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Age Structure of a Red Fox (*Vulpes vulpes*) Sample from Egypt

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ABSTRACT
Background:the Red Fox *Vulpes vulpes* is the most common and wide spread wild carnivore in Egypt. **Materials and methods:**we examine a museum sample of 179 specimens from different parts of Egypt to determine age structure using dentine layers counting method. Specimens were grouped into three population groups according to their geographical region of origin.
Results:the average age of foxes in the sample was 1.46 years and ranging from 1 to 7 years of age. Differences in age structure of populations from the three geographical regions and differences between sexes are presented and discussed.
Key words: Red Fox, Age structure, Dentine layers, Age classes

INTRODUCTION
The Red Fox *Vulpes vulpes* is one of the most common wild carnivores in Egypt[1]. This highly adapted carnivore occurs in a great variety of habitats throughout the country[2] and its distribution is somewhat linked to human distribution. Although some aspects of the distribution and genetics have been recently worked out[3] many aspects of its biology in Egypt are little known.[1, 4]
As the most common and widespread carnivore in Egypt, the Red fox holds a special position in zoonotic Medicine. World Health Organization (WHO) reports point out that rabies in red foxes is a public health problem in the Middle East, including Egypt.[5, 6, 7]

On the other hand, thousands of individuals of this fox are trapped every winter by professional trappers for the fur trade. Trapping of foxes and exportation pelts are not in any way regulated by the government. The impact of current trapping on the population in different areas and in Egypt in general remain unknown.
One of the key aspects in the biology of this fox in Egypt is its population characters. Population size, structure and trends are among the more important parameters that are instrumental for any effort to manage any species. A large, geographically comprehensive sample of the Red Fox is available at the Al-Azhar University Zoological Collection (AUZC) in Cairo. Investigating the age structure of this sample and the different population it represents can provide basis for efforts to control rabies or to

regulate the quickly expanding trapping and totally unregulated fur trade.
Several methods, based on morphological indicators have been used for age determination in *Vulpes vulpes*. These indicators include body weight, body length, cranial dimensions, dry weight of eye lens, extent of fusion of cranial sutures or development of the sagittal crest, tooth wear, occlusion of the dental pulp, or increments in dentine layers.[8,9,10,11, 12] Among many methods based on analysis of changes in morphological characters, the dental cementum analysis method is a widely accepted method for age determination of many mammals[13; 14; 15] and is often considered the most exact age determination method.[8,11,12,16] Roulichova and Andera[16] described a simplified method based on counting dentine layers in unstained, sanded canine roots. The method allows the simple, yet reliable age estimation from one year onwards. In this study we use the dentine layer counting method as described by Roulichova and Andera[16] to investigate the age structure of large museum sample of the red fox *Vulpes vulpes* representing different parts of Egypt.

MATERIALS AND METHODS
We used a series of 179 red fox skulls deposited in the Al Azhar University Zoological Collections (AUZC), Department of Zoology, Faculty of Science, Al Azhar

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University. The sample includes material collected from various parts of the country (Fig. 1) and covering both sexes.

We used counting the increment layers of secondary dental cement of canine root as a simple method for age determination as described by Roulichova and Andera[16]. In that method, we used one or two upper or lower canines tooth of adult foxes in that collection. The canine tooth was carefully extracted from the skull by hand. The root was then ground by hand down to roughly half its thickness using ca 80 sandpaper, and gradually smoothed and polished using progressively finer sandpaper. The preparation was examined under a stereoscopic microscope at 25x magnification without any staining. The age of the specimens of more than one year was determined by counting the dark lines. The dark lines are usually clearer at the sides of the root close to its apex. At least two preparations were examined from each specimen to ensure the precise counting of the lines.

RESULTS

Figure 2 shows examples of the dentine rings in animals of different ages in the sample. The method appeared reliable and was easily applicable to a wide spectrum of age classes covering the entire study sample of 179 adult foxes. As the method depends on counting the annual dentine rings, the resolution of the methods is one year. Fractions of a year or ages of animals of less than one year could not be detected using this method. It should be noted however, that most of the specimens in the study collection were collected in the winter which make them at least one year old (born the previous winter) as foxes are born during the winter.

The results showed that the mean age in a sample of 179 adult (male 49, female 66 and 64 unidentified) *Vulpes vulpes* is 1.46 years (SD 1.24). The estimated age in the sample ranged from one to seven years. Figure 3 shows the age distribution in the sample. It is clear from the figure that the great majority of the foxes in the sample are in the one to two years age class (showing one canine dentine ring).

