# Draft Proposal Submitted to CZA on Standardization of Animal Diets in Zoos

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# Proposal
# Submitted from IVRI to CZA

**Title: Standardization of Animal Diet in Zoos**

**Project Team**
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In addition to above core group of Scientists, association of following professionals experts in the field of Captive Animal Nutrition would be invited as and when required

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Dr. L. N. Acharjjyo, Member, Technical Committee, CZA, New Delhi
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Dr. Paneer Selvam, Senior Veterinary Officer, NZP, New Delhi
Dr. U. K. Shukla, Lucknow Zoo, Lucknow

**Duration of the project:**
3 years from the date of start

## Background

The science of nutrition is an integral component to the management of zoo animals and must be addressed in a scientific and professional manner. The challenge of a zoo nutrition programme is to provide a nutritionally balanced diet, that reasonably stimulates natural feeding behaviours, which the animal consumes consistently. The goal of a zoo nutrition programme differ vastly from those of livestock or pet nutrition. Zoo nutrition must encompass coordinated feeding with the captive animal management goals of reproduction, longevity and behavioural normality by attempting to meet psychological and physiological needs of species that have evolved under diverse environmental circumstances, to occupy specialized niches, with the ability to make diet choices according to seasonal, physiological, environmental or individual needs.

The most obvious challenge in providing optimum nutrition to captive exotic or native wildlife is the lack of known requirements. In most of the zoos animals are fed empirically based upon whether they are herbivore, omnivore or carnivore. However, such a practice is not quite scientific considering the fact that many herbivores will gnaw and carnivores like panda will thrive on completely vegetarian diet. Such imperial feeding practices followed in most of the zoos may either lead to under overfeeding which may ultimately result in various health hazards, reproductive disorder and reduced life-span.

Captive animals may adapt to a standard diet for a prolonged period without manifestation of any apparent symptoms of deficiency. However, such diet may severely impair growth, reproduction, immunity and lifespan. Report of metabolic bone diseases in large carnivores and monkey (Bland, 1988) was an eye opener in this regard, which reveals that nutritional deficiencies /imbalances are rather common in wildlife. As most of the zoos nowadays give emphasis on captive breeding, it will be appropriate to design a suitable nutritional programme that ensures nutritional support for all stages of life, including gestation, lactation and early neonatal growth. It can no longer be assumed that traditional zoo diets are adequate even when little evidences of nutritional deficiency is observed. Marginal nutrient deficiencies are manifested by increased susceptibility to diseases, reduced fertility, lower neonatal viability, sub-optimal milk production and retarded growth rate ( Hume,1995). In the absence of careful dietary evaluation it is unlikely that the nutritional components of this problems will be recognized.

## Nutrition and Health

Nutritional status is intimately linked to health and reproductive output in all species of animals. All nutrient categories – energy and protein, fatty acid, fat-soluble vitamin, and mineral imbalances – have been shown to directly, as well as indirectly, affect conservation goals of captive breeding.

### Energy

Over-nutrition, with accompanying obesity, is a health issue for many captive psitticines, and may negatively impact reproduction in these species. Over-condition can also be problematic for health of zoo primates, carnivores, and hoofstock, leading to problems like diabetes, respiratory and cardiac distress, hypertension, hypercholesteremia, foot/hoof problems, and reduced reproduction (Taylor & Poole,

1998; Van Houwald & Flach, 1998; Schwitzer & Kaumanns, 2001; Kenny *et al.*, 2003). Obesity can still be considered a major problem in many zoo collections. Therefore, it is imperative to develop a series of species-specific body condition indices, similar to those developed for domestic livestock and pet species (Thatcher *et al.*, 2000) and/or customized indices (for captive species) based on *in situ* populations as the guideline (ala Reuter & Adcock, 1998). These standardized scores can then be used to establish guidelines for amounts of diet to feed, based on energetics relationships, and will provide a tool for better understanding of management variables, including the impact of increased activity through behavioral enrichment, on a global scale.

