The Manipur Brow-antlered deer (*Cervus eldi eldi*) PHVA held in Mysore Zoo, Mysore 11 - 14 October 1992

Executive Summary

The Manipur Brow-antlered deer (Cervus eldi eldi), locally known as "Sangai" is a critically threatened subspecies of cervid. It is one of four subspecies, the other three of which are found outside India. Just over 100 individuals survive in the wild in a single population inhabiting the Keibul Lamjao National Park in the State of Manipur, India. Although this population has increased over the last ten years, risks to survival persist, including encroachment on the habitat with exploitation of the deer, difficulty of protecting the area due to local dissatisfaction with the park, floods and other environmental perturbation; epeidemic disease and other health threats;and further loss of genetic diversity.

The captive population of about 100 individual was derived from only two pairs of founders and is distributed among 15 Indian zoos in two seperate and distinct blood lines with very little or no interbreeding between them. Lack of exact predigree information has prevented use of standard methods for genetic analysis of captive population, although the meaningfulness of such analysis considering the paucity of founder stock is questionable. The captive population has fluctuated between 90 and 100 animals over the last decade.

As a single, small wild population, backed up by an inbred and unstable captive population, the Sangai is seriously "at risk".

Evaluation of risk is a major component of the scientific management of endangered species. Planning and implementing strategies to reduce the degree of risk of extinction to an acceptable level is one of the methods of small population recovery through intensive management. Software tools have been developed to assist simulation and quantitative evaluation of risk of extinction and can be used to assess a variety of management scenarios. Identification and ordering of risks can clarify options for management action.

Anomalies with regard to census of wild population, political difficulties, and conflicting views on habitat options, use of captive population and reintroduction protocol, combined with a lack of coordination between the in situ and ex situ managers had created a need for an assessment of a whole spectrum of possibilities and probabilities with regard to this species.

Historically Sangai occurs only in the southern part of Manipur and today only in the protected area of the National Park. The area is practically inaccessible by human beings, consisting of floating grass mats called "phumdis" of varying thickness, instead of solid ground. Narrow canals negotiated by small dug-out boats divide various size "islands" or mats from one another. Visibility is obstructed much of the year by the height of the grass which grows to more than six feet. Simply seeing Sangai is problematic.

Hence, Sangai was thought to be extinct until a single relict population of less than 100 was discovered mid-century. Subsequently a flood swept through the lake and destroyed many animals, among them Sangai. A census which followed this catastrophe reported only 14 animals. Alarmed authorities notified the area which ultimately resulted in its declaration as a National Park. Vigorous protection measures implemented by the Manipur Forest Department have supported what is believed to be a steady, although small, increase in population. The small size of hte population combined with the number and intensity of environmental, ecological, social and political threats have inspired great concern on the part of governmental and non-governmental agencies and individuals for many years.

As early as 1989, workshop on Sangai was proposed to authorities of the Chamarajendra Zoological Gardens by the Zoo Outreach Organisation/CBSG, India, which had conducted captive status and management surveys on the species for some years. The Chamarajendra Zoological Gardens was the first zoo to attempt acquire Sangai from both bloodlines for the purpose of maximising existing genetic potential. When the zoo planned to celebrate its Centenary with a scientific workshop, a Population and Habitat Viability Assessment for Sangai emerged as an appropriate theme. The Forest Department of

Manipur was requested to collaborate on the Workshop as well as the Indian Zoo Directors' Association. The Captive Breeding Specialist Group, SSC, IUCN was invited to provide technical support.

A Population and Habitat Viability Assessment (PHVA) was conducted for Sangai at Mysore 11-14 October 1992. The workshop was attended by more than seventy wildlife and zoo managers, population biologists, veterinariaons, wildlife biologists and wildlife enthusiasts. The goal of the Workshop was to pull together information from both in situ and ex situ populations to use for developing stochastic population simulation models. The PHVA employed estimated parameters about characteristics of the population and conditions of the environment, including the frequency and severity of different kinds of catastrophes, e.g.. floods and deterioration of park protection. Results of the PHVA predicted a 43% probability of extinction of this population in the next 100 years.

A major recommendation to reduce the risk of extinction of the wild population is establishment of additional wild populations using stock produced from the captive population, by translocation from the wild, or some combination. This issue needs further detailed analysis on the sources of stock for the programme, the timing and size of the releases and the effects of removals on the source populations.

A PHVA was also conducted on the captive population under two different scenarios: one of healthy growth such as occurred from inception of the two lineages (1956 and 1962) until 1980; the second of zero growth such as occurred from inception of the two lineages (1956 and 1962) until 1980; the second of zero growth which more or less characterises the population sicne 1980. Evidence suggests that unless improved management of the captive population is applied, the zero growth scenario is more probable. Under the zero growth scenario, the PHVA predicted a 15% probability that the captive population will become extinct over the next 100 years. Under the healthy growth scenario, the PHVA simulations predicted a 0% probability of extinction. However, no deleterious effects of loss of genetic diversity, (i.e., inbreeding depression) have been incorporated into the analyses conducted so far. Based on data from other similar small captive populations including another subspecies of Brow-antlered deer (Cervus eldi thamin), it is likely that inbreeding depression is a problem for this population, increasing the probability of extinction. Reproductive analysis may be done to determine loss of fertility in females. Identification of individuals and experimental mixing of lineages may be done.

