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ENDANGERED SPECIES RECOVERY WORKSHOP

ON 17TH TO 21ST NOV 2012

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durrell

ENDANGERED SPECIES RECOVERY WORKSHOP

ON 17TH TO 21ST NOV 2012

PADMAJA NAIDU HIMALAYAN ZOOLOGICAL PARK

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NOVEMBER 2012.


TO 21st NOVEMBER 2012.


TRAINING PROGRAMME ON
ENDANGERED SPECIES RECOVERY"
ELING 17th TO 21st NOVEMBER 2012.


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TRAINING PROGRAMME ON
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DARJEELING 17th TO 21st NOVEMBER


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SED BY:
ZOO AUTHOR
WILDLIFE CO
NAIDU HIMAL
Endangered Species Recovery


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ZOO STRATEGY
IN INDIA
PAST AND PRESENT
17th November, 2012
B.S. Bonal, MemberSecretary
DARJEELING


TRAINING PROGRAMME ON

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3. Inaugural speech by Shri. Subesh. K. Das, IAS, Addl. Chief Secretary (Forest) Govt. of West Bengal.
4. Keynote address by Mr. B.S. Bonal IFS, Member Secretary, Central Zoo Authority, Ministry of Environment and Forest, Govt. of India.
5. Speech by Dr. Saumitra Mohan IAS, District Magistrate, Darjeeling.
6. Speech by Mr. Mark Brayshaw, Head of Animal Conservation, Durrell Conservation Academy, Jersey, United Kingdom.
7. Vote of Thanks by Dr. Brij Kishore Gupta, Evaluating and Monitoring Officer, Central Zoo Authority, Ministry of Environment and Forest, Govt. of India.

TECHNICAL SESSION

1. The Evolution of Durrell. Mr. Mark Brayshaw, Head of Animal Conservation, Durrell Conservation Academy, Jersey, United Kingdom.
2. Endangered Species Recovery- Excellence within a Modern Zoo. Dr. Tim Wright, Dy. Head of Conservation Training, Durrell Conservation Academy, Jersey, United Kingdom.
3. Zoo Strategy in India- Past, Present and Future. Mr. B.S. Bonal IFS Member Secretary, Central Zoo Authority, Ministry of Environment and Forest, Govt. of India.
4. Managing Mammalian Carnivores in Captivity: Lessons Learnt. Dr. Andrew Routh, Head of Veterinary Department. Durrell Conservation Academy, Jersey, United Kingdom.
5. From Kanchendzonga- The land of Red Panda. Mr. A.K. Jha, IFS, Director Padmaja Naidu Himalayan Zoological Park, Darjeeling.
6. Norms for establishing Conservation Breeding Programme of Central Zoo Authority Funding. Dr. Brij Kishore Gupta, Evaluating and Monitoring Officer, Central Zoo Authority, Ministry of Environment and Forest, Govt. of India.
7. Central Zoo Authority's Guidelines, Rules and Strategies for Animal Management and Enclosure Design. Dr. Brij Kishore Gupta, Evaluating and Monitoring Officer,Central Zoo Authority, New Delhi.
8. Stud Book Management and Planning: *Fundamentals of Captive Animal Population Management.* Dr. Tim Wright Deputy head of Conservation Training. Durrell Conservation Academy, Jersey, United Kingdom.
9. Managing Animal Health: Food preparation/presentation: Dr. Tim Wright Deputy Head of

Conservation Training. Durrell Conservation Academy, Jersey United Kingdom.

10. "Managing Animal Health in Transit". Dr. Tim Wright Deputy Head of Conservation Training, Durrell Conservation Academy, Jersey United Kingdom.
11. Animal Record keeping. Dr. Tim Wright Deputy Head of Conservation Training. Durrell Conservation Academy, Jersey United Kingdom.
12. Collection Planning – Durrell as an example
13. Enclosure Design- Modern Trends and Lessons Learnt.
14. Zoos and Zoo Associations- Cooperating for Conservation.

SPECIES TALK :

15. Conservation breeding Programme in ASZBG, One Horned Rhinoceros and Golden Langur. Mr Utpal Bohra IFS Director Assam State Zoo cum Botanical garden.
16. Conservation Breeding Programme for Western Tragopan. Mr. Satish Negi. DFO, Sarahan Dist. Himachal Pradesh.
17. Activities on Conservation Breeding at Sepahijala Zoological Park (Clouded leopard) . Mr. A.K. Bhowmik IFS, Director Sepahijala Zoological Park, Tripura.
18. Hope for Hangul. Mr. Intesar Sohail, Wildlife Warden. Jammu and Kashmir.
19. Conservation Breeding of Hoolok Gibbon at Biological Park, Itanagar. Mr. Joram Dupam IFS, Director Itanagar Biological Park, Arunachal Pradesh.
20. Conservation Breeding Programmes at Arignar Anna Zoological Park Chennai (Lion Tailed Macaque). Dr. R. Thirumurugan, Asst. Veterinary Surgeon, Chennai.
21. Conservation Breeding Programme Mouse Deer, Nehru Zoological Park, Hyderabad by Dr. P.Srinivas. Hyderabad.
22. Conservation Breeding Programmes of Indian Pangolin Nandankanan Zoological Park, Bhubaneswar by Dr. S. Panda, Bhubaneswar.
23. Conservation Breeding of King Cobra Pilikula Biological Park, Mangalore. Mr. Jerald Vikram Lobo Scientific Officer, Manglore.
24. Captive breeding programme of Dhole (Indian Wild Dog). Indira Gandhi Zoological Park, Visakhapatnam. Mr. G. Ramalingam IFS Director, Visakhapatnam.
25. Vulture Conservation Breeding Programme, BNHS. Mr. Rohan N. Shringarpure, Curator, Pinjore.
26. Disease outbreak in Western Tragopan. Mr. Satish Negi. DFO, Sarahan Dist. Himachal Pradesh.
27. Enrichment Activities in Arignar Anna Zoological Park Vandalur, Chennai Dr. R. Thirumurugan.
28. Enrichment in Animal Enclosure, Shri Chamarajendra Zoological Park, Mysore Dr. C. Suresh Kumar Assistant Director. Mysore.
29. Importance of Enrichment in Breeding Pygmy Hog. Mr. Parag J Deka. Project Manager, Guwahati.

Schedule for training Programme on

"ENDANGERED SPECIES RECOVERY COURSE"

In Darjeeling (West Bengal)

17th- 21st November 2012

Day/Time	Subject	Resource Person
Day one: 17.11.2012 (Saturday)		
8:00- 8:30 a.m.	Registration	
8:30 – 8: 40 a.m.	Welcome address	Shri. A.K. Jha IFS, Director, Padmaja Naidu Himalayan Zoological Park.
8:40 – 8:50 a.m.	Inaugural speech	Shri. S. Das IAS, Addl. Chief Secretary (Forest) Govt. of West Bengal.
8:50 – 9:00 a.m.	Keynote address	Shri. B.S. Bonal IFS, Member Secretary, Central Zoo Authority.
9:00 – 9:10 a.m.	Speech	Dr. Saumitra Mohan IAS, District Magistrate, Darjeeling
9:10 – 9:20 a.m. a.m.	Speech	Mr. Mark Brayshaw Head of Animal Conservation, Durrell Conservation Academy, Jersey, United Kingdom.
9:20 – 9: 30 a.m.	Vote of Thanks	.Dr. Brij Kishore Gupta, Evaluating and Monitoring Officer, Central Zoo Authority.
TECHNICAL SESSION:		
9:30 – 10:05 a.m.	The Evolution of Durrell	Mr. Mark Brayshaw Head of Animal Conservation, Durrell Conservation Academy, Jersey, United Kingdom.
10:05 -10:35 a.m.	Endangered Species Recovery – Excellence within a modern Zoo	Dr. Tim Wright,
TEA BREAK – 10:35 -11:00 a.m.		
11:00 – 11:30 a.m.	Zoo Strategy in India- Past, Present and Future	Mr. B.S. Bonal IFS, Member Secretary, Central Zoo Authority.
11:30- 12:00 a.m.	From Kanchendzonga – the land of Red Pandas	Mr. A.K. Jha IFS
LUNCH BREAK – 12:00- 1:00 p.m.		
1:00 – 4:00	Visit to the Conservation Breeding	

p.m.	Centre for Snow leopard and Red panda.	
Day 2 18.11.2012 (Sunday)		
8:30 – 10:00 a.m.	SWOT analysis and its feed back	Mr. Jamieson Copsey
10:00-10:30 a.m.	Norms for establishing Conservation Breeding Programme of Central Zoo Authority funding	Dr. Brij Kishore Gupta,
TEA BREAK : 10:30- 111:00 a.m.		
11:00 – 11:30 a.m.	What makes Project Succeed or fail	Mr. Jamieson Copsey
11:30 – 12:30	Theory and Practice of leadership	Mr. Jamieson Copsey
LUNCH BREAK: 12:30 – 1:30 p.m.		
1:30 – 1:45 p.m.	Conservation breeding Programme in ASZBG, One Horned Rhinoceros and Golden Langur	Mr Utpal Bohra IFS
1:45 -2:00 p.m.	Breeding Programme for Western Tragopan	Mr. Satish Negi IFS
2:00- 2:15 p.m.	Activities on Conservation Breeding at Sepahijala Zoological Park (Clouded leopard)	A.K. Bhowmik IFS
2:15 – 2:30 p.m.	Hope for Hangul	Mr. Intesar Sohail
2:30- 2:45 p.m.	Conservation Breeding of Hoolok Gibbon at Biological Park, Itanagar	Mr. Joram Dupam IFS
2:45 -3:00 p.m.	Conservation Breeding Programmes at Arignar Anna Zoological Park Chennai (Lion Tailed Macaque)	Dr. R. Thirumurugan
3:00-3:30 p.m.	Conservation Breeding Programme Mouse Deer, Nehru Zoological Park , Hyderabad	Dr. P. Srinivas.
3:30- 5:00 p.m.	Lecture on "Leadership and Management"	Mr. Jamieson Copsey
DAY 3 19.11.2012 (Monday)		
9:00-9:30 a.m.	Enclosure design-questions we should ask	Mr. Mark Brayshaw
9:30-10:30 a.m.	Enclosure design- principles and practices	Mr. Mark Brayshaw
10:30-10:50 a.m.	TEA BREAK	
10:50 – 11:20 a.m.	Central Zoo Authority's Guidelines Rules and Strategies for Animal	Dr. Brij Kishore Gupta,

	Management and Enclosure Design.	
11:20- 11:50 a.m.	Designing Enclosures for Amphibian and Reptiles	Dr. Tim Wright
11:50-12:20 a.m.	Case study: Pheasant Conservation Breeding	
11:20-11:45 p.m.	Conservation Breeding Programmes of Indian Pangolin Nandankanan Zoological Park , Bhubaneswar	Dr. S. Panda
11:45-12:35 p.m.	Conservation Breeding of King Cobra Pilikula Biological Park, Mangalore	Mr.Jerald Vikram Lobo
12:35 : 1:35 p.m.	LUNCH BREAK	
1:35 – 2:35 p.m.	Studbook management and planning	Dr. Tim Wright
2:35: 3:35 p.m.	Critiquing Enclosure design: key questions	Dr. Tim Wright
3;35- 5:00 p.m.	Zoo visit	
Day 4 20.11.2012 (Tuesday)		
8:30 –9:30 a.m.	Feedback on Enclosure design	Mr. Jamieson Copsey
9:00-10:00 a.m.	Managing animal health: Food preparation/presentation/Hygiene and sanitation	
10:00-10:30 a.m.	Vulture Conservation Breeding Programme, BNHS	Mr. Rohan N. Shringarpure.
10:30-10:50	BREAK	
10:50-11:45 a.m.	What data should we record?	Dr. Tim Wright
11:45-12:30 p.m.	Cases in point	Mr. Jamieson Copsey
12:30-1:30	LUNCH	
1:30-2:15 p.m.	Principles of enrichment	Mr. Jamieson Copsey
2:15-3:00	Pygmy Hog example	Dr. Parag Deka
3:00-3:20 p.m.	TEA BREAK	
3:20 – 4:00 p.m.	Enrichment examples from other zoos : Enrishment activities in Arignar	 Dr. R. Thirumurugan

	Anna Zoological Park, Vandalur Enrichment in Animal Enclosure- Shri Charmarajendra Zoological Park, Mysore. -	 Dr. C. Suresh Kumar
4:00-4:45 p.m.	Managing animal health in transit	Dr. Andrew Routh
4:45 – 5:00 p.m.	Recap of the day and the week so far	Mr. Jamieson Copsey
DAY 5 : 21.11.2012 (Wednesday)		
8:00-8:40 a.m.	Making the Link:	Mr. Jamieson Copsey
8:40-9:30 a.m.	Case Study: Pygmy Hog and Red Panda	Dr Parag J. Deka & Mr. A.K. Jha IFS.
9:30-11:15 a.m.	Conveying a Conservation message including tea break	Mr. Jamieson Copsey
11:15-11:45 a.m.	Species Talk: Captive breeding programme of Dhole (Indian Wild Dog). Indira Gandhi Zoological Park, Visakhapatnam. Disease outbreak in Western Tragopan	 Mr. G. Ramalingam Mr. Satish Negi
11:45 -12:00	Lecture	
12:00-12:30	Chance for reflection	Dr. Tim Wright
12:30-1:00 p.m.	Conservation breeding and Reintroduction – Managers Prespective.	Mr. A.K. Jha IFS
1:00 – 1:45 p.m.	LUNCH	
1:45- 2:15 p.m.	Feedback	Durrell Academy
2:15- 5:00 p.m.	Valedictory	

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49	Mr. Anil Kumar T.V.	Curator	Zoological Garden, Museum & Zoo Dept, Trivandrum, Kerela.	04712 316275	09847567269	tuani4u@gmail.com
50.	Mr. Rohan N. Shringarpure	Research Biologisat/Curator	Bombay Natural History Society's Vulture Conservation Breeding centre, B-3, Forest Complex, Pinjore Pin-134102, Haryana	01733-231405	09671033987	rohanns789@yahoo.co.in

Sl No.	Name	Designation	Address	Office No.	Mobile No.	E-mail
51..	Mr. Jerald Vikram Lobo	Scientific Officer	Pilikula Biological Park, Vamanjoor, Manglore, Karnataka-575 028	0824-2263300	09980187057 7204155527	jeraldvikramlobo@gmail.com
52	Miss Meetu Gupta	Member	Chhatisgarhj State Wildlife Advisory Board	102, Neelgiri, Green Garden Colony, Mungeli Road, Bilaspur	09424140207	gupta.meetu@rediffmail.com/ meetugupta@gmail.com
53.	Dr. Minla Zangmu Lachungpa		C/o Ganden Lachunpa, Forest Colony, Balwakhani, Gangtok, 737101, Sikkim	03592-205273	0974512288	minlaz1806@gmail.com
54.	Mr. Lepzuk Jamir	Forest Ranger	Officer Incharge, Blyth's Tragopan Breeding Centre, Kohima.	03862-244417	09436607011	
55.	Mr. Sudhir Gahatraj	DR/Fr	Satellite Facility, Dowhill Kurseong		09933552037	
56.	Dr. Pankaj Kumar	V.O.	Padmaja Naidu Himalayan Zoological Park , Darjeeling - 734101 (West Bengal)	(0354) 2253709	09475032097	dr.pankajgupta7785@gmail.com
57.	Mr. Shiromani Syandgen	Estate Officer	Padmaja Naidu Himalayan Zoological Park , Darjeeling - 734101 (West Bengal)	(0354) 2253709	09434142972	
58.	Mr. Purna Ghishing	Animal Supervisor	Padmaja Naidu Himalayan Zoological Park , Darjeeling - 734101 (West Bengal)	(0354) 2253709	09609905060	-
59.	Mr. Pradip Singh	Compounder	Padmaja Naidu Himalayan Zoological Park , Darjeeling - 734101 (West Bengal)	(0354) 2253709	9800717428	
60.	Miss Upashna Rai	Research Scholar	Padmaja Naidu Himalayan Zoological Park , Darjeeling - 734101 (West Bengal)	(0354) 2253709	09474681178	upashna_33@yahoo.co.in
61.	Miss Deewa Basnett	Research Scholar	Padmaja Naidu Himalayan Zoological Park , Darjeeling - 734101 (West Bengal)	0354) 2253709	09832319916	
62.	Miss Shradhanjali Rai	Research Scholar	Padmaja Naidu Himalayan Zoological Park , Darjeeling - 734101 (West Bengal)	0354) 2253709	09593640561	shradha_peme88@yahoo.com
63	Mr. Bhupen Roka	Research Scholar	Padmaja Naidu Himalayan Zoological Park , Darjeeling - 734101 (West Bengal)	0354) 2253709		bhupenroka2012@rediffmail.com







22/02/2007

Welcome address by Mr. A.K. Jha, IFS Director Padmaja Naidu Himalayan Zoological Park, Darjeeling.

Respected Mr. B.S. Bonal Member Secretary Central Zoo Authority, Dr. S.K. Das, Addl. Chief Secretary Forest Govt. of West Bengal, Dr. Saumitra Mohan District Magistrate, Darjeeling , Mr Mark Brayshaw from Durrell Wildlife Academy , my friends from SAARC countries Nepal, Bhutan and Srilanka and my colleagues from the zoo fraternity in India I welcome you all here again in Darjeeling though we have met many a times earlier in different workshops and different occasions and this is going to be of a bigger one where we will be here for the next five days interacting with each other learning something from each one of us and also learning from the guests from Durrell Wildlife Academy. I welcome Mr. B.S. Bonal Member Secretary Central Zoo Authority, he as a member secretary of Central Zoo Authority has been a source of inspiration for all the zoo fraternity people in India and has been able to do a lot of change in the zoo upliftment, management, planning and other management aspects. I shall welcome Dr. S.K. Das from Indian administrative service as Addl. Chief Secretary Forest. He has been a pioneer in developing the zoo movement in West Bengal by formation of Zoo Authority of West Bengal not only formation but also going into the dynamics of zoo management and we have been under his leadership and have been striving very hard for the development of all the zoos and rescue centres in West Bengal. I shall welcome Mr. Mark Bryshaw , Mark began his career at Durrell twenty years ago studied Zoology at Liverpool University and has worked in the mammal department for many years working with a variety of taxa including primates and bears and has maintained the European and International Stud book for many species. He is now the head of the animal collection responsible for the daily management of the Wildlife Park but still enjoys working directly with the animals. Unfortunately Mr. Jameison Copsey who has always been in touch with me is not here today but he shall join us late today in the evening. I shall welcome Dr. Andrew Routh he was the chief Veterinary Officer of the Zoological Society of London and a qualified Veterinary Surgeon in 1981 from Liverpool. I shall welcome Dr. Saumitra Mohan District Magistrate, Darjeeling he has been helpful in managing the Padmaja Naidu Himalayan Zoological Park and all other forest and wildlife activities. I shall welcome Mr. T.V. N Rao Member Secretary, West Bengal State Zoo Authority as the head of all the zoos in West Bengal he is very dear friend of mine and as a real member secretary he has helped in the development of zoological parks in West Bengal. With this I welcome you all here again and I hope that in this limited facilities that we have here in a small town like Darjeeling you have all been comfortable in case of any problem please let us know . I welcome you all here again. Thank You.

Inaugural Speech by Dr. S.K. Das IAS, Addl. Chief Secretary (Forest) Govt. of West Bengal

Dignitaries on the desk, participants, I am not an expert in zoo but being Secretary of the Department I had to look into some issues I was looking through what is the oldest zoo in the world and when it started, if you think of it and also think why we have zoos, what is the reason we have zoos there are experts here but as a layman you know the oldest zoo started in Vienna in 1540 by a Roman emperor and if you look at the history some of the kingdom you will find the kings had personal zoos . Viena zoo was established in 1752 then also it was restricted to the public so basically if you look and think of it the zoos starts as an entertainment and amusement centre and then some basic education activity, but when London Zoo the Society was founded in 1828 but was open for scientific studies, only in 1874 it was opened to public. In USA Philadelphia Zoo it started in 1859 and then it was open to public in 1874. In West Bengal our Alipore Zoo is one of the oldest zoo and was opened in 1875, Darjeeling Zoo came up a little later but if you look at it gradually it started with an entertainment amusement centre, these are the ways we have been moving. We have two zoos mainly Alipore and Darjeeling zoo but some mini zoos have also come in different parts of the state we have now fifteen zoos basically one important issue is what I feel how you manage the zoos and the other thing what I feel is very important is who manages the zoos since it is under Forest Department but the mindset of the people who work in the zoos the way we protect the wildlife and manage the zoos are not the same so who are the people who should manage the zoo and specially the technical knowledge at the lowest level who are handling the animals, this is one of the important issue and I think we will discuss this issue and other issues in this forum and this will help in framing out policies for managing our zoo in future so with this word I declare this programme open .

Thank you.

Keynote address by Mr. B.S. Bonal IFS, Member Secretary, Central Zoo Authority

Good morning everybody let me first welcome on behalf of Central Zoo Authority and Darjeeling Zoo to all the members over here especially to the friends from Durrell wildlife Conservation Trust, and the friends from SAARC countries from Nepal from Srilanka and from Bhutan. Mr. Das and all the dignitaries on the dias and friends infact the Central Zoo Authority has been in collaboration with the Durrell Wildlife Conservation Trust since the inception of Central Zoo Authority and every year we used to send one Zoo Director and one Veterinary Officer for training over Jersey itself but we thought why not to bring that institution itself here in India and impart the training to more of our zoo officials that is how this course was conceived. Thanks to the authorities Durrell Wildlife Conservation Trust that they agreed I think this is the first time when they are venturing such type of courses outside of Durrell in the Jersey itself and also I would like to thank the SAARC secretariat because in 2010 we had a discussion and it was decided that we should have a common platform where the zoo directors, vetenarians, officials share there experiences and knowledge and the Central Zoo Authority extended their help and that is how we are here today and I am sure that this will really be a helping hand for all of us and at the same time I hope that such type of workshops, meetings will continue in future in similar structure with the Durrell Wildlife Conservation Trust as well as friends from the SAARC countries.

As you know that the Central Zoo Authority came into being in 1992 with the objective of supporting the conservation role of in-situ basically when we talk of recovery of endangered species one has to see that it naturally goes in for in-situ conservation but we cannot forget we cannot ignore the importance of the ex-situ conservation and especially in the present context when the habitat is lost, human populations are increasing tremendously and thereby encroaching upon the habitat of the animals and thereby increasing the day to day the animal- human conflict. The basic problem ultimately what I personally feel is the growth of human population, I don't know how to control that of course we have been talking about the population control of animals, the prolific breeding animals in the zoos, there also we feel the same problem but although we have been talking lots of measures but its a long way to go I feel that controlling human beings will be again be the same problem although there have been lots of step taken by the Government but again it depends on the individual concern whether it is the control of prolific breeding animals in the zoos. If the managers really do that, it can be done why not so it is now basically to all the individuals, managers and authorities.

As the history goes so far as zoo development is concerned as Dr. Das has already narrated but far as history of Indian Zoo is concerned I think the first zoo which was open for the public was Barrackpore zoo in 1883 but it is no more in existence but we have a history, the Marble Palace Zoo which was established in 1853 that still exists that is in Kolkota although that particular zoo has not been able to follow and implement the standards prescribed by the Central Zoo Authority but that has its own importance it has a heritage value that is what we want that it should be preserved and then with development we should continue with that. Anyway, as everybody might be thinking that it is something like a workshop but I must say that it is little different, it is a course as I told you earlier it used to be conducted or we used to send officers to Durrell now the same course is done here we tried to call as much as possible all the Zoo Directors and Veterinarians but you know that we have our own limitations but please realise that this is not the end this is the beginning and this course will continue even in future so therefore I am sure we will be able to cover and impart the training with our other colleagues who has not being able to attend here. From the SAARC this time there is no representative from Pakistan and Bangladesh although there had been some correspondence since it was beginning so therefore correspondence from the SAARC secretariat was little late but I am sure that from next year onwards we will have more representative from tthe other countries as well as the countries who have attended this time. With this I hope that the structure which has been built by the Durrell Wildlife Conservation Trust for the five days which we will be sharing here which they will be conducting where our colleagues will be benefitted a lot and as usual once they go back please try to implement all those things in all workshop and training course I have been telling this generally what happens whatever they discuss here, whatever they learn here once they go back to there field then in the same line which they have been doing in the past they continue to do so it's my earnest request that once you go back please implement at least if not hundred percent to some extent thereby definitely I'm sure that apparently there will be some improvement as you know that zoo management has shifted from entertainment to education now conservation so therefore conservation has to be the important aspect of Zoo management thereby we need to focus on our own local species first although we don't say that you don't emphasize on the exotic species but our endeavour should be to emphasize on endemic and local species unfortunately I must say that although we have 46,000 number of animals kept in the zoos but not much of endangered species are there we don't have amphibians in the exhibits in the zoos except one in Darjeeling so therefore even the enclosures for amphibian and that is what we have been thinking but it has not been there our managers have been emphasizing on nocturnal house but now we have to think for amphibians and even insectariums, insects are also not exhibited in the Indian Zoos I think we need to change our mindset of course it cannot be done at a time abruptly we need to have a knowledge first how and then only we should go otherwise we would fail and Conservation Breeding Programme being flagship programme for Central Zoo Authority or which has been emphasized and given importance by the Government of India and as Central Zoo Authority has identified quiet a good number of zoos as coordinating and participating zoos inspite of that it has not gone to the extent we desired but there has been a number of good conservation breeding programmes which really deserves a round applause especially the Red Panda in Darjeeling Zoo and Pangolin in Nandankanan Zoo and Snow leopard again in Darjeeling Zoo Lion Tailed Macque in Vandalur Zoo there are lots of examples including the Sepaijhala Zoo . I am sure that through this workshop those coordinating zoo especially the zoo directors and veterinarians they will work as a team and make the conservation group, who say no zoos so therefore we need to fight that and we have to show that zoos are there to support the in-situ conservation and we can say only if we show the successful in Conservation Breeding Programme in our zoos. With this I wish you all the best and thank you to the Durrell Wildlife Conservation Trust and thanks to Additional Principal Secretary Dr. Das and District Magistrate, Darjeeling and special thanks to Alankar Jha who readily agreed to conduct this course over here because during tourist peak time it becomes always difficult to manage so with his dynamic personality you all will enjoy here and share the experience.

Thank you very much.

Speech by Dr. Soumitra Mohan IAS, District Magistrate, Darjeeling

Mr. Alankar Jha Director, PNHZ Park, invited guests, distinguished guests, ladies and gentleman, the subject "Endangered Species" is something very new to me and I really feel out of place to say something about this but one thing again as a layman when one thinks about the problem associated with environment, the problem we are talking about these days about climate change or for that matter again the problem of endangered species lies to the overall problem of environmental degradation as we call it and moving whatever one can understand about the problem about the endangered species management problem. And the moment we talk about it one think its about the loss of habitat something that we always talk about that is basically the invasion of the habitat of a particular species. Today we know that the way the variety and diversity of species have been coming down at such a drastic pace everyday, the various assessments and the rate at which the species are being lost to us every day, every month, every year the diversity and variety of our planet exactly is much less than what it used to be at one point of time so at against this backdrop when we understand the human activities, the human society, the human civilization because of its intervention invasion of the various species habitat has actually negatively impacted. . What we can do I think this workshop can very well dwell upon those method and methodologies, techniques of species management but the simple theory or simple mechanism one can think of is again the restoration of the habitat which is being invaded, more awareness, more training of the people who are actually charged with or interested with the responsibility of the management of various zoos, various habitat and various authorities so I think here comes the importance of training, here comes the importance of awareness of common people and so if we can pull it off and more than that I think the basic problem with people like us or for that matter the developing countries or the third world countries if the problem of resource constraint the moment we talk about such a thing because as human society as human civilization we are always ceased with problem of immediate survival so such a thing comes very late to our understanding as to or the importance or the appreciation of species management. I just hope that this workshop, this seminar will dwell upon various themes, various methodologies, various mechanism of how we can actually have successful species management in future in India or in South Asia in world as a whole. With this I thank a lot for being here for being in the workshop as someone being the District Magistrate I also feel it is a privilege to be with you. Thanks a lot again.

Speech by Mr. Mark Brayshaw, Head of Animal Collection, Durrell Wildlife Conservation Trust, Jersey, U.K.

On behalf of Durrell Wildlife Conservation Trust, I wouls like to extend great thanks and appreciation to Dr. Das, Dr. Mohan, Mr Bonal from Central Zoo Authority and Mr. Jha the Director of Darjeeling Zoo for inviting us to come here and collaborate and to run a course on Endangered Species Recovery and it is very much a natural progression and extension of the long collaboration we have with the Central Zoo Authority At Durrell, we have had over hundred Indian national to come to Jersey to train with us and many of you who are here today and in a way this is just like making a return journey so we are very grateful for that. We are very honoured to read in the press in the "Times' and "The Telegraph" yesterday that four experts from Durrell are coming to run this course and we are very flattered but we are in an illustrious company and we have many experts amongst us and in a theme of collaboration we hope this week will be a real experience for all of us. So on that note I would just like to end and thank you all and we are all looking forward to a very fruitful and leaning experience this week working with you all. Thank you very much.

Vote of thanks by:

Dr. Brij Kishore Gupta
Research and Monitoring Officer
Central Zoo Authority

On behalf of the Central Zoo Authority which is a statutory body of the Ministry of Environment and Forest, Government of India and the Padmaja Naidu Himalayan Zoological Park I warmly extend my thanks to the Additional Chief Secretary Department of West Bengal, Government of West Bengal Dr. Das and I also extend my thanks to the District Magistrate, Darjeeling Dr. Soumitra Mohan the Member Secretary Central Zoo Authority Mr. B.S. Bonal and I extend my thanks to Director Padmaja Naidu Himalayan Zoological Park Shri Alankar Jha who has been working hard for the past 4-5 months on organising and getting things done and communicating with various authorities for this course and not the least warm thanks to Durrell Wildlife Conservation Trust United Kingdom, Channel Island, Jersey who accepted the invitation of Central Zoo Authority to conduct this course at Darjeeling though they have a hectic schedule I have seen that as I have been associated with the trust for the last twenty years and I know they have more than a dozen programmes in a year to conduct and inspite of that they have taken this invitation and they are here so I heartily congratulate and thanks to the Durrell Wildlife Conservation Trust particularly Mr. Jameison Copsey who is the head of the Department of Durrell Conservation Academy earlier it was known as ITC but recently they have named it as Durrell Conservation Academy and Mr. Jameison Copsey will be joining us tonight today sometime in the evening because his flight got delayed due to bad weather in Jersey and London however I extend my thanks to Dr. Tim Wright Deputy Head he is here and he will be with us the whole day, during the whole course. I extend my thanks to Mr. Mark Brayshaw who is the Head of Animal Collection in Durrell Wildlife Park, Dr Andrew Routh many of the participants here already know him because his expertise in Vultures he has been to India many times and has been assisting in Pygmy Hog Conservation Breeding Programme and many other programmes so he is very well known in this field and he will be with us during the whole training programme. I must thank the participant from Colombo Zoo, Srilanka and we had a really tough time communicating , getting approvals, getting permissions but we could do it on time and I'm happy and i extend my thanks to the Director and Assistant director and participant from Colombo Zoo and participants from Central Zoo, Nepal initially we had communication gap between the SAARC secretariat, Central Zoo Authority and Padmaja Naidu Himalayan Zoological Park but we could organise to get the participants from Central Zoo, Nepal and the participants from Bhutan, I extend my thanks to them.

I also thank the forest officials who are here from West Bengal very senior officials Mr. T.V.N Rao sir Member Secretary West Bengal State Zoo Authority, Director, Alipore Zoo and other forest officials and the participants from Indian Zoos without whom we couldn't have this workshop we have Directors, Curators, Veterinary Officers, forest Officials it is going to be a really good group for this workshop and i really extend my thanks to the authorities also to the Directors and management authorities, operating authority fro allowing them to attend this training, particularly Mr. Chettri, Mr Syangden they are really hard working and other staff members, the Research Scholars here they are really hard working and i extend my thanks to them. I also extend my thanks to the print and media without whose support which everyone requires in this field of conservation and communication with whatever we come out in this workshop.

Endangered Species Recovery Excellence within a Modern Zoo

Presented by:

Dr. Tim Wright

Director head of Conservation Training

Durrell Wildlife Conservation Trust

Jersey, U.K.

Darjeeling
17^{th}-21^{st} November 2012

Endangered Species Recovery
Excellence within a Modern Zoo

जहाँ है हरियाली ।
वहाँ है खुशहाली ॥

durrell

Endangered Species Recovery
Excellence within a Modern Zoo

Overall theme

- How can we optimise the way in which we run our zoos, and maximise their conservation role?

Course learning objectives

- What is our vision as a zoo community?
- The vital role of leadership
- Keys to successful project management
- Clear collection planning
- Understanding the needs of the species in our collections
- Managing animal health
- Understanding captive population management
- Strengthening the link to the wild – supporting *in-situ* conservation
- Connecting with our visitors – getting the message right

Endangered Species Recovery
Excellence within a Modern Zoo

Overall theme

- How can we optimise the way in which we run our zoos, and maximise their conservation role?

Course format

- lectures
- discussions
- group activities
- zoo tours

discussions are key – and we can all learn from each other...

Endangered Species Recovery
Excellence within a Modern Zoo

Saturday 17 November
Management and planning

Learning outcome: To understand the global zoo context and principles of collection planning

Time	Topic	Content	Format	Facilitator(s)	Location
08:30	Welcome	The welcome will be followed by a group photograph		[illegible]	Lecture room
09:00	Course introduction	To outline course format explaining main aims and highlighting mix of skills and understanding. Key focus on developing the skills of participants as leaders within their zoos, able to ask the critical questions necessary to achieve excellence	Talk	TW	Lecture room
09:15	The evolution of Durrell	In this first lecture we reflect on the stages that Durrell has gone through in its evolution as a conservation organisation with a zoo at its heart	Lecture	TW	Lecture room
09:45	The strategy for Indian zoos	Zoos in India: Present and Future Strategies	Lecture	BSB	Lecture room
10:30	BREAK				
11:00	Understanding the global zoo context	Here we outline the international zoo landscape, highlighting the structures and associations in place, the global and regional vision and strategic direction. We also consider examples of partnerships between zoos and how to develop effective links	Lecture	MB	Lecture room
12:00	Managing mammalian carnivores in captivity: lessons learnt	Carnivores are one group of mammals that the many zoos house within their collections. However, successfully managing this group in captivity is no easy task. Here we reflect on current 'best practice' with regards to enclosure design and management, focusing in on the care of big cats	Lecture	[illegible]	Lecture room
13:00	LUNCH				
14:00	Case in point: Examples of collection planning from our zoos	Here we present a talk providing examples of how collections can be categorised and subsequently modified to achieve our institutional goals	Talk	MB	Lecture room
14:30	Conservation at Padmaja Naidu Himalayan Zoological Park	An overview of some of the specialist conservation breeding work at Padmaja Naidu Himalayan Zoological Park, before our behind the scenes tour this afternoon	Talk	AKJ	Lecture room
15:00	BREAK (and transfer to zoo) [illegible]				
15:30	Zoo tour: behind the scenes in an ex-situ species conservation project	This tour will take us to Red panda, Snow leopard Conservation Breeding Areas as well as a general tour of the wildlife park. [illegible]	Guided tour	AKJ	Zoo grounds
17:30	END				
19:30		Evening Dinner			

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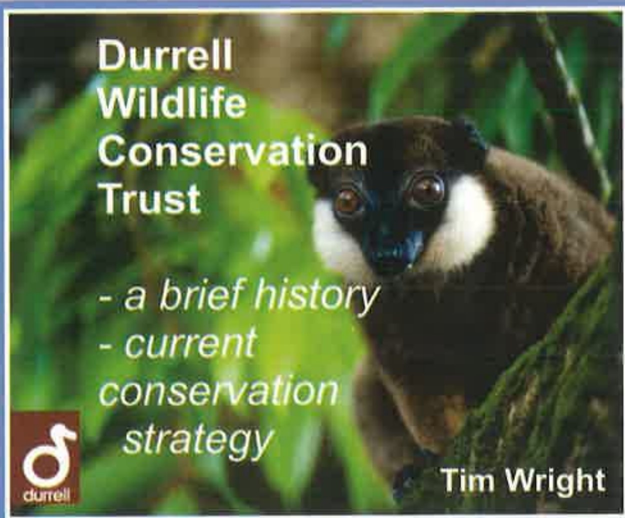


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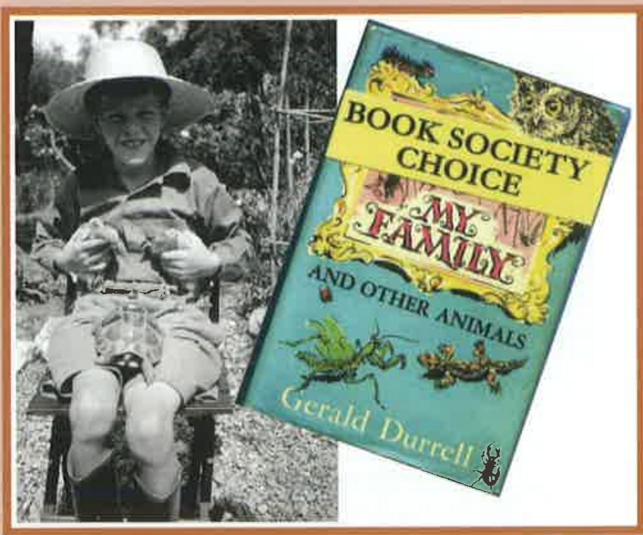
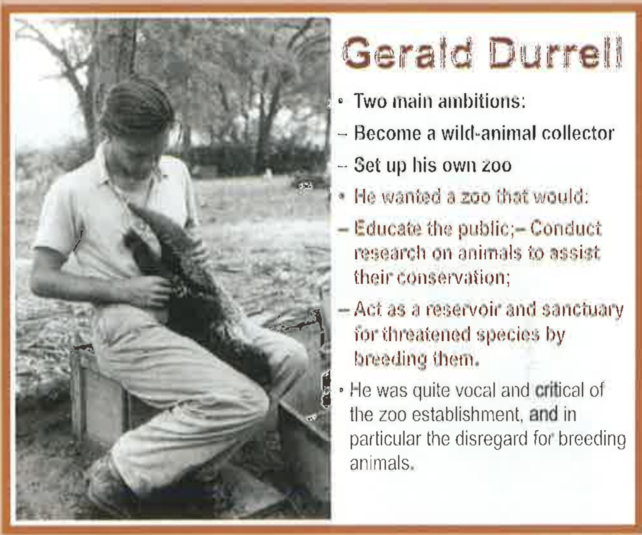
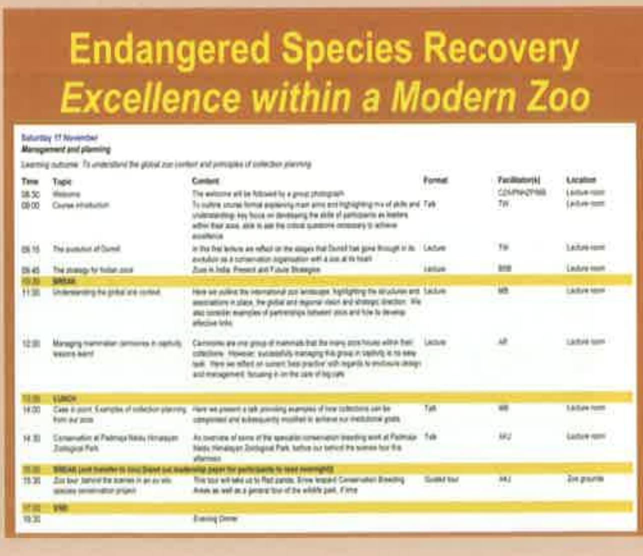
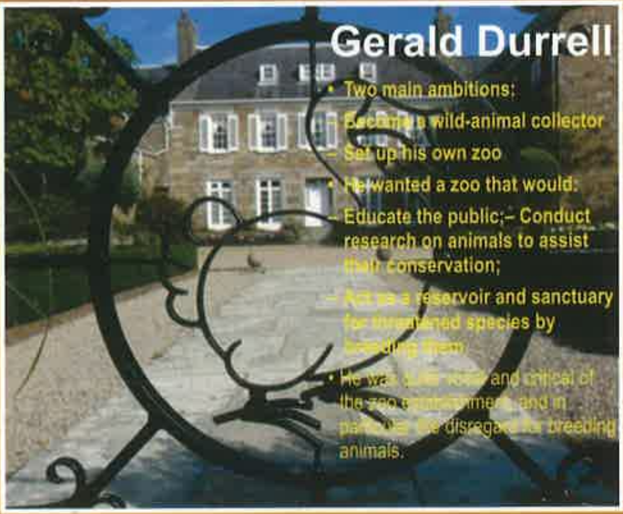
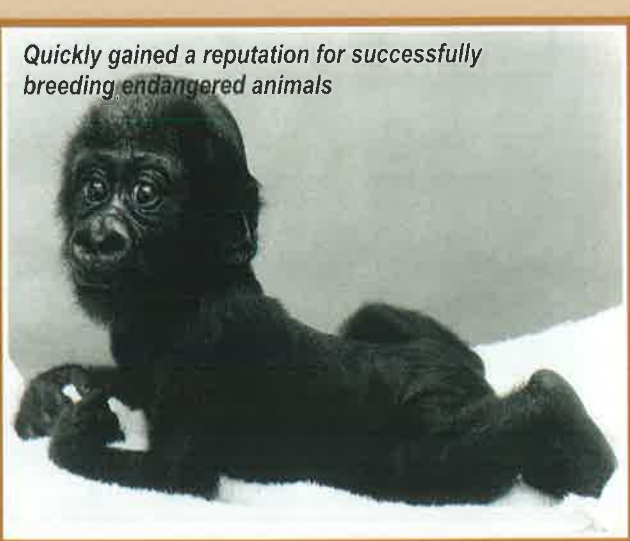

BOOK SOCIETY CHOICE
MY FAMILY
AND OTHER ANIMALS
Gerald Durrell

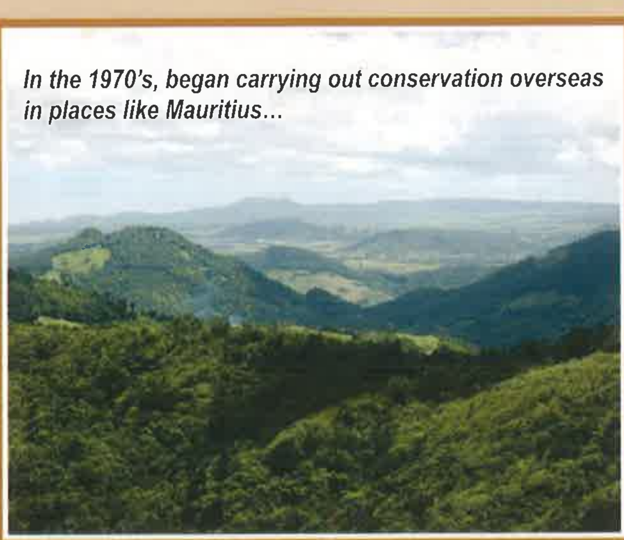

Gerald Durrell
• Two main ambitions:
– Become a wild-animal collector
– Set up his own zoo
• He wanted a zoo that would:
– Educate the public;– Conduct research on animals to assist their conservation;
– Act as a reservoir and sanctuary for threatened species by breeding them.
• He was quite vocal and critical of the zoo establishment, and in particular the disregard for breeding animals.


Endangered Species Recovery
Excellence within a Modern Zoo


Durrell
Wildlife
Conservation
Trust
- a brief history
- current
conservation
strategy
durrell
Tim Wright

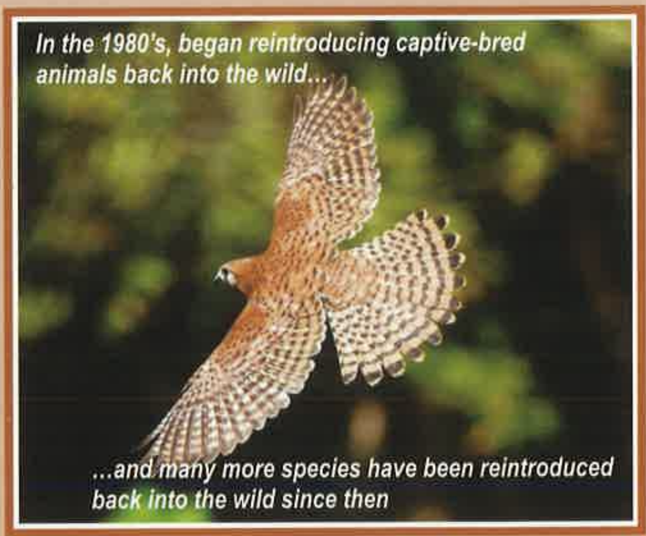


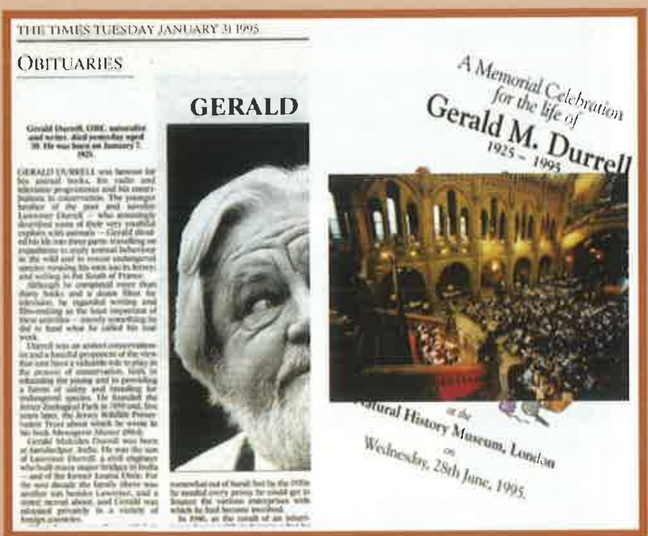

Quickly gained a reputation for successfully breeding endangered animals


In the 1970's, began carrying out conservation overseas in places like Mauritius...

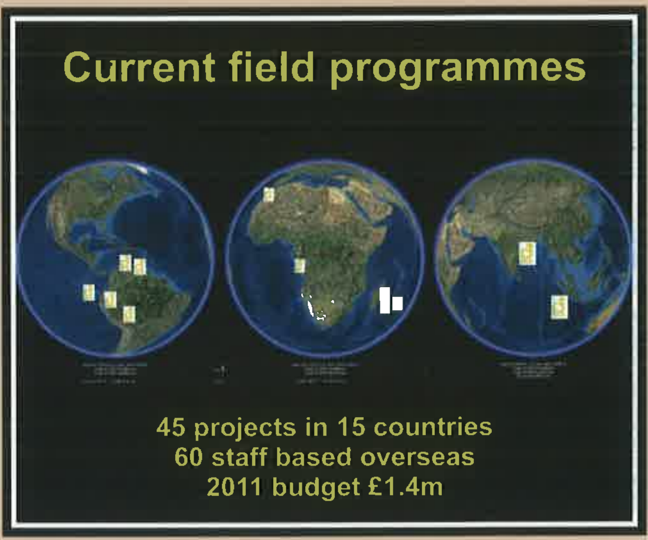

Mauritius kestrel (endemic to Mauritius)


Habitat restoration of Round Island...


In the 1980's, began reintroducing captive-bred animals back into the wild...
...and many more species have been reintroduced back into the wild since then


THE TIMES TUESDAY JANUARY 31 1995
OBITUARIES
GERALD
A Memorial Celebration for the life of
Gerald M. Durrell
1925 – 1995
at the Natural History Museum, London
on
Wednesday, 28th June, 1995.


How is Durrell's conservation mission delivered?
Training and Capacity - Led by Training Programme Courses, Durrell Conservation Learning Network (DCLN), internships, seed funding for young conservationists
In situ - Led by Field Programmes
Species and habitat restoration, research, community conservation, monitoring and evaluation, policy support, advocacy
Ex situ - Led by Wildlife Park
Conservation breeding, captive assurance, animal collection welfare, husbandry skills development
durrell


Current field programmes
45 projects in 15 countries
60 staff based overseas
2011 budget £1.4m


Mangrove finch
• Critically endangered – Impact of rats and parasitic fly
• Have shown that can restore population by controlling rats
• 2006-09 Darwin project – successful continuation 09-11
Floreana mockingbird – Island restoration
• Critically endangered
• Major restoration project – mockingbird is the flagship
• Field investigator hired – and major initiative for coming years
Pacific islands: Galapagos


Western Caribbean
• 3 yr project to establish protection measures for the Hispaniola solenodon and hutia
• Support to restoration of Cayman iguanas
Eastern Caribbean
• Restoration of the Montserrat mountain chicken
• Eradication of alien invasive species – St Lucia, Antigua
• Support to policy makers
Caribbean islands


• Farmland bird monitoring
• Habitat restoration for native birds
• Reintroduction of red-billed chough
• Reintroducing native plants
• Monitoring toads and agile frogs
• Headstarting agile frogs
• Education campaigns
Channel Islands

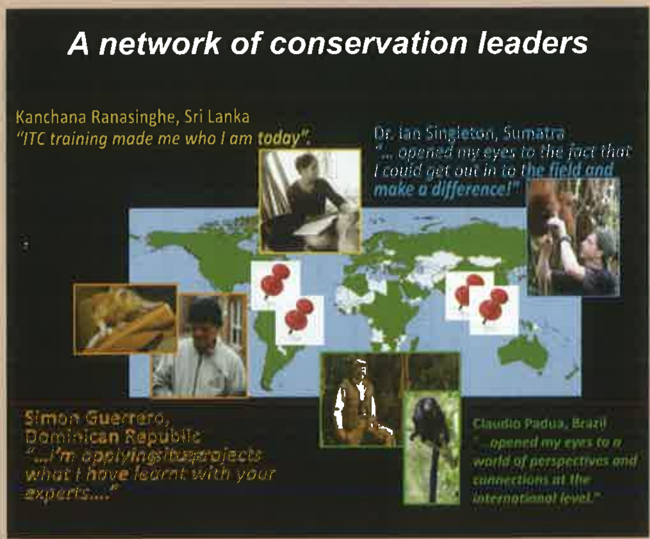

Conservation of endemic forest birds in Mauritius


• Endemic reptile communities
• Native passerines
• Seabird restoration
• Education and awareness
• Policy support
Mascarenes


First encounters in 1960's
Thought extinct – then re-discovered
Breeding centre started with 6 animals in 1990's
Releases started in 2006
Now have released >40 animals
Support to local communities
Restoration of the pygmy hog


Community management of natural resources
Restoration of Madagascar pochard
Monitoring endemic species
Restoration of ploughshare tortoise
Establishment and management of protected areas
Support to government
Education and capacity building
Field research
Madagascar & Comoros


Training - a global reach
3350+ conservationists trained from135 countries
A wide variety of conservation-related topics


A network of conservation leaders
Kanchana Ranasinghe, Sri Lanka
"ITC training made me who I am today".
Dr. Ian Singleton, Sumatra
"... opened my eyes to the fact that I could get out in to the field and make a difference!"
Simon Guerrero, Dominican Republic
Claudio Padua, Brazil
"...opened my eyes to a world of perspectives and connections at the international level."


Beyond Jersey…
Overseas courses run…
>13 countries/territories to date
3-5 per year
Often run in local language


Supporting our network
Seed funding (>£13,000 in 2010-2011)
Developing the 'social network'
Meeting the network
Solitaire – our graduate journal
facebook


Thank You

ZOO STRATEGY IN INDIA

Presented by:
B.S. Bonal IFS,
Member Secretary, Central Zoo Authority.

ZOO STRATEGY

- IN INDIA

PAST AND PRESENT

17th November, 2012

B.S. Bonal, MemberSecretary

Schedule of Presentation

- Introduction to CZA
- Intro. to Legislation, Policy, Rules, Guidelines

Introduction to CZA

The Central Zoo Authority

(A statuary body under the Ministry of Environment and Forests, Government of India, established in 1992)

Mission: To provide better upkeep and veterinary care to the wild animal housed in zoos in India to ensure their conservation through best practices of management and bringing education & awareness among the people.

VISION To complement and strengthen the national efforts in conservation of the biodiversity of the

Functions:

1) to specify the minimum standards
2) to evaluate and assess the functioning of the zoos
3) to recognise or derecognise zoos;
4) to identify endangered species
5) to coordinate the acquisition exchange
6) Identify priorities, themes and approval of Master Plan
7) Provide technical assistance to Zoos
8) to release financial assistance to Zoos
9) to ensure maintenance of studbooks
10) to coordinate training of zoo personnel
11) to coordinate research and education
12) to perform such other functions

Constitution of the Central Zoo Authority

The existing committee of the Central Zoo Authority was reconstituted in October 18, 2010 for a period of three years.

Committees:

1. Administrative Committee
2. Technical Committee
3. Expert Group on Zoo Designing
4. Expert Group on Conservation Breeding Programme
5. Appraisal Committee for zoo elephant

Establishment:

16 regular and contractual scientific/administrative personnel.

Administrative Committee

This is chaired by the DGF & Special Secretary, MoEF and Addl. DGF (WL) & Director Wildlife Preservation, Addl. Secretary & Financial Advisor, Joint Secretary Administration. Member Secretary CZA is convener.

Main Functions:

- To Screen and approve the proposal regarding creation of posts and up gradation
- To approve proposals for awarding consultancies, outsourcing of services/manpower and contract appointments.
- To approve annual budget of the Central Zoo Authority.

Technical Committee:

This is chaired by the Addl. DGF (WL) & Director Wildlife Preservation, MoEF, Government of India and all the non-official members of the governing body of the CZA are also the member of this committee and tenure will coterminous with CZA.

Functions:

1. To make recommendations regarding specifying the minimum standards for housing, upkeep and veterinary care of the animals kept in a Zoo.
2. To approve the grant of recognition or de-recognition to the Zoos and to make recommendations for the applications received for the creation of new Zoos.
3. Identify endangered species of wild animals for purpose of captive breeding and assigning responsibility in this regard to a Zoo.
4. To make recommendations regarding exchange of animals with foreign Zoos, accepting gift of animals from foreign Zoos and to gift animals to foreign Zoos.

Expert Group on Zoo Designing

Expert Group on zoo design- constituted coterminous with CZA.

Functions:

1. To scrutinise, suggest improvements, changes and make recommendations (to the Technical Committee) in the proposed master (layout) plan submitted by the various Zoos.

2. To scrutinise, suggest improvements/ changes and approve/ disapprove the designs of animal enclosures submitted by various Zoos.

3. To suggest standards and norms for designing of animal enclosures for various Zoos.

EXPERT GROUP ON CONSERVATION BREEDING PROGRAMM

Wildlife Legislation

- The Wild Life (Protection) Act came into being in 1972 to give proper shape to wildlife conservation in the country.
- The Act has later been amended in 1982, 1986, 1991, 1993, 2003 and 2006 to make it more comprehensive.

National Wildlife Action Plan

- The first National Wildlife Action Plan was adopted in 1983.
- Presently, the National Wildlife Action Plan (2002-2016) is in operation and is guiding in deciding the priorities for wildlife conservation.

National Zoo Policy, 1998

- To give proper direction and thrust to the management of Zoos in the country, the National Zoo Policy was framed and adopted by the Government of India in the year 1998.
- The main objective of the Zoos under the National Zoo Policy is to complement and strength the national efforts in the conservation of rich biodiversity of the country, particularly the wild fauna.
- Zoos can achieve this by supporting the conservation of endangered species by giving species, which have no chance of survival in wild, a last chance through coordinated breeding under *ex-situ* conditions and raise stocks for rehabilitating them in wild as and when it is appropriate and desirable.

Amphibian and Reptiles

- Snakes: 40 species
- Turtles: 20 species
- Lizards: 6 species
- Chameleon: 1 species
- Amphibian: 1 species (Himalayan salamander)

Rules and Guidelines

(wildlife (P) act 1972 –amendment 2003)

1. Recognition of Zoo Rules, 1992, 2009
2. National Zoo Policy, 1998
3. Guidelines for the scientific management of zoos
4. Guidelines on master planning of zoos
5. Guidelines for Mobilizing financial support from corporate to zoos for better management (marketing and fund raising)
6. Guidelines for utilization of volunteer in zoos.
7. Guidelines on prioritization on release of fund of CZA for zoos.
8. Guidelines on Conservation Breeding Programme
9. Protocol on transportation of wild animal

Wildlife Protection Act - CZA

Section 38 H (1) Wildlife (P) Act, 1972

No zoo shall be operated without being recognized by the Authority

Section 38 H (1A) Wildlife (P) Act, 1972 (2002)

No zoo shall be established without obtaining prior approval of the Authority (and Orders of the Supreme Court-As per PIL Judgement)

Section 38 H (4) Wildlife (P) Act, 1972

No recognition to be granted unless the authority ,having due regard to the protection and conservation of WL and satisfied with standards

Section 38 H (6) Wildlife (P) Act, 1972

Authority may cancel or suspend the recognition-due opportunity

Section 38 H (7 &8) Wildlife (P) Act, 1972

Appeal to Central Govt.& with in 30 days

Recognition of Zoo Rules, 2009

- **Rule 1,2,3,4,5,6,7,8,9**
- **Rule 10 with 12 standards.**
- **Standards and norms for recognition are laid.**
  - **1. General requirements**
  - **2. Administrative and Staffing Pattern**
  - **3. Development and Planning**
  - **4. Animal housing, display of animals and animal enclosures**
  - **5. Upkeep and healthcare of animals**
  - **6. Veterinary and infrastructure facilities**
  - **7. Post-mortem and disposal of carcasses of animals**
  - **8. Euthanasia of the animals**
  - **9. Acquisition and breeding of animals**
  - **10. Research activities**
  - **11. Education and outreach activities**
  - **12. Visitors facilities**
- **Rule 11 Maintenance of records and submission of inventory**

Regulator to facilitator

- Basic responsibility – State / zoo operator
- CZA – Technical support and supervisory function.

Financial support – To strengthen implementation of regulation.

Activities for implementation

1. Improvement of zoos.
2. Conservation breeding programmes.
3. Rescue and rehabilitation
4. Research and education.
5. Capacity building (HRD and trainings)
6. Operational cost.

1. Improvement of zoos

- Target 20 to 30 zoos
- Priorities -
  1. Strengthening of existing zoos as Centre of excellence - (NZP)
  2. Strengthening of existing zoos as model zoo – Each States / UTs
  3. Relocation of old zoos to new sites / de-novo at same site
  4. Strengthening of existing zoos as potential model zoos.
  5. Other zoos.

- Zoos are also required to inspire amongst visitors empathy for wild animals, an understanding and awareness about the need for conservation of natural resources and for maintaining the ecological balance.
- Opportunities for carrying out scientific studies useful for conservation in general and creation of data base for sharing between the agencies involved in *in-situ* and *ex-situ* conservation are also the objectives enshrined in the policy.
- Besides the aforesaid objectives, the Zoos will continue to function as rescue centre for rescued/ orphaned wild animals subject to the availability of appropriate housing and upkeep infrastructure. Where appropriate housing and upkeep is not available, the Government would ascertain setting up rescue facilities in off display areas of the Zoo subject to the availability of land.

Zoos in India

- 198 recognized zoos (including circuses). -2 zoos, 1 circus closed recently
- Major Zoos: 170
- Visitation-5ml/year(50 lak)
- No. of Animals Housed: 46003

1. Mammals : 44%
2. Birds : 38%
3. Reptiles : 18%
4. Amphibian : 1 Species
5. Fish : None

Recognized zoos

Large category zoos-	*7 (5) (22)*	
Medium category zoos-	*16 (20) (11)*	*157*
Small category zoos-	*48 (44) (34)*	
Mini zoo & Deer Park-	*86 (88) (90)*	
Circuses-		*23*
Rescue centre-		*18*
Total-		*198*

Operator of the zoos

• State Governments (Forest Departments)	114
• State Governments (Municipal corporation)	17
• Central Government	1
• Public Sector	6
• Private	8
• State Governments (Institution)	3
• NGO's/Society/Trust	26
• Circuses	23
	198

Birds in Indian Zoos

- Over 7444 birds of 153 species (12%, n=1300) of 16 taxonomic orders
- Critically Endangered
  1. White-backed Vulture *Gyps bengalensis*
  2. Long-billed Vulture *Gyps indicus*
  3. Slender-billed Vulture *Gyp teniurostris*
  4. King Vulture *Sarcogyps calvus*
  5. Forest Spotted Owlet *Athene blewitt*
- Endangered Species according to Indian Wildlife Protection Act 1972
  1. 37 Species
- Endemic Species
  1. Grey Jungle Fowl *Gallus sonneratii*
  2. Red Spur Fowl *Galloperidix lunulata*
  3. Blue Winged Parakeet *Psittacula columboides*

Mammals in Indian Zoos

- Only 25% (n=350) of the mammalian diversity found in wild was housed in the zoos in India.
- The mega fauna Indian Elephants, Indian two horned Rhinoceros, Bison, Bengal Tiger, Himalayan and Sloth Bear were housed in good numbers.
- The common and abundantly found wild ungulates were in good number specially which do not require any special husbandry and care.
- There was however hardly any representation of lesser mammals. The rodents were very poorly represented.
- Only 8.5% (n=47) of endemic mammals were represented in the zoos.
- None of the 10 critically endangered mammals were housed in the zoos.

In-situ ,ex-situ linkage

- 90% zoos in India are controlled by the Chief Wild Life Wardens of States/ UTs. State Zoo Authority has been established by states.
- The Chief Wild Life Wardens in the States/ UTs are also the controlling authorities of all the in-situ wildlife conservation areas.

That makes the coordination between in-situ and ex-situ activities much easier.

3.Rescue and rehabilitation

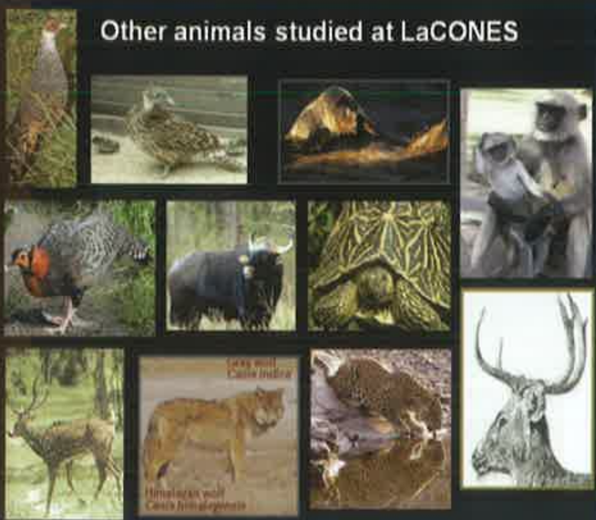
- Increasing man-animal conflict
- National zoo policy, 1998 – zoos to act as RC
- Established 7 nos. Rescue Centers for rehabilitation of ***lions, tigers, leopards, bears and monkeys*** rescued from circuses at Vishkapatnam, Tirupati, Bannerghatta, Vandalur, Nahargarh, South Khairbari, Bhopal.
- Funding- 100% for their maintenance including diet for the animals.
- 206 lions and 42 tigers still living in these rescue centres (Original 464 animals).
- (Designs – Different than exhibit and conservation breeding enclosure)

4. Research and Education

- IVRI Barriely – National Referral Center
- **LaCONES (CCMB)**-Sponsored by CZA for development of techniques for assisted reproduction, Frozen Bank, analysis of genetic homozygosity / heterozygosity for endangered species.
- Research Programme – in collaboration with universities, colleges
- Studbook – WII , Dehradun (14 species)

LaCONES, CCMB, Hyderabad

Other animals studied at LaCONES



Semen collection from Tiger

Zoos Relocated

Sl No	Name of the existing zoo	Area	Name of new site of zoo	Area
1	Rustomjee Deer Park	2 ha	Himalayan Zoological Pak, Bulbuly, Gangtok	205 ha
2	Peshwe Park, Pune	3 ha	Rajiv Gandhi Zoological Park, Katraj, Pune	65 ha
3	Sakkarbaug Zoo, Junagadh	6 ha	Sakkarbaug Zoo	198 ha
4	Kamla Nehru Prani Udyan, Indore	11 ha	Kamla Nehru Prani Udyan, Indore	32 ha
5	Sayaji Baug Zoo, Vadodara	15 ha	Ajwa Zoo at Ajwa	40 ha
6	Kohima Zoo, Kohima	2 ha	Rangapahar Zoological Park	161 ha
7	Mini Zoo Haddo (Port Blair)	3.75 ha	Biological Park, Chidiyatapu	40 ha
8	Rajkot Zoo	5 ha	Rajkot Municipal Zoo	55.37 ha
9	Mini Zoo, Bellary	2.4 ha	Atal Behari Vajpayee Zoological Park in the Bilikal Reserve Forest near Kamalpur of Hopset Taluk	64 ha

Zoos under Relocation

SL No.	Name of the existing zoo	Area	Name of new zoo	Area
1.	Jaipur Zoo, Jaipur	5.23 ha	Nahargarh Biological Park, Nahargarh	72.0 ha
2.	Jodhpur Zoo, Jodhpur	6.0 ha	Machai Biological Park, Udaipur	301.48 ha
3.	Udaipur Zoo, Udaipur	5.2 ha	Sajjangarh Biological Park,	35.69 ha
4.	Kota Zoo, Kota	2.2 ha	Abheda Biological Park, Kota	126.0 ha
5.	Bikaner Zoo, Bikaner		At Bichawaal.	10.0 ha

New Zoos

Following new zoos has been approved by the CZA :

1. Greater Noida Night Safari Park (2007)
2. Lion Safari Etawa UP(2007)
3. Gorakhpur Zoo, UP (2009)
4. Leopard rescue Centre, Ahmednagar, Maharastra (2010)
5. Panther safari, Roha, District Raigad, Maharastra(2008)
6. New zoo at Mukundpur Satna MP (along with White Tiger CB Centre)(2010)

2.Conservation breeding

- Flagship programme
- Identified 73 critically endangered wild animal species.
- Launched 19 species (CZA and states). Eg : Red Panda, Snow Leopard, Pangolin, LTM etc to be inserted)
- Identified – coordinating zoos
  participating zoos
- Funding - 100% (Infrastructure , Biologist , Vetenary support)
- (Designs – Different than exhibit enclosure)

List of the priority species under CBP (out of 73 identified endangerd species)

1	Pygmy hog	14	Great Indian bustard
2	Vultures (white backed, long billed, slender billed)	15	Wild ass
3	Hangul	16	Nilgiri langur
4	Golden langur	17	Musk deer
5	Wild buffalo	18	Hoolock gibbon
6	Brow antlered deer	19	Swamp deer (Hard surface)
7	Lion tailed macaque	20	Nilgiri tahr
8	Red panda	21	Hornbills (Bengal & Lesser)
9	Blyth's tragopan	22	Cheer pheasant
10	Asiatic lion	23	Clouded leopard
11	Rhinoceros	24	Painted roof turtle
12	Western tragopan	25	Snow leopard
13	Phayre's leaf macaque	26	Shaheen falcons

Ex-situ Conservation Breeding

- The conservation breeding programme in India is a joint venture of in-situ and ex-situ wildlife managers. It is a need based activity.
- The Chief Wild Life Wardens and Protected Area Managers have to identify the species which need immediate intervention in the form of ex-situ conservation breeding for the areas under their control.

