Enriching Lives

Improving the well being of Captive Animals

DR. BRIJ KISHOR GUPTA



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First Published in India in 2017 by Brij Kishor Gupta

ISBN No. 978-93- 5254-185- 0

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Enquries to obtain copies of this book to be addressed to: ***enrichingwildlives@gmail.com***

Dedicated to my parents
Satyendra Kumar Gupta and Malti Devi,
my wife Seema Gupta and daughters
Naincy and Shourya.

Anything good that has come to my life
has been because of your
encouragement, guidance, and love.

“Until the lions have their own historians,

the history of the hunt will always glorify the hunter.”

- Chinua Achebe



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FOREWORD

Dear Readers,

Animal Welfare is the most important precondition for every zoo to successfully work on all the key tasks described in the 'World Zoo and Aquarium Conservation Strategy', namely, research, education and conservation. Only if we keep our animals in visibly good conditions can the visitors be touched by their natural beauty and be convinced about the need to support their conservation.

Therefore I am very happy that this comprehensive manual about enrichment techniques for animals kept in Indian zoos has been published. It was a long lasting and laborious task to put together all the contents and pictures in an easy-to-read and pictorial way so that every zoo will benefit from it.

As a former WAZA President, I know that the public image of all our zoos is affected by those zoological institutions that are of no acceptable standard. We all have to work on this issue and try to raise welfare standards wherever possible! Towards this end, WAZA had recently launched a separate 'World Zoo and Aquarium Animal Welfare Strategy'.

I trust that this manual will be available across India and many interested readers will apply the examples described here.



Prof. Dr. Joerg Junhold
Director, Zoo Leipzig
Past-President of WAZA (World Association of Zoos and Aquariums)

Leipzig, Germany, 2016

PREFACE

Government of India

MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE

CENTRAL ZOO AUTHORITY

The Central Zoo Authority (CZA) is a statutory body constituted under the Ministry of Environment, Forest & Climate Change, Government of India in 1992 under the provisions of the Wild Life (Protection) Act, 1972 to oversee the functioning of zoos in the country and provide technical and other assistance to zoos.

The Recognition of Zoo Rules, 2009 (Rule 4, Sub Rule 6) explains that every zoo shall make special efforts to enrich the environment of the enclosure to meet the species specific behavioural requirements of the animals in accordance with the standards specified by the CZA. Further the animal enclosure in the zoo should not only be safe and secure for the animals, animal keepers and the visitors, but should also have requisite space for free movement, exercise and expression of natural behaviour by the animals. The present book authored by Dr. Brij Kishor Gupta on "Enriching Lives: improving the well being of captive animals", is an attempt to help zoo personnel's in their enrichment activities in the zoo.. It should also serve as a manual for understanding the components and skills required for designing various enrichment artifacts for the species housed in Indian zoos.

Wild animals spend considerable time and energy finding and processing food, building nests and defending their territories. Most of their time is spent in these activities in the wild. The high quality of care being provided in a captive environment in some of the zoos does not address the behavioural needs associated with these activities. It has become necessary to provide alternative methods of stimulating natural foraging behaviour to meet both the mental and physical needs of the a captive animal. Enrichment can promote species-typical behaviour by providing an animals with a complex and unpredictable environment as being encountered in their natural habitat in the wild. In zoos,& environmental enrichment is usefulplays an important role to in provide ensuring the welfare of the animals welfare. Enrichment also A, it mayenhancesupport the training procedures for thoseof animals that are intended to befor released in the wild, stimulating different natural behaviours such as foraging, orientation, avoidance ofavoiding predators and establishing social relationships.

It is high time that zoos should come up with innovative ideas and species specific enrichment for the species housed in zoos. The present publication shall serve as reference and checklist to ensure that zoo adopts various ideas to keep their animals physically, biologically and behaviorally healthy in captivity. The animal management team which includes Keeper, Head Keeper, Supervisor, Biologists, Veterinary Officer, Curator, Director work as a team and have enrichment schedule for the animal enclosures in the zoos. It would further help and guide them to come up with species specific innovative ideas.

This book establishes the close relationship between allied disciplines, particularly behavioural enrichment while designing the animal exhibits and the necessity of all zoo personnel related to exhibit enrichment. Numerous illustration and photographs from Indian context add to the utility of this publication. I hope this book proves to be a good milestone in the development of the enrichment of animal exhibits in zoos of India and for the well being of the animals.

(Dr. D. N. Singh),
Indian Forest Service,
Member Secretary

Date : 23/03/2017

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A LETTER FOR YOU

The seed for writing this book were sown when I was working on writing part of my book, "Barrier Design for Zoos". This book was published by the Central Zoo Authority (CZA) in 2007. During this period, I had opportunity to visit most large and medium category zoos in India (35 to be precise) in India and later in USA, Europe, Australia, and South-East Asia, in which environmental enrichment being practiced. This exposure generated interest to doing something for the welfare of the animals housed in Indian zoos. In 2009, the CZA was amending the Recognition of Zoo Rules, 1992 and enrichment of zoo exhibits was made mandatory. Rule 10, Sub Rule 3(6) states that "Every zoo shall make special efforts to enrich the environment of the enclosure to meet the species specific behavioural requirements of the animals in accordance with the standards specified by the Central Zoo Authority". Subsequently, in 2012, the CZA drew up guidelines to provide financial assistance for enrichment of exhibits. At CZA, I was involved in both amending the Recognition of Zoo Rules and in drawing up the guidelines for Environmental Enrichment.

Meanwhile, in 2010, I participated in a professional training course conducted by the Association of Zoos & Aquariums (AZA), USA, which was previously known as the American Association of Zoos and Aquariums at Wheeling, West Virginia, USA. The course was on "Managing Animal Enrichment and Training", and it gave me deep insights into the subject. It was an honor for me to be conferred the International Conservation Award of the AZA for the 2010 also during the training period many of you may not know that I have obtained first doctorate degree on "Behaviour & Environmental Enrichment Studies on Sloth bears" carried out at Agra Bear Rescue Facility during the year 2000-2003. The degree was awarded by the Dayalbagh Educational Institute (Deemed University), Dayalbagh, Agra in 2007. I must express my gratitude to my Ph. D thesis guide Dr. A. K. Sinha & co-guide Dr. Sant Prakash. I am thankful to Sh. S. C. Sharma, Retd. Addl. DGF (WL), MoEF & Founder Member Secretary, CZA, Sh P. R. Sinha, Country Representative, IUCN, India, Dr. D. N. Singh, IFS, Member Secretary, CZA, Mr. Himanshu Malhotra and Dr. Devender Kumar, Scientific Officer, CZA who provided many useful tips in preparation of this publication. Thanks to my wife Seema and daughters Naincy & Shourya, who provided untiring constant support during the compilation and preparation of this publication.

I also learnt about enrichment ideas from Jon Coe, the famous American landscape architect who now lives in Australia. Jon taught me concepts of in-built enrichment and changeable enrichment artifacts, since he was our zoo design team leader in 1993 at Coimbatore Zoological Park & Conservation Centre, Coimbatore. Also learnt more on enrichment from David Shepherdson, Valerie Hare, Monika Fiby who had been to India in past to deliver guest lectures on enrichment and zoo design.

With this training and knowledge, I began delivering lectures myself too about the role of environmental enrichment in zoos and animal welfare. In the audiences were zoo directors, curators, veterinary officers during the training and workshops organized by the CZA, students of the M.Sc. (Wildlife) course at the Wildlife Institute of India, Dehradun, IFS probation officers, students at National Institute for Animal Welfare at Ballabhgarh and M. Arch students at Jamia Millia Islamia, Central University, Delhi.

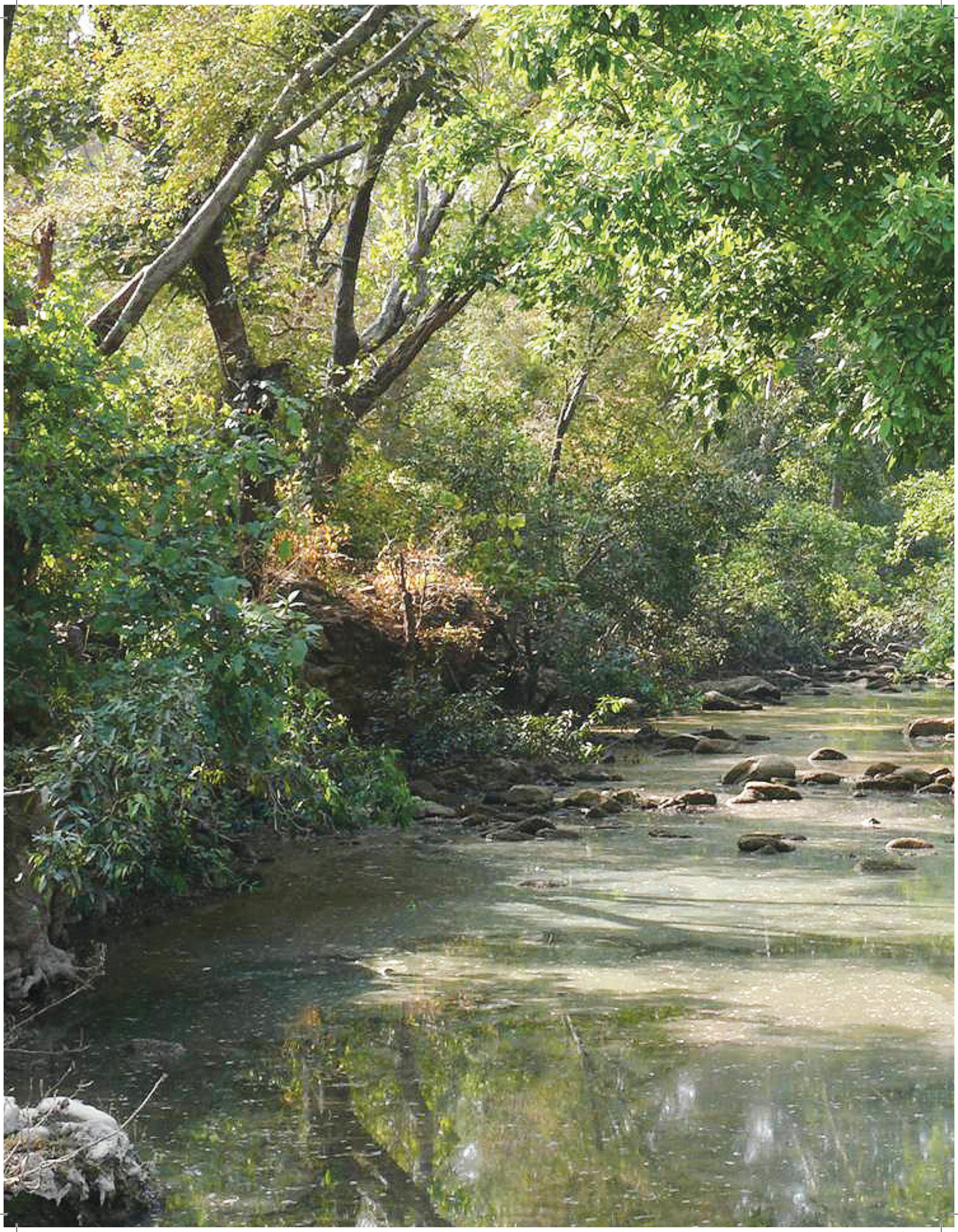
There was no book to guide keepers, zoo directors and anyone working with zoos in India interested in implementing environmental enrichment. I have attempted to fill this gap with this manual for which Leipzig Zoo, Leipzig, Germany has been kind enough to provide the funds. I have used photographs and drawings to illustrate ideas and to provide examples. The photographs in this book are mostly of my own, and wherever used from other sources, I have tried my best to acknowledge them appropriately, if I have failed to acknowledge any of the photos used in this book, I apologies for the same. The illustrations were drawn in kind by Arnab Roy, a nature lover, wildlife enthusiast and professional artist from Kolkata. I appreciate his valuable time, efforts and kind help. I acknowledge the untiring help rendered by Mr. Naushad Ali & Mr. Rohit Sharma, in designing of this book.

I hope that the book will be of use to zoo personnel as well as biologists, architects, engineers and anyone interested in zoos as well as organizations who have been engaged with Zoo Science & Animal Welfare subjects.



3rd April 2017

Dr. Brij Kishor Gupta



Environmental Enrichment: A Brief Overview

Chapter 1

ENVIRONMENTAL ENRICHMENT: A BRIEF OVERVIEW

Learning Objectives

- **To understand the consequences of confining animals in suboptimal conditions**
- **To investigate the concepts of improving captive environments and the methods used**

Wild animals housed in zoos need to express species-typical instinctive behaviours similar to their wild conspecifics. Often captive environments lack the novelty to stimulate the cognitive abilities of animals housed in them. Environmental enrichment is an animal husbandry principle that involves change to enhance the quality of captive animal's life or environment necessary for optimal psychological and physiological wellbeing and provides opportunities for expression of appropriate and naturalistic or wild behavioural patterns. The goal of environmental enrichment can be achieved by providing stimuli that increase the range or number of species-specific behaviors, increased positive utilization of the captive environment, preventing or reducing the frequency of abnormal behaviors such as stereotypies, and increasing the individual's ability to cope with the challenges of captivity.

Modern zoo design emphasizes the importance of integrating naturalistic enclosure design practices that not only invoke a sense of awe-inspired respect for nature in the visitors, but also creates a functionally complex environment for the animals kept in them. The era of designing of zoos with modern concept began in our country when the Indian Board for Wildlife in its meeting in 1952 decided that the Government of India should establish modern zoos in major cities of the country for educating the people at large on the rich fauna of the country and the need to conserve it. Consequently the construction work of Delhi Zoo (National Zoological Park) was started in 1955. The government wanted the Zoo to be developed as a world class zoo and therefore hired the services of the world's most renowned zoo designer of that era, Carl Hagenbeck owner of Hamburg Zoo to prepare the master plan of Delhi Zoo. The services of Director of Colombo Zoo were also hired to assist the Government officials in the construction phase of the zoo.

Development of zoos in the country was supported by Committee of Zoo Experts appointed by the Government of India, for suggesting measures to improve the efficiency of various operations forming part of zoo management. The Committee report recommended that "enclosures in a zoo should be sufficiently large to give fullest opportunity for expressing breeding rituals like chasing, providing opportunity to explore their environment, and withdrawal areas the zoo operator should simulate the natural habitat of the animal housed as closely as possible and others".

Animals that are housed in a barren unstimulating enclosure may suffer from psychological maladies that develop from the inability to express instinctive behaviours. Therefore while it is not possible for zoo animals to be provided with the complexity that life involves in their natural wild habitat zoos do have a duty to ensure optimal welfare, of animals in their care. It is important that captive environments incorporate essential features of the habitat of wild animals to provide opportunities for display of species-typical behaviour patterns.

As we know that wild animals expend considerable time and energy finding and processing food, building nests and defending their territories. Most of their waking hours may be spent meeting these needs. Intensive management in captive environments significantly reduces the time an animal spends in these pursuits; however, the behavioural needs associated with these activities remain unfulfilled. It therefore becomes necessary to provide alternative methods of stimulating natural behaviour to meet both the mental and physical needs of captive animals. Enrichment can promote species-typical behaviour by providing animals with a complex and unpredictable environment. That may include activities that are both challenging and time consuming and may serve several functions, such as:

a. Improving animal well-being by increasing exercise, satisfying behavioural needs and optimizing the level of stimulating animal receive, while also attempting to reduce abnormal behaviour patterns;

b. Educating both animal caretakers and zoo visitors by increasing natural behaviours, visibility and activity levels;

c. Assisting in the conservation of endangered species by improving the success of captive breeding and reintroduction programs through improvements in social group composition, the promotion of normal physiological and psychological development, and the maintenance of behaviours that may be required for survival in the wild.

There are many types of enrichment practices that involve manipulating the environment in which the animal lives for providing behavioural stimulii. Enclosure enrichment can be of various types, that includes manipulable, feeding, sensory, and social enrichments. Zoo-based research has proven that animals housed in enriched enclosures that are behaviourally stimulating are in a better state of welfare than animals housed in barren environments. Species-specific environment enrichments thus add a level of much-needed complexity in the enclosure that encourages animals to express a more diverse and species-typical behaviour repertoire.

In order to equip enclosures for animals to express species specific behavioural traits viz. exploratory behaviour for foraging, territorial patrolling, marking territorial boundaries, avoiding predators, wallowing, climbing, burrowing and seeking mates etc., it is important that the enclosure design incorporates species specific environmental features for the animals housed in enclosure at the time of conceptualizing the design of the exhibit. It is imperative that the animals' needs with regard to social behaviour includes parenting, courtship and other interactive activities are met. All these activities involve constant alertness of visual, olefactory and auditory stimuli.

To achieve the continued benefits of enrichment, care must be taken to ensure the novelty is maintained. A random or rotating schedule of enrichment is needed to keep the animals' interested to emulate the constant changes in their natural environment allowing them to adapt to new situations. Novel enrichment can stimulate the same flexibility. the zoo operators can provide the zoo animals ample opportunities to express their natural behaviour through imaginative enclosure designing and planned enrichment. The technical help of behavioural biologists may be obtained in developing the appropriate enrichment plan for the wild animals.

The important components of environmental enrichment are:

1. Keep animals in compatible social groups. Provide adequate three dimensional space for exercising the normal movement behaviour patterns i.e. walking, flying and climbing.
2. Provide suitable substrate to facilitate the animals to satisfy their digging, burrowing and exploratory instincts.
3. Provide suitable trees, shrubs and bushes in the enclosures to provide the animals opportunities for climbing, swinging, feeding, clawing, playing, rubbing the antlers, etc. Trees take substantial time in growing to required sizes, during the interim period, appropriately sized logs/ branches of trees could be used to meet the behavioural needs of the animals. There should be provision of alternative enclosures for the ungulates living in larger social groups, bears and primates so that the animals could be shifted from one enclosure to the other to facilitate recovery of vegetation.
4. Burrows/ dens could also be constructed to facilitate the animals to hibernate or to take shelter during extreme weather conditions.
5. Plant grass and reeds to provide cover area for the animals.
6. Fix mud pots, tree hollows, bamboo baskets to meet nesting and egg laying by birds.

Definitions: *Environmental enrichment*

Environmental enrichment is the provision of stimuli which promote the expression of species-appropriate behavioural and mental activities in an under stimulating environment (Reinhardt, 1999).

Environment (en•vi•ron•ment): The environment of an exhibit encompasses all the living and non-living things of that exhibit, including the weather and all the interactions of the living things.
Enrich (en•rich): Refers to the act of making something better (richer) by the addition or increase of some desirable quality or ingredient
Enrichment (en•rich•ment): An act or process of increasing intellectual or spiritual resources
That captivity can have adverse effects on the behaviour of some animals has been known for some time. Confining an animal to a cage or enclosure reduces the complexity, and increases the predictability, of its environment. As a result of this environmental impoverishment, undesirable behavioural patterns increase and desirable ones are exhibited less. This degradation causes a downward spiral

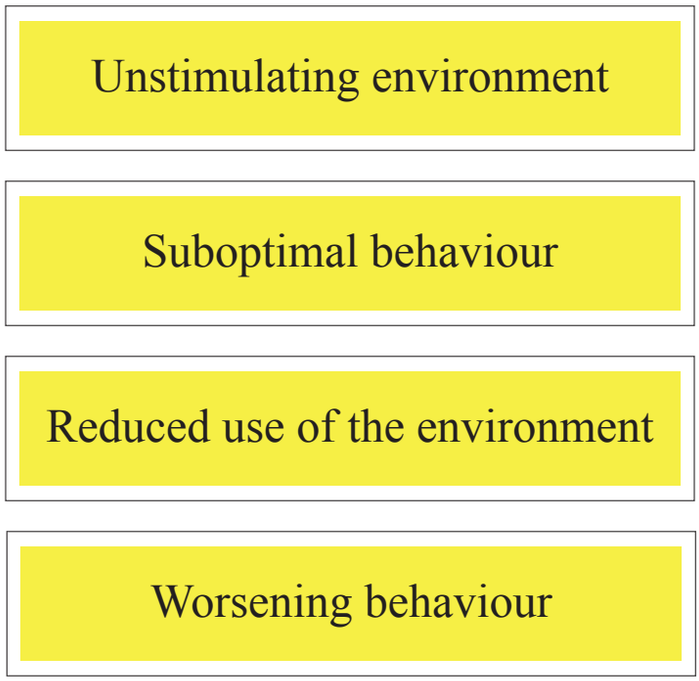


Figure 1: Downward spiral resulting from environmental impoverishment



Brown bear engaged in rotating feed roller

"Environmental enrichment techniques have been used on captive wildlife for several years in zoos as a tool to encourage the display of a variety of behaviours in different species. This concept has been around since Robert Yerkes (1925) wrote, 'The greatest possibility for improvement in our provision for captive primates lies with the invention and installation of apparatus, which can be used for play or work' (Sheperdson,1998)."

Many researchers are increasingly interested in interrupting this trend. Most of the works published in this context relate to animals living in small groups in zoos and some to individually housed animals (Markowitz, 1982, Gupta 2007), while others are based on laboratory studies (Erwin and Deni, 1979). Environmental enrichment describes the efforts made to alleviate the incidence of boredom in captive animals and reduce undesirable behaviours. Environmental enrichment serves to increase the attractiveness and educational value of exhibits.

The need to keep animals occupied in captivity was recognised as early as 1925, when Robert Yerkes noted that providing apparatus for play and work improved conditions for captive primates. However, concerns related to ease of maintenance and good hygiene have often overridden the psychological needs of the animals in the traditional zoo enclosure (hard concrete floors and ceramic-tiled walls). With improvements in our understanding of the physiological and behavioural needs of captive animals, enrichment has been brought into focus.

INTRODUCTION

Environmental enrichment is the provision of stimuli that promote the expression of species-appropriate behavioural and mental activities in an under-stimulating environment. Environmental enrichment techniques have been used on captive animals of different species for several years in zoos as means of encouraging them to display a variety of behaviours.

Environmental enrichment is a term that many people get confused about. Here are two explanations:

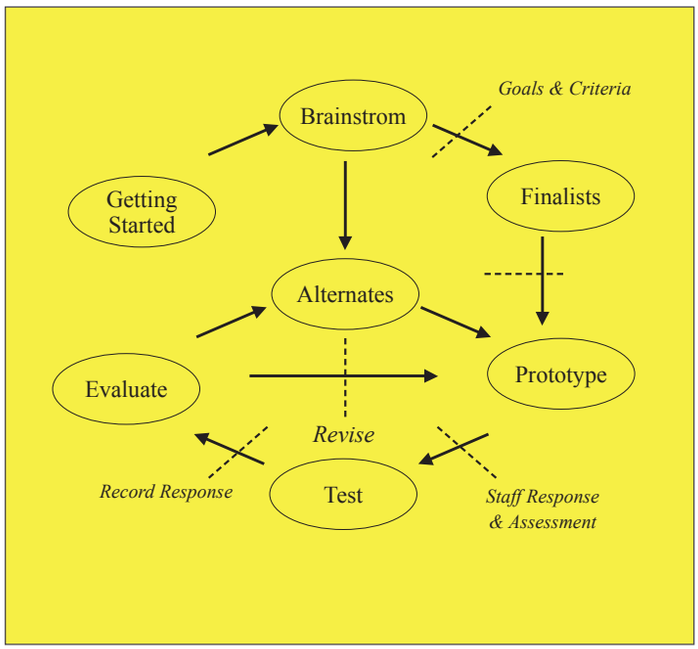
1. *Captive animals have an abundance of time on their hands (paws/hooves/wings/scales) and will often show stereotype or abnormal behaviour patterns if they cannot channel their energy and intellect in constructive ways. Most of the normal time spent in survival mode has been eliminated by being placed or reared in captivity. The animal has more time to play and lounge.*
2. *In captivity, food and water are supplied, territory is a ready delineated, social groupings are usually fairly st ble and structured, there are usually no predators to avoid, and mates are selected for them. With all the extra free time, the animal [has] a need for new and e ntertaining or challenging activities. That is where the role of enrichment comes [in].*

Several authors after Yerkes have agreed that managing the environment of captive animals may give them opportunities to optimise their activity time and display some behaviours that they exhibit in the wild. There are two different approaches to environmental enrichment: the 'naturalistic' and the 'mechanistic' ones.
The naturalistic approach defends the idea that technology and information from field studies must be combined to make naturalistic modifications in the physical and social environments of captive animals. The mechanistic approach was proposed by Markowitz (1982), who believed that some control should be exerted over the environments of captive animals through the incorporation of devices that make animals display certain behaviours. Markowitz's group devised games for use in old-fashioned menagerie-type enclosures; in newer, less restrictive enclosures, they introduced animated prey as well as trees and vines that responded electronically to pressure and sound. Food was delivered according to computer-programmed schedules triggered by the interactions of the animals with these devices.

History of environmental enrichment

Pioneering work in environmental enrichment was carried out in the 1920s, when Yerkes designed play items for primates in his laboratory, in Europe. These items provided physical and behavioural stimulation in an otherwise limited environment. Since then, numerous others have recognised and documented the need for sensory stimulation in captive animals. In addition, before the term enrichment was even coined, keepers all around the world had provided zoo animals with a variety of items in the exhibit areas to stimulate activity (Yerkes, Robert 1925.

To enjoy the benefits of enrichment continuously, care must be taken to ensure the novelty is maintained. A random or rotating schedule of enrichment is needed to keep an animal's interest. The natural world changes constantly, forcing animals to adapt to new situations. Novel enrichment can simulate the same variability.



Source: Valerie Hare et al, Zoo Biology: 22:401-416(2003)

Figure 2. Flow chart for creating and maintaining a successful enrichment plan

Function of environmental enrichment

In captivity, most of the physiological needs of an animal are provided by its keepers, but a wild counterpart will conversely expend energy meeting these needs in an unpredictable environment. Enrichment can promote species-typical behaviour by providing the animals with a complex and unpredictable environment. Improve animal well being by increasing exercise, satisfying "behavioural needs" and optimising the level of stimulation. Also reducing abnormal behaviour patterns. Refer to Figure 3, which was used by the author when designing environmental enrichment studies on Sloth bears at the Agra Bear Rescue Facility.

Uses of enrichment

In the wild, animals have to search for their food, shelter, conspecifics and predators and defend territories. Changes in the structures of enclosures, feeding schedules or social groupings can reduce neurotic stereotypical behaviours such as pacing and over-grooming. They also promote behaviours that resemble those observed in the wild. An enriched environment should offer a captive animal a sense of control from the ability of the animal to make choices for itself: whether or not to hide, what kind of temperature and weather to experience and when and how to feed.

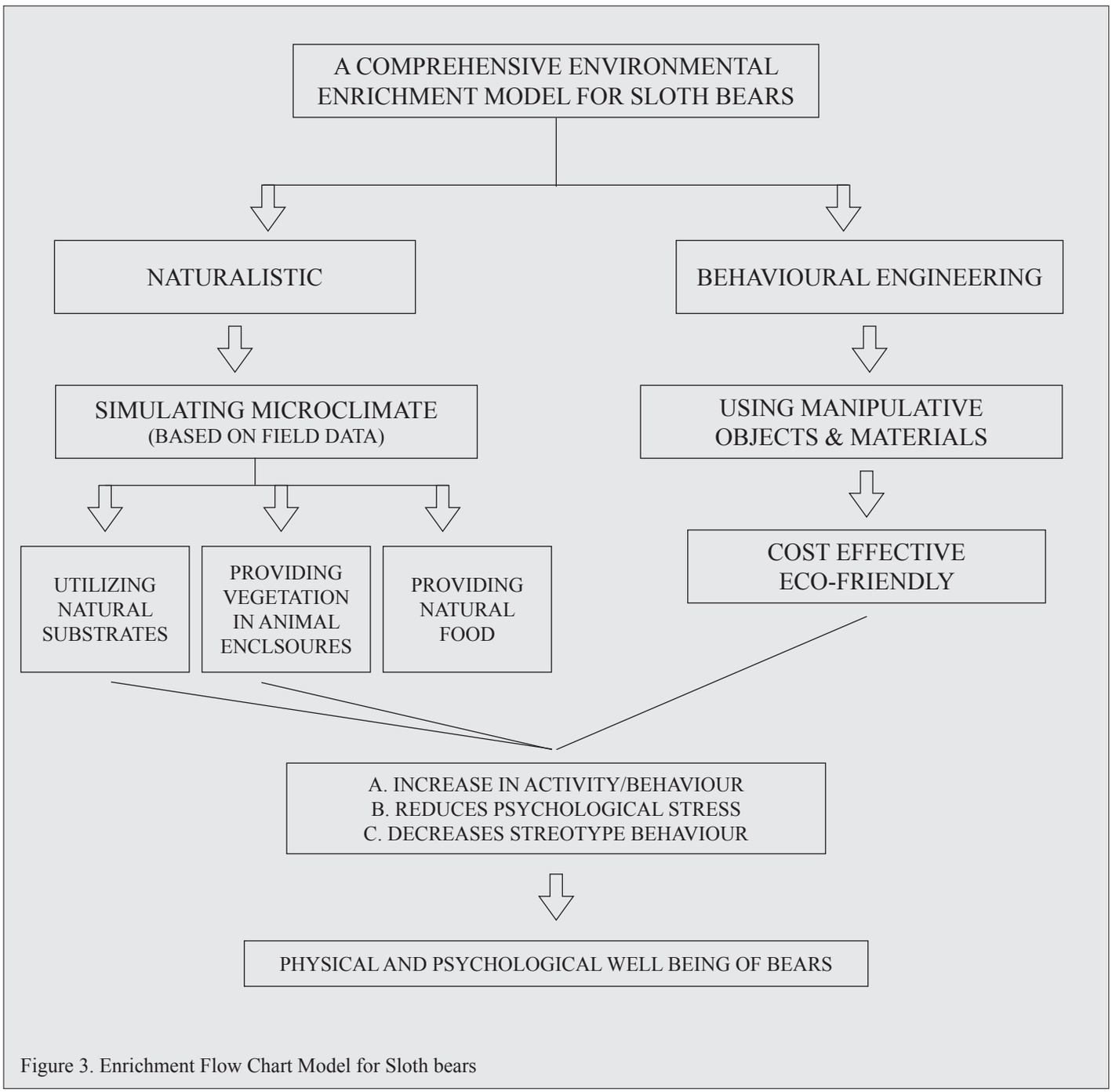


Figure 3. Enrichment Flow Chart Model for Sloth bears

Uses of enrichment in zoos and rehabilitation and rescue centres

At zoos and rehabilitation and rescue centres, environmental enrichment plays a role in ensuring the welfare of the animals. Enrichment may also support the training of animals for release in the wild, stimulating different natural behaviours such as foraging, orientation, avoiding predators and establishing social relationships.
The animal collections in zoos are very stable, and the animals are confined to particular enclosures and exhibits. In contrast, rescue and rehabilitation centres manage floating populations of different species, depending on the location, time of year, etc. Also, unlike zoos, rescue and rehabilitation centres cannot have specialised enclosures for different species. This makes the development of environmental enrichment programmes in these centres more difficult than in zoos.
Despite the operating differences, research on environmental enrichment in zoos is definitely useful for rescue and rehabilitation centres. Regardless of the type of institution, the aim of environmental enrichment is to encourage normal behaviours.

Classification and categories of enrichment

The following is the classification of environmental enrichment:

(1) Physical enrichment

Modifications to the physical elements of an enclosure, such as furniture, may be of a permanent or temporary nature. Addition of novel items to animal habitats can stimulate natural behaviours.

(2) Space

The area of an enclosure should be determined by the species, the size of the group and the size, weight, sex and age of an animal. However, it may not always be feasible to design a specific according to these. Particularly when an enclosure is small, the height should be increased to utilise three-dimensional space fully, that is, the vertical dimension should also be utilised to enhance the available space wherever appropriate. The length, width and height of an enclosure should be selected with care.

(3) Artefacts

An artefact is any object an animal can interact with. The most commonly used artefacts are live and artificial trees, trunks, branches (for shade or as visual barriers) and ropes. Artefacts can be added to an enclosure, removed from it or moved to add novelty, create new locomotive pathways and encourage exploratory behaviours. Non-stationary furniture serves to add unpredictability to locomotion.

(4) Pools

Pools are provided for swimming, and mud is provided for wallowing.

(5) Substrates

A variety of substrates may be provided for tactile stimulation or digging opportunities.

(6) Manipulable objects

These objects will be considered novel if they are changed frequently to stimulate investigatory behaviours. Providing several types of manipulable objects allows animals to choose from them. Exchanging or adding items periodically will increase use over longer periods of time. The number of objects should be sufficient to avoid dominant individuals from monopolising them.

(7) Feeding enrichment techniques

Novel food items are those that are not part of the usual captive diet of the species but will not cause nutritional disorders if used on a non-daily basis.

(8) Feeding enrichment devices

Feeding enrichment devices are very popular and can be designed by almost any person. They are useful for animal welfare purposes.



Wooden ring used by tiger

(9) Smell

The use of different fragrances to encourage animals to smell different places in an enclosure encourages exploratory behaviour.

(10) Auditive enrichment

Using different sounds to attract the attention of an animal is part of the training in rehabilitation programmes.

(11) Enrichment to meet physiological needs

The temperature and humidity of an enclosure need to be maintained at the appropriate levels. The photoperiod conditions must be such as to stimulate natural behaviour in each species.

(12) Social enrichment/social groupings

Captive social groupings should resemble those observed in the wild. Many species groom, play and court according to a social hierarchy. Even when the animals in a social group are not involved in these actions, they often interact in some fashion, be they feeding, marking their territories or engaging in social behaviours. In the zoo, animal caretakers and managers must recognise the importance of natural social groupings for animal welfare and consider the normal social structure of each species when designing and maintaining exhibits. Here are some examples of social enrichment:

- Housing social animals with appropriate members of their species
- Adding visual barriers (vegetation, furniture) to an
- exhibit to allow animals to retreat from both conspecifics and the public
- Creating mixed-species exhibits that may provide symbiotic or complementary activities between the species or merely provide diversions

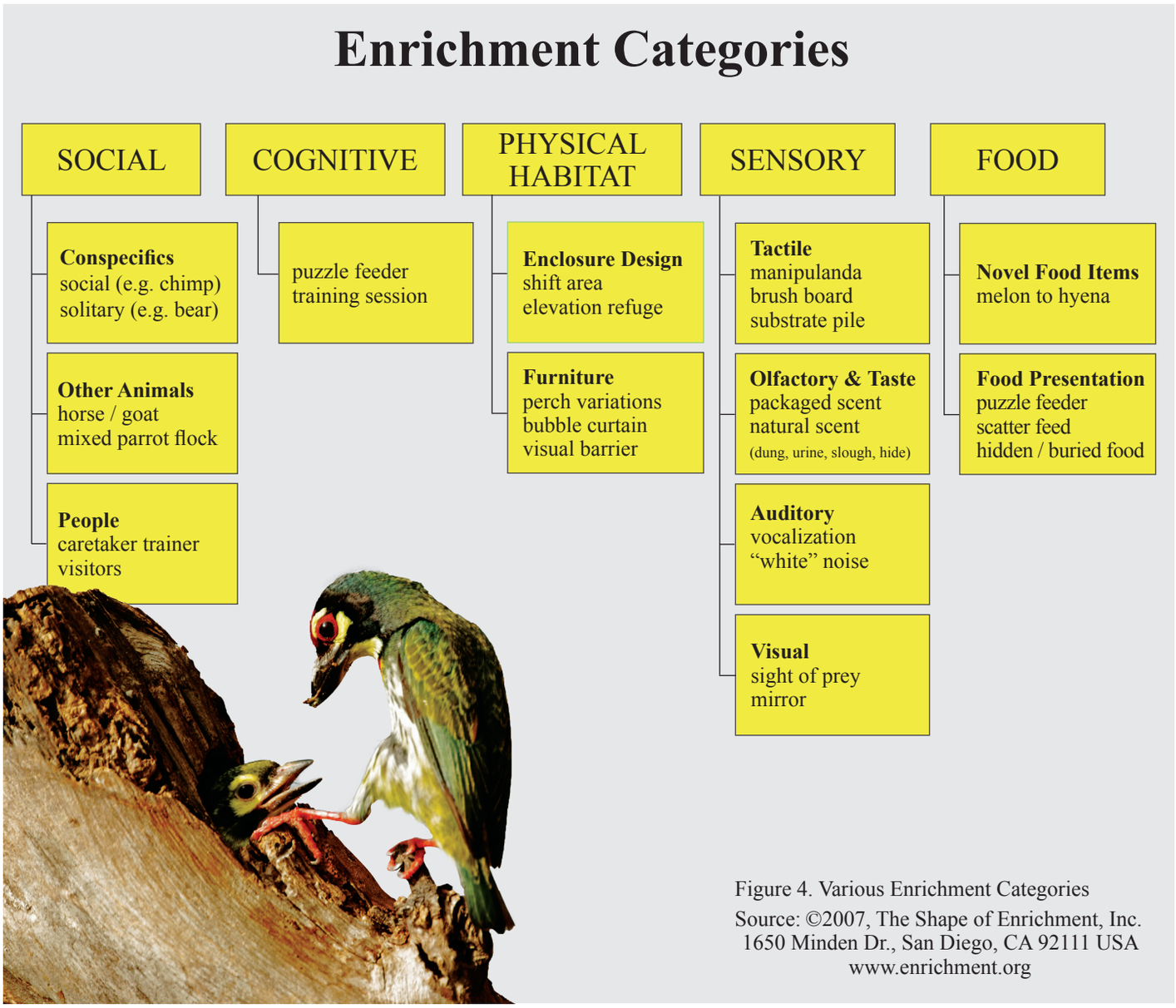


Figure 4. Various Enrichment Categories

Source: ©2007, The Shape of Enrichment, Inc.
1650 Minden Dr., San Diego, CA 92111 USA
www.enrichment.org

Table 1. The enrichment for Captive Animals Housed in Zoos is classified broadly in two categories; Built-in Enrichment and Changeable Enrichment (pers. discussion with Jon Coe & Monika Fiby).

S. No.	Built-in Enrichment	Changeable (Add on) Enrichment
1.	Rocks – View, Sun, Shade (Cool in morning & warm in evening) – naturalistic artifacts	Substrate – soil, water
2.	Big trees – view, shape	Feeding/Puzzle feed
3.	Water falls	Ropes
4.	Attachment points	Hoses
5.	Access gates	Vines
6.	Access road	Cable for hanging
7.	Base for substrate	Sway branches
8.	Access to change it	Browse
9.	Windows	Mealworms
10.	Skylight	Ropes
11.	Ventilation	Plantation
12.	Artificial termite mounds	
13.	Artificial feed logs	
14.	Feeder	
15.	Showers	
16.	Misters	
17.	Landscape complex/space	
18.	Wave machine	
19.	Under water jets of different velocity & temperature	
20.	Mud wallows (Wild boar, Rhino, Sambar, Hippopotamus and Elephant)	
21.	Mud bath	
22.	Solar Aspect – exposure to sun	
23.	Facility for rotation	



Illustration: Aishani Jain

Suggestions for enrichment of exhibits

- Climbing structures: trees, wooden poles, ropes, logs, rocks, fire hose hammocks
- Weather considerations: protection from rain, structures for shade, sunny spots, wind breaks
- Substrates for lying or sleeping on or buildings: grass, moss, hay, straw, leaves, Christmas trees
- Substrates for digging: grass, soil, sand, mulch, rotting logs
- Visual barriers: brush or log piles, trees, rocks, caves, hills
- A variety of feeding sites
- Water features: pools, waterfalls, moats, sprinklers, misters
- Mechanical devices to deliver random food items
- Options for hanging items
- Training area with safe access for vet examinations or training sessions
- Providing safe area for the use of keepers when they add enrichment to animal exhibits, during the daytime.
- Providing areas in large exhibits where large vehicles may enter with enrichment material, as desired.

Suggestions for Dietary enrichment

- Browse for eating and displaying
- Providing live animals (insects, invertebrates) as food
- Varying feeding times
- Increasing the number of instances of feeding
- Mixing whole food with processed or chopped food
- Edible local plant material, in and surrounding exhibit
- Strong or bitter tasting foods (can be used to cover up medications whenever needed)
- Seeds or nuts for food
- Treat foods: biscuits, hard-boiled eggs, sugarcane, honey-filled bamboo sticks
- Frozen foods
- Termite mounds
- Suction feeders

Suggestions for Social enrichment (housing animals with other animals and providing opportunities for interactions)

- Social opportunities: species-appropriate social groups
- Training for husbandry and management behaviours
- Interactions with keepers

Suggestions for Novel enrichment

- Recycled items: cardboard boxes, shredded paper, cardboard tubes (alone or stuffed with food items)
- Wooden logs
- Soil mounds
- Auditory enrichment: music, nature sounds, recorded vocalisations of same or other species
- Olfactory enrichment: hunting lures, spices, herbs, condiments, perfumes, items marked by other species
- Prey species

General Safety considerations to be considered when implementing enrichment measures in animal enclosures

- Animals can become entangled in ropes and hanging apparatus, or their extremities may be caught.
- Animals may fall while trying to reach enrichment objects placed high in an enclosure.
- Water features must provide a suitable escape area (an area to which animals may escape when they are in danger or feel uncomfortable) for the species.
- Dietary enrichment can lead to tooth decay, obesity, allergic reactions, impaction, diarrhoea, choking or aggressive reactions from cage mates.
- Items, or pieces of these, may be toxic or hazardous if they are ingested.
- Objects, if broken, can present sharp edges that can injure animals.
- There may be injuries or deaths due to social or mixed-species exhibits as a result of aggression or harassment by cage mates.
- Plants or parts of plants may be toxic to animals as a result of treatment with pesticides or fire retardants.
- Enrichment might cause excessive stress to animals.
- Training sessions may place a keeper in a compromised situation if a safe and appropriate setup is not present.
- Keepers need to be provided a secure area for use when they are working with animals and carrying out enrichment.
- Dietary enrichment may result in an animal not consuming important nutritional components of its regular diet.
- Parasites may be transmitted through enrichment items if these items are not properly cleaned and disinfected.

What are undesirable behaviours?

A captive animal behaving differently in captivity does not necessarily mean that the animal is suffering. But in the absence of criteria for judging welfare, it may be said that if an animal behaves the same in captivity as in the wild it is probably not suffering. Activities such as coprophagy, regurgitation, hair-pulling, self-injury or stereotyped movements are generally considered undesirable, whilst active exploration, play, affiliation and foraging are considered desirable. The desirability of a behaviour displayed by a captive animal must be considered from various perspectives.

Normality: Where possible, behavioural repertoires and activity patterns in captivity should approximate those in the wild. Because there are variations in nature and because sometimes field data are scarce, it may not always be possible to confirm what 'wild' behaviour is, but the principle still holds. The preservation of a species depends on maintenance of more than just genetic material.
Public acceptability: The zoo visitor wishes to see neither an inactive animal nor one exhibiting stereotyped or aberrant behaviour. Apart from any obvious benefit to the animals, environmental enrichment makes the exhibition of captive animals more interesting and more acceptable to the public. This is particularly important in the current situation, in which more and more doubts are being expressed about zoos and their social and ecological value.
Theoretical considerations: Some enrichment work has a theoretical rationale—for example, setting goals for expenditure of energy or pre-release training.
Practical considerations: Enrichment can often be a means of improving husbandry methods. Successful projects should see a reduction in instances of aggression, self-injury, stereotyping and other aberrant behaviours.

Types of Environmental Enrichment

Much of the pioneering work on behavioural enrichment was initiated in the U.S. during the last decade (2005–2015). Two schools of thought evolved, each emphasising a different way of enriching captive environments. The first is typified by Hal Markowitz, working mainly in Portland Zoo, Oregon, and is referred to as behavioural engineering (Markowitz, 1982). Faced with the task of encouraging more activity and more foraging-related behaviour from animals in traditional, sterile enclosures, Markowitz developed a number of mechanical devices that would deliver food to animals on completion of a task, such as the following:

- A system through which gibbons *(Hylobates lar)* were able to activate a food dispenser by operating two widely spaced levers
- A system through which Diana monkeys *(Cercopithecus diana)* could exchange plastic tokens for food at a food dispenser
- A display in which pumas *(Felis concolor)* were able to trigger the release of artificial prey animals. Capture of the 'prey' activated a food dispenser.

The alternative school of thought, known as the naturalistic approach, was pioneered by Woodland Park Zoo, in Washington (Hancocks, 1980). It aims to recreate the natural environment as far as possible using natural materials.

The criticism levelled at the behavioural engineering approach by Hutchins et al. (1978/1979) is that the behaviours the devices it uses stimulate are no more natural than the behaviours they replace. For example, a puma exhibit had to be abandoned when the target animal was hunting at a frequency of 200 hunts per day. However, Forthman Quick (1984) has pointed out that the two approaches can be reconciled. Although the naturalistic approach is attractive, it is not always possible to provide a naturalistic environment within the constraints of existing enclosures, either because of lack of space or because natural materials will be destroyed too quickly by the inhabitants (a particular problem with large primates). Mechanical devices can be used to reduce the predictability of captive environments, something that a purely naturalistic approach does not always achieve (Shepherdson, 1988).

Aims of Enrichment

Enrichment aims to enhance the social and physical environments of any captive animal.

Improvements to the Social Environment

Keeping animals with socially compatible individuals: Even species that in the wild are relatively solitary, such as orang-utans, otters and mink, may benefit from improvements to the social environment (Poole, 1987). Compatible social groupings may be very different from those seen in the wild because of the changed environmental constraints. The natural sociobiology of the species should be known before changes are made to grouping policies. The size and the structure of a social group are of great importance to its cohesion and overall health. The dominance hierarchies and age and sex distributions of a group will determine the levels of stress and competition experienced by its members.
Greater keeper input: The individual, or team, responsible for the care of an animal or group of animals may be responsible for much of the stress experienced by the animals. Routines must be established for feeding and moving animals so that this stress is minimised. The routines do not have to be inflexible so long as the animals understand what they are expected to do in response to certain requests or actions. An important part of this process is the establishment of the caretaker in a dominant position, as part of the group or as an outsider.
As the conditions in which animals are kept have improved, the standards of acceptability have changed. As a rule, establishments are being encouraged to house specimens in natural breeding groups. Appropriate socio-environmental conditions of captive animals are now regarded as more a necessity than a luxury. Having said this, the improvement of such conditions could be seen as a form of environmental enrichment.

