محمية دبي الصحراوية
DUBAI DESERT CONSERVATION RESERVE

Emirates

Mammals of Dubai Desert Conservation Reserve: Initial Assessment and Baseline Data.

using camera-traps

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2006
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Introduction

Dubai Desert Conservation Reserve (DDCR) was setout in 2003 as a conservation area with the main aims of conserving the natural resources of inland desert of Dubai and to restore the original biodiversity of fauna and flora. Habitat rehabilitation involving tree and shrub species are already in place, running and doing well so far. Antelope reintroductions are also running for the past six years. However, other species are also targeted for future reintroduction including smaller mammals and non-antelope species of the ecosystem. The status of these species is very data deficient. Very little or nothing at all is known about the contemporary status of the species belonging to Order Carnivora in UAE and Arabia in general. Any conservation measure is in deep trouble if faced with such situation of data deficiency. Thus it was decided that the first priority for DDCR now is to assess the current situation to know what species is still there and which is gone and further to determine the priorities of the next phase. Also there was a growing concern that some feral species like cats and dogs are present within the perimeter of the reserve and these should be spotted and eliminated to maintain the will being of the counter wildlife and not to consume the prey species out. So the main questions asked here are:

1) What are the wild species of carnivore that are surviving in DDCR?
2) Where are these species distributed or found?
3) What are the densities and population size of these species?
4) Is there any feral species in DDCR?
5) Where are the feral species concentrated?

Nevertheless, as being a baseline study it was also targeted to asses the diversity of the mammal species in DDCR and to account for spatial patterns that underlie the distribution of it as it is a significant parameter in terms of overall landscape assessment approach of DDCR. There is wide variety of methods to answer these questions, and many of which involves trapping the animals. The trapping option would conventionally require a lot of resources, manpower and time. In addition it is considered very invasive from the conservation point of view and may risk individuals from already stressed populations in a harsh habitat such as the sand dune system of DDCR. However, a compromise between those is achieved by using a new technological advance introduced recently. Recent advances in technology provided a solution for this problem by the introduction of camera-traps. Camera trap is a conventional camera bundled with an infrared sensor-trigger system that triggers the camera to shot when an animal passes through an infrared beam set in across a trail or path. The camera is also hooked to an event logger with a memory that records the date and time of events through the 24 hours of the day.

Camera-traps require minimal manpower to install and operate. In addition, the records of species are hard photographic documents with a complete log of time and date of events. In this way we have the advantage of a very measurable search effort and continuous homogenous sampling over the 24 hours of the day & night, all with the natural populations being approached with minimal impact and in a non invasive way.

The use of Camera-traps to sample mammals for estimating abundance or species richness is already documented in literature. Karanath (1995) and Carbone (2001) independently reported the method as efficient for fauna inventories, especially of cryptic species, also recommended the camera-trapping method as a capture-recapture method to estimate abundance and density of species for which individuals can individually recognized by patterns or marks on their bodies. Phototrapping was used to estimate the population size of tigers by Karanath and Nichols (1998) and for bears by Crooks et al. (1998). Silveria et al. (2003) compared between various methods of animal census versus the use of camera-traps and concluded that camera traps are very potential tools over other methods like track surveys and line transect census. According to Silveria advantages of camera trapping were summarized as; "despite of initial high cost of camera traps they are considered more cost effective on the long run especially when large area surveys are involved, also advantages include species determination accuracy when it is compared to track surveys". Camera traps also have the advantage of similar efficiency in detecting nocturnal and diurnal activities simultaneously with minimum environmental disturbance. In addition to animal detection, camera traps can provide additional information about patterns of activity and habitat use which is a major addition over the other methods used in the comparison.

Carbone *et. al*. (2001) used a random walk model and a regression equation that makes use the relation between photographic rate of animals and their densities to estimate the density even for animal populations with small numbers in relatively large areas. It is concluded that programs with more than 1000 days of camera trapping had a 95% chance of obtaining at least one photograph at densities of roughly between 2 and 5 individuals in 100 square Kilometers assuming even use of habitat. Although the model was developed for estimating tiger density, the model -in principle- can also be extended to wide range of species. Based on the results of camera used to trap tigers it is expected that the technique would be most effective for species that are relatively wide ranging (>1 km/day), with minimum animal density of two or more per 100Km^2.

