



Chairman's message

Despite the challenges of the global COVID-19 pandemic in 2020-21, the Dubai Desert Conservation Reserve (DDCR) has continued to build on its programs, partnerships and strong body of research to deliver its goals outlined under its strategic management plan 2019-2024.

The DDCR was created to provide a balance to Dubai's growth and rapid urbanisation, by conserving our desert areas and unique wildlife. It is an initiative which the Emirates Group has supported over the past 20 years and one that we see as an investment in our heritage, and in our future.

As tourism activity returns, the Reserve will continue to ensure that desert safaris, one of Dubai's major tourism attractions, remain a high quality experience and leave minimal impact on our natural environment.

This report outlines the key highlights at the DDCR for 2020-21, including the many projects which contribute to preserving and enabling our indigenous flora and fauna and natural eco-system to flourish.

We look forward to sharing more updates as we progress.

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HH Sheikh Ahmed bin Saeed Al-Maktoum Chairman, Dubai Desert Conservation Reserve

Table of contents

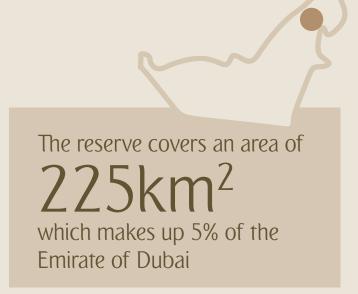
1.	Introd	uction	4	4.4.7. UAV - Machine Learning for Bio-diversity Monitoring and Tracking at Scale	19
2.	DDCR	Governance and Management	6	4.4.8. UAV (Unmanned Arial Vehicle) - Environmental Protection	20
3. Significant Events in 2021-22		8	4.4.9. Pathogen Risk Assessment of Arabian Felines	2	
4.	Conservation and Environmental Research Work			4.4.10. Statistical Evaluation of Atmospheric Forecasting System at DDCR	22
	4.1.	Desert Research Centre	10	4.4.11. Arthropod Diversity in Ghaf Groves	2.
	4.2.	DDCR Research Committee	12	4.4.12. Post Translocation Changes in the Behaviour and Population Dynamics of Antelopes in Arid Environment	24
	4.3.4.3.1.	Research Reports Arabian and Sand Gazelle in the Dubai Desert Conservation Reserve	13 13	4.4.13. Monitoring Long-term Vegetation Dynamics and Responses to Hydroclimate Changes Using Satellite Remote Sensing	2.
	4.3.2. 4.3.3.	Camera Trap Monitoring Report 2020 Monitoring of Pharaoh Eagle Owl in the DDCR	13 14	4.4.14. Habitat Mapping and Change Detection in the DDCR Using Remote Sensing and Geospatial Data Analysis	2.
	4.4.	Current Research	15	4.4.15. Air Dust Sources in UAE: Understanding Processes that Control Spatial Distributions of Dust Emissions	20
	4.4.1.	Monitoring Program for the Major Site Values of the DDCR	15	4.4.16. Archaeology, Geomorphology and Cultural Heritage in the DDCR	2
	4.4.2.	Quantitative analysis of the Hyper-arid vegetation changes under grazing pressure in the Dubai Desert Conservation Reserve	16	4.5 Intern, Undergrad student & Volunteers Projects	28
	4.4.3.	Assessment of forage productivity and carrying capacity	16	5. Wildlife Re-introductions	29
	4.4.4.	Monitoring of the Arabian Oryx (Oryx leucoryx) in the DDCR1	17	6. DDCR Visitors	30
	4.4.5.	The Genetic Study of the Arabian Oryx population in Dubai	18	7. Major Projects in 2019-2020	3
	4.4.6. Monitoring of arid rangeland ecology using unmanned		18	7.1. DDCR Visitor Centre	3
Aerial Vehicles (UAVs) desert drones over Dubai			8. DDCR Affiliations	32	



1. Introduction

Over the past year, the Dubai Desert Conservation Reserve (DDCR) has started to recover from the challenges posed by the global pandemic which impacted our finances, research work and tourism. In doing so, through the dedicated work of our DDCR team, we have continued to make progress in conserving the incredible species and landscapes of the Dubai inland desert ecosystem.

We continue to be true to our Vision, Purpose and Goals as we look to a successful future for the natural habitats and species we are working to protect while sharing the amazing environment with visitors to the DDCR.





Vision:

'A desert haven for nature A living heritage for people'

DDCR's overall purpose

Conserve a representation of Dubai's Inland Desert original landscapes and indigenous fauna and flora, through careful and effective management that promote natural processes for optimum conservation outcomes leading to rewilding of the desert habitat.

Provide an authentic desert experience for people which showcases the beauty and marvel of the natural environment and educates on the intricacies of nature and the living heritage of Dubai.

Strategic management goals

Our strategic management goals for the 2019 – 2024 planning period are



Embark and progress on a new rewilding paradigm for regional desert conservation fostering thriving habitats and a diversity of indigenous species



All species populations, particularly ungulates, are in balance with the natural regenerative properties of the available vegetation



All management interventions and practices are sustainable and orientated towards natural habitat rehabilitation



The reserve is an IUCN Green List protected area with effective management, good governance and planning that are realising optimum conservation outcomes



The DDCR is a regional leader in biodiversity conservation and building resilience to climate change in arid land ecosystems



The reserve is promoted and recognised as the premier destination for authentic nature-based experiences in the UAE









2. DDCR Governance and Management

The DDCR's governance is in accordance with the Rulers Decree 11-2003 on the establishment of Protected Areas in the Emirate of Dubai. A Memorandum of Understanding has been signed between the Government Authority (Dubai Municipality) and Emirates Airline, as the designated Management authority.

Underscoring its commitment to supporting conservation efforts, Emirates spent AED 8 million for DDCR over the last six years. Cumulative sponsorship support from Emirates now exceeds AED 28 million since the establishment of the reserve.

The Dubai Conservation Board (DCB) is Chaired by His Highness Sheikh Ahmed bin Rashid Al Maktoum.

Emirates Airline Executive Management is represented by

- Mr Ali al Soori General Secretary DCB,
- Mr Devarajan Srinivasan VP Asset Management,
- Mr Rahul Sawhney Manager (Asset Management)

Key responsibilities:

- Work with operational management to formulate and approve a strategic direction for DDCR (DDCR Management Plan 2019 2024)
- Due diligence on the induction of new Tour operators
- Revenue management strategies and tacticals
- Approval of annual operational budgets and monitoring of expenses
- Funds management





The Operational Management team

Greg Simkins-Conservation Manager DDCR

Greg has worked in the field of conservation and protected areas management since 2001. He began his career as a Field Guide with the Emirates Group in 1999 at the newly opened Al Maha Desert Resort & Spa. In 2001 he became a Reserve Officer and was heavily involved in the planning and implementation of ecotourism activities within the protected area of the DDCR, which was created in 2002. In 2003, Greg took on his current role and was appointed Conservation Manager for the DDCR. He is responsible for the overall management of the reserve and has been at the forefront of its development from conception in 2003 to its current international recognition. Greg also plays a major role in implementing the long-term strategy for the DDCR's conservation programs, sustainable tourism and species management, including the re-introduction programs for the Arabian Oryx, Macqueen's Bustard, Arabian and Sand Gazelles.

Key responsibilities

- Work with executive management to formulate a strategic direction for DDCR. (DDCR Management Plan 2019 - 2024)
- Implement all conservation programmes
- Implement all research and monitoring activities
- Manage sustainable tourism within the DDCR

Basil Roy - Conservation Officer DDCR

Basil has lived most of his life in the Arabian Peninsula and is attached to its people and natural environment. During his Masters of Environment Studies from the Sorbonne University Abu Dhabi between 2017 and 2019, Basil was involved in monitoring the DDCR's Spiny-tailed Lizard population and surveying the reintroduction of the Asian Houbara into the reserve.

