



Non-Human Primate Injuries in the Mefou Primate Sanctuary of Cameroon

Wamba Gery^{1*}, Akwanjoh Richard Seino², Njua-Yafi Clarisse³

¹Directorate of Veterinary Services, Ministry of Livestock Fisheries and Animal Industries, Yaounde, Cameroon

²University of Bamenda, Bamenda, Cameroon

³Department of Animal Biology and Physiology, Faculty of Science, University of Yaounde I, Yaounde, Cameroon

Email: *gerywamba@gmail.com, raseino@yahoo.co.uk, njua.clarisse@ubuea.cm

How to cite this paper: Gery, W., Seino, A.R. and Clarisse, N.-Y. (2025) Non-Human Primate Injuries in the Mefou Primate Sanctuary of Cameroon. *Open Access Library Journal*, **12**: e13316.
<https://doi.org/10.4236/oalib.1113316>

Received: March 21, 2025

Accepted: May 23, 2025

Published: May 26, 2025

Copyright © 2025 by author(s) and Open Access Library Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

The Mefou Primate Sanctuary is one of the wild animal sanctuaries in Cameroon, located in the Centre Region and houses 277 non-human primates and 55 workers. There is little or no published data on non-human primate and primate-related human injuries in Cameroon sanctuaries. The injuries at the Mefou Primate Sanctuary were assessed and documented between January 04, 2020 to March 30, 2020. The types of injuries and their causes put in place were evaluated. The prevalence of injuries in non-human primates was (59.57%). The non-human primate species and sex had no significant influence on this prevalence, though injuries were more frequent amongst *Pan troglodytes* and males respectively. With regards to age, the prevalence of injuries was significantly higher in adults compared to adolescents and juveniles ($P = 0.001$, $\chi^2 = 38,497$). With regards to the types of injuries, lacerations were the most common. In the Mefou Primates Sanctuary, injuries caused by fights were significantly higher compared to other causes ($P = 0.002$, $\chi^2 = 62,951$). The degree of injuries together with their nature varied significantly with the habitat of non-human primates ($P = 0.029$, $\chi^2 = 8,340$). These injuries were higher amongst the non-human primates living in satellite cages compared to those in enclosures. Fighting was the main cause of injuries in NH primates at the Mefou Primate Sanctuary, with other far-reaching consequences like primate escapes and primate-related staff injuries.

Subject Areas

Conservation Biology

Keywords

Wild Animal Sanctuaries, Non-Human Primates, Fights, Wounds, Escapes,

1. Introduction

The 1973 Convention accord on the International Trade in Endangered Species (CITES) of wild fauna and flora was aimed at preventing the risk of extinction and limiting international movements. This convention addressed three groups of protected species: threatened species (those whose survival is compromised hence necessitate a high degree of protection), vulnerable species (not actually threatened towards extinction but may be if trade is not controlled) and registered species (species listed so as to control their trade). The endangered nature of species led to the creation of both in-situ and ex-situ conservation sites for these species [1]. Following this, National reserves, wildlife sanctuaries and zoos were created. An animal sanctuary is a facility where animals are brought to live and to be protected for the rest of their lives. The Pan African Sanctuary Alliance recognizes 3 sanctuaries in Cameroon; The Limbe Wildlife Centre (LWC), The Mefou Primate Sanctuary (MPS) and The Sanaga Young Chimpanzee Rescue Centre (SYCRC) [2]. Sanctuaries are different from Zoos in that, their goal is to rescue and rehabilitate injured or captured animals and give them a lifelong home while zoos focus more on human entertainment [3]. Primate sanctuaries rehabilitate and socially integrate rescued primates, by offering an environment suitable for the expression of species-typical behaviours, allowing for a gradual recovery and introduction in an adequate social network [4]. Nowadays, wildlife sanctuaries not only house and care for rescued animals, but also strive to advocate for improved captive animal welfare conditions, law enforcement, raising awareness and in-situ conservation [5]. Despite the multiple efforts put in place to secure these animals in these environments, there are still a lot of threats, amongst which, injuries are the most common.

