

**A behavioural profile of captive bred pygmy hogs *Porcula
salvania* prior to reintroduction into the wild**

A Thesis Submitted to
The Manipal University

In partial fulfilment for the degree of
Master of Science
In Wildlife Biology and Conservation
2008

By
Robin Kurian Abraham

Post-Graduate Programme in Wildlife Biology & Conservation
Centre for Wildlife Studies
and
And National Centre for Biological Sciences
UAS-GKVK Campus
Bangalore - 560 065

SUMMARY

The restoration of endangered animal species in their natural habitats often relies on the reintroduction of animals from captive populations. These reintroduction programs rely heavily on understanding the ecological requirements of the species, gained from field studies. Some critically endangered species, however, have very small wild populations and occupy habitat or terrain intractable to monitoring. In such situations, studies on captive animals can sometimes provide information that can be used to systematically plan their release into the wild. Captive-animal studies also allow investigators to test hypotheses using data that is difficult to obtain in the field.

The pygmy hog (*Porcula salvania*) is a critically endangered suid endemic to the state of Assam, which has been released into its wild habitat in Sonai-Rupai WLS in May 2008, as part of a reintroduction programme initiated twelve years ago. This study focused on studying the behaviour of this animal in captive conditions in a breeding centre in Guwahati and then comparing the behaviour with hogs kept under semi-wild conditions at a pre-release centre in Potasali. Sampling was carried out from December 2007 to April 2008 at two locations in Assam.

Data on behaviour were collected from 25 individuals in the breeding centre, and since the study period coincided with the breeding season, much of the observations pertained to breeding behaviour. Fifteen minute long focal animal observations on individuals housed in the breeding enclosures were used to measure various behavioural events, with group scans between the focal animal observations to measure various states. Some sequence scans were also made opportunistically. The majority of observations were made on breeding pairs. In the pre-release centre in Potasali, where instantaneous scans were the priority, observations were made on 17 individuals, with focal animal sampling happening whenever hogs were visible, particularly during the feeding hours. The percentage time spent in behavioural states was calculated across individuals from group scans to obtain time activity budgets and the rates of a particular behavioural event were calculated from frequency of occurrence of that behaviour in focal animal samples.

An ethogram was constructed using the behavioural observations conducted during focal animal sampling and instantaneous scans. Behavioural sampling was also carried out at a hog pre-release centre. Comparisons were made between both sites in order to assess the adaptability of the animal to novel situations. It was seen that the hogs in both sites spent more time foraging more than on the other activities. In general the pattern of pygmy hog behaviour concurs with previous reports for other suids. Certain behaviours such as displaying and rump-sniffing which are associated with breeding were restricted to the males. In the pre-release centre, hogs exhibited behaviours not seen in the breeding centre. The results obtained from this study clearly show that the hogs, despite being maintained in captivity for a period of eleven years, over several generations, still exhibit the potential to adapt to new situations as well as display behaviour reflecting to their natural environment. This indicates a positive prognosis for the future of the project.

ACKNOWLEDGEMENTS

To start off with, I thank the Wildlife Conservation Society – India Program for having provided the funding support and assistance necessary for the study. I express my sincere gratitude to my Project Guide Dr. Anindya Sinha and Course Director Dr. Ajith Kumar for having helped me conceptualize this study and having provided crucial guidance and suggestions to me through this project. I am also thankful to my Project Co-Guide Dr. Goutam Narayan for all the logistic support and ideas given to me during the entire length of my field days. I am especially devoted to Dr. Geoff Hyde of NCBS for his help in preparing this thesis.

I am thoroughly grateful to Dr. Parag Jyoti Deka of the Pygmy Hog Conservation Program (PHCP) for his assistance and support throughout the project's duration. It would have been difficult to carry out this study without the assistance provided by Kishore, Raju, Dipen Deb, Abanai Mohanti, Pranav Kolita, Tulsi and Chand Mia of the PHCP. I would particularly like to thank Dhruva and Pooja of the Assam Haathi Project for their memorable company at Potasali. Thanks to Ranesh Roy of the Nameri Eco Camp for having provided exciting evening company. And accolades to the Durrell Wildlife Preservation Trust for having taken the initiative and effort to preserve the Critically Endangered Pygmy Hog and bring the species back from extinction.

I am also obliged to the Centre for Wildlife Studies (CWS) for having administered the project and facilities and Manipal University for certifying the Master's course.

I was reassured from monotony in the confines of the computer lab by the presence of the rest of my batch mates who, too had been going through the lows of data analysis and write-up. I also extend my gratitude to my colleagues, Kulbhushansingh and Nachiket for attending to and clearing ever popping doubts. And last but not least, my ever supportive family deserves credit, especially my mother for always rekindling my spirits.

Contents	Page
Summary	i
Acknowledgements	iii
General Introduction	1
A Behavioural profile of the pygmy hog <i>Porcula salvania</i> and Implications for their reintroduction	
Abstract	8
Introduction	9
Methods	11
Results	14
Discussion	19
Conclusions	21
Acknowledgements	22
References	22
Appendix – An Ethogram for the Pygmy Hog <i>Porcula salvania</i> in captivity	26

GENERAL INTRODUCTION

The pygmy hog *Porcula salvania* is one of the world's most endangered mammals (Anon. 1985; Oliver and Deb Roy 1993). The IUCN Red List status of the pygmy hog is **CR A1c, B1+2cd, E**, primarily due to human-induced habitat loss and degradation, and the harvesting of natural resources (IUCN Red List of Threatened Species 2007).

Recent genetic analyses (Funk et al. 2007) classify the pygmy hog as a unique, monotypic genus, *Porcula*. This has not only amplified its conservation value but, considering that it is the world's smallest suid, has also made it an extremely valuable genetic resource. Moreover, it has been considered one of the most useful indicators of current wildlife habitat management practices, particularly the effects of widespread, frequent burning and exploitative pressures on grasslands (Oliver 1981, 1984). Formerly, the species was more widely distributed throughout the alluvial grasslands along the southern Himalayan foothills but is now probably restricted to a single isolated wild population in the tall grasslands of the Manas Wildlife Sanctuary and its buffer reserves in northwestern Assam, India, along its border with Bhutan (Oliver and Deb Roy 1993). The size of this population is unknown but is unlikely to be more than a few hundred individuals, perhaps considerably less. The pygmy hog thus constitutes the top priority for conservation amongst all Suiformes (Oliver and Deb Roy 1993).

The principle recommendations for the conservation of the species have generally been (1) to determine the species' current distribution and priority requirements in the environs of Manas, (2) to identify any other possibly surviving, remnant populations elsewhere in the region, (3) to identify suitable sites for possible future reintroductions, (4) to establish a properly structured captive breeding program, both as a safeguard against the species' possible imminent extinction and as a source for future reintroductions, and (5) to initiate medium- to long-term field studies on the species' ecology, behaviour and its habitat management requirements (IUCN 1998).

As pygmy hogs have now been reduced to only a single remnant population in Assam, there is only a limited understanding of the ecology, habitat preferences and social interactions of these animals in the wild. A captive-breeding programme, which was initiated at the Pygmy Hog Conservation Centre (PHCC) at Basistha in Assam in 1996, has been successful in breeding and maintaining a healthy population of the pygmy hogs in captivity. The current aim of the programme is to release some of these captive-bred animals into the wild. Prior to release, however, a small

population of hogs would be maintained under semi-natural conditions for acclimatisation, in a pre-release enclosure. It is clearly imperative that the reintroduction programme should conduct detailed studies on certain aspects of the behaviour and ecology of the animals that are likely to be critical to their subsequent survival in the wild. The results of these studies would also be of vital importance in monitoring the released animals and in establishing a baseline for further studies.