**Protein**

Excess protein can also prove detrimental to animal health. Within weeks of switching from a high (>40% crude protein on a dry matter (DM) basis) to a low (<10%) protein nectar that better duplicated native diet composition (Brice & Grau, 1989), hummingbirds at the Bronx Zoo successfully reproduced (unpublished). A wide variability exists in commercial nectar product composition (Frederick *et al.*, 2003), with protein ranging from 2 to >20% of DM; these ranges appear to encompass levels that can prove harmful to captive populations of nectarivores. Similarly, the vulturine parrot (*Psittrichas fulgidus*), a fig specialist, experienced health problems associated with excessive dietary protein (kidney disease, poor reproduction and growth) on diets containing approximately 20% crude protein (DM basis). Nitrogen balance trials confirmed that adults of this species can maintain protein balance on diets containing only 2% protein (Pryor *et al.*, 2001). Similar link is evident between diet and disease in the Goeldi's monkey, or callimico (Callimico goeldii). Diets containing more than 25% crude protein (DM basis), fed in the US, have been linked with kidney disease, poor growth and reproduction. These problems have not been reported in animals from European zoos, where diets contain approximately 15% protein. In accordance with the newly updated National Research Council recommendations for non-human primates (NRC, 2003), recommended diets in US zoological facilities have been recently altered to lower (15% protein) level; true requirements and/or nitrogen balance, however, has not been determined in this species. It is also possible that high inbreeding co-efficient and stress in captive populations may be involved in this health issue, but requires investigation.

**Seasonality of Diet Composition**

Although certainly a component of most natural systems, seasonal diet changes are not widely understood nor particularly managed in many zoo-feeding programmes. Temperature influences the appetite in carnivores, and photoperiod-regulated intakes in temperate species of hoof stock have been documented. The practice of "flushing" livestock – maintaining them on a lower plane of nutrition prior to the breeding season, then raising their plane of nutrition immediately before breeding, or feeding at maintenance level compared to breeding diets for poultry species, has been typical in farm animals operations but less frequently evaluated with zoo species. The essentiality, or effectiveness, of this practice, has simply not been rigorously tested. The giant hornbill species may represent a group for which significant dietary changes occur on a seasonal basis, even within a tropical environment. Proportions of animal prey vary depending on location, season, and physiological state (pre-breeding vs. breeding vs. raising chicks, as do the concentrations of proteins, sugars, and lipids in native fruits (Dierenfeld *et al.*

1991). Field data on nutrient composition of diets, as well as feeding behaviours of animals may provide excellent clues to optimal diets for these species. Based on these observations, three distinct diets, differing in protein and fat content, are proposed for captive feeding of large, predominantly frugivorous hornbills: a maintenance diet comprising moderate protein and fat levels, and elevated fat level during courtship and breeding periods, and a higher protein and calcium – rich diet to support chick growth and female molt during the nesting period (Dierenfeld *et al.* 1991).

**Fatty Acids & Health**

Imbalanced omega-6: omega-3 fatty acid ratios have been associated variously with immune system problems, neurologic disorders, carbohydrate metabolism abnormalities in the black rhinoceros (*Diceros bicornis;* Miller, 1995). Investigation revealed that the FA composition of native browses in Zimbabwe was comparable with temperate browses harvested in North America, as well as typical diets fed in North American zoos (Grant et al., 2002). Freshly harvested browses contained concentrations of a-linolenic acid (an omega-3) at levels averaging about 15 times higher than measured for linoleic acid (an omega-6 FA). Conversely, zoo diets for this species showed the opposite proportions, with linoleic acid levels about 5 folds higher than seen in nature, and linolenic acid, about 1/3 that in native browses.

Clinical investigations with zoo rhinos showed a health response to dietary FA supplementation with a flax-based product that favourably altered circulating omega-3:omega-6 ratios; the typical zoo diet had the opposite effect on plasma FA ratios (Suedmeyer & Dierenfeld, 1998). Zoo diets themselves may predispose to FA deficiency/imbalances, as the most common sources of linoleic acid (the omega-6 eicosanoids) include typical ingredients in formulated rations: corn, safflower, cottonseed, soybean, and sunflower oils. The omega-6 FA are proinflammatory, associated with allergies, psoriasis, arthritis, and colitis. Linolenic acid (including the omega-3 eicosanoids) are found in green leafy plants, canola, flax, walnut, fish, and seafood oils, and have the opposite effects on immune function.