Ex-situ Conservation Breeding

- Wildlife Wings of the States/ Union Territories have to conduct time to time census of the targetted wild animals species and its related species in their areas to assess the status of the wild animals species, as well as to analyze the condition of its habitat.
- The in-situ wildlife managers need to identify the Protected Areas having/ had wild population of the proposed species/ re-introduction site.
- The in-situ managers also have to take corrective measures to address the cause of decline of the wild population of the targetted species in the natural habitat.

Ex-situ Conservation Breeding

- It is felt that critically endangered wild animal species with few hundreds/ thousands (or say 2500) left in the wild need to be taken up for ex-situ conservation breeding in the Zoos on immediate basis.
- Species with localized distribution should get preference in the scheme of things.

Ex-situ Conservation Breeding

- The existing Zoos are the right places for the ex-situ conservation breeding programme as there is huge infrastructure and trained manpower available over there to deal with the issue.
- One major zoo just next to the natural habitat of the identified species and having expertise and infrastructure has been identified as co-ordinating zoo for each species.
- Two-four Zoos in the habitat range of the targetted species will take part in the breeding programme as participating Zoos.

Ex-situ Conservation Breeding

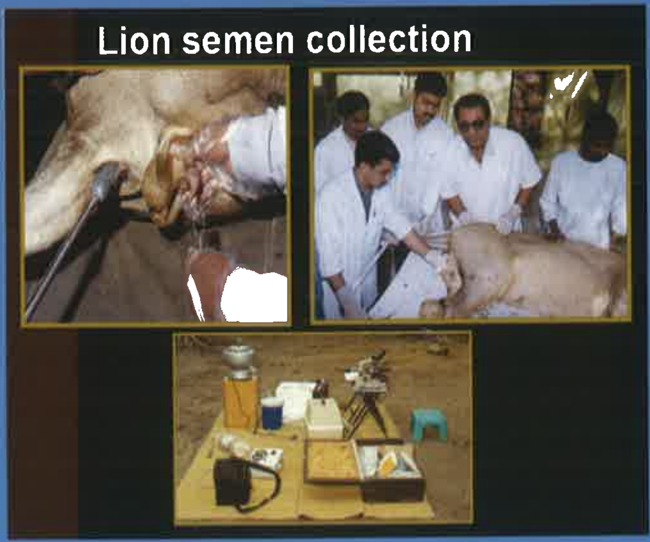
- The possibility of identifying at least 25 founders is being assessed from the existing captive stock in Indian Zoos. Efforts are being made to acquire suitable founders from Rescue Centres, foreign Zoos and even from wild.
- The target will be to have at least 250 physically, genetically and behaviourally healthy and identifiable individuals with animal history sheets of each targetted species in captivity in the world, of which at least 100 must be in India.

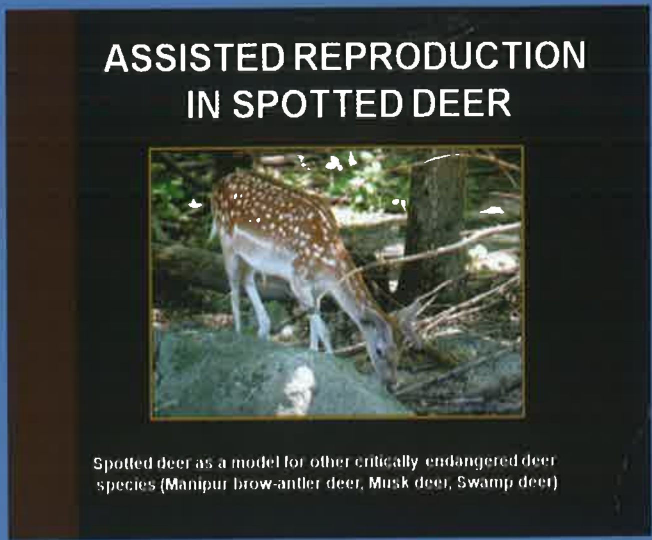
Ex-situ Conservation Breeding

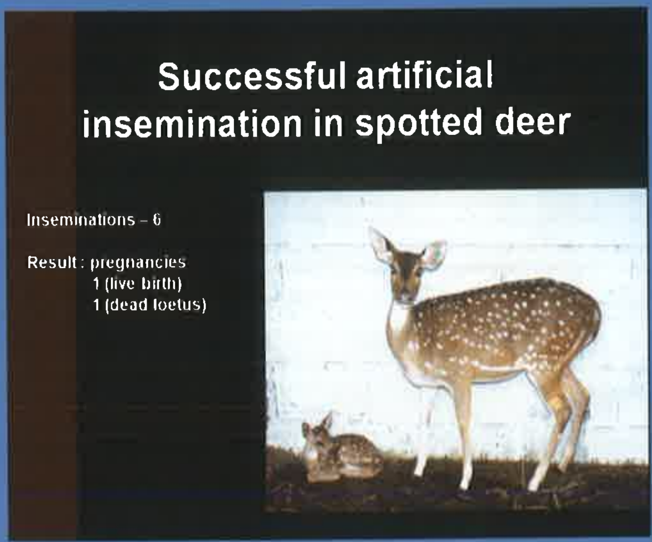
- The Central Zoo Authority will provide all possible technical, financial and other assistance to the zoos under the programme.
- The creation of appropriate animal housing facilities in the form of off-display conservation breeding centres/ satellite facilities along with the project office is financed by the Central Zoo Authority on 100% basis.

Ex-situ Conservation Breeding

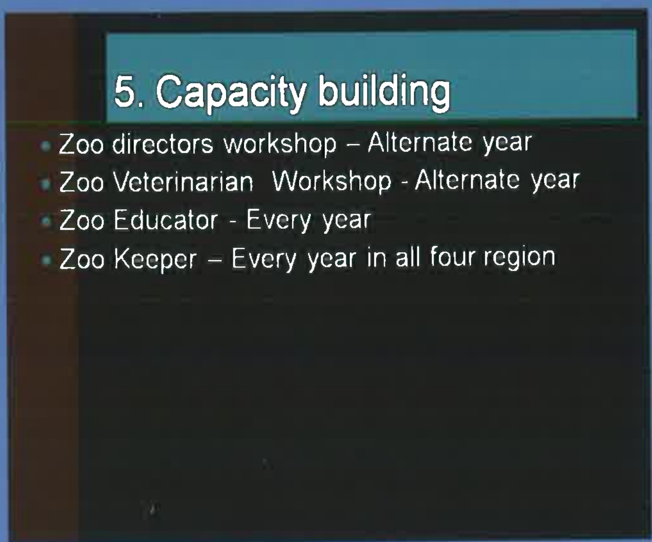
- The Central Zoo Authority is also providing funds as Small-Grants Fellowships for engaging technical manpower for preparation of captive breeding management plans for the targetted species.
- The maintenance of the conservation breeding facilities will be the sole responsibility of the Zoo Operators/ State Governments.
- The Central Zoo Authority is also considering providing maintenance expenditure on off-display Conservation Breeding Centres in the coordinating Zoos. Subject to availability of fund

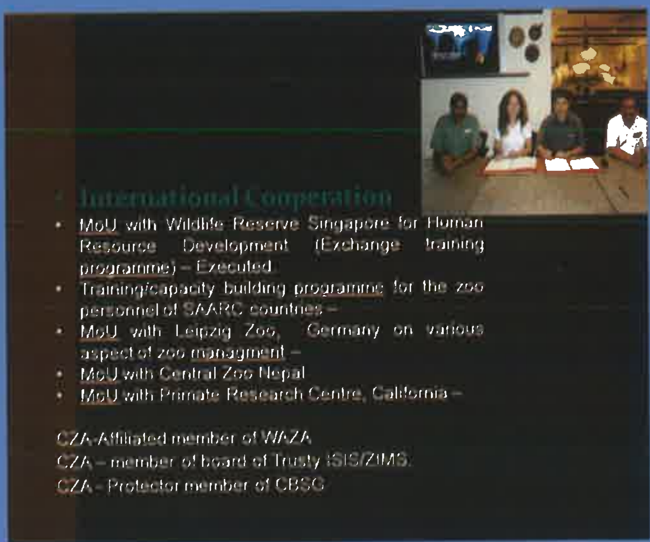

Lion semen collection


ASSISTED REPRODUCTION
IN SPOTTED DEER
Spotted deer as a model for other critically endangered deer species (Manipur brow-antler deer, Musk deer, Swamp deer)


Successful artificial insemination in spotted deer
Inseminations – 6
Result : pregnancies
1 (live birth)
1 (dead foetus)


Birth of endangered black buck fawn (Blacky) by artificial insemination


5. Capacity building
Zoo directors workshop – Alternate year
Zoo Veterinarian Workshop - Alternate year
Zoo Educator - Every year
Zoo Keeper – Every year in all four region

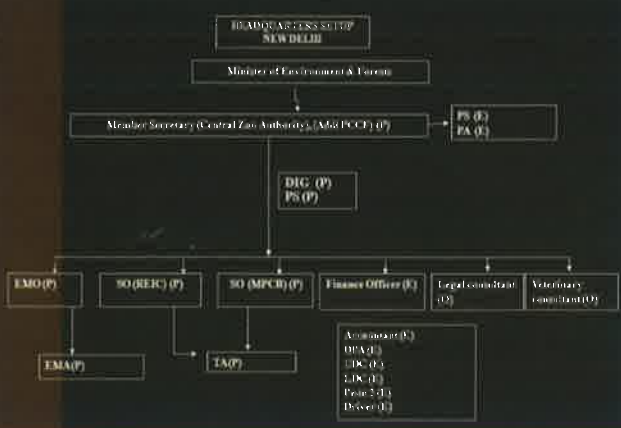

International Cooperation
MoU with Wildlife Reserve Singapore for Human Resource Development (Exchange training programme) – Executed
Training/capacity building programme for the zoo personnel of SAARC countries –
MoU with Leipzig Zoo, Germany on various aspect of zoo managment –
MoU with Central Zoo Nepal
MoU with Primate Research Centre, California –
CZA-Affiliated member of WAZA
CZA – member of board of Trusty ISIS/ZIMS
CZA - Protector member of CBSG

Workshop / Seminar

- Zoo Veterinarians Workshop at Guwahati (held 24-28 September, 2012)-SAARC Zoos
- Training Course on Endangered Species Management for Zoo Directors/Curators at Darjeeling during 17-21 November, 2012
- Zoo Biologists Workshop at Jodhpur
- WAZA Meeting at New Delhi - 9-13 Nov, 2014

6. Restructuring of the Central Zoo Authority

(Existing 16 nos of posts – No technical / scientific manpower)



Regional Offices

Guwahati | Jaipur | Nagpur | Hyderabad

Legend: E=Existing, P=Proposed, O = Outsourcing

EMO : Evaluating and Monitoring Officer

SO (REIC) : Scientific Officer (Research, Education and International cooperation)

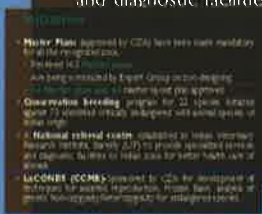
SO (MPCB) : Scientific Officer (Master Plan and Conservation Breeding)

PS : Private Secretary, PA : Personal Assistant

EMA : Evaluating and Monitoring Assistant, TA : Technical Assistant

Initiatives

- **Master Plans** (approved by CZA) have been made mandatory for all the recognized zoos.
  - Received 163 Master plans.
  - Are being scrutinized by Expert Group on zoo designing.
  - 14 Master plan and 44 master layout plan approved.
- **Conservation breeding** program for 22 species initiated against 73 identified critically endangered wild animal species of Indian origin.
- A **National referral centre** established at Indian Veterinary Research Institute, Bareilly (U.P) to provide specialized services and diagnostic facilities to Indian zoos for better health care of



-Sponsored by CZA for development of d reproduction, Frozen Bank, analysis of ıeterozygosity for endangered species.

Initiatives

- MoU with various National and International organisatios
- RE-ORGANISATION OF CZA-Streanthing of HQ and Regional centres
- Establishment of various State Zoo Authority to-constitution of Zoo Foundation,Zoo Society so as to enbie zoo to do Adoption,Marketing ,funding for self sustainable
- CZA funding direct to the Zoos
- Now this –Organizing DWLT training in India
- Invite Zoo personels of SAARC countries

Master Planning

- Major Steps
  - Collection Plan
  - Master(lay out) Plan
  - Master Plan

Website & MIS

- One can visit at ur Website **www.cza.nic.in** to know more about Central Zoo Authority.
- A **Management Information System** (MIS) has been developed in the Authority Office for more efficiency and transparency
- CZA publication and annual records of animal inventories can be downloaded from the CZA website.
- Quatrely CZA news "Ex-Situ updates"

Website & MIS

- EXPECTATIONS
- Continue international relations/trainings –
- DWLT,SAARC,WLRS
- WAZA meeting 2014
- CBP-Take further on with one plan goal Insitu-Ex situ link

THANK YOU

Managing Mammalian Carnivores in Captivity: Lessons Learnt

Presented By:

Dr. Andrew Routh

Head of Veterinary Services

Durrell Wildlife Conservation Trust

Jersey, U.K.

Panthera tigris ssp. tigris

- IUCN Red List "Endangered"
- Population "Decreasing"
- Major threats include
- habitat loss
- poaching
- Total in wild of sub-species estimated <2500, with 1706 in India and no sub-population >250

Panthera leo ssp. persica

- IUCN Red List "Endangered"
- Population "Stable"
- Current total wild population size is about 350 – about 175 mature - animals
- Reached its expansion limits – at least 100 animals outside Gir Forest protected area
- Increased poaching

Panthera uncia

- IUCN Red List "Endangered"
- Population "Decreasing"
- Major threats include
- prey base depletion
- illegal trade
- conflict with local people
- lack of conservation capacity, policy and awareness

Neofelis nebulosa

- Now two species clouded leopard (N. diardi)
- IUCN Red List "Vulnerable"
- Population "Decreasing"
- Major threats include
- loss of primary rainforest
- poaching for skins

Common Requirements

- The Five Freedoms
- Freedom from hunger & thirst
- Freedom from discomfort i.e. provision of shelter and shade
- Freedom from pain, injury or disease
- Freedom from fear and distress
- Freedom to express normal, natural behaviour

AZA General Requirements – Large Felids

- Temperature – tolerant if acclimated and with shelter. Clouded leopards most cold sensitive
- Lighting – nocturnal but do well on natural daylight cycles
- Ventilation – pertains mainly to indoor exhibits and "odor"
- Water – fresh, clean, available – cleaned and disinfected daily. Pools "as appropriate"
- Sanitation – non-porous areas cleaned and disinfected every day. Dirt substrates in outdoor planted exhibits – ditto raked
- Food – "prepared diets". Also animal carcasses - but warnings over contamination and deficiencies

AZA Housing "Very Large"

- At least 20 ft (6.1 m) wide x 15 ft (4.6 m) deep (300 sq.ft/27.9 sq.m); cages should be 50% larger per additional animal
- Smaller shift facilities to permit safe cleaning, cage repair, or other separations - should measure at least 8 ft by 8 ft (2.44 m x 2.44 m)
- Gives moat, wall and barrier dimensions
- Both species (lions and tigers) are easily bred. Owners not wanting young or who are unable to use birth control implants or neutering should build separate cages to separate adults

AZA Housing "Large"

- Generally kept indoors or in situations that permit viewing through glass, bars or sturdy wire. Otherwise their small size and secretive nature make them difficult to safely exhibit in large moated facilities commonly used for lions and tigers
- Minimum cage dimensions for single animals should equal at least 200 square feet, and be increased by 50% for each additional animal.
- As in the case of large pantherids, a shift cage(s) should be available
- Because all five species are excellent climbers and leapers, secure tops should cover all outside enclosures

What Do You Think Of It So Far?

- Old-fashioned? –
- or just common sense and accepted practices?

- and

- The Five Freedoms?

Asiatic Lions - EEP

- Combination of secure indoor housing and large outdoor enclosures
- Outdoor enclosure ~800m² - with larger being preferable - quality of the space within the enclosure is important
- Two or more inter-connected enclosures - young lions are not transferred until they are at least 18 months+
- Landscaped – naturalistic, stimulating environment utilising plants, water, rocks, dead trees and topography
- Visual barriers for privacy or "retreat"

Feeding

- As varied as possible
- Horse and/or beef, including bones, will constitute a major part of the diet
- Whole carcass items such as rabbit and chicken should also be provided
- Animals should be accustomed to being fed separately to reduce the likelihood of fighting and to assist with the management of the lions for enclosure maintenance
- Water should be provided ad libitum

Breeding

- Breed freely in captivity
- Females do not appear to show particularly good rearing skills until the second, usually third, litter
- Learn through this process. Hand-rearing not recommended unless circumstances dictate otherwise
- Gestation period is approximately 110-112 days

Behavioural Enrichment

- Enclosures should be designed to provide as natural and varied an environment as possible.
- Additional enrichment provided regularly - as soon as an enrichment item becomes a regular part of the enclosure it ceases to be enrichment.
- Varied enrichment plan - temporal or spatial unpredictability might overcome the tendency of rapid habituation.

- Olfactory enrichment - introducing faeces/urine of prey and/or other carnivore species.
- Operant conditioning/occupational enrichment thereby 'training' a behaviour, for example presenting paws or opening the mouth on command - working with veterinary dept to carry out regular health checks without the need for anaesthesia

http://www.zsl.org/zsl-london-zoo/news/behind-the-scenes-with-the-asian-lions,811,AR.html

Tigers - EEP

- "Some regions have legislation or guidelines for minimum enclosure sizes, but virtually without exception these minimums would be deemed far too small by our industry"
- Ideally - large, natural outside enclosure, good shade trees, raised wooden platforms, a pool, visual barriers to escape the gaze of their enclosure mates and visitors
- Smaller outdoor pen to facilitate separation - connects to both the main outdoor enclosure and indoor dens

Indoors

- Series of dens, usually at least four, so as to accommodate the need to separate members of a family group when required
- One may be larger with viewing access for the visitors via a 20 mm thick laminated window
- At least one should be covered to provide a pregnant female with a dark, quiet, secure place to give birth and rear cubs
- All should have raised wooden shelves for the tigers to feed and rest on
- A robust water dish that can be drained and filled from the service passage.
- Heating ? (Europe, Sumatran tigers)

Feeding the EEP Tigers

- "Tigers do not eat meat, they eat animals"
- Sections of horse or beef, with the bone included, and to make this a more nutritionally complete package
- Strongly advised to supplement with a "suitable vitamin and mineral powder" to present a Ca:P ratio of 2:1
- "Cod-liver oil"
- Occasionally feed whole, gutted chickens and rabbits. (Ideally the joints of meat should have skin and hair)
- "Starve days" – may increase stereotypic behaviour

Tiger EEP Enrichment

- There is a pattern…
- large heavy plastic balls
- large sections of cow or horse skin
- ungulate faeces for olfactory stimulation
- ditto human perfumes, herbs, spices
- Main form of enrichment should be food presentation
- suspending their joints of meat from trees or at the tops of large wooden poles
- occasional feeding of a whole, large ungulate carcass

Photo: Dublin Zoo - Skuterhijau

Tiger Vaccination

- EEP (around 2000) - Cubs should be vaccinated at 8 and 12, or 12 and 16 weeks of age, then annually thereafter -standard combination vaccines for feline panleucopaenia, feline rhinotracheitis and feline calicivirus
- BIAZA recommendations - Vaccinations for FELV, FIV + other feline viruses up to date (full vaccination history and opportunistic testing may negate need for testing prior to export)
- From both – caution with use of modified live vaccines in non-domestic felids.
- Rabies?

Snow Leopards

- Information scant

Mellen, J.D. (1997) Minimum Husbandry Guidelines for Mammals: Small Felids. American Association of Zoos and Aquariums (just in case)
James Doherty and Dan Wharton (1988) Breeding Management Of The Snow Leopard At New York Zoological Park

Older (range-country) Guidelines

- Yanfa, L. 1992 The care, breeding, and diseases of snow leopards in Qinghai, China Proceedings of the Seventh International Snow Leopard Symposium. Fox, J.L. & Jizeng, D. (eds.) 25-30 July 1992, Xining, Qinghai, People's Republic of China. Published 1994 ISBN 0 -913934-22-4
- Hongguang (1994) Captive Snow Leopards in the Chongquing Zoo
- Shuren (1994) An Introduction to the Feeding and management of Snow Leopards in Xining Zoo

Quick Summary

- Apparently quirky to get to pair and mate
- Need the cold and dry - access to outside and full sunshine – fresh air
- Feeding – broad but includes beef, mutton, rabbit, poultry – benefit from live food for stimulation (?!)
- Illnesses - gastroenteritis, infectious enteritis, cold, pneumonia and internal parasitic infections (mainly roundworm)
- Infectious enteritis is especially dangerous - vomiting, diarrhoea with blood and mucus, loss of appetite or anoxia, protrusive third eyelid, low spirits and a fever of over 40°C – especially young

- (My) Baseline proposals

Large facilities – flexibility etc as per other species – including breeding and rearing
Cold climate helpful
Areas of seclusion
Sloping exhibit with elevated resting areas and "vistas"
Good preventive health programme and disinfection

Marwell Conservation

- Fed a daily diet of beef (3-5kg joint), occasional pork, lamb or rabbit
- Vitamin and mineral supplement powder is sprinkled on the meat
- One 'starve' day a week in winter, sometimes 2 in the summer, to mimic their natural feeding pattern
- "Pretty chilled and male not aggressive to dam or cubs" (Pullen, pers. comm.)

Coloboma

- First reported 1976 – same year as studbook founded
- May be linked to other e.g. heart conditions
- Presume incomplete gene penetrance and possible environmental factors
- Much discussion at AZA meeting in Utah
- ???

Clouded Leopard - SSP

- Notes – shy, arboreal and males can be aggressive to females
- Feeding – as before – smaller quantities
- Enrichment
- Exhibits – one pair "400 sq ft with minimum 8 ft high – better 10"-12"
- Branches etc and resting areas up high
- Keep over 50°F
- Comprehensive notes on pairings, breeding and social management

SSP - continued

- Comprehensive notes on hand-rearing and growth curves
- Quarantine and health – screening for FeLV, FIV, FIV and toxoplasmosis plus regular faecal screening (plus heartworm)
- Vaccination protocol
- Anaesthesia – standard
- Copious notes on artificial insemination

Personal range-country experience (Thailand) – prone to obesity and infertility

- SSP – "should not be kept as pets"

BIAZA Pre-Move Viral Screening

- FIV – low likelihood (except in lions) but would stop a move – serology
- FeLV – low likelihood but would stop a move – serology – vaccines not validated in exotic species
- Feline coronavirus – "interpretation of antibody titres complicated – seek veterinary advice" – and I disagree with BIAZA advice
- Chlamydophila felis - medium likelihood – conjunctival PCR – vaccine
- FHV and FCV – throat PCR – history of collection including vaccination – don't want these
- Not a virus – Toxoplasma gondii
- Keep out feral, non-collection cats!!!

The Breeding Conundrum

- Management
- of numbers in a collection
- of numbers within a collaborative breeding programme
- of genetic diversity
- of stock disposition

Options

?

The Breeding Conundrum

- Management
- of numbers in a collection
- of numbers within a collaborative breeding programme
- of genetic diversity
- of stock disposition

Options
Breed and not worry
Breed and cull
Single-sex groups
Solitary confinement
Contracept

Contraception - Options

- Surgery – irreversible
- OVH/Castration/Vasectomy
- *Secondary sexual characteristics
- Chemical contraception – female
- Progestins – e.g. melengesterol-acetate implant – reversible but serious side-effects
- GnRH agonists – potentially reversible – e.g. deslorelin (Suprelorin®) – initially stimulate then down-regulate LH and FSH – separate or MGA female
- Chemical contraception – male
- Also the GnRH agonists – potentially reversible

The Feeding Conundrum

- Felids are obligate carnivores

?

The Feeding Conundrum

- Felids are obligate carnivores
- Source of the meat
- Provenance of the meat
- Disease risk from the meat
- Ensure balanced diet
- Renal disease in old age
- Natural diet and health
- Dental and masticatory muscle
- Gastro-intestinal
- Provides enrichment – transit to the wild
- Meat is expensive (quality meat more-so)
- Cultural considerations

- Keawcharoen et al. Avian Influenza H5N1 in Tigers and Leopards. Emerg Infect Dis. 2004 December; 10(12): 2189–2191 doi: 10.3201/eid1012.040759
- “Influenza virus is not known to affect wild felids.. …avian influenza A (H5N1) virus caused severe pneumonia in tigers and leopards that fed on infected poultry carcasses… …extends the host range of influenza virus… implications for virus epidemiology and wildlife conservation”

A complete diet?

The Range-Country Conundrum

- Impacts on collection planning and finite facilities
- Healthy vagrant cats caught up –
- conflict resolution
- overspill - leopards
- “man-eaters”
- Healthy and injured cats brought in - ?
- Euthanasia - controversial and mixed conservation messages

Options for release programmes but more chance of controversy

Restraint and Darting

- Squeeze/crush
- “Jab-stick”
- Dart-gun options
- Blow-pipe
- Air-pumped pistol
- Carbon dioxide pistol
- Carbon dioxide dart gun
- Dart options
- Metal/explosive
- Plastic/compressed air

Trained Behaviours

ZSL

Genetic Diversity and Conservation

- AZA Document - Welfare and Conservation Implications of Intentional Breeding for the Expression of Rare Recessive Alleles

- Intentional breeding to achieve rare color-morphs e.g. white tigers, deer, and alligators
- Produces a domesticated form of the species
- No longer represents or resembles wild population

Summary – concerns and conclusion

- Health and welfare problems
- directly associated with the trait itself
- related to intensive inbreeding to accomplish expression of rare and unusual traits - congenital deformities, decline in overall fitness and fertility, increased susceptibility to disease, shortened lifespan or stillbirth
- Affects population management
- Impairs ability to deliver appropriate animal welfare and conservation education messages

- "AZA-accredited institutions should not engage in intentional inbreeding practices for the purpose of producing anomalous phenotypes"

Acknowledgements

- Colleagues in other zoological collections, primarily ZSL
- Images are either ©ZSL or ©DWCT or credited (as far as possible but some unaccredited as were unaccredited on various web-sites – apologies)

From Kanchendzonga-Land of Red Panda

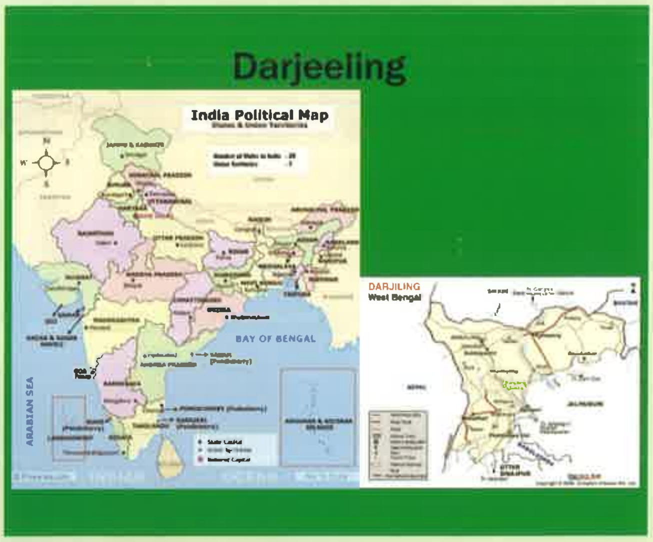
Presented by:

Mr. A.K. Jha IFS

Director

P.N.H.Z. Park, Darjeeling

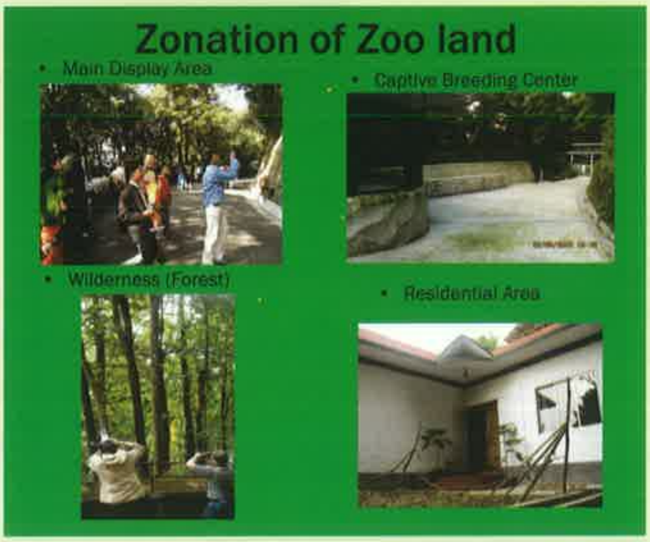

From Kanchendzonga—Land of
Red Panda


Darjeeling
India Political Map
BAY OF BENGAL
ARABIAN SEA
DARJILING
West Bengal


Google


Darjeeling Zoo
Established on 14th August 1958, was earlier known as Himalayan Zoo, was renamed after the then Governor of West Bengal – Late Shrimati Padmaja Naidu-by Smt Indira Gandhi on 21st November 1975
PADMAJA NAIDU HIMALAYAN ZOOLOGICAL PARK


PNHZ Park
• Established in 1958
• Work in the field of Conservation Breeding of Snow Leopards, Red Panda, and Tibetan Wolves
• Only Zoo to release captive bred Red Panda in wild, in South east Asia
• A Specialized Zoo for Himalayan species
• Stud Book keepers for Snow Leopards, Red panda
• Proper record keeping, and data management


Zonation of Zoo land
• Main Display Area
• Captive Breeding Center
• Wilderness (Forest)
• Residential Area

Objects of the zoo

Primary objective of management---

- Ex situ conservation and captive breeding of animal species.
- Educating ,motivating, and initiating awareness campaign among the local people as well as visitors on the importance of conservation of ecosystem; conservation awareness, wildlife education, interpretation programme with help from society and individuals.
- Initiating applied research on animal biology, behaviour and health care.
- Provide facility for health care of wild animals.

Conservation Breeding PROJECTS

ConservatioBreeding—

- Red Panda (Darjeeling Zoo AS the Coordinator)
- Snow Leopard (Darjeeling Zoo AS the Coordinator)
- TibetanWolf (Darjeeling Zoo AS the Coordinator)
- Blue Sheep(Darjeeling Zoo AS the Participating Zoo)
- Bhutan grey Peacock pheasant (Darjeeling Zoo AS the Participating Zoo
- Himalayan Tahr(Darjeeling Zoo AS the Participating Zoo)
- Blood Pheasant(Darjeeling Zoo AS the Participating Zoo)
- Satyr Tragopan (Darjeeling Zoo AS the Coordinator)
- Himalayan Monal(Darjeeling Zoo AS the Participating Zoo)
- Himalayan Salamander (Darjeeling Zoo AS the Coordinator)

Collection Plan

[illegible]	[illegible]
Common Leopard (*Panthera pardus*)	5 No
Snow Leopard (*Panthera uncia*)	12 No
Clouded Leopard (*Neofelis nebulosa*)	5 No
Golden Cat (*Felis temmincki*)	5 No
Marbled Cat (*Felis marmorata*)	5 No
Leopard Cat (*Felis bengalensis*)	5 No
Tibetan Wolf (*Canis lupus chanco*)	12 No
Jackal (*Canis aureus*)	5 No
Binturong (*Arctictis binturong*)	5 No
Himalayan Palm Civet (*Pamuga larvata*)	5 No
Large Indian Civet (*Viverra zibetha*)	5 No
Himalayan Black Bear (*Selenarctos thibetanus*)	5 No
Red Panda (*Ailurus fulgons*)	12 No
Blue Sheep (*Pseudois nayaur*)	5 No
Himalayan Tahr (*Hemitragus jemlahicus*)	5 No
Serow (*Capricornis sumatraensis*)	5 No
Goral (*Nemorhaedus goral*)	5 No
Sambhar Deer (*Cervus unicolor*)	5 No
Musk Deer (*Moschuss moschiferus*)	5 No
Barking Deer (*Muntiacus muntjak*)	5 No

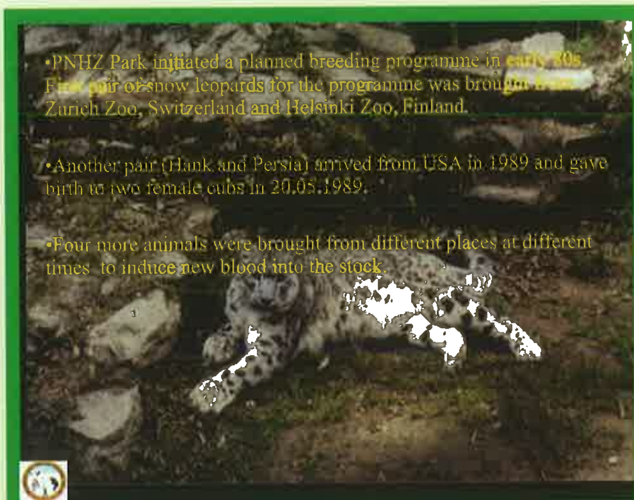
BIRDS	
Himalayan Blood Pheasant (*Ithaginis cruentus*)	6 No
Monal Pheasant (*Lophophorus impeyanus*)	6 No
Satyr Tragopan (*Tragopan satyra*)	6 No
Grey Peacock Pheasant (*Polyplectron bicalcaratum*)	6 No
Kalij Pheasant (*Lophura leucomelana*)	6 No
Red Jungle Fowl (*Gallus gallus murghi*)	6 No
Rufous throated Hill Partridge (*Arborophila rufogularious*)	6 No
AMPHIBIANS	
Himalayan Newt (Tylototriton Verucossus)	

S.No	Total Forest area	BMP	NVP	SWS	DARJ	KGN	KALM	DGHC	TOTAL
	In Sq Km ->	72.80	88.00	38.88	178.00	95.72	87.00	68.83	585.25
	SPECIES-->								
1	Yellow Throated Martin	132	228	148	41	108	82	83	811
2	Flying Squirrel	0	334	18	0	12	0	185	488
3	Red Panda	78	0	0	0	0	0	0	78
4	Himalayan Black Bear	3	18	20	24	0	0	0	65
5	Common Langur	0	0	0	0	209	0	220	429
6	Rhesus Monkey	68	1224	321	3221	2738	788	3887	12344
7	Gaur	0	81	0	0	0	0	0	81
8	Himalayan Tahr	13	32	14	12	0	0	6	77
9	Serow	84	88	8	0	0	0	0	191
10	Goral	68	73	0	0	28	3	231	419
11	Sambhar Deer	2	284	0	0	0	0	0	286
12	Barking Deer	122	890	234	148	282	57	588	2373
13	Hog Deer	0	0	0	0	0	0	40	40
14	Wild Boar	18	815	395	386	444	110	183	2152
15	Peacock	6	38	0	88	0	0	486	617
16	Blood Pheasant	285	0	0	0	0	0	0	285
17	Satyr Tragopan	80	125	0	88	140	0	0	418
18	Grey Peacock Pheasant	0	0	0	31	0	15	0	46
19	Kaleej Pheasant	0	328	306	1029	788	584	1958	4824
20	Red Jungle Fowl	0	442	0	143	88	48	477	1398
21	Hill Partridge	31	99	0	147	0	228	441	898
22	Grey Pied Hornbill	0	325	0	38	48	0	197	611

Conservation Breeding Programmes

PROJECT: SNOW LEOPARD

PROJECT : RED PANDA- back to the wild



11 snow leopards brought from other zoos/Wild

Name	Sex	Year Acquired
Vishna	M	1986
Kashi	F	1986
Persia	F	1989
Hank	M	1989
Quizil	M	1992
Quilla	F	1992
Quetta	F	1992
Tyson	M	2000
Meeta	F	2000
Neeta	F	2000
KIM	F	2012

- Since initiation, there has been 52 births of snow leopards in captivity at Darjeeling Zoo
  - Sex ratio with 25 males and 22 females, (5 cubs of unknown sex).
- The stud book records are used for get and recommend the right or best pair of mates and breed according to their inbreeding coefficient

SNOW LEOPARD

- Padmaja Naidu Himalayan Zoological Park in 2003 had 18 Snow Leopards (9 Males and 9 Females), one of the largest captive population, in a single zoo, in the world and a record for the zoo. As on now in Jan ,2008, there are 11 Snow leopards (6 males, 5 females)
- Another step taken was to have at least 4 - 5 stable captive populations of Snow Leopards at different high altitude zoos in the country, before any release/restocking in the wild can be contemplated. In 2004, a pair each of snow leopards was sent from Darjeeling Zoo to Gangtok, Nainital, and Shimla Zoos to start subsidiary snow leopard breeding centers in these Himalayan Zoos .

Off springs of the founder population

Source	Sire	Dam	Birth Date	Off spring M/F/U
LITTLE ROCK ZOO U.S.A	Hank	Quetta	15.10.1993	F (Rambha)
	Hank	Quetta	23.10.1995	F (Urvashi)
	Hank	Quetta	23.10.1995	M (Karan)
ZURICH ZOO, GERMANY	Quizzil	Rambha	31.10.1996	M (Kush)
ZURICH	Quizzil	Rambha	31.10.1996	M (Luv)
USA	Hank	Quetta	15.12.1997	F (Menoka)
USA	Hank	Quetta	15.12.1997	F (Meghna)
ZURICH ZOO, GERMANY	Hank	Quilla	22.3.1998	M (Karish)
HUBSTAND ZOO, SWEDEN	Tyson	Quilla	08.04.2000	F (Rani)
HUBSTAND ZOO, SWEDEN	Tyson	Rambha	18.03.2001	M (Jay)
HUBSTAND ZOO, SWEDEN	Tyson	Rambha	18.03.2001	M (Bijay)
HUBSTAND ZOO, SWEDEN	Tyson	Rambha	18.03.2001	F (Dolma)

Off springs of the founder population

Captive born	Karan	Neeta	29.03.2002	F (Teesta)
Captive born	Karan	Neeta	29.03.2002	F (Torsha)
HUBSTAND ZOO	Tyson	Rambha	19.06.2002	M (Buddha)
HUBSTAND ZOO	Tyson	Rambha	19.06.2002	F (Tillotoma)
HUBSTAND ZOO	Tyson	Rambha	19.06.2002	M (Dev)
HUBSTAND ZOO	Tyson	Urvashi	08.06.2002	M (Subash)
HUBSTAND ZOO	Tyson	Urvashi	08.06.2002	M (Prabath)
HUBSTAND ZOO	Tyson	Quilla	26.05.2003	F (Shibu)
Captive born	Karan	Neeta	11.03.2004	F (Rita)
HUBSTAND ZOO	Tyson	Rambha	25.05.2004	F (mallika)
HUBSTAND ZOO	Tyson	Rambha	25.05.2004	F (Yashmin)
HUBSTAND ZOO	Tyson	Rambha	25.05.2004	M (Ravi)

Present Status of Snow Leopards in PNHZP

Sl. No.	Name	Int. Stud no:	Sex	Date of Birth	Sire Int. Stud. no:	Dam Int. Stud. no:	Transponder No.
1	Karan	1897	M	23/10/1995	1059	1474	20572256
2	Tyson	1850	M	8/8/1995	1723	1285	0611163B
3	Tista	2399	F	29/3/02	1897	2228	06114DB1
4	Budha	2401	M	19/06/02	1850	1797	0610FA9B
5	Prabhat	2405	M	8/7/2002	1850	1899	061824ED
6	Rithu	2538	F	11-Mar-04	1897	2228	205647
7	Yashmin	2540	F	25-May-04	1850	1797	00F68A38
8	Kim						
9	Rare						

Further Activities

- New Conservation Breeding center being developed at Topkeydara for both Snow Leopards and Red Panda
- Import of animals started –one new female reached from Germany, another in pipeline from Jihlava-More variations of bloodline required
- Research project on Snow leopards ,DNA analysis
- CCTV, Dehumidifiers,

Ex-situ Conservation of Red Panda in Darjeeling Zoo

- A planned conservation Breeding Project as a part of Global Captive Breeding Master Plan which was initiated in 1990s in Darjeeling Zoo.
- Then, the Park already had four (1.3) red pandas of wild origin in the stock
- Five more red pandas were added at different times to continue the planned breeding.

- The first successful birth of Red Pandas in the zoo occurred in 20.6.1994 when Ekta and Friend were born to Basant and Amita (both the red pandas of wild origin).
- In 2003, and 2004 zoo bred animals were released in Singalila National park
- Two females, Mini and Sweetie, (Red Pandas) were released into the wild in 2003-04 in the first phase, after radio collaring
- In the second phase two more females , Neelam and Dolma were released in 2004-2005
- For one year complete recording of their movements done
- Birth of a cub recorded after mating with a wild male
- Further release proposed

Founder Population in Darjeeling Zoo

House Name	Stud Book Number	SEX	Date of ACQ	DOB
Anita	8221	F	WILD	Wild 9192
Basant	8649	M	WILD	Wild 9192
Chanda	8222	F	WILD	Wild 9192
Divya	8648	F	WILD	Wild 9192
Gora	9305	M	10.11.94	25.6.93
Hari	9302	M	10.11.94	26.6.93
Indira	9330	F	10.11.94	30.6.93
Omin	9404	M	25.12.96	17.7.94
Prity	9430	F	25.12.96	26.6.94

Animals for conservation breeding

Source	Number (Int. Stud Book number)	M/F/U	Age	Transponder No.
Wild	0561	M (John)	7 yrs	981-0961-02058449
PNHZ Park	0356	F (Sheetal)	8 yrs	981-0981-02055661
Ganglok Zoo	0789	F (Rigsel)	6 yrs	006B7107E
PNHZ Park	1089	F (Janaki)	2 yrs	0006B7428B
PNHZ Park	1128	M (Pokhraj)	12 yrs	ID-00-061-FD19
Auckland Zoo	02115	F (Durga)	8 yrs	00-062E-087C
Wild	0885	M (Kalpataru)	8 YRS	981-0981-02056409
PNHZ Park	0886	F)(Samridh	4 yrs	981 0981 0205573
PNHZ Park	1130	M (Siddartha)	11 yrs	ID-00-0611-5CCB

Record Keeping

- VETERINARY TREATMENT CARD
- ANIMAL HISTORY CARD
- STUD BOOK
- INDIVIDUAL TREATMENT FILE
- ANIMAL DEWORMING CARD
- ANIMAL VACCINATION CARD
- ANIMAL TRANQUILASATION CARD
- ANIMAL OPERATION CARD
- ANIMAL FEEDING CARD
- Beat (Daily) Report

ANIMAL HISTORY CARD

NAME—

SEX----
PARENTAGE—
SCIENTIFIC NAME---
VERNACULAR NAME---
DISTINGUISHING MARK---
HABITAT---

ACQUISITION

How and from where acquired---
When acquired, and birth date---
Age on arrival-----
Size and weight on arrival---

STUD BOOK

Taxon Name---
Studbook Number
Current Status >>>
Vital Statistics >>>>
Sex >>>
Age >>>
Origin >>>
Identifiers >>>
Birth type >>.
Birth Location >>>
House Name...
Birth date >>>
Global management
Plan .. YES
Sire ID...
Dam ID...
Rearing....
Transaction History

Sl No	Event...	Local ID....	Date In	Date Out

Special Data and Comments

Signage

Further developments

- New Conservation Breeding center being developed at Topkeydara for both Snow Leopards and Red Panda
- Research project on Red Panda –CZA support—Food designed after discussion with IVRI
- Enrichment changes frequently
- Census in Singalila and Neora valley national park-Scat Collection and DNA analysis—getting ready for PHVA in 2013-DNA analysis of all zoo bred animals
- International and National Exchange taking place-with Gangtok, Auckland and Adelaide

NORMS FOR ESTABLISHMENT OF CONSERVATION BREEDING PROGRAMME OF CENTRAL ZOO AUTHOPRITY FUNDING THEREOF

Presented by:

Dr. Brij Kishor Gupta

Evaluation & Monitoring Officer

Central Zoo Authority

NORMS FOR ESTABLISHMENT OF CONSERVATION BREEDING PROGRAMME OF CENTRAL ZOO AUTHOPRITY FUNDING THEREOF

Central Zoo Authority

(A statuary body under the Ministry of Environment and Forests, Government of India, established in 1992)

Brij Kishor Gupta, Ph.D
Evaluation & Monitoring Officer

जहाँ है हरियाली । वहाँ है खुशहाली ॥

durrell

Introduction

- CZA had already identified 72 species for planned conservation breeding programme. Out of that CZA has just prioritised 26 species. And out of 26 species, 14 species have already been taken off for establishing off-display conservation breeding programmes (CBP) in different states.

Criteria for selection of species

- Species are rated from 1 to 5. One is the least and five is the highest value in the rating for taking up for Conservation Breeding Project. The criteria to prioritize the species is given below:-
- Global distribution of the species
- Distribution of the species in India (past and present)
- Status of the species as per the IUCN list
- Status of the species as per the Wild Life (Protection) Act, 1972
- Numbers of animals in captivity
- Founders availability in the wild
- Founders availability in the captivity
- Availability of information on breeding biology and husbandry protocol
- Threat to the population

1.	Pygmy hog (Sus salvanius)	31
2.	Vultures (white-backed, long-billed, slender-billed)	31
3.	Hangul (Cervus elaphus hanglu)	30
4.	Golden langur (Trachypithecus geei)	29
5.	Wild buffalo (Buballus bubalis)	28
6.	Brow-antlered deer (Cervus eldii)	28
7.	Lion tailed macaque (Macaca silenus)	28
8.	Red panda (Ailurus fulgens)	28
9.	Blyth's tragopan (Tragopan blythii)	27
10.	Asiatic lion (Panthera leo)	27
11.	Rhinoceros (Rhinoceros unicornis)	27
12.	Western tragopan (Tragopan melanocephalus)	27
13.	Phayre's leaf macaque (Trachypithecus phayrei)	27
14.	Great Indian bustard	27
15.	Wild ass (Equus hemionus khur)	27
16.	Nilgiri langur (Semnopithecus johnii)	27
17.	Musk deer (Moschus chrysogaster)	27
18.	Hoolock gibbon (Hoolock leuconedys),	26
19.	Swamp deer (Hard surface-C.d. branderi)	26
20.	Nilgiri tahr (Nilgiritragus hylocrius)	26
21.	Floricans (Bengal & Lesser)	26
22.	Cheer pheasant (Catreus wallichi)	26
23.	Clouded leopard (Panthera nebulosa)	26
24.	Painted roof turtle (Kachuga kachuga)	26
25.	Snow leopard (Panthera uncia)	26
26.	Shaheen falcons (Falco peregrinus)	26

- **should have a recovery plan for each species**
- **linkage with in-situ conservation programme**

Pattern of Funding

- **Coordinating zoos which have been identified for species will be eligible for receiving financial assistance for establishing off display conservation breeding center (CBC) and the participating zoos for improvement in the existing enclosure from the Central Zoo Authority**

- The CZA would provide 100 % financial assistance for coordinating zoos and for improving the existing enclosures in participating zoos.

(i). Coordinating zoos:

- The Coordinating zoo shall create a housing facility as per the design approved by CZA in off-display area of the conservation breeding centre.
- CZA shall provide 100% funding for the establishment of the facility.
- The maintenance of the off display conservation breeding center shall also be funded subject to the availability of fund with the CZA on that point of time.

Coordinating Zoo-Funds provided for Activities

- Construction of off-display enclosures including feeding/retiring cell, kraal, paddock (herbivores), water facility, approach road or service path, power fencing, animal kitchen, store and enrichment artifacts etc.
- Fencing around the CBC.
- Material for the marking of animals (radio transponders & applicator, receiver, leg bands & applicator, and ear tags & applicator).
- Construction of Project office if require.
- Animal quarantine or isolation ward (away from zoo/CBC).
- Squeeze cage and transportation cages or box as per the need.
- Treatment kits, medicines and tranquilizing equipments.
- Kitchen utensils and food storage facility (freezer)
- Computer, printer and UPS

(ii). Participating zoos:

- **(A.) Non-recurring:**
  - Improvement in existing display enclosure including feeding/retiring cell, kraal, feeding shed, water facility, power fencing, kitchen, store and enrichment artifacts etc.
  - Material for the marking of animals (radio transponders & applicator, receiver, leg bands & applicator, and ear tags & applicator).
  - Improvement in animal quarantine or isolation ward.

(3). Initiation and duration of the project:

- The project shall be considered initially for the period of five years for each species with yearly break up of activities. This project should be submitted to CZA through Chief Wildlife Warden of the concerned states.
- Note: The zoo where CBC has already been taken off by constructing enclosures etc thus should also initiate the proposal i.e. preparation of project for 5 years.

(4). Processing of project proposal:

- Preliminary screening at the CZA.
- Field appraisal of the site.
- Scrutiny of layout plan and design of animal enclosure by Expert Group of Zoo Designing of CZA.
- Approval for the project by the Technical Committee of the CZA.
- Approval of Conservation Breeding Centre (CBC) from the governing body of CZA i.e. Authority.

(5). Sequence of steps to be adopted for the conservation Breeding

- Identification of *founders*
- Marking of founders (transponders, ear tags or rings)
- Preparation of **animal history sheets** and animal observation sheets of the identified founders by the zoos
- Compilation of Studbook by the National Studbook Keeper.
- Liaison with the International Studbook Keeper of the species (if any)
- Possibility of acquiring the founders from foreign zoos (if required) and details of the zoos from where founders can be acquired
- Physical health check-up of the founders using the veterinary hospital in the Zoo as well as National Referral Centre (Indian Veterinary Research Institute, Bareilly)
- Genetic health check-up of the founders using blood samples or body parts with help from LaCONES, Hyderabad
- Engagement of Technical Assistant (Biologist, Veterinary assistant etc) in the coordinating Zoo.

(6). Staff pattern:

- The CZA will provide fund for hiring of a biologist, a veterinarian or veterinary assistant and a keeper.
- Remaining supervisory or additional staff has to be matched by the concerned zoo or state government.

(7). Release of fund:

- Annual release of fund would be made as follows:
- (i) 50% of the approved grant as first installment
- (ii) 30% of the approved grant second installment
- (iii) 20 % of the approved grant last installment
- All CBC should submit half yearly progress report to CZA.
- Further grant of release will be subjected to the appraisal of report and submission of utilization certificate of the release fund. The CZA shall carry out mid-term evaluation of the CBP of the concerned species from time to time.

(8). Collaboration with institution:

- Concerned zoo should collaborate with Wildlife Institute of India, Indian Veterinary Research Institute Bareilly, and Laboratory for Conservation of Endangered Species (LaCONES), CCMB and Bombay Natural History Society etc. to carry out the studies efficiently in order to achieve the objectives.

Central Zoo Authority's Guidelines, Rules and Strategies for Animal Management and Enclosure Design

Presented by:

Dr. Brij Kishor Gupta

Evaluation & Monitoring Officer

Central Zoo Authority

Central Zoo Authority's *Guidelines, Rules and Strategies for Animal Management and Enclosure Design*

Central Zoo Authority

(A statuary body under the Ministry of Environment and Forests, Government of India, established in 1992)

Brij Kishor Gupta, Ph.D
Evaluation & Monitoring Officer

Rules and Guidelines

1. Recognition of Zoo Rules, 1992, 2009
2. National Zoo Policy, 1998
3. Guidelines for the scientific management of zoos, 2007
4. Guidelines on master planning of zoos, 2007
5. Guidelines on Conservation Breeding Programme, 2012
6. Guidelines for Mobilizing financial support from corporate to zoos for better management (marketing and fund raising)
7. Guidelines for utilization of volunteer in zoos, 2012
8. Guidelines on prioritization on release of fund of CZA for zoos, 2012
9. Protocol on transportation of wild animals, 2012
10. Guidelines for Minimum Dimension for Enclosures, 2012
11. Performance of the zoo as per key measureable indices

Rule 10 (4) Animal housing, display of animals and animal enclosures

	Rules stipulated by CZA	Comments/Observations
1	Every zoo shall endeavour to display the animals in nature immersing enclosures.	To be achieved
2	The designs and dimensions of every enclosure shall be determined having due regard to the biological behaviour of the species and the number of animals to be housed therein as per the standards specified by the Central Zoo Authority in this regard from time to time.	Up to some extent achieved by Large, Medium and few small category of zoos.
3	The zoo shall ensure that the enclosure is safe and secure for the animals, animal keepers and the visitors and has requisite space for free movement, exercise and expression of natural behaviour by the animals.	Security of animals, visitors and zoo staff though complied but still need to be relooked. (Example of Itanagar, Nagaland, Pilikuma, Bhiwani, Guwahati, Delji & Jamshedpur Zoos)
4	Adequate space shall also be made available to the animals in order to maintain safe distance from the dominant animals in the group or herd.	Complied by most Large, Medium and Small Zoos

Rule 10 (4) Animal housing, display of animals and animal enclosures

5	No zoo shall display any animal in the enclosure that is not in accordance with the standards specified by the Central Zoo Authority in this regard.	Complied, most, except Mini Zoos
6	Every zoo shall make special efforts to enrich the environment of the enclosure to meet the species specific behavioural requirements of the animals in accordance with the standards specified by the Central Zoo Authority.	Many zoos have started vigorously, however, many zoos are yet to understand enrichment concept.

Rule 10 (4) Animal housing, display of animals and animal enclosures

7	Adequate screening shall be provided between adjacent enclosures to safeguard against the animals getting unduly excited or stressed due to visibility of animals housed in these enclosures.	Yet to be complied by many zoos
8	No new enclosures for endangered species shall be constructed without prior approval of the Central Zoo Authority.	Some zoos have been noticed violating the Rules. Notices have been issues to such zoos.
9	Every zoo shall provide appropriately designed and effective stand off barriers at every animal display enclosure to regulate the movement of visitors in the zoo in a manner that facilitates the visitors in getting unobstructed view of wild animals, without reaching in the vicinity or proximity of the animals and getting the opportunity to physically touch or provoke the animals and shall also display adequate sign boards so as to give warning to the visitors to keep a safe distance from the animals.	Complied mostly, But few zoos are in the process of complying.

Rule 10 (4) Animal housing, display of animals and animal enclosures

10	Every zoo shall provide appropriate signage with relevant information on the biology, behaviour and the population status of the species in the wild at every display enclosure. Provided that large and medium zoos shall endeavour to provide interactive interpretation facilities for the purpose of explaining behaviour and biology of the species displayed in the enclosure	Signages have been provided but their effectiveness to be assessed. The information to be provided needs relook. The material used to visitor proof. Interactive signageshave been used by very few zoos.

Dimensions and size of animal enclosures

— The land area to be given to any animal exhibit enclosure should be decided having due regard to the maximum number of animals that can be displayed in the animal enclosures.

— Sambar Spotted deer, Swamp deer, angaiand some other ungulates can live in large social groups. Enclosures for such species can easily be designed for displaying 15-20 animals. However, the maximum number of animals that can be displayed in a single enclosure of hinkara howsinghaand Barking deer and similar species should not exceed 5-7.

Dimensions and size of animal enclosures

- *The area of the enclosure should have adequate land space for facilitating the animals to have free movement and exercise, adequate area to rest in shade and bask in the sun and have safe refuge from dominant animals and express their natural, social and rproductive ehaviour*
- The animal exhibit enclosures should not be given geometrical shapes, as the presence of corners is not congenial to smooth and unrestricted movement of animals. Enclosures with greater depth facilitate the animals to keep a safe distance from the visitorsand are always preferable

Dimensions and size of animal enclosures

— The dimensions and the area of any enclosure should follow CZA indicative sizes for the enclosures, both feeding cells and outdoors of important wild animal species.

— The area of the outdoor enclosures for herbivore safari and carnivore safari should not be less than 30 hectares and 20 hectares respectively.

— Mini zoos being operated as Deer Parks and displaying mega species (lion/tiger/leopard) should not be of less than five hectares

Making the animal enclosures safe for animals, animal keepers and the visitors

— Enclosure Barrier of all the enclosures, except the animal viewing area could comprise of natural cliffs (if any), wall, glass, power fence or chain-link fence, etc. of prescribed dimensions.

— The total land area under moat should not exceed 20% of the land area of the enclosure. The indicative design type and dimensions of enclosure barrier as prescribed by CZA should be followed.

Recognition of Zoo Rules, 2009

(In supersession of the Recognition of Zoo Rules, 1992)

- Application for renewal of Recognition a Requisite Fees.
- Submission of timely Animal Inventory
- Timely submission of Master Plan
- Perimeter fencing
- Refrain from Housing of Domestic Animals
- Feral cats/dogs
- Full time officer-in-charge

Recognition of Zoo Rules, 2009

(In supersession of the Recognition of Zoo Rules, 1992)

tleast30% of the area earmarked for the zoo shall ept under green belt and the area for animal ing shall not exceed 30% area of the zoo.

o now enclosures for endangered species shall be tructed without prior approval of the Central Zoo ıority.

ll staff involved with upkeep and healthcare of zoo als shall be screened against Zoo notice diseases : every year

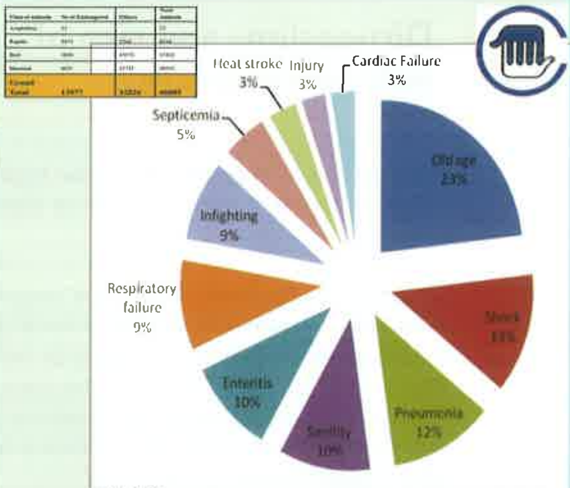
Recognition of Zoo Rules, 2009
(In supersession of the Recognition of Zoo Rules, 1992)

— All large, medium and small zoos to have Isolation ward, quarantine ward, animal restraining and tranquilizing equipments and a veterinary care reference library.

— Post mortem being inconclusive and no specific reason for death is identified, the zoo authorities shall send the samples of the tissues and organs, blood, viscera etc. for further examination to the qualified diagnostic laboratory having adequate specialiation for further investigation and identifying the cause of death.

— House only self-sustaining population of each species.

— Acquire mates for single and unpaired animals



Causes of mortality in various classes of animals in the year 2010-11

National Zoo Policy, 1998

- **Acquisitions of Animals**
- 3.2.1 Except for obtaining founder animals for approved breeding rogrammeand infusion of new blood inbred groups, no zoo shall collect animals from the wild.
- 3.2.2 Zoos shall not enter into any transaction involving violation of the law and provisions of international conventions on wildlife conservation.
- 3.2.3 Zoos hall not enter into any transaction in respect of their surplus animals with any commercial establishment Even the animal products should not be tilisedfor commercial purposes. The trophies of the animals could, however, be used for educational or scientific purposes

National Zoo Policy, 1998

- Successful implementation of identified breeding rogrammesby way of loaning, pooling or exchanging animals for the rogrammeand help creation of socially, genetically and demographically viable groups.
- Zoos shall continue o function as rescue entresfor orphaned wild animals.
- Zoos shall ot provide any infrastructure for recreation/entertainment of visitors hat is inconsistent with the stated objective of zoos.

Guidelines for Scientific Management of Zoos

- **Release of zoo animals into the wild**

2. **Optimum number of animals to be housed in a zoo**

	Tiger	Leopard	Bear	Ungulates/ erbivores of each species
Large	**10**	**10**	**10**	**20**
Medium	**6**	**6**	**6**	**12**
Small	**4**	**4**	**4**	**10**

Guidelines for Scientific Management of Zoos

- Marking of Animals
- Record Keeping (Keeper Diary, Daily Report, Animal History Cards, Studbook, Treatment Card
- Effective use of NIC-IVRI, aCONES
- Quality of Animal Feed
- Staff-capacity building
- E-governance (Dedicated website/email)

Guidelines for preparation of Master Plan for long term management of Zoos

- Theme of the Zoo?
- Mission of the Zoo?
- *Compliment the national efforts in conservation of wildlife through planned coordinated conservation breeding of endangered wild animal species of the region.*
- Conservation Message?
- Visitor Circulation Plan
- Animal Collection Plan

SPECIES TO BE GIVEN	PRESENT STOCK M F U	NUMBER TO BE GIVEN M F U	STOCK WITH THE RECIPIENT ZOO M F U	SPECIES TO BE GIVEN	PRESENT STOCK M F U	NUMBER TO BE GIVEN M F U	STOCK WITH THE RECIPIENT ZOO M F U	REMARKS/ PURPOSE OF EXCHANGE

Colour code for Layout Plan

- Existing structures: BLACK
- Proposed New Structure: LUE
- Existing structures to be demolished: ED
- Existing Structures to be modified: REEN

Facilities related to the zoo and its staff within the zoo campus

- **1 a. Creation of staff quarters within the zoo campus**
- As mandatory under Recognition of Zoo Rules, 2009, Rule 10, Schedule 1 (6) that no residential colonies for shall be constructed within the zoo premises following category of staff should be separated by a boundary wall from the animal exhibit areas:-
- Director/ Officer n harge of the zoo
- Officials and staff under Animal Section
- Efficials and staff under Veterinary Section
- Security personnel (if possible)
- Where such colonies already exist, the same shall be separated from the zoo premises by a boundary wall with a minimum height of 2 meters from the ground level. The entry to the residential colony shall not be through the zoo premises.

Arrangement to provide lighting within the animal enclosures and other areas

- The zoo should have a provision for emergency lighting inside the animal enclosures.
- The lighting in other areas may be provided, if required, at a lesser intensity to avoid disturbance to animals on account of glare.
- The alternate lighting like solar lights may be given preference.

Heritage structures within the zoo premises

- The heritage structures in and around enclosures should be preserved.
- Zoo animals should not be housed therein, unless such enclosures fulfill the biological and behavioral needs of such animals.

Facilities for visitors within the zoo campus

- **Children Park**

The zoos may have a separate area earmarked as Children Park with focus on wildlife conservation. ppropriate interpretative facilities/ activities for children may be created in the Children Park area to promote wildlife conservation.

Boating

- No zoo should allow oatingactivities inside the water bodies used as wintering ground by migratory birds. The existing boating facilities could however be continued in a very regulated manner, ensuring that it does not disturb the zoo animals in the nearby enclosures.

No new water body should be created in any zoo for creating boating facilities.

Train/ tram/ toy train/ battery operated vehicle

- Zoos larger than 50 hectares may have train/ trolley facilities if such facilities enable visitors to get a better view of the animals housed in various enclosures, without causing the disturbance and pollution.
- No Train/ trolley facilities should be permitted for recreation.

Entry of private vehicle

- Zoo should not all entry of private vehicles, if public facilities like battery operated trolley/ golf carts/ train exist there.
- If the area of the zoo is more that 75 hectares and facilities as mentioned above are not available, private vehicles may be permitted on specified routes on payment of such fees, and subject to such regulations as deemed appropriate by the management of te zoo.

Food courts/ kiosk/ restaurant

- The food courts/ kiosk/ restaurant should be restricted at the entrance of the zoo. However, the some kiosks (1-3 numbers) may be located suitably inside the zoo. It was also pointed out that such food courts/ kiosk/ restaurant should not cater/ sell any ake away food, package or disposable water bottles. Sale of alcoholic beverage should be banned.

Parties/ functions/ marriages/ melas

- The zoos should not allow their premises for holding party/ function/ marriage/ ela However, the zoo premises may be used for holding meetings/ conferences/ workshops related to the wildlife conservation.
- The zoos must ensure that such activities are carried out keeping in view of the welfare of the animals.

Animal ride

- No animal, forming part of the display, should be used for animal ride. Elephants and Yaks could be used for joy rides as per Zoo Recognition Rules but the same would be operated and housed outside the zoo display area.

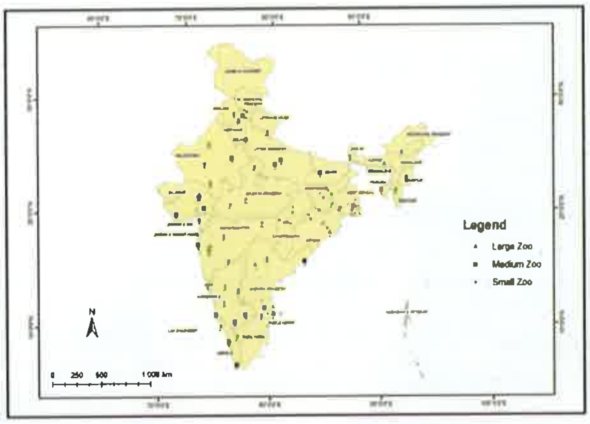
Animal demonstration/ handling of animals/ VIP's handling the animals

- The National Zoo Policy does not encourage animal handling and demonstration by the zoos, the same should not be allowed by the zoos.
- **Animal adoption** o raise funds in Zoos for its scientific management is permitted.
- **Telephone booths** re considered as an essential service today, the same should be allowed at appropriate places.
- **Mseum** in the zoo should be discouraged and the existing zoos having museums should be asked to separate these from the animal exhibit area.
- **Botanical gardens** n zoos should be encouraged which may also include butterfly park, arboretum, green houses, nurseries, rchidariumand green shops.