Prior to joining the DDCR team in 2022, Basil was an Environmental Consultant at Nautica Environmental Associates LLC, an environmental consultancy based in Abu Dhabi offering environmental services including terrestrial and marine surveying and environmental monitoring. His primary roles at Nautica included environmental data collections, analysis and scientific reporting, environmental education and outreach activities.

During his time at Nautica, he was part of the terrestrial environmental team embedded with the ADNOC/BGP 3D seismic survey project, providing oversight and feedback on seismic activities conducted inside Abu Dhabi's Environment Agency protected areas. Basil was in charge of gathering environmental data and supervising seismic operations in order to monitor the status of the flora and fauna found in these protected areas.

Currently, Basil's primary role is to plan, control, develop and regularly monitor the conservation practices and environmental work within DDCR. As part of his work, he conducts new research, plans and implements longterm monitoring programs including the Arabian Oryx monitoring program.



3. Significant Events in 2021-22

July 2021:

Construction work started for the DDCR Visitor Centre

August 2021:

102 Arabian Oryx were relocated from the DDCR to a protected area in Ajman

October 2021:

97 Arabian Oryx were relocated from the DDCR to the Oryx enclosures

December 2021:

39 Arabian Oryx were relocated from the DDCR to the Oryx enclosures

January 2022:

Start of the first Archeology Survey in the DDCR

March 2022:

24 Arabian Oryx were relocated from the DDCR to the Oryx enclosures

Research Collaborations

The 9th Research committee meeting was held on 4th of July 2021





Workshop Participation

"Global Standard for the identification of KBAs" for national experts. A workshop hosted by Ministry of Climate Change and the Environment (MOCCAE) to work with its partners on a project that aims at the identification of Key Biodiversity Areas (KBAs) of UAE, following the Global Standard for the Identification of KBAs as sites of importance for global persistence of Biodiversity. (September 20th - 22nd 2021) – Greg Simkins & Tamer Khafaga.

Expo 2020 Climate and Biodiversity Forum (October 4th 2021) - Greg Simkins

Presentations

Czech University of Life Science – Lecture to university students of the Protected Areas Management Course - "DDCR & the IUCN Green List of protected and conserved area" (November 1st 2021) - Greg Simkins.

Other Activities

Carbanna University Masta

Sorbonne University Masters 1 student field visit to DDCR (October 11th 2021)

Saving the Wild's Middle East premiere of Kimana Tuskers at the New Zealand Pavilion at Expo 2020 (November 3rd 2021

Sorbonne University students conduct the first Archeology Survey in the DDCR (31st of January to 11 March 2022)

American University of Central Asia students conduct Arabian Red Fox Survey in the DDCR (18th - 27th of February 2022)

4. Conservation and Environmental Research Work

Research Policy, DDCR Management Plan 2019-2023

Research conducted within the DDCR should assist in applying sound scientific ecological principles to the decision-making process or/and add new knowledge about the species and habitats of the DDCR. The DDCR will be promoted as a destination for applied research in arid land ecosystems by national and international academic institutions. The DDCR Research Committee will evaluate all research proposals based on relevance to the reserve, ethical, and practical implications.

Research is vital for the effective management of the DDCR and to make informed management decisions as well as in the mitigation against climate change and desertification.

4.1. **Desert Research Centre**

The vision of the research centre is to promote and facilitate scientific studies by establishing and running a program to solve environmental challenges with collaborative research on natural, human, social and ecological aspects of the inland hyper-arid desert toward developmental progress. DDCR seeks a leadership position within the UAE and the region by building a robust scientific community connected with the UAE, regional and international stakeholders.

We aim to prioritise the continued integrity of the ecological and social systems, values and resources, by facilitating research and providing study opportunities, logistical and field support within a research-friendly environment for students, researchers and volunteers to address essential questions and gain experience and network skills and to become a centre of excellence in biodiversity research.









The objectives of the Desert Research Centre are:

- Encourage and undertake high-quality research
- Conduct research addressing environmental policy objectives
- Develop research projects that provide practical evidence to inform policy
- Promote and facilitate collaborative and multidisciplinary research
- Establish links with both international and national research bodies for cooperation and sharing of research information
- Organise meetings, seminars and forums

The DDCR aims to utilise research collaboration for the following purposes:

- Grow functional capacity for effective management and governance of protected areas in the UAE and West Asian Region
- Draw on universities' strengths, expertise, and technical capabilities and other institutions in UAE and internationally to offer the highest quality research products
- Build on the regional opportunities and enhance the chances to demonstrate, guide and support quality research in protected areas
- Adapt, facilitate and coordinate protected area research and spread research results
- Recognise, adapt, develop and promote excellence and model practice in protected areas research
- Encourage and assist researchers willing to improve their knowledge and skills in protected areas' research activities to find research ideas and opportunities relevant to their needs, and facilitate ongoing learning and sharing through professional networks and communities of practice



Following the establishment of the DDCR Research Centre; DDCR initiated a Research Committee to evaluate all research proposals based on relevance to the reserve, ethical and practical implications with a defined Terms of Reference (ToR) and regular (Bi-annual) meetings to propose, evaluate and guide research activities within the DDCR.

The Research Committee members are from diverse backgrounds and well regarded in their respective fields.

Name	Affiliation	Institute			
Greg Simkins	Conservation Manager	DDCR - UAE			
Tamer Khafaga	Manager, Research & Natural Resource Management	King Salman Royal Nature Reserve - KSA			
Moayyed Sher Shah	Senior Ecologist Specialist, Wildlife & Natural Heritage Department	Royal Commission for AlUla - KSA			
Gary Brown	Ecologist	Freelance - Germany			
Brigitte Howarth	Entomologist	Zayed University - UAE			
Jacky Judas	Ornithologist	Emirates Nature -WWF - UAE			
Kosmas Pavlopoulos	Geologist	Sorbonne University Abu Dhabi - UAE			
Andrew Leonce	Computer Science	Zayed University - UAE			
Stephane Boissinot	Herpetologist	New York University - UAE			
Janin Tan	Entomologist	Zayed University - UAE			
Roxanne Whelan	Ecologist -young professional	Freelance			
David Gallacher	Ecologist	Sydney University - Australia			
Teresa Navarro	Botanist	Malaga University - Spain			





4.3.1 Arabian and Sand Gazelle in the DDCR

This survey aimed to collect species count and ecological data for the two gazelle species present in the reserve namely the Arabian gazelle (Gazella arabica) and the Sand gazelle (Gazella marica).

A total of 732 Arabian gazelles were recorded, they were mostly concentrated in the north and southwest regions of the reserve, specifically around farms, plantation areas and feeding points. A total of 178 Sand gazelles were counted and they were mainly gathered in irrigated areas but showed no interest in feeding spots. The number of females was higher in both species and their social structures were very similar. Both gazelle species increased in numbers since 2020 with a 161% increase for the Arabian Gazelle and 87% for the Sand gazelle. The more focused methodology used for this survey showed a much greater accuracy when compared to either the Biosphere survey or the Weekly DDCR Ungulate counts and will now be used annually as part of the DDCR Monitoring Program.