Current understanding of the species' recent history, distribution and present status are based largely on a limited number of field surveys (Oliver 1979a, b, 1980, 1981, 1984) and on observational records pertaining to several captive animals in various tea estates (Mallinson 1971, 1977) and in the Manas National Park. There have also been a handful of studies on the diseases of the pygmy hog in recent years, but these have exclusively originated from the captive population of the PHCC breeding programme (Rahman et al. 2001, 2005).

The knowledge we have of the morphology, ecology and behaviour of the pygmy hog is thus highly fragmented and based largely on informal observations from a very limited number of studies (reviewed in IUCN/SSC, 1998). It is known, for example, that adult males, distinguished by their relatively larger size, more robust appearance and exposed tusks, are usually solitary but join oestrous sows during the rut. They also appear to associate loosely at other times of the year with the basic social unit comprising about 4-6 individuals, including one or more adult females and their accompanying juveniles. Reproduction is believed to be very seasonal, with recorded data indicating a single birth peak, concurring with the onset of the pre-monsoons in late April and May. The litter size is reported to vary from two to six but is usually three to four (Mallinson 1977; Oliver 1979b, 1991 cited in Oliver and Deb Roy 1993).

The species is also unusual amongst suids in that its nests are constructed and utilized by both sexes at all times of the year. Nest-building is not, therefore, associated only with farrowing or inclement weather (Oliver 1980). Pygmy hogs are habitual foragers, spending in the region of six to eight hours per day actively searching for food. Foraging is essentially comprised of active searching with intermittent pauses to root in the ground, to dig and turn over litter and topsoil, thereby leaving small, but distinctive, forage marks; these represent the primary means of detecting their recent activity in the field (Oliver 1979a). All prior data indicate that this species is dependent on early successional riverine communities, comprising dense tall grasslands, which occur within a mosaic of a variety of herbaceous plants, early colonizing shrubs and young trees.

The success of release programmes of captive-bred or translocated animals depends to a large extent upon their behavioural skills. It is now clear that captive breeding often fails as a result of behavioural problems (Synder et al. 1996) and behavioural issues are today accepted to be of vital importance in the management of captive species (Gibbons et al. 1995). A population of captive-bred golden lion tamarins *Leontopithecus rosalia rosalia*, for example, was observed to lack the ability to recognize food or predators in the wild and even basic locomotory skills appeared to be absent (Beck et al. 1991). There is a clear need to ensure that introduced animals retain or acquire these skills. Many release schemes fail due to such behavioural lacunae and the problem of losing cultural skills. An understanding of social systems and dispersal behaviour should allow behavioural biologists to provide proper recommendations as to how such release schemes must be organized. Conservationists also need far more information on the habitat requirements of species of conservation concern. Much of this information is behavioural in terms of diet choice, home range, social system and breeding behaviour. The opportunity for using manipulated reproductive behaviour and physiology, extending from studies of captive animals, for wild populations under extreme risk of extinction, also appears to be under-explored.

In this study, I explored the basic behavioural biology of the pygmy hog at two sites, the breeding centre at Basistha and the pre-release centre at the Nameri National Park. It is hoped that the study would add crucial behavioural data for the captive breeding and reintroduction programme, which is the key to ensuring the re-establishment of this critically endangered species in its former domain in the *terai* grasslands of northeastern India. This manuscript titled "A behavioural profile of the Pygmy Hog *Porcula Salvania* and Implications for their reintroduction" is prepared for submission to the journal *Zoo Biology*.

References

- Anonymous. 1985. Choosing the 24 most endangered species. *Newsletter of the Species Survival Commission* 5: 17-23.
- Beck BB, Rapaport LG & Wilson AC. 1994 in Sutherland, W. J. (1998) The importance of behavioural studies in conservation biology. *Animal Behaviour* 56: 801-809.
- Funk SM, Verma SK, Larson G, Prasad K, Singh L, Narayan G and Fa JE. 2007. The pygmy hog is a unique genus: 19th century taxonomists got it right first time round. *Molecular Phylogenetics and Evolution* 45(2): 427-436.
- Gibbons EF, Jr Durrant BS & Demarest J. 1995. in Sutherland WJ. 1998. The importance of behavioural studies in conservation biology. *Animal Behaviour* 56: 801-809.
- [IUCN] International Union for Conservation of Nature. 1998. *Guidelines for Re-introductions*. IUCN/SSC Re-introduction Specialist Group, IUCN, Gland, Switzerland and Cambridge, UK.
- Mallinson 1971, 1977. in Oliver WLR and Deb Roy S. 1993. The pigmy hog (*Sus salvanius*) In: *Pigs, Peccaries and Hippos: Status Survey and Conservation Action Plan*, IUCN/SSC Pigs and Peccaries Specialist Group, pp. 121-129.
- Oliver WLR. 1984. The distribution and status of the hispid hare, *Caprolagus hispidus*: the summarised findings of the 1984 pigmy hog/hispid hare field survey in northern Bangladesh, southern Nepal and northern India. *Dodo* 21: 6-32.
- Oliver WLR and Deb Roy S. 1993. The pigmy hog (*Sus salvanius*) *Pigs, Peccaries and Hippos: Status Survey and Conservation Action Plan*, IUCN/SSC Pigs and Peccaries Specialist Group, pp. 121-129.

Rahman H, Chakraborty A, Deka PJ and Narayan G. 2005. Salmonellosis in pigmy hogs (*Sus salvanius*) – a critically endangered species of mammal, *Scientific and technical review / International Office of Epizootics* 24(3): 959-964.

Rahman H, Chakraborty A, Deka PJ, Narayan G and Prager R. 2001. An outbreak of *Salmonella enteritidis* infection in pygmy hogs (*Sus salvanius*). *Tropical Animal Health and Production* 33: 95-102.

Sutherland WJ. 1998. The importance of behavioural studies in conservation biology. *Animal Behaviour* 56: 801-809.

Synder NFR, Derrickson SR, Beissinger SR, Wiley JW, Smith TM, Toone WD & Miller B. 1996. in Sutherland WJ. 1998. The importance of behavioural studies in conservation biology. *Animal Behaviour* 56: 801-809.



Basistha (Breeding Centre)

© Robin Kurian Abraham



Potasali (Pre-release Centre)

© Robin Kurian Abraham



© Robin Kurian, Abraham

Female Pygmy Hog



© Robin Kurian, Abraham

Male Pygmy Hog

A behavioural profile of the Pygmy Hog *Porcula salvania* and Implications for its reintroduction

Abstract

A reintroduction program of an animal would be incomplete without background information on various aspects of its ecology and behaviour, including its time-activity budgets, social behaviour, ranging and foraging ecology, as well as the predatory pressures it faces in the wild. The pygmy hog (*Porcula salvania*), a critically endangered species with only a single remnant population in the wild, has been successfully bred in captivity, with reintroduction into the wild being the next step in its conservation plans. Much of the required knowledge on its ecology and behaviour is, however, still lacking for this species. A study that examines the behaviour and basic habitat preferences of the species in captive and semi-wild conditions would provide such baseline information, as the animal is extremely difficult to follow in the wild. Thus, my focus was a behavioural study conducted on captive bred pygmy hogs at the only breeding centre of the species in Basistha, near Guwahati, in Assam. An ethogram was constructed and behavioural observations conducted using focal animal sampling and instantaneous scans. I also carried out behavioural sampling at a hog pre-release centre in Potasali near the Nameri National Park of Assam. Comparisons were made between the two sites in order to assess the adaptability of the animal to novel situations and environments. The hogs spent the maximum time within their time-activity budgets on foraging and feeding and in general, the behaviours were similar to previously studied suids. In the pre-release centre, more time was spent on foraging and moving, while the hogs in the breeding centre spent relatively less time doing the same, which signifies that captive-bred hogs were adaptable enough to forage successfully in new environments, and thus, in their capability to revert to a 'wild' state. In general, the results from this first-ever detailed behavioural study of the species will provide important inputs into its future conservation strategies; the success of the breeding program will, however, ultimately be measured in terms of the increase in the number of individuals that would repopulate the endangered populations of the pygmy hog in its natural habitat.