Guidelines of CZA.....

- **Use of generators**
- The zoos which are located in remote areas and do not receive adequate amount of power supply, may use generators which are noiseless and pollution free.

- **Live feed to the animals**
- The animals earmarked for re-introduction in the wild should be kept in off-display soft release facilities to enable them to develop their natural instinct.
- All such animals should be treated at par with wild animals and should be provided feed accordingly.



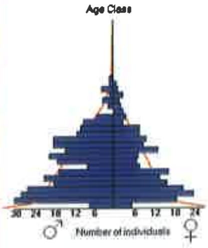
Fundamentals of Captive Animal Population Management

Presented By:

Dr. Tim Wright

Dirctor Head of Conservation Training
Durrell Wildlife Conservation Trust
Jersey, U.K.

Fundamentals of Captive Animal Population Management



Tim Wright
Durrell Wildlife Conservation Trust

Some basics of running a co-ordinated breeding programme (e.g. EEP)...

- Maintain accurate and up to date studbook.
- Prioritise most important individuals for breeding.
- Identify and arrange optimum pairs for breeding.
- Monitor growth rate and adjust breeding output accordingly.
- Request that certain animals are not bred from.
- Arrange transfers when necessary.
- Ideally prepare husbandry guidelines.
- Ideally support in-situ conservation in some way.
- Chair a species committee, which is responsible for making all major decisions (rather than the EEP co-ordinator making them alone).

In this session we will discuss...

- Why captive populations need managing
  - the importance of genetic diversity
  - the need for genetic and demographic management
- An overview of how zoos manage captive animal populations
  - the role of studbooks and breeding programmes
  - the importance of zoos co-operating and exchanging animals for breeding
- An overview of studbooks
  - the value of studbooks
  - how studbook analysis can help to manage populations
- Population management goals
- Selecting optimum pairings for breeding

Population management

- Overall aims of captive population management are to maximise long-term genetic diversity and minimise inbreeding, and to retain the genetic characteristics of the original wild founders.

- Captive populations require careful long-term management if they are to remain viable and ideally self-sustaining.

- Genetic Reasons
- Demographic Reasons

Genetic issues

1. Maintenance of Genetic Diversity/Heterozygosity

- Loss of genetic diversity is a serious threat to small populations, as genetic diversity is important for allowing a species to evolve and adapt to environmental change. In captivity, maintenance of genetic diversity is particularly important for species that may one day be reintroduced.

- Loss of genetic diversity is also linked to inbreeding.

Genetic issues

- 2. Avoidance of Inbreeding

- Inbreeding increases homozygosity and therefore increases probability of harmful recessive alleles being expressed, e.g. hairlessness in captive V. rubra is a recessive trait.

- For example, inbreeding leads to a reduction in reproductive fitness – so called 'inbreeding depression'.

- This can lead to harmful problems such as reduced fertility, increased infant mortality, increased risk of abnormalities such as funnel chest in some captive V. variegata, thought to be a result of inbreeding.

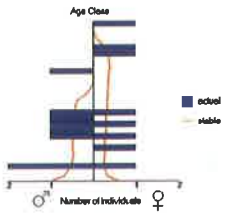
Demographic Issues

- Without correct management, captive populations can run into demographic problems, for example:

unstable age distributions, or

undesirable growth rates – such as negative

growth or excessively rapid growth



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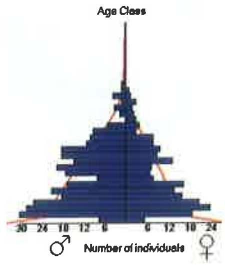


Managing genetic diversity

- Captive populations are normally managed by pedigree analysis – which is the recommended method provided that the pedigrees of your animals are known.
- Molecular techniques can be better at calculating genetic diversity and heterozygosity, but they normally only measure diversity at a few loci.
- Pedigree analysis provides a statistical measure of average genome-wide diversity relative to the source population – whereas molecular techniques provide precise values of absolute diversity, but only at a few loci.

see Ballou et al. in: Kleiman et al. (2010).

Population management

- Ultimate goal of a population manager is to maximise the long-term demographic and genetic viability of a population, whether wild or captive.
- Breeding can be controlled if necessary by contraception [or culling], e.g. over-represented gene lines of H. alaotrensis are contracepted with implants, Varecia with Depo-provera injections. Also achieves by encouraging single-sex groups.
- Genetic analysis of studbook data is used to select pairs for breeding.

Studbooks

- What is a studbook?
- Applications of studbooks.
- Understand the limitations of studbooks.
- Demographic and genetic analysis of studbook data.

Population management based on studbook analysis.

Introduction to PM2000 and PMx for more advanced analysis of studbook data, to assist management decision-making.

What is a Studbook?

- Captive populations require long-term management if they are to remain viable, and studbooks are a key tool for this...

A record of the history of a captive population of a particular taxon, detailing all births, deaths, transfers and reproduction of all known individuals.

May be international , regional , or single country (e.g. European, North American).

The ISIS 'Studbook Library' contains:
- 1350 regional studbooks
- 190 international studbooks
- (and 292 husbandry manuals)

What is a Studbook?

- Studbooks are managed by a 'studbook holder'.

For some species there may also be a 'breeding co-ordinator' who decides on optimal pairings etc.

Every few years, a studbook should be published as a printed document, including information on husbandry, research etc.

The Uses of Studbooks

1) Record keeping.

2) Problem identification.

3) Data for research.

4) Population management.

The Uses of Studbooks

- Record keeping.

Studbooks safely preserve data from many zoos, and can easily be widely distributed as a printed document.

Studbooks can be used to record and track hybrids, so that further breeding of them may be avoided.

The Uses of Studbooks

2) Problem identification.

Any general problem trends in the overall captive population (e.g. high juvenile mortality, or low fertility) can be spotted and investigated. Such problems may not be obvious in a single institution, and are easier to identify by looking at long-term historic data of a studbook.

Through a studbook, you can also tell whether a problem is linked to a specific institution.

The Uses of Studbooks

3) Data for research.

Studbooks often contain many years of valuable data on the life-history of endangered species.

- mean litter size
- mean interbirth intervals
- mean reproductive ages
- life expectancy data

etc.

This can be useful for research and PVA modelling, especially where the species is poorly studied in the wild.

The Uses of Studbooks

4) Population management.

Genetic and demographic analysis of the population.

Maximise long-term genetic and demographic health of the population.

Minimise inbreeding.

Selection of optimum pairings for breeding.

Minimum data required

1) Unique specimen identifiers.
2) Sex.
3) Identities of both parents.
4) Birth and death dates.
5) Full transaction histories.
6) Reproductive/contraceptive status.

Each animal is given a unique studbook number.

SPARKS

These studbook data are usually maintained using:
Single
Population
Analysis &
Record
Keeping
System

Produced by ISIS (latest version = 1.65)
free to all ISIS members

Principal activities of a studbook holder

- contact institutions to obtain up-to-date data;
- enter new animal records;
- edit existing animal records;
- co-ordinate transfers between institutions;
- run demographic and genetic analyses;
- produce population management plan and recommend pairings for breeding;
- disseminate information on husbandry and in-situ work, where relevant;
- publish written studbook, and submit data to ISIS.

SPARKS demonstration...

Problems with studbooks

- Studbooks are not perfect – they rely on assumptions, particularly about relatedness.

- Unknown paternity is a common problem, and seriously hinders genetic analysis.

- Relatedness and parentage can now be clarified by molecular techniques, although may still be expensive.

Population analysis using studbook data

for example:

- age structure;
- growth rate;
- mortality rate;
- life expectancy;
- reproductive data (e.g. peak reproductive age, mean interbirth interval);
- post mortem data (e.g. principle causes of death).

Studbooks for wild animals

- Studbooks are almost always used for populations of captive animals, but can be used for small well-known populations of individually recognisable wild or wild-released animals.

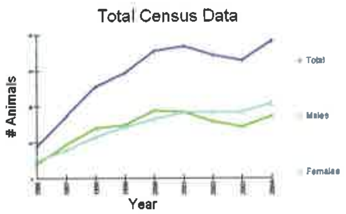
e.g. Mauritius pink pigeon.e.g. Pygmy hog.

Pygmy Hog Conservation Programme Studbook

Pygmy Hog Conservation Programme Studbook

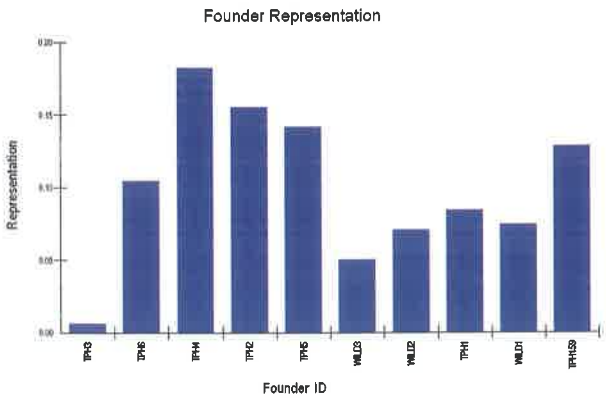
Brief Preliminary Analysis of Pygmy Hog Captive Population at Basistha

Current Population
Living population = 75
Total Males = 34
Total Females = 41
Unknown Age Males = 0
Unknown Age Females = 0
No. of founders = 10



Genetic Diversity = 0.9207 (max potential = 0.9403)
Founder Genome Equivalents = 6.31 (max potential = 8.38)

Pygmy Hog Conservation Programme Studbook



Pygmy Hog Conservation Programme Studbook

Living Animals ranked by Genetic Importance (measured by Mean Kinship) - FEMALES

Rank #	Studbook #	Sex	Sire	Dam	Age	Location	Inbreeding	Mean Kinship	# Offspring
1	TPH96	F	TPH6	TPH5	7	ASSAM PH	0	0.0650	0
2	TPH56	F	TPH6	TPH5	6	ASSAM PH	0	0.0650	0
3	TPH156	F	TPH6	TPH5	3	ASSAM PH	0	0.0650	0
4	TPH157	F	TPH6	TPH5	3	ASSAM PH	0	0.0650	0
5	TPH136	F	TPH6	TPH5	5	ASSAM PH	0	0.0650	0
6	TPH116	F	TPH6	TPH5	6	ASSAM PH	0	0.0650	0
7	TPH44	F	TPH11	TPH19	9	ASSAM PH	0	0.0676	0
8	TPH42	F	TPH11	TPH19	9	ASSAM PH	0	0.0676	0
9	TPH46	F	TPH11	TPH18	9	ASSAM PH	0	0.0701	0
10	TPH47	F	TPH11	TPH18	9	ASSAM PH	0	0.0701	0
11	TPH66	F	TPH2	TPH19	8	ASSAM PH	0	0.0714	0
12	TPH67	F	TPH2	TPH19	8	ASSAM PH	0	0.0714	0
13	TPH103	F	TPH7	TPH18	7	ASSAM PH	0	0.0726	0
14	TPH102	F	TPH7	TPH18	7	ASSAM PH	0	0.0726	0
15	TPH75	F	TPH2	TPH18	8	ASSAM PH	0	0.0739	0
16	TPH166	F	TPH50	TPH129	2	ASSAM PH	0	0.0743	0
17	TPH64	F	TPH6	TPH4	8	ASSAM PH	0	0.0752	0
18	TPH63	F	TPH6	TPH4	8	ASSAM PH	0	0.0752	0
19	TPH41	F	TPH2	TPH5	9	ASSAM PH	0	0.0777	0
20	TPH196	F	TPH159	TPH125	1	ASSAM PH	0	0.0849	0
21	TPH195	F	TPH159	TPH125	1	ASSAM PH	0	0.0849	0
22	TPH179	F	TPH159	TPH125	2	ASSAM PH	0	0.0849	0
23	TPH178	F	TPH159	TPH125	2	ASSAM PH	0	0.0849	0
24	TPH69	F	TPH7	TPH13	7	ASSAM PH	0	0.0870	0
25	TPH76	F	TPH7	TPH13	7	ASSAM PH	0	0.0870	0
26	TPH77	F	TPH7	TPH13	7	ASSAM PH	0	0.0870	0
27	TPH148	F	TPH7	TPH13	5	ASSAM PH	0	0.0870	0
28	TPH147	F	TPH7	TPH13	5	ASSAM PH	0	0.0870	0
29	TPH146	F	TPH7	TPH13	5	ASSAM PH	0	0.0870	0
30	TPH124	F	TPH7	TPH13	6	ASSAM PH	0	0.0870	0
31	TPH123	F	TPH7	TPH13	6	ASSAM PH	0	0.0870	0
32	TPH65	F	TPH2	TPH4	7	ASSAM PH	0	0.0876	0
33	TPH79	F	TPH7	TPH13	7	ASSAM PH	0	0.0887	1
34	TPH205	F	TPH159	TPH142	1	ASSAM PH	0	0.0895	0
35	TPH204	F	TPH159	TPH142	1	ASSAM PH	0	0.0895	0
36	TPH203	F	TPH159	TPH142	1	ASSAM PH	0	0.0895	0
37	TPH193	F	TPH159	TPH142	2	ASSAM PH	0	0.0895	0
38	TPH192	F	TPH159	TPH142	2	ASSAM PH	0	0.0895	0
39	TPH191	F	TPH159	TPH142	2	ASSAM PH	0	0.0895	0
40	TPH125	F	TPH7	TPH13	6	ASSAM PH	0	0.0988	7
41	TPH142	F	TPH2	TPH4	5	ASSAM PH	0	0.1081	12

Pygmy Hog Conservation Programme Studbook

Total number of deaths recorded:		130
Circumstance of death		
Euthanasia	0	0%
Self Inflicted Injuries	2	2%
Injury from Exhibit Mate	7	5%
Malicious Destruction	0	0%
Old Age	0	0%
Infection Associated	54	42%
Injury from Predator	0	0%
Env. or Beh. Conditions	4	3%
Stillbirth	11	8%
Premature Birth	18	14%
Anesth./Restraint Assoc.	0	0%
Died in Transit	0	0%
Stranded/Beached	0	0%
Other/Unknown	34	26%

Pygmy Hog Conservation Programme Studbook

Necropsy Code-Etiological		
Genetic and Prenatal	0	0%
Bacterial	48	37%
Fungal	5	4%
Metazoan	0	0%
PPLO	0	0%
Protothecal	0	0%
Protozoan	0	0%
Rickettsial	0	0%
Viral	1	1%
Toxicity	0	0%
Trauma	8	6%
Circulatory, secondary	7	5%
Enervation, secondary	2	2%
Mechanical Abnormality	4	3%
Metabolism	9	7%
Nutrition	2	2%
New Growths	3	2%
Unknown (after necropsy)	41	32%

Pygmy Hog Conservation Programme Studbook

DAM DATA: 16 reported dams, with 109.89 (198) offspring
(not including 0 offspring of unknown dams)

Youngest dams at first birth:
- TPH19 at age 1Y,3M,3D
- TPH18 at age 1Y,3M,16D
- TPH40 at age 2Y,0M,3D

Oldest dams at first birth:
- TPH67 at age 5Y,10M,10D
- TPH79 at age 5Y,8M,15D
- TPH78 at age 5Y,8M,10D

Oldest dams to have given birth:
- TPH4 at age ~8Y
- TPH5 at age ~7Y
- TPH4 at age ~7Y

Pygmy Hog Conservation Programme Studbook

Dams with most offspring	
TPH5	36
TPH4	32
TPH13	22
TPH19	18
TPH142	17
TPH18	15
TPH1	14
TPH125	9
TPH79	6
TPH78	6
TPH40	6
TPH129	4

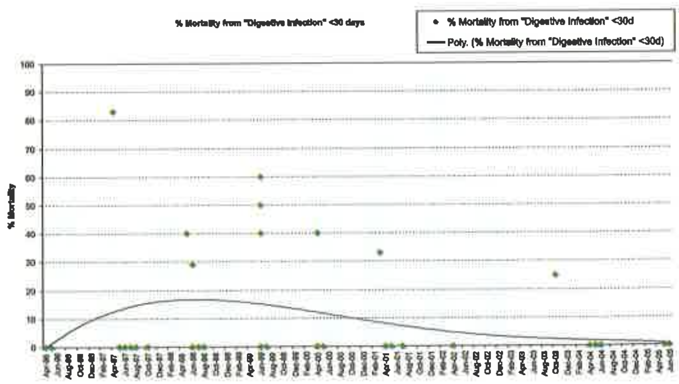
Birth seasonality (litters)		
January:	0	0%
February:	0	0%
March:	1	2%
April:	12	29%
May:	9	21%
June:	10	24%
July:	5	12%
August:	3	7%
September:	0	0%
October:	2	5%
November:	0	0%
December:	0	0%

Pygmy Hog Conservation Programme Studbook

Litter size	N	
1	1	2%
2	2	5%
3	3	7%
4	12	29%
5	12	29%
6	9	21%
7	2	5%
8	1	2%

42 total litters, mean size is 4.7

Pygmy Hog Conservation Programme Studbook



Madagascar Giant Jumping Rat International Studbook

Jumping Rat Studbook

Captive population started from 5 founders in 1990

International Studbook was established in 1995, and now has just over 340 animal records

All data complete, e.g. no unknown parentage

Currently ~65 living animals in 20 zoos

Jumping Rat Studbook

Updated throughout the year, by asking all zoos for new information (births, deaths, transfers, microchip implants, post mortem data).

The studbook holder (in this case) also acts as breeding co-ordinator, arranging all transfers and selection of breeding pairs.

Studbook analysis

Studbook contains much useful data, e.g.

Litter size	N	%
1	143	71%
2	56	28%
3	2	1%

201 total litters, mean size is 1.3

Studbook analysis

Youngest dam to give birth: 10m,12d

Oldest dam to give birth: 9y,1m,5d

Mean age of dams at 1st birth: 2y,6m,24d

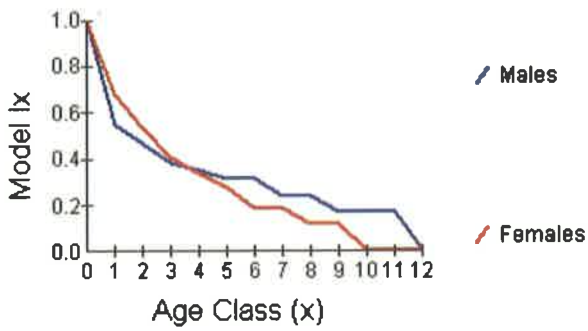
Youngest sire to conceive: 8m,18d

Oldest sire to conceive: 12y,7m,18d

Mean age of sires at 1st conception: 2y,4m,23d

Studbook analysis

Life Expectancy



Population management goals

1) Maintain a stable or slowly-growing pop with balanced age-structure.

2) Minimise inbreeding (by not pairing related animals).

3) Maximise genetic diversity and founder genome representation (by making sure you breed the animals that are genetically the most important).

Pair selection

One of the main tasks of a population manager is to arrange breeding pairings.
These need to be chosen carefully so as to avoid inbreeding, and maximise the genetic diversity of the population.

Four rules:

1) animals with the rarest gene lines should be priority for breeding (calculated using Mean Kinship);
2) animals closely related should not be bred together (calculated using offspring Inbreeding Coefficient);
3) animals with widely differing mean kinships should ideally not be bred together;
4) potential pairings should be chosen on their ability to increase population genetic diversity (Δ GD).

Pair selection

Mean Kinship (MK)

- Measure of how related an individual is to rest of the population. An individual with no living relatives has a MK of 0, meaning that its genetic material is unique and thus important. If an individual has numerous living relatives, it has a high MK and is less desirable for breeding, as its genetic material is already 'common' throughout the population.

- Animals with the lowest MK should be a priority for breeding.

Pair selection

Inbreeding Coefficient (F)
A measure of how closely related an individual's ancestors were. A value of 0 means an individual's parents were unrelated.

When considering a pairing, the F value of the potential offspring is important, and should be as low as possible (ideally zero).

Pair selection

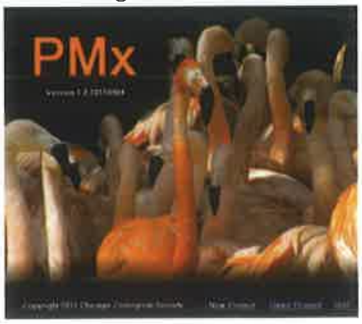
Change in Genetic Diversity (Δ GD)
When considering a pairing, this is a measure of whether the potential offspring would improve or reduce the population's genetic diversity.

Breeding together individuals with low MK will achieve this.

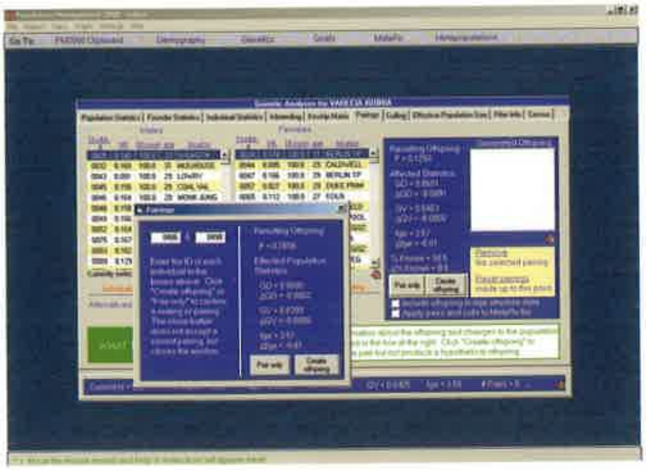
Breeding unrepresented wild-caught founders is particularly important.

Pedigree analysis software

- Software for the analysis of studbook data.
- PM2000 and Pmx.
- Allows more complex demographic and genetic analysis than is possible within SPARKS.
- Provides analysis on which management decisions can be based, e.g. pairings.



freely available from:
www.vortex9.org/



Pair selection

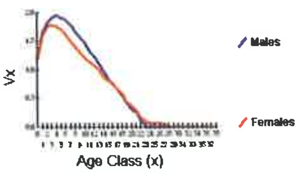
Various different ways of doing it...

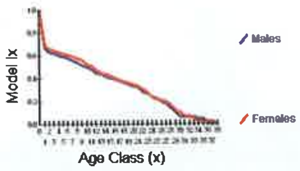
♂ x ♀	F	ΔGD
214 x 209	0.0125	+0.007
214 x 222	0.0650	+0.008
214 x 189	0.1242	-0.001

Also try to breed together animals with similar mean kinships

Pair selection

- That's the genetic theory, but then you have to take practical issues into account, such as...
- Age – breed together animals of similar ages if possible. – consider the age at which animals become post-reproductive...





Vx = reproductive value   Lx = age-specific survivorship
(graphs from Varecia variegata variegata EEP data)

Pair selection

- That's the genetic theory, but then you have to take practical issues into account, such as...
- Transfer distance.
- Welfare (especially of lone animals) – perhaps give a lone animal greater priority for pairing even if it is not genetically the best choice.
- To make these decisions, it is obviously important to have a good knowledge of the social organisation and natural behaviour of the species...

...Know your species!

Further reading

see also various resources on Course Flash Drive...

Hygiene and Sanitation: Getting the Basics Right

Presented by:

Dr. Andrew Routh

Head of Veterinary Services

Durrell Wildlife Conservation Trust

Jersey, U.K.

Hygiene and Sanitation: Getting the Basics Right

Andrew Routh
Head of Veterinary Services
Durrell Wildlife Conservation Trust

Background – UK (not Jersey)

- *Secretary of States Standards for Modern Zoo Practice (SSSMZP) (last updated September 2004)*

are there to inform and form the basis of -

- *The Zoo Licence Act inspections – mandatory for a zoo to have a licence to operate with this being overseen by -*
- *the Local Authority who issue conditions*

- *SSSMZP Introduction point 11: - Disease: Curative and preventive veterinary medicine should be provided. Every effort must be made to provide a correct diet and suitably hygienic environment from which pathogens are excluded or controlled.*

SSSMZP Sanitation & Control of Disease

- Clinical waste and refuse must be regularly removed and disposed of in a manner approved...
- A safe and effective programme for the control or deterrence of pests, vermin and predators...
- Health risks posed by the use of power hoses on animal waste must be minimised
- Staff must be instructed to report in confidence any medical condition... ...which might affect their capacity to manage the animals in a safe and competent manner

Staying Disease-Free – the Veterinary Angle

- Health-care of stock - veterinary checks (inc. pme), nutrition, housing, routine faecal screening (bacteriology and parasitology)
- Sylvatic disease – may be difficult to regulate – housing, disinfection and vaccination – pest control
- Incoming animals - source of animals (wild vs. captive-born), medical history, pre-move isolation and veterinary checks, post-move quarantine and veterinary checks
- Statutory regulations – CITES plus States of Jersey VO (or exporting equivalents) and (EU) Balai - generally apply to species and diseases affecting commerce
- Bio-pollution e.g. chytridiomycosis, consideration of incoming stock but also pathogen release in waste water

Sources of Infection

- **Incoming Animals – covered in "Diseases in Transit"**

Sources of Infection

- Wild Animals – visitors
  - Risk
  - Mitigation

Sources of Infection

durrell

- Wild Animals – Vermin
  - Risk
  - Mitigation

durrell

19 October 2012 Last updated at 17:52

London Zoo penguins die in malaria outbreak

Six penguins have died following an outbreak of malaria at London Zoo.

The birds contracted the avian strain of the disease from mosquitoes and died in August.

Zookeepers had increased the birds' anti-malaria medication due to fears that the wet weather would let the insects thrive.

Avian malaria cannot be passed on to humans nor can it be passed from bird to bird, and the zoo says the remaining penguins are "healthy and well".

'Sad occasion'

A spokeswoman for London Zoo said avian malaria is "endemic" in the UK's wild bird population.

Preventative measures, including anti-malaria medicine were in place on a daily basis to prevent this "very sad occasion" from happening again, she added.

- Avian malaria is caused by a different parasite to human malaria, and is endemic in domestic birds
- The human form is transmitted by the Anopheles mosquito, which does not thrive in colder areas of Europe
- However, the parasite that is carried by the Culex mosquito, which causes the avian strain, is an established UK species
- Although it does not usually kill, it can be lethal to species which have not evolved resistance to the disease, such as penguins

From fairies to emperors - find out more about penguins

Vaccination

durrell

Blue Tongue Virus 8 an EID to UK

- risk of exposure via culicoid midges
- certain species believed to be vulnerable
- vaccine not licensed or tested in our species
- has to be given by dart therefore im injection - not the data-sheet recommended sc
- good serological reaction

Sources of Infection

durrell

- **Food**
  - Diseased – meat, eggs, fish, invertebrates
  - Poor storage – rodent faeces, mould, bacterial
  - Contaminated – cross-contamination (also pesticides and pharmaceuticals)
  - Public feeding – any of the above as no quality control

Sources of Infection

durrell

- **The keepers – and the vets**

Anthroponoses - SSSMZP

durrell

- **"Members of the public who may have eaten recently should be requested to wash their hands;"**
- **"Parties should be asked to consider any health problems they have which may be transmittable to the animals".**

Post Mortem Examination

- Essential - and required
- Risk to workers
- Carcass disposal
- Archive
- Museum/research requests

Other Waste

- "Clinical Waste"
- "Sharps"
- Bedding – quarantine and non-quarantine
- Protective clothing
- Waste water
- PM room
- Laboratory – microbiology and clinical
- Pharmaceutical products
- Other chemicals

Disinfectant

- "an agent that frees from infection, usually a chemical agent but sometimes a physical one, such as x-rays or ultraviolet light, that destroys diseases or other harmful microorganisms but may not kill bacterial spores" (Block, 2000)
- used on inanimate surfaces - assumed to act rapidly and efficiently to kill or inhibit growth of microorganisms
- most effective for diseases that are not vector-borne, but are acquired by direct contact with contaminated fluids or animal products

Sterilisation

- Achieved when all living microorganisms and bacterial endospores have been destroyed
- Dry heat - surfaces must be exposed to 160 C to 170 C for periods of 2 to 4 hours
- Steam - exposing contaminated surfaces to moist heat at 121 C for at least 15 minutes – pressure increases efficacy
- Chemical sterilants - vapour or gas, such as formaldehyde or ethylene oxide, or immersion liquid such as glutaraldehyde

Disinfectant Types

- All require pre-cleaning
- Risks to personnel – include both zoonotic disease and the chemical disinfectant
- Disinfectants are tested for their bacteriocidal, tuberculocidal, sporicidal, fungicidal, virucidal (against enveloped and non-enveloped viruses), and antiparasitic (against eggs and coccidia) effects
- High-level - effective against bacterial endospores
- Intermediate-level - can inactivate tubercle bacilli, but do not kill bacterial spores
- Low-level - kill vegetative bacteria and fungi - not reliable for destruction of bacterial endospores, tubercle bacilli or small non-enveloped viruses within a practical period of time

Selecting the Ideal Disinfectant

?

Selecting the Ideal Disinfectant

- Wide antimicrobial range
- Absence of chemical hazards (i.e. toxicity, teratogenicity, carcinogenicity)
- Compatible with a wide range of chemicals
- Non-corrosive
- Active in the presence of organic debris
- Stable at ambient temperatures
- Long shelf-life
- Effective over wide range of temperatures
- Inexpensive and readily available
- Non-polluting and biodegradable

Bottom line - there isn't one

Real-World Efficacy and Limitations

- Surface type and finish
- Allied dirt and organic material
- Pathogen type – most resistant are bacterial spores, prions and non-enveloped viruses
- Potential for disinfection to damage area to be disinfected

Alcohols

- Inexpensive, relatively nontoxic, and colourless
- Ethyl and isopropyl alcohol are most widely used
- Intermediate level disinfectants - inactivate organisms by denaturing proteins
- Effective for destruction of enveloped viruses and tubercle bacilli, less effective against non-enveloped viruses and are not sporocidal
- 70% of ethyl alcohol is most effective but when used as a surface disinfectant rapid evaporation makes sufficient contact time difficult to achieve
- Tend to harden and swell plastic tubing and be absorbed by rubber products when used over time

Aldehydes

- E.g. formaldehyde (available in an aqueous 37% solution) and glutaraldehyde
- Formalin in solutions of 3% - 8% is effective for intermediate to high level disinfection. It is less effective than glutaraldehyde in the presence of organic matter
- Potential carcinogenicity. Known skin irritation, and irritating fumes
- Protective clothing
- However - aldehydes are common compounds in disinfectant preparations used in the veterinary field (i.e. breeding, husbandry and transport)

Alkalis

- Sodium hydroxide (NaOH) or lye - a caustic alkali that has a wide virucidal spectrum at a 2% concentration
- Effective against most bacteria, and enveloped and non-enveloped
- Viruses - higher concentrations may be necessary for some viruses
- Not to be used on wood
- At higher concentrations effective against prions
- Risks to staff, animals and surfaces

Biguanides – Cationic Compounds

- E.g. – chlorhexidine - low-level disinfectant - incompatible with anionic compounds
- Often used for hand/skin disinfection
- Activity is pH dependent and inactivated by organic debris
- More active against gram-positive than gram-negative bacteria. *Pseudomonas* spp. and *Proteus* spp. are resistant
- Active against enveloped viruses but not non-enveloped viruses and mycobacteria
- Most fungal species, such as dermatophytes, e.g. *Microsporum canis*, are resistant

Halogens – chlorine compounds

- Sodium hypochlorite (NaOCL or household bleach) solution - an intermediate-level disinfectant when properly diluted – on day of use
- Dependent on the formation of undissociated hypochlorous acid to oxidize peptide links and denature proteins
- 0.1% solution effective against e.g. enveloped viruses
- Corrosive and irritant
- Poorly active when organic debris around
- Rapidly loses activity of porous/rough surfaces

Halogens – iodine compounds

- Most commonly iodine compounds (iodophors)
- More active than chlorine compounds when organics around, and less corrosive
- At appropriate dilutions, iodophors are bactericidal, mycobactericidal, sporicidal, fungicidal, and virucidal
- Should not be used in alkaline conditions or mixed with other compounds

Phenolic Compounds

- Synthesised compounds - phenol effective but "dangerous"
- All can leave residues that can be toxic – especially to cats and pigs
- Intermediate to low level disinfectants
- Substituted-phenolics can be virucidal and active against coccidial oocysts

QACs

- Quaternary ammonium compounds – cationic detergents for low-level disinfection especially surfaces
- Relatively nontoxic but inactivated by organic debris, metal salts in water (i.e. hard water) and anionic detergents
- Some gram-negative bacteria, such as *Pseudomonas* spp. can survive disinfection with QAC and may grow in QAC solutions
- More of use in food industry than animal facilities

Others for Completeness

- Organic acids e.g. dilute acetic acid for wound cleaning
- Inorganic acids e.g. sulphuric and hydrochloric acids – house disinfection
- Peroxygen compounds. Hydrogen peroxide – non-polluting and fast-acting but unstable

The Ideal Animal Facility - Hygiene

?

The Ideal Animal Facility

- Easy to clean
- Non-porous surfaces
- Resilient surfaces for disinfection
- Minimal extraneous matter
- Physiological health paramount
- Psychological health

The Laboratory Model Option

- Retain underlying structure
- Retain underlying health screening and management
- Augment with clean/sterile substrate
- Spatial variation
- Behavioural enrichment

In the Zoo

- Freedom from hunger & thirst
- Freedom from discomfort i.e. provision of shelter and shade
- Freedom from pain, injury or disease
- Freedom from fear and distress
- Freedom to express normal, natural behaviour

Alkalis

Government AH Legislation

- May be at international, national or state level
- Generally regulated to protect commercial, domesticated species
- Human-health consideration
- Legal recognition of
  - Statutory Quarantines and pre-move screening
  - Notifiable Disease
  - Restrictions in outbreaks - Infected Premises
  - Obligatory culls
- Potential prevention of vaccination

Zoonoses – Visitors and Staff

- Staff – can be trained
- Visitors – are dependent on the zoo to minimise risk
- And there are some visitors beyond help

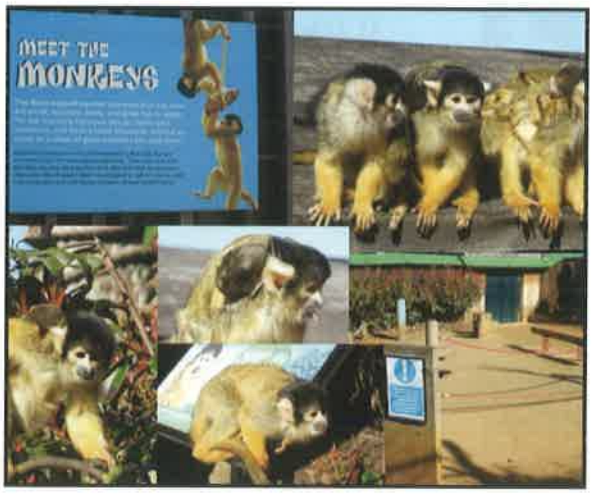
The Limitations of Testing

- SSSMZP "In walk-through exhibits with exotic herbivores/ primates, the following points should be noted":
- "Animals should be regularly and thoroughly screened for any zoonotic diseases, with particular reference to viruses in primates"

"As we know, there are known knowns. These are things we know we know.
We also know there are known unknowns. That is to say we know there are some things we do not know.
But there are also unknown unknowns – the ones we don't know we don't know."

DH Rumsfeld, February 12, 2002

- Understanding and managing risks from E. coli 0157 in an open farm context. Source HSE/LACoRS/HPE
- www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1267551712693
- People should not have contact with animal faeces
- *E. coli* O157 should be assumed to be present in the faeces of all ruminant animals, on the animals and on many surfaces - even if the animals look clean and healthy
- Hand-washing with soap and water - most effective method of reducing risk of infection
- Gels and wipes should not be used as an alternative to hand-washing
- Supervision of children's hand-washing is essential



Breaking the Chain

- Advisory Committee on Dangerous Pathogens Infection at work: Controlling the risks.
- A guide for employers and the self employed on identifying, assessing and controlling the risks of infection in the workplace
- *© Crown copyright 2003 Applications for reproduction should be made to: Copyright Unit, Her Majesty's Stationery Office, St Clements House, 2-16 Colegate, Norwich NR3 1BQ First published 2003*

- Does it work?
- Forms the basis for H&S Risk Assessments in e.g. the NHS

Chain of Infection

- Breaking a link in the chain at any point will control the risk of infection
- Identify the hazard
- Find out about the links in the chain
- Identify the best way to break it
- Control the risk

Assessing and Controlling the Risk

- **Assessing the risks**
  - If you determine that there is a risk - decide whether existing controls are sufficient or if you need to do more
- **Controlling the risks**
  - stop exposure
  - utilise good occupational hygiene
  - utilise good environmental hygiene and design

Without Knowledge How Can We Assess the Risk?


THE ROANOKE TIMES
Monday, September 20, 2004

Melissa Williamson, 35, a Bullitt Avenue resident, worries about the effect on her unborn child from the sound of jackhammers.

Biological agents of primary concern	Source of infection	ACDP hazard Rating	Likelihood of occurrence at CZ
Salmonella Campylobacter Chlamydophila	All three agents are found in faeces of infected birds. Chlamydophila can also be found in feather dust.	2	Low – opportunistic screening has rarely isolated these organisms in tropical house. There have been no clinical cases of disease attributable to these infections in the last 5yrs.

Managing the Risk

Control measures to minimize contamination risk	- Prior to being introduced into this enclosure, all birds will receive a health check and laboratory screening will be undertaken specifically for the diseases listed. - No birds suspected or confirmed as harbouring zoonotic diseases will be introduced. - All sick or dead birds from this enclosure will be screened for potential zoonotic disease. - Any bird diagnosed with a potentially zoonotic disease will be removed from the free flight enclosure and isolated until such time as is fully recovered and tests negative on microbiological screening and the collection vet and manager will undertake a risk assessment to determine whether any further action is required (eg decontamination of the enclosure /sampling in contact birds / restricting public access) - If removing the bird(s) is not possible, access to the enclosure will be restricted (commensurate with risk) until such time as the bird(s) is fully recovered and tests negative on microbiological screening. - Rodent and invertebrate pest control programme in place - Free ranging wildlife species are excluded from the building.

The Role of "Zoo-Vets"

- Identifying the biological agents of concern
- Carrying out veterinary screening (in sickness and in health) – primarily for the benefit of the animals e.g. faecal screening, quarantine health-checks, clinical work-up etc
- Perhaps an increased tier of e.g. annual health-checks for walk-through primate exhibits including virology for the common diseases – in particular anthropo/zoonoses
- Thorough post mortem examinations with full follow-up
- Communicate back to zoo management ensuring they have in place adequate measures to "break the chain"

Acknowledgements

- Colleagues past and present at DWCT & ZSL. Steph Sanderson on "Breaking the Chain"
- Images are either ©ZSL or ©DWCT or credited (as far as possible but some unaccredited as were unaccredited on various web-sites – apologies)

Managing Animal Health in Transit

Presented by:

Dr. Andrew Routh
Head of Veterinary Services
Durrel Wildlife Conserration Trust
Jersey, U.K.

Managing Animal Health in Transit

Andrew Routh
Head of Veterinary Services
Durrell Wildlife Conservation Trust

Outline

- Broad principles and definitions
- British and Irish Association of Zoos and Aquaria – Animals Transaction Policy with taxonomic example
- Transport
- IUCN Guidelines for Reintroductions
- Retention of Biodiversity

- **Case Studies**
  - Corncrake Crex crex
  - Potosi pupfish Cyprinodon alvarezi
  - Mountain chicken Leptodactylus fallax

Principles

- Zoological collections are often comprised of numerous species, non-sympatric, from diverse sources

- Bio-security in any collection can vary - historically may have been non-existent

Click to add titile

- Any collection can be host to numerous diseases which may or may not be significant to –

- its own species
- its staff
- the species in a receiving collection
- the species destined for a conservation breeding and reintroduction programme

- Beware of the "Rumsfeldian unknown unknowns"

Defining the Stages

- In situ - generally refers to conservation of a species in the wild - with ex situ being when the animals are taken from the wild and held in captivity either within or out of the range country
- Risk assessments take into account the likelihood of a disease being present/transmitted (L/M/H) and the impact on the programme if it is (L/M/H)
- Pre-move screening – decide what you want and what would stop a move before…
- Post-move quarantine – when it becomes your worry
- Pre-exit health checks - ensure nothing could adversely impact the individual or the wild you are saving
- Post-release monitoring – do it!

BIAZA Animal Transactions Policy

Appendix V - guidelines on minimising risk of disease transfer

- A sending institution has a duty of care to ensure that any animals transferred are, as far as can reasonably be ascertained, healthy and fit for purpose
- No animal showing clinical signs of disease should be moved between collections unless the condition in question is chronic in nature and the receiving collection is willing and able to continue to manage the animal in appropriate facilities

A "don't forget" from BIAZA

- Non-infectious diseases (including behavioural abnormalities) tend to affect only the health and welfare of specimens being transferred but they may also have other knock on effects – e.g. –
  - suitability for breeding if the animal is infertile due to testicular abnormality
  - suitability for enclosure type available if the individual cannot move normally

BIAZA Animal Transactions Policy

- Any animal move carries with it a risk of disease transfer
- Infectious diseases may cause problems in the individuals being transferred, their conspecifics, other species in the collection or in humans (staff and/or visitors)
  - The most important techniques for minimising disease transfer are:
  - Pre-export health screening
  - Quarantine and post-import health screening

BIAZA Animal Transactions Policy

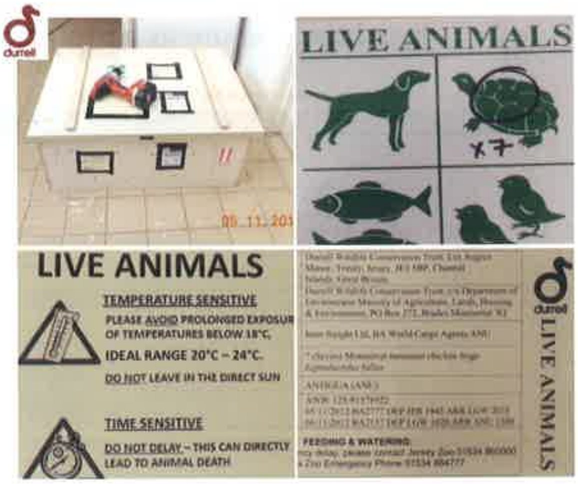
- Submit a full medical history of the animal to be transferred AT LEAST 1 WEEK PRIOR TO TRANSFER to the receiving collection
- In the absence of a medical history, as a minimum, a written declaration should be sent to the receiving collection stating
  - that the animal being transferred appears to be in good health
  - that there have been no known recent problems with it or its conspecifics – (or in the collection)
  - and a faecal screen results - parasites and bacteriology

BIAZA Animal Transactions Policy

- Notify the receiving collection AT LEAST 1 WEEK PRIOR TO TRANSFER of any disease concerns in its immediate group / or in the collection as a whole
- Where practicable carry out
  - a physical examination of the animal within 7 days of transport (by a vet)
  - a visual examination by a vet and/or experienced person with the species in question within 24 hours of transport/upon departure

Transport

- Factor in how the animal will be boxed (and un- boxed)
- Box or crate design – varies greatly but needs to accommodate animal by size and behaviour. IATA Live Animals Regulations (Manual in English US$220)
- Needs to be escape-proof, able to visualise animal, meshed ventilation (insect-proof) and leak-proof - bedding restrictions
- Water (and food?) – determined by journey length
- Keep within appropriate thermal range (and monitor)
- Disease risks – cross-infection, dehydration, starvation, suffocation, injury (box or other animals), hyper- and hypo-thermia
- Label



The Ground Rules

- Plan
- Be prepared
- Ensure animals have appropriate ID
- Communicate
- Be honest

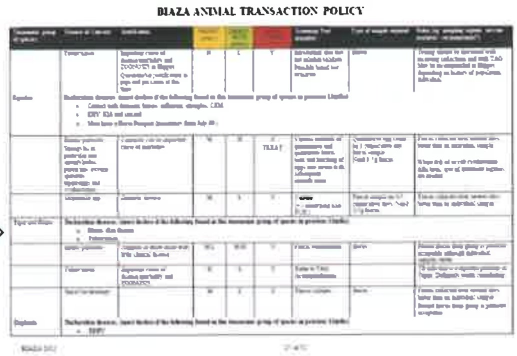
- If staff accompanying the animals then look after them

- Don't forget legislation and paperwork

You Want A New Tapir From Thailand

?

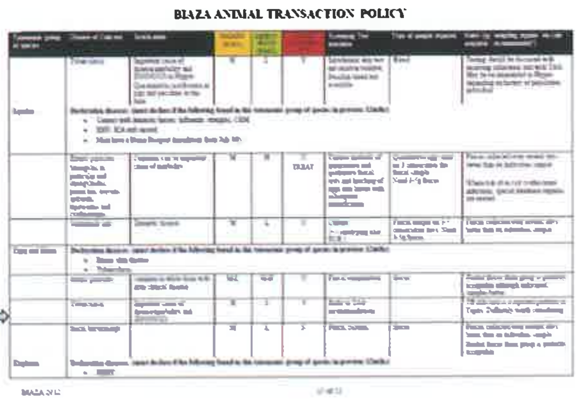
Sample Page (I know its hard to read)



Taxon Example – Rhino and Tapir

- Declaration diseases: (must declare if the following found in this taxonomic group of species in previous 12mths)
  - Rhino: skin disease
  - Tuberculosis

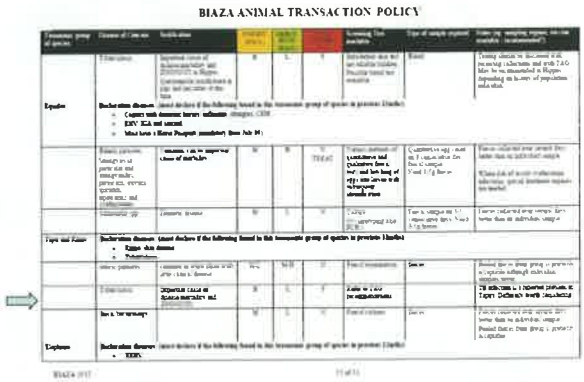
Sample Page (I know its hard to read)



Enteric Parasites

- JUSTIFICATION Common in white rhino with little clinical disease
- HAZARD (H/M/L) M-L
- LIKELIHOOD (H/M/L) M-H
- SHOW STOPPER? (Y/N) N
- Screening Test available Faecal
- Type of sample required Faeces
- Notes (e.g. sampling regime, vaccine available / recommended?) Pooled faeces from group is probably acceptable although individual samples better

Sample Page (I know it's hard to read)



Tuberculosis

- JUSTIFICATION Important cause of disease/morbidity and ZOONOSIS
- HAZARD (H/M/L) H
- LIKELIHOOD (H/M/L) L
- SHOW STOPPER? (Y/N) Y
- Screening Test available Refer to TAG recommendations
- Type of sample required Refer to TAG recommendations
- Notes (eg sampling regime, vaccine available / recommended?) TB infection is a reported problem in Tapirs. Definitely worth considering

Tuberculosis

- **JUSTIFICATION Important cause of disease/morbidity and ZOONOSIS**
- **HAZARD (H/M/L) H**
- **LIKELIHOOD (H/M/L) L**
- **SHOW STOPPER? (Y/N) Y**
- **Screening Test available Refer to TAG recommendations**
- **Type of sample required Refer to TAG recommendations**
- **Notes (eg sampling regime, vaccine available / recommended?) TB infection is a reported problem in Tapirs. Definitely worth considering**

IUCN Guidelines for Re-introductions

- Prospective release stock, including stock that is a gift between governments, must be subjected to a thorough veterinary screening process before shipment from original source.
- Any animals found to be infected or which test positive for non-endemic or contagious pathogens with a potential impact on population levels, must be removed from the consignment.
- The uninfected, negative remainder must be placed in strict quarantine for a suitable period before retest. If clear after **retesting, the animals may be** placed for shipment.
- Since infection with serious disease can be acquired during shipment, especially if this is intercontinental, great care must be taken to minimize this risk.

Retention of Biodiversity

- Colpocephalum californici
- Generally, in the wild, there is a host-parasite balance
- In captivity (more confined environment) parasite life cycles easier to complete – build up of numbers to pathogenic levels
- Exposure to low levels parasites generates a degree of immunity
- Releasing individuals with naïve immune systems may lead to over-whelming infection
- Is a condor without its louse a condor?

Corncrakes

- Adult birds held in breeding aviaries at ZSL WZ
- Wild-stock sourced from Europe and Scotland
- Breeding with these and, latterly, retained F_1 birds
- Clutches lifted and incubated
- Chicks reared in dedicated unit

Pre-move Health-check


Avian Biotech International
Blood collection card
Place blood in the circle, allow to dry for a few minutes. When dry slide card to zip-lock bag (circle first) and record this card number onto the order form.
UK 4995343

Pre-release Check (day 32-ish)

- Have been held at release site in naturalistic aviaries with supplementary feeding

Day of Release Check-list

- Need to know – age, weight, sex and genetic provenance
- Morphometrics
- Health check based on catch-up activity, auscultation of heart and lungs, body condition, size and maturity taking into account the above
- Feet, legs, wings and feather condition assessed. Internal beak and eyes checked

"Show-stoppers"

- Small birds with no pathology - review one week later
- Sometimes have healed (?greenstick) fractures
- Problems with joint infections including hocks and feet
- Bad feathers are bad news
- Seen coccidiosis with neurological signs
  NB:
- Raillietina presumed normal
- Aged adults - *Mycobacterium* spp. in particular *M. genavense*

ZSL
LIVING CONSERVATION

- Birds released generally before day 40 (up to mid-September) - have to migrate to Africa
- All have metal BTO ring
- Have used radio-transmitters to track immediately post-release
- Have put daylight GPS leg rings on males to retrieve the next Spring

Corncrake Project Summary

ZSL
LIVING CONSERVATION

- Birds held and breeding within a zoological collection but not part of the collection
- Utilisation of on-site aviculturalist and veterinary expertise
- Retention of breeding stock, with staged export of young to release site
- Young held in dedicated aviaries at release site but not a soft release
- Health checks at every stage, including breeders
- Successful release and return of a migratory bird – to the release site and not ZSL or Scotland
- Project hammered in 2012 by flooding

Potosi pupfish Cyprinodon alvarezi

- Family: Cyprinodontidae (Pupfishes)
  Order: Cyprinodontiformes (rivulines, killifishes and live bearers)
- Size: 5.0 cm TL
- Environment: benthopelagic; non-migratory; freshwater
- Climate: subtropical; 18 - 22°C; 25°N - 24°N. El Potosí in Nuevo Leon, Mexico.
- *Biology: Not a seasonal killifish. Minimum population doubling time less than 15 months. <u>Is difficult to maintain in aquarium</u>*
- *Red List Status: Extinct in the Wild (Ref: IUCN Red List, Contreras-Balderas, S. & Almada-Villela, P.)*

Photo and data from www.fishbase.org

Where Does It Come From?

- Already in wild stock on accession
- Cross-infection pre-accession i.e. in other collections
- Cross-infection within a collection not only between animals e.g. fomites, aerosol, tanks, pipe-work, filters and substrates.
- Water supply e.g. *M. fortuitum, M. chelonae, M. genavense,* (primarily an avian pathogen), in tap water
- Substrate e.g. sphagnum moss, plants
- Food items e.g. crustacea

Diagnostic Options for "Fish TB"

- Acid-fast stains of tissue harvested from skin lesions*
- Acid-fast stains taken from organs (with lesions) at pme*
- Acid-fast staining of tissues (with lesions) – histopathology*

  *Not discriminatory - ID limited to presence of "acid-fasts"
- Culture and subsequent ID down to species level
- PCR – down to species level and beyond (if primers available)
- Tests are of varying sensitivity and specificity (and cost) - Soldati *et al*. Vet Pathol 41:388–397 (2004)

Treat, Manage or Eradicate?

- **Treatment**
  - **Antibiotics, usually in combination and over extended periods**
  - **Organism may be shed during treatment**
  - **Success low**
  - **Potential antibiotic resistance**
  - **Falling out of favour**

Treat, Manage or Eradicate?

• Management

- "Ring-fence" affected systems
- A "dead-end/one-way system" even for progeny
- Optimise husbandry
- Vigorous cull of any individuals showing overt disease, looking off-colour, (definitely before they die and are scavenged) and aged specimens
- Employ "Apex-Predators"
- Manage breeding and progeny
- (Vaccination a long way away)

Treat, Manage or Eradicate?

• Eradication

- Difficult to sell, even to the Apex Predators
- All stock culled
- Exhibit broken down, cleaned and disinfected appropriately
- "Ring-fence" new exhibit if mycobacteriosis in the institute
- Manage breeding and progeny
- Source new stock carefully to prevent disease reintroduction

In the Interim - Breaking the Chain

- Manage in the most hygienic, bio-secure manner - with review and revision of SOPs
- Disinfection – review of type and usage with continued focus on the hidden elements in systems e.g. pipe-work, water-supply and storage areas
- No mixed species exhibits and a conscious split of a collection's species stock into exhibit and non-exhibit breeding
- A break, with disinfection, between generations (but
- live-bearers?)
  Lifting out aged, diseased fish - irrespective of perceived genetic value

Barrier-management/Ring-Fencing

Objective - Vigorous Captive Groups

- Feeding – eliminate food as a source of TB but optimise nutritional quality - and maintain natural behaviours
- Water Quality (constancy - too kind?) Harsh wild environment
- UV light – how much, is it beneficial, mimic the wild?
- Stocking densities – tendency to over-stock - vary for seasonality and breeding?
- Culling – in with the above giving optimal numbers of healthy fish but not forgetting…
- … managing what could be a restricted Genetic Diversity

Moving On and/or Out – a Proposal

- Short generation times. ?Take out stock one generation before proposed move and hold in minimalistic environment
- Bio-security and manage all inputs against mycobacteria
- Cull and sample at breeding age – confirming a "myco-negative" group
- Separate the generations
- "Release generation" held with same stringent, minimalistic, conditions
- Move, when large enough, to in-country dedicated facility prior to release

- All the above done cognisant of IUCN Guidelines, Disease Risk Analysis and habitat assessment

Fish TB Summary

- Encapsulates all facets of conservation breeding and captive management for endangered species where there is endemic disease
- The principles for husbandry and management hold as true for these species as they do for others
- More research needed

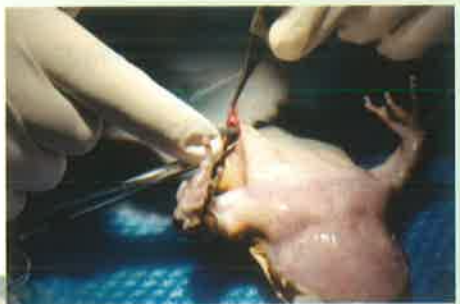
Mountain Chickens

- Large frog - now restricted to two islands in Caribbean
- Dominica lost nearly all its specimens to chytridiomycosis – fungal disease caused by the non-hyphal zoospore *Batrachochytrium dendrobatidis*
- May have been transferred to Montserrat by *Eleutherodactylus* spp. in bananas
- Monserrat population crashed and required immediate rescue

Bio-secure units for Frogs Entering Jersey

- "Treatment" on un-packing
- Dedicated unit built
- Highest level of bio-security

- Includes changing areas and disinfection of waste water
- Many of the frogs and their progeny have not entered the DWCT zoological collection



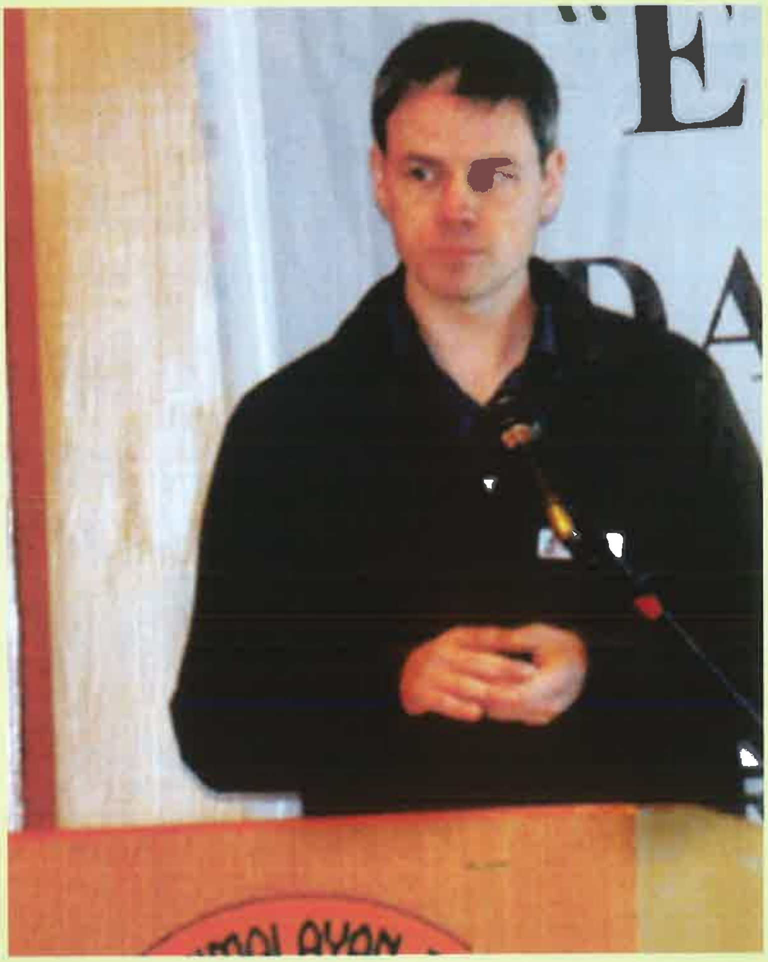
Mountain Chicken Summary

- Crisis response required to prevent species extinction
- Urgent requirement for specialised facilities and expertise not yet in range countries
- International programme requiring international exchange of programme animals
- Pathogen seen almost pan-globally and could infect *ex-situ* country native amphibia – indirectly via fomites or waste water
- Ongoing environmental persistence of causal organism in home range

Acknowledgements

- Former colleagues at ZSL and RSPB
- Colleagues past and present at DWCT
- Images are either ©ZSL or ©DWCT or credited (as far as possible but some unaccredited as were unaccredited on various web-sites – apologies)

ANIMAL RECORD KEEPING



Presented by:

DR. TIM WRIGHT
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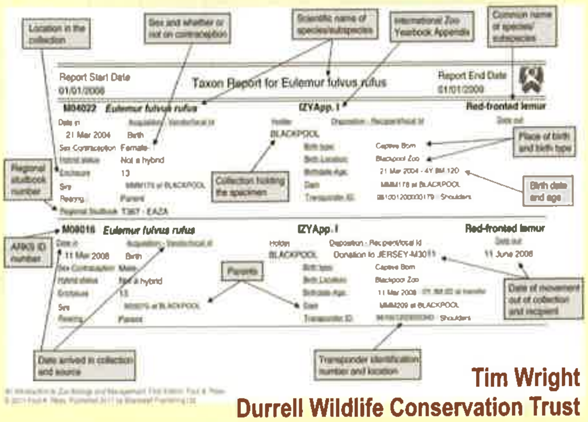
Durrell Wildlife Conservation Trust
Jersey, U.K.

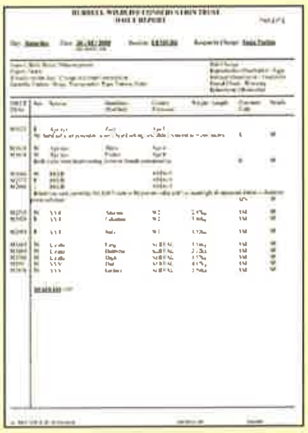
Animal Record Keeping



Tim Wright
Durrell Wildlife Conservation Trust

In this session we will discuss...

- Why keep records?
- The value of animal records data
- What data should we record?
- Daily recording
- Data storage – the role of ISIS
- Identifications of individuals



Why keep records?

- Zoos are increasingly relying on captive bred specimens - in 1990, ~67% of ISIS-registered zoo mammals were captive bred - this had risen to ~89% by 2007.
- Therefore well managed captive breeding programmes are increasingly important – and **good record keeping** is vital for this.
- Only good quality long-term record keeping of individually identified specimens will allow us to keep track of populations and the pedigrees of individual animals.

(Bingaman Lackey in: Kleiman *et al.*,

The value of animal records data

Recording animal data is a fundamental requirement for effective and continually improving management of our populations, and for facilitating the increasingly important conservation role of ex-situ institutions…

for example…

- Population management
- Institutional management and legal obligations
- Storing data on individuals
- Providing data for research – answering questions!
- Sharing data – the value of globally pooled data

The value of animal records data

1) Population management

- We increasingly rely upon captive populations to be self-sustaining – this requires very careful genetic and demographic population management.
- We have already looked at the importance of studbooks – and studbooks obviously rely on record keeping.
- Accurate record keeping is vital – data on numbers and location of individuals, origin, age, sex, parentage etc. are vital for effective population management by studbook holders or breeding programme co-ordinators.

The value of animal records data

2) Institutional management

- Record keeping is essential (and generally a legal requirement) for efficient and safe day-to-day running of zoos – by providing a current record of their stock.
- Wherever possible, animals should be individually identifiable – to allow data to be linked to specific records.
- Detailed records are often a requirement of animal movement legislation e.g. CITEs.

The value of animal records data

3) Storing data on individuals

- Record keeping is an obvious way of remembering useful information about an individual.
- For example, assessing the medical needs of an individual is greatly aided by having a written record of its medical history, past weights, vaccination history etc.

The value of animal records data

4) Data for research – answering questions!

- Data gathered from individual animals contributes to the collective knowledge on that species.
- Data gathered from zoos can assist with *in-situ* conservation.
- Record keeping also provides an extremely valuable pool of data for research, problem-solving, and constant improvement of husbandry, breeding success, health and welfare.
- examples…

The value of animal records data

4) Data for research – answering questions!

- What is the mean clutch size?
- What is the earliest age at which this species can breed?
- What is the mean adult weight?
- Are seasonal weight variations normal in this species?
- What are the 'normal' physiological blood parameters

The value of animal records data

4) Data for research – answering questions!

- Is there a link between time of year born and infan development problems?
- What are the main causes of death?
- Why is infant mortality so high?
- Have changes to diet or husbandry over time had an effect?
- Why does this species suffer from feather-plucking behaviour?
- Is it a seasonal behaviour?
- Is it linked to certain related individuals?
- Is it linked to certain enclosures?
- Does moving individuals to different enclosures have an effect?

The value of animal records data

5) Sharing data – the value of globally pooled data

The World Zoo Conservation Strategy encourages all zoos to share their animal records data…

- aids long-term monitoring of captive populations
- provides information on which species are in captivity, how many and where
- creates a huge pool of data for research etc.
- e.g. the accumulation of shared veterinary data has allowed the creation of a global database of 'clinical norms' for blood biochemistry and haematology values for captive zoo animals (ISIS, annually)

Analysis of large pooled global data sets also make it easier to

The value of animal records data

Life history traits

- Specimen identification number and scientific name
- Age on arrival / date of birth
- Source and provenance

•Sex
•Parentage
•Disposition

Daily events

- Any behavioural observations etc.

Medical information / clinical history

- Detailed information on a specimen's health problems, treatment history, vaccination history etc.

Morphometric and identification data

- Weights, measurements, microchip numbers etc.

Daily reporting

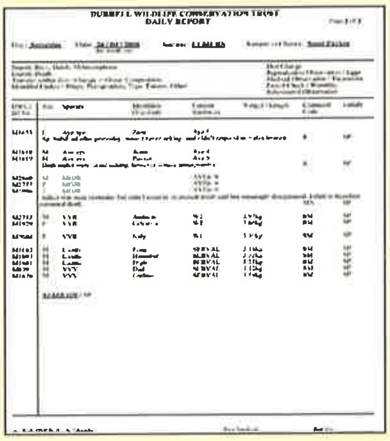
Daily records should be kept for each animal section / beat using 'Keepers Diaries' and/or 'Daily Report Sheets'

- Any unusual behaviours, interactions between animals etc.
- Any reproductive behaviours, signs of animals in oestrus etc.
- Any signs of illness, reduction in appetite etc.
- Any procedures carried out e.g. catching animals up, weighing, identification marking etc.
- Record if animals are moved to/from different enclosures
- Any external factors which may affect animals (e.g. extreme weather, noise etc.)
- If nothing happens that day, record 'nothing to report'!

See '*Standardization of Records Keeping in Indian Zoos and Marking Animals for Identification*' by PNHZP (2010) for reporting templates

The value of animal records data

An example daily report from Durrell


DURRELL WILDLIFE CONSERVATION TRUST
DAILY REPORT

Data storage – the role of ISIS

The World Zoo Conservation Strategy urges all zoos to submit their records data to ISIS.

Most ISIS-member zoos have been storing their records data using the ARKS software…

Some zoos additionally store detailed veterinary data in the related ISIS software MedARKS.

Data storage – the role of ISIS

However, zoos are gradually migrating their ARKS data to the new internet-based software ZIMS…

ZIMS

You can access much useful data
e.g. your own zoo's animal records

e.g. browse through global holdings for any species

Identification of Individuals

Wherever possible, we should ***individually identify*** each specimen in our collections.

Without individual identification - record keeping, day-to-day animal and clinical management, and longer term population management will be impaired.

