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Research Article

Conserving Big Cats in Captivity: Management practices used by National Zoological Park, New Delhi, India

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Abstract

The National Zoological Park, New Delhi is one of the prominent zoos housing large numbers of big cats. Zoos with time have been evolved as a prime institution that helps in the conservation of many wild animals but in the captive environment, the conditions are different in comparison to the wild. In the present study, the big cats i.e., Bengal tiger, Asiatic lion, and Common leopard housed at the National Zoological Park, New Delhi have been chosen. The captive environment provided to these animals' enclosure attributes, enrichment, upkeep, healthcare, population trend, breeding management, etc. has been reviewed. The data has been collected for every enclosure and analyzed as per the guidelines, norms, and species requirements. Besides, the population trend of these species in the zoo has also been analyzed. The results so obtained indicate that various management efforts are still required for conserving the species in captivity. Further, the population trend also depicts a more death trend than a birth trend in the case of big cats species which may be due to various reasons. The study, therefore, highlights that a more intensive species-specific captive management plan for the conservation of big cats may be formulated so that the main motive of zoos i.e., conservation and welfare of animals in captivity is being achieved successfully.

Keywords: Conservation, Zoo, Bengal tiger, Asiatic lion, Common leopard

Introduction

With the increasing extinction of the world's faunal species, zoos turn out to be the last resort for the conservation of wild fauna. Further, with the enactment of the Wild Life (Protection) Act, 1972, efforts towards conserving wild fauna and flora received considerable attention. The Zoos all over the country have accordingly evolved themselves from the menagerie concept to scientifically managed institutions having all the facilities for the wild animals ranging from naturalistic enclosures to healthcare. However, according to Zoos and Conservation (2005), the zoos still struggle to achieve high standards of conservation, animal welfare, and environmental education. One such zoo in India is the National Zoological Park, New Delhi where the conservation and management of big cats are being carried out.

The National Zoological Park (NZP), New Delhi is popularly known as the 'Delhi Zoo' having an area of 176 acres and comes under the Large Category Zoo recognized by the Central Zoo Authority (CZA). Delhi Zoo is home to a large number of animals representing different species of mammals, birds, and reptiles from around the world. The main objective of the zoo is to complement and strengthen the national efforts in conservation of the rich biodiversity of the country, particularly the fauna as stated in the National Zoo Policy, 1998 by Central Zoo Authority.

The Big cats (Lion, tiger, leopards, etc.) belongs to the family Felidae has a long back history of housing in Indian Zoos. All the big cats are listed under Schedule I of the Wild Life (Protection) Act, 1972, and therefore, zoos must take essential conservatory measures. According to Courtenay and Santow (1989), the animals in captivity enjoy the benefit of a regular supply of food, healthcare, lack of predators, however on the other hand the animals in captivity have been reported to suffer from various health issues, lack of exercise, poor adaptation to captivity, injury from exhibits, etc. according to Karstad and Sileo, (1971). Furthermore, according to Hediger (1950) species experience, a distortion in biological rhythmicity in the captive environment, and behaviors exhibited in captivity are much less diverse as compared to those in the wild. According to Hughes and Duncan (1988), physical health, as well as psychological well-being, is both important for any animal in captive conditions (Hughes & Duncan, 1988).

The Zoos in India are maintained as per the Recognition of Zoo Rules, 2009, and the guidelines prescribed by the Central Zoo Authority from time to time. The Zoos, therefore, try to maintain animals in their collection as per the norms. However, according to Zoos and Conservation (2005), in captivity, not just nutritional and veterinary aspects, but the biological needs of the animals must be met (Zoos & Conservation, 2005). Providing timely and good quality food to the Zoo animals is the main priority of the zoo along with upkeep and healthcare facilities. Further, as per the National Zoo Policy, 1998 "Every animal in a zoo shall be provided housing, upkeep, and healthcare that can ensure a quality of life and longevity to enable the zoo population to sustain itself through procreation". Besides, Recognition of Zoo Rule 10. 5 (2), also states about providing quality of food to animals wherein it is mentioned that "Feed supplied to animals should not only meet the nutritional requirements but should also meet the functional need of animals".