This document provides an interim report about the cameratrapping study that is applied in DDCR. The study was started in Oct. 2004 and is expected to continue until Dec. 2008. The findings and results reported here are representing the period up to August 2006.

Species Accounts

The DDCR area used to be part of the natural range of other medium and small mammals. Currently priority is given to mammals of the order Carnivora. Conservation efforts are now being wrapped around the assessment of the status of these animals in inland desert of Dubai. The current work describes a monitoring effort that have the task of assessing the presence and distribution of members or order Carnivora in DDCR. The targeted species are

Order Carnivora

Familly : Felidae
- Wild cat
- Sand Cat
- Caracal

Familly : Canidae
- Red Fox
- Sand fox (Rupellii)

Familly : Hyaenidae
- Striped Hyena

Globally Red fox Vulpes vulpes is the most widespread carnivore allover the world. Its distribution is limited from the north east by the tundra of Siberia and going westward through Asia, North Africa, Europe and across the Atlantic to North America. Red fox was introduced to Australia in 1868 (Corbet and Hill 1980: Ellerm and Morisson-Scott, 1966). Red fox is wide spread in Arabia. It could be found any where in Arabia except the for a central area the comprises Najad Plateau and some parts of the Empty Quarter. The species was assigned the status of **Least Concern** in UAE and Arabia in general. The sand fox or

The 3 cat species that are known to occur in UAE desert are in critical situation. The Caracal lynx *Felis caracal schmitzi* was known to the coastal and mountain areas of UAE but no recent sightings are reported. Lynx is classified as **Vulnerable** in UAE but not listed on the IUCN global Red List. The other two cats are smaller ones and are the sand cat *Felis margarita* and Jordon's wildcat *Felis silvestris gordoni* both are classified as **Endangered** for the regional UAE range.

All of the above mentioned species used to occur in UAE and are reported with several records during the 20th century by several investigators (Harison & Bates,1993 Iyad,). Only the striped hyena *Hyena hyena* and the wolf *Canis lupus* are of some doubts that although they are present allover Arabia no firm records are documented in the vicinity of Dubai or the northern Emirates. Drew et. al (2005) reported some unconfirmed records of wolfs and hyenas in UAE but concluded that these were of non resident individuals and confirmed the status of both species as Extinct in the Wild for UAE.

Methods:

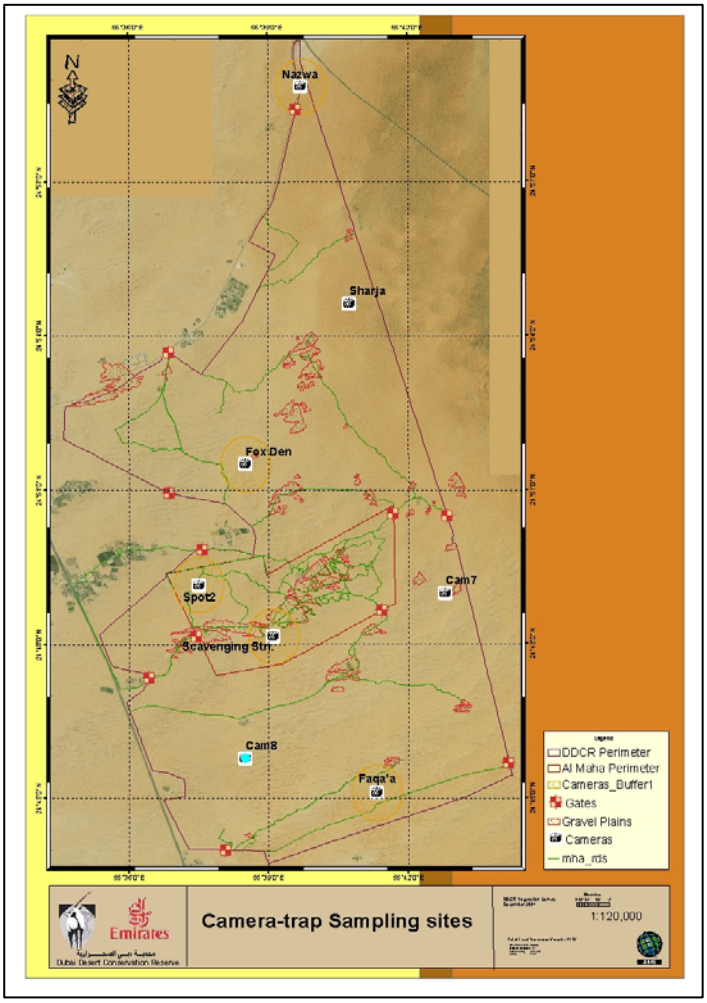
1-Camera housing:

Considering the fore mentioned benefits, it was decided to adopt camera-trapping as the sole sampling means for the purpose of this baseline study of assessing the mammal fauna of DDCR. The system provided by TrailMaster is acquired and deployed for the study. Four units are used for sampling throughout DDCR. Every unit involves a Transmitter, Receiver-logger and a Camera kit. Although the system provided by TrailMaster is meant to withstand hot weather conditions up to 50°C an additional housing was built by modifying a cool box to protect the receiver and the camera kit from the blazing sun and the blasting sandy winds. A glass front panel was fitted to the bottom of the glass box and a hole-window was drilled through the glass to allow direct access of the camera lens to the outside environment as to prevent the glare of flash light when it is reflected by the glass panel. A PVC sealing ring was also fitted around the lens to reduce sand infiltration into the housing. For the transmitter it was fitted into a PVC box and mounted on a pole. The infra red beam is maintained on the level of about 30cm which is the shoulder height of most of the target species. The two pieces of housing are shown in Pictures (1& 2).

Pictures 1 & 2 , showing on the left the modified coolbox forming a housing for the receiver and the camera kit. Straps are used to secure the housing to a base pole. On the right the transmitter is housed in a PVC box and fixed to a pole.

2- Site selection :

Topography is a factor that affects sampling site selection and should be taken in consideration when distributing camera units for the study. Fortunately, DDCR is of simple topography where the terrain is dominated by sand dunes and some sand flats among which few gravel plains occur. Thus, it was relatively easy to select sampling sites bearing in mind that a representative combination of terrain varieties to be included. So far 7 sites been sampled. One important restriction should be considered, as the Carbone method is adopted for density estimation, sampling sites should be at least 3 Km away from each other. In addition another 1.0 Kilometer is added to that distance to reduce edge-effect. Sites are baited on regular basis where quail guts, and feathers are used as bait. Map(1) shows the study region and the sampled sites.



Estimates of population densities are derived using photographic rates for each species and per site. Photographic rates are utilized per site to estimate the local density and then the estimates are interpolated to unsampled areas within the study region using kriging methods. Calculation of density was based on the Equation

$$x = \frac{\left(\frac{y}{2866 \ .4}\right)^{\frac{1}{-0.957}}}{12 \ .4}$$ Eq 1 (Carbone 2001)

Where y= camera days/photograph and x= number of animals /Km^2 . The constant numbers are determined by slopes and intercept of the relation between x & y as investigated by Carbone et. al. 2001 (Anim. Cons. 2001-4,75-79). These constants (2886.4 & -0.957) are determined by random walk model on the basis of assuming the animal is moving 3Km on average per day. If the animal is known to cover more distance the numbers should be changed, for 10 Km daily these are 703.1 and -0.938 respectively. The constant 12.4 is the correction factor.