Order	Scientific Name	Common Name	IUCN Status	No. of Images	No. of Events	No. of Locations	Occurrence	Occasion length
Mammalia								
Carnivora	Felis lybica	Arabian Wildcat	VU	38	5	2	5	24.2
Carnivora	Vulpes vulpes	Arabian Red Fox	LC	3,374	805	6	120	1.01
Lagomorpha	Lepus capensis	Arabian Hare	LC	0	0	0	0	0
Cetartiodactyla	Gazella arabica	Arabian Gazelle	VU	6,677	534	5	114	1.06
Cetartiodactyla	Oryx leucoryx	Arabian Oryx	VU	22,707	891	7	118	1.03
Cetartiodactyla	Gazella marica	Arabian Sand Gazelle	VU	2,785	141	4	61	1.98
Aves								
Accipitriformes	Torgos tracheliotos	Lappet-faced Vulture	EN	1,129	47	3	41	2.95
Strigiformes	Bubo ascalaphus	Pharaoh Eagle Owl	LC	178	40	5	28	4.32
Otidiformes	Chlamydotis macqueenii	Asian Houbara	VU	0	0	0	0	0

4.3.2 Camera Trap Monitoring Report 2020

A camera trap survey was included in the long-term monitoring program to target the following Major Site Value species, Lappet-faced Vulture, Pharaoh Eagle Owl, Asian Houbara and Arabian Wildcat. In addition, the Arabian Red Fox and Arabian Hare, as nocturnal species of interest in the DDCR, were also included as target species for the survey. The survey would also collect data on the remaining major site value faunal species, Arabian Oryx, Arabian Gazelle and Sand Gazelle. Camera traps have the advantage of detecting, with equal efficiency, nocturnal and diurnal activities while having minimal environmental disturbance. In addition to animal detection, camera traps can provide additional information about patterns of activity and habitat use.

Over the deployment period from 1 September until 31 December 2020, seven camera traps captured 87,194 images over a total of 811 Live Camera Days. In total 41 species were recorded: 7 mammalian species and 34 avian species. The highest biodiversity richness was at Tawi Fawi and Faqah CT sites with 28 and 18 species recorded at each site respectively. The lowest richness was recorded at Nazwa and Margham CT sites. There were no recordings of Arabian Hare and Asian Houbara in 2020.

Arabian Oryx, Arabian Gazelle, Laughing Dove, Eurasian Collared Dove and the Arabian Red Fox were both the most common species in CT images and the most widely recorded (most locations) species within the DDCR (Appendix 1).

Other Species: The camera traps located on waterholes proved good for recording birds, with 31 avian species recorded. Of particular interest were the recordings of Cinereous Vulture (3 events), Eurasian Griffon Vulture (1 event) and Barn Owl (6 events) - all rare sightings in the DDCR. The Vulture species were always detected together with Lappet-faced Vultures.

Other Raptors included: Bonelli's Eagle (4 events), Eastern Imperial Eagle (3 events), Shikra (3 events), Pallid Harrier (2 events), Long-legged Buzzard and Crested Honey Buzzard (1 event each).

As would be expected, doves were some of the most regularly recorded species: Laughing Dove (276 events) and Eurasian Collared Dove (271 events). However, 2 species of doves were recorded on rare occasions: European Turtle Dove (34 events) and Namaqua dove (1 event).



Behaviour	Time	Date	Comments	
Male owl regularly brings prey to the nest site, going inside the broom bush shrub	6 pm to 6 am	10th to 22nd March	Prey are all rodents	
The first appearance of an owl chick on camera trap	06:06 pm	23rd March	The date does not correspond to hatching dates, inside shrub is not visible by the camera trap	
Chicks stay at the entrance of the nest and are active	6 pm to 6 am	23rd March to 16th May	Chicks' activity includes being fed and moving around in close vicinity to the nest	
Male owl regularly brings prey to three chicks in front of the entrance of the nest	7 pm to 6 am	7th to 19th April	Prey are primarily rodents and one hare, lizard, and snake	
Adult owls leave the nest site	-	19th of April to 16th May	Dates correspond to when adult owls were last seen on camera trap	
Owl Chicks leave the nest site	-	16th to 19th May	Dates correspond to when chicks were last seen on camera trap	

The primary prey brought 1to the nest site by adult owls were rodents, including gerbils and jerboas. Other prey recorded on the camera trap was a hare, lizard, and snake

4.4.3 Monitoring of Pharaoh Eagle Owl in the DDCR

The DDCR is one of the few reserves in the UAE where Pharaoh eagle-owl, Bubo ascalaphus, breeding has been recorded. Globally the Pharaoh eagle-owl is classified as "Least Concern", but in the UAE it is classified as "Critically Endangered" and is a major site value for the DDCR. This survey is part of an annual and continuous study to record the Pharaoh eagle-owls population and breeding status in the DDCR.

On the 4th of March, during a resurvey of the southeast fence area, an owl nest containing three eggs was found inside a large Broom Bush, Leptadenia pyrotechnica, near the Sahara 3 Gate. Once identified, a camera trap was deployed a few meters from the entrance of the nest from the 4th of March until the 19th of May 2022.

A one-week survey to find Pharaoh eagle-owls, Bubo ascalaphus, was conducted inside the Dubai Desert Conservation Reserve (DDCR)

between the 10th and 18th of January 2022. The primary aim of the survey was to locate adult roosting owls or nests and identify potential sites for breeding. Once these sites were identified, they were then resurveyed in the last months of winter. On the 4th of March 2022, an owl nest containing three eggs was found inside a Broom Bush, Leptadenia pyrotechnica, near the southeast fence of the reserve. The nest site was then continuously monitored, by camera trap and regular visits using binoculars and long-range cameras, until the 19th of May 2022, when the nest was no longer in use.

During the Survey, three adult Pharaoh eagle-owls were sighted roosting in the DDCR, the owls were recorded in three different habitats, including a mountain slope with crevices, a Prosopis+ cineraria tree grove, and a sand dune with Leptadenia pyrotechnica shrub cover.

After reviewing the camera trap footage, several observations were made on the owl's behaviour and eating habits.

4.4 Current Research

4.4.1 Monitoring Program for the Major Site Values of the DDCR

This program includes the objectives, methodology and expected outcomes of monitoring each of the major site values (MSV) identified in the DDCR Management Plan. The results of this program will provide us with performance measures for each of these MSV and will be used to evaluate our success in achieving successful conservation outcomes. https://www.ddcr.org/media/Monitoring_Program_for_the_Major_Site_Values_of_the_DDCR.pdf

