

ENCLOSURE SIZE OF ANIMALS OF LAHORE ZOOLOGICAL GARDEN IN COMPARISON OF INTERNATIONAL NORMS

Z. Hussain*, Z. Ali, A. Nemat, S. Ahmad, S. K. Sikander and K. Saleem

Environmental Health and Wildlife, Department of Zoology, Punjab University Lahore, Pakistan

*Corresponding Author's Email: xsarah@ymail.com

ABSTRACT

The study was conducted in Lahore zoological gardens regarding the enclosure sizes of animals and birds to check that whether the sizes of the enclosures meet the international standard for enclosure sizes or not. Lahore zoo was established in 1872, it holds a number of exotic, endogenous and endangered species. The sizes of enclosures were compared with the standards of AZA, CZA, IWRC and NWRA. The study population comprises of 95 species of animals and birds with total number of individuals 521. Out of 11 species of mammals compared, the enclosure sizes of 7 were appropriate, out of 16 species of herbivores, 8 were having sufficient enclosure sizes, 6 species of primates were present out of which only 4 were having appropriate cage sizes, out of 10 species of reptiles the enclosure sizes of only 3 were appropriate. Out of 45 kinds of birds (38 species) the cage sizes of only 13 were appropriate, while all running birds and water birds were having sufficient enclosure sizes. It was concluded that at Lahore zoological gardens, 45% enclosures meet international standards and had area sufficient for the animals, while the rest needs to be provided with more area.

Key words: Lahore Zoo, Enclosure Size, International Zoo rules

Abbreviations: AZA: Association of Zoo and Aquarium, CZA: Central Zoo Authority, EAZA: European Association of Zoos and Aquaria, IWRC: International Wildlife Rehabilitation Council, NWRA: National Wildlife Refuge Association

INTRODUCTION

Mench and Kreger, (1996) states that the human being keeps wild animals in zoological parks for educational, conservational, research and recreational purposes. Wolf and Tymitz (1980) define zoos as a place for human enjoyment of the "natural" environment. Animals living in zoo survive in enclosures that often aim to reproduce their natural environment and behavioral patterns that are for the sake of both the animals and visitors. Animals need a roomy, airy and open environment.

Veasey, (2006) stated in his study that captivated animals need a habitat that is as motivating and as natural as possible. In zoo enclosures, animals are kept in spacious settings that allow them to express some of their natural behaviors. Despite that, many of the animals stay in minimally improved cages or barren tangible enclosures. In such cages, animals that naturally move over many miles each day, such as elephant that usually travel around 30 miles each day, are unable to perform this behavior in their enclosures. Rees, (2011) also suggests that a zoo necessity includes appropriate enclosure sizes. This means there should be sufficient

space for normal movement of an animal, such as running, flying or swimming at their natural speeds, horizontally as well as vertically, as is natural for the animal. EAZA, (2008) define an enclosure as any housing provided for animals in zoos and aquaria.

EAZA, (2008) suggests that to avoid the danger of persistent conflict between herd or group members, and for making sure that the physical carrying capacity of an enclosure is not exceeded and also to avoid the occurrence of undesirable build-up of parasites and certain pathogens.

Veasey, (2006) concluded that if the living circumstances are poor, the animals would display abnormal neurotic behavior such as pacing, head bobbing and biting the cage bars, for that reason it is extremely important for animals to be placed in enclosures having sufficient sizes. Tennessen, (1989) has given the core factors which involves the enclosure of an animal (Figure 1).

The main objective of this study was to estimate the situation at Lahore zoological gardens regarding enclosure/cage sizes of the existing animals and to see if the requirements met international standards of enclosure sizes.



Figure 1: Core factors involving animal enclosures

MATERIALS AND METHODS

The study was conducted at Lahore zoo and the data regarding the different enclosure/cage sizes was provided by the administration of zoo. This zoo was established in 1872. It falls under the Punjab Wildlife and Parks. A number of different species of animals are housed which belong to different families, including carnivores, herbivores, primates, rodents, ungulates, deer family. Many fancy birds are also present.