Information on injuries and impairments of animal populations in the wild is important because these conditions can cause disability, affect reproduction and cause mortality [6]. Such information would also provide insight on how to minimize risks, the evolution of wound healing, and other adaptations to injuries. In primates, reported impairments include birth defects [7], consequences of diseases like arthritis [8] [9] or aging as well as the result of injuries that are inflicted by external agents and accidents [10]. The origin of injuries in NH primate sanctuaries are numerous. However, visitor access strategies and the variety of enclosure designs used are not expected to expose the animals to any potential threat from visitors. Enclosures are designed to maximize the possibility of spotting animals to increase the visitor's satisfaction or to allow animals to easily retreat to off-display areas avoiding a forced on human presence [11]. In zoos as well as some primate rescue centres, animals are confronted with both familiar (caregivers, volunteers and researchers) and unfamiliar humans (visitors). Few systematic

studies on the nature and frequency of injuries and impairments have been conducted on wild primates or on arboreal monkeys [12]. Data on the frequency and types of non-human primate injuries and primate-related human injuries, is grossly lacking in Cameroonian sanctuaries. The reasons for the occurrence of injuries amongst NH primates and in humans at the MPS are not fully understood but there are several speculations concerning the type, the degree and the causes of these injuries. The present study was designed to evaluate the injuries amongst non-human primates at the MPS by looking at the different types, associated factors and the causes of these injuries.

2. Methodology

2.1. Study Site and the Non-Human Primates

This study was carried out in the MPS) which is found in the Mefou and Afamba Division in the centre Region of Cameroon. It is located between longitude 13°57'36" N and latitude 11°55'48" E [13]. The captive animals included 277 NH Primates of twelve (12) different species; two (2) apes: Gorillas "*Gorilla gorilla*" and Chimpanzees "*Pan troglodytes*", two (2) papionines: Olive Baboons "*Papioanubis*" and Mandrills "*Mandrillus sphinx*", two (2) mangabeys: Redcap Mangabey "*Cercocebus torquatus*" and the Agile Mangabey "*Cercocebus agilis*" and six (6) guenons: Putty nosed monkey "*Cercopithecus nictitans*", De Braza monkey "*Cercopithecus neglectus*", Moustache monkey "*Cercopithecus cephus*", Crown guenon "*Cercopithecus pogonias*", Talapuin monkey "*Miopithecus talapuin*" and the Mona monkey "*Cercopithecus mona*".

2.2. Data Collection

The parameters evaluated were based mainly on personal observation. This was done every day from morning to evening in various cages and enclosures of the sanctuary. With the help of the sanctuary Motorola (communication radio) information on injuries from other cages or enclosures could be received, facilitating follow-up. Information concerning individual animals was gotten from the keepers, the administration and the animal's data base. NH primate injuries were documented, taking particular note of the type of injury, its severity, the cause and factors associated with the prevalence of injuries. Precise information on the individual; sex, age, species, group, rank and behaviour, date and outcome of injury was documented. The information on the housing, environment and other group members was also collected. Data from the sanctuary's database on past cases of injuries was also included in this study. The sanctuary records every case of disease, injury, escape, arrivals and any other vital information related to each animal in the animal's database.

2.3. Data Analysis

The data was computed in Microsoft Excel. Descriptive statistics were used to explore the data and a normal distribution test was performed. All statistical analyses

were done using the SPSS (version 17.0) software while Excel (version, 2013) was used for graphs. Statistical significance was set at $P < 0.05$.

3. Results

Injuries assessed in non-human primates of the Mefou Primates Sanctuary were either wounds or traumas. The wounds recorded were either lacerations (**Figure 1**), incisions (**Figure 2**) or open wounds (**Figure 3**). The traumas (**Figure 4**) recorded in our study were either fractures, luxations, swellings, contusions or broken teeth.



Figure 1. (a), (b), (c), (d), (e), (f), (g), (h): various lacerations encountered in NH primates at the MPS (January - March 2020).



(a) Incised wound on skull

(b) Incised wound on nipples

Figure 2. (a) (b): incised wounds encountered in NH primates at the MPS (January - March 2020).