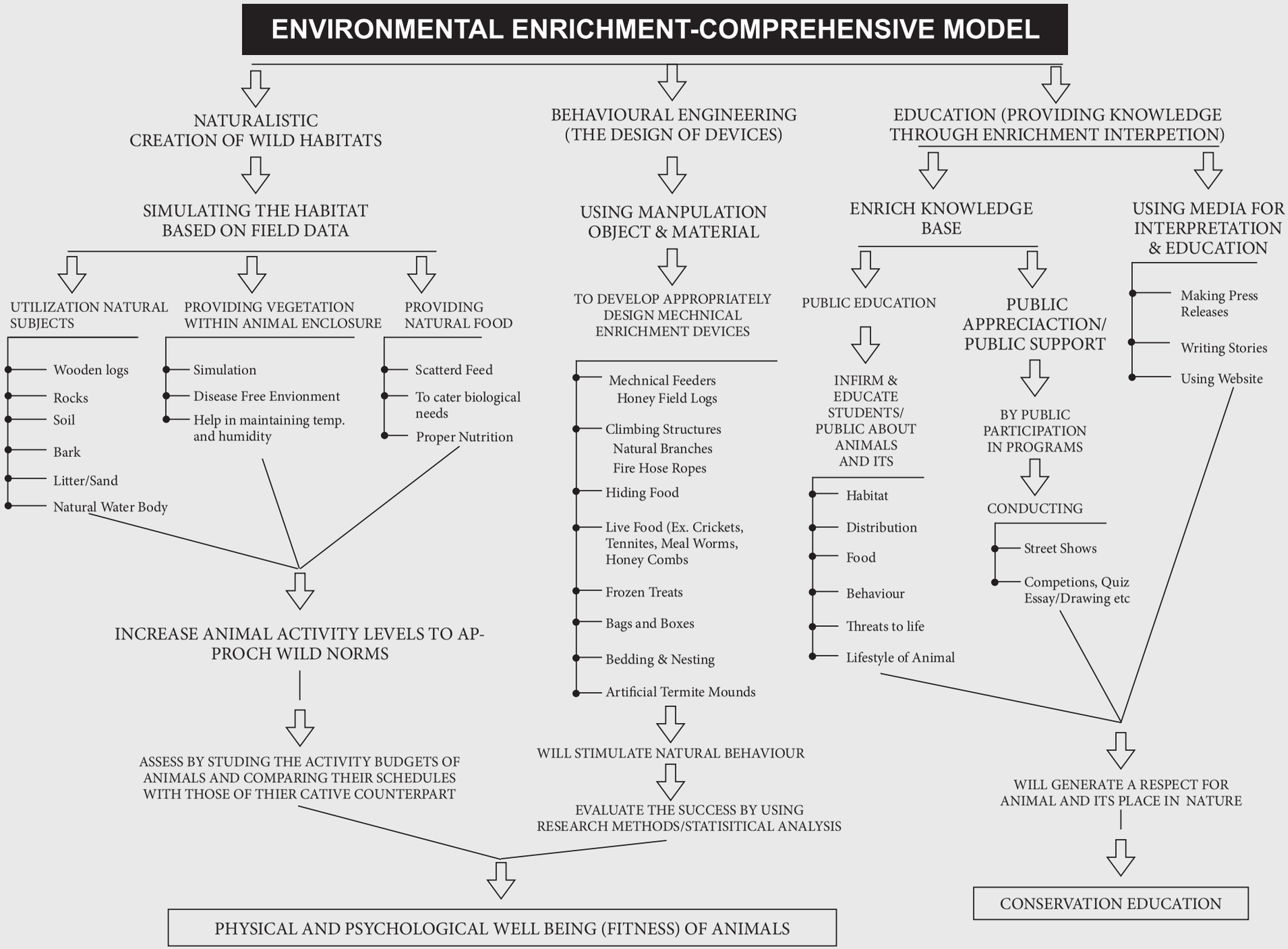


Figure 5. Comprehensive Environmental Enrichment Model



Nest Building in captivity by birds meets there biological requirement

Amelioration of the Physical Environment

Inclusion of more stimulating substrates: Grass, shavings, peat and wood wool can be used to replace the bare concrete floors of more traditional enclosures, representing a move from 'hard' to 'soft' cages.
Introduction of appropriate cage furniture: The provision of appropriate furniture within a cage facilitates locomotion and allows an animal to make full use of three-dimensional space within an enclosure.
Use of screens and panels: Used correctly, screens and panels subdivide space and create a series of more complex and partially compartmentalised environments.
Provision of manipulable objects: Manipulable objects such as puzzle boxes provide variability and serve as active stimuli for captive animals.

Improvements of the Psychological Environment

Reduction of stress levels: Management techniques and exhibition methods may be adopted to reduce unnecessary stress. Allowing species-specific traits to be expressed, for example, maintenance of the flight distance, is important.
Predictability: The spatial and temporal predictability of a captive environment may be reduced relatively easily by modifying routines. Though the necessity for a basic routine in a captive situation is indisputable, there should always be room for some flexibility.
This type of enrichment very often involves an aspect of training and development of new routines. The following types of behaviours are targeted by this approach:

- Foraging—the aim is to increase the time spent in searching for food in captivity to simulate nature. To this end, zoos have used a number of devices, such as artificial termite mounds for great apes (McEwan, 1986), dispersing food in a substrate for macaques (Anderson and Chamove, 1984) and providing live insect prey (mealworms, for example) for fennec foxes, meerkats and otters (Foster-Turley and Markowitz, 1982).
- Manipulative behaviour—animals are given artefacts to manipulate—straw, wood wool and leaves for bears and great apes to use for building nests; splash pools, ponds and streams for macaques; and climbing apparatus for arboreal species.
- Learning—new behaviours may be learnt that make use of natural ability and consume time. Some may be used educationally in demonstrations, not to be confused with shows, and others may be related to food acquisition.

This approach still has the greatest potential for development as it can be applied to existing enclosures and does not have to be expensive.

Enrichment and Food

Most enrichment programmes involve changes in the presentation of food, both spatially and temporally. Animals in captivity are now fed a number of times a day, and the diversity of items fed has also increased. In the wild, foraging and feeding are activities that dominate the daily activity pattern: for example, Mountain gorillas *(Gorilla gorilla beringei)* may spend up to 45% of the day feeding (Harcourt and Stewart, 1984), and the corresponding figure for Bushbabies *(Galago senegalensis)* is 30–50% (Martin, 1980). Any efforts to slow feeding rates and spread feeding out over a longer time period are beneficial as they prevent other activities from reaching unnaturally high levels. The amount of food offered does not have to be increased since the manner or form in which the food is presented to the animal may be changed instead. In many cases, the increased effort required to obtain food will in fact increase caloric expenditure by the animal.

Planning Environmental Enrichment

A major factor hindering the definition of simple, effective guidelines for optimising well-being in a wide variety of animals is the fact that environmental needs differ across species: husbandry techniques that promote the well-being of one species will not necessarily be applicable to another species. The most powerful platform from which to devise environmental enrichment devices for a specific taxon in captivity, and subsequently to evaluate their implementation, is detailed knowledge of that species' natural history. Comparison of the activity profiles of animals in the wild with those of conspecifics in captivity is a means of developing enrichment devices.

Choice of Species

All species require enrichment. However, it is important to identify the animals or species in a collection that will benefit most from a programme of enrichment. These are animals

- housed in inappropriate social groups;
- with special health care requirements;
- that were hand-raised and need to acquire natural skills;
- exhibit stereotypies;
- live in unnatural and environmentally impoverished environments; or
- live in appropriate social groups or naturalistic environments where enrichment will improve the behavioural repertoire.

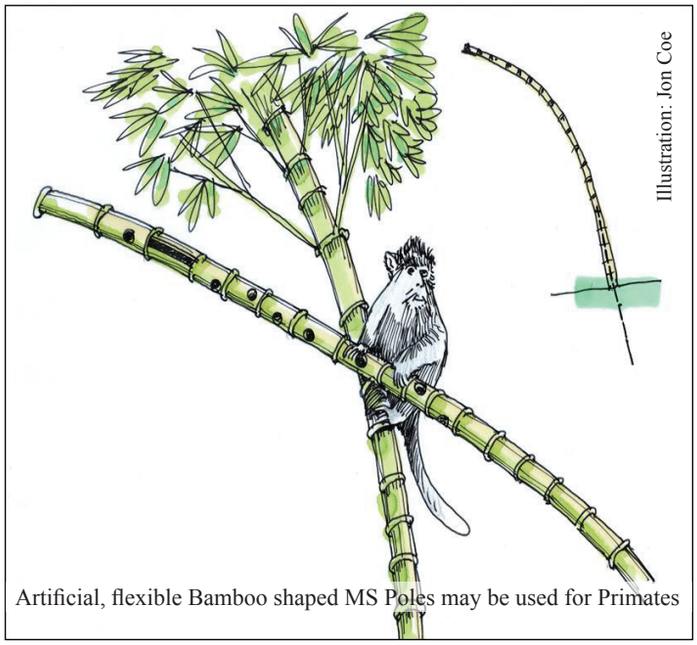
Potential Pitfalls

An environmental enrichment programme must be planned very carefully before it is embarked upon in order to avoid pitfalls. Additional cage furniture or apparatus may (1) make observation more difficult so that health or social problems become easier to miss, (2) reduce hygiene as new complex, surfaces obstruct cleaning, (3) make access in an emergency more difficult or (4) constitute a threat in themselves if they are sharp, unsafe, obstruct a flight path or become a potential trap (such as loose ropes).

If animals dismantle the apparatus, they may (1) eat it, which can provoke hardware disease, an illness due to foreign matter in the digestive system, which is often fatal; (2) use it as a weapon on cage-mates or people; (3) cut themselves with it; (4) make the apparatus structurally unsafe and a threat to themselves, other animals and members of the public; (5) suffer shock or electrocution; or (6) use it to escape.

Scarce apparatus can provoke aggression by becoming the object of competition.

Any apparatus must be designed and engineered according to the strength and destructive skills of the animal it is intended for. Every species and individual will respond differently to changes in the environment. It is important, if enrichment is to have a positive effect, that change not be introduced too quickly as this may stress the animals and cause negative behaviours, such as displaced aggression within a group. Most animals are naturally curious and will respond well to changes as long as they are not too big or too sudden.
Environmental enrichment can make problems easier to identify. For example, lethargy or unnatural behaviour is much more easily recognised in an otherwise active animal. It should also increase the health of the animals.



Artificial, flexible Bamboo shaped MS Poles may be used for Primates

Restrictions

A number of factors will determine the implementation, progress and ultimately success of a project.
Permission: Before an environment enrichment project is started, sufficient research and planning should have been carried out to ensure that permission will be granted for its implementation.
Cooperation: In most cases the major 'cost' in environmental enrichment is time, not money. It is vital that keepers be involved and informed so that they provide support.
Resources: Adventurous projects require larger budgets and specific skills. The help of a proficient maintenance department may be necessary, and special materials may be needed. Arrangements should be made for funding once the budget has been agreed on by the relevant personnel so that the project is executed continuously.

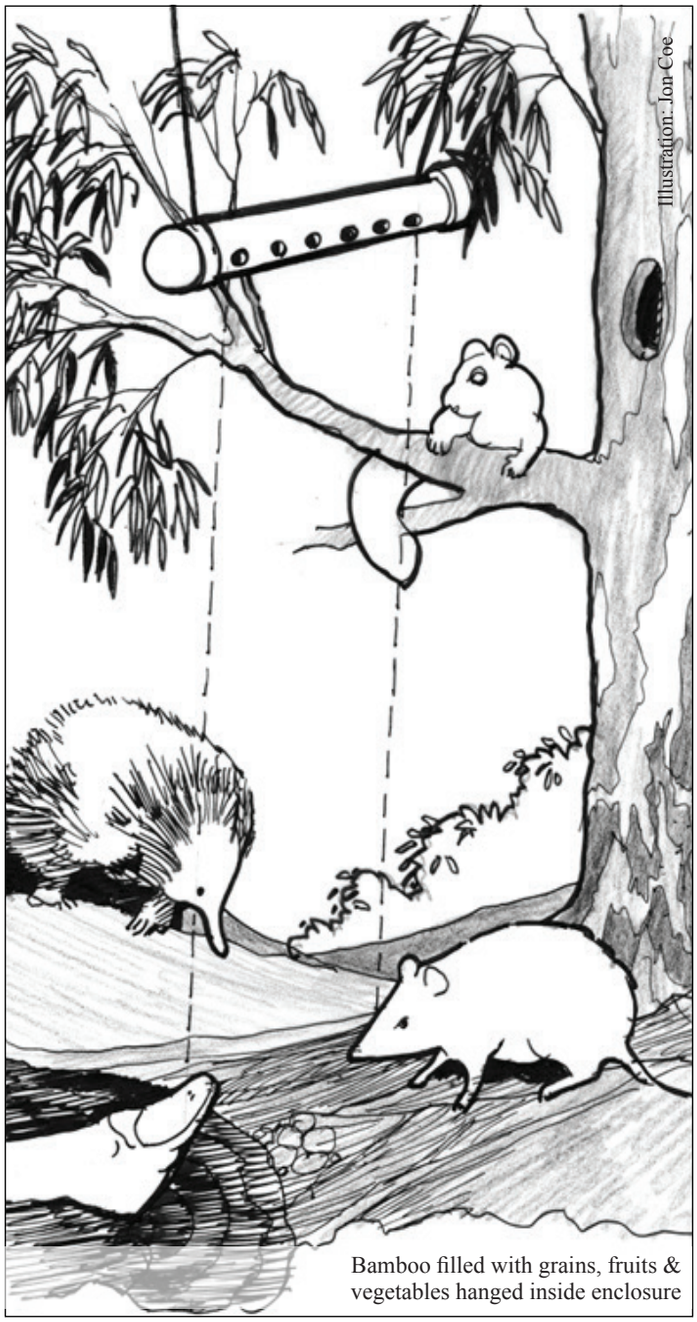
Evaluating Environmental Enrichment

It is important to assess the benefits an animal is deriving from enrichment. Of course, it is impossible to know whether or not an animal is 'happy' or content with its environment. Ultimately, an intuitive decision has to be made on the basis of one's own experience. However, it is possible to use scientific evidence to increase the chance that one's decision is correct. This problem can be approached by:

- Measuring various physiological parameters, such as steroid levels in the blood, which are known to be associated with stress and to be secreted in situations such as physical injury. The problem with these measurements is that it is difficult to decide how much stress indicates suffering. Furthermore, some of the physiological responses to excitement, which is a positive emotion, are similar to those of stress.

- Observing an animal's behaviour. Watching the behaviour of an animal, for example how it reacts to aversive situations (such as being hurt or attacked), can indicate its emotional disposition. If the same behaviour is observed in another context, it can be assumed that that situation is also aversive to the animal. An alternative is to compare the captive animal with its wild counterparts, with the assumption that wild animals are on the whole 'happy and contented' because they have evolved to live successfully in their environment. Thus, the more similar the captive animal's behaviour is to that of wild animals, the better the situation is.

Another important observation is the extent to which a captive animal displays different or abnormal behaviours. A positive evaluation based on the above criteria will justify the continuation of the enrichment programme and further work on other exhibits and species. Such an assessment requires the study of the animals' behaviour before ('the baseline study') and after or during enrichment, if it is an ongoing exercise. The following behavioural changes confirm the benefits of enrichment:



Bamboo filled with grains, fruits & vegetables hanged inside enclosure

- An increase in the behavioural repertoire (other than fearful or aversive behaviours) of the subject
- A decrease in abnormal or stereotyped behaviours
- Positive changes in an animal's activity patterns—lethargic animals becoming more active, hyperactive ones becoming calmer
- Better use of enclosure space and of the environment
- Improved locomotory activity, climbing, swimming and flying
- Reduced aggression





Enrichment Ideas for Amphibians

Chapter 2

ENRICHMENT IDEAS FOR AMPHIBIANS

Introduction

The class Amphibia includes three orders, namely, the anurans (frogs and toads), caecilians and caudates (salamanders and newts). There are over 6000 amphibian species, exhibiting a wide range of natural histories and reproductive strategies. Although some amphibians follow a reproductive model that allows individual identification, known parentage and controlled pairings, many more do not. In addition, behavioural considerations are very important in maintaining captive amphibian populations, and specific environmental conditions may be needed to achieve reproduction in captive breeding programmes.

Worldwide, amphibian populations are declining, and India has more than 400 species, more than 70 percent of which are endemic to the region. India is home to more threatened species of amphibian than is any other country in the Indo-Malayan realm.The Western Ghats and the Eastern Himalaya are recognised biodiversity hotspots, with high levels of amphibian endemism. The amphibians of the Western Ghats are enigmatic, and new species are being described with astonishing frequency. New amphibian genera were described as recently as in 2013. It is estimated that just 50 percent of amphibians in the South Asian region have been described.

Know Your Species

Amphibians have complex and varied husbandry requirements and are not always easy to maintain and breed. Keepers should aim to replicate wild micro-environments and conditions in captivity as closely as possible, and where feasible captive management should be informed by field data as well as knowledge of the biology of the species involved. Replicating wild conditions may improve captive breeding success. Unfortunately, as little is currently known about the micro-climates utilised by most amphibian species in the wild, keepers may have to collect these very important data for themselves or correspond with field biologists.


Photo: Navendu Page

Spade footed burrowing frog


Photo: Navendu Page

Indian baloon frog


Photo: Karthikeyan Vasudevan

Himalayan newt



Enclosures

The dimensions of enclosures will depend on the type of species being kept. Typically, larger and more active amphibians require larger-sized enclosures. Arboreal species (e.g., Polypedates spp., Rhacophorus spp., Pedostibes tuberculosus) should be provided with tall enclosures, and terrestrial species (e.g., Duttaphrynus spp., Fejervarya spp., Clinotarsus curtipes) should be provided with more floor space. The height of the enclosure is less important for these species.
Note that some species can be incredibly active and jumpy and that when they are maintained in small enclosures they may be prone to rostral abrasions.
There are several important factors to consider when creating an enclosure for amphibians:

1. Enclosures must be escape-proof. Due to their permeable skin, amphibians may quickly desiccate and die if they escape.
2. The construction material should be easy to clean and preferably be smooth.

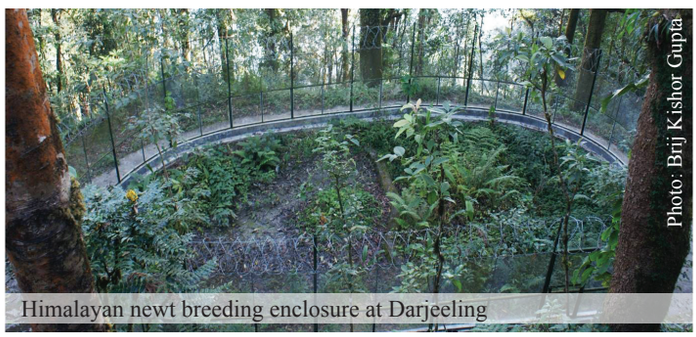
a. Wood is not appropriate as it may warp under conditions of high humidity. It is not possible to disinfect wood during routine cleaning, and so this material should be avoided. Many chemicals used to seal wood are toxic to amphibians.

b. Plastic enclosures are a suitable alternative. Any plastic should be food-grade as many plastics can leach substances that may be detrimental to amphibian health over time. Plastics may also become brittle when exposed to UVB radiation (an important component of amphibian husbandry). Plastics can be easily cleaned and disinfected.

c. Glass is another alternative. It is readily available and easy to clean and disinfect although it may break easily. Construction of enclosures using brick and cement should be avoided as these materials may leach minerals into water bodies and may be detrimental to water quality.

d. Amphibians are ectothermic and require a gradient of UVB radiation, temperature, visible light and humidity. Therefore amphibian enclosures need to be lit and to have appropriate-sized meshed apertures in the roof or lid of the enclosure for air exchange.

3. Keeper access is also an important factor to consider. Enclosures should be easy to maintain. At the same time, chances of escape when servicing the enclosure should be minimal. Ideally, drainage holes with taps will need to be provided to facilitate easy cleaning.



Himalayan newt breeding enclosure at Darjeeling

Enrichment Ideas

Substrate

A huge variety of substrates is available for enriching amphibians' habitats in captivity. The type of substrate used will depend on the species being maintained. The depth of the substrate is also important. Fossorial amphibians (e.g., Caecilians, Sphaerotheca spp.) may require deep substrates that they can bury into. The humidity of the substrate and its potential for absorbing and retaining water need to be considered. As amphibians have permeable skins (and drink through them), the substrate should have a moist area at all times. A gradient of humidity should be provided in the enclosure that will allow the animals to regulate their water balances. For the majority of species, water-logged substrates are not optimal. Amphibians do need to be given the opportunity to sit in dryer areas within an enclosure, and failing to provide some dry areas could result in serious health issues.

Substrates should be changed as and when needed and at least once in 6 months.



Soft substrates with gravels provided to the Himalayan newt



Photo: S U Sarvana kumar

Venated gliding frog *Rhacophorous pseudomalabaricus*



Glass fronted amphibian exibit

Refugia/Furniture

All amphibians should be provided with refugia. *The provision of multiple refugia within an enclosure will make the enclosure more heterogeneous. This is of great importance as amphibians select sites to regulate their temperature and water balance.* Objects that provide shelter and visual barriers are also important. Amphibians are eaten by a wide variety of other organisms. Keeping amphibians in very open enclosures with limited cover can result in severe rostral abrasions, stress and disease.



Tadpole rearing in captivity

To have the desired effect of providing adequate humidity and reducing stress, shelters will need to be individually selected so that the animals fit in or under them snugly.
Arboreal species will require branches for use as perches or resting sites, and some species that perch on leaves will benefit from live plants (e.g., Rhacophorus spp.).
Aquatic species (including tadpoles) have also been shown to benefit from shelters. Ensure that any live plants are obtained from sources free of agrochemicals. Also make sure that plants do not have thorns, irritants, toxic sap, hairy leaves or stems or other features that may harm amphibians. Additionally, food insects may feed on plants in terraria before being consumed themselves. So ensure that plant toxins cannot be ingested by amphibians by this route.



Himalayan newt in captivity at Darjeeling zoo

Light and Temperature

Wild amphibians have evolved in accordance with their environments. They will reconcile requirement and provision by self-regulating their exposure to heat, light and the associated UVB radiation. *The optimal UVB, light and temperature levels for a species will be those found in its natural habitat, specifically at the microhabitat level for each life-history stage. Where possible the UVB, light and temperature microclimate throughout the year should be established.*
In order to mimic the situation in the wild, heat (infrared radiation), light and UVB should be provided together (i.e. the highest levels of UVB should be associated with the warmest areas of the enclosure, and the lowest levels with the coolest areas). Most importantly, all three must be provided as gradients in the enclosures for appropriate lengths of time each day in order to facilitate self-regulation, with retreats that provide deep shade and no direct UV radiation.

Enclosures should be such that the amphibians cannot come into direct contact with any lamps or heaters as they have extremely sensitive skins and may be easily burnt. All lamps will emit heat, but additional heating and cooling may also be necessary. Rooms can be heated and cooled with air conditioning units. Amphibian enclosures should not be placed under such units, or normal fans, as the air movement can cause severe dehydration. Chilling systems can be installed to cool water in enclosures, if required, during periods of excessive heat.



Terraria type amphibian & reptile exhibits at Jersey Zoo, UK

Water

Water quality is an extremely important aspect of amphibian husbandry. Monitoring water quality is vital to rearing healthy captive amphibians successfully. Fluctuating levels of water parameters create stress for individuals. Therefore it is better to maintain constant conditions, even if these are slightly suboptimal although consistent optimal water quality should always be the goal.

It is important to know certain details about the water source. Sources can be tested for dissolved substances, pH and hardness and treated if necessary to provide the appropriate conditions. Unfortunately the optimal levels of the water parameters are unknown for most amphibian species. Most institutions use municipal water sources, which are generally treated with chlorine, or chloramines. The levels of these chemicals should be tested for and the water treated accordingly. Reverse osmosis (RO) water can be made suitable by adding either salts or a known quantity of tap water. Avoid water that has been stored in metal tanks or has been exposed to any other substances that could have leached into the water. Even low levels of dissolved metals can be toxic to amphibians.
Consideration must be given to the points of access of the water body. Many amphibians are surprisingly poor swimmers and can easily drown.

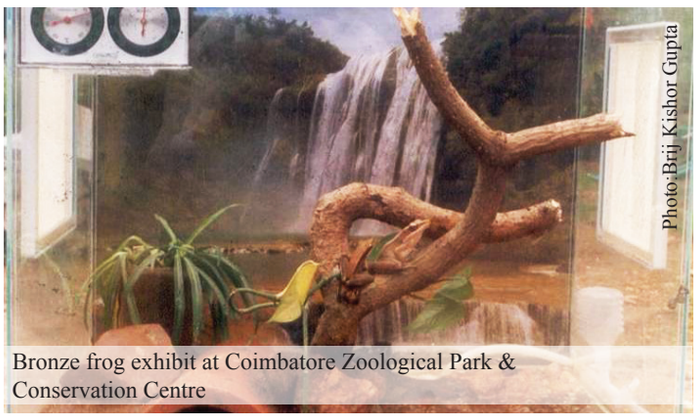


Photo: Brij Kishor Gupta

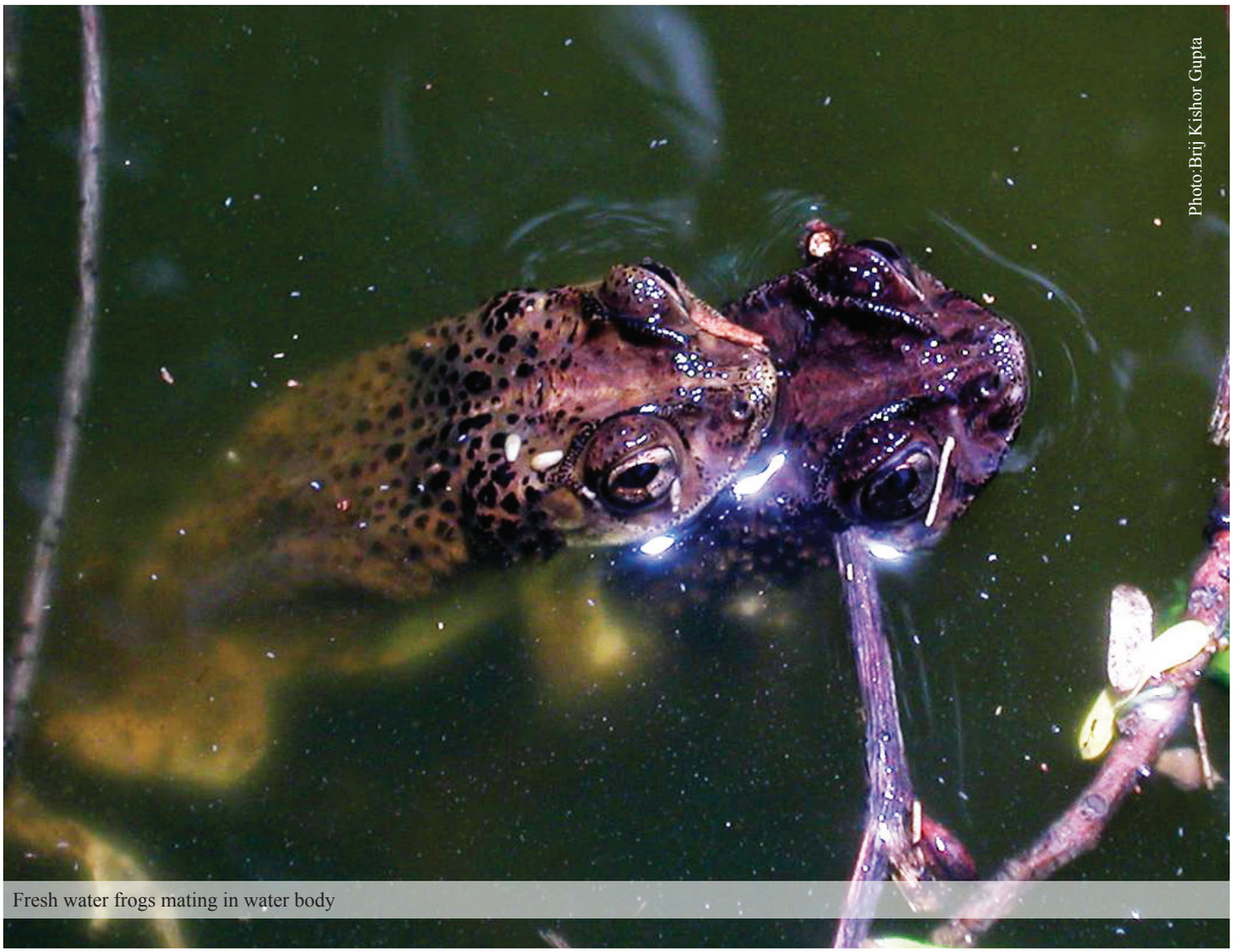
Bronze frog exhibit at Coimbatore Zoological Park & Conservation Centre

Plants

Plants are beneficial in amphibian enclosures. Not only do they provide resting sites for amphibians but they also create microhabitats (e.g., humid pockets of air caused by transpiration and also shade from heat and light) as well as oviposition sites for some amphibian species. *Plants are particularly important in aquatic exhibits as they use the nitrogenous compounds for growth, as well as absorb many pollutants, and can improve the water quality.*

Diet

Nutritional problems are a major barrier to successful amphibian husbandry. The nutritional requirements of most amphibians are unknown, and the requirements change with the stage of life. Even when the diet is known, it is often impossible to replicate in captivity as captive diets are limited by the commercial availability of food species and the ability to establish breeding colonies of appropriate species. Further, there are difficulties in providing the prey species themselves with suitable diets. Nevertheless, nutrition is a key factor in keeping amphibians healthy and in successful breeding. All possible efforts should be made to provide captive amphibians with as much variety and good nutritional content as possible. Most post-metamorphic amphibians are insectivores and will only feed on live, moving prey items.



Fresh water frogs mating in water body



Golden poison arrow frog in captivity at London Zoo

Invertebrates can be cultured or collected from the field. Food offered to amphibians should be no larger than the width of their heads. All food should be well fed prior to being offered to the amphibian, in addition to being dusted with an appropriate dietary supplement.

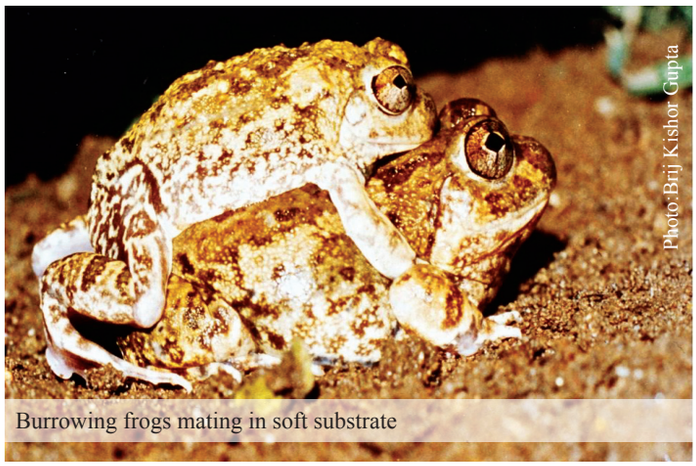
To encourage natural feeding behaviour, amphibians should be fed at the periods of peak activity. This will ensure that they encounter the food and that prey items are still coated with dietary supplements when they are ingested.

Seasonality and Breeding

Many amphibians breed in response to environmental cues. These include, but are not limited to, temperature, humidity, precipitation, barometric pressure and changes in water quality. *It is important that the seasonal changes found in nature be replicated in captivity even if breeding is not the desired outcome as failing to provide animals with seasonality may cause health issues, e.g., obesity and females becoming egg bound.*



Arboreal frog with foam nest



Burrowing frogs mating in soft substrate

Providing rain chambers is one of the most common ways of breeding amphibians in captivity. These systems re-create rain showers and usually involve a small pump sitting in a few centimetres of water and supplying water to a rain bar. The frequency and duration of the rains can be controlled by using a timer.







Illustration: Arnab Roy

Enrichment Ideas for Reptiles

Chapter 3

ENRICHMENT IDEAS FOR REPTILES

Most large zoos in India and around the world exhibit reptiles. Examples include the London Zoo (U.K.), Singapore Zoological Gardens (Singapore), San Diego Zoological Gardens (San Diego) and National Zoological Park (Washington, D.C., U.S.A.).

There are also some specialized zoos in India that deal exclusively with reptiles:

1. Centre for Herpetology, Madras Crocodile Bank Trust, Mamallapuram, Tamil Nadu
2. Chennai Snake Park, Chennai, Tamil Nadu
3. Snake Park, Rajiv Gandhi Zoological Park & Wildlife Research Centre, Pune, Maharashtra
4. Snake Park, Shetkari Shikshan Mandal, Kolhapur District, Maharashtra
5. Parassinikadavu Snake Park, Kannur District, Kerala
6. St. Irwin Crocodile Farm, Thiruvananthapuram, Kerala
7. Snake Park, Malampuzha, Kerala

India is home to three species of crocodile, 34 species of turtles (including marine species), 280 species of snake and 205 species of lizard. Many of these species are housed in zoos and attract visitors.

"Environmental enrichment for reptiles in captivity is very important from the point of view of upkeep, maintenance and care of these animals. It is also important for meeting the biological demands of the animals in captivity, making the exhibits attractive and ensuring that species-typical behaviours are exhibited. Enrichment provides a level of stimulation conducive to good health".

It is important to keep the natural history of each species in mind when developing a safe and effective enrichment programme. Reptile care is highly specialised. Resource materials and knowledgeable individuals should be consulted when possible and veterinary and supervisory approval sought prior to initiating enrichment.

Reptiles as a group are very varied. They are found in an array of habitats and ecological niches. They exist in deserts, with extremes of temperature, in moist tropical rainforests and in saline marine environments, to name just a few. Reptiles have adapted to the vastly different conditions of these habitats and exploited the microhabitats and climatic gradations prevailing in them in order to survive. Reptiles may be aquatic, terrestrial, arboreal, subterranean or combinations of these, depending on the stage of development and time of year.

Reptiles utilise various types of food and adopt different feeding strategies. They may be herbivores, insectivores, carnivores, frugivores or omnivores. Some are primarily predators, while others are primarily prey of other species. Most are both predators and prey to some extent. Therefore, placement on the food chain greatly influences a reptile's life history strategies.

The locomotive styles of reptiles include terrestrial locomotion using sprawling limbs, terrestrial limbless locomotion (snakes have six different recognised modes), aquatic locomotion and even aerial locomotion, wherein an animal parachutes or glides to its destination. Other behaviours typical of most reptiles include excavation of nests or burrows, sexual displays and territorial displays. Some of these latter behaviours may only occur in a social context though reptiles range from gregarious crocodilians to relatively solitary chameleons.



Indian monitor lizard resting on rock outcrop I n captivity



Photo: Dr. Brij Kishor Gupta

Reptiles are ectothermic, or cold-blooded, animals. Because their body temperature is dictated by the external temperature, reptiles must regulate their body temperatures through their behaviour.

Reptile lives and reproductive cycles are influenced by the availability of water. In some species the amount of moisture in the air is critical, while in others access to a pond, lake, river or estuary is essential for the health of the animals.
Zoos located in different parts of India where there are large variations in temperature, such as Delhi, where the temperature ranges from 4 to 48 degrees Celsius, require very specialised husbandry protocols. Particularly in winter, reptile enclosures in these places need to be provided with heating arrangements, and in summer the enclosures must have sufficient water and moisture. Failure to provide these may result in high rates of mortality. Enclosures may be provided with substrates that are particularly suitable for snakes and other reptiles to hibernate in.

Chameleon using the wooden perch at Chennai Snake Park, Chennai

Crocodilians

Mugger *Crocodylus palustris*

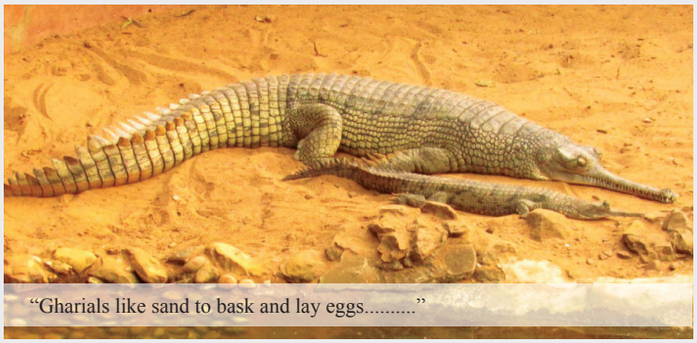
In captivity, muggers consume crustaceans, insects and small fish when young. They move on to a diet of fish, frogs, crustaceans, birds, monkeys and squirrels in adulthood.



Mugger basking at sand at MCBT, Mamallapuram

Gharial *Gavialis gangeticus*

Nesting occurs during the dry season. The females drag themselves onto dry land to excavate holes. They lay around 40 large eggs, which are then.



"Gharials like sand to bask and lay eggs....."

Snakes

Snakes differ from lizards in that they do not have moveable eyelids, limbs or external ears. Snakes only have one functional lung. In some species the left lung may be totally absent, as opposed to being present in a reduced form. Some species may have 'limbs' that are greatly reduced and serve no purpose. Snakes 'walk' on articulated ribs that are connected to a backbone or spine. They have a retractile tongue that is used for smelling. The tongue picks up scent particles and places them in the Jacobson's organ for identifying them.

As a rule snakes are carnivorous, but there are a few insectvores. Snakes are grouped into five main categories. The classification is based on the jaws and teeth or fangs.

The groups are (1) the family Typhlopidae (teeth in the upper jaw only), (2) the family Leptotyphlopidae (teeth in the lower jaw), (3) the family Colubridae (teeth in both jaws, two highly venomous species with fixed rear fangs), (4) the family Elapidae (fixed front fangs) and (5) the family Viperidae (with hinged front fangs). Snakes of the families Elapidae and Viperidae have developed specialised teeth that are hollow or grooved to carry venom from the venom glands.



Lizards

Lizards are the most species among the extant reptiles. Lizards typically have feet and external ears, while snakes lack these characteristics. Vision, including colour vision, is particularly well developed in most lizards, and most lizards communicate using pheromones, body language and bright colours on their bodies. Sight is very important for most lizards, both for locating prey and for communication, and, as such, many lizards have highly acute colour vision. Most lizards rely heavily on body language, using specific postures, gestures and movements to define territories, resolve disputes and entice mates. Some species of lizard also use bright colours, such as the iridescent patches on the belly of Sceloporus. As these colours make a lizard highly visible to predators, they are normally hidden on the underside or between scales and only revealed when necessary.



Photo : Dr. Brij Kishor Gupta

Tokay gecko at Assam State Zoo, Guwahati using wooden logs

Turtles and Tortoises

Turtles are ectotherms—their internal temperature varies according to the ambient environment. Such animals are commonly referred to as cold blooded. However, leatherback sea turtles, because of their high metabolic rate, have body temperatures that are noticeably higher than that of the sea.

The term tortoise usually refers to any land-dwelling, non-swimming chelonian. Most land-dwelling chelonians belong to the family Testudinidae.

Terrapin is the name given to several species of small, edible, hard-shelled turtle, typically found in brackish waters.

Turtles are thought to have exceptional night vision due to the unusually large number of rod cells in their retinas. Turtles have colour vision, with a wealth of cone subtypes, with sensitivities ranging from the near-ultraviolet to red. Some land turtles are very slow moving, but carnivorous turtles have the ability to move their heads quickly to snap.

Although many turtles spend large amounts of their lives underwater, all turtles and tortoises breathe air and must surface at regular intervals to refill their lungs. They can also spend much or all of their lives on dry land.


Photo: MCBT

Fresh water turtle basking near water body in captivity

and invertebrates such as insects, snails and worms. They have been reported to eat dead marine animals occasionally. Several small freshwater species are carnivorous, eating small fish and a wide range of aquatic organisms. However, proteins are essential for turtle growth, and juvenile turtles are purely carnivorous.

Sea turtles typically feed on jellyfish, sponges and other soft-bodied organisms. Some species of sea turtle that have stronger jaws have been observed to eat shellfish, whereas some species, such as the green sea turtle, do not eat any meat at all and, instead, have a diet largely made up of algae.


Photo: Dr. Brij Kishor Gupta

Star tortoise provided with natural substrate in Zoos



Young one of Mugger crocodile at MCBT, Mamallapuram





Calotes provided with large logs vertically and horizontally in the enclosure

Enrichment of Exhibit Areas

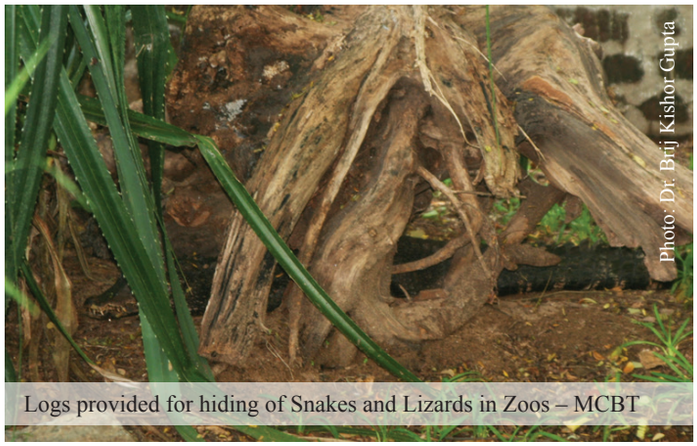
Perches for climbing/hanging. Providing vertical and horizontal perches is crucial in most reptile enclosures. Perches provide pathways and arboreal access for both partially and fully arboreal species. Using tree branches of various sizes in providing perches affords an important mechanism for thermoregulation. Perches should be placed so that the animals can bask. There should be at least as many basking sites as the individuals housed.

Placing perches at varying distances from a source of heat provides a temperature gradation that allows the animals to maintain body temperatures within the range appropriate to the species.

Such placement of perches can also encourage locomotive behaviour between sites. Providing perches where the temperature is outside the optimal range can encourage movement into and out of that area, rather than having an animal continuously basking in the same location.



King cobra breeding enclosure at Pilikula Zoological Park, Mangaleru



Logs provided for hiding of Snakes and Lizards in Zoos – MCBT

Vines or wooden logs as well as horizontal sites can offer additional dimensions to an enclosure and stimulate climbing in some species. For example, vipers that hunt by positioning themselves above potential prey items can sometimes be stimulated to feed more often with the addition of a large, flat rock or pile of rocks on which they can rest. Pythons use thick wooden logs for climbing. Periodically changing perches in their enclosures may stimulate movement to a healthy extent when the animals explore their 'new', enriched environment.

Misting, whether by hand spray or via an automated misting system, can also increase the level of activity and help when reptiles shed skin in summer. Water features (shallow or deep pools, water cascades, etc.), where appropriate, can make the landscape of an enclosure more interesting and raise the humidity level. Addition of plants, moss and soil can also help maintain the humidity and moisture.

Natural substrates such as soil, wood chips, moss, etc., can allow reptiles to manipulate their environments and engage in natural behaviours such as excavating a burrow or creating a nest site. Moisture, texture and temperature gradients may all play roles in the selection of a nest site. It is also important to provide the proper substrate and conditions for potentially gravid females. This can reduce the risk of their not depositing their eggs and becoming egg-bound. Natural substrate such as bark often contains live insects, which may be discovered by a foraging animal.

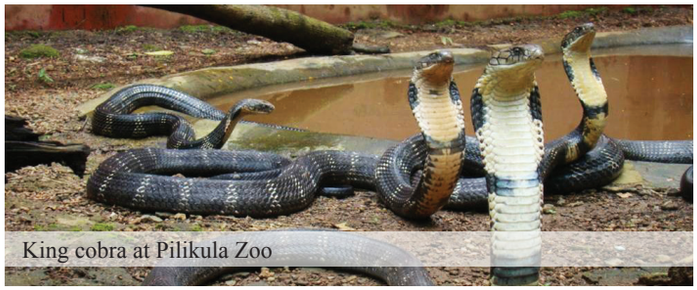
Cover, an important feature for many reptilians, can be provided in ways such that the animals are still visible to the public. Plants can be positioned so that the leaves are both above and below perches. Forward-facing caves can be created using rocks and logs. These shelters make animals feel protected even when they are visible to caretakers and visitors. Providing them with more than one sheltered location allows the animals to make choices. The addition of substrates to a cave gives animals means of modifying the cave's micro-environment by pushing the substrate out or creating a mounding as desired.

These shelters also allow them to use areas that are less brightly lit. This is a welcome feature for forest-floor species that may be adapted to conditions of lower light levels than those found in exhibits. With some snakes, the addition of a 'hide box' to an enclosure promotes eating.

The minimum sizes and relative dimensions of reptile enclosures have been prescribed by the Central Zoo Authority. It should be kept in mind that the requirements of an individual reptile species depend on its preferred temperature range and habitat. In case a mixed-species exhibit is planned, the exhibit area should be large enough to meet the standards prescribed for each species within it. In general, larger enclosures are easier to design with more enriching features and can provide temperature, moisture and light gradients. The larger space can also reduce bacteria buildups and thereby reduce the frequency with which the substrate needs to be changed. Furthermore, for some species, placing animals in a larger enclosure raises long-term increases in the activity level and widens the behavioural repertoire. Therefore, all care must be taken when planning enrichment.

Dietary Enrichment

Live insects (crickets, grasshoppers, termites, etc) or mice may be provided to reptiles requiring live prey, depending upon the size and age of the animals. Insects can elicit foraging behaviours from reptiles and keep them healthy. For some species (such as chameleons), the provision of a variety of live insect prey items daily is essential for health. For other species, live prey, if infrequently offered or offered as a novel item, can be very stimulating, for example, providing varieties of aquarium fish for turtles or large fish or mice for snakes such as the cobra, rat snake and king cobra. For crocodiles, particularly gharials, freshwater fishes of an appropriate size promote foraging. Adding earthworms to a turtle's substrate can also stimulate foraging behaviour. Hand-scattering of insects that are routinely provided in the diet can also be enriching if the quantities are unpredictable and if feeding is done at irregular intervals. Star tortoises will readily feed on a variety of browse plants and vegetables and even some fruits. If branches with fruits are arranged within the enclosure so as to form a temporary leafy perch, the animals will feed on it for days or even weeks (if misted or maintained in water, the browse may stay fresh longer).



King cobra at Pilikula Zoo



Photo: Dr. Brij Kishor Gupta

Komodo dragons provided with natural substrate and shade at Smithsonian National Zoological Park, Washington DC



Water monitor lizard provided with sufficient sand and stones to meet its biological behavior

Venomous snakes typically release their prey after injecting venom. The prey then wanders off to die, only to be tracked by the snake. The snake then engages in rapid tongue flicking and performs searching movements to locate and follow the prey's trail. Tongue flicking is a behaviour that sometimes declines in captive snakes over time if novel stimuli are not presented. Live prey can stimulate an increase in this behaviour, as can a blood trail (made by dragging a dead prey item around the enclosure and then hiding it under leaves or other substrates or exhibit furniture). Varying the feeding schedule can lead to increased predatory behaviour and therefore an overall increase in the activity level.