Methods for marking animals
- Natural distinctive markings
- Artificial marking methods
  - temporary
  - permanent

Identification of Individuals

Characteristics of an ideal marking method include…

- Permanent (unless being deliberately used for a short-term study)
- Legible at a distance, to avoid the need to handle the animal
- Fast and easy to apply, to minimise stress to the animal
- Inconspicuous, to avoid detracting from the animal's natural appearance
- Humane and not stressful, for ethical reasons
- Inexpensive

Identification of Individuals

Method	Advantages	Disadvantages
Unique markings/ features	Inexpensive; visible remotely (no handling required); unobtrusive (no visible artificial marks).	Opportunity for error; potential for confusion with unrecorded individuals; requires skill/knowledge
Ringing	Relatively inexpensive; visible remotely (no handling required	May fall off; colours may wear off; risk of skin or digits getting trapped in rings
Ear tagging	Inexpensive; visible remotely (no handling required)	May fall off; colours may wear off
Wing tags/ bands	Inexpensive; visible remotely (no handling required)	May fall off; colours may wear off; bands can entrap birds in vegetation; may harm wings (Jackson and Wilson, 2002)
Beads/ necklaces	Inexpensive; visible remotely (no handling required	May fall off; colours may wear off; could lead to infection (ASM -ACUC, undated)
Bells	Inexpensive; visible/audible remotely (no handling required	Limited use for large groups; may fall off; may affect natural behaviour; may entrap birds in vegetation; can damage eggs (do not use on nesting individuals).
Ear notching	Permanent; inexpensive; visible remotely (no handling required).	Ethically questionable; may cause bleeding and infection; may become obscured by hair or ear injuries

Identification of Individuals

Method	Advantages	Disadvantages
Toe clipping	Permanent; inexpensive	Ethically questionable; may cause pain; bleeding and infection; may be difficult to see remotely
Freeze branding	Permanent; range of markings possible; visible remotely (no handling required); thought to be painless.	Specialist procedure; animal must be restrained carefully; may not be suitable for many animal types; permanently alters the animal's appearance
Dying/ painting	Good for temporary marking; inexpensive; visible remotely (no handling required).	Conspicuous to public; may affect animal behaviour; may wear off relatively quickly
Collars	Inexpensive; visible remotely (no handling required.	Not permanent; risk of strangulation (require regular checking); conspicuous to public
Tattooing	Inexpensive; relatively inconspicuous to public.	Not always permanent; may fade over time; cannot be read from a long distance, requires some skill.
Fur clipping	Good for temporary marking; inexpensive; visible remotely	May be conspicuous to public
Microchip transponders	Permanent; visually inconspicuous to public	Relatively expensive; need to be close to read; requires equipment to read; currently several rival brands/systems in use

To summarise, **Managing a Population** requires:

- Accurate data on the individual animals – **Record Keeping**;
- Ability to distinguish individual animals – **Identification of Individuals**;
- Tools for monitoring and optimising the demographics and genetics of individuals within a population – **Studbooks and Co-operative Breeding Programmes**;

Further reading

see also various resources on Course Flash Drive…

COLLECTION PLANNING
DURRELL AS AN EXAMPLE

Collection planning

Durrell as an example

Outline

- Durrell's vision and collection strategy
- Categorizing species roles
- Coordinating collection planning

Durrell Wildlife Park

Vision

To be a centre of excellence for intensive captive animal management that advances species recovery in the wild, setting the highest standards of animal welfare, and providing an unrivalled animal experience for visitors at the wildlife park.

The Wildlife Park

Strategic Objectives

(1) Promote endangered species recovery through the animal collection, facilities and staff of the wildlife park

(2) Establish the wildlife park as a premier visitor attraction

(3) Create skilled animal managers that will be the conservation project leaders of the future

(4) Enhance Durrell's pioneering reputation within the zoo community

(5) Move wildlife park operations to financial and environmental sustainability

1. Promoting endangered species recovery

....through the movement of animals....

- Captive breeding and reintroductions
- Head-starting and supplementation programmes

1. Promoting endangered species recovery

....and through the transfer of skills

- Technical advice and staff support to conservation programmes
- Providing training to conservationists

Durrell Animal Collection

	Individuals	Species
Invertebrates	101	6
Fish	205	8
Amphibians	342	17
Reptiles	258	32
Birds	517	59
Mammals	227	28
	1650	150

NE	DD	LC	NT	VU	EN	CR
5	1	51	14	24	22	13
3.8%	0.8%	39.2%	10.8%	18.5%	16.9%	10.0%
			54.6%	45.4%		

Species role classification

- Conservation

(a) ARK – Extinct in the wild and would become completely extinct without ex situ management

- RESCUE – In imminent danger of extinction and managed in captivity as part of a recommended conservation action
- REINTRODUCTION – Captive breeding for release back into the wild benefiting the wild population as part of a recommended conservation action

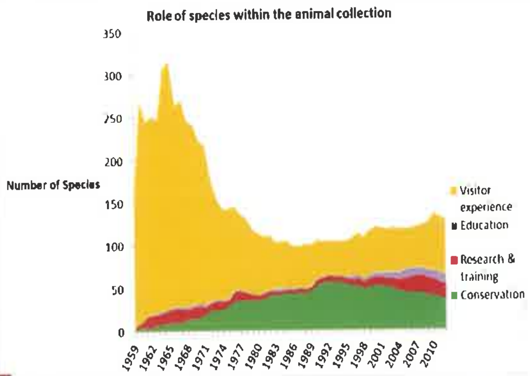
- **Research and Training**
  Undergoing specific applied research that directly contributes to conservation of that species/related species **or** provides targeted training opportunities that contribute to the conservation of that species or related taxa

Species role classification

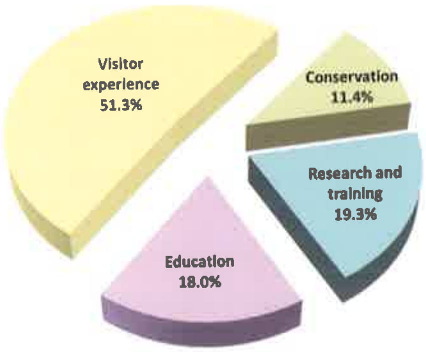
- Education
  - Conservation Education – Raises awareness and generates financial or other support for Durrell's conservation programmes
  - General Education – has clearly defined educational value on the basis of novel or remarkable characteristics of appearance, natural history and behaviour

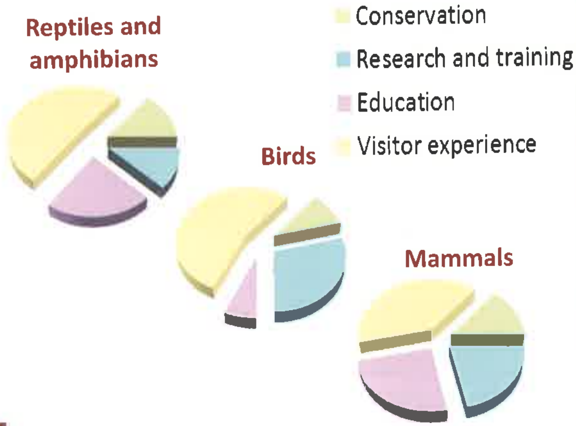
- **Visitor experience**
  Engaging to visitors and is held in the collection to drive revenue through admissions, adoptions or shop sales, and/or enhances an exhibit space. Makes no clearly defined contribution to conservation, education, research or training.

Historical species' roles



Species' roles - current collection





Collection planning

- Set and reassess objectives for each species
- Annually assess species' roles
- Include contribution of a variety of stakeholders
- Coordinate with other zoos and organisations

ENCLOSURE DESIGN

MODERN TRENDS AND LESSONS LEARNED

Enclosure design

Modern trends and lessons learned

Outline

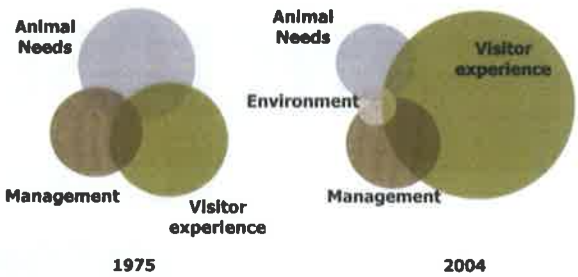
- Stakeholders
- Recent developments
- Examples
- Questions and discussion

Animal exhibits – the stakeholders

- Animal (resident)
- Managers (keepers)
- Visitors
- Environment

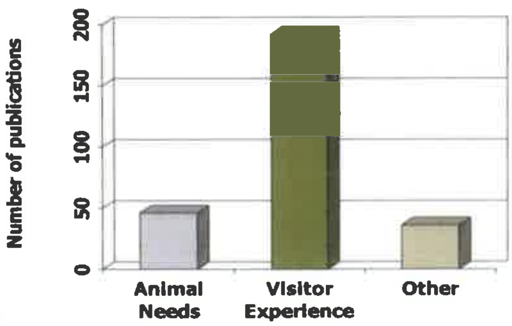
"Vets and **architects** are the most dangerous animals to let loose in the zoo"
Gerald Durrell, *The Stationary Ark*

Approximate proportion of content focussing on various design elements gathered from Zoo Design Symposiums



Melfi, Bowkett, Plowman and Pullen, 2005

Numbers of references to animal needs, visitor experience and other issues in Zoo Design Bibliography (www.zoolex.org)



Melfi, Bowkett, Plowman and Pullen, 2005

The Five Freedoms

Freedom	Provision
From thirst, hunger and malnutrition	Access to fresh water and a nutritionally balanced diet
From discomfort	A suitable environment, including shelter and a comfortable resting area
From pain, injury and disease	Prevention or rapid diagnosis and treatment
To express natural behaviours	Sufficient space, proper facilities, and company of the animal's own kind
From fear and distress	Ensuring conditions that avoid mental suffering

Naturalistic enclosures

- Real or realistic?
- Immersion exhibits
  - simulated
  - walkthrough
  - free-ranging

Human-animal contact

- Benefits to people
  - 'biophilia'
  - provide enhanced educational opportunities

- Benefits to zoo managers
  - increase zoo attraction (petting zoos)
  - fundraising opportunities

Human-animal contact

- Benefits to animal
  - enriching or stressful?
  - differences between species (e.g. primates and felids)
  - keeper bonds important

- Risk of zoonoses and injury

Space versus complexity

- How big is big enough?
  - flight distance determines minimum
  - visitor and management issues influence maximum
- Complexity equally, or if not more, important?
- Needs to be complex, dynamic and large enough to house appropriate social groups

Hosey et al. (2009). Zoo Animals: Behaviour, Management and Welfare. Chapman & Hall .

Jewels of the Forest

- Aim – create walkthrough exhibit showcasing birds of SE Asia
- Constructed 2005
- Natural enclosure – minimal signage

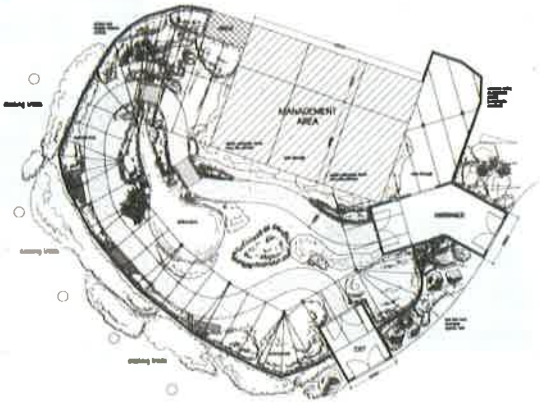
Problems...

- Poor survivorship and breeding in walkthrough aviaries historically
- EAZA Bird TAGs stated captive bird populations must be sustainable – no wild imports

...and solutions

- Numerous off-show areas
- Discrete, refuges within main enclosure space
- Close monitoring by staff

Jewels of the Forest



Jewels of the Forest



Jewels of the Forest



Jewels of the Forest



Jewels of the Forest

- Popular with visitors – cited as one of best exhibits in park

- Breeding success with every species housed in aviary

Free-ranging tamarins

Aim – to display tamarins in naturalistic setting


What is "free-ranging"?

•Minimal physical or management restrictions on ranging behaviour

- not a large cage/enclosure
- not an island
- minimal human intervention
- exploit behaviours as boundaries

•Ultimately some restrictions on ranging do exist

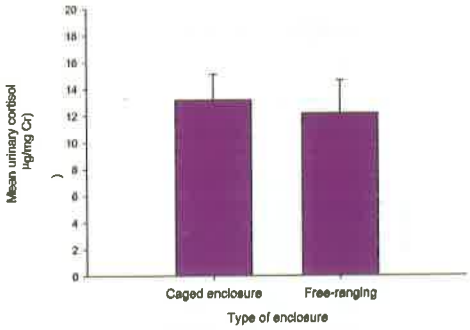
Free-ranging tamarins

- Ongoing since 1990
- 20 releases to date
- Approx. 130 individuals
- 8 species
- Multi-species

Benefits of free-ranging

- Improved quality of life for animals
  - improved health
  - enhanced environmental enrichment
- Improved public exhibit and education tool
- Provide opportunities for research

Improved health



The mean urinary cortisol values for Pied tamarins housed in a caged enclosure and those in a free ranging environment

Conserving natural behaviours

"Failure to reproduce an environment that is at least functionally equivalent to that of the wild will inevitably result in the loss of many forms of natural behaviour."
Sheperdson (1994), *Creative Conservation*, Chapman & Hall

"The diversity of culturally transmitted behaviours (such as infant rearing and food preference) has the potential to be lost much faster than genetic diversity."
May (1991), *Symposium Zool. Soc. London* (62), 145 -163

- Unlike genes behaviour cannot be frozen in a test tube!

Improved public exhibit and education tool

Reactions of zoo visitors to free-ranging monkeys

Price et al.

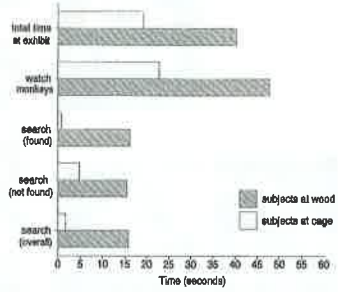


Fig. 1. Mean time per visitor spent at two different cotton-top tamarin exhibits.

Price *et al* (1994), *Zoo Biology* **13** (4), 355-373

Reactions of zoo visitors to free-ranging monkeys

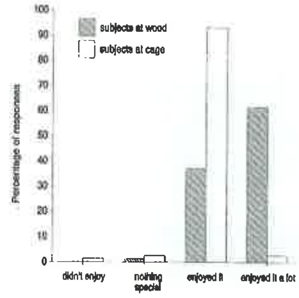


Fig. 3. Enjoyment of zoo visitors at two different types of cotton-top tamarin exhibit.

Price *et al* (1994), *Zoo Biology* 13 (4), 355-373

Reactions of zoo visitors to free-ranging monkeys

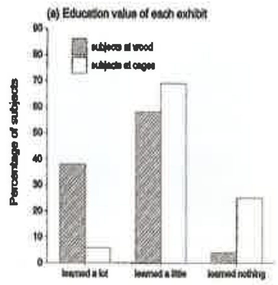
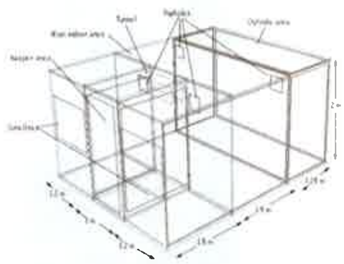


Fig. 5. Assessment by visitors of the amount learned at the two different types of exhibit.

Price *et al* (1994), *Zoo Biology* 13 (4), 355-373

Free-ranging internal accommodation

New woods shed for free-ranging pied tamarins (3)



Free-ranging tamarins - analysis

- Positive experience for visitors
- Relatively cheap enclosure to construct and maintain
- Inherent risks to free-ranging option
- Overall improved health – physiological and behavioural

Island Bat Roost - background

- Livingstone's fruit bat – critically endangered
- Small captive population established 1993
- Large-bodied
  - 800 - 950 g adult body weight
  - 1 m adult wingspan

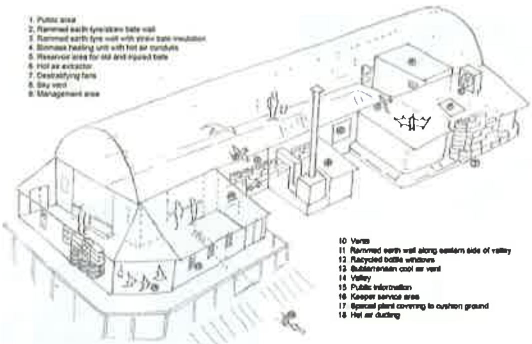
Island Bat Roost - background

- Colony initially housed in modified orangutan enclosure

Island Bat Roost - aims

- Provide adequate flight space
- Provide safe space allowing non-flying bats to develop skills
- Provide appropriate environmental conditions
- Engage visitors with a 'non-engaging' species
- Build to have low environmental impact

Island Bat Roost



Island Bat Roost – the 'green' build

- Tyre wall construction
  - recycling a discarded material
  - provides a heat sink

Island Bat Roost – the 'green' build

Island Bat Roost – the 'green' build

Island Bat Roost

Island Bat Roost - analysis

- Significantly improved welfare standards – increased fitness and flying ability

- Improved visitor experience and influence on public perception

Island Bat Roost – environmental credentials

- Low environmental impact of building materials – large proportion recycled or natural
- Passive heating and cooling reduces energy costs
- Bio-burner combusts zoo waste

Enclosure design process

- Represent stakeholders (and consider external personnel)
- Demonstrate environmental sustainability, biophilia and animal welfare at every opportunity
- Consider employing a designer on staff
- Include natural vegetation whenever possible
- Utilise other zoo designs – but don't perpetuate mistakes

David Hancocks, The Future for Zoos, IZN, 2012

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ZOOS AND ZOO ASSOCIATION

COOPERATION FOR CONSERVATION

Zoos and Zoo Associations

Cooperating for Conservation

Outline

- Introduction to zoo organisations
- The World Zoo Strategy
- Critique – are zoos doing enough?
- Cooperation within the zoo community
- Discussion

National level - CZA

- Established 1992
- Assess zoo standards and grant recognition where appropriate
- Increase technical skills and promote research within member institutions
- A government body for zoo regulation

National level - CZA

- Vision
  "Our zoos will have healthy animals in eco-system based naturalistic enclosures, supportive to in-situ conservation, with competent and contented staff, good educational and interpretive facilities, the support of the people and be self-sufficient."

National level - BIAZA

BIAZA
BRITISH & IRISH ASSOCIATION OF ZOOS & AQUARIUMS

- Established 1966
- Paid subscriptions
- Promotes animal welfare, education and conservation work within UK zoos
- Endorses research projects
- Liaises with UK government on zoo licensing

Regional associations

EAZA
PEAZWV
ARAZPA
ASSOCIATION OF ZOOS & AQUARIUMS
PAAZAB
AFRICAN ASSOCIATION OF ZOOS & AQUARIA

Regional level - EAZA

- Facilitates cooperation within European zoo community, primarily through collection planning
- 322 members
- Established 1992
- Subscription based
- EEPs /ESBs
- Training in studbook management
- Campaigns

International level - WAZA

World Association of Zoos and Aquariums | WAZA
United for Conservation

- Founded in 1946
- Represents 24 regional and national zoo associations
- 1300 zoos and aquariums worldwide
- Membership fees
- Based at IUCN headquarters

International level - WAZA

World Association of Zoos and Aquariums | WAZA
United for Conservation

- Objectives:
  - to promote cooperation between zoos and aquariums with regard to the conservation, management and breeding of animals in captivity
  - to promote and coordinate cooperation between national/regional associations **and** with other conservation organisations
  - to assist in representing zoos and aquariums in other international assemblies
  - to promote environmental education, wildlife conservation and environmental research

IUCN

- Largest professional global conservation network
- Established 1948
- >1000 member organisations (200 GOs / 800 NGOs)
- Funded by governments, bilateral and multilateral agencies, foundations, member organisations and corporations
- Neutral forum
- Red List of Threatened Species

ISIS

ISIS
International Species Information System

- Knowledge database
- Established 1973
- Subscription
- ARKS / MEDARKS / SPARKS
- ZIMS

CITES

- Convention on International Trade in Endangered Species of Endangered Flora and Fauna
- 5000 animal species / 28000 plant species protected
- Controls international trade through licensing

How do these organisations interact?

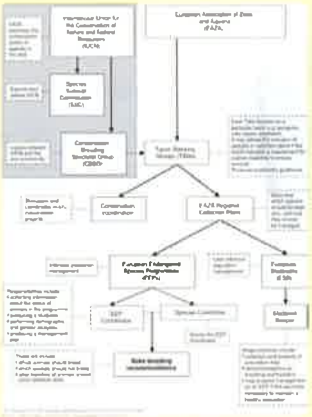


Fig. 18.8 The organisation of EAZA breeding programmes

Zoos – a force for change?

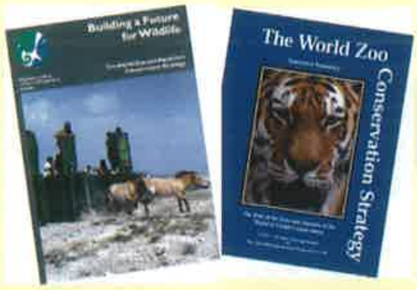
- Zoos maintain over 500,000 individuals of terrestrial vertebrates, representing 3,000 species of mammals, birds, reptiles and amphibians
- For the major 1,000 world zoos, capital represents around US$ 5 billion and at least US$ 2 billion dollars per year in operating costs
- More than 600 million people visit zoos annually (over 10% of entire world population)

Zoos – uniquely placed

- Models of "integrated conservation"
  - ex-situ breeding
  - research
  - public education
  - training
  - advocacy
- Huge 'captive audience'
- Large resource of technical skills and dedicated people

WAZA strategy

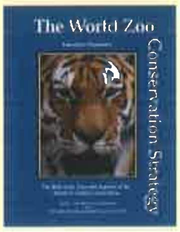
World Association of Zoos and Aquariums | WAZA
United for Conservation



"The major goal of zoos and aquariums will be to integrate all aspects of their work with conservation activities"

WAZA Conservation Strategy (v1)

- First World Zoo Conservation Strategy published 1993
- 10 year strategy
- Unifying purpose and philosophy
- Outlined zoos **must** support conservation
- Introduced "integrated conservation"



WAZA Conservation Strategy (v2)

- Published 2005
- 250 contributors
- 9 chapters

"Today more and more of us live in cities and lose any real connection with wild animals and plants"

(David Attenborough, 2004)

WZACS - Conservation of Wild Populations

- Reintroductions and translocations
- Wildlife health
- Develop field conservation units
- Pool funding
- Zoo site enhancement for native wildlife
- Training courses

...shift in focus from transfer of animals to transfer of knowledge and skill...

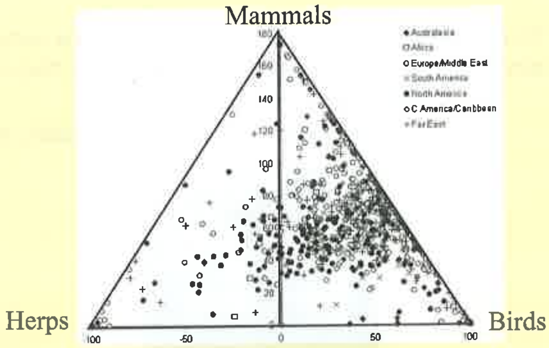
WZACS - what should zoos be?

- Respected scientific institutions, integrated into the scientific community
- Centres of expertise in small population biology
- Learning organisations
- Ethical and maintaining high standards of welfare
- Sustainable
- Fun!
- Cooperative

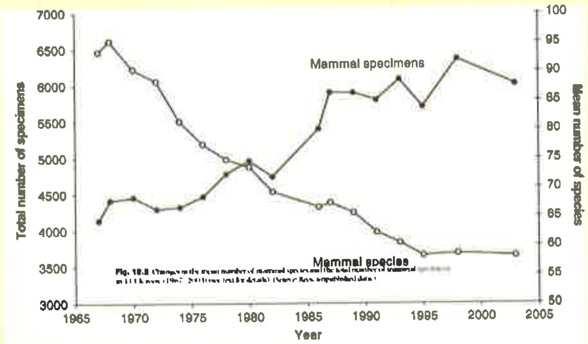
Do most zoos implement WZACS?

- Zoo collections not yet geared to in-situ conservation efforts - can a conservation agenda compete against commercial reality? (Stanley Price & Fa, 2007)
- A dramatic difference exists across institutions in their commitment to conservation (Miller et al., 2004).
- Scope for species conservation through captive breeding limited:
  - limited availability of space and resources
  - problems of husbandry, reintroduction, cost, domestication and disease.

Zoo collection profiles

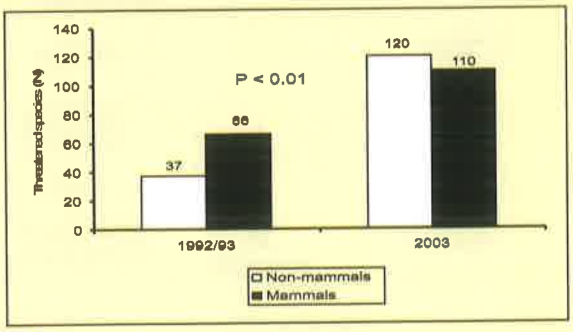


Zoo collection profiles



An Introduction to Zoo Biology and Management First Edition. Paul A. Rees
© 2011 Paul A. Rees. Published 2011 by Blackwell Publishing Ltd

Threatened species in captive programmes in 1992/93 and 2003



Are zoos doing enough?

- Positives
  - More coordinated programmes
  - Better balance of non-mammals to mammals
- Negatives
  - Continued skew to large mammals and birds
  - Continued lack of emphasis on "re-introducability"


Are zoos doing enough?

- More quantitative analysis is required – performed by conservation biologists to provide balance and constructive analysis
- Develop rational criteria to identify threatened taxa to include in captive breeding programmes
  - select small bodied animals (breeding and cost)
  - ensure habitat remains for reintroductions

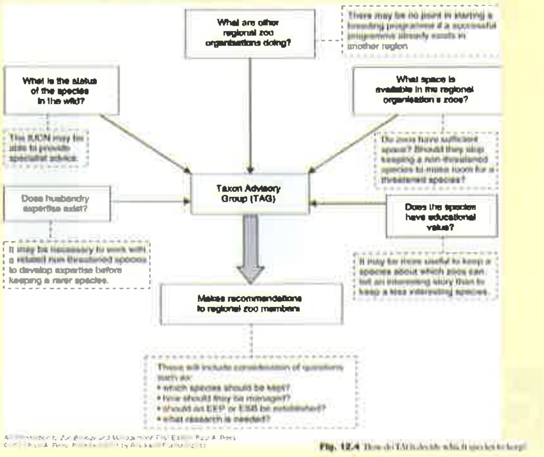
Why cooperate?

"No zoo or aquarium is an island – it cannot alone carry out everything needed for biodiversity conservation. Thus these institutions need partnerships..."
(Building a Future for Wildlife - WZACS, 2005)

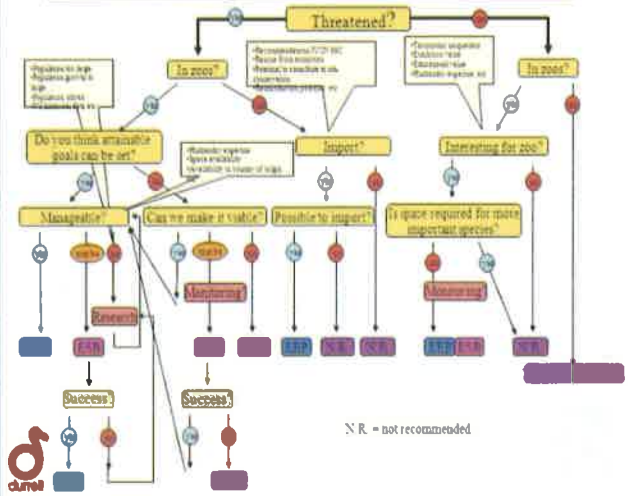
Population management

- Provide emergency responses to accommodate and breed threatened species
- Target self-sustaining zoo populations – removal from the wild politically and ethically problematic
- Regional collection planning metapopulation management


Regional collection planning



Decision Tree for Regional Collection Plan for Callitrichidae



Influencing policy and legislation

Information exchange

- Collaborative research projects
- ISIS
- Husbandry guidelines
- zoobiology/zoonews web forums

Improving standards

- Collective responsibility to raise welfare standards in zoos
- Zoo outreach programmes
  - to raise standards in developing zoos
  - enable effective conservation programmes

What impedes cooperation?

- Cultural differences
- Distance
- 'Politics' - hubris
- Competition

...some institutions opt out, others 'evicted'...

Mountain chicken (*Leptodactylus fallax*) - reintroduction

Mountain chicken (*Leptodactylus fallax*) - reintroduction

- Chytrid fungus severe threat to a compromised wild population
- Emergency collection of captive population in 1999
- Biosecure units established at four European zoos
- Animals bred under strict quarantine conditions
- 3 releases to Montserrat to date

Mountain chicken (*Leptodactylus fallax*) - reintroduction

- Collaborations on
  - Husbandry development
  - Staff interchange between institutions
  - Development of anaesthesia protocol
  - Funding
  - Grant applications
  - Staff to field for reintroductions

Conclusions

- WZACS provides a robust guiding strategy
- Collectively zoos have yet to implement it effectively
- Cooperation imperative to effectively conserve endangered species

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Conservation Breeding Programme In Aszbg

Presented by :

Mr. Utpal Borah, IFS

Director, Assam State Zoo cum Botanical Garden

CONSERVATION BREEDING PROGRAMME IN ASZBG

Prepared by :
(U. Bora, IFS)
Director,
Assam State Zoo-cum-Botanical Garden,
Guwahati-5

Breeding success

- Assam State Zoo-cum-Botanical Garden is considered as one of the important ex-situ conservation centre with particular reference to rare and endangered wild fauna of the North East Bio-geographic zone.
- The zoo since its inception achieved remarkable success in the breeding of rare species of mammals, birds and reptiles.
- Breeding of various species viz. Leopard Cat, Rhino, Serow, Jungle Cat, Tiger, Golden Langur, Black Buck, Himalayan Black Bear, Brow antlered deer, etc. are taking place in this zoo.
- Lately, the zoo has initiated steps for systematic conservation breeding programme for 3 species out of total 5 designated species suggested by Central Zoo Authority.

Successful captive breeding:

- Assam State Zoo is famed for it success in breeding in captivity.
- During 1974 the zoo had taken up the breeding of the endemic Pygmy Hog in captivity and 4 hogs were brought form Barnodi RF and kept in specially designed enclosure away from visitors. The efforts were rewarded, as 4 piglets were born in 1976.
- White-winged Wood Ducks was brought to the zoo in 1970, and it bred regularly in the zoo, before succumbing to diseases.
- The zoo has a glorious past history with regard to the breeding in captivity of various species such as Golden Langur, Stamp Tailed Macaque, Pig tailed Macaque, Himalayan Black bear, Serow, Rhino, Tiger, Leopard Cat, Jungle Cat, Rosy Pelican (regularly) et.

- Regarding breeding of exotic species, breeding of Hippopotamus has been quite successful. Egg laying of Cassowary has been a regular phenomenon, but raising chicks of this species has not been successful.
- The Central Zoo Authority has assigned the zoo with the responsibility for the conservation breeding of certain identified critically endangered species.

Conservation Breeding Programme

- **Coordinating Zoo**
  hino, Golden angur erow Golden cat, & Grey peacock pheasant.
- **Participating Zoo**
  louded leopard, Sun Bear, Binturong, Pigtailed macaque,Stump tailed macaque,Hoolockgibbon,hamindeer,Pygmy hog & Vulture.

Recent initiatives

Rhino Conservation Breeding enclosure constructed during 2011-12
Features :
- Off-display (1.3 ha / 4 compartment)
- Some degree of enrichment
- Founder population : 2:2 (4)


Breeding and species recovery plan : in the process of preparation.

Golden langur Conservation Breeding enclosure constructed during 2012-13

Features :

- ❖ Off-display (2316 sq.mt)
- ❖ Enrichment : Good
- ❖ Founder population: 4:2 (6)

Breeding and species recovery plan : in the process of preparation.

Rhino

Details of the captive population in Assam State Zoo

Sl. No.	House Name	Identification Mark (Ear tag)	Sex	Date of Birth	Date of Arrival	Ageat the time of arrival	Type of birtj	Wild origin	Sire	Dam	National Studbook No.	International Studbook No
1.	Laxman	Nill	M	-	27-1-1980	4. yrs. apprpx	Wild born	Kuruwa	Wild	Wild	Nil	169 Assam-21
2.	Bishnu	Nill	M	11.5-1987	-	-	Zoo born	-	Laxman	Gita	Nil	173 Guwahati-5
3.	Mahesh	Nill	M	30-3-1989	-	-	Zoo born	-	Laxman	Gita	Nil	176 Guwahati-5
4.	Baghek haili	CE 0092 07	F	-	10-8-1991	1 year	Wild born	Kaziranga	Wild	Wild	Nil	192 Kaziranga-27
5.	Pori	CE 0093 07	F	4-6-2002	-	-	Zoo born	-	Bishnu	Baghekhahi	Nil	Nill

Criteria for selection Rhino for breeding:

- ⦿ uitable age: For male 12 to 25 years of age. For female 10 to 22 years of age.
- ⦿ reeding status: Breeding experience (proven sire or dame).

Golden langur

Details of the captive population in Assam State Zoo

Sl No.	House Name	Identification number (Microhip)	Sex	Date of arrival	Age at the time of arrival	Date of birth	Sire	Dam	Source	Status
1.	Ramunda	0006B761FF	Male	22/4/03	8yrs appx	....	Wild	Wild	Kachugaon Division	Captive
2.	Joon	0006B71796	Male	....	....	03/11/2	Ramunda	Chameli	Zooborn	Captive
3.	Moon	0006B715ED	Male	......	....	04/04/08	Ramunda	Chameli	Zooborn	Captive
4.	Ramu	0006B769A3	Male	3/7/7	2yrs appx	....	Wild	Wild	Kachugaon Division	Captive
5.	Uma	0006B71EB7	Female	17/2/11	7yrs appx	....	Wild	Wild	Bongaigaon	Captive
6.	Aievy	....	Female	4/12/11	3yrs appx	....	Wild	Wild	Bongaigaon	Captive

Criteria for selection Golden langur for breeding:

- ⦿ Suitable age: For male 5 to 20 years of age. For female 4 to 18 years of age.
- ⦿ Breeding status: Breeding experience (proven sire or dame).

Issues

- ⦿ **Biologist / Resource personnel**
- ⦿ **Field personnel**
- ⦿ **Founder population**
- ⦿ **Genetic profiling**

For executing Conservation Breeding Programme adequate manpower with experts are required as this activity demands tremendous work such as data handling, recording physiological and genetical behavior, etc. Hence some special posts like for instance a Biologist needs to be appointed in this zoo.

Golden langur at ASZ

Golden langur at ASZ

CONSERVATION BREEDING OF WESTERN TRAGOPAN

PRESENTED BY:

MR. SATISH NEGI

DFO Wildlife Sarahan
Himachal Pradesh

Western Tragopan
(Tragopan melanoephalus)

SARAHAN PHEASANTRY

- **LOCATION :** SARAHAN BUSHAHAR [188 KM FROM SHIMLA]
- **YEAR OF ESTABLISHMENT :** 1987-88
- **INITIAL AREA :** 3.50 HA.
- **PRESENT AREA :** 11-12-37 HA.

SARAHAN PHEASANTRY

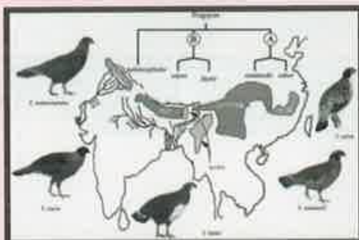
- **OBJECTIVE :-**

➢ RESCUE & REHABILITATION CENTRE FOR "WESTERN HIMALAYAN FAUNA" [1987-88]
(due to heavy snow fall in high reaches)

➢ CONSERVATION BREEDING CENTRE FOR "WESTERN TRAGOPAN" [1989-90]

SARAHAN PHEASANTRY

- INITIALLY 2 PAIRS OF WESTERN TRAGOPAN WERE RESCUED. [THAR JOT AREA]
- YEAR 1993 :1ST EVER BREEDING OF WESTERN TRAGOPAN IN CAPTIVITY WITNESSED.



WPA, 1972: Schedule – I

IUCN: vulnerable

CITES: Appendix- I

- Pakistan, Kashmir, Himachal Pradesh and Uttarakhand
- Population estimate: ~5000 individuals [Richard & Garson]
- Decreasing population trend due to poaching, habitat loss and grazing

WESTERN TRAGOPAN

- Endemic to north-west Himalayas
- Inhabits high altitude temperate forests (1750- 3600m)
- Sexually dimorphic
- Seasonal breeders: April-June
- Clutch size: 3-5 eggs; Incubation time: ~28days

SIGNIFICANCE

- Flagship species and State Bird of Himachal Pradesh
- Known for their distinctive and unique courtship patterns
- Inadequate data on the biology and behavior of the species

CAPTIVE POPULATION

- Key facility: Sarahan Pheasantry (Kufri Zoological Park with 2 males for exhibit purpose)
- Established during 1989-1990
- Currently housing 4 species of pheasants viz. Western tragopan, Himalayan Monal, Kalij pheasant and Cheer pheasant
- Consists of both wild-born and captive bred individuals
- Previous breeding years (Western tragopan): 1993, 2005, 2007, 2008 and 2009

INVENTORY SARAHAN PHEASANTRY

SPECIES	NO. OF INDIVIDUALS		Total
1. Western tragopan	12 males /	12 females	24
2. White-crested Kalij pheasant	2 males /	1 female	3
3. Himalayan Monal	2 males	-	2
4. Cheer pheasant	-	1 female	1
		Total	30

INFRASTRUCTURE

DETAILS OF ENCLOSURES

Block 1	Block 2	Block 3	Block 4	Block 5	Block 6
2 aviaries	3 aviaries	2 aviaries	1 aviary	2 aviaries	10 aviaries
Western tragopan	Western tragopan	Western tragopan	Western tragopan	empty	Other species

PROJECT OBJECTIVES

CAPTIVE POPULATIONS

- Genetics (level of inbreeding in population) and demographic parameters
- Studies on behavior and reproductive biology
- Veterinary management
- Husbandry guidelines for captive management

WILD POPULATIONS

- Mapping distribution and estimating population size in Himachal Pradesh
- Identification of potential release sites

2011 AND BEFORE...

- Mortalities during breeding season
- Breeding problems: Weak-shelled eggs, no incubation behaviour by females, low reproductive output of the population

↓

- Mortalities during breeding season
- Breeding problems: Weak-shelled eggs, no incubation behaviour by females, low reproductive output of the population

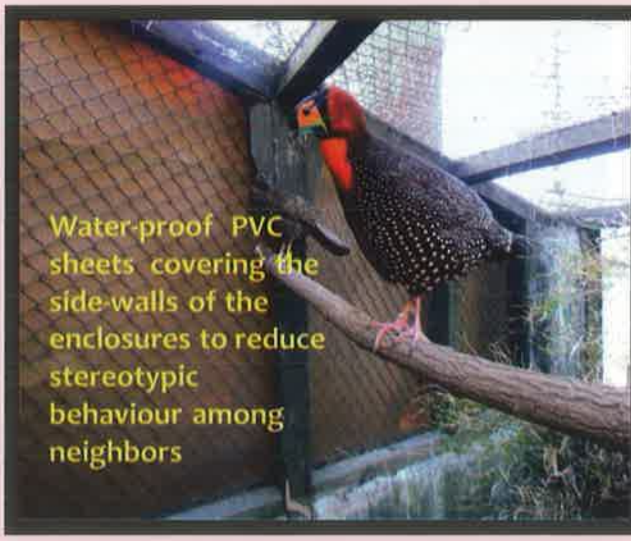
IN LATE 2011...

- Initiation of the project
- Coordinated efforts towards improving the situation at the pheasantry was carried out in terms of:
  - Enclosures
  - Feeding
  - Breeding requirements
  - Stress reduction

IMPROVEMENTS

ENCLOSURES

- Reinforcement of old enclosures
- Merging of multiple enclosures to provide additional space to the birds
- Installation of visual barriers
- Pest management in terms of rat trapping and repair of enclosures



IMPROVEMENTS

DIET IMPROVEMENTS

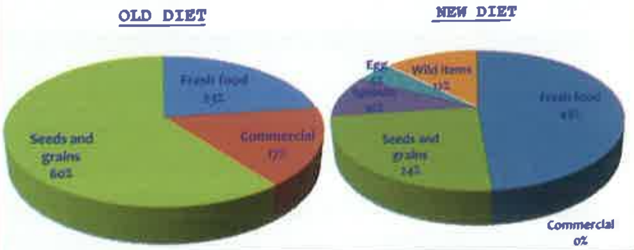
- A new feeding regime was developed with emphasis to the feeding ecology of the birds
- The new feeding system was initiated prior to the onset of breeding season in 2012

DIET

- 20% fruits+20% vegetables+25% greens+20% seed mix+10% sprouts+5% animal protein (egg/insects)
- Emphasis givrn to fresh vegetative matter
- Feeding done twice a day: 0600-0700h and 1400-1500h

FEEDING

DIVERSITY, QUANTITY AND PRESENTATION



FEEDING TIMES	
Fresh food, egg, sprouts and wild items	Morning: 0600-0700h
Seeds and grains	Afternoon: 1400-1600h

IMPROVEMENTS

BREEDING REQUIREMENTS

- Improvised elevated nesting platforms
- Multiple nesting sites in each enclosure
- Nests placed at different heights

OUTDOOR NESTS

INDOOR NEST

Female inspecting nest site

IMPROVEMENTS

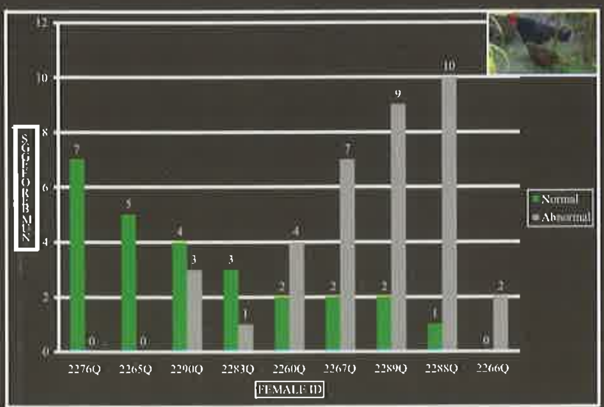
STRESS REDUCTION

- Practice of reduction of day-light hours available to the birds discontinued
- Continuous administration of antibiotics discontinued
- Keeper regimes improved

RESULTS

1. Egg laying

1. All the females of the captive population have laid eggs in the breeding season 2012
2. A total of 25 normal eggs have been laid by 8 different females
3. "*Less females have abnormal eggs.*"

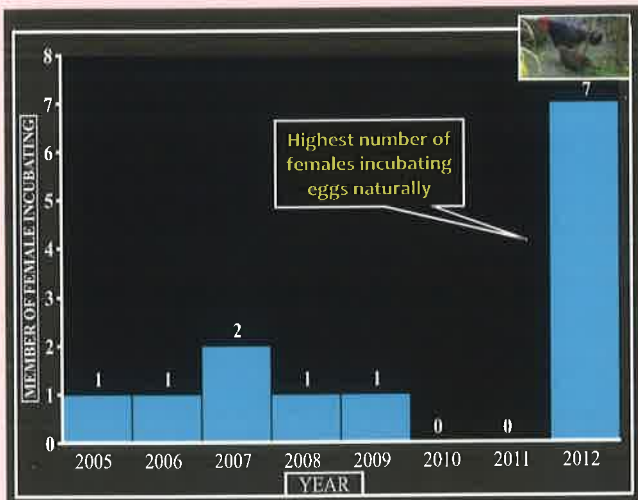


EGG LAYING BY DIFFERENT FEMALES: 2012

RESULTS

2. Incubation

- Seven out of nine females showed incubation behaviour in 2012
- "*The breeding season 2012, recorded the highest number of females incubating the eggs naturally.*"

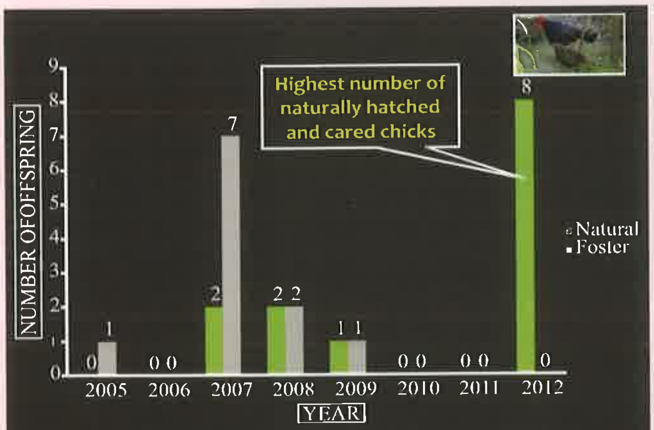


Incubation behaviour in females: 2005-2012

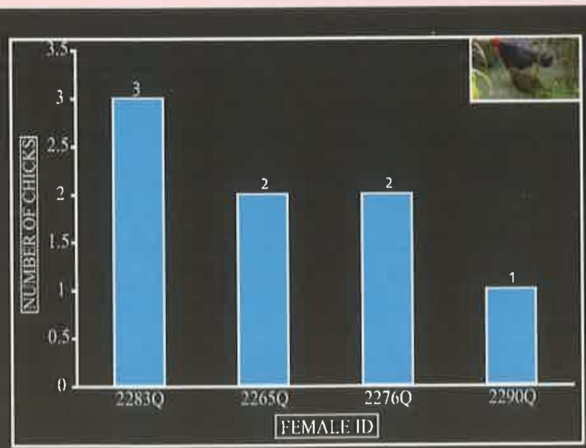
RESULTS

3. Hatching and chicks

- All the seven hens have completed the incubation successfully
- Eight chicks have hatched and Seven are being cared naturally under four different hens
- "*The breeding season 2012, has recorded the highest number of naturally hatched and reared chicks.*"



Chicks hatched under natural mothers and foster hens: 2005-2012



Chicks reared under different hens: till July 2012

EXPECTED OUTCOME

- Distribution and population assessment of wild populations of Western tragopan
- Genetic and demographic profile of captive birds
- Activity profile and behavioral patterns in captive birds
- Protocols for science-based management of captive populations
- A list of possible release sites for future reintroductions


Thank You
Lakshminarasimh

ACTIVITIES OF ON CONSERVATION BREEDING AT SEPAHIJALA ZOOLOGICAL PARK, TRIPURA.

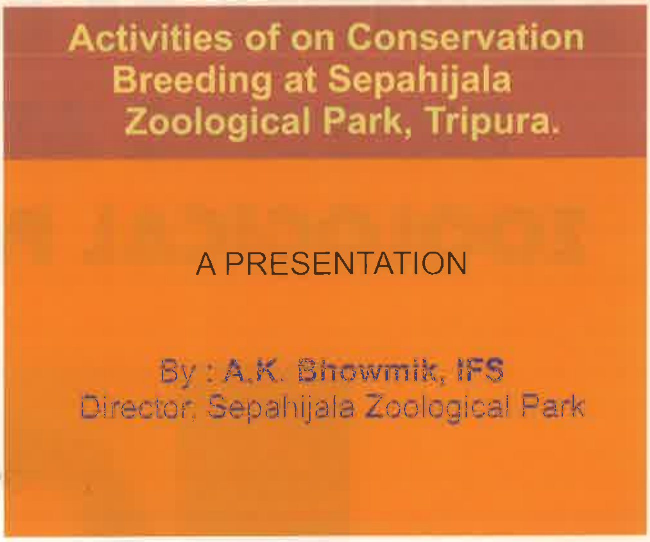
PRESENTATION BY :

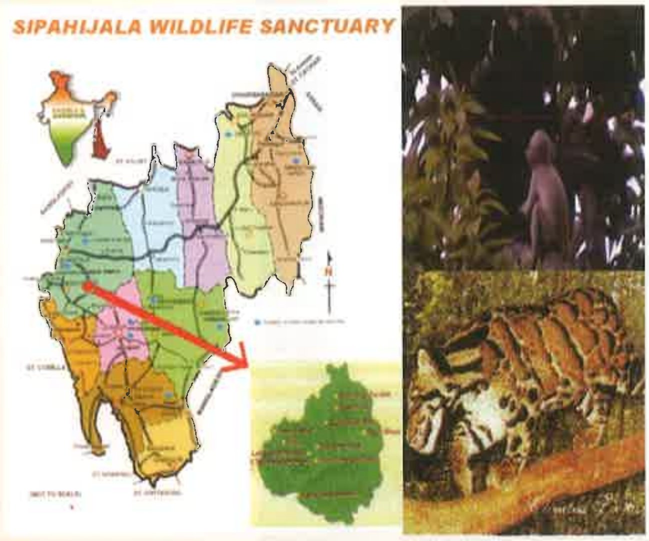
A.K. Bhowmik, IFS

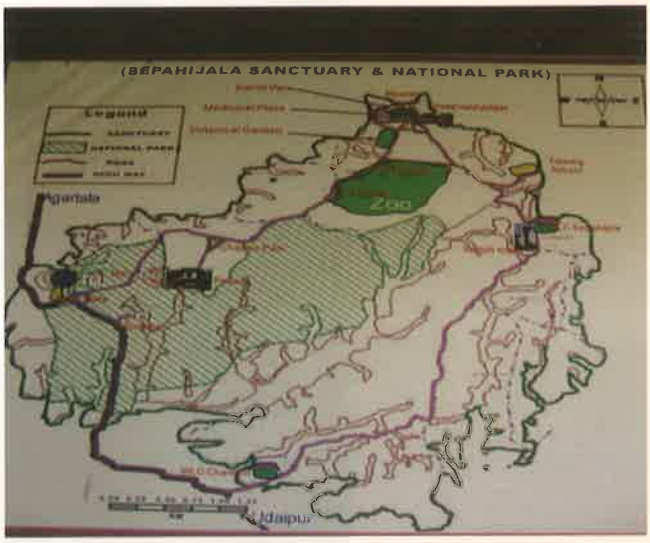
Director, Sepahijala Zoological Park

Tripura


Welcome
Resource persons as well as Participants attending endangered Species Recovery course at Darjeeling Zoo.


Activities of on Conservation Breeding at Sepahijala Zoological Park, Tripura.
A PRESENTATION
By : A.K. Bhowmik, IFS
Director, Sepahijala Zoological Park


SIPAHIJALA WILDLIFE SANCTUARY


(SEPAHIJALA SANCTUARY & NATIONAL PARK)
Legend
Zoo
Agartala
Udaipur


SIPAHIJALA ZOO


SEPAHIJALA ZOOLOGICAL PARK TRIPURA
PREMIER EX-SITU CONSERVATION CENTRE

Introduction

- Sepahijala Zoo was stared with a small deer park in 1972 and was later extended slowly over the years by introduction of more animals for Ex-situ conservation and creation of awareness among the masses, particularly the school children, on the values of wildlife and necessity to conserve it.
- The zoo is situated within Sepahijala wildlife Sanctuary in west Tripura district and about 30 km. away from Agartala, the state capital.
- It is surrounded by lush green forests on three sides and by road on the Northern Side. Presently the zoo is extended over 68 hectares area.
- The necessity to manage and develop the zoo on scientific lines has been felt in tune with modern principles of zoo management.

Status of Sepahijala Zoo

As per instant Recognition by CZA, Sepahijala Zoo has been placed as one of the **16** Medium Zoos in the Country.

Status of animals of Sepahijala Zoo as on 31-3-2012.

Particulars	No of Species	Sex-wise total individual	Total
Birds	18	20.24.3	47
Mammals	27	219.248.14	481
Reptiles	6	8.11.0	19
Total	51	47.283.17	547

Endangered species displayed by Sepahijala Zoo as on 31-3-2012

Species	Numbers
Birds	7
Mammals	20
Reptiles	6

Total= 33 species

Total animals of endangered species = 146

Recognition of Sepahijala zoo

The Central Zoo Authority, Govt. of India evaluated Sepahijala Zoo on 15-05-2011 and granted renewal recognition of Sepahijala zoo up to 31st July 2015.

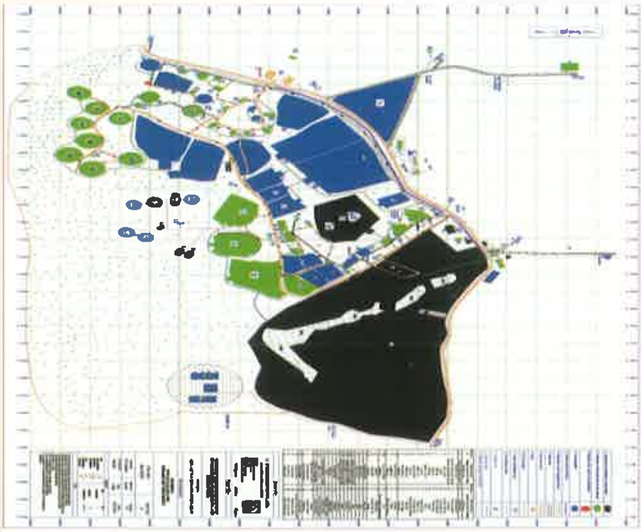
Master Plan of Sepahijala Zoo

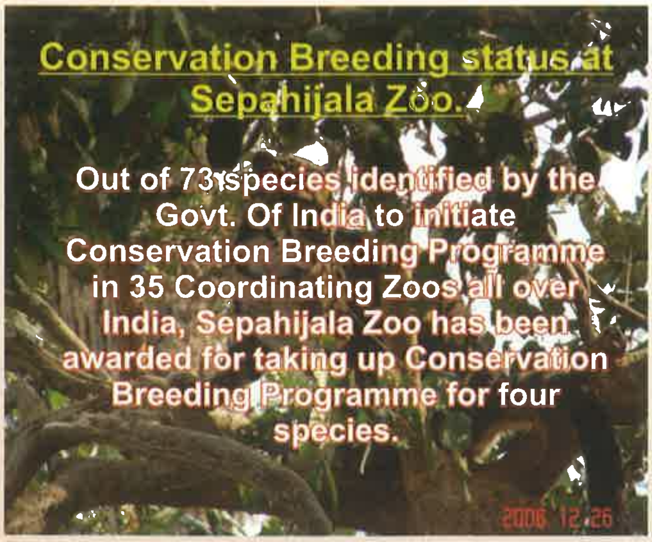
As per instruction of CZA Master Plan of Sepahijala Zoo has been finalized and will be sent soon to CZA on receipt of approval of State Govt. Master Lay out Plan has already been approved by CZA.

CZA expert team visited Sepahijala Zoo on 16-6-2011 led by Mr. R. S. Bhaduria, Ex. PCCF, UP for finalization of Master Plan.

Master Lay out Plan status

Master lay out Plan of Sepahijala Zoological Park has been accepted by the CZA





Pride for Sepahijala Zoo

It is a great honour for Sepahijala Zoological Park, Tripura which has been selected as National Coordinating Zoo for taking up Conservation Breeding Programme of four species viz. **Phayre's leaf monkey, Binturong, Clouded leopard, Pig tailed macaque and Participating Zoo for Hoolock gibbon.**

Coordinating Zoo & Participating Zoo of four species

Name of sp.	CO. ZOO	Pa. Zoo
CL. Leopard	Sepahijala	Guwahati
Binturong	Sepahijala	Guwahati, Aizawl
Pig-tailed macaque	Sepahijala	Guwahati
Spectacle Langur	Sepahijala	--

Selection of Off display CB site

*The Member Secretary, CZA visited Sepahijala Zoological Park on 1-12-2007 and selected off-display CB site adjacent to Tiger enclosure of Sepahijala Zoological Park comprising an area of 16.0 HA.

Total nos of animals to be kept out of CB project in Zoos

It is felt that Indian zoos have at least 250 properly and scientifically bred and physically, genetically and behaviourally healthy individuals of each endangered wild animal species in captivity to act as insurance cover in case of population loss of the species in the wild.

Nos of Founders required for CB project

The Conservation breeding Programme should preferably start with around 25 founders, which are unrelated and have high heterozygosity.

The founders should preferably be of wild origin or of known lineage. Where on account of restricted availability it is not possible to have 25 founders, the programme could be started with fewer animals.

Additional founders could be added in subsequent years.

Minimum time to achieve the goal

Since loss of haterozygosity with each generation is inevitable, it is important that the target effective population is reached in minimum generation.

This would necessitate that reproductive potential of every animal in the programme is fully utilized and no founder animal remain unproductive.

Consultation with National Referal Center & Laboratory for Conservation of Endangered Species (LaCONES)

For genetic health analysis and for reproduction potential evaluation, help of LaCONES have been taken up before induction of any founder animal into the breeding programme.

The National Referral Center as well as LaCONES are continuously being kept involved into the breeding programme.

Marking of individual related to CB project at Sepahijala Zoo

The individuals of all the above four identified species (except infants and carrying females) were marked with microchips and bloods were collected and sent to LACONES, Hyderabad & IVRI, Bariely for genetic as well as physical health checkup.

We received testing reports from CCMB, Hyderabad and found 3 nos Clouded leopard (1 male, 2 female), Three no spectacle langur (1 male, 2 female), 6 nos pig-tailed macaque (3 male, 3 female) are genetically vibrant. Out of the five existing Binturongs, none was found genetically vibrant.

Marking of individual related to CB project at Sepahijala Zoo

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Reading of Marking done with Reader

Proforma for Studbook for Clouded leopard (*Neofelis nebulosa*) of Sepahijala Zoo.

Sl No	Home name and Number	National Stud book number	International Studbook number (If any)	Sex	Sire (National Stud book number)	Dam (National Studbook Number)	Date of Birth dd.mm yy	Location	Since dd.mm.yy	Date of Death dd.mm.yy
1	Nandan, 0006B73987	Nil	Nil	Male	Wild	Wild	10/2/1992	Sepahijala zoo	10/2/1996	Still alive
2	Ghaura, 0006B7F07E	Nil	Nil	Male	Wild	Wild	23-7-97	C.B.C	23-07-01	Still alive
3	Reshmi, 0006B887B1	Nil	Nil	Female	Tazu	Sipi.SEP/000CLO-03	4/5/2003	C.B.C	4/5/2003	Still Alive
4	Rahul, 0006B899A8	Nil	Nil	Male	Tazu	Deshi	13-5-06	Do	13-5-06	Still alive
5	Parul, 0006B88836	Nil	Nil	Female	Nandan	Rehana	29-5-06	Do	29-05-06	Still alive
6	Pratibha, 0006B73C0D	Nil	Nil	Female	Tazu	Rani, Sep/000CLO-19	19-3-07	Do	19-3-07	Still Alive
7	Manmohan, 00064TB34D	Nil	Nil	Male	Gaura	Reshmi	21-6-08	DO	21/6/2008	Still Alive
8	Megh, 00064F38D0	Nil	Nil	Male	Wild	Wild	2/4/1995	DO	22-3-09	Received through exchange from Darjeeling zoo (CH)
9	Lily, 0006590805	Nil	Nil	Female	Nandan	Prativa	14/04/2011	Do	14/04/2011	Still Alive
10	Jui,000647D94C	Nil	Nil	Female	Nandan	Prativa	14/04/2011	Do	14/04/2011	Still Alive
11	Sriti,	Nil	Nil	Female	Gaura	Reshmi	14/03/2010	Do	14/03/2010	Still Alive
12	July, 00065?4EBA	Nil	Nil	Female	Nandan	Reshmi	1/7/2011	C.B.C	1/7/2011	Still Alive
13	Prasanta,	Nil	Nil	Male	Wild	Wild	20/08/2009	Sepahijala Zoo	25/08/2010	Still alive
14	Unnamed	Nil	Nil	Unsex	Nandan	Sathi	19/03/2012	Do	19/03/2012	Still alive
15	Unnamed	Nil	Nil	Unsex	Gaura	Reshmi	2/6/2012	C.B.C	2/6/2012	Still alive
16	Unnamed	Nil	Nil	Unsex	Gaura	Reshmi	2/6/2012	C.B.C	2/6/2012	Still alive

Proforma for stud book for Binturong (Arctictis binturong) of Sepahijala Zoo

Sl. No.	Home name & Number	National Studbook number	International Studbook number(If any)	Sex	Sire(National Studbook Number)	Dam(National Studbook Number)	Date of Birth dd.mm.yy	Location	Since dd.mm.yy	Date of Death dd.mm.yy
1	Kashem, 0006B7DF1A	NiL	NiL	Male	Hashem	Radha	28/01/2003	C.B.Centre	28/01/2003	still alive
2	Mohini 0006B6917E	NIL	NIL	Female	Hashem	Radha	24/12/2000	Sepahijala zoo	24/12/2000	still alive
3	Karishma 0006591EAF	NIL	NIL	Female	Kashem	Radha	28/01/2003	C.B.Centre	28/01/2003	still alive
4	Hashem 0006B7E90C	NiL	NIL	Male	Kashem	Radha	20/03/1992	Sepahijala zoo	20/03/1992	still alive
5	Sonia 0006B737A2	NIl	NiL	Female	Kashem	Mohini	25/03/2007	Sepahijala zoo	25/03/2007	still alive

Proforma for stud Book for Pig-tailed macaque (*Macaca nemestrina*) of Sepahijala Zoological Park

Sl. No	Home name & number	National Stud Book Number	International studbook number (If any)	Sex	Sire (National stud Book number)	Dam(National Studbook number)	Date of Birth dd.mm.yy	Location	Since dd.mm.yy.	Date of Death dd.mm.yy
1	Aaisharia, 0006b71222	Nil	Nil	Female	Wild	Wild	10/6/1993	C.B.C	10/6/1999	Still alive
2	Kumar, 0006B74968	Nil	Nil	Male	Amit	Sonali	18/10/2006	Sepahijala zoo	18/10/2006	Still alive
3	Manish, 0006B74444	Nil	Nil	Male	Wild	Wild	20/03/2004	Sepahijala zoo	21/05/2004	Still alive
4	Ritesh, 0006B71ACB	Nil	Nil	Male	Wild	Wild	25/08/2006	C.B.C	28-5-09	Still alive
5	Sudhir, 0006B7EB25	Nil	Nil	Male	Wild	Wild	23/01/2004	Sepahijala zoo	9/5/2004	Still alive
6	Rina, 0006B88519	Nil	Nil	Male	Wild	Wild	16/09/2004	C.B C	16-12-06	Still alive
7	Misthu, 000659038F	Nil	Nil	Male	Swapan	Sonali	16/03/2008	Sepahijala zoo	16/03/2008	Still alive
8	Maman, 0006590471	Nil	Nil	Female	Manish	Aaisharia	5/6/2008	Sepahijala zoo	5/6/2008	Still alive
9	Shashi, 0006591COD	Nil	Nil	Female	Swapan	Mili	23/01/2007	Sepahijala zoo	23/01/2007	Still alive
10	Manik,0006B72897	Nil	Nil	Male	Manish	Buri	2/7/2008	C B C	2/7/2008	Still alive
11	Kajal, [illegible]	Nil	Nil	Female	Wild	Wild	16/03/2003	Sepahijala zoo	16/03/2005	Still alive
12	Trisha, [illegible]	Nil	Nil	Female	Swapan	Kajal	12/3/2006	Sepahijala zoo	12/3/2006	Still alive
13	Swapan, [illegible]	Nil	Nil	Male	Wild	Wild	14/04/1993	Sepahijala zoo	14/09/1993	Still alive
14	Mili,0006B722C3	Nil	Nil	Female	Wild	Wild	10/5/2006	Sepahijala zoo	20/09/2000	Still alive
15	Mir	Nil	Nil	Male	Wild	Wild	2/1/2007	C.B.C	15-6-2009	Still alive
16	Sarbani,	Nil	Nil	Female	Swapan	Aaisharia	12/7/2003	Sepahijala zoo	12/7/2003	Still alive
17	Buri, 0006B72F3A	Nil	Nil	Female	Bijoy	Sarbani	22/07/2006	C.B.C	22/07/2006	Still alive
18	Unnamed	Nil	Nil	Unsex	Sudhir	Trisha	11/2/2012	Sepahijala zoo	11/2/2012	Still alive
19	Noor	Nil	Nil	Male	Manik	Buri	22/02/2011	C.B.C	22/02/2012	Still alive
20	Kajal	Nil	Nil	Male	Ritesh	Rina	5/3/2012	C.B.C	5/3/2012	Still alive
21	Bani	Nil	Nil	Female	Mili	Aaisharia	19/04/2012	C.B.C	19/04/2012	Still alive

Proforma for Stud Book for Spectacled langur (Trachypithecus obscurus phayrei) of Sepahijala Zoological Park

Sl. No	Home name & Number	National studbook number	International studbook number(If any)	Sex	Sire(National studbook number)	Dam(Natinal studbook number)	Date fo Birth dd.mm.yy.	Location	Since dd mm.yy.	Date of Birth dd mm.yy.
1	Bulti, 00065921B1	NiL	Nil	Female	Wild	Wild	14/12/1996	Sepahijala zoo	14/121996	Still alive
2	Bishu, 0006B71CF7	NiL	Nil	Male	Wild	Wild	7/6/1993	C.B C	17/06/1999	Still alive
3	Ruma,	NiL	Nil	Female	Wild	Wild	28/07/1995	C.B.C	28-7-2000	Still alive
4	Nirmal, 0006671996	NiL	Nil	Male	Wild	Wild	25/10/1999	Sepahijala zoo	20/10/2001	Still alive
5	Sharmista, 0006B7DBF8	NiL	Nil	Female	Wild	Wild	12/2/2001	Sepahijala zoo	12/2/2002	Still alive
6	Rina, 0006590E01	NiL	Nil	Female	Durga	Jhuma	11/11/2006	Sepahijala zoo	11/11/2006	Still alive
7	Reshmi, 0006B718CC	NiL	Nil	Female	Santu	Sampa	1/3/2007	Sepahijala zoo	1/3/2007	Still alive
8	Chumki, 0006590388	NiL	Nil	Female	Durga	Jhuma	25/12/2007	Sepahijala zoo	25/12/2007	Still alive
9	Risha, 0006B72830	NiL	Nil	Female	Dugu	Sharmista	13/03/2009	Sepahijala zoo	13/03/2009	Still alive
10	Lipika	NiL	Nil	Female	Wild	Wild	6/4/2007	Sepahijala zoo	15-6-2009	Still alive
11	Anamika	NiL	Nil	Female	Nemai	Rina	15-2-2012	Sepahijala zoo	15-2 2012	Still alive
12	Pranab	NiL	Nil	Male	Nemai	Sarmistha	4/3/2012	Sepahijala zoo	4/3/2012	Still alive
13	Pratima	NiL	Nil	Female	Wild	Wild	10/2/2009	C.B.C	9/4/2012	Still alive

Present status of animals in CB Project site

Name of species	Nos
Clouded leopard	1:2:2 = 5
Pig-tailed macaque	4:5:0 = 9
Sp. Langur	1:2:0 = 3
Binturong	1:1:0 = 2

Criteria followed for selecting the individuals in CB Project

We selected only those individuals for inclusion in CB project who are genetically more vibrant and recommended by CCMB, Hyderabad.