	DDCR Monitoring Plan						
	Major Site Values	Monitoring Study	Aim	Methods	Timelines	Performance Measures	Thresholds
1	Fauna						
1.1	Arabian Oryx Oryx lueoryx	Monitoring of Arabian Oryx in the DDCR	Maintain a healthy, optimum and self-sustaining population of Arabian oryx in the reserve.	Species Weexkly Counts	Weekly (Every Tuesday)	Population Size	200 - 300
	Or yx lueor yx	Oryx III THE DDCK	To achieve this aim it is imperative to implement a long-term monitoring program in order to have a better understanding of the Arabian oryx population and their requirements and subsequently to utilise this understanding to make better management	Body Condition Scoring	Annual	Body Condition Score	3
				Distribution Assessment	Annual (January)	Breeding Effort	Min. replacement
			decisions for the DDCR.	Movement Studies	Continuous (Tracking Data)		
1.2	Arabian Gazelle Gazella arabica	Monitoring of Arabian Gazelle in the DDCR	Maintain a healthy, optimum and self-sustaining population of Arabian gazelles in the reserve. To achieve this aim it is imperative to implement a long-term monitoring program in order to have a better understanding of the Arabian gazelle population and their requirements and	Species Weekly Counts	Weekly (Every Tuesday)	Population Size	200 - 300
			subsequently to utilise this understanding to make better management decisions for the DDCR.	Distribution Assessment	Annual (January)		
1.3	Sand Gazelle Gazella marica	Monitoring of Sand Gazelle in the DDCR	Maintain a healthy, optimum and self-sustaining population of Sand gazelle in the reserve. To achieve this aim it is imperative to implement a long-term monitoring program in order to have a better understanding of the Sand gazelle population and their requirements and subsequently	Species Weexkly Counts	Weekly (Every Tuesday)	Population Size	200 - 300
				Distribution Assessment	Annual (January)	Breeding Effort	Incr. Population
			to utilise this understanding to make better management decisions for the DDCR.	Movement Studies	Continuous (Tracking Data)		
1.4	Lappet-Faced	Monitoring of	Gain a better understanding of the status of the Lappet-faced vulture population visiting	Observations	Continuous	Population Size (visiting)	20 - 40 individuals
	Vulture	Lappetfaced Vulture in	the reserve and identify their home-range, breeding and roosting sites	Camera Trapping (Water points)	Continuous	Roosting	Roosting site identified
	Torgos tracheliotus the DD0	the DDCR		Camera Trapping (Vulture Resturant)	Continuous	Breeding	Breeding site identified
				Movement Studies	Continuous (Tracking Data)	2.000g	2. 303 3 3
1.5	Pharaoh Eagle Owl	Monitoring of Pharaoh	Gain a better understanding of the population status of the Pharaoh eagle owl within the DDCR and to learn more about their diet and breeding ecology.	Survey (Pharaoh Eagle Owl)	Every three months	Population Size	5 - 10 Pairs
	Bubo ascalaphus	Eagle Owl in the DDCR		Nest Survey (Pharaoh Eagle Owl)	Annual (Feb - May)	Breeding Effort	2 - 5 Nests
				Diet Analysis	Every three months	Brecomy Errorr	Z 3 Nests
				Camera Trapping (Water points)	Continuous		
1.6		Monitoring of the	To have a established breeding population of Macqueen's bustard in the DDCR and surrounding area. Macqueen's bustards are released annually during the winter months by NARC.	Release	Annual (January/February)	Population Size	25 - 50 individuals
1.0		Macqueen's Bustard in the		Species Weekly Counts	Weekly (Every Tuesday)	Breeding Effort	1 - 5 Nests
				Distribution Assessment	Annual (January)	Dreeding Entors	1 3 116313
				Movement Studies	Continuous (Tracking Data)		
					, , ,		
				Standardized Circular Observation Counts	Annual (Feb - May)		
17	Anabian Wildoot	Manitaring of Arabian	To have a better understanding of the population status of the Arabian wildcats exists in DDCR and collect morphological data . As main threat to Arabian wildcats the Feral cats will be eriducated from DDCR.	Nest Survey (Macqueen's Bustard)	, ,,	Donulation Size	Dracanca
1.7	Arabian Wildcat Felis lybica lybica	Monitoring of Arabian Wildcat in the DDCR		Trapping - monitoring	Annual (January)	Population Size	Presence
				Trapping - Survey	Every three years	Feral Cats	
				Camera Trapping	Annual (January - February)	Breeding Effort	
				Trapping (Feral Cats)	Continuous		
2.1	Habitats Sound Shoot with	Vanatatia		Va C	F C	D:	0.0 0.0 (6:
2.1	Sand Sheet with Perennial Herbs	Vegetation survey for sand sheets with perenial	To implement the continuous practical and efficient vegetation monitoring program with the application of appropriate functional analysis for valid data interpretation that will lead to	Vegetation Survey	Every five years	Diversity	0.8 - 0.9 (Simpson)
	. Cremmar Fieros	herbs	adaptive management plans for the reserve with sets of priorities and objectives.	Vegetation Monitoring	Annual (January)	Cover	05 - 10 %
2.0	1			N. C.	5 6	Species Distributions	0.0.00.00
2.2		Vegetation survey for interdunal and gravel plains	To implement the continuous practical and efficient vegetation monitoring program with the application of appropriate functional analysis for valid data interpretation that will lead to adaptive management plans for the reserve with sets of priorities and objectives.	Vegetation Survey	Every five years	Diversity	0.8 - 0.9 (Simpson)
	ano diaveri lams			Vegetation Monitoring	Annual (January)	Cover	05 - 10 %
7	-		adaptive management plans for the reserve with sets of priorities and objectives.			Species Distributions	
5	Flora						
3.1	Ghaf Groves Prosopis cineraria	Ghaf Groves Drone Survey	Mapping the change in the natural Ghaf groves over time is an essential aspect of conservation of the DDCR natural resources. Current drone-based methods can estimate the change in biomass, but monitoring at the species level currently requires on-ground	Drone Survey (Ghaf Groves)	Annual (January - May)	Trees population	
		observations. This project will explore the viability of tracking changes of individual tree plants over time across the two Ghaf groves, by capturing information from each temporal survey and combining into a single database format.				Tree health (NDVI)	



4.4.2 Quantitative analysis of the Hyper-arid vegetation changes under grazing pressure in the Dubai Desert Conservation Reserve. DDCR (2020/FL-EC/02)

Implement a continuous practical and efficient vegetation monitoring program by applying analytical tools for effective data interpretations. As vegetation is the base of the food pyramid, the expected data and information are indispensable for managing the Dubai Desert Conservation Reserve (DDCR). This study will evaluate the current state of the DDCR vegetation, and it focuses on the assessment of density, cover, and biodiversity of the flora in the DDCR and follows the continued monitoring and repeated vegetation studies of 2004 (El Alqamy, 2004) and 2009 (Khafaga, 2009). To present the results by mapping the vegetation and defining the linkage between different floral communities, using multivariate analysis combined with GIS techniques.

Update: this project is in the stage of writing a comprehensive report as part of Tamer Khafaga's PhD thesis, which will be submitted to the University of Malaga.

4.4.3 Assessment of forage productivity and carrying capacity. DDCR (2012/FL-EC/01)

To investigate and recommend strategies to manage and restore the rangelands and conserve their biodiversity in the Dubai Desert Conservation Reserve.

- Quantification of the forage productivity and evaluation of the impact of important determining factors, such as soil and rainfall.
- Estimation of the rangelands carrying capacity, that is, the maximum possible stocking of livestock that a rangeland can support on a sustainable basis.
- Assessing the response of soil and vegetation to different grazing management practices for optimal rangeland use.
- Assessment of the possibility of restoring the degraded rangelands with indigenous forage plants and defining the most appropriate conditions for this process.







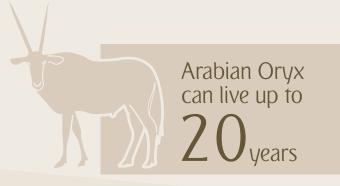
4.4.4 Monitoring of the Arabian Oryx (Oryx leucoryx) in the DDCR. DDCR (2016/FN-EC/01)

To gain an understanding of the ecology of the Arabian Oryx within the DDCR, in particular, we will look to determine their home range and which habitats, within that home range, they prefer and finally which plant species they utilise within that habitat.

- Gain a better understanding of the movements of Arabian Oryx through the use of GPS collars and so collect data on their home range and habitat selection.
- Gather data on activity patterns (i.e. time spent grazing, resting or moving) of the Arabian Oryx in relation to factors such as habitat, temperature, sex and life phase.

- Gain an understanding of the dependence of the Oryx herd on the provided feed and how this can affect their behavioural and distributional patterns.
- Study the grazing habitats of the Arabian Oryx to establish grazing preferences in relation to plant species and growth form.

Update: During the reporting period, out of the six Arabian Oryx secured with GSM/GPS collars in DDCR, four collars were retrieved. Locations and other data related to the movements of the collared Arabian oryx were successfully recovered from the collars. Data analysis is on-going and a research paper will be completed in 2022.





4.4.5 The Genetic Study of the Arabian Oryx population in

Dubai. DDCR (2018/FN/01)

Over the past 20 years, the breeding of Arabian Oryx has been very successful, both in Dubai and around the world. Bringing the species back from the state of Extinct in the wild and classified as Endangered by the IUCN Red List to having healthy re-introduced populations in several countries have led to a downgrade of its endangered status to Vulnerable. However, it is important to now change the objective from reproduction to a sustainable population by ensuring we have the most genetically diverse and viable population possible to ensure their long-term survival.

This research aims to achieve the following:

- Ascertain the genetic diversity of the Oryx population found within the Dubai Emirate.
- Utilise the genetic data to develop a strategy to improve the genetic quality of Dubai's Arabian Oryx population.
- Contribute to the regional efforts for the conservation of Arabian Oryx.