Social Enrichment

Mixing species reptile exhibits is not a common practice in Indian zoos. Exhibiting individuals of various age groups of a single species is also not a common feature since results in socialisation and requires the behavior of the animals to be monitored. Rotating animals into a conspecific's (preferably of the opposite sex) enclosure can also stimulate reproductive behaviour in species. Creating a group exhibit (many lizards are colonial) or a mixed-species exhibit can also lead to a more interesting and socially complex environment, increasing the likelihood of territorial behaviours.

In some social situations, such as with crocodilians, the addition of visual barriers can alleviate competition and stress at feeding times. Animals in mixed-species exhibits with aquatic turtles, terrestrial lizards and arboreal snakes, for example, may benefit by occupying different strata, which will minimise competition for space. In addition, exhibiting species from the same locale together can decrease the likelihood of transmission of pathogens between species. When snakes are being transported, behavioural observations should be carried out. Further, zoo staff members may examine them for health and other reasons when they are in off-exhibit areas (those areas that are not open to visitors).



Mixed species exhibit for Gharial and fresh water turtles at MCBT, Mamallapuram

Enrichment Ideas

Exhibit Enrichment

- Perches: to create basking sites with temperature gradations, provide arboreal access, create vertical sites (rock piles, hanging vines) and encourage climbing. Changing the perches in the exhibit can stimulate activity and maintain a healthy environment.
- Misting (by hand or automated)
- Water features: shallow pools, deep pools, water cascades, etc.
- Natural substrates: soil, wooden logs, moss, leaf litter, bark, sand, etc.
- Cover: plants, forward-facing caves made from logs or rocks.
- Larger enclosures: to add complexity, facilitate temperature and moisture gradations and increase the activity levels and widen the behavioural repertoires of the animals.

Dietary Enrichment

- Rotten logs with insects
- Insect dispensers such as fake logs that release insects on a random schedule
- Variety of vegetables
- Variety of insect prey
- Novel live prey: various species of fish and insect
- Scattering insects that are provided routinely in the diet in unpredictable quantities and at unpredictable intervals
- Providing prey items at varied feeding schedules

Social Enrichment

- Snake sheds
- Behavioural tools to introduce animals to shift boxes, tubes and squeeze chutes
- Rotation of animals into enclosures of conspecifics
- Housing animals in natural social groupings
- Mixed-species exhibits (with appropriate species)
- Visual barriers: to reduce social stress and feeding competition







Enrichment Ideas for Aves

Chapter 4

ENRICHMENT IDEAS FOR AVES

Avian species are seldom the topic of discussion in the context of behavioural enrichment even though captive birds exhibit abnormal behaviours, presumably because of boredom. Birds in captivity are liable to suffer from a number of stress-related health and behavioural problems. They are also likely to be unsuccessful in breeding when placed in situations where social and environmental deprivations exist. This chapter deals with the meaning of behavioural enrichment and the need for it in zoos today. It provides several examples of how best birds can be maintained in zoos, rescue centres and conservation breeding centres.

We all know that *"behavioural enrichment is important because it helps reduce the possibilities of abnormal behaviour, increases the educational value of the exhibits, helps validate captive displays and can stimulate greater interest in the physical environment, leading to enriched social interactions between birds". Specifically, "enrichment techniques optimise the levels of social and physical stimulation provided in captive environments to maximise reproductive potential and ensure normal behavioural development" (Shepherdson, 1994).*

In this chapter enrichment ideas are presented for the following groups of birds:

1. Pheasants and birds belong to the order Galliformes
2. Parrots and birds belonging to the order Psittaciformes
3. Water birds and birds belonging to the orders Pelicaniformes and Anseriformes
4. Storks and cranes
5. Birds of prey (kites, falcons, vultures and owls)



Photo: Dr. Brij Kishor Gupta

Parakeets provided with hollow tree logs to lay eggs and rear young ones



Photo: Dr. Brij Kishor Gupta

Perch provided to Raptors covered by coir ropes to avoid Bumblefoot (ulcerative pododermatitis) is a bacterial infection and inflammatory reaction on the feet of birds in captivity

Introduction

Since the inception of the Central Zoo Authority, in 1992, attempts have been made at several zoos to exhibit birds in large aviaries that provided them the space and natural vegetation that they require. It is mandatory under the Recognition of Zoo Rules, 2009 for every zoo to provide a naturalistic environment that meets the biological, physical and psychological needs of the birds. When issuing guidelines for scientific management of zoos, the Central Zoo Authority prescribed minimum sizes for outdoor enclosures for the major species:

Species	Minimum size of aviary (in sq. meter)	Minimum height of aviary (in meter)	Minimum size of water body within aviary (in meter)
Birds of prey	300	8	10
Pheasants*	80	3	3
Water birds (mixed-species enclosure)	300	8	60 (with a depth of 1.5 m)
Flying birds (mixed-species enclosure)	300	8	20
Flying birds (single species)	80	6	2

Table 2: CZA's Recmended size of the Aviaries

* The aviary size should be at least160 m2 for peafowl.

The Central Zoo Authority has also issued guidelines regarding the use of innovative exhibit designs and barriers for holding and displaying birds in zoos, which plays a very important part in designing the enrichment for a species. The details are provided in the following section.

Type	Front barrier/rear barrier	Remarks
Pheasants	Enclosure covered with wire mesh, 3 m high, 10–12 m deep, 6–7 m wide	a. Double-galvanised mesh (12 mm × 12 mm × 4 g) should be installed 0.5 m below the earthen surface to prevent the entry of rodents. b. The plinth should have an overhang of 7 cm to prevent the entry of rodents/snakes through the chain-link mesh from the viewer side or rear.
Walk-through aviary	i. The area of a walk-through aviary should not be less than 2 ha, with a withdrawal area for the birds that is at least 100 m wide. ii. The height of the aviary should be 12 m.	a. Adequate vegetation should be provided. b. Ideally, visitors should be provided a board walk.

Table 3: Recommendations for aviary types, enclosures and barriers

Birds housed in aviaries should induce a 'sense of freedom' in the mind of the visitor (Polakowski, 1987). The ability to visualise a bird in its natural surroundings will lead not only the visitor but even the zoo personnel, to conclude, and reasonably so, that every provision had been made to maximise its well-being in captivity.

It is important to remember when birds are housed in large, spacious aviaries that these aviaries should be enriched with live plants, naturally-occurring substrates and water bodies to meet the birds' physical and behavioural requirements and animal welfare standards.

In the long run, however, behavioural enrichment does more than just ensure the welfare of the individual. As wild habitats continue to shrink, and human pressures on wildlife continue to rise, zoos are increasingly being concerned with the conservation and well-being of groups (populations and species) as well as individuals (Shepherdson, 1994). These new and inter-related roles of enrichment have developed from the predominantly individual-oriented approach of the past. Thus the goals of zoos include conservation of culturally defined repertoires of behaviour for research and education and facilitating the reproduction of captive populations (especially endangered species). Furthermore, with the present emphasis being on conserving entire ecosystems rather then individual species, zoos play an important role in the re-introduction of captive-bred animals into the wild. This has intensified the need for continued preservation of natural behaviours in captivity. Meeting this goal is greatly aided by behavioural enrichment.

One of the most important misconceptions concerning birds in captivity, in my opinion, lies in the enclosure size, relative to body size. Now, for most carnivores, the enclosure size relative to body size is small. For instance, a lion is housed in an enclosure of 1000 m2 area. A bird in the same enclosure, on the other hand, has a much bigger enclosure size relative to body size, even if it is a large parrot like a macaw. In short, people tend to think that birds have 'plenty of space' because of their relatively smaller size. This, however, is far from true. Some birds are migratory, and others cover long distances in search of food. Yet others have territories extending over hundreds of square miles. The size of an animal does not necessarily determine the space required; it is the behavioural needs that determine the space. Birds need environments that closely resemble their native habitats to express their behavioural characteristics (Polakowski, 1987).

When environments resembling their habitats are lacking, birds can end up with a multitude of problems. The absence of certain key stimuli in the physical environment of a captive animal can result in failure to express certain behavioural patterns (Thompson, 1996). According to the theory of natural selection, the rarity of certain essential behavioural patterns may cause them to be 'phased out' gradually in a species. Research has shown that animals kept in socially and physically impoverished conditions tend to develop rigid, unvarying behavioural patterns (stereotypic behaviour) rather than displaying an interest in exploring their environment and being alert to stimuli (Shepherdson, 1994). Needless to say, stereotypic behaviour in confined birds is an indication of poor conditions.

How to Design Exhibit Enrichment

When designing an exhibit for a bird species, one of the most important factors to consider is the species' natural history and its biological requirements. Another important consideration is whether the bird is a predator or a prey animal? Predators and prey species should be housed separately.

The following are a few questions that one might ask when planning an exhibit:

- What are its feeding strategies?
- Does the bird live in large colonies or singly?
- Is the species tolerant of other species, and if so, which species?
- Is it capable of flight, or has it lost the ability?
- Does the birds spend time in or near water?

With these questions in mind, one can begin to construct an exhibit that is well suited for a particular species.
When dealing with pre-existing exhibits, providing new enrichment may be more challenging than building enrichment into a new exhibit. It is important to look at the birds as individuals and how they are adapted to their environments in the wild. Providing flighted birds with perches at various heights and locations is a good place to start. Potted plants and trees can be used for this purpose. They can also be used as screens against the sun, inclement weather and conspecifics. A variety of substrates, such as sand, peat moss and dirt, can be offered for birds that have the habit of dust bathing. Water is an important element to consider. Pools or shallow pans can be provided for birds that bathe in water. Sprinklers can be run periodically in an exhibit, or birds can be misted by hand. Providing enough space and areas to retreat to is also essential, especially when dealing with mixed species exhibits.

Nest construction can be a time-consuming project for birds during the breeding season. A variety of nesting sites and features, such as nest boxes, logs, mudflats, platforms and burrows, can be built into an exhibit to promote natural nest building or excavating behaviour. The time spent and the experience of building a nest or excavating a nest log may be essential for successful breeding. Nesting material (twigs of various sizes, green grass, dry grass, dry and green leaves, hollow wooden logs, nesting platforms) should be provided before the onset of the breeding season to give birds opportunities to indulge in the natural behaviour of preparing a log for nesting.

Enhancing a bird's living quarters is only one aspect of a successful enrichment programme. The components of the bird's daily diet offer a number of additional enrichment options.



Photo: DWCT

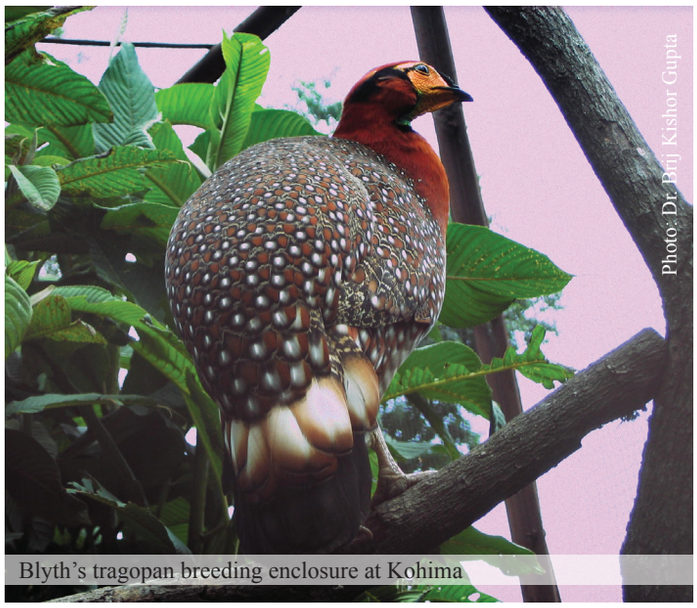
Types of nesting material may be provided to Aves

Pheasants and Allies: The Galliformes

The order Galliformes includes all the pheasants and partridges, in the family Phasianidae, which is the largest family of the order, including around 155 species from the Old World. The members of this order constitute a diverse family of small to large terrestrial birds, primarily ground-dwelling, with squat bodies that are large in relation to the head, bill, short neck, wing and tail. In most species, the males are larger than the females. The males also have brilliantly coloured plumage, whereas the females have drab plumage. Most species are fairly sedentary and use more of less the same habitat throughout the year. They rarely disperse for different activities such as nesting and feeding. The daily habits of phasianids generally follow a simple pattern, involving a round of feeding after emergence from the roost, a latent period in the afternoon and a late-afternoon feeding session followed by a return to the roost. Although significant variations are observed in the feeding regimes, the diet primarily includes seeds, leaves, flowers, buds, roots and a variety of animals, ranging from invertebrate larvae to small reptiles.

Most phasianids are highly adaptable and quickly get acclimatised to conditions of captivity. They also survive for fairly long periods, provided their basic requirements are met. A few basic amenities that most phasianids require to survive in captivity are listed here:\

1. The location and orientation of an exhibit must be chosen such that it faces the east and daylight falls on it.
2. Pheasants, being exclusively terrestrial birds, need dry sandy areas for dust bathing, an activity that is of use in feather maintenance by ridding the feathers of parasites that infest them. The ground has to be covered with soil or sand. It must have the right slope for water to drain away easily. Persistent dampness in enclosures must be avoided under all circumstances.
3. Exhibits have to be designed such that they provide the maximum ground space for the birds. Basic shapes such as squares and rectangles provide the maximum surface area for the birds. The size of an enclosure depends on the number of birds to be housed; however, when designing enclosures, care must be taken to ensure that each pair gets at least 5–6 m2 of space.
4. Having indoor pens (around 2 m × 2 m × 2 m) attached to outdoor exhibits is an option that can provide protection against inclement weather and can be of use special situations when birds need to be separated for a while. Indoor pens have to be well-ventilated and can have concrete flooring with the right slope. Additional openings in the roof could be provided to allow sunlight, with a provision to close them whenever required.
5. Enclosures can be constructed adjacent to each other, with doors connecting the enclosures to permit keepers to move from one to another and allow shifting of birds from one pen to another without their having to be handled.



Blyth's tragopan breeding enclosure at Kohima

6. Enclosures need to be rodent–proof. This can be achieved through the use of appropriate fencing material. Galvanised chain-link mesh with an eye gap of not more than half an inch is recommended. Although the use of such a mesh hinders visibility to a certain extent, in the long run, it is a worthwhile trade-off, with the birds being healthier and breeding. Visibility can be improved by painting the fencing with darker colours such as black.
7. Enclosures should have a lot of vegetation, which adds to the aesthetic appeal and provides the birds with areas in which they can conceal themselves. Roosting sites and perches need to be provided at various heights to encourage the birds to use them at dusk.

Certain variations are needed with regard to the housing, nest sites and additional cage furniture for certain species. These are explained in the following section. An account of the husbandry and environmental enrichment provided for the phasianids housed at Sri Chamarajendra Zoological Gardens, Mysore follows.

All phasianids should be housed in outdoor aviaries constructed using chain-link mesh. They should measure 7.3 m × 4.6 m × 4.3 m, and the ground should be covered with soil. Originally, chain-link mesh of larger size was used, which resulted in the enclosures becoming infested with rodents. TThe rodents ate the food provided for the birds and defecated in the feeding trays, which introduced health hazards. Rodents even destroy eggs and occasionally prey on newly hatched chicks. The enclosures lacked shelters and hide-outs for the birds. They also lacked vegetation. Logs were provided inside the enclosures for use as perches. But these served as refuges for rodents. Abnormal and stereotypic behaviours (pecking of pheasants housed in adjacent enclosures) was observed. The enclosures also lacked appropriate nesting sites and roosting sites.

A number of measures were adopted and modifications implemented to improve the well-being of the pheasants and enrich their enclosures.

Exhibit Enrichment

The exhibit should have been provided with branches of trees that would have served as perches. Perches may be at various heights, depending on the aviary, but they should preferably be located at a height between 1.8 and 2.5 m. Perches at multiple levels should be available for the birds. Logs also serve as roosting sites in the night. Bamboo mats (4 feet or more in height) should be erected between enclosures as partitions. These mats serve as visual barriers and prevent interactions between adjacently housed pheasants. Bamboo and other foliage may be planted inside an enclosure, along the sides. They will serve as places to hide in when mates are aggressive and conceal the pheasants when they are disturbed by visitors.

Wooden platforms of size 1.2 m × 1 m may be provided inside enclosures and positioned about 0.6 m above ground level. The platforms may be covered at the top and on two sides. They should be positioned away from the viewing areas. These will serve as nesting sites and offer privacy to the pheasants. Covering the platforms with hay will provide nesting material. Multiple platforms of different heights should be provided so that the birds have a choice of nesting sites. Pheasants, being particularly terrestrial birds, need dry, sandy areas for dust bathing, a feather maintenance activity in which excess moisture is soaked up. An aviary may be partly covered on top to provide protection to birds when it rains. Areas with dry and loose soil mixed with small amounts of ash should be provided for pheasants to dust bathe.

Tragopans are elevated nesters and prefer nest sites that are located high up in an enclosure. A tree stump was added to the satyr tragopan exhibit at Sri Chamarajendra Zoological Gardens, Mysore. It was approximately 4 m high, and it was positioned away from the viewing area. A bamboo basket was placed on the top of the stump for building a nest on, and the basket was filled with nesting material, specifically hay and dried leaves. The aviary was covered from the top to prevent rainwater from entering the nest. An additional nest was provided, again a bamboo basket, at a corner of the enclosure. The tragopans used the nest. During the breeding season, eggs were laid in the elevated nest and not in the nest site provided down below.



Photo: Dr. Brij Kishor Gupta

Waterfowls constructing nest in captivity at Manipur Zoo

Dietary Enrichment

The feeding regime of the avian residents at Sri Chamarajendra Zoological Gardens, Mysore follows a pattern in which the birds are fed twice a day, once late in the morning and the second time in the late afternoon.

In the wild, birds have access to a wide variety of food. So, considering the behavioural needs of most birds housed in a zoo, a variety of dietary components may be provided. Wild phasianids feed early in the morning and late in the afternoon. The primary intentions when planning dietary enrichment was to mimic the natural feeding cycle, to increase the foraging time and to encourage the use of more of the enclosure space.

Dry leaves were scattered on the floor of the enclosure, and grain was scattered in the litter. A portion of the the enclosure was also used to grow grains and cereals. The seedlings were protected from the pheasants using a mesh. This ensured that the pheasants had access to the seedlings only when they had grown sufficiently. Fish meal, liver function enhancers and vitamin supplements were provided in the diet. Live insects such as termites were included in the diet, and these were offered on a regular basis. The insects in the feed served as a protein supplement. The diet with insects mimicked the natural food. Phasianids forage for insects in their natural environment. The insects stimulated their interest in feeding and made them more active.

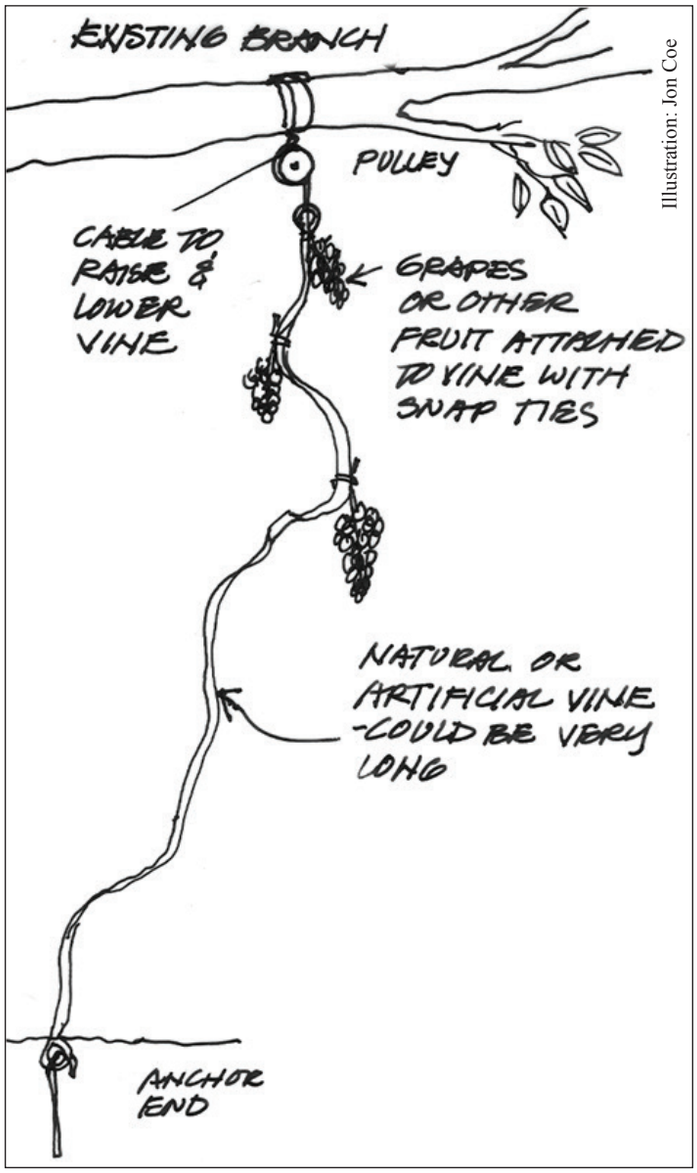


Illustration: Jon Coe

Parrots and Allies: The Psittaciformes

Birds in captivity tend to grow unwell when they are deprived of the basic amenities. Psittacines are quite sensitive birds, but they can be successfully kept and bred in captivity, provided the physiological and psychological needs of the species are taken care of. Some of the basic requirements that have to be considered when housing parrots and their allies are listed here.

1. Selection and preparation of sites for outdoor aviaries have to be carefully planned. The direction of the morning sun and the primary direction of the wind and rain need to be considered to provide the birds maximal protection.
2. Enclosures for psittacines need to be fairly large, deep rather than long or high, and should provide sufficient space for the birds to exercise in and to display normal behaviour. In general, the larger the size of the enclosure, the better it is for the birds (Table 1).

Table 4. Recommended minimum sizes of enclosures

Species	Dimensions of enclosure (height × depth × width, in feet)
Large macaws	12 × 8 × 15
Large cockatoos, medium-sized macaws	10 × 6 × 12
Amazon parrots, African grey parrots	8 × 6 × 12
Conures	6 × 6 × 8
Cockatiels, small conures	4 × 4 × 6
Lovebirds, budgerigars	2 × 2 × 2

3. A typical enclosure needs to be an outdoor area with an attached indoor facility, which will serve as a refuge during inclement weather. The enclosure should be properly drained so that there is no clogging during rains or cleaning.
4. The mesh used for the construction of the enclosure should not allow the entry of rodents into the enclosure. The preferred fencing material is 10–14 gauge galvanised chain-link mesh with an eye-gap of not more than 0.5 inch.
5. The enclosure should have rough textured, non-toxic, preferably unprocessed wooden perches of different diameters positioned at different heights. They must be secured properly and should serve as optimal sites for copulation. The number of perches inside the enclosure should be just sufficient for the birds and should not interfere with their ability to fly.
6. Multiple nest boxes have to be positioned inside the enclosures. The nest boxes have to be shielded from direct sunlight and rain and should contain comfortable bedding material.
7. The enclosures should have a lot of vegetation that will add to the aesthetic appearance of the enclosure and serve as hiding places for the birds.



All enclosures housing psittacines should meet these requirements. They were found to meet the requirements of macaws, cockatoos, conures, African grey parrots, lories, lorikeets, toucans and turacos. However, there are also certain species-specific variations that need to be considered.

Dietary Enrichment

The feeding regime plays a very important role in the health of captive birds. In the wild, birds have access to a wide range of foods, varying from season to season. A captive diet that has been arbitrarily formulated, that is unbalanced and that is predictable can seriously affect the well-being of birds.

Knowledge about the feeding behaviour of free-ranging birds is required for understanding their dietary requirements. When dietary enrichment for psittacines was planned, the main goals were to induce a higher level of activity among the birds and increase the foraging time by formulating a diet that meets the nutritional requirements of the birds and simultaneously offers them an opportunity to exercise their natural behavioural repertoires. It should also be noted that in the wild, psittacines forage on various items including fruits, flowers, buds, seeds, grains, roots and even some insects. The availability of these items is essentially seasonal. The variations in the diet with the seasons influences their reproductive cycles. Hence, a diet that provides the necessary psychological stimulation to the birds is necessary for them to be healthier and to breed.

Whole food was offered instead of chopped food to encourage the food processing abilities of the birds. Dry food items such as groundnuts were scattered on the floor of the cage to simulate natural foraging conditions. Whole corn and cuttlefish bone were tied at various places in the enclosure, and this encouraged the birds to exercise their manipulative skills, the latter also serving as a supplemental source of calcium.



Whole maize provided parakeets in captivity



Mealworms, source of good protein provided as food to many Galliformes and insectivorous birds



Cheer pheasant feeding in group in captivity



Photo: Dr. Brij Kishor Gupta

Painted storks provided with basket to help birds to construct nest in captivity

Anseriformes

At the Mysore Zoo, birds belonging to the orders Anseriformes, such as ducks, swans and geese, and Pelecaniformes were housed in large aviaries and in mixed species exhibits. These enclosures were severely infested with rodents. The rodents would feed on the food provided for the birds and defecate in the feeding trays. They would also prey on the newly hatched chicks. It was observed that certain species of duck such as Muscovy duck *(Cairina moschata)* were breeding prolifically in these exhibits and hence were present in excessive
numbers, thus depriving other birds of space and preferred nesting sites. Due to the lack of a separate feeding area, the greens and the vegetables offered to these birds were scattered in the pond, which would spread, causing accelerated algal growth.

As the mesh used in the construction of the exhibit was not in accordance with the relevant specifications, the enclosure was repaired to seal all possible entry points and make it rodent-free. Regular trapping of rats inside the enclosure using rodent traps and flushing of rats from their burrows using water at high pressure were also been initiated to control the rodent population inside the enclosure. A feeding pond was constructed with a drain channel so that regular cleaning after feeding was easy. Species-appropriate nest boxes were installed for ducks that breed in tree hole breeders such as the Carolina wood duck *(Aix sponsa)* and Mandarin duck *(Aix galericulata)*.

Water Birds and Allies: Pelicaniformes, Anseriformes and Others Pelicaniformes, Ciconiiformes and Allies

Pelicans, storks and other birds including herons, spoonbills and ibises were housed in mixed species exhibits. Elevated nest platforms were provided for grey pelicans *(Pelecanus philippensis)* and storks. Low-level nest platforms were provided for pink pelicans *(Pelecanus onocrotalus)*. Small sticks, branches and hay were always scattered inside the enclosure to encourage the birds to select their preferred nesting material.



Pelicans constricting nest in captivity – IGZP, Vishakhapatnam



Vultures perching on wooden log covered by coir rope at Vulture Conservation Breeding Centre at Pinjore

Vultures

Zoos and conservation breeding centres exhibit vultures or provide care for birds that are to be released back in the wild. The zoo needs to enrich the environment of these vultures. Provision of nest material should be during the breeding season of the vultures, when the birds start occupying and defending nest ledges. The nest material should be a mixture of twigs from locally available large trees. The amount of nest material to be provided depends on the number of breeding pairs in the aviary. In an aviary housing 15 breeding pairs, 35–40 kg of nest material should be provided at a time. It is good to give a mix of leaves, twigs and branches of various diameters from large trees growing in the vicinity. Twigs of thorny species should be avoided. It has been observed that in the wild, vultures utilise twigs from the neem *(Azadirachta indica)*, amaltas *(Cassia fistula)*, silk cotton *(Bombax ceiba),* peepal *(Ficus religiosa)*, banyan *(Ficus bengalensis)*, kadam *(Neolamarckia cadamba)*, acacia *(Acacia species)* and even lantana *(Lantana camara)*. Fresh green twigs with leaves should also be provided.

Provision of water. Vultures require water for drinking and bathing. Thus water should be provided in a water trough in each aviary. It is important to check algal growth in the troughs. It has been observed that vultures do not bathe if the water is not topped up every day. The troughs should therefore be topped with fresh water every day. Two water troughs should be emptied every feeding day, and a third should be filled.

Perches and nesting areas. Vultures should be provided long, thick wooden poles or branches or trees (10 inch diameter) for perching. Coconut ropes must be wound around the perches to provide a rough surface for perching. This prevents the development of bumblefoot infection, which is common in large birds when they use smooth perches. Due to wear and tear on the coconut rope caused by repeated perching, brushing against the feet of the vultures, or mutilation by the vultures' sharp bills, the rope may get loosened and hang from the perch. This should be attended to carefully. The rope should be tied in such a way that knots and open ends are hidden and the vultures are not able to pull them out.

Future Approaches

Old enclosures may be revamped as mentioned previously using fencing material to make them rodent-proof. Using rodent-proof feeding trays prevents rodents from gaining access to food items, thereby reducing the risk of infections and thus ensuring that the birds get their diet.

If the number of nest sites and hiding places inside pheasant enclosures is increased and these places are covered them with dry hay during all seasons, the birds get habituated to them. Facilities such as small enclosures will be helpful in keeping surplus birds of species that breed prolifically such as the budgerigar and Java sparrows. Installation of mist-makers in parrot and ratite enclosures will encourage these birds to play in the water and will cool them during summer.

Ostriches and other ratites are often housed in large yards that do not have service routes. This presents a problem during the breeding season, when these birds become extremely aggressive and territorial. Any attempts to enter the enclosures during such seasons might prove to be dangerous. To avoid such encounters with the animals during such seasons, service routes that offer safe access to the enclosure are needed. Such service routes make cleaning and feeding easier and provide a safe means of collecting eggs from the enclosure if circumstances permit this to be done. These enclosures need places that offer shelter and refuge to the animals when it rains. Secluded and sheltered places for laying eggs and incubation are also needed.

There are plans to install cameras and data loggers inside the nest boxes so that the activity of the birds can be monitored in a less stressful manner and some of the important and obscure behaviours of these birds, including maternal behaviours, and incubation patterns can be documented. Live screening of the feeds from the cameras in front of the respective animal enclosures will serve as a means of educating people, increase awareness and contribute to the conservation of the species. Some futuristic designs developed for psittacine and ratite enclosures. More mixed species exhibits may be created to manage surplus birds. Such exhibits are also aesthetic. Housing different species together can provide enrichment for many birds but may also create problems. It is important that each species has its own feeding station and areas to retreat to from the other birds. Newly introduced birds should be closely monitored for any signs of aggression toward or from cage mates. It may become necessary to separate birds if serious harassment occurs. The next section lists the various strategies employed to enrich the lives of birds in captivity.



Photo: Dr. Brij Kishor Gupta

Naturalistic walk through aviary at Jurong Bird Park, Singapore provided with artificial vines and perches

Summary of Ideas for Enrichment for Birds

Dust bath

Pheasants do not wash – they keep their plumage clean by dust bathing. Therefore we need to provide them with a suitable dust bathing area, or they will create one themselves. If the aviary floor is not covered with sharp sand, it is probably best to provide a sandy, dusty area in a spot which gets plenty of sun. If the dust bathing area is put in the shade, the pheasants will probably scratch out one themselves in a sunny spot. Smaller galliformes have even been known to dust bath in bowls of pellets when no other site is available. To allow the birds to keep their plumage healthy, it is best to ensure that the dusting area drains well and dries out quickly after rain. One enterprising aviary builder has used a large tyre to contain the sand.



Dust bath is important for birds to keep them healthy

Perches

Two smaller perches across the corner angles help to keep birds apart when roosting, particularly when the male wishes to dominate a perch area. It is also easier for keepers to maintain without hitting their heads going underneath perches.

Problem perches

Perches should be sufficiently thick that, when the pheasant roosts in winter, the body feathers cover the feet. This diminishes the risk of frost damage to toes, particularly to non-Himalayan species.

Perches should be scrubbed and disinfected on a regular basis, particularly if droppings are found on them. A minor cut on a pheasant's foot can easily become infected if it has to spend the night perching on top of its own droppings. Bumblefoot can be caused by soiled perches. However, perches should also be checked regularly for potential hazards. Here, a long-standing perch has split with age. The male Satyr has managed to catch one of his claws in the crack and pulled the claw out in his struggle to escape.

Aviary furniture

Logs & rocks provide interesting low perches and allow birds views of their surroundings. Don't place these close to an adjoining pen or the birds will use them to stand on and display at each other. They can be very useful for stopping birds "rattling" up and down the wire.
This slide shows a Temminck's tragopan male displaying from behind a log.



Logs and rocks provide ideal enrichment to birds

Replicating a natural diet

Grey Francolin in Sariska Nature Reserve, India, feeding naturally on termites. It is hard to replicate an exact natural diet under aviary conditions, but the nearer we can get to it, probably the better quality of birds we will produce. Many breeders dig up ants' nests or use ants' eggs to supplement diet, particularly with young chicksEncourage natural feeding behaviour

In areas of heavy snowfall, the roof needs to be sufficiently strong to withstand the weight of snow. In this aviary, at Kufri in the Indian Himalayas, more than 2m of snow had fallen on the roof.

It is always a good idea to clear the roof of snow as quickly as possible. If the roof is well designed, it should be possible to place a scaffold board on top and then sweep the snow away. If this isn't practical, another solution is to lay a rope across the roof and, with one person at each end, use it to drag the snow off the roof.

Another major disadvantage of allowing the snow to remain on the roof was experienced by the birds in this aviary. Outside it was very sunny and quite warm, but under the snow-covered roof, the birds were in the shade and were soaking wet from the constant dripping of the melting snow.



Encouraging natural feeding behavior

Aviary planting

By keeping the plants pruned to a lowish level, the birds will not use them to roost in. This has two advantages; firstly the birds roost under cover in winter where you want them to, and secondly the bushes don't get covered in unsightly droppings.



Planting in aviaries

Protect new plants

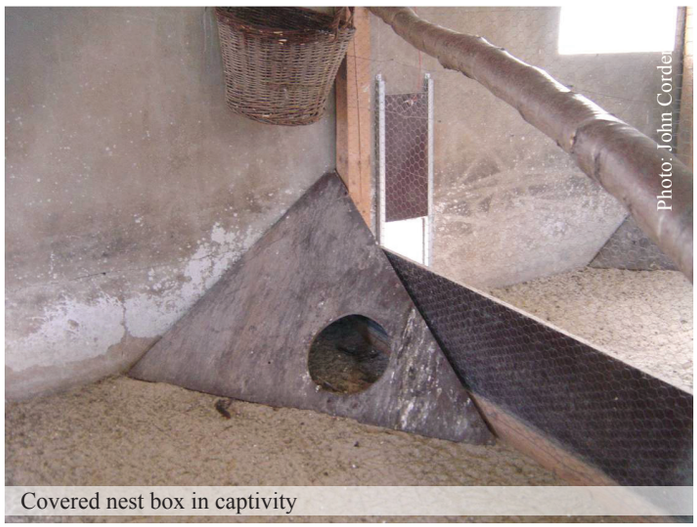
Monals are great diggers and can often be found excavating their way to Australia. It is sometimes necessary to protect the roots of plants, particularly when they are newly planted. This monal actually was less interested in excavating the roots of the plant, than in dust-bathing. We had provided a dust-bathing area, but had failed to plan properly and it was in an area that got little sunlight, so the monal created a better site.



Plants to be provided to birds to eat and destroy

Protection for Hens

This simple triangular device can provide a harassed hen with security from an over-eager cock, and it will also provide a potential nesting site for a ground-nesting female.



Covered nest box in captivity

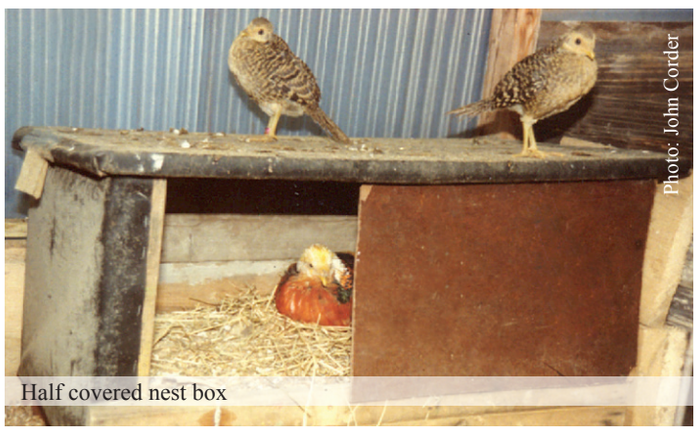
Nest box - covered

A Golden pheasant male using a nest box as a respite from his chicks on a sunny day.

Note – it is raised on bricks to avoid disturbance by mice to the hen when she is sitting at night. Place it under cover so that the hen doesn't have to sit in a wet nest box, or that the straw and sand doesn't become so wet that the eggs chill or go mouldy. Washed, sharp sand and straw, not hay, is best. It is too easy for mould to grow on hay – it must be dry, or there is danger from the spores of aspergillosis forming on it.

It is possible to "persuade" birds to lay where you want them to, particularly young hens. In an aviary, usually a hen will lay in a secluded corner, but sometimes she will just drop her eggs anywhere. We have found that, provided we don't take eggs away from a young hen, she will soon learn what to do. If her eggs are always taken to be incubated, nature's natural processes are not encouraged and she never learns what to do. This is often when egg-eating starts.

With a young hen, if she hasn't used the nest box to lay in, we move the nest box to the site where she laid her first egg and put the egg in it. Then, when she lays her second egg, we move the nest box nearer to where we want it to be. Usually, once she is used to the box, she follows it and we can then place it in its final, safe and dry position.



Half covered nest box



Raised nest for birds

Nest box - raised

Our monals have actually chosen to use a closed box on the ground. This particular hen likes to use the nest box as an escape site when pestered too vigorously by her mate. Tragopans will use this type of nest box, particularly young hens.

Nest boxes – across a corner

This design makes it easy for the bird keeper to clean under, without hitting one's head. It is useful when space is limited. Note the perch on the front to make it easier for the hen to fly up to it.



Nest boxes provided in the corner of aviaries

Nest baskets

Remember to offer the birds a variety of nest baskets and sites – they are all different and it might be the difference between successful breeding and half-hearted approaches. This pair of satyrs likes to roost in an old cat basket when they don't have chicks, and they fight over its use each evening. We have found that young tragopan hens often prefer a shallower basket but, once they have raised young successfully, they often choose a deeper basket, where they can be hidden from the outside world. Dr. Deng Weng-hong is having considerable success in China by installing artificial nests in forests inhabited by the very endangered Cabot's tragopan. He is applying some of the information we have learned about tragopan nesting habits in conservation breeding situations.



Baskets provided to act as artificial nest for many pheasants

Ladder perch for Young ones

A hen brooding chicks on the ground at night is obviously far more likely to be predated than if they are all roosting in a tree. When a pheasant hen decides that her young are fledged sufficiently to roost on a perch, she will usually fly up and then call the chicks to her. Quite frequently, particularly when the hen has a number of chicks, she will go to roost once some of them have reached her on the perch. It is not uncommon to come to an aviary late in the evening and find one or two chicks cowering in an aviary corner, having been unable to reach their mother. Of course, they still need their mother's warmth at night and will die if not re-united.



Photo: John Corder

Wooden log covered with green leaves provides ladder for the young one to approach nest basket as well to feed and destroy.

Chick Drinker

Inevitably, chicks will walk everywhere so, by placing small pebbles in the water container, +they are unlikely to get very wet, and they will soon learn to use the pebbles as stepping stones.



Photo: John Corder

Chick feeder

This needs to be sufficiently shallow for chicks to see the food and to reach it, whilst not allowing mealworms to crawl out and escape.



Photo: John Corder

Case Study: Sri Chamarajendra Zoological Gardens, Mysore

The first step in enriching the enclosures was to reduce the rodent infestation of the enclosures. This was achieved by re-fencing them using appropriate materials. Subsequently, other steps were taken. New feeding platforms were constructed and fixed in the indoor areas so that the feeding trays were protected from rain. Untrimmed coffee tree branches and Casuarina poles were planted inside the enclosure as perches. Perches (any wood) of varying diameters were positioned at various heights in the indoor and outdoor areas of the enclosure. The perches were placed such that they did not hinder the flight of the birds. The perches were located away from the feeding platforms to prevent contamination by excrement. Horizontal trapezes were added as additional cage furniture to increase the activity of the birds.

Species-appropriate nest boxes were made and fixed in the indoor areas to shield the nest boxes from the rain and sun. The nest boxes were made using hard wood and were lined with metal sheets to protect them from damage caused by chewing damage.

The positioning of a nest box is an important factor in that the box should provide the optimal level of stimulation to the birds occupying it. Some birds such as cockatoos and parakeets prefer nest boxes that are placed upright, while others, including macaws and lorikeets, prefer nest boxes fixed at an angle. Soft wood shavings were provided for use as nesting material. Wood chips were also provided that the birds could chew and make their own nesting material from.

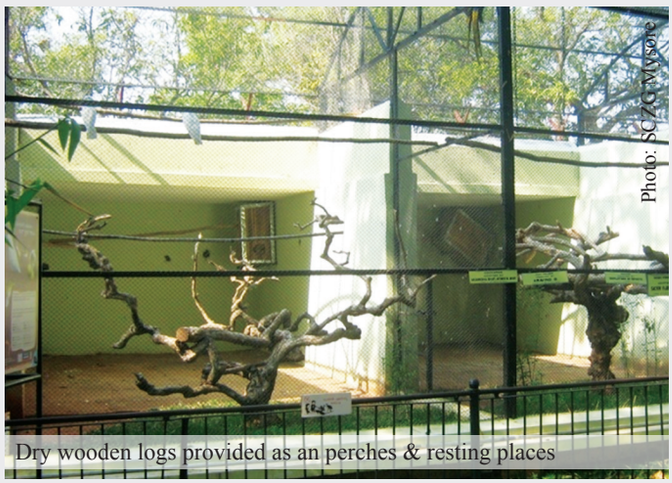


Photo: SCZC Mysore

Dry wooden logs provided as an perches & resting places

"The other enrichment ideas that may be appropriate with respect to Aves are given below :

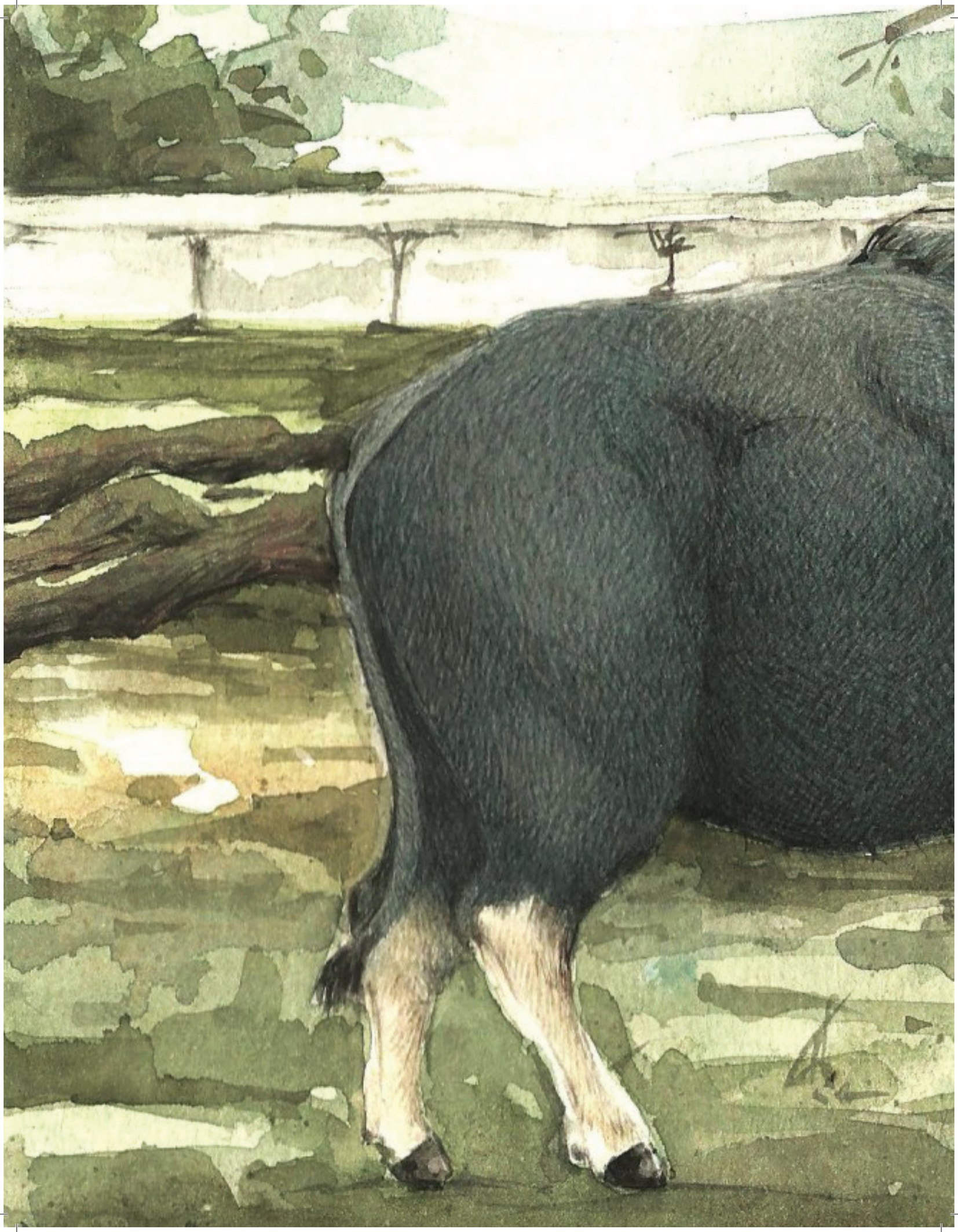
Exhibit Enrichment

1. Areas that promote free flight
2. Variety of perching sizes and locations (re-perching periodically can stimulate activity) and sunbathing perches
3. Live plants
4. Branches from trimmed plants for shade, screening and rain cover
5. Water features: pools, running water, sprinklers, etc.
6. Sand for dust baths
7. Nest boxes, logs, platforms, burrows
8. Multiple feeding stations
9. Areas for escape from aggressive cage mates or other species in mixed exhibits

Dietary and Social Enrichment

1. Live insects: crickets, termites, mealworms, etc.
2. Whole food instead of chopped food
3. Several feedings throughout the day (at unpredictable times)
4. Scattered feeding
5. Nesting material
6. Group exhibits for gregarious animals
7. Mixed species exhibits
8. Recorded vocalisations of same or similar species





Enrichment Ideas for Ungulates

Illustration: Arnab Roy

Chapter 5

ENRICHMENT IDEAS FOR UNGULATES

Ungulates are among the animals most commonly exhibited in zoos. Their numbers in zoos are large as many of them are prolific breeders. It is important to create a stimulating environment in which the animals' daily routines are varied and they are provided time-consuming and complex activities that encourage species-typical natural behaviours.