Total number of animals included in this study is 542 representing 88 different species, including many endangered, indigenous and exotic species. The study population is tabulated in table 1. All the animals are included in this study without any discrimination of age, gender, species and health condition that are currently residing at Lahore zoo. The sizes of enclosures were compared with the standards of AZA, CZA, IWRC and NWRA.

RESULTS

Lahore Zoo covers an area of 98 ha. It holds a total of 133 animal species which are kept in enclosures

Table 2. Checklist of Enclosures & Cages

Animal/ Species	Presence of Utensils of Food	Availability of Water\ Bath Pool	Kind of Substrate	Presence of Resting Cubicle\ Shelter	Presence of Wooden Logs	Presence of Plantation
African lion <i>Pantheraleo</i>	Yes	Yes	Tiled	Yes	No	No
Bengal Brown Tiger <i>Pantheratigristigris</i>	No	Yes	Tiled	Yes	No	Yes
Leopard <i>Pantherapardus</i>	No	No	Tiled	Yes	No	Yes
Wolf <i>Canis aureus</i>	No	Yes	Tiled	Yes	No	Yes
Puma <i>Pumaconcolor</i>	No	Yes	Muddy	Yes	No	Yes
Otter <i>Lutralutra</i>	Yes	Yes	Muddy	Yes	No	No
Black Bear <i>Selenarctosthibtenatus</i>	No	Yes	Muddy	Yes	No	Yes
African Bush Elephant <i>Loxodontaafricana</i>	No	Yes	Muddy	Yes	Yes	Yes
White Rhinoceros <i>Ceratotheriumsimum</i>	No	No	Muddy	Yes	Yes	Yes
Lama <i>Lamaglama</i>	No	No	Muddy	Yes	No	Yes

of different categories and sizes according to their requirements.

Table 1. Study Population

Sr.No.	Category	No of Species	No. of Individuals
1	Mammals	11	33
2	Herbivores	16	91
3	Primates	6	20
4	Reptiles	10	44
5	Birds	38	269
6	Running Birds	3	5
7	Water Birds	4	55

Complexity of Enclosures: Various factors related to the complexity of enclosures including presence of utensils of foods, presence of shelter, wooden logs, plantation, bath pool and shelter were observed for all the animal enclosures and cages at Lahore Zoo and a checklist regarding the complexity of these enclosures is tabulated in table 2 below:

