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Evaluation of Non-Human Primates' Welfare in Captive Sites of Cameroon

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ABSTRACT

In other to evaluate the welfare of non-human (NH) primates in captive sites of Cameroon, the body condition scoring (BCS) technique was used to score the NH primates present in two sanctuaries (the Mefou Primates Sanctuary "MPS" and the Sanaga Yong Chimpanzee Rescue Centre "SYCRC" and two zoological gardens (the Limbe Wildlife Centre "LWC" and the Mvogbetsi Zoo Botanical Garden "MZBG"). A total of 633 NH primates (223 "35.2%" in LWC, 277 "43.8%" in MPS, 61"9.6%" in MZBG and 72"11.4%" in SYCRC) were found in these captive sites. They were composed of 16 different species; 2 Apes (Gorillas and Chimpanzees), 3 Papionines (Drills, Mandrills and Baboons), 3 Mangabeys (Agile, Red cap and Gray chicked) and 8 Guenons (Crown, Putty nosed, De braza, Mustached, Red tail, Preus, Patas and Tantalus). Chimpanzees were the most abundant (36.3%) species, while Debraza and Preuss guenon (0.3% each) were the least abundant. It was noticed that the captive sites category and the housing facilities of these captive NH primates had an impact on their welfare. The NH primates in sanctuaries had better mean BCS (4 – 5) compared to those living in zoos whose mean BCS ranged between 3 - 4. Concerning the housing of the NH primates, those living in natural enclosures had the best mean BCS (5). Those in enriched habitats followed with a mean BCS ranging between 4 and 5 while hose in un enriched habitats had the least mean BCS (3). It was also notice that NH primates housed in groups of 6 – 10 had the best BCS (5) compared to other group sizes. Meaning very large groups and very small groups had negative impact on their welfare. Keepers were found to influence the BCS of NH primates under their care in the sense that, keepers with higher level of education, keepers at the adult age group and keepers that had spent between 6 – 10 years in the captive sites had NH primates with the best mean BCS (4 -5). This shows that the environment of NH primates, their group size, and the keepers taking care of them are very key factors to the well-being of these primates. Captive sites have to take these aspects in to consideration so as to replicate the management, the biome and the niche of captive NH human primates such that it reflects that in the wild. This will permit them to express most of their natural potentials even though they are in captivity.

INTRODUCTION

Wildlife is normally defined as free-roaming animals (mammals, birds, fish, reptiles, and amphibians) (Krus *et al.,* 2004). The 1973 Convention on the International Trade in Endangered Species (CITES) of wild fauna and flora accord 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) (Njoya and Force, 2012). The endangered nature of species led to the creation of both in-situ and ex-situ conservation sites for these species (Njoya and Force, 2012). Following this, National reserves, wildlife sanctuaries and zoos were created (Jana, 2019). An animal sanctuary is therefore a facility where they are brought to live and to be protected for the rest of their lives (PASA, 2002). 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 (Soham & Akanksha, 2023). Primate sanctuaries aim to 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 (Jana, 2019). 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 (Tom, 2018). Zoos and Wildlife sanctuaries are considered as a hub for public recreation and education. This is highlighted by the fact that visitors to the zoos are increasing year by year and they generate sizeable revenue (Chethan *et al.,* 2013). It is also noticed that zoos and sanctuaries can play an important role in conservation and education. Visitors' attitudes towards animals and conservation can be improved after a positive and enjoyable experience at a captive facility (Turnock, 2002). The attraction of tourists towards monkeys and great apes have been to surpass that of other species and NH primates, particularly great apes,

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are the most exhibited and popular animals in zoos. NH primate sanctuaries therefore offer suitable environment for species-typical behaviours, geared towards recovery, rehabilitation and integrate rescued NH primates in an adequate social network (Alvares *et al.,* 2019).

Also, it can be noticed that animals in zoos are often in environments which differ from their native habitats and may be housed in close proximity to species with which they would never have contact in the wild. Management practices can significantly influence disease processes (Mikola & Aguilar, 2003). This is a call for concern so far as the management of NH primates in captivity is concerned. Welfare assessments are an important tool for determining an animal's current welfare status, and the welfare risks of the animal's current situation. Cameroon like in the Serengeti-Mara ecosystem, have core protected areas which are surrounded by multi-use buffer zones (Sarah, 2019). This has made Cameroon have a number of conservation sites where animals can either be free-ranging or in captivity. The free ranging conservation sites include; Wild animal national parks and reserves. The captive sites include; Zoological gardens (zoos) or sanctuaries (Mesmin *et al.,* 2000). Cameroon is well known in both the primate species and population richness. Unfortunately, the primate population has faced severe conservation challenges both in free-ranging primates due to hunting pressure for bush meat consumption and captive primates due to management issues (Chethan *et al.,* 2013). This present study was aimed to evaluate the welfare of captive NH primates in captive sites in Cameroon using the BCS system so as to throw more light on the management procedures and wellbeing of the NH primates.

LITERATURE REVIEW

Welfare assessments can be used to monitor animal welfare long-term (Barber, 2009; DEFRA, 2012). Originally, welfare assessments focused primarily on management-based measures and resource-based measures such as provision of food, enrichment and space. Recently, there has been a significant shift towards including animal-based measures, such as body condition score (Maher *et al.,* 2021). Body condition score (BCS) has been used in welfare assessments of bottlenose dolphins (Tursiops truncatus) (Clegg *et al.,* 2015), Dorcas gazelles (Gazella dorcas) (Salas *et al.,* 2018) and has been validated in African elephants (Loxodonta africana) (Morfeld *et al.,* 2014) by measuring subcutaneous fat. BCS systems have been studied and validated for use in several NH primate species (Ghassani *et al.,* 2023; Reamer *et al.,* 2020; Summers *et al.,* 2021; Torfs *et al.,* 2023). The term "body condition," which is related but not synonymous with body composition, is often used to describe the general state of an individual, emphasizing the importance of fat and lean mass abundance (Schulte-Hostedde *et al.,* 2001). It follows that visual examination and palpation can provide insights into an organism's body condition, (Labocha & Hayes, 2012). Focusing on body weight without considering body composition can result in misclassification of individuals and may become problematic when making comparisons at the individual and population levels. Individuals with the same body weight and body size might fall into different body composition categories (Alexana *et al.,* 2025).