Mortality seems to be rather high resulting in a life span that seems to be much shorter than the natural life expectancy with the 74.4% of animals in the sample being adults of less than two years of age. The reason for this relative dominance of the youngest age group among adults is not clear. Assuming that the sample actually represents the age structure of the population, the data shows that the great majority of the adult foxes lose their life before reaching their second year of age. By the third year, 86% of the foxes would have lost their life. Older foxes of more than three years of age seem to represent a fairly stable percentage of the population until the sixth years of age when percentage of foxes of six or more years of age decline indicating the maximum life expectancy.

It should be noted however, that almost all the animals in the samples are collected using leg-hold trapping. It may be assumed that the age structure of the sample reflects or is at least significantly affected by the trap ability of the different age classes. It may be assumed that the young, un-experienced animals are easier to fall in the trap. As animals become older, they become more experienced and are more difficult to trap. If this is the case, one would expect these older animals to be under-represented in the sample.

Animals in the sample were grouped in three age classes as follows:

- Age class 1. These are animals with one canine dentine ring and range in age from one year to just below two years of age.
- Age class 2. Animals with two to four canine dentine rings representing an age range between two to four years of age.
- Age class 3. This class includes all animals showing four or more canine dentine rings representing four or more years of age.

Age structure in fox samples based on the above three age classes from different regions shows some interesting results (Table, 1). Three fox populations corresponding to three geographical regions in Egypt are considered for this analysis. The dominance of the age class 1, and by inference, the life expectancy beyond two years of age varies in different regions (Fig. 4). In the Nile Valley, the Nile Delta and Faiyum older foxes (more than two years of age) represent 31.2% of the sample. By comparison, that percentage in the samples from the Western Desert Oases and the Western Mediterranean Coastal Desert is considerable smaller being 13.13 and 9.1% respectively. Assuming equal trap ability for

different age classes in the three regions, these data may suggest that life expectancy of Red Foxes living in the Nile Valley and Delta habitats is longer than those foxes living in the hyperarid oases or arid coastal desert habitats.

DISCUSSION

Most if not all the Red Fox trapping in Egypt takes place in the Nile Valley, Nile Delta and Faiyum. Although no commercial trapping takes place in the Western Desert Oases and the Western Mediterranean Coastal Desert regions, poisoning of carnivores (foxes and jackals) is often practices in the inhabited and cultivated areas of these regions. The extent of the poisoning campaigns and their impact on the wild carnivores' populations in these area is often mentioned in the literature[1,17] but their magnitude and frequency are not known. It seems, however, that the impact of trapping activities in the Nile Valley and Delta region is tolerated as a result of the abundance of food and habitat resources in that region in comparison with the meager resources in available to the desert-dwelling foxes.

The average age of females in the sample is lower than that of the males (Table, 2). This is consistent in the three geographical regions (Figs. 5 and 6). The smaller average age of females in the sample is difficult to explain. If the sample adequately represents the natural population, the lower average rate of females may either indicate one features of sexual dimorphism of this species. It may equally indicate that young female foxes are more easily trapped than older ones and are therefore over-represented in the sample.

It does not seem that trapping foxes at the present rate is adversely affecting the population even the heavily trapped Nile valley and Delta. The Red Fox population of this region seems to remain viable with a large percentage of young foxes in the population. The high reproductive rate of this fox seems to allow the species to tolerate this intensive harvesting of this fox.

