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Cover Photos:
Clockwise from top-right:
• Ian Stringer on Mariwhenua Island, New Zealand site for beetle and weevil capture.
• Released Arabian oryx in Umm Al Zammoul, UAE @ Mayas Al Quarqaz
• Close up of a Takahe feather, New Zealand @ Glen Greaves
• Bearded vulture in Spain
• Siamese crocodiles being checked with a microchip reader before release in Thailand
• Channel Island fox, USA with snake @ Tim Coonan
Center of page:
• Releasing teal on Campbell Island, New Zealand @ Helen Gummer

The views expressed in RE-INTRODUCTION NEWS may not necessarily be those of the IUCN/SSC Re-introduction Specialist Group, IUCN-The World Conservation Union, Environment Agency-Abu Dhabi and Denver Zoological Foundation.
## CONTENTS

### GENERAL ISSUES
- 1st International Wildlife Re-introduction Conference, USA 2008 .......................................................... 5
- Symposium on Science & Management of Avian Translocations & Conservation ........................................... 5
- Release & re-introduction efforts in Indochina ........................................................................................................ 5
- Veterinary aspects of re-introductions .................................................................................................................. 7

### INVERTEBRATES
- Experimental introductions of Roesel’s bush cricket, Sweden ........................................................................... 9
- Update on UK Species Recovery Program for field cricket .................................................................................. 11
- Translocation of snails, beetles & Weevils to Lady Alice, Hen & Chicken Island, New Zealand ....................... 12

### FISH
- Re-introduction of Adriatic sturgeon, Ticino River, Italy ..................................................................................... 14

### BIRDS
- Species re-introduction as a tool for conservation of takahe, New Zealand ......................................................... 16
- Update on Wattled Crane Recovery Program, South Africa .................................................................................. 17
- Re-introduction planning for bearded vulture, Picos de Europa National Park, Northern Spain ....................... 19
- Re-introduction of Campbell Island teal, New Zealand .......................................................................................... 19
- Houbara re-introduction, Kingdom of Saudi Arabia ............................................................................................. 21
- Hawaiian Maui parrotbill re-introduction planning for the future ......................................................................... 23
- Ospreys over Michigan, USA ................................................................................................................................. 25

### Dummy transmitters for pre-release acclimation of captive-reared birds ......................................................... 28

### MAMMALS
- Recovery efforts for the Vancouver Island marmot, Canada .................................................................................. 30
- Florida panther re-introduction, Florida, USA ......................................................................................................... 32
- Re-introducing swift fox to Blackfeet Tribal Lands, Montana, USA ................................................................. 34
- Re-introduction & conservation of Channel Island foxes, California, USA .......................................................... 35
- Re-introductions & translocations of large mammals in Southern Africa .............................................................. 38
- Behavioral modification in metapopulation management of black rhino, Southern Africa .................................. 41
- Twelve years of mammal re-introduction & introductions by the Australian Wildlife Conservancy .................. 43
- Governmental role in non-human Primate re-introductions in Nigeria ............................................................... 45
- Gibbon rehabilitation project, Thailand .................................................................................................................. 48
- Arabian oryx release, Abu Dhabi Emirate, UAE ...................................................................................................... 49
- Arabian oryx re-introduction program, Saudi Arabia ............................................................................................. 51

### REPTILES
- Turks & Caicos iguana translocation, Bahamas Archipelago ................................................................................. 53
- Re-introduction of Siamese crocodiles, Thailand .................................................................................................... 55
- Re-introduction of American Alligators, Louisiana, USA ....................................................................................... 57
Letter from the Chairman — Dr. Frédéric J. Launay

At a time when a power point presentation (a well done one!) is winning an oscar and the issue of climate change is finally reaching a large audience, it might seems appropriate to reflect on the adequacy and purpose of re-introductions as a long-term conservation tool.

Climate change, and its range of effects, will no doubt affect species worldwide, it is likely that distribution range will change (decrease or increase), physiology and behavior might be affected, habitats will disappear (or in some case appear), species interaction might change and many more effects could be envisaged.

In any case the impact of climate change on species is likely to become one of the key research areas for conservationists worldwide. Very interesting areas for research and study will be the effects on and possible solutions for plants. With a greater understanding of the possible effects, the needs to develop solutions for the species at risk will increase.

It is very likely that species re-introduction and or translocation will increasingly be applied as a response to climate change and it is urgent that re-introduction practitioners and conservationists start looking at the multiple consequences, opportunities and challenges that this situation will represent in the near future.

Species re-introduction and/or translocation are already largely used as conservation tools. In this issue alone, re-introduction projects on more than twenty-three species of invertebrates, reptiles, fish, mammals and birds are being described. I could foresee the use of re-introduction / translocation as conservation solutions as a response to climate change is likely to increase sharply in the near future.

I would encourage all RSG members to include climate change issues and problematic is their planning, experiments and research priorities.
GENERAL ISSUES

1st International Wildlife Re-introduction Conference
Applying science to conservation

Co-hosted by IUCN Reintroduction Specialist Group (RSG) and Lincoln Park Zoo from 14th–16th April 2008, Lincoln Park Zoo, Chicago, Illinois, U.S.A.

Presentations will include topics on experimental design and adaptive management, captive born animals and behavioral issues, disease, use of RSG guidelines, and methodological tools (computer modeling, GIS, stress and genetic analysis, and techniques for post-release monitoring). Speakers will be invited to give their most current research and will be selected by a review committee from contributed proposals. Information on the process for proposal review will be posted in March 2007. Information on registration will be available in March 2007.

Conference coordinators:
- Joanne Earnhardt, Director, Alexander Center for Applied Population Biology, Department of Conservation and Science, Lincoln Park Zoo, Chicago, IL, USA (email: JEarnhardt@lpzoo.org)
- Devra Kleinman, Ph. D., Zoo-Logic, LLC, Chevy Chase, MD, USA (email: Dgkleiman@aol.com)
- Frederic Launay, Ph.D., Chair, IUCN/SSC Reintroduction Specialist Group, Abu Dhabi, UAE (email: FLaunay@ead.ea)

A Symposium on the Science and Management of Avian Translocations for Conservation

Hosted by the Zoological Society of London from 8th-9th May 2008, London, UK

Invited speakers will present their expert opinions on a range of topics that encompass current priorities in conservation translocations. Our aims are to bring wildlife ecologists, population modelers, geneticists, animal husbandry professionals and veterinarians together in order to discuss their contributions to translocation. This broad expertise base often results in differing and sometimes conflicting, goals and approaches. There is a desperate need to coordinate our thinking across these disciplines to promote a stronger knowledge base for more efficient and ideally more successful conservation translocations in the future.

Organizers:
- John Ewen, Institute of Zoology, United Kingdom (email: john.ewen@ioz.ac.uk)
- Doug Armstrong, Massey University, New Zealand & Oceania Section Chair of the IUCN/SSC Reintroduction Specialist Group (email: D.P.Armstrong@massey.ac.nz)
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- Phillip Seddon, University of Otago, New Zealand & Bird Section Chair of IUCN/SSC Re-introduction Specialist Group. (email:philip.seddon@stonebow.otago.ac.nz)

Release and re-introduction efforts in Indochina

The release of wild animals is becoming increasingly common in Indochina. Adjacent to the wildlife consuming market of China, Indochina is the centre of the wildlife trade. Aside from a small national market, wildlife is traded in large quantities to the northeast to be used as specialty foods, in traditional medicines or as pets (Compton & Le, 1998). All the countries have laws to protect their wildlife and with support from international organizations have in recent years started to address the wildlife trade supported by international organizations. Animals are confiscated as single individuals or in large shipments, but the disposal of the confiscated animals remains a problem. Conservation considerations often suggest culling as the most cost effective solution, but for religious, cultural or political reasons this is not well accepted. Authorities and the public lack the ecological overview to understand the necessity of culling for a larger conservation benefit. Rescue centers have been established to house confiscated wildlife, but they only postpone the problem. Soon they reach their maximum capacity and the question of the disposal occurs again. Release of the animals is considered the ultimate solution. The following gives an overview about projects planning or conducting releases and re-introductions in Indochina as far as information could be obtained:

Vietnam

1) Official releases of confiscated wildlife through Forest Protection bodies: The release of confiscated wildlife is common. Animals are released without prior health checks or quarantine, occasionally without proper species identification. Sometimes the animals are released in tourism destinations as an additional attraction. This has led to the establishment of invasive macaque populations in various protected areas. Public health and security issues are also insufficiently addressed as with the release of sun bears (Helarctos malayanus) into Cat Tien National Park without health screening, quarantine or monitoring after being held in captivity for many months. The Conservation Division in the Forest Protection Department in the Ministry of Rural Development and Agriculture is aware of the problem, but releases are usually decided at a provincial level.

2) Endangered Primate Rescue Center: The centre was established by the Forest Protection Department, Frankfurt Zoological Society and Cuc Phuong National Park for the rescue, captive breeding and re-introduction of confiscated endangered primates. A study on the re-introduction of pygmy lorisises (Nycticebus pygmaeus) has been conducted at the centre and several pygmy lorisises have been released into Cuc Phuong National Park. The project has recently started to prepare the re-introduction of Hatinh langurs (Trachypithecus latum hatinhensis) in Phong Nha-Ke Bang National Park (Nadler & Streicher,
2003). First animals will be transferred to a semi-wild (rehabilitation) enclosure at the release site by the end of 2007. Thorough veterinary protocols are implemented and field surveys, captive studies, habitat protection programs and educational activities are other components of the re-introduction project.

3) Hanoi Rescue Center Soc Son: This governmental facility near Hanoi was established to receive all confiscated wildlife. From here animals have been released into nearby protected areas without quarantine and health screening protocols. Species are often incorrectly identified and animals have been released far from their distribution range. The administration has recently changed and there are improvements. But the placement of the confiscated animals remains a problem.

4) Small Carnivore Conservation Program/Owston’s Civet Conservation Program: This project was established at Cuc Phuong National Park to improve the conservation of small carnivores in Vietnam. Re-introduction efforts have thus far been limited to the monitored release of two captive bred Owston’s civets (Chrotogale owstoni). A future focus is the rescue, care, rehabilitation and monitored release of all rare small carnivores confiscated from the illegal trade and the development of general protocols for their rehabilitation in Vietnam.

5) Turtle Conservation Center: The Turtle Conservation Center at Cuc Phuong National Park focuses on conservation of Vietnamese turtles through education, captive breeding, research, re-introduction and release. The centre assists the authorities with the confiscation of large numbers of turtles and provides quarantine facilities, makes the necessary administrative arrangements for the release and provides funding and expertise to conduct the release. A monitored release of Pyxideia mouhoti, the species native to Cuc Phuong, has been undertaken to determine survivorship of released animals.

6) Animal Rescue and Release Centre Pu Mat National Park: In 2001 the Social Forestry and Nature Conservation Project in Nghe An Province set up a small animal holding facility at Pu Mat National Park, the Animal Rescue and Release Centre, to receive and quarantine wildlife confiscated in the surrounding of Pu Mat National Park. Staff was trained in animal husbandry and veterinary care and specific protocols for confiscated animals were developed. After a time of quarantine animals are released or transferred to a long-term facility.

7) Siamese Crocodile Re-introduction Project: Within the WWF Cat Tien National Park Conservation Project ten genetically identified purebred Siamese crocodiles (Crocodylus siamensis) from a South Vietnamese commercial crocodile farm have been released in an area where this species has been extinguished. A monitoring program has been established and meanwhile breeding has occurred.

8) Animal Rescue and Release Centre Phong Nha - Ke Bang National Park: This facility was established by Phong Nha-Ke Bang National Park with advice and financial assistance from Cologne Zoo. Animals confiscated in and around the National Park are treated, quarantined, and then released into the park. Animals unsuitable for release are transferred to a long-term holding facility.

9) Cu Chi Center: The Ho Chi Minh based organization Wildlife at Risk in cooperation with the forest protection authorities has recently established a facility for the rescue and quarantine of confiscated wildlife at Cu Chi. It is hoped that the presence of the centre will help to prevent the random release into the neighboring national parks.

10) Asian Pangolin Conservation Program: A program for pangolins (Manis spp.) was started in 2006 at Cuc Phuong National Park and releases are planned for the near future, because it seems impossible to cope with the number of confiscated pangolins in a captive solution.

Cambodia

1) WildAid - Care for Rescued Wildlife Project: Wildlife Rapid Response Teams confiscate illegally kept and traded wildlife. Confiscated animals which have been in captivity for only a short period of time are potential candidates for release. Animals inappropriate for release are taken to Phnom Tmao Wildlife Rescue Center at Phnom Tmao Protected Forest. Leopard cats (Prionailurus bengalensis), civets (Paradoxurus hermaphroditus), mongooses (Herpestes javanicus), long tailed macaques (Macaca fascicularis), muntjac (Muntiacus muntjak), sambar (Cervus unicolor) and various bird species have been soft released here and the release of slow lorises (Nycticebus bengalensis) and jackals (Canis aureus) is in preparation. Released animals are monitored visually or by radio tracking. But for many species Phnom Tmao Protected Forest is not suitable as release site and surveys are being conducted to establish additional sites in other parts of the country. If suitable areas are identified, pig tailed macaques (Macaca nemestrina), pileated gibbons (Hylobates pileatus), slow lorises, jackals and binturongs (Arctictis binturong) might be released in the future following health checks, behavioral assessments and rehabilitation in large enclosures.

2) Conservation International Cardamom Mountain Project: Wildlife is occasionally confiscated by rangers. Such animals are immediately released back into suitable appearing habitats.

Laos

1) Wildlife Conservation Society Wildlife Trade Program: Addresses wildlife trade issues in the country’s capital Vientiane. When deciding on the placement of confiscated animals, the IUCN decision tree has been adjusted to local requirements and animals are released according to this protocol.

2) Watershed Management and Protection Authority at Nakai-Nam Theun Protected Area: This authority occasionally confiscates wildlife and immediately releases it into suitable appearing habitats. The development of locally appropriate guidelines is planned.

3) The Gibbon Experience: An NGO operating an eco and wildlife tourism facility in Northern Laos, has over the years released a number of wild animals including civets.
and macaques and one black gibbon (*Nomascus concolor*) in the protected area, where the project is located. The monitored release of an Asiatic black bear (*Selenarctos thibetanus*) is planned.

**Review and Discussion**

Re-introductions and releases of wild animals are numerous and include a wide array of species. It appears that more species specific projects as for example the Endangered Primate Rescue Center, the Owston's Civet Conservation Program or the Siamese Crocodile Re-introduction Project are prepared to spend much more resources on re-introductions. But these projects work only with one or with a limited range of species, receive few animals and are under little pressure to look into placement options. Re-introduction can be properly prepared and monitored and conducted closely along IUCN guidelines. Such re-introduction efforts should be supported. With the shrinking and increasingly fragmented populations they might soon become vital for the survivorship of some species in the region.

In all three countries some releases are conducted by projects or authorities, which are confronted with confiscated animals without having any logistics to deal with them. There might be awareness on the IUCN guidelines and the potential problems of such releases, but unwilling and unable to cull for political, religious and cultural reasons and lacking another placement option, confiscated animals are released. There is no adequate preparation, quarantine or monitoring. Many of these releases remain undocumented. Release sites are not necessarily suitable. It is unknown if the released animals survive, and what impact they have on the resident wild animal populations. These efforts must be reviewed and protocols for such releases developed as done for example by the WCS program in Laos. Releases should be monitored wherever possible since even if they fail they might yield important results. And authorities must be trained to understand that in some cases culling is inevitable.

Finally there are the rescue centers caring for a wide range of species. They receive large numbers of animals and in order to cope with the number of incoming animals they look into options to return animals to the wild. These projects often strive to implement IUCN guidelines but the finances for release are limited and this leads to limitations concerning the knowledge on the ecology of the release site, the released species' ecology or the health screening and monitoring and many of these releases remain undocumented. Projects are usually aware that the released animals have a compromised chance for survival, but since there are no captive options, release is still considered the most sensible option. More financial and personal capacity should be made available for the release including adequate monitoring and documentation.

The forests in Indochina are increasingly empty. At the same time rescue centers in the area are packed to their operational limits with confiscated wildlife. Releases and re-introductions of species can not easily be dismissed as an option in particular since they are popular with the governments in these countries. Conducted in a responsible manner releases could be beneficial. They could serve to re-enforce small populations and to link fragmented populations. In addition there is a different sense of ownership for released animals than for anonymous animals in the wild and when protection is enforced to protect the released animals, wild animals inevitable benefit. And finally, releases provide a focus for education work.

But at present political considerations, the lack of capacity and funding compromise re-introductions. However there is also a lack of communication. The failure rate occurring in a re-introduction is not accepted well by authorities and international projects operate in a glass house, depending on a good publicity. Releases too often remain undocumented. The lack of monitoring and publication prevents a learning process and consequently any much needed improvement. At the moment releases might often be the only politically and culturally accepted option, and by not documenting and publishing the ongoing efforts we miss out on the only tool we have to gradually change attitudes towards a more ecologically oriented point of view.

**References**


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**The veterinary aspects of re-introductions**

The risks associated with the translocation of animals from one location to another are typically assessed on contemporary issues of natural history and economics; for example, predator avoidance, management of key threatening processes, and/or cost-benefit analyses. Until recently, disease surveillance and monitoring in recovery and re-introduction programs for rare species have not been given due priority because of a lack of awareness or little consideration of the target species to disease risks. The importance of pathogens to wild animal conservation, including translocations, is now being recognized (MacDonald & Laurenson, 2006).

Detecting potential pathogens, or diagnosing disease, are fundamental to interpreting the health of a population, and to managing (and substantially reducing) the risk in...
advances. Indeed, reports of disease outbreaks are typically ad hoc and have been often retrospective following significant mortality events in populations. The World Organization for Animal Health and the IUCN both recommend that disease risk be established for wild and domestic animals at any release or destination ecosystem to ensure there is no ecological or economic impact of an introduced disease (Woodford, 2001). Translocated animals may be particularly vulnerable because of a lack of acquired immunity from previous exposure, and stress-induced immunosuppression that may come from their handling and transport. However, for most species of conservation concern, the baseline data required to determine which agents to monitor are often lacking.