Binturong at CB Project

Inclusion of new blood required

For inclusion of new blood of Binturong & Clouded leopard and exchange deal in between Sepahijala Zoo & Aizwal is pending with CZA.

Facilities developed during 2008-09 for CB Programme with100% CZA Fund:

Constructed CB enclosure for Spectacled langur, Clouded leopard, Pigtailed macaque, Binturong and Project office.

Total amount spent in this regard:

Rs. 69.30 Lakhs.

CB Project office at Sepahijala

Inauguration of Conservation Breeding Project on 24-5-2010

Inauguration of CB project at Sepahijala

First birth success at CB project

Clouded leopard birth success at CB project

Spectacle langur with baby

Birth success achieved at CB site

Clouded leopard --- One (1-7-2011),
two (2-6-2012)

Pig-tailed macaque---- One (22-2-11),
one (5/3/2-12)
one (19-4-2012)

Maintenance of record for CB project

History sheets of all the individuals of the above five species have been maintained and sent to CZA as was requested.

As per decision of The Central Zoo Authority, Govt. of India, Sepahijala Zoo, Tripura sent stud book information of all the above four species to the CZA

Financial proposal send to CZA during the year 2010-11

As per recent guide line as of CZA, we formulated revised proposals in respect of continuity of Conservation Breeding Programme of four identified species based on long term vision and initial financial involvement was kept for five years duration.

Break up of project proposal 2nd phase

1) Rs.173.80 lakhs for Binturong CB Programme,
2) Rs. 206.40 lakhs for Pig-tailed macaque CB programme,
3) Rs. 218.70 Lakhs for Phayre's leaf monkey CB programme,
4) Rs. 255.90 lakhs for Clouded leopard CB Programme And total financial involvement for an amount of Rs.854.80 Lakhs has been sent to CZA with required information

CZA Expert team visited on 30-01-2011

Evaluation of CZA expert team at CB project of Sepahijala

The expert team of CZA visited Sepahijala Zoological Park on 30-1-2011 and evaluated the Conservation Breeding Project and also as per their recommendation the CZA has released 126.86 lakhs for the year 2011-12 against Conservation Breeding Programme for above mentioned four species. We initiated further proposal of 127.99 lakhs during 2012-13

Major infrastructure component

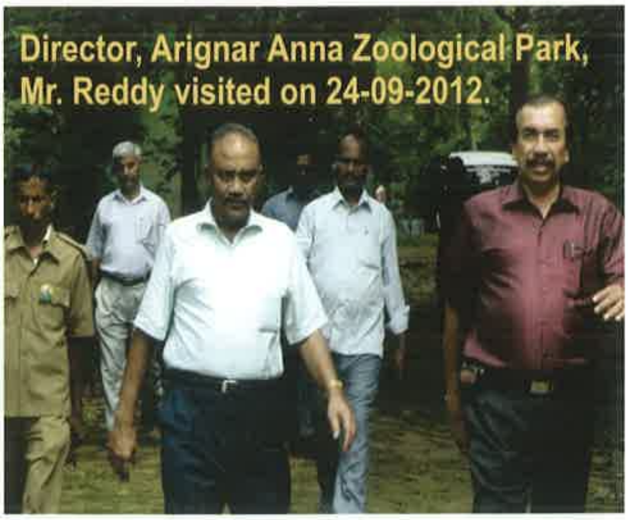
CZA funded wages of two keepers, one vety Assistant & a Biologist during 2011-12 for CB project of which the amount already spent in respect of two keepers and due to non availability of fund we had to discontinue the keepers at CB project since August 2012.

Engagement of a Biologist for behaviour study.

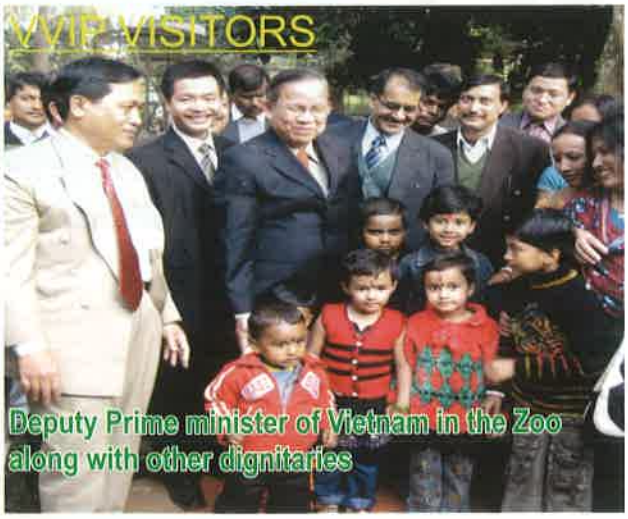
On receipt of CZA fund, we engaged one Biologist for carrying out behaviour study of Spectacle angur & Pig-tailed macaque wef August 2012.

Further immediate requirement

* Wages of two keepers,
* Salary of One vety assistant
* CCTV camera for behaviour study
* Addl. fund for Const. against Clouded leopard & spectacle langur enclosure
* Feeding charges of animals at CB center.


Director, Arignar Anna Zoological Park,
Mr. Reddy visited on 24-09-2012.


VVIP VISITORS
Visit of hon'ble minister of Thailand in the
Zoo along with other dignitories


VVIP VISITORS
Deputy Prime minister of Vietnam in the Zoo
along with other dignitaries


Director General of Forests, Govt. of
India visited on 15-09-2012.

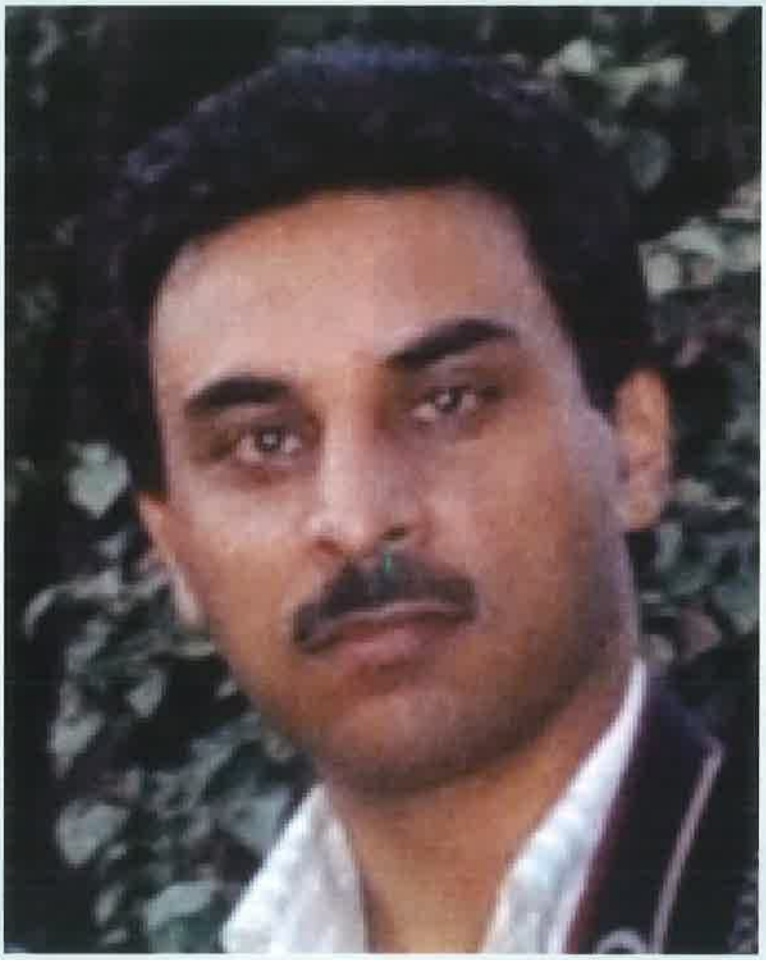

Mr. Altamas Kabir, Hon'ble Supreme Court
Judge, the present Chief Justice of India visited
on 28-04-2012.

Conclusion

We look forward
support from
all corners to place
Sepahijala Zoo
as one of the best
Zoo in India.

HOPE FOR HANGUL

(*Cervus elaphus hangul*)



Presented by:

Mr. Intesar Sohail

Wildlife Warden, Hangul CBC
Jammu and Kashmir.

HOPE FOR HANGUL

The Land of Hangul

- Jammu & Kashmir lies at the northern most tip of India.
- Has two bio-geographic zones:
  - 1. Trans-Himalaya
  - 2a. Northwestern Himalaya

Kashmir valley falls in the Northwestern Himalayas

INTRODUCTION

Kashmir Red Deer or Hangul

Cervus elaphus hanglu

A sub-species of the European Red deer (*Cervus elaphus elaphus*)

Only survivor of the Red Deer Group in the Indian sub-continent

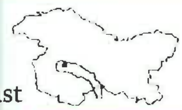
#Critically endangered as per IUCN Red List (2004) but Least Concerned as per IUCN Red List (2012)

#Listed in Appendix I of CITES

Listed in Schedule I of Indian and J&K Wildlife (Protection) Acts.

PAST DISTRIBUTION

Historically restricted to an arc of 65 miles, north and east of Jhelum and Lower Chenab rivers up to Ramnagar.

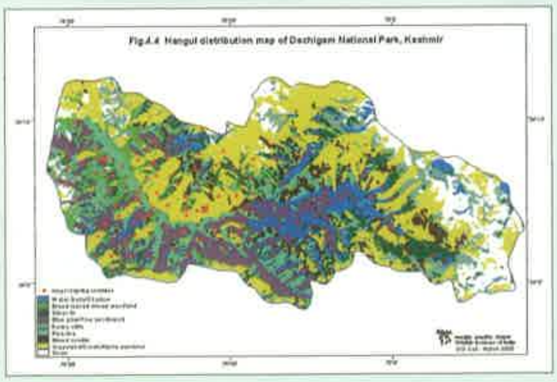


Gamgul Siya-Behi Sanctuary in Himachal Pradesh is the only place outside J&K that held Hangul populations in the past

PRESENT DISTRIBUTION

Now restricted only to Dachigam National Park and some adjacent areas in the Kashmir valley.

HANGUL IN DACHIGAM



BREEDING

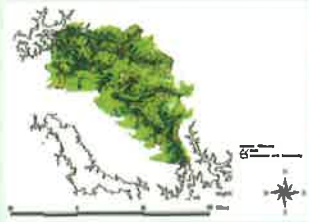
- Breeding season commences with the rut in late September.
- Rutting is at its peak by mid October
- Gestation period: 230-240 days
- Only one young is born in May-June
- Females conceive in alternate years

THREATS

Habitat loss and fragmentation

Domestic livestock grazing

Poaching



Why Conservation Breeding is necessary?

Only surviving representative of the Red Deer group in the Indian subcontinent

Endemic to Kashmir valley

Wild population has gone below 200

Only 'viable' population is found in a single restricted area.

Not a single individual exists in captivity anywhere in the world

The Conservation Breeding Centre

Site selected at Shikargah, which lies 50 km south of Dachigam

#Shikargah is a Conservation Reserve & has a small relict population of Hangul

Has ecological affinity with Dachigam

Infrastructure

- Area enclosed: 5.5 ha
- Height of paddock: 10 ft.
- Power-fenced at the top
- Concertina wires provided as a barrier.

Procuring Founder Animals

- Founder animals are to be obtained from the wild
- Dachigamthe only place to do so
- Attempts being made in collaboration with the Wildlife Institute of India.

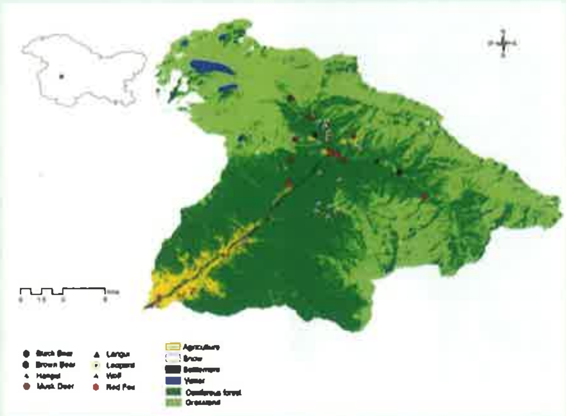
Possible methods of capture

- Darting
- Drop netting
- Hand-held Net-guns
- Drive netting/Funneling

HANGUL HINDS AT THE SALT LICK IN DACHIGAM NATIONAL PARK

Providing of salt lick at Dachigam NP is one of the ways to habituate Hangul so that the founder members could be procured from the wild

Do we have the habitat for Hangul reintroduction?



THANK YOU

HOOLOCK GIBBON CONSERVATION BREEDING CENTRE, BIOLOGICAL PARK, ITANAGAR (AP)

Presented by:
Mr. Joram Dupam, IFS
Director
Biological Park,Itanagar, Arunachal Pradesh

HOOLOCK GIBBON CONSERVATION BREEDING CENTRE, BIOLOGICAL PARK, ITANAGAR (AP)

Department of Environment & Forests
Govt. of Arunachal Pradesh

INTRODUCTION

1. Biological Park, Itanagar has started conservation breeding programme on Hoolock Gibbon during the year 2007 duly approved and funded by CZA.
2. 5 pairs of adult Gibbons, identified for parental stock and 5 male juvenile Gibbons were rescued from fragmented habitat area of Dello under Koronu circle of Lower Dibang Valley District of Eastern Arunachal Pradesh.
3. On 5th july' 2008, first ever captive Gibbon was born in the Breeding Center, Biological Park, Itanagar.

STATUS OF HOOLOCK GIBBON

1. Critically endangered listed in IUCN Red Data and schedule – I, Wild life protection Act 1972. It has 2 sub-spp, western and eastern hoolocks.
2. The IUCN Species Survival Commission(S.S.C) primate specialist group has estimated that there are about 600-700 western hoolocks distributed sparsely in North east India viz. Assam Meghalaya, Manipur, Tripura etc.
3. The eastern hoolocks is found only in Lohit and Dibang Valley District of Arunachal Pradesh.

Taxonomy

- **Kingdom** :- **Animalia**
- **Phylum** :- **Chordata**
- **Class** :- **Mammalia**
- **Order** :- **Primates**
- **Family** :- **Hylobatidae**
- **Genus** :- ***Hoolock***
- **Species** :- ***Hoolock Leuconedys***
- **Species Authority** :- **Groves, 1967**
- **Local Name** :- **Uluck (Hindi)**

Distribution

1. The only Ape Primate found in India. It is found in the states of Assam, Arunachal Pradesh, Meghalaya, Manipur and Tripura.
2. In Arunachal, it is mainly distributed in he districts of Lower Dibang Valley, Lohit, Changlang and Tirap.
3. The total population of Eastern Gibbons is estimated to be around 500.

Description of the Gibbons

1. Adult males are black in color with white eye brow that run up to the end.
2. Adult females are copper tan in color with a white eyebrow.
3. Neonates are creamy white and then both males and females turn black there after but again females turn into copper tan color after 4-5 years of age.
4. The body weight of the adult varies from 5-5.5 Kg in wild while it may be up to 6-7 Kg in captivity.

Gibbon photographs

Male

Female

A juvenile

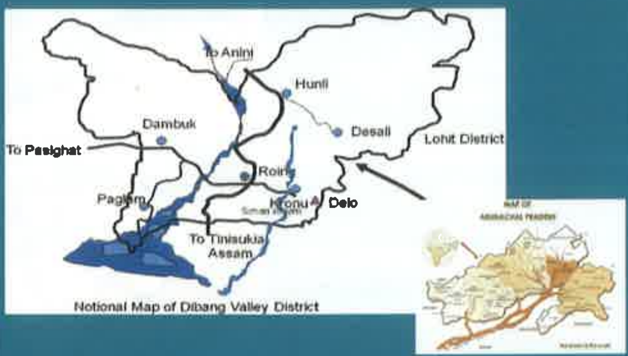
An infant with mother

Ecology and behaviour

1. Hoolocks are monogamous and territorial animals. They are strictly arboreal and clumsy on the ground.
2. Hoolocks are normally frugivorous. They solely depend on the ripened fruits with fleshy pulps.
3. Sexual maturity is attained normally at the age of 6-7 years in both male and female.
4. Hoolocks are restricted to tropical wet evergreen forests, tropical semi evergreen forests, tropical moist deciduous forests and sub tropical broad leaved hill forests.

The site of rescue

'DELO' near Koronu circle in Roing



Reason for rescue

1. Habitat loss:-

Tea plantation ➡

⬅ Jhum cultivation

⬅ Thunderstorm

Forest fire ➡

2. Evidence of predation by dogs

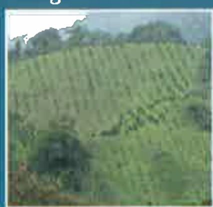
Local dogs killed a female and its dependant young ➡

⬅ PM reveals severe biting injuries and internal organ damages.

3. Worm infestation

Revealed on post mortem examination

4. Agricultural activities



Forest clearance for agriculture

Enclosure

Specification.

- Area....2500 sq.mtr.
- Open moat, Brick wall, smooth finish with 9ft.height.
- Treatment cell cum store at corner.
- Feeding platform on tree trunk.

Design

Enrichment

Lots of tall (Canopy) trees.
Ropes ledges,
Bamboo bridge.
Plantation of natural food – picus, banana, bamboo, jamun, bola etc .

Feeding schedule

Morning

Sl.no.	Items	Qnty
1.	Banana	04 nos
2.	Gram	150 gm
3.	Sweat potato/ tapioca	04 nos
4.	Egg/ silk worm	01 nos/ 50gm
5.	Apple	02 nos
6.	Orange / citrus fruit/tomato	02 nos
7.	Cucumber/ Water melon /pears/ nag.	300gm

Evening

Sl.no.	Items	Qnty
1.	Rice mixed with pumpkin	300gm
2.	Lichi/ Guava/Plum	250 gm
3.	Tender leaves/shoot	Ad lib
4.	Grapes /pineapple/ mekhahi fruits	100 gm
5.	Mango/papaya/pome granate	01 nos
6.	Green pea/ Carrot	250 gm

Feeding

Maximum care given based on;-

1. Protein-both Animal and plant
2. Vitamin:-mostly vit.A, D, B Compex etc.
3. Minerals:- Ca, P, Fe, Cu etc.
4. Carbohydrate, sugar and fat.

Green leaves

Garden

wild

Health care

1. Personal hygiene of keeper.
2. Screening of zoonotic diseases and de worming of keeper every 6 months.
3. Cleaning of utensils, feeding platform & feeds regularly.
4. Avoid rampant use of drugs to prevent drug resistant.
5. Stool test every month.
6. De-worming only when required.
7. No vaccination & preventive medication

Major health problems

1. Viral influenza.
2. Endo-parasite
3. Diarrhoea and dehydration.
4. Infighting.

Breeding

1. There is no particular season, but pick period - April - Jun.
2. Mating observed mostly during rainy season.
3. Mating observed during pregnant. Not after birth till 1 year.

Mating photos

Hoolock mating.

Mating prior to change of colour.

Sex determination & Coloration

1. Infant creamy.
2. 1-5 yrs black in both Male & Female
3. Female turns copper tan from 5 yrs onward starting from fore-head.

Growth Chart

Sl.no.	Age	Body weight
1.	0-4 month	70---300gm
2.	4 month- 1year	300---500gm
3.	1—2 years	500---1kg
4.	2—3 years	01---2.4 kg
5.	3---5 years	2.4—4.5 kg
6.	5—6 years	4.5---5.4 kg
7.	6 years and above	5 ---6.5kg

CAPTIVE BRED HOOLOCK GIBBONS , BIOLOGICAL PARK, ITANAGAR, DURING 2007 – 2012 (UPTO 31.10.2012)

S. No.	Stud Book No. if any	Local/Zoo identification/House name	Transponder No.	Sex (M/F)	Sire (Father)	Dam (Mother)	Event/ Transfer/ Death	Date of Birth	Current status
1	10/H/18	Anga	981020858060	F	Lagder	Rukhmini (died)		05.07.2008	Transferred to Sepahijala Zoo Agartala recently
2	10/H/19	Jimmy	98102057183	M	Nega (died)	Yasum		22.09.2008	Kept with partner (baby)
3	10/H/20	Toram		F	Lingi	Dello		05.10.2008	Kept with the parents
4	10/H/23	Bogi		M	Lagder	Rukhmini (died)		09.08.2010	Death
5	10/H/24	Jisu		U	Lingi	Dello		25.12.2010	Kept with the parents
6	10/H/26	Infant		U	Corneal oapacity	Mishimi Baidew		18.09.2011	Kept with parents
7	10/H/27	Jyoti		U	Mr. Batt	Yapa		30.06.2012	Kept with parents

DETAILS OF *HOOLOCK LEUCONEDYS* (HOOLOCK GIBBON) AS ON 31.10.2012, CBC, BIOLOGICAL PARK, ITANAGAR

Sl. No.	Studbook no (if any)	Local/Zoo identification/House name	Transponder No.	Sex (M/F)	Sire (Father)	Dam (Mother)	Source of animal (Captive bred/Wild/Rescued)	Event/ Transfer/Death	Captured/ Birth Date	Current status
1	10/H/1	Ungi	NA	M	U	U	Rescued from Dello, Roing Dibang Valley(A.P)	Transferred in the Zoo	12/03/07	Paired with Dello and kept in display
2	10/H/2	Dello	NA	F	U	U	-do-	-do-	12/03/07	-do-
3	10/H/20	Turam	NA	F	Ungi	Dello	Captive bred	-do-	5/10/08	Kept with the parents
4	10/H/24	Jisu	NA	U	Ungi	Dello	Captive bred	-do-	25//12/2010	-do-
5	10/H/05	Lagder	NA	M	U	U	Rescued from Dello	-do-	15/03/07	Paired with Mumumunu
6	10/H/25	Mumumunu	98102056396	F	U	U	Brought from Miao Zoo	-do-	20/06/11	Paired with Lagder
7	10/H/16	Baby	98102057 sb156	F	Ungi	Dello	Rescued with parent	Transferred in the Zoo	12/03/07	Kept with Anga and Jimmi
8	10/H/19	Jimmy	98102057183	M	Naga (Died)	Yasum	Captive bred	-do-	22/09/08	Paired with Anga and kept with baby
9	10/H/09	Corneal Opacity	98102057899	M	U	U	Rescued from Dello	Transferred	04/12/07	Paired with Mishmi Baideo
10	10/H/14	Mishmi Baideo	98102055876	F	U	U	Rescued from Dello	-do-	23/02/08	Paired with Corneal Opacity
11	10/H/26	Infant	NA	U	Corneal Opacity	Mishmi Baideo	Captive born	-do-	18/09/11	Kept with parents
12	10/H/07	Mr. Batt	98102055475	M	U	U	Rescued from Dello	-do-	15/03/07	Paired with Yapa
13	10/H/10	Yapa	98100800507	F	Corneal Opacity	Died due to Dog bite injury	Rescued from Dello	-do-	04/12/07	Paired with Mr. Batt
14	10/H/27	Jyoti	NA	U	Mr. Batt	Yapa	Captive bred	-do-	30/06/12	Kept with the parents
15	10/H/15	Cute	98102056666	M	U	U	Rescued from Dello	-do-	23/02/08	Paired with Yasum
16	10/H/04	Yasum	F	F	U	Rescued from Dello				Paired with Cute
17	10/H/13	Inow	98102056553	M	U	U	Rescued from Deomali	-do-	20/01/09	Kept with Taping
18	10/H/12	Taping	[illegible]	M	U	U	Rescued from Dello	-do-	04/12/07	Kept with Inow

Present status :

1	Total numbers of Hoolock Gibbons	:-	18 Nos
2	Nos. of Captive bred	:-	07 Nos
3	Nos. of Male	:-	08 Nos
4	Nos. of Female	:-	07 Nos
5	Unidentified	:-	03 Nos
6	Nos. of death due to various reasons	:-	03 Nos
7	Transferred to Sepahijala Zoo, Tripura recently	:-	01 No (female)

On 30th June 2012, a baby Gibbon was given birth to Cute and Yasum in the breeding centre enclosure no. II and has been named as **SONU**.

Some photos:-

Mother with the newly born Baby

Both parents resting on the top of a tree.

Future plan

1. Reintroduction/release back to wild.
2. Act as nodal training centre for the species.
3. Education & research on behavioral, biology, nutritional, Vety. & husbandry aspect of the spp.
4. To provide rich genetic pool for future conservation breeding of spp.
5. To develop strategy for monitoring & modifying management practice of species in captivity as well as in the wild.
6. To rescue injured & stranded hoolock of Delo in particular and from other habitat in general and to release them back in wild or trans-locate them into suitable habitat.

PROBALE RELEASE SITE IN FUTURE

The release site will be decided after habitat study of the probable sites are carried out. There are two probable sites which is considered as of now :-

1. Reintroduction in Mehao Wildlife Sanctuary :-

2. Introduction in Pakke Wildlife Sanctuary (needs critical decision):-

THANK YOU

CONSERVATION BREEDING PROGRAMME

AT ARIGNAR ANNA ZOOLOGICAL PARK LION-TAILED MACAQUE

(*Macaca silenus*).

Presented by:

Shri.K.S.S.V.P.REDDY, I.F.S.,
CHIEF CONSERVATOR OF FORESTS AND DIRECTOR,
ARIGNAR ANNA ZOOLOGICAL APRK,
VANDALUR, CHENNAI

Dr. R. THIRUMURUGAN,
ZOO VETERINARY ASSISTANT SURGEON,
ARIGNAR ANNA ZOOLOGICAL APRK,
VANDALUR, CHENNAI

CONSERVATION BREEDING PROGRAMMES AT ARIGNAR ANNA ZOOLOGICAL PARK (AAZP), VANDALUR, CHENNAI

Shri.K.S.S.V.P.REDDY, I.F.S.,
CHIEF CONSERVATOR OF FORESTS AND DIRECTOR,
ARIGNAR ANNA ZOOLOGICAL APRK,
VANDALUR, CHENNAI

Dr. R. THIRUMURUGAN,
ZOO VETERINARY ASSISTANT SURGEON,
ARIGNAR ANNA ZOOLOGICAL APRK,
VANDALUR, CHENNAI

CO-ORDINATING ZOO:

- Lion Tailed Macaque *(Macaca silenus)*
- Nilgiri Langur *(Semnopithecus johnii)*
- Nilgiri Tahr *(Nilgiritragus hylocrius)*

Found only in Western Ghats, South India.

PARTICIPATING ZOO:

- Wild Dog *(Cuon alpinus)*
- Indian Gaur *(Bos gaurus)*
- Royal Bengal Tiger *(Panthera tigris tigris)*
- Malabar Giant Squirrel *(Ratufa indica)*

CO-ORDINATING ZOO:

- Lion Tailed Macaque – 21 individuals
- Nilgiri Langur – 14 individuals
- Nilgiri Tahr - NIL

PARTICIPATING ZOO:

- Wild Dog – 7 individuals
- Indian Gaur – 10 individuals
- Royal Bengal Tiger – 7 individuals
- Malabar Giant Squirrel – 3 individuals

CONSERVATION BREEDING PROGRAMME FOR LION TAILED MACAQUE

- Breeding program started with original population of 4 wild caught individuals (1:3)
- Present population = 21 (8:13)
- Five troops in four enclosures
- Participaing Zoos:
  Sri Chamarajendra Zoological Gardens, Mysore and Trivandrum Zoo

CONSERVATION BREEDING PROGRAMME FOR LION TAILED MACAQUE

ENCLOSURES FOR PUBLIC DISPLAY:

- One moated island – 7 individuals
- One cage enclosure – 8 individuals

OFF-VISIT CONSERVATION BREEDING ENCLOSURES:

- Enclosure I – 3 individuals (1:2)
- Enlcosure II – 3 individuals (1:2)

MOATED ISLAND ENCLOSURE FOR LTM

CAGE ENCLOSURE FOR LTM

LOCATION OF CONSERVATION BREEDING ENCLOSURES

OFF-VISIT ENCLOSURES FOR LION TAILED MACAQUE

- Funded by Central Zoo Authority
- Two moated enclosures
- Island with fruiting trees
- Enrichment devices in animal houses and islands to encourage arboreal behaviour
- Efforts to raise *Cullenia sp.* failed

OFF-VISIT ENCLOSURES FOR LTM

OFF-VISIT ENCLOSURE – I FOR LTM

OFF-VISIT ENCLOSURE – II FOR LTM

OFF-VISIT LTM BREEDING ENCLOSURE - I

OFF-VISIT LTM BREEDING ENCLOSURE - I

OFF-VISIT LTM BREEDING ENCLOSURE - I

OFF-VISIT LTM BREEDING ENCLOSURE - I

OFF-VISIT LTM BREEDING ENCLOSURE - II

SELECTION AND RELEASE OF LTMs IN OFF-VISIT ENCLOSURES

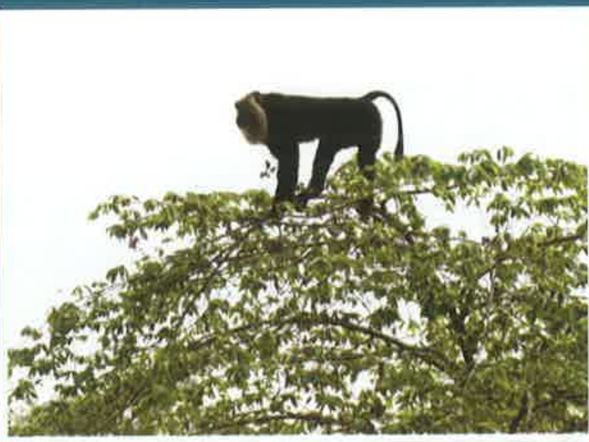
- Two troops were identified from the existing population based on studbook
- Selected macaques were captured, marked, grouped and released in off-visit enclosures

- Enclosure I – 3 individuals (1:2)
- Enlcosure II – 3 individuals (1:2)
- Human intervention kept minimal
- Proposal for remote feeding

LTMs IN OFF-VISIT LTM BREEDING ENCLOSURE - I

LTMs IN OFF-VISIT LTM BREEDING ENCLOSURE - II

LTMs IN OFF-VISIT LTM BREEDING ENCLOSURE -I I



BREEDING IN OFF-VISIT ENCLOSURES

- Male and a female 1 started to mate in Enclosure – I
- Female 2 in Enclosure II developed para-anal gland swelling last month and the male was found mating
- Eagerly waiting for the outcome

DNA ANALYSIS ON IDENTIFIED LTMs

- Blood and faecal samples were collected and sent to LaCONES, Hyderabad.
- 11 polymorphic microsatellite loci were amplified and their alleles scored by Gene Scan

DNA ANALYSIS ON IDENTIFIED LTMs - Microsatellites

Locus	N	Na	Ne	I	Ho	He	UHe	F
1S	7	5.000	4.083	1.494	1.000	0.755	0.813	-0.324
2S2	7	1.000	1.000	0.000	0.000	0.000	0.000	#N/A
2S3	7	5.000	3.500	1.390	0.857	0.714	0.769	-0.200
3S	7	3.000	2.579	1.004	0.714	0.612	0.659	-0.167
4S	7	5.000	3.920	1.470	1.000	0.745	0.802	-0.342
5S	7	3.000	2.882	1.079	1.000	0.653	0.703	-0.531
7S	7	2.000	1.324	0.410	0.286	0.245	0.264	-0.167
10S	7	3.000	2.513	0.992	1.000	0.602	0.648	-0.661
11S	7	4.000	2.513	1.116	0.857	0.602	0.648	-0.424
18S	7	3.000	2.279	0.898	1.000	0.561	0.604	-0.782
19S	7	3.000	2.800	1.061	0.714	0.643	0.692	-0.111

Mean and SE over all Loci for chennai Pop

Mean	7.000	3.364	2.672	0.992	0.766	0.558	0.6000	-0.371
SE	0.000	0.388	0.288	0.135	0.101	0.069	0.075	0.069

Na = No. of Different Alleles
Ne = No. of Effective Alleles = 1 / (Sum pi^2)
I = Shannon's Information Index = -1* Sum (pi * Ln (pi))
Ho = Observed Heterozygosity = No. of Hets / N
He = Expected Heterozygosity = 1 - Sum pi^2
UHe = Unbiased Expected Heterozygosity = (2N / (2N-1)) He F = Fixation Index = (He - Ho) / He = 1 - (Ho / He)

Where pi is the frequency of the ith allele for the population & Sum pi^2 is the sum of the squaredpopulation allele frequencies.

DNA ANALYSIS ON IDENTIFIED LTMs

Finding:

- Observed heterozygosity is greater than the expected heterozygosity values for each loci, characteristic of a typical '**outbred**' population

PHASE II PROPOSAL FOR CONSERVATION BREEDING PROGRAMME OF LION TAILED MACAQUE

COMPONENTS

1. Feasibility study and background research
2. Research into previous reintroductions
3. Choice of release site and type
4. Evaluation of reintroduction site
5. Availability of suitable stock
6. Preparation and release stages
7. Post release activities

FINANCIAL PROPOSALS FOR PART II PROPOSAL

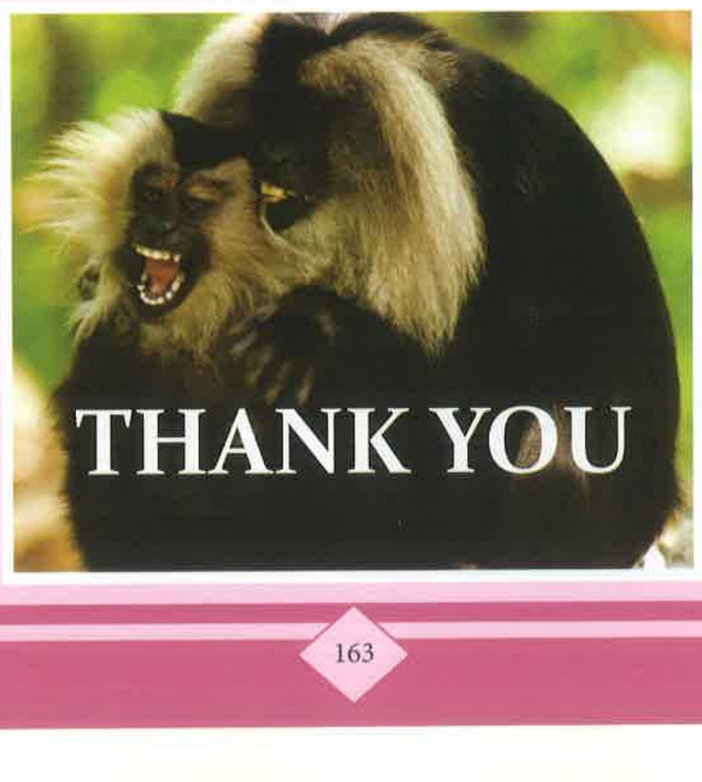
SL No	Titles	Amount in lakhs			Total
		2012-2013	2013-2014	2014-2015	(Rs in lakhs)
1	Enclosure enrichment in captivity (artificial & natural)	0.50	0.50	1.0	2.00
2	Care taker for maintaining the two off exhibit LTM colonies at Arignar Anna Zoological Park -2Nos	1.44	1.44	1.44	4.32
3	JRF to monitor and record scientific data on captive and wild colonies explained in components	2.16	2.16	2.16	6.48
4	Transporting animals including fabrication of cages	0.25	0.25	0.50	1.00
5	Purchase of equipments (Binoculars, computer & peripherals, SLR camera & video camera, transponders microscope attached with photo micrometry) & Cryo preservation facility	1.00	0.50	0.50	2.00
6	Consumables (Chemicals, sample tubs, preservatives etc for analysis hormones, stationary etc.,)	0.25	0.25	0.50	1.00
7	Veterinary care including special feed, medicine, vaccination etc	0.25	0.25	0.50	1.00
8	Construction of referral centre for documentation of captive breeding and re-introduction including safe storage of documents and scientific equipments	5.00	-	-	5.00
9	Construction of satellite enclosure for preconditioning for soft release programme at re-introduction site	-	2.00	3.0	5.00
10	Travel	0.25	1.00	0.75	2.00
11	Workshop & Training	0.50	-	0.50	1.00
12	Preparation of LTM husbandry manual	-	-	0.50	0.50
13	Contingencies				0.36
	Total				31.66

CONSERVATION BREEDING PROGRAMME FOR NILGIRI LANGUR

- Present population = 14 (5:7:2)
- Two troops in two moated enclosures
- Participating Zoo: Sri Chamarajendra Zoological Gardens, Mysore
- Revised proposal has been submitted for the construction of off-visit enclosures, giving due consideration to the comments and modifications suggested by the technical committee.

CONSERVATION BREEDING PROGRAMME FOR NILGIRI TAHR

- Present population - NIL
- Proposal for satellite facility in Ooty, Nilgiris.



CONSERVATION BREEDING PROGRAMME
MOUSE DEER
Nehru zoological Park Chennai
(Lion Tailed Macaque)

PRESENTED BY:

DR. P. SRINIVAS

Veterinary Asst. Surgeon
Nehru Zoological Park, Hyderabad.

Conservation Breeding Programme

MOUSE DEER

(Indian Spotted Chevrotain : *Moscoila indica)*

Nehru Zoological Park
Hyderabad, A.P
Dr.P.Srinivas

MOUSE DEER

- One of earliest hoofed mammals
- One of Four Chevrotains
- 3- Chambered stomach; 4 toes on each foot.
- Upper canine teeth elongated as tusks, in males

Appearance:

- Tiny, little creature, slender limbs.
- High and rounded hindquarters.
- Olive brown coat, speckled with yellow.
- Flanks marked with rows of buff / white spots, extending as longitudinal bands.
- Sex distinction difficult, but for tusks in male.

Distribution:

- Equitorical Forests, from Sri Lanka to South India.
- Inhabits grass-covered rocky hills, forest lands; upto 1850M altitude
- Decline in population, due to habitat disturbance

Behaviour:

- Timid, Shy, Reclusive, Nocturnal.
- Very difficult to observe; very little knowledge.
- Depends on concealment for protection.
- Males generally solitary.
- Diet : Varied - Fruits, leaves, insects, small animals etc.

Breeding:

- Breeding habits not documented properly.
- Most specimens hand reared, Zoo born; yet not become established.
- Specific longevity is doubtful.
- Sexual maturity at 4-5 months age.
- Continuous receptivity.
- Gestation: 4-6 months; Single fawn in each birth
- Weaning: 2-3 months.

Breeding History at NZP:

- Captive Breeding encouraging, but establishment is discouraging
- Initial Stock : 20/02/64, lasted upto 13/8/81
- Next Stock : 30/3/89, upto 23/8/90.
- Next Stock : 9/3/91, upto 13/12/93.
- Present Stock : 20/10/94.

New Breeding Enclosure:

- Started on 3.3.2010
- Initial Stock : 6 Mouse Deer (2:4)
- Size of Chamber : 15 x 8 mtrs.
- Plantations: Bamboo, Acalypha, Palm and Grasses

Present Diet:

Item	Quantity (in Grams)
Apple	50
Banana	100
Carrot	50
Sweet Potato	50
Mixed Grains	50
Lucern	100
Hay /Kutti	500
Acalypha / Peepal leaves	500
Mineral Mixture	5 -10

Breeding Activities:

Month	No. of Oestrus	No. of Births
January	4	2
February	9	6
March	6	3
April	6	3
May	2	1
June	3	1
July	2	4
August	2	2
September	4	3
October	5	4
November	4	1
December	3	-

Observations:

- Breeding season: through out the year
- Sexual Maturity : 4 to 5 months
- Oestrus Period : 2 days
- Gestation Period : 150 - 180 days

Present Population:

- Opening Stock : 2:4
- Wild Rescued : 3
- No. of Births : 23
- Present Stock : 30 (9:21)
- Sent Stock : 1

Births:

- 2010 -2011 : 3 (2:1)
- 2011 – 12 : 12 (3:9)
- 2012 – 13 : 8 (3:5)

Susceptibility to casualty:

- Unexpected deaths due to varied reasons.
- **Reasons at NZP:** Pneumonia, Internal hemorrhage & shock, Retention of urine, Paraplegia, Nephritis / Enteritis /Hepatitis/ Septicemia, Chocking of Food etc.

Modification of Diet:

- Mixed grains
- Cabbage & Tomato discontinued.
- More green leaves (eg. Lucerne) given
- Soaked Oats given.

Prophylactic Measures:

- Antibiotic sensitivity tests.
- Treated with suitable antibiotics for 5 days
- Housing restored to old site.
- Animals kept in groups, rather in pairs.
- Breeding resumed.

Breeding Scheme:

- NZP, Coordinator; NKZP: Participator
- Available facility had mixed results

- New Off-Display Facility : Individual cubicles attached to common enclosures .
- Close Observation by Biologist, CCTV etc.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Objectives of the Scheme:

Main Objective To achieve Progressive Breeding, so as to replenish stock in the Wild

Subsidiary Objectives:

- Study of Biology and Nutrition needs.
- Study of Social & Reproductive Behaviour.
- Study of causes of unexpected deaths..
- Identification of suitable habitats for release in the wild.

Thank You

Conservation Breeding Programme of Indian Pangolins

Presented by:

Dr S. Panda, IFS
Director
Nandankanan Biological Park

Dr. S.K. Sahoo
Veterinary Officer
Nandankanan Biological Park

Conservation Breeding Programme of Indian Pangolins

NANDANKANAN

Dr S. Panda, IFS
Director
Nandankanan Biological Park

Pangolins

- Pangolins are toothless small mammals with overlapping horny scale on their body and long rotrusibletongue and rihensiletail, usually rolls up into a ball when threatened.
- Pangolins belongs to the family anidaeof order holidota(means "the scaled animal.
- The name "pangolin" derives from the Malay word engguling(means "something that rolls up").
- Pangolins are covered with protective, overlapping scales which are made from same protein (α-keratin and β-keratin) that form human hair and fingernail.

Pangolin Species

There are eight species of pangolins native to warmer parts of Africa and Asia.

African pangolins

- **Four toed pangolin** (*anisetradactyla*
- **Arboreal pangolin** *anisricuspis*
- **Giant pangolin** *anisigantea*
- **Common pangolin** (*anisemmincki*.

Asian pangolins

- **Indian Pangolin** (*anisrassicaudata*
- **Chinese pangolin**(*anisentadactyala*
- **Sundapangolin**(*anisavanica*
- **Palawan pangolin** (*anisulionensis*

Unlike African pangolins, Asian pangolins have thick hairs that emerge between their scales (Dickman and Richer, 2001).

Pangolins found in India

Two species of pangolins (Indian Pangolin and Chinese pangolin)occur within Indian territory.

Indian pangolins

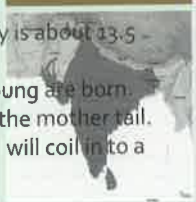
- Occurs throughout peninsular India
- 1-13 rows of body scales
- Larger scales and smaller ear innae
- Post anal depression in skin bsent
- Terminal scale is present on ventral side of the tail

Chinese pangolins

- Occur in North-Eastern India, China and Nepal
- 5-18 row of body scales
- Smaller scales and larger ear Pinnae
- Post anal depression in skin resent
- Terminal scale is absent on ventral side of the tail

Indian Pangolins

- Indian pangolins are solitary, osorial nocturnal and yrmecophagus
- The head is small and cone shaped, with small eyes protected with thick eyelids.
- Long muscular tongue.
- It has 11 3 rows of scales on the trunk, scales on the forelegs are horizontal and on the hind legs are vertical with respect to the ground.
- Found throughout peninsular India and Sri Lanka.
- Males are larger than females.
- Longevity of *anisrassicaudata*in captivity is about 13.5 years. Unknown in wild.
- Usually a single and occasionally two young are born.
- Young are carried on the dorsal base of the mother tail.
- When disturbed, the female with young will coil in to a sphere around its offspring.



Conservation status

- **Threats**
- Hunting for live pangolin, skin, scale and meat and habitat destruction are major threats to pangolins.
- The biology of Indian Pangolin, particularly low reproductive rate and a large distribution, make them vulnerable to over-exploitation.
- **Conservation**
- **Schedule I** f the Wildlife (Protection) Act, 1972
- IUCN conservation status: **ulnerable**
- CITES: **ppendix II** ith a zero annual quota for commercial trade
- **Role of zoos**
  Wild animals kept in captivity for education, conservation and research.
- To understand Reproductive biology of wild animals
- Pre-eminent domains of captive breeding programs
- A genetic reservoir for reintroduction

Indian pangolins in captivity

- First report of the management of the Indian pangolin in captivity is that of anyal(1892) at the Zoological Garden, Calcutta.
- Nandankananzoological park has the experience to keep Indian pangolins since 30^{h}June 1962.
- At andankananZoological Park, the first birth of Indian pangolin was took place in October 1971.
- Knowledge of best management of this species in captivity was still lacking.
- Research within zoo for understanding of its ehaviour reproduction, physiology, nutrition and disease can contribute to a better husbandry practice and welfare of the animal.



INDIAN PANGOLIN CONSERVATION BREEDING CENTRE

- The angolin Conservation Breeding Center as been established during the year 2008, funded by Central Zoo Authority (CZA).
- The conservation breeding centre for Indian Pangolin (*anis crassicaudata* ray) is constructed in an off exhibit area with the objectives of developing proper methodology for captive breeding, studying the activity pattern and successful upkeep & housing of these endangered species.
- Although it is very difficult to up keep these animals, they are being fed with their natural food i.e. red weaver ant (*ecophyllamaragdina* which facilitate their long term survival of these species.
- Pangolins are micro-chipped with a PIT (Passive Integrated Transponder)
- Behaviour of the pangolins are recorded with the infra-red sensitive CCTV cameras during the night time as pangolin is strictly nocturnal.

Objectives of the project

- Identification and establishment of founder stock to initiate ex-situ breeding of physically, genetically and behaviourally healthy pangolin in the appropriate off-display housing facility.
- Preparation of animal history sheets and stud book details of the species under the breeding programme.
- Systematic data collection on the behavioural, social and reproductive aspects of the species so as to make appropriate intervention as and when needed.
- Replication of the proto type of enclosure developed at Nandankanan and if needed carry out necessary modification, so as to confirm with the activity, behavioural, social and reproduction profile of the species in the wild.
- Engagement of dedicated biologist/researchers, for the required technical inputs during implementation of the project.
- Identification of the protected area having wild population of the proposed species i.e., reintroduction site.
- Developing husbandry protocol of Indian pangolin.
- Develop a scientific data base on rearing and breeding of the Indian Pangolin.

Founder stock

- **Founder stock**
- Rescued from wild
- Physical health check up before release to PCBC
- **Individual identification**
- assive Integrated Transponders (PIT).
- Sexing


Female Indian pangolin Male Indian pangolin

Enclosures

- Indian Pangolins (*anis crassicaudata* solitarily housed in enclosure of 3.0m X 4.0m X 3.5m dimension .
- Eight enclosures were provided with red laterite soil as substrate and moundhollow wooden log and wooden poles as enrichment material.
- Two mating enclosures with concrete as substrate to facilitate isolation of individuals after mating and observational study of the mating event
- Large saucer shaped water pools are provided
- **Installed CCTV Cameras**
- Wide angle cameras in enclosures
- Long range cameras in corridor
- PTZ (Polarize-Tilt-Zoom) camera in breeding enclosure

Husbandry

- Red weaver ant (*ecophyllamaragdina* as their daily food.
- When red-weaver ants is insufficient, chopped boiled egg mixed with milk powder (mulspray) is given as alternative diet.
- Feed given, feed left out, and fecal matter are weighed on daily basis.
- Environmental parameters e.g. temperature, humidity and intensity of light are measured every day.
- **Maintenance of hygiene**
- Fecal matter and leftover food are removed from the enclosure every day
- Pools and water bowls are drained, scrubbed and refilled every day and bleached twice in a month to prevent algal growth


Health care

- Holistic to evaluation of health status by observation from CCTV cameras, direct observation, body weight measurement,detailed physical examination and photo documentation

- Immediate veterinary action for sick animal
- Minimum handling of sick animal to avoid stress
- Examination of faecal samples
- **Regular deworming**
- Multivitamin supplement

Behavioural monitoring

- Observation room is constructed near the pangolin enclosures with all the basic requirements to meet the need of the JRF to monitor and record the ehaviours
- Behaviouralobservation was carried out with instantaneous sampling technique through digital video recording assisted by infrared enabled CCTV cameras.
- Time spent in different ehaviour enclosure utilization gives significant insight to their biology, welfare and necessary enclosure modification .

Breeding

- Till date three young pangolins have taken birth at PCBC at Nandankanan.
- Courtship behaviour includes inspection and interaction between the pangolins of opposite sex in neighboring enclosures.
- Breeding pair was allowed for mating with a keen observation by PTZ camera in the breeding enclosure to facilitate isolation after mating.
- Mating behavior includes mutual Flehmanand repetitive mounting.
- Single baby pangolin was born at each Time.
- The pangolin baby used to stay inside the burrows made by the mother for about three months.
- Mother introduced the young to the enclosure carrying in her back

Rearing

- Rearing of rescued young pangolin
- Rescued at about one month old (weight 140g)
- Fed with Royal anin aby dog milk
- Kept in keepers room in close observation
- Feed 6 times per day
- Immediate veterinary assistance when equered
- Vitamin supplement
- Fecal examination and eworming
- Present weight 1185g after 85 days.

Record keeping

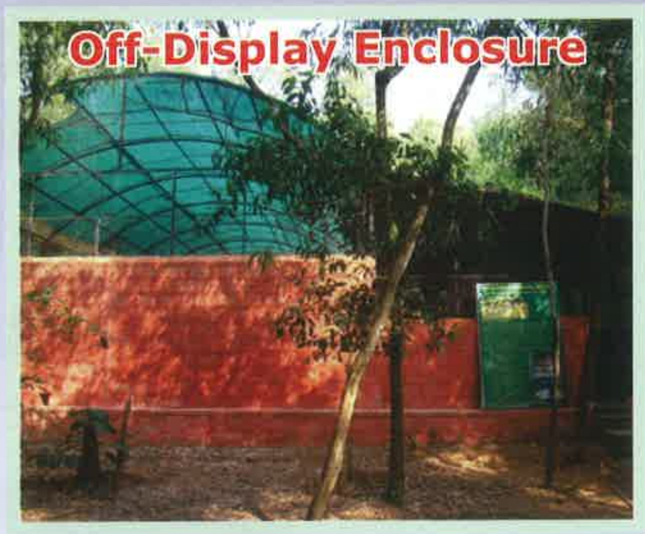
- Feed given, feed left out, fecal material recovered on daily
- Present housing status of animal and its swapping
- Body weight of individual pangolin is monitored on monthly basis.
- Mating record provides information about past mating trials, successful mating
- Keeper Diary
- Animal History Cards
- Studbook
- Report of birth and death of animals
- Recording of observations regarding social, biological & reproductive behaviour,nd health status of pangolins including preventive and curative treatment provided, birth and care of young ones, sicknesses and mortalities.

THANK YOU

CONSERVATION BREEDING OF
KING COBRA
Pilikula Biological Park, Mangalore

PRESENTED BY
Mr. Jerald Vikram Lobo
Scientific Officer
Pilikula Biological Park, Karnataka


Conservation Breeding of King Cobra in
Pilikula Biological Park, Mangalore.
Jerald Vikram Lobo
Scientific Officer


Off-Display Enclosure


Enrichment


Water sprinklers
CCTV


Marking - Microchip


Courtship and Mating

Nest Building

Egg Laying

Observation of Mother and Eggs

Egg Incubation

Hatching of Eggs

New Born King Cobras


Hand Feeding


Feeding


Feeding


Thank you

CAPTIVE BREEDING PROGRAMME OF DHOLE OR INDIAN WILD DOG

(Cuon alpinus duckhanensis)

Presented by:

Mr. G. Ramalingam

Curator

INDIRA GANDHI ZOOLOGICAL PARK

VISAKHAPATNAM, ANDHRA PRADESH

CAPTIVE BREEDING PROGRAMME OF DHOLE OR INDIAN WILD DOG (Cuon alpinus duckhanensis)

**INDIRA GANDHI ZOOLOGICAL PARK
VISAKHAPATNAM ANDHRA PRADESH**

CONSERVATION BREEDING

Successful Conservation Breeding program needs knowledge of following subjects:

- Population Management
- Reproductive Biology
- Genetics
- Animal Behaviour
- Nutrition
- Veterinary care and Husbandry standards

(WAZA, 2005)

SUB-SPECIES

- Eleven (11) sub species known(debated- Iyengar 2005)
- From India, 4 sub species known
- Peninsular India: *C. a. dukhunensis* (Most abundant sub species)
- Northeast India: *C. a. adjustus*
- Himalayas : *C. a. primaevus*
- Kashmir (Trans-himalayas): *C. a. laniger*

PHYSICAL APPEARANCE

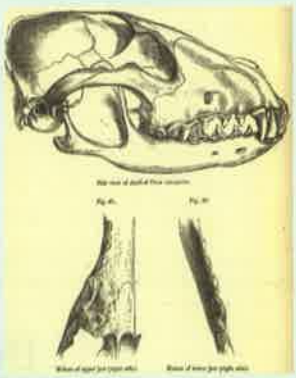
- Body size: 12-20 kgs
- Coat usually rusty red with white patch on the chest (color pattern vary across sub species)
- Black bushy tail
- Rounded ears

BEHAVIOUR OF DHOLES

- Highly social and co-operative animal
- Lives in groups(pack) ranging from 10 to 30
- Hunt in packs - it requires intelligence, co-ordination and some times courage

UNIQUE CHARACTERISTICS

- Lives in a complex social organized group
- Have a unique whistle call
- Six molars instead of five as seen in other canids
- Have 12 teats instead of 10



DISTRIBUTION

DISTRIBUTION OF DHOLES IN INDIA

- Patchy distribution
  Major populations
  - Western Ghats
  - Eastern Ghats
  - Central Indian landscape
  - North East India
- Highest densities seen in Peninsular India(Western and Eastern Ghats)
- North East India, Kashmir, Himalayas: sparse and fragmented populations

HABITAT

Lives in Diverse range of habitats

- Tropical evergreen/semi-evergreen forest
- Moist/Dry deciduous forest
- Scrub and thorn forest
- Mountainous regions(Himalayas)
- Open meadows and steppes (Kashmir)

CONSERVATION STATUS

- IUCN Red list: Endangered (Ver 3.1)
- Population trend: Decreasing
- CITES: Appendix II (2003)
- Wildlife Protection Act (1972), India: Listed in Schedule II
- Protected through out its range

MAJOR THREATS

- Habitat destruction
- Prey depletion
- Competition from sympatric carnivores
- Hunting
- Prosecution
- Isolated (fragmented) populations
- Diseases (from feral dogs)

NEED FOR THE CONSRVATION OF DHOLES

- Major sympatric predator along with the Tiger, Leopard and the Wolf in the subcontinent
- Controlling prey population (Cheetal, sambar, wildboar, etc.)
- Indicator species for the health of the forest
- Dwindling populations

CONSERVATION ACTION

- No conservation specific action plan focused on Dholes through out the range
- Dholes benefit from conservation of other large mammals (India: Project Tiger, Project Elephant)
- Species specific captive breeding programmes initiated by EAZA and CZA (India)

DHOLES IN CAPTIVITY

- Maintained in European zoos since 1900
- Present Global captive population: ~300 (Mostly European zoos: EAZA populations)
- Very few zoos in US (three zoos)
- Asian captive population: Few founders (India, Indonesia, Singapore, Malaysia, Thailand, Japan and China)
- EAZA population suffers possible genetic hybrid effect between different sub species

CAPTIVE BREEDING IN INDIA

- Sporadic till late 1990's (few founders)
- Planned coordination breeding (begging 2000) initiated by CZA
- Aim - To have a genetically strong and viable captive population
- Four zoos
- Indira Gandhi Zoological Park (3 Packs)
- Mysore zoo(1 pack)
- Chennai zoo (2 packs)
- Sri Venkateshwara zoological park (1 pack)

OBJECTIVES OF THE BREEDING PROJECT

- To initiate ex-situ breeding of physically, genetically and behaviourly healthy animals to maintain a sustainable buffer
- population in captivity
- For systematic data collection on social and reproductive behavoiur of dholes
- To develop a complete ethogram of dholes
- To develop network of zoos for information sharing on husbandry and other management issues

OBSERVATIONS/FINDINGS OF CAPTIVE BREEDING AT INDIRA GANDHI ZOOLOGICAL PARK, VISAKHAPATNAM


CAPTIVE BREEDING BEHAVIOUR

- Sexual maturity: at 2-3 years of age
- Breeding in captivity(India) was observed between September to December
- Gestation period: 60-70 days
- Mating generally lasts for 2-3 days
- Births were reported from November to February
- Litter size:1-9

ENCLOSURE DESIGN

- Good landscape enclosure
- Good canopy cover trees of mixed species with bamboo
- Preferably flat terrain with some undulations
- Good water source (pond or a stream)

ENCLOSURE DESIGN

- Enclosure size: min 500 sq.mt. per pair
- For a pack of 8 -10 animals 2500 sq.mt.
- Open moat wall height : Minimum 3.5 mt.
- Open moat distance to the viewing area and display arena: >6 mts
- A large earthen mounted den

NIGHT HOUSING

- Preferably in packs
- Either large night crawls of size 40 feet by 15 feet for 6-8 individuals (pack)or can be sub divided into 20 feet by 15 feet (best) with 5 feet height.
- Provision for drinking water
- Good ventilation required
- Regular cleaning of night houses
- Avoid night housing during breeding season and during the first 3 months of pup rearing

LIST OF VARIOUS BEHAVIOURAL CATEGORIES AS WELL AS BEHAVIORS (WITH CODES) OBSERVED IN CAPTIVE DHOLES:

BEHAVIOR CATEGORIES AND CODES

1.	Affilitative Greeting	= a/g
2.	Attention Soliciting	= asol
3.	Care giving	= cg
4.	Dominance /Aggression	= d/a
5.	Submission /Defense	= s/d
6.	Sexual	= sex
7.	Social Play	= spla
8.	Special Behaviours	= spbh

CAPTIVE BEVAVIOUR - Aggression

- Behavioral aggression seen between adults and pups
- Behavioral aggression seen among pack members for resources(food, space and dominance)
- Aggression for dominance

PACK DYNAMICS

- Pack maintained by an Alpha ♂ and Alpha ♀ along with subordinate ♂ and ♀
- Alpha ♂ and Alpha ♀ being the breeding animals
- All subordinate members of the pack help in hunting and care takers of pups
- Members of the same sex are related

PUP MORTALITY

- Still born
- Diseases (also depends on health of adults)
- Injuries resulting due to constant movement by the parents due to disturbance
- Injuries resulting due to biting from in-experienced yearlings

ADULT MORTALITY

- In fighting
- Disease
  - Trypanomiasis
  - Canine Distemper
  - Rabies
- Ecto-parasitic infection
- Stress (both physiological and anthropogenic)

OBSERVATIONS/FINDINGS

FEEDING:

- Monitoring of the feed intake by different Individuals- *ad libitum* feeding recommended
- Supplementary diet for the alpha female during pregnancy
- Feed supplements to be provided to pups once they start feeding on meat

PUP MANAGEMENT

- ❖ Retention of the pups with the pack for at least a year
- ❖ De-worming of pups during initial months
- ❖ Appropriate social group with three to four non breeding subordinate adults acting as helpers

PACK MANAGEMENT

- ❖ Appropriate pack size (4-6 memebers)
- ❖ Split a pack of more than 8 dholes into two groups due to space constraint
- ❖ Observations on the aggressive integration among pack member
- ❖ Timely intervention and temporary isolation of the aggressive /receiver member(s) of the pack

WHAT WE NEED FURTHER

- ❖ Training of staff in various aspects of Captive management such as animal handling, capturing etc.
- ❖ Veterinary expertise in animal treatment and chemical immobilization
- ❖ An integrated approach involving researchers, veterinarians and managers for necessary technical and management inputs
- ❖ Adequate funding to meet the recurring and non-recurring expenses
- ❖ Vocal communication and Spatial use patterns in Dholes is to studied as it is a complex process.

Resting of bonding pair

Body Stretching

Neck rotation

Play mounting

Dholes in play

Thank You

VULTURE CONSERVATION BREEDING PROGRAMME

Presented By:

ROHAN N. SHRINGARPURE

Research Biologist, Vulture CBC
Bombay Natural History Socity
Pinjore, Haryana

Vulture Conservation Breeding Programme

By: Rohan N. Shringarpure

Vultures are scavengers. They feed chiefly on animal carcasses

Physical Characteristics

- Powerful eyes help locate food from thousands of feet while hovering over the thermals in the sky

- Strong beak and claws help them to rip open a carcass and devour it within minutes

Why Conservation Breeding?

- Establishment of diclofenac as the sole cause of vulture decline.
- As less as one carcass in 40 needs to be contaminated with diclofenac, to cause the rate of vulture decline as that seen.
- Conservation breeding programme will help in rescue of remaining vultures, and provide regular supply of diclofenac free food, for the vultures to breed and attain populations which would be sustainable in the wild.

Vulture Conservation Breeding Programme

Results of A Simple Deterministic Model

1. 600 pairs of each of the three species will form a viable population
2. 25 pairs of each of the three species at one centre will be able to produce a population of 100 pairs of each of the species in the next fifteen years
3. Six centres need to be set up to produce 600 pairs

Age composition of vultures for captive breeding

A total of 180 birds in one centre.

- Seventy percent will be nestlings/juveniles
- Fifteen percent sub-adults
- Fifteen percent adults

Vultures at the Conservation Breeding Programme

- Long-billed vulture

- White backed vulture

- Slender-billed vulture

Temporary Quarantine Aviary

Marking and Measurements

- Wing-Tag

- Micro-chipping

- Ringing

- Morphometrics

Housing for vultures

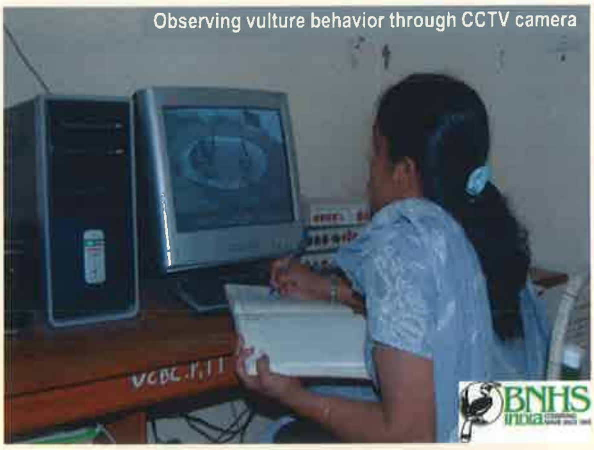
- Different types of aviaries are required for various purposes
  - Nursery aviaries- For housing nestlings
  - Holding aviaries- For housing juvenile birds
  - Colony aviaries- For housing large flocks of sub adult and adult birds to facilitate breeding
  - Breeding aviaries- For housing 1-2 pairs of birds to facilitate breeding
  - Hospital aviaries- For isolation and treatment of sick birds

Colony Aviary

Husbandry and care of vultures in captivity

Husbandry and care

- Observation of vultures through CCTV camera and on field.
- Food provision
- Provision of water
- Provision of nesting material
- Cleaning of aviaries



Healthy vulture
- Alert.
- Looking around.

Sick vulture
- Neck drooping
- Feathers ruffled
- Looking dull

Cleaning of aviaries

Veterinary Care

Veterinary Care

- Checking the general health of the vultures
- Isolation, diagnosis and treatment of sick vulture
- Annual health check
- Maintenance and interpretation of records pertaining to various health parameters

Parameters

9 Weight
9 Body condition
9 Feather condition
9 Thorough examination of body parts such as:

Eyes	Abdomen
Nares	Pectoral muscles.
Beak	Cloaca
Neck	Wing
Crop	Feet (Bumble foot)

9 Monitoring heart and respiratory rates.
9 Presence of ecto-parasites.

Random blood sampling.

- Random blood sampling should be done from at least 20% of vultures for monitoring the blood parameters of that colony.
- The drawn blood samples should be processed for hematology and biochemistry.

Annual health check: Interpretation

- During the annual health check if any vulture shows following symptoms then it is shifted to the hospital aviary and is treated accordingly:
- Presence of bumble foot.
- Weight loss (more than 500 gm to 1 kg), as compared to the previous records.
- Secretions from ear, nares or eyes.
- Severe external injury.

Artificial Incubation and Hand Rearing of Nestlings

Why artificial incubation?

- Vultures are long living, but slow breeding birds
- Pairs lay only one egg during a breeding season
- Known to lay again, if the first egg is removed within a specific amount of time
- First egg is incubated artificially, while the second egg is incubated by the parents.

Artificial incubation and hand rearing of nestling

- Thus artificial incubation improves the breeding efficiency of vultures
- Nestlings are reared by hand, in small groups, so that they imprint on each other.
- Feeding the nestlings depends on the rate of their weight growth, and it is supplemented with specific percentages of liver, brain, heart and bones.

Research Activities

Molecular Sexing of Vultures

- Vultures are sexually monomorphic
- They pair for life, and in such animals, a sex ratio of 1:1 is very important
- Since they cannot be distinguished as male or female by mere observation, their sexing must be carried out using their DNA, which is a fool- proof method.
- Using the results from the population at the conservation breeding centre, appropriate management strategies can be developed.

Study of vulture microflora

- Microflora of the three *Gyps* vultures in captivity has not been studied.
- Vultures- scavengers, probably have a unique microflora.
- Studying the normally found bacteria in vultures will help in finding out pathogens.
- Deviations from an established list of bacteria may be looked into as abnormalities. If the corresponding bird is showing alteration in health, appropriate measures can be taken.