Further, according to Vaz et al. (2017), various enclosure attributes (size, shape, and design) and different enrichment seem to influence the behavior pattern of captive carnivores in Zoos (Vaz et al., 2017). The Central Zoo Authority has prescribed the minimum sizes for outdoor open enclosures, feeding cubicles, etc. for tigers, lions, and leopards and along with the guidelines on diet (Das et al., 2013), and veterinary care (Swarup et al., 2009) as well. Apart from this, the enclosure enrichment act as stimuli that aid in fostering the expression of species-suitable behavioral as well as mental activities in an under-stimulating environment.

Bengal tiger (*Panthera tigris*) and Asiatic lion (*Panthera leo persica*) has been listed as Endangered (IUCN Red List) and Common leopard (*Panthera pardus*) has been listed as Vulnerable in the IUCN Red List. The Delhi Zoo housed a large number of animal species which includes felids species as well i.e., big cats like Bengal tiger, Asiatic lion, Common leopard, etc. The National Zoological Park has 20 numbers of felids (large cats) which includes 2 Bengal tigers, seven White tigers, four Asiatic lions, four Common leopards (as of June 2020).

The present study was conducted at National Zoological Park (NZP), New Delhi which mainly focuses on the management aspects of the big cats – Bengal tiger, Asiatic lion, and Common

leopard. The management aspects include the Enclosure attributes (design, size, shape, kraal, night shelters, provision of sunlight, water, ventilation, etc.), Enrichment practices, Diet (Feeding and Nutrition), Healthcare, Population management, etc. have been studied. This study is an attempt to review the present facilities available with the zoo for the management of big cats and identify the existing gaps and recommend better management strategies for conserving the species in captivity.

Material and methods

The methodology used for the study included the secondary data as well as the primary data collection. The primary data includes the collection of data regarding various management measures by an on-site visit to the Delhi Zoo during the year January 2020 wherein every enclosure for Bengal tiger, Asiatic lion, and Common leopard were reviewed for enclosure attributes (Enclosure dimensions, area, shape of the cage, moat, barrier, sunlight received, water supply, ventilation) feed & nutrition provided, facilities in retiring cells, healthcare facilities, record keeping, and enrichment, etc. The secondary data included the annual inventory of animals for NZP (by Central Zoo Authority), data from Species360 (ZIMS), and National Studbooks records (which has data regarding the sex, birth, death, acquisition well as disposal) data from the annual report of the zoo and Master Plan of the Delhi Zoo (2012-31), etc.

The data collected concerning the management practices were compiled in the checklist form and was then analyzed by using the standards and norms prescribed by the Central Zoo Authority about the enclosure dimensions, shape, feed, enrichment, healthcare, etc. The data was also analyzed keeping in mind the biological needs of the species under study. Further, about the population management, the quantitative methods were used and the results were obtained in the form of graphs, charts, and tables which depict the population trend over the years for which the data from Central Zoo Authority was mainly analyzed and considered for the calculation of population trend.

Results

Evaluation of enclosure attributes

A total of six enclosures were studied to know about the facilities available for the animals in the enclosure which includes the enclosure size, dimension, moat, barrier, kraal facility, night shelters/retiring cells, provision of sunlight, ventilation, water, etc. Table No. 1 shows the comparative statement about the enclosure attributes present for Bengal tiger, Asiatic lion, and Common leopard at the National Zoological Park, New Delhi.