Information on the health status of individuals provides conservation practitioners with a baseline dataset that can be as important as the translocation event itself. A screening program related to wildlife translocations or reintroductions has three functions: the first is to protect the recipient population from new pathogens, the second is to be aware of the stress-induced risks to the individuals being moved, and the third is to establish the risks to the founder group from pathogens endemic in the recipient population. If future changes are detected in the diversity or prevalence of microflora and potential pathogens among a captive or released population, or in the general health of the animals, reference to databases holding information on previous health records can be an invaluable tool for disease assessment. Furthermore, where screening for pathogens has occurred as part of a translocation project, the precautionary principle can be applied using evidence-based approaches to minimize the risks of transfers of potential pathogens. The effects of contagious disease may be particularly exacerbated in captive animals where space is a limiting factor, and where husbandry practices may elevate risk of transfer. There is also a potential to lose endemic parasite assemblages in captive species, which may be important for the host to maintain immunity (at the individual level) or genetic diversity (at the population level).

In a recent study on marsupial dibblers (Parantechinus apicalis) in Australia (Mathews et al., 2006), individuals were screened at source, captive, and release sites to establish a baseline set of information for intestinal microflora at each location (see photo 1). House mice (Mus domesticus), an introduced species at the source location, were in high densities and it was also of interest to learn whether mouse parasites were being transferred to the marsupials. Diagnosis of infection was made non-invasively by direct microscopy and bacterial culture of faecal pellets. Results showed that even routine surveillance can provide informative data; the investigation could report on the diversity of faecal flora in each species at each location, and we found that the prevalence of faecal taxa was highest among animals held in captivity. Importantly, there was no evidence for Cryptosporidium or Giardia in sampled individuals, although there was evidence for the known pathogen Bacillus cereus, indicating its presence should be monitored in this species in future.

Longitudinal studies reveal additional information about the health and survivorship of individuals that can be otherwise unknown from one-off studies. These studies significantly improve our understanding of survivorship during post-release monitoring following re-introduction events. For an introduction of water voles (Arvicola terrestris) to newly-restored wetlands in the UK (Mathews et al., 2006), samples of tracheal aspirates, blood, and urine, together with body condition index, were collected from all individuals involved in the translocation and screened for several parasites and pathogens in order to develop a database of information for these individuals (see photo 2). Survivorship of released individuals was related to blood parameters (haematocrit, haemoglobin, erythrocyte counts), and bacteria of zoonotic potential (Cryptosporidium and Mycobacterium bovis) were both found in several of the voles screened. One individual, infected with the enteric pathogen Yersinia enterocolitica, was withheld from future release.

Conservation practitioners involved in wildlife re-introduction projects would benefit if they maintained a vigilant health assessment of individuals, including information on clinical and non-clinical (e.g. body condition) parameters. In circumstances where captive animals are to be released into areas that support conspecifics, the risks of disease transfer or encounter are higher and the importance of health screening becomes evident to mitigate the transfer of microflora to potentially susceptible hosts. A priori pathology surveillance of wild and captive cheetah informed managers to abort translocation programs following the detection of infectious pathogens (Munson et al., 2004). Similarly, marsupial western barred bandicoots (Perameles bouguanville) collected from wild populations for a breeding program have been found to suffer eye infections and could be treated before captive breeding (Warren et al., 2005).

Monitoring disease can be challenging. It may require specialized equipment, and specialist training. Disease surveillance also requires pre-planning and liaison with field personnel to ensure that biopsy materials (especially sera) are collected in an appropriate manner. The type of sampling protocol useful for microbiological surveys thus becomes important in terms of collection methodology and assays (Woodford, 2001). The collection protocol and assays underlying serologic tests are more complex and require a higher level of funding and animal-ethics licenses if the information collected is to be reliable. Alternatively, sampling of faecal pellets is an inexpensive method for evaluating the health of mammals destined for
Experimental introductions of Roesel’s bush-cricket in Sweden

In spite of the conservation work and effort put into species introductions, translocations and re-introductions, there is deficiency of knowledge of the determinants for successful colonization’s. The reason why research in this area has not progressed as rapidly as the actual introductions is best explained by the nature of the problem itself. When working with threatened species there is often an air of urgency around the work, and it is commonly thought that time should be used to take action immediately rather than doing “time wasting” pre-introduction research. Another concern is that because of the threatened status of the species in question, it may appear risky to conservation managers to involve valuable individuals in studies involving handling or moving and thus such studies are often avoided. This attitude may compound problems in the longer term as present and future introductions may fail or succeed without it being clear as to why they did so. An alternative approach is to use a model species. Ideally the model species should be similar enough to the species in question in morphological characteristics, behavior or habitat use, so that meaningful results can be obtained from studies undertaken on them. The model species’ conservation status should be lower than species the results will be used for, allowing greater manipulation of introduction variables than would otherwise be possible. The obvious concern in using this procedure is that there are always differences between species, so caution in generalizing results to other species must always be kept in mind. This paper combines findings from two different experimental introduction studies on a model species: Roesel’s bush-cricket (Metrioptera roeselii) (Berggren 2001, Berggren et al., 2001). The two main aims in these studies were to investigate how different landscape and population variables affect the colonization success of the species.

Approach

Roesel’s bush-cricket is a small insect, 12 - 18 mm in length, and is common in south and central Europe, Finland and Latvia (see photo 1). In Sweden the species is predominantly found in the south-east around Lake Mälaren. Their preferred habitat is moist ungrazed tall-grass areas where they feed on grass, grass seeds and small insects. Adult males stridulate from July to October, and if the weather is warm or sunny, they will stridulate almost continuously at this time during the day. The song is characteristic, making the males of this species easy to census. M. roeselii is not a threatened species and

References


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Invertebrates
Invertebrates

currently expanding its distribution in Sweden. Because of this it is an ideal model species as there is no impediment to using it from a conservation perspective. Its current restriction to well-defined areas in the south-east of Sweden and its documented range expansion make it an excellent candidate for introduction experiments. Moving it from areas where it occurs abundantly to areas where it has yet to colonize means that individuals later found in the introduction sites were either the originally introduced individuals (if found the same year) or their descendants. This ensured that there would be no confusion with already existing individuals and allowed easy interpretation of the species ability to establish and expand in the landscape. The south-western introduction sites were the closest to the current natural species distribution (17km) and it was estimated that they would naturally colonize these areas within 10 years.

The Introductions

Different sized propagules of *M. roeseli* were introduced onto 70 habitat islands, previously uninhabited by the species, in a large-scale experiment in 1994 - 1995. These consisted of five different sizes (number of individuals) with an even sex ratio. The smallest propagule contained only two individuals (one male and one female), with the other sizes numbering 4, 8, 16 and 32 individuals. All introduced bush-cricket were in the last nymphal stage and hence virginal. The experimental areas were situated in the agricultural landscapes in the counties of Uppland and Stockholm, located in south-eastern Sweden. The habitat islands consisted of patches of ungrazed semi-natural grasslands of varying sizes (264 - 8,642 m²) within arable fields (see photo 2). Some of the selected habitat islands were connected to other suitable habitat patches (unoccupied by *M. roeseli*), while others were isolated by up to 85 m. The surrounding matrix consisted of arable fields, forests and human settlements including potential barriers such as creeks and roads. Although the type of landscape was the same for all introductions, the sites differed in the amount and number of different landscape variables. The propagules were then randomly distributed across these patches. There were no differences between the five propagule sizes regarding the landscape composition or structure they were released into.

Population Censuses

A minimum area of 30 ha around the introduction patch was censused annually from the year of introduction at the end of the reproductive season (i.e. August and September). Within this area more than 95% of the males present are expected to be detected (de Jong & Kindvall, 1991). With the dispersal of individuals, the censused area increased after the first year up to 78 ha around the introduction patch. Censuses were undertaken by listening for stridulating males. An ultrasound detector was also used to detect individuals more effectively at longer distances. Roads were also used as census locations at a distance of approximately 2 km from the release point when entering and leaving the sites. The inventories were made only in warm, dry and sunny weather to maximize detection. Numbers of males found at each site and their locations were entered on digitized maps. Presence of one or more stridulating individuals was the criterion for successful colonization.

Habitat Mapping

Maps (1.5 x 1.5 km) centred around the introduction patch of all introduction sites were digitized. Five different types of landscape elements were defined based on information found on land use maps (scale 1:10,000) and habitat mapping during field-visits. These include arable fields, forests, semi-natural grasslands, uninhabitable land (housing areas, streams, lakes), and linear landscape elements (ditches, road verges). Areas of all landscape elements were measured on the digitized maps. Data on patch size, their isolation from other suitable habitats and the number of nodes (intersections of linear landscape elements) were also estimated from the maps. In the analyses, landscape data within a radius of 238 m from the centre of the habitat island was used. The distance chosen was based on the 95% limit of dispersal data from all individuals the first year after introduction. This distance was used to get a suitable estimation of the landscape that might be encountered by individuals (and affecting them).
Results and Discussion

One of the most important features determining whether Roesel’s bush-cricket will successfully colonize an area is the size of the introduced propagule. The probability for successful colonization of an area increased with increasing propagule size. Patches with large initial propagules had larger local population sizes for all periods after introduction as more individuals were found in all census periods. Three months after introduction (at the end of their first breeding season), survival of local populations increased with propagule size from 21.4% (propagule size=2) to 75.6% (propagule size=32). One year after the experimental introduction a similar pattern was found. Survival of local populations increased with propagule size from 7 to 64%. Two years after the experimental introduction, all local populations founded by a propagule size of two individuals had become extinct, while survivorship of the remaining local populations ranged from 30% (propagule size = 4) to 93% (propagule size = 32). Three years after the experiment was initiated the pattern was the same for the reduced dataset of 50 introductions. Propagules that initially were smaller showed a higher extinction risk. For a propagule size of two individuals, 20% now persisted, showing that the absence of individuals in some areas the year before was a pseudo-extinction (this was because of the insect’s life cycle where eggs may not hatch for >18 months). Persistence in the remaining local populations of larger propagule sizes ranged from 30% to 100%.

The results from my study show that as few as four individuals can establish a persistent local population, but the success rate is much lower than with the larger propagules. If future introductions were to be made with this species or a similar species, a propagule size of at least 32 individuals would be required to establish a viable population with a high probability of persistence. However, this number should be used judiciously when the goal is conservation, since the introduced M. roeseli have in this study only been followed for three seasons since introduction. Habitat quality was also important for establishing an introduced population. Populations in landscapes with many linear landscape elements (e.g. habitat corridors) showed a higher colonization success than populations with fewer, even when propagule size was taken into account. This was the only landscape variable that had an effect on colonization success. Thus, an ideal habitat would be suitably large, heterogenous and would allow opportunities for movement between patches when conditions fluctuate.

My studies show that to maximize the successful introduction of a population both the size of the introduced propagule and the quality of the landscape must be well defined. This is not only to maximize short-term population growth, but to secure a long-term surviving population. Understanding population dynamics in a modified landscape is the key to successful management of the world’s species. This is true for species that are managed in ‘naturally’ occurring populations and those that are introduced into new areas. This study shows that an animal’s ability to move between patches is an important aspect for increasing the chances of a population surviving. Landscape corridors are vital structures in landscape management for a number of reasons. First, they offer an increased area of suitable habitat for the species in question. Second, they facilitate movement between favorable habitat patches allowing successful expansion of the population with minimal loss of individuals in unfavorable matrix. Third, high connectivity increases the possibility for interchange of individuals between populations and thus maximize genetic flow.

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Update on the UK Species Recovery Program for the field cricket

Due to alteration and fragmentation of its highly selective grassland habitat, the UK population of the field cricket (Gryllus campestris) was reduced by the late 1980s to a single surviving colony of less than 100 individuals in the county of West Sussex (see photo 1). In 1991 the species was placed on English Nature’s Species Recovery Program (SRP), with the remit of establishing 10 secure field populations in managed areas of the species’ historic range.

Approach

Because the surviving population was too low to support direct translocations, a conservation breeding and release program was established in 1992 at the Zoological Society of London. A total of 3 male and 3 female founder crickets were collected annually from the surviving wild

Photo1: A female field cricket (Gryllus campestris)
Invertebrates

population each spring to produce the large numbers of late-instar nymphs necessary for establishing the new colonies. The management regime is detailed in Pearce-Kelly et al. (1998) and Jones et al. (1999). To help clarify natural health profiles, a faecal screening and post mortem protocol was implemented for all field-collected founder crickets. Newly collected crickets were reared to the adult stage and paired up. Resultant hatching nymphs were reared to late instar stage before being released into the selected sites (see photo 2).

Discussion

To date, the breeding program has provided in excess of 17,000 late-instar nymphs for the SRP field establishment program. Four of the seven field colonies established with Zoo bred crickets are still extant, the longest of which was shown to have persisted to the eighth generation. In addition to providing large numbers of release stock, the breeding program helped clarify fecundity ranges (Clarke, 2005). The knowledge derived from monitoring the fluctuation dynamics of the field-released *Gryllus campestris* populations has informed optimal site management requirements for the species, and helped clarify the subtle environmental factors influencing colony survival. The breeding program has also helped raise public awareness of the field cricket and its conservation issues and provides a model for developing similar recovery initiatives for the species in other range countries.

As was the case in 1996, the importance of effective post-arrival and pre-release health screening protocols was highlighted in 2006 by the discovery of gregarine parasites in the captive population, preventing field releases in both these years (see photo 3).

Conclusion

The increasing number of invertebrate re-introduction programs support the contention that many invertebrate species can make excellent reestablishment program recipients with good chances of successful conservation outcome. The field cricket program personifies this assertion but also provides a valuable case study for highlighting the necessity of ensuring that adequate infection barriers and health monitoring protocols are effectively maintained for all *ex situ* populations destined for re-introduction.

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References


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Translocation of snails, beetles and weevils to Lady Alice, Hen & Chicken Islands, New Zealand

The Hen & Chickens Islands are Nature Reserves, the strongest form of reserve protection in New Zealand. Landing on the islands is by permit only. Pacific rats (*Rattus exulans*) reached Lady Alice Island about 200 years ago (Brook, 1999). Much of the forest on the three largest Marotere or Chickens Islands (Lady Alice Island, Whatupeke Island and Coppermine Island) is regenerating after being modified by human activity. As a consequence many rare and vulnerable invertebrate...
species became extinct on these islands although some still survived on small islets and rock stacks within the Marotere Island group. Three species of land snail were known only as fossils (Brook, 1999), and one of these, Amborhytida tarangaensis, which feeds on other snails, still survives on the very much larger Hen or Taranga Island situated to the south of the Marotere Islands.

Following the eradication of Pacific rats from the three largest Marotere Islands between 1993 and 1997 (Lady Alice in 1994) a Restoration Plan was written (Towns & Parrish, 2003) which included re-introducing a variety of species including lizards, invertebrates and even possibly seabirds. There have been seven translocations of lizards and all species appear to have successfully established so far: four transfers to Lady Alice Island, two to Whatupuke Island and one to Coppermine Island. This is an account detailing translocations of the first three invertebrates: the snail A. tarangaensis (Pulmonata: Rhytididae) which reaches a shell diameter of about 2.5 cm, a darkling beetle, Mimopeus opaculus (Coleoptera: Tenerbrionidae), with a body length of about 2 cm, and Turbott’s weevil, Anagotus turbotti (Coleoptera: Curculionidae) with a body length of up to about 2.7 cm. The latter is fully protected by law under the Wildlife Act.

Surveys of two of the islets provided estimates that about 300 Turbott’s weevils were present on Muriwhenua Island, while captures of darkling beetles in traps set for lizards indicated darkling beetles were abundant there (Parrish, 2006). Surveys of the snails on Taranga Island indicated that there were more than 100,000 individuals present, and identified localities where they could be easily and quickly collected (Parrish et al., 2006). Lady Alice Island had numerous suitable localities where the beetles could be released, but unless they were protected they were likely to be eaten because of a high density of insectivorous predators - saddleback birds (Philestumus carunculatus), morepork owls (Ninox novaeseelandiae), tuatara (Sphenodon punctatus) and the large Duvaucel’s gecko (Hoplodactylus duvauceli). The decision was therefore made to release most of the beetles into two large cages enclosing suitable food plants with the intention that their progeny could be released after the beetles became established. The areas where the cages were built were chosen for their easy accessibility. Choosing a location for releasing the snails involved surveying both for suitable habitat and for the presence of sufficient numbers of other snail species that A. tarangaensis preys upon (Brook, 2006). In line with the Department of Conservation requirements, two Translocation Proposals, one for both insect species and one for the snail were written and subsequently approved.

Approach

The translocations to Lady Alice Island took place in September 2006 after 42 darkling beetles and 30 Turbott’s weevils were collected from Muriwhenua Island and 43 snails were collected from Hen Island. Thirty-one darkling beetles were found by turning over logs and stones during the day and the remainder were caught in nine 4 litre pit-fall traps baited with a canned meat-based cat food. These were set overnight on top of the islet where there are numerous seabird burrows. All of the Turbott’s weevils were collected from ngaio shrubs (Myoporum laetum) by hand at night (see photo 1). The adults eat the leaves of ngaio and karaka (Corynocarpus laevigatus) and the larvae bore into the trunks of both species – there are about 30 ngaio shrubs and about 25-30 small karaka trees and saplings on Muriwhenua Island. The snails were collected on Taranga Island by a team of seven people in a little over one hour’s searching through leaf litter. They were released the same day in two groups 19.7 m apart (see photo 2). Fourteen of the snails were fitted with harmonic radar transponders (see Lovei et al., 1997) to facilitate finding them again when they are monitored (see photo 3).