Fatty Acids & Reproduction

Fatty acids also influence animal reproduction. Sperm morphology and motility is positively correlated with polyunsaturated fatty acid (PUFA) concentrations, and avian sperms have been shown to contain lower levels of PUFA overall compared with mammalian sperms. It is well known that dietary FA supplements can alter the n-3: n-6 PUFA ratios; increased fertility has been demonstrated and implemented in livestock breeding programs, as well as in reptiles (alligators). Fatty acid concentrations and amounts also impact gonadotrophic hormone production. An area yet to be investigated thoroughly is the effect of varying dietary FA concentrations on elephant sperm quality (and ultimately, reproduction). African elephant sperm has been demonstrated to have viability following freeze-thaw cycles, hence can be used successfully in artificial insemination programs. Asian elephant sperm, however, is not as viable following freezing (Swain & Miller, 2000). Dietary effects of FA on semen membrane characteristics need to be investigated in more detail to better understand these links between nutrition and reproduction in a variety of species.

**Minerals and vitamins**

*Vitamin A:* Laboratory-reared whole rodents have been found to contain vitamin A concentrations more than 10-fold relative to those measured in free-ranging rodents

(Douglas *et al.*, 1994; Thomas *et a*l., 2004) and may result spondylysis. Vitamin A is also linked with reproduction, both directly and indirectly. Deficiency leads to impaired sperm production, birth defects, and reduced immunity, whereas excess has been associated with teratogenicity (Olson, 1984). Additionally, β-carotene added to diets of domestic cats has been shown to increase progesterone, estradiol, and uterine protein content (Chew *et al.*, 2001).

*Vitamin E:* Vitamin E nutrition has been evaluated relatively in much more detail in zoo species (Dierenfeld & Traber, 1992, Dierenfeld, 1994). Deficiencies in captive populations have been reported frequently, possibly due to improved detection techniques as well as a higher proportion of trained staff in many zoos compared to past. Clinical signs of deficiency vary by species, but can include: skeletal/cardiac myopathies (in any species, but particularly in hoof stock), equine degenerative myoencephalopathy (in equids), microangiopathy (noted in swine and elephant species), erythrocyte hemolysis (primates including humans), exudative diathesis (avian species), and steatisis in carnivores (Dierenfeld & Traber, 1992).

Mineral imbalances have long been recognized in zoo species – the first documented nutrition problems in large carnivores fed meat – based diets, and primates and birds raised primarily on fruits – were reported from the London Zoo in the 18$^{th}$ century (Bland Sutton, 1888). Meat- and insect-based diets, lacking calcium, have been problematic in zoos for numerous species, resulting in supplementation recommendations as well as formulation of nutritionally-complete commercially-available products for feeding of these species More recently, however, mineral imbalances in zoo hoofstock diets are being reported, resulting in the formation of gastroliths, enteroliths, uroliths, hypomagnesemia/ hypocalcemia/ rumenitis/ and acidosis syndromes (Edwards, 1999; Gaffney *et al.*, 1999; Wolfe *et al.*, 2000; Ball *et al.*, 2003; Miller *et al.*, 2003).In each instance, problems have been noted with hoof stock (both grazers and browsers) fed lucerne (*Medicago sativa*) as the primary forage. The mineral content of Lucerne compared with grasses (high in both Ca and Mg relative to P), may predispose ungulates to mineral imbalances and needs to be investigated in more detail.

Separate from these health aspects, mineral nutrition also has direct and indirect effects on animal reproduction. Lesser adjutant stork (*Leptoptilos javanicus*) chicks fed whole prey containing 2% Ca (DM basis) developed beak and leg deformities indicative of calcium deficiency / imbalance – even though the appeared adequate in both Ca and P (Dierenfeld & Fidgett, 2003). Further comparisons of semen characteristics in cats fed a nutritionally-complete commercial feline diet compared to chicken necks or red meat revealed improved motility (40 to 56%), % normal sperm (9 to 20%), and an increase in the amount of sperm per ejaculate (up to 10 times more; Swanson *et al.*, 1994).

