

SANITARY CONDITIONS OF A COLONY OF URBAN FERAL CATS (*Felis catus* LINNAEUS, 1758) IN A ZOOLOGICAL GARDEN OF RIO DE JANEIRO, BRAZIL

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SUMMARY

The colony of urban stray cats living in the Rio de Janeiro zoological garden was studied in order to develop a population and health control program. As many cats as possible were captured during two months (47 animals) and were classified according to gender, age, weight and coat markings. They were submitted to a general health evaluation, examined for the presence of ectoparasites and sent to a surgical neutering program. All animals had a blood sample drawn for CBC, platelet count, heartworm and retroviruses detection. Capillary blood smears were made for hemoparasites detection. Coat marking and colors were tabby (59.7%), followed by solid black (17%); torbie (10.6%); bicolor (10.6%) and harlequin (2.1%). The only ectoparasites found were fleas, which infested 28% of the animals. The hemoparasites found were *Haemobartonella felis* (38%) and piroplasmas that could not be differentiated between *Cytauxzoon* spp. and *Babesia* spp. (47%). No cat was found infected by *Dirofilaria immitis* or FeLV (Feline Leukemia Virus), although FIV (Feline Immunodeficiency Virus) antibodies could be detected (21%). There was no correlation between hemoparasites and FIV infections. The estimated total cat population (mark-recapture method) was 59; 68% female and 32% male, suggesting that a neutering program is in fact needed.

KEYWORDS: Feral cats; Populational composition; Retrovirus; Hemoparasites; Animal Welfare.

INTRODUCTION

The total population of ownerless or free-roaming cats is composed by abandoned cats, usually accepting human approximation, and by their descendents already born in freedom, which, if untouched by humans until the 8th week of age will avoid contact with people and probably never will allow being touched by human hands^{8,21,26,31,33,35,36}. Territorial organization, population density and size of a colony of free-roaming cats are the result of environmental factors, especially availability and quantity of food and shelter^{13,23,26,30,38,52}. Extremely adaptive and able to survive under adverse conditions, kittens and adults organize themselves socially where sufficient resources are found^{8,21,24,30,36,40,51}. The social structure of a colony may comprise a varying number of cats, there may be cats living alone or great groups.

Great part of what is known about the epidemiology of domestic cat diseases is based on experimental studies carried out in the lab, distant from reality. The epidemiology of diseases of cats living under natural conditions in the sociobiological context is a relatively new source of knowledge in the field of epidemiology, especially when an urban stray colony is studied because it may be sentinel for the circulation of new pathogens in the area²⁴. The sanitary status of a colony is usually evaluated

by a general health examination of the animals and identification of ectoparasites, as well as by additional laboratory tests such as a complete hemogram, platelet count and detection of endoparasites^{6,24,27,48}.

Among the most common endoparasites reported in the feline population throughout the world there are *Cytauxzoon* spp., *Babesia* spp., *Haemobartonella felis* (Clark 1942) Kreier & Ristic 1984 (*Candidatus Mycoplasma haemofelis*)³² and *Dirofilaria immitis* (Leidy 1856). Once infected with *Cytauxzoon* spp., *Babesia* spp. or *Haemobartonella felis*, the cats become persistently parasitized^{29,45}. Wild felids, considered natural reservoirs of the parasite *Cytauxzoon felis* (Kier 1979), rarely manifest the disease. On the contrary, in the domestic cat as far as it is known, the disease takes an acute and fatal course^{18,29,45}. Representatives of the genus *Babesia* spp. are found parasitizing erythrocytes and, although, the species of tick responsible for the transmission of feline babesiosis is ignored, transmission is believed to occur mainly through inoculation of sporozoites during a blood meal of ixodid ticks^{34,46}. *D. immitis* in felines leads to acute and generally fatal disease, but which also can follow an asymptomatic course. The species *H. felis*, highly pleomorphic, seems to be transmitted naturally by hematophagous arthropods, mainly fleas, or through injuries caused by bites or through blood transfusion^{10,15,47}.

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Cats are susceptible to infection by a variety of viruses of different families. The viruses of the family Retroviridae cause persistent infection, in general chronic disease and are directly transmissible. The feline leukaemia virus (FeLV), causes a variety of diseases, including highly malignant neoplasias^{2,14,22,25,28,42}. Its transmission occurs through pacific or non-pacific cohabitation of infected and susceptible cats. The feline immunodeficiency virus (FIV), causes various signals and symptoms, always associated with opportunistic infections^{9,19,20}. FIV as well as FeLV is eliminated in the saliva, its transmission however occurs mainly through injuries caused by bites. As territorial disputes always involve much fighting, especially among males, the higher frequency of these infections in males is ascribed to this behavior^{49,50}. While the diagnosis of infections caused by FIV is made by detection of antibodies, the diagnosis of FeLV is made by detection of viral antigens in the blood, in general using ELISA^{3,5}. The detection of antibodies to FIV indicates previous exposition and infection and, as the infection is persistent, it also indicates that the animal is and will remain infected¹². The prevalence of retroviruses in populations of stray cats in Brazil is unknown and reports in the international literature are scarce. In Africa, the prevalence of FeLV antigens was of 26%¹. In Europe, on the other hand, the prevalence of antibodies to FIV varied from zero to 89%⁵⁰, in the United States it ranged between 25% and 27%⁵⁰ and in Japan it was of 40%¹⁶.