All beetles were released within three days of being captured. Most of the darkling beetles and all of the weevils were released into two large cages made of wood framing covered in 40% windbreak cloth. Zip-up doors, sewn into the fabric, provided access for both releasing the beetles and for future monitoring. One cage was constructed around a karaka sapling within tall scrub and the other around an ngaio shrub amongst low vegetation growing on sand. Both were located out of sight from the sea so as not to encourage illegal landings out of curiosity (see photo 4). Twenty weevils were released into the enclosure around the ngaio shrub and the remaining 10 into the karaka enclosure. Thirty-two darkling beetles were released in the karaka enclosure. The remaining 10
were released nearby, directly onto tree trunks in a grove of mixed broadleaf trees to determine if they could survive a direct release. The trunks of these trees contained numerous small holes and crevices in which the beetles could hide during the day and they were also covered with a thin layer of algae and lichens on which other species of *Mimopeus* have been observed elsewhere feeding at night. However, apart from this, their food requirements are not well known and they may also feed on decaying organic material. All beetles were marked on the dorsal surface of the elytra with a spot of white correction fluid (“Twink” Gillette Ltd) before being released so they could be distinguished from any of their progeny. This was done because the developmental period and lifespan is not known for either species.

**Discussion**

The outcomes of these translocations have yet to be determined because the first monitoring is not due until September 2007, and will be followed by yearly monitoring thereafter. The decision to transfer beetles and weevils directly was made firstly, because there were suitable numbers in the source populations and, secondly, because nothing is known about how long development to adult takes and determining this would involve a lengthy and expensive laboratory study. The decision to attempt to establish breeding colonies of both beetle species in cages on the island and subsequently liberate some of their progeny was made mostly to protect the translocated specimens from predators. This was done because there has been no sign of darkling beetles since they were released directly onto Korapuki Island, one of the Mercury Islands (Chris Green, pers. comm.). Our intention is also to attach harmonic radar transponders to any beetles and weevils that are released outside the cages to facilitate finding them again, so that their subsequent survival and movements can be ascertained.

Finally, the decision to do a wild–to–wild translocation of the snails was influenced by the results of previous translocations of land snails in New Zealand. These have had mixed success but overall the indications are that direct wild–to–wild transfers may be the most effective. Two successful wild–to–wild translocations of 32 and 33 *Placostylus ambagiosus* snails were made to new sites within 500 m of the source population at Cape Maria van Diemen in 1990, whereas seven laboratory-reared snails died within a year after being translocated to a cage in November 1999. Furthermore, only one of four translocations of captive-bred *P. ambagiosus* snails made to islands in 1984 and 1985 was successful. These island translocations involved groups of at least 42 snails to Nukutauanga Island, 32 to Horonui Island, 17 to Motutakapu Island (all in the Cavalli Islands group) and 62 to Motu Puruhu Island, one of the Symonds Islands, but the documentation is poor. One known translocation of 100 *Placostylus hongii* to Motuhoropapa Island in the Noises Group in 1934 was successful whereas all 11 laboratory-bred snails released on Limestone Island near Whangarei in 2001 died within 2.6 years. Both species of *Placostylus* feed on leaves that fall from broadleaf trees and shrubs and we know of only three translocations involving carnivorous snails in New Zealand and these involve the rhytidid *Paryphanta busbyi*. This species now occurs at three locations well south of their natural distribution: Little Huia, west of Auckland, and at two locations in the Kaimai Ranges. All three populations resulted of early undocumented translocations.

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main river systems for the breeding season (see photo 1). Some genetic and morphometric studies have demonstrated that in the mid-20th Century this species ranged from the Adriatic sea to the Iberian peninsula (Garridos-Ramos et al., 1997 & De la Herran et al., 2004). Direct and indirect impact of human activities - fisheries, water pollution, habitat degradation, river damming - and intrinsic factors - slow growth rates and first reproduction from eight years of age - are responsible of the historical decline of the Adriatic populations of sturgeon. As a consequence, a strong reduction in the distribution of this species has occurred (Crivelli, 1996).

Sturgeon is a fully protected species classified as vulnerable (VU A1ac) in the IUCN Red Data Book (Sturgeon Specialist Group, 1996). It is included in Annex B of CITES, Annex II of the Bern Convention and Annex II (designation of special areas of conservation is needed) and IV (strict protection) of Habitat Directive of European Union. In Italy the historical distribution range of the Adriatic sturgeon covers the northern part of the Adriatic Sea from which, in the first months of the year, fishes migrate upstream in the main rivers and tributaries - Po, Adige, Brenta, Piave and Tagliamento - remaining in freshwater until October (Bernini and Nardi, 1990; Birstein et al., 1997). Regarding the Po river basin, in the 19th Century the sturgeons migrated upstream until Turin but the presence of limiting factors affected further spread of the species. Now the Adriatic sturgeon is the only survivor of the three sturgeon species historically recorded in sympatry in this area namely the Adriatic sturgeon (Acipenser naccarii), common sturgeon (Acipenser sturio) and beluga sturgeon (Huso huso).

Since 1961 the damming of the Po river at the confluence with Adda River (dam of Isola Serafini) prevented Acipenser naccarii from reaching its main spawning areas (middle-lower reach of Ticino, Agogna and Sesia rivers) from the sea (Delmastro, 1982). The environmental agency of the regional government of Lumbardy has been involved in the conservation of this species for about two decades through re-introduction programs. Since 1988, in the course of these projects, about 250,000 young individuals of Adriatic sturgeon of confirmed identification, originating from a stock of 70 wild specimens reared in a fish farm (Azienda Agricola VIP, Brescia, Italy) have been released. Bruno (1987) reports the capture of some young individuals and adults of 20 - 25 kg in the Ticino river. This confirms that, recently, a small population of Adriatic sturgeon settled in this area (upstream the dam of Isola Serafini) performing its entire life cycle in freshwater (Nardi, 1982; Bruno, 1987; Gandolfi et al., 1991). This population is protected since 1974 by the establishment of Ticino Regional Park. The aim of the Ticino Park Three Years Life Project, supported by the European Union and the environmental agency of the regional government of Lumbardy, was to restore this land-locked population in the Ticino river, where the species is threatened by low density, introduction of exotic species and habitat fragmentation and reduction.

Re-introduction Program

The results of monitoring survey on fish fauna along the Ticino river, which were carried out during previous projects, from 1999 to 2004, have confirmed the strong decline of this land locked population and the consequent potential increase of genetic drift. Both effects suggest that the long term persistence of this nucleus can hardly occur without a reinforcement measure. During the three years of re-introduction, a total of 1,040 individuals (1,016 of class 1+ with 40/80 cm size, and 24 adults of 90/120 cm) from the same fish farm (Azienda Agricola VIP, Brescia, Italy) have been released in the project area. All these specimens were marked with subcutaneous PIT tag for individual recognition over the long term; none of them showed signs of tissue inflammation or migration of the PIT tag from the implant point (see photo 2).

Thirty adults and 10 class 1+ individuals were fitted with an
Impact of Exotic Species

Intentional and unintentional introductions of exotic species have affected the fish composition of the Ticino river: of 50 species, only 27 are autochthonous. Data from a previous Life Project on conservation of marbled trout (Salmo trutta marmorata) and pigo (Rutilus pigus) carried out from 2001 to 2004 has underlined the strong presence of the introduced sheat fish (Silurus glanis) and their negative impact on all the autochthonous species. To determine the ecological impact of this alien species and its foraging ecology, a specific study was carried out on a sample of 4,293 specimens of different ages. The results confirmed that the sheat-fish can occupy all the habitats suitable for the sturgeon and can prey upon different taxa (aquatic invertebrates, fishes, amphibians and also birds). An abundance control protocol of the sheat-fish by electro and net fishing was implemented giving the possibilities to remove 4,327 individuals (9.55 tons) from the river in 128 surveys (see photo 3). These data seem to exclude the possibility to eradicate sheat-fish from the river. However, the abundance control of this alien species has to be maintained and implemented to support the growth of Adriatic sturgeon population.

Habitat Fragmentation and Reduction

To assure the long-term persistence of one species it is necessary to adopt management measures which preserve its habitat. Thus, as a first step, a habitat analysis on project area was carried out with particular reference to the potential breeding sites. These data, linked to the available scientific information and data from the monitoring program, were used to formulate a specific Action Plan including management measures and priority recommendations needed to conserve and increase this sturgeon population endemic to the Adriatic. Planning of two fish stairs for the Porto della Torre and Panperduto dams, in the northern part of Ticino river, was a further important goal to mitigate the fragmentation of the Adriatic sturgeon distribution area. The realization of the stairs is scheduled for the 2008 and will be followed in 2010 by building a fish elevator for the Isola Serafini dam. These interventions will contribute to restore the ecological freshwater corridor with the Adriatic Sea, which is a natural migration route for Acipenser naccarii and will be one of the most important tool for the long term conservation of this species.

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BIRDS

Species re-introduction as a tool for the conservation of takahe, New Zealand

The takahe (Porphyro hochstetteri) (see photo 1) is an endemic rail that was once widespread throughout New Zealand, but who’s natural range is now restricted to the Murchison Mountains area of Fiordland (see photo 2). Since it’s ‘rediscovery’ in 1948 (the species was formerly considered to be extinct since 1908), the takahe and its habitat have been the focus of an intensive management regime, including the
translocation of ‘excess’ eggs and subsequent raising of chicks at the Burwood Bush Captive Rearing facility. Recent analysis has shown that this management effectively raises the chick survivorship by over 70%, through increasing the fledge success of both the transferred chicks and those left in the natural nest. Due mainly to the combined successes of this nest management and habitat recovery following intensive deer control, the Murchison Mountains takahe population has increased markedly in recent years, and is now probably approaching carrying capacity (ca 70 breeding pairs). As such, the recovery program is at a point where establishing a second viable mainland population is of the highest priority.

Prospective sites for this re-introduction are currently being short-listed, with their suitability determined by factors such as amount and connectedness of appropriate habitat, ease of access and level of infrastructure for staff and public use, history of takahe inhabitation, and extent of predator and deer control currently in place. Research has shown that we may ‘harvest’ a set number of juveniles from the Murchison Mountain and off-shore island sites (via Burwood Bush) to found and supplement the new population, whilst maintaining the health of these source populations. The success of this endeavor will provide further defense against the threat of extinction, and enhance public advocacy for both takahe and conservation in general.

When the Burwood Bush Captive Rearing facility was established in the mid 1980’s the aim was to produce birds to establish a second Fiordland population north of the Murchison Mountains. From 1987, annual liberations were made at this new site (Stuart Mountains) for several years but were discontinued in the mid 1990’s. The birds were needed to boost the Murchison Mountain population that had declined following a series of particularly severe winters. The birds in the Stuart Mountains had also suffered from the severe climatic conditions. The mobility of the released birds and the small number being released annually had also contributed to the limited success of these earlier liberations. Increased productivity at the Burwood Bush facility and also sourcing birds from now established island populations will enable liberations of greater numbers of takahe.

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Update on the Wattled Crane Recovery Program, South Africa

The wattled crane (Bugeranus/Grus carunculatus) is a strictly African species with three main populations found in south-central Africa, Ethiopia and South Africa respectively (see photo 1). Recent surveys indicate that there are 7,700 wattled cranes remaining in the wild. Results of a recent genetic diversity study suggest that wattled cranes of South African origin are genetically unique to populations found in other regions of Africa, making conservation of this species in South Africa all the more urgent (Jones, et al., 2006). One of five critically endangered birds in South Africa, the wattled crane is now on the verge of local extinction (Barnes, 2000). Historically this species once flourished throughout South Africa, extending as far south as the western parts of the Cape Province. A crane census conducted in 2004, however, found just 235 individuals remaining in isolated pockets, with the main concentrations occurring in the Mpumalanga Highlands and KwaZulu-Natal. A few breeding pairs also remain within the Wakkerstroom region, the Eastern Cape and the north-eastern Free State. With a 35% decline in population in just the last two decades, these remaining populations are facing major threat as the result of wetland degradation, conversion of surrounding grasslands to agriculture, collisions with power lines and illegal removal of eggs and chicks for the international bird trade. These threats are further compounded by a naturally low reproductive rate and a wetland dependant lifestyle.

Field conservation programs have been actively...
addressing the threats to wattled cranes since 1985. In July 2000, extreme concern over the decline of South Africa’s wattled crane population led to a PHVA Workshop, one of major outcome of which was the recommendation for a captive breeding and supplementation project. Thus the Wattled Crane Recovery Program was formed. The Wattled Crane Recovery Program (WCRP) is supported and managed by the Johannesburg Zoo in co-operation with the South African Crane Working Group, the African Association of Zoos and Aquariums and the Ezemwelo KZN Wildlife Conservation Board. Ten captive management facilities participate in the breeding program. The two main objectives of the program include: maintenance of a captive breeding flock to serve as a genetic reservoir in the case of catastrophic extinction of wattled cranes in the wild and supplementation of the wild population through the release of captive-bred fledglings into existing floater flocks.

Wattled cranes typically lay one or two eggs per clutch. However, even when two eggs are laid, only one chick is reared and the second egg is abandoned. This phenomenon allows for the collection of abandoned eggs, as this has no known detrimental effect on the productivity of the wild population. Ezemvelo KZN Wildlife conducts aerial surveys in KwaZulu-Natal to locate wattled crane nests after which a fieldworker from the South African Crane Working Group monitors the nests throughout the breeding season. Abandoned eggs are collected and transported to a local breeding facility for hatching. At two days of age, the hatchlings are flown to Johannesburg Zoo where they are costume-reared (see photo 2). Once fledged, the cohort is relocated with one of the ten participating institutions. Adults are paired at approximately two years of age. Once a target population of 40 captive adults has been reached, offspring of the captive population will be used to supplement the wild population via release into existing floater flocks. The current captive population consists of 28 birds of South African origin. Feasibility trials were conducted between 1995 and 2000, during which a total of 13 wattled cranes were released into the wild wattled crane floater flocks. Costume-rearing and gentle release into floater flocks, has proven successful with the Mississippi Sandhill crane (Grus canadensis pulla) in North America (Urbanek, 1994). Currently five of the released birds are still living. Post-release mortalities have included power line collisions, poisoning and natural predation by caracal. Much experience was gained from these trials, including the refinement of the release technique as well as identification of suitable release sites.

Since 1986 more than 60 wattled crane chicks have been successfully fledged from abandoned eggs. Much remains unknown about the captive reproduction of Wattled cranes as efforts to breed this species in captivity have only proved marginally successful. Poor fertility remains a major obstacle to captive reproduction. However, on 1st September 2006, the first captive bred Wattled crane produced in South Africa in nearly ten years was hatched at the Johannesburg Zoo. The zoo credits improved diet and husbandry practices for this successful breeding. In July of 2007 the Johannesburg Zoo will host a Wattled Crane Husbandry and Assisted Reproduction Workshop to address the issues of captive reproduction; which will include an international survey of wattled crane husbandry practices and hands-on instruction in semen collection and artificial insemination. While the WCRP has made significant progress toward safeguarding this species, continued concerted efforts will be necessary to prevent local extinction of the wattled crane in South Africa.

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Re-introduction planning for the bearded vulture, Picos de Europa National Park, Northern Spain

Experts from the Spanish Foundation for the Conservation of the Bearded Vulture have developed a study to assess the suitability of re-introducing the bearded vulture (*Gypaetus barbatus*). The Guidelines for Re-introductions, established by the Re-introduction Specialist Group (RSG) of the IUCN/SCC, were adopted. A Population Viability Analysis provided information regarding the effect of the extraction of individuals from the Pyrenean (Nowadays, the unique viable population of the EU) on the trend of this population under different scenarios: i) removal of fledglings from viable nests and ii) removal of the clutch from pairs with reiterated breeding failure and with selective supplementary feedings. Models of single population and meta-populations were used. A prospective analysis on the evolution of the re-introduced population allowed quantifying the optimal number of individuals to be released per year and the duration of this supplementation in order to establish a viable population.

A Habitat Viability Analysis permitted to locate the most suitable release-sites in the Picos de Europa National Park by modelling the nest-sites in the Pyrenean population and identifying significant environmental and population variables. The disappearance of the atrophic factors, which generated the extinction of the species, has been concluded. The attitudes of local people to the proposed project were investigated to ensure long term protection of the re-introduced population, showing an excellent acceptance. A re-introduction protocol pointing out the guidelines for the development of the project were conformed: pre-release, release and post-release. The results of this feasibility study will allow starting a re-introduction project according to the biological, demographical and social criteria established by the IUCN (The World Conservation Union).

Contributed by Gerardo Báguena, Emma Sánchez-Castilla, Ramón J. Antor, Luis A. Longares, F. Espejo, Spanish

Re-Introduction of the Campbell Island Teal, New Zealand

Campbell Island teal are a small (300 g for females and 450 g for males) flightless duck which was only found on subantarctic Campbell Island, approx. 700km south of New Zealand. The introduction of rats (*Rattus norvegicus*) shortly after the islands discovery in 1810 eliminated all the teal, and several other bird species, from the main island before they could be discovered by early scientists. However a small population (30 - 50 birds) managed to persist on 26ha Dent island approx 3 km off the coast from which birds apparently swam to the main island on at least two occasions when the only specimens were collected. In 1975 an expedition to Dent Island confirmed the presence there of teal and it is from this sole remaining population that the recovery of the species has arisen. Following the development of a recovery plan a captive-breeding program was initiated, an insurance against any “disaster” on Dent Island and to provide birds for any future re-introduction to Campbell Island. A total of 11 birds from Dent Island were caught in three visits in 1984 and 1990 but it was not until 1995 that the first breeding occurred at the Department of Conservation’s National wildlife Centre captive breeding facility at Mt Bruce.