**Art of Feeding**

Most of the findings described above have emanated form research conducted abroad. However, in practical feeding situation, they are either difficult to follow or ignored. The situation is even worse in Indian zoos. More often than not, little is known of the nutrient requirements, and often if they are known, specific nutrients native to the animals natural habitat is not available, making substitution a necessity. Three main sources of information are used to develop zoo diets.

1. The documented natural food habits of the animal, which often does not contain specific ingredients.

2. Records from other captive management facilities, which are often incomplete or developed by trial and error methods, and
3. Domestic animal models

Although at first glance there may be more similarities than differences between domestic animal and their counterparts, unique metabolism, physiologies and behaviors are not simply duplicated in domestic animal models. For instance, both giraffe and cattle are ruminants, however, the nutritional profile may vary considerably as giraffe is a selective browser and cattle are bulk grazers. Availability of diet item is another problem. Although diet items may have been identified, they may not be available or may not be cost effective. Using giraffe again as an example, although they have never been observed to feed on grasses in the wild (Pellow, 1984), they are usually fed alfalfa or other types of hay and concentrates.

Enrichment attempts to meet some of the psychological needs of the captive animals. It is achieved by modifying or adding ingredients to a captive diet to stimulate behaviors resembling those of healthy wild animals ( Shepherdson, 1992). The fact that wild animals spend considerable amount of their time in finding and processing food (Brigham, 1997: Poole, 1997) needs to be taken into consideration while making a diet schedule. Pastes, such as peanut butter, yoghurt can be smeared or loaded into feeding devices such as puzzle feeders to allow animals naturally. Many such feeding devices have been used for chimpanzees to allow the opportunity for the behavior of termite fishing. This type of food items are difficult to track and if proper care is not taken can be easily overfed.

Food enrichment of ungulates can be even more challenging, as they are least impressed by items like fruits and take the supplemental browse form. Animals develop what appear to be stereotypes as a result of denial of opportunity to engage in that behavior. A common stereotypic behavior of giraffe is repetitive licking of non-food substances. Attempts made to curb this behavior with chemical sprays have met with failure, due to giraffes apparent motivation to use it's tongue in foraging behavior (Torou *et al.*, 2003).

The more solitary species such as large felids can be fed individually, which helps monitor intake and avoid aggression. However, when feeding large social group of animals, such as chimpanzees or other primate's individual intake often depend on the dynamics of the group. Rations may need to be adjusted in such a manner that most subordinate gets adequate feed. Besides, taste, texture, odour, colour, size and shape are important factors and can be more compelling than the actual nutrient content of the diet (Dierenfeld, 1996).

**Indian Scenario**

The pioneer work of Sanyal (1892) forms the very basis of feeding of zoo animals in India. Diets of zoo animals have been developed on the basis of food preferences of the free ranging animals, domestic animal data and experience of the keeper. As a result such diets are empirical and cause a lots of nutritional problems as discussed earlier. Of late with the effort of CZA, Arora (2001) compiled the feeding schedule of zoo mammals practiced in different zoos in the country. It is evident from those compilations that inter-zoo variation in feeding schedule is very high. Hence, CZA felt the necessity of preparing a standard diet schedule for zoo animals, which could be uniformly used across the country. Such a diet schedule should provide the entire nutrient in optimum

quantity so as to improve general health, immunity, life span and chances of captive breeding. Keeping these points in mind the present project is proposed with the following objectives.

## Objectives:

- To find out the nutritional status of some important zoo animal species.
- To find out and ameliorate the nutritional imbalance/ inadequacies in commonly fed zoo animal diets.
- To prepare a standard diet schedule for some selected zoo animal species

**Practical Utility / Expected Outcome of the Project**

- Development of rational feeding programs for captive animals that will be based on sound scientific principles
- Helping advance rational zoo nutrition practices
- Provide service in the fields of nutrition and dietary husbandry to Indian Zoos
- Develop guidelines and protocols for general use