Keywords: pygmy hog, behaviour, captive breeding, reintroduction

Introduction

Restoration of endangered animal species to their natural habitats is becoming increasingly frequent around the world, and often relies on the reintroduction of animals from captive populations (IUCN 1998). Some reintroductions have succeeded (Magdalena et al. 1996) but many have failed (Griffith et al. 1989). A greater level of success would presumably follow if detailed studies were conducted, prior to reintroduction, on the status and biology of wild populations to determine the critical needs of the species. For animals, these would include descriptions of habitat preferences, intra-specific variation and adaptations to local ecological conditions, social organisation and behaviour, home range size, shelter and food requirements, foraging and feeding behaviour, predators and diseases (IUCN 1998).

Some critically endangered species, however, have very small wild populations and occupy habitat or terrain intractable to monitoring (Visser and Lambrechts 1999). In such situations, studies on captive animals can provide information that can be used to systematically plan their release into the wild. Captive-animal studies have often been used to also test hypotheses that cannot be examined with field experiments (Visser and Lambrechts 1999). When carrying out such studies, however, researchers must be aware of the potential problems that may arise. Experiments with captive animals have the disadvantage that the often-inappropriate environments may provoke abnormal behaviour (King 1999; Winkler and Leisler 1999). In addition, within a few generations, captive animals may become quite different in their behaviour from their wild counterparts, particularly if they are exposed to new selection regimes while in captivity (Kohane and Parsons, 1988).

The pygmy hog *Porcula salvania* is one of the world's most endangered mammals (Anon. 1985; Oliver and Deb Roy, 1993). In the IUCN Red List, the pygmy hog is categorized as Critically Endangered **CR A1c, B1+2cd, E**, due to human-induced habitat loss and the degradation and harvesting of natural resources. Key recommendations for the conservation of the species are to identify suitable sites for possible future reintroductions, the establishment of a properly structured captive breeding program, both as a safeguard against the species' possible imminent extinction and as a source for future reintroductions, and the initiation of medium- to long-term field studies on the species' behavioural ecology and habitat management requirements.

Recent genetic analyses (Funk et al. 2007) classify the pygmy hog in a monotypic genus, *Porcula*, amplifying its conservation value. Formerly, the species was more widely distributed

throughout the alluvial grasslands along the southern Himalayan foothills, but is now probably restricted to a single population in northwest Assam, India, along the border with Bhutan (Oliver and Deb Roy 1993). The pygmy hog constitutes the top priority for conservation amongst all Suiformes (Oliver and Deb Roy 1993). A prerequisite for its survival in the wild is the availability of relatively undisturbed tall '*terai*' grasslands. This habitat has dramatically declined in extent and quality over the last century, and now only occurs in small isolated patches. These grasslands are also crucial for the survival of a significant number of other endangered species (Narayan et al. 1999, Oliver and Deb Roy 1993) such as the Bengal Florican (*Houbaropsis bengalensis*) and Greater one-horned Rhino (*Rhinoceros unicornis*).

Pygmy hogs have now been reduced to only a single isolated wild population in the tall grasslands of the Manas Wildlife Sanctuary and its buffer reserves in north-western Assam. The size of this population is unknown but is unlikely to be more than a few hundred individuals, perhaps considerably less. There is thus only a limited understanding of the ecology, habitat preferences and social interactions of these animals in the wild. A captive breeding programme, which was initiated at the Pygmy Hog Conservation Centre (PHCC) in Basistha, near Guwahati, in Assam in 1996, has been successful in breeding and maintaining a healthy population of the pygmy hogs in captivity (Oliver 1979a, b, 1980, 1981, 1984). The current aim of the programme is to release some of these captive-bred animals into the wild. Prior to release, however, a small population of hogs would be maintained under semi-natural conditions for acclimatisation, in a pre-release enclosure. It is clearly imperative that the reintroduction programme conduct detailed studies on certain aspects of the behaviour and ecology of the animals that are likely to be critical to their subsequent survival in the wild. The results of these studies would also be of vital importance in monitoring the released animals and in establishing a baseline for further studies.

Current understanding of the species' recent history, distribution and present status are based largely on a limited number of field surveys (Oliver 1979a, b, 1980, 1981, 1984) and on observational records pertaining to several captive animals in some tea estates and in the Manas National Park (Mallinson 1971, 1977). Studies on the diseases of the pygmy hog are based on the captive population of the PHCC breeding programme (Rahman et al. 2001, 2005).

In this study, I collected quantitative behavioural data on several individual pygmy hogs kept in breeding enclosures, using focal animal studies and the instantaneous scan approach, in order to

build a basic behavioural profile of this species in captivity. I also carried out a study of select animals kept in pre-release enclosures in the Nameri National Park in Assam.

I prepared an ethogram and described the behavioural profile of the pygmy hog in captivity. A second goal was to make comparisons between animals kept in captive and semi-natural conditions in order to understand the adaptability of the captive-bred hogs following exposure to conditions simulating their natural environment. I monitored social interactions among individuals of the same and opposite sexes, maintained as pairs or in groups. Finally, a documentation of the time-activity budgets of individuals kept singly and in groups, particularly related to foraging while in captivity and in a semi-natural context, was also an important objective of the study.

Methods

This study was divided between two sites in the state of Assam. The Pygmy Hog Conservation (Breeding) Centre (PHCC) is located in Basistha, which is situated in the outskirts of Guwahati, capital of Assam in the district of East Kamrup. The pygmy hog was selected for a captive breeding program initiated by the Durrell Wildlife Conservation Trust, UK in collaboration with both the IUCN Specialist Group for Pigs and the Assam Forest Department (AFD). The centre has been maintaining a captive-bred population of hogs from the six wild individuals initially captured from Manas National Park in March 1996 and brought to the breeding facility. The programme has met with significant success with a population of more than 70 individuals now shared between the breeding centre and a pre-release facility at Potasali near Nameri National Park in Sonitpur district.

I carried out the study on 25 hogs in the breeding centre at Basistha, comprising of 13 females and 12 males, and 17 hogs in the pre release facility, of which 10 were females and seven were males. Of the hogs in the breeding centre, there were nine breeding pairs, while the remainder were either solitary or in groups of the same gender. Here, the hogs were housed in concrete enclosures that were divided into three 'houses'. The largest of these housed the breeding pairs of hogs, with each enclosure holding a single male-female pair. The other two held the aged individuals and the latest cohort of hoglets.

At the pre-release centre at Potasali, there were three enclosures of dimensions 30 m × 80 m (Fig. 1) planted with simulated grasslands to help the hogs, acclimatise to their future habitat prior to

release. A central tower aided in observing the hogs in all three enclosures while their activities were concentrated in a feeding sub-paddock. However, the main ranging paddocks of these enclosures, having been vegetated with the tall grasses, prevented sighting of the animals during most of the day. Much of the observations were thus possible only when the hogs came to the feeding paddock in the mornings and evenings, with frequent but random visits in between. Some observations, however, were also possible in the waterholes inside the ranging paddocks.

I spent a total of 192 hours observing the hogs across both sites. In the pre-release centre in Potasali, the breeding program managers had divided the individuals into three groups housed in three pre-release enclosures numbered 1, 2 and 4 (Table 1). The groups in enclosures 1 and 4 comprised of an adult male and an adult female hog with four juveniles while enclosure 2 comprised a single adult female, two sub-adult males and two juvenile females. All the juveniles were less than a year old and were from the previous year's cohort.

