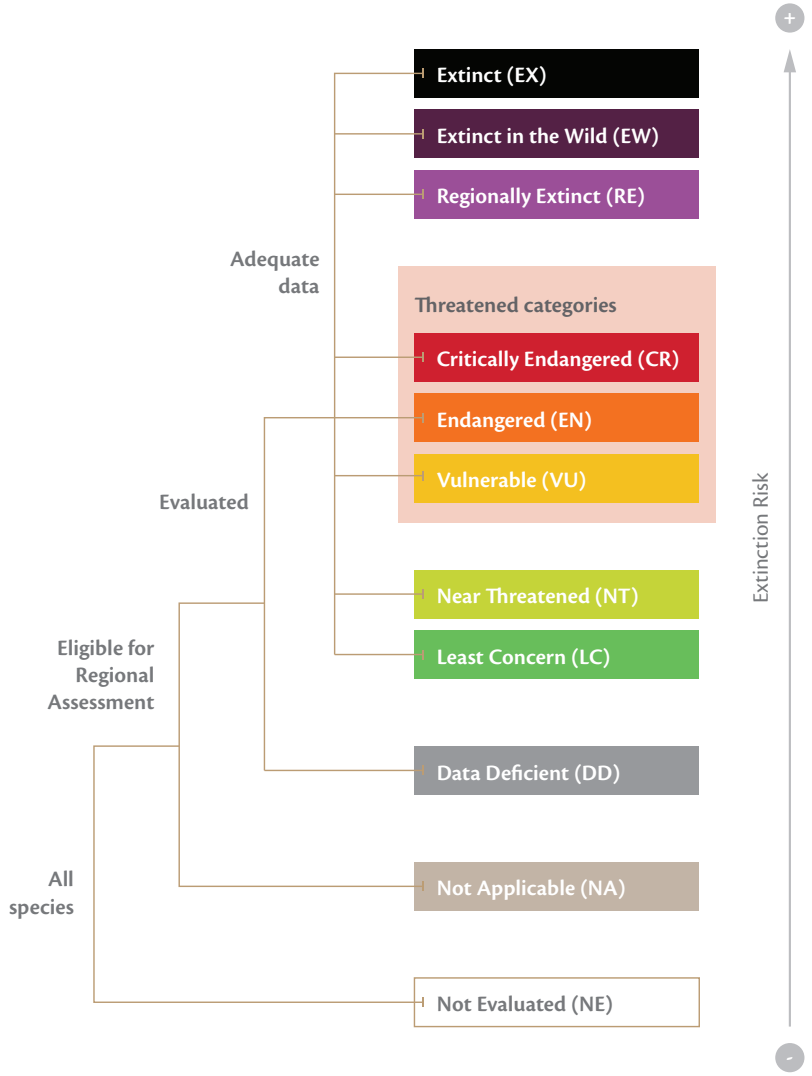

Figure 4: Structure of the IUCN Red List Categories used at the national level.

2.4. Distribution maps and analyses

Draft digital distribution maps were created by downloading the global distribution map for each species in GIS shapefile format from *The IUCN Red List of Threatened Species* website and clipping to the national land and EEZ boundaries provided by MoCCaE. The draft maps underwent review and editing during the assessment workshop, then a second stage of review after the workshop, before finalisation (including aligning with the altitude range for species where appropriate, and polygon smoothing) by D. Allen.

Metadata coding was used to distinguish presence, origin, and seasonality across the spatial extent of species' distributions in the UAE. These codes differentiate the species presence (extant, possibly extant or extinct); seasonal presence (the default setting of 'resident' was assigned); and the origin of the species (native, introduced, reintroduced or uncertain). The coding information can be found in the Red List digital distribution metadata guidance (IUCN 2018).

The spatial data were analysed to produce species richness maps; these used only distributions of species with the following Presence, Seasonality and Origin codes:

- Presence: Extant and Possibly Extant
- Origin: Native and Re-introduced
- Seasonality: Resident, Breeding Season, Non-Breeding Season, Passage, Seasonal Occurence Uncertain.

Spatial data were analysed using a geodesic discrete global grid system, defined on an icosahedron and projected to the sphere using the inverse Icosahedral Snyder Equal Area (ISEA) Projection (S39). This corresponds to a hexagonal grid composed of individual units (cells) that retain their shape and area (865 km^2) throughout the globe. These are more suitable for a range of ecological applications than the most commonly used rectangular grids (S40). The range of each species was converted to a hexagonal grid for analysis purposes. Coastal cells were clipped to the coastline. The pattern of species richness was mapped by counting the number of species in each cell (or cell section, for species with a coastal distribution).

2.5. Red List Index methodology

An RLI for mammals of UAE was calculated based on national-scale assessments of the 58 native mammal species made in 2018 and 1996, following the guidelines of Bubb *et al*. (2009) and recent practice (e.g. Butchart *et al*. 2010; Hoffmann *et al*. 2010,2011). To our knowledge, this is the first time national RLI values have been calculated for the UAE using national data.

The status of each species was back-casted to determine what it would have been in 1996 in order to identify species whose 2018 categories reflect a genuine change in status, as opposed to species that changed categories as a result of, for example, changes in knowledge or taxonomy (Butchart *et al*. 2007). The UAE mammal assessments published by Hornby (1996) provided a useful starting point for the back-casting process. However, the 1996 assessments could not be used directly, and retrospectively corrected, because they were based on an earlier version of the IUCN Red List Categories and Criteria with different standards and thresholds (IUCN 1994). The back-casted 1996 assessments relied heavily on the knowledge of experts at the workshop.

It was conservatively assumed that the current category applied to the earlier 1996 assessments, except where there was evidence that the species had undergone a genuine improvement or deterioration in status of sufficient magnitude to cross the Red List Category thresholds. Such evidence included, for example, documented population trends and distribution declines, known trajectories of habitat extent or quality, and dates and outcomes of efforts to eradicate invasive alien species or to translocate populations of target species. In order to assess extinction risk nationally, we followed the IUCN Regional Guidelines to account for potential source and sink effects that result from interchange with populations beyond the national borders (IUCN 2012b).

The calculation of the RLI used 'equal steps' weights for each Red List Category (0 for LC, 1 for NT, 2 for VU, 3 for EN, 4 for CR and 5 for EW [RE] and CR species tagged as Possibly Extinct in the Wild sensu IUCN Standards and Petitions Subcommittee (2017)) rather than weights based on relative extinction risk, as the latter approach makes the index much less sensitive to changes in status of less threatened taxa. The number of taxa in each IUCN Red List Category was multiplied by these weights and the sum expressed as a fraction of the maximum possible sum (equating to all taxa having gone extinct i.e. the number of species multiplied by the maximum weight of 5) and subtracted from one. Calculations were made using a RLI calculator tool that has been developed in Microsoft Excel (see https://nc.iucnredlist.org/redlist/resources/files/1521626524-RLI_Calculator_for_Office_2003_and_earlier.xls).

The calculation produces an index value that ranges from 0 to 1. The lower the value the faster the set of species is heading toward extinction. If the value is 1, all species in the set are Least Concern and if the value is 0, all species are (Regionally) Extinct. We calculated the RLIs following Bubb *et al*. (2009), with one exception. The revised method of RLI calculation by Bubb *et al*. (2009) excludes species categorized as EX in the first assessment. The UAE Mammal Red List, however, includes one species, the Arabian Oryx, which was listed as Extinct in the Wild (EW) in 1996 (regionally and globally). We included this species in the calculation of the RLI. From a national perspective, it is reasonable to include RE species in calculations because regional extinction is not necessarily irreversible.

In order to assess the performance of a country, the RLI should in theory first be calculated for species threatened by processes or affected by conservation actions within that country, even if they occur elsewhere. However, to understand the extent to which national trends are driven by external threats or conservation actions, the RLI can be recalculated including all changes regardless of location of threat. For the UAE mammal species recorded as having genuine changes in status, the primary reasons for the changes were threats or conservation within the UAE although for some, declining populations in neighbouring countries meant a reduced likelihood of any rescue effect. Hence for the UAE mammals there was no need to calculate the RLI twice.

3. Results

3.1. Threat status

Information on distribution, status and threats for all mammal species in the UAE was reviewed and the 58 confirmed native species were assessed for the national Red List. Appendix 1 lists these species and their national and global Red List status. Table 2 lists the 20 introduced, feral and unconfirmed species, which are not eligible for Red List assessment and are categorised as Not Applicable (NA).

The full Red List assessments, including supporting information on distribution, population, threats and conservation, are available MoCCaE website. A summary of the status and distribution of the species not assessed is provided in Appendix 3.

Species	
INTRODUCED	
Procavia capensis	Rock Hyrax
Sciurus anomalus	Persian Squirrel
Funambulus pennanti	Five-striped Palm Squirrel
Rattus norvegicus	Brown Rat
Rattus rattus	Black Rat
Mus musculus	House Mouse
Meriones hurrianae	Indian Desert Jird
Dolichotis patagonum	Patagonian Mara
Capra nubiana	Nubian Ibex
Ammotragus lervia	Barbary Sheep
UNCONFIRMED	
Herpestes edwardsi	Indian Grey Mongoose
Hemiechinus auritus	Long-eared hedgehog
Suncus murinus	House Shrew
Meriones libycus	Libyan Jird
Capra aegagrus	Wild Goat
Ovis orientalis	Mouflon
FERAL	
Felis catus	Domestic Cat
Canis familiaris	Domestic Dog
Equus [asinus]	Donkey
Capra hircus	Domestic Goat

Table 2. Not Applicable (NA) terrestrial mammal species that are unconfirmed, introduced, or feral in the United Arab Emirates. These NA species are discussed in more detail in Appendix 3.

Three species are Extinct in the Wild (EW), all large carnivores (Grey Wolf *Canis lupus*, Leopard *Panthera pardus* and Striped Hyena *Hyaena hyaena*). The number of species assessed in each category are listed in Table 3 and shown graphically in Figures 5-7. There are 25 species whose status was not known and were categorised as Data Deficient (43%). DD terrestrial species comprise 28.2% and marine 73.7%.

Fourteen species are assessed in one of the three 'threatened' categories (Critically Endangered, Endangered, Vulnerable), 24% of the total. If only extant species are considered (i.e. omitting the three Regionally Extinct species) the proportion threatened is 25.5%. However, the precise figure for those threatened is uncertain, because an unknown proportion of species categorised as Data Deficient (DD) may in fact be threatened. Therefore, the real total could lie between 25.5% (if all DD species are not threatened) to 70.9% (if all DD species are threatened). The best estimate is 46.7% threatened.