Update: During the Arabian Oryx Relocation and sorting project, 70 tissue samples were collected and they will now be sent for analysis.

4.4.6 Monitoring of arid rangeland ecology using unmanned Aerial Vehicles (UAVs) desert drones over Dubai.

DDCR (2014/EC/01)

To establish a base in this emerging field within DDCR for the civilian use of aerial photography from Unmanned Aerial Vehicles (UAVs) and demonstrating its values for arid rangelands conservation. Collecting accurate, inexpensive data to:

- Monitor grazing pressure on rangelands and estimate botanic health of an arid ecosystem.
- Estimate and monitor the population of protected and endangered species
- Arabian Oryx, gazelle species, foxes, Gordon's wild cats, Houbara bustard, birds of prey and Spiny-tailed lizards.
- Feral and invasive species, e.g. Prosopis juliflora

- Evaluate the extent of damage caused by off-road recreational driving.
- Increase the accuracy of ecological maps and consequently habitat classifications.

Update: The research project has been developed to use Al and ML with deep neural networking to detect single and multiple animals (Ungulates). This research is supervised by a professor from Loughborough University (LU) and three PhD students under his direct supervision. There is a MoU signed between both LU and DDCR.

400

Highest count of Arabian Oryx as of March 2022



4.4.7 UAV (Unmanned Aerial Vehicle) - Machine Learning for Bio-diversity Monitoring and Tracking at Scale.

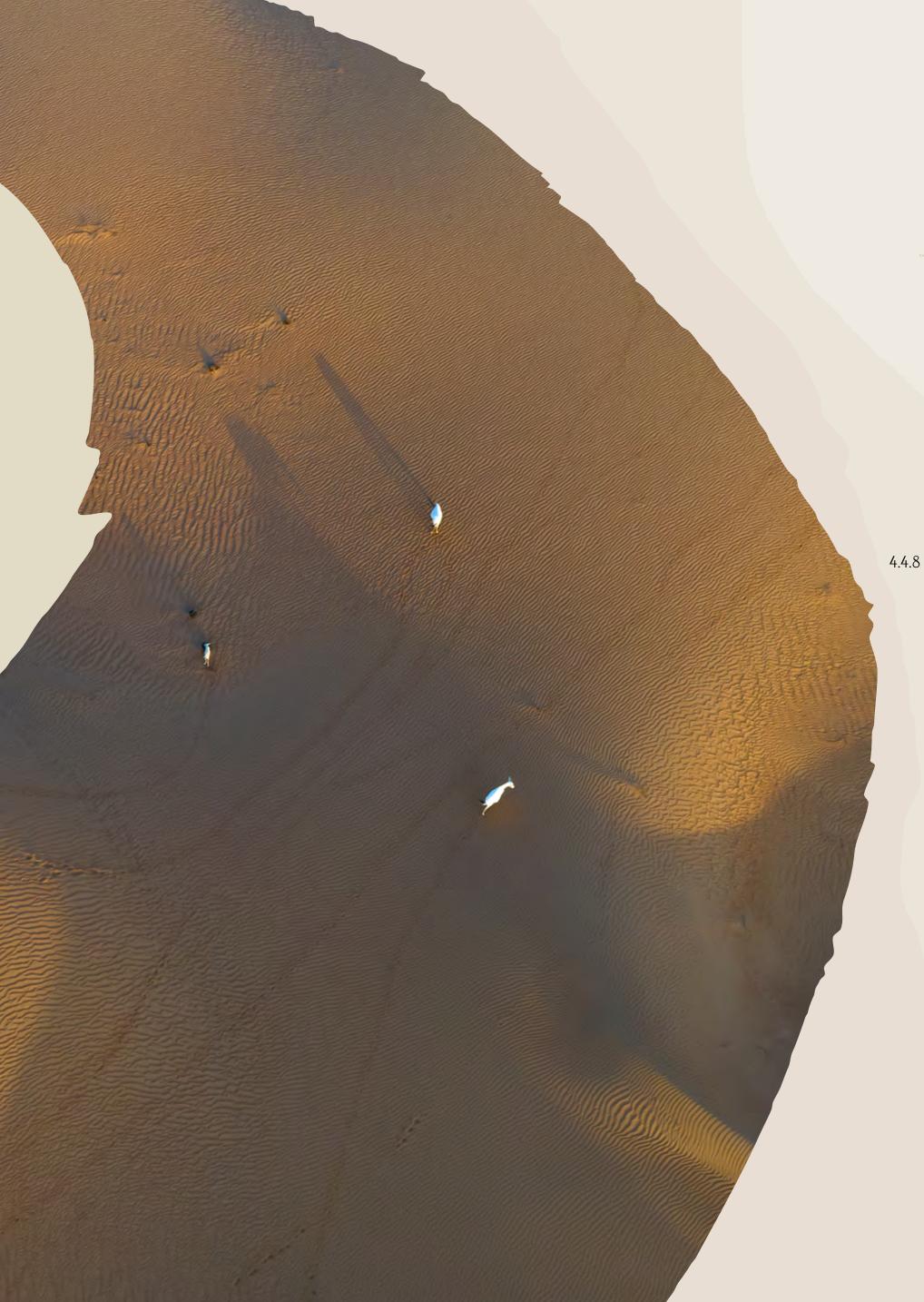
Zayed University (2019/FN-EC/05)

The need to protect the environment has taken centre stage in recent years as the damage to the Earth's natural ecological balance has become increasingly tangible. Natural reserves are set to protect biodiversity. Understanding the populations of animals and vegetation living inside the reserve is a key parameter to secure the equilibrium and the continuity of the ecosystem. We propose investigating the problem of biodiversity monitoring and tracking using machine learning techniques for useful mining information from complex data, image/videos. Deep learning methods have proven to be efficient in the image processing field. Their introduction in this area has reshaped the way images are processed and understood. The novelty in this project is two-fold: it is the first time that the performances of existing algorithms will be evaluated in such large magnitude and diversity of experiments, which will support the investigators to propose

new algorithms. The second novelty resides in the application of the approach in the area of biodiversity tracking and monitoring in the desert. In fact, the investigators are not aware of any existing efforts that suggest the application of image mining in the desert. The investigators intend to work closely with the DDCR to help detect and monitor the different species, their evolution, movement, and gender. This will directly help the DDCR better estimate the number of animals, predict their evolution, understand their moves, and understand the density of those animals. The project is expected to be beneficial for wildlife and biodiversity.

Update: This research project runs in parallel with the above project of using Al and ML with deep neural networking to detect Arabian Oryx and Gazelle in groups and as individuals. Furthermore, an animal detection and identification, of 8 species, from camera trap images has been developed.

All research results will be presented as either conference or journal articles within 2022.





As humans, we generate a large amount of plastic, and it is common practice to dispose of unwanted waste improperly in the form of litter and illegally dumped garbage. Littering has become a significant problem in many societies and contexts. Deep learning methods have proven to be efficient in the image processing field. Their introduction in this area has reshaped the way images are processed and understood. A large number of works have been performed, and many methods have been proposed to tackle different aspects of the problem. The novelty in this project is two-fold: it is the first time that the performances of existing algorithms will be evaluated in such large magnitude and diversity of experiments, which will support the investigators to propose new algorithms. The second novelty

resides in the application of the approach in the area of litter identification in the desert. In fact, the investigators are not aware of any existing efforts that suggest the application of image mining in the desert. The investigators intend to work closely with the DDCR to help detect and monitor litter in three key areas; along the boundary fence, camp areas and driving routes throughout the reserve. This will directly aid the DDCR in coordinating litter recovery as well as issuing fines to parties who have violated the regulations regarding litter. In addition to a potential monetary gain and reduction in resources deployed to patrol the reserve, the wildlife will benefit from reduced exposure to harmful objects which they may mistake for food.