Potasali	Hog Id	Sex	Age (years)	Status
Enclosure 1				
1	PH125	F	7	Died after release
2	PH206	M	2	
3	PH215	F	1	
4	PH216	F	1	
5	PH223	M	1	
6	PH224	M	1	
Enclosure 2				
1	PH124	F	7	Died before release
2	PH199	M	2	
3	PH200	M	2	
4	PH231	F	1	
5	PH235	F	1	
Enclosure 4				
1	PH116	F	7	
2	PH176	M	3	
3	PH210	F	1	
4	PH211	F	1	
5	PH221	F	1	
6	PH232	M	1	

Table 1. Details of the hogs in the Potasali (pre-release) Facility as on 15/01/2008

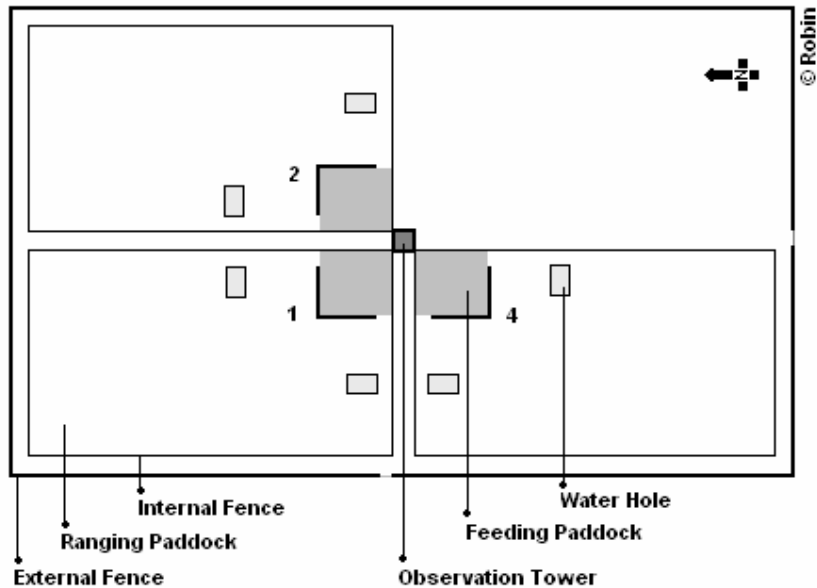


Figure 1. Potasali Pre-release Enclosures 1, 2 and 4

I carried out behavioural sampling, with one set of observations from December 2007 to mid-January 2008 and the other in mid-March 2008, at the Basistha breeding centre. Mean (\pm SE) observation times were 13.04 (\pm 0.22) hours at this site. Behavioural sampling was conducted between 0800 to 1600 hrs at both sites. In Basistha, I initiated each sampling session with an instantaneous scan of individuals chosen randomly for observations, followed by a focal animal sample of a predetermined individual within the group for a duration of 15 minutes. I preceded each subsequent focal animal sample by an instantaneous scan of all the hogs in enclosures adjacent to the focal enclosure. Hence, the numbers of animals scanned varied across the day. Paired individuals in enclosures were sampled randomly. Every hog had been assigned identification (ID) numbers by the managers of the breeding centre and so recordings were entered based on these ID numbers. Observations were made from outside the enclosure through the metal cage fence. The majority of observations (90%) in Basistha were made on breeding pairs.

I conducted behavioural observations in Potasali from mid-January till early March 2008. I made observations on each individual with a mean (\pm SE) of 32.50 (\pm 0.28) hours at this site. Instantaneous scans were given priority over focal animal samples at this site, the latter being conducted whenever hogs were visible, particularly during the feeding hours. .

The instantaneous scans and the focal animal samples recorded a large number of behavioural states and events, which have been listed in Appendix 1. Some of the principal behaviours that were scored include allogrooming, resting, displaying, foraging, moving and being in the nest (Appendix 1).

Due to very few individuals performing certain behaviours or the low sample sizes obtained for the relatively rare behaviours, several of them have not been analysed independently but have been pooled into various functional behavioural categories.

Data Analysis

I partitioned the observation time into three periods – forenoon (0800 -1100 hrs), midday (1100 -1400 hrs) and afternoon (1400 -1600 hrs). I compared various behaviours for significant differences between these three time periods using Mann-Whitney U tests. This test was also used to examine differences in the time-activity budgets of the study individuals at the two sites. I tested for variation in the behaviours displayed by the two sexes using the Mann-Whitney U test and the Chi-square test, while the frequency of performance of the different behavioural events were compared across and within the sexes using the Mann-Whitney U test and the Wilcoxon matched-pairs signed-ranked test.

Results

Basistha breeding centre

Seventy-six behavioural states and events exhibited by the pygmy hog are listed in Appendix I. For ease of comparing between activities, many behavioural states were pooled into functional behavioural categories as mentioned above. Analysis of the time-activity budgets of the study individuals showed that the highest proportion of observation time was dedicated to foraging (mean percentage time \pm SE of $51.81 \pm 6.4\%$ for females and $43.42 \pm 7.88\%$ for males) and moving ($26.46 \pm 3.40\%$ for females and $29.45 \pm 3.74\%$ for males), followed by being inside the nest, resting, displaying, and allogrooming (Fig. 2).

The two sex classes partitioned their time rather differently. The activity budget of males and females differed significantly over the study period for foraging (Fig. 2; Mann Whitney U test; $U =$

25024, $Z = -6.254$, $n = 22$, $p < 0.001$), allogrooming ($U = 32710$, $Z = -4.438$, $n = 22$, $p < 0.001$), display ($U = 26084$, $Z = -9.008$, $n = 22$, $p < 0.001$), inside nest ($U = 32065$, $Z = -3.043$, $n = 22$, $p = 0.002$) but did not differ for resting ($U = 35144$, $Z = -0.287$, $n = 22$, $p = 0.774$) and other behaviours ($U = 35230$, $Z = -0.723$, $n = 22$, $p = 0.470$). The differences were especially large for display and allogrooming, behaviours in which the study males spent a significantly greater proportion of time than did the females.