3-Picture categorization:

Sometimes cameratraps could be very unpredictable devices, producing photos that may give some confusion to the analyst. Therefore, a process of classification of these photos should be put in place before they are utilized by analysis. Thus, Pictures were categorized and as; 1)Test: operator passing in front of the camera to test after installation or before service , 2)Empty: camera is triggered but nothing on picture, 3)Malfunction: the camera is spontaneously triggered by the receiver at certain repetitive fixed time periods with nothing actually passing through the beam , 4)Live: true pictures . Only live pictures were included in further analysis**.** Live pictures were further classified as a) wild mammals, b) wild birds c) Grazing and d) feral mammals.

4-Effort Calculation :

The current study is targeting to detect the presence or absence of about six mammal species that are believed to occur in the region. In addition there are 3 introduced antelope species that are very likely to pass through the camera traps. That gives us a total of 9 target species to be sampled. These species comprises the potential large to medium mammal fauna in DDCR and it is an essential value of this study to account for the alpha diversity (species richness) of this community and document it in the current early steps of DDCR. This piece of information is crucial from the management point of view as it could be used later as indicator of progress in conservation measures and also to be used as a legitimate justification of any diversity restoration measures planned or proposed. Alpha diversity is one of the parameters that are problematic and hard to account for. It is very sensitive to methodologies applied, spatial distribution of survey effort and sample size. Thus, it is important to have an estimate of the minimum sampling effort that is required to account for all species present and also a minimum effort that would enable density estimates with considerable reliability.

Effort could be accounted for as a measure of trapping days or as number of sampling sites. Number of sampling sites would give also an indication of how representative the sampling over the study region. So the question was; what is the least number of sampling sites needed to reliably account for 9 species of mammals? An obvious way to answer this question is to conduct a pilot survey using several sites and use the species accumulation curve to estimate the asymptote or S_{max}, then the corresponding X axis value would represent the minimum number of sites required. Using data accumulated so far from the trapping in 7 sites, calculations estimated that minimum of 18 sites are to be sampled to reliably account of S_{max} (species richness) of 9 mammal species. The current level of sampling is only reliably detecting only 6 species Fig(1).

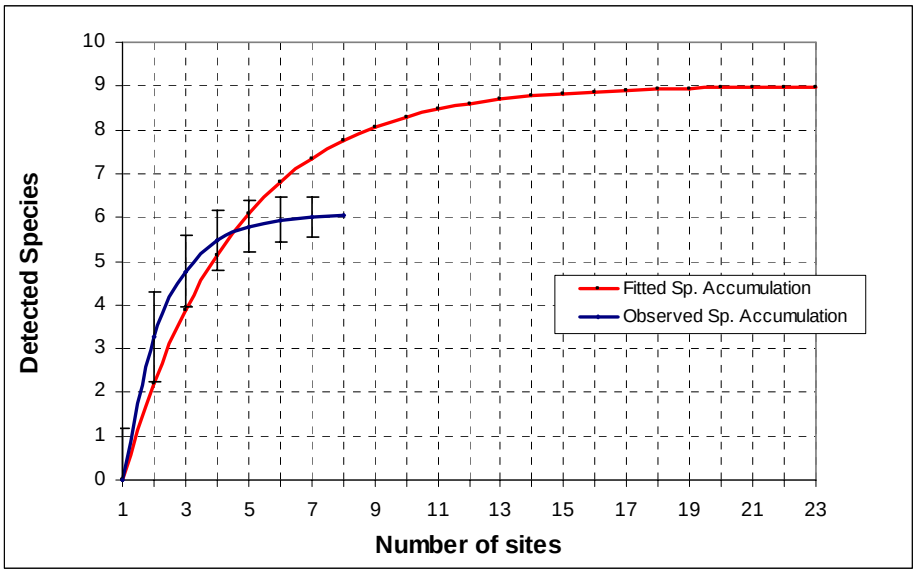


Fig (1) species accumulation curve shows that the current sampling effort accounts for 81.7% (6 species) only of the expected species richness and it requires at least 18 sites to be sampled to account reliably of the mammal fauna of DDCR. However, a compromise of 95% of the species could be detected after sampling 11 sites.

