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## Haematology and biochemistry values of captive sand cats (*Felis margarita*) in Al Ain Wildlife Park and Resort, United Arab Emirates

Stephen Chege<sup>1\*</sup>, Arshad Toosy<sup>1</sup>, Judith Howlett<sup>1</sup>, Ahmed Saker<sup>1</sup>, John Kagira<sup>2</sup>

<sup>1</sup>Al Ain Wildlife Park and Resort, Life Sciences Department, Veterinary Section PO Box 1204, Al Ain, UAE

<sup>2</sup>Jomo Kenyatta University of Agriculture and Technology, PO Box 62000–00200, Nairobi, Kenya

### PEER REVIEW

#### Peer reviewer

Dr Maina Ngotho, BVM, PhD, Lab Animal Scientist, Institute of Primate Research (IPR), P.O. Box 24481 – 00502, Nairobi, Kenya.  
E-mail: ngothojm@yahoo.co.uk  
m.ngotho@primateresearch.org

#### Comments

This paper is a good start for generation of physiological data on a rare and near endangered animal species. It should form the basis for further studies to consolidate the missing information and enhance the survival of this animal species.  
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### ABSTRACT

**Objective:** To investigate the haematology and biochemistry values of apparently healthy captive sand cats kept in Al Ain Wildlife Park and Resort, United Arab Emirates, with a view to establishing baseline values.

**Methods:** Blood was collected from the femoral vein using aseptic techniques, kept in a cool box and sent to laboratory for analysis. The blood was analysed for haematological and biochemical values using veterinary hematology and chemistry analysers (ABX ABC Vet, Horiba ABX SAS<sup>®</sup> Montpellier, France).

**Results:** Haematological values were within the normal ranges recorded in domestic cats and there was no statistical difference between values found in males and females. Aspartate aminotransferase values were higher ( $P<0.05$ ) in males compared to female cats. Serum protein, creatinine and glucose values for females were significantly ( $P<0.05$ ) higher than those for males. Creatinine kinase, urea and lactate dehydrogenase levels were higher than those reported for normal domestic cat, but there was no statistical difference ( $P>0.05$ ) between males and females values.

**Conclusions:** Our results present reference ranges for haematology and biochemistry parameters in captive sand cats. These values will be important for diagnosis of various diseases and monitoring of treatments.

### KEYWORDS

Al Ain Wildlife Park and Resort, Apparently healthy, Biochemistry, Haematology, Sand cats

## 1. Introduction

The sand cat (*Felis margarita*) is a small-sized desert felid weighing 2–3 kg (Figure 1). It is found in sand and stone deserts ranging from the north of Africa to Asia, with the Arabian Peninsula as its center of distribution. It is well adapted to living in arid areas and in areas, where temperature changes are extreme, with temperatures ranging from 0 °C to 58 °C[1]. The sand cat is mainly nocturnal, spending the days in a shallow burrow or under

vegetation. The cats are solitary by nature; males and females only come together during the mating season. Its prey consists of small rodents and occasional birds and reptiles. Sand cats can be able to exist for long periods without drinking free water[2]. The Arabian sand cat is listed as near threatened by the International Union for Conservation of Nature, although current wild population trends are unknown[3]. The sand cats at the Al Ain Wildlife Park and Resort, United Arab Emirates are kept for conservation purposes.

\*Corresponding author: Dr. Stephen Chege, Al Ain Wildlife Park & Resort, P.O Box 1204, Al Ain, UAE.

Tel: +971 3 7992627

E-mail: stevmah@yahoo.com

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Haematological and biochemical analyses can be used in diagnosis of malnutrition, disease or health problems in specific individuals or across the population[4]. Further, they can be very useful in monitoring prognosis following treatment. However, there are few baseline haematologic and serum chemistry values for small free-ranging felids in the literature, which means that, at present, domestic cats values are used as a reference[4]. This is in spite of the fact that the values might not be similar in different felid species. Baseline blood chemistry and hematology data are particularly valuable for rare or endangered species because reference values for free-ranging populations may be difficult or impossible to obtain[5].

In the current study, baseline values for haematology, biochemistry, body temperature and body weight were measured in captive sand cats in Al Ain Wildlife Park and Resort, United Arab Emirates. Differences between male and female cats were tested. Our aim was to provide baseline values for haematology and serum chemistry of the captive sand cat living in the park.



**Figure 1.** An adult sand cat at Al Ain Wildlife Park & Resort. The cat has a wide, flat face and big ears.

## 2. Materials and methods

### 2.1. Study area

The study was conducted in Al Ain Wildlife Park and Resort (Latitude 24°10'45.37"N, Longitude 55°44'19.99"E), Abu Dhabi, in the United Arab Emirates. The area is characterised by two main seasons: a long and dry summer, with temperatures rising to about 48 °C between May and September, and a short, moderate winter between December and March, with temperatures rarely dropping below 6 °C. The annual average rainfall is recorded at 110.2 mm[6].