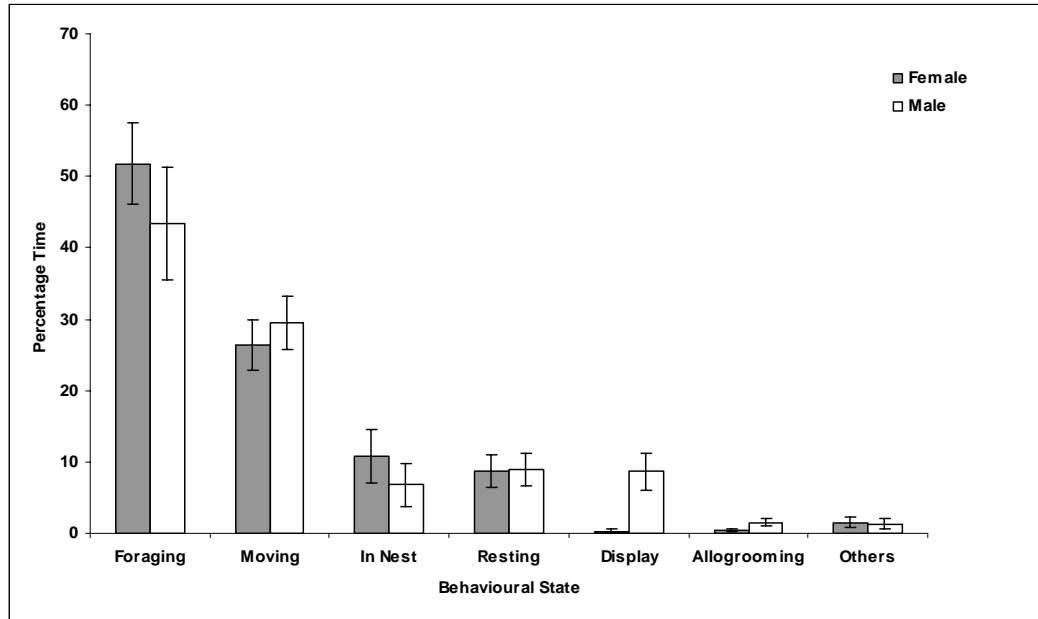


Figure 2. Time-activity budgets of male and female hogs in Basistha

There was a significant difference in the time-activity budgets of males and females in the forenoon with females spending a greater proportion of time in foraging (Fig. 3a; Mann Whitney U test; $U = 101.5$, $n = 22$, $p = 0.001$) and inside the nest (Fig. 3e; $U = 116$, $n = 13$, $p = 0.042$) while males moved (Fig. 3d; $U = 112.5$, $n = 22$, $p = .002$), displayed (Fig. 3b; $U = 92$, $n = 22$, $p < 0.001$) and allogroomed (Fig. 3c; $U = 147$, $n = 22$, $p = 0.003$) significantly more. Significant differences also existed between the midday activity budgets of the two sexes for foraging ($U = 82$, $n = 22$, $p = 0.019$), displaying ($U = 68$, $n = 22$, $p < 0.001$) and allogrooming ($U = 102$, $n = 22$, $p = 0.010$). Such intersexual differences, however, could not be discerned for any behaviour in the afternoon activity budget.

Although the study females foraged significantly more than did the males, the proportion of time spent foraging by them followed a slightly decreasing trend over the day, although this was not statistically significant (Fig. 3a). The males, on the other hand, spent more time moving and allo-

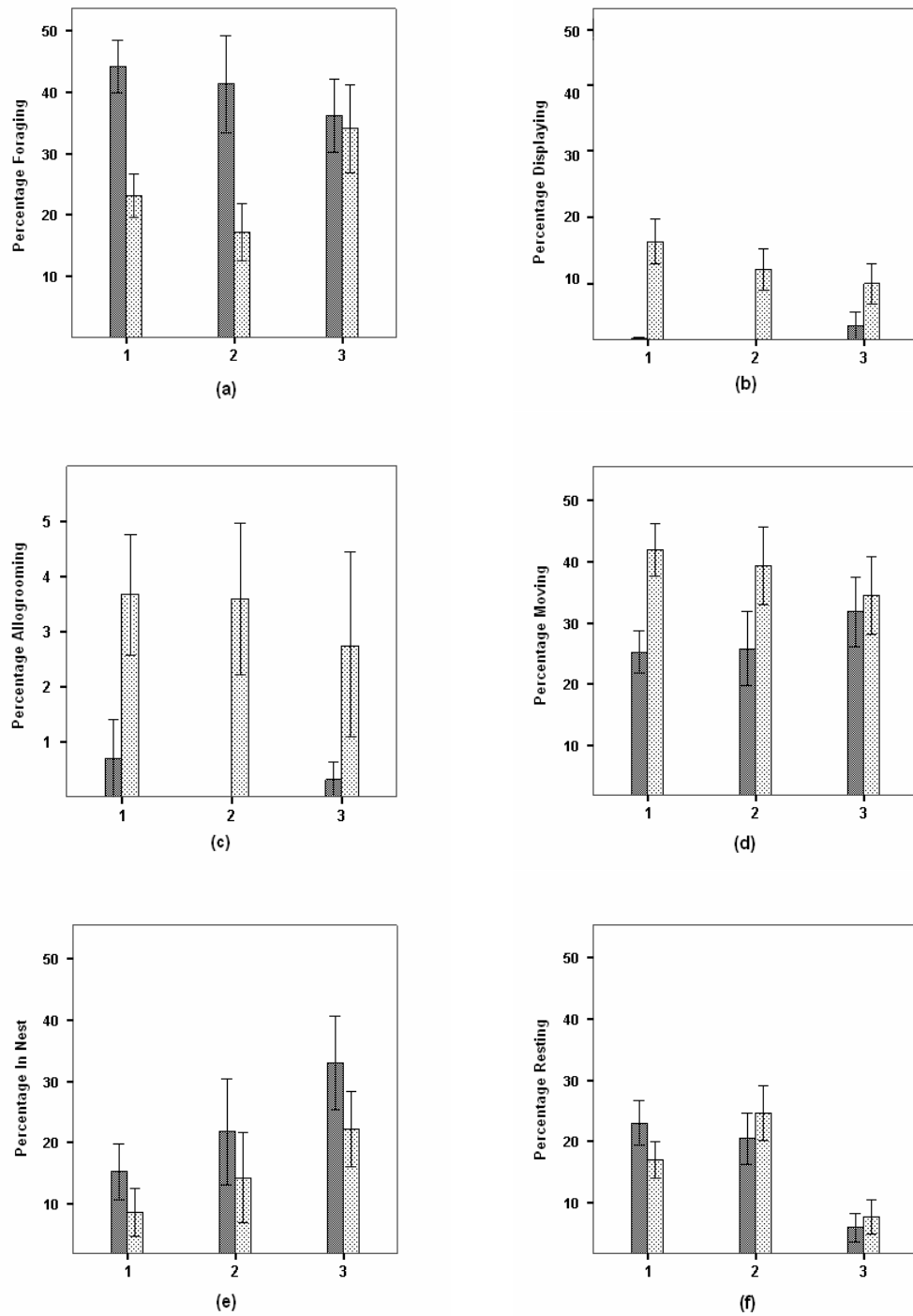


Figure 3. Percentage time (mean \pm SE) spent in (a) foraging, (b) displaying, (c) allogrooming, (d) moving, (e) in nest and (f) resting during forenoon (1), midday (2) and afternoon (3) by male and female hogs in the breeding enclosures of *Basistha* [Females – dark grey, Males - light grey]

grooming than did the females and seemed to present these behaviours consistently throughout the day (Fig. 3d). Both sexes exhibited similar patterns of resting throughout the day, spending about 20% of the budget during forenoon and midday (Fig. 3f). As mentioned earlier, females also spent more time inside the nest, with a noticeable peak in the afternoon (Fig. 3c). Displaying is a behaviour that was exclusively demonstrated by breeding adult males during the study. There were however, variations in the proportion of time spent displaying by males of different enclosures (Fig. 4). Displaying, however, appeared to be shown by males of all age categories at comparable levels ($\chi^2 = 4.651, df = 2, n = 7, p = 0.098$).

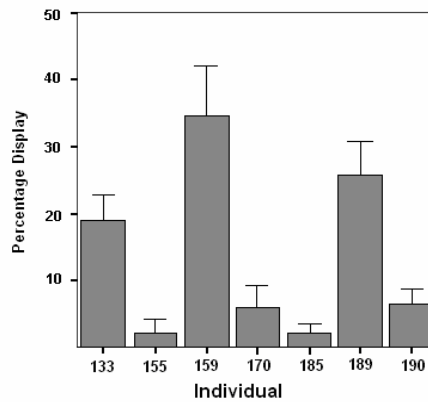


Figure 4. Variation in the proportion of time spent in (male to male) display by the different breeding males at Basishta.