Red List Category	All mammals	Marine mammals	Terrestrial mammals
Extinct (EX)	-	-	-
Extinct in the Wild (EW)	-	-	-
Regionally Extinct (RE)	3	-	3
Critically Endangered (CR)	4	-	4
Endangered (EN)	7	4	3
Vulnerable (VU)	3	-	3
Near Threatened (NT)	3	1	2
Least Concern (LC)	13	-	13
Data Deficient (DD)	25	14	11
Total species assessed	58	19	39

Table 3. The threat status of the terrestrial and marine mammals assessed for the UAE National Red List.

At the global level, 25% of extant mammal species are currently threatened, but the proportion that may be threatened ranges between 22% and 36%. The range in proportion of possibly threatened species is wider, and the upper bound much higher, at UAE level compared to the global figures. This is explained by the higher number of species assessed as DD at national level and thus the potential for a higher proportion of species utimately assessed as threatened.

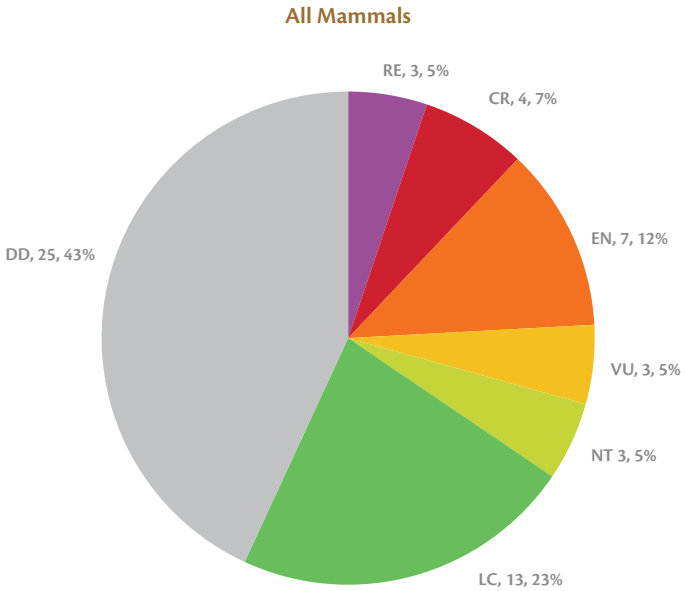

Figure 5: The proportion of species assessed in each Red List Category; each slice is labelled with the Red List Category abbreviation, the number of species in that category and the proportion this represents.

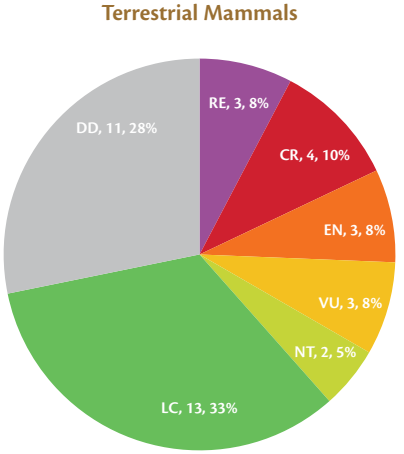

Figure 6: The proportion of terrestrial species assessed in each Red List Category; each slice is labelled with the Red List Category abbreviation, the number of species in that category and the proportion this represents.

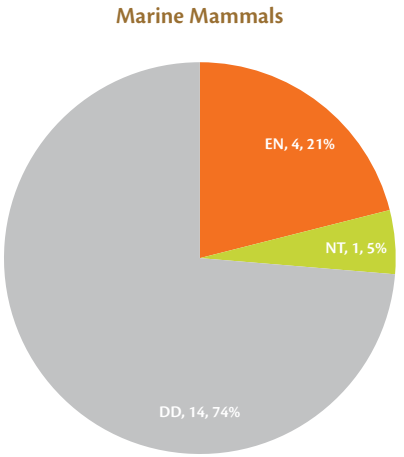

Figure 7: The proportion of marine species assessed in each Red List Category; each slice is labelled with the Red List Category abbreviation, the number of species in that category and the proportion this represents.

3.2. Mapping analysis

The pattern of overall species richness was mapped by counting the number of species in each cell (or cell section, for species with a coastal distribution). Patterns of threatened species richness were mapped by counting the number of threatened species (categories CR, EN, VU at the UAE national level) in each cell or cell section. The distribution of species assessed as Data and Regionally Extinct were similarly mapped.

Terrestrial mammals

Figure 8 shows clearly that the highest richness of terrestrial mammal is found in the east of the country, in the Hajar Mountains, foothills and Jebel Hafeet. This is mainly explained by a combination of the wide range of habitat and vegetation types available and higher precipitation due to relief, leading to higher basal productivity. Bats are particularly well represented in the mountains, where rock crevices and caves provide a range of potential roost sites and vegetated wadis and permanent pools support higher densities of invertebrate prey. Observer effort is also likely to be a contributory factor since many more surveys have been conducted in these areas than elsewhere, with large areas of the western deserts, in particular, being under-surveyed. Some adjustments to the pattern of species richness may be expected following completion of systematic surveys across the desert zone.

Figure 8: Overall species richness of terrestrial mammals.

The pattern of threatened terrestrial species distribution (Figure 9) follows that of the overall mammal richness, with higher numbers of threatened species found in the eastern parts of the UAE, in the Hajar Mountains and Jebel Hafeet (Arabian Tahr *Arabitragus jayakari*, Caracal *Caracal caracal*, White-tailed Mongoose *Ichneumia albicauda*, Wildcat *Felis silvestris* and Blanford's Fox *Vulpes cana*). To the east, across Abu Dhabi Emirate, are found the Sand Cat *Felis margarita* and Rüppell's Fox *Vulpes rueppellii*.

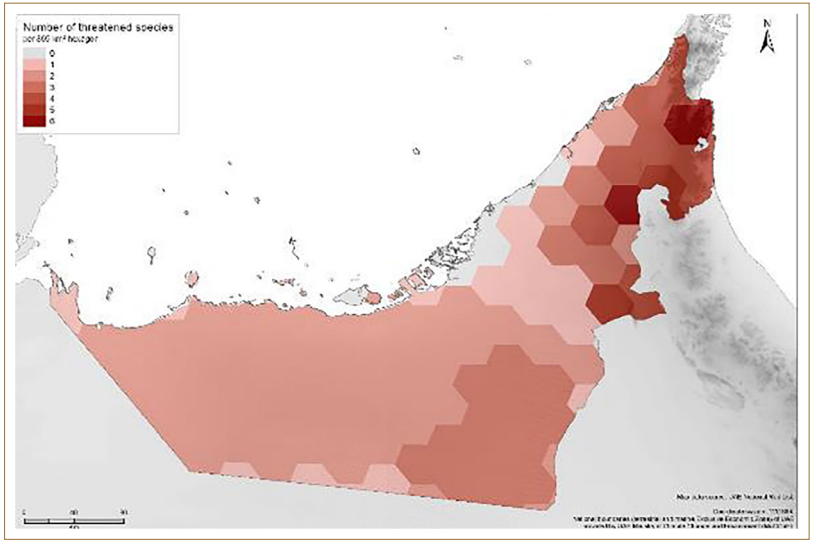

Figure 9: Number and distribution of threatened terrestrial species.

The relatively widespread Data Deficient terrestrial species (Baluchistan Gerbil Gerbillus nanus, Sundevall's Jird Meriones crassus, and Savi's Pygmy Shrew Suncus etruscus) are found across much of the UAE (Figure 10), whilst most other DD species consist of bats (Geoffroy's Trident Bat Asellia tridens, Geoffroy's Bat, *Myotis emarginatus*, Sind Serotine *Bat Eptesicus bottae*, Desert Long-eared Bat *Otonycteris hemprichii*, Egyptian Tomb Bat *Taphozous perforatus*, Persian Trident Bat *Triaenops persicus*), several of which are known from few or occasional records.

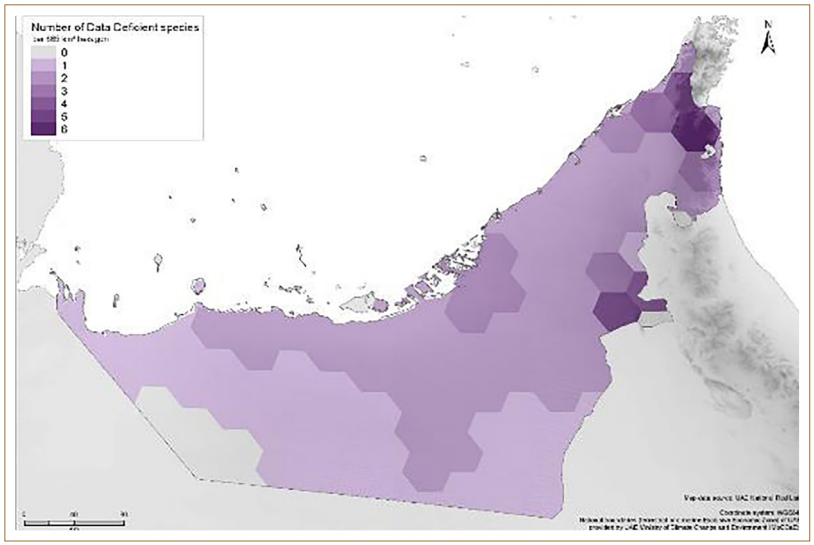

Figure 10: Number and distribution of Data Deficient terrestrial species.

The distributions of the three terrestrial mammals that are assessed as Regionally Extinct in the UAE (Grey Wolf *Canis lupus*, Striped Hyena *Hyaena hyaena* and Leopard *Panthera pardus*) are shown in Figure 11. The former ranges of the Grey Wolf and Striped Hyena are not well understood, but they are assumed to have once been present across most of the UAE, The Grey Wolf is considered to have gone extent the 1990s, with unconfirmed records up until 2004. The distribution of the Leopard in UAE has always been restricted to the Hajar Mountains, with some old reports from Jebel Hafeet.

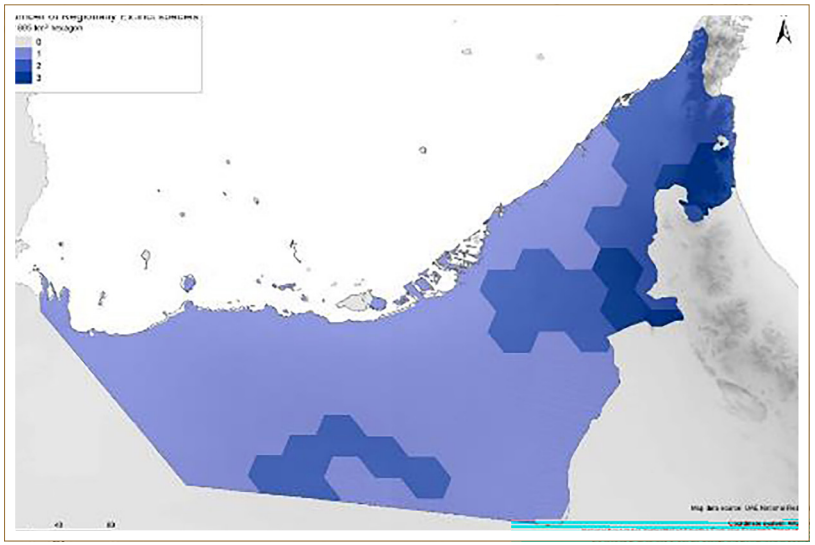

Figure 11. Number and distribution of Regionally Extinct terrestrial mammal species.