MATERIALS AND METHODS

CAPTIVE SITES AND NH PRIMATES' SPECIES

Four wildlife captive sites were involved in our studies. The Sanaga Yong Chimpanzee Rescue Center (SYCRC) managed by the NGO In Defence of Africa (IDA) found in Mbargué forest in the East region of Cameroon and houses 72 NH primates. The Mefou Primates Sanctuary (MPS) managed by the NGO Ape Action Africa (AAA) found in Mefou and Afamba division in the Centre region

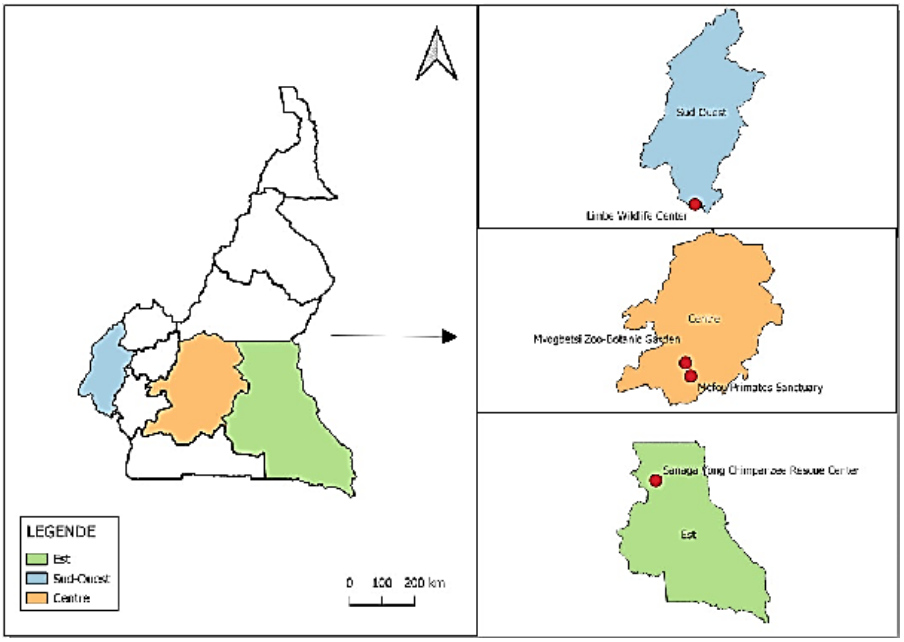

Figure 1: Map showing the various NH primates captive sites of Cameroon

of Cameroon and houses 277 NH primates. The Limbe Wildlife Centre (LWC) managed by the NGO Pandrillus foundation found in the Fako division in the South west region of Cameroon and houses 223 NH primates. The Mvogbetsi Zoobotanical Garden (MZBG), managed by the government, is found in Yaounde, Mfoundi division, and houses 61 NH primates (Figure 1. Amongst these captive sites, three (3) are recognized by the Pan African Sanctuary Alliance (PASA) they include: The Limbe Wildlife Centre, The Mefou Primate Sanctuary and The Sanaga Young Chimpanzee Rescue Centre. These captive sites had a total of 633 NH primates composed of 16 different species; 2 apes (Gorillas and Chimpanzees), 3 papionines (Olive Baboons, Drills and Mandrills), 3 mangabeys (Gray chick mangabeys, Red cap mangabeys and Agile mangabeys) and 8 guenons (Mona monkeys, Putty nosed monkeys, Moustache monkeys, Tantalus monkeys, Patas monkeys, De Brazza monkeys, Preus monkeys, Talapoin monkeys, the Crown and Red eared monkeys).

Assessment of Body Condition in NH Primates

The welfare assessment of these NH primates was done using the Body Condition scoring system. BCS systems are subjective semi-quantitative procedures that consist of visually inspecting and palpating fat and lean tissue on distinct anatomical landmarks. Individuals are then rated, using an ordinal scale with species-specific descriptions as reference (Clingerman, 2005). For this work to be carryout successfully, the NH primates had to be restained either manualy in the of infant NH primates friendly adilt guenons or chemically using anestasia for great apes, papionynes and aggressive adult guenons. This was done following the routine programs of the various captive sites. This was either; during the routine health check proccedure done on the NH primates of the captive sites, when ever a NH primate had an injury, during transfer proceedures, during severe sickness needing hospitalisation or sugical interventions and during implant procedure for females or vesectomie for the males. Once the NH primate restrained, the work was conducted by palpation of key elements. Figure 2. The Hips/Pelvis (ilium, sacrum, ischium), Spine (thoracic and lumbar), Thorax (ribs and scapula), Muscle mass (epaxials, gluteals, deltoids), Subcutaneous fat and Fat deposits (abdominal, inguinal, axillary). Following the recommendation of Clingerman (2005).

Figure 2: Primates Body condition evaluation procedure

The nine-point body condition scoring protocol was used, following the ZIMS software (Species360, Minneapolis, MN, USA): 1: emaciated, 2: very under-conditioned, 3: moderately under conditioned, 4: slightly under-conditioned, 5: ideal, 6: slightly over-conditioned, 7: moderately over-conditioned, 8: very over conditioned, 9: obese figure 3. The factors of variation evaluated were the NH primates sites, housing facility, species, age, sex and group size. The impact of keepers on the NH primates too was evaluated. We focused on the keeper's level of education, age and their duration in the captive site.