<i>Behavioural interactions</i>	<i>Frequency of occurrence</i>		<i>Difference in directionality</i> (Wilcoxon's W, n, p)
	Males to Females	Females to Males	
Allogrooming	0.23	0.05	W = 17, n = 12, p = 0.94
Following	0.12	0.15	
Lying Down	0.06	0.15	
Running Away	0.02	0.07	
Rump Sniffing	0.15	0	
Walking Away	0.11	0.17	

Table 2. The principal social interactions displayed by the breeding pairs of pygmy hogs in Basistha. The difference in directionality of these behaviours have been tested with the Wilcoxon's matched-pairs signed-ranks test

The frequency of occurrence of the principal social interactions, exhibited by the male and female pygmy hogs in Basistha, is depicted in Table 2. All the interactions, except rump- sniffing, were symmetrically directed by the two sexes towards each other at comparable frequencies; males sniffed the rumps of breeding females significantly more than vice versa.

Potasali pre-release centre

Of all the behaviours that potentially contributed to the time-activity budgets of the hogs in the pre-release centre, the only two that could be observed to any significant extent were foraging and moving. If we compare the percentages of time spent on foraging and moving between the two sites then, the males seemed to spent significantly more time foraging (Mann Whitney U test; $U = 9337$, $Z = -12.997$, $n = 17$, $p < 0.001$) and less time moving ($U = 20452$, $Z = -5.146$, $n = 17$, $p < 0.001$) in the pre-release site than in the breeding centre (Fig. 5). The females too foraged significantly more ($U = 24865$, $Z = -8.358$, $n = 17$, $p < 0.001$) in the pre-release centre though moving was not significantly different between the two sites ($U = 39538$, $Z = -0.606$, $n = 17$, $p < 0.544$). However, these results are probably skewed by the fact that many behaviours seen at Basistha could have been cryptically performed in Potasali.

Given the paucity of the focal animal samples that could be conducted on the study animals at the pre-release site, the data have not been analysed further.

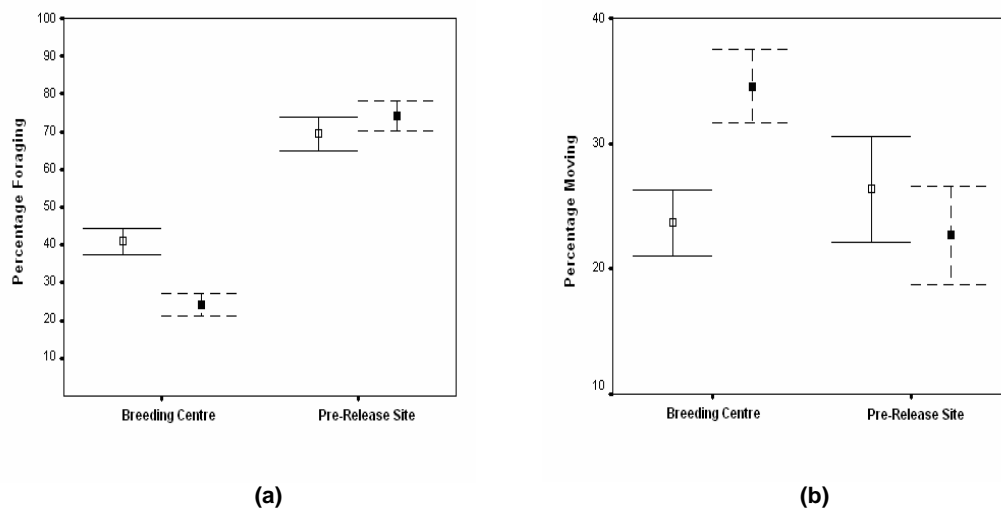


Figure 5. Percentage time spent in foraging and moving by the male and female pygmy hogs in the breeding centre at Basista and the pre-release centre in Potasali, Assam [---Males, — Females]

Discussion

The primary goal of this research was to prepare an ethogram and to describe the behavioural profile of the pygmy hog in captivity, based on a study of captive animals at the Basistha breeding centre. A secondary goal was to compare the behaviour of the Basistha animals with those in a semi-natural setting in the pre-release centre in Potasali.

My sampling approach at Basistha and Potasali differed based on the different conditions at the two sites. I used focal animal scans with instantaneous scan sampling at the breeding facility where animal activity was visible at most times, but gave priority to instantaneous scans at the pre-release site where the simulated grassland conditions did not permit observation of the animals at all times. Focal animal sampling was thus pursued here only when animals were sighted for a substantial period of time. I was also restricted by management from making close observations on the pre-release hogs so as to help wean them of the human presence they were accustomed to, in captivity. Hence, at most times only limited behavioural sampling was possible through observations from atop a central observation tower.

Behaviour of captive animals in the Basistha breeding centre

My results revealed a hierarchy of behaviours exhibited by the animals in the breeding enclosures at Basistha. The most important behavioural component for the time-activity budget of both sexes was foraging with females foraging significantly more than males. Foraging was followed by moving, in terms of time spent on these behaviours. Males moved more than females and this was associated with elevated levels of display behaviour and courtship performed by them. This was followed by time spent inside the nest and resting activities (shown more by females than by males). Display was exhibited only by males and performed during the breeding season. It is, in fact, known that the most successful mating efforts (85% in captivity) occur, particularly from December to February (Narayan et al. unpubl. data). Allogrooming was the most prominent social interaction observed, with certain individuals grooming more than others. Moreover, among the breeding pairs, males groomed considerably more than females. It is possible that male hogs move a lot and display considerably to increase their potential reproductive success. Most individuals, however, apportioned the greatest proportion of their time budget to foraging perhaps because displaying and running are clearly energy-

demanding behaviours. Allogrooming is the most preferred social behaviour possibly because this behaviour not only helps individuals maintain social bonds with each other, but may also be performed in response to ectoparasitic infestations (ter Hofstede and Fenton 2005). Males allogroomed females significantly more than the other way around, indicating a possible, additional role for this behaviour in courtship. Another behaviour commonly displayed during courtship was the sniffing of the breeding female's rump by the male; this presumably allowed the male to evaluate the receptive status of the female.

Studies with captive animals sometimes suffer from the disadvantage that the often-inappropriate environments in which they live may provoke abnormal behaviour (Winkler and Leisler 1999). Within a few generations, captive animals may become quite different in their behaviour from their wild counterparts if the former are exposed to new selection regimes (Kohane and Parsons 1988). Captive animals are not exposed to selection pressures such as threats from predators and the difficulties of acquiring and assimilating wild food. The genetic diversity of captive animal populations is also typically reduced compared to wild populations (Alexandre et al. 2004).

But, unlike many captive-housed animals, the pygmy hogs studied at Basistha did not show the typical abnormal behaviours associated with keeping animals in captivity. Stereotypic pacing or similar repetitive behaviours were not recorded, perhaps indicating that these animals do not require vast home ranges. It has been recorded that if breeding opportunities are ample, home ranges tend to be small for *Sus scrofa* boars (Wood et al. 1980). The male hogs were also documented indulging in typical reproductive behaviours in this study. Overall, the behavioural profile developed during the study compliments the profile associated with typical suid behaviour (Wood et al. 1980). The pattern of behavioural emphases described for both captive and wild suids probably derives from the hierarchy of reproductive and survival requirements of this Family.

Further evidence that the pygmy hogs are living a more-or-less normal existence is provided by the success itself of the Basistha breeding program. A total of 80 hogs have been bred from an initial stock of six wild-caught individuals over an eleven-year period. This is a clear indication that the hogs are being maintained here under satisfactory environmental and dietary conditions. Other studies have shown that the breeding success of captive animals in a zoo positively correlated not only with enclosure area but also with a number of breeding females greater than two (Carlstead et al. 1999) along with husbandry style (Mellen 1991).