Following the initial breeding, the captive population grew rapidly to the point where 12 birds could be released on a holding island in both 1999 and 2000. Codfish Island / Whenua Hou Nature Reserve (1396ha) off the Northwest coast of Stewart Island, was selected as the holding island due to the range of habitats and relative ease of access. The teal bred during their first summer on Codfish, nine months after release and this population was monitored for three years after the first release. During this time seven different females established 14 nests, 45 eggs were laid (range 2-5, avg. 3.5/clutch), 36 ducklings hatched (range 2-5 avg. 2.8/nest), and 19 were known to have fledged. There were other breeding attempts during this time as several “unknown” juveniles were later found. The next step on the recovery plan was to re-establish the birds back onto 11,000 ha Campbell Island. This became possible with the eradication of the rats in 2001. Cats, which had also been present on the island, died out several years earlier, possibly due to the
recovery of the vegetation following the removal of sheep in 1990. A check in July 2003 failed to find any sign of rats on Campbell Island so the decision was made to carry out the first release the following year. A re-introduction plan was written and detailed three annual releases of approximately 50 birds and a monitoring program covering five years.

In order to reduce quarantine risk, only two facilities were chosen to provide the captive bred birds for the release (Mt Bruce and the Isaac Wildlife Trusts-Peacock Springs). These facilities produced 28 birds for the first release and these were supplemented by 22 birds caught on Codfish Island – a mix of captive raised (released) birds and wild bred birds. An outbreak of *Erysipelas* in Kakapo (*Strigops habroptilus*) sharing the island refuge meant that all birds, from both Codfish and the captive facilities, had to be vaccinated for this disease, as well as undergoing standard disease screening for a range of pathogens.

All birds for release had 8 g backpack transmitters attached so that they could be monitored post release. On the day of transfer all the birds were bought together in Invercargill where they had a health check and were tube fed before being transported to the boat in individual transfer boxes (approx. 340mm x 250mm x 250mm) for the 40 hour trip to Campbell Island (see photo 1). As well as having *ad lib* access to pellets and water all birds were tube fed 12 hourly during the trip. On arrival at Campbell the birds were transferred into individual 1350mm x 675mm x 675mm pens (some birds which had previously been kept together were initially placed together but in all cases one bird monopolised the food and the other lost weight so they were all segregated). Of the 50 birds transferred two gained weight during transfer while the greatest weight lost was 40 g approx. 10% average of 15g, 4% loss. All birds put on weight while being held prior to release range 3 - 73 g avg. 44 g. Birds were held in their pens until they gained a preset target weight based on with their captive weight for the Codfish birds or calculated average for the captive raised birds, which were all above normal weights before transfer. The birds reacted differently to their time in the pens with some birds having to be tube fed in order to get them up to their desired weights. The birds were released in groups as they reached their target weights, this was between 8 and 12 days after arrival at the island. Three sites were selected for the releases, all at the head of Perseverance Harbour - the main inlet on the island. Behaviour following release varied greatly with some birds staying close to their release site while others rapidly travelled over 1 km from their release site and one even going over 5 km. Several birds went well up the hills surrounding the harbour with one going over 1.5 km up a small stream to an altitude of 500 m. All 50 birds were alive 2 weeks after their release (see photo 2).

In February 2005 a party was sent to the island to check for survival and possible breeding. This group caught 22 birds and found that another 13 birds were definitely alive but could not be caught. Of equal importance is the fact that they did not locate any dead birds despite them all have transmitters when released, indicating that the other birds may have moved out of the search area and that the survival rate was very high. Unfortunately no evidence of breeding was found. A second release of 55 birds was carried out in September 2005 made up of 33 captive bred and 22 wild birds. The information on weight changes and survival gathered during the first release allowed the birds to be released sooner this time – between 2 and 8 days. In addition to releasing 20 birds at
the same site as the previous release, to supplement that population. 30 birds were released at NW Bay on the other side of the island and five birds were released at 6ft lake – the largest freshwater body on the island and the home of a lone male teal which was discovered in 2004 and had presumably swum over 20km around the coast of the main island as well as 2 km across open sea from Dent island, the teals sole natural refuge at Campbell island. Post release monitoring found a good survival rate with one bird being predated by a skua.

A monitoring trip to check survival, dispersal and breeding took place in February 2006 and confirmed breeding with the discovery of two nests and four un-banded birds, including one which is believed to be an adult i.e. bred during the 2004/05 season. While the trip only managed to catch 29 of the 54 birds from the 2005 release they confirmed another 12 were alive (via radio tracking) and did not find any dead birds, which indicates another high survival rate. The inability to find the other birds may be due to the wide dispersal of the birds with birds having been recorded as travelling over the top of ridges at least 120 and 140m high. A third release took place in August 2006 to give a top up to the population. This involved the release of 54 birds - 20 at a new site at North East harbour, 20 to top up Northwest Bay and 13 at 6 ft Lake - one bird self released from the pens at Perseverance Harbour. Departure of this trip was delayed by 12 hours due to bad weather to try and give the birds and the bird feeders as comfortable ride down as possible, this proved to be a good call minimising the time the birds were at sea and enabling the release team to tube feed the birds each 12 hours with little difficulty. Building on what had been learnt from the previous two transfers the first group of twenty birds were released after only 24 hours in the holding pens. This gave them time to clean themselves after nearly three days in small boxes, to have a feed of meal worms and to be tube fed again before release. The other birds were released on the two following days. All the birds for this transfer were captive-bred and continued the trend of captive-bred birds tending to be harder to maintain during the transfer than wild caught birds. A third monitoring trip will take place in December 2007, which due to the difficulties in locating birds after breeding found during the two previous monitoring trips will focus on locating territorial birds and nests earlier in the breeding season. The results of the monitoring will then be gauged against the re-introduction plan to decide where the project goes from here but there is a high level of confidence that we can now leave the birds to their own devices.

It is expected that the planned releases will lead to a self sustaining population of Campbell Island teal on Campbell Island, at which stage the species can be downgraded from its current Nationally Endangered status. The re-introduction of the teal, along with the self-colonisation of the main island by the even rarer Campbell Island snipe from its sole refuge on another small islet, and the re-establishment of other land and seabirds show the benefits of removing predators from islands, and in the case of the teal, how these projects can benefit from well planned and well managed captive breeding programs.

This report updates the one in Re-introduction News No 19 - November 2000.

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Houbara bustard re-introduction in the Kingdom of Saudi Arabia

The Houbara Bustard (Chlamydotis undulata) is one of the Globally Threatened species according to IUCN. This medium-sized arid and semi-arid area bird inhabits open or scrub-covered plains and occurs over a huge range from the Canary Islands, Spain, across North Africa to the Middle East and Central Asia via South Asia to mainland China (Ali & Ripley, 1987) (see photo 1). The population has been estimated at 49 - 62,000 individuals, but it is likely to exceed 100,000 birds (BirdLife International, 2001). There are three sub-species recognized 1) Chlamydotis undulata undulata (9,800 birds) is resident in North Africa where it has declined in Libya, Egypt and Tunisia, and probably also in Algeria, Mauritania, Morocco and Sudan; 2) Chlamydotis undulata fuertaventurae (700 - 750 birds) occurs on the Canary Islands, Spain; and 3) Chlamydotis macqueenii is thought to occupy six sub - regions: resident and migratory birds occur in the Middle East (Turkey, Jordan, Israel, Iraq, Kuwait, Bahrain, Oman, Qatar, Saudi Arabia, United Arab Emirates, Syria, Yemen) and in Russia (including in the Asian region), Iran, Pakistan, India, Afghanistan, Uzbekistan, Tajikistan, from western Kazakhstan to Turkmenistan, and on the Mongolian plateau and in the Gobi desert of Mongolia and western China.

The population of C.macqueenii estimated at 39 - 52,000 individuals, mostly breeding in Kazakhstan (30 - 40,000) (BirdLife International, 2001), although numbers in the mainland China are likely to be much higher than the current estimate of 500 birds (BirdLife International, 2001). Declines are reported from Bahrain, Jordan, Iran, Iraq and India. Populations from some sub-regions are thought to mix on the wintering grounds. In order to restore the native population of Houbara Bustard the captive breeding programs were started in the UAE, Saudi Arabia, and Morocco.

Houbara Captive Breeding Program

The breeding program of Houbara bustard (Chlamydotis macqueenii) was started in Saudi Arabia in 1986 to undertake the restoration of native species such as the Houbara bustard through a captive-breeding program and re-introduction, involving the release of captive-bred birds. Two sites were selected for houbara re-introduction 1) Mahazat as-Sayd and 2) Saja Umm Ar-Rimth protected areas in Saudi Arabia, keeping in mind the IUCN resolutions on re-introduction.

IUCN Guidelines for Re-introductions

The ‘IUCN Guidelines for Re-introductions’ (1998) states that: “If captive or artificially propagated stock is to be used (for re-introductions), it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology. […] Re-introductions should not be carried out merely because captive stock exists, nor solely as means of disposing of surplus.
Re-introduction Sites

**Mahazat as-Sayd Protected Area** in Makkah province of about 219,000 ha of area with fairly level, sandy plain at 900 - 1,100 m with a few rock outcrops. Mahazat is a special Nature Reserve established in 1988, especially to re-introduce Arabian oryx, gazelle and Houbara bustard. Mahazat as-Sayd is about 175 km north-west of Taif and south of al-Muwayh and other nearby town are Zalim and al-Khurmah. It is fenced and moderately to well vegetated with *Acacia tortilis*, *Indigofera* and *Salsola* as dominant shrub/trees. The substrate at Mahazat consists of sand, gravel or alluvial clays, and is usually loose, but not shifting, forming an even surface. During the breeding season most of the females make nests in open areas and avoid vegetative cover but males were seen in the vegetative cover which consists of moderate or sparse perennials, primarily grasses, herbs and shrubs but some times including larger bushes and trees such as *Acacia* spp.

**Saja Umm Ar-Rimth Protected Area** is another protected area that was established as an extension of the Mahazat as-Sayd protected area in March 1994 by H.R.H. Prince Saud Al Faisal as a possible re-introduction site for Houbara bustards. In 1998, a 6,000 km² area was proposed by the NWRC for the re-introduction of Houbara bustards and of that 10% of the total protected area was fenced to release Houbara, 400 km² (20 x 20 km) in the area of Jibal Barah, which is 5 km east of the Zalim-Afif road.

Breeding in the Wild

Captive bred Houbara bustards have been released in Mahazat as-Sayd protected area since 1992 by NWRC and those released birds have been successfully breeding. The nesting season of the houbara at Mahazat starts from February to May. There were 29 nests located in Mahazat as-Sayd protected area in 2006 but no nestling recorded from Saja Umm Ar-Rimth protected area and most of the nests in Mahazat were shallow scrapes occasionally lined with vegetation, that were gentle slopes and elevated ground, rather than in depressions. These nests were found close to sandy wadis, in areas of small basaltic boulders and in good vegetation cover. We also found that large number of ant colonies around Houbara bustard nests, that could be the reason of nests locations for easy accessibility of food for females and their broods.

Re-introduction Methods

Captive-bred juveniles of 4 - 6 months old were translocated to long tunnel shaped cages in Mahazat and Saja and after three to four weeks were released in the enclosures after fitting them with radio-transmitters (MP2 Microprocessor with active/inactive indicator circuitry, wgt. 35 g). In the Mahazat as-Sayd protected area, in 2006, 20 houbara (13:7) were released by the Shoura (Council members) along with Prof. Abuzinada, the former Secretary General of NWCD and the NWRC team. In the Saja Umm Ar-Rimth Protected Area, on 26th April 2006, 44 Houbara were released in the enclosure by Dr. Mohammad Shobrak, Director, NWRC. Out of these 44 birds, 30 were predated within a 1.5 month duration, mostly by foxes and falcons. From May 2004 to April 2006, a total of 86 Houbara bustards were released in Saja Umm Ar-Rimth Protected Area in three releases. First release was on 27th May 2004 in which 12 birds were released, the second release was on 19th March 2005 in which 30 birds were released, and the third release was on 26th April 2006 in which 36 new birds and eight old birds from NWRC, which could fly due to prior surgery (experimental release), were finally released.

Monitoring

Regular monitoring of released Houbara bustards have been carried out by the team of researchers in Mahazat as-Sayd and Saja Umm Ar-Rimth protected areas using radio transmitters to track Houbara that include checking missing Houbara using aerial tracking techniques and also with vehicles for terrestrial tracking. In Mahazat as-Sayd, nesting females were regularly monitored and later wild born Houbara bustards were captured and fitted with transmitters for monitoring. Total population of Houbara bustards in Mahazat as-Sayd is roughly estimated around 450 - 500 birds, using the following: N=n1+n2+n3+n4+n5 (n1 = released or wild born, radio, regularly monitored/checked; n2 = radio tagged missing; n3 = wild born chicks not recorded; n4 = wild born chicks, recorded but not tagged; n5 = immigrants).

In Saja Umm Ar-Rimth only seven birds (3:4) are alive and there are four known cases of hunting or poaching, one case of mortality due to carnivore predation and there are a few cases of starvation or disease related deaths. The mortalities of Houbara bustards in Saja Umm Ar-Rimth Protected Area is mainly due to key reasons that
the vegetation is not adequate and it will take some time to improve, there is no pre-release enclosure (predator free) as we have in Mahazat as-Sayd protected area, where Houbara bustards could get acclimatized to the natural environment that helps in increasing the survival rate. We have observed that most of the mortalities occurred in one month duration after the release. We requested NWRC to setup pre-release enclosures of 2 km x 2 km fenced within the fenced protected area.

Acknowledgement
We want to extend thanks and gratitude to H.R.H. Prince Bandar bin Mohammed Al Saud and Secretary General, NCWCD for his leadership, generosity and continuous support towards the research and conservation work by the NWRC in the Kingdom. We want to thank to Mr. Abdurrahman Khoja for his continuous support and encouragement for the field work and also all the staff of NWRC and rangers in Mahazat and Saja for their support.

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Hawaiian Maui parrotbill
re-introduction: planning for the future

The Maui Parrotbill (Pseudonestor xanthophrys) is an endangered Hawaiian honeycreeper (Drepanididae) and one of Hawaii’s rarest birds (see photo 1). In fact the species was thought extinct and only “rediscovered” in 1950 (Richards & Baldwin, 1953). Historically the Maui Parrotbill was found on the island of Maui and the adjacent island of Molokai, but today can only be found in about 50 km² of wet, montane rainforest between 1,200 m and 2,350 m elevation on the slopes of Haleakala volcano in East Maui. In 1980, the population was estimated at 500 ± 230 birds, with average densities of 12 - 17 birds/km². Subsequent surveys suggest that these estimates have not changed and the population remains stable. The species is insectivorous using its massive hooked bill to crack and chisel wood in search of beetle and moth larvae, its preferred food. One of the more peculiar characteristics for this small (26 g) passerine is its relatively slow reproductive rate; it lays only one egg and the fledgling is dependent on the parents for up to 8 months, traveling with them in a family group. The species can be long-lived (oldest bird recorded to date is +13 years), is socially monogamous and probably does not breed successfully until at least two years old. Its specialist feeding habits and life-history strategy have also contributed in part to its rarity.

Pimm (1997) has estimated that 90% of Hawaiian birds are extinct, most of which disappeared during Polynesian settlement. The species that survived into contemporary times were further subjected to predation by introduced cats, black rats (Rattus rattus) and mongoose (Herpestes auropunctatus), habitat degradation by introduced weeds and the effects of introduced mosquito-borne diseases, avian malaria and avian pox. Maui Parrotbill may be particularly susceptible to avian disease as the species is absent from most areas below 1,350 m despite the availability of suitable forest. Subfossil bones have suggested that historically, Maui Parrotbill occupied a much wider range than today including lowland and dry leeward forests. Historically too, Maui Parrotbill were reported to favor koa (Acacia koa) for foraging, a mesic/dry native tree species, from which they extracted longhorned beetle larvae (Cerambycidae). Widespread logging and ranching has all but destroyed mesic/dry forests on Maui, and the wet montane ohia (Metrosideros polymorpha) forest habitat currently occupied by Maui Parrotbill may be suboptimal.

Re-introduction to Kahikinui, East Maui

In order to improve the conservation status of the Maui Parrotbill, a second disjunct population of birds is needed to reduce the risk of stochastic and demographic events leading to the extinction of the one remaining population. A State of Hawaii land parcel at Kahikinui on the leeward side of East Maui was chosen as a potential site for a second population because, when restored, it will support a mesic koa-ohia forest in which, historically, Maui Parrotbill were found. It is also sufficient distance from the current population that movement of birds between populations would be unlikely, and is high enough elevation to be relatively disease-free. Currently, Kahikinui supports only very small patches of remnant koa-ohia forest which are highly degraded and fragmented with little or no regeneration; the remaining area comprises pasture and scrub, and a high density of feral goats. However, work has already begun to create a 480 ha fenced ungulate-free enclosure (goats, pig and deer) that will be restored and comprise the core of a re-introduction site. The area is part of a mosaic of potential recovery sites that are part of an ongoing effort to restore and reconnect key habitats across the island of Maui.
Captive Propagation

Captive propagation will no doubt play a significant role in the recovery of Maui Parrotbill, allowing for re-introductions into restored habitats. An endangered bird captive propagation facility has been maintained on Maui since the 1970s, and since 1999 the Maui Bird Conservation Center (MBCC) and the Keauhou Bird Conservation Center (KBCC) on the island of Hawaii have been managed by the Zoological Society of San Diego. Maui Parrotbill was first established in captivity between 1997 and 1999 with three founders (1:2) from wild eggs, artificially incubated and hand-reared, and two founders (1:1) added in 2001, one from a wild-collected egg and one of which was a rehabilitated wild male. First generation captive breeding occurred in 2001 and up to end 2006, 9 out of 11 young hatched have survived to wean (Lieberman, 2005). As part of the re-introduction plans, the Maui Parrotbill Recovery Working Group addressed the need to increase genetic diversity in the captive population, increase the number of males in the group thereby increasing the number of potential breeding pairs, and to investigate the differences between hand-reared versus wild parent-reared birds as captive breeders. To this end, in November 2006 the Maui Forest Bird Recovery Project captured two wild adult males from the Hanawi Natural Area Reserve (NAR), East Maui, for the captive-breeding program. The birds were captured at the Frisbee Meadows study site at 1,800 m elevation, and transported to MBCC by helicopter. Both males were initially quarantined at MBCC after which one of the males was subsequently transferred to the KBCC facility. These birds brought the captive population to 12 (5:7) at end 2006.