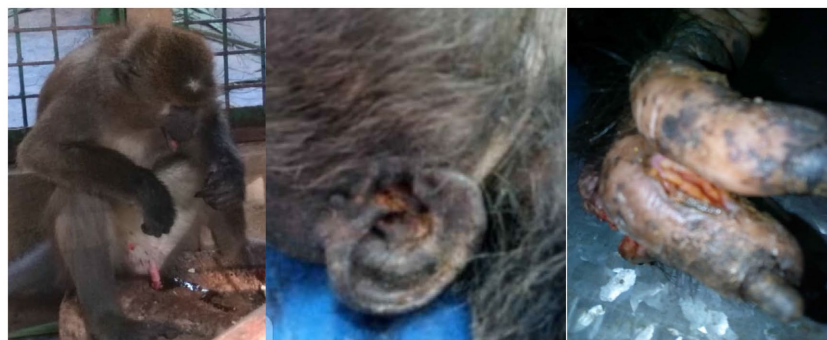
(a) Open wound on right thigh

(b) Open wound on right foot



(c) Open wound on mouth

(d) Open wound in anus



(e) Open wound in mouth

(f) Open wound in ear

(g) Open wound on fingers

Figure 3. (a), (b), (c), (d), (e), (f), (g): Opened wounds in NH primates at the MPS (January - March 2020).



Figure 4. (a) (b): Traumas encountered in NH primates at the MPS (January - March 2020).

Injury prevalence in NH primates

Amongst the twelve (12) species of NH primates, the overall prevalence of injuries was 59.57%, highest amongst *Pan troglodytes* (68.9%) (**Table 1**).

Table 1. Prevalence of injuries amongst captive NH primates at the MPS.

Species	N	Prevalence		
		No injury (%)	Injury	(%)
<i>Gorilla gorilla</i>	24	11 (45.8)	13	54.17
<i>Pan troglodytes</i>	115	36 (31.3)	79	68.69
<i>Papio anubis</i>	27	11 (40.7)	16	59.25
<i>Mandrillus sphinx</i>	38	16 (42.1)	22	57.89
<i>Cercocebus tonquartus</i>	6	3 (50)	3	50
<i>Cercocebus agilis</i>	23	12 (52.1)	11	47.82
<i>Cercopithecus neglectus</i>	3	1 (33.3)	2	66.67
<i>Cercopithecus nictitans</i>	20	10 (50)	10	50
<i>Cercopithecus mona</i>	9	4 (44.4)	5	55.56
<i>Cercopithecus pongonias</i>	3	3 (100)	0	0
<i>Cercopithecus cephus</i>	6	4 (66.6)	2	33.33
<i>Miopithecus talapoin</i>	3	1 (33.3)	2	66.67
Total	277	112 (40.4)	165	59.57

Types of injury in NH primates

The injuries encountered in NH primates at the MPS were either wounds or the outcome of trauma. Majority of the wounds observed were lacerations, with very few open wounds. Traumas were more of swellings and a few contusions and fractures. In both cases, the prevalence was highest in *Pan troglodytes* (Table 2).

Table 2. Nature of injuries in NH primates at the MPS.

Specie	Nature of injury									
	Wounds				Trauma					
	lacerated w	punctured w	incised w	open w	fracture	luxation	swelling	broken teeth	contusion	Total
<i>Gorilla gorilla</i>	27	11	9	4	1	5	6	0	2	65
<i>Pan troglodytes</i>	58	22	11	5	5	5	23	6	3	138
<i>Papio anubis</i>	34	11	7	5	0	3	1	1	0	62
<i>Mandrillus sphinx</i>	25	1	9	1	0	1	1	4	0	42
<i>Cercocebus tonquatus</i>	6	1	1	0	2	0	0	1	1	12
<i>Cercocebus agilis</i>	10	2	3	0	0	1	0	0	0	16
<i>Cercopithecus neglectus</i>	1	0	0	0	0	0	0	0	0	1
<i>Cercopithecus nictitans</i>	10	1	2	0	1	1	0	0	0	15
<i>Cercopithecus mona</i>	2	2	0	0	0	0	0	0	0	4
<i>Cercopithecus cephus</i>	0	0	1	0	0	0	0	0	0	1
Total	173	51	43	15	9	16	31	12	6	356
X ²	88,451									
P	0.091									

Variation of injuries with sex, age and habitat of NH primates

Table 3. Variation of injuries with sex, age and habitat of NH primates at the MPS.