Giraffe <i>Giraffacamelopardalis</i>	No	No	Muddy	No	Yes	Yes
Hippopotamus <i>Hippopotamus amphibious</i>	Yes	Yes	Muddy	No	Yes	Yes
Hog Deer <i>Axis porcinus</i>	No	No	Muddy	No	No	Yes
Spotted Deer <i>Axis axis</i>	No	No	Muddy	No	No	Yes
Fallow Deer <i>Damadama</i>	No	No	Muddy	No	No	Yes
Black Buck <i>Antilope cervicapra</i>	No	No	Muddy	No	No	Yes
Chinkara <i>Gazella gazelle</i>	No	No	Muddy	No	No	Yes
Red Deer <i>Cervus elaphus</i>	No	No	Muddy	No	No	Yes
Mouflon Sheep <i>Ovis montanus</i>	No	No	Muddy	No	No	Yes
Porcupine <i>Erethizon zibethicus</i>	No	No	Muddy	No	No	No
Rabbit <i>Oryctolagus cuniculus</i>	Yes	No	Muddy	Yes	No	No
Burchell's Zebra <i>Equus burchelli</i>	No	Yes	Muddy	Yes	No	No
Guinea Pig <i>Erethizon zibethicus</i>	Yes	No	Muddy	No	No	No
Arabian Camel <i>Camelus dromedarius</i>	No	No	Muddy	No	No	Yes
Vervet Monkey <i>Chlorocebus pygerythrus</i>	No	Yes	Muddy	No	Yes	No
Capuchin Monkey <i>Cebus sp.</i>	No	Yes	Muddy	No	Yes	No
White and Black colobus <i>Mantled guereza</i>	No	Yes	Muddy	No	Yes	No
Olive Baboon <i>Papio sp.</i>	No	Yes	Muddy	No	Yes	No
Rhesus Monkey <i>Macaca mulatta</i>	No	Yes	Muddy	No	Yes	No
Chimpanzee <i>Pan troglodytes</i>	Yes	Yes	Muddy	Yes	No	Yes
Emu <i>Struthio camelus</i>	Yes	Yes	Muddy	Yes	No	Yes
Ostrich <i>Dromaius novaehollandiae</i>	Yes	Yes	Muddy	Yes	No	Yes
Cassowary <i>Casuarus casuarus</i>	Yes	Yes	Muddy	Yes	No	Yes
Land Tortoise <i>Chelonoidis nigra</i>	No	No	Muddy	Yes	No	No
Water Turtle <i>Malaclemys terrapin</i>	No	Yes	Muddy	No	No	No
Indian Rock Python <i>Python molurus</i>	No	No	Muddy	No	No	No
Russell's Viper <i>Daboia russelii</i>	No	No	Muddy	No	No	No
Water Snake <i>Pelamis platurus</i>	No	No	Muddy	No	No	No
Sand Boa <i>Euryx jaculus</i>	No	No	Muddy	No	No	No
Spectacle Cobra <i>Naja naja</i>	No	No	Muddy	No	No	No
Crocodile <i>Gavialis gangeticus</i>	No	Yes	Muddy	Yes	No	No
Krait <i>Bungarus caeruleus</i>	No	No	Muddy	No	No	No

Enclosure Size of Mammals: The enclosure sizes of 11 species of mammals kept at Lahore zoological gardens were compared with the standards of AZA, CZA, IWRC

and NWRA. The total number of individuals is 32. The enclosure sizes varied for each species and are tabulated in Table 3 below:

Table 3. Comparison of enclosure size of mammals of Lahore Zoo with AZA, CZA, IWRC and NWRA standards

Sr. No.	Name of Animal	Enclosure Size/ Cage Size (sq.ft)	No. of Individuals	Minimum prescribed by IWRC & NWRA (sq.ft)	Minimum prescribed by AZA (sq.ft)	Minimum prescribed by CZA (sq.ft)	Status
1	African lion <i>Panthera leo</i>	4931.1	6	N/A	6000	5289	Inappropriate
2	Bengal White Tiger	4089	1	N/A	3229	N/A	Appropriate
3	Bengal Brown Tiger	4089	1	N/A	3229	N/A	Appropriate
4	Leopard <i>Panthera pardus</i>	1646.2	2	N/A	400	500	Appropriate
5	Wolf <i>Canis aureus</i>	1646.2	3	288	500	400	Appropriate
6	Puma <i>Puma concolor</i>	4089	6	N/A	N/A	1076.39	Appropriate
7	Otter <i>European lutra</i>	649.7	3	N/A	1076.5	N/A	Inappropriate
8	Jungle Cat <i>Felis chaus</i>	65.62	1	144	N/A	N/A	Inappropriate
9	Black Bear <i>Ursus thibetanus</i>	3447.9	7	720	N/A	4356	Inappropriate
10	Mongoose <i>Atilax paludinosus</i>	4089	1	N/A	86	N/A	Appropriate
11	Fox <i>Vulpes vulpes</i>	3064	1	172.4	N/A	N/A	Appropriate

Enclosure size of Herbivores:In Lahore Zoo, there are 16 species of herbivores present. The total number of individuals is 33. The enclosure size differed for each

species was compared with the AZA, CZA, IWRC and NWRC standards and are tabulated in table 4 below:

Table 4. Comparison of enclosure size of Herbivores in Lahore Zoo with AZA and CZA standards