Update: This research project is running in the stage of field data collection.



4.4.9 Pathogen Risk Assessment of Arabian Felines.

UAE University (2019/FN-EC/07)

Arabian felines (Arabian leopards, cheetahs, wildcats, sand cats and caracals) are either regionally extinct, critically endangered or their populations are worryingly declining in the Arabian Peninsula. Thus, the International Union for Conservation of Nature (IUCN), claimed the need to carry out further research on the factors that may threaten these five felids.

Felid conservation will increasingly need to include assessments of disease risks and strategies for disease management to be successful since it is known that most wild-feline populations are at risk of exposure to new pathogens due to deterioration of many of their inhabited ecosystems, as well as the fact that historic geographic barriers have been bridged, which might imperil population health. At the same time, due to the gravity

of these animals' situation in the wild, they are held and bred in captivity at centres worldwide.

Such captive breeding programmes are essential in maintaining genetic diversity and saving these species from extinction, since their reintroduction may be the only means of restoring their populations in the wild. Nevertheless, captive animals are more likely to contract diseases because animals live in close proximity to each other. Whereas in nature diseases that are caused by parasites comprise one of the major problems resulting in even morbidity and mortality in these animals, in captivity the effects range from sub-clinical to death. In this framework, this project would aim to determine the types, prevalence, and intensity of parasitic, bacterial and viral infections in the wild and captive Arabian felines located in the United Arab Emirates and Oman. Very little has so far been published on pathogenic diseases of these felines in the Arabian Peninsula either in the wild or

in captivity, and a study of this scope in such a field would be the first of its kind. The results obtained will constitute baseline data and a vital reference for future research in such a neglected area. Moreover, the knowledge obtained from this project will, inevitably, be used in future reintroduction and reinforcement projects of these species in both countries.

Update: A total of 11 carnivore faecal samples were collected during systematic surveys in DDCR, of which none of them was from felines. The DNA isolated from all faecal samples was sent to be analysed by Next Generation Sequencing and Bioinformatic analyses was carried out to determine the microbial species present in the samples and their abundance. Statistical analysis is being performed on this data and manuscripts are being prepared to publish in the coming academic year.





The following predictions currently available by SUAFS (http://forecast.psuad.ac.ae) are:

Weather forecast for 72 hrs ahead (3 days)



Desert dust forecast for 72 hrs ahead (3 days)

SUAFS is operational since July 2018 and an annual archive of weather and desert dust forecasts are almost available for evaluation. This research proposal offers a unique opportunity to initiate the framework for an important collaboration with DDCR in terms of environmental warnings and monitoring. Thus, the main aim of Phase-1 is to validate SUAFS forecasts

identify the forecast errors of the system and their propagation into the period of the simulation. The results of this research work will lead SUAFS forecasts to achieve greater accuracy and reliability especially over the area of interest.

These results will be the base of Phase 2, which focuses on the air quality monitoring and dust forecasting for the DDCR. All the results will be available to the DDCR and SUAD and a report with all the data will be submitted. Phase-1 will also act as a preparatory phase for attracting additional funding to launch the demanding Phase-2.

Update: Project is in phase-1 data collection





4.4.12. Post Translocation Changes in the Behaviour and Population Dynamics of Antelopes in Arid

Environment. (2020/FN-EC/08)

The intentional movement of antelopes from one protected site to another - known as translocation - has been practised in the Middle East region for over 30 years. It has proven its effectiveness in saving the rare Arabian Oryx (Oryx leucoryx). Often, to ensure the animals' fitness and survival, managers have to provide food and water for the ungulates, especially in the condition of scarce vegetation cover in the desert. What impact do these management measures and new environmental conditions having on the antelope? Direct human presence, as well as the presence of man-made structures or activities in proximity to animals, may influence the animals' natural behaviour by altering their space use pattern and habitat selection (Cable 2013; Lone et al. 2015; Jobson et al. 2020), flight response (Stankowich 2008; Lima et al. 2015; McCance et al. 2015; Uchida et al. 2019), drive changes in migratory routes (Found & St. Clair 2016) and self-directed behaviour (McDougall 2012). The animal habituation to external support might play a negative role in their long-term survival and form altered behaviour patterns in the young generation. Moreover, animals' interaction with manmade structures, response to human or vehicle approaches, and habituation to anthropogenic disturbance will affect antelope temporal space-use patterns. It is therefore important to detect early signs of habituation

in wildlife and adjust management measures accordingly, to guarantee that antelopes will survive after the management support is reduced or minimised.

Another interesting direction of the research is the alteration within the population dynamics parameters in response to changing animals' density in the area. We will focus on the following parameters. Age-sex structure (e.g., calf:adult female, adult female:adult male ratios). This parameter is density-dependent and used to monitor ungulate populations - their age structure, recruitment, survival, and reproductive rates (Harris et al. 2008). What group organisation pattern is prevalent at the range-limited areas with interventional management should be discovered.

The focus species of the current research is the Arabian Oryx (Oryx leucoryx), re-introduced into the Dubai Desert Conservation Reserve (225 km², fenced). The founder population on the site was born in captivity. There are several factors in the reserve that potentially influence the behaviour of antelopes: artificial barriers (fence), feeding supplies, constant human presence, human recreation area, roads. The management team is well-aware of potential hazards and limitations on the facility type from a conservation perspective and therefore, implement several effective counteractions.

We aim to expand our understanding of the impact of translocation and management measures on behaviour patterns



and population dynamics of the Arabian Oryx in managed breeding facilities, by investigating the dynamics of population parameters within the range-limited population of desert antelope with regard to the translocation activities, performed on these individuals. Complex understanding of demographic parameters (survival rate, mortality rate, group size, age-sex structure, etc.) and factors (environmental, demographic, social) playing a role in the Oryx population development will help to predict the species population's future on the translocation site. The second aim is to understand the behaviour strategies of the desert antelope at the translocation sites in response to particular anthropogenic influence. Such behavioural parameters (activity pattern, strategies in dealing with human presence) will provide crucial information on preserving the natural behaviour of the species within conservation management strategy.

Such a complex understanding of demographic and behavioural parameters will provide crucial information for species conservation management strategy. Moreover, it will assist in identifying potential hazards both for the animal population on the site and for human actors working there. Finally, it might provide solutions on how to maintain the natural behaviour of rare ungulates. The project duration is 2021-2023 and aims to result in several scientific publications, conference presentations and publishing of guidelines.





4.4.13. Monitoring Long-term Vegetation Dynamics and Responses to Hydroclimate Changes Using Satellite Remote Sensing. (2021/GE-EC-FL/02)

Seasonal dynamics and interannual variation of vegetation growth are strongly related to temperature variations in most terrestrial biomes, but water moisture is a significant factor in determining vegetation production in arid and semi-arid regions. Studies using satellite remote sensing have been widely used to demonstrate that vegetation productivity and associated ecohydrological processes are strongly influenced by hydroclimate changes in dry climate zone. Despite its importance, there are few studies on the changes in vegetation growth, and the resulting responses to climate and environmental changes in dryland ecosystems, particularly within the UAE. This investigation will use satellite remote sensing data records to assess long-term trends in temperatures, precipitation, soil moisture, and the metrics related to vegetation growth and productivity. We will examine vegetation growth responses to hydroclimate changes derived from precipitation and soil moisture over the Dubai Desert Conservation Reserve (DDCR). The multi-sensor satellite data records would include daily air and land surface temperatures, daily accumulated precipitation, surface and root-zone soil moisture, vegetation index, gross primary productivity, and evapotranspiration as

well as the quality of the water bodies and their biota that existing within the studied area. This research will provide a better understanding of long-term trends in climate changes and vegetation growth, spatial and temporal patterns of these variables, and the seasonal response of the vegetation growing season cycle and soil moisture feedbacks to hydroclimate change and provides important insights for future climate and environmental feedbacks and their consequences on biogeochemical dynamics in arid or semi-arid ecosystems.