Factors	Nature of injury										χ ²	P	
	Wound				Trauma								
	lacerated	punctured	incised	open	fracture	luxation	swelling	broken teeth	contusion	Total			
Sex	male	145	34	35	12	8	10	25	11	5	285	11,895a	0.156
	female	28	17	8	3	1	6	6	1	1	71		
	Total	173	51	43	15	9	16	31	12	6	356		
Age	adult	155	47	32	12	9	10	18	10	4	297	38,497a	0.001
	adolescent	13	2	8	2	0	3	6	1	1	36		
	juvenile	5	2	3	1	0	3	7	1	1	23		
	Total	173	51	43	15	9	16	31	12	6	356		
Habitat	satellite cage	149	43	35	11	7	15	23	10	2	295	28,340a	0.029
	enclosure	18	8	6	4	1	1	8	2	4	52		
	free ranging	6	0	2	0	1	0	0	0	0	9		
	Total	173	51	43	15	9	16	31	12	6	356		

The type of injury varied significantly with the age of the NH primates' $P = 0,001$ and $\chi^2 = 38,497$. Injuries were generally more frequent in adults compared to adolescents and juveniles. Injuries were significantly higher ($p = 0.029$, $\chi^2 = 28.34$) amongst NH primates living in satellite cages compared to those in enclosures and those free ranging (**Table 3**).

Causes of injuries in non-human primates

The causes of injuries included fights, falls, bites, injuries from the cage, objects, during the introduction of a new animal or during an escape. Injuries caused by fights were significantly higher than those resulting from other causes ($P = 0.002$, $\chi^2 = 62,951$). Fighting was also the highest cause amongst the various species taken individually. All non-human primates that sustained only a single injury during this period was due to fighting (**Table 4**).

Table 4. Causes of injuries amongst different HN primate species at the Mefou Primates Sanctuary.

Specie	Cause of Injury							Total
	fight	cage	fall	object	bite	introduction	escape	
<i>Gorilla gorilla</i>	44 (12.4)	6 (1.7)	4 (1.1)	7 (2)	3 (0.8)	1 (0.3)	0 (0.0)	65 (18.3)
<i>Pan troglodytes</i>	93 (26.1)	13 (3.7)	7 (2)	11 (3)	6 (1.7)	5 (1.4)	3 (0.8)	138 (38.8)
<i>Papio anubis</i>	56 (15.7)	1 (0.3)	1 (0.3)	1 (0.3)	0 (0.0)	3 (0.8)	0 (0.0)	62 (17.4)
<i>Mandrillus sphinx</i>	33 (9.3)	2 (0.6)	1 (0.3)	3 (0.8)	2 (0.6)	1 (0.3)	0 (0.0)	42 (11.8)
<i>Cercocebus torquatus</i>	7 (2)	0 (0.0)	0 (0.0)	3 (0.8)	0 (0.0)	0 (0.0)	2 (0.6)	12 (3.4)
<i>Cercocebus agilis</i>	10 (2.8)	0 (0.0)	0 (0.0)	3 (0.8)	1 (0.3)	0 (0.0)	2 (0.6)	16 (4.5)
<i>Cercopithecus neglectus</i>	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)
<i>Cercopithecus nictitans</i>	14 (3.9)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	15 (4.2)
<i>Cercopithecus mona</i>	4 (1.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (1.1)
<i>Cercopithecus cephus</i>	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)
Total	263 (73.9)	22 (6.2)	13 (3.7)	29 (8.1)	12 (3.4)	10 (2.8)	7 (2.0)	356 (100)+
χ^2								62,951
P								0.002