Ungulates, which are highly sensitive, flighty animals, are successful in their natural environments due in part to their ability to escape from predators. However, the instinct and behaviour that save them in the wild can be detrimental in captivity. A multitude of injuries can result from panic in a confined area, and one may lose a precious animal.

In captivity ungulates exhibit stereotypic behaviours frequently, and as soon as they experience stress, they collapse. The variety of behaviours shown by ungulates is not documented well, compared with other mammals and birds.

The group of ungulates comprises a wide array of animals including the following:

1. Spotted deer
2. Sambar
3. Four-horned antelope
4. Chinkara
5. Barking deer
6. Musk deer
7. Mouse deer
8. Brow-antlered deer
9. Blackbuck
10. Nilgiri tahr
11. Indian gaur

Any objects that are to be placed in an ungulate enclosure should be approved by the veterinary officer of the zoo. Enrichment should be introduced gradually in ungulates' enclosures, and the response of the animals should be observed regularly. The animals may become less sensitive to foreign and potentially frightening items. When the animals are calmer, it is safer to shift them and injuries resulting from panic are less likely. Enrichment of environment can result in healthy, positive stimulation of animals that have lived in constant fear of objects in their environment.

Ungulates are not well known for self-destructive, aberrant behaviour. However, the exhibition of stereotypic behaviour even to a limited extent in captivity is an indication that activities are needed. Evaluation of the possible causes of a particular behaviour can help animal keepers and the curator or officer in charge of the zoo determine the type of action to be taken to alleviate this behaviour. For example, a behaviour that is related to social problems within a herd will require an approach different from the approach required for a behaviour caused by an animal feeling threatened by the public. If an animal is found to be not comfortable with the object provided to it, the problem should be resolved immediately. Otherwise, there may be aggression towards other animals, keepers or essential components of the enclosure, such as the barrier used to separate the visitors from the animals.

The habitat within an enclosure should have positive effects on the behaviour of the animals housed in the enclosure. Addition of scents, curious objects and intriguing tastes can bring out behaviours that are possibly dormant in captive animals. This type of enrichment can create fascinating interactions between herd members and elicit play behaviour in both young and old animals, potentially awakening atrophied senses. Some enrichment ideas for ungulates are presented in the following.

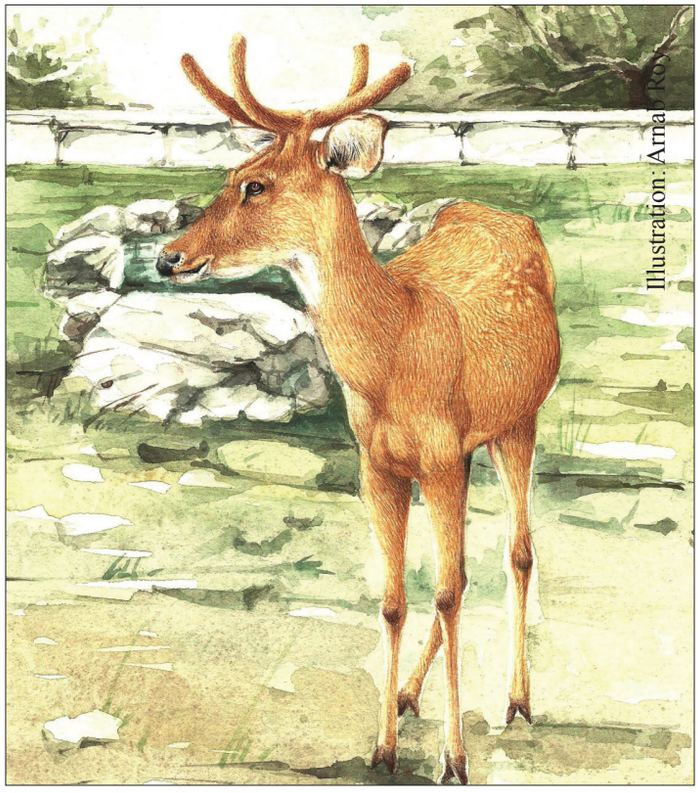


Illustration: Arnal Roy



Photo: Dr. Brij Kishor Gupta

Gaur at Indira Gandhi Zoological Park, Visakhapatnam

Spotted deer

Chital are active throughout the day. In the summer, time is spent in rest under shade and the sun's glare is avoided. Chital activity peaks as dusk approaches. As days grow cooler, foraging begins before sunrise and peaks by early morning. Activity slows down during midday, when the animals rest or loiter about slowly. Foraging recommences by late afternoon and continues till midnight. They fall asleep a few hours before sunrise, typically in the forest which is cooler than the glades.

Spotted deea a gregarious animal, the chital forms matriarchal herds comprising an adult female and her offspring of the previous and the present year, which may be associated with individuals of any age and either sex, male herds and herds of juveniles and mothers.

Small herds are common, though aggregations of as many as 100 individuals have been observed. Groups are loose and disband frequently, save for the juvenile-mother herd.

Sambar

This is primarily a grazer, feeding mainly on grasses, although other plants are taken, depending on availability. The species has a narrow muzzle, short tail and pointed hooves.

Sambar can swim easily, with the body fully submerged and only the head above the water. The sambar is one of the few deer that attack sizeable predators, and it prefers to hold confrontations in shallow water. When confronting predators, the Sambar produces a loud alarm, a bark, and raises the hair on its neck.

Hog deer

Hog deer feed upon a variety of grasses, although they will occasionally forage on leaves and other plant parts. They feed during the cooler parts of the day, digesting the food in the shade when it is hot.



A herd of young Blue bulls

Enrichment of the Exhibit Area

Incorporating enrichment in an exhibit area at the design stage itself is ideal. Once the construction of an enclosure is completed, it is difficult to introduce large objects such as tree trunks and wooden logs. The enrichment should not be made a permanent feature; it should be replaced after a period of time. Enrichment objects should be replaceable, management friendly and easy to clean and maintain.

Objects to be provided as enrichment should be introduced first when the animals are housed off-exhibit. It may not be appropriate for the public to view any abnormal behaviours that the animals exhibit due to the objects.

Dietary Enrichment

Dietary enrichment plays a very important role in managing ungulates in captivity. Under conditions of captivity, many ungulates develop digestive problems such as colic, rumenitis and metabolic acidosis.

It should be ensured that each ungulate receives the appropriate amount of food. New food items are regularly introduced to animals, and this should be done in such a manner that the animals get adjusted to these. Even if an item is rejected at first, an animal may begin to investigate it after some time and learn to enjoy it, especially if the food item has been associated with a positive aspect of the animal's environment.



Social Enrichment

The behaviour of the animals in an exhibit should have be observed closely, and the findings should be used to identify enrichment that will promote socialisation. The ungulates housed in an enclosure may have a harem, which may not provide a newly introduced animal with freedom. Therefore when an animal is introduced to a group, it should be allowed to mix with the group for only a few minutes, rather than hours or days. When an animal is found not to mix well with a group, a gap should be introduced between it and the group. This will reduce the stress and allow the animals to mingle better after some time.

Social situations can also provide enrichment. Knowing the social structure of a species can help a keeper determine whether captive social groups can be altered to provide healthy stimulation. Appropriate social groups can promote breeding, elicit natural vocalisations and species-specific displays and help eliminate aberrant behaviours caused by alienation or improper herd dynamics.

Conditioning programmes are also valuable tools for improving husbandry and veterinary capabilities as well as providing occupational enrichment for ungulates. The process may allow to “work” with animals for a positive reinforcement, at the same time it provides opportunity to control the outcome of a situation, improve mental agility and can assist with general desensitisation.

Enrichment ideas that may be appropriate for ungulates in captivity are listed in the following.

Exhibit Enrichment

1. Rubbing/scratching artefacts for legs, neck, head, body, horns, antlers: rockwork, artificial termite mounds
2. Weather considerations: shade, cover from rain
3. Substrate variety: hard packed substrates to help wear hooves and provide solid ground during the wet months and winter
4. Novel substrates to provide olfactory enrichment
5. Comfortable areas to lie in: pits with mulch, soil, silage, etc.
6. Natural watering opportunities: moats, pools, streams, waterfalls
7. Areas for escape from aggressive conspecifics or animals of the opposite sex and larger species in mixed exhibits
8. Variety of feeding sites at varying heights, away from visitors' reach
9. Objects securely suspended from high locations
10. Safe access to the exhibit for keepers so that enrichment can be offered throughout the day as well as areas for the animals privacy.

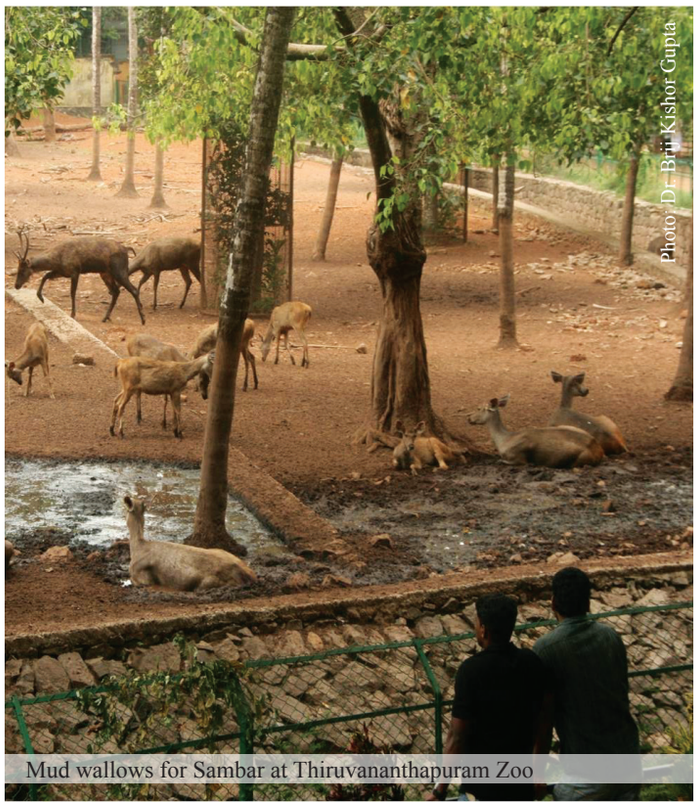


Area for escape & privacy for ungulates provided for ungulates at M.C. Zoological Park, Chhatbir

11. Access for trucks to provide additional substrates and large items, if any
12. Safe pulley systems for handling enrichment devices
13. Large, live, non-destructible trees (palm species)
14. Artificial trees with provisions for attaching browse attachments wherever trees or logs are not available
15. Fine mist system placed at an appropriate height so that animals cannot reach it
16. Multiple species for social stimulation
17. Varied topography in exhibit areas
18. Visual barriers behind which animals may hide from the public
19. Safety zones in which the animals can avoid objects entirely
20. Mud wallow areas
21. Baskets, planters or browse holders in the ground in which large plants can be rotated regularly



Mud wallows for Sambar at Thiruvananthapuram Zoo



Mud wallows for Sambar at Thiruvananthapuram Zoo

Dietary Enrichment

1. Variety of browse and greens
2. Edible local weeds
3. Variation of feeding times and frequency of feeding
4. Variety of hay types: alfalfa, oat, barley, etc.
5. Mineral salt blocks
6. A variety of flavours to help mask medication and offer novel sensory experiences: honey, spices, bitter flavours, savoury flavours, herbs



Photo: Dr. Brij Kishor Gupta

Spotted deer provided with hay & dry grass in their feeding and retiring cells as enrichment



Wooden logs are used to hang browse material in animal exhibits – PNHZP, Darjeeling



Photo: Dr. Brij Kishor Gupta

Feed provided at various intervals and locations keeps animals active

Novel Enrichment/Social Enrichment

1. Baskets made of natural materials
2. Bramble (for bark chewers)
3. Appropriate social groupings—bachelor herds, female/calf groups, pairs (vs solitary animals), harems
4. Water: misters, running faucets, pools, mud wallows

Other Behavioural Enrichment Options

1. Sturdy, suspended objects
2. Puzzle feeders and licking devices to encourage vigorous use of tongue
3. Dangling items to simulate sparring partners
4. Objects for scent marking
5. Scent-marked items from a different or similar species
6. Recorded vocalisations of same or similar species

Self-grooming

1. Brush heads, fibrous matting affixed to furniture
2. Log piles for scratching legs and bellies
3. Rocks

Safety Considerations

With any enrichment activity, it is important to comply with safety protocols. The input of veterinarians, curators and keepers forms an integral part of safe enrichment.

When introducing enrichment in an exhibit, knowledge of an animal's physiology can be helpful in avoiding problematic situations: Does the animal have horns? Can the horns become lodged in an object, causing panic, horn loss or myopathy? Is leg entanglement a concern? Will a substrate cause intestinal impaction if ingested? Can less dominant animals get cornered and injured in an area? Are safe areas available for smaller species or subordinate animals? Does the substrate or floor covering provide enough traction for hooves? These are just a few of the many questions that can be posed when designing safe enrichment for ungulates.

As stated previously, many species of ungulate are sensitive to unfamiliar stimuli. Therefore, gradual introduction of new devices and objects may be necessary. Partially covering foreign objects with something familiar such as straw or browse can reduce stress or even help stimulate curiosity. As the animals become accustomed to the introduction of new objects on a regular basis and the interactions are positive, their nervous reactions will likely diminish and give way to the desire to investigate and explore the new items. However, for the staff, knowing when to back off and remove an object entirely is essential. Some animals have such an overwhelming flight response that ensuring there is ample space for the animals to avoid the enrichment objects may be necessary for their safety.



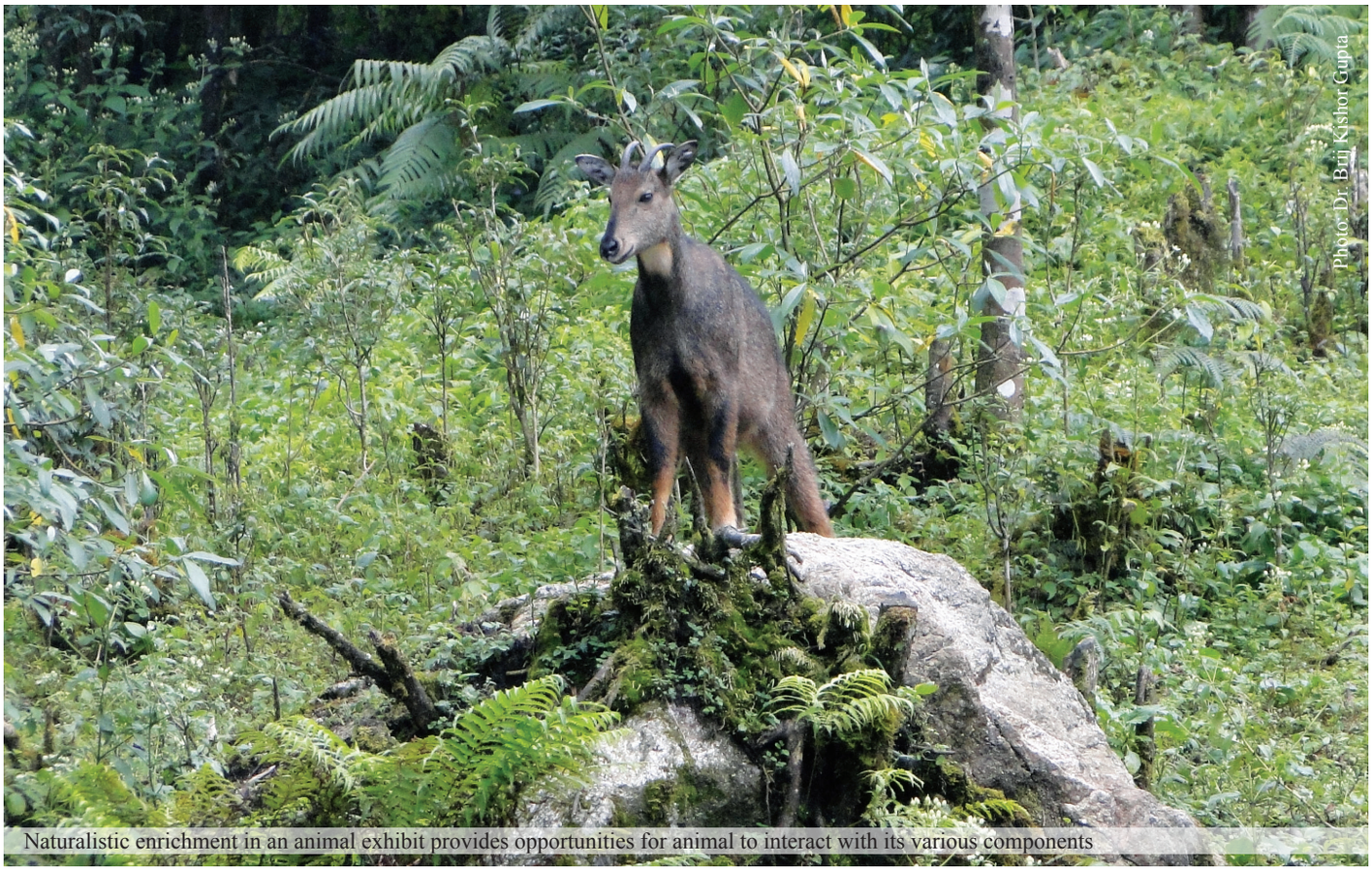


Photo: Dr. Brij Kishor Gupta

Naturalistic enrichment in an animal exhibit provides opportunities for animal to interact with its various components

Enrichment artefacts should be viewed critically before they are presented to animals. For example, if a species or an individual has a tendency to chew or ingest ropes, better options may be available in the form of chains and cables for hanging browse or toys. If the animals can destroy an item, it is important to consider whether the animals will be safe in the exhibit until the debris is retrieved. Many questions should be considered to assure the safety of the animals. For example, can the item become attached to an animal? If yes, will the individual react rationally until it the object is dislodged, or will it panic? Some animals react to activities very energetically, which can lead to an unsafe situation for cage mates. Knowing individual animals can help keepers predict the outcome of an activity with some accuracy. Observing the animals when an item is introduced can help eliminate problems in the future and help resolve unforeseen predicaments. Because many ungulates are large and can be dangerous when they are in a state of panic, it is advisable for the keepers to be aware of their own capabilities in the event of a situation going awry.

Browse and plant matter are important aspects of an ungulate's dietary enrichment. The material within an enclosure and material provided from outside should be examined in consultation with botanists or horticulturists or using regional field guides. Such examination can help a keeper determine if plants that are to be fed to animals are toxic



Zoo keepers constructing animal naturalistic sheds using the local material for the animals – these are being used also by the animals to interact within the exhibit.

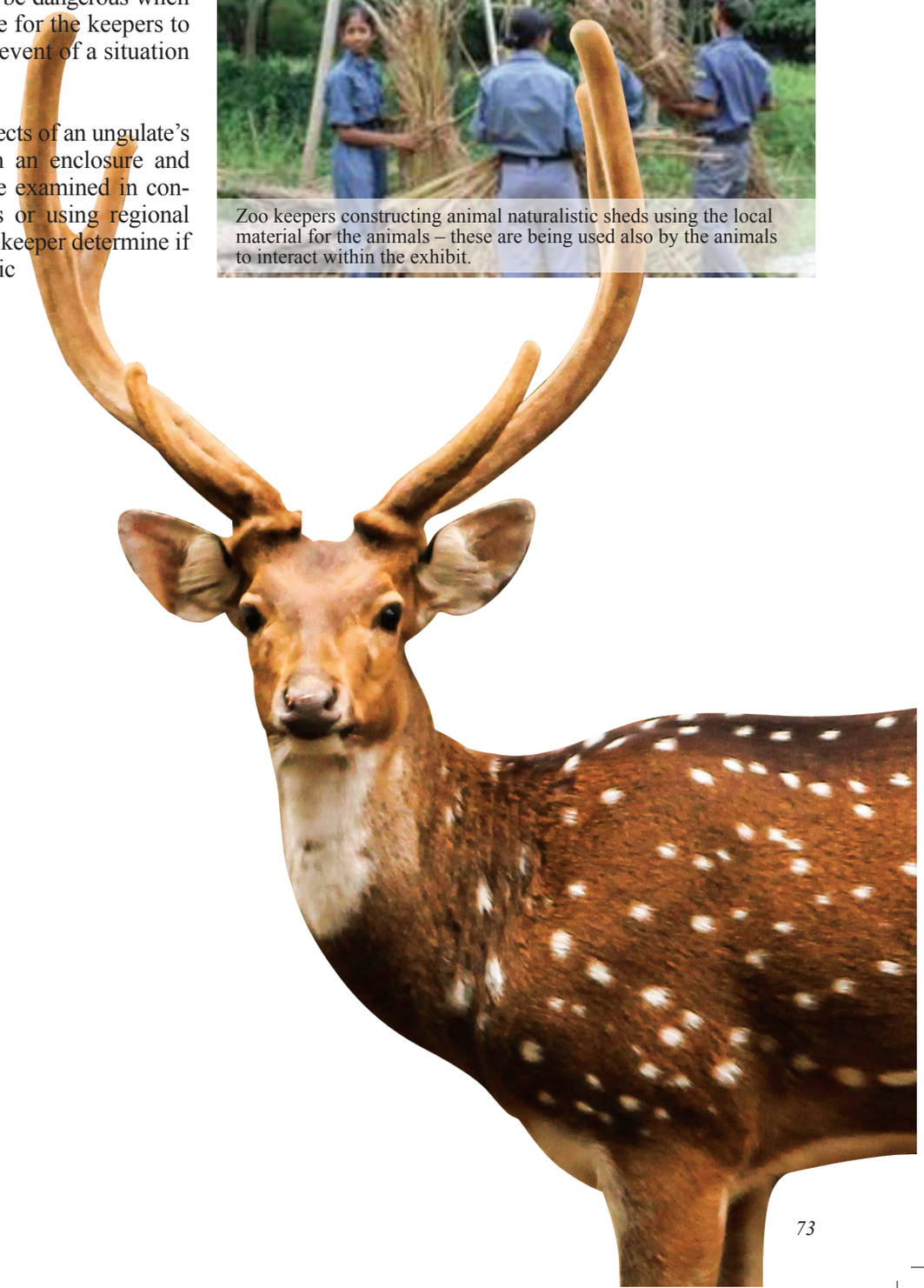






Illustration: Arnab Roy

Enrichment Ideas for Carnivores

Chapter 6

ENRICHMENT IDEAS FOR CARNIVORES

The order Carnivora includes members of the cat, dog, bear, civet and hyaena families. This diverse group of animals shares a common trait, the possession of four carnassial teeth. Only a minority, including the wolves, wild dogs, otters and cats, are still true meat eaters; most members of the order have adapted to a broader diet. These latter animals are considered omnivorous, insectivorous or herbivorous. Enrichment ideas for a few major large carnivores are discussed in this chapter.

Tiger *Panthera tigris*

The tiger is capable of taking prey much larger than itself, including water buffaloes, small elephants and rhinos. Unlike other species of cat, the tiger is a competent swimmer: it will readily enter water and can frequently be found lying half-submerged in streams and lakes when it is hot.



Photo: Dr. Brij Kishor Gupta

Tiger provided with inbuilt water body as an enrichment

Asiatic lion *Panthera leo persica*

The lion is the only truly social cat, with related females residing together in prides and related or unrelated males forming coalitions that compete for tenure of prides in fierce and often fatal battles.

Lions occupy the remnant forest habitats of the two hill systems of Gir and Girnar, which constitute Gujarat's largest tracts of dry deciduous forest, thorny forest and savanna and provide valuable habitats for a variety of plants and animals.



Natural sun facing rocks provides ideal inbuilt enrichment for carnivores.

Leopard *Panthera pardus*

This is an exceptionally agile climber, and it frequently stores large kills in trees. When a leopard hunts, it first locates its prey from a vantage point, such as a tree, rock or ridge, or it waits at places where prey may come to feed or drink. The leopard is adapted to surviving in many different habitats, from deserts to rocky hills, mountains, lowland forests, woodlands, jungles, grasslands and swamps. The leopard does not occur in deserts and arid habitats, but it is relatively common in areas with reasonable extent of cover, such as rocks and vegetation.



Wooden ball can be placed in animal exhibit for animals to play



Carnivores are found every major ecosystem, including semi-evergreen forests, dry deciduous forests, deserts, grasslands and mangroves. They have cursorial, arboreal, fossorial and aquatic habits. Social communication occurs through facial expressions, posturing, scent marking, vocalisation and olfaction. Olfaction, one of the primary senses in gathering information, is significant to carnivore behaviour, but vision and the auditory sense are also very important.

Natural vegetation provided animals to hide and wooden log are being used to rest.

Carnivores are primarily nocturnal animals, with the exception of some species, such as the cheetah, which hunt during the daytime, relying primarily on vision. Many carnivores are considered solitary, but some exhibit cooperative behaviours with conspecifics. Female coatis, for example, form tight social groups although the males are solitary. Other species, such as the mongooses, form groups for defence against predators.

Carnivores are generally similar with regard to hunting and foraging. They are opportunistic by nature, to hunt & forage for their food and often spending hours doing so. Some species have special adaptations and rely on olfaction to pursue prey. Some hunt in packs, while others locate prey using refined tactile systems. Yet others secure their prey by ambush or by tunnelling. Wild cats and dogs spend hours crushing bone, tearing flesh and plucking fur from a carcase, and bears spend approximately 80 percent of their time searching for food. Typical carnivore behaviours to consider in an enrichment program include foraging, olfaction, digging, nesting, denning, courtship and sexual activity.

In captivity carnivores are known to exhibit stereotypic, self-destructive or abnormal behaviours. These behaviours include over-activity, inactivity, pacing, head-swinging and over-grooming, many of which are frequently observed in bears, felids, canids, civets and hyaenas. These activities may be a method of coping with inadequate, sterile environments, or the animals could be displaying redirected searching behaviours such as mate-finding, patrolling of home ranges and hunting. Loud noises, small quarters, being locked inside feeding and retiring cells, waiting for food in the exhibit area, once-a-day feeding and scheduled feedings may also contribute to these behaviours.

Evaluation of abnormal behaviours by biologists working in zoos has helped discourage these undesirable behaviours. Foraging, exploratory and play behaviours are all known to interrupt stereotypic patterns.

When developing enrichment programmes (for all species in general, not only carnivores), it is important to look at the natural behaviour of each species. The social structure, habitat use, feeding strategy, diet, primary senses and activity cycles of a species should be considered when planning enrichment. It is important that zoo keepers, zoo supervisors, zoo biologists and veterinarians be consulted before enrichment in an animal enclosure is changed. Biologists or experts working in the field on wild populations of the species may be involved. A group may be formed from the staff of a zoo to plan and implement enrichment programmes. An assessment of each enrichment activity should also be carried out. What works and is beneficial to the species and if any improvement is required need to be evaluated and documented.





Natural substrate consisting of soft soil with grass meets animal behavioural and biological requirement in captivity



Illustration depicts tiger playing with wooden logs in a zoo

Exhibit Enrichment

Providing choices for captive animals in an exhibit, such as dens, large paddocks, retiring cells to feed in, large trees and large rocks, allows the animals a degree of control over their lives. Introducing complexity in the environment is important when designing a carnivore exhibit, and enrichment should be included in the initial phases when possible as an integral feature. Large naturalistic enclosures may be provided.

Large logs, rocks and substrates may be introduced during design itself as it may difficult to add these artefacts once an enclosure has become functional. Natural substrates and new enrichment artefacts should be provided in planned manner to enhance the functional requirements of the exhibits.

With some creativity, older exhibits can be renovated into functional yet enriched environments. Vertical and horizontal spacing are important in terms of how animals utilise their exhibits. The focus should be on the quality of the space rather than on extent. Many carnivores are arboreal: thus, arranging different levels with perches provides complexity in the exhibit that allows climbing, leaping and jumping behaviours and promotes activity. *Moving perches* can simulate trees. Changing enrichment artefacts can stimulate activity as animals are likely to explore new surroundings. Ropes and vines can also provide locomotion opportunities for some of the more arboreal carnivores, such as the jungle cat, golden cat, binturong, rusty spotted cat, leopard cat, clouded leopard and the civets. Note that the rusty spotted cat is only partly arboreal. Also, the jungle cat and golden cat are not truly arboreal; however, in captivity, the provision of large wooden logs helps locomotion activities.

Visual barriers in the form of vegetation or hollow logs can provide privacy and a sense of security.

Large rocks, trees or hilly landscapes can also create visual barriers that may help decrease competition for food and aggression within a population while adding a sense of visual complexity when the animals are not able to see their entire environment from all areas. Trees serve as rubbing posts and provide scratching and climbing opportunities. Rotten logs, mounds of dirt and logs drilled with holes and stuffed with food items offer animals a chance to forage and to dig for insects and other treat items. Living trees and vegetation provide shade and cool areas; however, with some animals, trees may need to be protected with hot-wires or skirting to prevent destruction or escape. Burrows or dens may intensify reproductive activity.



Photo: PNHZP, Darjeeling

Sun facing rock outcrops provided to Snow leopards housed at Padmaja Naidu Himalayan Zoological Park, Darjeeling



Photo: Pratyush Mohan

Gunny bag filled with husk being placed for young animals to play at Lucknow Zoo

When various substrates, such as mulch, sand, soil, hay, leaf litter and grass, are provided the animals have a choice of textures for bedding.

Water features such as pools and streams can provide enrichment to carnivores that swim or fish. Pools with varying depth offer choices to aquatic carnivores, therefore creating a more interesting environment.



Photo: Dr. Brij Kishor Gupta

Leopard cat provided with elevated platform made of Bamboo at Pilikula Biological Park, Mangaluru



Photo: Dr. Brij Kishor Gupta

Wild dogs using the naturalistic den at IGZP, Vishakhapatnam



Photo: Dr. Brij Kishor Gupta

Clouded leopard resting on a tree inside the animal exhibit at Sepahijala Zoological Park, Sepahijala

Like exhibit areas, holding areas should also be carefully planned. Factors to be taken into account include whether the animals will spend most of their time in this area and whether it should simulate a natural environment.

Enrichment features should be provided especially if the animals spend most of their time off the exhibit area. Non-natural items should be avoided; however, these may be utilised in holding areas if they cannot be used in the exhibit areas. Designing specific areas for isolation and quarantine purposes with squeeze cages should also be considered, as they can be beneficial for veterinary examinations.



Elevated wooden platforms provided to White tiger at Kamla Nehru Prani Sangrahalaya, Indore as an physical enrichment

Dietary Enrichment

Foraging behaviours are important to the well-being of carnivores. Novel presentation of food items can be accomplished by hiding food across the exhibit area in logs, under rocks and high in trees or perches. Randomised feeding schedules, unpredictable delivery and a higher frequency of feedings can encourage foraging and reduce the frequency and duration of stereotypic behaviours. Introducing variety, by providing whole and chopped food items alternately, is significant in discouraging boredom. Encouraging stalking, crouching, chasing, leaping, reaching, grabbing, pulling, jumping and climbing for food allows natural hunting behaviours to be exhibited.

Carnivores have the ability to crush bone and tear flesh. Feeding them with meat and bones can elicit natural behaviours and make their teeth healthier. Crickets, mealworms and fish are examples of natural prey items that can easily be fed live. Because carnivores expend a considerable amount of energy foraging for food, efforts should be made to allow them to work for their meals. Complexity in food items increases the energy expended and the activity level.

Social Enrichment/Olfactory Enrichment

Many zoos exhibit carnivores such as cats and otters in pairs or groups. This does not always replicate their natural social situations, in which the animals are generally solitary except during breeding. However, companionship in captivity can be beneficial as it can encourage healthy competition as well as occasional aggressive tendencies and cooperative behaviours. *Carnivores have complex social systems. Communication and scent marking using faeces, urine and glandular secretions furnish conspecifics with information regarding an animal's territories and movements. Odours have social functions and are often used for identification of individual animals and for reproduction.*

Fragrances, perfumes, spices and aromatic oils provide opportunities for carnivores to investigate new scents. Bedding, faeces or fur from prey animals or conspecifics in another area can also stimulate the olfactory sense. Appropriate social situations can improve reproduction and natural social behaviours.

Interactions between care-givers and animals can improve the well-being of animals. Providing a positive and secure environment can lead to a trusting relationship. This relationship, especially with small felids, may increase reproductive success and reduce pacing.

Novel Enrichment: Manipulable Objects

Artificial and novel objects can encourage natural behaviours through the expression of manipulative and exploratory behaviours. A carnivore may rip a cardboard box to shreds as if it were its prey. The use of mechanical prey (for example, cheetahs pursue and capture a moveable target) can be beneficial for locomotion and mental stimulation. Such enrichment artefacts are popular in European and American zoos.

Examples of enrichment that may be appropriate for carnivores are provided in the following. An overview of safety issues that should be considered in implementing enrichment programmes is also provided.



Photo: Dr. Brij Kishor Gupta

Hollow log provided at Amtes Animal Ark, Hemalkasa are ideal places for animals to hide

Exhibit Enrichment

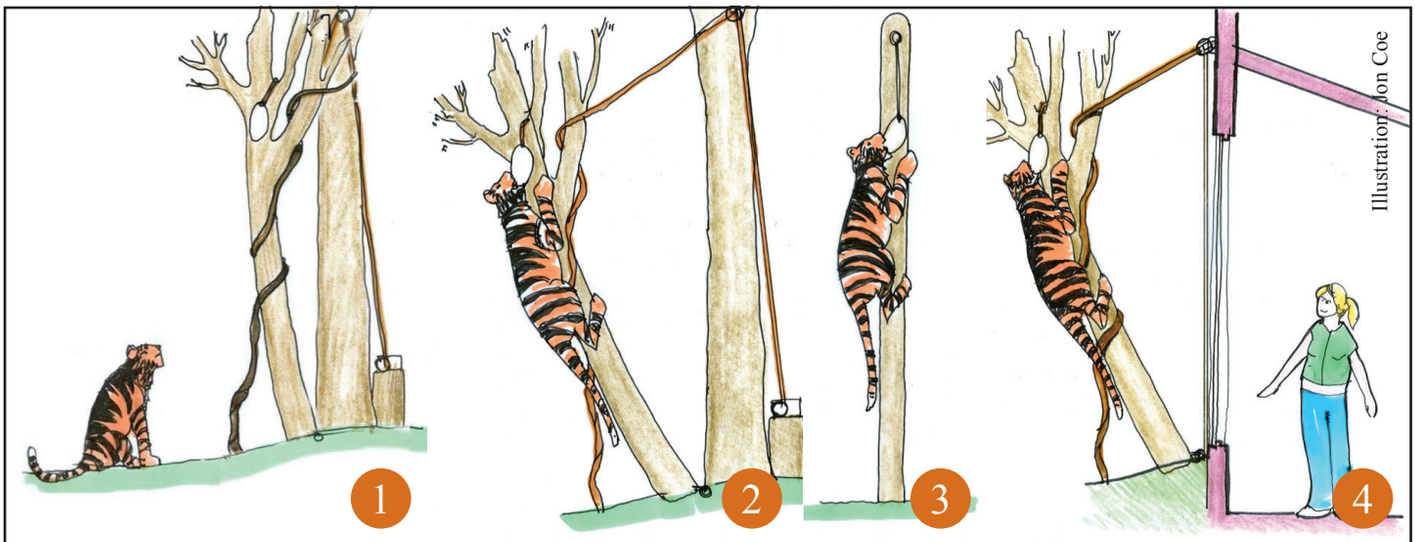
1. Visual barriers for privacy: Hollow logs, trees, live vegetation, termite mounds, mounds of dirt, large rocks and topographical features that are visible to the public but allow the animals to feel hidden and secure may be provided.
2. Natural trees or logs may be provided for climbing, rubbing or scratching. Holes may be drilled and hollow logs provided for offering treats.
3. Natural substrates (mulch, sand, gravel, soil, moss, leaf litter) should be introduced in paddocks for providing digging opportunities or for scattering or hiding food in.
4. Water features (shallow and deep pools, streams) should be provided in paddocks if a species requires these.
5. Plants can serve as visual barriers, and grasses and herbs may be added for grazing.
6. Logs may be placed horizontally and vertically in the exhibit area and in the feeding and retiring cells. They may be interlinked so that the animals have climbing opportunities.
7. Removable perches may be fixed at various levels and changed periodically
8. Coolers or misting systems may be used during warm weather.
9. Holes or dens
10. Holes may be made high in rocks where food may be hidden. This will encourage jumping.
11. Vines or ropes may be provided in the exhibit area according to the species' needs.



Leopard using the large wooden logs in zoo to rest

Dietary Enrichment

1. Novel live prey: mealworms, crickets, grasshoppers, grubs
2. Varied feeding schedules and several feedings per day
3. Food items may be hidden in piles of branches
4. A piece of meat could be placed on an elevated area so that an animal must jump or reach for it to grab the food. A bungee cord or spring could be placed in the off-exhibit area as enrichment.
5. Honey and feeder logs (made from natural logs)
6. Fish, meat, fruit, vegetables
7. Scattered food items
8. Variety of chopped and whole food items
9. Melons and pumpkins—to provide different textures
10. Eggs (raw or boiled)
11. Browse



Loose wooden log, placed in a way that by loosing the string from outside of exhibit by the keeper, provides a swing, so as to encourage carnivores to climb for feed hanged on the pole. This provides an opportunity in captivity to climb and feed as of such animals may be feeding in wild



At Lion Breeding Centre & Multiple Safari Parks (LBCMSP), Etawah - Asiatic lions are provided with feed wrapped inside weaved box made of natural material as an feeding enrichment

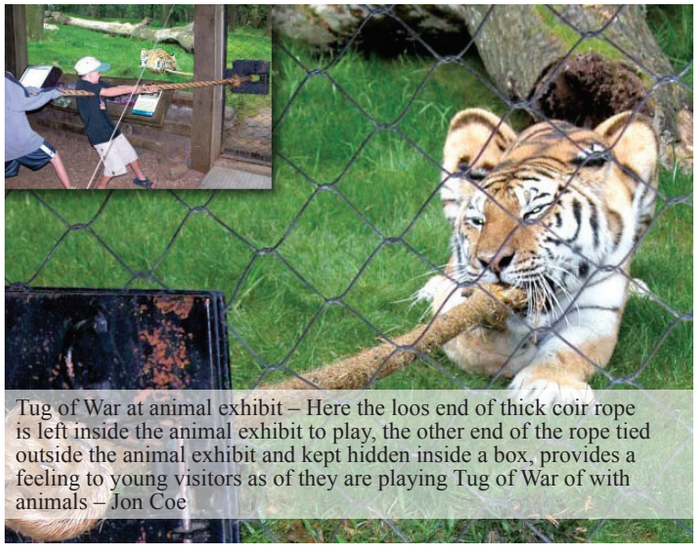


Photo: LBCMSP, Etawah

Hanging wooden ball inside the animal exhibits keeps the large carnivores engaged and playful

Novel Enrichment/Social Enrichment

1. Olfactory: urine and faeces from prey or conspecifics, extracts (from plants and flowers), spices, herbs, perfumes, bedding from prey species, aromatic oils
2. Wooden balls, with holes drilled throughout to create food dispensers
3. Cardboard boxes, paper tubes, cereal boxes with treats hidden inside
4. Grain bags, paper bags
5. Artificial rats and lizards: remote-controlled rats that run through hollow logs may be used, operated from the off-exhibit area.



Tug of War at animal exhibit – Here the loos end of thick coir rope is left inside the animal exhibit to play, the other end of the rope tied outside the animal exhibit and kept hidden inside a box, provides a feeling to young visitors as of they are playing Tug of War of with animals – Jon Coe

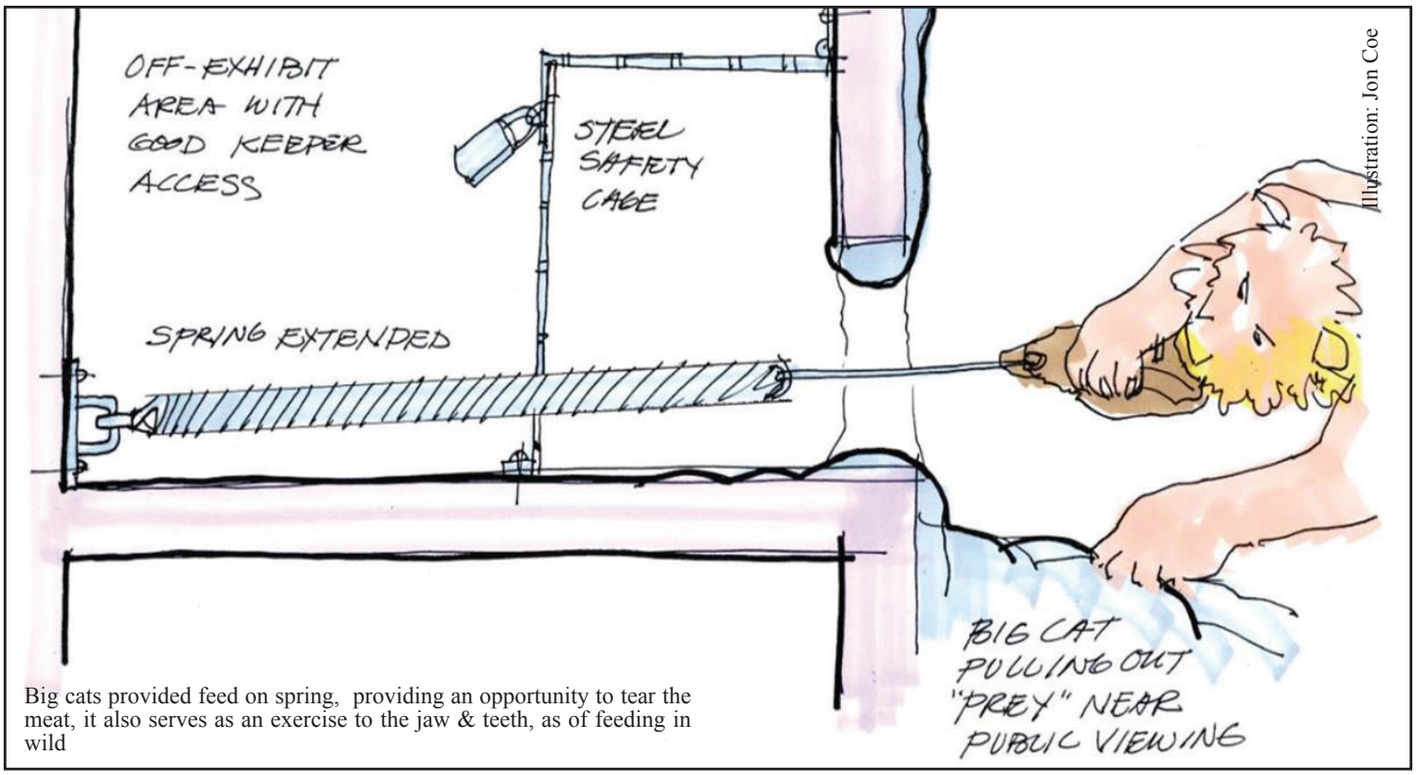
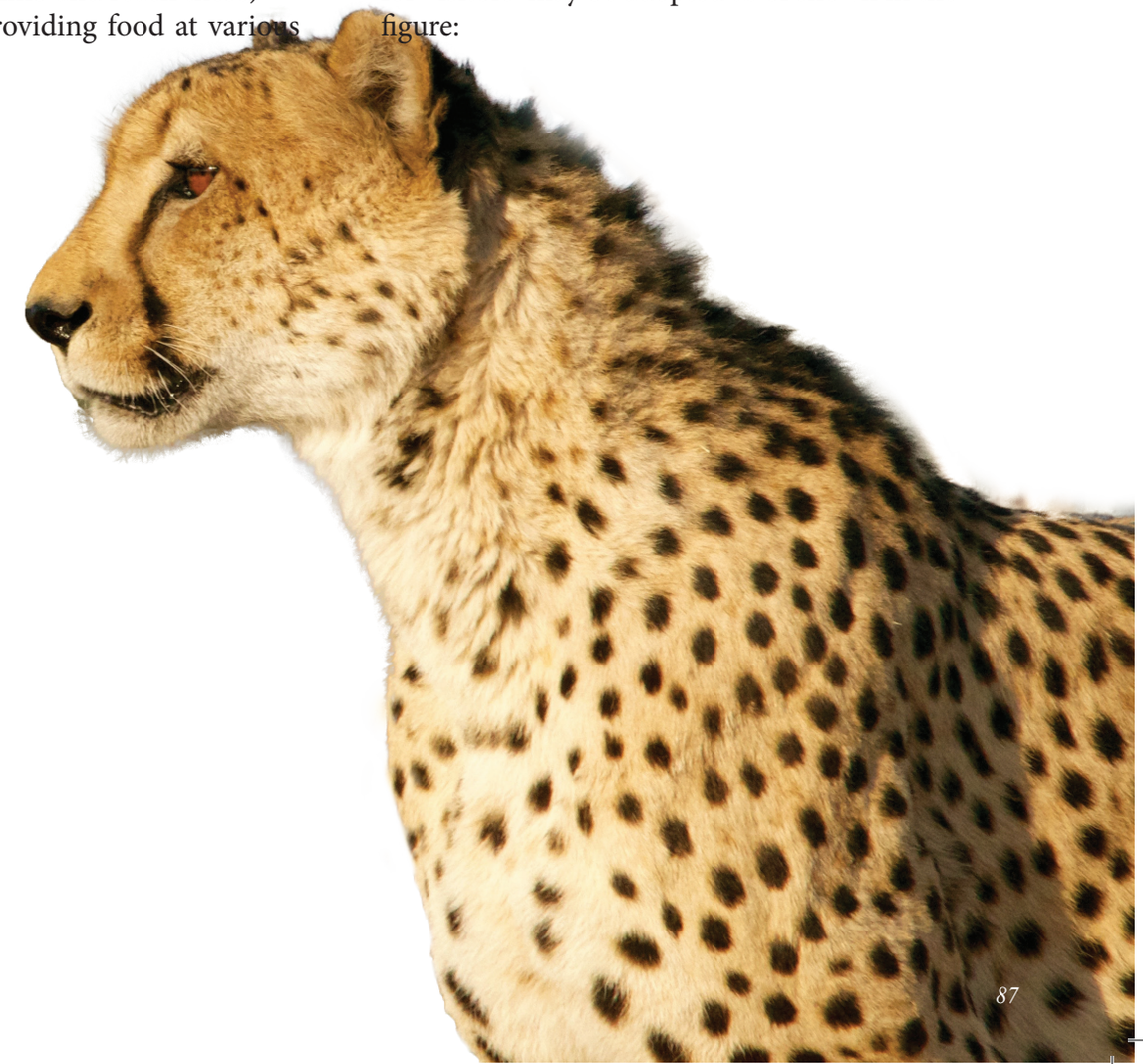


Illustration: Jon Coe

Big cats provided feed on spring, providing an opportunity to tear the meat, it also serves as an exercise to the jaw & teeth, as of feeding in wild

6. Natural ropes, bungee cords—to hang objects or food from
7. Feed boxes full of treats on top of cages (the animals must use logs or ropes to climb and reach these)
8. Time release system for providing food at various times during the day
9. Bamboo tubes
10. Auditory: natural sounds, sounds from the same species
11. Enrichment for animals cum educational options for visitors may be adopted as of shown in the figure:





Enrichment Ideas for Ursids

Illustration: Arnab Roy

Chapter 7

ENRICHMENT IDEAS FOR URSIDS

The family Ursidae, the bear family, comprises animals that normally have large home ranges. They are very strong for their size. Bears are intelligent and opportunistic. They learn quickly where their food comes from in captivity. The behaviours they exhibit when food is delivered become predictable.