ENRICHMENT ACTIVITIES IN ARIGNAR ANNA ZOOLOGICAL PARK, VANDALUR, CHENNAI

Presented by:

Dr .R.Thirumurugan,

Zoo Veterinary Assistant Surgeon,
Arignar Anna Zoological Park,
Vandalur, Chennai

ENRICHMENT ACTIVITIES IN ARIGNAR ANNA ZOOLOGICAL PARK, VANDALUR, CHENNAI

Dr.R.Thirumurugan,
Zoo Veterinary Assistant Surgeon,
































Thank You

ENICHMENT IN ANIMAL ENCLOSURE

Presented by:

Dr. C. Suresh Kumar

Assistant Director

Sri Chamarajendra Zoological Gardens, Mysore

Dr. C. Suresh kumar
Assistant director
Sri Chamarajendra Zoological Gardens, Mysore

ENICHMENT IN ANIMAL ENCLOSURE






Thank You

Importance of Enrishment in Breeding of Pygmy Hog

Presented by:

Dr. Parag J Deka

Project Manager in charge,

Pygmy Hog Conservation Programm

Assam

Enrichment in Breeding of Pygmy Hog

Parag J Deka

EcoSystems-India

Durrell Wildlife Conservation Trust *IUCN/SSC Wild Pig Specialist Group*

Pygmy Hog

(Porcula salvania)

- Critically Endangered – IUCN Red List Category CR-C2a(ii), Schedule I - Wildlife (Protection) Act
- Original wild population only in Manas Tiger Reserve – numbers in lower hundreds
- No other recent record from anywhere else; possibly extinct in Nepal and north Bengal
- No sighting since 1992 in Barnadi Wildlife Sanctuary from where the species was re-discovered in 1971.

PHYSICAL FEATURES

How small is a pygmy hog?

- Adult hogs are only about 25 cm (10") high and 60 cm (23") long
- Adult males weigh 8 to 9 kg and females are about 7 kg. Newborn babies are barely 150 g.
- Compared to the wild pig (*Sus scrofa*), the pygmy hog is about 10 to 15 times smaller in bulk.

How can one tell a pygmy hog from a young wild pig?

- By its tail. The tail in adult pygmy hog is only about 2-3 cm (1") long, much smaller than that in a baby wild pig.
- The pygmy hogs has streamlined, 'bullet-shaped' body.
- Pygmy hogs females have only three pairs of teats.

Threats

- Habitat destruction / degradation
  - Encroachment for agriculture and settlements
  - Grass burning
  - Livestock grazing
  - Thatch, fuelwood, MFP collection
- Hunting / trapping

N.B. Threats to pygmy hog are very similar to those faced by Bengal florican and hispid hare (BNHS-USFWS and Univ. of East Anglia projects in India and Nepal)

Pygmy Hog Conservation Programme

a collaborative project of

Durrell Wildlife Conservation Trust
IUCN/SSC Wild Pig Specialist Group
Forest Department, Govt. of Assam
Ministry of Environment & Forest, Govt. of India

local partners

EcoSystems-India (Rare & Endangered Species Conservation Unit)

supporters

Durrell, IUCN-SOS, US Fish & Wildlife Service, Darwin Initiative, CEPF, ZGAP, AVWS, Joe Mayo and others

Pygmy Hog Conservation Programme

OBJECTIVES

- Reduce population decline
- Promote recovery of the species

  LONG-TERM GOAL: Ensure survival of pygmy hog into perpetuity

  SHORT-TERM GOAL: Establish at least three wild and captive populations each

ACTIVITIES

- Conservation breeding
- Reintroduction after habitat restoration
- Assessment of grassland management practices and recommendations for scientific management of habitat
- Extension activities in the fringe villages of Manas Nameri, and Sonai Rupai
  - Awareness generation
  - Conservation networking
  - Community interventions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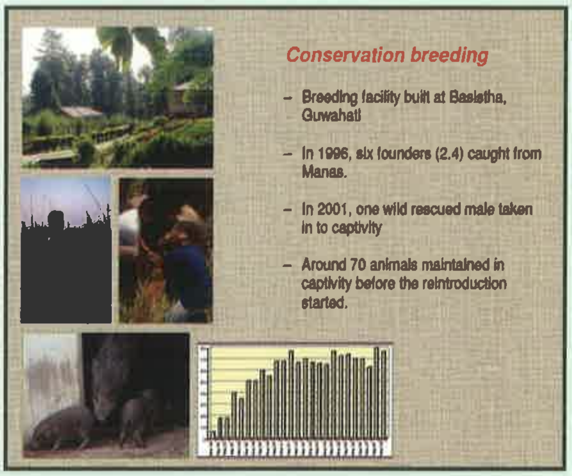
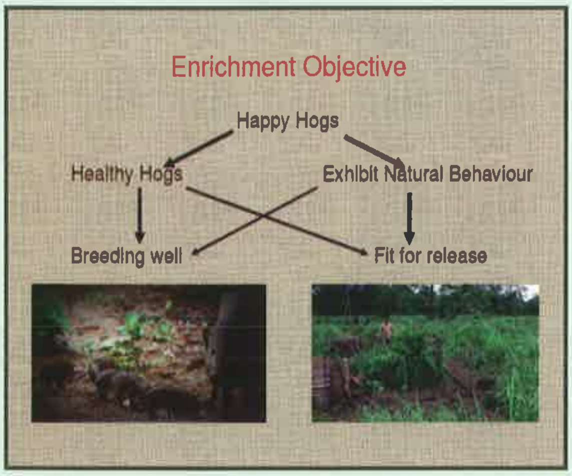
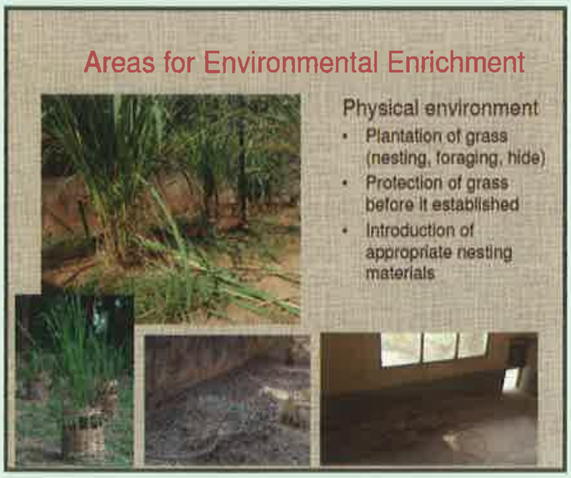
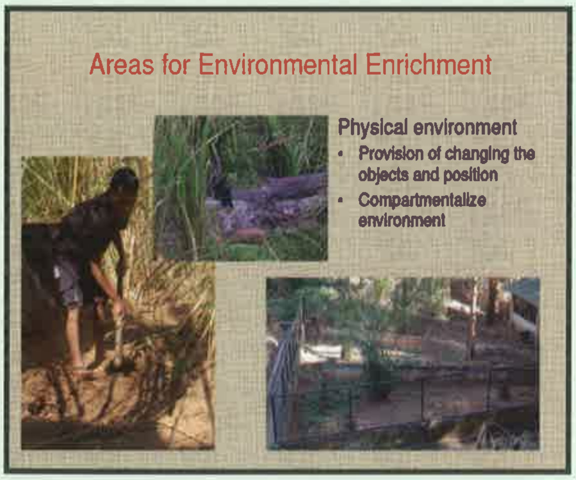

Conservation breeding
– Breeding facility built at Basistha, Guwahati
– In 1996, six founders (2.4) caught from Manas.
– In 2001, one wild rescued male taken in to captivity
– Around 70 animals maintained in captivity before the reintroduction started.

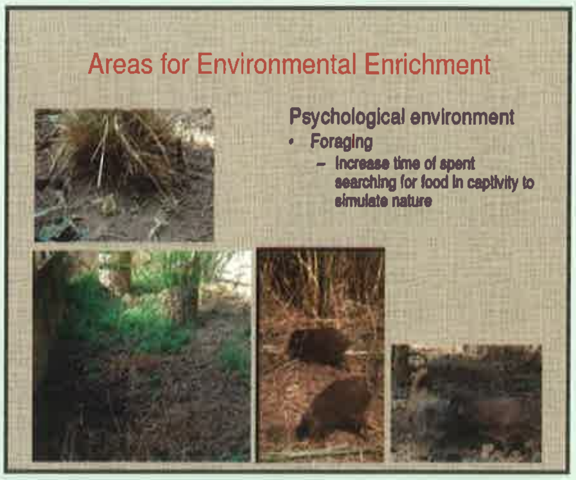

Enrichment Objective
Happy Hogs
Healthy Hogs
Exhibit Natural Behaviour
Breeding well
Fit for release

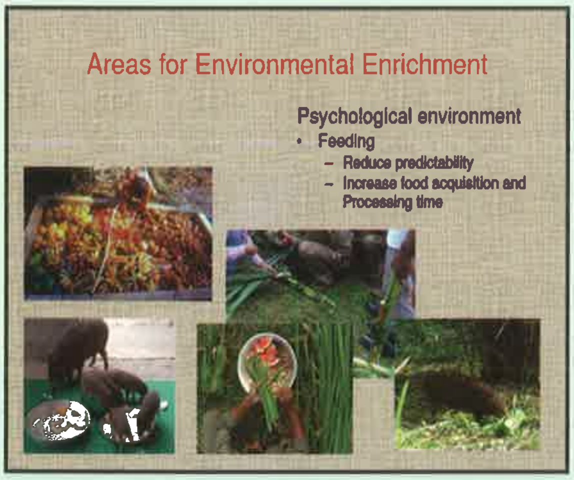

Type of Enrichment
Naturalistic
Recreate the natural environment as far as possible using natural materials

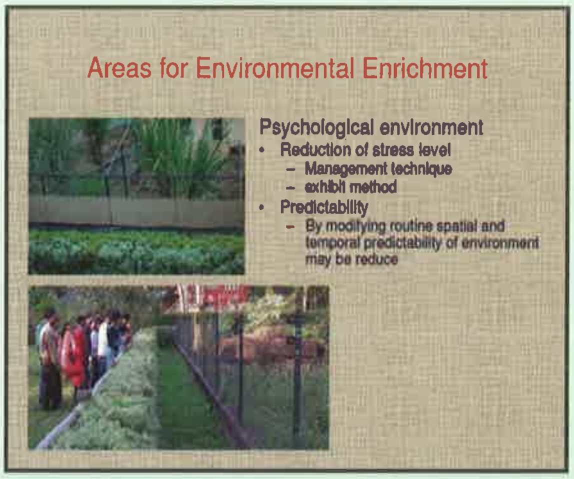

Areas for Environmental Enrichment
Physical environment
• Plantation of grass (nesting, foraging, hide)
• Protection of grass before it established
• Introduction of appropriate nesting materials


Areas for Environmental Enrichment
Physical environment
• Inclusion of more stimulating substrate
• Creating wallowing pools


Areas for Environmental Enrichment
Physical environment
• Provision of changing the objects and position
• Compartmentalize environment


Areas for Environmental Enrichment
Psychological environment
• Foraging
– Increase time of spent searching for food in captivity to simulate nature


Areas for Environmental Enrichment
Psychological environment
• Feeding
– Reduce predictability
– Increase food acquisition and Processing time


Areas for Environmental Enrichment
Psychological environment
• Reduction of stress level
– Management technique
– exhibit method
• Predictability
– By modifying routine spatial and temporal predictability of environment may be reduce


Areas for Environmental Enrichment
• Social grouping
– Compatible social grouping
– Size and structure of group (dominance hierarchies, age, sex)


Areas for Environmental Enrichment
• Breeding hogs
– Gradual introduction of breeding hogs
– Compatible pair


Areas for Environmental Enrichment
• Breeding hogs
– Behavioural Security
• Breeding pair
• Pregnant sow
• Farrowing sow
• Newborn hoglet


We are Happy
Thank You

c0025

CHAPTER

25

Release and Reintroduction of Captive-bred Red Pandas into Singalila National Park, Darjeeling, India

Alankar K. Jha

IFS, Padmaja Naidu Himalayan Zoological Park, Darjeeling, India

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s0010

INTRODUCTION

p0010 The red panda, *Ailurus fulgens* is an endangered species, its range extends from Nepal in the west to a few provinces of China in the east. In India, it is found in the Darjeeling and the Sikkim Himalayas and in the north-eastern state of Arunachal Pradesh. Its image is represented on one of a new series of postage stamps issued by the Indian government

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f0010 

FIGURE 25.1 Indian postage stamp depicting a red panda.

to represent the rare fauna of that region (Figure 25.1). The decline of the red panda population in the past has been directly proportional to the human population explosion, which has resulted in increases in hunting, trapping, trading, habitat disturbance and fragmentation. To preserve the red panda for the future requires us to make conservation efforts which, fortunately, the local population supports.

s0015 THE STATUS OF RED PANDAS IN THE DARJEELING AREA

p0015 There are few data available on the status of the red panda in the wild in India. It is believed to be very rare, and a recent study in the Singalila National Park near Darjeeling in West Bengal showed that a small population of about 78 animals was surviving in the area. Red pandas have also been sighted on a number of occasions in the Neora Valley National Park, also in the vicinity of Darjeeling, and one animal was sighted in the Kainjaley area in 2008. This area is not a national park and also lies outside of the usual range of the red panda.

s0020 Darjeeling Zoo

p0020 The Padmaja Naidu Himalayan Zoological Park (PNHZP) in Darjeeling is dedicated to the conservation of endangered Himalayan fauna and it is seriously concerned about the possible extinction of Himalayan fauna, in particular of the red panda. This zoo is situated at Birch hill in a patch of virgin forest. The town of Darjeeling itself is situated in the lower Himalayas at 27°3′N and 88°18′E, at a distance of 640 km from Kolkata. The town is situated on a long spur, which projects to the north from the Senchal-Singalila range of mountains. This spur rises somewhat abruptly from Ghoom to an elevation of 7886 ft (2404 m) at Katapahar, and then gradually descends to 7520 ft (2292 m) at Jalapahar and to 7002 ft (2134 m) at Chowrasta, the centre of the town. The left fork of the spur leads to Lebong

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and the right to the Birch Hill and the Zoological Park, which is situated at an altitude, at the highest point, of 6874 ft (2095 m) above sea level. The annual rainfall in this area varies between 100 and 115 ins (2500–2925 mm) and the daily temperatures range from nearly freezing in the winter to about 20°C in summer. Winter snowfall can be quite heavy at times (about once every 3–4 years) and frosts are common. This type of temperate climate is well suited to the sub-alpine fauna and flora and is therefore appropriate for the breeding and cultivation of Himalayan fauna and flora. The natural ranges of a number of indigenous species such as the snow leopard, *Panthera unica*, the marbled cat, *Pardofelis marmorata*, the Indian fox, *Vulpes bengalensis*, the clouded leopard, *Felis nebulosa*, the leopard *Panthera pardus* and the bharal, *Pseudois nayaur*, all overlap with the altitudinal zone at which the Zoological Park is situated. The forest type at this altitude corresponds to Champion's type 11B/C1 or Northern Montane/East Himalayan wet temperate forest [1]. This type of forest is found at altitudes between 5000 and 8000 ft (1524–2440 m), and is dominated by oaks, *Quercus spp.*, laurels, *Lauraceae*, magnolias *Magnolioideae*, alders, *Alnus spp.*, maples, *Acer spp.*, birches, *Betulaceae*, and bucklandia.

p0025 The 80 acres of the Birch Hill Forest where the zoo is located are the remnants of the original woodlands of the region. History shows that, as recently as 50 years ago, this area was still home to a variety of Eastern Himalayan fauna including Himalayan black bear, *Selenarctos thibetanus laniger*, barking deer, *Muntijacus*, plus various species of Himalayan cats, squirrels and civets including Hogsons's flying squirrel, *Petaurista magnificus*, and the orange-bellied Himalayan squirrel, *Dremomys lokriah*, etc. The Indian fox, the red fox, *Vulpes vulpes*, and the Asiatic jackal, *Canis aureus*, were also a common sight [2].

p0030 The Darjeeling Zoo first opened on 14 August 1958. On 21 November 1975, it was renamed the Padmaja Naidu Himalayan Zoological park, by the then prime minister of India, Mrs Indira Gandhi, in honour of the memory of the late Padmaja Naidu, the former governor of West Bengal, the state where the zoo is situated, although the zoo is generally better known as simply as Darjeeling Zoo. PNHZ Park was established with the primary objective of studying and preserving Himalayan fauna and efforts are still on-going to achieve these objectives by means of the following goals:

o0010 **1.** Providing appropriate facilities for husbandry and veterinary care of captive wild animals

o0015 **2.** Captive breeding of endangered Himalayan fauna, preferably those originating from the Eastern Himalaya, with the aim of providing suitable individuals for reintroduction/restocking in their natural habitat

o0020 **3.** Educating local people, students and visitors about their wildlife and raising awareness about the importance of preserving the Himalayan ecosystem

o0025 **4.** Undertaking both pure and applied research into wildlife biology, behaviour, veterinary care and conservation.

s0025 Conservation Breeding Programme in Darjeeling Zoo

p0055 There are only two zoos in India which currently hold red pandas; the Padmaja Naidu Himalayan Zoological Park, Darjeeling and the Himalayan Zoological Park in Gangtok, Sikkim. Of these, only the Darjeeling Zoo holds a good sized, breeding population of red

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pandas. However, the Gangtok Zoo has also started breeding with the species and is also a part of the Red Panda Conservation Breeding Programme that was instigated by the Indian Government.

p0060 The IUCN–SSC Action Plan for Ailurids and Procyonids recommended the establishment of captive populations of red panda in its stated range. The breeding programme in India conforms to this recommendation. Therefore a captive population of red pandas in Indian zoos formed an integral part of a global red captive breeding masterplan [3]. As a result of the masterplan recommendations, PNHZP received five red pandas from several European zoos to augment the group of four wild caught red pandas that were already living in the zoo at that time.

p0065 At that time, the PNHZP was the only zoo located in the vicinity of red panda habitat that was holding red pandas, the Himalayan Zoo opened at a later date. It was an ideal partner for the international red panda breeding effort as it lay within the natural range of the red panda and had suitable facilities for managing red pandas in captivity. Furthermore, there were at least two protected areas with wild red panda populations close to the zoo; the Singalila National Park and the Neora Valley National Park.

p0070 The Indian captive breeding programme for red pandas was initiated in the early 1990s in the PNHZP in response to the IUCN recommendations and the global captive breeding masterplan. The main objectives of the Indian breeding programme were as follows:

o0030 1. To establish a viable captive population of red pandas in the Indian sub-continent held in zoological collections based within the natural range of the species

o0035 2. To distribute surplus captive-bred red pandas, from the prime breeding centre at PNHZP, to other subsidiary conservation breeding centres in suitable locations in Eastern Himalaya

o0040 3. To provide surplus captive-bred red pandas for restocking the dwindling populations of the species in the Singallila and Neora Valley National Parks and to reintroduce red pandas into the Senchal Wildlife Sanctuary

o0045 4. To provide scientists and naturalists with the opportunity to study various aspects of the biology and behaviour of this rare species

o0050 5. To stimulate public awareness of the plight of this endangered species and to provide the people with information on this species.

s0030 The History of the Current Captive Population of Red Pandas in Indian Zoos

p0100 The Indian zoo population of red pandas was originally founded on nine animals; four wild caught animals already living in the zoo in the early 1990s and five zoo-bred animals imported from Europe. The details of these are presented in Table 25.1.

p0105 In addition to these founding individuals, one further red panda was brought from Rotterdam Zoo in April 1993. Unfortunately, this individual did not survive. He was less than one year old when he was sent to India and, in retrospect, it was felt he may have been too young for the stresses of transport.

p0110 The first successful (planned) breeding of red panda occurred on 20 June 1994 when two cubs 'Ekta' and 'Friend' were born to 'Basant' and 'Amita' before the arrival of the new founders from Europe. The next births occurred the next year when new arrivals

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t0010 TABLE 25.1 Red pandas founding the Indian breeding programme

House Name	Stud Book number	Sex	Date of arrival and source	Date of birth
Anita	8221	F	91–92 Wild	±1986
Basant	8649	M	91–92 Wild	±1986
Chanda	8222	F	91–92 Wild	±1986
Divya	8648	F	91–92 Wild	±1986
Gora	9305	M	10.11.94 Cologne Zoo	25.6.93
Hari	9302	M	10.11.94 Rotterdam Zoo	30.6.93
Indira	9330	F	10.11.94 Madrid Zoo	26.6.93
Omin	9404	M	25.12.96 Antwerp Zoo	17.7.94
Prity*	9430	F	25.12.96 Rotterdam Zoo	26.6.94

**Prity together with 'Jugal', a Darjeeling born male, was later transferred to the Himalayan Zoo in Gangtok to start a new breeding group there.*

'Hari' and 'Indira' produced their first cubs followed by more cubs from 'Basant' and 'Amita' and 'Basant' also produced his first cubs with 'Divya', one of the other wild caught females.

p0115 Between 1994 and 31 December 2008 around 50 red pandas have been born at the PNHZP. Table 25.2 presents an overview of the births in Darjeeling and Figure 25.2 shows a young panda in a nest box in the zoo enclosure. Furthermore, it is good to note that the pair of red pandas established in Gangtok also started breeding.

s0035

THE REINTRODUCTION

p0120 By 2003, the Indian zoo population of red pandas had increased substantially and there were 22 red pandas living in the PNZHP in Darjeeling. The population was therefore considered to be well enough established to be able to take the next step in the programme, namely to release two zoo-born red pandas back into the wild. Two young females, Sweety (born 25 June 1997) and Mini (born 17 June 1998), were selected for release, neither of which has been used for breeding while in the zoo. Females were chosen for release as it was felt that females would be more likely to they would contribute to the wild population through giving birth. After their selection, the acclimatization process began; their diet was slowly changed from the zoo diet which included milk, sugar, fruit and eggs provided at regular intervals to a more natural diet based largely on bamboo which was provided at more irregular intervals. This change in their diet took about 6 months and meant that, when the animals arrived at the release facility, they were ready for total dependence on a natural diet of wild fruits, bamboos and berries. In the meanwhile, during this acclimatization process, the required health checks of the two females were undertaken so that the necessary clearances from the Government of India and Central Zoo Authority could

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t0015 TABLE 25.2 Red panda births in PNHZP, Darjeeling

Year	No. born	No. litters	No. deaths (<30 days)
1994	2	1	0
1995	5	3	1
1996	6	3	3
1997	5	3	2
1998	6	2	0
1999	7	3	0
2000	2	1	0
2001	5	2	0
2002	1	1	1
2003	3	2	0
2004	3	2	0
2005	0	0	0
2006	1	1	0
2007	1	1	0
2008	2	1	0

f0015

FIGURE 25.2 A young panda in a nest box in PNHZP.

be obtained. In addition, genetic studies were undertaken by the Center for Cellular and Molecular Biology, Hyderabad, India to confirm the taxonomic status of the pandas and to record their genetic finger prints.

s0040 The Soft Release Protocol

p0125 The females were first transferred to a special soft release facility that had been constructed in the Gairibas area of the Singalila National Park. The flora of this area comprised *Castanopsis hystrix, Quercus lamellata, Machilus odoritissima, Evodea spp., Michelai excelsa,* Rhododendrons, *Eurya japonica, Arundinaria maling, Rubus spp., Daphne cannabina.* The soft release facility had an area of 5 hectares and was situated at 27°03′N and 88°01′E, at an altitude of 2626 m. Sufficient care was taken to watch and protect this facility against predators. Straight iron sheets surrounded the area, and the shrubs and trees near the perimeter fence were removed to prevent any accidental escape by one of the animals (Figure 25.3). The two females were brought to the facility in mid-April. During the first month they were housed in a small enclosure (10 m^2) situated within the soft release facility (Figure 25.4) and then gradually released into the whole area. The animals were kept in the facility for a period of 7 months where they were observed and acclimatized prior to their final release on 14 November 2003. By the time of release the animals were completely dependent on the natural food available in the enclosure.

p0130 The Singalila National Park was chosen as the place for the reintroduction as it is the only national park in vicinity of the zoo that supported a wild population of red pandas. The choice of Gairibas as the release site was based on an earlier pre-release survey conducted by the Wild Life Wing of the Forest Department, Government of West Bengal, in

f0020 FIGURE 25.3 The enclosure used for the soft release.

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f0025 FIGURE 25.4 The small early release enclosure.

f0030 FIGURE 25.5 Forest cover at release site.

collaboration with staff of the PNHZP. It was the area with the highest density of red pandas in the region. This was deemed to be an important factor as it increased the likelihood that the two females would find mates. Moreover, the forest there had a dense vegetation of maling bamboo (*Arundinaria maling*), the red pandas' preferred diet. Figure 25.5 shows the typical habitat found in the area. In addition, the location of an office of the Forestry Service in the vicinity and the presence of very small villages were also important factors in the decision as they were considered to provide both accessibility and thus constant monitoring.

s0045 Post-Release Monitoring of the Pandas

p0135 Prior to release each female was fitted with a radio collar (Telenoics, USA). After release the pandas were monitored using the non-triangulation location technique known as "Homing in on the Animal Method" [4]. The method is simple and the positional data are obtained by following the transmitted signal's increasing strength until the radio-collared animal is seen. The Wildlife Wing of the Forest Department of Government of West Bengal monitored the females on alternate days. This method provided a good overview of the movements of the released pandas as well as information on their behaviour, breeding and eventual death. Figure 25.6 is a typical data sheet showing the tracking locations of a single female over one month.

p0140 The two females behaved quite differently, one female, Mini, remained close to the release site and settled in an area referred to here as the Middle Area (average altitude 2800 m) which lay between PWD road and the Nepal boarder. Although she did explore the adjacent areas (Pulkhola and Plantation area) in the weeks following her release, however, she spent 80% of her time in the Middle Area. Sweety, on the other hand, was considerably more mobile than Mini.

p0145 Mini also started interacting with the wild pandas much earlier than did Sweety. The first wild panda was sighted in her area was on 18 November, just 4 days after the release. She was sighted again with wild pandas in the Middle Area on the 4 December and then on December 13, 21 and 31. The sightings were repeated on three dates in January; 1, 16 and 23 and a further five dates in February; 9, 11, 13, 20, 23 and 25.

p0150 Despite all these positive indications of Mini's adjustment and survival in the wild, the project lost her in March when she was predated, probably by a clouded leopard. Her remains, the skull, part of her tail and a paw, were found together with the radio collar by a member of the monitoring team on 15 March 2004.

p0155 Sweety, on the other hand, as already mentioned earlier, was very mobile. She remained close to the release site for 6 days and then travelled a distance of about 2 km. Her relocation over this distance from the release site, to a comparatively unknown area, made tracking and monitoring her difficult initially. In December, she settled in an area about 1–1.5 km from Gairibas known locally as MR Road. She remained there throughout January but, from February, she started moving further exploring the areas towards Kaiyakatta. She spent a lot of her time in this area between February and June. The first wild red panda was seen in the MR road area on the 4 December. However, Sweety was not seen with a wild panda until 17 February. She was seen with wild pandas again on 26 February, 11 March, 1 April and 3 April. Mating was recorded on 12 March 2004. The courtship and mating with the wild male were successful, Sweety became pregnant and, on 7 July 2004, she gave birth to single a cub in a tree hollow nest. This cub unfortunately went missing from the nest a month later.

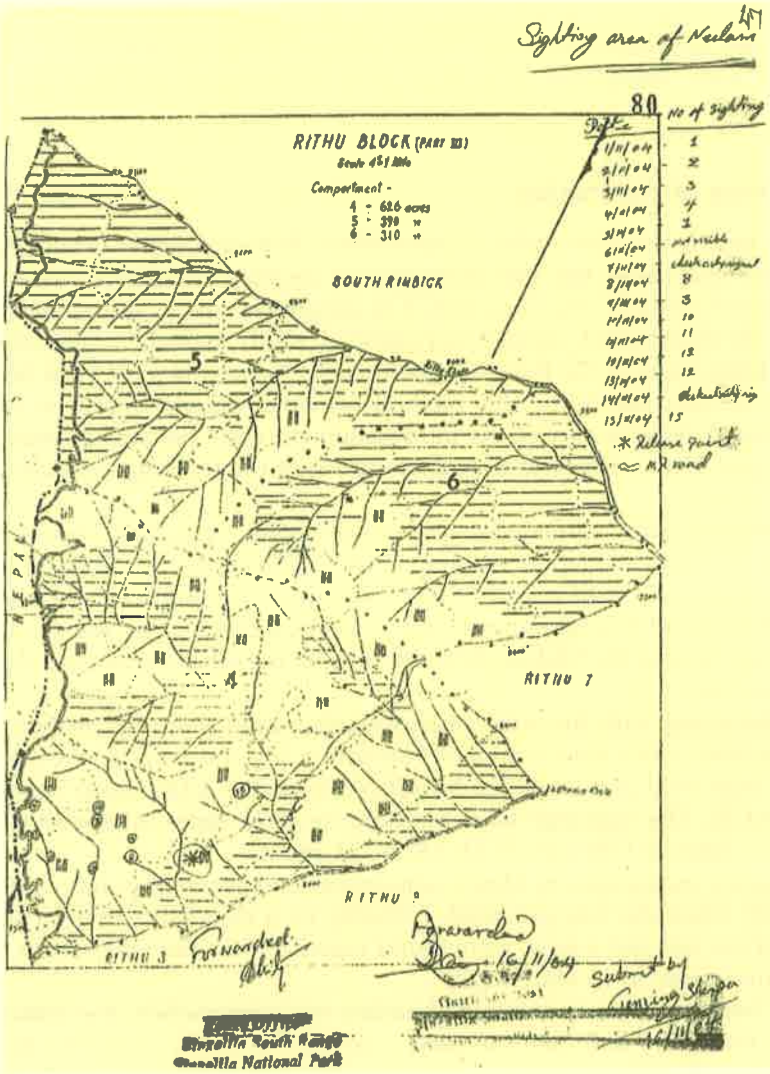
f0035 

FIGURE 25.6 An example of the tracking results for a released female.

s0050 Behavioral Observations

p0160 Behavioral observations of the collared animals showed that Sweety was not only more mobile than Mini but she also urinated more frequently. This could indicate that she was putting substantially more effort in establishing herself in the wild and in an area of habitat where she would not encounter other pandas as easily as Mini. The high frequency of urination and movement seem to indicate that Sweety needed to scent mark to communicate her presence to conspecifics in and around the area more vigorously than Mini did.

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s0055

CONCLUSION

p0165 The release of the red pandas into the Singalila National park conformed to the Reintroduction Guidelines of the IUCN SSC Reintroduction Specialist group [5]. A pre-release study of the area was undertaken, the conclusion of which was that the habitat was suitable for a release and that there was a high density of wild red pandas. These conclusions were confirmed by the observations; Mini did not venture fare from the release site, which would indicate that she was satisfied with the habitat. Also the attention that Mini received from potential mates as soon as she arrived in the Middle Area would indicate that the release site was apparently a good location for a potential breeding female. The density of wild red pandas was clearly an appropriate consideration when releasing a potentially breeding female. However, two points of concern emerged, these were the proximity of both a trekking route and the Nepal boarder. This meant that the area was subject to disturbance from trekkers and that led to concerns for the safety of the animals. The international boarder meant that there were problems for the trackers on the four occasions when Mini entered Nepal. These factors should be taken into account for future re-stocking projects in the area.

p0170 These results and observations confirm previous findings that the MR road area, oak forest habitat, only supports a very low density of red pandas [6]. The few pandas that were sighted and reported from this region were transient animals; there is no clear evidence of permanent use of this habitat by pandas. Sweety's temporary residence would seem to indicate that the MR road area could support red pandas, although her later preference for the Kaiyakatta Area could be taken to indicate that it is not ideal habitat. Information collected during the project on the use of this area was based on direct sightings and, as such, may be an artifact resulting from infrequent chance sightings rather than a reflection of actual habitat use. An earlier study in the Singalila National Park questioned if this area was good red panda habitat or whether it had just not yet been colonized by the species [6]. Some animals do not necessarily occupy their entire potential habitat even though they are able to disperse into unoccupied areas; a behaviour that limits the distribution of the species [7]. Alternatively, the density of red pandas in the area was so low that that sub-adults did not need to disperse far from the area where they were born.

p0175 The method for locating the source of the radio signal when tracking the pandas that was used in this project was fairly simple. However, the location of the animal by this technique was followed by a period of direct observation that meant it was possible to see how the animals were behaving and to ensure their welfare. On the other hand, actually getting close to the animals could be disruptive. This disadvantage had to be weighed against the benefits of the benefits of direct observation. Also the work required meant that Mini and Sweety could only be monitored on alternate days.

p0180 A common concern when placing a radio tracking device on a relatively small animal, is the weight of the transmitter [4]. The transmitter used in this project weighed approximately 95 g which was considered as an acceptable weight for an animal of the size of a red panda (correspondence with Telenoics). Indeed, during the project, the animals gave no indication that they were hindered in any way by the radio collars. This was further confirmed by Sweety's survival and the successful reproduction.

p0185 A second point of concern was that life in captivity might have led a zoo-born animal to lose some of the basic instincts and behaviours that are essential for survival in the wild. However, the behaviour of these pandas and the eventual birth of a cub clearly demonstrate that zoo-born female pandas were capable of surviving in the wild despite their captive origin.

p0190 Behavioural observations conducted in the pre-release facility showed that Sweety was more active than Mini even prior to actual release. If this activity is predictive of exploratory behaviour after release, observations of behaviour in the pre-release facility could be used to select which individuals are better suited behaviourally for release back into the wild. In addition, tests and simulations to evaluate and train anti-predator behaviour could be used to improve post-release success.

p0195 This reintroduction project was a pioneering one in this part of world. This was the first time in India, or even south-east Asia, that a captive-born animal has been purposely reintroduced into the wild as part of a re-stocking project. The full impact of its success and failure cannot be measured at this stage. The reintroduction of Mini and Sweety was just the first phase of a longer programme. A second introduction of two more females (Neelam and Dolma) took place in shortly afterwards. These animals were taken to the soft release facility in November 2003 and were released into the wild in August of 2004. They were monitored after their release but no breeding occurred. The information collected from these releases has been analysed and the project has been reviewed. The conclusions and recommendations of this will be taken into account in the planning of the second phase of the project. The PNHZP and the Wildlife Wing of Forest Department are planning to release two male red pandas, in the same location. The Wild Life Institute of India is in the process of conducting a habitat study of the location and, in the meantime, two animals have already been identified by the zoo for this reintroduction, their diet is currently being adapted and the plan is to implement this introduction in the very near future.

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EEP-Husbandry Recommendations for Asiatic lions (*Panthera leo persicus*)

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Biology of the species:

The Asiatic lion is a large cat restricted to India's Gir Forest, part of the Gir National Park and Wildlife Sanctuary, with a population of approximately 350 animals. The Gir is a dry deciduous forest dominated by teak. The drier Eastern part of the Gir is vegetated with acacia thorn savannah and has an annual rainfall of approximately 650 mm while the Western has a higher rainfall in the region of 1000 mm. Asiatic lions have a different social structure to African sub-species with males being less social and only associating with females during mating or following a large kill.

The lesser degree of sociality may be a function of the smaller prey species available to them with the most commonly taken species being the chital (45% of known kills) only weighing in the region of 50 kg. Sambar deer are also a regular part of the diet as is domestic livestock, farmed by the reserve's human population. Radio-telemetry studies in 1993 estimated the annual home range for male coalitions to be between 100-150 km^2 and for females and single males at approximately 50 km^2. A morphologically distinct sub-species Asiatic lions have an abdominal fold of skin running longitudinally and wild males do not show as fully developed manes as their African counterparts.

Captive Management

Housing: A combination of secure indoor housing and large outdoor enclosures, as is typical for other lion and tiger sub-species, is suitable for Asiatic lions. The recommended size of the outdoor enclosure is ~800m^2 - with larger being preferable. While enclosures should be as large as possible it is equally important to remember that the quality of the space within the enclosure is as important as, if not more than, the physical size. Enclosures should be designed so that either two (or more) inter connected enclosures are available or alternatively one large enclosure that can be separated into two to allow for the separate management of adult lions when cubs are present (in those instances where the male is removed). Young lions are not transferred to other institutions until they are at least 18 months to two years of age to enable correct social skills to be learnt; therefore it is equally important to ensure that adequate facilities are incorporated to hold young adult lions for an interim period between removal from the adult lions prior to being transferred to another institution.

As a means of containment the enclosure perimeter can either be a fence or moat (dry or water). Dimensions vary between institutions but it is recommended that fences should be 4.5m high with a 1m overhang set at 45° and water moats no less than 7m wide. Water moats should have a shallow incline on the animal side of the enclosure to facilitate easy exit by the lions. Asiatic lions will willingly enter water and there should be adequate height above the water level on the visitor side of the enclosure to deter escape.

All substrates should be natural and varied. The enclosure should be landscaped to provide a naturalistic and stimulating environment utilising trees, plants, water, rocks and dead trees. A variety of topographical levels should be provided, either by utilising the natural ground or by constructing raised platforms etc. Visual barriers should also be provided to give areas of privacy for the cats or to retreat from other lions if they so wish.

Feeding: This should be as varied as possible and although horse and/or beef, including bones, will constitute a major part of the diet whole carcass items such as rabbit and chicken should also be provided. Animals should be accustomed to being fed separately to reduce the likelihood of fighting and to assist with the management of the lions for enclosure maintenance. Water should be provided *ad libitum*.

Breeding: Reproduction in the wild is year-round although there appears to be a birth peak between February and early April. The mean litter size is 2.5, roughly the same as in captivity. Adolescent males have been noted in the presence of the dam to approximately two years of age and beyond and young females remain with the dam and related females, forming the nucleus of the pride structure.

Asiatic lions breed freely in captivity although females do not appear to show particularly good rearing skills until the second, usually third, litter. They do however learn through this process and hand-rearing is not recommended unless circumstances dictated otherwise. The gestation period is approximately 110-112 days.

Behavioural enrichment: In the first instance enclosures should be designed to provide as natural and varied an environment as possible. Additional means of enrichment should be provided regularly and it is important to remember that as soon as an enrichment item becomes a regular part of the enclosure it no longer provides stimulation and ceases to be enrichment. A varied enrichment plan should be produced and implementing either temporal or spatial unpredictability might overcome the tendency of rapid habituation. The concept of several inter-linked exhibits which allow the rotation of different species is a novel one and would provide stimulation from experiencing the smells of a different species that had occupied the enclosure previously. In a simpler form olfactory enrichment can be achieved by occasionally introducing faeces/urine of prey and/or other carnivore species. An extension of behavioural enrichment is that of operant conditioning/occupational enrichment thereby 'training' a behaviour, for example presenting paws or opening the mouth on command, so as to carry out regular health checks without the need for anaesthesia. A programme such as this should be prepared in conjunction with the veterinary department.

The EEP-Husbandry recommendations for Asiatic lions (*Panthera leo persicus*) are the synopsis of the experience of the members of the EEP for this species.

Welfare and Conservation Implications of Intentional Breeding for the Expression of Rare Recessive Alleles

Association of Zoos & Aquariums
Animal Welfare Committee: Taskforce on Animal Breeding Practices
Approved by the AZA Board of Directors – June 2011

AZA Position Summary:

Breeding practices that increase the physical expression of single rare alleles (i.e., rare genetic traits) through intentional inbreeding, for example intentional breeding to achieve rare color-morphs such as white tigers, deer, and alligators, has been clearly linked with various abnormal, debilitating, and, at times, lethal, external and internal conditions and characteristics, which are outlined in this paper. Many of these conditions may seriously compromise the welfare of individual animals. In addition, such breeding practices are also problematic from a population management and conservation perspective, impairing our ability to develop and maintain sustainable captive populations for the future and to deliver appropriate animal welfare and conservation education messages.

Therefore such practices are not in adherence with AZA's Board-approved Policy on the Presentation of Animals (22 July 2008), which maintains that "... animals should always be presented according to the following core principles: 1. Animal and human health, safety, and welfare are never compromised; 2. Education and a meaningful conservation messages are integral components of the presentation; and, 3. The individual animals involved are consistently maintained in a manner that meets their social, physical, behavioral, and nutritional needs."

Based on the welfare, population health and management, as well as conservation and education concerns outlined in this paper, AZA-accredited institutions should not engage in intentional breeding practices for the purpose of producing anomalous phenotypes.

At times, inappropriate breeding practices by others (outside of AZA) may yield animals with anomalous phenotypes and adverse internal conditions, which may be in need of rescue. Providing holding and care for such animals and responding to rescue requests from local, state, or federal agencies are appropriate activities for AZA-accredited institutions, provided that the delivery of thoughtful educational messages about the unfortunate results of intentional inbreeding for rare genetic traits are part of any public display.

Interestingly, the very instinct that appears to draw humans towards novel patterns and diversity in general also seems to underlie our fascination with unusual and abnormal patterns and phenotypes expressed only rarely, or occasionally, in nature. The spectacle provided by displays of calves with two heads, five toed cats, and traits such as albinism, melanism, or dwarfism, continues, even today, to provide an attraction to many, unaware of the biology underlying such odd occurrences. Even among today's frequently well informed and educated zoo visitors, the interest in seeing white tigers, white lions, white alligators, or king cheetahs continues often in preference over the 'normal' looking individuals of the same species.

Of greater concern, in some cases, there exists the misconception that these unusual color morphs, or other phenotypic aberrations, may represent a separate endangered species in need of conservation. Various articles and education efforts over the years have tried to put this issue into a proper scientific perspective, at least for the tiger (e.g., Leyhausen & Reed, 1971; Latinen 1987; Schroeter, 1981; EAZA 2010). However, some of the myths persist and will require additional education and a clear stance on this issue from the AZA community.

The purpose of this White Paper, therefore, is to highlight some of the well documented welfare and conservation concerns involved in breeding, or support of breeding, for unusual and rare traits (in any species) and provide recommendation with regard to this practice for AZA accredited institutions and certified related facilities.

A precedent for such recommendations has been set in the area of pet and farm animal welfare in Europe and the UK, where various legislative efforts are under way, or have already been put in place, to discourage the intentional breeding for rare recessive alleles with known potential deleterious effects and welfare concerns. A long list of potentially harmful recessive traits exists for pet animals, from fish and hamsters to dogs and horses, that are associated with either substantial physical or behavioral impairment and/or even lethal outcomes such as a drastically shortened lifespan (e.g., Not et al., 2008; Stucki et al., 2008; Kirkwood et al., 2010). For example, taillessness in some duck breeds can lead to lowered reproductive rates and shorter lifespan as well as problems with copulation and egg laying (Stucki et la., 2008).

Lack of pigmentation in snakes has been associated with detrimental changes in skin and eyes, such as reduced heat exchange ability and neural issues (Not, 1998). Dwarfism in rabbits has been associated with problems in teeth positioning and eating, as well as thermoregulation and reproduction. Indeed most dwarf forms of a variety of species seem to be more prone to general infections and may show compromised immunity (Not et al., 2008). In cats, breeds such as the Manx cat and tailless cat are associated with locomotive disorders, dispositioning of the vertebral column, difficulties defecating, and a loss of about a quarter of offspring when breeding for the trait of "taillessness". The "dominant white" trait in domestic cats (in spite of the word "dominant" in the trait's name the individuals are actually homozygous for this recessive color morph) has been associated with increased occurrence of deafness. Similarly in dogs, the "Merle factor" (e.g. Blue Merle Collie, or Merle Bobtail) has been associated with a disposition to deafness and eye disorders (Steiger et al., 2008). The list is lengthy and several comprehensive reviews have documented the various problems associated with intentional breeding for rare and recessive alleles in a wide variety of species (e.g., Not et al., 2008; Steiger 2005, 2008; Steiger et al. 2008; Stucki et al., 2008; Kirkwood et al., 2010; Rooney and Sargan, 2010).

As a consequence of these findings, a declaration of intent was adopted in 1995 by the European Convention for the Protection of Pet Animals based on a multilateral consultation with stake holders. Some of the highlights of the declaration included an agreement to take necessary measures to control the breeding of animals that show genetic or phenotypic characteristics harmful to the welfare of the animals in order to prevent suffering, and to develop educational information for the public regarding these issues (website; Steiger et al., 2008).

Similarly, in 1999, the Federation of Veterinarians of Europe (FVE) urged its member countries and the European Commission to consider the introduction of measures designed to safeguard the welfare of animals with respect to the risks inherent in selective breeding for rare and recessive traits. It was stated that this form of selective breeding may cause welfare problems of the following types: offspring produced may be unable to express their natural behaviors and/or may be predisposed to a variety of hereditary, congenital, metabolic or infectious disease, disability, and early death (FVE, 1999; Steiger et al. 2008). Since then various European countries have indeed implemented legislative standards for animal breeding and have even gone so far as to outlaw breeding for some of the more extreme traits, such as intentional breeding of Manx cats or 'Merle factors' in dogs (e.g., Germany, 2000; Austria, 2005).

In exotic species hereditary problems associated with selective breeding have also been clearly documented. For example, most white tigers currently in captivity are Amur-Indian hybrids that have been highly inbred to achieve continued occurrence of the colormorph (Thornton et al., 1967; Thornton, 1978; Roychoudhury and Sankhala, 1979). Various abnormalities and deformities associated with such selective breeding practices have been documented, such as the occurrence of an abnormality of the visual pathways in the brain, resulting in visual impairments such as strabismus, a condition that involves a lack of proper alignment of the eyes, preventing binocular focus on any particular point or object, and thus negatively affecting depth perception (Guillery and Kaas, 1973). This congenital defect has been listed as a common abnormality also found in Siamese cats, and in albino ferrets, albino mink, and other albinos of various mammal species that have been studied (Creel and Giolli, 1972; Sanderson and Guillery, 1973; Guillery and Kaas, 1973; Guillery, 1986).

Vascular ring anomaly around the trachea and esophagus has also been reported. This abnormality leads to the inability to feed and swallow effectively and requires an operation for correction and survival (Ketz et. al. 2001). This type of abnormality similarly represents a common congenital problem in domestic dogs and cats (e.g., Fox, 1988) resulting from inbreeding. The same abnormality has also been reported in white lions (Goldin and Lambrechts, 1999). Other congenital defects, such as changes in cranial structures and skull development, as well as cleft palate have also been well documented in white tigers and other rare color morphs in other species. More generally, albinism has been associated with a wide variety of health problems and congenital defects and is regarded as a hereditary defect rather than a desirable trait in wild and most domestic populations (Creel and Giolli, 1972; Guillery, 1986; Laikre, 1999).

The underlying cause for the multitude of the above cited health and welfare issues is a relatively simple one. Several of the traits such as albinism are located on recessive alleles that are only expressed phenotypically (in appearance) if two copies of the same trait are obtained by a given offspring (homozygous representation of alleles). For example, in the case of the white tiger one recessive allele has to come from each parent to allow for expression of the white striped color morph. While this has happened rarely in wild tiger populations, such as one in India many decades ago, and may occur in wild populations of various species occasionally (e.g., white deer, lion, ferret), such traits only rarely get expressed, and, when expressed, it is very likely that they confer a disadvantage resulting in reduced fitness for a given individual under most circumstances. Indeed, the very rarity of the traits in natural populations is itself strong evidence that they have deleterious consequences.

A wide variety of heritable defects and abnormalities have been found associated with recessive alleles, and the occurrence of these detrimental and/or lethal recessive traits is termed the genetic load of a population and species. Since these alleles are generally rare in a given population, some level of inbreeding (i.e., breeding of closely related individuals, which increases the chance that the same two rare and recessive alleles will be present in the two parents and therefore can be transmitted to and expressed in offspring) has to be practiced to achieve phenotypic expression of the trait with greater than a miniscule frequency of occurrence. Selective breeding for such traits will therefore usually lead to a variety of negative consequences also documented for severe inbreeding, such as increased expression of the genetic load, congenital defects, such as cleft palate, and overall decline in fecundity and increase in morbidity (e.g., Falconer, 1981). In summary, the welfare concerns associated with intentional breeding for rare (and thus usually detrimental) traits are therefore twofold:

1. Health and welfare problems directly associated with the trait itself, such as visual and neural problems associated with albinism, or gait and elimination problems associated with taillessness.

2. The sometimes more indirect, but just as problematic, health and welfare consequences related to intensive inbreeding to accomplish expression of rare and unusual traits, such as congenital deformities, decline in overall fitness and fertility, increased susceptibility to disease and infection and shortened lifespan or still birth.

Furthermore, in terms of effective conservation management and population health, selective breeding for specific phenotypes is in direct opposition to standard zoo population management goals of maximizing genetic diversity by minimizing inbreeding. Recessive alleles (or any particular alleles) should neither be selected against nor selected for, since doing so would lead to a loss of overall genetic diversity (Lacy, 2000).

Selection for specific traits will hasten a population's loss of gene diversity, lead to higher inbreeding levels more quickly, and create a domesticated form of the species that no longer represents or resembles the wild population.

Occasional expression of a rare and deleterious allele may occur by chance, but should not be 'forced'; rather, these traits should be allowed to appear at their naturally occurring frequencies. Retaining all alleles at their naturally occurring frequencies helps retain genetic diversity and provides populations with adaptive potential in the face of environmental change. The standard genetic management strategy in zoos, using mean kinship rather than phenotype to select breeding animals, is specifically intended to maintain gene diversity and minimize inbreeding (Ballou & Lacy, 1995). The mean kinship genetic management strategy aims to efficiently equalize all founder lineages in small populations, whereas preferential breeding of rare or abnormal phenotypes within the limited space in zoos causes over-production of a few lineages at the expense of known-pedigreed animals from genetically valuable lineages. Inequality of founder lineages will lower genetic diversity at the population level and will eventually lead to individual genetic problems associated with inbreeding.

Modern zoos are concerned with future sustainability of wildlife populations. Problems for many captive populations arise from the small genetic base (i.e., few founder individuals) from which zoo breeding programs often are started, the difficulty of obtaining breeding activity reliably and successfully, and the small populations that can be maintained with the resources available for most programs. It is especially counter-productive therefore, to allocate breeding program resources toward practices that rapidly degrade the genetic variation with which the program was started, cause reduced reproductive fitness, shorter life spans, and reduce the resources that can be allocated for animal management programs that do serve bona fide conservation and education purposes.

From an education perspective, intentional inbreeding for the production of anomalous phenotypes is in direct contrast to the mission of modern zoos. Propagating animals that specifically do not represent the normal characteristics and variation of the species creates a confused educational message. If animals in zoos and aquariums are to be ambassadors for their species then the exhibition of phenotypic aberrations creates difficulty in properly interpreting what modern zoos are about. Further, it is counter-productive to the overall conservation message of preserving essential characteristics of a species and ensuring genetically healthy and sustainable populations both in zoos and aquariums and in the wild.

Primary roles of modern zoos are to help protect wildlife and natural habitat, educate the public about conservation efforts, and directly engage the public in these efforts. These commendable goals are forfeited when intentional inbreeding is practiced to create or abnormally augment the occurrence-frequency of anomalous phenotypes outside of the natural variation in the species. Such practices cause rapid depletion of the normal genetic variation, the maintenance of which is a stated goal of the professional zoological community, while simultaneously subjecting some of the animals that are produced to, now documented, poor welfare, poor health, and reduced fitness.

Breeding practices that increase the phenotypic expression of single rare alleles through intentional inbreeding cause abnormal or aberrant external and internal conditions and characteristics. The predictability of such outcomes from intentional inbreeding to produce phenotypic anomalies indicates that these practices are not in adherence to AZA's Board-approved Policy on the Presentation of Animals (22 July 2008). Thus, AZA-accredited institutions should not engage in intentional inbreeding practices for the purpose of producing anomalous phenotypes from the perspectives of welfare, education, population management, and conservation.

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Clouded leopard (*Neofelis nebulosa*)

Husbandry Guidelines

(originally published 2000)

Disclaimer: The information provided here is a guideline and is a result of the collective experiences of a number of clouded leopard managers. Scientific studies conducted since publication of this original document and other management practices developed since may alter these guidelines. The Clouded leopard SSP does not support ownership of clouded leopards by those individuals/facilities not qualified to care for them. The SSP strongly discourages ownership of clouded leopards as "pets".

Introduction

The Clouded leopard (*Neofelis nebulosa*) is a medium-sized cat found in the jungle and forested regions of Malaysia and the countries of Southeast Asia. First mentioned by Sir Stamford Raffles in the Descriptive Catalogue of a collection made in Sumatra it was given the scientific name of *Felis nebulosa* by Griffith in 1821. Known common names in range countries include *harimau-dahan* (branch or tree tiger) or mint leopard by the Chinese due to its markings being similar to mint leaves. Regardless of its name one thing is readily accepted-this cat is arguably the most beautifully marked felid and perhaps the most challenging to study.

Little to nothing is known of its habits in the wild. This has compounded captive management efforts as this species' behavior is most unique. This document is designed to serve as a "jumping off point" by offering guidelines for current captive management practices and, perhaps more importantly, to encourage intensive study of this species in captivity and in the wild. Information included in this document has been drawn from the experiences of clouded leopard managers as well as published works.

Natural History

Range

Historically the clouded leopard was found from Nepal to Indochina, Indonesia, southern China and Taiwan. Population numbers are thought to be lower outside protected areas and are probably healthiest in Borneo because of the absence of tigers and leopards. Surveys in Borneo suggest a density of one individual per 4 square kilometers. Four sub-species are recognized:

Neofelis nebulosa brachyurus: Taiwan. Probably extinct in the wild.

Neofelis nebulosa diardi: Sumatra, Borneo and Java

Neofelis nebulosa macrosceloides: Nepal to Burma

Neofelis nebulosa nebulosa: Southern China to East Burma

Habitat

Once thought to be highly arboreal, recent evidence indicates the clouded leopard may spend considerable amount of time on the ground. Its arboreal talents are numerous—it can hang upside down from branches by its hind feet, climb on horizontal branches with its back to the ground and run headfirst down tree trunks. These talents are most likely utilized to move through the trees and for hunting. Clouded leopards are most closely associated with primary evergreen tropical rainforest but do utilize other types of habitat such as secondary and logged forest, dry tropical forest, mangrove swamps, grassland and scrub. Sightings at elevations as high as 1,450 meters in the Himalayans have been reported. They are primarily nocturnal.

Diet

Birds, primates (proboscis monkey, pig-tail and other macaques and gibbons), muntjac and wild pigs. Clouded leopards are thought to stalk from the ground and ambush from the trees.

Social Organization

Due to their highly secretive nature virtually nothing is known of the clouded leopard's habits in the wild. Knowledge of its social behavior is based on observations of this species in zoological institutions. In captivity they are typically housed with the same mate for life once they are paired. Mated pairs are most successful when animals are introduced by one year of age.

Conservation Status

The cat is listed as Vulnerable in the IUCN Red Data Book, as Appendix I species under CITES and Endangered under the United States Endangered Species Act. The species is estimated to be in decline based upon the decreasing number of sightings of live clouded leopards by resident peoples within its range.

Physical Description

The clouded leopard is sometimes described as bridging the gap between large and small cats. In general the clouded leopard is short in stature with short legs and a long body. The head is large in proportion to the rest of its body and the tail is nearly as long as the body. Body length (head, body and tail) averages 1.3-2 meters. Body weights range from 11 to 20 kilograms for adults. Shoulder height is 50-55 centimeters. Males tend to be larger than females.

Clouded leopards have an ossified hyoid that allows them to purr but not roar. They also can make a very distinctive chuffing sound as well as other vocalizations. When threatened this cat can make a sound similar to a roar that is unnerving to the unfamiliar. The clouded leopard is capable of climbing down vertical branches with ease and frequently hangs from its rear legs.

The head and neck of the clouded leopard is patterned variably but general characteristics do occur. There are rows of fine spots (some running together) on top of the head. Patterns of smaller dark spots on the sides of the head lead to stripes predominating on the cheeks. Eyes are large with vertical apertures. Short rounded ears are black on the backside with lighter colored central patches. The most prominent feature of the clouded leopard head is the unusually large canines. These teeth can be 3.8-4.5 cm long and have a very sharp back edge. The canines in the clouded leopard are the largest in relation to body size of any extant feline and it is the closest living relative to *Smilodon tatalis.*

The body pattern is one of elliptically shaped black edged spots with the insides of the spots generally darker in color than the background pelt color. Pelt color is widely variable from ochre to tawny brown to silvery gray. Melanistic as well as pale white individuals are reported in the literature. Two longitudinal black stripes run along the back. The underside of the belly is whitish but marked with large black spots. Legs are covered with rings of black spots. Feet are finely spotted with hair growing between the balls of the feet. Soles of the feet are generally dark colored. Differing sub-species do display differences in color patterns. *Neofelis nebulosa nebulosa* has a more yellowish coat and the spots are more elongated across the body. *Neofelis nebulosa macrosceloides* is darker with a grayer coat and larger blotches. *Neofelis nebulosa diardi* is darker with smaller, sometimes rosette-like blotches. The tail is encircled with black rings with longitudinal lines on the upper half of the tail. The fur on the tail is quite thick.

Captive Management

Individual Identification Methods

All clouded leopards should be permanently identified via transponder or tattoo. For consistency purposes transponders should be used as recommended by the AZA Veterinary Advisors group. Tattoos should be on the inner right thigh and include the animal's International Studbook number. Individuals can be identified via pelage pattern, however, this should not be the only method utilized.

Restraint Methods

Generally adult clouded leopards are too large to restrain manually. Some institutions have had success using nets and specially designed squeeze chutes/boxes (see resting box illustration at end of this section). Managers must be aware of the secretive and easily stressed nature of this species when selecting restraint methods. Remote capture equipment, particularly blow pipes are acceptable. Higher powered equipment such as CO2 can cause serious injury and should be avoided, particularly at close range.

Crating and Transport Procedures

Ideally clouded leopards should be "crate trained" before relocation. This involves gradually acclimating the animal to the transport container over a period of time. For shipment purposes all transport crates should meet IATA (International Air Transport Association) guidelines. For international transport a licensed broker should be used. Proper permits should be obtained with flexibility in timing to allow for dealing with logistical problems. Crate sizes vary depending upon the size of the individual but generally a minimum size of 36 inches long by 24 inches wide by 26 inches tall is recommended for adults. As Clouded leopards are intolerant of cold temperatures air shipments during winter months should be avoided. It is essential that all openings in the crates be covered with burlap or shade cloth to allow the animal privacy.

Diets

Clouded leopards are maintained on a variety of meat-based diets. Most institutions feed a commercially prepared horsemeat based diet at a rate of 1-2 lbs. per day for 4 to 6 days per week. Some facilities feed a variety of chunk meat and chicken products as well as whole animal supplements. Amounts offered vary dependent upon the condition of the individual cat. As with other cat species one or two fast days per week are recommended. On fast days clouded leopard's can be offered knuckle bones and/or whole animal supplements such as chickens, mice or rats.

Any raw meat offered should not be allowed to warm to room temperature or above for extended periods of time. This may result in growth of harmful bacterial organisms. In general clouded leopards should be separated into individual enclosures for feeding. This reduces the risk of fighting over food and allows for accurate measurement of food consumption.

Environmental Enrichment

To combat stereotypic behaviors such as pacing, hair pulling, etc. it is recommended that clouded leopards be provided enrichment on an ongoing basis. Items suggested below should be offered at random so that a pattern is not developed as cats become easily desensitized. Also doing nothing is enrichment on some days. **All managers must review the list and set guidelines for appropriateness/safety/disease control. It is suggested that each institutions veterinarian review the items prior to use.** Food items should be used in quantities or frequencies that will not adversely affect the dietary needs of the animal.

1) Sand box (may become a defecation site)
2) Rib bones
3) Frozen feline diet balls
4) Knuckle bones
5) Rats/mice/rabbits-live or dead
6) Whole chickens
7) Feline diet blood trails
8) Straw/hay that has been used in ungulate exhibit/holding
9) Wood chips
10) Browse
11) Logs/stumps
12) Boomer ball
13) Spices and herbs--Russian sage, mint, cumin, nutmeg, oregano, cinnamon, vanilla, catnip, cloves, sage, basil, rose hips, rose petals
14) Peanut butter, jams and jellies, honey, finger Jell-O
15) Gelatin made with blood drippings from feline diet
16) Melons
17) Gourds
18) Pumpkins
19) Raccoon or elk urine-commercially purchased
20) Rope pulls-?

21) Telephone books
22) Cardboard tubes (smaller than head size)
23) Feathers from birds in collection
24) Christmas trees
25) Fish
26) Ice blocks containing food
27) Branches/wood chips from primate or small mammal exhibits
28) Cornstalks, cardboard boxes
29) Pine cones
30) Hard boiled eggs
31) Snow
32) Nothing
33) Animal skins and/or feet (deer/pig/domestic stock)-freeze for 90 days then cut into appropriate sizes

Housing

When designing housing areas for clouded leopards some important factors to consider are: their arboreal skills, their shy and reclusive nature, and the reputation of the males for aggression towards females. A successful housing situation will include areas where the animals feel secure, as well as a place where the female can feel unthreatened by the male and be able to defend herself. Because of the cat's extraordinary climbing and leaping abilities, both vertical and horizontal types of apparatus are necessary. Whether these are natural or artificial will depend upon individual design.

Exhibits

Height, complexity and proximity to the public are three key issues to consider when designing clouded leopard exhibits. Exhibits should be viewable by the public on no more than two sides. Animals need to be able to hide from each other and from the public. As much vertical height as possible needs to be available for climbing (8 ft. minimum). Minimum exhibit size for one pair of animals is 400 square feet with at least an 8 foot ceiling height (10-12 feet is recommended). Recommended containment barriers include 11-gauge behlen paneling (2 inch by 4 inch openings), 2-inch diameter chain link, glass or reinforced piano wire. All enclosures must have a top made of impenetrable material. If the exhibit perimeter makes contact with a natural substrate it is recommended that chain link or similar material be buried to a depth of 18 inches along that perimeter. Animal access to the exhibit should be through remotely operable shift doors with horizontal sliding doors preferable over the guillotine type.

Clean fresh water should be available at all times in the exhibit. Exhibit substrates should be able to be cleaned and sanitized. Overcleaning via use of strongly odored disinfectants is discouraged as this removes scent markings and can cause the cats undue stress. Natural substrates are encouraged as long as they can be cleaned periodically to prevent parasites. A varied topography in the exhibit is strongly encouraged. As clouded leopards are arboreal it is critical that large amounts of climbing structures and resting places above the ground be provided in the exhibit. Areas within the exhibit that allow the cats to hide from public view if and when they choose are also important. Those facilities not open to the public should use the exhibit parameters as a guideline when designing holding enclosures.

As clouded leopards are intolerant of temperatures below 50 degrees Fahrenheit institutions in northern climates are urged to consider indoor exhibits. All outdoor exhibits should provide shaded areas during hotter weather and humidity should be in the 30-70% range. Indoor exhibits should have a negative air pressure of 10 air exchanges per hour. If possible a separate ventilation system should be maintained from the public. Clouded leopards can be exhibited in either a diurnal or nocturnal setting. If not exposed to natural sunlight, artificial light cycles need to be provided. Supplemental heating should be provided for temperatures below 50 degrees.

Holding enclosures

If animals are part of an exhibit program each cat needs to have its own off-exhibit holding area measuring a minimum of 6 ft by 6 ft by 8 ft high. Substrates should be such that the area can be readily cleaned. Overcleaning via use of strongly odored disinfectants is discouraged as this removes scent markings and can cause the cats undue stress. Quaternary ammonia compounds should not be used. In addition each cat should have its own resting/nesting box within the off exhibit enclosure. These boxes can vary in size and materials but should be mounted off the ground (4 ft minimum) and include a remotely operable closing mechanism if at all possible. Nesting box materials are not always necessary but hay is recommended over straw. All boxes should have drainage and vent holes. Avoid large nestboxes as most clouded leopards (particularly females) feel comfortable in a box just large enough to allow them to stand and turn around. One suggested nestbox design used successfully by the Minnesota Zoo can be found at the end of this section. It is strongly recommended that pregnant females be offered multiple nestboxes. Some elaborate nestboxes have included mechanisms for weighing, observing and examining cats.

Each enclosure needs to have clean, fresh water available at all times. Lix-its are not recommended as cats cannot always utilize them effectively.

Facilities breeding clouded leopards need to provide the female a secluded off exhibit area. This area can be the cats' holding den, however, it needs to be of sufficient size to allow for at least one nestbox and should have an adjacent area allowing the female the opportunity to move away from the kittens when she desires. Females should not be moved from their normal holding area nor their routine changed close to parturition so careful planning is essential to assure the female's comfort prior to parturition.

Video equipment and other remote monitoring devices are useful, especially in the maternity den and during introductions.

Pest Control

An active and aggressive pest control program should be followed. Rodent control can be accomplished using snap traps, live traps, glueboards, etc. Rodent baits should only be used if there is no possibility of the clouded leopard gaining access to the bait. Insect control can include fly or pest strips, natural or synthetic pyrethrins and growth inhibitors. All chemicals used should be approved by the institution's veterinarian prior to use. Applications should be performed by a licensed pest control technician accompanied by staff members to assure the safety of the animals and staff.

Social organization

The Clouded leopard is a secretive cat that inhabits dense forests and is difficult to locate in the wild. As a result wild populations have been virtually unstudied. Most of what is known about the behavior of clouded leopards has been learned from captive observations. Those who manage these cats in captivity have described them as shy, secretive, and nervous, often being slow to adapt to changes in their environment.

Group Composition

For reproductive purposes the optimal grouping is one male and one female. Occasionally trios have worked with both females producing cubs. Same sex pairs, both male and female, have been maintained but these animals were either siblings or animals that were hand raised together. Most successful pairings have been the result of introducing young animals ranging from preweaning to one year old. These cats form strong pair bonds and are usually managed as a pair for life. Mixed species exhibits are not recommended for this species.

Male / Female Interaction

Male/female pairs have been successfully housed together year round 24 hours a day. However, many clouded leopard managers feel a separation at night is necessary to prevent aggressive incidences from occurring during times of little supervision.

It has been noted that when cats are housed continuously as pairs many species lose interest in mating. A separation period, followed by reintroduction period can be beneficial to breeding success in some felids [Law et al, 1997]. However, in clouded leopards the risks associated with this separation oftentimes outweigh the benefits.