Table 1. Enclosure attributes present Big cats at the National Zoological Park, New Delhi

Enclosure attributes	Species		
	Bengal Tiger	Asiatic lion	Common leopard
No. of Animals	2:0:0:2	2:2:0:4	2:2:0:4
No. of enclosures	02	02	02
Enclosure Area (visitor Arena)	Encl. No. 1 -1344 sqm Encl. No. 2- 1445 sqm	Encl. No. 1 -1384 sqm Encl. No. 2- 2697 sqm	Encl. No. 1 -158 sqm Encl. No. 2- 136 sqm
Provision of shelter, water etc. in the enclosure area	Yes	Yes	Yes
Moat	Yes	Yes	No

Barrier	Present as well as vegetation between barriers present	Present as well as vegetation between barriers present	Present as well as vegetation between barriers present
Day Kraal	Present	Present only in one enclosure	No day kraal for the off-display animal
Night shelters/Retiring area	6 cells in each enclosure	7 cells in each enclosure	3 cells in each enclosure
Provision of water in night cells	Yes	Yes	Yes
Provision of sunlight and ventilation in night cells	Limited access to sunlight and fresh area. Ventilation not adequate	Limited access to sunlight and fresh area. Ventilation not adequate	Limited access to sunlight and fresh area. Ventilation not adequate
Substrate type used in night cells	Cemented floor	Cemented floor	Cemented floor
Breeding enclosure/cells	No	No	No

Evaluation of Enrichment Practices

The results show that no enrichment practices were used by the National Zoological Park for the Bengal tiger and Asiatic lion. However, in the case of the Common leopard is only social enrichment was there.

Evaluation of Upkeep and Healthcare

The facilities including the feed (type, quantity, frequency, etc.) and healthcare- vaccination, deworming, health screening, facilities available in the veterinary hospital, quarantine protocol, pest management, sample testing, etc. present in the National Zoological Park, New Delhi for all the three species under study were evaluated and it was found that Bengal tiger and Asiatic lion were given 12 kg of Buffalo Calf Meat in winters and 10 kg in summers (per animal) with fasting on Fridays and in case of Common leopard 7 kg of Buffalo Calf Meat in winters and 6 kg in summers (per animal) with fasting on Fridays. In the case of veterinary facilities, it is found that most of the facilities are available in the zoos and regular vaccination, deworming, testing of samples, etc. is been carried out by the zoo.

Population Management

An overview of the overall population trend along with the birth and death trend of Bengal tiger, Asiatic lion, and Common leopard during the year 1995 to 2019 at Delhi Zoo is shown in figures 1, 2 and 3.