Research to Support Re-introduction

The Maui Forest Bird Recovery Project undertakes research to support conservation activities for Maui’s endangered honeycreepers. In 2004 MFBRP initiated research to investigate reproductive success and survival of Maui Parrotbill, to better understand the causes of rarity and factors that are limiting the population. Our two study sites are between 1,500 m and 2,100 m elevation in wet ohia-dominated montane rainforest within the Hanawi NAR, the core of the species’ range. To determine annual survival rates, birds are captured with mist-nets, color-banded and re-sighted. Color-banding of Maui Parrotbill has been ongoing since 1994 when initial studies of the species were conducted by the U.S. Geological Survey and State of Hawaii biologists (Simon et al., 2000 & Pratt et al., 2001). MFBRP continued to color-band birds as part of the Po‘ouli (Melamprosops phaeosoma) recovery program, and presently we target-net birds for focused studies. Color-banded birds also enable us to monitor breeding pairs between years, and to determine individual productivity. Nest success is also key to understanding the species’ population dynamics but because of the difficulty of the terrain and the birds’ rarity, nests are very hard to find. However, preliminary results suggest that, within their current range, poor breeding success may be limiting Maui Parrotbill numbers. Adult annual survival rates are relatively high (81%), juveniles (less than one year old) fare slightly worse (58%), but nest success averages only about 30%. The main cause of nest failure appears to be severe weather when females abandon their nests; Hanawi NAR receives up to 10,000 mm rain annually and high winds gusting to 80 km/hr are not unusual. Low nest success rates may have a disproportionate impact because Maui Parrotbill fledge only one young per year.

When establishing a new population through re-introduction, understanding population dynamics can help guide recovery efforts by enabling us to anticipate population growth rates subsequent to reintroduction and thus plan for the species’ re-establishment in new areas. In addition to providing for a second population, Kahikinui’s mesic forest may be more typical for Maui Parrotbill and in fact may support a population better than the habitat currently occupied. Although the re-introduction of Maui Parrotbill to Kahikinui may be between 10 and 20 years from now, research, captive-breeding and forest restoration will need to continue in order to achieve re-establishment in the koa-ohia forests of Haleakala.

References


Ospreys over SW Michigan, USA

The osprey (Pandion halietus) is a large raptor (1.6 kg) with a worldwide distribution (see photo 1). Most notable is its behavior of hovering over bodies of water and plunging from 15-60 meters high, talons first into water foraging for fish. Of all raptor species affected by the toxic effects of DDT pesticide between 1950-1970 it became the poster child of this eye-opening environmental abuse. The state of Michigan is two peninsulas between three of the Great Lakes of North America and the land is covered with lakes, ponds, marshes, bogs, streams and lakes. It is an ideal habitat for any creature that uses water, land and air. At one time it may have been a fortress of the osprey. The osprey enjoyed a favored status among farmers compared to other birds of prey. On the northeast coast of the USA, local knowledge held that a nesting osprey on the farm would protect its territory from the forays of other hawks. Thus young chickens could be safely allowed to roam free if an osprey had its nest nearby. In the early 1900’s a cart wheel placed horizontally on a long pole served as early osprey platforms. In 1912 there were federal regulations preventing the destruction of osprey. The first birding book of Michigan by W.B. Barrows (1912) states, “is powerful and picturesque, which adds much to the interest of the shore in the summer”. In 1931 F.W. Rapp reported numerous osprey nests in the counties along the Kalamazoo River.

After World War II the pesticide DDT (1,1,1-trichloro-2,2-bis-(p-chlorophenyl) ethane) was introduced to agriculture to great utilization and economic benefit. However, its side effects were unknown at the time and today its adverse effect is well documented as a catastrophic disaster to populations of birds of prey and fish eating birds. In the 1970’s the rivers had accumulated an entire spectrum of environmental toxins. DDT accumulated from numerous farmed fields and an assortment of light industries used the rivers for waste disposal. People remember that the rivers ran in different colors: red, blue and purple combined with brown depending on the discharge of the day. A cross section of PCB’s and other toxic acronyms can still be found in the river’s sediment. However, the public and private environmental awaking of the last 40 years has seen a return of natural conditions.

Osprey survived in small numbers after 1970 and the populations in the more remote Upper Peninsula and northern lower peninsula began to recover. However it was evident that southern areas with known historical populations and suitable habitat were not being repatriated. The first natural re-introduction of osprey into the area was recorded in 1994. An older female who possibly originated from the neighboring state of Indiana was sighted and nested on the St. Joseph River. In 1999 there were three pairs in the 25,000 km² and two of these reproduced successfully. A northward movement was noted as one pair nested on the Kalamazoo River, in 2001, 2002 and 2003 there were three pairs and two managed to reproduce. In 2004, four pairs were found and three had successful nests. In 2006 6 pairs were recorded, one on the St. Joseph River, four on the Kalamazoo river, and one on the Grand River. Only three of these nests were confirmed to be successful and it seemed that improved river’s health could sustain more ospreys. Maybe a human led effort could encourage a more rapid increase in the population? So who will take on re-introduction of a species? A veterinarian with a passion for wildlife who since 1985 had found professional and personal joy looking after natural environments. Raptor monitoring involved observing birds, locating territories, finding nests, and determining reproductive success. This evolved into banding of chicks and collecting biological samples to assess health and the bio-accumulation of PCB’s (polychlorinated biphenyls). In addition to raptor monitoring Dr. Mehne had completed ecological monitoring of mussels, fish and otters in the SW Michigan watershed for the Michigan Department of Environmental Quality, US Environmental Protection Agency, US Fish and Wildlife Agency, and other organizations. In 2001 the gift appeared from a fellow nature lover, an offer to purchase an intact 20 ha piece of water and forest.

The first view of the osprey platform comes from the top of a 30 m gravel mound (see photo 2). In the last ice age two glaciers collided here and left this mound. From the mound two bodies of water totaling 5.2 ha surrounded by wetlands are visible. The 16.7 and 6.7 meter deep lakes are the last foot prints of broken pieces of glacier. One of lakes holds a large 1 m deep shelf where fish cruise the shallow water. At the foot of the mound an endangered Michigan habitat, a prairie fen hangs on. The mound is
covered in hardwood/softwood forest of remarkable
diversity. Any sentient being with an eye for nature would
be impressed. The platform sits on a 5.5 m tower made of
scaffolding steel. The structure was provided by the
Michigan Department of Natural Resources (DNR). A
ladder runs up one side. A plywood platform of 2.4 x 2.4
meter sits on top of the structure. Holes are drilled in the
platform floor for drainage. The cage on top is a 2.4 m.
long, 2.4 m. deep and 1.2 m high frame covered with 2.54
cm wire mesh. The roof of the cage is 2 cm. plywood with
a waterproof covering.

Expansion of the osprey re-introduction program in
Michigan led to a search of sites in the south west. The
criteria for a suitable release site are the following:

1. Open shallow waters with plentiful fish, where fish swim
close to surface.
2. Water areas of 100 to 300 acres however this varies
depending on type of fish present, amount of shoal or
shallow water, and vegetation types present.
3. Proximity to other bodies of water with suitable fish
habitats.
5. Not near areas of heavy human usage such as boat
launches, beaches, parks and other developments
6. Away from power lines or other wires
7. Locations where dead snags or other natural roosting
sites are available.

8. Water habitat management practices for other species
such as waterfowl, beaver, or game fish are compatible
with osprey management.

The last factor for this piece of land was that it was owned
by a wildlife-inspired veterinarian who happened to be the
state appointed monitor of osprey and bald eagle
populations of the southwestern waterways of Michigan’s
lower peninsula.

Osprey re-introduction in Michigan had begun in 1998 led
by Al Stewart, a DNR Biologist. Presently Lori Sargent of
the Michigan DNR Wildlife Division is the program
coordinator. The first sites was Kensington Metro Park in
the greater Detroit area and Maple River State Game
Area. The present site at Stoney Creek Metropark is in its
fourth year and has re-introduced 14 ospreys chicks. To
date a total of five active nesting pairs and numerous
sightings are recorded annually in a large arc around the
Detroit urban area. The south west Michigan project
started in May 2003 with approval from the DNR. Only
male chicks from nests that had at least 2 - 3 nestlings
were collected. In 2003, three six week old chicks were
collected. From the successive year 4.5 - 5.5 week old
chicks were collected. At 4.5 weeks old the chicks are
considered to be 75% of their adult body weight and by
identifying coloration of breast feathers they can be
accurately sexed. The chicks are transported 340 km and
arrive in the evening at the new site. They are kept
overnight in traveling boxes and in the morning they
receive a veterinary examination and placed in the tower’s
enclosure. Veterinary care consists of 0.05 ml of a large
animal injectable vitamin B complex product (Butler
Animal Health Supply) and 0.05 ml vitamin E plus
selenium (BoSe, 1mg/ml sodium selenite & 68 IU/ml
vitamin E, Schering-Plough Animal Health) intramuscular
injections at arrival and repeated at two weeks after
arrival. The birds are treated for internal parasites with
fenbendazole (100 mg/ml liquid) orally at 20 - 50 mg/kg
once a day for three days and repeated at 14 days for two
total doses. Treatment for biting lice is accomplished with
very light dusting with Ovitrol Plus (Vet-Kem, Wellmark
International) placed first on the front of the bird and two
days later on the back of the bird. Ovitrol Plus insecticide
powder contains methoprene, pyrethrin and piperonyl
butoxide and is considered safe for small dogs and cats.
Fecal and blood examination are only performed if the
chicks appeared to be unwell. The nestlings are taken
from a seemingly healthy population on the northern
portion of the lower Michigan peninsula. This is a less
developed area that has not suffered the intense toxic
pressure from agriculture and industry. The nests here
had been monitored since the 1960’s by Dr. Sergej
Postupalsky. The scientist/artist eyes of Dr. Postupalsky
have the 40 years of experience that allows almost 100%
accuracy of the 4.5 week old nestlings’ sex.

Prior to the chicks arrival the platform and cage are
sanitized with soap and water. Two months prior the cage
is sprayed with chlorpyrifos insecticide. Fresh substrates
are provided for the floor. A nest of woven fox grape vines
of up to 1.5 cm in diameter creates a 1 m wide disk. In the
center a bed of soft shredded bark from tulip and ash
trees is placed. The remainder of the floor is either left
bare plywood and larger pieces of tree bark. In particular
the bare wood is used by the nestlings during hotter days.
The chicks arrive in early July and the younger chicks
usually required two days of force feeding. After that they adapt to being feeding themselves on fish offered suspended on the end of a stick. Interestingly the older chicks may required up to two weeks of force feeding before adapting to stick feeding. Birds are fed twice a day even when small. Each bird is fed to satiation and the amount of food ingested is recorded. Regular weighing of the birds is avoided to prevent regular handling and the birds’ progress is monitored via the daily feed record.

The chick’s caretaker is a remarkable individual, David Matekel is a widowed American Indian martial art expert suffering from rheumatoid arthritis. In his own words, “I was living in town and slowly dying”. Then he moved out to the woods and occupied the caretaker’s house. The advantage is that he has the time and mental focus to sit and bond with the chicks. A successful grant application to the Natural Heritage Foundation of the DNR has provided $5,000 per year to support David’s work. At the beginning of the process David spends 90 - 120 minutes with the birds 2 - 3 times per day. In his observation he noted that the chicks always rest at parallel positions to each other. So he always holds his body parallel to the chicks. Feeding times are at 10:00 a.m. and 7:00 p.m.

Toward the end of the process feeding is reduced to once a day as the birds adapt to the feeding regimen the birds will consume 18 - 21 pieces of 1.25 cm fish cubes at each feeding. By the end of process up to 3.6 kg fish are used each day. Frozen fish are thawed in a bucket with 56 gm. Nutri-cal (Evenco Pharamaceuticals), a calorie and vitamin B supplement to provide additional thiamine. The fish used for feeding is a mixture of white sucker (Catostomus commersoni), brown bullhead (Ameiurus nebulosus) and other species. The local DNR Fisheries in Plainwell, MI provides the wild-caught, electro shocked fish. Wildlife Division personnel at Barry County State Game Area clean, freeze and store the fish. This is important as the chore of cleaning 181 kgs of fish every year is not small.

At the end of August the door of the release cage is opened and the birds are encouraged to leave. Each bird receives Federal Fish and Wildlife band and a green plastic numbered hacking ID band. The criteria to judge the flight readiness of the chicks is based on their progress there several wing flapping phases.

- Wing stretching
- Hop flying
- Hang flying (from side of cage or upside down from ceiling)
- Flying to a perch 76 cm. high
- Once they have mastered these the chicks are judged ready. Chicks may be released at different times depending on progress. In 2003, three birds were released; in 2004, two birds; in 2005, one bird; and two birds in 2006.

The birds instantly take to the air and a steep learning curve can be appreciated. Chuck and David report many entertaining moments observing the bird making mistakes in the air or water surface and then immediately gaining control of new skills. The first flights maybe as long as 8 km. and last up to an hour. One bird released on 11th August 2006 was seen 400 Km away in the first week of freedom and then returned. Fish are left on the roof of the hacking cage for the first week, but is rarely consumed. The ability to catch fish is an innate behavior and fishing attempts start within the first days of flight. The birds leave to the south as autumn arrives in the area. As with any large bird of prey re-introduction project the proof of success takes time to appear. This little project has been active for four years and young wild osprey from North America are known to migrate south before their first winter to Central and South America. There they stay for their second summer and then begin to wander. When sexual maturity approaches they journey back home. The males are loyal to the land of their childhood and will chose a nest site and hope to attract a female.

In the summer of 2006 an unknown osprey appeared around the release tower. It was seen for several days exchanging vocalizations with the two young residents. Unfortunately no identification band could be seen on the visitor’s flybys and binoculars were never close by when the bird appeared. Judging from the visiting bird’s behavior it seemed to be familiar with the site and showed little concern to the presence of humans. Could it be a bird from an earlier year? In 2005, Dr. Mehne was nominated as the first DNR Volunteer of the Year by the employees of the DNR. This is in recognition of his long term effort monitoring bald eagle, hawk, owl, and blue heron populations for environmental toxins, participation in the Kalamazoo River mussel survey of the Natural Heritage Program of Michigan DNR, and for his personal efforts to revive the ecosystem of his own 20 ha of Mother Earth. The reward is one thing but the in the words of Dr. Mehne, “I come here to lower my blood pressure.” What motivates this project… where does the passion come from? What motivates a person to devote 30% of energy to a project with no financial reward? It is a simple love of nature and an appreciation of natures complexities. A love that comes from being in the woods as a child. Of having mud under your toenails on a regular basis. From parents who encourage spending time outdoors and shared natural beauty. As one grows up and learns different philosophies a spiritual connection to Mother Earth developed that parallels native American’s worship of their environment. The land provided food, shelter, joy and beauty. All the gifts give rise to the complex force known as love and set the internal compass towards the natural environment.

References
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Contribution by Thomas deMaar, D.V.M. who is a member of the IUCN/SSC RSG. He is senior veterinarian at the Gladys Porter Zoo, Brownsville, TX, USA.
Email: tom_demaa@hotmail.com
Dummy transmitters for pre-release acclimation of captive-reared birds

Monitoring the fate of captive-reared or translocated birds following release is an essential component of any release or reintroduction program. In most cases, post-release monitoring involves radio-telemetry (e.g., Snyder et al., 1994, Seddon et al., 2000, Collazo et al., 2003, Brightsmith et al., 2005, White et al., 2005). Because telemetry instrumentation can potentially affect post-release behavior and survival (Ramakka 1972, Johnson and Berner 1980, Marks and Marks 1987, Gessaman and Nagy 1988, Massey et al., 1988, Hooge 1991, Reynolds et al., 2004), researchers should take measures to minimize any potential negative effects of instrumentation. One method is to adequately acclimate birds to radios prior to release (Sims 2000, Collazo et al., 2003, White et al., 2005). However, because of the finite and relatively short life (i.e., weeks, months) of most avian transmitters, pre-release attachment of such devices to birds for sufficient time for effective acclimation can also reduce the potential life of the radios post-release. Even if radios are not activated when attached, the magnetic switches of avian transmitters can easily become dislodged during the acclimation process, thereby activating the transmitters. Also, some birds (e.g., psittacines, raptors) can physically damage the antenna and attachment mechanism during the acclimation process, rendering the device useless. To overcome these problems, we developed a practical and effective method for constructing facsimiles, or “dummy”, transmitters for pre-release acclimation of captive-reared birds.

Methods

As models for the dummy transmitters, we used Holohil® Models SI-2C and SB-2C avian transmitters. These “necklace type” radios have cylindrical brass transmitter housings and are designed for small to medium psittacines or other similarly sized (i.e., 120 - 400 g) avian species with strong beaks. Accordingly, the dummy radios also had to withstand any potential abuse by such birds during pre-release acclimation. We used empty cartridge cases as the housing for the dummy radios, and found that 9mm Lugers® and .38 Special/.357 Magnum caliber cartridge cases most closely matched the external dimensions of the SB-2C and SI-2C radios, respectively (see figure 1). Centerfire rifle cartridge cases (e.g., 5.56mm caliber) can also be used after trimming to proper length with a small pipe-cutting tool. To fabricate the dummy radios, we first drilled 2 small (2-3mm diameter) holes along one side of the case (see figure 2). These holes were used to insert an approximately 12 cm - long piece of 36kg (80lb) minimum test plastic-coated steel wire to serve as the attachment mechanism. We also inserted into one of the holes an additional 16cm - long piece of the same wire to approximate the transmitter antenna (see figure 3). We then filled the cases with small lead fishing weights to attain a weight equal to the actual radios (e.g., 12g for SI-2C). Finally, we sealed all openings with dental acrylic (see figure 4). We then inspected the dummy radios for any rough or sharp edges, which we removed using a small file. The total time required to fabricate a single dummy radio was approximately 10 - 12 minutes.