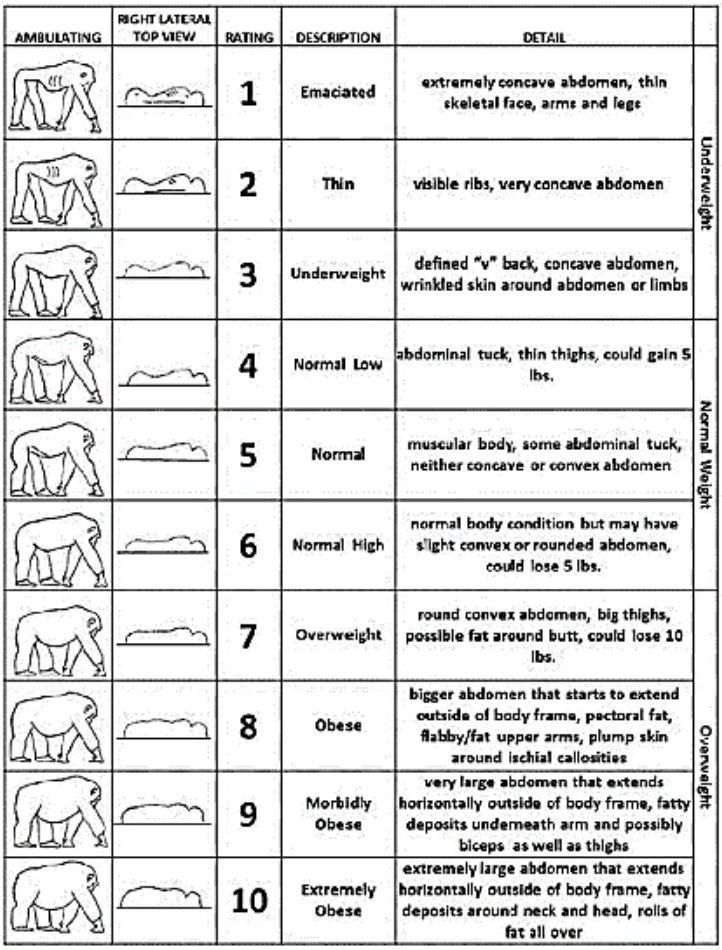

Figure 3: Primates Body condition chart
Source: Clingerman (2005)

Data analysis

The data collected was computed, grouped and organised using in the Excel® (Microsoft Corporation Inc.) software. The data was then analysed using Stat Graphics software. Descriptive statistics on demographic characteristics was summarized using frequencies and percentages. The one-way analysis of variance was used to compare the means of the different levels. The Kruskal-Wallis test was used to test the null hypothesis that the medians of Body condition score within each of the variables were the same. P-value less than 0,05, showed that there was a statistically significant difference amongst the medians at the 95,0% confidence level. The Multiple Range Tests, were used to determine which means were significantly different from the others. The Box-and-Whisker Plot selected the median notch option in such a way that if two means are the same, their intervals will overlap 95,0% of the time.

RESULTS AND DISCUSSIONS

Identification of the Captive Non-Human Primate's Species

A total of 633 NH primates were found in the captive sites. 223 in the Limbe Wildlife Centre, 277 in the Mefou Primates Sanctuary, 61 in the Mvogbetsi Zoo Botanical Garden and 72 in the Sanaga Yong Chimpanzee Rescue Centre. Chimpanzees were the most abundant (36.3%) species, while Debraza and Preuss guenon (0.3% each) were the least abundant. The sex ratio was 1.1 (male-biased) and most of the animals (66.8%) were adults. Moreover, concerning the duration of the animals in the sanctuaries, 5.2%, 8.2%, 19.6% and 67% spent less than

Table 1: Socio-demographic characteristics

Sanctuary/variables	LWC	MPS	MZBG	SYRC	Total
Species					
Drill	99 (92.5)	0(0.0)	8(7.5)	0(0.0)	107(100)
Agile Mangabey	4(11.1)	23(63.8)	9(25.0)	0(0.0)	36(100)
Baboon	9(18.7)	27(56.3)	12(25.0)	0(0.0)	48(100)
Chimpanzee	43(18.7)	115(50.0)	0(0.0)	72(31.3)	230(100)

Gorillas	17(41.5)	24(58.5)	0(0.0)	0(0.0)	41(100)
Mandrill	26(34.7)	38(50.7)	11(14.7)	0(0.0)	75(100)
Mona Monkey	0(0.0)	9(100)	0(0.0)	0(0.0)	9(100)
Mustached monkey	2(18.1)	6(54.5)	3(27.3)	0(0.0)	11(100)
P. Nosed Guenon	9(30.0)	21(70.0)	0(0.0)	0(0.0)	30(100)
Preuss Guenon	2(100)	0(0.0)	0(0.0)	0(0.0)	2(100)
R. C Mangabey	8(57.1)	6(42.9)	0(0.0)	0(0.0)	14(100)
Red- eared Guenon	4(100)	0(0.0)	0(0.0)	0(0.0)	4(100)
Tantalus	0(0.0)	0(0.0)	13(100)	0(0.0)	13(100)
Grey Chick	0(0.0)	0(0.0)	5(100)	0(0.0)	5(100)
Talapoin	0(0.0)	3(100)	0(0.0)	0(0.0)	3(100)
Crown	0(0.0)	3(100)	0(0.0)	0(0.0)	3(100)
Debraza	0(0.0)	2(100)	0(0.0)	0(0.0)	2(100)
Gender					
Female	118(38.4)	127(41.4)	25(8.1)	37(12.0)	307(100)
Male	105(32.4)	148(45.7)	36(11.1)	35(10.8)	324(100)
Age					
Baby	0(0.0)	26(86.7)	4(13.3)	0(0.0)	30(100)
Adolescent	0(0.0)	28(100)	0(0.0)	0(0.0)	28(100)
Juvenile	23(31.9)	34(47.2)	11(15.3)	4(5.6)	72(100)
Subadult	31(100)	0(0.0)	0(0.0)	0(0.0)	31(100)
Adult	139(32.9)	188(44.4)	38(9.0)	58(13.7)	423(100)
Old	30(61.2)	1(2.0)	8(16.3)	10(20.4)	49(100)
Duration in the sanctuary					
< 1 year	0(0.0)	29(87.9)	4(12.1)	0(0.0)	33(100)
1-5 years	13(25.0)	30(57.7)	5(9.6)	4(7.8)	52(100)
6-10 years	59(47.6)	52(41.9)	5(4.0)	8(6.5)	124(100)
> 10 years	151(35.6)	166(39.1)	47(11.1)	60(14.2)	424(100)