Figure No. 1: Population trend of Big cats at Delhi Zoo

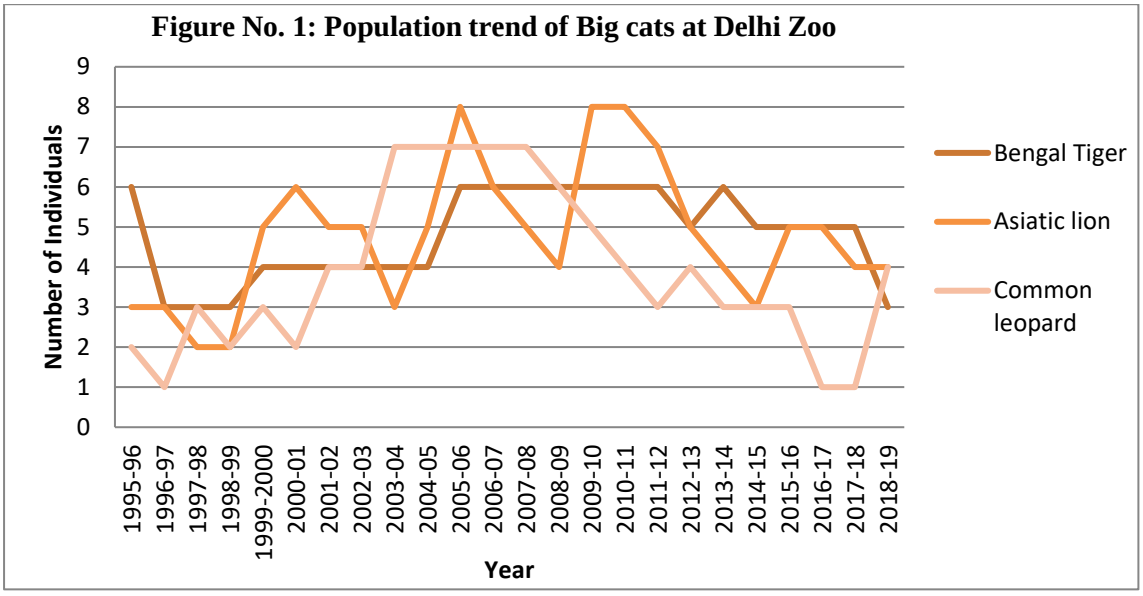


Figure No. 2: Birth trend of Big Cats at Delhi Zoo

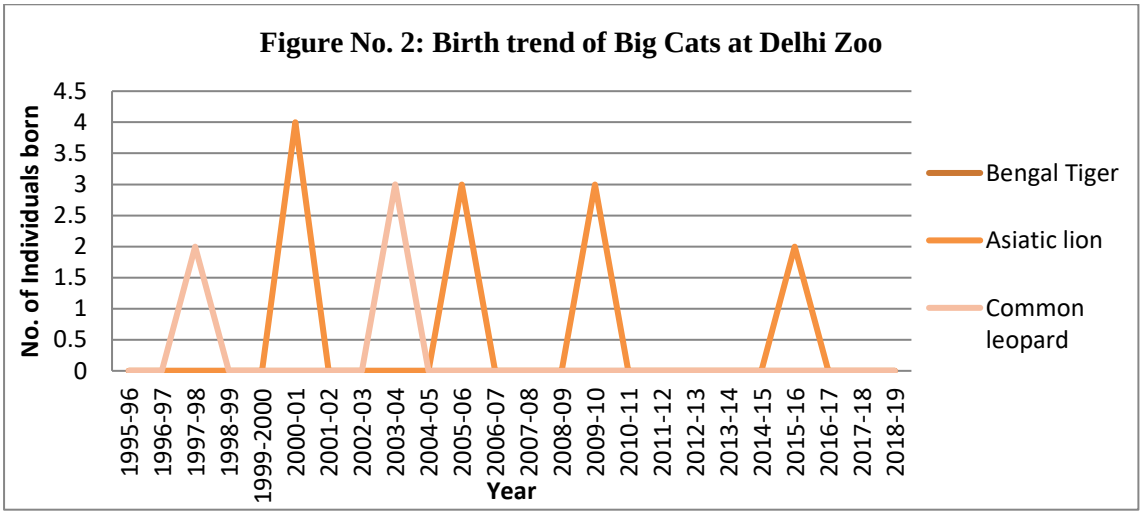
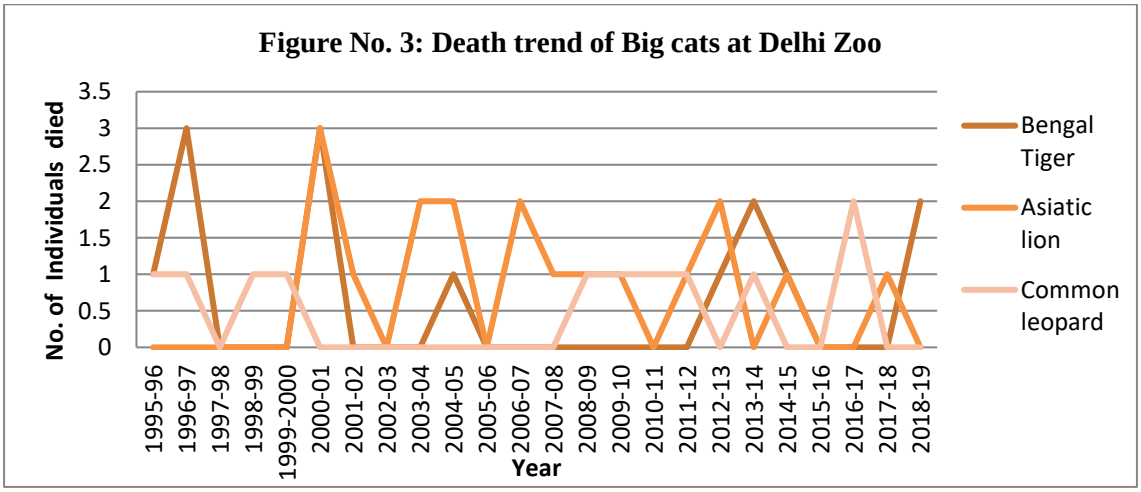