The dummy radios are attached to birds in the same manner as the actual radios, using either the small brass crimp supplied by the transmitter manufacturer, or small steel crimps used for securing wire fishing leaders. We normally attach the dummy radios approximately 30 days prior to release in order for the birds to become accustomed not only to the presence of the device, but also to flying and foraging with a transmitter. We carefully observe all birds for several hours immediately following attachment to detect any initial adverse effects of the device. We then replace the dummy with a functioning radio approximately 3 - 5 days prior to release.

Results

To date, we have successfully acclimated 111 captive-reared Amazona parrots prior to release using this dummy transmitter design. We first deployed the dummy radios with captive-reared Hispaniolan Parrots (Amazona ventralis; n = 49) in the Dominican Republic (Collazo et al., 2003), and also have used them with captive-reared Puerto Rican Parrots (A. vittata; n = 82) in Puerto Rico (White et al., 2005, U.S Fish and Wildlife Service, unpubl. data). The initial reaction of parrots to the dummy radios includes “preening” the antenna, and attempts to dislodge the device. These reactions normally occur for approximately 3 - 4 days, after which the birds display steadily decreasing preoccupation with the devices. However, intensity and duration of these reactions may vary widely among individual birds, with some individuals adjusting to the devices more quickly than others. In all cases however, the parrots have appeared completely acclimated and oblivious to the devices within 10 -15 days. Following acclimation with the dummy radios, parrots display no noticeable reaction following attachment of the actual radios prior to release.

Discussion

Our facsimile, or dummy, avian transmitter design has proven simple, effective, and practical for acclimating captive-reared parrots to telemetry instrumentation prior to release. A major advantage of the design we have developed and described is that it can easily be adapted to correspond to a wide variety of avian transmitters and attachment styles. The dummy radios can also be painted with nontoxic enamel paint for individually marking birds during acclimation periods. Because of the diversity of existing cartridge cases, researchers need only to select a specific cartridge case that most closely matches the intended model or style of radio to be deployed. Further, empty cartridge cases are widely available, and can be easily acquired from hunters, local gun clubs, police stations, or military facilities.

Based on our observations of the parrots following subsequent attachment of functioning radios, the birds appeared oblivious to the radio-transmitters following the acclimation period. Moreover, post-release flight skills and foraging activities did not appear hampered by the transmitters following acclimation with the dummy radios (Collazo et al., 2000). When radio telemetry is to be used, we believe that effective pre-release acclimation to radio-transmitters facilitates post-release adjustment to the
release environment by captive-reared birds. Intuitively, this should promote increased survival by allowing released birds to focus on critical activities such as foraging and predator avoidance, rather than the distraction of adjusting to telemetry instrumentation. Our dummy radio package has proven to be an effective means for pre-release acclimation of captive-reared birds.

Acknowledgments
We thank the U. S. Fish and Wildlife Service – Puerto Rican Parrot Recovery Program for financial support for this work. We also thank Gilberto Ortiz and Kim Joyner for helpful comments and suggestions during fabrication and deployment of the initial dummy transmitters in 1997. The use of trade names in this manuscript does not imply endorsement by the United States Government.

References


MAMMALS

Recovery efforts for the Vancouver Island marmot, Canada

The Vancouver Island marmot (Marmota vancouverensis) is a housecat-sized ground squirrel that is endemic to Vancouver Island, British Columbia, Canada (see photo 1). Like other marmots the species is colonial, fossorial, herbivorous and hibernates during winter. M. vancouverensis is closely related to the hoary marmot (M. caligata) and Olympic marmot (M. olympus) which occur on nearby mainland areas of British Columbia and Washington State. It differs from other species in fur colour and other physical and behavioural characteristics. On average, Vancouver Island marmots achieve sexual maturity at age 3 - 4, with females producing litters of 3 - 4 pups in alternate years. Some two-year-olds disperse but adults tend to be relatively sedentary, occupying home ranges of 1 - 30 ha depending upon local habitat conditions. The natural habitat of Vancouver Island marmots consists of subalpine meadows located at 900 - 1500 m a.s.l. Such meadows are thought to be maintained by avalanches or fire, are typically small in size (1 - 30 hectares), and comprise a small fraction (<1%) of the otherwise forested landscape. Consequently M. vancouverensis is rarer and more sparsely distributed than M. caligata or M. olympus.

Recent population declines were not related to habitat loss or reproductive failure. The proximate cause of decline was unsustainably high levels of predation by wolves (Canis lupus), cougars (Felis concolor) and golden eagles (Aquila chrysaetos), all of which occur naturally on Vancouver Island. Predator populations increased during the 1980s, apparently in response to changing populations of their principal prey (the black-tailed deer Odocoileus hemionus), which in turn are thought to have responded to widespread forestry operations (Bryant & Page, 2005). Given these trends, the Vancouver Island Marmot Recovery Team proposed that a captive-breeding and re-introduction program was essential if extinction of the species was to be prevented (Janz et al., 2000).

Captive-breeding Program

The captive program began slowly, with six marmots being sent to the Toronto Zoo in 1997. Calgary Zoo joined the program a year later, followed by the privately-operated Mountain View Conservation and Breeding Centre in 1999. Finally, a specially-designed marmot facility was constructed at Mount Washington on Vancouver Island; the intent was that this facility would serve as a “halfway house” to habituate marmots to local conditions prior to release. This facility was completed in 2002. A total of 56 wild-born marmots were taken into captivity from 1997 through 2004. Most animals were captured as pups (n = 31) or yearlings (n ≥ 8). This age-bias was intentional; the reasoning was that younger marmots would more readily habituate to captivity. In addition the intent was to minimize disruption to established breeding pairs at wild colonies. Marmots inhabiting man-made clearcut habitats were also preferentially targeted, and in three cases “sole survivors” from historically larger colonies were captured (Bryant,...
The management philosophy at all captive facilities was to minimize handling so that marmots might retain natural behavior. Animals were not on public display and strict quarantine protocols were followed to minimize the risk of between-facility disease transmission. Breeding pairs were selected and housed together based on a genetic studbook, and marmots were allowed to hibernate as they do in the wild (McAdie et al., 2003). A total of 171 pups were born in captivity from 2000-2006, including 56 in 2006 alone. Annual survival rates were high ($S = 95.3\%$) and the observed population growth rate was positive ($\lambda = 1.31$).

**Transplants of Wild-born and Releases of Captive-born Marmots**

Re-introduction efforts involved transplants of wild-born marmots and releases of captive-born marmots. Efforts began modestly, with six marmots being captured from clearcut sites and transplanted to a single natural meadow in July of 1996. This initial experiment was unsuccessful, with four animals dying during hibernation, one apparently being killed by a predator, and one disappearing. Numbers of transplanted marmots thereafter remained small due to a lack of candidate animals, although in several cases solitary wild females were provided with a wild-born male to ensure the possibility of reproduction. The first two captive-born marmots were released in 2003. Numbers have gradually increased over time, with 31 animals being released in 2006 (see table 1). Given the current captive population size and growth rate, the Team envisions release of 30 - 50 marmots annually without negative demographic or genetic impacts to the captive population.

Release methods were straightforward. After being surgically implanted with a radio transmitter (Bryant & Page, 2005) and allowed to recover, marmots were released in natural meadows that were historically or currently occupied by marmots. Most individuals were provided with a plywood shelter box and food for several weeks; other releases were "hard" with no site preparation or supplemental feeding. A variety of age-classes and group sizes were released, including yearlings, two-year-olds and adults, with group sizes of two being most common (range = 1 - 6). Marmots were monitored using radio-telemetry, with some sites being visited daily and others only every week or two. At one site an electrified fence was erected in an effort to deter terrestrial predators (see photo 2). At another site several anti-predator approaches were employed simultaneously, including human “shepherds”, radios left playing in tents, tape-recordings of barking dogs, and use of “bear-banger” noisemakers.

<table>
<thead>
<tr>
<th>Year</th>
<th>Male (m)</th>
<th>Female (f)</th>
<th>Total</th>
<th>N captured as pups</th>
<th>Male (m)</th>
<th>Female (f)</th>
<th>Male (m)</th>
<th>Female (f)</th>
<th>N subsequently recaptured</th>
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<td>6</td>
<td>2 f</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>6</td>
<td>2</td>
<td>8</td>
<td>3 m</td>
<td>3</td>
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<td>19</td>
<td>6 m, 4 f</td>
<td>2</td>
<td>2</td>
<td>-</td>
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</tr>
<tr>
<td>2000</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>2 m, 2 f</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1 f</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>2 m, 3 f</td>
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<td>1</td>
<td></td>
<td></td>
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<tr>
<td>2002</td>
<td>4</td>
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<td>6</td>
<td>2 m, 2 f</td>
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<td>4</td>
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<td>8</td>
<td>2 m</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>1 f</td>
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<tr>
<td>2004</td>
<td>1</td>
<td>1</td>
<td>1 f</td>
<td></td>
<td>5</td>
<td>4</td>
<td>9</td>
<td></td>
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</tr>
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<td>2005</td>
<td>-</td>
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<td>4</td>
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<td>2006</td>
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<td>11</td>
<td>11</td>
<td>11</td>
<td>31</td>
<td>70</td>
<td>1 m, 2 f</td>
</tr>
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</table>

**Table 1: Annual numbers of marmots taken into captivity, transplanted and released**

Notes: 1) wild-born marmots (excluding three recaptures of previously released marmots); 2) wild-born marmots with little or no time spent in captivity prior to release & 3) captive-born or wild-born marmots that spent at least one winter in captivity prior to release.
The captive-breeding component of the recovery project has been resoundingly successful. Re-introduction success is more difficult to evaluate, and it would be premature to describe efforts as successful or unsuccessful. The Team designed short-term measures-of-success that are sequential, explicit and measurable, with the intention of determining what factors encourage success. The measures included:

- Immediate post-release site-fidelity and survival.
- Use of historical marmot habitat (burrows, vegetation and lookout spots).
- Weight gain (similar to that of wild marmots).
- Social behavior (grooming, nose-greeting and sleeping behavior).
- Anti-predator behavior (whistling or retreat into burrows when approached).
- Timing of hibernation (compared to wild marmots).
- Survival rate during hibernation (compared to wild marmots).
- Site-fidelity and appropriate social behavior in subsequent spring.
- Successful reproduction in subsequent years.

All of these measures of success have been achieved, although not all were achieved by all animals. Some marmots quickly adapted to release habitats and behaved just as their wild-born counterparts do, eating grasses and flowers, gaining weight, whistling when an eagle flew over, digging burrows and hibernating at appropriate times. One milestone was achieved in 2002, when a transplanted male produced a pup with a wild-born female. Another milestone was reached in 2004 when a captive-born male produced pups after mating with a wild female. In 2006 two captive-born marmots that were released in 2004 produced a litter of 4 pups, becoming the first captive-born pair to achieve the 9th measure of success. Other marmots were less successful, dispersing immediately from the release site, showing up in unsuitable habitat, or choosing sites that prevented successful hibernation. A few marmots made impressive (1 - 27 km) dispersal movements to other historical marmot habitats, where more often than not there was no potential mate present. Other re-introduced marmots were killed by wolves, cougars or golden eagles, just as wild marmots were (Bryant & Page, 2005). The anecdotal evidence to date is that it is easier to introduce a male to a female rather than vice versa, that marmots can be successfully introduced at any time from May through September, and that while presence of existing burrows and marmots is an asset, they are not essential.

It will take many more years of patient data-collection to quantify the various factors that may encourage or discourage successful re-introduction, but the fact remains that there are marmots on five mountains at which extinction occurred during the 1990s, and that captive-born marmots can and have survived and bred in the wild. Ultimately the prognosis is hopeful.

Acknowledgements
The Vancouver Island marmot recovery project is a collaborative effort funded by various levels of government, private forest companies, and the general public. Many people worked tirelessly under difficult conditions to monitor marmots in the field and in captivity. Funding for this analysis was provided by the Marmot Recovery Foundation (MRF), which serves as the fund-raising and administration arm for the recovery effort and the Recovery Team.

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Florida panther re-introduction, Florida, USA

The Florida panther (Puma concolor coryi) is the last subspecies of Puma still surviving in the eastern United States. Historically occurring throughout the southeastern United States, today the panther is restricted to less than 5% of its historic range in one breeding population of less than 100 animals, located in south Florida. The panther is threatened with extinction and human development in panther habitat negatively impacts recovery. Panthers are wide ranging, secretive, and occur at low densities. They require large contiguous areas to meet their social, reproductive, and energetic needs. Panther habitat selection is related to prey availability (i.e., habitats that make prey vulnerable to stalking and capturing are selected). Dense understory vegetation provides some of the most important feeding, resting, and denning cover for panthers. Habitat degradation, fragmentation, and loss are among the greatest threats to panther survival, while human’s lack of tolerance is one of the greatest threats to panther recovery. Problems associated with being a single, small, isolated population and vehicle strikes have continued to keep the panther population at its current low numbers. Potential panther habitat throughout the Southeast continues to be affected by urbanization, residential development, conversion to agriculture and silviculture, mining and mineral exploration, and lack of land use planning that incorporates panther needs. The recovery strategy for the Florida panther is to maintain, restore, and expand the panther population and its habitat in south Florida.
this population into south-central Florida if sufficient habitat exists, re-introduce at least two additional viable populations within the historic range outside of south and south-central Florida, and facilitate panther recovery through public awareness and education (U.S. Fish and Wildlife Service, 2006). Range expansion and reintroduction of additional populations are recognized as essential for panther recovery.

**Re-introduction Feasibility Studies**

The Florida Fish and Wildlife Conservation Commission conducted two re-introduction feasibility studies, from 1988 - 1989 (Belden & Hagedorn, 1993) and from 1993 - 1995 (Belden & McCown, 1996), to evaluate the feasibility of re-introducing panthers into unoccupied areas of their historic range. In 1988, seven reproductively sterilized pumas (P. c. stanleyana) captured in west Texas were released in northern Florida as surrogates for evaluating the feasibility of translocating Florida panthers (see photo 1). The pumas included three adult males, three adult females, and one yearling female. They were monitored from June 1988 to April 1989. These pumas established overlapping home ranges, killed large prey at predicted frequencies, and settled into routine movement and feeding patterns prior to the deer and wild hog hunting season. However, during the hunting season, the pumas were either killed or abandoned their home ranges. Subsequent wanderings into urban areas and livestock operations necessitated the early removal of study animals. Belden & Hagedorn (1993) recommended additional research with a larger initial stocking rate of 10-20 pumas to ensure that a social structure could be established even if some of the animals did not survive.

In 1993, 19 pumas (P. c. stanleyana) were released into north Florida, including 11 females and eight vasectomized males. Six of the pumas were born and raised in captivity, 10 were captured in the wild in western Texas and translocated to Florida, and three were captured in the wild in western Texas and held in captivity for two to eight years prior to release. Animals were monitored using radio-telemetry from February 1993 to June 1995 (see photo 2). Fifteen pumas established one or more home ranges. Captive-raised animals tended to establish home ranges more quickly and were more likely to be in association with other animals than were wild-caught animals. However, captive-raised animals, particularly males, were more likely to be seen and caused most of the human/puma interactions that created negative attitudes toward the program. The study concluded that reestablishment of additional Florida panther populations is biologically feasible. It would require incorporating the advantages and planning around the disadvantages of both captive-raised and wild-caught translocated animals. However, complex social issues were identified that must be satisfactorily addressed, and it must be decided whether the tremendous costs involved (economic, political, social, etc.) in the re-establishment of additional Florida panther populations can be offset by the benefits gained in reducing the risk to the present Florida panther population. The study highlighted the need for an effective and comprehensive public education and outreach program that occurs well ahead of releasing panthers into re-introduction sites.

**Next Steps**

Thatcher et al. (2006) identified nine potential re-introduction sites throughout the historic range of the Florida panther. Evaluations were based on area size, amount of public lands, prey base, livestock density, road density, and human population size. No one site was found to be optimal for all the criteria evaluated. These potential re-introduction sites need to be further evaluated in coordination with agencies and the public in the other southeastern states. This needs to include conducting preliminary public scoping, conducting field surveys, and using the National Environmental Policy Act process to develop and refine appropriate re-introduction alternatives. Once a site is chosen, protocols will need to be developed to determine the number of panthers from each age and sex class that are needed and which individuals are the best candidates for release, methods of release, and monitoring. Education and outreach efforts will be needed to address social concerns before and
after panthers are released.

References


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Re-introducing the swift fox to Blackfeet Tribal Lands, Montana, USA

We released 123 (57:66) captive-bred swift fox (Vulpes velox) on Blackfeet Tribal Lands in Montana, USA, over five years using a semi-hard release method. The restoration of the culturally important species was in accordance with a request from the Blackfeet Nation for the Cochrane Ecological Institute (CEI) in Alberta, Canada to provide captive-bred swift fox and a release protocol. The CEI had also provided swift fox for the Canadian re-introduction (see Smeeton & Weagle, 2000). The program was entirely dependent on funding from private donations raised mainly by Defenders of Wildlife in the USA and the CEI in Canada. Costs for the program were under varying constraints particularly in the first few years.

Methods

The Release Site and Area: The Blackfeet Reservation in northwest Montana is 600,000 ha, approximately half of which is native grassland habitat. Swift fox had previously occurred in the area with relatively high abundance (Knowles et al., 2003). The release site was a tribally owned ranch which consisted of 3,200 ha of grassland habitat and was 30 km southeast of Browning, Montana. Largely contiguous pastureland occurred both to the south of the ranch and north to the Canadian border. Surveys confirmed that Richardson’s ground squirrels (Spermophilus richardsonii), North American badgers (Taxidea taxus) and other small rodents and passerines were present (Knowles, unpub. data).