1 year, 1-5 years, 6-10years and more than 10 years in the sanctuaries respectively table 1.

NH Primates Scored

The nine-point body condition scoring for some NH

Figure 4: Some NH primates scored in the various captive sites (a, b, c, d, e. f, g, h)

primates in the captive sites gave a large range of variation figure 4. The scores of the NH primates were between 1 for the emaciated animals, and 8 for the obsessed. The score of 5 was for the normal animals.

The Effects of the NH Primates' Captive Sites Category, The Housing Facilities and the Various NH Primates' Species on the BCS Of the NH Primates. The result shows the various frequencies, percentages and

Table 2: BCS of the various captive NH primates with respect to the 'captive sites category, the housing facilities and the various NH primates' species are presented

Modality	Variable	Frequency (percentage)	Median[min - max] (Mean ± SD)	P-Value
NH primates captive site	MPS	277(43.76)	4 [3 - 8] (4.04 ± 0.69)[a]	0.000
	LWC	223(35.23)	5 [2 - 8] (4.58 ± 0.89)[b]	
	SYCRC	72(11.37)	5 [4 - 5] (3.08 ± 0.17)[c]	
	MZBG	61(9.64)	3 [1 - 4] (4.97 ± 0.67)[d]	
	Total	633(100)	4 [1 - 8] (4.28 ± 0.89)	
Housing of NH primates	enriched cage	41(4.42)	4 [3 - 5] (3.87 ± 0.64)[a]	0.000
	enriched zoo enclosure	108 (17.06)	4 [3 - 8] (4.36 ± 0.81)[a]	
	natural enclosure	292 (46.13)	5[3 - 5] (4.73 ± 0.50)[b]	
	un enriched cage	28 (6.48)	3,5 [2 - 8] (4.28 ± 1.96)[c]	
	un enriched zoo enclosure	164 (25.91)	4 [1 - 5] (3.56 ± 0.71)[c]	
	Total	633 (100)	4 [1 - 8] (4.29 ± 0.89)	
Specie of NH primates	Chimpanzee	230 (36.33)	5 [3 - 8] (4.89 - 0.43)[a]	0.000
	Drill	107 (16.9)	4 [2 - 8] (3.71 ± 0.85)[a]	
	Mandrill	61 (9.64)	4 [1 - 5] (3.92 ± 0.80)[b]	
	Baboon	48 (7.58)	4 [2 - 5] (4.02 ± 0.60)[c]	
	Gorilla	41 (6.48)	5 [3 - 8] (4.76 ± 0.80)[a]	
	Agile mangabey	38 (6)	4 [2- 5] (3.89 ± 0.89)[d]	
	Putty nosed guenon	30 (4.74)	4 [3 - 5] (4.01 ± 0.58)[ed]	
	Mona guenon	24 (3.79	4 [3 - 8] (4.21 ± 0.98)[fd]	
	Red cap mangabey	14 (2.21)	4 [3 - 5] (4 ± 0.68)[gd]	
	Tantalus guenon	13 (2.05)	3 [2 - 3] (2.85 0.38)[hd]	
	Moustache guenon	10 (1.58)	4 [2 - 8] (3.7 ± 1.70)[if]	
	Grey chick mangabey	5 (0.79)	3 [3 - 3] (3 ± 0) [jd]	
	Red ear guenon	4 (0.63)	4 [3 - 5] (4 ± 0.82)[kd]	
	Talapuin guenon	3 (0.47)	4 [3 - 4] (4.01 ± 0.58)[lf]	
	Crown guenon	3 (0.47)	4 [4 - 4] (4 ±0)[md]	
	Debraza guenon	2 (0.32)	4 [4 - 8] (6 ± 2.83)[a]	
	Total	633 (100)	5 [1 - 8] 94.23 ± 0.89)	

a-m Significant difference between variables (p<0.05)

the interval around each median, the mean ± standard deviation body condition score for each variable. The intervals currently displayed are based on Fisher's least significant difference (LSD) procedure table 2.

The Effects of the NH Primates Sex, Age, Group Size, Together with the Keeper's Age, Level of Education, Duration on Sites on the BCS of The NH Primates The result gives their various frequencies, percentages

Table 3: The effect of the NH primates sex, age, group size, together with the keeper's age, level of education, duration on sites on the BCS of the NH primates

Modality	Variable	Frequency (Percentage)	Median[min - max] (Mean ± SD)	P-Value
Sex	F	310 (48.97)	4 [2 - 8] (4.30 ± 0.88)	0.6951
	M	323 (51.03)	4 [1 - 8] (4.28 ± 0.90)	
	Total	633 (100)	4 [1 - 8] (4.29 ± 0.89)	