Compatible males and females are able to coexist in the same enclosure with little incident. However the compatibility of the pair may change if they are separated for any length of time. If a period of separation has occurred a gradual introduction should take place.

It is thought that males who are successful breeders are able to "read" females for signs of reproductive receptiveness.

As a female begins to come into estrus, a change should be noticeable in the male. The male may begin watching the female intently from a distance, but not stare at her aggressively. It is a good idea to alternate cats through areas so males may investigate the area a female has inhabited. An increase in urine marking, cheek marking or claw marking should be demonstrated by the male. Increased marking behaviors are often seen in females as well. Males sniffing objects a female has marked will often flehmen and make a calling vocalization. If in close contact, cats will often prusten to each other. The female may roll or assume the lordosis posture. An increase in these positive behaviors should be noted prior to physically introducing the cats. Once physically together if a female is not receptive and indicates this by hissing, growling, or swatting at the male, the successful male will back down and resume watching the female for signs of receptiveness

Female / Offspring Interaction

Both mother-reared and handreared females have reared their young successfully. Mothers are watchful and protective of their young. As cubs learn to climb the females often climb up below them as if to guard them from a fall [Fellner, 1965]. Some females have been observed carrying their young down a tree if they have ventured up too high, or could not make their way back down.

As with most animals, care should be taken if any change is to occur in the clouded leopard's environment while rearing young. A female, with 1.1 five month old cubs, became ill and was removed from the area while she was treated and recovering. After a 20-day separation an attempt was made to reintroduce her to her cubs. Several attempts failed and it was noted that the male cub was very aggressive towards his mother and defensive of his female sibling, not allowing the mother near them. This was felt to be due to the fact that the cubs were at an age when they were reaching independence [Breitbeil, pers. ob].

Another incident occurred when a female with a four-month-old male cub was separated from the cub for her annual physical. She was returned to the enclosure later that same day, but was aggressive towards her offspring. A second attempt that same day, and a third the subsequent day both failed, as the female showed marked aggression. This same female and cub had been separated for a day when the cub was three months old and required medical treatment. At that time there was no difficulty in reuniting them [Breitbeil, pers. ob].

Male / Offspring Interaction

Typically female clouded leopards are housed separately from males prior to parturition, and during the rearing process. However there is documentation of a dam and sire rearing offspring together. The male tolerated the presence of the cubs, most notably the male cub, for approximately three months [Geidel et al, 1976]. This three-month length of tolerance time was also observed in a male who lived in close proximity to a female with cubs and passed the maternity area daily. Although no aggression was demonstrated toward the female cub, aggression was shown toward the male cub when the cub reached three months of age [Breitbeil, pers. ob].

Dispersal of young

Dam and litters can be kept together up to one year; however, extended periods of separation from the male may hamper reintroduction. Some institutions have had success with leaving males in with females and kittens; however, this is only in unique situations. Dam and kittens generally are kept separate from the male until kittens are removed. The male should be kept in visual and olfactory contact with the female in most situations.

Communication

Vocalizations: Clouded leopards have several vocalizations. Close contact calls consist of a short, high-pitched meow, and a prusten which is a soft expulsion of air through the lips making an 'iff, iff' sound. These vocalizations are used in greeting and as reassurance. The cry or call is a loud extended meow that can be heard over a distance of 100 meters [Law et al., 1997]. This call is often used when one cat is attempting to locate another. Growling and hissing are used as aggressive or warning vocalizations.

Marking: Clouded leopards like many species utilize olfactory markings as a form of communication. Cheek marking, when a cat rubs its head or cheek along an object, is seen in this species. Law, MacDonald and Reid [1997] found upon histological examination that these cats have enlarged sebaceous glands in the cheek region that are more prominent in males than females.

Urine marking, the spraying of urine on the ground or an object, is used to mark territory. This marking behavior is often accompanied by the scraping of substrate with the hind feet. This scraping behavior creates mounds that can serve as visual signals as well. Males will check for indicators of a female's reproductive receptiveness by sniffing her urine. Claw marking is another territorial mark and consists of scratching an object, usually wood with the front claws. Not only does this scratching leave visual marks, but also cats have glands on their front paws that leave an olfactory mark on the object.

Behavioral indicators of stress

Hair plucking has been noted in many clouded leopards and is believed to be associated with stress. This behavior was noted in a female prior to parturition, in a situation where it was felt the maternity quarters did not meet the needs of the cat [Murphy, 1976]. It was also been observed in a female after her cubs were pulled for handrearing. The behavior subsided after approximately a month's time [Breitbeil, personal ob]. Another plucking episode occurred when the cat was exposed to new personnel in the area. She began plucking fur prior to parturition. This cat continued plucking her tail until it was denuded, and after the birth of the cub she began over-grooming the cub. This behavior continued even after the staff member was removed from the area. The situation was resolved after offering the cat a fully feathered dead chicken, which the cat was allowed to pluck and consume [Breitbeil, pers. ob].

Care must be taken when making changes to the environment of clouded leopards, as these cats appear to require long adjustment periods.

Cats and their keepers

It has been noted in both mother reared and handreared cats the tendency to bond with their primary caretakers. Fellner [1965] wrote of a cat that formed a strong bond to a keeper. The cat was able to distinguish the keeper from other people. He greeted the keeper by mewing, and drove all other people away by spitting at them. This behavior is not thought to be unusual, 25 out of 29 of those surveyed found clouded leopards to have formed bonds with their caretakers [Breitbeil, unpubl. data].

A difficulty in adjusting to new caretakers has also been noted. A male cat reacted strongly when a new male keeper was brought into the area. The male's aggression toward the keeper still had not subsided after six months [pers. obs].

Clouded leopards seem to react positively to meowing and prusten greetings when mimicked to them by their caretakers. This vocalizing may in some instances calm a nervous cat.

Introduction of Pairs

One component of the Clouded leopard SSP program is the development of introduction guidelines for opposite sex pairs. As this species is one of the most challenging felids to manage there is no one "right way" to manage all introductions. Management challenges center around mate incompatibility that has resulted in the SSP recommending that, whenever possible, clouded leopards be paired with future breeding partners before both animals reach one year of age. This pairing of juveniles has historically resulted in less likelihood of mate incompatibility as the animals reach sexual maturity. However, there are cases where clouded leopards that were paired when very young went on to experience incompatibility problems. Establishing lifelong pairs that will never be separated limits the SSP's ability to maximize genetic diversity in the population. Due to aggression clouded leopard managers are hesitant to pair older unpaired cats, or to re-pair a cat whose long term mate has died. In a 1997 international survey 15 out of 19 facilities reported exclusive mating among their cats (Breitbeil, unpub.)Data). This high percentage could reflect the tendency for managers to create these long-term pairs and the hesitancy to tamper with this bond once it has been established. Therefore a successful procedure for introducing adult animals is needed. Establishing this procedure within strict guidelines is prohibitive due to the large variance of behavior within the species.

It is the recommendation of the SSP that the guidelines below be used for introducing younger animals. These guidelines may also apply to older adult animals; however, it is essential that all parties involved in the process be aware of the potential risks. The occurrence of male aggression towards females is high. In an international survey conducted in 1997 18 out of 28 survey respondents reported having females injured or killed by males. Only in two of these cases were there indications that an attack was imminent. Sudden and unexplained instances of males fatally attacking females have occurred during the process. Managers who have little experience introducing clouded leopards are strongly encouraged to contact those facilities that have had success in this regard for advice. Once physical introductions begin veterinary care should be available immediately in case of injury.

Basic keys to success for the introduction of pairs are:

- STABLE ROUTINE, FEEDING, CLEANING. STAFF WORKING WITH THE PAIR SHOULD REMAIN ON A FAMILIAR SCHEDULE TO MAKE THE ANIMALS COMFORTABLE IN THEIR SURROUNDINGS.
- Adjacent caging of adequate size for each animal (12 ft by 12 ft by 8 ft high). Solid walls between cages with two shift doors-one solid, the other allowing visual and olfactory access minimally. Some facilities prefer small diameter mesh walls separating enclosures thereby allowing each cat total visibility to each other to enable them to observe and become comfortable with each other's movements and behaviors.

- Nestboxes for each cat with remote closing capabilities.
- Large amount of cage props such as sleeping boards, tree limbs, cargo nets, etc. to allow multi-level use of the enclosure and areas to retreat to or defend.
- Seclusion from other animals who are not part of the introduction.
- Minimal outside disturbance.
- Remote viewing capabilities (via video camera) for keeper staff.

Suggested introduction protocol:

Any small changes in routine can result in the cats becoming agitated and increasing the likelihood of aggression. If the introduction process has to be stopped or curtailed for any reason it is suggested that the process be slowed or started anew:

1. Acclimatization: Allow sufficient time for each new animal to adjust to its new surroundings before implementing changes or beginning the introduction process. This period can take a month or more depending upon the individuals involved.

2. Visual Introductions: Once animals are at ease with their surroundings, limited visual introductions can begin. The first visual introductions should be for short periods of time and always with familiar staff present. Behavioral cues such as postures, vocalizations, etc. should be monitored. Number and length of exposures can be increased over the next several days. At this stage some facilities rotate the pair between the two enclosures. This allows close exploration of smells and may help reduce territoriality. Aggressive behaviors, particularly by the male should abate before proceeding to tactile introductions.

3. Tactile Introductions: Tactile introductions through a common wall is the next step. This wall should be constructed of wire or similar materials with very small openings (1/2 inch or less) to prevent injuries to either cat. Many institutions modify the shift doors between the adjacent enclosures to facilitate this stage. Clouded leopards usually show one of three different behaviors when housed in close proximity. Antagonistic or aggressive behavior such as growling, hissing or spitting may be shown initially and usually passes within a short period. Do not move forward with introductions until this period passes. The second behavior is one of disregard for one another characterized by cats spending little time in close proximity. The third behavior may be shown when the female is in estrus: prusten, cheek rubbing, rolling, crying and lordosis. In some cases females who previously showed no signs of heat when isolated may act differently when put in close proximity to a male.

It is thought that males who are successful breeders are able to "read" females for signs of reproductive receptiveness.

As a female begins to come into estrus, a change should be noticeable in the male. The male may begin watching the female intently from a distance, but not stare at her aggressively. It is a good idea to alternate cats through areas so males may investigate the area a female has inhabited. An increase in urine marking, cheek marking or claw marking should be demonstrated by the male. Increased marking behaviors are often seen in females as well. Males sniffing objects a female has marked will often flehmen, and make a calling vocalization. If in close contact, cats will often prusten to each other. The female may roll or assume the lordosis posture. An increase in these positive behaviors should be noted prior to physically introducing the cats. Once physically together if a female is not receptive and indicates this by hissing, growling, or swatting at the male, the successful male will back down and resume watching the female for signs of receptiveness.

4. Physical Introductions: When the pair appears to be at ease with each other at the tactile access point as demonstrated by lying side by side or one animal presenting itself in a vulnerable position while the other animal reacts non-aggressively they are ready for partial physical introductions. Make sure both cats are fully aware of each other's presence before they are physically put together. Catching one or both of the cats off guard can trigger and immediate and sometimes fatal defensive reflex.

   Prior to the first partial physical introduction remove the female from her enclosure by either shifting her to an adjacent enclosure or locking her in her nestbox. Allow the male access to her empty enclosure. The male's reaction to female's urine/feces markings should be monitored closely. Males who show no reaction or ignore these markings <u>may</u> be more aggressive towards females when introduced. Males who investigate these markings and seem interested in the females <u>may</u> be less aggressive. A positive reaction may include flehmen, prusten and vocalizations.

   If the male is reacting in a positive fashion open the dividing door a few inches to test how the pair react. <u>Clouded leopards that give every indication of non-aggression and/or compatibility while separated may exhibit the exact opposite behavior when the physical barrier is removed.</u> <u>NEVER THROW THE DOOR OPEN AND LET THE MALE IN WITH THE FEMALE WITHOUT TESTING THEM FIRST</u>. If aggressive behavior is displayed, limit this type of access to short periods and repeat for several days until the cats become non-aggressive. Once that has been achieved the door can be opened a few inches at a time until the animals have full access to one another. All parts of the enclosure should be clearly visible to both animals. Make sure ample escape routes exist for both cats so that neither can be trapped or cornered by the other. This full access should be done with staff members present to separate the animals if necessary. Staff must be extremely vigilant in observing the cats as fatal attacks have occurred when staff has momentarily turned their backs. Hoses, CO2 fire extinguishers or any object that makes a loud noise should be kept close by in case of a fight. If a fight ensues separate the cats immediately.

Periods of supervised access can be increased in duration as long as the cats continue to feel comfortable with each other. This increase should be slow and careful attention should be paid to the pair's behavior during this time. Changes in environment (new cats in the vicinity, new keepers, veterinary procedures, etc.) could result in an increased risk of aggression. It is recommended that these changes be kept to an absolute minimum during this time. Over time the pair can be allowed short periods of unsupervised access. The use of remote monitoring equipment at this stage will give valuable insight to the pair's behavior when alone. Some clouded leopards react very differently when keepers are not present.

5. Post Introduction management: Some managers leave their clouded leopards together 24 hours a day once the pair feels comfortable with each other. Others continue to separate pairs at night or only introduce their pairs when the female is in estrus. Each pairing and situation is unique. The procedure outlined above is a guide only. As these cats tend to be crepuscular or nocturnal the use of video recording equipment is encouraged. Some managers feel it takes a year of more to successfully introduce pairs. Cues from the pair are the most important factors in successful introductions. It is critical that keepers caring for the animals know the behaviors of the cats and be able to distinguish changes in behaviors. It is recommended that introductions take place in off exhibit areas. Once the pair has been introduced off exhibit the process of introducing the pair to the exhibit can begin. The female should be allowed access to the exhibit first. After she has had time to explore her surroundings the male can be re-introduced to her on exhibit.

Care must also be taken when reintroducing pairs that have been split for births, medical or management reasons. The introduction process may need to begin anew in cases where cats have been separated for as little as one day.

Current Knowledge about the Reproductive Biology of the Clouded Leopard

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Introduction

Nothing is known about the reproductive biology or mating strategies of free-living clouded leopards. However, there is substantial data on the reproductive physiology and endocrinology of clouded leopards maintained under zoo conditions.

Most research has fallen under the following categories: 1) semen and sperm characteristics within and among clouded leopards over time; 2) hormonal patterns in both males and females, especially longitudinal reproductive cyclicity in females; 3) developing methods to stimulate ovarian activity and ovulation; 4) artificial insemination (AI); 5) *in vitro* fertilization (IVF); and 6) semen cryopreservation technology and genome resource banking (GRB). Although generating a substantial database, these studies also have identified some unique characteristics of the species that may present challenges to captive management and the use of both natural and assisted breeding. Thus, like all good research, these systematic studies have spawned a host of potential high priority research issues.

Reproductive biology studies are a high priority because reproduction, of course, is the essence of species survival. An ability (for example) to detect: 1) reproductively active from inactive animals; or 2) if an animal is a seasonal breeder allows managers to attempt propagation using only appropriate individuals at appropriate times. This appears particularly relevant for the clouded leopard because of the species' high propensity for sexual incompatibility. Using current breeding regimens, it is quite common for males to make lethal physical attacks on females, even those that are demonstrating overt estrus. Therefore, a common problem with captive breeding of clouded leopards is an unwillingness of managers to pair genetically-appropriate individuals because of fear that the female will be injured, traumatized or killed. One result has been a worldwide distribution of 'isolated' females that are not paired with males. The problem is confounded further by a general lack of genetically valuable males in zoo populations. For example, it is known that most clouded leopards from North America are descended from only a few founders, leaving an extraordinarily few genetically valuable animals (n < 10) in the region.

As a result, there is general consensus that well-conducted reproductive studies eventually could lead to developing consistently effective assisted reproductive techniques like AI, IVF and embryo transfer. For example, the advantages of AI for the clouded leopard would be profound, not the least would be the ability to utilize all reproductively and genetically healthy singleton females. Because the ultimate goal is to maintain a high level of genetic diversity in all extant clouded leopard populations, AI also could be used to move genes among populations (via germ plasm) rather than take the more dangerous and stressful route of moving living animals. This strategy also might eventually allow valuable genes to be 'captured' from wild populations, introduced into zoo populations, the result being that no additional animals would need to be removed from the wild. This approach, in fact, would have the benefit of boosting the genetic viability of captive populations while ensuring that wild clouded leopards remain in native habitat to protect nature.

Male Reproductive Biology

The technique of electroejaculation conducted under a surgical plane of anesthesia is safe for collecting semen/sperm from clouded leopards [Wildt et al., 1986a; Howard, 1993]. Many males have been evaluated using this technique, and there is considerable data in the literature on semen volume, sperm count, sperm motility, number of motile sperm per ejaculate and the incidence of structurally abnormal sperm in an ejaculate [Table 1]. Repeated electroejaculations over time can identify males that produce different quality semen samples. However, although there is some natural variation within individuals, most clouded leopards produce approximately 1-3 ml of ejaculate containing ~30 million total sperm of which about 70% are motile. Semen samples are not milky in appearance, but rather slightly opaque, and it is essential that the seminal fluid be removed from the ejaculate as soon as possible by low speed centrifugation (300 x *g*; 8 min). Maintaining the sperm and seminal fluid together is lethal to sperm with most cells exhibiting a loss in motility within 30 min. Following centrifugation, the sperm pellet can be resuspended and motility sustained in common tissue culture medium, especially Ham's F10 supplemented with 5% heat-inactivated clouded leopard serum.

The functional capacity of clouded leopard sperm is determined by assessing the: 1) ability of sperm to acrosome react (acrosome is a membrane bound, cap-like structure located on the anterior region of the sperm head required for fertilization); and 2) ability of sperm to bind to the egg, penetrate the zona pellucida (outer covering of the egg) and enter the perivitelline space. For assessing the ability to acrosome react, sperm are incubated in tissue culture medium for various time intervals and then exposed to a calcium ionophore (A23187; 4 μM) to induce the acrosome reaction [Long et al., 1996a].

Subsequently, the acrosomal status is evaluated with an acrosome-specific fluorescent stain [Long et al., 1996a]. To assess sperm-oocyte interaction, in vitro-matured, salt-stored domestic cats oocytes are co-incubated with clouded leopard sperm for 6 h (38°C, 5% CO_2 in air) and the extent of zona penetration assessed using differential interference contrast microscopy [Howard et al., 1993]. The ability to acrosome react and penetrate an oocyte is considered a reliable measurement of fertilizing ability.

Protein source in the culture medium is known to influence sperm capacitation (activation) and ability of sperm to undergo the acrosome reaction. Therefore, the effect of heterologous proteins (fetal calf serum, human serum albumin) and homologous protein (clouded leopard serum) on sperm motility and zona penetration has been assessed in clouded leopards [Long et al., 1996b]. Clouded leopard serum improves sperm motility and longevity compared to fetal calf serum, however, zona penetration is not improved. Clouded leopard serum also enhances acrosome reaction and zona penetration compared to human serum albumin. Although ~30% of clouded leopard sperm acrosome react in the presence of homologous serum, this is considerably lower than results reported in a variety of other species.

Interestingly, almost 70% of all clouded leopard sperm from an average ejaculate are malformed, the two predominate abnormalities being abnormal acrosomes and tightly coiled tails. It now is well-known that these 'abnormally-shaped' sperm cannot penetrate and fertilize eggs, so this condition of 'teratospermia' in the clouded leopard is not normal [Howard et al., 1993]. However, it is similar to the condition observed in the cheetah (*Acinonyx jubatus*), which is thought to be related to the remarkable and historic loss in genetic diversity in that species [Newman et al., 1985]. These findings would be consistent with the impact of inbreeding which also has been measured in other felids like the Florida panther (*Felis concolor coryi*) and Asiatic lion (*Panthera leo persica*) where poor sperm quality occurs simultaneously with a measurable lack of genetic diversity [Wildt, 1994]. Based on molecular analysis, percent polymorphism (the frequency of polymorphic loci) is lower in the clouded leopard (6%) than in the domestic cat (22%), ocelot (21%), free-ranging Serengeti African lion (11%), captive tiger (10%) and captive leopard (10%) [Newman et al., 1985; Miththapala et al., 1991]. Percent average heterozygosity per individual also is reduced in the clouded leopard (2.3%) compared to other felid species (domestic cat, 8.2%; ocelot, 7.2%; Serengeti African lion, 3.8%; captive tiger, 3.5%; captive leopard, 3.1%) [Newman et al., 1985; Miththapala et al., 1991]. Interestingly, ejaculates collected from wild-caught animals maintained in Thailand zoos also contained a high proportion (>85%) of structurally abnormal sperm [Table 1]. This lends support to the possibility that the sperm abnormalities routinely observed in this species also is due to diminished genetic diversity. Finally, substantial studies have been conducted on circulating concentrations of adrenal (or stress) hormones in this species [Wildt et al., 1986b]. Compared to some other felid species, the clouded leopard has high peripheral concentrations of glucocorticoids which may be consistent with this species' shy temperament. Stress can adversely affect reproductive capacity, and it is worth noting that there could be a relationship between what appears to be physiological evidence of stress sensitivity and semen characteristics.

Female Reproductive Biology

A survey in 1989 of the international studbook revealed that 75% of all clouded leopard litters were born to females between 1 and 5 years of age. Sexual maturity ranged from 17 to 28 months with gestation ranging from 85 to 121 days (mean, 93 days) [Yamada and Durrant, 1989]. An analysis of international breeding records for captive female clouded leopards reveals that 46% of parturitions occur in March and April, indicating that most estrual periods occur from late December through February. These birth records largely have been corroborated by recent monitoring of fecal hormone metabolites in a substantial sized population of zoo-maintained clouded leopards [Brown et al., 1995]. On the basis of fecal estradiol profiles, duration of the estrous cycle was 24 ± 2 days (mean ± S.E.M.), with estrus lasting 6 ± 1 days and the duration of the nonpregnant luteal phase being 47 ± 2 days. If females are maintained under a 12 hour light:dark cycle, they will cycle regularly throughout the year. Females under natural light fluctuations experience a seasonal anestrus during the late summer and early fall. One female has been shown to demonstrate a lactational anestrus after birth of 3 cubs [Brown et al., 1995]. Of the 14 clouded leopard females monitored to date, ~40% were observed to spontaneously ovulate based on elevated excreted progestagen in the absence of mating [Brown et al., 1995; Figure 1]. The use of fecal steroid metabolite monitoring is extremely important because it offers a method of longitudinally assessing reproductive activity using a completely atraumatic approach, thereby eliminating the potential confounding impact of stress.

Ovulation Induction

Exogenous hormone treatments are effective in animals and humans for artificially stimulating the ovary to grow ovarian follicles and ovulate. These females then can mate naturally or embryos can be produced by assisted reproduction techniques. Like most mammals, the clouded leopard responds to intramuscular injections of the hormones (gonadotropins) routinely used for ovulation induction in many felid species. These include equine chorionic gonadotropin (eCG) to provoke follicle growth and human chorionic gonadotropin (hCG) to stimulate ovulation [Table 2]. These hormones have been used in conjunction with AI to produce offspring in 7 felid species, including the clouded leopard [Howard, 1999; Howard et al., 1996]. However, it now is well established that this species is exquisitely sensitive to these gonadotropins. For example, although weighing 4 times the body mass of the domestic cat, the clouded leopard actually requires less eCG and hCG to stimulate a comparable ovarian response. Ovarian hyperstimulation can sometimes occur, and there is concern that this could result in abnormal ovarian steroid secretion, influencing estrogen/progesterone ratios, thereby reducing the chance of eggs to fertilize and/or embryos to implant and develop normally. The problem is accentuated by the relatively high incidence of spontaneous ovulation within the species. These ovulating females secrete high concentrations of progesterone which can negate the effectiveness of the administered eCG/hCG [Howard et al., 1997]. The result can be normal follicular stimulation, but an absence of ovulation, so that successful AI cannot occur. These findings have highlighted the importance of determining the stage of estrus cycle in individual females prior to starting the hormonal therapy for assisted reproductive technologies.

Artificial Insemination

As described above, it is necessary for electroejaculated semen (designated for AI) to be processed to remove seminal plasma. This can be accomplished by low speed centrifugation (300 x *g*, 8 min) with re-suspension of the sperm pellet in Ham's F10 culture medium containing 5% heat-inactivated clouded leopard serum. The female can be induced to ovulate with intramuscular injections of 75-100 i.u. eCG followed by 75 i.u. hCG given 80 hours after hCG. Thirty-eight to 40 hours after hCG, the female will ovulate [Howard et al., 1996, 1997]. It now is well known that AI conducted after the time of ovulation is preferred to pre-ovulatory AI. This is because various anesthesia used at the time of AI (to restrain and sedate the female) may block ovulation in preovulatory females (i.e., females whose ovaries only contain follicles). Thus, AI in the clouded leopard should not be attempted before 38 hours after hCG. Furthermore, studies conducted during the non-breeding season demonstrate that clouded leopard females exhibit a normal follicular response to exogenous hormones, but fail to ovulate suggesting an ovarian refractoriness to hCG induced ovulation during the non-breeding season.

Site of Insemination

In most species, there are several options available for the site of sperm deposition for artificial insemination. These include the vagina, cervix or the uterus. Although pregnancies have resulted in domestic cats after vaginal insemination of anesthetized females, the incidence of pregnancy is low (~10%) [Platz et al., 1978]. Numerous insemination attempts in cheetahs and clouded leopards using nonsurgical vaginal or transcervical insemination were not successful [Howard, 1999; Howard et al., 1996]. It has been determined that anesthesia inhibits sperm transport to the oviduct after vaginal or transcervical insemination resulting in failure of fertilization. Therefore, a laparoscopic intrauterine insemination technique that permits direct deposition of sperm in the uterine horn has been developed for insemination of felids [Howard et al., 1992].

For laparoscopic insemination, females are anesthetized and subjected to laparoscopy. Ovaries are assessed for ovarian response to gonadotropins and the presence of unovulated follicles and post-ovulatory corpora lutea (ovulation sites). After confirmation of fresh ovulations, the uterine horn is stabilized with an accessory grasping forceps and cannulated with a sterile indwelling catheter inserted percutaneously. Then a sterile polyethylene tubing attached to a syringe containing the sperm suspension is inserted into the catheter and the semen expelled into the lumen of the uterine horn. The entire procedure is then repeated on the contralateral horn. With the advent of this technique, the overall pregnancy rate has increased significantly (~50%) in the domestic cat and cheetah [Howard et al., 1992, 1997]. Furthermore, use of this intrauterine insemination strategy has resulted in the production of offspring in the leopard cat, ocelot, snow leopard, puma, cheetah, tigrina and tiger [Howard, 1999]. However, only one pregnancy has been achieved in the clouded leopard [Table 3], suggesting the need to further examine factors (such as spontaneous ovulation) that may influence the efficiency of AI in the clouded leopard [Howard et al., 1996]. Studies are underway examining various methods to control the female reproductive cycle (inhibit ovarian function) to allow a predictable ovulatory response to exogenous gonadotropins which in turn, could improve the AI success in clouded leopards.

Genome Resource Banking and Sperm Cryopreservation

A Genome Resource Bank (GRB) is the organized collection, storage and use of biomaterials (sperm, embryos, oocytes, tissue, blood products and DNA) used for the purposes of conservation. The advantages of GRBs are profound, including: 1) allowing the easy and safe movement of genes among populations to help maintain genetic diversity, 2) helping reduce the total number of animals needed in captivity to achieved targeted levels of genetic diversity, 3) providing 'insurance' against catastrophes, including disease epidemics, and 4) as a resource for other biomaterials like tissue, blood by-products and DNA that are useful for addressing issues related to taxonomy, subspeciation, paternity, disease surveillance and forensics.

Clouded leopard sperm can survive freezing, showing reasonable post-thaw motility. In early studies to determine an optimal cryodiluent in clouded leopards, PDV-egg yolk diluent was chosen for its cryoprotective abilities in felids [Platz et al., 1978]. However, recent studies have demonstrated that the commercially available sperm diluent 'Test Yolk Buffer' (TYB; Irvine Scientific, Santa Ana, CA) modified to contain 4% glycerol was superior to 'PDV' for maintaining sperm motility and acrosomal membranes. Modified TYB diluent is prepared from 2 commercially-available (Irvine Scientific, Santa Ana, CA) cryodiluents marketed for human sperm cryopreservation: 1) "Refrigeration Medium-TEST Yolk Buffer" containing 0% glycerol (catalog#9972); and 2) "Freezing Medium-TEST Yolk Buffer" containing 12% glycerol (catalog#9971).

To yield a 4% glycerol concentration, thawed aliquots of "Freezing Medium-TEST Yolk Buffer" containing 12% glycerol are added to thawed aliquots of "Refrigeration Medium-TEST Yolk Buffer" containing 0% glycerol at the following ratio: one part of Freezing Medium-TEST Yolk Buffer with 12% glycerol and two parts of Refrigeration Medium-TEST Yolk Buffer with 0% glycerol.

The minimum acceptable criteria for freezing a clouded leopard sperm sample are ejaculates containing: 1) at least 2 million motile sperm; and 2) forward progressive sperm motility ratings of at least 2.5 (scale 0-5, 5=best). The post-thaw viability of ejaculates containing fresh viability ratings less than these probably are inadequate for use in AI or IVF. However, it may be important to cryopreserve all collected sperm samples from genetically valuable males using present technology. Although this germ plasm may be minimally useful for AI or IVF, it may have important alternative value in the future especially in conjunction with sperm injection technology.

Ejaculates to be cryopreserved are washed by centrifugation, and the sperm pellet is slowly resuspended in 100-200 µl of 'Test Yolk Buffer diluent' containing 4% glycerol. The diluted aliquot is cooled slowly for 30 min at 5°C and then pelleted (~30 µl/pellet) on dry ice for 3 min before plunging into liquid nitrogen. Pellets then are packaged into a cryovial that is labeled with the species, date of collection, location of collection and animal studbook number. To evaluate post-thaw sperm viability, one pellet from each sample can be thawed and evaluated *in vitro* as described above for freshly-collected sperm. In these cases, a pellet is thawed in a sterile 12 x 75 mm glass culture tube containing 100-150 µl Ham's F10 culture medium. Individual pellets are held in air for 10 sec and then dropped into test tubes containing the media with vigorous mixing at 37°C for 30 sec. Thawed semen suspension is transferred into a 1.5 ml plastic, microcentrifuge tube and centrifuged at 300 x *g* for 8 min. Supernatant is removed, and sperm pellet is resuspended in fresh Ham's F10 medium. Aliquots are evaluated for sperm motility and forward progressive motility over time. Although clouded leopard offspring have not yet been produced by AI with thawed sperm, success has been achieved in the leopard cat, ocelot and cheetah [Howard, 1999].

Conclusions

As a result of more than 15 years of systematic research, there now is a valuable database on the reproductive biology of the captive clouded leopard male and female. Among other accomplishments: 1) viable sperm can be collected routinely and safely by electroejaculation; 2) sperm processing techniques have been developed that allow sperm motility to be sustained; 3) the reproductive cycle (duration and interval of estrus) has been characterized in detail by fecal hormone technology, a tool that allows the accurate, noninvasive determination of reproductive status; 4) it now is known that this species can ovulate spontaneously at a relative high frequency compared to other felid species; 5) artificial insemination has been successful on one occasion, and it is known that sperm must be deposited in the anterior aspect of the uterine horn after ovulation has commenced; 6) one hormonal regimen has been identified to induce ovulation; and 7) sperm can withstand the stress of cryopreservation by demonstrating post-thaw motility.

On the contrary, there remains concern about the: 1) homozygosity in the captive population; 2) inability of managers to routinely pair animals for natural breeding because of sexual incompatibility; 3) high percentage of malformed sperm in electroejaculates; 4) inability to routinely produce an ovarian response mimicking 'normal' by the use of exogenous gonadotropins, in part, because the species is exquisitely sensitive to these hormones; and 5) difficulty in achieving successful *in vitro* fertilization as a result of poor sperm and/or egg function or interaction. The greatest unknown is the absolute total lack of information on the reproductive biology of wild, free-ranging clouded leopards.

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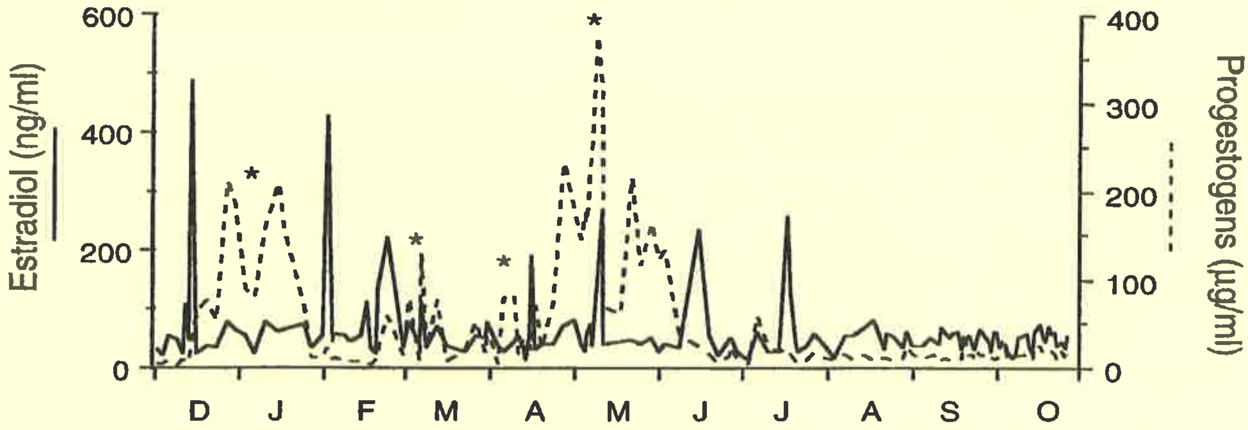

Figure 1. Fecal steroid profiles in a clouded leopard exhibiting spontaneous ovulation. Asterisk denotes incidence of ovulation. (From Brown et al., 1995).

Table 1. Ejaculate traits in captive-born and wild-born clouded leopards.

	North American Zoos Captive-Born (60 males; 134 ejaculates)	Thailand Zoos Wild-born (17 males; 22 ejaculates)
Ejaculate volume (ml)	2.72 ± 1.9	0.81 ± 0.1
Sperm concentration/ml (x 10^6)	41.6 ± 4.7	28.4 ± 4.2
Total sperm/ejaculate (x 10^6)	29.9 ± 2.9	27.7 ± 6.2
Sperm motility (%)	70.2 ± 1.1	52.6 ± 4.4
Sperm progressive motility [a]	3.6 ± 0.1	3.1 ± 0.2
Structurally normal sperm (%)	23.9 ± 2.2	11.4 ± 1.4

[a]Sperm progressive motility is based on a scale of 0-5 (5= rapid forward progression).

Table 2. Influence of dosages of equine chorionic gonadotropin (eCG) and human chorionic gonadotropin (hCG) on ovarian activity in clouded leopards.

	Dosages of eCG/hCG (IU)				
	200/140 or 400/280 (n=6)	100/75 (n=5)	75/75 (n=5)	50/75 (n=7)	25/75 (n=4)
No. post-ovulatory females/total number of females (%)	6/6 (100%)^a	4/5 (80%)^a	4/5 (80%)^a	7/7 (100%)^a	1/4 (25%)^b
No. fresh corpora lutea/female	5.3 ± 1.3^a	3.6 ± 1.2^{a,b}	3.2 ± 0.9^{a,b}	2.6 ± 0.6^b	0.8 ± 0.7
Mean diameter of fresh corpora lutea (mm)	3.7 ± 0.1^a	5.1 ± 0.3^b	5.4 ± 0.2^b	5.6 ± 0.3^b	3.7 ± 0.3^a
No. unovulated follicles/female	6.2 ± 2.2	7.2 ± 2.5	5.2 ± 2.3	5.1 ± 1.7	8.5 ± 2.2
Mean diameter of follicles (mm)	4.6 ± 0.2	4.9 ± 0.3	4.8 ± 0.2	4.1 ± 0.1	4.0 ± 0.1

[a,b]Within rows, values with different superscripts differ ($p < 0.05$). (From Howard et al., 1997)

Table 3. Ovarian activity and inseminate traits of a successful laparoscopic intrauterine artificial insemination in a clouded leopard.

Ovarian stimulation	
Dosage of eCG/hCG (IU)	100/75
Time of insemination (h post-hCG)	45.0
No. fresh corpora lutea	5.0
Mean diameter of fresh corpora lutea (mm)	7.0 ± 1.0
No. unovulated follicles	0.0
Inseminate traits	
Sperm motility (%)	70.0
Sperm progressive motility[a]	4.5
No. of motile sperm ($\times 10^6$)	88.5
No. of cubs born	2

[a]Sperm progressive motility is based on a scale of 0-5 (5=most rapid forward progression). (From Howard et al., 1996)

Birth, Growth and Development

Contraception

Currently methods of reversible contraception center around the use of Melengesterol acetate (MGA) implants that prevent females from becoming pregnant. Recent studies have found that felids continually exposed to MGA may develop severe endometrial hyperplasia and have higher risk for mammary gland and uterine cancers. Managers considering the use of these implants in clouded leopards need to consider the long term effects of these implants.

Currently the most effective contraceptive measure in clouded leopards is separation of the pair while the female is in estrus. However, due to the highly sensitive nature of this species to changes in routine and the problems associated with separating pairs this method is not always practical.

Management of the pregnant female

In general females should be separated from the male two to four weeks prior to parturition. Strongly bonded pairs may be left together longer but should be separated at night during the last week of gestation. Some facilities chose to leave the male with visual and olfactory access to the female as long as the female does not become stressed. There should be multiple nestboxes available to the female well before parturition. Some facilities mount the nestbox five feet off the ground. These boxes can be bedded with grass hay. Some females will remove all bedding from the nestbox or may bury the kittens in the bedding in the box. Diet for the female should be increased slightly (5-10%) in the last trimester with an equivalent increase post-parturition.

No significant changes to the female's routine should be made in the four weeks prior to anticipated parturition. It is strongly suggested that only experienced keepers whom the female is used to care for the female. It cannot be emphasized enough that changes in the female's environment can be detrimental. Every effort should be made to give the female clouded leopard as much privacy as she needs. Managers may want to consider reducing the frequency of cleaning in the female's enclosure. Nestbox materials should not be changed unless soiled and no more than 40-50% of the bedding should be changed at any given time.

Remote monitoring of the nestbox via video camera is recommended. This can be accomplished by modifying the nestbox to include a camera and low level lighting. Again these nestboxes should be in place weeks before births are anticipated.

Usually within 24-48 hours before birth the female will exhibit changes in behavior such as anorexia, increasing amounts of time in the nestbox and restlessness. Once birth has occurred access to the female's den and the holding area should be strictly limited and if at all possible the female should be left totally alone for 24 hours. If video monitoring is used nursing should be observable. In general, if the female is spending large amounts of time in the nestbox and food is disappearing many managers feel everything is okay. Disturbances at this early stage and as late as eight weeks post-partum may cause the female to neglect or become aggressive to the kittens. If the decision is made to hand rear the kittens, females should be allowed to nurse the kittens for the first 12-24 hours to provide colostrum to the kittens.

Females may not eat for the first few days after birth but freshwater should be available at all times. After the initial post-partum period (7 days minimum) as the female becomes more comfortable a gradual return to normal cleaning and activities in the area can begin. Cubs should be left undisturbed for the first week minimally depending upon the behavior of the female. When the opportunity arises cubs can be weighed and sexed but this should only occur when the female is voluntarily out of the box and when kittens are at least 2-3 weeks old. It is important to keep these encounters to a minimum of time and with the people that the female is most familiar. Cubs should initially be handled with rubber gloves that have been soiled with feces from the den. As the cubs get older it is wise to have adequate room for the female to get away from them if she chooses.

The protocol below for care of the pregnant female and neonates has been successfully used at the Minnesota Zoo.

Clouded leopard-Pregnant/Lactating Female Management

1. Two to four weeks prior to parturition the male should be separated from the female allowing visual access only. Nestboxes can be bedded with straw or grass hay.
2. General diet for a 12-13 kg* gestating female:
    a) 250-300 grams meat based diet twice daily, knucklebones twice weekly.
    b) Approximately two weeks prior to parturition, add 50 grams meat based diet to each feeding.
    c) One week post parturition an additional increase of 50gms per feeding should be added.

       ***Diet amounts and increases should be customized to each female and situation. Changes are made by monitoring how quickly the female responds and consumes each feeding. Knuckle bones are withheld for one week from all animals in the immediate area following a birth. All but the dam can resume bones after one week.**
3. First 24 hours following a birth:
    a) the service area for the dam is closed off as much as possible.
    b) Staff traffic and noise in the area is restricted.
    c) Cleaning of adjacent cages is minimal with no hosing.

    After the first 24 hours, cleaning of cages can be resumed if it does not cause stress or annoy the dam and cubs. The nestbox with the cubs and nursing female are off limits unless otherwise approved.
4. A log is started on the day of birth for the dam's activity and cub vocalizations. Audio and visual monitoring equipment is used at the discretion of the curator.
5. Vaccination schedule:
    a) at two weeks of age, the cubs are vaccinated with modified live (intranasal) vaccine.
    b) The are vaccinated at three week intervals thereafter until six months of age.
6. Physical examinations:
    a) at two weeks of age the cubs are separated briefly from the dam for vaccinations and a quick physical exam which includes: sexing, heart and respiration rate, temperature, weight, blood sampling and a stool sample if available.
    b) Cubs need to be identified by fur clipping or tattoos for purposes of record keeping.
    c) Nails can be trimmed
    d) Nestbox bedding material can be changed.
    e) Cubs and dam should be reunited as quickly as possible
    f) Physical exams can be given opportunistically in conjunction with the vaccinations

7. Knuckle bones can be offered to the dams once the cubs are coming out of the nestbox on their own. Offering the bones in the PM allows the cubs to participate (outside of the nestbox) in the chewing/investigating of the bone with the dam.
8. Cub diet*:
   a) between six and eight weeks of age the dam's diet should again be increased as the cubs will be eating some of the meat offered.
   b) Increase 50 grams per feeding per week for two weeks once cubs are observed sharing dams diet regularly.
   c) As soon as the dam shifts for food during this period, allow the cubs to be separated for 15-30 minutes to eat on their own.
   d) The group can be reunited if the cubs or the dam become alarmed or after the cubs return to the nestbox.

   ***Again diet increases and food amounts offered should be determined on a individual basis. Litter size, cub and/or dam condition are the key indicators.**
9. Tree branches and other natural props should be added to shift cages to stimulate climbing and aid in development and coordination of the cubs.

Infant Development

As with other carnivores clouded leopards are born blind and helpless. Umbilical cords usually fall off within 3-7 days after birth. Eyes open at 10-14 days. Teeth begin erupting at three weeks and shortly thereafter the cubs will begin chewing on all surfaces so care must be exercised to prevent ingestion of splinters, etc. By one month cubs should be moving steadily on all four legs and by five weeks most are jumping, running and attempting to climb. They also will begin to venture out of the nestbox at this stage.

Littermates become increasingly independent at six weeks. Intense play with siblings begins during this time and the first "chuff" vocalizations may occur. Most kittens begin eating solids at about nine weeks and are weaned at 90 to 100 days. Increase the female's rations when kittens are six to eight weeks old. Increase diet again when kittens are observed eating regularly. Kittens should be allowed to eat on their own (shift female away) for 15-30 minutes once they begin eating. It should be mentioned that females may become intolerant of kittens as they age so careful observation is needed to avoid aggressive encounters. Aggression between littermates at 60 to 90 days is not unusual and kittens may need to be separated for feeding.

Hand rearing

Many facilities chose to hand raise their clouded leopard kittens for a number of reasons. Due to this species secretive nature, some female's unwillingness to raise their kittens and aggression to the kittens by the female there is a large base of information concerning hand raising clouded leopards. Some managers feel hand raised clouded leopards are better exhibit animals as they tend to exhibit fewer signs of stress in an exhibit situation. Hand raised female clouded leopards have gone on to raise their own offspring (Fletchall, unpublished data).

If the decision is made to hand rear cubs it is essential that all necessary formulas and equipment be on hand. Records of animal weight, weight gain, rectal temperature, formula composition, amount eaten, behavior, ambient temperatures, etc. should be maintained throughout the rearing process. As clouded leopards tend to be a challenge to get to suck and are more susceptible to aspiration it is recommended that only experienced keepers work with cubs during the first weeks.

In the event of a singleton birth every effort should be made NOT to rear the kitten alone. A domestic kitten or another cat species can be introduced at three to four weeks of age. This companionship provides valuable play experience necessary for proper socialization and normal developmental skills. It is a critical ingredient to the animal's later success in dealing with conspecifics. Ultimately a "nursery group" of clouded leopard kittens is preferable to even a small litter. The more opportunity kittens have to interact with conspecifics the more adaptable they are to pairing and bonding.

Clouded leopard kittens are very active and moving well by four weeks of age and climbing and leaping skills develop shortly thereafter. Hand reared clouded leopards should be provided ample space to improve climbing and leaping skills. Padding an enclosure floor with straw and providing several levels of shelving or other climbing apparatus, and well as "toys" for pouncing, chasing and carrying are recommended. These activities are an important beginning to ongoing environmental enrichment. Clouded leopards can also be offered shallow water pools for play.

The following protocols have been submitted by three facilities who have had success in hand raising clouded leopards. Other successful methods have been used and managers are encouraged to discuss hand rearing techniques with other clouded leopard managers. Historically Esbilac and KMR have been the primary milk replacer products used for clouded leopards. In 1995 butterfat replaced coconut (vegetable) oil in both formulas. Some felids have experienced severe constipation when on this new formula. In the past few years many institutions have had success with Pet-Ag's Zoologic Milk Matrix as the primary milk replacer. Managers are encouraged to contact the SSP Coordinator or other facilities experienced in hand raising felids before purchasing replacer for the most up to date information.

Hand rearing protocol for Clouded leopards

Feeding procedures

1. Weigh cub before first feeding daily and before stimulating urination/defecation. This weight will be the one used to determine amount of formula to be offered the next day.
2. Check body temperature at least once daily. Body temp. should range between 96-99 degrees. Do not feed if temp. is below this range and notify vet staff. Incubator temp. should be 90 degrees initially then gradually reduced as kittens grow.
3. Check gums for pink color (should return to pink quickly after touching gums with finger).
4. Check hydration (pull skin gently at scruff of neck, should bounce back if hydration is adequate).
5. Based on weight taken above, mix days formula (add 1 drop lactaid/100cc formula). Quantity offered determined by; (cub's weight) x (% of body weight to be offered)=quantity for 24 hr. period. Divide this number by the number of feedings per day=the amount of food offered per feeding.
6. Feed appropriate amount of Esbilac formula. Place twice the amount to be fed in bottle to avoid kitten sucking air. Warm bottle by placing in hot water before feeding. Weigh bottle periodically throughout feeding until proper amount has been fed. Keep kitten upright with head raised during feeding.
7. After feeding stimulate to urinate and defecate by rubbing cotton balls on anogenital area. Note and record amts., color and quantity of stool. Specific gravity of urine can be monitored to assess hydration.

Formula concentrations/amounts to feed

1. Week 1: Feed every 3 to 4 hours. Feed 25% of body weight over a 24 hour period. Concentration of formula should be 8% (8 grams powdered Esbilac and 92cc distilled water). Add 1 drop Lactaid to each 100cc formula.* Gradually increase concentration of Esbilac to 15% by Day 7.

   *1st day only: Heat formula for 90 minutes at 90° F to predigest lactose. Day 2 on add Lactaid and make 24 hours in advance, refrigerate.
2. Day 8-21: 7 feedings per day at 23-25% of body weight. Increase concentration of formula to 18% by Day 21.
3. Day 22-35: 6 feedings per day at 20-23% of body weight. Formula concentration to 21% by Day 35.
4. Day 36-60: Decrease feedings to 5 per day. Feed at 20% of body weight. Formula concentration 22%. Begin eliminating bottle feedings and substitute solid food/formula mixture offered in saucer or flat pan.
5. Day 60 on: Gradually eliminate formula feedings. Kitten weaned and eating all solids by Day 90.

Clouded leopard Hand rearing protocol

Initial incubator temperature should be between 88°-99° F. Remove kittens from incubator at 1 ½ months and keep at room temperature.

- Day 1: Offer 15-25% of body weight divided into five feedings. Formula is Esbilac mixed at ½ normal strength with water. Add 1/2cc serum from mother's blood per feeding to formula to provide antibodies.
- Day 2: Full strength Esbilac. Feed 15-25% of body weight dispersed into 5 feedings. Add ½ cc serum at each feeding. Add Poly-vi-sol to formula.
- Day 9: Feeding full strength Esbilac. 5 feedings per day at 15-25% body weight. Begin adding Lactaid to formula.
- Day 41: Start offering 1 tsp. of meat once daily.
- Day 56: Decrease number of formula feedings to 4x daily.
- Day 63: Decrease formula feedings to 3x's daily. Offer solid meat twice daily.
- Day 82: Decrease formula feedings to 2x's daily.
- Kittens weaned completely at 15 weeks.

Clouded leopard Hand-rearing protocol

Formula: 1 cup distilled water
½ cup powdered Zoologic milk matrix
¼ tsp. dicalcium phosphate (add beginning the end of the first week)
granules of one lactobacillus capsule

- Day 1: 1st feeding-Offer Pedialyte or 5% dextrose only
- Day 1-3: Offer mixture of distilled water:Zoologic matrix at a 3:1 ratio.
- Day 4-7: Gradually increase ratio to 2 parts distilled water to 1 part powdered Zoologic matrix. In general kittens eat 10-20% of body weight per day.

- Days 1-14: Kittens eat every 3 hours/ 7 times per day. ¼ to ½ ounce per feeding. Let go six hours at night between feedings.
- Day 14-21: Kittens eat every 4 hours/ 6 times per day. ¾ to 1 ounce per feeding. Let go eight hours at night.
- Week 3: Kittens eat every 4 hours/ 5 times per day. 1 to 1.5 ounces per feeding.
- Week 4: Kittens eat every 5 hours/ 4 times per day. 1.75 ounces per feeding. Add turkey baby food to formula at a rate of 1 tablespoon per cup of formula offered.*
- Week 5: Kittens eat every 5 hours. 1.75 ounces per feeding.
- Week 6: Kittens eat every 5 hours. 1.75 ounces per feeding. Parboiled chicken "drumettes" with skin removed are offered at this stage to stimulate chewing activity.

*Increase amount of baby food gradually until feeding ½ jar baby food per cup of formula at 4-5 weeks of age; 1 jar to 1 cup formula at 5-6 weeks. 2 jars to 1.5 cups formula from 6 weeks until weaning. Introduce solid food with some formula poured over it in a saucer or bowl at 8-9 weeks. Kittens should be off bottle entirely by 11 weeks.

Do not use incubator as the temperature and humidity seem to be the major cause of neonatal hair loss. For the first two weeks kittens are kept in a small carrier with a heating pad on low. Heating pad is covered with a towel or heavy flannel and one half is covered with an extra layer to allow kittens to move away from the heat. After the first week the heating pad can be turned off during the day. Try not to keep the kittens too warm. A kitten should feel comfortably warm to the touch and should not make the caregiver conscious of hot or cold. Kittens' feet should be warm to the touch, never sweaty.

Kittens should be stimulated to urinate and defecate. All kitten stools are somewhere between mustard and pudding consistency ("milk stools") during the period that they are on formula. Worrisome diarrhea is the consistency of water and will dehydrate a neonate very rapidly. If this occurs take them off formula and feed only Pedialyte for 12 hours, gradually reintroducing formula beginning with a 3:1 ratio and working back to 2:1 as stools firm up. Stool color can be an indicator of problems: yellow or brown is normal, greenish indicates too much food, white indicates kitten not digesting milk.

Use a Four Paws pet nursery with a small rounded nipple. Small size of nipple seems to work better than preemie or regular baby nipples.

If the kitten has nursed even once from the mother (you will know this because the stool will be a sticky consistency and yellow in color) it will be difficult to get them interested in a rubber nipple. The longer the amount of time it has been with the mother, the longer it will take to get them on a nipple. Do not assume that when kittens get hungry enough they will eat-they won't. Take time to let them feel the nipple in their mouth and slowly drip milk onto the tongue. If a kitten is not closing its' mouth around the nipple and creating good suction put your thumb and index finger on either side of its mouth by the nipple and this will create suction. Give the kitten a rest during the feeding, don't let it drink everything all at once.

Always hold baby flat on it's stomach with head tilting only slightly upward. NEVER HOLD A BABY ON IT'S BACK WHILE NURSING OR IT WILL ASPIRATE FLUID INTO ITS LUNGS.

Growth rates

Weights of hand-reared clouded leopards*		
Days of age	Average weights (grams)	Range of weights (grams)
0-5	214	166-260
6-10	276	200-345
11-15	370	280-457
16-20	518	367-669
21-25	633	475-790
26-30	800	613-988
60	1795	1500-2075
90	3100	2700-3500
*Includes weights of both sexes. Males tend to be slightly above the average, females slightly below. (N=20+)		

Weights of mother-reared clouded leopards*		
Days of age	Average weights (grams)	Range of weights (grams)
0-5	190	160-230
6-10	418	220-550
11-15	546	292-776
16-20	757	658-812
21-25	885	728-1008
26-30	1000	583-1360
60	1556	1358-1820
90	2470	2100-2600
*Includes weights of both sexes. Males tend to be slightly above the average, females slightly below. (N=4)		

Veterinary Care

Quarantine

Ideally newly arriving clouded leopards should be quarantined separate from other species of carnivores, particularly other felids. If animals were housed together at the previous institution they may be housed together at the receiving institution, however, they should be watched closely for signs of aggression and separated if needed. Clouded leopards are easily stressed so care should be taken to keep the quarantine area quiet and keep contact with keepers to only those who will routinely care for the cats. It may take several days or weeks for clouded leopards to settle into their new environment. If the diet at the new institution differs from the old a gradual transition should be made to the new diet.

During quarantine the individual cat should be evaluated for internal and external parasites, and the following serological tests performed: feline leukemia virus, Feline Immunodeficiency Virus (FIV), Feline Infectious Peritonitis (FIP), toxoplasmosis and Feline heartworm antigen and antibody. A CBC/sera profile should be done and evaluated. It is also recommended that sera be stored from females if possible.

A minimum of 30 days quarantine is recommended.

Chemical Anesthesia

In general Clouded leopards have been anesthetized using different chemical agents as outlined below:

1. 10mg/kg body weight ketamine in combination with 0.5mg- 1 mg/kg body weight xylazine (yohimbine used as a reversal).
2. Medetomidine at a rate of 0.05-0.08 mg/kg in combination with 2-3 mg/kg ketamine. Atipemazole is used as reversal agent.

NOTE: One veterinarian reported bradycardia and apnea in a clouded leopard anesthetized with a combination of 3mg/kg telazol, 2.5mg/kg ketamine and 0.6 mg/kg xylazine.

Inhalant Anesthesia

Clouded leopards are routinely placed under inhalent anesthesia with normal recoveries. Isoflourane is recommended as the gas anesthesia of choice. One should be aware that clouded leopards frequently become apnic after intubation and therefore must be ventilated manually.

CLOUDED LEOPARD VETERINARY PROTOCOLS

The clouded leopard veterinary protocols that follow are suggested guidelines that will vary based on institution, geographic location and disease prevalence.

VACCINATION: ADULTS – Should be vaccinated annually or every two years against the following diseases.
Feline panleukopenia (parvo virus)
Feline viral rhinotracheitis (herpes virus)
Calicivirus
Rabies

NEONATES - Should be vaccinated at least three times if possible between the ages of 8-10, 12-14, and 16-20 weeks. Rabies vaccine should be given at 16 weeks and then again at one year.

Members of Felidae are susceptible to canine distemper virus, but vaccination is not recommended at this time.

Vaccines used: FVR, Calici, Panleukopenia (Killed Vaccine), Fel-o-Vax PCT, Fort Dodge, Fort Dodge, Iowa
FVR, Calici, Panleukopenia, Rabies (Killed Vaccine), Fel-o-Vax PCT-R, Fort Dodge, Fort Dodge, Iowa
Rabies vaccine (Killed Vaccine), Imrab, Rhone Merieux, Inc. Athens, Ga.

References: 1998 Report of the American Association of Feline Practitioners, 1998; Bush et al., 1981; Crawshaw et al., 1996; Eberle et al., 1991; Junge et al., 1991; Spencer, 1991; Spenser and Burroughs, 1991; Wack, 1991; and Wack et al., 1993.

PARASITE SURVEILLANCE : Fecal flotation and fecal smear performed annually or biannually or as clinical signs warrant.

Deworming: **Pyrantel Pamoate** (Given orally at 5mg/kg. This dose should be given starting at two weeks of age and repeated every two weeks until six weeks of age).
Ivermectin (Has been used at a rate of 200µg/kg without adverse effects both subcutaneously and intramuscularly. Ivermectin has also been tolerated at the same dose injected into a rodent carcass as a food source).

INFECTIOUS DISEASE SURVEILLANCE : During quarantine procedures as well as annual physical examinations, blood should be submitted for the following seriologic testing.

Feline Leukemia Virus
Feline Immunodeficiency Virus
Feline Infectious Peritonitis
Toxoplasmosis
Feline Heartworm Antigen and Antibody

Questions regarding Neofelis SSP veterinary protocols should be addressed to:

Norah B. Fletchall
SSP Coordinator
John Ball Zoo
1300 W. Fulton
Grand Rapids, MI 49504

Analysis of International Studbook Data

An analysis of historical data contained in the International Studbook for the Clouded leopard is summarized in Charts 1 through 4. Median age at first reproduction is 38 months in females and 35 months in males. The earliest recorded age of reproduction is 16 months in females and 18 months in males. Average litter size is 2. 83 males and 91 females have produced offspring.

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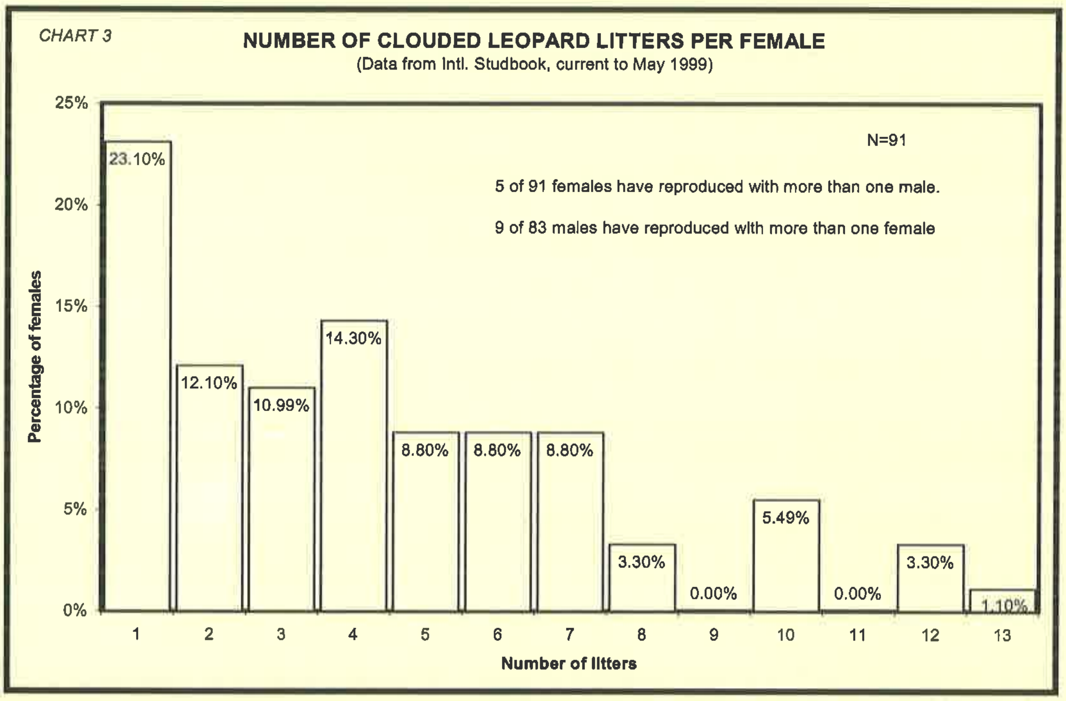

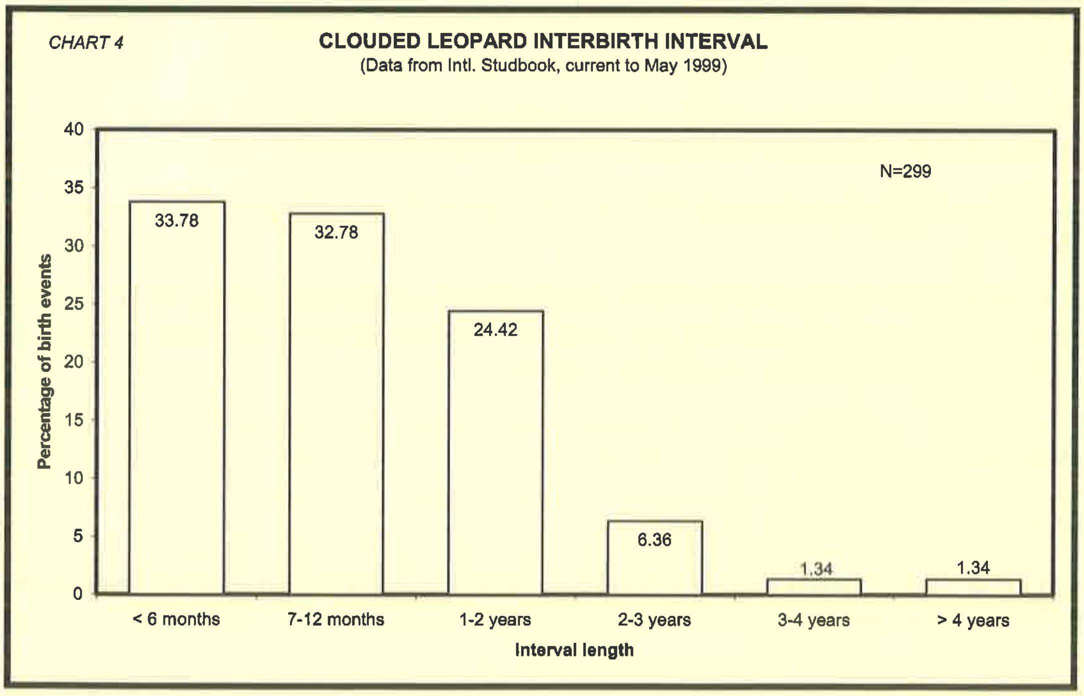

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(DRAFT)

EEP-Husbandry Recommendations for Tigers (*Panthera tigris*)

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Biology of the Species

The tiger is considered the largest species of felid and six extant subspecies are generally recognised, with one, the South China tiger *P. t. amoyensis*, believed to be extinct in the wild. Males of the largest subspecies, the Amur tiger *P. t. altaica*, weigh between 160 and 200 kg, with females about 1/3 less. Males of the smallest subspecies, the Sumatran tiger *P. t. sumatrae*, are usually about 100 to 110 kg.

The species is found in a wide range of forest habitats from temperate in the Russian Far East to tropical in Sumatra and mainland Southeast Asia. They occupy large territories that can vary from 50 to 4,000 km^2 depending on the density of the prey base. Although opportunistic hunters, the preferred prey species are the larger species of deer and wild pigs.

In the literature they are usually labelled as a solitary species, although it would appear from some observations in the field and in captivity that there is a significant amount of contact between mated pairs and their offspring.

Captive Management

The tiger has a long captive history, dating back more than two thousand years, but it is only since the middle of the last century that their captive needs have been more clearly understood and successful breeding became more common place. When attention is paid to some fairly basic husbandry criteria, the species presents few problems. In all aspects of managing tigers within a captive environment, extreme care must be taken due to the real risks the species represents to humans and safety for staff and visitors is a primary consideration when looking at all aspects of their management.

Housing: Traditionally tigers were, and in some cases still are, kept in large buildings with other species of large felid, with adjoining outside enclosures which were usually fairly small in area with little in the way of natural substrates or planting. More commonly now, tigers are maintained in larger species specific facilities with a greater focus on the size and naturalness of the outside enclosure. Some regions have legislation or guidelines for minimum enclosure sizes, but virtually without exception these minimums would be deemed far too small by our industry.

A good tiger facility should ideally include the following features: a large, natural outside enclosure with good shade trees (not next to the perimeter fence), raised wooden platforms, a pool and visual barriers that provide the animals with the ability to escape the gaze of their enclosure mates and visitors; a smaller outdoor pen to facilitate separation of individuals when required that connects to both the main outdoor enclosure and the indoor dens (this pen can be on or off exhibit); a series of indoor dens, usually at least four so as to accommodate the need to separate members of a family group when required, and one may be larger with viewing access for the visitors via a 20 mm thick, laminated window; at least one of the indoor dens should be covered so as to provide a pregnant female with a dark, quite, secure place to give birth a rear cubs and all should have raised wooden shelves for the tigers to feed and rest on, and a robust water dish that can be drained and filled from the service passage. Heating for the indoor areas is potentially required for the tropical subspecies, although some zoos have successfully managed Sumatran tigers without any supplementary heating.

From a safety perspective, all tiger areas, either indoor or outdoor, should be accessed by staff through a double door system, with the inner door providing good visibility. All doors that open into tiger areas should open into the den or enclosure to avoid a cat pushing an unlocked door open. All animal doors should be horizontal sliding doors and not vertically operated guillotine doors as they are more prone to failure, can injure animals, and can in some instances be lifted by the animals which presents a significant safety hazard. There should also be no gaps in or around these doors where tails and paws can pass through, including those of young cubs.

Tiger enclosure barriers are usually high walls or fences and/or deep wide moats, either dry or water-filled. Vertical barriers should be at least 5 m high and if climbable, they should be topped with a minimum 1 m overhanging section that leans into the enclosure at a minimum angle of 45°. Dry moats should also be 5m deep with a recommended width of about 10 m with the visitor side of the moat slightly higher than the animal side; a dry moat should be accessible for the tigers should one fall in and the floor of the moat should be soft to reduce the chances of injury in a fall. Water-filled moats can be slightly shallower with a 2.3 m water depth and the moat wall extending a further 1.5 m above the water line.