Table 1. Survivorship & mortality of radio-collared swift fox between 1998-2002

<table>
<thead>
<tr>
<th>Year Released</th>
<th>No. Released</th>
<th>No. Collared</th>
<th>Confirmed Deaths</th>
<th>Discarded Collars</th>
<th>Not Located After 1st winter</th>
<th>Confirmed Alive After 1st winter</th>
</tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0/0</td>
<td>N/A</td>
</tr>
<tr>
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<td>15</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>0/0</td>
<td>0/6</td>
</tr>
<tr>
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<td>16</td>
<td>6</td>
<td>1</td>
<td>0/6</td>
<td>0/3</td>
</tr>
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<td>25</td>
<td>11</td>
<td>4</td>
<td>3</td>
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<td>0/1</td>
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Results

Individual behavior varied on release but the majority of animals immediately entered the PPS and did not exit for some time, whereas others were extremely active within the...
vicinity of the PPS. Radio-collared foxes ceased to use the PPS after a maximum of five days. Thirty juvenile foxes released in 1998 were not radio-collared and were monitored by track and sign (see table 1). In 1999, eight radio-collared adults were released with seven juveniles. These adults ranged in age from 1-3 years. Six individuals (75% of radio-collared individuals for 1999) were located up to and including July 2002 and had, by then, survived almost three years in the wild with one of the females then aged six years. In 2000, the fitting of mortality sensors was omitted from the radio collars (S. Bremner-Harrisson, pers. comm.) and, as a result, data regarding survivorship are uncertain.

Results give an overall minimum survival rate at 12 months of 26.8% (the total number of swift fox proven alive (11) divided by all radio-collared foxes (41)) for radio collared swift fox released. Our minimum survival rate is marginally higher than survival rates reported by Carbyn et al. (1994) (z = 1.70, P = 0.04). The first breeding observation was in spring 1999 (M. Carpenter & B. Crawford, unpub data). In total, between 1999 and 2002, a minimum of 78 swift fox were born on Tribal Lands with 10 natal dens and 31 cubs observed in the spring of 2002. A live trapping survey conducted in the winter of 2003 captured three ear-marked adult foxes which had been released in 1998 (E. Schauster, unpub. data). Additionally, trapping efforts in 2004 found another ear-marked female that had been released in 1998.

Discussion

The failure to locate 12 (29.3%) of the radio-collared animals was probably due to a combination of factors. Apart from collar failure and the possibility that a fox was undetected during surveys, funding constraints meant that monitoring was not given top priority, thus losing the opportunity to collect data at crucial times particularly the months after the foxes were released. Additionally, the sporadic nature of the monitoring meant that many dead radio-collared foxes were too decomposed to ascertain cause of death. This is the first re-introduction program for swift fox using only captive-bred animals and the first time that the PPS have been used consistently. Although a direct comparison with survival of hard-released foxes in Canada is difficult, we believe that the behavior of the foxes post-release and the subsequent higher survival rate merit further investigation regarding release protocols. A semi-hard method of release may have both welfare and economic benefits as it results in appropriate behavior upon release, which may contribute to higher survivorship, and it is much less expensive than labor intensive soft-release methods.

Acknowledgements

We are very grateful to all project volunteers. Thanks to Ira New Breast, Minette Johnson and Blackfeet residents. We are grateful for financial support from many organizations and individuals.

References


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Re-introduction and conservation of Channel Island foxes, California, USA

The island fox (Urocyon littoralis), a diminutive relative of the gray fox (U. cinereoargenteus), is endemic to the California Channel Islands (see photo 1). Six subspecies are recognized, one on each of the six Channel Islands on which the fox occurs. Four of the six island fox subspecies experienced catastrophic declines in the late 1990s (see table 1). By 2001, the three fox subspecies on the northern Channel Islands (San Miguel Island fox [U. l. littoralis], Santa Rosa Island fox [U. l. santarosae], and Santa Cruz Island fox [U. l. santacruzae]) had declined by as much as 95% from 1993-1994 levels, due to predation by golden eagles (Aquila chrysaetos) (Roemer et al. 2001a, Coonan et al. 2005a, 2005b). Additionally, the island fox subspecies on Santa Catalina Island (U. l. catalinae) in the south declined precipitously in 1999-2000 due to an epidemic of canine distemper virus (Timm et al, 2000). In 2004, the U.S. Fish and Wildlife Service listed those four island fox subspecies as endangered. The four listed subspecies are now the object of aggressive recovery programs which utilize re-introduction and/or translocation to increase the currently small wild populations. The island fox conservation actions have included efforts to mitigate two major recent threats: canine distemper virus (CDV) in Santa Catalina Island foxes and golden eagle predation on the three northern Channel Islands fox subspecies. All efforts have included captive breeding of island foxes to...
increase the populations of each island subspecies to viable levels. As inhabitants of small islands that have been dominated by human activities for hundreds of years, island foxes will likely require intensive monitoring for the foreseeable future in order to avoid similar catastrophic declines.

**Natural History:** Island foxes are opportunistic omnivores, taking a wide variety of seasonally available plants and small animals. Island foxes generally have smaller territories, exist at higher densities, and have shorter dispersal distances than mainland fox species. Island foxes, like most foxes, are distributed as socially monogamous pairs occupying discrete territories. However, despite being socially monogamous and territorial, island foxes are not exclusively genetically monogamous. They do, however, show biparental care (Roemer *et al.*, 2001c).

**Santa Catalina Island:** On Santa Catalina Island, the Santa Catalina Island Conservancy, which owns and manages 88% of the island, contracted with the Institute for Wildlife Studies (IWS) from 1999 - 2005 to develop and implement island fox recovery activities after the fox population had drastically declined due to the CDV outbreak. Beginning in 2006, the Conservancy assumed full responsibility for island fox recovery and management. Although Santa Catalina is a single island, the island’s fox population can be considered as two subpopulations due to a narrow isthmus which restricts nearly all movement between the eastern and western ends. The recovery actions included translocation of juveniles from the dense population on the western end of the island to the eastern end, where foxes had been essentially extirpated, vaccination of nearly the entire island fox population against CDV following captive trials of vaccine safety and efficacy, and a captive breeding program to provide juveniles for release to the eastern population. From 2000 to 2004, a total of 57 foxes were released from captivity, and 22 were translocated from the west end to the east end. By 2004, the minimum number of known foxes was 271, with an island-wide population estimate of 360 foxes (D. Garcelon, Institute for Wildlife Studies, unpubl. data) (see photo 2). Based on the high survival (75%) of foxes released from 2001 - 2003, and the high productivity of foxes in the wild, the captive breeding effort was terminated after the 2004 breeding season. The wild population has continued to increase annually since that time. As of December 2006, the minimum number of known foxes on Catalina Island was 346 and the island-wide population estimate was 509 foxes (J. King, Catalina Island Conservancy, unpubl. data).

Recent investigation indicates the increasing importance of ear tumors (ceruminous gland carcinomas) as a mortality factor for Santa Catalina Island foxes. The tumors, first discovered in 2001, are associated with severe *otitis externa* and the presence of ear mites (*Otodectes*), which occur at high rates in Catalina foxes. In 2005, ear tumors were found in 38% of Catalina foxes older than 3 years (W. Vickers, Institute for Wildlife Studies, unpubl. data). Investigation of risk factors that may play a role in the development of these tumors in Santa Catalina foxes is ongoing.

**Northern Channel Islands:** Concerned about the deepening decline in the three subspecies of island foxes from Channel Islands National Park (CINP), the National Park Service (NPS) convened an Island Fox Working Group in 1999, to develop strategies to recover island fox populations to viable levels. Based on the group’s recommendations, the NPS began initiating emergency actions that same year, the objectives being to remove the primary mortality factor affecting island foxes (golden eagle predation), and to recover island fox populations to viable levels via captive breeding. Eventually all wild foxes were brought into captivity on San Miguel and Santa Rosa, while only a portion of the Santa Cruz population was brought in. A model based on likely rates of reproduction and survival suggested that annual releases of 10 - 20 foxes for a decade could restore populations to levels (250 - 300 foxes) robust enough to resist demographic extinction (Roemer *et al.*, 2001b). Recent PVA workshops have been evaluating the potential impact of continued golden eagle threats on the Northern Islands and have developed models that can be used in a recovery plan to specify population-specific recovery criteria (D.

Table 1. Estimated number of wild adult & juvenile foxes for the four listed island fox subspecies (Numbers of foxes in captivity are in parentheses).

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<td>216.0</td>
<td>1,780</td>
<td>14</td>
<td>51 (28)</td>
</tr>
<tr>
<td>Santa Cruz</td>
<td>243.1</td>
<td>1,465</td>
<td>50-60</td>
<td>&gt;300 (24)</td>
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<tr>
<td>Santa Catalina</td>
<td>194.0</td>
<td>1,342</td>
<td>103</td>
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Photo 2: Channel island fox (*Urocyon littoralis*) being released © Tim Coonan
Doak, University of California, Santa Cruz, and V. Bakker, University of California, Davis, unpubl. data). On the northern Channel Islands, removal of golden eagles and captive breeding of island foxes have moved the three island fox subspecies away from the brink of extinction and have allowed the re-establishment of small wild populations.

**Translocation of Golden Eagles:** From 1999 through 2006 raptor biologists from the Santa Cruz Predatory Bird Research Group trapped 44 golden eagles from Santa Cruz and Santa Rosa Islands and relocated them to northeastern California. (Latta et al., 2005, D. Garcelon, Institute for Wildlife Studies, unpubl. data). None of the first 12 translocated golden eagles attempted to return to the islands for the 1.5-year life of their satellite transmitters. As of 2006 as few as five golden eagles were estimated to remain on the northern Channel Islands and as of early 2007, no nesting golden eagles were known from the northern islands. The last confirmed sighting was in summer of 2006. Evidence from radiocollared island foxes indicates that eagle removal has reduced predation and increased annual survivorship of wild island foxes. Annual fox survivorship on Santa Cruz Island increased from 61% in 2001, the second year of eagle removal, to 70% in 2002, and to over 80% in 2003 (Coonan et al., 2005a). Although survivorship of wild island foxes on Santa Cruz increased over the period of eagle removal, predation was high on foxes from the initial release groups. Seven of 12 captive island foxes released to the wild on Santa Cruz in 2002 and 2003 died from eagle predation within 5 weeks of release (Coonan et al., 2005a). On Santa Rosa Island, where eagles also have nested, 10 released foxes died from predation from 2004-2006.

**Captive Breeding and Re-introduction:** The NPS established an island fox captive breeding program on San Miguel Island in 1999, on Santa Rosa in 2000 and, in conjunction with The Nature Conservancy (TNC), on Santa Cruz Island in spring 2002. Captive breeding was conducted on the islands as opposed to on the mainland due to concerns about exposing naïve island fox populations to mainland pathogens and the lack of availability of sufficient small canid space in mainland zoos. On San Miguel and Santa Rosa Islands, there were few remaining foxes with which to begin captive breeding. In 1999, 14 foxes were brought into captivity on San Miguel, of which only four were males. By 2004, the San Miguel captive population had increased to 50 individuals. Since foxes were first released back into the wild in fall 2004, the small wild population has seen high survival and reproductive success. As of 2007, there were 84 foxes in the wild on San Miguel, including 32 young of the year. With 16 foxes remaining in captivity, the total for the subspecies was 100 individuals.

Captive breeding began on Santa Rosa Island in 2000, when 14 foxes were brought into captivity, with nine remaining in the wild. By 2003 the San Rosa captive population had grown to 56 individuals, and initial releases to the wild began. Since that time at least 15 litters and over 25 pups have been born in the wild. As of 2007, there were known to be 51 foxes in the wild on Santa Rosa, and 28 in captivity, for a subspecies total of 79 foxes. With golden eagle numbers minimal, the Santa Cruz fox subspecies appears to be recovering with minimal augmentation from the captive population, due to high survivorship and recruitment in the wild (D. Garcelon, Institute for Wildlife Studies, unpubl. data).

The increasing difficulty of detecting and removing the few remaining golden eagles may mean that island fox recovery will ultimately depend on promoting ecological conditions that dissuade golden eagles from becoming resident on the islands. Such changes include the removal of feral pigs on Santa Cruz Island, expected to be completed by 2007, and the scheduled removal of deer and elk from Santa Rosa Island by 2011. In addition, the ongoing restoration of bald eagles to the northern Channel Islands may provide a deterrent to golden eagle use of the islands. As of December 2006 there were over 30 bald eagles on the northern Channel Islands, and they had nested successfully on Santa Cruz Island for the first time in 50 years.

**Summary:** The mitigation of major mortality factors (golden eagle predation and canine distemper virus) allowed re-introduction efforts to become the predominant recovery action for the four listed island fox subspecies. The incipient recovery of those subspecies is due in no small part to the success of captive breeding and re-introduction efforts. In 2000, the San Miguel and Santa Rosa subspecies were functionally extinct in the wild, and 14 foxes from each subspecies had been brought into captivity. After four years of annual releases from captivity, San Miguel and Santa Rosa now have small, expanding wild populations of around 80 and 50 foxes, respectively. Trapping and remote cameras have provided evidence of reproduction and recruitment in the wild by both released and wild-born foxes. On Santa Cruz and Santa Catalina Islands, wild fox populations now number in the hundreds, and the re-introduction/translocation programs have ceased or will cease in the near future, as wild population recruitment outstrips the relative contribution made by release efforts. A final perspective on the success of re-introduction and of the other recovery actions will be gained with the publication, hopefully in 2007, of a U.S Fish and Wildlife Service recovery plan for island foxes, which will contain population-specific recovery criteria developed via population viability analysis. The plan will also likely recommend long-term monitoring of fox populations. Such monitoring will be required to avert future catastrophic declines in this vulnerable canid species.

**References**


Latta, B. C., D. E. Driscoll, J. L. Linthicum, R. E. Jackman and G. Doney. 2005. Capture and translocation of golden eagles from the California Channel Islands to mitigate depredation of endemic...
The black rhinoceros, once extinct, returned to Zambia during 2003, when five animals were released in a sanctuary in North Luangwa NP (Re-introduction News 23). The first calf was born in 2005. During June 2006, 10 additional rhinos were flown in: three males and seven females from the Eastern Cape, Kruger NP and Pilanesberg NP. The local community attended a ‘hand-over’ ceremony, when the rhinos were given local names and ceremonial blessings. During the following weeks, each rhino was fitted with an implant radio transmitter and freed from its pre-release pen into a new, 150 km² fenced sanctuary, adjacent to the first sanctuary. Initially radio tracking was undertaken from a light aircraft or vehicle. Later, animals were tracked on foot, to determine their condition and the variety of browse eaten. Two monitoring teams were deployed. In the first sanctuary, they aimed to see and identify each rhino every month. In the new sanctuary, they aimed to see and identify each rhino every three days and to see each rhino every fortnight. Several rhinos initially lost condition and were removed temporarily, she was herded back into the sanctuary soon after release. After part of the fence was removed temporarily, she was herded back into the sanctuary using a helicopter. However, she broke out again and this time she was left where she was, while Zambia Wildlife Authority (ZAWA) officers were deployed nearby. During early October, they found the spoor of a baby rhino - only the second born in Zambia during the last 20 years. With the arrival of the second batch of rhinos and the training of Wildlife Police Officers in North Luangwa, ZAWA assigned 15 recruits to rhino security. Although poaching incidents in the Game Management Areas to the west, north and east of the park declined during 2006, cf. 2005, there was increased poaching by well-organized commercial gangs in the Munyamadzi corridor to the south. This re-introduction is an international initiative between the Governments of Zambia and South Africa, under the umbrella of the SADC Regional Program for Rhino Conservation (RPRC). The implementing organizations include ZAWA, South African National Parks, the South African North West Parks Board and the Eastern Cape Parks Board, Frankfurt Zoological Society’s North Luangwa Conservation Program (NLCP) and Frankfurt Zoo.

Large Mammal Re-introductions to Limpopo National Park

The establishment of transfrontier conservation areas (TFCAs) is a recent initiative in southern Africa. Their proponents hope that TFCAs will support sustainable economic development, particularly of tourism. During 2002, the Great Limpopo Transfrontier Park (GLTP) was proclaimed, with the signing of a treaty by Mozambique, South Africa and Zimbabwe. The GLTP is intended to link Limpopo NP in Mozambique, Kruger NP in South Africa and Gonarezhou NP in Zimbabwe, as well as intervening communal areas, to form a single conservation area of 35,000 km², managed as a single unit across international boundaries. Formation of the GLTP is the first phase in the establishment of a larger transfrontier conservation area that will include Mozambique’s Bahnine and Zincave NPs, the Massingir and Corumana areas and areas in between, as well as private and state-owned conservation areas in South Africa and Zimbabwe that border on the transfrontier park.

Development of the new Limpopo NP, formerly Coutada (hosting area) 16, is important to the development of the GLTP. Limpopo NP is c.10,000 km² and immediately east of Kruger NP. For many years, it was separated from Kruger by a wildlife-proof fence. The Mozambican civil war saw the elimination of many animals from Coutada 16 and its occupation by numerous people and domestic livestock. Now the Peace Parks Foundation is assisting the National Directorate for Conservation Areas to develop this park. Activities have included de-mining, a
community development program, establishment of a 350 km² wildlife sanctuary, ranger training and deployment, and drafting tourism and management plans.

It was believed that tourists would visit Limpopo only once there were substantial numbers of wildlife. Limpopo and Kruger have similar landscapes and vegetation and so Kruger was an obvious source of wildlife for Limpopo. There were two options. The first was to remove the fence that divided these parks and allow animals to move across the international border in their own time. However, it was thought that most species would take years to move in sufficient numbers to establish populations at densities that would attract tourists. The second option was to translocate animals from Kruger. During 2001 - 2006, 3,885 large herbivores were moved to Limpopo (see table 1). Initial releases were in the sanctuary, the location of which had been chosen by the local communities in order to ensure that no people were resident in it. Once community consultations and the management and tourism plans were completed, the wildlife would be allowed to move out of the sanctuary into the remainder of the park. Then the enclosure would be an intensive protection zone for rare species such as rhino, sable and roan antelope.