Pearsons correlation R^2	*K*	*Scale*	*No. Iterations*	*Error*
0.86529	0.24996001	2.48E-35	100	0.991980

Sampling 18 sites with camera traps would take about 5 years time. The graph in fig(1) shows that sampling 11 sites would account for 95% of the target species. This is a good compromise since this will cut the study time down to 3 years instead of 5 provided that the current sampling effort is limited to 4 cameratrap units. This, compromise would be adopted and a total camera trapping period of at least 3 years is recommended as sufficient effort to detect the alpha diversity of mammals fauna in DDCR.

Results:

Currently sampling was done over a period of 1029 life camera days in 7 sites over the study region of DDCR. These sites were representative of most habitats and vegetation covertypes present in DDCR. These resulted in 1991 pictures out of which 1286 (64.59%) are classified as life pictures which are utilized into further analysis. The activity in these sites varied considerably. Table (1) summarizes the sampling parameters for all sites.

Table (1) sampling parameters for cameratrapping effort in DDCR during the period Dec.2004 June 2006.

Site	*Total sampling days*	*Live days*	*%*	*Total Photos*	*live photos*	*photo/day*
Fox den	241.45	189.35	78.42%	344	215	1.135
Nazwa	352.74	279.37	79.20%	196	116	0.415
Faqa'a	265.83	232.55	87.48%	506	360	1.548
Spot	222.75	165.35	74.23%	186	98	0.593
Cam7	164.45	68.34	41.56%	292	254	3.717
SHJ	181.22	82.71	45.64%	293	112	1.354
Cam8	75.32	26.13	34.70%	174	131	5.012

Photo-rate or photo per day was used as an index to show differences in activity where only live pictures were utilized. The lowest activity was recorded in Nazwa which is the rocky outcrop in the most northern point of the reserve while the highest peak of activity was recorded on Cam8 which is a gravel plain in the middle of the reserve with a neighborhood of camel farms. Activity was also classified into several categories shown in table (2). Wild birds were seen to be the dominant activity category in most sites except for FoxDen and Cam7 sites.Grazing activity was observed in several sites but with varying intensities. The

highest percentage of grazing was in Faqa'a site as of its closeness to camel farms community. Fortunately, the proportion attributed to feral mammals was very small in regard to cumulative activity recorded at all sites where only one site (Nazwa) detected feral cats. Table (2) lists activity categories scores for all sites in the study region.

Table (2) Categorization of activity recorded on cameratraps in DDCR during the period Dec.2004 June 2006.

Site	Wild mammals	Wild Birds	Grazing	Feral mammals	Total wildlife activity
Fox den	87.14%	0.00%	5.71%	0.00%	87.14%
Nazwa	17.78%	40.00%	0.00%	35.56%	57.78%
Faqa'a	35.61%	31.62%	19.37%	0.00%	67.24%
Spot	26.87%	52.00%	0.00%	0.00%	78.87%
Cam7	83.71%	14.93%	0.90%	0.00%	98.64%
SHJ	17.14%	58.09%	7.62%	0.00%	75.23%
Cam8	47.06%	16.18%	5.88%	0.00%	63.24%

Species-wise, only two species of the target species were recorded so far. These were the red fox *Vulpes vulpes* and Jordon's wild cat *Felies jordoni.* Unfortunately sampling efforts failed to establish the presence of any of the other target species in DDCR. Also some other mammal species were recorded; these include Cape hare *Lepus capensis* and Brandt's hedgehog in addition to the introduced antelopes that are known to roam in DDCR. Unfortunately, the study showed that the caracal, Sand cat, Wolf, Jackal and the striped hyena are highly likely to be ruled out from DDCR. The current study holds about a thousand days of camera trapping with no signs for these species to occur in DDCR. This fact was not unexpected but solid evidence was required.