Sr.No.	Name of animal	Enclosure size\ Cage size (sq.ft)	No. of individuals	Minimum Prescribed by IWRC & NWRA (sq.ft)	Minimum prescribed by AZA (sq.ft)	Status
1	African Bush Elephant <i>Loxodonta africana</i>	39017	1	N/A	5400	Inappropriate
2	White Rhinoceros <i>Ceratotherium simum</i>	39017	1	N/A	10763	Inappropriate
3	Giraffe <i>Giraffa camelopardalis</i>	39017	2	N/A	3487.50	Appropriate
4	Hippopotamus <i>Hippopotamus amphibius</i>	39017	2	N/A	N/A	Inappropriate
5	Hog Deer <i>Axis porcinus</i>	1262	14	3500	N/A	Inappropriate
6	Neel Gai <i>Boselaphus tragocamelus</i>	13784	5	N/A	550	Appropriate
7	Spotted Deer <i>Axis axis</i>	1147.5	6	1714	N/A	Inappropriate
8	Fallow Deer <i>Dama dama</i>	6720.6	4	1500	800	Appropriate
9	Black Buck <i>Antilope cervicapra</i>	4150.4	7	N/A	1400	Appropriate
10	Chinkara <i>Gazella bennetti</i>	5861	7	N/A	1400	Appropriate
11	Red Deer <i>Cervus elaphus</i>	4450.3	4	1500	N/A	Appropriate
12	Porcupine <i>Erethizon zibethicus</i>	238.9	5	480	N/A	Appropriate
13	Rabbit <i>Oryctolagus cuniculus</i>	515.2	24	960	N/A	Inappropriate
14	Burchell's Zebra <i>Equus burchelli</i>	29865	6	N/A	N/A	Inappropriate
15	Wallaby <i>Macropus agilis</i>	6083.3	1	N/A	N/A	Appropriate
16	Sambar Deer <i>Rusa unicolor</i>	1262	2	N/A	N/A	Inappropriate

Enclosure size of primates:In Lahore Zoo, there are 6 species primates are present. The total number of

individuals is 20. The enclosure size differed for each species and is tabulated in Table 5 below:

Table 5. Comparison of enclosure size of Primates in Lahore Zoo with AZA and CZA standards

Sr.No.	Name of animal	Enclosure size\ Cage size (sq.ft)	No. of individuals	Minimum prescribed by AZA (sq.ft)	Minimum prescribed by CZA (sq.ft)	Status
1	Vervet Monkey <i>Pan troglodytes</i>	6944.83	2	N/A	5382.2	Appropriate
2	Capuchin Monkey <i>Cebus sp.</i>	6944.83	3	N/A	1076.2	Appropriate
3	White and Black Colobus <i>Mantled guereza</i>	6944.83	3	3375	1076.2	Appropriate
4	Olive Baboon <i>Papio sp.</i>	6944.83	7	N/A	21528.8	Inappropriate
5	Rhesus Monkey <i>Macaca mulatta</i>	6944.38	3	N/A	1076.2	Appropriate
6	Chimpanzee <i>Pan troglodyte</i>	1644.4	2	2000	21528	Inappropriate

Enclosure size of reptiles:In Lahore Zoo, there are 10 species of reptiles are present. The total number of

individuals is 44. The enclosure size differed for each species and is tabulated in Table 6 below:

Table 6. Comparison of enclosure size of Primates in Lahore Zoo with and CZA, IWRC and NWRA standards

Sr. No.	Name of animal	Enclosure size\ Cage size (sq.ft)	No. of individuals	Minimum prescribed by IWRC & NWRA (sq.ft)	Minimum prescribed by CZA (sq.ft)	Status
1	Land Tortoise <i>Chelonoidisnigra</i>	2152.8	1	N/A	1622.7	Appropriate
2	Water Turtle <i>Malacylemys terrapin</i>	1012	12	930	861.11	Appropriate
3	Indian Rock Python <i>Pythonmolorus</i>	40	1	296.65	861.11	Inappropriate
4	Russell's Viper <i>Daboiarusselii</i>	40	8	998.88	430	Inappropriate
5	Saw Scaled Viper <i>Echiscarinatus</i>	40	8	1091.6	430	Inappropriate
6	Water Snake <i>Pelamisplaturus</i>	40	3	282.33	430	Inappropriate
7	Sand Boa <i>Eyrxjaculus</i>	40	1	863	430	Inappropriate
8	Spectacle Cobra <i>Najanaja</i>	40	6	784.02	430	Inappropriate
9	Crocodile <i>Gavialisgangeticus</i>	5990.9	1	4661.6	5382.0	Appropriate
10	Krait <i>Bungaruscaeruleus</i>	40	3	N/A	430	Inappropriate