## Plan of Work
## Phase I

The following aspects of nutrition and feeding in captivity will be considered

- ✓ Chemical composition and nutrient profile of food staff
- ✓ Seasonal variation in nutrient profile of important feed staff
- ✓ Effect of processing (hay vs green, raw grains vs reconstituted one, cooked food vs raw food etc) on nutrient profile and feeding value
- ✓ Effect of storage on nutrient profile
- ✓ Different methods of food presentation on palatability and animal performance
- ✓ Effect of number and size of meals
- ✓ Group feeding and individual feeding
- ✓ Controlled fasting
- ✓ Food hygiene
- ✓ Hand rearing protocol for different species
- ✓ Therapeutic diet for different species during commonly observed ailments

**I Review of literature**
**I1. Species of Animals**
**Please see Annexure I**

**III zoos to be covered**

**Please see annexure II.**

**IV Information collection :** following information would be collected

**Description of the animal**
Common and scientific name
Normal body weight adult males and females
Age at maturity
Longevity in the wild and in captivity
Description of the gastrointestinal tract
Physiological needs like effect of seasonal changes, growth spurts in juveniles, weaning, old age etc.
Digestive strategies (browser, grazer, carnivore etc.)
**Feeding ecology**
Composition of the natural diet and its nutrient content
Description of previously used diet
Zoo diet description
Evaluation of diets for captive animals
Feeding schedule
Feeding schedule enrichment
Feeding place(s)
Water supply

**Hand rearing protocol**
Nutrient composition of hand rearing diets
Normal growth curve in the wild and captivity
Additional information
Establish: body condition index
Physiological normal ranges of blood values.
Faecal scoring system
Evaluation of the diet schedule
Update schedule literature
Special diets (geriatric, diseases, lactating, non-lactating, growing animals etc

**V Sampling**

Food ingredients
Fecal samples
Blood samples ( subject to permissibility)

**VI Analysis**
Food: Carbohydrate, protein, fat, Ca, P, Mg, Cu, Zn, Fe, Mn
Feces Carbohydrate, protein, fibre, fat, Ca, P, Mg, Cu, Zn, Fe, Mn,
Fecal condition score, consistency
General: body weight and measurements in some animals, body condition score
Blood: glucose, protein, albumin, globulin, cholesterol, triglycerides, creatinine, SGOT, SGPT

**VII Training**
Two training programme of 1 week duration each will be imparted to zoo keepers/ supervisors/ Officers/ Zoo Vets which will cover "Practical aspect of recent advances in scientific feeding of zoo animals'

**Budget Requirement**

| | |
|---|---|
| Pay/ Honorarium | |
| SRF( total 3 posts)@Rs 11500/- p.m.( fixed)+HRA( total Rs 13225/-) | Rs. 14.50 lakhs |
| Honorarium to invited experts and Holding meeting | Rs 1.00 lakhs |
| Training/ Foreign Deputation | |
| Dr. D. Swarup & Dr. M. Saini to San Diego Zoo, California, USA to collect the diet chart and study the feeding management of captive animals | Rs 5.0 lakhs |
| Training for Dr. A. Das to European Zoo Nutrition centre, Amsterdam, The Netherlands for 3 weeks in the area of " Latest techniques and guidelines for conducting nutritional experiments in zoo animals" | Rs 3.0 lakhs |
| Dr. A. Das to London Zoo, UK to collect the diet chart and study the feeding management of captive animals | Rs 1.0 lakh |
| Dr. A. Das to National Zoological Garden, Pretoria, South Africa to collect the diet chart and study the feeding management of captive animals | Rs !.0 Lakh |
| Traveling allowance | Rs 6.0 lakhs |
| Stationery, Publication other miscellaneous expenses | Rs 2.70 lakhs |
| Training to zoo keepers/ supervisors/ zoo officials | Rs 2.0 lakks |
| Equipments | |
| UV-VIS Spectrophotometer | Rs 6.00 lakhs |
| Digital balance | Rs 1.00 lakh |
| Table top centrifuge | Rs 0.30 lakh |
| Deep freeze | Rs 0.50 lakh |
| Kjelatech – N estimation assembly | Rs 5.00 lakhs |
| • Chemicals | Rs 2.00 lakhs |
| • Glassware | Rs 1.00 lakh |
| **Sub- Total** | **Rs 52.00 lakhs** |
| Institutional charges @10% | Rs 5.20 lakh |
| **Total** | **Rs 57.20 lakh** |