Figure No. 3: Death trend of Big cats at Delhi Zoo



Other management practices

The other management interventions used by the National Zoological Park concerning the population management aspects are listed under Table No. 2.

Table. Population Management interventions used by the National Zoological Park for Big cats

Population Management Aspects	Species Name		
	Bengal Tiger	**Asiatic lion**	**Common leopard**
Record Keeping			
Keeper's Dairy	Yes	Yes	Yes
Daily Report	Yes	Yes	Yes
Animal History Cards	Yes	Yes	Yes
ZIMS / Species360	Yes	Yes	Yes
Studbook	No	No	No
Marking of Animals	Yes	Yes	No
Founder Stock identified	No	No	No
The breeding population identified and managed	No	No	No
Genetic analysis of the stock	No	No	No
Exchange and Acquisition did on the basis of studbook/genetic analysis	No	No	No
Any managemental interventions pre and post-birth	No	No	No
Assisted rearing	No	No	No
Proper birth facilities	No	No	No
Species recovery plan	No	No	No

Discussion

Evaluation of Enclosure Attributes

Enclosure area/paddock area- The enclosure outdoor area/visitor arena area where the animal spends most of its active period is also known as the paddock area i.e., the outdoor display area. The study shows that the paddock area in the case of the Bengal tiger and Asiatic lion is as per the prescribed guidelines issued by the Central Zoo Authority (as shown in table No. 1). However, in the case of Common leopard, the enclosure area is not as per the guidelines. According to the guidelines issued by CZA (Zoos in India, 2014), the minimum prescribed size of outdoor open enclosure for tiger and lion is 1000 square meters/pair and for Panther/leopard is 500 square meters/pair.

Enclosure barrier and moat- A barrier is used to contain the animal inside the enclosure. The barrier determines the distance between the animal and the zoo visitor, therefore, the distance and type of barrier used are very important in determining the behavior and proper management of animals in zoos. Bengal tiger and Asiatic lion enclosure studied has a moat and Common leopard enclosure has a chain link mesh. Besides, the enclosures studied have a wooden type barrier of more than one meter in height (having vegetation in between).

The results of the study revealed that the Guidelines on the use of innovative exhibit design and barrier design for holding and display of animals & birds in Indian Zoos by CZA needs to be implemented for all the three species under study especially in the case of the common leopard because the enclosure for Common leopard is not as per the norms and needs lots of renovation/ repairing work.

Substrate use- Substrate is the surface in the enclosure which comes into contact with the animal housed. It is used for the animal in the display area as well as in the night/ retiring cells. The most natural and earthen type substrate is the best one to be used for the animals. The study revealed that in the display area the earthen substrate is used for all the species under study. However, it has been noticed that cemented substrate/flooring is used in the night cells/ feeding/retiring cubicles for all the species in all the enclosures studied.

Retiring area- The area where the animals are brought during the night hours and when the animals are not opened up in the display area/ paddock. The retiring area is an off-display area. The retiring area has retiring cells/night cubicles/feeding cubicles and a kraal area. This area ensures the safety of the animals. Each of the individual animals or group may not necessarily be released in the paddock area and are released/ opened upon rotation basis due to which sometimes an individual animal has to spend most of the time in the retiring area. Kraal is the opened up off-display area, having a larger area in comparison to cells so that the animal's activity- animal movement, physical exercise, etc. will not be hampered.