The red fox *(Vulpes vulpes)* was the most abundant and most dispersed species compared to other recorded species where it was almost recorded in all the sites. Following was the mountain gazelle (*Gazella gazella*) as it was also recorded in all sites but with much lesser frequency. The wild cat (*Felis jordoni*) comes as the third most dispersed species, though, again with very few occasions regarding both numbers-wise and site-wise. Fortunately feral mammals (cats and dogs) were not so abundant. and comprised only 35% of the activity observed. These were subsequently captured and removed from DDCR perimeter in a humane way. Table 3 lists the species recorded as distributed site-wise.

Table (3) Mamal species detected on camera traps and their distribution over sampled sites in DDCR during the period Dec.2004 June 2006.

Site	Sand Gazelle	Mountain Gazelle	Oryx	Red fox	Wild cat	Brandt's hedgehog	Cape hare
Fox den		✜	✜	✜	✜		
Nazwa		✜		✜	✜		
Faqa'a	✜	✜		✜	✜		✜
Spot		✜	✜	✜			✜
Cam7		✜	✜	✜	✜	✜	
SHJ		✜		✜			✜
Cam8		✜		✜			

Density Estimation

The method suggested by Carbone 2001 is applied where the photo-rate is used to estimate density of species involved.

The density estimate shows that red fox still is occurring in DDCR area with strong representation. The total population is estimated as around 168 red foxes are roaming the DDCR with a pooled density of about 0.748 ind./Km^2. Though, apparently there is strong spatial heterogeneity in these density estimates where some places show about ten

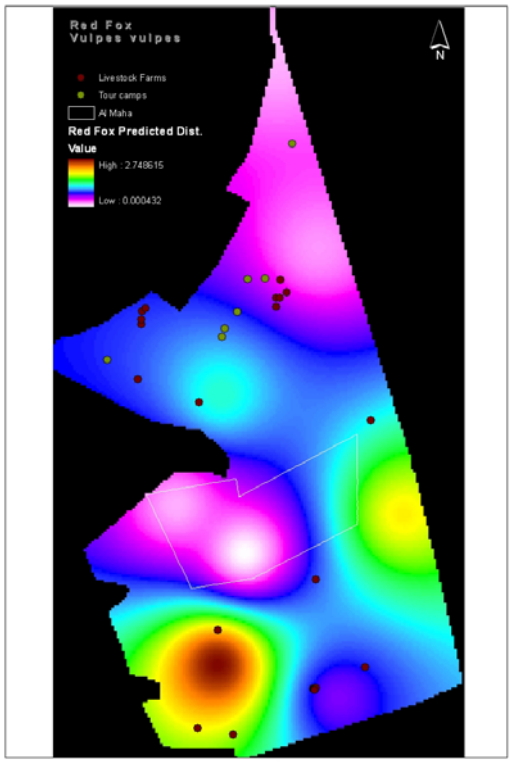
folds density as others (Cam7 & Cam8 vs. SHJ). Anthropogenic effects are very likely to be shaping the distribution of this mammal as it is know for its scavenging nature and thus may maintain good presence around livestock farms and tour camps. The sample size obtained so far is yet insufficient to investigate into this issue but certainly larger sample size at the end of the project would entail better assessment. In conclusion the red fox is still occurring in DDCR and could be classified as *Least Concern*.

Table (4) Estimated density of red fox (*Vulpes vulpes)* over the sampled sites in DDCR during the period Dec.2004 June 2006.

Site	number of foxs/100 km²	Corrected	Density Km²	Pooled Pop. Size Estimate
Fox den	1557.40	125.60	1.256	168
Nazwa	179.56	14.48	0.145	
Faqa'a	801.88	64.67	0.647	individuals are estimated to inhabit DDCR
Spot	188.61	15.21	0.152	
Cam7	2648.90	213.62	2.136	
SHJ	264.29	21.31	0.213	
Cam8	3401.19	274.29	2.743	