**Terms and Conditions**

1. The project will be developed as a collaborative programme following guidelines issued by ICAR
2. It will be totally funded by CZA
3. The Indian Veterinary Research institute would provide scientific resources and other infrastructure for effective implementation of the programme
4. PI/ Coordinator would submit annual project report to the IVRI and through the Director, IVRI and Joint Director (Research), IVRI
5. The MoU Should be developed after receiving acceptance from CZA for funding the project

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## ANNEXURE I
## Species to be Covered

**The present proposal will concentrate on the following species**

I Order Artiodactyla

1 **Family Suidae**

Wild boar

**2. Family Camelidae**

Camel

3. **Family Traguiidae**

Mouse deer

**4. Family Cervidae**

Sambar, Sangai, Swamp deer, Chital, Barking andhog deer

5 **Family Giraffidae**

Giraffe

6. Family Bovidae/ ovidae/ capridae

Chinkara, Black buck, 4 horned antelope, goral

**II Order Perissodactyla**

1 **Family Equidae**

Wild ass, zebra

2 **Family Rhinocerotidae**

Indian one-horned rhino.

**III Order Probiscidea**

1 Family Elephantidae

Elephants.

**IV Order Lagomorpha**

1 **Family Leporidae**

Indian wild hare

**V Order Primate**

1 **Family Cerocopithicidae**

Rhesus monkey

Bonnet monkey

Assmaese macaque

Stump-tailed macaque

Lion-tailed macaque

2 **Family Colobinae**

Common langur/ capped langurSpectacled monkey

Nilgiri langursGolden langur

Capuchin/Red/Potash/ Spider

Baboon

3 **Family Lorisidae**

Slow Loris

4 **Family Pongidae**

Hoolock gibbon

Chimpanzee

Orangutan.

Gorilla

**VI Order Rodentia**

**1 Family hystricidae**

Indian porcupine

**2 Family Scuiridae**

Giant squirrel

**VII Order Chiroptera**

Frugivorous bats.

**VIII Order Carnivora**

**1 Family Canidae**

Jackal

Wolf

**2 Family Hyenidae**

Hyena

**3 Family Ursidae**

Sloth bear.

Himalayan black bear

**4 Family Procyonidae**

Red panda

**5 Family Viviridae**

Binturong

Palm civet

Large Indian civet

**6 Family Mustelidae**

Otter

Hog badger

Retell

7 **Family Felidae**

**Asiatic Lion, Tiger**

**IX order Insectivoira**

**1 Family Erinacidae**

Desert Hedge Hog,Pangolin

**Reptiles**

Python

Garial

Tortoise

**Birds**

Horn bill

Parakeet

Pea fowl

Pelican

## Annexure II

## LIST OF ZOOS TO BE COVERED

### I LARGE ZOO

1. Nehru Zoological Park, Hyderabad
2. Assam State Zoo and Botanical Garden, Guwahati
3. Sanjay Gandhi Zoological Park, Patna
4. National Zoological Park, Delhi
5. Sri Chamrajendra Zoological Park, Mysore
6. Rajiv Gandhi Zoological Park and Wildlife Research Centre, Pune
7. Nandankanan Zoological Park, Bhubaneswar
8. Sepoyjala Zoological Park, Tripura
9. Kamla Nehru Zoological Park, Ahmedabad
10. Sakkarbag Zoo, Junagarh
11. Arignar Anna Zoological Park, Bandalur, Chennai
12. Alipore Zoological Park, Kolkata
13. Lucknow Zoological Park, Lucknow
14. Kanpur Zoo, Kanpur
15. Indira Zoological Park, Visakhapattanam
16. M.C. Zoological Park, Chattbir, Chandigarh
17. Bannerghata National Park, Bangalore
18. Modern Crocodile BankTrust, Chennai

### II MEDIUM ZOO

1. Vir Mata Jijabai Bhosale Zoological Park, Mumbai
2. Itanagar Zoo
3. Zoological Garden, Thiruvananthapuram
4. Gandhi Zoological Park, Gwalior
5. Maitri Bagh Zoo, Bhilai, Chattishgarh
6. Van Vihar National Park, Bhopal
7. Imphal Zoo, Imphal
8. Jaipur Zoo, Jaipur
9. Jodhpur Zoo, Jodhpur