Sloth Bear
Melursus ursinus

Sloth bears are mainly solitary animals, except for mothers with their cubs. Adult sloth bears are generally active throughout both the day and night, except again for females with cubs, which seem to restrict their activity to the daylight hours. Sloth bears are unique amongst bears in that the bulk of their diet consists of insects, particularly termites and ants. Breaking open a termite mound with its strong front claws, a sloth bear will insert its snout and blow away earth and dust before sucking the termites into its mouth. The lack of upper incisors provides a channel through which the bear sucks insects. Sloth bears are able to close their nostrils voluntarily to prevent inhalation of dust. Sloth bears also feed on honey, enduring the stings of bees to obtain honeycombs. These bears also feed on eggs, carrion, vegetable matter and fruits.

Malayan Sun Bear
Helarctos malayanus

With slightly inward-turned feet, large, naked paws and long, curved claws, the sun bear is well adapted for climbing trees. Its feet are extraordinarily large for its body size, and these are used for digging and for breaking into dead wood in search of insects.

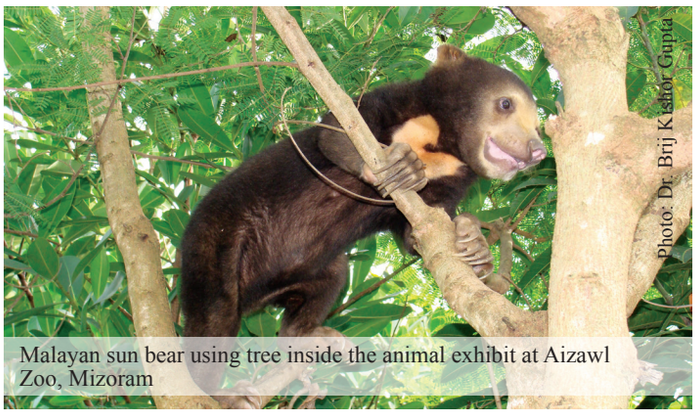


Photo: Dr. Brij Kishor Gupta

Malayan sun bear using tree inside the animal exhibit at Aizawl Zoo, Mizoram



Photo: Dr. Brij Kishor Gupta

Sloth bear mother with young one. The naturalistic vegetation provides a feeling to the animals as if they live in their natural habitat

Asiatic Black Bear
Ursus thibetanus

These bears spend around half their time in trees, where they construct platforms from branches and vegetation. They use these platforms for resting. Females give birth to a litter of usually two cubs in the safety of a winter den, which is often located within a tree hollow. Cubs stay with their mother for 1 to 1.5 years. With the exception of the mother–cub groups, Asiatic black bears are fairly solitary. At the northern extreme of the range, black bears have been observed to go into hibernation to survive cold winters, but to the south, these bears migrate to warmer areas and thus avoid the need for hibernation.

Himalayan Brown Bear

Ursus arctos isabellinus

Himalayan brown bears are omnivores and will eat grasses, roots and other plant parts as well as insects and small mammals. They also like fruits and berries and prey on large mammals, including sheep and goats. Adults eat before sunrise and again in the afternoon. These bears go into hibernation around October and emerge during April and May. Hibernation usually occurs in a den or cave made by a bear.



Photo: Dr. Brij Kishor Gupta

Himalayan brown bear interacting with vegetation inside the exhibit at Himalayan Nature Park, Kufri



Photo: Dr. Brij Kishor Gupta

Asiatic black bears utilizing the dead wooden log to rub, scratch and bite the wood, as well feed upon insects while the wood is gone decaying

Diets and Dietary Adaptations of Bears

In general the diets of ursids vary from habitat to habitat, but the species found in India are all omnivorous. In general, bears are well adapted to their environments. Their eyesight and hearing are sufficiently well developed to allow them to negotiate their natural environment. Bears also have an excellent sense of smell. They are excellent climbers.

All species have heavy builds, with powerful limbs, and can be dangerous if provoked. They possess strong claws that are adapted for tearing and digging and, for some species, climbing.

Management of captive bears can be challenging. Stereotypic behaviours, such as pacing, pattern swimming, solicitation of food from the public and repetitive behaviours are commonly seen in captivity. As a result of the nocturnal or crepuscular nature of some species, animals may be inactive or hidden during much of the public viewing time.

Promoting normal wild behaviour through provision of suitable species-specific enrichment can lead to improved mental and physical health. Well-adjusted animals should exhibit behaviours that reflect reduced stress levels and are appropriate for public display.

Random and variable enrichment can provide novelty and stimulation that mirror changes in the animals' natural world.

Exhibit enrichment

Ursids are relatively large and destructive animals, requiring appropriately sized enclosure furniture. Artefacts may be selected to enrich bear exhibits depending on the size and type of the exhibits.

Because many bears are strong diggers, the mesh around the enclosure must be of a heavy gauge. It should also be embedded deep in the ground to prevent the bears from tunneling opportunistically. For many species, providing opportunities for climbing is desirable. Juveniles of normally terrestrial species may also benefit from climbing structures. However, large props can break, causing injury to animals, and may provide potential escape routes. Therefore, climbing structures should be monitored for structural integrity and the potential of being used by the animals to escape if these are broken or compromised.

Off-exhibit areas should offer suitable climbing and sleeping or denning opportunities, especially if the animals are to spend evenings or winters in these areas. Bears benefit from continuous access to indoor and outdoor areas.

It must be stressed that all bear areas should contain appropriate and sufficient enrichment choices. The type of enrichment may take different forms. For example, shelter, sun, shaded areas and water features, in or off the exhibit areas, allow the animals to regulate their own activity levels, temperature and visibility to the public.

Rock structures, uneven terrain, trees, logs and log piles may be used as visual barriers behind which bears can hide. Apart from acting as visual barriers, trees and bushes can provide shade and climbing opportunities. Dens can permit bears to escape from the elements, apart from providing them cubbing areas.

Certain trees may need collars, metal sheet covers, electric fencing or other barriers to prevent damage from bears scratching the trunks or rubbing themselves on them. Trees located close to exhibit barriers may provide escape opportunities and should be trimmed to ensure that the bears cannot walk or jump out of the enclosure or use fallen limbs to escape. Similarly, strong animals may be able to knock down or rearrange furniture against the perimeter fencing, which may allow them to escape from the enclosure.

Many ursids find various substrates very interesting. Mulch, sand, gravel, soil, grass, leaves, hay and moss can encourage natural exploratory behaviours. Ingestion is not normally a problem with these items, but animals should be monitored when they are offered access to new substrates. A number of substrates can provide bears with options for foraging, digging and nest-building. Water features are desirable for many bear species and often encourage species-typical behaviours. Shallow pools and streams provide sources of drinking water and can be stocked with live fish or floating objects, while deeper pools provide swimming and relaxing options.

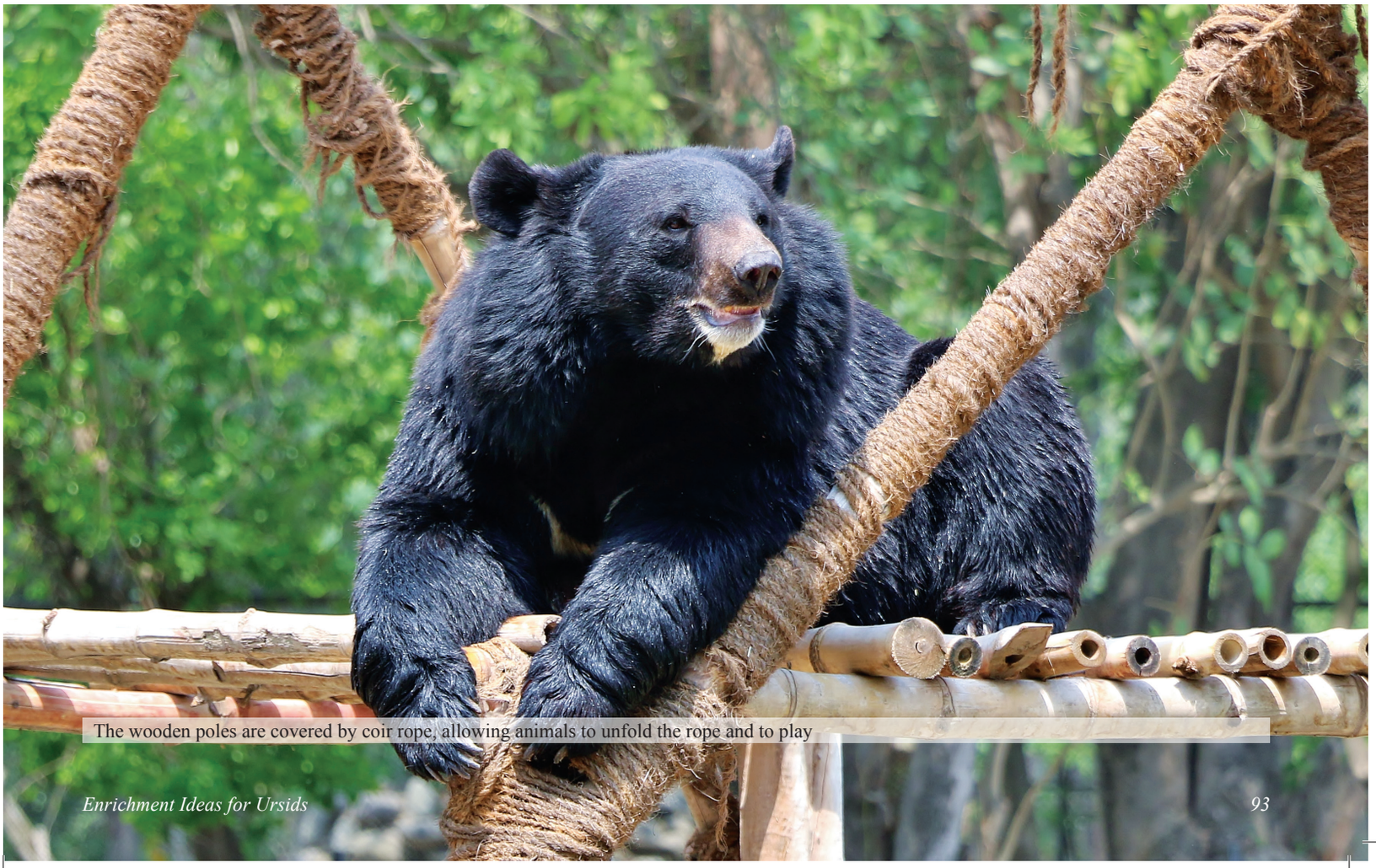


Photo: Dr. Brij Kishor Gupta

Large boulder piled in a way to act as naturalistic den for bear at Pune.



Ice covered by gunny bag provided as an enrichment at Kamla Nehru Prani Sangrahalaya, Indore



The wooden poles are covered by coir rope, allowing animals to unfold the rope and to play

Dietary enrichment

Bears are generally omnivorous but differ in the extent of carnivory, folivory and insectivory exhibited by them. Dietary enrichment could be carried out by providing natural or artificial termite mounds and distance suction feeders to highlight specialised adaptations to feed on insects, such as those seen in sloth bears.

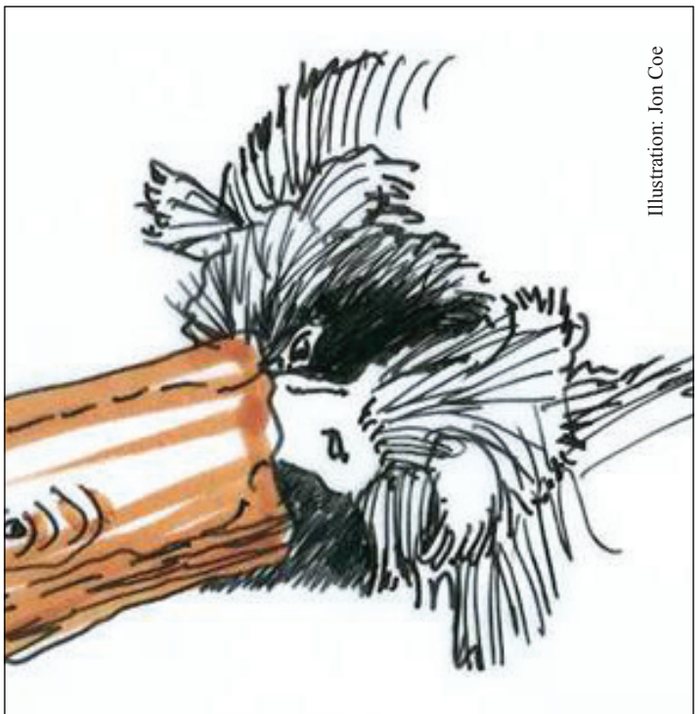


Illustration: Jon Coe

Live termite mound inside exhibit are added enrichment feature

Social enrichment

Zoos often exhibit bears in pairs or groups although many species are solitary for much of the year in the wild. This is done because the bears are more active, which is beneficial to them, and the public find such groups interesting. Housing animals in social groups can be an effective form of enrichment, but zoo staff members should regularly monitor the behaviour, food intake and use of enrichment and exhibit furniture to ensure that the needs of all the animals in an enclosure are being met. Subordinate animals often need places to which they can escape from unwanted attention, without getting trapped. Food should be provided in more than one location to ensure that all the animals are able to obtain appropriate quantities. Providing multiple food stations, feeding bears more than once a day and scattering food to provide opportunities to forage are all methods used to address this issue. Mother-and-cub groupings may also be successful until the younger animals reach sexual maturity or become aggressive. Breeding and cub-rearing opportunities can be valuable enrichment: not only are both the mother and cubs mentally stimulated they can also exhibit species-appropriate behaviours, and the cubs are provided an environment in which to develop normal social skills.



Photo: Dr. Brij Kishor Gupta

Vertical rocks used by bears

Conditioning/training as enrichment

Conditioning/training programmes are commonly conducted in many zoos in Europe and USA. These programmes stimulate animals and can be used as valuable management tools. Many bears can be conditioned to exhibit simple behaviours, such as presenting body parts or opening the mouth for physical examination. Training animals to move co-operatively can provide keepers with safe and reliable access to exhibit areas for placing enrichment and can be useful during emergencies.

Transporting bears in crates should be considered where appropriate to minimise stress due to transport and to improve the safety of keepers and animals. Holding areas should be designed with conditioning or interaction areas that are safe for both the zoo staff and animals. Removable panels should be provided so that bears of various sizes (cubs, sub-adults, adults) may be accommodated.

Safety considerations and documentation

Safety should be a primary consideration when introducing new enrichment. The participation of supervisory staff is important, and the bears should always be closely monitored when new items are offered. A botanist or horticulturist should be consulted regarding the toxicity of browse and plants. Plant material should be checked to determine if pesticides have been applied. Because the responses of different individuals to the same enrichment can be very different, careful observation and documentation are necessary. One animal may wrestle with an item for extended periods, while another might destroy it immediately and leave it, and a third might try to ingest it. Documentation of individual differences will allow keepers to tailor enrichment to maximise the benefits.

Documentation of each enrichment event is desirable. A compendium of ideas may serve as a spark for developing the interest of other staff members, who could use an idea for other species. At the least, documentation will reduce constant reinvention of the wheel.

Bear management: Suggestions for enrichment Exhibit enrichment

1. Climbing structures: trees, wooden poles, ropes, logs, rocks (illustration shows the use of wooden logs as exhibit enrichment)



Photo: Dr. Biji Kishor Gupta

Elevated wooden platform provided to Sloth bears at Agra Bear Rescue Facility

2. Weather considerations: cover from rain, shade structures, sunny spots, wind breaks
3. Substrates for lying on, sleeping or nest-building: grass, hay, straw, leaves



Naturalistic substrate provided in Sakkarbaug Zoo, Junagadh provides naturalistic resting places to Sloth Bears.

4. Substrates for digging: grass, soil, sand, mulch, rotting logs



Photo: Dr. Biji Kishor Gupta

Multi layered exhibit area at Thiruvananthapuram Zoo provides animals to climb in its natural skills.

5. Balancing treat logs may be provided using wooden logs for bears to play with it.

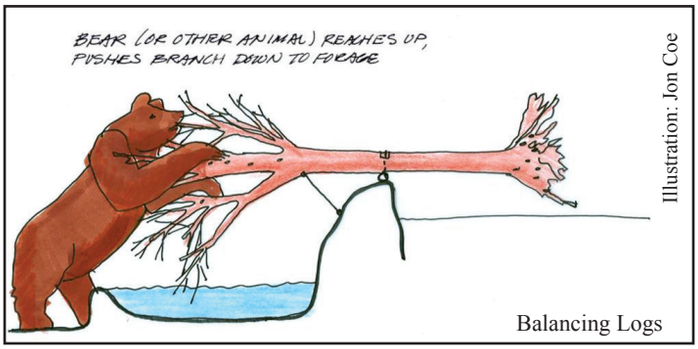


Illustration: Jon Coe

Balancing Logs

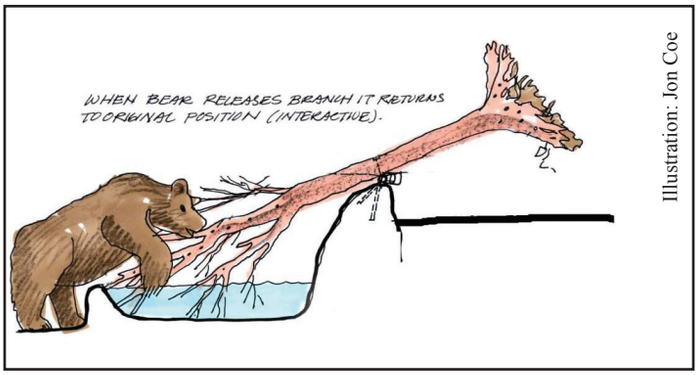


Illustration: Jon Coe

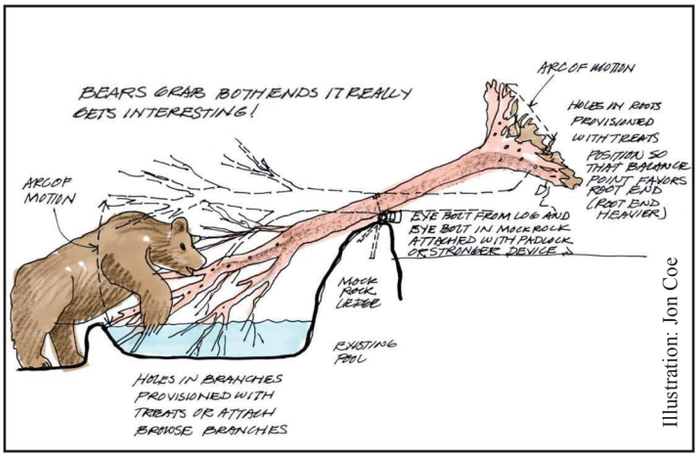
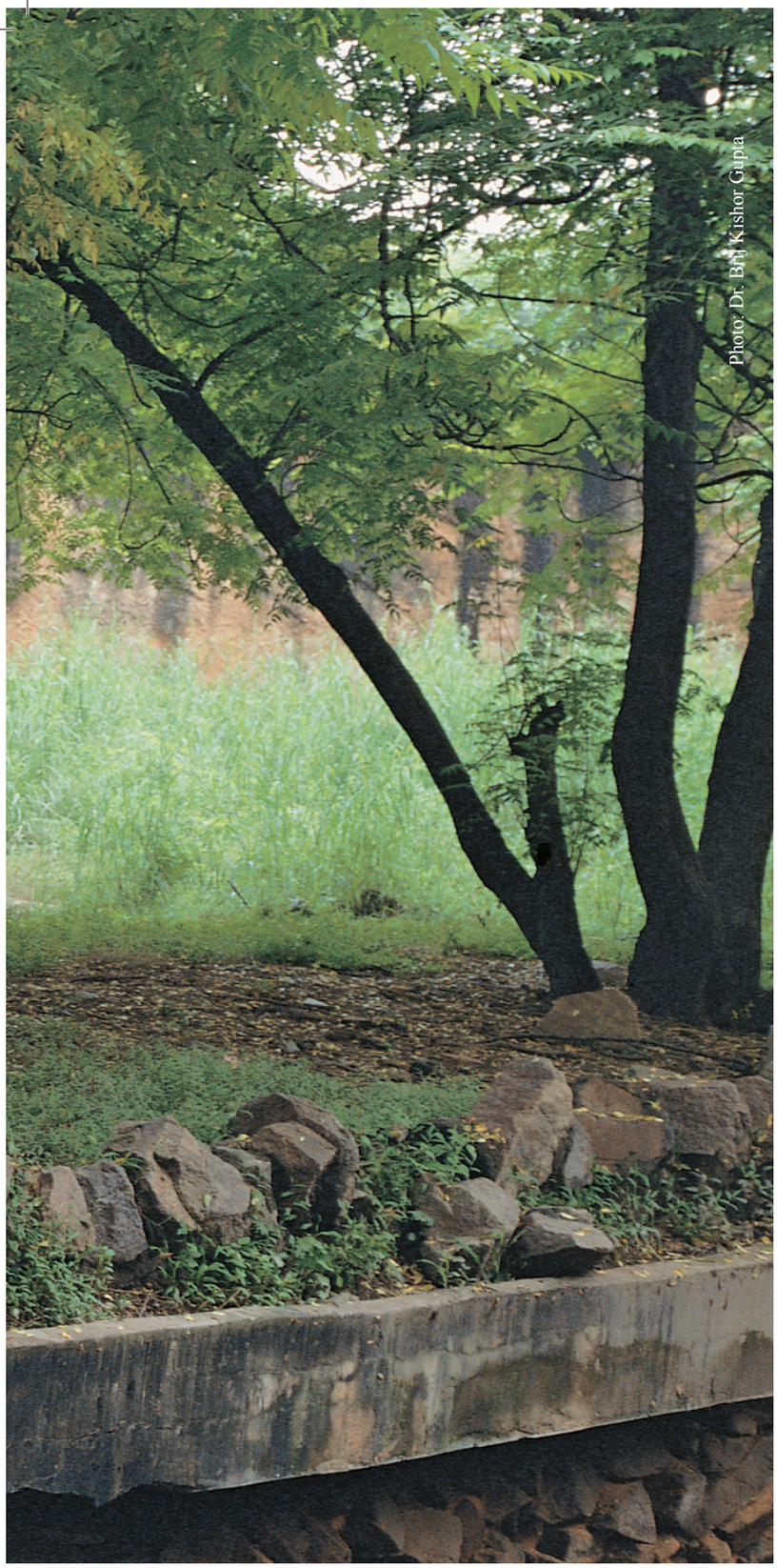


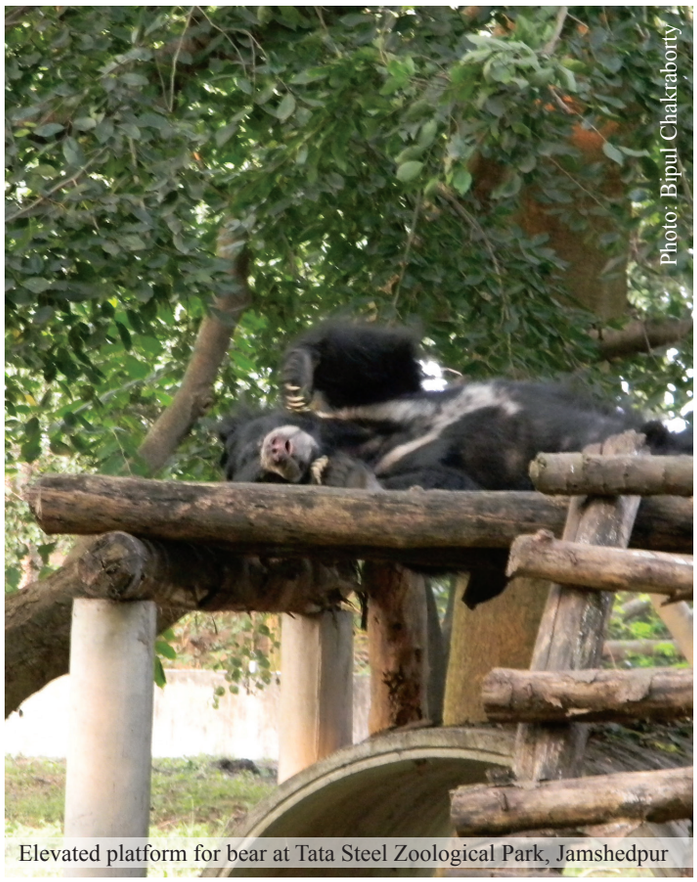
Illustration: Jon Coe



National Zoological Park Delhi provides Sloth bears with natural vegetation

6. Elevated Wooden platforms or other material may be used for feeding and resting of animals and scratching/ rubbing.
7. Visual barriers: log piles, trees, rocks, caves, dens
8. Number of feeding sites
9. Water features: pools, moats, sprinklers, misters
10. Mechanical devices to deliver random food items
11. Provisions for hanging food items at various locations
12. Area with safe access for veterinary examinations
13. Area to which animals may be shifted to allow keepers safe access to the exhibit area for adding enrichment or introducing food items
14. Means of access to the exhibit area by vehicles for major changes or for replacing furniture





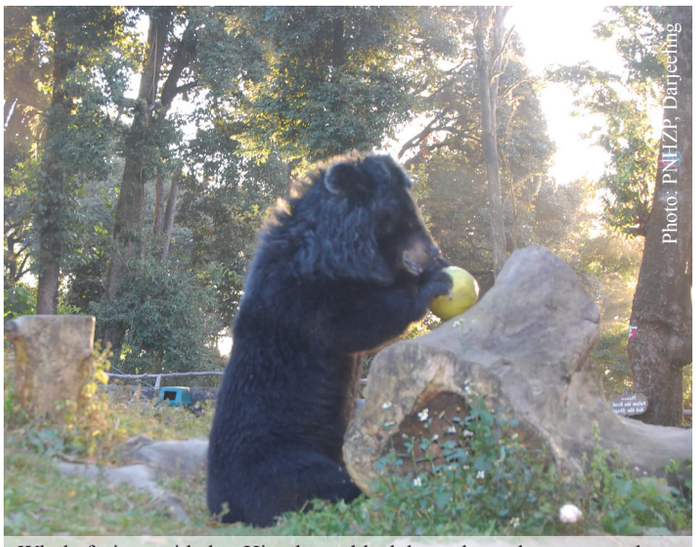
Elevated platform for bear at Tata Steel Zoological Park, Jamshedpur



Large water body at Nehru Zoological Park, Hyderabad provides animals to play inside the water body during summers



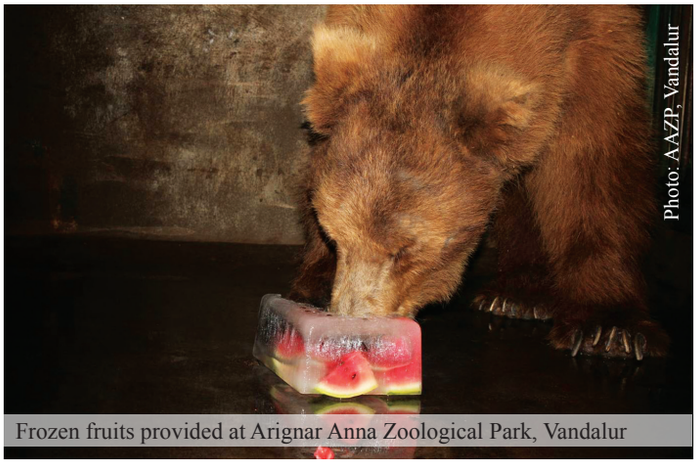
Lives trees shows sign of bear scratch



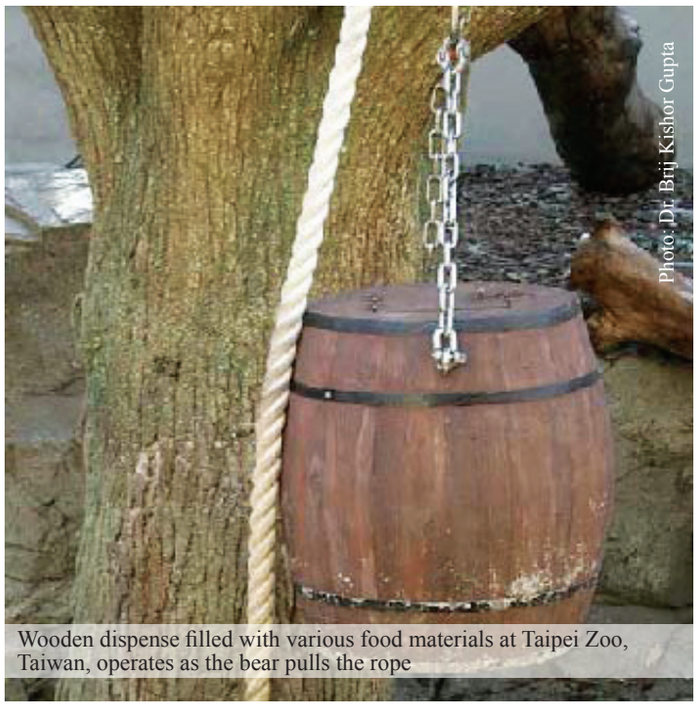
Whole fruit provided to Himalayan black bears keep them engaged

Dietary enrichment

1. Browse for eating, destruction and displaying (De struction of browse keeps an animal busy—it is also a part of natural behaviour.)
2. Live animals (insects, other invertebrates)
3. Randomising feeding times
4. Increasing the feeding frequency
5. Mix of whole versus processed or chopped foods
6. Introducing edible local plant material in and around the exhibit area
7. Strong or bitter-tasting foods (leaves of neem Azadirachta indica)
8. Cereal, popcorn, seeds or nuts for foraging
9. Treat foods: honey, hard-boiled eggs, sugarcane, honey-filled sticks, fruits frozen in the ice.
10. Rotating fruit dispenser.
11. Termite mounds
12. Suction feeders and honey dispenser made of wooden logs may been used for Sloth bear and Himalayan black bear for feeding.



Frozen fruits provided at Arignar Anna Zoological Park, Vandalur



Wooden dispense filled with various food materials at Taipei Zoo, Taiwan, operates as the bear pulls the rope



Honey comb could be provided as feeding enrichment to the bear in captivity

Social enrichment

1. Social opportunities: species-appropriate social groups
2. Socialisation for husbandry and management of behaviours (through sex ratios and numbers of animals in captivity)


Bears waiting for their chance to climb on elevated platforms



Photo: Aizawl Zoo

Unique ladder for bears to climb at Aizawl Zoo, Aizawl



Photo: WTI

Fixed wooden logs in captivity utilized by bears encourages natural behaviour

Other novel enrichment

i. Recycled items: cardboard boxes
ii. Wooden logs
iii. Soil mounds
iv. Auditory enrichment: music, nature sounds, recorded vocalisations of same or other species
v. Olfactory enrichment: herbs, condiments, perfumes, items marked by other species





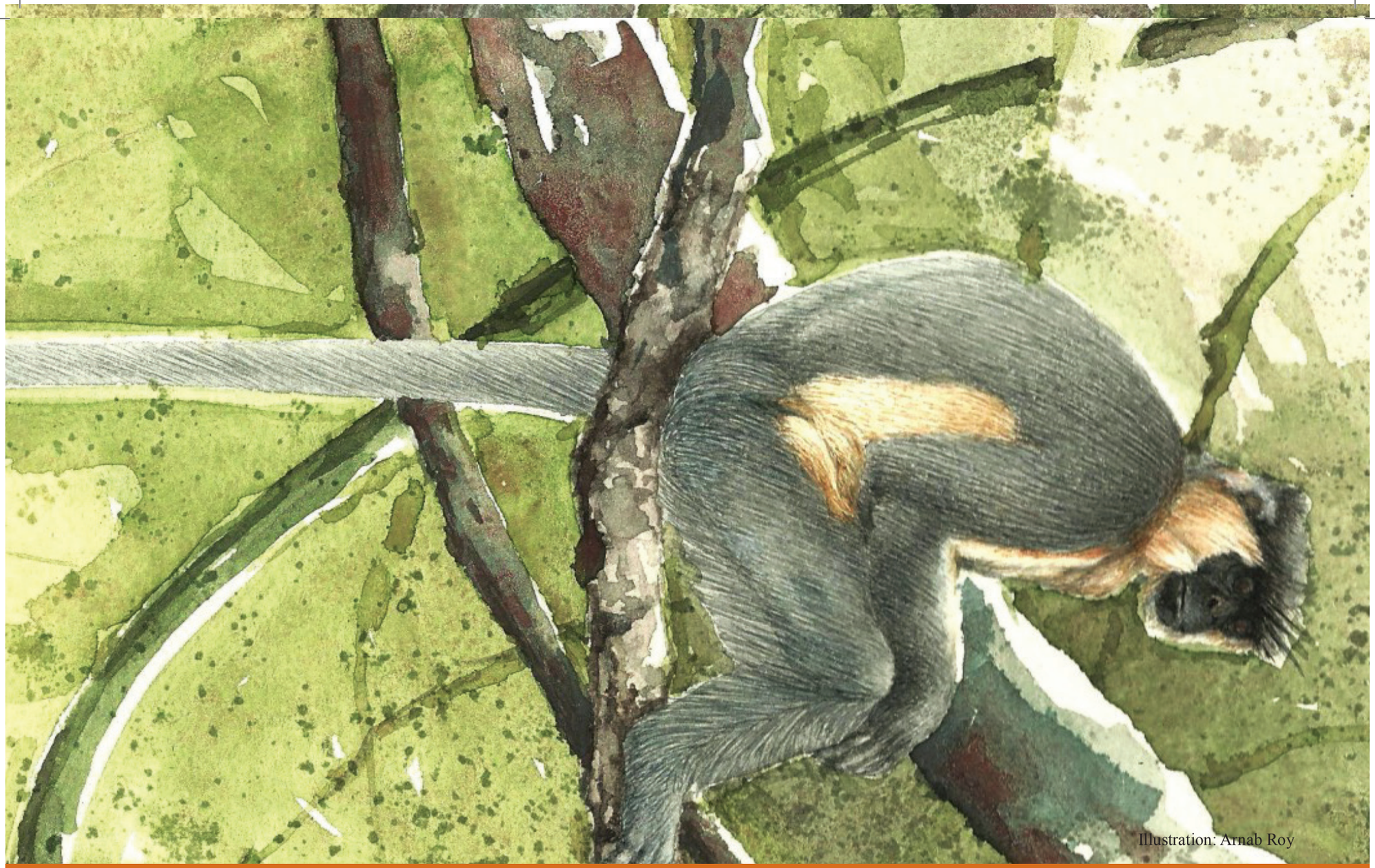


Illustration: Arnab Roy

Enrichment Ideas for Primates

Chapter 8

ENRICHMENT IDEAS FOR PRIMATES

The order Primates includes a wide variety of species with an incredible range of abilities. The primates housed most commonly in Indian zoos are the Rhesus macaque, Bonnet macaque, Assamese macaque, Common langur, endangered species such as the Lion-tailed macaque, Nilgiri langur, Crab-eating macaque, Golden langur, Stump-tailed monkey, Pig-tailed macaque and Hoolock gibbon and exotic primates such as the Chimpanzee, the Gorilla, Baboons, Tamarins and the Orangutans.

A lot of activities need to be planned when designing an enrichment programme for primates to meet their need for psychological and behavioural enrichment. Most primates are curious, complex animals with the ability to manipulate objects in their environment. When the environment has been limited by the confines of an exhibit, paddock, feeding space or night shelter, the intelligent primate requires some type of external stimulation. Without constructive activities, primate behaviour can become aberrant and repetitive, and some individuals may indulge in self-mutilation or become aggressive towards cage mates. Exhibiting animals that are engaging in unhealthy behavior, such as rocking or consumption of faeces, does not fulfil the educational niche that zoos are hoping to occupy. The public feels sorry for the animals and learns little about the unique characteristics of the species, and the animal possibly leads a sub-standard quality of life. Enrichment can play a significant role in creating the quality of life that keepers and animal managers are seeking to provide for the animals in their care.



Photo: Dr. Brij Kishor Gupta

To meet the behavioural need of primates in captivity live trees becomes essential



Photo: Dr. Brij Kishor Gupta

A well-developed enrichment programme is a necessity for any captive primate. Monkeys and apes are clever and quick. They are dexterous, often agile, and engage in numerous play behaviours. Their natural curiosity can lend itself to unending possibilities for activities.

It can be a challenge for keepers to create new devices or games for animals that have nothing but time and intelligence on their hands. Creating a satisfying, complex environment for captive animals can help reduce or eliminate stereotypic or other undesirable behaviour, thereby improving the lives of individual animals.

Lives trees in the animal exhibit meet the primates requirement, it also provides natural food to animals



Photo: Dr. Brij Kishor Gupta

Elevated wooden platform made of bamboo serves good resting places for primates

Numerous primate species are highly endangered in their wild habitats. Frequently, the commoner primate species are housed during transit to places they are being relocated to. Some day, re-introducing captive specimens may become a reality. Therefore, ensuring the survival of the necessary natural behaviours in these animals is essential. Successful parenting skills, foraging skills, appropriate group behaviour and mental agility are important for animals for survival without the comforts of the zoo. If these behaviours are slowly eliminated over generations through a captive lifestyle, the likelihood of re-introduction programmes succeeding is reduced.

Exhibit Enrichment

When an exhibit is being designed with enrichment, it is important to examine the natural history of the species to be housed. Several questions can be posed when designing exhibit enrichment: Does this species brachiate, or is it more of a ground dweller? Is it shy by nature? How does it acquire its food? What is its natural tendency for destructive behaviour? Knowing the distinct characteristics and behavioural inclinations of the species can help design exhibit enrichment.



Photo: Dr. Brij Kishor Gupta

Elevated island provided for resting at Tata Zoo, Jamshedpur

Zoos may use permanent features. These should be sturdy and weatherproof. Exhibit enrichment items should be able to withstand the rigours of disinfection regular use by animals. Enrichment devices should be easy to remove or repair if they break. Permanent features should comply with the Central Zoo Authority's directives, the Recognition of Zoo Rules and guidelines regarding aesthetics (i.e., naturalistic vs non-naturalistic enrichments on exhibit). Because primates can quickly lose interest in items, it must be possible to modify permanent cage features. Off-exhibit holding space should also be considered. Animals may spend as much, if not more, time in their night quarters than in the exhibit space. Therefore, functionality, durability and convenience for the keeper may take precedence over aesthetics.

Access to exhibits is an important aspect of exhibit enrichment. When possible, exhibits should be devised such that they allow keepers to offer enrichment without having to occupy the same space as the animals or requiring the animals to shift. This set-up will be conducive to random enrichment offerings. If the enrichment set-up is simple, keepers are more likely to change enrichments regularly. The access to the exhibit should allow the use of large machinery to facilitate removal of live trees that have been destroyed, props that have worn out or substrates that need to be refreshed. If this is built into the exhibit design, maintaining it will be more cost-efficient. This type of access can make many enrichment projects easier to implement.



Photo: Dr. Brij Kishor Gupta

Naturalistic vegetation and water body acts as enrichment



Photo: Dr. Brij Kishor Gupta

Hoolock gibbon exhibit at Aizawl Zoo

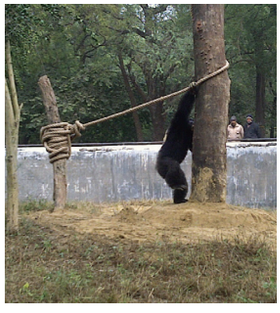














Large wooden logs erected at Kanpur Zoological Park, for Chimpanzees.

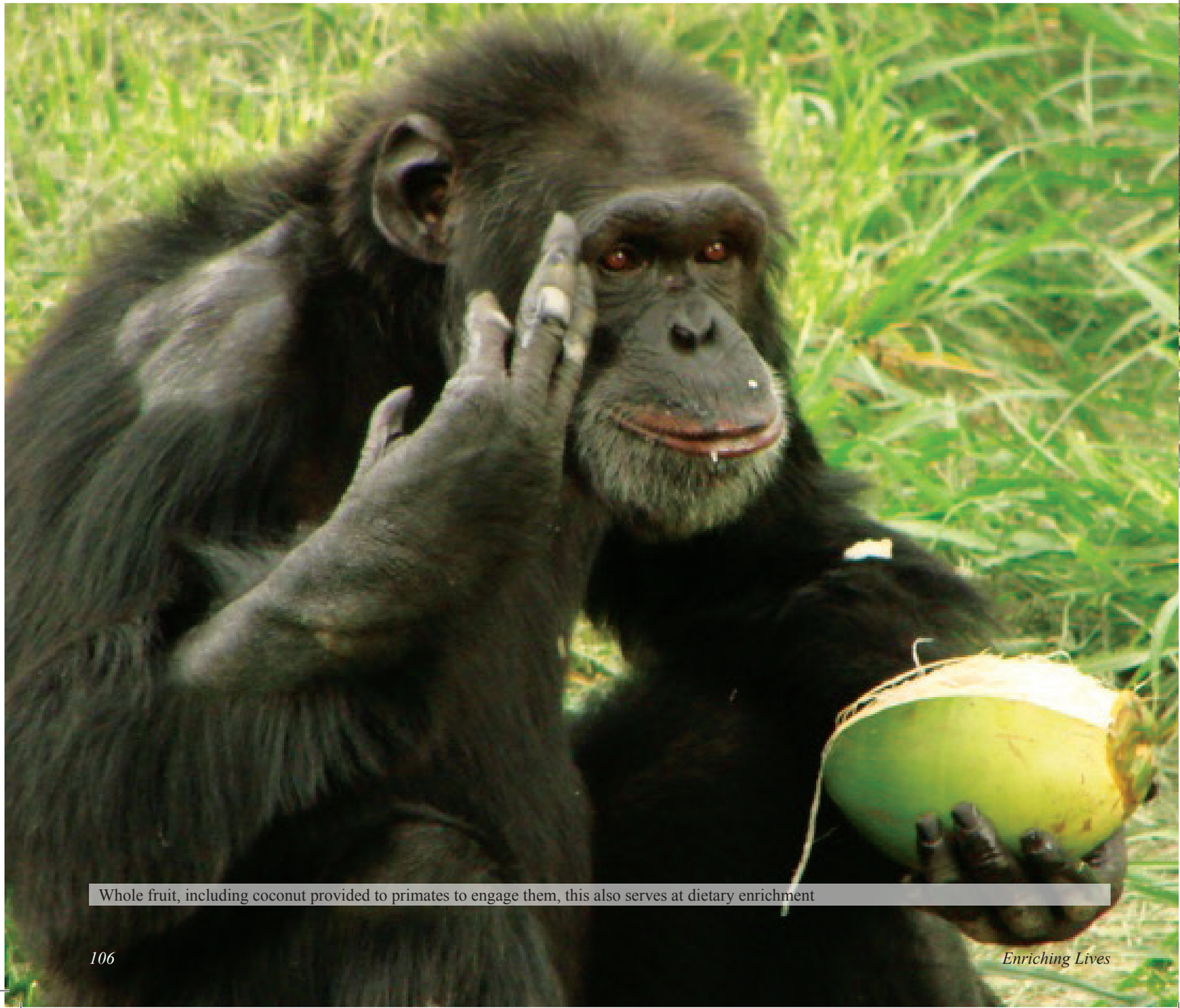
Dietary Enrichment

Dietary enrichment is one of the more popular forms of enrichment. New items should be approved by the necessary curators, veterinarians or zoo managers. Obesity, tooth decay, diarrhoea and allergies are a few of the concerns associated with the provision of some food items. Appropriate choices and moderate amounts should be the rule when novel foods are introduced.

New foods may be rejected initially, while an appreciation of others is an acquired taste. Repeated offerings may be the key to getting an animal to try unfamiliar foods. Offering the new item in conjunction with a favourite item could be helpful. In addition, desensitising the animals to a variety of sweet and savoury flavours can help the keeper with offering medicines to animals when they are sick.

Dietary enrichment does not necessarily require that food outside the regular diet has to be offered. A variety of seasonal fruits and vegetables can provide a wide range of flavours, textures and vitamins. Offering the produce in its 'whole' form may in itself increase the feeding time of animals that can manipulate large pieces.

When searching for dietary enrichment options, referring to the natural history of the species can provide a direction. Leaf-eating macaques may appreciate browse, but the most palatable and frequently offered leaves would be offered to a langur. And the dietary preferences of exotic species of primate such as the spider monkey and marmosets might encourage the zoo staff to build a worm-log dispenser (a log with hidden dispensers in which mealworms may be filled—monkeys have to shake the dispensers to get the worms—when a dispenser is shaken, it releases two to five mealworms at a time).



Whole fruit, including coconut provided to primates to engage them, this also serves at dietary enrichment

Novel Enrichment/ Social Enrichment

Creating ideas for novel devices can be a challenging endeavour. Observation can be essential in finding inspiration. Knowledge of the species' traits and inclinations, as well as the idiosyncrasies of an individual, can provide insight as to what an animal might find interesting. For instance, is it a scent marking species? Does it have opposable thumbs? Does it use tools? Behavioural studies conducted on similar species, both in captivity and in the wild, can spark ideas.Because many curators, biologists, supervisors and keepers in zoos in India and abroad specialize in certain types of animals, it can be helpful to consult all the concerned staff members with other areas of expertise. Some devices designed for carnivores or birds may be modified for use with primates. Observing animals with their enrichment devices can provide excellent opportunities to devise new enrichment ideas. Animals often use a device for a purpose that is completely different from the keepers' intent. A few simple changes to an existing device can produce an entirely new activity.