Enclosure size of running birds: In Lahore Zoo, there are 3 species of running birds are present. The total number of individuals is 5. The enclosure size differed for each species and is tabulated in Table 7.

Table 7. Comparison of enclosure size of running birds in Lahore Zoo with CZA standards

Sr. No.	Name of animal	Enclosure size\ Cage size (sq.ft)	No. of individuals	Minimum prescribed by CZA (sq.ft)	Status
1	Emu <i>Struthiocamelus</i>	6715	2	5382.0	Appropriate
2	Ostrich <i>Dromaius novaehollandiae</i>	8192	2	5382.0	Appropriate
3	Cassowary <i>Casuariscasuaricus</i>	8192	1	5382.0	Appropriate

Enclosure size of water birds: In Lahore Zoo, there are 4 species of water fowls are present. The total number of individuals is 24. The enclosure size differed for each species and is tabulated in Table 8.

Table 8: Comparison of enclosure size of water fowls in Lahore Zoo with IWRC and NWRA standards

Sr. No.	Name of animal	Enclosure size\ Cage size (sq.ft)	No. of individuals	Minimum prescribed by IWRC & NWRA (sq.ft)	Status
1	Demoiselle Crane <i>Anthropoidesvirgo</i>	1272	18	1125	Appropriate
2	Ruddy Shelduck <i>Tadornaferruginea</i>	1272	3	60	Appropriate
3	Pintail <i>Anasacuta</i>	1272	3	250	Appropriate
4	Mallard Duck <i>Anasplatyrhynchos</i>	158.55	31	620	Appropriate

Enclosure size of birds: The enclosure sizes of 295 individuals of birds belonging to 38 different species were compared with the standards of CZA, IWRC and NWRC and the results are given in table 9 below:

Table 9. Comparison of enclosure size of birds in Lahore zoological gardens with CZA, IWRC and NWRA standards