### 2.2. General husbandry of the sand cats

Currently, there are 31 adult sand cats (16 males and 15 females) kept in the Park. Males and females are kept separate to control breeding, and only bred when desired. They are housed in six different enclosures, each with two compartments (inside bedroom and a backyard) measuring 16 ft×13 ft×8.5 ft. The inside bedroom is made of concrete floor while the backyard has sand on the floor. Each compartment has boxes and old tree branches for

enrichment purposes. Other enrichments consist of balls, ropes, grass, snakeskins and peacock feathers. The cats were fed on preserved food consisting of mice and day-old chicks, in alternate days, with mice given 4 d and day-old chicks given 3 d in a week, respectively. Each cat received an average of 300 g of food per day and had access to clean water always.

### 2.3. Sample collection and analysis

The cats were acclimatized to human handling and physically restrained to allow health screening and 3 mL blood was collected aseptically from the femoral vein using syringe and gauge 25 mm needle. About 1 mL of blood was put in a tube with ethylene diamine–tetraacetic acid and 2 mL in plain serum tubes, and kept in a cool box and transferred to a refrigerator within 30 min. Serum tubes were allowed to settle for 3 h before centrifugation at 5000 r/min. Ethylene diamine–tetraacetic acid blood and serum were sent to the laboratory within 12 h of sample collection.

Haematology parameters were measured using a fully automated veterinary hematology analyzer (ABX ABC Vet, Horiba ABX SAS® Montpellier, France). The output included total white blood cells counts, differential white blood cells counts (basophils, eosinophils, neutrophils, lymphocytes and monocytes), red blood cells counts, hemoglobin and hematocrit. Serum biochemistry parameters were measured using ACE chemistry analyzer (Alfa Wassermann®, New Jersey, USA) whose output was alanine amino transferase, aspartate amino transferase (AST), creatinine kinase, cholesterol, creatinine, glucose, lactate dehydrogenase, total protein, urea and calcium.

### 2.4. Statistical analysis

Data were analysed using Genstat Discovery Edition 3 (VSN International, United Kingdom) and presented in the form of mean±SD. Significant differences between males and females were assessed using student's *t*-test at 5% significance level ( $P<0.05$ ).

## 3. Results

Thirty-one apparently healthy adult sand cats (16 males and 15 females) were monitored in this study. Body condition ranged from fair to good with majority of the cats in good body condition (85%) and the rest in fair body condition (15%). Males were heavier than females with mean body weights of (3.05±0.42) kg compared to female body weights of (2.59±0.27) kg and the differences were statistically significant ( $P<0.05$ ). There was no statistical difference ( $P>0.05$ ) between males and females body temperatures and observed values were within the reference ranges for domestic cats.

Mean±SD values and reference intervals for haematological and serum biochemical data are shown in

Tables 1 and 2, respectively.

**Table 1**

Hematology values of sand cats in Al Ain Wildlife Park and Resort, UAE.

Parameter	N	Mean±SD	Range	Reference range for domestic cats <sup>[7]</sup>
Weight (kg)	30	2.8±0.4	2.0–4.2	2.2–3.6
Temperature (°C)	15	39.2±1.1	37.6–41.0	38.1–39.1
Basophils (%)	25	0.4±0.5	0.0–1.0	0.0–1.0
Eosinophils (%)	25	1.6±0.8	1.0–3.0	0.0–4.0
Hemoglobin (g/dL)	25	13.6±1.9	5.9–15.7	9.6–14.9
Hematocrit (%)	25	46.2±4.5	30.0–52.0	30.0–45.0
Neutrophils (%)	25	53.5±2.2	50.0–58.0	45.0–64.0
Lymphocytes (%)	25	41.5±2.6	37.0–47.0	27.0–36.0
Monocytes (%)	25	3.0±0.8	2.0–5.0	0.0–5.0
RBC ( $\times 10^{12}/L$ )	25	9.4±1.8	4.5–12.2	5.0–10.0
WBC ( $\times 10^9/L$ )	25	6.8±2.4	3.8–15.2	5.5–19.5

WBC: White blood cells, RBC: Red blood cells, N: Number of cats analysed.

**Table 2**

Serum biochemistry values of sand cats from Al Ain Wildlife Park and Resort.

Parameter	N	Mean±SD	Range	Domestic cat ranges <sup>[7]</sup>
Alanine amino transferase (IU/L)	29	60.0±28.8	16.0–172	25–97
Aspartate amino transferase (IU/L)	29	48.5±8.6	31–68	7–38
Calcium (mg/dL)	29	9.8±0.5	9.1–11.2	8.7–11.7
Cholesterol (mg/dL)	29	189.5±28.0	124–244	71–156
Creatinine kinase (IU/L)	29	157.9±375.0	27–2025	69–214
Creatinine (mg/dL)	29	0.8±0.1	0.4–1.1	0.9–2.2
Glucose (mg/dL)	29	143.8±51.0	48–244	60–120
Lactate dehydrogenase (IU/L)	28	742.7±366.0	161–1479	58–120
Total protein (g/dL)	29	8.8±0.4	7.8–9.9	6.0–7.9
Urea (mg/dL)	29	50.9±9.7	36.7–72.0	19–34

N=Number of cats analysed.