4. Discussion

The overall prevalence of injuries in the Mefou Primate Sanctuary was 59.57 %. These injuries were more prevalent in *Pan troglodytes* though the difference was not significant. Our results show that NH primates' species have little or no influence on the prevalence of injuries. This is contrary to the work of [14] who found that species differed in proportion of individuals with injuries and also in the types of injuries encountered. The nature of injuries; wounds (lacerated, incised, punctured and open) and trauma (fracture, luxation, swelling, contusion and broken teeth) varied significantly with the age of the NH primates. In all the cases, injuries were significantly higher amongst adult NH primates compared to adolescents and juveniles. These findings are similar to those of [14] who found that adult

animals had more injuries than juveniles. This is probably due to the fact that adult animals are those frequently involved in competition for dominance, and dominance has typically been associated with aggression. Thus, primates that often compete become aggressive towards each other [15]. Mating is a common cause of aggression among adult animals. Conflicts due to mating are common, given that the males would generally mate with the females irrespective of whether they consent or not [16].

The number of injuries together with the nature of injuries; wounds and trauma did not vary significantly with the sex of non-human primates despite all injuries being higher among males. Males fight seriously when a solitary male tries to take over his group [14] and also compete for resources such as food or water; like amongst females, competition levels and frequency of aggressive interactions vary depending on food availability [17]. Aggression among males also frequently occurs in a mating context, as predicted by the theory of sexual selection.

Injuries varied significantly with the habitat of NH primates. In all the cases, injuries were higher amongst the NH primates housed in satellite cages compared to those in enclosures and free ranging. This could be explained by the fact that NH primates in cages are more stressed and more prone to aggression since cages have less space, little enrichment facilities and are different from their natural biome. It has been recognized that the welfare of environments and habitats are not just a conservation concern but also compromise the welfare of wild-living animals due to potential stressors [18]. In a study on non-human primate housing carried out by [19], they showed that the rhesus macaque group of the Monkey Temple at the Bristol Zoo, had a mean of 4.4 fights per hour when 41 animals were present, but only 1.5 fights per hour when half of the animals were removed. Based on this, they hypothesized that fighting was a social pathology in response to overcrowding. Extensive study of the chimpanzees in the naturalistic enclosure at Arnhem showed that aggression rose only slightly when the animals were crowded, and they used other social behaviours to maintain amicable social relationships when threatened by crowding-induced stress [20]. It is important to consider the characteristics and context of any aggressive interaction, as these will sometimes be determined by the species' ecology and behaviour [21]. According to [22], auto aggression (self-mutilation) can be a significant problem in primates housed in cages. Enrichment is often used to increase the activity of the animals and decrease their abnormal behaviours, and a range of techniques is used which varies from manipulation of the social group to the provision of toys [23]. The most common method of providing enrichment is to modify the home (cage) environment in a manner that expands the range of behaviours that can be expressed by the animal. [24].

In the MPS, causes of injuries ranged from; fighting, cage-related causes, falls, objects, bites, during the introduction of new animals and during animal escapes. Amongst all these causes of injuries, injuries caused by fights were significantly higher than the others. Overall, fighting was the main cause of injuries in NH pri-

mates at the MPS. Hence, it was also highest amongst the various species taken individually [25]. In addition, NH primates who sustained only a single injury during the study period was due to fighting. These results are similar to those of [26] who found that the high number of injuries in adult males resulted mainly from fights with other males as a direct consequence of aggression or due to falls during chases. This shows that fighting amongst NH primates is a major concern in the MPS and the fights are mostly linked with aggressions, agonistic behaviours, stress and competition for food. In addition to fighting over specific resources, such as food and mates, primates frequently compete over status. In most primate species, individuals of one or both sexes can be ordered in a linear dominance hierarchy. Individuals generally appear keenly aware of their own place in the hierarchy [3].