Traditionally, zoos would secure tigers into the indoor holding areas each and every evening for safety reasons, which can result in animals being locked into small dens for up to 16 hours out of every 24. The larger outside enclosures should be designed to be secure enough to be able to comfortably avoid this practice and the animals should be left with access at all times and only be secured indoors for cleaning, veterinary or breeding purposes.

Feeding: Tigers do not eat meat, they eat animals, therefor it is important to try and either feed whole animal carcasses or supplement their food accordingly. In Europe, tigers are normally fed sections of horse or beef, with the bone included, and to make this a more nutritionally complete package, it is strongly advised to supplement the meat with a suitable vitamin and mineral powder. The key role of the powdered supplement is to ensure that the food presents the animal with as near to a 2:1 ratio of calcium to phosphorous. Many zoos also coat the meat with a small amount of cod liver oil. Such a diet will avoid the normally historic problems of skeletal weaknesses in young and growing cats. It is also advisable to occasionally feed whole, gutted chickens and rabbits and ideally the joints of meat should have the skin and hair still attached.

There is wide variation in the nature of tiger diets when it comes to quantity and frequency of feeding, from feeding 4 to 8 kg per day, to 60 kg once per week. Although a wild tiger, depending on the size of the prey and reproductive status, may only make a kill once every 4 days or so, there is an increasing amount of evidence to suggest that the tradition of starve days – a practice alleged to duplicate the fact that large predators do not eat every day in the wild – is no longer appropriate and actually increases the occurrence of stereotyped pacing behaviour. The other argument for starve days is to stop tigers from becoming over-weight, which they are prone to do in captivity, but this can be avoided by noting the general body condition of the individual tiger and varying the amount fed accordingly. Training tigers to walk onto scales for weight monitoring is a very useful and simple practice and will also allow for more precise dose rates when darting an animal.

Many zoos separate their tigers from each other at feeding times to avoid fighting, but in large enclosures with reasonably compatible animals, this is unnecessary if the sections of food are appropriately spread around the area.

Breeding: In most cases, male and female tigers will not breed until their 3rd or 4th year, usually the latter. The gestation is normally 100 to 110 days and is preceded by a period of intensive mating over 4-7 days. The litter size is normally 2 to 3.

Introducing a pair of tigers together can be a nerve wracking process and should be done gradually with the animals in adjacent areas to begin with, separated by strong welded mesh barriers that do not allow any body part to pass through or around. There is debate over whether the full introduction should be done in an indoor area where there is more control over the animals and greater opportunities for separation should they start to fight, or in the larger outdoor enclosure where there is room to escape from each other and a small fight is less likely to escalate into a full-blown battle to the death; there are a number of accounts of males killing females during initial introduction attempts. Having water hoses, CO^2 fire extinguishers and anything that can make a loud noise, like an air-horn, on hand will help separate fighting cats should the need arise. A common mistake is for staff to misinterpret a minor argument that is nothing more than noise and a bit of swatting with the paws, and separate the pair prematurely rather than letting it run its course. Once a pair is established and positive interactions are regularly seen, *e.g.* head rubbing, they can generally be left together permanently. Depending on the size of the indoor dens and compatibility of the pair, it is probably not advisable to secure the adult animals in the same indoor den.

Although tigers can produce cubs at any time of year, births during the main winter months, especially at higher latitudes, are rare, with Amur tigers showing a stronger degree of seasonality than the other subspecies. A female tiger's reproductive cycle is about 25 days and her increased level of calling and rolling behaviour will signify that she is sexually receptive. She will often present to the male to trigger mating, which can be a noisy affair, especially when the mating pair separates with the female rolling over and throwing the male off; this is normal.

Once conception has taken place, there will usually be no further mating seen until about a week or so before the expected parturition date when there can be a few bouts of very mild mounting behaviour by the male which will be tolerated by the female, but without the noisy finish. Females who have been on birth control implants sometimes appear to continue to cycle throughout the pregnancy and mating will be noted every 3 to 4 weeks until they give birth.

Two to three weeks before the expected birth date, the female should be given access to the dark and quiet cubbing den, usually situated at the quietest end of the indoor facility, so that she can become familiar and comfortable in it. A wooden floor with straw bedding is preferred by most females. Once the cubs are born, and ideally for a short period before the expected birth date, keeper disturbance in the area should be reduced to a minimum and cleaning completely suspended. Remote video cameras or a microphone system for monitoring cub vocalisations are useful for assuring staff that the cubs are fine and it reduces the risk of staff feeling the need to visually check the cubs.

The cubs will come out of the den regularly by the age of 4 weeks, and can generally be introduced to their sire at this time, if the female feels confident enough to allow this; she will control his access to the cubs initially. It is perfectly appropriate to manage tigers as family groups and the practice of keeping the adult male completely separate is to be avoided if at all possible. The cubs should be kept with their parents until they are at least one year old and ideally two years, before they are exported to other collections.

Enrichment: Giving tigers a range of reasonably durable play objects is to be encouraged, *e.g.* large heavy plastic balls or large sections of cow or horse skin. Ungulate faeces can provide olfactory stimulation, as can some human perfumes, but the main form of enrichment should be food presentation. Suspending their joints of meat from trees or at the tops of large wooden poles can provide much needed physical exercise which is proven to enhance muscle density to a level seen in their wild counterparts. The occasional feeding of a whole, large ungulate carcass is highly recommended.

Veterinary Care

(All of the following advice should be read in conjunction with the "EEP Felid Regional Collection Plan & Veterinary Guidelines", (2000) Blomqvist, McKeown, Lewis & Richardson.)

Vaccination: Cubs should be vaccinated at 8 and 12, or 12 and 16 weeks of age, then annually thereafter. Only inactivated (killed) vaccine should be used and the standard combination vaccines that cover them against feline panleucopaenia, feline rhinotracheitis and feline calici virus are the norm.

Parasite Control: Depending on parasite load, tigers will need to be dewormed as often as every 3 months, or as little as once per year. It is recommended to check faecal samples every few months, or if a change in the health or physical condition of the animals indicates a problem, *e.g.* unexplained weight loss and/or diarrhoea.

Kidney Function: As with virtually every felid species, older tigers (16+ years old) are normally prone to suffering from reduced kidney function that will eventually result in a compromised quality of life followed by complete kidney failure and death. There is little that can be done to prevent this from happening or treat it when it occurs. Humane euthanasia should be strongly considered earlier in the process rather than later.

Handling & Transportation: Other than young cubs, staff should never share the same space with conscious sub-adult or adult tigers or attempt to physically restrain them. If a tiger needs to be the subject of a veterinary examination or procedure, it should be sedated with an appropriate, ideally reversible, drug combination. There are some good squeeze cage designs, *e.g.* at London Zoo, that the tigers can be conditioned to routinely for hand injection and even blood sampling, although there have been significant advances in protected contact training of big cats, particularly in America, to facilitate simple veterinary procedures.
When moving a tiger to another collection, it is preferable to give the cat access to the travelling crate for a few weeks prior to the date of transport to allow the cat to become familiar with it and to negate the need for sedation to get the tiger in the box. Offering the individual some or all of its daily food, initially near the entrance to the box then gradually placing it further in until the tiger confidently walks into the container. This will result in a significant reduction in transport induced stress.

Contraception: (*the following information is taken from "Tiger EEP – Current veterinary issues, September 2009" by John Lewis, International Zoo Veterinary Group*)
The Tiger EEP Contraception guidelines have not been updated since 2000. However, in the intervening years new contraceptive approaches have been developed, perhaps the most significant of which are the gonadotropin releasing hormone (GnRH) agonists such as deslorelin available in implant format (e.g. "Suprelorin®" Peptech Animal Health). For several decades progestin-based contraceptives such as the melengesterol-acetate implant have been used in European collections to provide temporary and (usually) reversible contraception in female cats. Although highly effective, progestins can be associated with potentially serious side effects in carnivores.
Although GnRH agonists are hormone analogues, they are peptide based rather than steroidal and as a result provide an alternative to progestin-based contraception with fewer side effects. The initial release of GnRH from an implant temporarily stimulates reproductive hormones, but continued release then causes down-regulation of LH and FSH production in the pituitary resulting in "reversible ovariectomy" in females and "reversible castration" in males.
Studies into the efficacy, duration of action and reversibility of these implants have been ongoing in the United States since 2002, and several European collections have had experience with GnRH implants in a number of species. Important observations & recommendations to date include:
Although it appears safe and effective, dosages and duration of efficacy have not been well established for all species
The duration of suppression can vary widely from individual to individual within a species, but each individual tends to respond consistently with each successive treatment.
Deslorelin implants are effective in virtually all female carnivores once the appropriate dose has been established.

Breeding

We have found that after successful pairing, the female will generally produce her first litter after 2 years of being with the male. The gestation period is usually around 90 days, but can last anywhere between 85 and 100 days. On average the litter will normally consist of 2 cubs but may vary from 1 to 5.

Upon the discovery of newly born cubs, it is imperative that mother and cubs are left alone. We have found that unnecessary interference and/or disturbance will greatly increase the infant mortality rate and the probability of infanticide. At Howletts Wild Animal Park, minimal contact and disturbance is maintained for a period of 8 weeks after birth up until the first inoculations are administered. During this period, keeping staff only enter the enclosure when feeding and to provide fresh water.

Housing & Enclosure Design

As Clouded Leopards are predominantly arboreal, enclosures should have as much height as possible as platforms and shelving at height seem to be the preferred places of rest and refuge. The enclosures at Howletts Wild Animal Park are approximately 27ft in height, 25ft in width and 66ft in length. Ideally, enclosures should be in excess of or at least equal to these dimensions.

Multiple platforms and shelving should be linked by an extensive network of branches with at least 2 exits from each platform, preventing the more agile female from being cornered by the much larger male. The enclosure should be heavily planted with vegetation such as pampus grasses and bamboo, which are hardy, grow quickly and provide good visual barriers. When left to grow on 2 or 3 sides of the outside of an enclosure, climbing vegetation is another excellent way to provide a visual barrier from large numbers of visitors and shelter from the elements, thus reducing stress for the animals.

External nest-boxes provide the perfect place for the female to give birth in whilst large 3-bay sheds (heated during winter months) provide a retreat for the male, as well as being a very good way of manoeuvring the animals without causing undue stress. Inside a solid outer door, a mesh grill allows safe inspection of the animals when needed. If an indoor area with a glass viewing bay is used, ensure the animals do have access to an indoor area that is completely off-show.

Feeding

At Howletts Wild Animal Park our collection of Clouded Leopards are fed once daily (usually around mid to late afternoon) on a diet consisting mainly of rats, rabbit, chicken and meat (horse or beef). Goat, day old chicks, pheasant and fish, amongst other food items, are also fed to them when available. All food items are fed out with the feathers/fur, skin and bone intact. Feeds are alternated daily so that the same food item is not fed out two days in succession. Approximate mass weight of daily feeds is 0.5kg, which equates to roughly 1/2 rabbit, 1/2 chicken or 4 medium sized rats. When using pure meat as a feed (e.g. horse or beef) this excludes the added weight of any extra bone.

Veterinary care

Vaccination: All Clouded Leopards should be vaccinated. Kittens should be vaccinated from 9 weeks and have their second vaccination 3 weeks later. Unvaccinated adult cats should also have 2 vaccinations, 3 weeks apart. Vaccinated adult cats should have an annual booster. A dead multivalent vaccine should always be used such as fevaxyn pentofel.

Parasites: Ideally all cats should have faecal screening for internal parasites bi-annually. Only animals testing positive should be given anthelmintics. If screening is not possible all cats should be given anthelmintics three times a year as routine and more often if there are specific problems.

Anthelmintic	**Dose**
Fenbendazole	50mg/kg PO sid for 5 days
Milbemyin oxime	2mg/kg PO
Praziquantel	5mg/kg PO
Pyrantel embonate	57.5mg/kg PO

Ideally all cats should be prescribed lufenuron 30mg/kg PO every month to prevent flea infestation.

Viral Diseases: Blood samples should be taken from all cats whenever they are sedated. Each cat should be tested for feline immunodeficiency virus (FIV), feline leukaemia virus (FeLV), feline herpes virus, toxoplasmosis and calicivirus. Institutions with cats testing positive for these diseases should contact the studbook keeper.

Sedation: The easiest way to sedate most Clouded Leopards is by administering an intramuscular injection by blow dart. A double combination of ketamine and medetomidine is recommended at a dose rate of medetomidine 0.05mg/kg and ketamine 2mg/kg IM. Atipamezole should be used to anatagonise the medetomidine to speed recovery at a dose of 0.25mg/kg IM. Cats that are sedated for any length of time should be intubated and maintained on oxygen and isoflourane or sevoflourane.

A full clinical exam should be performed whenever a cat is sedated. Cats that have not been microchipped can have a microchip implanted during sedation. Blood samples should always be taken from sedated cats, both for analysis and serum storage. As in domestic cats, blood sampling from the jugular vein is easiest and yields the best samples. Radiographs of at least the chest and abdomen should be taken whenever a cat is sedated. All sedated cats should be weighed.

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GENERAL INTRODUCTION

Within the family Felidae, determination of minimum husbandry needs of large cats is variable because of differences in size, morphology, and behavior. For purposes of this discussion, a large felid is identified as any species of cat belonging to the genus Panthera, including: lion, *P. leo*; tiger, *P. tigris*; jaguar, *P. onca*; leopard, *P. pardus*; and snow leopard, *Uncia uncia*; as well as the puma (cougar or mountain lion), *Puma concolor;* clouded leopard, *Neofelis nebulosa*; and cheetah, *Acinonyx jubatus*.

With one exception, large felids are solitary carnivores functioning at or near the top of their trophic level. While this behavior permits them to be housed singly, it also requires that the introduction of potential mates be done carefully to prevent fighting, injury, or death. Their aggressive nature and physical capabilities demand that owners exercise the utmost care when designing cages or exhibits for any species, regardless of size, to insure that specimens cannot escape or reach into adjacent cages or public areas. Caution also should be exercised when handling otherwise "tame" individuals.

Minimum requirements for exhibit size and furnishings, diet, veterinary needs, and social groupings are broken down in the following way: 1) very large pantherids, 2) other large felids, and 3) cheetahs.

GENERAL REQUIREMENTS

Some aspects of captive management for all large felids are similar and are discussed below. Requirements unique to certain groups are listed separately.

Temperature - Although large felids may originate from all manner of climates, most are tolerant of wide temperature extremes, at least during daylight hours. Animals kept outside should always have access to shade, especially during warmer months of the year. When acclimated, most species without young require only minimal unheated shelter at night. Clouded leopards are more cold sensitive than the other species and should be protected from minimum extremes in weather. When kept indoors year around, animals should be protected from temperatures above 85 degrees Fahrenheit.

Lighting - In nature, most species of large felids are nocturnal and, therefore, less active during daylight hours. Accordingly, they all do well under normal light cycles although shy or secretive specimens will thrive with less exposure. Smaller species may be exhibited under reversed light cycles without harm. Fluorescent lighting is an efficient light source providing broad-spectrum illumination.

Ventilation and Humidity - Indoor exhibits should have a negative air pressure of 10-15 air changes per hour of non-recirculated air. Relative humidity should be within the range of 30 - 70%. Separate ventilation systems should be maintained between exhibit and visitor areas to reduce the potential of disease transmission from the public as well as complaints from odor. If possible, separate systems also should be maintained for individual exhibits.

Water - Fresh clean water for drinking should be available at all times. Watering devices should consist of either exhibit built-ins for the larger species or sturdy portable containers for smaller species. Regardless of size, water containers should be cleaned and disinfected daily. Some large felids, especially tigers and jaguars, enjoy bathing and swimming, and large pools should be incorporated into outside exhibits, as appropriate.

Sanitation - Hard-surface primary enclosures and food containers (if used) should be cleaned daily with detergent and disinfectant. Perches and shelves where animals climb and sit should also be included in this regime. Dirt substrates in outdoor planted exhibits should be raked and spot-cleaned daily. Footbaths containing quaternary chemicals should be used prior to entering all felid enclosures or areas containing enclosures. Each should be filled with a disinfectant and its use strictly adhered to by all personnel.

Food - Large felids are easily maintained when fed prepared diets made from beef or horse products. Diets of this type may be obtained from commercial sources that already have the appropriate vitamins and minerals added, in amounts that vary according to the age and status of the specimen. Similar diets may also be prepared in-house. Whole animal carcasses (rodents, rabbits, or fowl), may be substituted upon occasion to vary the diet. To address problems with obesity, felids may be fasted one or two days a week. Bones, especially those from joints or knuckles, also should be given at least once or twice a week to maintain good oral hygiene and muscle tone; fast days are good opportunities.

In the past, many zoos fed large felids muscle meat from freshly butchered livestock. Although this source of feed is still occasionally used, owners are cautioned that diets consisting primarily of whole or ground muscle meat may be inadequate in vitamin/mineral content. Diets containing high percentages of fowl by-products such as chicken or turkey necks may also be nutrionally unbalanced. Owners should also be wary of carcasses obtained from road kills or donations because of the potential for contamination, and feed animals selected from such sources should be inspected to insure that they are free of disease..

Veterinary Care - Services of a veterinarian should be available. Periodic (at least twice yearly) fecal examinations should be required to check for parasite infestation. When circumstances permit, overall examinations should be performed and the results recorded. Annual vaccinations should include prophylaxis against feline panleukopenia (distemper), rhinotracheitis, and calicivirus. In areas where tetanus is endemic, felids should be vaccinated for this disease on an annual basis. Felids also are susceptible to non-specific diseases like tuberculosis.

All large felids nearing adult size that are likely to be transferred to another institution in the future should be tattooed or receive microchip implants when the opportunity arises. Common species such as pumas, and specimens not otherwise eligible for studbook registration should be identified by their accession or ISIS numbers. Specimens entered in regional or international studbooks should have their registration number tattooed on the inner aspect of the thigh, or other area as directed by the studbook keeper.

SPECIAL REQUIREMENTS

For purposes of the following discussions, large felids are divided into three groups based primarily on size, husbandry, or behavioral idiosyncrasy. No taxonomic relationship should be inferred.

1. VERY LARGE PANTHERIDS: *Panthera leo*, lion, and *P. tigris*, tiger.

Two species of felids may be described in this fashion, the African or Asian lion and the tiger; each species is represented in captivity by several subspecies or combinations thereof. Both are large species filling carnivorous niches at the top of their respective trophic levels. A number of subspecies have been named for each species but husbandry requirements do not differ among them.

Lions are the largest predator in Africa (and formerly the Middle East to India) and males attain weights of 330-550 lb (150-250 kg). Females are somewhat smaller (Nowak & Paradiso, 1983). Tigers occupy a similar niche in Asia and although there is less dimorphism in size; tigers from insular origins are smaller than those from the mainland and Siberia. The most northerly race is the largest living cat and males weight 390 -675 lb (180 - 306 kg). In contrast, male tigers from Sumatra weigh only 220 - 300 lb (100 - 140 kg). Both species have gestations of approximately 105 days, and produce litters of 2-5 young (Nowak & Paradiso, l983). Both orange and white morphs are present in captivity, although the former is more common (Seifert and Muller, 1987).

A. Social Grouping: Since they are solitary at least part of their life, either species may be kept singly as well as in pairs. Large exhibits may contain additional females although some older female tigers may not tolerate other females. Males should normally be kept separate from other males. Mothers with infants should be moved to a cubbing den or location away from other animals prior to birth, and not reintroduced to other adults until after the cubs are 2 or 3 months old. Adult lions of both sexes will tolerate cubs of other females if adequate space is available. Many adult male tigers also tolerate females and their cubs.

B. Exhibit Size: Lions and tigers are easily maintained in traditional barred or heavily wired cages as well as in large outdoor exhibits employing moats to separate animals and public. A cage for a single animal should measure at least 20 ft (6.1 m) wide x 15 ft (4.6 m) deep (300 sq.ft/27.9 sq.m); cages should be 50% larger per additional animal. Although adults do not climb well, their leaping ability should not be underestimated. Outdoor cages should have vertical jumpwalls at least 16 ft (4.88 m) high or be provided with tops at least 10 ft (3.1 m) high. If moats are used as a barrier, they should be at least 25 ft (7.6 m) wide and 15 ft (4.6 m) deep. All enclosures must have smaller shift facilities to permit safe cleaning, cage repair, or other separations. Shift cages should measure at least 8 ft by 8 ft (2.44 m x 2.44 m). Because both species are easily bred, owners not wanting young or who are unable to use birth control implants or neutering should build separate cages to separate adults.

C. Remarks: Although both lions and tigers are terrestrial in nature, they benefit from raised shelves or ledges for sleeping and resting. Large logs are used for claw sharpening. Young of both species may be raised naturally or by hand without impairing future parenting ability.

2. OTHER LARGE FELIDS: *Panthera onca*, jaguar; *P. pardus*, leopard or panther; *Uncia uncia*, snow leopard; *Puma concolor*, puma, cougar, or mountain lion; *Neofelis nebulosa*, clouded leopard.

The five felids listed above are discussed together because of their similarity in size. All but the snow leopard have numerous subspecies whose distinctions may be ignored for purposes of this discussion.

The jaguar is the largest New World felid and ranges from the southern tip of South America northward into Mexico, and formerly, into the United States. Although similar in length to the leopard, jaguars are heavier and males weigh 79 - 348 lb (36 - 158 kg) ; females are somewhat smaller (Hall, 1981; Nowak & Paradiso, 1983).

The puma, also called cougar, panther, or mountain lion in various parts of its range, is distributed throughout the New World from the tip of South America northward to British Columbia and

Alberta. Puma weights, 148 - 227 lb(68 - 103 kg) vary widely throughout their range; specimens from Canada are largest (Hall, 1981; Nowak & Paradiso, 1983).

The leopard is the widest ranging felid in the world, and is found from South Africa across that continent to the Middle East, Java, and northward to Siberia. Sizes vary widely according to habitat, and range from 82 - 200 lb (37 - 90 kg)(Nowak & Para-diso, 1983); those from desert areas are smallest. Patterns vary markedly throughout their range and animals from moist dense forests may be melanistic (Kingdon, 1977).

The snow leopard appears similar in size to the common leopard although thick fur belies its lighter weight: 55- 165 lb (25-75 kg) (Nowak & Paradiso, 1983). The smallest member of the "large" felids is the Clouded leopard (Nowak & Paradiso, 1983). Highly arboreal and restricted to undisturbed forests of South-east Asia and Indonesia, it weighs only 35 - 50 lb (16-23 kg). Average gestation for all five species is 90 - 103 days, slightly less for clouded leopards. Litter sizes average 2-3 young (Nowak & Paradiso, 1983).

A. Social Grouping: All five species are solitary in nature and may be kept by themselves or in pairs except when young are present. Compatibility in some species, especially leopards and clouded leopards, may be a problem. Some leopards are only compatible while the female is in estrus (heat).

Clouded leopards are the most difficult members of this group to establish as compatible pairs. To insure compatibility, potential mates should be introduced to each other while approximately 4-12 months of age and not separated for long periods thereafter. While the female is separated and raising young, the male should be housed nearby; some females will, while raising cubs, even tolerate the male in the same exhibit if space and den size is sufficient (Shoemaker, pers. ob.).

B. Exhibit Size: Felids in this group are generally kept indoors or in situations that permit viewing through glass, bars or sturdy wire. Otherwise their small size and secretive nature make them difficult to safely exhibit in large moated facilities commonly used for lions and tigers. Minimum cage dimensions for single animals should equal at least 200 square feet, and be increased by 50% for each additional animal. As in the case of large pantherids, a shift cage(s) should be available. Because all five species are excellent climbers and leapers, secure tops should cover all outside enclosures.

C. Remarks: All five species are arboreal or live in rocky habitats and should be furnished with elevated ledges or perches for sleeping and resting. Wood logs or other devices should also be included. Young of all species may be raised naturally or by hand.

3. CHEETAH: *Acinonyx jubatus*. The cheetah is morphologically and behaviorally quite unlike the two groups discussed above. A diurnal species, cheetahs are physically adapted for running at very high speed over short distances. Although approximately the same length as most large felids, they are much lighter in build and weigh only 77 - 125 lb (35 - 57 kg). Like other large felids, males are larger. Gestation is 90-95 days and litter sizes are 3-5 (Nowak & Paradiso, 1983).

A. Social Grouping: In nature, cheetahs tend to be solitary but adults may be kept as pairs or in larger groups with little difficulty. Problems in establishing breeding groups may, however, necessitate keeping adults of either sex separate from each other except during pairing to stimulate reproduction.

B. Exhibit Size: Cheetahs do best in spacious outdoor areas surrounded by fence or moated barriers. If kept in caged conditions, minimum dimensions should equal at least 200 square feet

(18.6 square meters). Because they lack sharp retractable claws, cheetahs climb poorly but benefit from elevated wooden platforms or ledges for sleeping and resting.

C. Remarks: Cheetahs are relatively easy to keep in captivity but remain the most difficult large felid to propagate consistently. With the exception of the Pretoria Zoological Garden's breeding facility at DeWildt Breeding and Research Center, this species is not self-sustaining in captivity (Marker,l977). Although consistent husbandry techniques have not been identified to date, many owners experiencing successful reproduction keep female(s) separate from males except when they are in estrus (heat). Young may be raised naturally or by hand although breeders were primarily mother reared.

Cheetahs suffer from unusually high incidences of liver disease and research is presently (1988) seeking solutions to this aspect of their husbandry. Other investigations of their physiology seem to suggest that dietary idiosyncrasies play a more important role in the cheetah's fecundity than for other large felids, and managers should stay abreast of new developments.

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EEP-Husbandry Recommendations for the North Chinese Leopard (*Panthera pardus japonensis*)

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Biology of the species:

The North Chinese leopard is distributed in the Northern part of China. Like the other leopard subspecies the North Chinese Leopard is very adaptable to different habitats. They need places for hiding their offspring and enough structure (plants, rocks etc.) for hunting in their typical way. North Chinese leopards usually live solitary. The home range of the male includes one or more female home ranges. The sizes of the home ranges depend to the number of possible prey. The one to five offspring (usually 2-3) stay with there mother until the age of about two years.
There are nearly no data or study results available from China. There is even no information available on the number of free living animals.

Captive management:

Housing:
In European climate North Chinese leopards can be kept outside around the year. There should be at least two outside enclosures and a possibility to separate each animal in a smaller cage (for feeding, immobilisation, treatment etc.). Further a box or cave where the female can give birth is necessary.
A possible way is to use one large outside enclosure, one smaller outside enclosure and an unheated house with single animal cages. One part of this house can be used as nesting box.

The main outside enclosure should have a minimum size of 200 sqm and a minimum height of 5 m. The leopards like to lay at higher view points (trees, rocks). Different ground surfaces (rocks, grass, sand, bark pieces etc.) like in the natural habitat should be used. Trees (living or dead) give the leopards the chance to climb and to sharpen the claws. A lot of plants are necessary for enough privacy of the leopards. Even sunny areas have to be in the enclosure. Fresh water (maybe a little brook) is a good addition for the habitat.

The second outside enclosure has to be the area where the female can go with its young offspring when they have their first days in the sun. It can be smaller than the first enclosure and it should be without danger for the babies (no possibilities to climb higher than 1-2 meters, no deep water etc.). It also can be used for one of the adult leopards when they are separated for example to avoid breeding.

The walls of both enclosures and the indoor boxes should be of strong wire-mesh.

The recommended size for the cages in the house is 2-5 sqm and the height is 2-3 m. The ground should be concrete or epoxy. In the nesting box straw can be used as substrate. The wire in the front has to be covered with a board of wood to give the necessary privacy to the female. It is very helpful to use a camera in the nesting box to get an overview of the situation without disturbing the female..

Feeding:
The food is offered once a day. 1 or 2 days a week the animals are not fed. The food should be as variable as possible. Meet with bones (cattle, goat, horse, sheep), chickens, rabbits, guinea pigs are possible. If possible whole animals are fed. Depending to the diet a Calcium- and or a mineral/vitamin supplementation is necessary. Water is provided ad libitum. The leopards should be fed separated.

Breeding:
The breeding of North Chinese Leopards was successfully in many zoos in captivity. The introduction of male and female is easy in most of the cases. The pregnancy duration is 92-98 days. An early adaptation of the female to the nesting box is very helpful. The female should be separated about 10 days before birth. The offspring should stay with there mother until they are about 15 months old.

Behavioural enrichment:
The most important point for behavioural enrichment in North Chinese leopards is the enclosure design. Different ground surfaces, enough possibilities for climbing, higher resting points with view in the surroundings etc. help to keep the leopards free of stereotypic behaviour.
Further feeding of whole carcasses and hiding of small peaces of food are methods of enrichment.
Another possibility is to place smells in the enclosure (cinnamon, pepper, maybe faeces of hoofstock etc.).

Hereditas 103: 221–229 (1985)

Multiple ocular coloboma (MOC) in snow leopards (*Panthera uncia*)

Clinical report, pedigree analysis, chromosome investigations and serum protein studies

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A unique retinocolobomatous syndrome, the multiple ocular coloboma (MOC) is described in sixteen snow leopards belonging to the Helsinki Zoo pedigree. MOC has been diagnosed in snow leopards from four other zoos in the world. The same syndrome has been reported in the domestic cat, but is not known in any other species.

Multidisciplinary investigations have not been able to explain the causes of MOC.

MOC is an example of a hitherto unknown type of familial malformations where the available evidence strongly points to nongenetic maternal influences or some external factor affecting all the fetuses in the same way.

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Modern conservation biology pays a special attention to endangered animal species in the world. International studbooks have been started in the zoos for registration of individual animals belonging to important endangered species. The snow leopard studbook was started in 1976 and is kept by the Helsinki Zoo (BLOMQVIST 1978 a, b, 1980, 1982). This registration system has provided data to construct pedigrees and establish lineages of animals from which inheritance of genetic defects can be traced.

The snow leopard, native of the high mountains of Central Asia (USSR, Mongolia, China, Nepal, Bhutan, India, Pakistan and Afghanistan), is a rare animal spread over a wide geographical area with a patchy population structure. Very little is known about the wild snow leopard population. There are, however, clear indications that the snow leopard population is constantly diminishing in our days (BLOMQVIST 1978 a, b; BRADEN 1982). Snow leopard has been designated a species of particularly high priority in the Species Survival Plan developed by the American Association of Zoological Parks and Aquariums (FOOSE 1982).

A unique congenital eye malformation, multiple ocular coloboma (MOC), is described in sixteen animals in the Helsinki pedigree of snow leopards. This anomaly is also known in snow leopards from the zoos in Amsterdam, Zurich, Omaha and Dublin. The snow leopards in the zoos of Amsterdam and Omaha are unrelated to the Helsinki zoo snow leopards.

Typical colobomas of the iris, chorioidea and the optic nerve, well known in human beings and domestic animals (MC CORMAC et al. 1975) are caused by an incomplete closure of the embryonic eye fissure. A frequent cause for the coloboma complex is a dominant gene with a wide range of expression (SORSBY 1973). Chromosomal abnormalities can furthermore cause the coloboma (HITTNER et al. 1979). The clinical variation of this anomaly is considerable, ranging from little or no effect on the vision to fully developed microphthalmia or

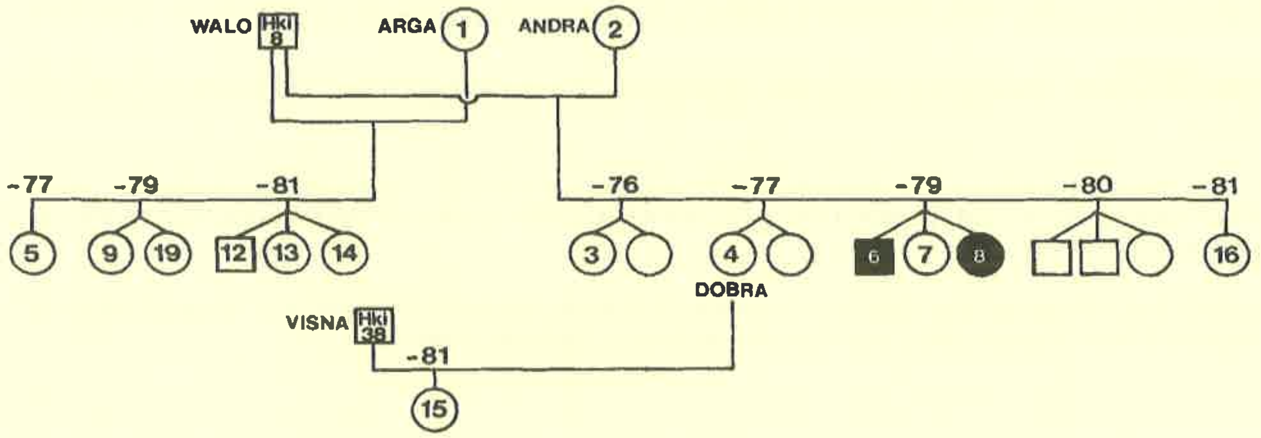

Fig. 2. The occurrence of multiple ocular coloboma in the offspring of WALO (Hki 8) transferred to Zurich Zoo.

anophthalmia leading to total blindness. Other than genetic factors may also determine the failure in closure of the embryonic eye cleft. These include environmental factors, deficiencies and various teratogenic agents.

Multiple ocular coloboma in the snow leopard, however, is a specific clinical entity, different from the coloboma complex described above, and so far unknown outside the felid group (Wahlberg 1978; Wahlberg and Tarkkanen 1980; Wahlberg et al. 1982). This entity consists of a coloboma of the upper lid and, in its complete form, of a bilateral microphthalmia with uveal, retinal and optic nerve coloboma, persistent primary hyperplastic vitreous and retinal dysplasia. The upper lid coloboma is the only constant feature in affected animals associated with or without any of the ocular signs.

The same combination of lid and ocular coloboma is previously described in the domestic cat (Bellhorn et al. 1971).

Lid colobomas are generally regarded to be of nonhereditary origin. They may result from a localized failure of adhesion of the lid folds externally caused during the late phases of embryonic development (Mann 1957).

In this paper we utilize the known pedigree for examining whether MOC in snow leopards is genetically transmitted or not. We also report cytogenetic and biochemical genetic studies of zoo animals.

Material

The Helsinki pedigree of snow leopards (Fig. 1) and that part of the Zurich pedigree (Fig. 2) comprising offspring from the male Walo (Hki 8, transferred from the Helsinki Zoo to the Zurich Zoo) (Wahlberg et al. 1982) include eighteen MOC affected animals in total.

The first ancestors of the Helsinki pedigree, VILMA (Hki 1) and VILLE (Hki 2), were wildborn animals and trapped in 1964 and 1966, respectively. Their geographical descent is unknown. During the years 1967–1974 VILMA (Hki 1) and VILLE (Hki 2) produced seven litters totalling altogether 15 cubs. Ten of the cubs survived past the age of six months. In back-crosses between VILLE (Hki 2) and two of his daughters, VILKKU (Hki 3) and VÄLKKY (Hki 4), nine litters with altogether 19 cubs were born between 1971–1976. Of these cubs 13 survived past the age of six months. The first cub affected with MOC was VÄINÄMÖ (Hki 32). He was born in 1976 as a son of VILLE (Hki 2) and his daughter VÄLKKY (Hki 4). VÄLKKY (Hki 4) herself has a slight eye anomaly, described as a weakness in the structure of iris of the left eye leading to an assymmetrical pupil. This assymmetry is not considered as a symptom of MOC, although it was originally described as an iris coloboma (Wahlberg 1978).

In 1978 VÄLKKY (Hki 4) again gave birth to a male cub VASILI (Hki 48) with MOC. The sire, a related male VELLAMO (Hki 30), was born in 1976 as a son of VÄLKKY's sister VENLA (Hki 6) and CHARLIE (LPZ 9) from the Lincoln Park Zoo, Chicago. A second cub (Hki 49) in the same litter was found dead and partly eaten. The eye status of this cub is unknown.

During the years 1974–1981 VILKKU's (Hki 3) and VÄLKKY's (Hki 4) two sisters VENLA (Hki 6) and VALPURI (Hki 13) gave birth to eight litters comprising 21 cubs, 11 of which were affected with MOC. The sire was CHARLIE (LPZ 9) from Chicago. VALPURI (Hki 13) was later transferred to the Nettuno Zoo, Italy, where she produced a litter of two unaffected cubs.

In 1983 VENLA's (Hki 6) daughter VIENO (Hki 24) gave birth to a litter with three cubs, all affected with MOC. The sire was the unrelated KARA (Cin 6), born in the Cincinnati Zoo.

All MOC affected cubs were born after 1976. Before 1976 37 unaffected cubs were born in Helsinki Zoo. All cubs in the same litters have been either affected or unaffected; no litters consisted of both affected and unaffected cubs.

The mortality of snow leopard cubs in the zoos has been approximately 30 % during the last years (Blomqvist 1981). Some of the cubs have been stillborn, others, living at birth, have been killed and eaten by their mothers. Offspring of unknown sex represent cases where only parts of the legs or the tail have remained left in the den. The eye status of the early dead cubs is unknown.

The Helsinki pedigree of snow leopards has a total of 75 cubs born between 1967–1983. Of these, 50 survived the age of six months (mortality 33 %). Before 1980 only those young snow leopards, which reached the age of six months, were numbered and named. From 1980 on, all captive born cubs have been given their own numbers already at birth.

Methods

Clinical investigations of the eyes

Since 1976 all the snow leopards in the Helsinki Zoo have been examined ophthalmologically.

Animals over three months of age are sedated with a mixture of Xylatsin (Rompun®, Bayer) and Ketamin-chloride (Ketalar®, Park Davis) given intramuscularly. 500 mg Xylatsin is dissolved in 5 ml Ketalar® (100 mg/ml Ketaminchloride). The dose is approximately 0.07 ml of the mixture per kilogram body weight. Examinations of younger cubs is performed without sedation. The eyes were anaesthetised with Oxibuprocain HC1 (Oftan Obucain®, Star, 4 mg/ml). The external ocular examination is carried out with magnifying spectacles and spot light. Corneal diameters were measured, pupillary light reactions tested and the lids and anterior ocular structures inspected. Pupils are dilated with Tropicamid (Oftan Tropicamid®, Star 5 mg/ml). Opthalmoscopy is performed with direct as well as indirect methods.

The cubs born in the zoo are examined for the first time at approximately four weeks of age. The examination is repeated at least once at an age over three months.

A full pathological and anatomical examination of the eyes of all those animals that died or were euthanized has been performed at the Helsinki University Eye Hospital.

Analysis of the Helsinki pedigree

Possible genetic transmission of MOC was analysed assuming that a single-gene character was originally transmitted by either of the ancestors VILMA (Hki 1) or VILLE (Hki 2). It was also assumed that only the direct descendants of the ancestral couple in the present pedigree are allowed to carry the allele. It soon became evident that this hypothesis requires incomplete penetrance of the allele (Wahlberg and Tarkkanen 1980), but only rough approximations were used to estimate the penetrance for two reasons: 1) the number of cases was not large enough to allow reliable estimates, and 2) the segregation patterns suggested that the genetic assumptions underlying the penetrance estimates were not likely to be valid in this case.

The segregation patterns were tested using chi-square heterogeneity tests.

Chromosome examinations

Chromosome examinations were performed on twenty animals, twelve of which were healthy subjects. The unaffected animals are the males Hki 2, 38, 43, 44, 53, 54, 56 and Cin 6, and the females Hki 4 and 14, Zu 13 and Okla 18. The MOC affected males studied are Hki 35, 40 and 48. The affected females are Hki 36, 60 and 61, and two euthanized cubs, born in 1978.

The chromosomes were studied in selected metaphases obtained from blood cultures stimulated by pokeweed mitogen (Gibco), Bacto Phytohaemagglutinin P (Difco) or Concavalin A (Sigma).

Several band-staining methods were applied: G-, Q-, R-, C-banding and Ag-NOR stainings. On some slides subsequent G- (GAG) and C- (CBG) bandings were performed.

Serum protein investigations

For serum protein studies samples were collected from seventeen animals: Hki 4, 18, 34 (MOC), 41 (MOC), 43, 51, 52, 53, 54, 55, 56, 58, 59, 60 (MOC), 61 (MOC), Cin 6 and Zu 13. Of these animals Hki

43 is the only wild-born animal. The samples were subjected to routine serum electrophoresis in a agarose gel and stained with Coomassie Blue. All samples were run on the same gel.

Results

The eye findings in MOC individuals

The clinical findings in the sixteen affected animals belonging to the Helsinki pedigree are shown in Table 1.

The predominant symptom is the palpebral coloboma (Fig. 3). The appearance of the palpebral coloboma varies from a very small notch in the eyelid to a total absence of the margin of the outer lateral half of the upper lid. The palpebral lesion is found only on the upper lid and is always affecting its central and lateral portion. The lower lid and the medial half of the upper lid are never affected.

In four of the cases no changes were present in the eye globe (Hki 34, 36, 41 and 42).

One case (Ve 78/2) presents the complete MOC syndrome with all described symptoms occurring in one individual. A retinal dysplasia, one of the uncommon traits in MOC, is observed in three cases (Ve 78/1, Ve 78/2, see above, and Hki 46). Whether the retinal dysplasia is a sequela to the colobomatous changes, particularly the microphthalmia, or is considered to be a separate abnormality is not clear.

Fig. 3. A typical coloboma of the upper lid on a snow leopard with multiple ocular coloboma (VÄINÄMÖ, Hki 32, right eye). The arrows enclose the coloboma. The lower lid is normal. The corneal haze is also seen.

Results of the pedigree analysis

Assuming that MOC is affected by a single gene locus, recessiveness of the allele can be ruled out. This assumption would require that three individuals not descending from this pedigree (KARA (Cin

Table 1. The eye findings in the sixteen MOC affected snow leopards belonging to the Helsinki Zoo pedigree. *d, right eye; s, left eye*

Birth	Subject	Palpebr. Coloboma	Microph- thalmia	Cataract	Hyperpl. Vitroeous	Uveal Coloboma	Retinal Cyst	Retinal Dyspl.
1976	Hki 32	+	(+)	−	−	+	+	−
1978	Ve78/1	+	d++ s+++	+	+	+	+	+
1978	Ve78/2	+	+++	+	−	+	+	+
1978	Hki 34	+		−	−	−	−	−
1978	Hki 35	+	(+)	−	−	+	−	−
1978	Hki 36	d(+) s−	−	−	−	−	−	−
1979	Ve79/1	+	++	+	−	+	−	−
1979	Hki 40	+	(+)	−	−	+	−	−
1979	Hki 41	+	−	−	−	−	−	−
1979	Hki 42	d− s(+)	−	−	−	−	−	−
1981	Jki 45	d+ s−	d+ s −	−	−	−	−	−
1981	Hki 46	+	+	+	−	−	−	+
1981	Hki 48	+	+	+	−	−	−	−
1983	Hki 60	d− s+	−	−	−	−	−	−
1983	Hki 61	+	−	−	−	+(iris)	−	−
1983	Hki 62	d− s+	−	−	−	−	−	−

6), CHARLIE (LPZ 9) and ANDRA (Zu 2)) were carriers. Since MOC is also expressed in a male line (a son of WALO (HKI 8)), the possible inheritance pattern should be autosomal. Because MOC is commonly expressed in cubs of unaffected individuals, the possibility of a dominant allele with complete penetrance can further be eliminated. Thus the only hypothesis left is that of dominance with incomplete penetrance. It has to be assumed that either VILMA (Hki 1) or VILLE (Hki 2) has been heterozygous. Those individuals in the pedigree which must be heterozygous (if the hypothesis is correct), can be picked up on the basis of affected offspring. The expected frequency of heterozygous cubs in the outbred crossings of those parents is 0.5. Comparing this expectation with the observed frequency of affected offspring, after removing the index cases, the penetrance estimates are 0.41 (13 out of 32) assuming VILMA (Hki 1), or 0.36 (13 out of 36) assuming VILLE (Hki 2) to be the original carrier.

The above estimations and the assumptions based on them are undermined by the segregation patterns among and within the families. First, if the single-gene hypothesis with incomplete penetrance is correct, the penetrance has to be highly variable among families. The proportion of the affected offspring in the progenies of VILMA (Hki 1), VENLA (Hki 6) and WALO (Hki 8) differ significantly from each other ($\chi^2=11.8$, df=2, $P<0.01$). Second, the affected offspring show a clustered appearance within the families. This is best seen in the offspring of VENLA (Hki 6), the probability of complete yearly segregation of affected and unaffected cubs is very low ($P=0.00093$ using a randomization test with the observed progeny sizes and the probability 8/16=0.5 for coloboma).

Chromosome findings

The felids are well known for a rather unique karyotype characterized by conservative traits. The chromosome number is 38. Only a few species in the marginal borders of the original distribution area of the cats have only 36 chromosomes. The chromosomes are distributed in six classes A–F. A small metacentric satellited marker chromosome E1 is found in all felids as also in some other carnivores (Wurster-Hill and Gray 1975). Silver stained NOR regions are found only in the marker E1 (Fig. 4).

The G-banded karyotype of the snow leopard (Söderlund et al. 1980) (Fig. 4) shows numerous homologies with other felids. The karyotypes of the different cat species have as a rule been compared with the chromosomes of the domestic cat, *Felis domestica,* the karyotype of which has thus been used as the standard cat karyotype (Wurster-Hill and Gray 1973). The banded chromosomes in groups A, C and E are identical with the corresponding chromosomes of the domestic cat. Homology is also demonstrated in groups B (B1, B2 and B3), D (D1, D3 and D4) and F (one pair).

Differences from the standard cat karyotype have been found in *Panthera* (*Panthera leo, tigris, pardus* and *onca*) (Wurster-Hill and Gray 1973). The following changes have been observed: a pericentric inversion in B4, a small light region close to the centromere in D2p, the two F group chromosomes represent the pairs 2 and 3 of the three original F group pairs occurring in the karyotype of ancestors to presently living cat species. In the standard cat karyotype the F group is represented by the original felid chromosomes F1 and F2.

The karyotype of the snow leopard is principally identical with the karyotype of the other *Pantherae*, which fact confirms the close relationship between the snow leopard and the *Panthera* species.

Furthermore the snow leopard shows the same slightly pronounced negatively stained area in the paracentric region of A1p as is observed in the lion (Wurster-Hill and Gray 1973; Gripenberg et al. 1982).

The C-band pattern (Gripenberg et al. 1982 (Fig. 4) of the snow leopard shows large dark blocks on the sex chromosomes. The proximal parts of Xp and Xq have large C-bands, most of Yq is heavily stained. In many autosomes the C-bands, however, are small and dot-like (A1, B2, B3, B4, D group chromosomes, E1 and E3). On several autosomes C-bands are hardly discernible. The C-band pattern of the snow leopard is in agreement with the general felid C-band pattern (Pathak and Wurster-Hill 1977). Satellite DNA seems to be lacking in many cat species (Arrhigi et al. 1970).

The R-band pattern (Gripenberg et al. 1982) shows the expected reverse pattern of the G-band staining.

Comparing the chromosomes of unaffected snow leopards and animals with MOC, neither numerical nor structural differences could be observed.

Serum protein results

Transferrin, albumin, complement C3, and several other protein fractions likely to include Gc, Hp and $_1$AT are visible as monomorphic bands. No variant phenotypes have been observed. Also serum

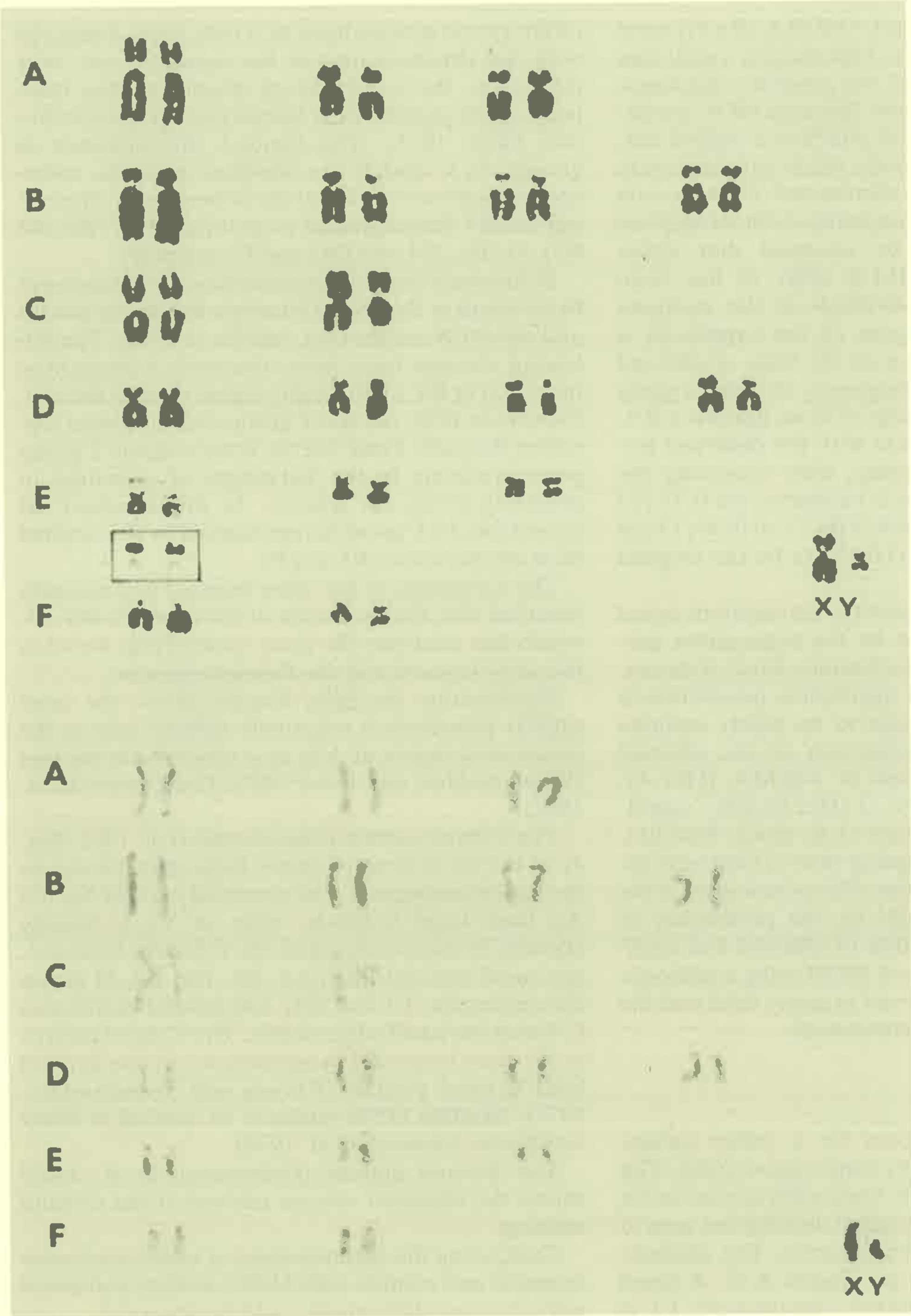

Fig. 4. G- and C-banded karyotypes of the snow leopard. Inserted the marker chromosome E1 with silver stained NOR's. 2n=38.

catalase shows no variants (ATROSHI, personal communication). In other words, there is no evidence of electrophoretically detectable variation in the snow leopards studied so far.

Discussion

Before we are going to discuss the findings associated with MOC we would like to make some remarks in connection with the karyotype findings of the snow leopards.

The snow leopard is a species detected late in the history. The first descriptions are from the end of the eighteenth century (RIEGER 1980). Taxonomically the position of the snow leopard seems obscure. In the English literature the snow leopard mainly is called *Panthera uncia* while German authors often use the name *Uncia uncia*. Formerly the snow leopard was referred to the genus *Felis* and accordingly named *Felis uncia*.

The karyotype of the snow leopard has the same characteristics as the chromosomes of the four species generally accepted to belong to the genus *Panthera* (lion, tiger, leopard and jaguar). The chromosomal similarities seem thus to justify the genus name *Panthera* for the snow leopard.

Also other cat species have taxonomically dubious positions in the system. It seems that previous (WURSTER-HILL and MERITT 1974) and more recent (GRIPENBERG et al. 1982) chromosome findings in different cat species could be useful in a possible future revision of the systematics in *Felidae*.

The eye anomaly MOC in the snow leopard deserves special interest for several reasons. The combination of eye coloboma together with coloboma of the upper lid seems obscure since the affected tissues have different origin: the eye tissues are of neuroectodermal origin whereas the lids have developed from the mesoderm. Furthermore the two structures develop at different stages during the embryonic development. Thus the etiology of this entity seems confusing.

As already mentioned nothing is known about the occurrence of MOC, cub mortality or the causes of the deaths in the wild population.

The understanding of the causes of MOC in the captive animals is most urgent. If hereditary, the breeding of affected animals of an endangered species with a small gene pool would rapidly disseminate the deleterious gene through the zoo populations.

The analysis of the Helsinki pedigree showed that MOC is probably not transmitted by simple genetic rules. The first case in Helsinki resulted from a father-daughter crossing (see above) but later cases do not indicate that MOC would follow from inbreeding (WAHLBERG et al. 1982). The tight clustering of the affected offspring from the same parents speaks against purely genetic effects. The same holds for the hypothesis that the malformation would depend either on the maternal genotype or on inbreeding depression of nonspecific allelic effects. The available evidence strongly points to nongenetic maternal influence, or some other external factor which affects all the embryos similarly.

Serological tests have so far not been able to confirm the involvement of any viruses as the cause of MOC, nor have investigations of toxic agents given evidence as to the etiology of MOC (WAHLBERG and TARKKANEN 1980).

The serum proteins showed no differences between any of the individuals examined, indicating high homozygosity in the zoo animals. This should not be taken as an evidence for genetic impoverishment in the zoo population, because low levels of genic variation are commonly found in large mammals (NEVO et al. 1984). It has to be stressed that protein polymorphism in wild snow leopard populations has not been studied.

The chromosome investigations revealed identical karyotypes in affected and unaffected animals. No numerical or structural differences could be observed. Our opinion is that a chromosomal abnormality most probably is not the cause of this congenital eye anomaly. Analyses of prolonged chromosomes have, however, not yet been performed. A change in some minute parts of a chromosome can thus not be fully excluded.

The investigations here presented have not been able to explain the causes of MOC.

Reports on the occurrence of other familial anomalies, possibly observed but not published because of an unsolved etiology, would be highly desirable.

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ZOO STANDARDS FOR KEEPING SMALL FELIDS IN CAPTIVITY

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INTRODUCTION

The family Felidae is one of the most diverse groups of carnivores, and includes species that range in size from 1 kg (2.2 lb) to over 500 lb (230 kg). Small cats are defined here as those felids having an adult body weight of less than 20 kg (44 lb (Emmons, 1991, p.62). In most "small" felids, a group that covers 29 species, males are larger than females. This group excludes lions, tigers, leopards, snow leopards, and jaguars, *Panthera sp.*; cheetah, *Acinonyx jubatus*; clouded leopard, *Neofelis nebulosa*; and puma, *Felis concolor.*

In the wild, all species of small cats are more or less solitary, i.e. intolerant toward adults of the same sex, and exhibit a spatially and temporally dispersed social system (Bekoff, Daniels, and Gittleman, 1984). Most species predominate in woodland and woodland fringe terrain although some species may be found in nearly all terrestrial habitat types. While larger species function at or near the top of the trophic level, many small cats also serve as prey for other carnivores. Larger felids, tigers, lions, leopards, etc., also procure substantially sized prey and typically eat only once in several days; many smaller species take rodents and small birds and must hunt and eat several times per day.

HUSBANDRY

Minimum size specifications - Minimum recommended enclosure size is based upon two weight categories of the cats, those under 10 kg (22 lb and those ranging from 10-20 kg (22-44 lb) (see Table 1). Recommended minimum space **per cat** is as follows:

<10 kg = 6.5 x 6.5 x 8 ft (2 x 2 x 2.5 m) per cat (l x w x h)

<20 kg = 13 x 6.5 x 8 ft (4 x 2 x 2.5 m) per cat (l x w x h)

Floor space should be increased by 50% for each additional cat. Terrestrial species should have more floor space allocated than arboreal ones. Table 1 lists which cats are terrestrial; the above dimensions can be adjusted accordingly.

Enclosure contents - More important than an enclosure's size is its complexity and usability. Care should be taken to allow cats to utilize the vertical component of an enclosure by providing aerial pathways. Cats should have access to at least 75% of the enclosure's vertical space. Furthermore, small cats seem to prefer perching platforms at or near the top of their enclosure, a place from which they can "hide" and peer out. They also prefer localized heated areas. Durable plastic materials as well as wood make good platforms/shelves for cats. Small cats also require logs upon which they can "sharpen" their claws. Rotting logs exposed to the elements further stimulate clawing activity.

Each enclosure should include at least one visual barrier for a cat to completely hide behind. Each cat also needs a den or secure area that can be defended against a cagemate.

Shift or secondary holding areas are strongly recommended in order to safely move animals from their primary enclosure for cleaning, feeding, and medical procedures. There should be one holding cage for each cat. For cats weighing less that 10 kg (22 lb), each shift areas should be no less than 2 feet (.61 m) high with minimum of 6 square feet (0.6 m2). For cats weighing 10-20 kg (22-44 lb), each shift area should be no less than 3 feet (1 m) high with a minimum of 10 square feet (1 m2).

GENERAL REQUIREMENTS

Temperature - Temperature extremes should not exceed those of the cats' respective native habitats. Each cat should be able to move to an area protected from wind, rain and direct sunlight. Heat pads can provide additional sources of heat for cats housed outside; appropriate placement of heat pads can encourage the cats to stay in public view. Cats housed continuously outdoors should each be provided with a den designed to protect the cat from the elements and temperature extremes.

Some tropical species of small cats as well as temperate ones can tolerate a fairly wide range of temperatures but it is necessary to acclimate them slowly to lower temperature ranges. Where indoor temperatures exceed 85 degrees F (29 degrees C), a ventilation system must be used.

Lighting - Sufficient lighting (approx. 100 foot candles at 10 feet (3 meters) should exist in indoor enclosures to permit routine cleaning, but more subdued light levels (20-30 foot candles) are recommended for exhibition purposes [**There is some suggestion that cats maintained indoors should be kept under full spectrum light but this is not substantiated.**] The majority of small cats are thought to be nocturnal in the wild and as a result, numerous zoos exhibit cats under a reverse day/night light cycle. Regardless, there are no data to suggest that reverse cycles increases the activity of the cats. In fact, small cats seem more attuned to the noises and activities of staff than to light levels.

Ventilation - Indoor housing should be well ventilated in order to minimize drafts, odors, dust, and moisture condensation. There should be 8-10 complete changes of non-recirculated air per

hour, and with a 15-40% intake of fresh air. If possible, separate circulating systems for each indoor cat enclosures should be available to reduce the risk of disease transference.

Water - Fresh clean water should be available at all times. Water bowls should be cleaned and disinfected daily. Some species routinely defecate in water bowls. This behavior is difficult to discourage. Elevating water bowls 6-12 inches above the ground sometimes discourages this behavior. Automatic watering devices may be used for some cats.

Sanitation. Hard surfaces of primary enclosures, food con-tainers, and water bowls should be cleaned and disinfected daily. Perches and shelves where animals climb, sit, and rest should also be kept free of feces and urine but it may not be necessary to clean them daily. Dirt substrates in outdoor planted exhibits should be raked and spot-cleaned daily. Footbaths should be used prior to entering and exiting all felid enclosures, or areas containing enclosures. Each should be filled with a disinfectant and its use strictly adhered to by all personnel. Appropriate controls for vermin infestation should be maintained.

Nutrition - The nutritional needs of small felids is well under-stood and the following summary by Mary Allen is offered (from Wildt, Mellen and Seal, 1992, pp 24-25).

"In general, wild felids share the same nutritional requirements as the domestic cat, although there is evidence that some species differ with respect to selected nutrients. Nonetheless, from a comparative perspective, wild felids are relatively easy to maintain nutritionally. The advent of commercially-prepared, nutritionally complete diets have alleviated earlier reports of bone disease, common when cats were solely fed muscle or organ meats. Although well-balanced, these frozen meat-based products have several inherent problems. First, Vitamin A is present in exceptionally high concentrations. The domestic cat requires fewer than 10,000 (IU)/kilogram (kg) of dry matter (DM). Some commercial preparations contain 48,000 IU/kg DM. These is some evidence that liver damage in the cheetah may be related to excessive dietary intake of vitamin A. Because these products are well-fortified with other micronutrients, additional vitamins and minerals should not be supplemented. Secondly, fat content in these products usually is in excess of 35% DM. Obesity in zoo-maintained cats may be due, in part, to excessive dietary intake of fat contained with insufficient physical activity. Third, these foods are typically soft when thawed. Soft diet consistency may contribute to poor oral health. Evidence suggests that feeding bones with meat attached, 2 days/week, may help provide physical stimulation to teeth and gums. The provision of small, whole vertebrate prey (mice, rats, rabbits) twice/week will provide similar benefits to small-sized cats. And lastly, these meat-based diets are highly subject to spoilage. Thawing under refrigeration and delivery in insulated containers will check the growth of potentially harmful microbes. Other methods of feeding also can present problems. For example, it is well-recognized that leopard cats fed a specific canned felid diet (formulated to meet domestic cat requirements), developed severe optic problems eventually traced to a taurine deficiency. In cases where muscle or organ meat comprises the bulk of the diet (for instance in institutions with performing cats"), vitamin and mineral deficiencies can occur.

Based upon present knowledge, it can be concluded that inadequate nutrition does not appear to be affecting the health or reproductive fitness of most wild felids in captivity. Nonetheless, there are serious recommendations to be made, all of which should be adhered to at the institu-tional level. These include:

1. offering vitamin and mineral supplements only if the bulk of the diet consists of muscle or organ meats (appropriate types and amounts of supplements include 2 kg muscle [horsemeat], 15 g of steamed bonemeal and 1 Centrum @ tablet [vitamin/mineral source]).

2. providing detailed instruction to keepers as to the proper thawing, delivery and handling of foods highly subject to spoilage.

3. instituting a system for occasionally changing the diet and maintaining detailed records and dietary histories.

4. considering the regular use of a whole prey and/or bones with meat attached both for oral health and to stimulate natural eating behaviors."

Traditionally, captive felids have been fasted one day per week. While this method may be appropriate for larger cats, it is inappropriate for smaller felids. Fast days are NOT recommended for cats under 10 kg (22 lb).

VETERINARY CARE

Quarantine - Small felids are especially susceptible to diseases of the domestic cat and all newly arrived felids should be quarantined at least 30 days prior to entering the collection area. For cats originating from the wild or a range country source, the quarantine period should be extended. Beyond basic tests (CBC, serum chemistry panel, serum banking, and physical exam), serology testing for Feline Immunodeficiency Virus (FIV), Feline Infectious Peritonitis (FIP), Feline Leukemia Virus (FeLV), and Toxoplasmosis should be completed before the animal is mixed with other specimens. Three negative fecal checks should be completed, and the animal treated for external parasites (fleas, ticks, ear mites, etc.), if present.

Vaccinations - Adult felids should receive annual vaccinations against feline distemper (panleukopenia), rhinotracheitis, and calicivirus (FVRCP), semi-annually if practical. Killed products are best. They should also receive prophylaxis against rabies, annually or at three year intervals, depending on the product used. Only killed rabies vaccines should be used for cats. In areas where tetanus is endemic, felids should be vaccinated for this disease on an annual basis. Felids are also susceptible to non-specific diseases such as tuberculosis.

Kittens should be vaccinated with killed (FVRCP) (Fel-o-vax) vaccine at 6-8 weeks, and receive a series of four immunizations every three weeks as well as when six and 12 months old. Young should also be given rabies vaccine at 4-6 months if a risk of exposure is present.

Fecal exams - A minimum of two fecal examinations are recommended per year, and appropriate parasite therapy instituted as necessary.

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Table 1. Weights of small cats (after Sunquist, 1991)

Cats weighing <10 kg

Cats weighing 10 - 20 kg

Genus Species	Common Name	Wt (lb)	Wt (kg)	Habits
Prionailurus rubiginosa	Rusty-spotted cat	2.2	1.0	arboreal
Prionailurus planiceps	Flat-headed cat	3.4-4.5	1.6-2.1	terrestrial
Felis nigripes	Black-footed cat	3.3-5.5	1.5-2.5	terrestrial
Oncifelis guigna	Kodkod	4.5-5.5	2.1-2.5	terrestrial
Leopardus tigrina	Oncilla/tiger cat	3.8-6.0	1.8-2.8	arboreal
Felis margarita	Sand cat	4.5-6.5	2.0-3.0	terrestrial
Otocolobus manul	Pallas' cat	5.5-7.8	2.5-3.5	both
Felis catus	Domestic cat	6.5-8.8	3.5-4.0	terrestrial
Leopardus wiedii	Margay	5.5-8.8	2.4-4.0	arboreal
Pardofelis marmorata	Marbled cat	4.5-11.0	2.0-5.0	arboreal
Oncifelis geoffroyi	Geoffroy's cat	4.5-13.3	2.0-6.0	arboreal
Herpailurus yagouroundi	Jaguarundi	6.5-13.3	3.0-6.0	terrestrial
Oncifelis colocolo	Pampas cat	7.0-14.0	3.2-6.4	terrestrial
Prionailurus bengalensis	Leopard cat	6.5-15.5	3.0-7.0	both
Felis silvestris	Wildcat	6.5-17.5	3.0-8.0	terrestrial
Oreailurus jacobita	Mountain cat	8.85	4.0	
Lynx canadensis	Canadian lynx	19-22	8-10	terrestrial
Lynx rufus	Bobcat	15-22	7-10	both
Profelis aurata	African golden cat	11-27	5-12	terrestrial
Lynx pardinus	Spainish lynx	26-28	12-13	terrestrial
Prionailurus viverrina	Fishing cat	13-30	6-13	terrestrial
Leopardus pardalis	Ocelot	15-29	7-13	both
Catopuma temmincki	Asian golden cat	27-33	12-15	terrestrial
Caracal caracal	Caracal	24-33	11-15	terrestrial
Felis chaus	Jungle cat	9-35	4-16	terrestrial
Leptailurus serval	Serval	18-40	8-18	terrestrial
Lynx lynx	Eurasian lynx	37-44	17-20	terrestrial

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