Marine mammals

The higher richness of marine mammals (Figure 12) off the east coast results from the presence of several deep-water, offshore species that have wide distributions in the northwest Indian Ocean. Two species of dolphin were recorded here recently for the first time in UAE waters and continuing surveys may detect additional species of cetaceans. The pattern in the Arabian Gulf depicted in Figure 12 reflects both the known distribution of species such as *Dugong dugon*, Indo-Pacific Humpback Dolphin *Sousa plumbea*, Indo-Pacific Finless Porpoise *Neophocaena phocaenoides*, and Indo-Pacific Bottlenose Dolphin *Tursiops aduncus* in their preferred habitats in the shallow waters, inlets and seagrass beds of the coastal zone, and intensive survey effort in those areas. Thorough surveys of the entire EEZ may reveal wider distributions of some species and thereby influence the pattern of richness as shown here.

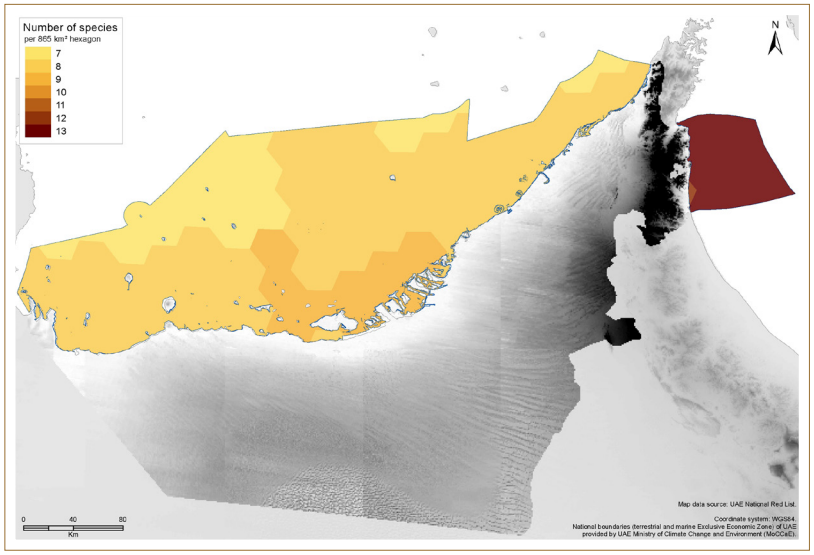

Figure 12: Overall species richness of marine mammals.

The four marine mammal species assessed as threatened (Figure 13) in UAE (Humpback Whale *Megaptera novaeangliae*, Indo-Pacific Finless Porpoise, Indo-Pacific Humpback Dolphin and Indo-Pacific Bottlenose Dolphin) are all found in the Arabian Gulf waters, and only one of these (Humpback Whale) occurs off the east coast. The Indo-Pacific Humpback Dolphin is especially important given that it is thought that the largest global subpopulation of this species occurs in UAE waters.

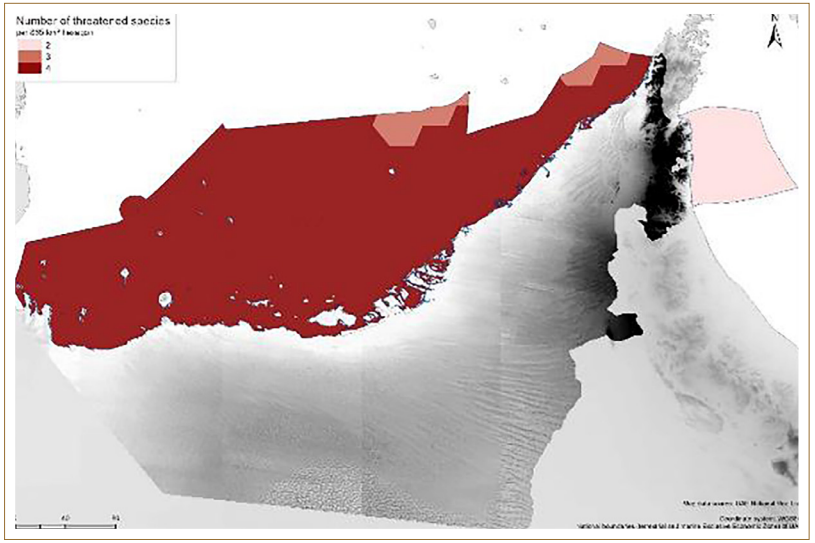

Figure 13: Number and distribution of threatened marine mammal species.

The distribution of Data Deficient marine mammals (Figure 14) ranges from three species (Bryde's Whale *Balaenoptera edeni*, Killer Whale *Orcinus orca* and False Killer Whale *Pseudorca crassidens*) in the west of the Arabian Gulf, to 11 species off the east coast of the UAE. This reflects both the higher species richness found in the deeper waters found off the east coast and the benefit of intensive survey work undertaken there, for example, by the Fujairah Whale Project, and also the difficulties involved in establishing the status of these species. Further research is needed to understand the status of these DD species in the UAE.

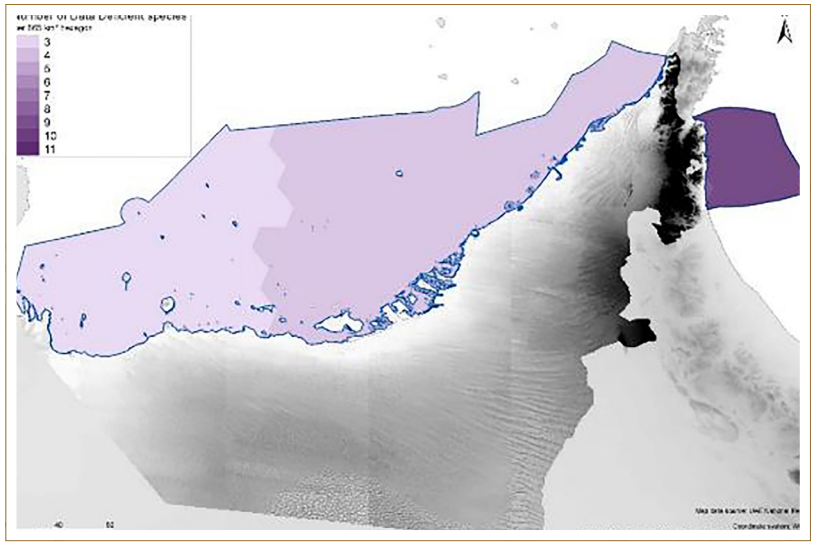

Figure 14: Number and distribution of Data Deficient marine species.

3.3. Red List Index for the mammals of the UAE

The UAE RLI data point in 1996 as calculated from the back-casting exercise was 0.61 and in 2018 it was 0.63, indicating that there was a 2.97% decrease in regional extinction risk, which is a positive trend (Figure 15).

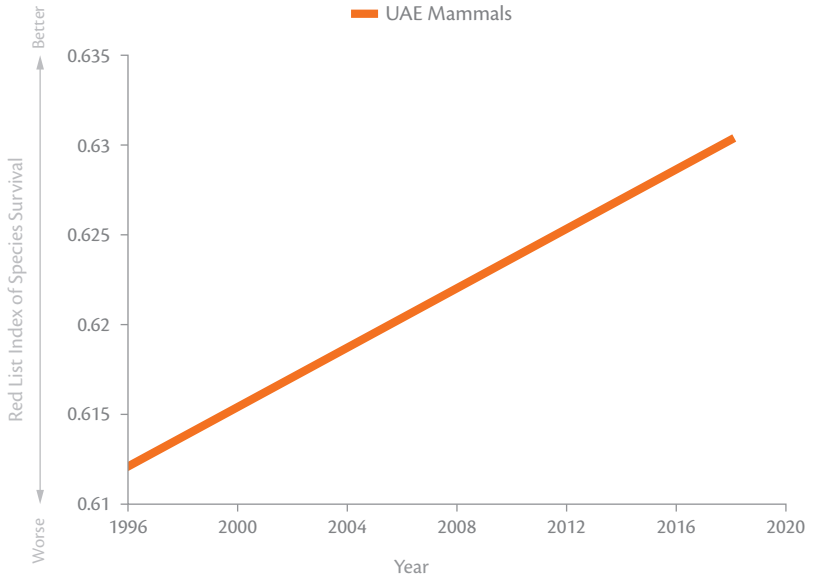

Figure 15: Red List Index (RLI) of mammal species survival in the UAE. An RLI value of one equates to all species being categorised as Least Concern (LC) and hence that none are expected to go Extinct in the near future. An RLI of zero indicates that all species have gone Extinct. N = 33 non-Data Deficient extant species at the start of the period in 1996.

The global RLI for mammals in 2008 was 0.85, a 0.72% decrease from the value in 1996, indicating an overall increase in extinction risk (Figure 16). A higher proportion of the mammals in UAE are threatened with extinction than they are globally, as reflected by the RLI start and end points being closer to zero than the global mammal RLI data points. The key difference is that the RLI for the UAE is going up, indicating that improvements in status are outweighing the decreases at present, while the global RLI is declining. Figure 16 shows the global mammal RLI and the UAE mammal RLI on the same graph to place the UAE RLI in the global context. Figure 16 also includes the combined (aggregate) global RLI for the UAE based on data from amphibians, birds, mammals and corals which has been weighted by the fraction of each species' distribution occurring within the country (this RLI data is updated annually and made available via the UN Sustainable Development Goals indicators database at https://unstats.un.org/sdgs/indicators/database/ and is displayed in the UAE country Profile available via the Integrated Biodiversity Assessment Tool (IBAT) for Conservation and Planning website at https://ibat-alliance.org/country-profiles). This combined RLI has been calculated over a longer time period (1980–2019) although Figure 16 only shows it from 1992. The global combined RLI for the UAE indicates that although a relatively high proportion of species within the groups considered are conserved, the downwards trend indicates declining aggregate survival probability of the country's species. However, the combined RLI uses the coarse species range maps from The IUCN Red List of Threatened Species, so the start and end points of this RLI are probably overly optimistic. A disaggregation of the combined RLI to just show the trend for mammals has not been produced because the mammal data is only available for the period 1996 to 2008 and so does not reflect the changes in status that have happened since 2008.