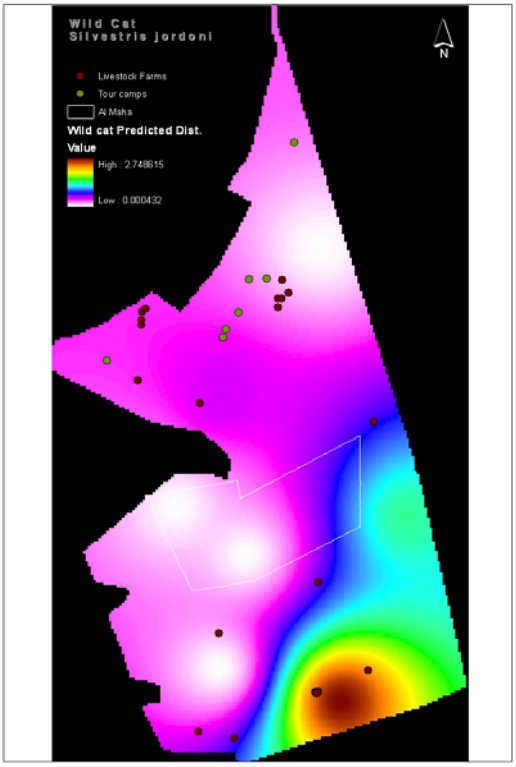
Table (4) Estimated density of red fox (*Vulpes vulpes)* over the sampled sites in DDCR during the period Dec.2004 June 2006

Site	number of Wild cats /100 km²	Corrected	Density Km²	Pooled Density Estimate Km^2
Fox den	17.10	1.38	0.014	5
Nazwa	11.39	0.92	0.009	
Faqa'a	99.98	8.06	0.081	individuals are estimated to inhabit DDCR
Spot	--	--	0.000	
Cam7	49.61	4.00	0.040	
SHJ	--	--	0.000	
Cam8	--	--	0.000	



Map (2) showing the predicted distribution of red fox and the sites of livestock farms and Tour Camps in DDCR suggesting some correlation between the presence of the farms in the southern range and the presence of the red fox. Yet this still unverified.

In case of the wildcat the situation is different. The species was recorded to still occur in DDCR but yet the density estimate is very low. The density of the species was estimated as 0.023 ind./Km^2 yielding a population size of only 5 individuals in DDCR. The spatial distribution of the wild cat seems to be less variant compared to that of the red fox as expected given the relatively lower numbers. This small population of wild cats in DDCR seems to be concentrated in the south eastern corner of the reserve with a distribution that is strongly related to the presence of livestock farms in that range. Map (3) shows the predicted distribution of wildcats in DDCR.



Map (3) showing the predicted distribution of Wildcat and the sites of livestock farms and Tour Camps in DDCR suggesting some distribution shift as a result of competition with the feral cats in the north .

Knowing the fact that there is a known established population of feral cats in the northern Range of DDCR (as livetraps have captured as much as seven cats in a week around tour camps) there is a strong evidence to suggest that competition with the feral animals has driven the wild individuals out of the landscape and they were forced to areas shift their range into other grounds.

Unfortunately, the density estimation method provided by Carbone only calculates point estimates and provides no account for variance or confidence interval. Bootstrapping would be the alternative in such case but yet the sample size is too small for either jackknife or bootstrapping as data comes from only 7 sites so far

Species richness & Biodiversity:

The data was also used to account for the biodiversity of the mammal fauna in DDCR. The whole sampling time where the camera-unit is considered active and alive was regarded as a one continuous session of sampling for each site. Individual pictures were considered as independent events representing counts of each recorded species. These counts were used to calculate the diversity indices per site. The highest no of species recorded was 5 species of wild mammals which included the re-introduced antelopes. The lowest was 2 species only in Cam8 site. Diversity indices show very low diversity in most of the sites. Again, this is not unexpected and adds more emphasis to fact that mammal fauna in DDCR is deeply impacted by unsustainable activities that been affecting the dune habitat of inland desert of Dubai. Also the values of the diversity indices show that there is considerable spatial variation among the sites. Table 4 shows the calculated values of biodiversity in DDCR.

Table (4) Diversity of mammal species in DDCR as per site accounted for by utilizing pictures as independent count events in DDCR during the period Dec.2004 June 2006.