Zoological gardens attempt to avoid the presence of domestic cats but even in those zoos where great efforts are employed to keep cats away, the offer of food and shelter attracts these potential transport hosts of pathogens³⁹. Unavoidable as they are, domestic cats are a problem with which the Rio de Janeiro Zoo has been dealing for years and for this reason it was decided to design a model allowing a healthy cohabitation with the animals in exhibition. The first step in this direction is to know the profile of the feline population studying its composition and health conditions, which is the subject of this paper.

MATERIAL AND METHODS

This work was carried out in the Rio de Janeiro Zoological Garden, situated at Quinta da Boa Vista, São Cristóvão, northern district of the city of Rio de Janeiro. Cats were captured from 7:00 to 10:30 AM and from 4:00 to 8:00 PM for six days, by six people using nets and traps. Captures were done at every 10 days during June and July, 2001.

The captured cats were sedated using a combination of ketamine (Vetaset® Lab. Fort Dodge Saúde Animal Ltda.) in a dose of 10 mg/kg and xylazine (Rompum® Lab. Bayer do Brasil S.A.) in a dose of 2 mg/kg, intramuscularly. After sedation, the animals were marked by subcutaneous application of microchips (Friendchip® AVID) at the interscapular region. The animals were photographed and the photos attached to their individual records containing their biological data (gender, age, weight, coat-markings and color). They were submitted to a general health evaluation and examination for the presence of ectoparasites and alterations of the mucosae. The age was estimated as younger than six months or older than six months, based on the dentition¹¹. For their welfare all of the animals received a polyvalent vaccine for panleukopenia, calicivirosis, rhinotracheitis and chlamydiosis (Felocell CVR-C® Lab. Pfizer), one dose of antirabies vaccine (Rabisin-I® Lab. Merial) and one application of selamectine (Revolution® Lab. Pfizer). A blood sample was collected by femoral or jugular venopuncture for a complete hemogram and for detection of retroviruses and *D. immitis*

by ELISA (SNAP Combo® Lab. IDEXX, Maine, USA). Two smears of the first drop of capillary blood of each animal were stained with GIEMSA and examined for hemoparasites by optical microscopy. The animals were transferred to the population control program and afterwards released to their original sites.

Census was taken during June and July 2001, using mark-recapture method estimated by Lincoln-Petersen index⁴³.

$$N = (n1+1)(n2+1) / (m2+1) - 1,$$

where, N = estimated total population

n1 = number of animals at the first capture

n2 = number of animals at the second capture

m2 = number of marked-recaptured animals

The statistical method applied to the health tests was the χ^2 proof, considering the 47 captured cats by significance analyses of differences between the variables determined with contingency tables. The contingency coefficient (C) was used for verifying the level of association between the characteristics. The proof of significance of C was performed and the significance level was fixed at 93%^{41,44}. Significance analyses of different means was performed by Student's t Test.

RESULTS

A total of 47 cats were captured at the Rio de Janeiro zoological garden and all animals were considered in the analyses of the biological data.

Among the different coat markings and colors found were pointed tabby, 32% (15/47), followed by solid black, 17% (8/47), tabby mackerel 14.9% (7/47), tabby bicolor 12.8% (6/47), torbie 10.6% (5/47) and bicolor 10.6% (5/47). Only one cat was harlequin (2.1%). The greater part of cats weighed between 2 and 3.93 kg (70%). The less heavy adult cat weighed 0.81 kg and the heaviest 4.815 kg ($\bar{x} = 2.9 \text{ kg} \pm 1$) (Table 1).

Table 1

Gender and weight of domestic cats living at the Rio Janeiro zoological garden, RJ, Brazil

Gender	Weight (kg)		$\bar{x} \pm dp$	Total
	0.81	3	3	4.815
Females	21/47 45%	10/47 21%	2.194 ± 0.833 ^a	31 66%
Males	3/47 6%	13/47 28%	2.937 ± 0.929 ^b	16 34%
Total	24/47 51%	23/47 49%	—	47 100%

There was association between characteristics ($\chi^2 = 10.1$; C = 0.42; p = 0.001); ^{ab} – Different letters in column indicate significant different (t = 2.790; p = 0.008)

In the general health examination no alterations of the mucosae or signs and symptoms of the diseases under study were found in any of the cats. The only ectoparasite found infesting the animals were fleas, which were present in 28% of the captured animals.