Sr. No.	Name of bird	Cage size (sq.ft)	No of individuals	Minimum prescribed by IWRC & NWRA (sq.ft)	Minimum prescribed by CZA (sq.ft)	S
1	White Peafowl <i>Pavocristatus</i>	156.3	10	N/A	4302	Ir
2	Java Green Peafowl <i>Pavomuticus</i>	156.3	2	N/A	861.1	Ir
3	Black Shoulder Peafowl <i>Pavocristatus</i>	156.3	20	N/A	861.1	Ir
4	Houbara Bustard <i>Chlamydotisundulata</i>	156.3	1	N/A	861.1	Ir
5	Blue Peafowl <i>Pavocristatus</i>	156.3	15	N/A	6027.4	Ir
6	Pied Peafowl <i>Pavocristatus</i>	156.3	14	N/A	6027.4	Ir
7	Emerald Peafowl (hybrid)	156.3	1	N/A	861.1	Ir
8	Ring Necked Pheasant <i>Phasianuscolchicus</i>	156.3	27	112	861.1	Ir
9	Silver Pheasant <i>Lophuranythemera</i>	156.3	9	32	861.1	Ir
10	Blossom Headed Parakeet <i>Psittacularoseata</i>	156.3	3	N/A	1722.2	Ir
11	Alexandrine Parrot <i>Psittaculaeupatria</i>	156.3	7	N/A	1291	Ir
12	Sulphur Crested Cuckatoo <i>Cacatuagalerita</i>	156.3	2	N/A	861.1	Ir
13	Budgerigar <i>Melopsittacusundulatus</i>	156.3	6	N/A	481.38	Ir
14	Red Headed Pouchard <i>Nettarufina</i>	28.35	7	N/A	1722.2	Ir
15	Finches <i>Fringillacoelebs</i>	28.35	4	N/A	322.2	Ir
16	Babblers <i>Pomatostomusruficeps</i>	28.35	4	N/A	1722.2	Ir
17	Grey Ring Necked <i>Psittaculakrameri</i>	28.35	3	N/A	1722.2	Ir
18	Olive Ring Necked <i>Psittaculakrameri</i>	28.35	6	N/A	2538.3	Ir
19	Jendey Sun Conur <i>Aratingajandaya</i>	28.35	3	N/A	1722.2	Ir
20	Blue Mask <i>Agapornispersonatus</i>	158.55	2	N/A	161.46	Ir
21	Peach Face <i>Agapornisroseicollisroseicollis</i>	158.55	6	N/A	484.38	Ir
22	White Java Sparrow <i>Paddaoryzivora</i>	174.24	5	N/A	161.46	A
23	Grey Java Sparrow <i>Lonchuraoryzivora</i>	174.24	21	N/A	161.46	A
24	Canvasback Pouchard <i>Athyavalisineria</i>	158.55	1	N/A	80	A
25	Blue Rock Pigeon <i>Columba livia</i>	158.55	14	256	80	Ir
26	Green Ring Necked <i>Psittaculakramerimanillensis</i>	158.55	1	N/A	861.1	Ir
27	Shoveler <i>Anasclypeata</i>	158.55	1	N/A	80	A
28	Chakur <i>Chukar partridge</i>	158.55	3	N/A	80	A
29	Red Golden Pheasant <i>Chrysolophuspictus</i>	158.55	8	16	861.1	Ir
30	African Grey Parrot <i>Psittacuserithacus</i>	158.55	18	N/A	7749.9	Ir
31	Blue Gold Macaw <i>Araararauna</i>	158.55	2	N/A	861.1	Ir
32	Green Winged Macaw <i>Arachloropterus</i>	158.55	2	N/A	861.1	Ir
33	Pied Dove <i>Reinwardtoenabrowni</i>	158.55	4	128	1722.2	Ir
34	Blue Ring Necked Parakeet <i>Psittaculakrameri</i>	158.55	1	N/A	861.1	Ir
35	Marbled duck <i>Marmaronettaangustirostris</i>	317	2	N/A	80	A
36	White Fronted Geese <i>Anseralbifrons</i>	317	4	N/A	80	A
37	Greater Flamingo <i>Phoenicopterusroseus</i>	317	13	N/A	80	A
38	Lesser Flamingo <i>Phoenicopterus minor</i>	317	2	N/A	80	A
39	Gadwall Duck <i>Anasstrepera</i>	317	2	N/A	80	A
40	White Pelican <i>Pelecanuserythrorhynchos</i>	317	9	N/A	80	A
41	Common Shelduck <i>Tadornatadorna</i>	317	1	N/A	80	A
42	Bar Headed Goose <i>Anserindicus</i>	317	2	24	80	A
43	Black Swan <i>Cygnus atratus</i>	317	1	32	80	A
44	White Winged Dove <i>Zenaidaasiatica</i>	317	10	128	344.3	Ir
45	Little Corella	317	4	N/A	161.5	A

DISCUSSION

It was recorded that at Lahore Zoological gardens proper visual conspiracy and multiplicity of substrates was confined to only some of the species of animals which should be taken care of as for the animal, not only the size of exhibit is important but the value of space also has prodigious importance. According to AZA, (2008), multiplicities of substrates are all vital elements of a multifarious and successful animal exhibit, for all species.

Out of 11 mammalian species kept at Lahore zoological gardens, the enclosure areas of African lion, Otter, Jungle cat and Black bear were found to be inadequate. Fisher *et al.* (1980) and Hogan *et al.* (1988) says that many researches have been conducted on the effect of enclosure sizes on the behavior of the animals in captivity. Tan *et al.* (2013) concluded in a study that the size and complexity of the enclosure affects the extent of activity and stereotypic behavior and that highlights the significance of suitable enclosure design and enrichment in the welfare of captive bears.