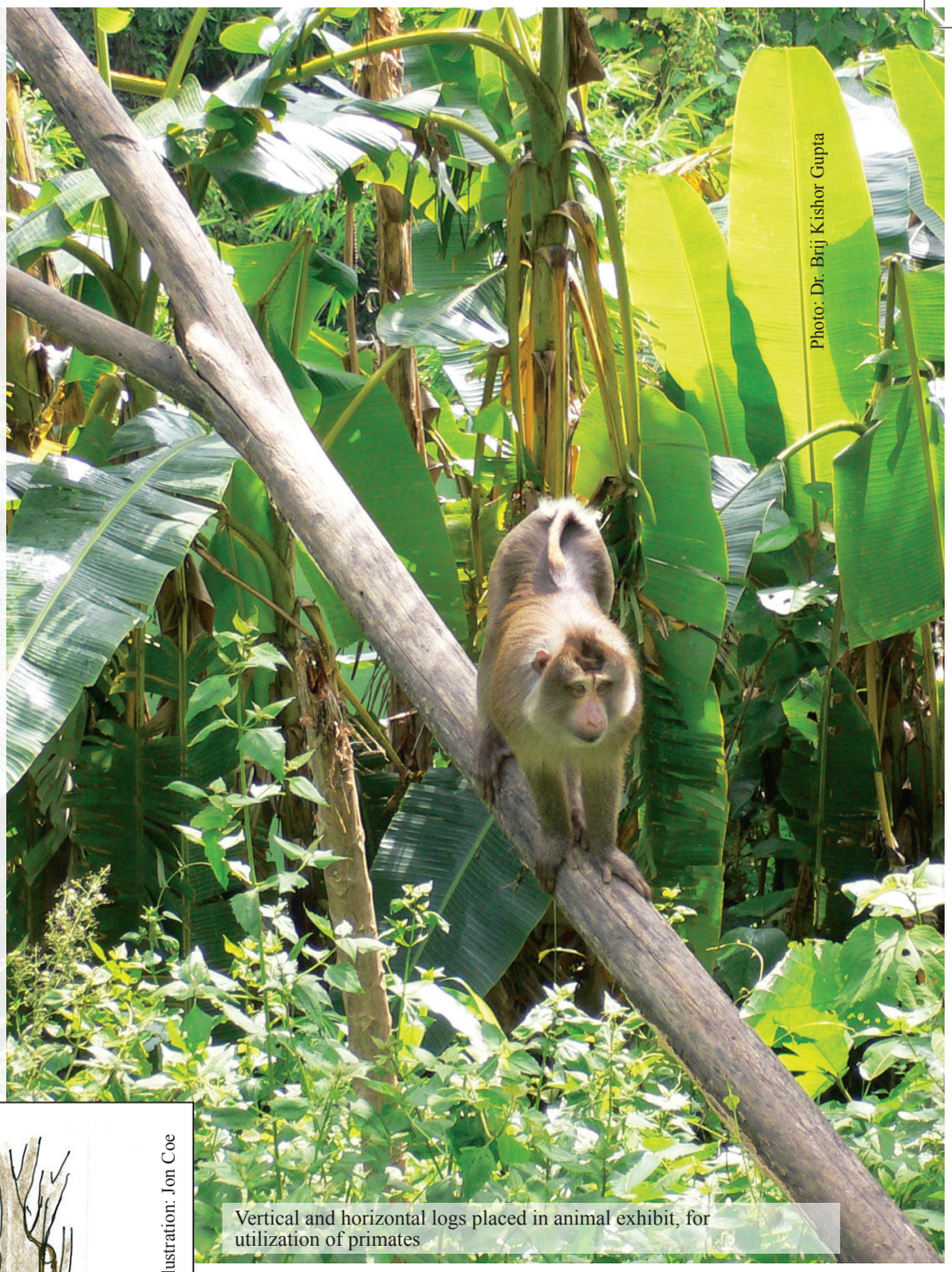


Photo: Dr. Brij Kishor Gupta

Vertical and horizontal logs placed in animal exhibit, for utilization of primates

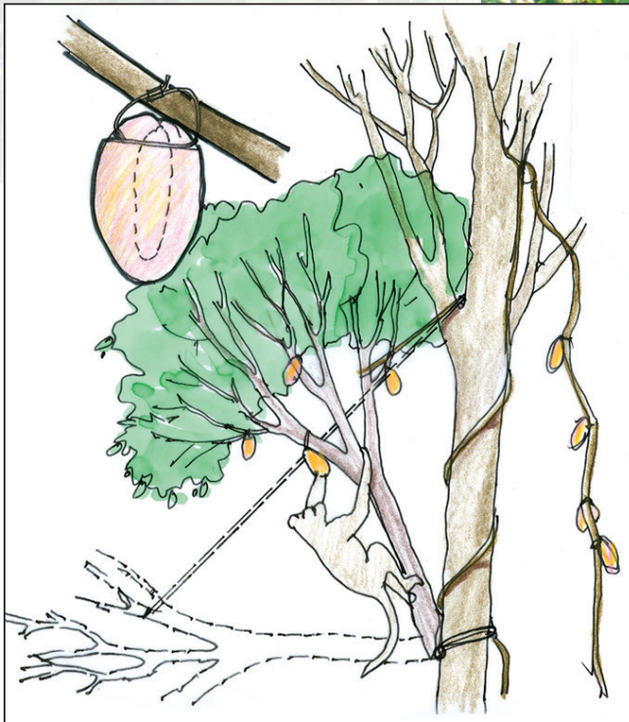


Illustration: Jon Coe

Dense vegetation with natural vines provides brachiating space to Hoolock gibbon and Orangutans in Zoos.

Primates are generally highly social beings. Group interaction is essential to their psychological well-being. Grooming, intra-specific communication, squabbling and parenting are just a few of the activities that occur in a natural group. Appropriate troop dynamics can help relieve boredom, alienation, depression and self-destructive behaviour in these intelligent creatures.

Individual animals that have not been raised in a natural social grouping may not benefit from intra-specific interaction as they may be unfamiliar with the etiquette of the species. Interaction with the keepers may make for a happier, less lonely existence for these animals. Initiating an operant conditioning programme can not only offer occupational enrichment but prove valuable for both husbandry and veterinary management. The individual facility's protocol regarding animal handling will likely dictate the appropriate amount of interaction for each animal.

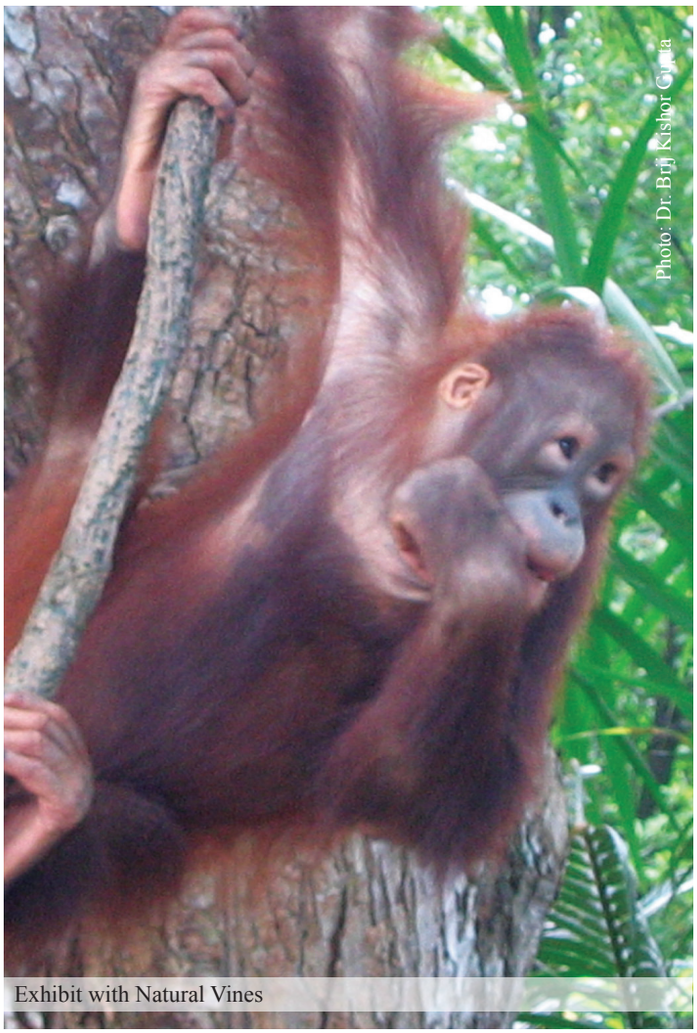
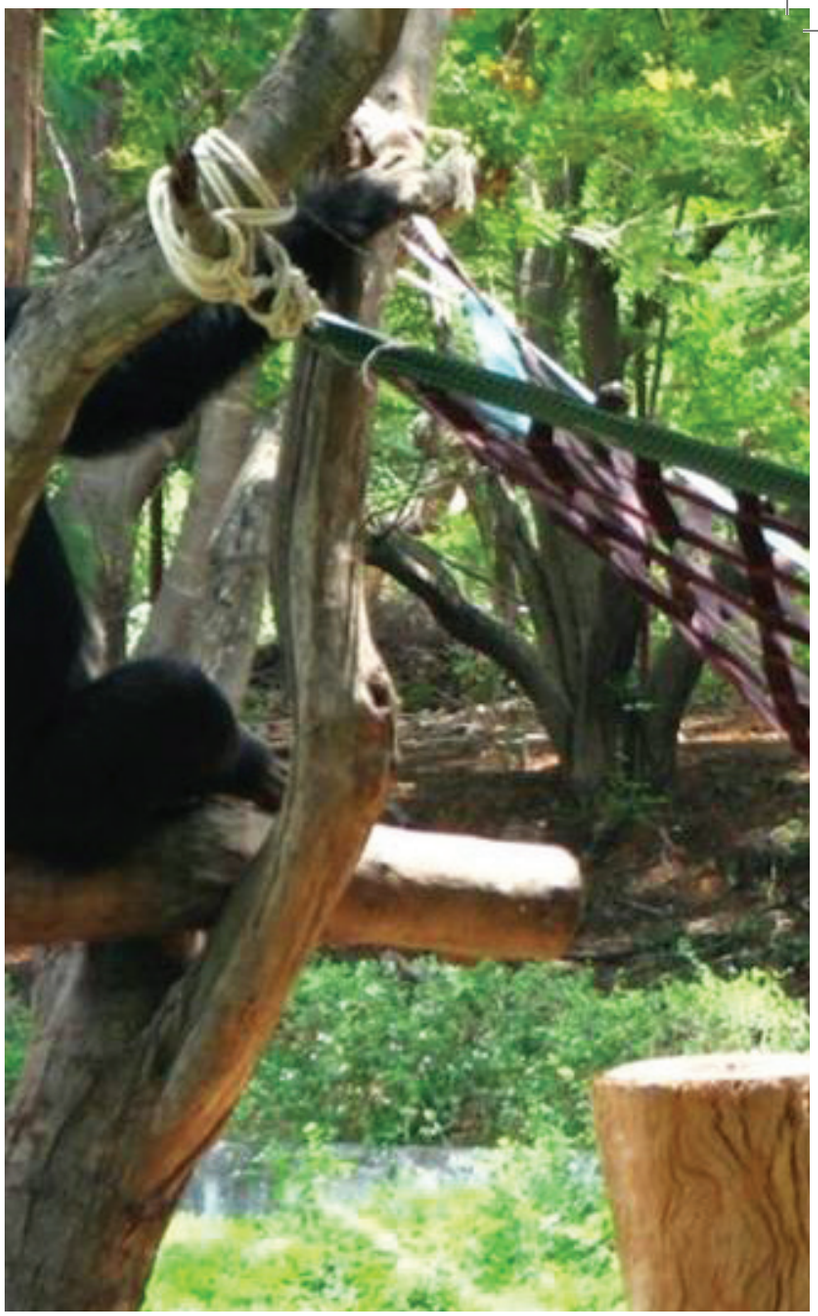


Exhibit with Natural Vines



Types of Exhibit Enrichment that Can Be Provided to Primates Housed in Zoos

- Climbing structures: trees, bamboo, artificial vines, ropes, etc.
- Weather considerations: cover from rain, structures providing shade, sunny spots, wind breaks, etc.
- Substrate variety: grass or ground cover for reclining on, sandy areas for digging, soil, compost, mulch piles, piles of hay and straw (good for night houses)
- Log piles to re-arrange, to hide forage foods in, to break up the exhibit space and to offer protection for subordinates
- Variety of feeding sites or feeding options
- Water features: pools, waterfalls, moats, sprinklers, showers, misters
- Items that can be hung at varying heights
- Mixing of species for social stimulation (i.e., exhibiting some primate species with small ungulates, or exhibiting small primate species with birds, reptiles, etc.)



Logs provided to Marmosets



Hammock - a hanging bed of rope canvas, suspended on two trees provided to primates at Mysore Zoo.



Photo: Dr. Brij Kishor Gupta

Elevated platform made of wooden logs / bamboo utilized by primates in zoos



Photo: Dr. Brij Kishor Gupta

Elevated platform made of wooden logs / bamboo utilized by primates in zoos



Dead logs of different shape & size may be provided in animal exhibits for resting purposes of animals.



Photo: Dr. Brij Kishor Gupta

Natural running water source in animal exhibit is an additional enrichment for the animals



Photo: Dr. Brij Kishor Gupta

Dead large tree logs provided to Lion-tailed macaque (LTM) at Delhi Zoo



Photo: Dr. Brij Kishor Gupta

Large boulders provided to LTM at Mysore Zoo to utilize to leap



Photo: Dr. Brij Kishor Gupta

Bamboo filled with insect provided as feeding enrichment at Jersey Zoo

Dietary Enrichment

- Browse for eating and for augmenting the complexity of the exhibit
- Varying feeding times
- Edible material from local plants
- Seeds, nuts
- Cereal, crackers, popcorn
- Treat foods: honey, etc.
- Insects and snails for lion-tailed macaques
- Increased number of feedings as opposed to increased amounts of food

Novel Enrichment/Social Enrichment

- Recycled items: cardboard boxes and cardboard tubes stuffed with forage foods
- Browse: loose and hanging, for eating, to enhance the complexity of exhibits, for perching, for olfactory stimulation, as tools.
- Olfactory enrichment: aromatic flowers, spices, perfumes, odours of other animals, etc.
- Visual enrichment: colourful items, mirrors, wooden balls filled with different types of food items
- Auditory enrichment: music, nature sounds, recorded vocalisations of other species
- Social activities: species-appropriate social groups and conditioning programmes to build rapport with keepers, improve husbandry and reduce stress.

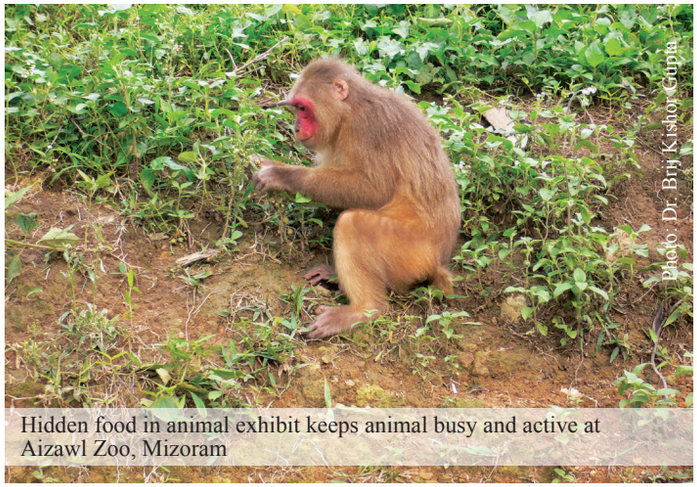


Photo: Dr. Brij Kishor Gupta

Hidden food in animal exhibit keeps animal busy and active at Aizawl Zoo, Mizoram





Photo: Dr. Brij Kishor Gupta

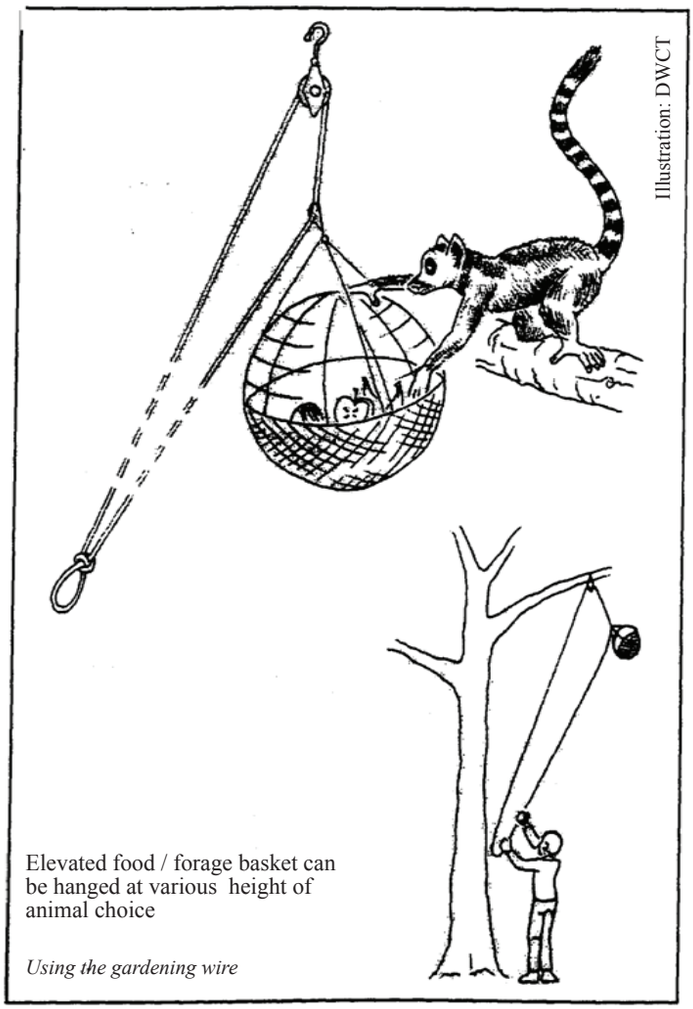
Large elevated platform with dry grass provided on top as shade in summer, utilized by animals to rest and play in large group at Indira Gandhi Zoological Park, Vishakhapatnam



Ropes may be provided for the climbing of animals

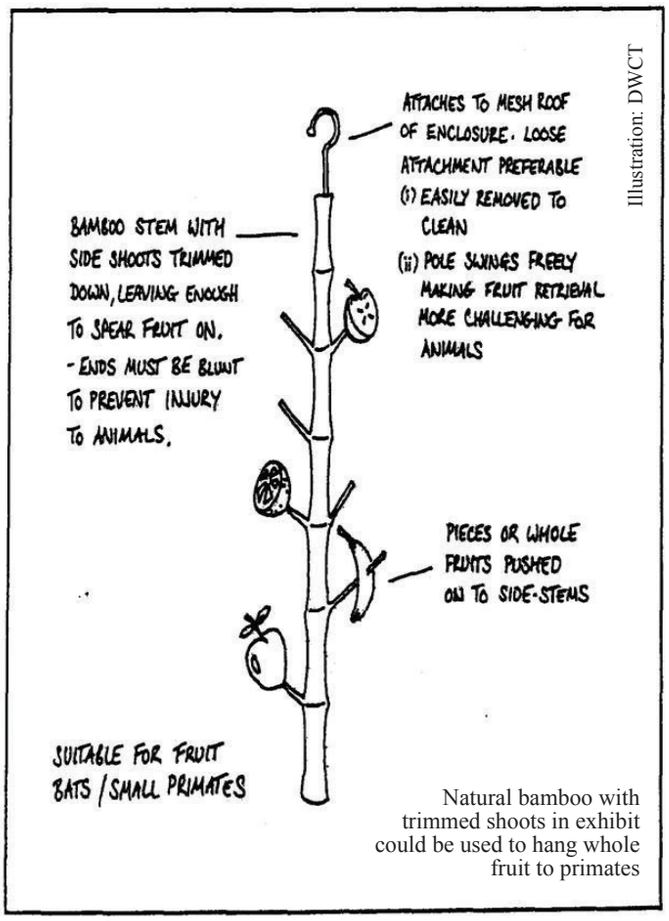
The Illustration shows a feeding device used for lemurs at the Durrell Wildlife Conservation Trust, Jersey, U.K. (This figure and the following two figures, as well as the accompanying descriptions, have been provided by the Durrell Wildlife Conservation Trust.) The feeder is constructed using two 12 inch wire mesh baskets. These are standard wire baskets used for hanging plants and floral displays. The baskets come fitted with three chains joined with a hook, allowing them to be hung. The chains are removed from one of the baskets, but left on the other, allowing it to be suspended. The baskets are wired together with pliable plastic-covered gardening wire. The lemurs are not particularly destructive. So a thin gauge wire is enough to hold the baskets together. A wire mesh insert is now fitted into the bottom section of this sphere to stop food from falling through the larger mesh of the baskets. This insert is fixed to the lower basket

A simple pulley is then secured to a high point in the cage or, if in a wooded enclosure, to a branch. Nylon rope (diameter approximately 1.5 cm) is threaded through the pulley, and the two ends of the rope are tied together to create a continuous loop of rope. This loop has a clip attached to it and a smaller loop knotted in it. The distance between the two is the distance from where the basket hangs in the tree or cage top and the fixing point on the cage furniture or tree trunk. Food items that are to be placed in the baskets are cut to a size so that they can be removed through the wire mesh. A number of these baskets can be used in one enclosure, providing more than one feeding point. This can reduce the level of competition between and among the species in the enclosure.

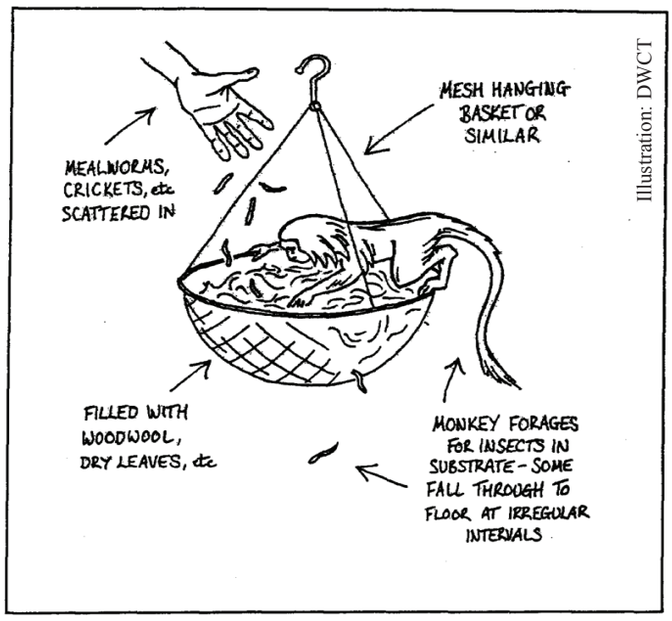


Elevated food / forage basket can be hanged at various height of animal choice

Using the gardening wire



Natural bamboo with trimmed shoots in exhibit could be used to hang whole fruit to primates



Feed basket for providing live food to marmosets and tamarins.

Two other devices have been used successfully with tamarins and marmosets at the Trust. The first employs the same wire baskets used for constructing the lemur feeder mentioned in the foregoing, but these are used without modification. These are simply filled with wood wool or dried leaves, and then the live food is scattered in the basket

The marmosets or tamarins are forced to forage through the material in the basket to find the food. Some of the live food that is not immediately found will work its way through the basket and fall to the ground. This provides additional enrichment as the animals can forage for food through the substrate provided on the floor or ground of the enclosure.

The second of these devices is simply a piece of bamboo stem with the side shoots trimmed down. Enough of the side shoot is left to allow pieces of food to be pushed on to it. The ends of the cut side shoots must be blunt to avoid any potential risk to the animals. A hook is then fixed to the top of the stem, allowing it to be hung in a suitable position in the enclosure

The divice shown in the above illustration has also been used successfully with fruit bats. These three devices are all simple to construct but can provide a substantial degree of enrichment to an animal's environment. This can result in reduction in stress and its manifestations, such as aggression and stereotypic behaviours.







Enrichment Ideas for Nocturnal Animals

Chapter 9

ENRICHMENT IDEAS FOR NOCTURNAL ANIMALS

Nocturnal Animals are those which are more active at night than during the day. These animals sleep during the day, often in a burrow or den or in their nest . Many animals, like desert animals, are nocturnal in order to escape extreme daytime heat. These special adaptations have been developed among nocturnal animals that help them survive in the dark.

In zoos, nocturnal animals are usually kept in special night-illumination enclosures to invert their normal sleep-wake cycle and to keep them active during the hours when visitors will be there to see them. However, the animals housed in nocturnal house requires special attention with respect to their upkeep and housing. Due precaution has to be taken to taken to take care of their health, it should be ensured that they get the adequate diet and their biological and behavioural requirement are met in captivity. Today most nocturnal houses house animal the animals as mixed species exhibit and zoos rotate them between exhibit to exhibit as well from paddock open to spy to night houses which are open for visitors view.

To keep your animal behaviourally health, it is advised that nocturnal animal house should have provision of a off-exhibit area, where the animals should get adequate sunlight, natural substrate and it should be of size as prescribed by the Central Zoo Authority. This area should be available to meet animal biological requirement. The animals from this open off-exhibit paddock may be rotated to the night house for exhibit purposes.

While the animals live in captivity there is need to enrich their environment to meet the biological requirements of the animals. Enrichment features such as mounds, burrows, caves, termite mounds, hollow tree trunk could be constructed in the animal exhibits (in the viewing areas) as well as in off-exhibit area to provide an opportunity to meet the animals behavioural requirement. Many of the nocturnal animals are good burrower, thus adequate measure should be taken while designing all animal exhibits. These exhibits should be provided with escape proof concrete layer with a layer of weld mesh. This may be filled up with soil 0.50 mts to 0.65 mts depending on the species.

The basic enrichment details on some of the common nocturnal animals could be adopted by the zoos is as follows:



Photo: Dr. Brij Kishor Gupta

Soft soil provided as substrate is for all burrowing animals including Porcupines.



Photo: Dr. Brij Kishor Gupta

Slender loris utilizing the tree logs to rest at Nehru Zoological Park, Hyderabad

Hedgehogs:

Hedgehogs are primarily nocturnal, though there are reports seen them active during the day also. Hedgehogs sleep for a large portion of the day under bush, grass, or rock, or most often in dens dug in the ground, with varying habits among the species. In wild hedgehogs hibernate, though not all do, depending on temperature, species, and abundance of food. In captivity they should be provided soft soil as substrate. The part of substrate should have common wild species of grass, piled rocks to hide and small bushes for hiding as well as leaf litter.

As Hedge hogs have broad diet, including worms, slugs, caterpillars and many other invertebrates, as well as frogs, berries and the eggs, so in captivity wide variety of food should be provided as feeding enrichment. Hedgehogs are good swimmers, thus a water body of saucer shape of the size in proportion to the body size of the animal should be provided as in-built enrichment. Hedge hogs can run fairly quickly, and are well known for their habit of rolling into a tight ball when threatened.

Civets

They are usually active between 6:00 pm and 4:00 am, being less active during nights when the moon is brightest. They are good climbers. They are known for well known scent marking behaviour and olfactory response. The exhibit should be provided with wooden logs for them to climb and elevated wooden platform for hiding. They should also be provided hollow tree trunk for hiding and adequate bushes, leaf litter in the exhibit.

Binturongs

They are exhibited an arrhythmic activity dominated by crepuscular and nocturnal tendencies with peaks in the early morning and late evening. They are arboreal. These animals are active during the day and at night.

Binturongs are omnivorous, feeding on small mammals, birds, fish, earthworms, insects and fruits. Captive binturongs are particularly fond of plantains.

The binturong uses its prehensile tail as an extra hand, moving slowly, but efficiently, carefully placing each footstep, although it will occasionally drop to the ground to move between forest gaps, and even swim in rivers and catch fish. As binturongs are not very nimble, they may have to descend to the ground relatively frequently when moving between trees, so large logs or live trees of adequate size should be provided to meet their biological requirement.



Photo: Dr. Brij Kishor Gupta

Large live trees provided inside the animal exhibits, as of used in the wild by arboreal animals like Binturong



Photo: Dr. Brij Kishor Gupta

Civet cats provided with elevated platform made of Bamboo for hiding and resting



Photo: Dr. Brij Kishor Gupta

Flying squirrel provided with nest boxes to hide and bamboo perch

Flying squirrels

Flying squirrel are nocturnal and arboreal in nature, These squirrels roost in tree hollows lined with bark, fur, moss, and leaf. These squirrel many times occupy nest abandoned woodpecker holes, owl nest boxes and natural cavities in snags, so wooden logs having such cavities may be provided for squirrel in captivity, if not nest boxes may be provided on the wooden logs of the size of the species is houses. They may use regular nest boxes or gourds. Flying Squirrels are the only nocturnal tree squirrel, and are the smallest of all squirrel. The size of the flying squirrel should be large enough with adequate height, so the flying squirrel should be able to take glide by adjusting the tautness of the patagium (furry membrane).



Photo: HZP, Sikkim

Flying squirrel with large trees covered by live moss and lichens, which serves as food material too for these Squirrels



Slow loris, arboreal in nature, mostly found on canopy should be provided with large trees with foliage

Lorises:

Indian has two species of lorises (Slender loris and Slow loris). The species have life spans of 15 years and are nocturnal. Slender lorises generally feed on insects, reptiles, shoots of plants and fruits. All lorises are nocturnal and eat a variety of fruits and vegetation in addition to insects, small mammals, and birds. As per the records available they are solitary with the home ranges of males overlapping those of females. During the day, lorises sleep in branches, crevasses or buried in leaf litter on the ground. Their normal sleeping posture is curled up with their heads tucked up between their thighs. In captivity they should be provided with nest boxes of adequate size, tubes, and dense foliage. In slender lorises, it is particularly important that these retreat areas are provided in the lower part of the cage.

Slow lorises are slow and deliberate climbers, and often hold on to branches with three of their four limbs, thus adequate braches to provided for climbing.

Porcupines:

Porcupines are rodentian mammals with a coat of sharp spines, or quills, that protect against predators. They are generally nocturnal but are occasionally active during daylight. Porcupines are the third-largest of the rodents. They live in forests and deserts, and on rocky outcrops and hillsides.

Indian porcupines have a very broad and mostly herbivorous diet. They consume a variety of natural and agricultural plant material, including roots, bulbs, fruits, grains, and tubers, along with insects and small vertebrates. Because they are cecal digesters, they are able to exploit low quality forage. They have also been known to chew on bones to acquire minerals, such as calcium, that aid in quill growth. Their capability to form substantial fat reserves is a useful adaptation for living in seasonally fluctuating habitats. Both adults and weaned juveniles spend an average of 7 hours foraging every night.

During the day porcupines, remain in their dens. but throughout the winter they will occasionally emerge from their dens during daylight hours to bask in the sun. Thus enough sand should be provided to Porcupines to construct their dens on their own.

The Indian crested porcupine is semi-fossorial. They live in natural caves or in excavated burrows. Because they do not climb or jump well, they spend most of their life on or under the ground. However, they are good swimmers. Thus zoos may construct natural caves or excavated burrow as in-built enrichment. A water pool of adequate size and shape should also be provided as an added enrichment.



Porcupine enclosure should have underneath a lining of C.C, embedded with weld mesh to prevent escape

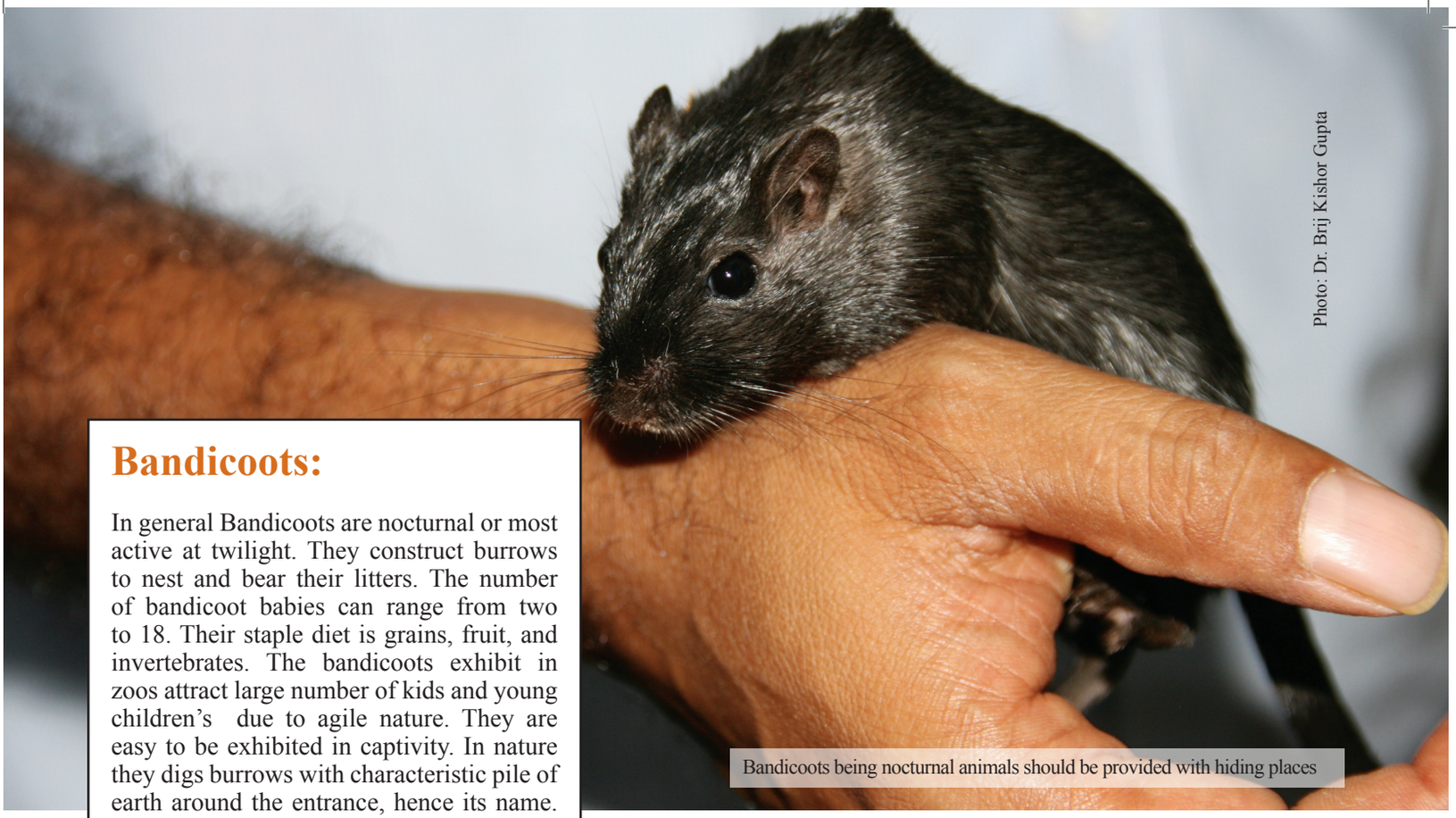


Photo: Dr. Brij Kishor Gupta

Bandicoots being nocturnal animals should be provided with hiding places

Bandicoots:

In general Bandicoots are nocturnal or most active at twilight. They construct burrows to nest and bear their litters. The number of bandicoot babies can range from two to 18. Their staple diet is grains, fruit, and invertebrates. The bandicoots exhibit in zoos attract large number of kids and young children's due to agile nature. They are easy to be exhibited in captivity. In nature they digs burrows with characteristic pile of earth around the entrance, hence its name. The burrow system is extensive and elaborate, consisting of numerous chambers (sleeping, storing, etc.), galleries and exits or 'bolt-holes', which are covered with loose earth, facilitating an easy escape during emergencies. The storage chambers are stocked with large amounts of grain, specially during harvest time. In captivity they should be provided with enough nesting material consist of grass, hay and soft soil substrate. They should be provided with variety of grains, and nuts as an feeding enrichment.

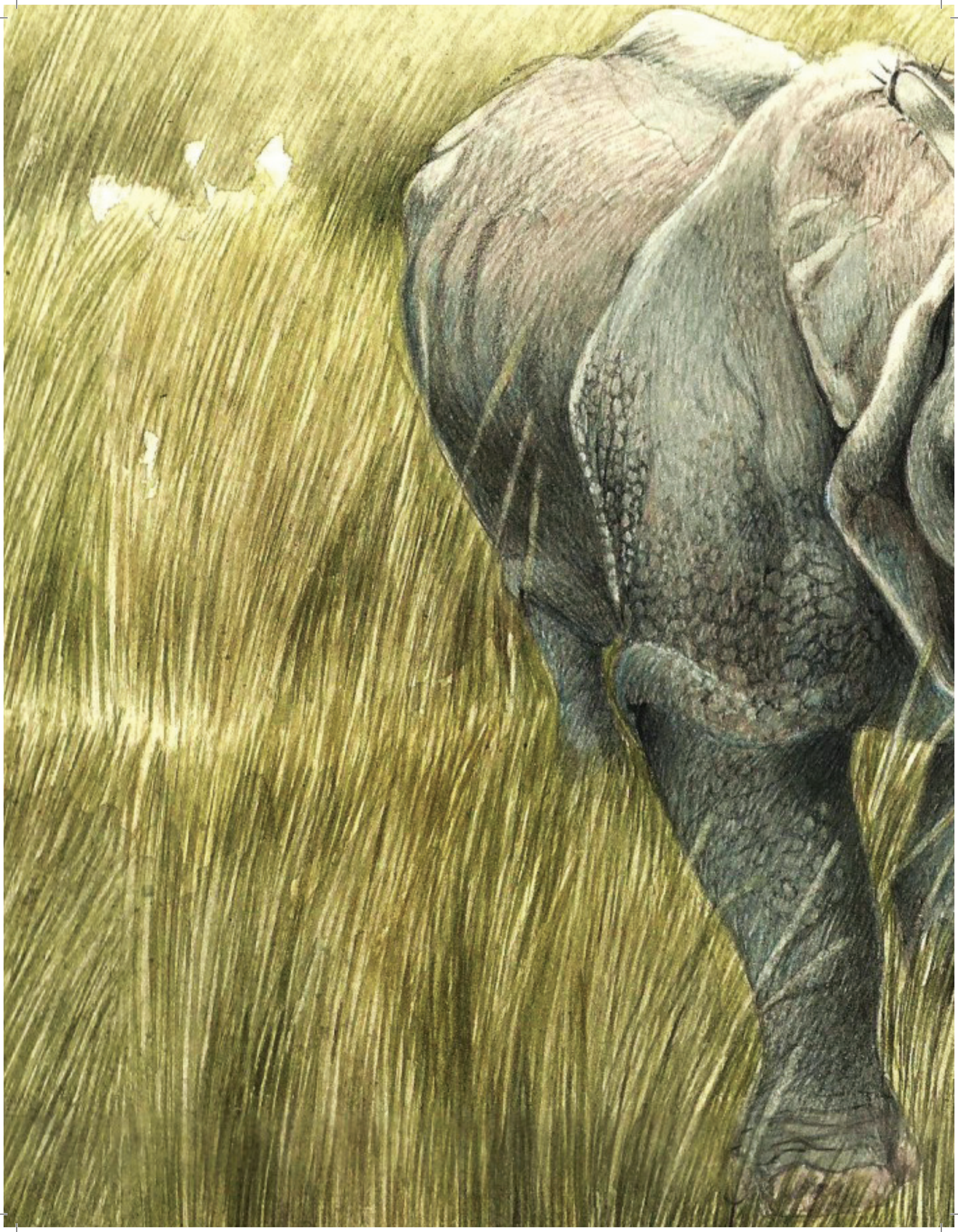




Illustration: Arnab Roy

Enrichment Ideas for One-horned Rhinoceros

Chapter 10

ENRICHMENT IDEAS FOR ONE-HORNED RHINOCEROS

Indian rhinos, or One-horned rhinoceroses, are mostly solitary animals. Adult males have loosely defined territories, which they will defend. Rhinos feed mostly in the twilight hours, and they are generally grazers, tending to feed on tall grasses such as Saccharum species. However, they are also known to feed on other vegetation, including fruits, leaves, cultivated crops and branches of shrubs. Woody browse typically constitutes about 20 percent of this species' diet in winter. The Indian rhino uses its semi-prehensile upper lip to gather long grass and leaves and can tuck the tip of the lip away when feeding on shorter grass.

The One-horned rhinoceros is also known to regularly use mineral licks. Thus, rhino exhibits should be provided with salt licks. The Indian rhino is more aquatic than most other rhinoceros species, readily swimming and wading. Thus, a shallow pool of water of adequate depth and with a gentle slope should be provided for the animals as enrichment. The one-horned rhinoceros sometimes feeds on aquatic grass-like plants when it is immersed in water, and therefore a pool of water with aquatic plants may be created in a rhinoceros enclosure. However, the plants should be tested for toxicity before the animals use the pool. A wallowing area with mud should also be provided.

The Indian rhinoceros has rather poor vision, but what it lacks in sight, it makes up for with its good hearing and strong sense of smell.



The One-horned rhinoceros exhibit at Delhi Zoo provided with shallow pool of water and adequate grass to graze



Wallowing Pod of – wet mud provided in zoos to one-horned rhinoceros to meet their biological requirements at Assam State Zoo, Guwahati



Photo: Dr. Brij Kishor Gupta



Soft substance in enclosures meets the animal's biological requirement - Assam State Zoo, Guwahati

Structural Enrichment and Enclosure Design

Enclosures of greater complexity provide rhinos with more stimulation. A variety of structural features, such as pools, mud wallows, sprinklers, rubbing posts and rocks, visual barriers and dirt mounds will potentially improve an animal's well-being. Items that may be manipulated, such as logs, laid on the ground or suspended, and whole trees planted on a raised rock or other hard surface, may be lifted by rhinos using their horns or shoulders for extended periods providing them physical exercise. Care should be taken when introducing such items to easily frightened or nervous animals.



Photo: Dr. Brij Kishor Gupta

One horned Rhinoceros housed in natural habitat





Tall grass in exhibit provided for grazing and to hide



Rocks used as barrier are being used by animals for rubbing

Behavioural Enrichment

Grouping animals in an enclosure provides very stimulating enrichment. In average-sized zoos female rhinos may be grouped in one enclosure, and in larger facilities a male may be housed with the females. A calf will generate much interest and activity. Thus including a calf in a group as soon as possible after it is born is encouraged. Where males are held separately, further enrichment may be provided by swapping the enclosures of males and females, with dung heaps being left in place.

Olfactory access and visual contact between males and females should be allowed.



Large shallow pool provided as in-built enrichment in exhibit



Photo: Dr. Brij Kishor Gupta

Dry as well as natural grass used by animals to build its nest for resting

Food as an Enrichment Tool

Although Indian rhinos are more grazers than browsers, browse branches and mulch spread throughout an enclosure will keep rhinos busy for a long time. Make sure that no poisonous species such as Acacia have been mulched. Miscellaneous food items hidden in the substrate, at different times and locations, will also help keep the animals occupied.

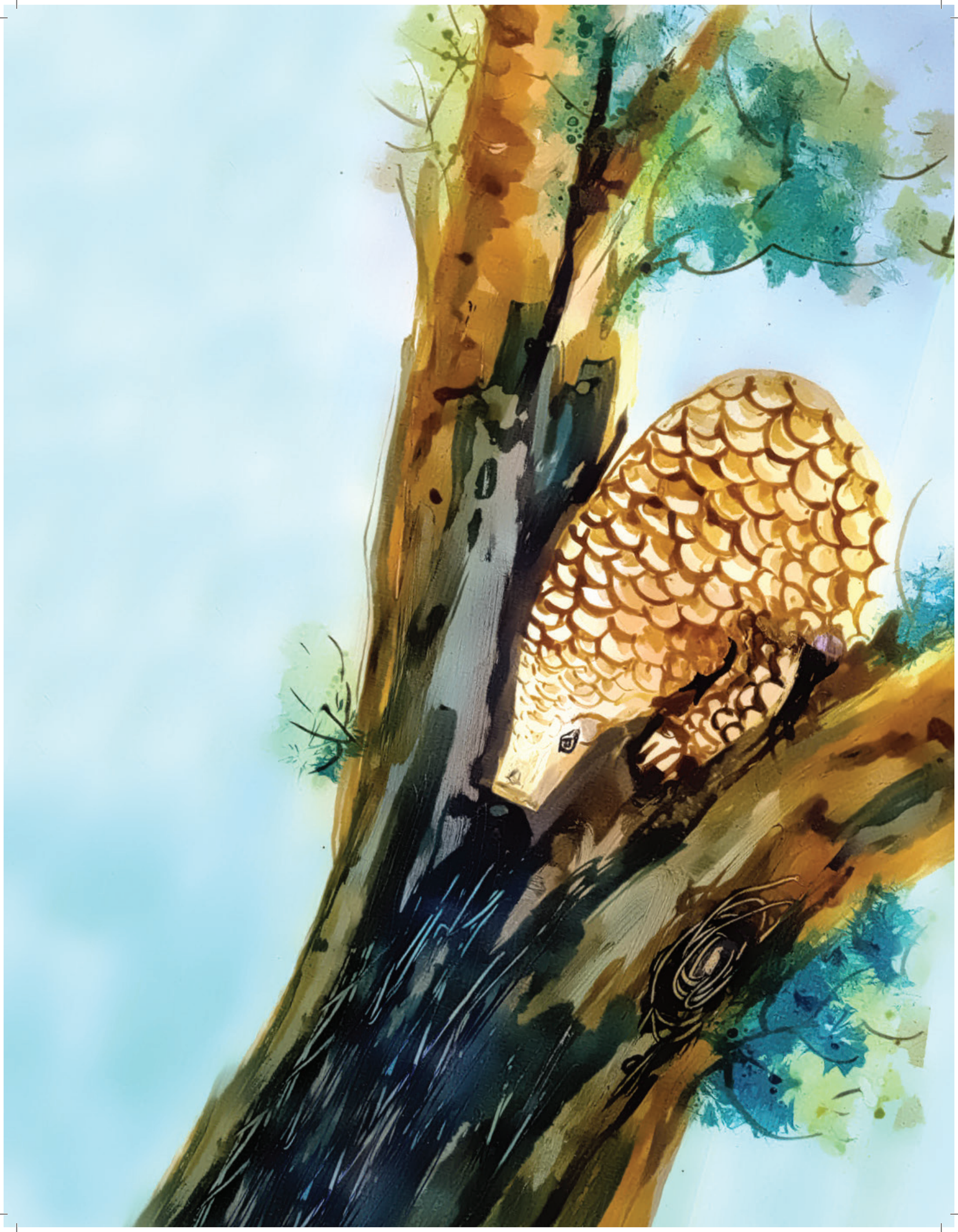
Rhinos may ingest sand or pebbles when digging for hidden items. To prevent such ingestion, hide food under mulch on hard surfaces. Whole fruits such as apples, pears, melons and cucumbers floating in a pool of water will often evoke play behaviour, especially in calves and sub-adults. Branches of trees fixed at various locations in an enclosure will keep animals busy much longer than will browse lying on the floor.