5. Conclusion

The prevalence of injuries amongst NH primates' species in the MPS was quite high. The prevalence of injuries was higher in adult non-human primates. There was no significant disparity in sex and species despite male non-human primates and the *Pan troglodytes* having more injuries respectively. Injuries were higher amongst the NH primates present in satellite cages. Fighting was the most important cause and the main factor associated with injuries amongst NH primates at the MPS. The fights were more frequent amongst adults, males and the *Pan troglodytes*. Fighting was associated with stress caused by the housing situation of the non-human primates and was the main cause of injuries of NH primates in the MPS.

Acknowledgements

We thank the administration of MPS (Mefou Primate Sanctuary) for permitting us to carry out this study in their site. We equally thank the entire staff for their support and collaboration.

Significant statements

This study uncovered a great variety of injuries of non-human primates together with the causes and the factors associated with these injuries.

Funding

This research received no external funding

Ethical Considerations

The necessary authorisations to carry out our survey were sought from the director and the management team of the Mefou Primates Sanctuary. The study protocol was approved by the department of Forestry and Wildlife management of the University of Dschang.

Conflicts of Interest

The authors declare no conflict of interest.

References

- [1] Njoya, I.S., Force, E., *et al.* (2021) Faune protégé du Cameroun—Guide des principales espèces soumises à réglementation. Ministère des Forêts et de la Faune, Yaoundé, Cameroun. Ambassade de France au Cameroun.
- [2] Pan African Sanctuary Alliance (2002) Operational Manual. 4th Edition.
- [3] Gerloff, U., Hartung, B., Fruth, B., Hohmann, G. and Tautz, D. (1999) Intracommunity Relationships, Dispersal Pattern and Paternity Success in a Wild Living Community of Bonobos (*Pan Paniscus*) Determined from DNA Analysis of Faecal Samples. *Proceedings of the Royal Society of London. Series B. Biological Sciences*, **266**, 1189-1195. <https://doi.org/10.1098/rspb.1999.0762>
- [4] Jana, L.A., Yaiza, S., Sara, S., Dietmar, C. and Miquel, L. (2019) Looking for Visitor's Effect in Sanctuaries: Implications of Guided Visitor Groups on the Behaviour of the Chimpanzees at Fundació Mona. *Animals*, **9**, Article 347.
- [5] Tom, R. (2006) Jaulas Vacías. El Desafío de los Derechos de los Animales (in Spanish). Fundación Altarriba.
- [6] Lovell, N.C. (1991) An Evolutionary Framework for Assessing Illness and Injury in Nonhuman Primates. *American Journal of Physical Anthropology*, **34**, 117-155. <https://doi.org/10.1002/ajpa.1330340608>
- [7] Turner, S.E., Gould, L. and Duffus, D.A. (2005) Maternal Behavior and Infant Congenital Limb Malformation in a Free-Ranging Group of *Macaca Fuscata* on Awaji Island, Japan. *International Journal of Primatology*, **26**, 1435-1457. <https://doi.org/10.1007/s10764-005-8861-y>
- [8] Jurmain, R. (2000) Degenerative Joint Disease in African Great Apes: An Evolutionary Perspective. *Journal of Human Evolution*, **39**, 185-203. <https://doi.org/10.1006/jhev.2000.0413>
- [9] Nakai, M. (2003) Bone and Joint Disorders in Wild Japanese Macaques from Nagano Prefecture, Japan. *International Journal of Primatology*, **24**, 179-195. <https://doi.org/10.1023/a:1021458815090>
- [10] Jurmain, R. (1997) Skeletal Evidence of Trauma in African Apes, with Special Reference to the Gombe Chimpanzees. *Primates*, **38**, 1-14. <https://doi.org/10.1007/bf02385918>
- [11] Lambert, J.E. and Whitham, J.C. (2001) Cheek Pouch Use in *Papio Cynocephalus*. *Folia Primatologica*, **72**, 89-91. <https://doi.org/10.1159/000049928>
- [12] Bloomsmith, M.A., Laule, G.E., Alford, P.L. and Thurston, R.H. (1994) Using Training to Moderate Chimpanzee Aggression during Feeding. *Zoo Biology*, **13**, 557-566. <https://doi.org/10.1002/zoo.1430130605>
- [13] Annuaire Statistique du Cameroun (2011) Recueil des séries d'informations statistiques sur les activités économiques, sociales, politiques et culturelles du pays jusqu'en 2010.
- [14] Arlet, M.E., Carey, J.R. and Molleman, F. (2008) Species, Age and Sex Differences in Type and Frequencies of Injuries and Impairments among Four Arboreal Primate Species in Kibale National Park, Uganda. *Primates*, **50**, 65-73. <https://doi.org/10.1007/s10329-008-0119-9>
- [15] Kessel, A.L. and Brent, L. (1998) Cage Toys Reduce Abnormal Behavior in Individu-