The hemoparasites found infecting the cats were the piroplasmas *Cytauxzoon* spp. / *Babesia* spp. (47%) and *Haemobartonella felis* (38%). No animal was found with antigenemia of *D. immitis* or with feline leukaemia virus (FeLV), although antibodies to the acquired immunodeficiency virus (FIV) were detected (21%). Four males (25%) and six females (19%) presented antibodies to FIV. Although the males were showing higher seroprevalence as compared to the females, the difference was not significant ($C = 0.07$; $p = 0.3$) (Table 2).

Hematimetry displayed normal values in most cats. In one animal hematimetric evaluation was impossible. The values were normal in 87% of animals (40/46) and low in 13% (6/46). The mean value was 6.40 ± 1.14 million/mm³. Hematocrit was normal in 98% of cats (45/46) and one cat was anemic. The mean value was $31.6\% (\pm 4.36)$. Most cats (83%) presented erythrocytes of normal volume ($\bar{x} = 49.5 \pm 5.07$ fl) and the mean globular hemoglobin concentration (MGHC) was normal in 77% of animals (27/35) and low in 23% (8/35) ($\bar{x} = 31.9 \pm 2.06$). In samples of 11 animals the mean globular hemoglobin concentration could not be evaluated due to technical failure. Hematocrit, mean globular volume (MGV) and MGHC data could not be submitted to statistical evaluation, since the test conditions were not met.

Platelet counts ranged within the reference values in 95% of cats (44/46) and were low in 4% (2/46). The average value was 317552

platelets/mm³ (± 123201). Due to the high variability of normal values, the platelet count results could not be submitted to statistical evaluation.

Global leukocyte counts showed normal values in 76% of cats (35/46), increased values in 24% (11/46) and the average value was 15439 cells/mm³ (± 4625). The mean value of eosinophils was 895 cells/mm³ (± 795); of segmented neutrophils 11162 cells/mm³ (± 3879); lymphocytes 2946 cells/mm³ (± 1307) and monocytes 320 cells/mm³ (± 246).

For estimating the total population only 42 animals were considered, seen that five could only be captured after the period established for marking and recapture. In the capture phase 25 cats were captured and 29 during recapture, 17 of them for the first time and 12 recaptured. Using the Lincoln-Petersen formula with a confidence interval of 95%, the population estimate was of 59 cats. Applying the percentages of females, males and age ranges observed in the captured population to the total estimate population (59), it was possible to infer that between June and July 2001 there were 31 adult females (53%), 18 adult males (30%), eight female (13%) and two male (4%) kittens lived in the Rio de Janeiro zoological garden. Thus, the total of 47 captured cats is a representative sample (80%) of the total population and all animals were considered in the analyses of the biological data.

DISCUSSION

Adult males were heavier than adult females as confirmed by the comparisons between gender and weight, which were significant. Four different coat markings were found: four types of tabby, two with two

Table 2
Presence of erythrocyte forms of hemoparasites, antibodies anti-FIV by ELISA¹ in domestic cats of the population living in the Rio de Janeiro zoological garden, Brazil

Cats	N	Pirop.	<i>H. felis</i>	Pirop./ <i>H. felis</i>	FIV	FIV/Pirop.	FIV/ <i>H. felis</i>	FIV/Pirop. <i>H. felis</i>
		n %	n %	n %	n %	n %	n %	n %
♀ 6m	6	2 33%	2 33%	0 -	0 -	1 17%	0 -	0 -
♂ 6m	2	0 -	1 50%	0 -	0 -	0 -	0 -	0 -
Subtotal	8	2 25%	3 37.5%	0 -	0 -	1 12.5	0 -	0 -
♀ 6m	25	8 32%	4 16%	5 20%	4 16%	0 -	0 -	1 4%
♂ 6m	14	2 14%	2 14%	3 21%	3 21%	0 -	1 7%	0 -
Subtotal	39	10 26%	5 13%	8 20.5%	7 18%	0 -	1 3%	1 3%
Total	47	12 25.5%	8 17%	8 17%	7 15%	1 2%	1 2%	1 2%

Pirop. - Piroplasmas- *Cytauxzoon* spp. / *Babesia* spp. *H. felis* - *Haemobartonella felis*; FIV - Feline immunodeficiency virus; N - Studied population; n - number of animals; ¹ ELISA - SNAP Combo® Lab. IDEXX, Maine, USA.

different colors and one of solid color. Most cats were tabby, which is the original marking of the species and still prevails in the population.