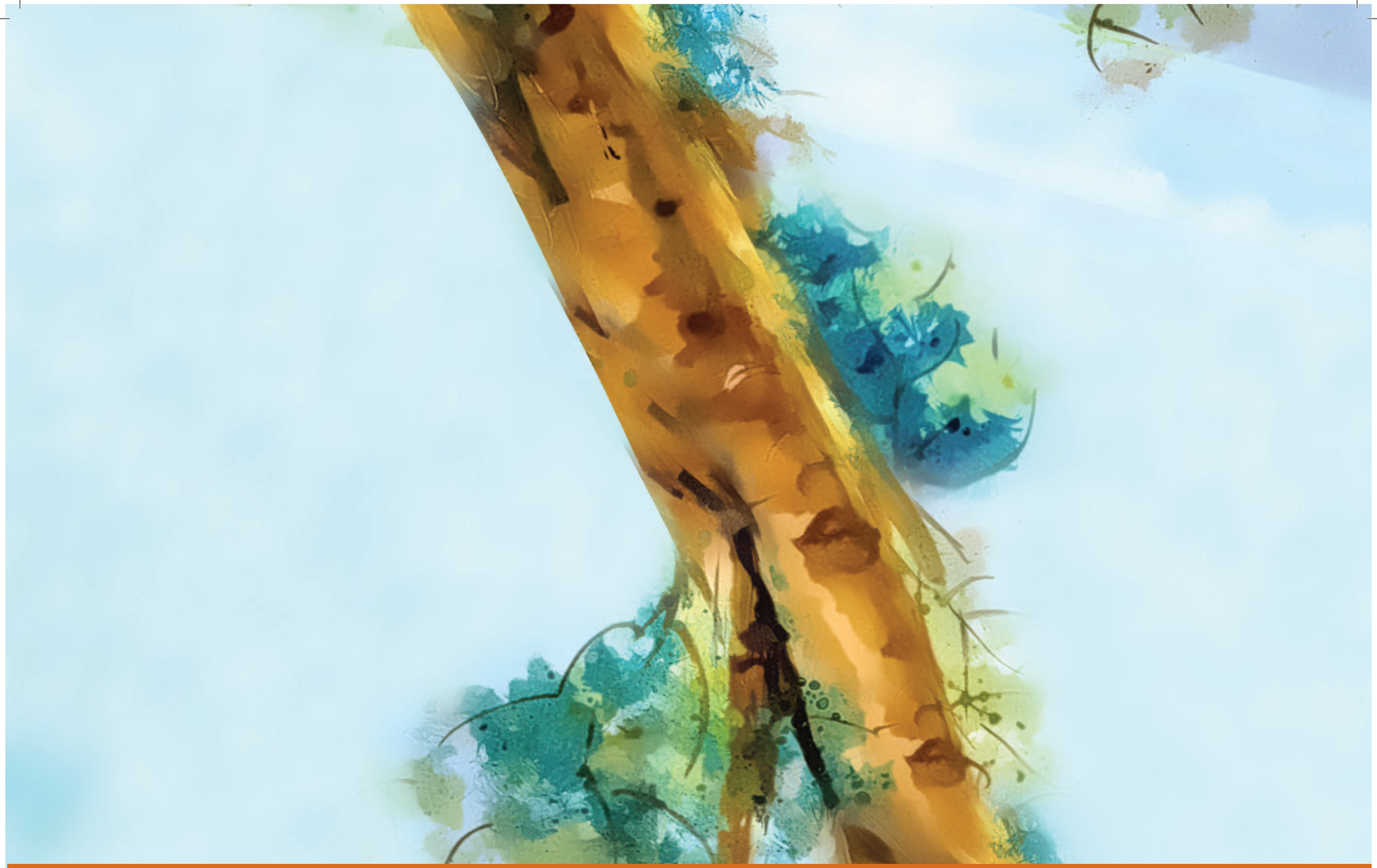


Photo: Dr. Brij Kishor Gupta

Lots of fresh green provided as feeding enrichment







Enrichment Ideas for Pangolins

Chapter 11

ENRICHMENT IDEAS FOR PANGOLINS

The Indian pangolin, being exclusively insectivorous, plays an important role in controlling insect pests in terrestrial agro-ecosystems. Moreover, burrowing animals are ecologically important at a larger scale as their burrows provide shelter and breeding habitats for many other animals. Little is known about the status, ecology, behaviour and reproductive biology of the Indian pangolin in the wild due to its shy, burrowing and nocturnal habits. Besides, very little information is available on its upkeep, which poses a great challenge to rearing it successfully in captivity.



Pangolin provided substrate of soft soil to allow them to burrow



Photo: Nandankanan Zoological Park

Pangolin at Nadankanan Zoological Park, Bhubaneshwar have been breeding well as they have been provided with naturalistic habitat inside the captivity

The diet of the pangolin consists of ants and termites, and the animal has some very effective tools that allow it to hunt these tough little insects. The strong claws on its forelimbs are used to hack into termite mounds and ants' nests, but these claws also allow pangolins to climb trees to feed on harder-to-reach ants. The pangolin has a strong prehensile tail, which provides support when it is feeding, and an extraordinarily long, sticky tongue, which flicks through the passageways of a nest, picking up ants or termites. When feeding, the pangolin is capable of closing not only its eyes, with its thick eyelids, but also its nostrils and ears, to protect these delicate parts from biting ants. The thick-tailed pangolin has no teeth; instead, it has small pebbles in its stomach to grind up food for digestion.

Pangolins are only active at night, spending the day in a burrow, which is often situated under large rocks. It is a solitary species except during the mating season, during which an adult male and female may share the same burrow.

The gestation period is around 65 to 70 days. The single offspring (occasionally twins) will remain in the mother's burrow for 2 to 4 weeks after birth. The young one is then carried out on the mother's back or tail, where it will remain until it is weaned after 3 months. It is not known if male pangolins play any role in bringing up the young.

Indian pangolins are primarily myrmecophagous. They feed on ants and termites using frequent in-and-out movements of their tongues.

Pangolins in captivity at Nandankanan Zoological Park, Bhubaneshwar, are provided freshly procured red weaver ants *(Oecophylla smaragdina)* and their eggs to feed on. About 600 grams of red weaver ants is given as feed to each adult pangolin (5 percent of body weight). Young pangolins may be provided with red weaver ants representing about 10 percent of their body weight. In case red weaver ants are not available, boiled chicken eggs mixed with milk powder (Amulspray) can be provided as alternate food.

The diet of a pangolin may be enriched by providing it with termite combs, which it will readily accept. To encourage exploratory behaviour, pangolins may be offered food at different elevations or feeding platforms.

Drinking water may be provided in a saucer-shaped pool.

Hollow logs and dry branches of trees may be provided as enrichment in exhibits. The pangolin exhibit may be provided with heap of soft soil, atleast 2-3 feet above from the pucca floor for the pangolins to dig, burrow and hide, as they love to burrow. In order to take necessary precaution from their escape from the exhibit or breeding centre, the floor below the soil heap may be made of concrete with a layer of suitable mesh.



Drinking water provided to Pangolins in captivity in saucer shaped pool.





Illustration: Arnab Roy

Enrichment ideas for Elephants

Chapter 12

ENRICHMENT IDEAS FOR ELEPHANTS

Attempts should be made to provide elephants conditions as close as possible to those found in nature. Perennial sources of (running) water, shade provided by trees and opportunities for grazing or browsing are essential for the physical and mental health of captive elephants.



Elephants in captivity provided with natural vegetation, soft substrate, large wooden logs and sufficient quantity of mud to meet their biological and behavioural requirement.

Asian elephants *(Elephas maximus)* are highly intelligent and long-lived animals: Asian elephants may live as long as 70 years, in captivity at least. The dexterous trunk provides a wide variety of functions, from feeding, vocalization and bathing to fighting. The trunk of the Asian elephant has a single finger-like process at the base, whilst the African elephant has two. Elephants use their trunks to pluck grasses and pass them into their mouths.

The average daily intake of food is 150 kilograms of vegetation. Grasses are the mainstay of the Asian elephant's diet, but scrub and bark are also eaten, and a calf may eat its mother's dung to obtain nutrients. Because elephants consume large quantities of vegetation each day, they substantially alter their ecosystem by creating new habitats for emergent vegetation. They also defecate up to 18 times per day and thus play an important role in dispersing the seeds of many plant species. Where elephants range near plantations, they will readily feed on banana or rice crops.



Male elephant provided with emergent vegetation and tubers along with other forage and browse in captivity as dietary enrichment.

Enriching the Captive Environment of Elephants:

1. Forested/vegetated environments and lakes or water bodies are required.
2. Elephant enclosures in zoos should have a minimum extent of 1.2 acres per elephant (according to the CZA's directives).
3. Elephants should be housed in small groups and not as single animals.



In captivity elephants may be housed in compatible groups to meet their behavioural requirement.

4. Elephants love to wallow in mud at all times. The ex hibit areas should therefore be provided with mud wal lows. These wallows should have loose and wet mud. The surface must be soft and should not have any sharp objects or protruding rocks that may injure the elephants.



Elephants enjoying mud wallows in captivity

5. The elephant housing should have a water body that meets the biological requirements of the animals. It should be large enough for the animals to submerge themselves in. Inspite of this other water sources should also be made available for drinking as well as to play to the elephants.
6. Humane training and handling methods must be employed.
7. The interactions between elephants and humans, including mahouts or keepers, should be minimal.
8. The elephant enclosure should have an earthen floor.



Young elephant in mud wallow. It is important in captivity to provide mud wallows to meet their physical, biological and behavioural requirement.



Photo: Jon Coe

Elephant pressing a knob to get automates shower in Zoos

9. The elephants should be allowed to walk at least 5 kilo metres on their own early in the morning.
10. Fodder from trees such as peepal *(Ficus religiosa)*, jamun *(Syzigium cumini)*, neem *(Azadirachta indica)* and Bamboo should be provided, with branches.

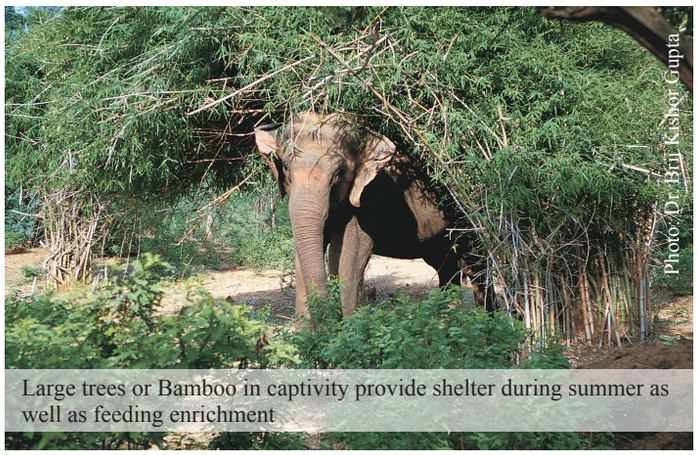


Photo: Dr. Brij Kishor Gupta

Large trees or Bamboo in captivity provide shelter during summer as well as feeding enrichment



Mixture of mud, sand and hay provided good enrichment to elephants in captivity, this also keeps animals busy.

11. The food should be provided at different parts of the enclosure so that the elephants are active and utilise the enclosure maximally.
12. Feeding of particular fruits that the elephants enjoy will be used for enrichments and for po itive rewards when the elephants are needed to do something that is not natural for them, i.e. needs to be weighed or approached for medical check-ups. Coconut pieces, groundnuts, Chana and jaggery are recommended treats which act as motivation and have nutritional value.
13. Whole fruits (pumpkins, watermelons, tom toes), bamboo and sugarcane must be provided for the animals to play with and eat.
14. Edible browse may be suspended at various locations.
15. Sand piles should be provided in the exhibit area so that the elephants can have sand baths.



Large wooden logs provided an opportunity to rub their body



Sand piles used by elephants

16. Whole trees and logs should be set out vertically and horizontally in the exhibit area for elephants to play with and to rub and scratch against.

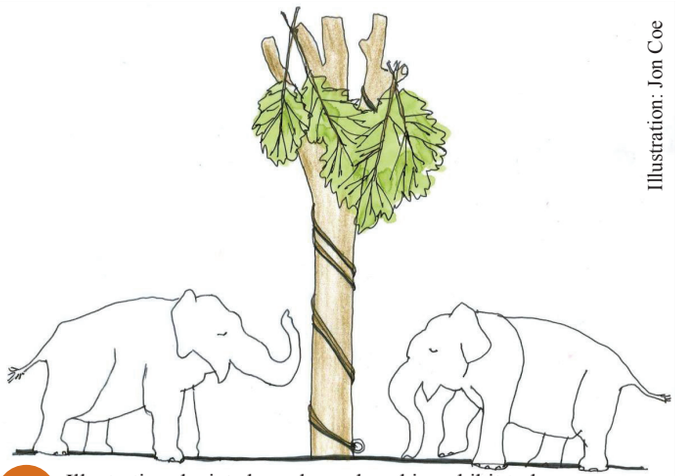


Illustration: Jon Coe

1 Illustration depicts large logs placed in exhibit to hang animals forage

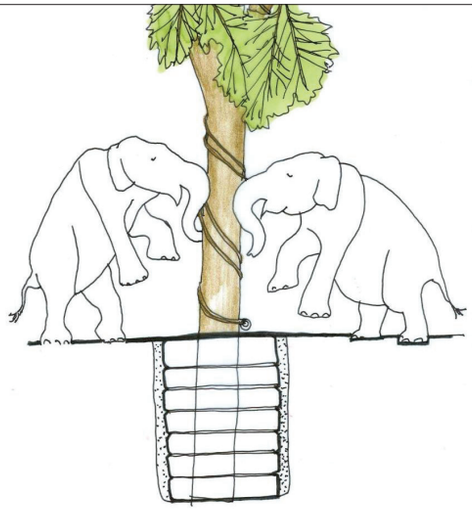


Illustration: Jon Coe

2 The log placement can be seen, as almost 25% of total length kept under the loose soil/sand surrounded by used tires

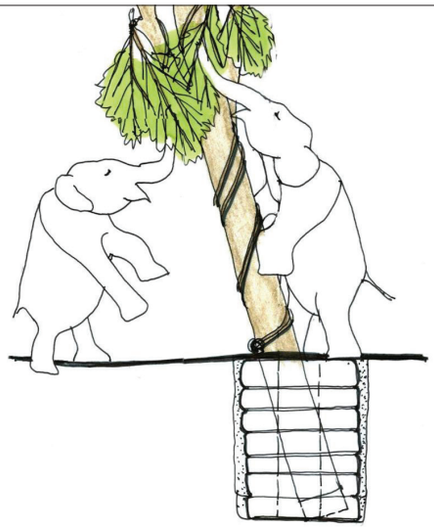


Illustration: Jon Coe

3 As the elephant approach to forage/browse on greens, the log falls, this action generates an excitement among animals

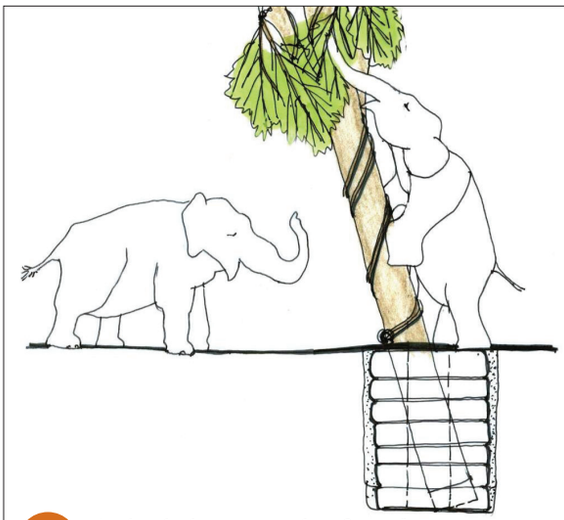


Illustration: Jon Coe

4 As the elephant approach to forage/browse on greens, the log falls, this action generates an excitement among animals

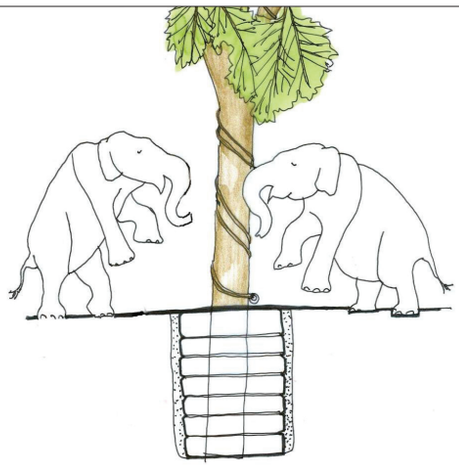


Illustration: Jon Coe

5 This activity of foraging on green provided on logs is being enjoyed by elephants and shows positive behaviour among Elephants

The best form of enrichment in an elephant's environment is the company of another elephant. The lack of company and activities of captivity can be compensated for by providing toys or other physical facilities.



Photo: Dr. Brij Kishor Gupta

Elephant approaching outside exhibit foliage, this should be avoided, as animals may fall inside the moat and injure



The living conditions of housed elephants can be improved by devoting some careful thought. Innovative ideas will help satisfy the physical and emotional needs of elephants. When a log or huge rubber or iron ball is left in an elephant's enclosure, it will gradually start to play with it. A pond of clean water, a water hose or even a hanging bell can serve to save an elephant from the boredom of loneliness and eventual development of stereotypic behaviours such as continuous swinging of the body and trunk. Some elephants even start throwing missiles such as pebbles and foodstuff at visitors and handlers. An elephant displaying such unacceptable stereotypic behaviours should be shifted to the off-display area. All possible attempts should be made to correct these behaviours and to restore the on-display status of the elephant. This may be done only if a reassessment of the animal's behaviour indicates normalcy. A stroll outside the confines of the elephant enclosure is an ideal behaviour enrichment activity for all elephants. Being allowed to move about freely for a while in a meadow or in a forest is an elephant's idea of heaven on earth.

Dusting and throwing mud on themselves is a natural instinct of elephants, and they enjoy mud baths. Mud helps keep insects away from an elephant's body, aids thermoregulation and provides protection against the sun. Loose sand/soil heaps should be provided in the outdoor yard, which the elephants can use for dusting or as surfaces on which to lie down. Every elephant should have access to multiple sand/soil heaps.

The height of a heap will depend on the individual elephant. It can vary between 2 feet and 5 feet. The heaps must be made and rearranged daily in different locations in the outdoor yard and must be soft and loose.

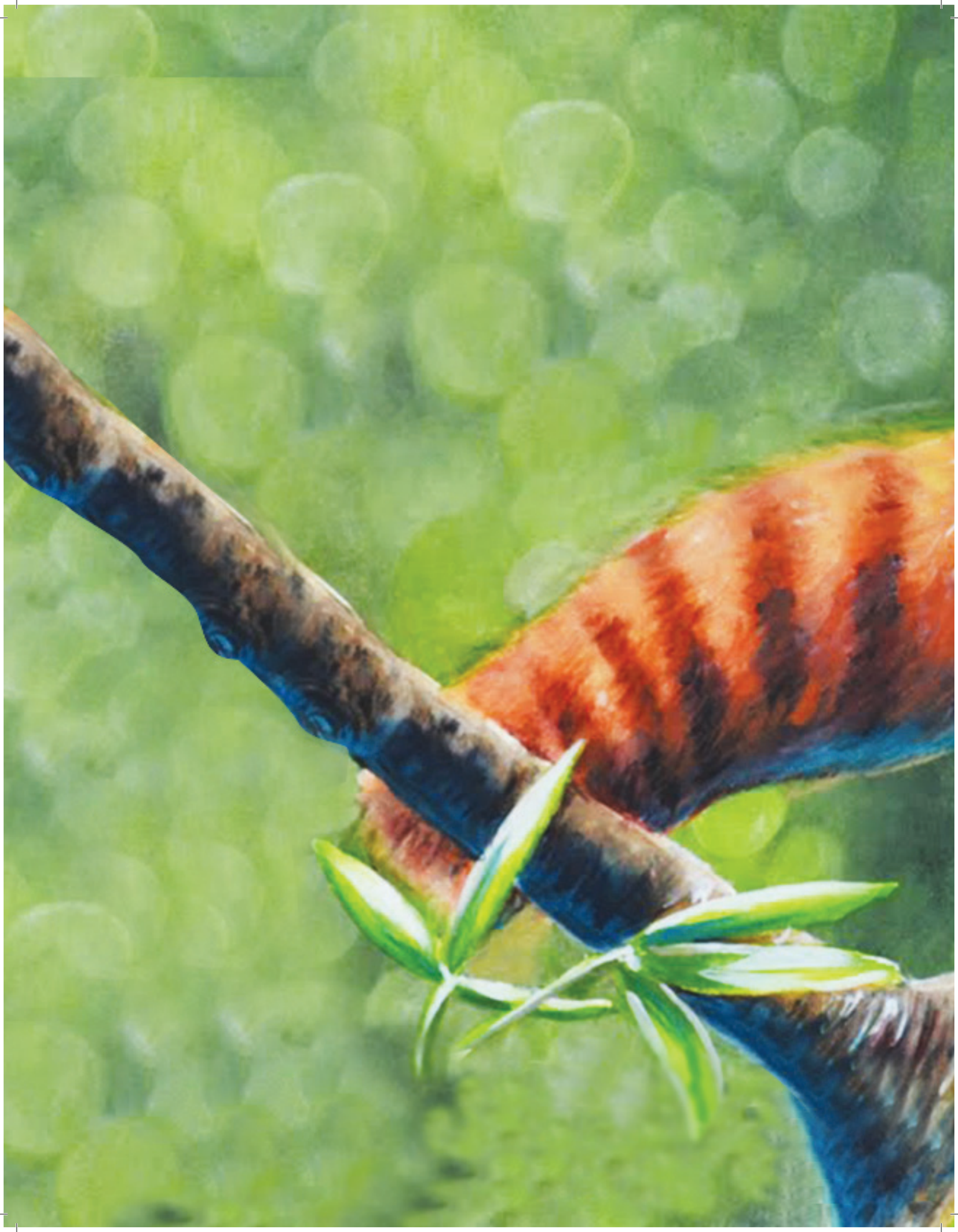
Overhanging fodder and fruit feeders, feeders that make the elephants stretch themselves either vertically or horizontally, can be used as enrichment since these provide elephants good physical exercise. Other strong structures such as wooden logs can be also given to elephants as enrichment to play with or scrub themselves against.



Photo: Dr. Brij Kishor Gupta

Elephant exhibit with loose soil and large wooden logs, as an physical enrichment and to keep them engaged in captivity





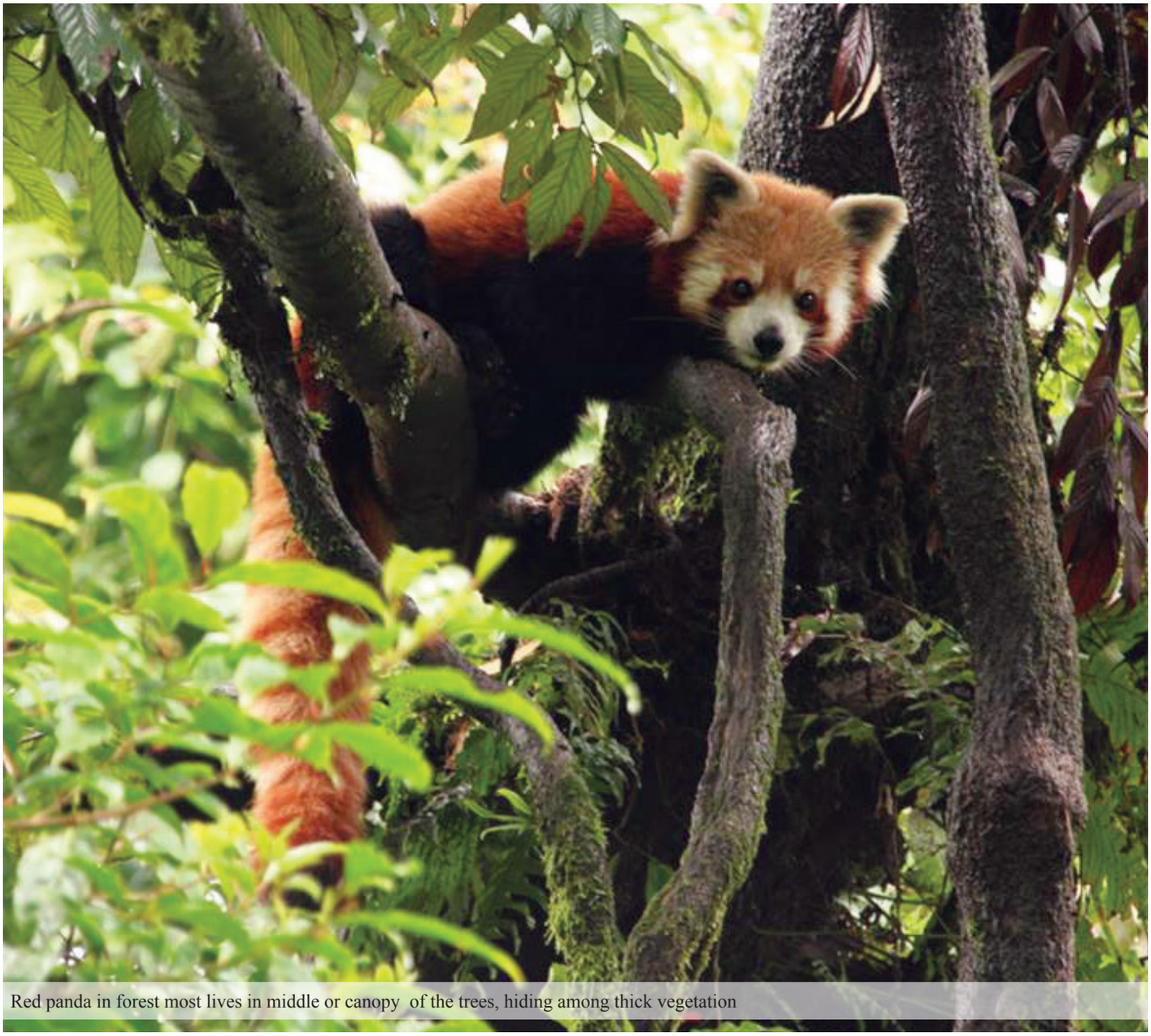


Enrichment Ideas for Red Panda

Chapter 13

ENRICHMENT IDEAS FOR RED PANDA

Red pandas are one of the few animals whose diet consists almost entirely of bamboo. These animals grasp the stems with their forepaws and shear the leaves off with their sharp teeth. Red pandas are only active for around 56 percent of the day and have an extremely slow metabolism. Other foods such as roots and fruit as well as small lizards and birds' eggs are also eaten in the wild. Red pandas have an ungainly walk on the ground but are much more agile in the trees, using their tail for balance, although it is not prehensile. On the ground, the tail is carried horizontally away from the body. After eating or resting the Red panda grooms itself thoroughly.



Red panda in forest most lives in middle or canopy of the trees, hiding among thick vegetation



Red pandas use the vines & logs which has various species of ferns, fungi, which many times also form part of their diet.

Photo: Dr. Brij Kishor Gupta

Live trees provides climbing opportunity to the Red pandas in captivity

Red panda exhibits may be enriched by providing the following:

1. Physical enrichment—providing elevated resting places, nest boxes and vertical and horizontal logs for climbing.
2. Providing live trees, bamboo and other plants and shrubs that are used in the wild.



Nest boxes made of wood and hay provides place for Red pandas to hide & for breeding



Illustration: Jon Coe

3. Earth with rich vegetation and leaf mulch, with sand as the substrate, may be provided.
4. Nest boxes made of wood or hollow tree trunks should be provided for shelter and breeding at different heights. The height of these nest-cum-breeding boxes should be 3 feet, and the circumference should be 6.5 feet (Source: PNHZP, Darjeeling).
5. During the non-breeding period, dry leaves and twigs should be provided as these materials are used by red pandas for making nest-like structures.
6. Resting platforms may be provided in the enclosure at different heights, allowing the animals to climb and utilise the space in the enclosure fully.
7. Aerial walkways interconnecting the platforms may be provided using bamboo.



Wooden Nest box with rain protection on top



Red pandas feeding on bamboo leaves / stem, using the wooden platform

8. Edible grasses should be planted that can act as an alternative source of food.
9. Visual barriers should be provided for the privacy of the animals by planting bamboos.
10. Food may be offered in a variety of ways (i.e., hidden, scattered, frozen in ice, etc.).
11. Scents/sounds of other red pandas or animals of different species may be introduced as stimuli.



Vertical logs provided for climbing of animals at Himalayan Zoological Park, Gangtok, Sikkim



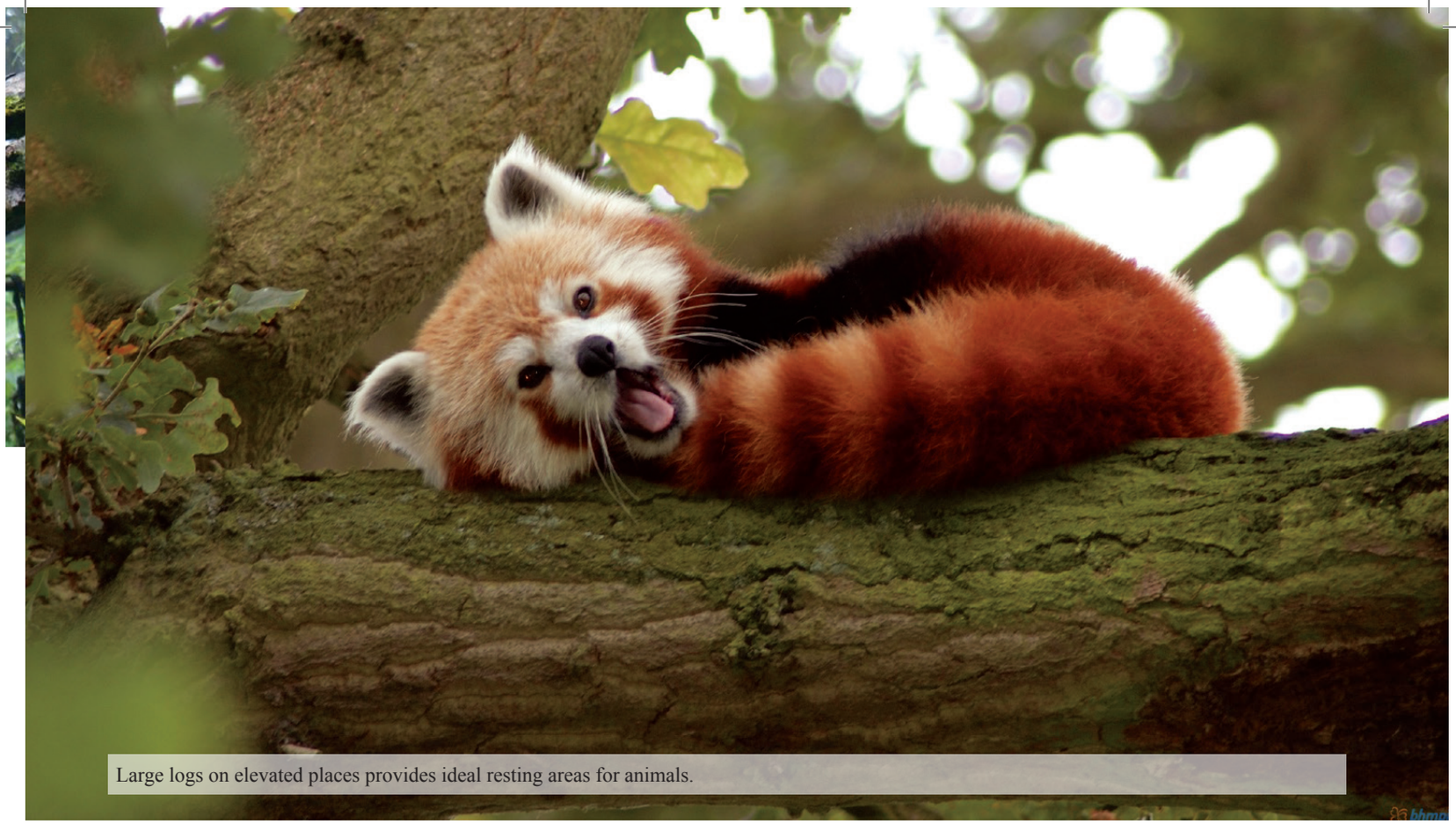
For aerial walkway for animals, horizontal logs are provided to connect adjacent trees.

List of plant species used by red pandas in the wild (Source: PNHZP, Darjeeling; Bhupen Roka and A.K. Jha, Census of Red panda *(Ailurus fulgens)* at Singalila National Park and its surrounding area, Darjeeling, West Bengal, India. ZOO's PRINT Volume XXIX, Number 4, April 2014, pp. 11–14.)

Plant species	**Uses reported**
Rhododendron griffithianum	Stems and leaves used by red panda for defecation
Quercus pachyphylla	Leaves and stems used for defecation
Castonopsis tribuloides	Red pandas sighted resting on this species
Schefflera impressa	Red panda sighted, substrate used for defecation
Abies spectabilis	Red panda sighted, substrate used for defecation
Acer campbelli	Red panda sighted, substrate used for defecation
Sorbus cuspidata	Fruits and leaves eaten, substrate for defecation
Vitex heterophylla	Red panda sighted, edible
Tsuga brunoniana	Substrate used for defecation
Synplocos theifolia	Red panda sighted
Arundinaria maling	Edible

List of shrub species on which red pandas feed in the wild (Source: PNHZP, Darjeeling; Bhupen Roka and A.K. Jha, Census of Red panda *(Ailurus fulgens)* at Singalila National Park and its surrounding area, Darjeeling, West Bengal, India. ZOO's PRINT Volume XXIX, Number 4, April 2014, pp. 11–14.)

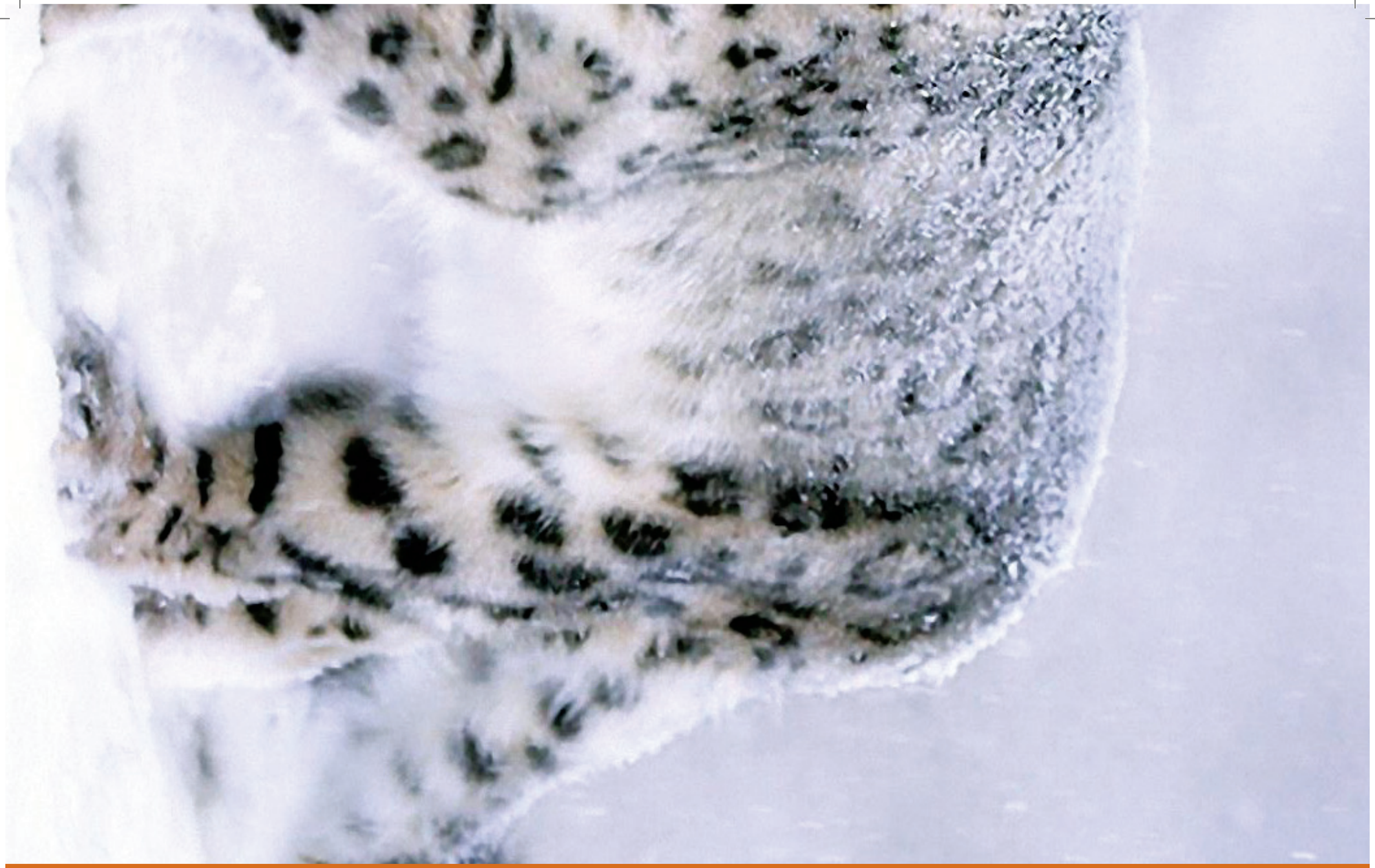
Species	**Local name**	**Family**
Dryopteris sp.	Unniu	Euphorbiaceae
Polygonum molle	Thotnay	Polygonaceae
Actinidia callosa Lindl.	Thakiphal	Actinidiaceae
Daphne cannabina	Lokti	Thymelaeaceae
Virburnum erubescens	Virburnum	Caprifoliaceae
Rubus paniculatus	Jhyala kara	Rosaceae
Arundinaria maling	Malingo	Polygonaceae



Large logs on elevated places provides ideal resting areas for animals.







Enrichment Ideas for Snow leopard

Chapter 14

ENRICHMENT IDEAS FOR SNOW LEOPARD

Snow leopards are most active at dawn and dusk. They are opportunistic predators capable of killing prey up to three times their own weight. Their prey consists mainly of wild sheep and goats, although livestock are also taken, especially if wild prey has been depleted. These cats kill an average of one large animal twice a month.



Rock structures facing sun provided for resting in captivity to Snow leopards

1. Social structure: Solitary. Like most cats, snow leopards tend to travel alone.
2. Males and females may be seen together during the ma ing season. Cubs leave their mother when they are 2–4 years old.
3. Reproduction: Snow leopards mate in late winter. The gestation period is 90–100 days, with cubs being born between April and June.
4. Litter size: Varies from 1 to 5 cubs, with the average b ing 2.2 cubs. Cubs open their eyes when they are 7 days old, walk at 5 weeks' age, are fully weaned by 10 weeks and become fully independent at 18–22 months' age.
5. Behaviour—nocturnal vs diurnal: Crepuscular (most a tive at dawn and dusk). May become primarily nocturnal if living near humans.
6. Shy vs curious: Very shy.
7. Jumping ability (snow leopards are leapers): 50 feet (15 m)
8. Land speed: Up to 40–50 mph.
9. Water speed: Can swim, but top speed not known (swi ming not typical behaviour).



Rocky dens provided for Snow Leopard for their privacy and care of young ones

Enrichment Ideas:

Physical Enrichment

1. Rocks structures for resting
2. Wooden logs for scratching against and playing with
3. Elevated wooden platforms for resting on
4. Large logs for use as walkways
5. Artificial dens to afford privacy and shelter
6. Bamboo, as visual barriers
7. Grass, hay, straw and leaves as substrates for lying down upon
8. Built-in water bodies

Dietary Enrichment

1. Whole feed to encourage natural instincts of the animals
2. Hidden feed to encourage instincts to locate prey
3. Live food to promote predatory and foraging behaviour (In off exhibit areas)
4. Hanging feed at different heights



Snow acts as an additional enrichment as well as it meets animals biological requirement in captivity.

Whole carcass provided in off exhibit areas serves as an dietary enrichment to the animals.

Social Enrichment

Housing compatible individuals in the same enclosure to promote the expression of natural behaviours and enhance the chances of successful mating

Olfactory Enrichment

Fresh herbs, spices, perfumes and even elephant dung serve as olfactory enrichment. Snow leopards enjoy just about any scent they encounter.

Auditory Enrichment

Playing recordings of vocalisations made by snow leopards and species that are hunted in the wild



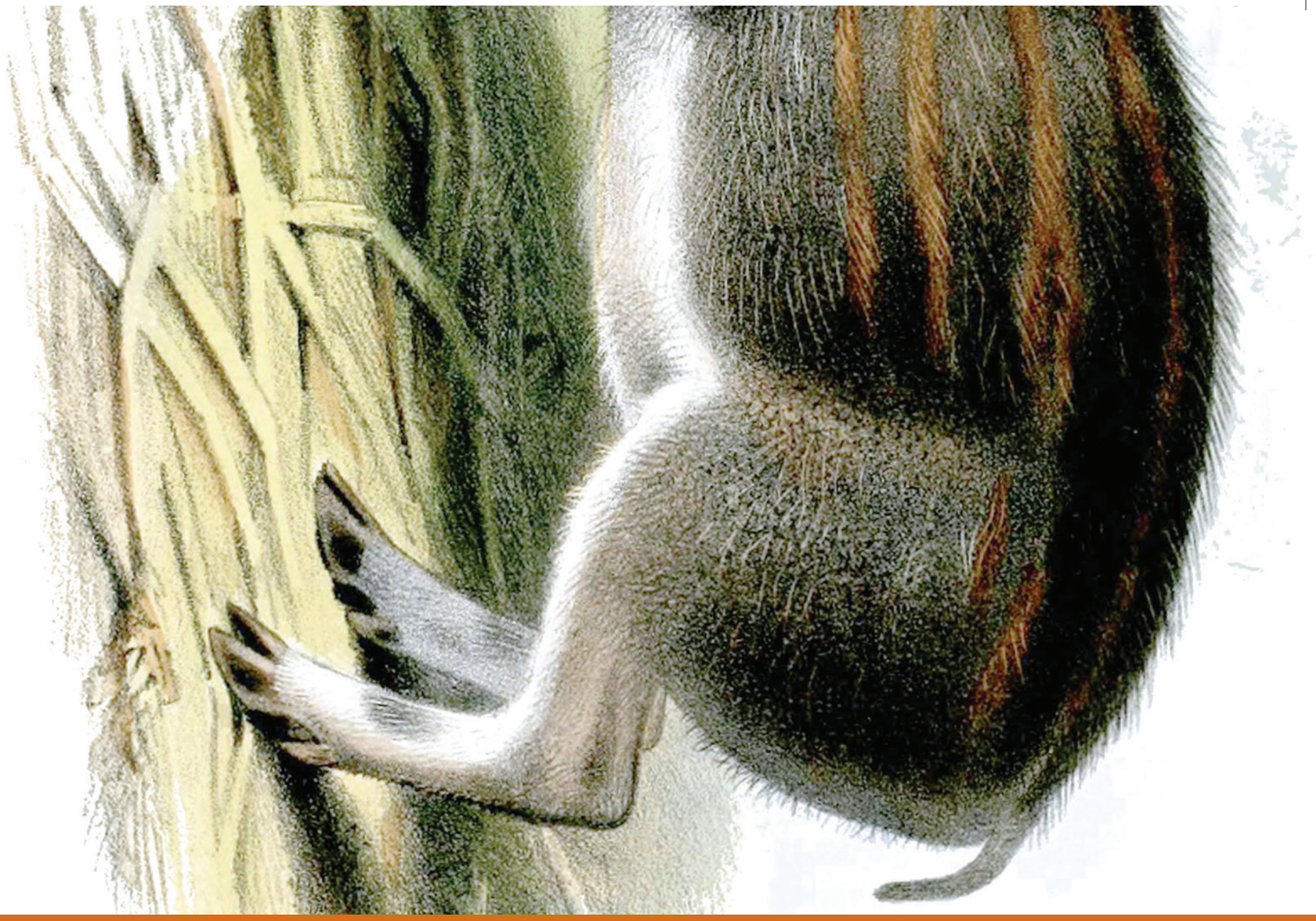
Elevated mound provides unique opportunity to hide & play in captivity.

Novel Enrichment Ideas: Promoting Natural Behaviour

Snow leopards need to use their muscles. Thus a jute sack filled with feed (meat wrapped inside the sack) may be hung inside the exhibit so that the snow leopards can bring them down just as they would their prey in the wild. They then need to rip the sack open, which is like ripping through the skin of their prey. Gunny sacks also act as dental floss, keeping the teeth of the snow leopards healthy.







Enrichment Ideas for Pygmy Hogs

Chapter 15

ENRICHMENT IDEAS FOR PYGMY HOGS

As its common name suggests, the pygmy hog is the smallest member of the pig family. It is also the most endangered member of this family. Pygmy hogs are unusual in that both sexes use nests round the year. The whole family makes use of the nest, which is constructed in a depression in the ground and is lined with grasses.

Pygmy hogs forage for a wide variety of foods, eating roots, grasses, fruits, insects and earthworms, amongst other items. Groups occupy small home ranges of about 25 hectares, and regularly used paths can be seen in the tall elephant grass.

As Pygmy hogs have requirements specific to their species, the following may be provided as enrichment in zoos and conservation breeding centres.



Photo: Dr. Goutam Narayan

Pygmy hogs provided with hidden food to engage them and keep them active



Photo: Dr. Parag Jyoti Deka

Keeper hiding the various food materials inside the green



Pygmy hogs using hay, grass and other vegetation to build their nest in captivity

Nest-Building Enrichment

Hogs use nests throughout the year in the wild. They built their nests on the ground using selected grasses. They repair their nests from time to time. Sometimes they abandon their nests and move to different locations to build fresh nests. This process of nest building is a community activity, and pygmy hogs live in small groups. Similarly, any hogs that livie alone also build their own nests. Nest-building activities consume at least an hour daily.

At the Pygmy Hog Conservation Breeding Centre, in Guwahati, the hogs have been provided everything they need to build their nests by themselves. Varieties of grasses are planted regularly in the paddock and allow the hogs to cut grass to build their nests. Thatch is provided in the pens, and this is used to build nests. This thatch is changed when it becomes unsuitable (after a month of use it breaks into small pieces) for building nests.

Foraging Enrichment

Looking for Insects

The hogs constantly search for insects in the topsoil and go for sewing tender parts of the stems of grasses in the wild. In captivity such foraging is to be encouraged. Hogs have been found using most of their time in their paddocks looking for insects. In order to manage the hogs' paddocks such that enough insects multiply in the ground, it is a practice to stop using some paddocks for some time and then allow the hogs to go foraging in those paddocks again. In the dry season, foraging pits (5 feet × 5 feet) are created. The number of pits depends on the number of hogs and the size of the paddock . Used nesting material is mixed with soil and introduced in a corner of a paddock with a lot of water to encourage insects to grow there.