4.4.15 Habitat Mapping and Change Detection in the Dubai Desert Conservation Reserve (DDCR) Using Remote Sensing and Geospatial Data Analysis. (2021/EG-EC/01)

The main objective of this project is to utilise remote sensing and geospatial data analysis to support and inform the efficient management of the DDCR. The project is expected to include the major work packages described below. The habitat mapping efforts in the DDCR will focus on understanding the relationships between land use and habitat changes. The several outcomes are expected to help to define and describe the anthropogenic influences on the reserve from existing upland watersheds, and environmental stressors related to climate change for more concerted monitoring efforts of the reserve.





4.4.15. Air Dust Sources in UAE: Understanding Processes that Control Spatial Distributions of Dust Emissions. (2021/GE-AS/01)

Desert dust mineralogy has recently attracted great attention, because of its influence on ocean productivity through the available iron content, its effect on the ice nucleation process, radiation and the climate. Also, the human health impact depends? on the iron content of dust particles, and thus from their mineralogy. Concerning the mineralogy of dust particles, only a few works try to estimate the impact of mineralogy, each one on a different aspect (e.g., radiation, biochemistry etc.). The main reason is the lack of reliable information, which could provide the necessary minerals mass fraction of desert dust.

The aim of the project is the investigation of the mineralogy in the broader UAE area, which will cover all the potential dust sources in the region of interest. This will be realised with soil measurements, and in-situ sampling methods, which will be deployed in order to analyse the geochemical characteristics of outcrops and associated alluvial fans and dunes in the United Arab Emirates (UAE), the Sultanate of Oman and the Kingdom of Saudi Arabia (KSA) areas. The outcome will primarily provide the essential information for the parameterisation of dust particles chemical and physical processes. The soil measurements will also set the foundations for future studies related to the impact of dust composition on the radiation budget, cloud physics (clouds seeding), ocean productivity, the climate and human health. Additionally, the compatibility with existing databases of dust mineralogy and satellite products will be tested against the soil measurements, revealing their potential for future development of a mineralogical database in the greater Middle East. SUAD will be the principal investigator (PI) with three collaborated departments (Geography and Planning, Science and Engineering and IT) University of Sharjah, Harokopio University and Dubai Desert Conservation Reserve (DDCR) the co-PI of this project.



4.4.16. Archaeology, Geomorphology and Cultural Heritage in the Dubai Desert Conservation Reserve. (DDCR) (2021/GE-SE/01)

Sorbonne University Abu Dhabi has an interest to develop archaeological and geoarchaeological research in the broader DDCR area. The submitted research project will be directed by Dr. Caroline Autret, archaeologist and Head of the Department Archaeology and History of Art of Sorbonne University Abu Dhabi (SUAD). It is a collaborative project scheduled to start in September 2021. Partners are Prof. Kosmas Pavlopoulos, geologist-geomorphologist, and Dr. Haifa Ben Romdhane, sensing and GIS specialist, from the Geography and Planning Department of SUAD, as well as and Tamer Khafaga,

environmental specialist from DDCR, Dr Brigitte Howarth, a specialist in Desert ecology from the American University in Dubai, and Dr. Daniel Moraitis specialist in geochemistry from the University of Sharjah.

The ArGeCH-DDCR Research Project is an innovative research project as survey and archaeological/geomorphological research has never been done in the DDCR area. With the help of students from various Departments of SUAD, this multidisciplinary scientific team will develop and support archaeological surveys into the context of the paleo-environmental evolution in the broader DDCR area and understanding the interplay between human occupation and environmental/climatic variability of the past. As DDCR is a protected and relatively undisturbed area, it will provide the

researchers and the post-graduate students the opportunity to study the archaeological and environmental analogues of the past as a key for our understanding of both ancient desert environment occupation and the future climate change.

The ArGeCH-DDCR project also aims at raising the awareness of the students to the value of areas such as DDCR and their importance for heritage preservation and valorisation, and hence the importance of protecting and promoting cultural heritage sites in the Dubai Emirate and the UAE in general.

Update: Sorbonne University students conduct the Archeology Survey in the DDCR from 31st of January to 11 March 2022 collecting many artefacts which are now being cleaned and sorted. Seismic geophysical survey was also completed at a prime site with core soil sampling to now be conducted.





Ungulate populations policy:

In line with the DDCR's purpose and as an ecological imperative, the policy is to significantly reduce and then regulate ungulate populations to restore the natural balance and aid the recovery of the desert ecosystem.

This will be accomplished by a tested, phased and carefully monitored program of reducing and subsequently regulating the ungulate populations that will involve a combination of translocation, controlled eradication and natural predation of the Oryx and two gazelle species, with consequent adjustments to their supplementary feeding.

The populations of Arabian Oryx in the Reserve had reached unsustainable numbers that exceeded the reserve's carrying capacity with evidence of overgrazing being evident with damaging impacts on the natural vegetation. The situation had arisen as the Arabian Oryx have no natural population regulators such as food restrictions (supplementary feed is provided), migration or predators. Excessive populations create risks of disease transmission, mortality from aggression and

of resources. It has, therefore, been necessary to implement a project to remove some Arabian Oryx from the DDCR into two adjacent enclosures and then stop the continued breeding by the separation of males and females.

Starting in April 2021 until March 2022, an additional 237 Arabian Oryx were moved to the new enclosures. These animals were then weighed, tagged and males and females separated and then released back into the enclosures. Furthermore, a total of 102 Oryx were translocated from the enclosures to a private reserve in the UAE. As of the end of March 2022 we had 230 females in the south enclosure and 163 males in the north enclosure. Further relocations to the enclosures are planned for April and September 2022.

Due to the relocation of a further 237 Oryx to the enclosures, the Arabian Oryx population on the DDCR has decreased to an estimated population of 401 as of March 2022.

Population Thresholds have been establish of 200 to 300 Arabian Oryx for the DDCR

On the 13th of July 2021, a survey was conducted in the DDCR that focused on the two gazelle species found in the reserve. A total of 732 Arabian Gazelle and 178 Sand Gazelle were counted during the survey

This project is done in conjunction with the National Avian Research Centre (NARC) and the office of HH Sheik Mohammed bin Rashid al Maktoum Since the first release in 2010, a total of 3101 individuals have been released up into the DDCR. Due to logistical complications caused by Covid-19, no MacQueen's Bustards were released over the past two years but occasional sightings of birds without satellite tags are reported by the DDCR staff.