Behaviour of animals in semi-natural conditions at the Potasali pre-release centre

The transition from captive conditions to a simulated pre-release setting is a significant step in the process of reintroduction. Studies have shown that pre-release experiences enhance chances of survival in reintroduced animals (Bigginsa et al. 1999). It was observed, during this study, that the pygmy hogs spent relatively more time in foraging and related activities in the pre-release site as compared to captivity. The hogs in two of the three pre-release enclosures also formed integrated groups, with each group always moving and nesting together except during foraging when they would spread out. The groups were, at most times, led by the adult female, with the four juveniles following her and the adult male bringing up the rear, which could perhaps be the pattern followed in the wild. This shows that the behaviour of pygmy hogs raised in captivity may be quite flexible and individuals are likely to exhibit traits that were never expressed under captive regimes. Such conditional behavioural traits are thus likely to have developed under significant genetic control.

The adult animals in the pre-release enclosure were observed to have lost weight from the time of their introduction to a month later (data not shown). It is thus imperative that captive animals that have been marked for release be put under a feeding program that enables them to adapt better to pre-release conditions. The pre-release animals were, however, supported with provisioned feed that altered their foraging regime towards the latter part of the study. They were thus observed to have fallen into a schedule matching the feeding hours, arriving at the feeding paddock at the times they normally received provisioned food. It may thus be important to experiment with randomized feeding schedules at the pre-release phase.

Conclusions

How relevant are the findings of this study to the reintroduction program? With respect to the breeding program itself, it appears that the current conditions are largely conducive to normal pygmy hog behaviour, which likely explains the success of the program. With respect to the likely success of the re-introduction program, the ability of hogs kept in captivity to adjust their behaviour when relocated to the semi-natural conditions of the pre-release centre indicates that they have considerable

behavioural plasticity. Therefore, they will probably be able to adjust further when released into the wild. This indicates a positive prognosis for the future of the project. Further work now needs to be done to properly document the behaviour of pygmy hogs in the pre-release centre where conditions are much closer to those found in the wild.

Acknowledgements

I thank the Wildlife Conservation Society – India Program for having provided the funding support and assistance necessary for the study. I express my sincere gratitude to my Project Guide Dr. Anindya Sinha and Course Director Dr. Ajith Kumar for having helped me conceptualize this study and having provided crucial guidance and suggestions to me through this project. I am also thankful to my Project Co-Guide Dr. Goutam Narayan for all the logistic support and ideas given to me during the entire length of my field days. I am especially devoted to Dr. Geoff Hyde of NCBS for his help in preparing this thesis. I am thoroughly grateful to Dr. Parag Jyoti Deka of the Pygmy Hog Conservation Program (PHCP) for his assistance and support throughout the project's duration. It would have been difficult to carry out this study without the assistance provided by Kishore, Raju, Dipen Deb, Abanai Mohanti, Pranav Kolita, Tulsi and Chand Mia of the PHCP. I would particularly like to thank Dhruba and Pooja of the Assam Haathi Project for their memorable company at Potasali. And accolades to the Durrell Wildlife Preservation Trust for having taken the initiative and effort to preserve the Critically Endangered Pygmy Hog and bring the species back from extinction. I am also obliged to the Centre for Wildlife Studies (CWS) for having administered the project and facilities and Manipal University for certifying the Master's course.

References

Alexandre R, Sarrazin F, Couvet D and Legendre S. 2004. Releasing adults versus young in reintroductions: Interactions between demography and genetics, *Conservation Biology*, 18 (4): 1078-1087.

- Bergan JF, Smith LM and Mayer JJ. 1989 Time-Activity Budgets of Diving Ducks Wintering in South Carolina, *The Journal of Wildlife Management* 53 (3): 769-776.
- Biggins DE, Vargasb A, Godbeya JE and Anderson SH. 1999. Influence of prerelease experience on reintroduced black-footed ferrets (*Mustela nigripes*), *Biological Conservation* 89 (2): 121-129.
- Carlstead K, Fraser J, Bennett C, Kleiman DG. 1999. Black rhinoceros (*Diceros bicornis*) in U.S. zoos: II. Behavior, breeding success, and mortality in relation to housing facilities, *Zoo Biology* 18 (1): 35-52.
- Funk SM, Verma SK, Larson G, Prasad K, Singh L, Narayan G and Fa JE. 2007. The pygmy hog is a unique genus: 19th century taxonomists got it right first time round. *Molecular Phylogenetics and Evolution* 45 (2): 427-436.
- Griffith B, Scott JM, Carpenter JW and Reed C. 1990. Translocations of captive-reared terrestrial vertebrates, 1973-1986. *Endangered Species UPDATE* 8:10-14.
- ter Hofstede HM and Fenton MB. 2005. Relationships between roost preferences, ectoparasite density, and grooming behaviour of neotropical bats, *Journal of Zoology* 266: 333-340.
- [IUCN] International Union for Conservation of Nature. 1998. *Guidelines for Re-introductions*, IUCN/SSC Re-introduction Specialist Group, IUCN, Gland, Switzerland and Cambridge, UK
- Kleiman DG. 1989. Reintroduction of captive mammals for conservation, *BioScience* 39 (3): 152-161.
- Kohane MJ and Parsons PA. 1988. Domestication: evolutionary change under stress, *Evolutionary Biology* 23: 31-48.
- Krasinski Z. 1967. Free-living European bisons. *Acta Theriologica* 12: 391-405.

- Lambrechts MM, Perret P, Maistre M and Blondel J. 1999. Do experiments with captive non-domesticated animals make sense without population field studies? A case study with blue tits' breeding time, *Proceedings of the Royal Society, London: Biological Sciences* 266 (1426): 1311-1315.
- Magdalena WC, Griffith B, Reed C and Temple SA 1996. Avian and mammalian translocations: Update and reanalysis of 1987 survey data, *Conservation Biology* 10 (4): 1142-1154.
- Martin K. 1998. The role of animal behavior studies in wildlife science and management, *Wildlife Society Bulletin* 26 (4): 911-920.
- Mellen JD 1991. Factors influencing reproductive success in small captive exotic felids (*Felis* spp.): A multiple regression analysis, *Zoo Biology* 18 (1): 95-110.
- Narayan G, Oliver WLR and Deka PJ. 1999. The Status and Conservation Program for the Pygmy Hog (*Sus salvanius*). In: *Seventh World Conference on Breeding Endangered Species: Linking Zoo and Field Research to Advance Conservation*, Roth, T. L., Swanson, W. F. and Blattman, L. K. (eds), Cincinnati Zoo and Botanical Garden, Cincinnati, pp. 109-127.
- Oliver, W. L. R (1980) The Biology and Conservation of the Pigmy Hog *Sus (Porcula) salvanius* and the Hispid Hare *Caprolagus hispidus*, *Special Scientific Report No. 1*, Jersey Wildlife Preservation Trust, Jersey, UK.
- Oliver WLR and Deb Roy S. 1993. The Pigmy Hog (*Sus salvanius*) In: *Pigs, Peccaries and Hippos: Status Survey and Conservation Action Plan*, IUCN/SSC Pigs and Peccaries Specialist Group, pp. 121-129.
- Rahman H, Chakraborty A, Deka PJ and Narayan G. 2005. Salmonellosis in pigmy hogs (*Sus salvanius*) – a critically endangered species of mammal, *Scientific and technical review / International Office of Epizootics*, 24 (3): 959-964.

Rahman H, Chakraborty A, Deka PJ, Narayan G and Prager R. 2001. An outbreak of *Salmonella enteritidis* infection in pygmy hogs (*Sus salvanius*), *Tropical Animal Health and Production* 33: 95-102.

Visser ME and Larnbrechts MM. 1999. Information constraints in the timing of reproduction in temperate zone birds: great and blue tits. In: *Proceedings of the 22nd International Ornithological Congress* Adams, Y. J. and Slotow, R. H. (eds), Durban, South Africa.