- ally Housed Pigtail Macaques. *Journal of Applied Animal Welfare Science*, **1**, 227-234. https://doi.org/10.1207/s15327604jaws0103_3
- [16] Van Schaik, C.P. (1989) The Ecology of Social Relationships amongst Female Primates. In: Standen, V. and Foley, R.A., Eds., *Comparative Socioecology: The Behavioural Ecology of Humans and Other Mammals*, Blackwell, 195-218.
- [17] Honess, P.E. and Marin, C.M. (2006) Behavioural and Physiological Aspects of Stress and Aggression in Nonhuman Primates. *Neuroscience & Biobehavioral Reviews*, **30**, 390-412. <https://doi.org/10.1016/j.neubiorev.2005.04.003>
- [18] Kirkwood, J.K., Sainsbury, A.W. and Bennett, P.M. (1994) The Welfare of Free-Living Wild Animals: Methods of Assessment. *Animal Welfare*, **3**, 257-273. <https://doi.org/10.1017/s0962728600017036>
- [19] Sainsbury, A.W., Bennett, P.M. and Kirkwood, J.K. (1995) The Welfare of Free-Living Wild Animals in Europe: Harm Caused by Human Activities. *Animal Welfare*, **4**, 183-206. <https://doi.org/10.1017/s0962728600017796>
- [20] Nieuwenhuijsen, K. and de Waal, F.B.M. (1982) Effects of Spatial Crowding on Social Behavior in a Chimpanzee Colony. *Zoo Biology*, **1**, 5-28. <https://doi.org/10.1002/zoo.1430010103>
- [21] Clingerman, K.J. and Summers, L. (2005) Development of a Body Condition Scoring System for Nonhuman Primates Using *Macaca Mulatta* as a Model. *Lab Animal*, **34**, 31-36. <https://doi.org/10.1038/labana0505-31>
- [22] Chamove, A.S., Anderson, J.R. and Nash, V.J. (1984) Social and Environmental Influences on Self-Aggression in Monkeys. *Primates*, **25**, 319-325. <https://doi.org/10.1007/bf02382270>
- [23] Reinhardt, V. and Roberts, A. (1997) Effective Feeding Enrichment for Non-Human Primates: A Brief Review. *Animal Welfare*, **6**, 265-272. <https://doi.org/10.1017/s0962728600019850>
- [24] Hebert, P.L. and Bard, K. (2000) Orangutan Use of Vertical Space in an Innovative Habitat. *Zoo Biology*, **19**, 239-251. [https://doi.org/10.1002/1098-2361\(2000\)19:4<239::aid-zoo2>3.0.co;2-7](https://doi.org/10.1002/1098-2361(2000)19:4<239::aid-zoo2>3.0.co;2-7)
- [25] McGraw, W.S., Cooke, C. and Shultz, S. (2006) Primate Remains from African Crowned Eagle (*Stephanoaetus coronatus*) Nests in Ivory Coast's Tai Forest: Implications for Primate Predation and Early Hominid Taphonomy in South Africa. *American Journal of Physical Anthropology*, **131**, 151-165. <https://doi.org/10.1002/ajpa.20420>
- [26] McComb, K., Packer, C. and Pusey, A. (1994) Roaring and Numerical Assessment in Contests between Groups of Female Lions, *Panthera Leo*. *Animal Behaviour*, **47**, 379-387. <https://doi.org/10.1006/anbe.1994.1052>