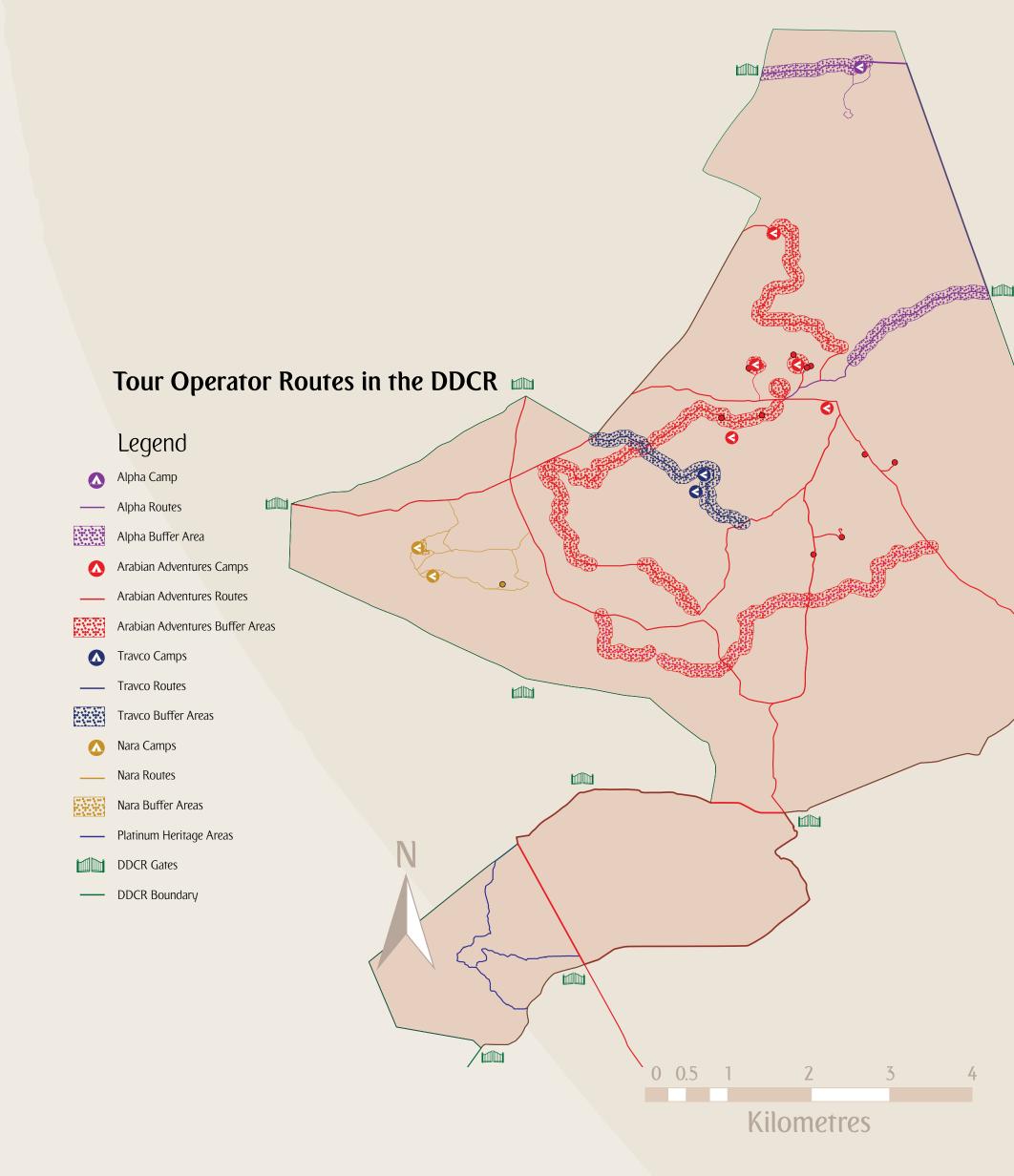
6. DDCR Visitors

Visitor Management Policy, DDCR Management Plan 2019-2024

As a premium tourism destination, the DDCR will continue to deliver a range of authentic and quality experiences for visitors by enforcing regulations and limiting visitor numbers to levels that do not undermine the Reserve's inherent values. In line with the DDCR's stated Purpose, high impact visitor activities will be strictly restricted to existing designated areas while low impact nature-based visits and activities will be promoted and encouraged with greater access to the Reserve.

Visitors to the DDCR are all through Tour Operators that hold a concession agreement with the Reserve or as guests of Al Maha Desert Resort.

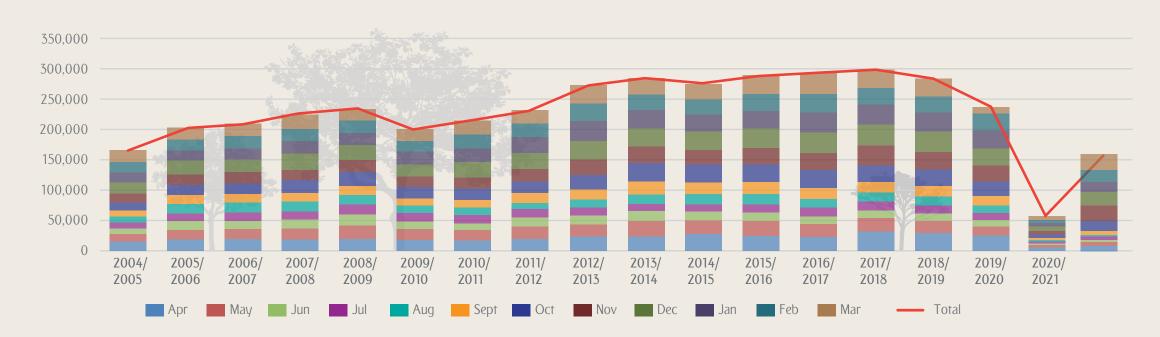
158k+
Visitors/year
in 2021/22





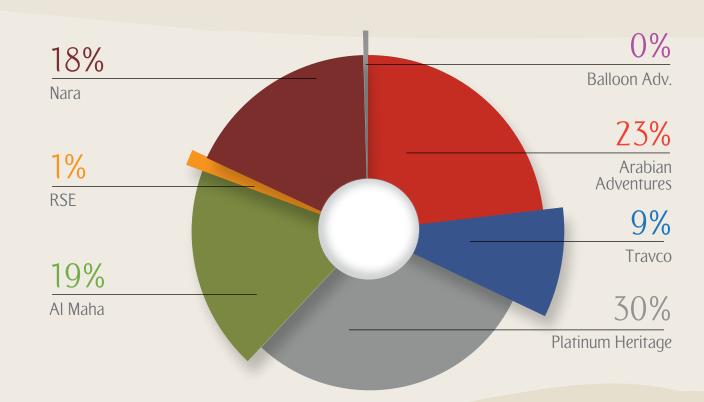
As tourism recovers from the global Covid-19 pandemic, the DDCR saw significantly increased visitor numbers, up 175% from the previous year (2020-21). However this was still well short of pre-pandemic visitor numbers.

Dubai Desert Conservation Reserve - annual visitors



A total of 60,537 visitors came to the DDCR in 2020-21, with Al Maha Resort providing the bulk of visitors.

Tour operator summary 2019-20



Alpha Tours discontinued their operation in the DDCR and a new tour operator, 57 Heritage, has been selected to replace them and should start operations in September 2022. Nara Escape have had their proposals for an Overnight camp (The Nest) and a low-impact camp at Tawi Hussein approved and will start operations at these locations from April 2022.



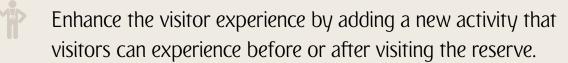
7.1.. **DDCR Visitor Centre**

Outreach and Public Awareness Policy, DDCR Management Plan 2019-2024

Concerted efforts will be made and resources mobilised to raise local, national and international awareness of the DDCR's natural and heritage significance, its conservation purpose and social values. The aim is to build wide public understanding and support for the Reserve's conservation and will involve designing and implementing awareness, outreach programs and marketing campaigns. The target audiences will be local and international visitors, tour operators, local communities and senior decision-makers.

The desert visitor centre will be a place for people to enhance their environmental awareness and connect them with the unique desert habitat of the DDCR. Visitor centres are facilities that prepare visitors physically; mentally and spiritually to experience special places.

Better visitor experience leads to better word of mouth which lead to the better success of DDCR visitor activities. The visitor centre will aim to achieve the following;



To connect the DDCR visitor with the authentic desert experience.

To be used as a platform to develop an educational program for schools and higher education.

To better understand DDCR visitors' motivation and needs to identify the opportunities to provide a better experience.

To raise the visitor's awareness of the desert values and to elicit support for its conservation.

Update: The Visitor Centre Project is in the construction phase with an estimated opening of October 2022.



8 DDCR Affiliations



IUCN Green List of Protected Areas

The IUCN Green List of Protected and Conserved Areas is the first global standard of best practice for area-based conservation. It is a program of certification for protected and conserved areas that are effectively managed and fairly governed. The DDCR is a Candidate Site for the IUCN Green List.