**III SMALLZOO**

1. Bhagwan Birsa Zoological Park, Ranchi
2. Hadoo Zoo, A & N Island, Port Blair
3. Bondla Zoo, Goa
4. Himalayan Nature Park, Kufri
5. Panchkula Zoo
6. Padmja Naidu Himalayan Zoological Park, Darjeeling
7. State Museum and Zoo, Thrissur

**IV MINI ZOO**

1. Deer park, Thenjaval, Mizoram
2. Mini Zoo, Pipli
3. Manda Mini Zoo, Manda, J & K.
4. Shivagagnga Garden Mini Zoo, Thanjavore
5. Deer Park, Satmalia, D & NH
6. Deer Park, Maithan, Jharkhand
7. Srinagar Deer Park, Srinagar
8. Aurangabad Municipality Zoo

**SUMMARY SHEET**

| Zone | Large | Medium | Small | Mini | Total |
|---|---|---|---|---|---|
| **North** | 4 | 2 | 2 | 3 | 11 |
| **South** | 6 | 1 | 2 | 1 | 10 |
| **East** | 5 | 2 | 2 | 2 | 11 |
| **West** | 3 | 4 | 1 | 2 | 10 |
| | **18** | **9** | **7** | **8** | **42** |

**Zone wise selection of zoos**

**North Zone**

**I Large – 4**

1. National Zoological Park, Delhi
2. M.C. Zoological Park, Chattbir, Chandigarh

3. Kanpur Zoo

4. Lucknow Zoo

**II Medium Zoo- 2**

1- Jaipur Zoo

2- Jodhpur Zoo

**III Small Zoo- 2**

1- Himalayan Nature Park, Kufri

2- Panchkula Zoo, Punchkula

**IV Mini Zoo- 3**

1- Mini Zoo, Pipli

2- Manda Mini Zoo

3- Srinagar Deer Park

**South Zone**

**I Large Zoo – 6**

1. Nehru Zoological Park, Hyderabad
2. Sri Chamarajendra Zoological Park, Mysore
3. Arignar Anna Zoological Park, Bandalur, Chennai
4. Bannerghatta national Park, Bangalore
5. Indira Gandhi Zoological Park, Visakhapattanam
6. Modern Crocodile Trust, Chennai

**II Medium Zoo- 1**

1. Zoological Garden , Thiruvanathapuram

**III Small Zoo- 2**

1. Hudoo Zoo, Port Blair, A&N Island
2. State Museum and Zoo, Thrissur
3. Shivaganga Garden Mini Zoo, Thanjavore

**III Mini Zoo- 1**

1. Shhivaganga Garden Mini Zoo, Thanjavore

**East Zone**

**I Large Zoo – 5**

1. Assam State Zoo and Botanical Garden, Guwahati

2. Sanjay Gandhi Zoological Park, Patna
3. Nandankanan Zoological Park, Bhubaneswar
4. Sepoyjala Zoological Park, Tripura
5. Alipore Zoological Park, Kolkata

**II Medium Zoo- 1**

1. Itanagar Zoo
2. Imphal Zoo, Imphal

**III Small Zoo- 2**

1. Bghagwan Birsa Zoological Park, Ranchi
2. Padmja Naidu Himalayan zoological Park, Darjeeling

**III Mini Zoo- 3**

1. Deer Park, Thanjaval, Mizoram
2. Deer Park, maithan, Jharkhand
3. Deer Park, Science City, Kolkata

**West Zone**

**I Large Zoo- 3**

1. Rajiv Gandhi Zoological Park and Wildlife Research Centre, Pune
2. Kamla Nehru Zoological Park, Ahmedabad
3. Sakkarbagh Zoo, Junagarh

**II Medium Zoo- 4**

1. Vir Mata JijaBai Bhosale Park, Mumbai
2. Gandhi Zoological Park, Gwalior
3. Maitri Bagh Zoo, Bhilai, Chattishgarh
4. Van Vihar National Park, Bhopal

**Small Zoo- 1**

1. Bandla Zoo, Goa

**IV Mini Zoo- 2**

1. Deer Park, Satmalia, D& NH
2. Municipality Zoo, Aurangabad