Ten of the 33 species used in the calculation of the UAE mammal RLI underwent genuine changes in status, six became more threatened (Rüppell's Fox, Caracal, Sand Cat, Leopard and Striped Hyena) and four became less threatened (Arabian Gazelle *Gazella arabica*, Arabian Sand Gazelle *G. marica*, Arabian Oryx *Oryx leucoryx* and Dugong). The positive trend in the national RLI is therefore the result of conservation actions leading to the significant recovery of the latter four species.

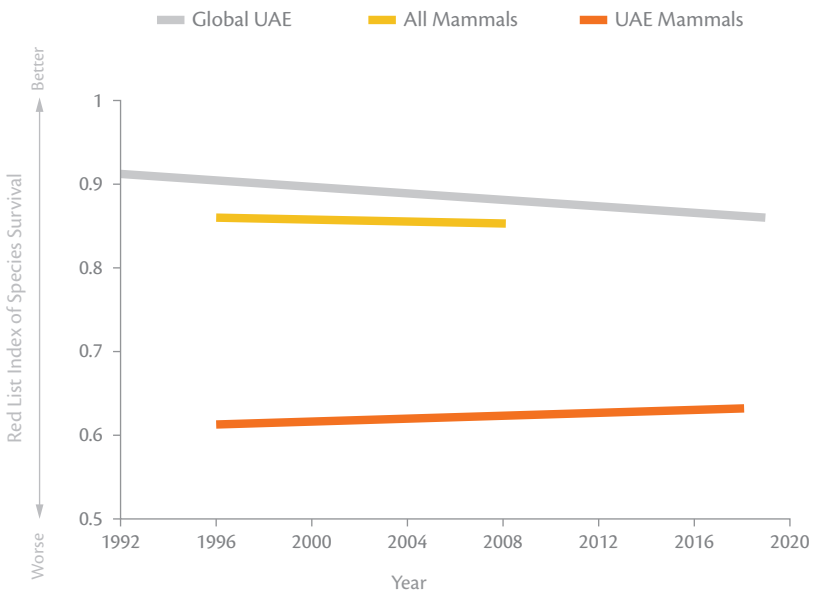

Figure 16: The 1996–2018 regional UAE RLI for mammals (orange line) is plotted alongside the 1996–2008 global RLI for all mammals (blue line) and the UAE cut of the 1980–2019 global aggregate RLI (using amphibians, birds, mammals and corals) weighted by the fraction of each species' distribution occurring within the UAE (grey line).

3.4. Major threats to mammals

The threats to each species were coded in the SIS database using the IUCN Threats Classification Scheme. A summary of the relative importance of the different threatening processes is shown in Figure 17 (terrestrial mammals) and Figure 18 (marine mammals). The threats impacting most terrestrial mammal populations are overgrazing by domestic livestock and hunting and persecution. Uncontrolled hunting is considered to have been the main cause of the extinction of the Arabian Oryx and a severe reduction in the numbers of Arabian Gazelle and Arabian Sand Gazelle. Revisions of hunting laws and more stringent enforcement have, however, reversed this trend and allowed these three species to increase and expand their ranges. Generalised persecution of carnivores through shooting trapping and poisoning is long-established in the region and has been a major factor in the extirpation from UAE of three large carnivores and the deterioration in status of smaller species compared to regions outside the Arabian Peninsula.

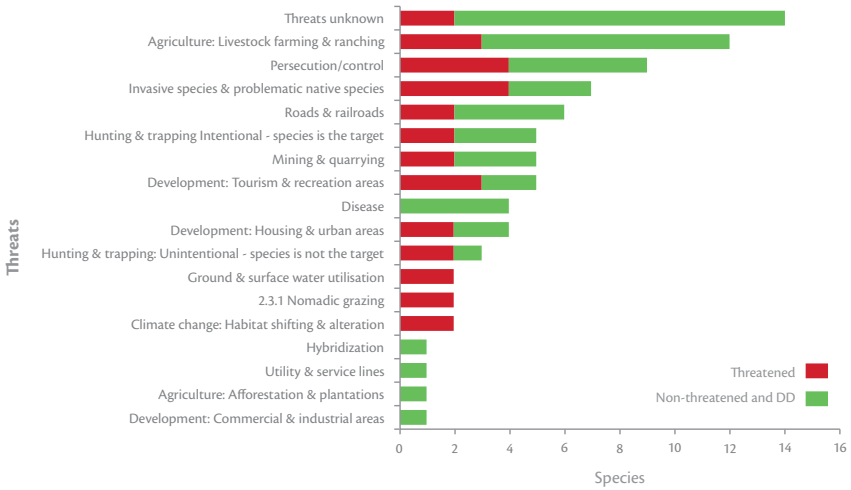

Figure 17: Threats to terrestrial mammals in UAE.

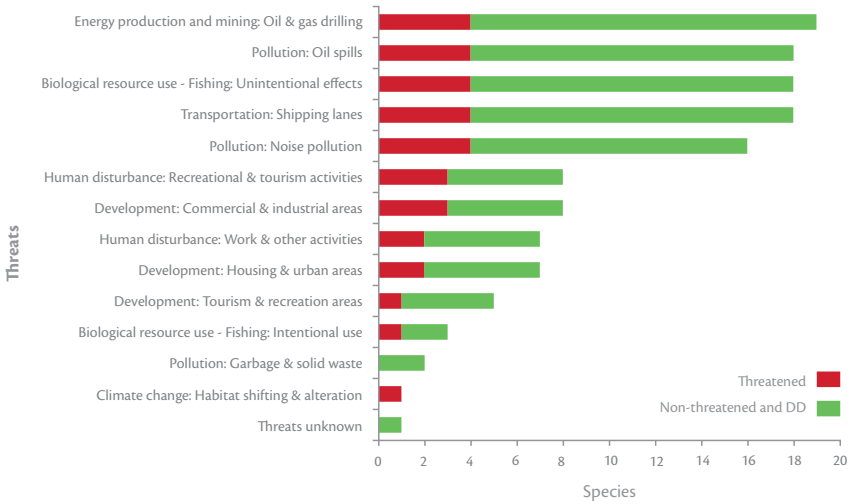

Figure 18: Threats to marine mammals.

For marine species, bycatch in fishing nets and abandoned fishing gear is the most prominent threat, with boat strikes, pollution and oil and gas activities also affecting several species.

3.5. Population trends

Only two terrestrial species are estimated to be increasing, four are stable and six are decreasing. There is insufficient knowledge of the status of 24 species to evaluate the population trend (Figure 19). For marine species, one is stable, one decreasing and the other 17 are unknown (Figure 20).

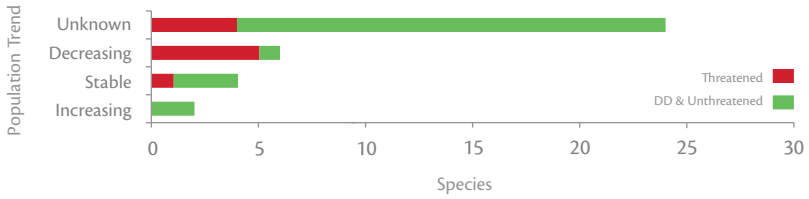

Figure 19. Population trends in terrestrial mammals.

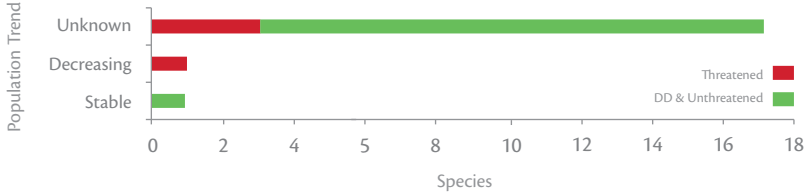

Figure 20. Population trends in marine mammals.

3.6. Gaps in knowledge

Twenty-five species were assessed as Data Deficient (43% of the total), because they were so poorly known. Fourteen of these were marine mammals, representing 73.3% of the total number (19) occurring in UAE waters. This high figure reflects the lower amount of survey effort compared to terrestrial species and the logistical and methodological difficulties in obtaining accurate information on deep-water species. Seven out of 12 bat species are listed as DD (58%), again an indication of the methodological issues involved in systematic surveys for these species. In addition to the DD species, a further six had an unknown population trend and for 14 species the threats were unknown or not understood. Thorough information on distribution is available for only a few species, while details of population dynamics, foraging and other aspects of their ecology are lacking for most species. The many gaps highlight the need for systematic research and monitoring programmes.

4. Conservation

4.1. International Policy

The UAE is a signatory to the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Conservation of Migratory Species of Wild Animals (CMS) and the Ramsar Convention. A National Biodiversity Strategy and Action Plan has been developed (Ministry of Environment and Water 2014).

4.2. Protected Areas

The UAE has gazetted 43 protected areas (PAs), as listed on the World Database on Protected Areas (https://protectedplanet.net). These are listed in Table 4 and their locations are shown in Figure 21. The total area covered by PAs is 18,900 km^2, comprising 12,734 km^2 of terrestrial PAs (18.0% of the total area) and 6,166 km^2 of marine PAs (11.2% of the total area). The combined total represents 15.0% national protected area coverage. Individual sites range in size from 0.13 km^2 to 5,975 km^2. Marawah Marine Biosphere Reserve was established to protect Dugongs and small cetaceans and its boundaries were based on the results of surveys for these species.

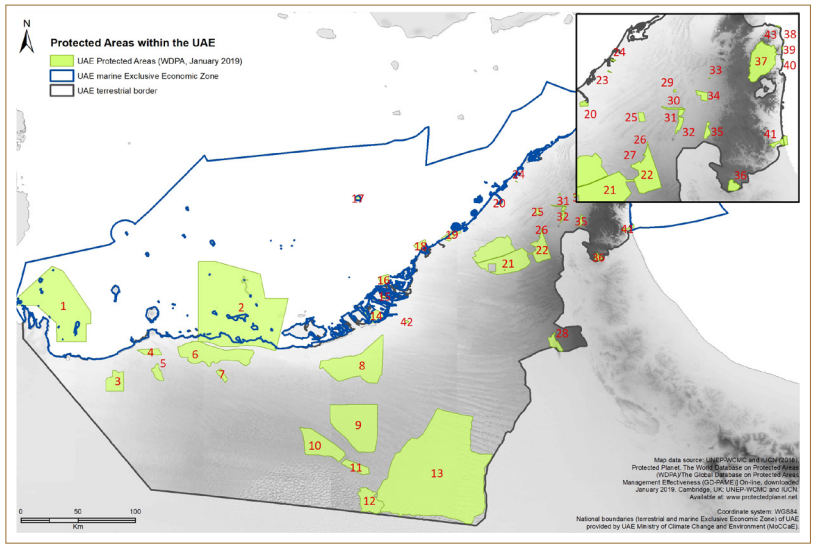

Figure 21: Location of protected areas (PAs) in the United Arab Emirates.