A major recommendation for the captive population is to rapidly increase the number of animals by what ever means can be made practicable such that a sustainable harvest of viable surplus animals will be available to establish new populations in natural habitats. Ideally within the historical range of the subspecies or-as a last resort-outside the range in a suitable habitat. There is, however, uncertainty about the utility of the captive population for reintroduction or introduction considering the small number of founders from which it originated. Although nutrition, housing, etc. was felt to be adequate, some experimentation with immproved diets and enclosure design which would make possible more productive social groupings may yield a good result.

The P.H.V.A. Workshop reviewed assembled information about Sangai and forming Working Groups for specialised areas: e.g. In situ Modelling, Habitat Evaluation, Human Impact/Education, Disease/Mortality Group, Ex situ Modelling, Husbandry, and Captive Carrying Capacity. This Workshop Report includes recommendations from these groups as well as sections on population history, simulation modelling, and a subsequent follow-up meeting Report.

While the PHVA has reinforced the importance of establishing a second population, the groudwork done here requires follow-up. More specific information is needed to examine some of the questions in greater detail.

This workshop has laid foundations for further analysis of specific problems that have been identified, with an objective of formulating priorities and determining management action in terms of those priorities. It has been the experience of CBSG that the development of management plans for complex species problems is a step-wise process. Thus, this "final" Report is not final in any sense, but is instead another step towards a more rational methodology for saving the Sangai. Another PHVA should be organised when

some of the recommendations in this Report have been carried out, particularly in the area of collection of quantative data on the species, both in situ and ex situ.

This Report was circulated to all participants and published with their comments as a Second Draft in May, 1993. Further comments were solicited and a Third Draft was circulated previous to the Workshop Followup meeting held in Madras in October 1993. This Final Report was delayed awaiting comments and information which never materialised.

Summary of Major Recommendations

Population Recommendations

1. Alternative populations should be established, ideally within the traditional biogeographic range of the subspecies.
2. The captive population should be enhanced and improved as rapidly possible as breeding stock to insure against catastrophe and for possibly for reintroduction programmes, although the latter was not supported by all in the workshop.
3. The content, consistency and reliability of annual census data, both in situ and ex situ, should be enhanced including population size, demography and reproductive index.

Wild Population Management Recommendations

4. Monitoring the demography of the wild population should be enhanced, giving a high priority to counting of fawns as an index of reproduction in the population.
5. A process should be set into motion which would result reclamation of genetic material from in situ stock. This could be done with the assistance of artificial insemination or embryo transfer.
6. An estimate of confidence limits, or data quality index, should be added to the annual census data report.

Recommendations for Captive Population

7. An enhanced captive populaiton should serve as security against catastrophe and possibly reintroduction programmes. For this, the captive population should be increased as rapidly as possible by improved management assisted by recent advances in reproductive physiology.
8. The captive management of the species must include marking of individual animals, scrupulolus maintenance of birth, transfer, and death records, including infant mortalities. Demographic and genetic information should be utilised in strategic management and collection planning for the species.
9. The present captive population should be managed for maximum genetic variance through a system of exchange of individuals among zoos. Judicious import from the wild was also recommended although not supported by all in the workshop.

Habitat Management

10. Habitat quality should be improved by judicious adjustment of human interaction and land management, e.g., relocation of enclave, removal of encroachment, demarcation of boundary of the National Park, realignment of roads, enhancement of staff with better equipment and mobility and interface forestry.
11. Fringe populations should be provided with alternative life-styles through eco-development programmes.

Diseae/Mortality

12. A thorough analysis of diseases of domestic animals in the surrounding area should be pursued by the veterinary community, supported by appropriate laboratory back-up. Carcases of Sangai encountered in the field should be subjected to detailed necropsy examination to identify the cause of death.
13. The extent and effect of potential nutritional deficiencies, such as mineral deficiency, as well as unwanted additives, such as pesticides which are used for killing fish should be investigated.
14. Preventative and curative captive medical care should be improved, including a protocol for identification and animal health records, development of a centralised data base, in-house and intra-zoo movement to minimise stress, injury and death.

15. Infant mortalities and non-conception by females should be reduced by aggressive and systematic investigation into possible causes, implementation of improved husbandry, and by acquiring technical expertise in handrearing and artificial insemination.

Human Impact / Education /Public Awareness

16. Biotic pressure on Kelbul Lamjao National Park is one of the major threats to Sangai both directly and indirectly, and should be reduced with suitable precautions to care for the needs of the people living in the area.

17. A full time coordinator for eco-restoration activities should be identified for integrating of various projects and agencies in this type of work.

18. Education and awareness programmes should focus first on people living in and around the National park, integrating attempts to foster local pride with social welfare and eco-development programmes to address problems and reduce destruction of habitat.

19. Meetings and seminars for various levels of officials, administrators, scientists, business people and policy makers should be organised to create awareness and a sense of participation in solving the problems of the National Park and Sangai.