The study revealed (Table 1) that in the retiring cells of all the enclosures studied there is limited access to sunlight and fresh area and ventilation is not adequate. However, there is a provision of 24 hours potable water for the animals. About the kraal facilities, the facility is not present in the case of one enclosure for Asiatic lion and Common leopards (in both the enclosures) and breeding cells are absent also at the Delhi Zoo. Further, the enclosure retiring cells partially meet the minimum size prescribed by the CZA guidelines for the species. Besides, the cemented flooring in the retiring cells is also of great concern as it may cause a sore footpad to the animal house. Therefore, there is a need for the implementation of the prescribed guidelines so that the animals may not suffer and animal welfare is not compromised at all.

Evaluation of Enrichment Practices

In captivity, the enrichment helps in keeping the animal active and hence prevents stereotypic behavior. Various studies and Bashaw et al. (2003) showed that using different kinds of enrichment could not only benefit the animals directly but it can also benefit the zoo visitors indirectly through improving their experience of zoo visits (Bashaw et al., 2003). According to the Shepherdson et al. (1993) felids are often notoriously inactive exhibit animals and therefore, emphasis should always be given to their enclosure enrichment to stimulate their natural behavior.

The results of the present study are partially per the studies mentioned above as the exhibits for big cats i.e., felids at Delhi Zoo are provided with environmental/ exhibit enrichment with only a few enrichment artifacts and no feeding, social as well as olfactory enrichment. Besides, other enrichments are also important for the captive animals so that the natural behavior repertoire of an animal may be stimulated. The Recognition of Zoo Rules, 2009 also made emphasis on the same "Every Zoo shall make special efforts to enrich the environment of the enclosure to meet the species-specific behavioral requirements of the animals in accordance with the standards specified by the Central Zoo Authority". Therefore, the Delhi Zoo needs to incorporate different kinds of enrichment for the felids for stimulating their natural behavior.

Evaluation of Upkeep and Healthcare

According to Hughes and Dunchan (1988), for the animal welfare of an animal in captivity, both physical health and psychological well-being are important (Hughes & Dunchan, 1988). Recognition of Zoo Rules, 2009 also made emphasis on the Upkeep and healthcare of the animals which includes feed provides, its quantity, frequency, place where the feed is given, veterinary care, health screening, etc.

Concerning the feed, the zoo is giving Buffalo Calf meat to all the big cats (Bengal tiger, Asiatic lion, Common leopard), once a day (in the evening) in retiring cells which are as per the norms and species requirements. Further, the suggested guidelines by Das et al. (2013) in the book

"Standardization of Animal Diets in Indian Zoos" may also be followed for much better care of the animals.

Besides, about the healthcare, as per the records available, the zoo is regularly monitoring the animal health and carries out testing of samples, deworming, vaccination, quarantine protocols, a pest management protocol, etc. The study concluded that the Standard Guidelines and Protocols on Disease Diagnosis by Swarup. et al. (2009) should strictly be followed in case of healthcare and the Veterinary facilities for Large Category Zoo made mandatory under the Recognition of Zoo Rules, 2009 should be developed at the Delhi Zoo for making management of felids more effective.

Population Management

According to Ballou et al. (2010), the future population growth of any species in captivity is only be determined by assessing the historical as well as current population pattern (Ballou et al., 2010). The present study attempts to determine the trend in population growth over the years at Delhi Zoo for Bengal tiger, Asiatic lion, and Common leopard. The increase in population trend is because of the increase in the stock position of the captive animal which may be due to births, acquisition in captivity, etc. Moreover, the decreasing population trend shows the fewer number of individuals in the stock because of no births, no acquisition, and more deaths and maybe disposal. The population trend carried out in the present study is purely based on the data from the CZA.