No.	Site	No.	Site
1	Al Yasat PA (Mar)	23	Wasit PA (Terr)
2	Marawah UNESCO-MAB Biosphere Res. (Mar)	24	Al Zorah PA (Mar)
3	Yaw Al Dibsa PA (Terr)	25	Al Wohoosh Desert PA (Terr)
4	Barqat Al Soqour PA (Terr)	26	Nazwa Mountain PA Area (Terr)
5	Bida'a Hazza' PA (Terr)	27	Al Ghaf of Nazwa PA (Terr)
6	Al Houbara PA (Terr)	28	Jebel Hafeet PA (Terr)
7	Al Tawi PA (Terrestrial)	29	Ed-Dhelaimah PA (Terr)
8	Al Marzoum (Al Ghadha) PA (Terr)	30	Hezaam Ghabat Elmentether PA (Terr)
9	Bidaa PA (Ter)	31	Meleiha PA (Terr)
10	Ramlah PA (Terr)	32	Elfaya PA (Terr)
11	Dilfawya PA (Terr)	33	Al Naseem PA (Terr)
12	Qaser Al Sarab PA (Terr)	34	Elebriddi PA (Terr)
13	Arabian Oryx PA (Terr)	35	Lemdynah PA (Terr)
14	Bul Syayeef Ramsar Site (Mar)	36	Hatta PA (Terr)
15	Eastern Mangrove PA (Mar)	37	Wadi Wurayah Ramsar Site (Terr)
16	Al Saadyat PA (Mar)	38	Dhadna PA (Mar)
17	Jazirat Sir Bu Naair Ramsar Site (Mar)	39	Al Aqqa PA (Mar)
18	Ras Ghanada PA (Mar)	40	Al Bidiya PA (Mar
19	Jabal Ali PA (Mar)	41	Alqurm Wa Lehfeiyah (Mar & Terr)
20	Ras Al Khor Ramsar Site (Mar)	42	Al Wathba Ramsar Site (Terr)
21	Al Marmoun Desert PA (Terr)	43	Birds Island (Jazeraat Al Tuyur) PA (Mar)
22	Dubai Desert Conservation Reserve (Terr)		

Table 4. Protected areas in the United Emirates (Terr – terrestrial; Mar = marine)

Only three marine mammal species are known to occur in at least one protected area (Figure 22). However, it should be pointed out that there have been relatively few detailed surveys of marine mammals and it is likely that more species, especially those that prefer coastal and inshore habitats, occur within the main marine PAs. Furthermore, marine PAs in UAE are at present found only in nearshore waters whereas many cetaceans inhabit deeper waters of the Gulf and off the east coast of the Arabian Gulf.

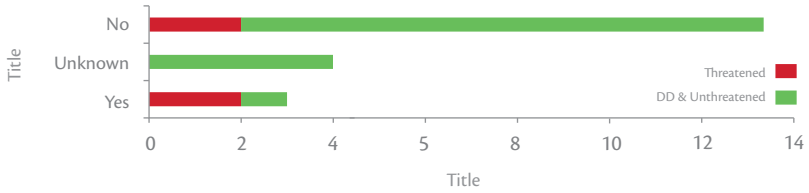

Figure 22: Occurrence of marine mammal species in at least one PA.

For terrestrial species, the occurrence in PAs is higher, 27 species out of 39, reflecting both the higher coverage of PAs and the better knowledge of the distribution of these species (Figure 23). Further research may show that some of the species currently listed as 'unknown' may also occur within one of the existing PAs.

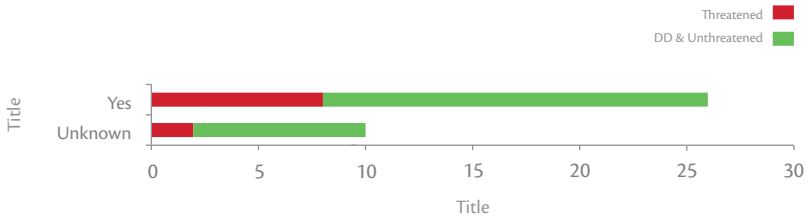

Figure 23: Occurrence of terrestrial mammal species in at least one PA.

4.3. Reintroduction

The Arabian Oryx was reintroduced to the Arabian Oryx Protected Area at Umm al Zummul in southeastern Abu Dhabi in 2011. Releases have subsequently taken place at Al Marmoom Protected Area in Dubai and at other sites. This species became Extinct in the Wild in 1972 and together with similar initiatives in Oman, Saudi Arabia and Jordan, the reintroduction programme has succeeded in improving the global and national status of the species on *The IUCN Red List of Threatened Species* to Vulnerable. Arabian Gazelle and Arabian Sand Gazelle are thriving at several release sites in the United Arab Emirates, resulting in a national category for both species of Least Concern, compared to Vulnerable globally. Many more animals have been released into extensive fenced areas and forestry plantations.

4.4. Captive breeding

There are several government and private breeding facilities in the UAE as well as many private collections. The Breeding Centre for Endangered Arabian Wildlife in Sharjah holds breeding populations of many local species including small carnivores and rodents. Al Ain Zoo and Al Bustan Zoological Center also both have breeding groups of some important mammal species such as Arabian Leopard and Sand Cat. The MNC centre at Al Ain specialises in breeding Arabian Tahr, with several hundred currently present. EAD and other agencies maintain large breeding groups of ungulates, as do some private collections. In total, there are several tens of thousands of oryx and gazelles in various types of management across the country and these have been used to provide source animals for release sites.

4.5. Strategic planning

A National Conservation Strategy for Arabian Tahr in United Arab Emirates has been developed (Al Bustan Zoological Centre and Environment Agency – Abu Dhabi, 2015). Conservation strategies and action plans for species in the Arabian Peninsula that include or have relevant actions for UAE have been developed for: Arabian Leopard *Panthera pardus nimr* (Breitenmoser *et al*. 2006, 2007); Arabian Oryx (EAD 2010); and Sand Cat (Banfield *et al*. 2014). The General Secretariat for the Conservation of the Arabian Oryx (GSCAO) which coordinates conservation efforts for the species at government level across the region is based at the Environment Agency – Abu Dhabi (EAD).

4.6. Field Projects

Survey and monitoring as well as conservation work are carried out by government agencies in each emirate and their partners. There are three principal initiatives on marine mammals. The Environment Agency – Abu Dhabi has an ongoing project on monitoring and conservation of dugongs and has established a Dolphin Conservation Programme to study the biology, habitats and distribution of cetaceans in Abu Dhabi waters and to support their conservation. The UAE Dolphin Project surveys and monitors cetaceans in Dubai waters. The Fujairah Whale and Dolphin Research Project involves systematic surveys to detect the presence of sperm whales and other cetaceans off the east coast based on sightings from boat transects and acoustic surveys.

5. Conclusions and Recommendations

5.1. Red List Index discussion

While the results of the assessment indicate that the proportion of mammals threatened with extinction in the UAE is higher than the global figure, the positive trend in the UAE RLI between 1996 and 2018 stands in contrast to the overall declining trend of mammals at the global level. This positive national trend is driven by the genuine improvements in status of four species (Arabian Oryx, Arabian Gazelle, Arabian Sand Gazelle and Dugong). These changes have been driven by reintroductions and releases of the first three species and establishment of marine protected areas and implementation of specific measures in the case of the Dugong. However, given the high proportion of threatened mammals, failure to focus conservation efforts on the other species, especially those undergoing declines, will result in a quick reversal of the positive trend.

Currently, 25 of the 58 species assessed (43%) are listed as Data Deficient (DD). While a small number of these species may be vagrants or marginal to UAE (e.g. Particoloured Bat *Vespertilio murinus*), it is imperative that these DD species are prioritised for further survey and research so that their extinction risk can be properly assessed and appropriately back-casted. Clarification of the status of these species could have a significant impact on the RLI.

Although the RLI serves as an important tool for monitoring the changing extinction risk of species over time, there are some important considerations that should be borne in mind. The RLI is recognised to be a relatively coarse measure of change (Hoffmann *et al*. 2011) and does not adequately measure reductions taking place among slowly declining species. Many UAE mammal species are slowly declining, because of a combination of factors involving extraction of groundwater, increasing aridity due to climate change and overgrazing by livestock, all of which impact on vegetation cover; however, these changes may take a long time before they are reflected by changes in Red List status. At a global scale, the Living Planet Index (LPI) tracks trends in vertebrate species populations in the wild by calculating the annual rate of change for each species population

based upon time-series data (Collen *et al*. 2003). Efforts should be made to collect a time series of population data for UAE mammal species so that a national LPI can be generated to complement the RLI.

Calculating the RLI from national scale assessments of extinction risk has a clear benefit as the index provides a more sensitive metric of biodiversity loss than a national disaggregation of the global index for the taxonomic group. This is because a higher proportion of species tend to qualify as Threatened or Near Threatened when their extinction risk is assessed at a finer spatial scale, and hence more species tend to move between categories when assessments are repeated, leading to RLI trends that are more representative of the changing regional status of the species concerned. The counter-argument to this is that the national RLI can be driven by changes in status of species with a 'trivial' proportion of their global range in the UAE. This is certainly true in this instance as six of the ten species with genuine changes have extremely wide ranges with large populations outside of the UAE and hence a disaggregated UAE cut of the global RLI weighted by the proportion of each species' global distribution within the country would look very different to the RLI produced here. However, as the focus of the exercise is to see how the UAE is faring in its commitment to conserve its national biodiversity, the national RLI is more meaningful. The combined (aggregate) global RLI for the UAE, weighted by the fraction of each species' distribution occurring within the UAE provides a coarse indication of adequately species are being conserved in the UAE relative to its potential contribution to global species conservation. This RLI indicates that while the UAE is performing relatively well, there is a clear downwards trend indicating declining aggregate survival probability of the country's species and action is required to reverse this overall trend.

It should be noted that the RLI is usually relatively slow to change and therefore difficult to incorporate into short-term political and conservation-planning cycles. Thought therefore needs to be given as to how frequently the UAE Mammal RLI should be recalculated. Ideally it should be repeated every 4–5 years, but realistically, given global trends, it would probably only be done at 10-year intervals. Future work on the RLI could be to investigate the linkage between RLI changes with conservation investment levels (McCarthy *et al*. 2008), identifying the optimal expenditure to achieve the greatest improvement in RLI.

Calculation of the RLI at the country level is a valuable addition to national biodiversity benchmarking, and one that will increase in value with time as the time-series of data becomes longer. Although conservation efforts in the UAE are having a positive impact, there is an urgent need to address declines in a number of other species in order to sustain the positive RLI trend.