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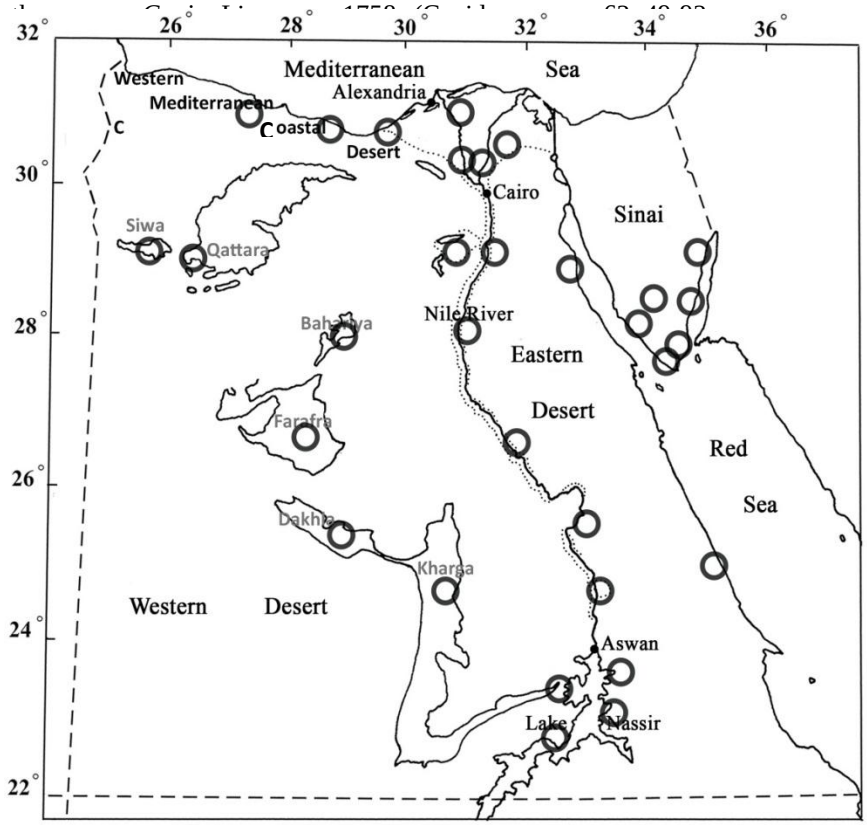

Figure 1: Collection localities of examined *Vulpes vulpes* material

Figure 2. Increment layers of secondary dental cement rings in a canine tooth of a one year (top) and 5 years (bottom) old *Vulpes vulpes*

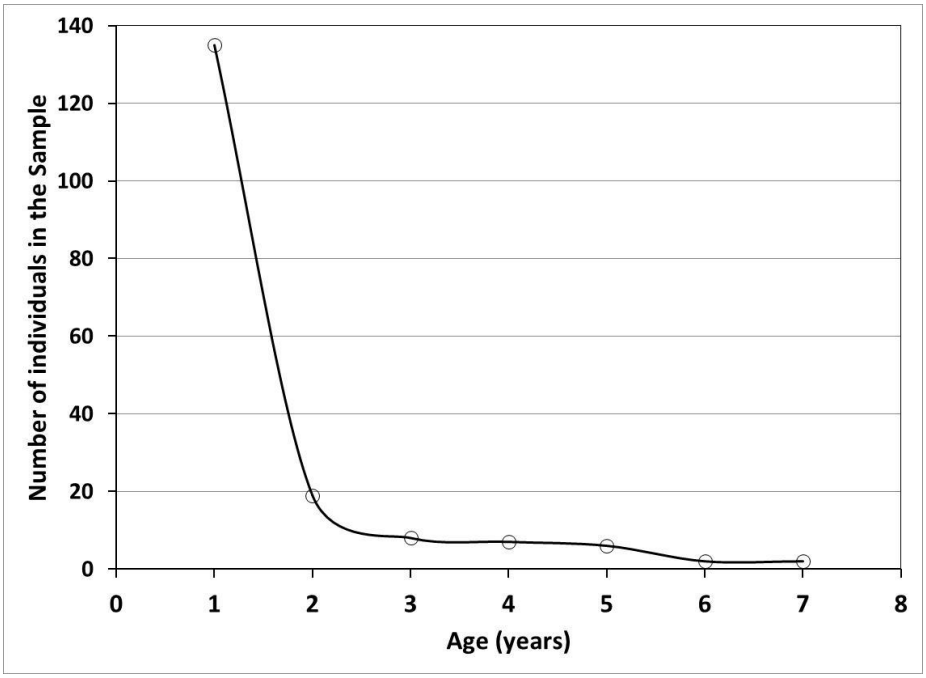

Figure 3. Age structure in a sample of 179 individuals of *Vulpes vulpes* from Egypt

Table 1. Age classes in Red Fox *Vulpes vulpes* samples from three geographical regions in Egypt

Geographical region	**Age class 1 (1 - <2 years)**	**Age class 2 (2 - 4 years)**	**Age class 3 (>4 year)**
Nile Valley and Delta	68.9%	23.8	7.4%
Western Desert Oases	85.7%	10.7%	3.6%
Western Mediterranean Coastal Desert	90.9%	9.1%	0.0%
TOTAL	**74.4%**	**19.8%**	**5.8%**