Primates age	adult	423 (66.82)	4 [1 - 8] (4.27 ± 0.81)	0.0948
	juvenile	72 (11.37)	4 [2 - 8] (4.25 ± 1.21)	
	old	49 (7.74)	4 [2 - 8] (4.22 ± 0.98)	
	sub adult	31 (4.9)	4 [2 - 8] (4.16 ± 1.0)	
	baby	30 (4.74)	5 [3 - 8] (4.5 ± 0.97)	
	adolescent	28 (4.42)	5 [4 - 5] (4.71 ± 0.46)	
	Total	633 (100)	4 [1 - 8] (4.28 ± 0.89)	
Group size	6 - 10 primates	319 (50.39)	5 [3 - 5] (4.63 ± 0.57)^{a}	0.000
	> 20 primates	150 (23.7)	4 [2 - 5] (3.87 ± 0.69)^{b}	
	11 - 20 primates	73 (11.53)	4 [2 - 5] (4.24 ± 0.83)^{c}	
	single	48 (7.58)	4 [2 - 8] (4.31 ± 1.72)^{d}	
	2 - 5 primates	43 (6.79)	3 [1 - 5] (3.30 ± 0.83)e	
	Total	633 (100)	4 [1 - 8] (4.29 ± 0.89)	
Keepers age	adult	446(70.46)	5 [2 - 8] (4.56 ± 0.77)^{a}	0.000
	sub adult	99 (15.64)	4 [2 - 8](3.74 ±0.86)^{bd}	
	old	55 (8.69)	3 [1 - 5](3.45 ± 0.79)^{cd}	
	adolescent	33 (5.21)	4 [2 - 5] (3.69 ± 0.68)^{d}	
	Total	633 (100)	4 [1 - 8] (4.29 ±0.89)	
Keepers age	secondary	336 (53.08)	5 [2 - 8] (4.54 ± 0.81)^{a}	0.000
	primary	207 (32.70)	4 [2 - 8] (3.98 ± 0.84)^{b}	
	non scolarised	46 (7.27)	3 [1 - 5] (3.34 ± 0.77)^{c}	
	higher	44(6.95)	5 [3 - 5] (4.80 ± 0.50)^{d}	
	Total	633 (100)	4 [1 - 8] (4.29 ± 0.89)	
Keepers duration on site	6 - 10 years	443 (69.98)	5 [3 - 8] (4.60 ± 0.75)^{a}	0.000
	1 - 5 years	118 (18.64)	4 [2 - 5] (3.63 ± 0.75)^{b}	
	> 10 years	55 (8.69)	3 [1 - 5] (3.45 ± 0.79)^{ac}	
	< 1 year	17 (2.69)	4 [2 - 4] (3.47 ± 0.62)^{bc}	
	Total	633 (100)	4 [1 - 8] (4.29 ± 0.89)	

a-d Significant difference between variables (p<0.05)

and shows the interval around each median, the mean ± standard deviation body condition score for each variable. The intervals currently displayed are based on Fisher's least significant difference (LSD) procedure table 3.

The Box and Whisker Plot of the Effect of the Captive Sites on the Welfare of NH Primates

The box and whisker plot shows more details on the variation of BCS in the various captive sites. It can be seen that NH primates in sanctuaries (SYCRC and MPS) had better BCS that is ranging between 4 (normal low) and 5 (normal) with SYCRC being the best (5). NH primates found in zoos (LWC and MZBG) had a lower mean BCS score ranging between 3 (underweight) and 4. with NH primates in the MZBG being the least with the mean BCS (3) figure 5.

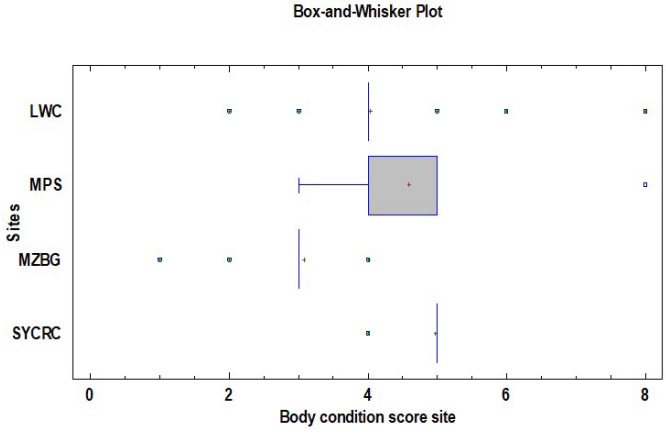

Figure 5: The box and whisker plot shows more details on the variation of BCS in the various captive sites

The Various Housing Facilities of NH Primates in the Various Captive Sites

Captive NH have two main housing facilities which are enclosures and cages. Enclosures are fenced zone where some NH primates like great apes either live temporally during the day or where other species like guenons live permanently. Cages on the other hand are a zone enclosed with wire bars where some NH primates like the great apes spend the night or other species live permanently. These enclosures were either natural enclosure found in sanctuaries or modified enclosure found in zoos. These zoo enclosures where either enriched (facilities permitting NH primates to express their natural behaviours) or un enriched (no enriched facilities). The cages too were either enriched or un enriched figure 6.