Chewing Grasses

Hogs sometimes chew tender stems of grasses. They also dig around grass stumps to chew thick roots of grasses.

Looking for Food

Pieces of sugarcane may be regularly hidden in grass clumps to encourage the hogs to look for food in the paddock. Spreading maize may also be practiced.



Pygmy hogs searching for food

Wallowing Enrichment

Pygmy hogs usually wallow during the pre-monsoon period to cool themselves. When they wallow, they vigorously rub their hindquarters into the mud. After a wallowing, they rub their sides and rumps on dry surfaces. Small, shallow wallowing puddles are established in paddocks by digging in the ground. The depressions are filled with water every day in the morning. The locations of the puddles may be changed from time to time. The hogs sit, squatting or laterally recumbent, in the water at times.

Social Enrichment Interactions with Others

With neighbours. At the Pygmy Hog Conservation Breeding Centre, in Guwahati, there are four gates made of iron grills in each paddock. The hogs can have contact through these gates to a limited extent with the neighbouring hogs on either side. Sometimes the paddocks are changed, and the hags have a feeling of moving to new areas and spend considerable time exploring the new paddocks. Also, when their neighbours are changed, they spent time interacting with their new neighbours.

Group formation. Sometimes young hogs are maintained in small groups at the Pygmy Hog Conservation Breeding Centre. During such times, the hogs are found to spend much time interacting with each other.



Photo: Dr. Brij Kishor Gupta

Female Pygmy hog with young ones formed a nest using hay and other grass material for the care of young ones

Food Bundles

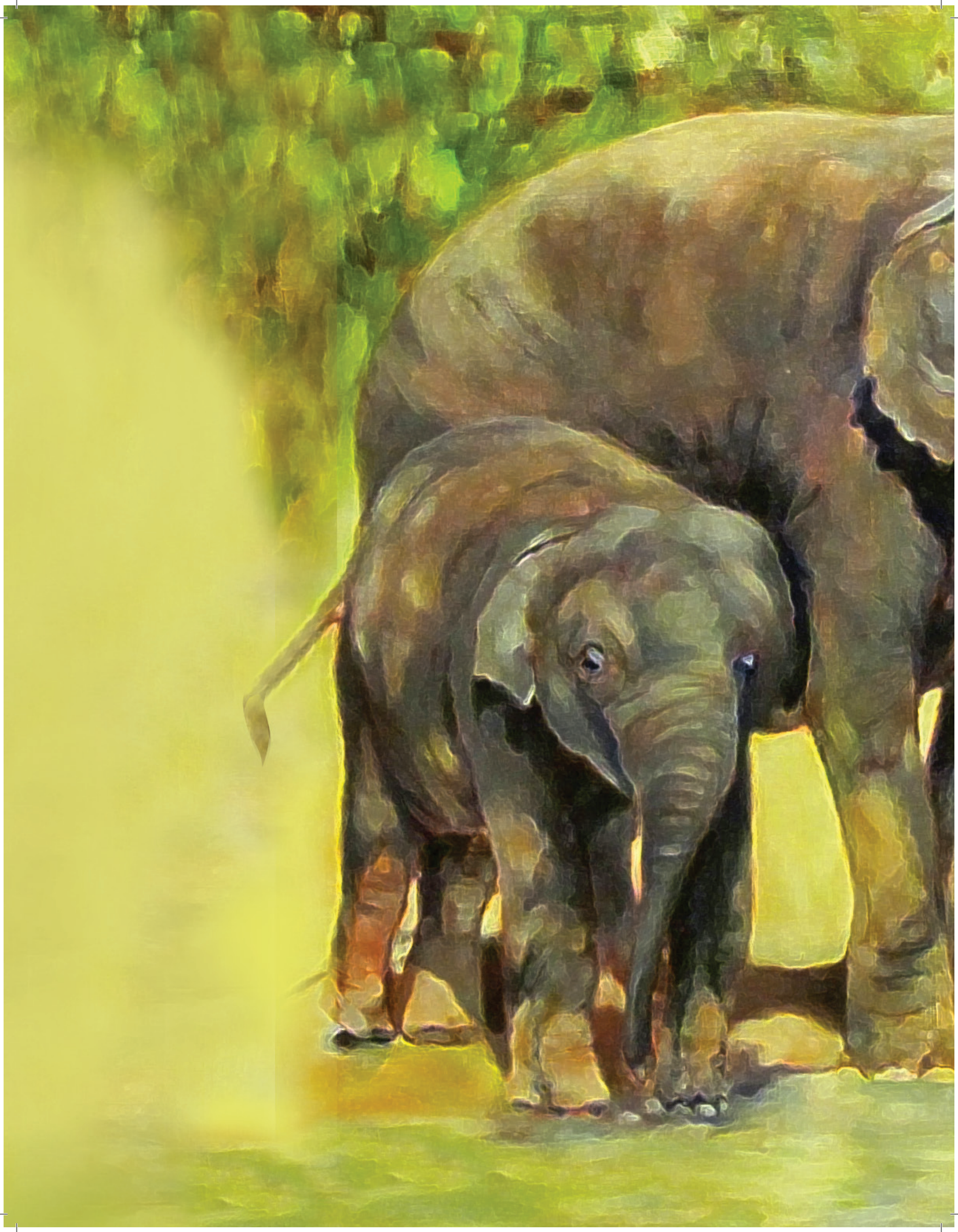
Small pieces of fruit may be tightly wrapped with grass to make bundles, which are then spread about the paddock. The hogs need to discover the grasses bundle first and then spend time tearing the grass to get the food.



Photo: Dr. Parag Jyoti Deka

Food bundles offered at various locations in animal enclosure as dietary enrichment







Enrichment Ideas for Animal Houses (Feeding and Retiring Cells)

Chapter 16

ENRICHMENT IDEAS FOR ANIMAL HOUSES (FEEDING AND RETIRING CELLS)

Today in zoos where the numbers of individual species are beyond its carrying capacity and many large carnivores and herbivores do not live in large groups or Zoos are unable to socialize their animals, thus zoos are force to release single animal into the paddock area for viewing of visitors. Such animals are Leopard, Tiger, Asiatic lion, Sloth bear, Asiatic black bear and many more species. In such situations the most animal in the collection of the zoo spends time in feeding and retiring cells or in krrals.

At some zoos, the animals are opened to paddock only once a week, thus in year the animals are opned to paddock less 50 days only in 365 days, and approximate of 400 hours only out 8760 hours which is about 20 % only. The remaining time these animals spends in feeding and night cells of a size varied from 2.0 to 3.0 meter in length to 2.0 to 3.0 mt in width and about 1.5 to 2.0 meter in height. And these Night Cells do not have any artifacts or any enrichment for the animals and do not provide any activity for the animals, except a water trough made of cement, elevated platform at few zoos and wooden platform on the bottom in the zoos located in colder climate.



Feeding and retiring cells for carnivores should have provision of wooden plank, hay and other enrichment artifacts



Photo: Dr. Brij Kishor Gupta

The feeding & retiring cells and kraals in zoos, particularly where animals are housed for longer hours should have adequate enrichment, as to engage them and to reduce boredom

In zoos the animals are fed between 4.00 PM to 5.30 PM every day with meat with bones. Most zoos have one days as fasting for most animals. Thus no activity. Now you can imagine animals housed for such a long period without any activity, will certainly show abnormal behavior.

Today zoos worldwide provide large night house areas, infact at few places the night houses are provided bigger than the animal paddock because they spend more time in off exhibit in Night Houses, thus their welfare is major concern. The animals while housed in Animal Houses may be provided wooden planks, wooden logs which are good for animal during winter climate as well animal especially the large and small carnivores also like to climb and take rest. They are good insulators during the winter season. The wooden chips and hay also serve as good substrate and bedding material for most mammals in their animal houses. The large carnivores could also be provided with hanging wooden logs also to play with such enrichment tools to encourage animal to engage in various activities. These materials are easily available in market and can be provided as raw or with minor engineering they can be designed as per the animals requirement. These materials are also used by the animals to



Bears provided with artificial nest with bedding material as enrichment



Elevated wooden platform provided for animals to rest, very important particularly in winters and zoos located in colder climate.

play with it. It also prevents animals from bed sore if they stay longer in the animal houses.

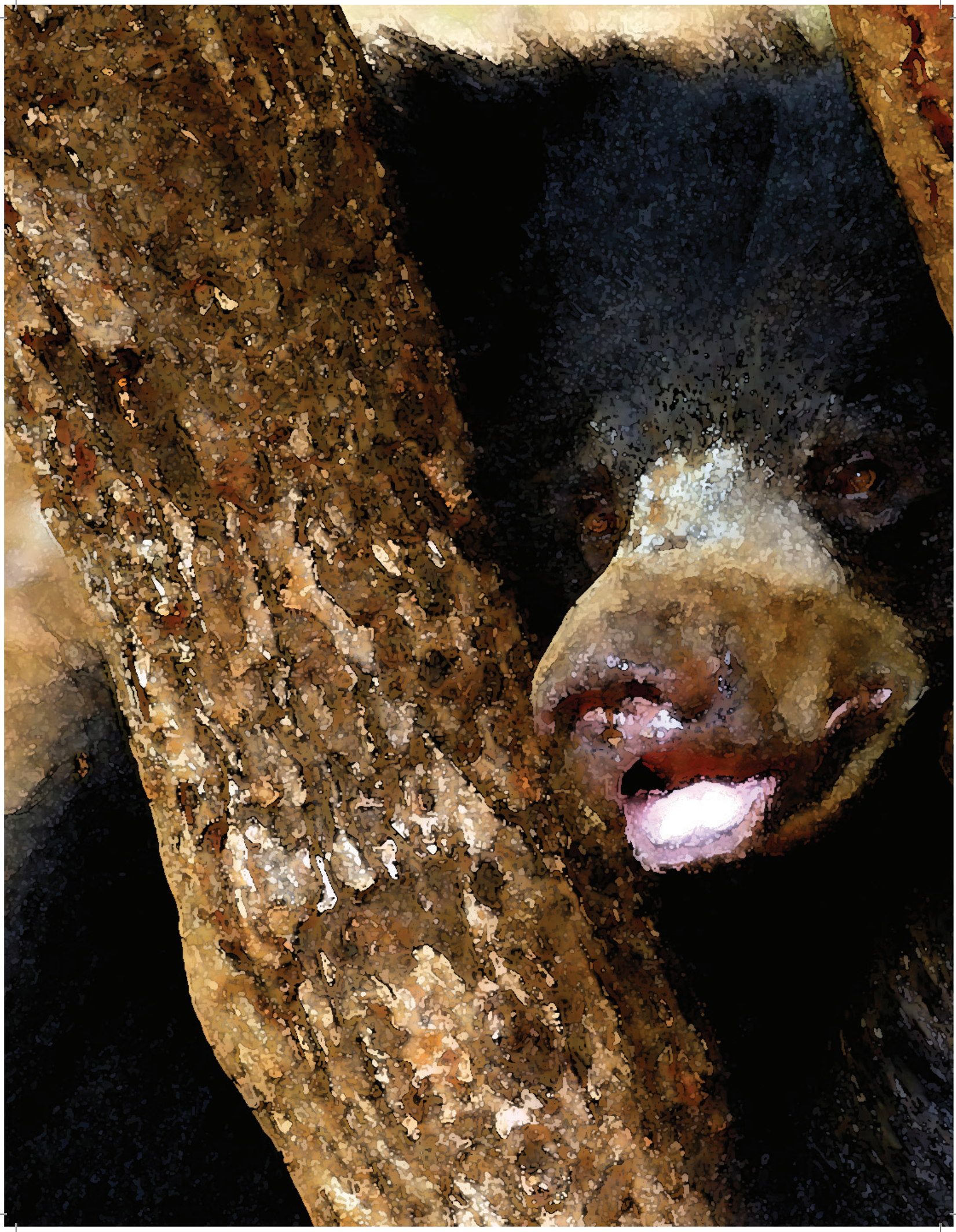
The bears may be provided with platform and basket of hay for them to rest. The birds shall be provided with plenty of dry leaf material, twigs and sticks as well as grass for building nest. The burrowing animals like mongooses, civet cats, porcupines and pangolins, hedge hogs may be provided with solid as substrate for burrowing and engaging them with various activities.



Photo: Dr. Brij Kishor Gupta

The night cell for herbivores should have separate provision for feed and water and should be provided with soft substrate.







Suggested Safety Considerations

Chapter 17

SUGGESTED SAFETY CONSIDERATIONS

When introducing any of the enrichment described in this manual in animal enclosures, the safety considerations outlined in this chapter should be kept in mind. Accordingly, the appropriate precautions should be taken:

I. Amphibians

Amphibians have complex and varied husbandry requirements and are not always easy to maintain and breed. Keepers should aim to replicate wild micro-environments and conditions in captivity as closely as possible, and where feasible captive management should be informed by field data as well as knowledge of the biology of the species involved. Replicating wild conditions may improve captive breeding success. Unfortunately, as little is currently known about the micro-climates utilised by most amphibian species in the wild, keepers may have to collect these very important data for themselves or correspond with field biologists.

Enclosures

The dimensions of enclosures will depend on the type of species being kept. There are several important factors to consider when creating an enclosure for amphibians:

1. Enclosures must be escape-proof. Due to their permeable skin, amphibians may quickly desiccate and die if they escape.
2. The construction material should be easy to clean and preferably be smooth.
3. Wood is not appropriate as it may warp under conditions of high humidity. It is not possible to disinfect wood during routine cleaning, and so this material should be avoided. Many chemicals used to seal wood are toxic to amphibians.
4. Plastic enclosures are a suitable alternative. Any plastic should be food-grade as many plastics can leach substances that may be detrimental to amphibian health over time. Plastics may also become brittle when exposed to UVB radiation (an important component of amphibian husbandry). Plastics can be easily cleaned and disinfected.
5. Glass is another alternative. It is readily available and easy to clean and disinfect although it may break easily. Construction of enclosures using brick and cement should be avoided as these materials may leach minerals into water bodies and may be detrimental to water quality.
6. Amphibians are ectothermic and require a gradient of UVB radiation, temperature, visible light and humidity. Therefore amphibian enclosures need to be lit and to have appropriate-sized meshed apertures in the roof or lid of the enclosure for air exchange.
7. Keeper access is also an important factor to consider. Enclosures should be easy to maintain. At the same time, chances of escape when servicing the enclosure should be minimal. Ideally, drainage holes with taps will need to be provided to facilitate easy cleaning.

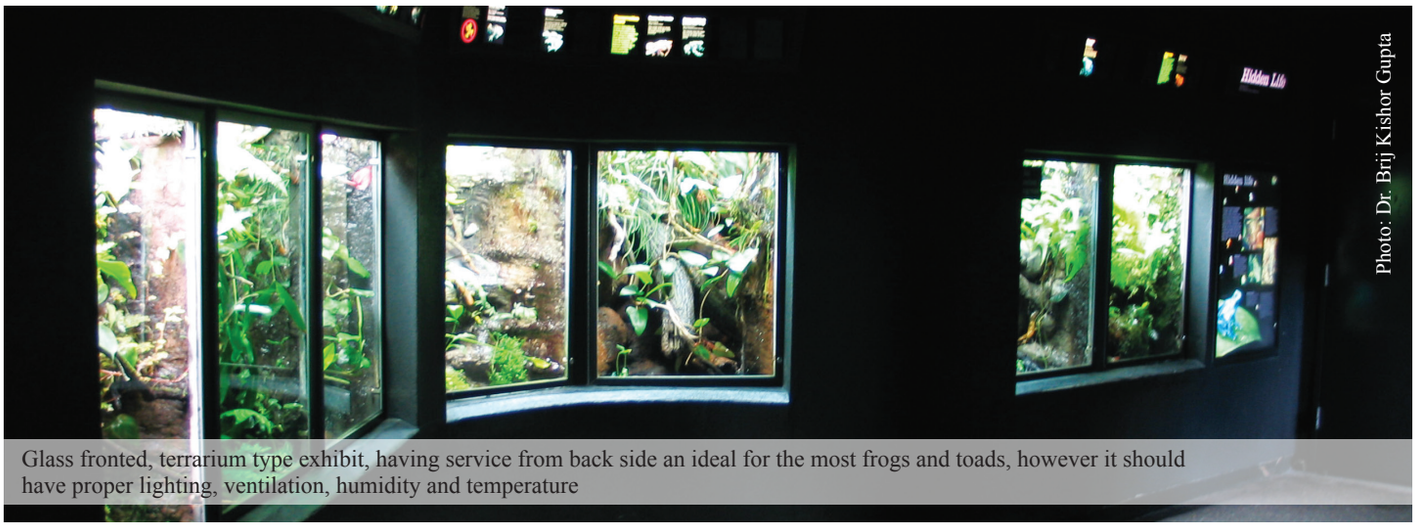


Photo: Dr. Brij Kishor Gupta

Glass fronted, terrarium type exhibit, having service from back side an ideal for the most frogs and toads, however it should have proper lighting, ventilation, humidity and temperature

Substrate

A huge variety of substrates is available for enriching amphibians' habitats in captivity. The type of substrate used will depend on the species being maintained. The depth of the substrate is also important. Amphibians do need to be given the opportunity to sit in dryer areas within an enclosure, and failing to provide some dry areas could result in serious health issues. Substrates should be changed as and when needed and atleast once in 6 months.



Plants, dry leaves provided to amphibians in captivity to hide.

Refugia/Furniture

All amphibians should be provided with refugia . The provision of multiple refugia within an enclosure will make the enclosure more heterogeneous. This is of great importance as amphibians select sites to regulate their temperature and water balance. Objects that provide shelter and visual barriers are also important.

To have the desired effect of providing adequate humidity and reducing stress, shelters will need to be individually selected so that the animals fit in or under them snugly.
Arboreal species will require branches for use as perches or resting sites, and some species that perch on leaves will benefit from live plants (e.g.,Rhacophorus spp.). Aquatic species (including tadpoles) have also been shown to benefit from shelters. Ensure that any live plants are obtained from sources free ofagro chemicals. Also make sure that plants do not have thorns, irritants, toxic sap, hairy leaves or stems or other features that may harm amphibians. Additionally, food insects may feed on plants in terraria before being consumed themselves. So ensure that plant toxins cannot be ingested by amphibians by this route.

Light and Temperature

Wild amphibians have evolved in accordance with their environments. They will reconcile requirement and provision by self-regulating their exposure to heat, light and the associated UVB radiation. The optimal UVB, light and temperature levels for a species will be those found in itsnatural habitat, specifically at the microhabitat level for each life-history stage. Where possible the UVB, light and temperature microclimate throughout the year should be established.

In order to mimic the situation in the wild, heat (infrared radiation), light and UVB should be provided together (i.e. the highest levels of UVB should be associated with the warmest areas of the enclosure, and the lowest levels with the coolest areas). Most importantly, all three must be provided as gradients in the enclosures for appropriate lengths of time each day in order to facilitate self-regulation, with retreats that provide deep shade and no direct UV radiation.

Enclosures should be such that the amphibians cannot come into direct contact with any lamps or heaters as they have extremely sensitive skins and may be easily burnt. All lamps will emit heat, but additional heating and cooling may also be necessary. Rooms can be heated and cooled with air conditioning units. Amphibian enclosures should not be placed under such units, or normal fans, as the air movement can cause severe dehydration. Chilling systems can be installed to cool water in enclosures, if required, during periods of excessive heat.



Gliding frogs in captivity should be provided with adequate area for their jump, other wise they tend to injure themselves

Water

Water quality is an extremely important aspect of amphibian husbandry. Monitoring water quality is vital to rearing healthy captive amphibians successfully. Fluctuating levels of water parameters create stress for individuals. Therefore it is better to maintain constant conditions, even if these are slightly suboptimal although consistent optimal water quality should always be the goal.
It is important to know certain details about the water source. Sources can be tested for dissolved substances, pH and hardness and treated if necessary to provide the appropriate conditions. Consideration must be given to the points of access of the water body. Many amphibians are surprisingly poor swimmers and can easily drown.


Photo: Dr. Brij Kishor Gupta

Amphibian exhibit are provided with live vegetation and if possible circulating water.

Plants

Plants are beneficial in amphibian enclosures. Not only do they provide resting sites for amphibians but they also create microhabitats (e.g., humid pockets of air caused by transpiration and also shade from heat and light) as well as oviposition sites for some amphibian species. Plants are particularly important in aquatic exhibits as they use the nitrogenous compounds for growth, as well as absorb many pollutants, and can improve the water quality.

Diet

Nutritional problems are a major barrier to successful amphibian husbandry. The nutritional requirements of most amphibians are unknown, and the requirements change with the stage of life. Even when the diet is known, it is often impossible to replicate in captivity as captive diets are limited by the commercial availability of food species and the ability to establish breeding colonies of appropriate species. Further, there are difficulties in providing the prey species themselves with suitable diets. Nevertheless, nutrition is a key factor in keeping amphibians healthy and in successful breeding. All possible efforts should be made to provide captive amphibians with as much variety and good nutritional content as possible. To encourage natural feeding behaviour, amphibians should be fed at the periods of peak activity. This will ensure that they encounter the food and that prey items are still coated with dietary supplements when they are ingested.

Seasonality and Breeding

Many amphibians breed in response to environmental cues. These include, but are not limited to, temperature, humidity, precipitation, barometric pressure and changes in water quality. It is important that the seasonal changes found in nature be replicated in captivity even if breeding is not the desired outcome as failing to provide animals with seasonality may cause health issues, e.g., obesity and females becoming egg bound.


Amphibians with eggs should be provided with sufficient water & humidity and adequate food

Providing rain chambers is one of the most common ways of breeding amphibians in captivity. These systems re-create rain showers and usually involve a small pump sitting in a few centimetres of water and supplying water to a rain bar. The frequency and duration of the rains can be controlled by using a timer.



Reptile exhibit provided with multiple habitat types, natural substrate, wooden logs to meet their biological requirement of reptiles

II Reptiles

A major consideration in reptile care and enrichment is that form is not the same as similarity. Two snakes can look superficially alike and yet come from entirely different habitats. It is the species' natural history that should be considered in the implementation of enrichment. The natural history of the king cobra, for example, suggests that because this animal has a large home range in the wild, it will require more stimulation, have a higher overall activity level and need a larger cage compared with a species of boa that occupies a much smaller territory. It is also important to avoid a super-stimulus effect. For example, a Uromastix lizard, which is native to the desert, if given a bowl of water all the time, may sit in it to the extent that algae begin to form on the animal's back. Something is triggered that would be appropriate in the wild but is not shut off in captivity. Over-misting can also be a problem for some species, depending on the specific climates they are adapted for. Caution should be exercised when supplying new sources of water.

Drowning in (relatively) deep, smooth-sided pools has been known to occur with reptiles that are not good swimmers or floaters. Baby turtles have drowned under dense moss in aquatic tanks. When new water bowls or pools are added to turtle or tortoise enclosures, it is important that the animals are able to right themselves from a 'turned over' position in the water, or they may drown. To test for this, the animal should be placed in the water on its back and observed to ensure that it can flip itself right side up. If the animal cannot do, this the water depth should be increased until it can.

Enrichment in an enclosure can create new opportunities for escape or injury and therefore should be planned well in advance. In addition, adequate ventilation must not be compromised by new items in the exhibit. Modifications to an existing habitat can create new hazards, such as drains trapping animals or perches placed too close to the cage mesh causing skin abrasions. Observation after the implementation of changes in an exhibit is critical to ensuring that the enrichment is safe. The potential for an animal to experience stress as a result of changes to its environment should be considered. Stressors can create subtle problems that can be monitored by observing body condition, measuring weights regularly,

The addition of substrates in a reptilian enclosure can provide opportunities for a variety of behaviours, including foraging and locomotion. However, with the exception of desert-dwelling reptiles and some aquatic turtles, sand is not recommended as a substrate because of the risk of gastrointestinal impaction if it is ingested. There is no single substrate that is acceptable across all terrestrial reptile species. Some may be too absorbent and may cause a decrease in the humidity level in the exhibit, leading to animal dehydration; others may not absorb well enough and may cause an excessive build-up of moisture. The frequency with which the substrate will need to be changed to maintain hygienic conditions will depend greatly on the type of substrate, the species housed and how they are maintained (e.g., how frequently they are misted, number of animals, etc.). Gastrointestinal impaction, suffocation and providing a medium for pathogens are all risks associated with the addition of substrates to reptile exhibits. A substrate can be a great asset in an enclosure. When used appropriately, the benefits of its use will, in most cases, far outweigh the risks.

Dietary enrichment often incorporates variety into the animals' diets; however, this can be problematic, especially with snakes. Variety can create finicky eaters, leaving keepers without food options if a snake goes 'off feed'. Live prey items (even crickets) also pose potential danger if they are not eaten immediately as they can bite and injure the animal being fed. This risk can be minimized by (1) monitoring the situation and not leaving live prey in the enclosure for any length of time if the reptile seems uninterested and (2) offering live prey. Prey items may bite the predator out of hunger. Insect prey should be removed from the enclosure regularly as the nutritional value of the prey may diminish over time. When insect prey is collected locally, it should be gathered from areas that have not been sprayed with pesticides. It is also important that browse offered is non-toxic and free of pesticides. The same caution employed in providing mammals and birds with browse should be exercised with reptiles.



Eggs & hatch lings should be reared with care in captivity



Snakes in captivity should be provided with species specific temperature and humidity and lots of wooden logs/bamboo or wines to rest

Keepers should always be careful when working around and handling reptiles as even non-venomous species can deliver septic bites and have anti-coagulants in their saliva. Some people develop skin rashes as a result of a mild reaction to a snake's saliva. Reptiles frequently carry Salmonella in addition to many other transmissible pathogens that pose a risk to both humans and other reptile species. This should always be a consideration when exchanging sheds, increasing the number of conspecifics in an enclosure or creating a mixed-species exhibit.



Photo: Dr. Brij Kishor Gupta

Glass as barrier and glass fronted viewing areas, protects the reptiles from visitor vandalism

There are a number of considerations to ensure the health and well-being of the animals involved when new enrichment is implemented. Consultations with those experienced in reptile husbandry and researching appropriate sources PRIOR to the implementation of enrichment can help prevent mistakes and greatly improve the lives of the animals.

The following are examples of enrichment that may be appropriate for reptiles. They also serve as an overview of safety issues that should be considered in implementation of enrichment.

1. Form does not equal similarity; the natural history of each individual species should be considered
2. The super-stimulus effect should be avoided, e.g., providing water at all times to desert animals can cause problems.

3. Over-misting can cause health problems in some species.
4. The potential of animals drowning in deep (relative to the species), smooth-sided pools should be minimised.
5. A substrate, if used improperly, can cause impaction, suffocation or serve as a medium for pathogens.
6. The use of sand as a substrate should be avoided for most non-desert species.
7. Dietary variety in snakes can create finicky eaters.
8. Live prey items can bite and injure the animal being fed.
9. Browse should be checked for pesticides and other chemicals.
10. Mixed-species exhibits should be designed such that the animals do not prey on exhibit mates. The design should be such that aggression, social stress and dietary competition are avoided.
11. Even non-venomous reptiles can deliver septic bites and may have anti-coagulants in their saliva. Keepers should exercise care when working around them and handling them.
12. Transmissible pathogens such as Salmonella pose a risk to other reptiles and to humans.

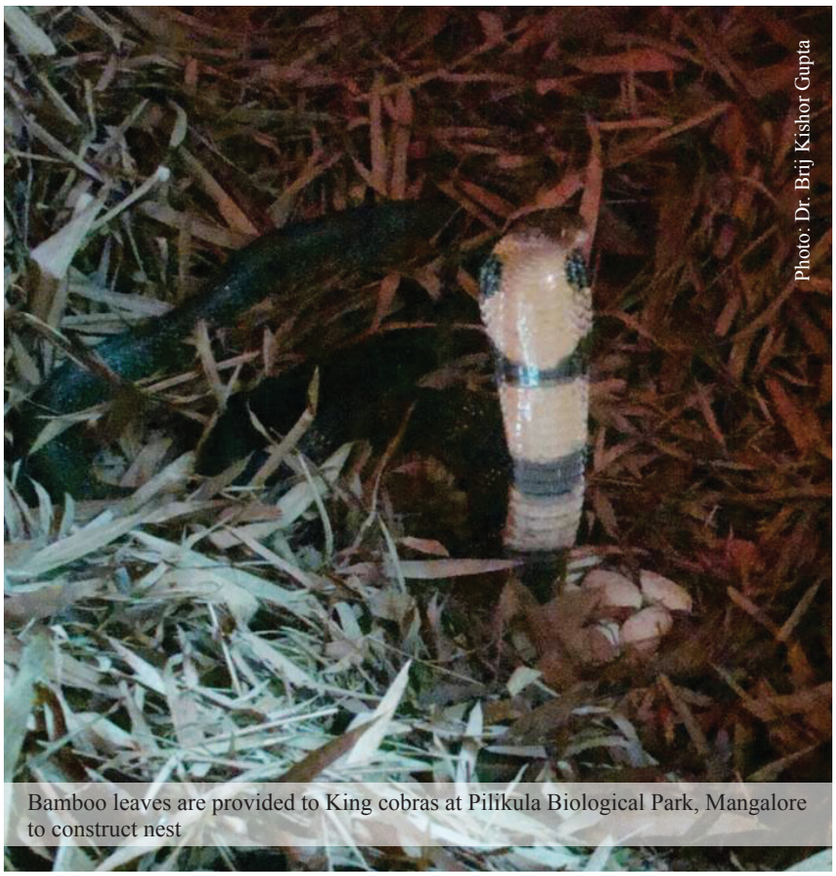


Photo: Dr. Brij Kishor Gupta

Bamboo leaves are provided to King cobras at Pilikula Biological Park, Mangalore to construct nest



Photo: Dr. Brij Kishor Gupta

Nesting Platform made of iron used by birds to construct nest during breeding season

III. Birds

Housing bird species in captivity requires the following safety protocols to be followed:

1. Nesting material should be screened to ensure that there are no parts of plants that may be toxic or sharp objects.
2. Dietary enrichment, if not properly managed, can lead to weight gain.
3. Animals can choke on large pieces of food.
4. Live insects such as mealworms have been known to bite small birds that swallow them. Whole worms should be killed before being offered to small birds.
5. Animals may become aggressive towards each other in mixed-species exhibits.
6. Foreign items (pieces of toys, bedding material, etc.), if ingested, can cause impaction. No such items should be provided to birds.



Natural wooden logs provided with bedding material for birds to rear their young ones in captivity

IV. Ungulates

Housing ungulates in captivity entails a number of considerations:

1. Animals can become entangled in pulleys, ropes and chains.
2. Overwhelming panic can lead to injury of an individual animal or enclosure mates.
3. Dietary concerns include colic, impaction, metabolic acidosis and rumenitis.
4. Plants or parts of plants may be toxic to some animals.
5. The effects of breeding, herd dynamics and negative interactions between dominant animals/species and subordinate ones are among the social concerns. Over-excited animals can be dangerous to smaller species in mixed-species situations.
6. Animals can choke on large pieces of food.
7. Dietary enrichment can lead to weight gain or animals not eating important dietary supplements.
8. Animals may ingest unsuitable objects such as substrates, twine, rope or string.
9. Loss of flight distance between animal and keeper can lead to a deviation from natural behaviour and can be dangerous in free-contact situations.



Mouse deer provided with natural substrate and lot of places for hiding, this may include tall grass

V. Carnivores

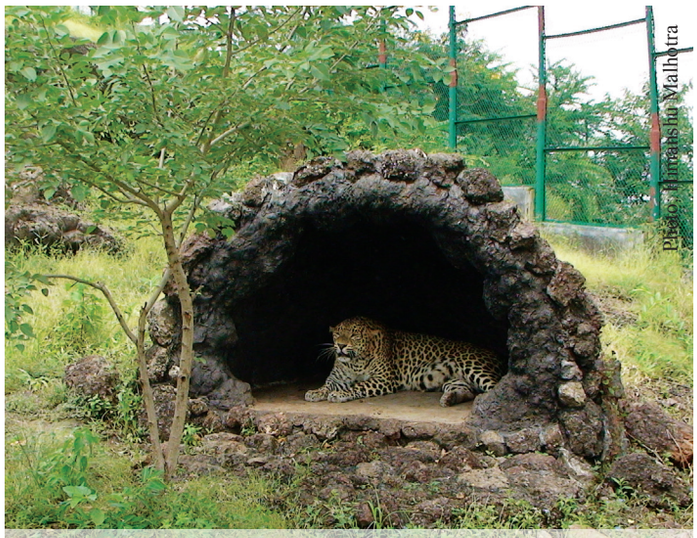
Carnivore species need special attention with respect to safety when enrichment is being provided.

1. The involvement of veterinary and curatorial staff members and keepers is important when designing enrichment ideas. Animals should be observed for problems when offering new enrichment.
2. Ingestion of novel items such as plastic containers and ropes can cause serious medical problems. Individual animals may react differently to enrichment items offered. For instance, a jungle cat at one zoo may play with a plastic jug, biting, crushing and swatting it around, while a similar animal at another zoo may choose to eat such items.
3. Rope or chain is often used as perches or to hang objects on. To ensure that animals cannot become entangled, such items should be hung so that there are no loops at attachment points and that feet, legs and heads cannot get caught. In addition, animals may have a tendency to ingest ropes used for hanging objects. Chains or natural ropes may offer more feasible options and should be used when possible.
4. Horticulturists can be consulted regarding the toxicity of plants. Some carnivores eat plants. Therefore, it is wise to be aware of the types of vegetation that are utilised in carnivore enclosures.
5. Browse should be rinsed to rid it of any chemicals if the source is unknown, especially if it is collected from outside. The faeces of animals that are offered to carnivores should be checked for parasites routinely.
6. Meat should be obtained only from reliable sources. Before any meat is offered to animals as feed, its quality should be certified by the veterinary officer of the zoo. If animals involved in road kills are used, only freshly killed animals that have not been sitting in the elements for hours and that do not show any signs of parasites should be used. Freezing a carcase for several days can also help reduce the risk of parasite infestations.
7. Some animals may become possessive of enrichment items and aggressive toward cage mates. To help reduce the potential of aggression, several identical items can be scattered throughout the exhibit, providing ample activity for all inhabitants. The ability to exhibit predatory behaviour can be an important aspect of a captive lifestyle particularly for carnivores. However, fake prey items (scarecrows, etc.) should not resemble humans in any way, so that the potential risk of predators learning that it is acceptable to attack humans is minimised. In addition, it is important to realise the risk to the safety of the animals and staff when new items or staff are utilised. Animals may show increased anxiety or aggression, which, coupled with the potential of inexperienced staff members making mistakes in shifting animals, can result in the animals posing a danger to each other, the staff or the public.





The hanging object provided to carnivores should be placed in such way in animal exhibit that animals should not get entangled and should not harm.



The concrete den provided to carnivores should be designed in such a way that it should not provide an opportunity to any animals to dominate.


Photo: Dr. Brij Kishor Gupta

The objects provided to primates should not have any sharp objects and it should be animal friendly

VI. Primates

Safety considerations are very important in primate exhibit enrichment since most primates are very intelligent and agile.

When initiating any enrichment activity, the protocols and regulations of the Central Zoo Authority and of the zoo should be in place and should be complied with. Before new devices are installed in an exhibit area, it is essential to ascertain the safety issues involved. Although every scenario cannot be predicted, many dangerous incidents can be avoided with careful planning. For example, is entanglement or strangulation a concern? Will a substrate be harmful if it is ingested? Can a less-dominant animal be cornered or injured in an area? Are physical and visual barriers available for subordinate animals? Are objects sturdy enough to resist dangerous fragmentation? Familiarity with the species and knowledge of the individual animals' personalities will help the keeper predict the animals' initial reactions to an enrichment material or situation. It might be helpful for new keepers to start with simple objects and gauge animal reactions. Observing and working with an animal can provide insight into an individual animal's behaviour. Observation and evaluation should accompany new devices. It is also important to consider the possibility of an animal reacting adversely to an enrichment item. Is there keeper access to the exhibit to remove the offending device? Is there a threat to cage mates due to the excitement over the new item? Many primates are formidable animals with large teeth. Staff members may choose to devise a contingency plan of how to deal with such an animal when it is in a panicked state.

Many primate species are leaf eaters or enjoy some type of natural browse. Help can be sought from local botanists, horticulturists and forestry experts to draw up a list of locally available browse.

Determining whether any toxins or pesticides have been applied to plants before these are fed to the animals is important. Properly disinfecting branches or logs intended for cage furniture can also reduce the risk of cross-contamination.

The following are examples of enrichment that may be appropriate for primates. They provide an overview of the safety issues that should be considered in implementation of enrichment:

1. Animals can become entangled in ropes, vines and hanging apparatus.
2. Animals may fall while trying to obtain enrichment placed high in the exhibit.
3. Animals can drown in water features.
4. Dietary enrichment can lead to tooth decay, obesity, allergies, diarrhoea, etc.
5. Some items may contain materials that can be toxic or hazardous if ingested.
6. Objects, if broken, can produce sharp fragments that can cut animals.
7. There are social concerns of subordinates being 'trapped' in places from which they cannot escape and of negative interactions between animals.
8. Animals might become stressed as a result of the enrichment offered.
9. Some plants or parts of plants can be toxic to some animals.
10. Enrichment should be designed such that animals cannot get their extremities caught in devices.

Keepers should have a safe manner of interacting with animals during contact.







Appendix: Further Readings

APPENDIX
FURTHER READINGS

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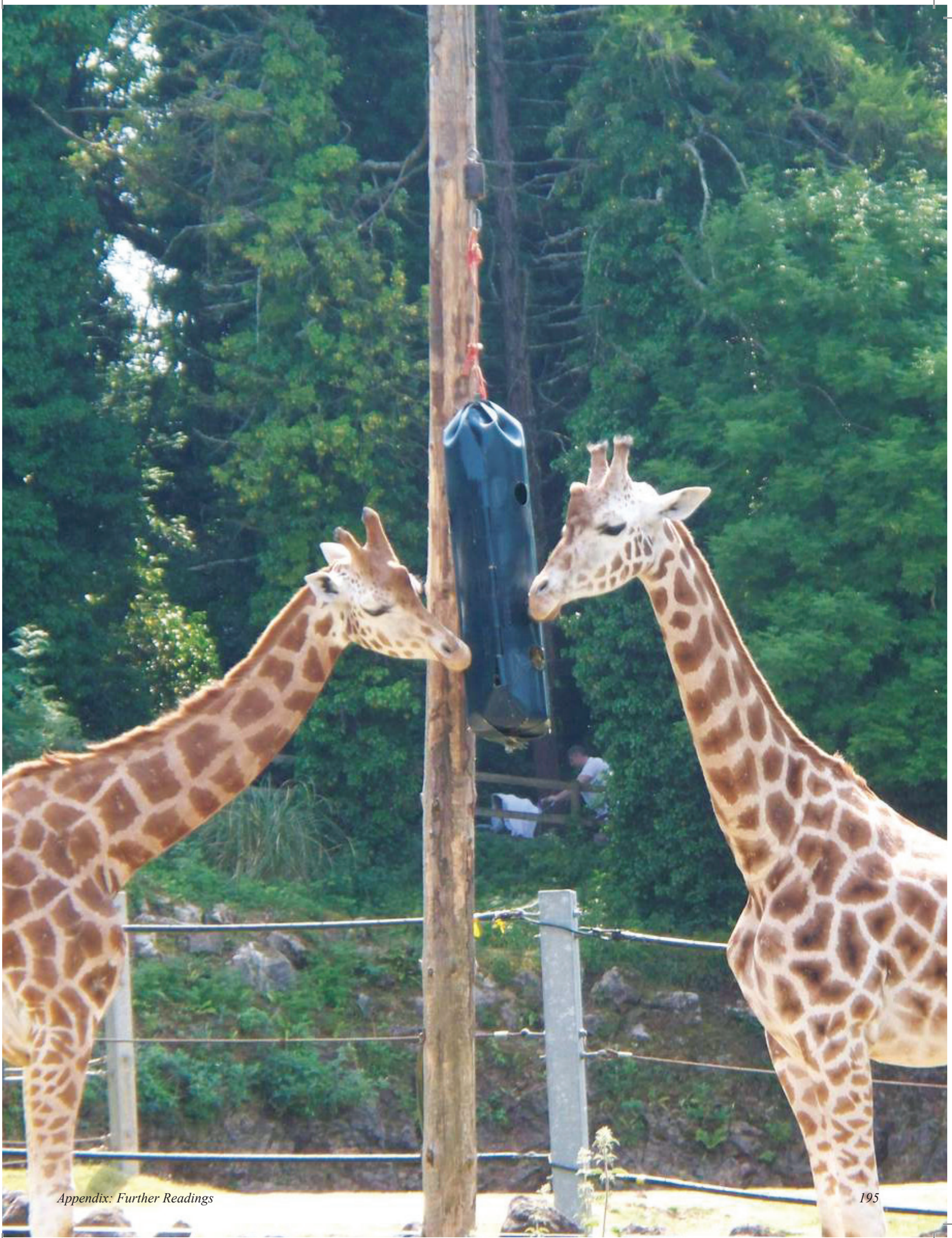

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NOTES

NOTES



About the Author

Brij Kishor Gupta is currently Evaluation & Monitoring Officer with Central Zoo Authority (CZA), an statutory body of the Ministry of Environment, Forests and Climate Change at New Delhi, India. He joined CZA as Scientist in 2000 and than also worked as Scientific Officer.

Dr. Gupta's academic background that he obtained graduation from Durrell Wildlife Conservation Trust (DWCT) and Masters Degree in Environmental Zoology from D.E.I., Agra. He obtained his doctorate thesis studying Behavioural on the Bear Population in Bear Rehabilitation Centre in Agra to develop a Model for the Enrichment of the Environment.

In the past he had worked with Coimbatore Zoological Park & Conservation Centre, Bombay Natural History Society and World Wide Fund for Nature India and Wildlife S.O.S in various capacities.

Dr. Gupta received training on Wildlife Conservation and Management & Environmental Education at Smithsonian Conservation and Research Centre at Front Royal, Virginia, USA. He further received intensive training and skill development programme on Environment Education from North American Association for Environment Education in Malaysia. He has also obtained specialized training in Amphibian Biodiversity Conservation from DWCT, Managing Animal Enrichment and Training Programs for Association of Zoos & Aquariums, USA and Conservation Breeding Centres for Wildlife Sustainability from George Mason University, USA.

Dr. Brij Gupta is member of Conservation & Sustainability and Population Management Committee of World Association of Zoos and Aquariums (WAZA). He is also member of IUCN/SSC Conservation Breeding Specialist Group, Bear Specialist Group and South Asian Amphibian & Reptile Specialist Group as well as Country Representative (India) for Durrell Wildlife Conservation Academy, United Kingdom & Regional Representative (South Asia) for International Zoo Educators Association.

Dr. Gupta, fellow of National Academy of Biological Sciences had received Proggy Award for Animal Welfare Scientist from People for the Ethical Treatment of Animals (PETA), International Animals Rights Leadership Award from PETA as well as Heroes of Animal Protection Award received from India for Animals, FIAPO for the year 2016. Dr. Gupta is also recipient of International Conservation Award for the year 2010 from Association of Zoos & Aquariums (AZA), USA.

Dr. Gupta has been teaching on various subjects of ex situ management and zoo architecture to zoo personnel and forestry personnel's in India on request of CZA, Wildlife Institute of India and Jamia Millia Islamia University. Dr. Gupta is Regional Editor, South Asia- Journal of the International Zoo Educators Association.

Dr. Gupta is a versatile writer in English daily. He has contributed more than 100 scientific papers in various peer reviewed journal. His popular books are "Captive Care of Common Indian Frogs and Toads", "Barrier Designs for Zoos" and Ex situ Management of Amphibians". He also authored & co-authored proceedings on "Master Planning of Zoos", "Zoo Designing and Landscape Architecture", "Designing Enclosures & Landscape Planning for Indian Zoos".

How do we provide the best possible welfare for animals in zoos? The World Association of Zoos and Aquarium recommends the application of the model called the 5 Domains for Animal Welfare; and fundamental to this is the delivery of good animal enrichment. The aim of enrichment in zoos is to maximise animals' health, psychologically and physically, and through providing a dynamically engaging environment. Dr Brij Kishor Gupta's Enriching Lives: improving the wellbeing of captive animals is a valuable guide which outlines animal enrichment ideas for many species held in zoos. These are presented in a clear and practical manner. I commend and endorse this guide for use by zoo professionals.

Susan Hunt PSM
Chief Executive Officer, Perth Zoo
President, World Association of Zoos and Aquariums

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WAZA | *United for Conservation®*

Every responsible member of the international zoo community recognizes animal welfare as their primary responsibility and environmental enrichment as an essential component for achieving it. It is our duty to continuously evaluate and improve our ability to meet the biological and behavioral needs of all animals in our care, whether they are for exhibit or play an explicit conservation role.

This book is a comprehensive resource for zoo professionals, offering an abundance of beautifully presented, detailed information across a wide variety of taxa.

With this manual, Dr. Brij Kishor Gupta has made a great contribution to improving the care and well being of animals in captivity.

Dr. Onnie Byers
Chair
IUCN SSC Conservation Breeding Specialist Group

CONSERVATION BREEDING SPECIALIST GROUP
Planning a Future for Wildlife

Ex –situ management of wild animals requires a range of skills. Enrichment of animal enclosures is the most important component of this skill set as it requires understanding of the habitat requirements of the concerned species in nature. Putting the essential elements of the natural habitat in a small space without compromising on safety of the display animal and visitors is challenging. Given the fact that our understanding of ecology of species, particularly the lower taxa are limited, zoo manager has to be innovative in his approach in designing enrichment artifacts inside an enclosure.

Dr Brij Kishor Gupta has captured all the essential elements of enrichment in this manual. The manual is not only scientifically robust in terms of details but also easy on reading with a reader friendly format and design.

Dr Gupta has the requisite knowledge and experience in the field of Zoo management. He is a scientist, a practitioner and also part of regulatory institution which has helped him in accessing and acquiring knowledge, skills and experience in the field of zoo management. This manual reflects this rare mix. It is a must read for all zoo managers, zoo designers and biologists.

I compliment him for his efforts. He has done a great service to the cause of animal welfare.

Priya Ranjan Sinha (Mr)
Country Representative
India Country Office
IUCN (International Union for Conservation of Nature)

IUCN

ISBN No. 9789352541850
978-93-5254-185-0
INR 999.00
US$49

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Cover Illustration: Sloth bear in a enriched exhibit in a zoo © Arnab Roy