Winkler H and Leisler B. 1999. Curiosity in birds: functions and mechanisms. In: *Proceedings of the 22nd International Ornithological Congress* Adams, Y. J. and Slotow, R. H. (eds), Durban, South Africa.

Wood GW and Brenneman RE. 1980. Feral hog movements and habitat use in coastal South Carolina, *The Journal of Wildlife Management* 44 (2): 420-427.

Appendix I:

AN ETHOGRAM FOR THE PYGMY HOG *Porcula salvania* IN CAPTIVITY

The ethogram includes descriptions of distinct behaviours displayed by pygmy hogs *Porcula salvania* in captivity. The details and context in which these behaviours occur are described in the following list.

I. BEHAVIOURAL STATES

Behavioural states are long-lasting behaviours, which occupy a finite duration and can be measured through instantaneous scans. These behaviours contribute to the time-activity budget of an individual.

ALERT	The freezing or rapid cessation of any activity by an individual upon detecting a disturbance
BROWSE	The browsing by an individual on leaves/grass blades
ALLOGROOM	Caressing/massaging of another individual with the snout disc, occasionally pulling its hair with the mouth
GRUNT	The characteristic breeding vocalization produced by a male hog
INSIDE NEST	The act of remaining inside a nest by the actor
MOVE	The act of walking by an individual as it moves from one point to another
PROBE	The using of the snout by an individual to probe into the undergrowth for food
ROOT	The rooting of the soil for food
SNIFF EARTH	The act of sniffing of the substratum or a potential food plant by an individual male or female
STAND STILL	The motionless standing by an individual

2. BEHAVIOURAL EVENTS

These are relatively rapid behaviours, which last for negligible durations of time and are usually recorded in terms of their frequency of occurrence per unit time. Behavioural events are usually measured by focal animal or group sampling. Behavioural events often include most social interactions and can, therefore, be classified further into different functional categories.

2.1. AFFILIATIVE BEHAVIOURS

ALLOGROOM	Caressing/massaging of another individual with the snout disc, occasionally pulling its hair with the mouth. The initiation of an allogrooming bout can be considered a behavioural event
COME	The approach of an individual to another just prior to an affiliative interaction being initiated by either of them
FOLLOW	The trailing behind of an adult hog or a breeding partner by the actor
NUZZLE	The act of placing one's nose/muzzle under the belly of another individual, usually directed by adult females towards adult males
SOLICIT ALLOGROOMING	The act of sitting or lying in front of another individual expecting to be allogroomed. It could also involve a nudge or shove made by the actor to initiate the grooming event
TOLERATE	The tolerance shown by an individual to allow another hog to stand in its close vicinity without opposing it in any way

2.2. AGONISTIC BEHAVIOURS

AGONISTIC APPROACH	The approach of an individual towards another followed by the display of any agonistic behaviour by either of them
AVOID	The avoidance by the actor of an individual's approach or any behaviour directed towards it
BITE	The biting of another hog by the actor, often displayed during competition for food at a provisioning site
CARRY FOOD AWAY	An individual carrying away a provisioned

	parcel of food in its mouth to prevent others from getting access to it
CHARGE	Sudden rush by an individual towards another, often during an agonistic interaction. This behaviour could also be considered a display behaviour (see below)
CHASE	The chasing of an individual by the actor during agonistic interactions, often during feeding
DISPLACE	The supplanting of an individual at a feeding site and taking away of its food by the actor
STEAL FOOD	The stealing of food, often in the form of a parcel at a provisioned site, from another feeding individual
THROW	The aggressive tossing away of a juvenile by an adult, often a male, usually displayed during feeding competition at a provisioning site

2.3. SEXUAL BEHAVIOURS

ATTEMPT MOUNT	An attempt by a male to copulate with a female
CROUCH	A kneeling-down, crouching behaviour sometimes displayed by an adult female when approached by an adult male
HEAD OVER RUMP	The actor, usually a male, places his head over the rump of a female
LICK RUMP	The licking of an adult female's genitalia by the actor, usually a male
MOUNT	The climbing on the back of a female by an adult male usually in an attempt to copulate with her
SEXUAL APPROACH	The approach of an individual towards another followed by the display of any sexual behaviour by either of them
SMIFF	The sniffing of any body part of an individual, male or female, by a male or female actor
SQUEAK	A typical vocalization elicited by an adult female when prompted by a male to subdue to mounting
WARY	An alert posture usually adopted by an adult female when standing close to a harassing male

2.4. DISPLAY BEHAVIOURS

The display behaviours described below are usually exhibited by adult males and directed towards other males, primarily during the breeding season.

CHAMP	Mouth movements, similar to that of chewing, made by an individual, often a breeding male
CLIMB GATE	An attempt made by an individual to jump to a neighbouring paddock over the gate
DISPLAY ROOT	The act of rooting aggressively, accompanied by the throwing of soil all around
DISPLAY RUN	The rapid running displayed by breeding males, usually from one enclosure gate to another
DISPLAY SQUEAL	The high-pitched breeding squeal usually produced by an adult male
DISPLAY YAWN	A display of tusks by an individual male while flanking to another male
FLANK	The exhibition of the actor's flank to a neighbouring individual, usually a male
GRUNT	The characteristic breeding vocalization produced by a male hog
PILE GRASS / STRAW	The gathering of dry grass and its rolling into a ball, usually performed by a breeding adult male
RAM	The ramming of the head or the full body against the gate of the paddock, usually displayed by adult males
SNIFF GATE	The sniffing of the enclosure gate during breeding display by individual males

2.5. NEUTRAL BEHAVIOURS

CROAK	A distinctive vocalization, resembling closely a <i>krrr...krrr</i> sound, produced usually by an adult female
GROUP	The act of joining other hogs to form a group
MOVE AWAY	The moving away of an individual from another terminating an affiliative interaction between them

SQUEAL A typical vocalization produced by an adult male or a female; the calls of the two sexes appear audibly similar to the observer

2.6. SOLITARY BEHAVIOURS

BITE The aggressive biting of an individual by the actor

CHEW The chewing of dry grass/thatch by an individual

CLOSE EYES The shutting of the eyes by an individual while resting, often leading to sleep

DEFECATE The elimination of bodily wastes by an individual, usually in the form of pellets

DIG The digging of a hole or cavity in the substratum by an individual using its forelegs

DOZE The falling asleep displayed by an individual in its resting position

EAT The ingestion of solid food by an individual

ENTER NEST The entering of a nest through its main or subsidiary entrance by an individual

EXIT NEST The exit of a nest through its main or subsidiary entrance by an individual

GLANCE The actor stands still but turns its head to the left and right to glance in either direction

LIE DOWN The act of lying down from a standing position by the actor

LOOK The act of looking up by an individual as it stands still

NIBBLE The pulling of leaves or other material from plants during feeding

OPEN FOOD PARCEL The opening of a food parcel with the snout, usually displayed at provisioned sites

PACE The act of pacing to and fro in front of the gate separating the actor from another individual, usually displayed by an adult male

PAUSE The sudden act of pausing to look in front or in either direction by an individual while walking

PROP The getting up on the two hind legs by the actor in an effort to pull leaves from relatively taller plants

RUB	The rubbing of the entire body or a part of it against the substrate or any other inanimate object
RUN	Swift running by an individual, often into the feeding paddock
SIT	The sitting down by an actor from its standing position
SNEEZE	The rapid expulsion of air through nose by an individual
STAND UP	The getting up by an individual from a sitting / resting position
URINATE	The expulsion of liquid nitrogenous wastes by an individual
WALLOW	The wallowing displayed by an individual either in wet / dry soil or in a water pool
YAWN	A typical short exhalation displayed by an individual while resting or lying down, usually associated with sleeping