The infections by *H. felis*, *Cytauxzoon* spp./ *Babesia* spp. on the contrary to what was expected, could not be correlated with infestation by their vectors (fleas and ixodid ticks)^{10,18,34,46,47}. The fact that infections by *Cytauxzoon* spp./ *Babesia* spp. and by *H. felis* showed paradox behavior suggests that further studies will be necessary for better elucidating susceptibility to and form of transmission of these parasites.

The presence of antibodies to feline immunodeficiency virus (FIV) did not render the cats more susceptible to the other infections under study. On the contrary, animals, carriers of FIV were less infected by piroplasmas and *H. felis*. Both FIV and *H. felis* are immunosuppressors^{4,12} and as such should render the cats more susceptible to other infections, a fact that was not observed. It is noteworthy that no signals or symptoms associated with the immunodeficiency syndrome were observed in any of the studied animals suggesting that they were in the latent phase of infection³⁷ and thus their immunity was preserved. One female kitten presented antibodies to FIV but, although having been considered as infected animal in the terms of this study, the animal could be merely a carrier of antibodies of maternal origin^{12,37}.

Although some cats (38%) were found infected by erythrocyte parasites (*H. felis*), the results of the red blood cell counts of the greater part of cats ranged within the parameters normal for the species¹⁷. Piroplasma and FIV infections can also alter the values of the erythrogram, such alterations however are generally associated with clinical symptoms^{2,29}. The studied cats were apparently healthy and probably the diagnosis of the infections occurred at a moment of balance between infection and host, which was reflected by the erythrogram and turned it impossible to correlate the rare alterations found with the diagnosed infections or any of the other studied features.

The study of the population of domestic cats living in the zoo of Rio de Janeiro showed that the estimated population was mainly composed by adult cats and, with regard to the gender, females. It is noteworthy that none of the animals infected by piroplasmas (*Cytauxzoon* spp. / *Babesia* spp.), *H. felis* or FIV presented clinical signs.

The total of 47 captured cats is a representative sample (80%) of the total estimated population (59), reflecting the great capture effort and therefore showing that health parameters are representative of the population.

The most frequent gender in the population was female (66%), the greater part in reproductive age (53%). The total female population was approximately the double of the male population, a fact that, although there seem to be no rules and different proportions of males and females have been reported^{7,21,24,52}, has not been described before.

Analysis of the population based on the age showed a small number of kittens (17%) in comparison to adults (83%). This composition suggests high infant mortality associated with natural migration of the young, especially males, and with the fact of kittens being frequently adopted by people^{21,31,52}. This fact suggests that the stray cat population under study, needs a neutering program associated with measures to control introduction of adult animals either by natural migration or

abandonment by the human population. A program for controlling this population should therefore restrict the availability of food and shelter and guarantee neutering procedures that preserve the social structure of the cat population so that the behavior of the animals would discourage migration of adult animals into the colony. It is noteworthy that pathogens found infecting at the Rio de Janeiro zoological garden are unknown to threaten human health, care dispensed to stray cats in public areas reduce zoonotic risk, especially of rabies. Furthermore, a cared for stray cat population certainly contributes to a good relationship between those animals and people, with a strong and healthy bond.

RESUMO

Condições sanitárias de uma colônia urbana de gatos (*Felis catus* Linnaeus, 1758) em um jardim zoológico do Rio de Janeiro, Brasil

As condições sanitárias e composição populacional de uma colônia de gatos urbanos, errantes, habitantes do zoológico do Rio de Janeiro foram estudadas, objetivando-se um programa de controle populacional e sanitário. Capturou-se o maior número de indivíduos possível durante dois meses (47 animais). Os animais capturados foram examinados quanto ao gênero, idade, peso, pelagem, inspeção geral e presença de ectoparasitas e eram encaminhados a um programa de esterilização cirúrgica. Cada animal teve uma amostra de sangue colhida para realização de hemograma completo, plaquetometria, pesquisa de hemoparasitas e de retrovírus. As marcações e cores de pelagem encontradas foram "tabby" (70%), preta (17%); bicolor (11%) e arlequim (2%). A presença de pulgas foi observada em 28% dos animais. Os hemoparasitas encontrados foram *Haemobartonella felis* (38%) e piroplasmas indistinguíveis entre *Cytauxzoon* spp. e *Babesia* spp. (47%). Nenhum dos gatos foi encontrado com antigenemia de *Dirofilaria immitis* ou do vírus da leucemia felina (FeLV), embora anticorpos contra o vírus da imunodeficiência felina (FIV) tenham sido detectados (21%). Não houve correlação entre infecção por FIV e hemoparasitas. A população total estimada (método de captura-recaptura) foi de 59 gatos, sendo 68% fêmeas e 32% machos. Os resultados sugerem que um programa de esterilização cirúrgica é de fato necessário.

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