5.2 Application of project outputs

The main outputs of this assessment are: 1. the first RLI for mammals in UAE; 2. national assessments of the extinction risk of the 58 native species; and 3. compilation of comprehensive species data and distribution maps. These outputs can be applied by MoCCaE and other government agencies to track trends in mammal conservation, to inform reports on, and revisions to, the National Biodiversity Strategy and Action Plan (NBSAP), to prioritise species and sites for conservation action, and identify internationally important sites for biodiversity such as protected areas and Key Biodiversity Areas.

5.3. Recommendations

If the information on the mammal species of the United Arab Emirates is to be effectively integrated within the developmental and environmental planning processes, then:

- The data collated need to be maintained and updated regularly through on-going collaboration with the network of experts who have contributed their valuable time to this project;
- A survey and monitoring programme should be established to obtain essential data on the status of species currently categorised as Data Deficient so that their actual Red List status in UAE can be assessed;
- A date for the next national assessment workshop should be set with targets established for the collection of the necessary data;
- Links between IUCN and its partners, policymakers and regional decision makers must be maintained and strengthened, and data made freely available to these people and organizations.

References

- Amr, Z.S. 2012. *Mammals of Jordan*. Second Edition. Amman.
- Aspinall, S., Hellyer, P. and Drew, C. (with Gross, C., Ashley-Edmonds, J., and Budd, K.) 2005. Terrestrial Mammals. Pp. 307-333 in: *The Emirates – a natural history*. Environment Agency – Abu Dhabi.
- Balmford, A., Bennun, L., ten Brink, B., Cooper, D., Côté, I.M., Crane, P., Dobson, A., Dudley, N., Dutton, I., Green, R.E., Gregory, R.D., Harrison, J., Kennedy, E.T., Kremen, C., Leader-Williams, N., Lovejoy, T.E., Mace, G.M., May, R.M., Mayaux, P., Morling, P., Phillips, J., Redford, K., Ricketts, T.H., Rodríguez, J.P., Sanjayan, M., Schei, P.J., van Jaarsveld, A.S. and Walther, B.A. 2005. The Convention on Biological Diversity's 2010 target. *Science* 307: 212–213.
- Bubb, P.J., Butchart, S.H.M., Collen, B., Dublin, H.T., Kapos, V., Pollock, C., Stuart, S.N. and Vié, J.-C. 2009. IUCN Red List Index – Guidance for National and Regional Use. IUCN, Gland, Switzerland.
- Butchart, S.H.M. 2008. Red list indices to measure the sustainability of species use and impacts of invasive alien species. *Bird Conservation International* 18**:** S245–S262.
- Butchart, S.H.M., Akçakaya, H.R., Chanson, J., Baillie, J.E.M., Collen, B., Quader, S., Turner, W.R., Amin, R., Stuart, S.N. and Hilton-Taylor, C. 2007. Improvements to the Red List Index. *PLoS ONE* 2: e140.
- Butchart, S.H.M., Stattersfield, A.J., Baillie, J., Bennun, L.A., Stuart, S.N., Akçakaya, H.R., Hilton-Taylor, C. and Mace, G.M. 2005. Using Red List Indices to measure progress towards the 2010 target and beyond. *Philosophical Transactions of the Royal Society* B 360: 255–268.
- Butchart, S.H.M., Stattersfield, A.J., Bennun, L.A., Shutes, S.M., Akçakaya, H.R., Baillie, J.E.M., Stuart, S.N., Hilton-Taylor, C. and Mace, G.M. 2004. Measuring global trends in the status of biodiversity: Red List indices for birds. *PLoS Biology* 2: e383.
- Butchart, S.H.M., Walpole, M., Collen, B., van Strien, A., Scharlemann, J.P.W., Almond, R.E.A., Baillie, J.E.M., Bomhard, B., Brown, C., Bruno, J., Carpenter, K.E., Carr, G.M., Chanson, J., Chenery, A.M., Csirke, J., Davidson, N.C., Dentener, F., Foster, M., Galli, A., Galloway, J.N., Genovesi, P., Gregory, R.D., Hockings, M., Kapos, V., Lamarque, J.-F., Leverington, F., Loh, J., McGeoch, M.A., McRae, L., Minasyan, A., Hernández Morcillo, M., Oldfield, T.E.E., Pauly, D., Quader, S., Revenga, C., Sauer, J.R., Skolnik, B., Spear, D., Stanwell-Smith, D., Stuart, S.N., Symes, A., Tierney, M., Tyrrell, T.D., Vié, J.-C., and Watson, R., 2010. Global Biodiversity:

Indicators of recent declines. *Science* 10.1126/science.1187512.

- Cassinello, J., Cuzin, F., Jdeidi, T., Masseti, M., Nader, I. and de Smet, K. 2008. *Ammotragus lervia*. *The IUCN Red List of Threatened Species* 2008: e.T1151A3288917. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T1151A3288917.en.
- Chakraborty, S., Nameer, P.O. and Molur, S. 2016. *Meriones hurrianae* (errata version published in 2017). *The IUCN Red List of Threatened Species* 2016: e.T13163A115109827. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T13163A22433767.en
- Collen, B., Loh, J., Whitmee, S., McRae, L., Amin, R. and Baillie, J.E.M. 2009. Monitoring change in vertebrate abundance: the Living Planet Index. *Conservation Biology* 23: 317–327.
- Cunningham, P.L. 1999. A population of Rock Hyrax (*Procavia capensis*) on Jabel Hafit. *Tribulus* 9(2): 29.
- Cunningham, P.L. 2004. Checklist of the terrestrial mammals from the United Arab Emirates. *Zoology in the Middle East* 33: 7-20.
- Drew, C. and Tourenq, C. 2005. *The Red List of terrestrial mammalian species of the Abu Dhabi Emirate*. Terrestrial Environment Research Center, ERWDA, Abu Dhabi.
- Duckworth, W. 1996. Land mammals of Abu Dhabi. Pp. 148-171. In: Osborne, P.E. (ed.). *Desert ecology of Abu Dhabi – a review and recent studies*. Pisces Publications, Newbury, UK.
- Gärdenfors, U. (ed.). 2010. *Rödlistade arter i Sverige 2010—the 2010 Red List of Swedish Species*. ArtDatabanken, Uppsala.
- Gross, C. 1987. *Mammals of the southern Gulf*. Motivate Publishing, Dubai.
- Hambler, C. 2004. *Conservation*. Cambridge University Press, Cambridge.
- Harrison, D.L. 1968. T*he Mammals of Arabia. Vol. II. Carnivora, Hyracoidea, Artiodactyla*. London, UK: Ernest Benn.
- Harrison, D.L. and Bates, P.J. 1991. *The mammals of Arabia*. Sevenoaks, Kent, UK: Harrison Zoological Museum Publications.
- Hellyer, P. 1994. Mammals. *Tribulus* 4.2: 28-29.
- Hoffmann, M., Hilton-Taylor, C., Angulo, A., Böhm, M., Brooks, T.M., Butchart, S.H.M., Carpenter, K.E., Chanson, J., Collen, B., Cox, N.A., Darwall, W.R.T., Dulvy, N.K., Harrison, L.R., Katariya, V., Pollock, C.M., Quader, S., Richman, N.I., Rodrigues, A.S.L., Tognelli, M.F., Vié, J.-C., Aguiar, J.M., Allen, D.J., Allen, G.R., Amori, G., Ananjeva, N., Andreone, F., Andrew, P., Aquino Ortiz, A.L., Baillie, J.E.M., Baldi, R., Bell, B.D., Biju, S.D., Bird, J.P., Black-Decima, P., Blanc, J.J., Bolaños, F., Bolivar-G., W., Burfield, I.J., Burton, J.A., Capper, D.R., Castro, F., Catullo, G., Cavanagh, R.D., Channing, A., Chao, N.L., Chenery, A.M., Chiozza, F., Clausnitzer, V., Collar, N.J., Collett, L.C., Collette, B.B., Cortez Fernandez, C.F., Craig, M.T., Crosby, M.J., Cumberlidge, N., Cuttelod, A., Derocher, A.E., Diesmos, A.C., Donaldson, J.S., Duckworth, J.W., Dutson, G., Dutta, S.K., Emslie, R.H., Farjon, A., Fowler, S., Freyhof, J., Garshelis, D.L., Gerlach, J., Gower, D.J., Grant, T.D., Hammerson, G.A., Harris, R.B., Heaney, L.R., Hedges, S.B., Hero, J.-M., Hughes, B., Hussain, S.A., Icochea M., J., Inger, R.F., Ishii, N., Iskandar, D.T., Jenkins, R.K.B., Kaneko, Y., Kottelat, M., Kovacs, K.M., Kuzmin, S.L., La Marca, E., Lamoreux, J.F., Lau, M.W.N., Lavilla, E.O., Leus, K., Lewison, R.L., Lichtenstein, G., Livingstone, S.R., Lukoschek, V., Mallon, D.P., McGowan, P.J.K., McIvor, A., Moehlman, P.D., Molur, S., Muñoz Alonso, A., Musick, J.A., Nowell, K., Nussbaum, R.A., Olech, W., Orlov, N.L., Papenfuss, T.J., Parra-Olea, G., Perrin, W.F., Polidoro, B.A., Pourkazemi, M., Racey, P.A., Ragle, J.S., Ram, M., Rathbun, G., Reynolds, R.P., Rhodin, A.G.J., Richards, S.J., Rodríguez, L.O., Ron, S.R., Rondinini, C., Rylands, A.B., Sadovy de Mitcheson, Y., Sanciangco, J.C., Sanders, K.L., Santos-Barrera, G., Schipper, J., Self-Sullivan, C., Shi, Y., Shoemaker, A., Short, F.T., Sillero-Zubiri, C., Silvano, D.L., Smith, K.G., Smith, A.T., Snoeks, J., Stattersfield, A.J., Symes, A.J., Taber, A.B., Talukdar, B.K., Temple, H.J., Timmins, R., Tobias, J.A., Tsytsulina, K., Tweddle, D., Ubeda, C., Valenti, S.V., van Dijk, P.P., Veiga, L.M., Veloso, A., Wege, D.C., Wilkinson, M., Williamson, E.A., Xie, F., Young, B.E., Akçakaya, H.R., Bennun, L., Blackburn, T.M., Boitani, L., Dublin, H.T., da Fonseca, G.A.B., Gascon, C., Lacher Jr., T.E., Mace, G.M., Mainka, S.A., McNeely, J.A., Mittermeier, R.A., McGregor Reid, G., Rodriguez, J.P., Rosenberg, A.A., Samways, M.J., Smart, J., Stein, B.A. and Stuart, S.N. 2010. The impact of conservation on the status of the world's vertebrates. *Science* 330: 1503–1509.
- Hoffmann, M., Belant, J.L., Chanson, J.S., Cox, N.A., Lamoreux, J.F., Rodrigues, A.S.L., Schipper, J. and Stuart, S.N. 2011. The changing fates of the world's mammals. *Philosophical Transactions of the Royal Society* B 366: 2598–2610.
- Hornby, R.J. 1996. A Red List of Mammals in the United Arab Emirates. *Tribulus* 6(1): 13–14.
- IUCN. 1994. *IUCN Red List Categories*. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland.
- IUCN. 2001. *IUCN Red List Categories and Criteria: Version 3.1*. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
- IUCN. 2003. *Guidelines for Application of IUCN Red List Criteria at Regional and National*