Haematological values measured were within the reference range of domestic cats and there was no statistical difference ( $P>0.05$ ) between males and females. Most serum biochemistry values were within the reference range for domestic cats. AST, total protein, creatinine, and glucose values were statistically different ( $P<0.05$ ) between males and females. AST was higher in males [(53.13±7.40) IU/L] as compared to females [(43.43±7.00) IU/L] and the difference was statistically significant ( $P<0.001$ ). Serum protein values for females [(8.95±0.40) g/dL] were slightly higher than male values [(8.6±0.4) g/dL] and the differences were statistically significant ( $P<0.04$ ). Creatinine levels were slightly higher in females [(0.85±0.10) mg/dL] than that of in males [(0.72±0.20) mg/dL] and the differences were statistically significant ( $P<0.011$ ). Glucose levels of the sand cats were comparable to those of domestic cats but females had significantly ( $P<0.018$ ) higher values [(166.6±42.6) mg/dL] as compared to males [(122.7±50.2) mg/dL]. Creatinine kinase, blood urea nitrogen (BUN) and lactate dehydrogenase levels were

elevated compared to domestic cat levels, but there was no statistical difference ( $P>0.05$ ) between male and female cats.

#### 4. Discussion

This study provides the first set of data on the hematology and biochemistry values of captive sand cats. The sand cats were healthy and were captured and sampled during a routine health screening and vaccination procedure. Results of haematologic parameters were generally similar to those published for domestic cat and there was no statistical difference between males and females<sup>[7,8]</sup>. The lack of difference in hematology between males and females is consistent with those measured for Iberian lynx (*Lynx pardinus*)<sup>[9]</sup>.

The levels of AST, creatinine kinase and lactate dehydrogenase values for sand cats were higher than those of the domestic cat values. Similar findings were reported during restraint of captive European wildcats (*Felis silvestris*)<sup>[10]</sup>. Increased muscle enzymes are associated with stress, which may have a physical or a psychological component in many other mammals<sup>[11]</sup>. In our case, increased AST is likely a response to a perceived threat rather than as a result of physical stress since the animals were acclimatized and physically restrained with minimal stress.

Total protein levels were slightly higher in females than males and statistical significance was near cut-off point ( $P<0.04$ ), and there was no difference in albumin levels between males and females ( $P<0.105$ ). Differences between albumin and total protein has been observed in other carnivores which was attributed to different age groups<sup>[12]</sup>, but in our study, there was no difference as our study subjects were of similar age group.

Elevated BUN in association with increased levels of creatinine has been attributed to renal failure<sup>[13]</sup>. In the current study, the higher mean value for BUN in the sand cats compared to the domestic cat was not associated with higher mean values for creatinine and hence cannot be attributed to renal dysfunction. BUN values are influenced by diet and we postulate that the diet of sand cats probably had higher protein content than that of domestic cat, which would explain the higher BUN. The high creatinine and glucose values in females than males may be due to the fact that females were more vulnerable to the perceived threat of capture than the males.

Male sand cats were heavier than their female counterparts. These findings are consistent with findings of a previous study of Canada lynx where they found males were heavier than females<sup>[4]</sup>. The difference in weights between males and females could be explained by high androgen levels in males.

The current study has provided an indicator reference range for adult captive sand cats and can serve as a useful guide for baseline during clinical practice. Deviations from normal may be as a result of nutritional status and/

or reproductive condition. Consideration of these aspects will allow for better evaluation of the physical condition of the captured sand cats, monitoring of treatments, acclimatization to captivity and derivation of a colony born sand cats. Future studies should be evaluated whether the reference ranges reported in this study are affected by seasons.

### Conflict of interest statement

We declare that we have no conflict of interest.

### Acknowledgements

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### Comments

#### Background

The justification of this study is good with measurements taken as part of regular clinical and vaccination procedures. There is lack of reference ranges for hematology and biochemical values for sand cats. Such measurements can be useful for clinical evaluation of sand cats.

#### Research frontiers

The determination of physiological parameters is essential for any species and this paper makes a very laudible attempt. There is need for further follow up to plug some gaps on season, day/night time for the sand cat which lives in such extreme environmental conditions.

#### Related reports

The authors make good reference to available and comparative data. Generally, data on hematology and biochemical parameters of sand cats appear to be close to that of domestic cats.

#### Innovations and breakthroughs

This is the first set of data on haematology and selected serum biochemistry parameters and is good for publication. The handling and acclimatization of animals to captivity and relationship with handlers should be a natural consequence for further study.

#### Applications

This set of data should be used to grow and sustain an animal species which is already listed as near endangered. The park should be encouraged to grow a colony of cats, and contribute to sand cat conservation programs.

### Peer review

This paper is a good start for generation of physiological data on a rare and near endangered animal species. It should form the basis for further studies to consolidate the missing information and enhance the survival of this animal species.

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