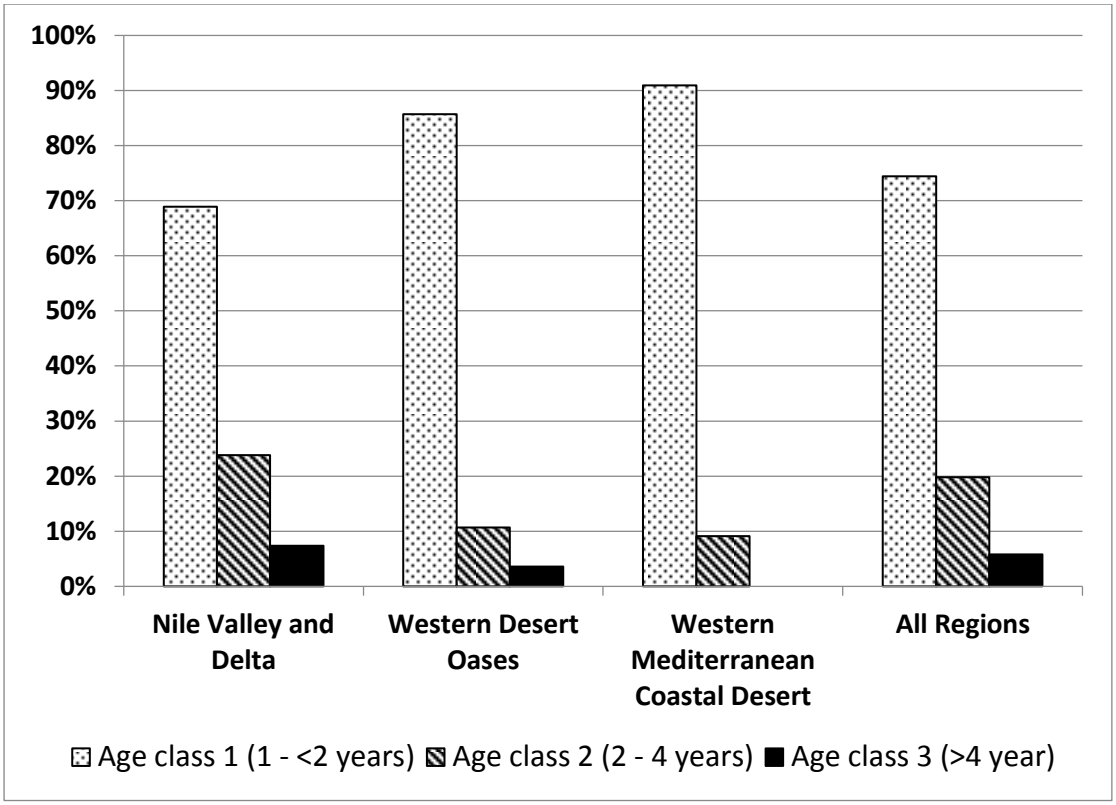

Figure 4. Red Fox age classes in different geographical regions in Egypt

Table 2. Age structure in samples of male and female Red Foxes from different geographical regions in Egypt

Region	Male			Female			Unidentified sex		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Nile Valley and Delta	1.62	0.94	1-4	1.83	1.44	1-5	1.69	1.51	1-7
Western Desert Oases	1	0	1	1.23	0.83	1-4	1.6	2.07	1-6
Western Mediterranean Coastal Desert	1	0	1	1.25	0.77	1-4	-	-	-