In the case of all the species under study, the results showed the fluctuating trend with more deaths (14 deaths in Bengal tiger, 19 in case of the Asiatic lion, 11 in case of Common leopard) and fewer births (no birth of Bengal tiger, 12 in case of Asiatic lion, 5 in case of Common leopard) during the period of April 1995 to March 2019 at Delhi Zoo. The same was also observed in the National Studbook Bengal Tiger and Asiatic lion (Wildlife Institute of India, 2018). In Delhi Zoo, during this period a total of 10 acquisitions were carried out in the case of the Bengal tiger, 9 acquisitions of the Asiatic lion, and 9 of Common leopards. This showed that better and more advanced upkeep and veterinary care etc. are required for these species housed at Delhi Zoo. So that these species may be managed more scientifically and breeds well in captivity i.e., a scientific management strategy is urgently needed at Delhi Zoo.

Other Management Practices

There are various other management practices and measures used by the zoos in the country. In the present study, only a few of them are used to access the measures used at Delhi which includes record-keeping so that every detail on the animal is known which may be used in the future for their genetic as well as behavioral management. Besides, the management practices used about the breeding and genetics were also accessed during the study as the same is of utmost importance for maintaining a viable and healthy population in captivity.

The results show that at the Delhi Zoo, the record-keeping of the animals was carried out wherein various records of animals are maintained on regular basis like Keeper's Diary, Animal History Cards, Treatment Cards, ZIMS/Species 360 records but the studbooks are not maintained for all the species under study. Further, from the records collected through secondary data collection i.e., National Studbooks, CZA records, and Species360 records, it has been observed that there is a mismatch of data between all the record sources.

Further, table 2 depicts that there is a lack of facilities used by the Delhi Zoo about the identification of stock, assisted rearing, genetic analysis, breeding population identification & management, birthing facility, random exchange of animals (without referring to the studbooks or animal history), species recovery plan, etc.

Therefore, the results of the study suggest that better and more effective record keeping should be carried out for these species in captivity. Further, for more accurate breeding population management strategies for the species in captivity should be employed so that the individuals can be easily recognized even if they were exchanged between zoos. The same will also help in maintaining the pedigree details of the individual and other factors may also be determined which in turn serves as a tool for maintaining and managing heterozygosity in the captive population (Ballou et al., 2010). It will determine the reasons behind any genetic disease, infant mortality, etc. under captive breeding as well.

Recommendations

The study suggests the following recommendations for the better management of Bengal tiger, Asiatic lion, and Common leopard in captivity (Delhi Zoo):

- The guidelines and norms prescribed by the Central Zoo about the housing of animals (enclosure, retiring cells), upkeep, healthcare, enrichment, record keeping, etc. should be strictly followed.
- Provision of Kraal, separate breeding cells, and other facilities like proper substrate, ventilation, sunlight in the retiring area to be made mandatory for all the big cats housed at Delhi Zoo.
- A species-specific Enrichment plan should be formulated and implemented.
- Housing facilities may be upgraded and renovated with more innovative ideas/ means.
- Breeding management along with population management and behavioral management to be carried out on a priority basis for the conservation of species.
- More appropriate Record keeping should be done for the animals.
- Healthcare facilities are to be made more advanced and as per the IVRI guidelines.

Conclusion

Studying the basic management strategies used by the zoo serves as an important tool for managing and conserving the animals housed in zoos in a much better and easy way so that animal welfare in captivity is not compromised. So far, no study has been carried out in this regard in National Zoological Park, New Delhi. This study is the first attempt to know about the housing, upkeep, healthcare, and other management measures practiced by the Delhi Zoo for big cats. The study revealed the present management interventions used for big cats and provides valuable information on the population trend of big cats in the Delhi Zoo over the years. The present study is the basis for filling gaps in the existing management strategies used for the Bengal Tigers, Asiatic lions, and Common leopards in captive conditions and will help in the formulation of a zoo-based species-specific management plan which may form the basis for successful captive breeding programs of big cats.

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