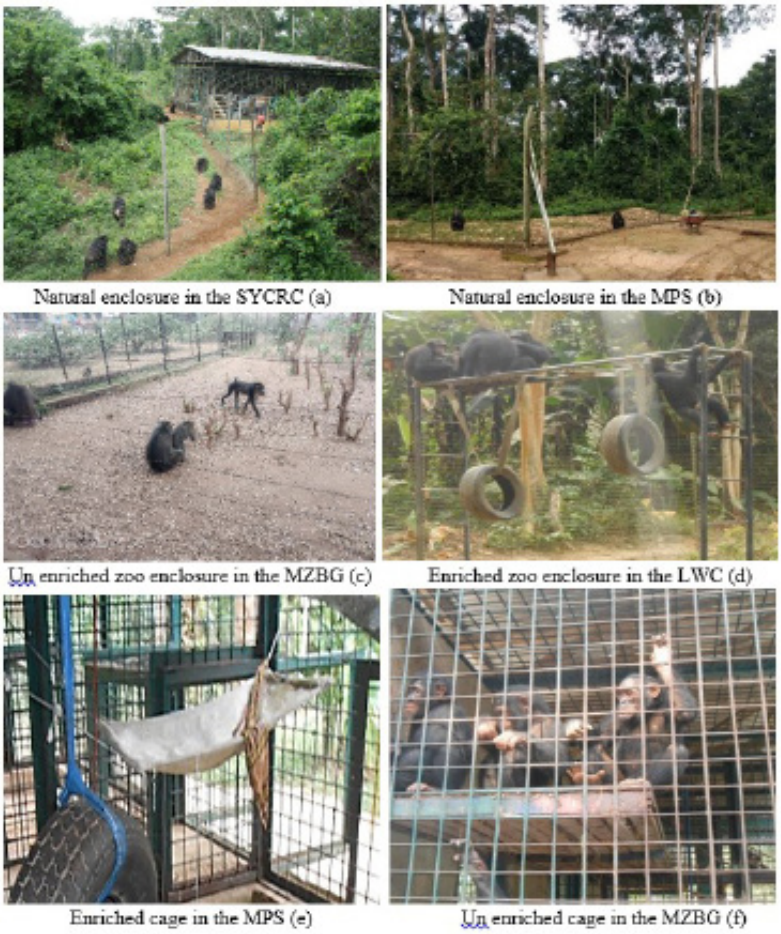

Figure 6: Different housing facilities of NH primates in the different captive NH primates' sites (a, b, c, d, e and f)

The Box and Whisker Plot Representation of NH Primates Welfare with Respect to Their Housing Facilities

The box and whisker plot shows more details on the variation of BCS with respect to the various housing facilities of the NH primates. It was noticed that, NH primates living in natural enclosures had the best mean BCS (5). Enriched zoo enclosure followed with the mean

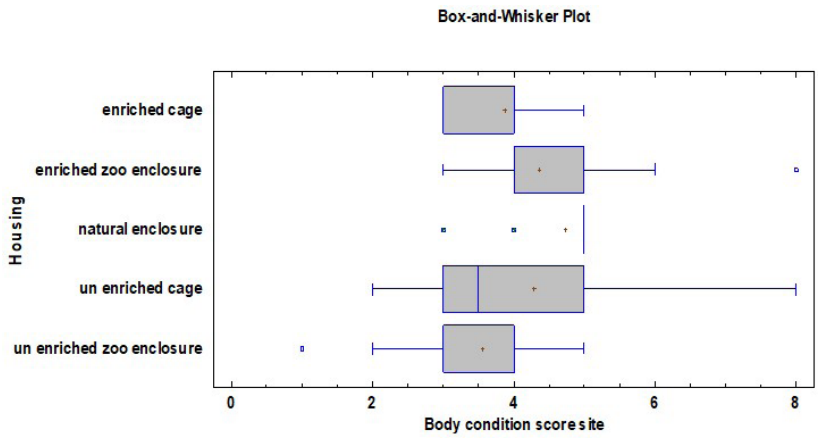

Figure 7: The box and whisker plot shows more details on the variation of BCS with respect to the various housing facilities of the various captive sites

BCS ranging between 4 and 5. Un enriched zoo enclosure and the un enriches zoo cages had the least mean BCS (3) with the lower limit (2) "emaciated" and upper limit of unenriched caged being (8) "obsessed" figure 7.

Other Factors Affecting the Welfare of Captive NH Primates

Other factors that influenced the welfare of captive NH primates were; the group size, NH primates specie, the age and level of education of keepers together with their duration in the captive sites. Median plots were used to bring forth more details. As concerns the NH primates specie, it was noticed that great apes (Chimpanzee and Gorillas) had the best BCS (5). The group size of (6 – 10 NH primates) had the best BCS (5).

The level of education of keepers was found to influence the BCS of NH primates, where keepers of the secondary and higher education level had NH primates with the best BCS (5). As concerns age, keepers at the adult age range had NH primates had NH primates with the best BCS (5). Looking at the duration of keepers in the various captive sites, keepers that had spent between 6 – 10 years in the captive sites had NH primates with a BCS of 5 figure 8.