AZA, (2012) states that the zoo exhibits of tigers should be provided visual privacy from guests and conspecific sand should include various substrates. Too hard surfaces can result in trauma to bony prominences. Hard and artificial substrates (e.g., cement) should be minimized in tiger enclosures, as these have been associated with footpad injuries and early symptoms of arthritis.

The enclosure size of elephant present at the Lahore zoo is 39017sq.ft and which is large enough as compared to the international standers for minimum enclosure size of elephant that is 5400 sq.ft for 1 individual. According to AZA, (2011), all institutions that are planning new construction for elephants or are modifying existing elephant accommodations must

contain holding space for adult males in their construction or renovation plans.

Out of 16 species of herbivores, 8 are having sufficient enclosure sizes. The enclosures that needs enhancement includes African bush elephant, white rhinoceros, hippopotamus, hog deer, spotted deer, rabbit, Zebra and Samber deer, although, the deer family at Lahore zoological gardens is in good health and reproductive stage.

There are 6 species of primates kept at Lahore zoological gardens out of which 4 were having sufficient enclosure sizes. Those having inappropriate enclosure sizes included Olive Baboon and Chimpanzee. Hennessy *et al.* (2014) conducted a study on rhesus monkeys regarding the effect of enclosure size recommended that cage size does not have a noticeable impact on habitual kinds of abnormal behavior but may significantly affect the level of tension.

Out of all the species compared, only 31 % (Refer to Figure 2) species were having sufficient enclosure sizes. Judy *et al.* (2013) suggested enclosure of birds shall be large enough for the bird to undertake all natural postures. Protection from weather and sun shall also be ensured. Captive birds were still highly prone to use flight as means of locomotion, and useful information should be provided regarding the careful designing of bird enclosure. At least one side of the aviary and part of the rooftop should be sheltered to protect birds from wind and rain.

The reptile house of Lahore zoo covers an estimated area of 6227.1 sq.ft in which 10species of reptiles were present. It was found that in reptiles the animals having appropriate sizes included Land tortoise, water tortoise and crocodile, while python and the species of snakes needs to be provided with bigger enclosures.