Levels: Version 3.0. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

- IUCN. 2012a. *IUCN Red List Categories and Criteria: Version 3.1*. Second edition. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
- IUCN. 2012b. *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0*. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
- IUCN. 2018. *Mapping Standards and Data Quality for the IUCN Red List Categories and Criteria*. Version 1.16 (September 2018). Prepared by Red List Technical Working Group. IUCN: Cambridge and Gland. https://nc.iucnredlist.org/redlist/resources/files/1539098236-Mapping_Standards_Version_1.16_2018.pdf
- IUCN Standards and Petitions Subcommittee. 2017. *Guidelines for Using the IUCN Red List Categories and Criteria. Version 13. Prepared by the Standards and Petitions Subcommittee. Available from:* http://www.iucnredlist.org/documents/RedListGuidelines.pdf.
- Jones, J.P.G., Collen, B., Atkinson, G., Baxter, P.W.J., Bubb, P., Illian, J.B., Katzner, T.E., Keane, A., Loh, J., McDonald-Madden, E., Nicholson, E., Pereira, H.M., Possingham, H.P., Pullin, A.S., Rodrigues, A.S.L., Ruiz-Gutierrez, V., Sommerville, M. and Milner-Gulland, E.J. 2011. The why, what, and how of global biodiversity indicators beyond the 2010 target. *Conservation Biology* 25: 450–457.
- Judas, J. and Hellyer, P. 2016. Five-striped Palm Squirrel, *Funambulus pennanti* (Wroughton, 1905) – a new addition to UAE's exotic fauna. *Tribulus* 24: 126-129.
- Juslén, A., Hyvärinen, E. and Virtanen, L.K. 2013. Application of the Red-List Index at a national level for multiple species groups. *Conservation Biology* 27: 398–406.
- Mallon, D. and Budd, K. eds. 2011. *Regional Red List status of the carnivores in the Arabian Peninsula*. Cambridge, UK and Gland, Switzerland: IUCN and Sharjah, UAE: Environment and Protected Areas Authority.
- McCarthy, M.A., Thompson, C.J. and Garnett, S.T. 2008. Optimal investment in conservation of species. *Journal of Applied Ecology* 45: 1428–1435.
- Miller, R.M., Rodríguez, J.P., Aniskowicz-Fowler, T., Bambaradeniya, C., Boles, R., Eaton, M.A., Gardenfors, U., Keller, V., Molur, S., Walker, S. and Pollock, C. 2007. National threatened species listing based on IUCN criteria and regional guidelines: current status and future perspectives. *Conservation Biology* 21: 684–696.
- Ministry of Environment and Water. 2014. UAE National Biodiversity Strategy and Action Plan 2014-2021. Abu Dhabi, UAE. [In Arabic, with English Annex].
- Moreno Saiz, J.C., Lozano, F.D., Gómez, M.M. and Bañares Baudet, A. 2015. Application of the Red List Index for conservation assessment of Spanish vascular plants. *Conservation Biology* 29: 910–919.
- Mosseri-Marlio, C. 2003. The rat remains from Kalba, UAE. In D.T. Potts, P. Hellyer & H. Naboodah, (eds). *Archaeology of the Emirates: Proceedings of the First Archaeological Conference on the UAE*. London, UK: Trident Press.
- Quayle, J.E., Ramsay, L.R. and Fraser, D.F. 2007. Trend in the status of breeding bird fauna in British Columbia, Canada, based on the IUCN Red List Index method. *Conservation Biology* 21**:** 1241–1247.
- Pihl, S. and Flensted, K.N. 2011. A Red List Index for breeding birds in Denmark in the period 1991–2009. *Dansk Ornitologisk Forenings Tidsskrift* 105**:** 211–218.
- Roach, N. 2016. *Dolichotis patagonum*. *The IUCN Red List of Threatened Species* 2016: e.T6785A22190337. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T6785A22190337.en.
- Secretariat of the Convention on Biological Diversity. 2010. *Global Biodiversity Outlook 3*. Montreal, Canada.
- Secretariat of the Convention on Biological Diversity 2014. *Global Biodiversity Outlook 4*. Montreal, Canada.
- Szabo, J.K., Butchart, S.H.M., Possingham, H.P. and Garnett, S.T. 2012. Adapting global biodiversity indicators to the national scale: A Red List Index for Australian birds. *Biological Conservation* 148: 61–68.
- United Nations. 2017. The Sustainable Development Goals Report 2017. United Nations, New York. Available from: https://unstats.un.org/sdgs/files/report/2017/thesustainabledevelopmentgoalsreport2017.pdf.
- Woinarski, J.C.Z, Burbidge, A.A and Harrison, P.L. 2015. Ongoing unraveling of a continental fauna: Decline and extinction of Australian mammals since European settlement. *Proceedings of the National Academy of Science* 112: 4531–4540.
- Ziolkowski, M.C. 1998. A study of the petroglyphs of Wadi al-Hayl, Fujairah, United Arab Emirates. *Arabian Archaeology and Epigraphy* 9: 13-89.

Appendix 1.

National and global Red List status of mammals in the United Arab Emirates.

Species	Common name	UAE National status		Global Red List status
TERRESTRIAL		Category	Criteria	Category
Paraechinus aethiopicus	Ethiopian Hedgehog	LC	-	LC
Paraechinus hypomelas	Brandt's Hedgehog	LC	-	LC
Suncus etruscus	Savi's Pygmy Shrew	DD	-	LC
Taphozous nudiventris	Naked-bellied Tomb Bat	VU	D1	LC
Taphozous perforatus	Egyptian Tomb Bat	DD	-	LC
Asellia tridens	Geoffroy's Trident Bat	DD	-	LC
Triaenops persicus	Persian Trident Bat	DD	-	LC
Rousettus aegyptiacus	Egyptian Fruit Bat	LC	-	LC
Rhinopoma muscatellum	Muscat Mouse-tailed Bat	LC	-	LC
Eptesicus bottae	Sind Serotine Bat	DD	-	LC
Eptesicus nasutus	Botta's Serotine Bat	LC	-	LC
Myotis emarginatus	Geoffroy's Bat	DD	-	LC
Otonycteris hemprichii	Desert Long-eared Bat	DD	-	LC
Pipistrellus kuhlii	Kuhl's Pipistrelle	LC	-	LC
Vespertilio murinus	Particoloured Bat	DD	-	LC
Lepus capensis	Cape Hare	LC	-	LC
Jaculus jaculus	Lesser Jerboa	NT	A2c	LC
Hystrix indica	Indian Crested Porcupine	CR	D	LC
Acomys dimidiatus	Arabian Spiny Mouse	NT	B1b(iii)	LC
Gerbillus cheesmani	Cheesman's Gerbil	LC	-	LC
Gerbillus dasyurus	Wagner's Gerbil	LC	-	LC
Gerbillus nanus	Baluchistan Gerbil	DD	-	LC
Meriones arimalius	Arabian Jird	LC	-	LC
Meriones crassus	Sundevall's Jird	DD	-	LC
Canis lupus	Grey Wolf	RE	-	LC
Vulpes cana	Blanford's Fox	VU	D1	LC
Vulpes rueppellii	Rüppell's Fox	CR	C2a(i)	LC
Vulpes vulpes	Red Fox	LC	-	LC
Caracal caracal	Caracal	CR	C2a(i)	LC
Felis margarita	Sand Cat	EN	D	LC
Felis silvestris	Wildcat	EN	C2a(ii)	LC
Panthera pardus	Common Leopard	RE	-	VU
Ichneumia albicauda	White-tailed Mongoose	EN	D	LC
Hyaena hyaena	Striped Hyena	RE	-	NT
Mellivora capensis	Honey Badger	DD	-	LC
Arabitragus jayakari	Arabian Tahr	CR	D	EN
Gazella arabica	Arabian Gazelle	LC	-	VU
Gazella marica	Arabian Sand Gazelle	LC	-	VU
Oryx leucoryx	Arabian Oryx	VU	D	VU

Species	Common name	UAE National status		Global Red List status
MARINE		Category	Criteria	Category
Balaenoptera edeni	Bryde's Whale	DD	-	LC
Balaenoptera musculus	Blue Whale	DD	-	EN
Balaenoptera omurai	Omura's Whale	DD	-	DD
Megaptera novaeangliae	Humpback Whale	EN*	D	LC
Delphinus delphis	Short-beaked Common Dolphin	DD	-	DD
Grampus griseus	Risso's Dolphin	DD	-	LC
Orcinus orca	Killer Whale	DD	-	DD
Pseudorca crassidens	False killer Whale	DD	-	NT
Sousa plumbea	Indo-Pacific Humpback Dolphin	EN	A2bc	EN
Stenella attenuata	Pantropical Spotted Dolphin	DD	-	LC
Stenella coeruleoalba	Striped Dolphin	DD	-	LC
Stenella longirostris	Spinner Dolphin	DD	-	LC
Steno bredanensis	Rough-toothed Dolphin	DD	-	LC
Tursiops aduncus	Indo-Pacific Bottlenose Dolphin	EN	A2bc	DD
Tursiops truncatus	Common Bottlenose Dolphin	DD	-	LC
Neophocaena phocaenoides	Indo-Pacific Finless Porpoise	EN	A2bc; C2a(i); D	VU
Kogia sima	Dwarf Sperm Whale	DD	-	DD
Physeter macrocephalus	Sperm Whale	DD	-	VU
Dugong dugon	Dugong	NT	C2a(ii)	VU

Notes

* Humpback Whale was downlisted by one Category due to a rescue effect.

RE = Regionally Extinct; CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient.

Appendix 2.

List of participants and contributors to the UAE National Red List of Mammals.

Participants in the UAE National Red List Assessment Workshop, Dubai, 2018

Name	Organisation
Maha Adbdullateef **Al Beshr**	ADNOC
Mahmoud **Abdelmobdy**	ADNOC
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Name	Organisation
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Name	Organisation
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Roxanne **Whelan**	RAK Nature
Athar **Noor**	Tridel Technologies
Ramaiah **Nagappa**	Tridel Technologies
Ada **Natoli**	UAE Dolphin Project
Aaron **Henderson**	United Arab Emirates University
Dawood **Al Ajmi**	United Arab Emirates University
Oliver **Manlik**	United Arab Emirates University
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Abdul **Nasser**	Wadi Wurayah National Park
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Additional Contributors to the UAE Mammal assessments

Robert Baldwin and Andrew Wilson (Five Oceans Environmental Services LLC and the Fujairah Whale and Dolphin Research Project) contributed to the marine mammal assessments.