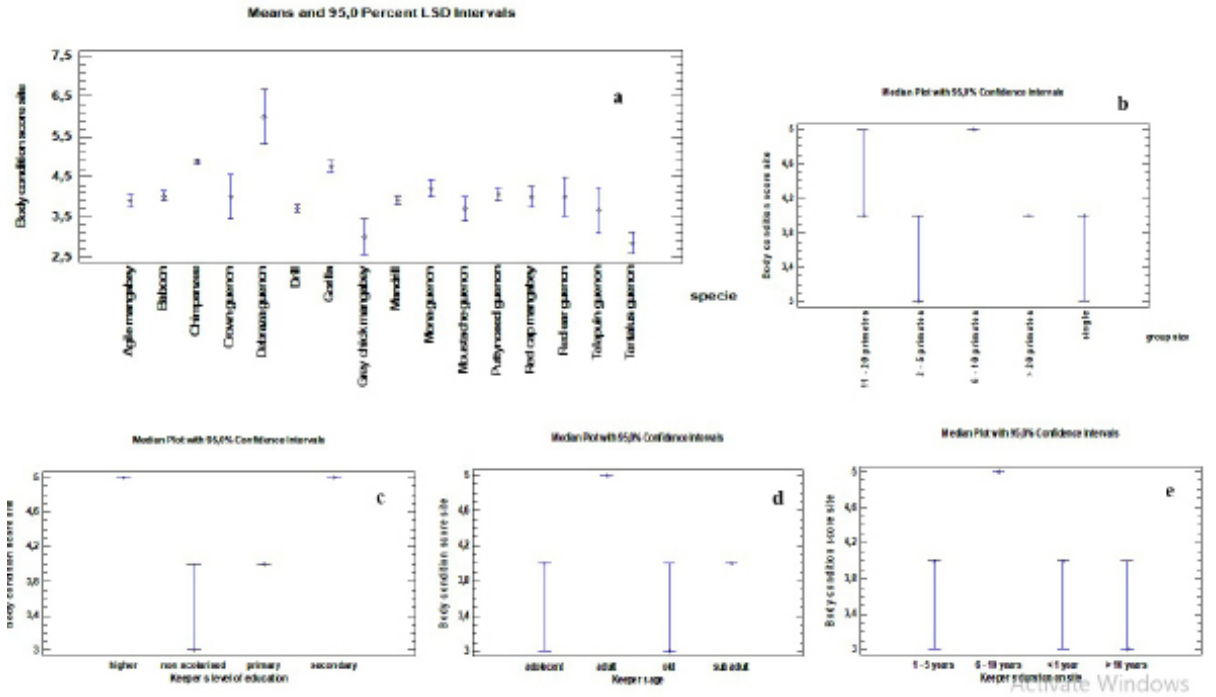

Figure 8: The median plots with confidence intervals of the NH pimates specie, group size, keepers level of education, age and duration on site (a, b, c, d and e)

Discussion

A total of 633 NH primates from four different captive sites (two sanctuaries; the Mefou Primates Sanctuary "MPS" and the Sanaga Yong Chimpanzee Rescue Centre "SYCRC" and two zoological gardens; the Limbe Wildlife Centre "LWC" and the Mvogbetsi Zoobotanical Garden "MZBG") were included in our study. 223 NH primates were found in the LWC, 277 in the MPS, 61 in the MZBG and 72 in the SYCRC. The study population was composed of 16 different Captive NH primates; 2 Apes (Gorillas and Chimpanzees), 3 Papionines (Olive Baboons, Drills and Mandrills), 3 Mangabeys (Gray chick mangabeys, Red cap mangabeys and Agile mangabeys) and 8 Guenons (Mona monkeys, Putty nosed monkeys, Moustache monkeys, Tantalus monkeys, Patas monkeys, De Brazza monkeys, Preus monkeys, Talapoin monkeys, the Crown and Red eared monkeys). The NH primates found in these captive sites are similar to the Cameroon NH primates used as pet and bush meat; following the work of Pourrut *et al.* (2010). This shows that there is no imported NH primate specie in captivity. In our study, Chimpanzees were the most abundant species (36.3%), while Debraza and Preuss guenon (0.3% each) were the least abundant species. This may be explained by the findings of Michael & Koen (2017) who found that, in logged forest group, densities of chimpanzee, red-capped mangabey, mona monkey and red-eared monkey decreased between the two survey years, whilst remaining constant or increasing in unlogged forest. Another research shows that, Chimpanzees, being amongst one of the most abundant and most assessable NH primates species (PASA, 2002). The sex ratio of the NH primates in the captive sites was 1.1 (male-biased) and most of the (66.8%) were adults. Sex ratio (SR) being the ratio of males to females in a population, this sex ratio is similar to that of most NH primates in the wild and in captivity. Several research has been carried out as concerns sex ratio in NH primates. The SR tends to be 50:50 in sexually reproducing animal species, although deviations have been observed in wild and captive populations (Clutton-

Brock & Iason, 1986; Burke & Birch, 1995). Concerning the duration of the animals in the sanctuaries, 5.2%, 8.2%, 19.6% and 67% spent less than 1 year, 1-5 years, 6-10 years and more than 10 years in the sanctuaries respectively. This shows that conditions in zoos and sanctuaries have been made favourable for animals to be more comfortable and live longer. Reason why more than 67% of the primates have been in these captive sites for more than 10 years. Hosey (2023) found that, during 200 years, many important advances have been made both in zoo practice and philosophy and in the housing and husbandry of primates.

According to Dawkins (1990), the welfare of an animal depends upon its biological features and the housing and management conditions under which it is kept. He also pointed out that the welfare of an animal will become poorer if it cannot successfully adapt to the conditions in which it is kept. In the same way, environmental conditions that significantly depart from an animal's 'niche' can be the source of welfare problems, the extent of which depends on their prevalence, duration and intensity, and on an animal's ability to adjust to them. Originally, welfare assessments focused primarily on management-based measures and resource-based measures such as provision of food, enrichment and space. Recently, there has been a significant shift towards including animal-based measures, such as body condition score (Maher *et al.,* 2021). In our studies, we focused on BCS to evaluate the welfare of NH primates.

It was found that the captive sites where the captive NH primate belong had an influence on their welfare. NH primates in sanctuaries (SYCRC and MPS) had better BCS that is ranging between 4 and 5 with SYCRC being the best (5) while those found in zoos (LWC and MZBG) had a lower mean BCS score ranging between 3 and 4. with NH primates in the MZBG being the least with the mean BCS (3). The work carried out by Lake (2012) sanctuaries only take in animals that need help in some way while zoos very much differ from this approach as they acquire animals that will be entertaining for the public. He concluded that since sanctuaries always try to release healthy animals back into the wild, they focus on creating an environment that replicates their natural environment. Phillips, (2005) also found that some zoos have faced continual criticism for a number of animal welfare concerns due to lack of space and the absence of natural foraging behaviour are the most serious, but inadequate social groupings and diet/;s have also been mentioned. This could explain why animals in sanctuaries had better BCS.