Site	No. Species	Simpson	Shannon-Wiener	Brillouin
Fox den	4	0.215	0.660	0.614
Nazwa	3	0.400	0.964	0.792
Faqa'a	5	0.629	1.820	1.700
Spot	4	0.636	1.550	1.370
Cam7	5	0.261	0.785	0.690
SHJ	3	0.643	1.470	1.240
Cam8	2	0.154	0.391	0.285

Conclusion:

Mammal fauna of DDCR is badly impacted by decades of unsustainable utilization of the desert habitat and un-controlled access for different activities such as grazing, off-road driving. Out of 9 species that were expected to dwell in the study region the presence of only two species was established. It could be concluded with considerable confidence that species like sand cat, Ruppelii's fox and caracal are absent from DDCR. Only red fox and Jordon's wildcat are the remaining wild medium mammals in DDCR. The red fox population is relatively of a good abundance that was estimated as 168 individuals while on the other hand the wildcat population is believed to be much suppressed where a population of only 5 individuals is believed to be still surviving in DDCR.

Red fox exhibits good distribution in the study region and is believed to be doing well overall. The remaining feline species is facing competition with feral cats and is obliged to shift its distribution to the south eastern part of the reserve as the feral cats are thriving on the leftovers in the tour camps area in the northern range of the reserve. A management measure is already in place where live-trapping is taking place to control feral cats. This procedure is required to continue further as to protect the prey species and to allow the wildcat to spread and utilize the new grounds.

Anthropogenic-related effects are evident to act on controlling the distribution of these medium-sized mammals in DDCR thus, it is very important to emphasize the proper sanitation and waste management for the livestock farms and tour camps operating in DDCR.

The diversity of the mammal fauna in DDCR is in very critical status. Many member species are lost and it is time to take some conservation measures. It is suggested to immediately embark on a biodiversity restoration program to reintroduce some of these species. The current results show that there is no indigenous populations left of these species thus reintroduction is ruled very safe. The current status of the habitat is suitable for viable red fox population which should indicate a potentially successful introduction of the sand fox as their ecological niches are not very different. Similarly sand cat should also be addressed as a possible species for reintroduction in the very near future.

References:

Drew, C.R., Al Dhaheri, S.S., Barcelo, I., Tourenq, C., 2005- The Terrestrial Mammals, Reptiles And Amphibians Of The Uae – Species List and status Report- January 2005- Terrestrial Environment Research Centre(TERC), Environmental Research & Wildlife Development Agency (ERWDA)-Abu Dhabi, UAE (Internal Report)

Harrison, D L, and Bates, P J, 1991- The Mammals of Arabia 2nd ed. Harrison Zoological Museum publication.

Karanath, K. U., Nicholas, J. D., 1998- Estimation of Tiger Densities in India using photographic captures and recaptures *Ecology* 791:2852-2862.

Kucera, T. E., and Barret, R. H., 1993- The Trailmaster camera system for detecting wildlife. *Wildlife Society Bulletin* 21:505-508.

C. Carbone, S. Christie, K. Conforti, T. Coulson*, N. Franklin, J. R. Ginsberg, M. Griffiths, J. Holden, K. Kawanishi, M. Kinnaird, R. Laidlaw, A. Lynam, D. W. Macdonald, D. Martyr, C. McDougal, L. Nath, T. O'Brien, J. Seidensticker, D. J. L. Smith, M. Sunquist, R. Tilson and W. N. Wan Shahruddin , 2001- The Use of Photographic Rate to Estimate Densities of Tigers and Other Cryptic Animals, *Animal Conservation* 4:75-79.

Colwell, R., K., 2005- Statistical Estimation Of Species Richness And Shared Species From Samples ver. 7.5 Persistent URL. <purl.oclc.org/estimates>

Silveira, L., Jacomo, A. T. A., Diniz-Filho, A. J. 2003- Camera trap, line transect census and track surveys: a comparative evaluation. *Biological Conservation* , in press.