Appendix 3

Introduced, unconfirmed, feral and possible mammal species in the United Arab Emirates.

INTRODUCED SPECIES

Funambulus pennantii Five-striped Palm Squirrel

This species is native to South Asia and it was first reported in UAE in 2009, presumably from escaped or released pets. Between 2009 and 2016 there were 42 records from widespread localities in Abu Dhabi, Ajman, Dubai, Fujairah, Ras Al Khaimah, and Sharjah, including the east coast (Dibba, Kalba). Breeding populations have become established and at least some of these colonies appear to be self-sustaining (Judas and Hellyer 2016). The population size is unknown, but it is reported to be common in Sharjah National Park where >50 have been estimated. In UAE it lives in parks, gardens and farms. In their indigenous range, this species is very adaptable, using a wide range of habitats from dry deciduous subtropical forest and scrublands to plantations, rural and urban areas. The species has the potential to achieve pest status, as it has in Australia, so monitoring of the population and its effects on the environment is needed (Judas and Hellyer 2016).

Sciurus anomalus Persian Squirrel

A small population of this species was present in parks and gardens in Abu Dhabi in 1999-2003, presumably derived from escaped pets (Aspinall *et al*. 2005) but the species has not been reported since then (Judas and Hellyer 2016) and the population appears not to have become established. An individual was also recorded in Al Ain in the 1990s; this was a young animal suggesting that breeding had place in the area (B. Haworth pers. comm. 2018). The species is native to the northern part of the Arabian Peninsula, Turkey and Iran (Harrison and Bates 1991). The species predominantly lives in mixed and deciduous forest, although it also occurs in coniferous forests as well as rocky outcrops (Amr 2012).

Procavia capensis Rock Hyrax

Native to Africa and the western and southern Arabian Peninsula (Harrison and Bates 1991). In the UAE it was introduced to Sir Bani Yas island around 1995 but has not established itself there (Aspinall *et al.* 2005). It either escaped or was released on Jebel Hafeet in 1998-1999 (Cunningham 1999). The population seemed to be declining (Cunningham 2004) but it is still present and recent photos have been posted on websites. Hyrax could be possible threat to the ecology of Jebel Hafeet. The introduced population on Jebel Hafeet receives some protection. There is a captive breeding population at the Breeding Centre for Endangered Arabian Wildlife in Sharjah, UAE. The geographic origin of the released animals is unknown.

Meriones hurrianae Indian Desert Jird

This species occurs in northwest India, Pakistan, extending westwards in a narrow coastal band to Bandar Abbas in Iran (Chakraborty *et al*. 2016). Photos taken in 2008 and 2011 of animals on farms in the Ajban area have been posted on the mammal section of the UAE Birding website (http://www.uaebirding.com/photos-mammals.html) and the colony was described as 'very healthy'. The species is apparently available in pet shops and the Ajban animals are presumed to result from an escape. This species is adapted to arid environments and it is possible that it may be able to extend is range in the UAE, potentially competing with the indigenous *M. arimalius*.

Dolichotis patagonum Patagonian Mara

This species is native to central and southern Argentina where it occupies a range of open habitats, including grasslands, scrub and semi-arid areas (Roach 2016). It is kept in some private collections in the UAE and escaped animals have been observed around Bab Al Shams in Dubai, in hotel gardens and on roundabouts. It is not known whether breeding has taken place. The species is not adapted to desert conditions and it is likely to be restricted to Irrigated and watered sites. It is too early to judge whether this population can be considered established.

Mus musculus House Mouse

The House Mouse has arrived in UAE through accidental introductions and has spread to all areas of human settlement and agriculture. The expansion of roads, settlements and oil camps into desert areas has allowed it to extend its range (Aspinall *et al*. 2005). This species is found on some Gulf islands such as Zirku and Arzanah, where it may constitute a potential threat to seabird species (Drew and Tourenq 2005). It is **common where it occurs. It is c**ommensal, occurring in and around settlements, farms and agricultural areas, and is presumed to occur in some protected areas.

Rattus rattus Black Rat

The Black Rat is native to South and East Asia and has extended its distribution around the world through ship-borne introductions. It has been present in the UAE for millennia; rat remans at an archaeological site in Kalba were dated to ca. 4,000 years BP (Mosseri-Marlio 2003). It is common and widespread in urban areas of the UAE, including inland and its distribution in the UAE has benefited from the spread of urbanisation and agriculture (Aspinall *et al*. 2005). It is c**ommon where it occurs,** bold and frequently observed by day. It is an accomplished climber and spends more time off the ground than *Rattus norvegicus* and builds conspicuous nests in the tree canopy (Aspinall *et al*. 2005). It is water-dependent which limits its ability to colonise desert areas. Black rats are invasive and pose a potential threat to nesting birds, invertebrates, molluscs and other indigenous wildlife. This threat may be highest for colonial seabirds nesting on islands in the Gulf. It is presumed to occur in some protected areas.

Rattus norvegicus Brown Rat

At least until recently this species has been less successful in establishing itself in the Arabian Peninsula, but is now common in towns and villages, as well as in desert oilfield camps, including in UAE (Harrison and Bates 1991, Aspinall *et al*. 2005). It is also reported to be present on offshore islands, such as Zirku, where it constitutes a threat to seabirds (Drew and Tourenq 2005**). Less common than** *Rattus rattus* **in UAE.** It is invasive and an agricultural pest as well as a potential threat to indigenous wildlife. It is presumed to occur in some protected areas.

Capra nubiana Nubian Ibex

Some petroglyphs in Wadi Al Hayl, Fujairah, may represent this species (Ziolkowski 1998). There are no other UAE records. Horns were obtained of a male ibex reportedly shot by a local villager in autumn 1967 in the Hajar Mountains near Fizz, Oman, and donated to the Harrison Zoological Museum (Harrison 1968). There is no evidence of an established population in the Hajar Mountains. Captive breeding populations are maintained at the Breeding Centre for Endangered Arabian Wildlife, Sharjah and Al Ain Zoo. Animals from private collections have escaped or been released on Jebel Hafeet, where they represent a competitor – and potential threat – to the remnant Arabian Tahr population.

Ammotragus lervia Barbary Sheep or Aoudad

This species is endemic to mountains across North Africa and the Sahara (Cassinello *et al*. 2008). It is kept in some private collections in UAE and animals have escaped or been released in the Hatta area and on Jebel Hafeet. In both localities they represent a competitor – and potential threat – to the remnant Arabian Tahr populations.
UNCONFIRMED SPECIES

Hemiechinus auritus Long-eared hedgehog

There are some reported sightings of this species in the Al Ain area during the 1980s (Duckworth 1996, Cunningham 2004), but presence has not been confirmed: the nearest known range is in eastern Saudi Arabia and Qatar (Drew and Tourenq 2005). It appears not to be a true desert hedgehog (Harrison and Bates 1991).

Suncus murinus House Shrew

This commensal species is native to South and East Asia and has been accidentally introduced to many sites in Africa and the Middle East. It has been recorded from many ports in the Arabian Peninsula (Harrison and Bates 1991). Duckworth (1996) considered it was likely to occur in UAE but there are no conformed records (Cunningham 2004, Drew and Tourenq 2005).

Herpestes edwardsi Indian Grey Mongoose

Sightings have been reported Al Aweer and Ras Al Khaimah (Gross 1987) and two unidentified mongooses recorded in Abu Dhabi in 1985 and 1988 may also have been this species (Aspinall *et al*. 2005). The only confirmed record is of one animal caught in Dubai and presented to Dubai Zoo. The species is indigenous to Iran and South Asia. Its range in the Arabian region is restricted to the Gulf coast of Bahrain, Kuwait and Saudi Arabia, apart from one record from Oman, an animal brought to the Oman Mammal Breeding Centre in 1997 (Mallon and Budd 2011). It is not clear if its occurrence in the Gulf region is natural or results from ship-borne introductions, as suggested by its distribution adjacent to sea ports. If the species is present in the UAE, it is almost certainly as a result of introduction or an escape.

Meriones libycus Libyan Jird

There is some taxonomic uncertainty around records of this species in the UAE. The subspecies *M. l. arimalius* has been recorded in the UAE but this is now regarded as a full species *M. arimalius*. However, the possibility that *M. libycus* also occurs in parts of western UAE cannot be excluded.

Ovis orientalis Wild Sheep

The status of this species in UAE is unclear. Gross (1987) reported that several individuals had been shot near Hatta about 30 years previously (i.e. in the 1930s). Harrison and Bates (1991) cited a report from 1981 of an individual in Dubai Zoo that was live-caught in 'Hatta, Oman' and provided local reports of the species in the Hajar Mountains of Oman. It is possible therefore, that a population of this species once occurred in the Hajar Mountains, but this has never been confirmed.

Capra aegagrus Wild Goat

There are only anecdotal reports from UAE. A male in London Zoo was obtained from a bedu who said he had caught it as a kid in the foothills near Masafi (Harrison 1968). Two young animals, a four-month old female and a one-year old male were donated to Al Ain Zoo from private collections in 1994; both animals reportedly came from the Hajar Mountains (Hellyer 1994). There are no other reports or any evidence of an established population in UAE or elsewhere in the Hajar Mountains.FERAL SPECIES

Canis familiaris Feral Dog

Feral dogs occur in a few places. These animals may prey on indigenous mammals and pose a threat in some cases (e.g. dogs have been photographed pursuing Arabian Tahr on Jebel Hafeet).

Felis catus Feral Cat

Feral cats are widespread and are known to interbreed with Wild Cats, posing a real threat. It is often difficult to distinguish hybrids and feral cats from genuine Wild Cats, which hinders an assessment of their status. Feral Cats are also likely to prey on small mammals.

Equus asinus Donkey

Feral donkeys occur in several parts of the mountains where they may compete for grazing with wild species.

Capra hircus Feral Goat

Feral goats also occur widely in the mountains where they may compete for grazing with wild species and are a potentially serious competitor with the Arabian Tahr.

POSSIBLE SPECIES

Four species that occur in areas close to UAE that have not yet been recorded in the country, but which may be present and shown to occur in future.

Crocidura arabica* Arabian Shrew** has been recorded from Birkat Khaldiya in the Musandam of Oman (Harrison and Bates 1991) not far from the UAE border. Three species of bats that occur in the Hajar Mountains of Oman and could possibly also be present in UAE are: ***Rhinolophus blasii, Tadarida aegyptiacus, Pipistrellus arabica. A provisonal record of *Rhinolophus blasii* in the northern UAE (Ras Al Khaima) from an echolocation call recording was reported in early 2019.

For further information or feedback:

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