Concerning the housing of the NH primates, primates living in natural enclosures had the best BCS (5). Those in enriched zoo enclosure followed with the mean BCS ranging between 4 and 5. Those in un enriched zoo enclosure and the un enriches zoo cages had the least mean BCS (3) with the lower limit being 2 and upper limit of those in unenriched caged being 8 referring to obsessed NH primates. It was noticed that, housing conditions have been found to significantly influence physiological measures of stress in primates, in particular immune competence and reproduction (Shepherdson and Carlstead, 2009). In practice, this means providing a complex and diverse environment that increases the possibility that the captive animal's own behaviour will produce what it needs: finding food, demarcating territory, nest building, escaping conspecifics or hiding (Carlstead, 1996). Since captive enclosures are, by their very nature, likely to be more simplistic than natural habitats, and this has both advantages and disadvantages for the exhibited animals. A suitable environment for any animal encompasses a wide range of needs. It should provide space in which the animals can express their physical and social behaviour. (Shepherdson, 2003). This could explain why NH primates in natural enclosures had better BCS. It was noticed by (kuhar *et al.,* 2006; FAWC, 2009) that the levels of locomotion were lower in captive chimpanzees than in their wild counterparts, and increases in species-typical behaviours in captive populations were typically equated with increases in well-being, increases in locomotion were generally considered to be related to positive welfare. They also found a statistically significant positive correlation between locomotion and another behavioural indicator of positive well-being (Ross *et al.,* 2009).

This could explain why NH primates in enriched habitat had better BCS than those in un enriched habitats. Concerning enriched habitats, Other studies have used the level, rate, or presence/absence of species-typical behaviours to make inferences about positive welfare states. this includes behaviours such as tool use, nesting, and grooming (Forthman, 1992). The enclosure should allow the animal to adopt as wide a behavioural repertoire as possible, provide it with a sense of security, and a suitably complex environment to allow the animal to run, walk, climb and jump. Materials providing tactile stimuli are also valuable. Opportunities for the animals to have some control over the environment should be provided (Hossey, 2019).

The other factors that influenced the welfare of captive NH primates, were; the group size, NH primate's specie, the age and level of education of keepers together with their duration in the captive sites. As concerns the NH primates specie, it was noticed that great apes (Chimpanzee and Gorillas) had the best mean BCS (5). Concerning group size, it was noticed that a group make up of 6 – 10 NH primates had the best mean BCS (5). A study carried out by Bacon (1999) showed that primates should be housed in stable groups of sufficient size and composition to allow the full expression of these behaviours. Also, since most primates are social species, it is likely that stressful events have repercussions on how, when and for how long individuals interact with each other. Social network analysis is increasingly used in the study of animal behaviour (Croft *et al.,* 2008). Social grooming is an extremely important behaviour, as it maintains and strengthens social bonds, provides a source of comfort and reassurance, and helps maintain

coat condition. However, over-grooming and hair plucking are associated with poor welfare states. (Bacon, 1999). It was also noticed that social play is often used to indicate positive welfare, but this behaviour occurs at low frequencies (Barber, 2009).

The level of education of keepers was found to influence the BCS of NH primates, where keepers of the secondary and higher education level had NH primates with the best mean BCS (5). As concerns age, keepers at the adult age range NH primates with the best mean BCS (5). Looking at the duration of keepers in the various captive sites, keepers that had spent between 6 – 10 years in the captive sites had the best mean BCS (4-5). This shows the importance of keepers in the welfare of NH primates. Meehan *et al.* (2016) found that, zoo staff in progressive accredited zoos attempt to ensure that the animals in their care experience the best possible welfare, not only because this is a laudable goal in its own right, but also because it is essential in achieving the zoos' educational and conservation mission and vision. He suggested that one of the strongest contributions to improving zoo animal welfare science is the investigation of the impact of human-animal interactions. Martin and Melfi, (2016) found that, animals in zoos are capable of discriminating between and responding differentially to unfamiliar and familiar keepers. This shows the importance of animal – keeper relation. Another studies showed that, when keepers spent more time with gorillas in training and play sessions, they showed reduced stereotypies, inactivity and aggression (Carrasco *et al.,* 2009). Also, knowledge, attitude and empathy for animals have been found to be instrumental in the development of human animal relationships in other contexts (Hosey and Melfi, 2019; Hemsworth and Coleman, 2010). Hinde, (1987) found that caretakers and animals engage in a high frequency of positive interactions, and human–animal relationships can form in captive settings. Due to these positive relationship keepers have formed with the animals under their care, they observe more active behaviours. Eridia *et al.,* (2024). Then concluded that, staff should be trained in the management, husbandry and training of animals under their care. For animal carers and scientists working with NH primates, training should include species-specific information.

Conclusion

In other to evaluate the welfare of non-human (NH) primates in captive sites in Cameroon, body condition scoring technic was used to score the NH primates present in two sanctuaries (Mefou Primates Sanctuary "MPS" and Sanaga Yong Chimpanzee Rescue Centre "SYCRC" and two zoological gardens Limbe Wildlife Centre "LWC" and Mvogbetsi Zoo Botanical Garden "MZBG") of Cameroon. A total of 633 NH primates They were composed of 16 different species with Chimpanzees were the most abundant (36.3%) species. The captive sites category and the housing facilities influenced the welfare of these captive NH primates. NH primates in sanctuaries and those living in natural enclosures had the best mean BCS. It was also notice that NH primates housed in groups of 6 – 10 had the best mean BCS compared to other group sizes. Meaning very large groups and very small groups had negative impact on their welfare. Keepers were found to influence the BCS of NH primates under their care in the sense that, keepers with higher level of education, keepers at the adult age group and keepers that had spent between 6 – 10 years in the captive sites had NH primates with the best mean BCS. This shows that the environment of NH primates, their group size together with the keepers taking care of them are very key factors to the wellbeing of these NH primates. Captive sites have to take these aspects in to consideration so as to replicate the management, the biome and the niche of captive NH human primates such that it reflects that in the wild. This will permit them to express most of their natural potentials even though they are in captivity,

Significant Statements

This study discovered a great variety of the conservation facilities, methods and procedures of NH primates together with their effect on the welfare of NH primate in the various captive sites.

Conflicts of Interest

The authors declare no conflict of interest.

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