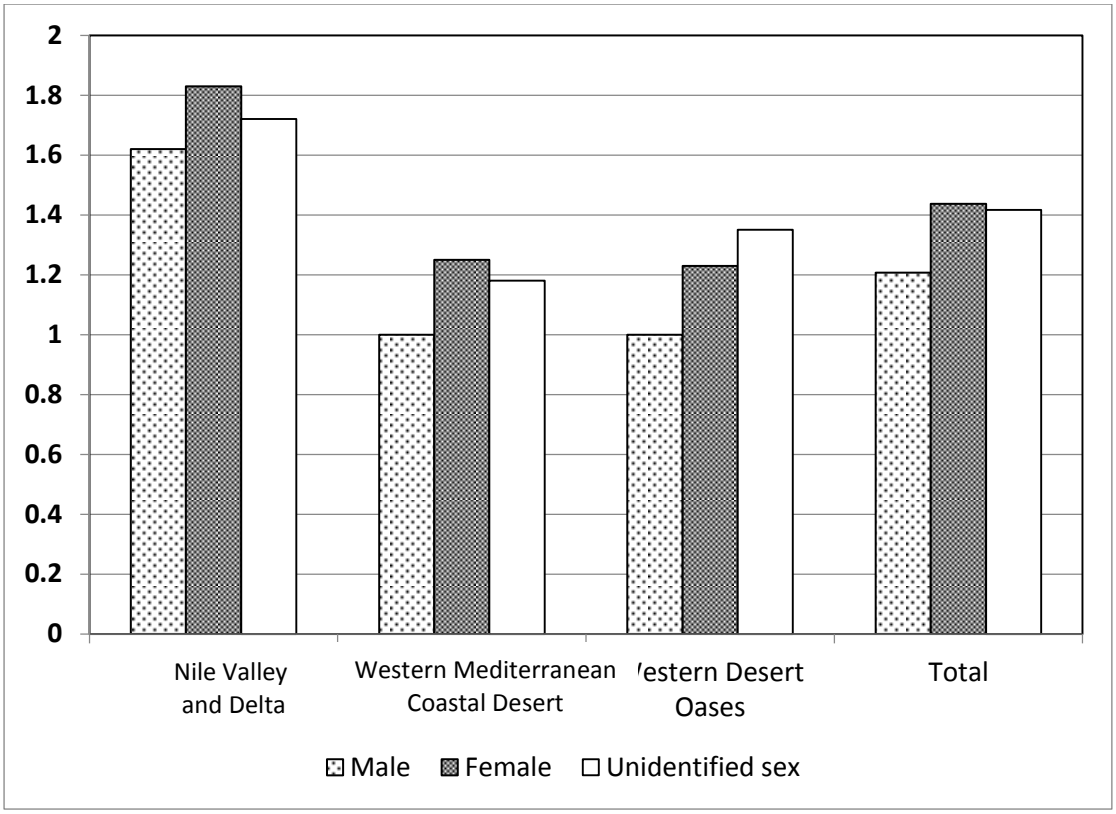

Figure 5. Mean age of male and female Red Foxes in samples from three geographical regions

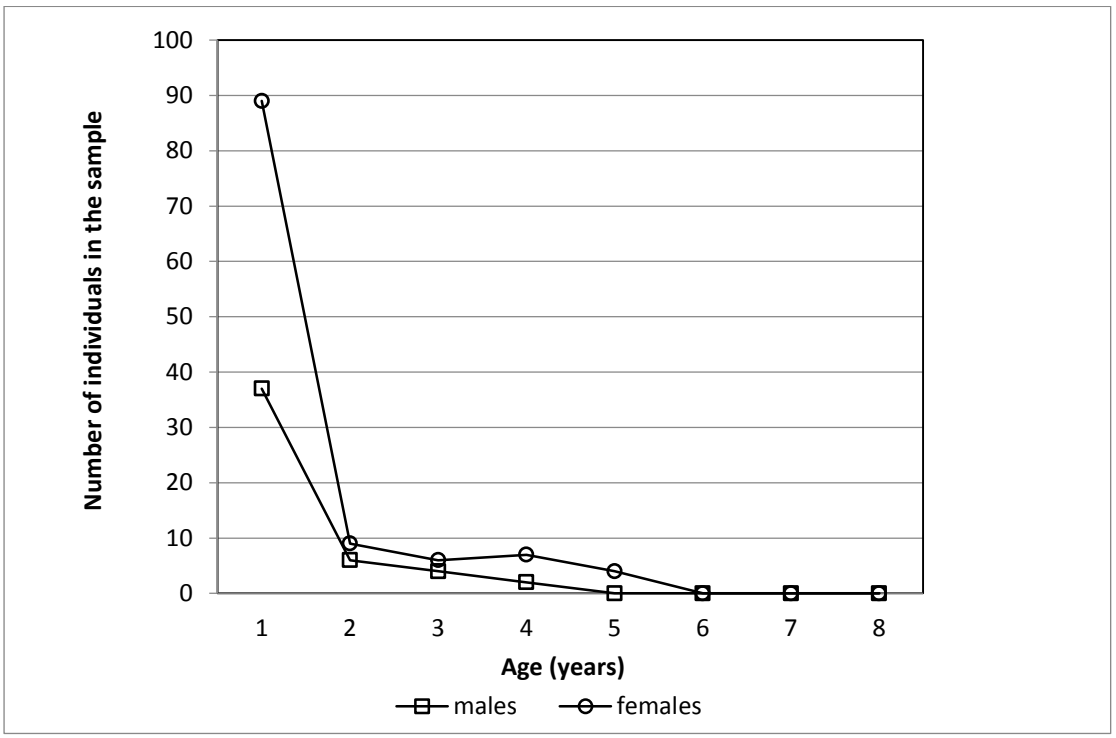

Figure 6. Age structure in a sample of 115 (49 males, 66 females) individuals of *Vulpes vulpes* from Egypt