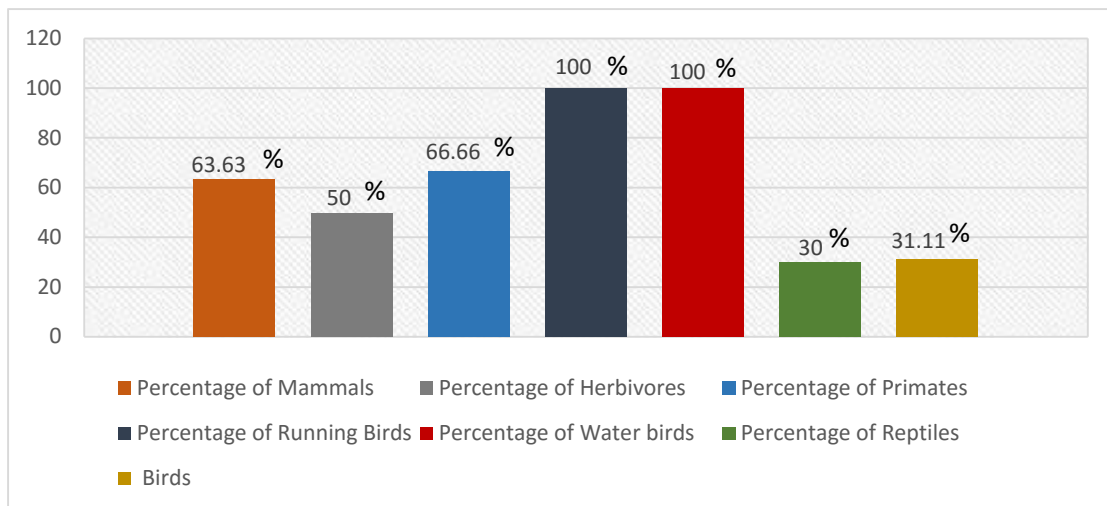
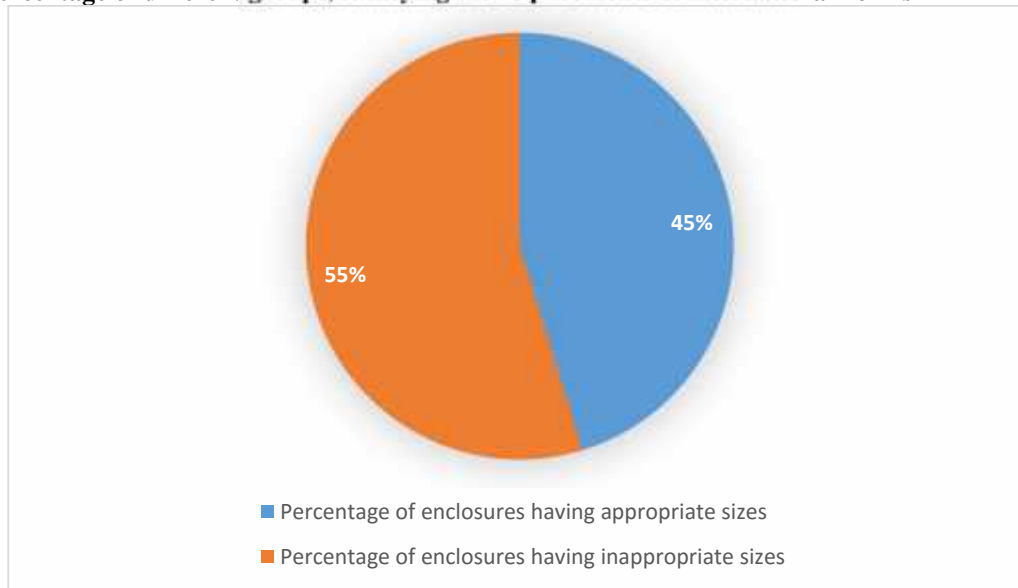


Figure 2: Percentage of different groups, satisfying the requirements of international norms**Figure 3: Percentage of enclosures having appropriate vs. inappropriate sizes**

Recommendations: It is an established fact that an enclosure plays a vital role in the overall well-being of animals and birds kept at zoos. If the enclosure size is not sufficient, animals may suffer from abnormal stereotypic behavior. The animals and birds having insufficient enclosure/cage sizes should be provided more area. It is further recommended that improper substrate of many species must be replaced, for instance, at Lahore zoological gardens an abnormal pacing and head bobbing behavior was noticed in the white Bengal tigers that can be related to the presence of concrete floor instead of a proper substrate. It is recommended that visual conspiracy from the visitors should be given and enclosures/cages should be cleaned or disinfected or regular basis in order to prevent the prevalence of infections. Furthermore, the enclosures of animals and especially birds should be designed in such a way that protection from sun and severe weather is ensured.

Conclusions: It is concluded that at Lahore zoological gardens, out of 95 species of animals and birds, the enclosure/cage sizes of only 43 species were meeting standard sizes representing that 45% enclosures met international standards and the rest needs to be provided with more area (Figure 3). The bird cages and enclosures of reptiles need a serious attention in this regard. It is essential for well-maintained animals and healthy animals that their enclosures should comprise of sufficient size and designed in the proper way as close to their natural environment as possible. When the living conditions including availability of sufficient area, are poor then there will be a negative impact on the behavior, reproductive abilities and overall fitness of the animals exhibited. Research based suggestions are given in this *Proceedings of The National Conference and Training Workshop "Wildlife and Aerobiology" held on February 6-7, 2015 Lahore, Pakistan*

study which should be taken into account and recommended changes should be implemented at Lahore zoo in order to maintain the health and population of animals and birds.

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