This multispecies program was planned to adhere to the IUCN Guidelines for Re-introductions. It started during October 2001, when 25 elephants were translocated from Kruger as a trial run. Elephants in each of three cow herds, as well as four adult bulls, were fitted with collars to track their movements. All but one of these animals headed straight back to Kruger! During 2002, >1,000 animals were translocated. Two white rhino bulls that had walked through fence breaks into Limpopo from Kruger were moved to the sanctuary to protect them from poaching. During 2004, ten more white rhinos were translocated to join them. Rhinos in the GLTP, as elsewhere, are susceptible to poaching and Mozambique has the dubious distinction of being the only country where the white rhinoceros has twice been hunted to extinction.

The first buffaloes were moved to Limpopo during 2004. Buffalo translocations are of particular concern, because buffalo and domestic cattle share diseases such as brucellosis, foot and mouth disease (FMD) and bovine tuberculosis. Bovine tuberculosis became endemic in Kruger after being introduced by cattle, and the buffalo is a principal host there. Buffaloes can also be asymptomatic carriers of FMD. Control of animal and human diseases is a major challenge facing the development of TFCAs. The problems of the numerous people and domestic animals in Limpopo are being addressed by a voluntary resettlement program and compensation packages. During 2005, roan antelopes were translocated to Limpopo for the first time. Meanwhile, the legal movement of people between Kruger and Limpopo was facilitated by the construction of a new border post. Wildlife movements were facilitated by the removal of part of the fence along the international border. During December 2003, South African and Mozambican ministers removed a symbolic 20 m of fence and since then other sections, kilometers-long, have been dismantled. Consequently, many animals have walked from Kruger into Limpopo. The progress of these re-introductions was assessed recently when Limpopo staff used a helicopter to count large herbivores in the southwest of the park as follows: Elephant - 630, Nyala - 257, Kudu - 273, Waterbuck - 86, Zebra - 325, Giraffe - 23, Wildebeest - 358, Buffalo - 225, Impala - 496, Sable - 62, Roan - 6, Lichtenstein's hartebeest - 7, Grey duiker - 56, Ostrich - 36, White rhino - 16, Steenbuck - 12, Warthog - 48, Bushpig - 8, Bushbuck - 1, Domestic cattle - 3,142 & Domestic goat - 527. Many elephants have walked across the international border, but many more will have to follow if the creation of the TFCA is to lead to a significant reduction in the number of elephants in Kruger. And even then, the reduction in elephant density in Kruger will be relatively short-term.

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Buffalo Translocation to Gorongosa National Park

Surveys of Gorongosa in central Mozambique during the 1970s revealed numerous animals, including 14,000 buffaloes, 5,500 wildebeests, 3,500 waterbucks, 3,000 hippos, 3,000 zebras and 2,200 elephants. But during the Mozambican civil war, most were slaughtered. Now there is a strategy to translocate wildlife to Gorongosa NP (Anderson et al., 2006?). Few species will be re-introduced: most species addressed by the strategy are still in Gorongosa, but in small numbers. These will have their numbers supplemented. Increasing animal numbers in order to obtain quickly the high densities that would make the park a world-class tourism destination is the major reason for the translocations. Nevertheless, it is intended that the program will follow the IUCN Guidelines for Re-introductions.

The buffalo was a key species in the grazing succession and was once the most numerous large herbivore. Increasing the number of buffalo is essential to restoring the succession. It is also a key species for the sport hunting that operates around Gorongosa NP. During 2006, 54 buffaloes, mostly cows, from a captive herd in Kruger NP were moved by truck to Gorongosa across two international borders, a straight-line distance of 400 km and further by road. One source described the journey taking 28 hours from loading in Kruger until unloading, but a second source said that travelling took 42 hours. Three buffaloes died during the journey and another two were destroyed because they sustained back injuries due to trampling. The reason for this is uncertain, but because extra-pyramidal symptoms were reported, it may have been due partly to excessive tranquillisation. A sixth animal died the day after arrival. The buffaloes, although free of bovine tuberculosis and brucellosis, were placed in a small pen, partly to satisfy Mozambican veterinary regulations. They were monitored daily and later released into a 30 ha paddock, where they spent more than a month, before release into an adjacent, 62 km² sanctuary. This is surrounded by an all-weather road and a 1.8 m, wire-mesh fence with three electrified wires. This first buffalo release highlighted problems with the water supply, problems that were addressed by establishing artificial waterpoints (Pereira, 2006?). The buffaloes are now reported as doing well. There have been no problems with trypanosomiasis, despite the buffaloes coming from an area without tsetse flies.

Poaching is common in Gorongosa and occurred even in the sanctuary during mid - 2006. The park staff now have new leadership as a first step towards reducing poaching at least to a level where it no longer limits animal numbers. It is planned that the sanctuary will have a full-time anti-poaching patrol. The strategy calls for the translocation of 295 elephants, 18 white rhinos, 10 black rhinos, 350 hippos, 1,850 buffaloes, 2,000 zebras, 2,000 wildebeests, 170 elands, 1,500 impalas, 300 kudus, 75 tsessebes and 40 roan antelopes to Gorongosa during 2006 to 2015. The proposed numbers of rhinos are fewer than the recommended minimum number of founders - the SADC Regional Program for Rhino Conservation guidelines call for at least 20 founders. Gorongosa was the site of two previous re-introductions, but both failed. Poaching was undoubtedly the reason why the white rhino re-introduction failed, but why the cheetah re-introduction failed is unclear: six cats were released during 1973, but it is not known if they were monitored. In fact, it is not clear that the cheetah release was really a re-introduction, rather than an introduction. Today one could easily speculate that the release of just six cheetahs in a park renowned for its high density of lions was unlikely to be a success.

For most species in Gorongosa, their extinction or low number was due to excessive hunting, but this was probably not so for roan antelope and tsessebe - the tsessebe was extinct before poaching caused massive declines in the numbers of other herbivores. Both roan and tsessebe prefer to feed in medium-height grass swards and are sensitive to changes in sward structure. The declines in their numbers may have been, at least partly, a consequence of competition for food with more-numerous and larger grazers, particularly those that favoured a short sward.

The Gorongosa strategy considers Kruger to be the most suitable source of numerous buffaloes for Gorongosa, despite the presence of Tb amongst Kruger’s wild buffaloes and the high cost of screening animals to ensure that they are Tb-free. The strategy does not address why Marromeu Buffalo Reserve, just c.150 km eastwards of Gorongosa, on the southern Zambezi delta, and with several thousand buffaloes was not considered as a source population. At Marromeu, buffaloes are numerous enough for sport hunters in the adjacent coutadas to be allowed to shoot them (and, according to rumours, some hunters shoot buffaloes even within the Reserve - control is difficult in this watery environment).

Gorongosa NP is within the catchment of Pungwe River, but the watershed between the Zambezi and Pungwe catchments lies just c.20 km northwards. The Urema trough (rift valley) that Gorongosa spans extends northwards until it is dissected by the Zambezi River. As one moves northwards along this trough, there is no significant barrier to animal movement and there can be little doubt that the Gorongosa system is more closely related biogeographically to the Zambezi system than to the more-distant Limpopo system in which Kruger lies. The Gorongosa strategy acknowledges that the same type of FMD virus is found in buffalo in southern Mozambique as in buffalo in Kruger, but that a different type occurs in buffalo in western Zimbabwe and the Zambezi Valley. It called for a study to determine which types are in Gorongosa’s native buffaloes, and thence to define the acceptable sources of buffaloes for supplementation. However, it appears that this was not done, because although there are plans to release more buffaloes in Gorongosa, the origin of these will depend on work to determine the health status of the resident buffaloes.

The objectives over the first 10 years of the Gorongosa project are to increase rapidly the numbers of large herbivores and to re-establish the grazing succession. It is pointed out that the impact of the present levels of predation and poaching will be proportionally greater on small numbers of animals released gradually, than on the same total numbers introduced rapidly. The timetable for release will be accelerated if some species can be released directly into the park via temporary enclosures, rather than via the sanctuary. It is anticipated that after 10 years the sanctuary will be used only for breeding rare or endangered species, such as rhinos, roan and tsessebe.
The proposal to translocate elephants to Gorongosa is made against a background of a current population of c.250 animals that run or hide from tourists, but which conflict with people living near the Pungwe River on the park boundary. Translocating more elephants is mainly in order to provide tourists with good, easy sightings of well-behaved elephants. The target is a population of 1,000 elephants, but the strategy does not consider how the population will be maintained at this number, nor what effect the elephants will have on the vegetation. The strategy considers elephants in the Gonarezhou - Kruger system to be the nearest, genetically - similar source population for Gorongosa. There may be a lesson to be learnt from the translocation of elephants from Gonarezhou NP, Zimbabwe, to the nearly Save Valley Conservancy during the 1990s. Approximately 600 elephants were moved <15 years ago, but already managers are concerned about the effects of elephants on the woodlands and plan to reduce the number of elephants in the Conservancy.

Wild Dog Translocation to Hwange National Park

During October 2006, 16 wild dogs were released after spending five months in a rehabilitation facility near Hwange NP, Zimbabwe. The dogs had been moved from South Africa earlier during the year. There are already wild dogs in Hwange and its surrounds and the release site was within the territory of one local pack. Within a few weeks of release, two freed dogs were killed by lions. This translocation appears to have been executed without reference to the IUCN Guidelines for Re-introductions. Regardless of what is currently limiting the number of wild dogs in the Hwange region, it is unlikely that this release will lead to any long-term increase in the number of dogs. Perhaps factors other than ecological ones, maybe publicity or fundraising, were the main drivers behind this supplementation?

Acknowledgements

Many people provided information, directly or via the websites and reports. Where it is not clear that the IUCN Guidelines for Re-introductions were, are and will be followed, I refrain from naming correspondents in order - as the saying goes - to protect the innocent. Ms Jessica Groenendijk (jessica@fzs.org) and Ms Heloise de Villiers provided valuable information about the translocations to Luangwa and Limpopo respectively.

References


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Behavioral modification in meta-population management of black rhino, Southern Africa

Black rhino are in the midst of a conservation crisis (Linklater, 2003) (see photo 1). Of the world’s approximately 65,000 black rhino in 1970 habitat loss and hunting for horn reduced the species to approximately 2,450 individuals by the early 1990s (Amin et al., 2006). To avert the crisis and facilitate a recovery, black rhino are being translocated across the African continent into safer reserves, re-introduced to new reserves for the expansion of the meta-population, and transferred between reserves for demographic and genetic management, particularly of small populations. Moreover, the removal or ‘harvest’ of rhino from reserves with large endemic populations not only supplies rhino for translocation but also serves to improve breeding and survival rates by keeping densities in those donor reserves below carrying capacity. In this way translocation, along with habitat and population protection, has facilitated an initial, although slow, recovery such that there are now around 3,610 black rhinoceros (Emslie, 2004).

Unfortunately, injury and death are common after the release of black rhino, particularly if there are already conspecifics resident at the release site, thus limiting the success of black rhino translocations and ultimately species recovery. The most common causes of injury and death are behaviorally mediated: stress-related debilitation, collisions with both artificial and natural

Photo 1: Black rhinoceros (Diceros bicornis) & field Ranger: Neto Pule @ Wayne Linklater
hazards like fences, and conspecific fighting. Our objective, therefore, was to improve understanding about the behavioral ecology of the species and trial ways of improving survivorship and breeding after translocation by modifying rhino post-release behavior in ways that might reduce injury and death. In particular, we considered that black rhinoceros behavior might be modified by manipulating the scent environment into which individuals are released or currently live (Linklater, 2004).

**Approach**

Using an adaptive-management (science-by-management) framework we have followed the fates of 88 black rhinos captured from donor reserves and translocated since 2002 to 15 reserves ranging in size from 670 to 45,000 ha including small private reserves and larger National Parks. Major donor populations included Hluhluwe-iMfolozi Park in South Africa and Etosha National Park in Namibia. While the black rhino were held temporarily in boma (reinforced enclosures) prior to release we conducted scent presentation tests to measure their olfactory capabilities. To monitor post-release behavior and outcomes the rhinos were fitted with hom-implant transmitters that emit a radio signal for up to 22 months after installation. To date data have been collected for released rhino on more than 4,000 occasions. Data collected include a combination of direct behavioral observations, remotely tracking the track and sign of known individuals, and location data obtained via direct observation or triangulation. Several scent broadcasting experiments have been conducted; some about the reserves or release sites before re-introductions and others within donor populations from which some of the rhino were captured for translocation. We broadcast rhino scent in the form of urine and dung about the release site or reserve prior to a release, or about 1 km² areas within the Hluhluwe-iMfolozi donor population and measured for changes in black rhinoceros movement and activity.

**Discussion**

Black rhinos are a relatively asocial species and therefore probably depend on the scent from dung and urine to communicate with conspecifics. In the scent presentation experiments black rhinoceros responded differently to dung and urine from conspecifics that differed in their sex, reproductive status, individual identity, and dominance. We also showed that dung serves as an olfactory signal for at least 30 days after it is deposited. Thus, black rhinos do indeed possess a sophisticated olfactory communication system. Rhino released into reserves where conspecific dung had been spread moved further from the release site initially and traveled more about the reserve than rhinoceros released into reserves where conspecific dung had not been spread. The effect was greatest for rhino whose own dung was spread compared to those that encountered the dung of other rhino. We interpreted these results as indicating that the presence of dung facilitated initial exploration or ‘confidence’ (see also Linklater et al., 2006). There was also a tendency for rhinos to settle next to areas spread with the dung of other rhino than in areas spread with their own dung or no-dung controls. Although solitary and aggressive, black rhino still prefer to settle in areas apparently occupied by other rhino, perhaps because dispersing rhino use the presence of conspecifics as a cue to find suitable habitat when they are unfamiliar with the area. We speculate that the effect might also reduce the probability of conflict and accident. Thus, preliminary results support our hypothesis that scent functions as a conspecific attractant and might be used to facilitate home range establishment and formation of social and breeding relationships (Linklater et al., 2006).

Scent broadcasting in the Hluhluwe-iMfolozi donor population demonstrated that black rhino reduced their feeding activity in areas spread with the scents of other, previously unfamiliar, rhino. While browsing intensity in control sites where sand had been spread increased, browsing rates in areas broadcast with scent decreased. The effect last for up to 9-months after the dung is spread and also appears to be greatest and more persistent when female, compared with male, scent is broadcast. It may be that black rhino avoid areas with unfamiliar scent. This avoidance response means that scent might be used to reduce black rhino activity in some areas or spread in other areas to encourage rhino to leave the area to feed. In this way scent broadcasting might be used to limit or encourage emigration or dispersal.

Managing post-release behavior for improved survival involves more than just olfactory management. Our findings indicate that several aspects of the release strategy also influence translocation success. For example, we describe the advantages of releasing rhino from individual sites that are spaced across the landscape (i.e., free-release) in tandem with a scent-broadcasting regime (Linklater et al., 2006) rather than the technique of releasing all rhino from the same site from boma most used in the past. So long as the reserve is large enough to accommodate multiple well-spaced release sites, free-releasing appears to reduce encounter rates and conflict during the immediate post-release period when the rhino are in an unfamiliar habitat and social context, and removes the costs in time, money and disruption of on-site boma construction and the need for an additional acclimation challenge to rhino. Reserve size and the density of rhinos also affect post-release success. Our measures of movement and association with conspecifics after releases indicated that black rhino endeavor to avoid each other, in a way that probably minimizes confrontation and conflict. However, the results show there to be a threshold somewhere between reserve sizes of 11,500 and 18,000 ha and population densities greater than 0.05 rhino per km² (or less than 20 km² per rhino) when association and movement rates after release become elevated. In reserves smaller than 11,500 ha released rhino regularly encountered the fenced boundary and other rhino. Three rhino sustained injuries requiring intervention and four died. All of the injuries and two of the deaths were fight-related. All but one of the interventions and deaths occurred on reserves 11,500 ha or smaller. These results indicate that reserves smaller than 18,000 ha pose an increasing risk to rhino survivorship as reserve size declines due to increasing rates of encounter by the rhino with the key hazards associated with post-release mortality: fences and other rhino. The tendency for rhino released at lower densities and in larger reserves to almost entirely avoid associating with other rhino suggests that the high rates of association in smaller reserves are forced upon the rhino by smaller reserve size and higher population density.
Our work demonstrates the usefulness of understanding black rhinoceros behavioral ecology to help refine criteria for selecting between release strategies and the reserves to receive rhino. A better understanding of black rhinoceros behavior is likely to also provide new ways of improving population management. The ecology of communication by scent, in particular, is a promising avenue of investigation for the development of innovative wildlife management tools.

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Twelve years of mammal re-introductions and introductions by the Australian Wildlife Conservancy

The Australian Wildlife Conservancy (AWC) is an independent, non-profit organization dedicated to the conservation of Australia’s threatened wildlife. AWC’s strategy for conserving all Australian animal species and the habitats in which they live includes: establishing wildlife sanctuaries, implementing practical, on-ground conservation programs, conducting scientific research, and public education. This national organization manages 15 wildlife sanctuaries across Australia, covering a total area of over 1.1 million hectares. AWC has successfully conducted numerous threatened mammal translocations. Combined with existing fauna, AWC sanctuaries now protect more than 55% of all Australian mammal species.

Methodology and Results
Between 1994 and 2006 AWC translocated 16 species of mammals to four wildlife sanctuaries in Western Australia and New South Wales, ten of which are listed as ‘Vulnerable’ or ‘Endangered’ in the IUCN’s Red List of Threatened Species (IUCN, 2006). The four wildlife sanctuaries each have different strategies to combat threatening processes, particularly predation by introduced foxes and feral cats. These strategies have enabled the creation of faunal communities that were previously extinct regionally or from mainland Australia.

Karikamia Wildlife Sanctuary - covers 280 ha of Jarrah forest ecosystems and is located about 50 km north east of Perth in the Darling Scarp of Western Australia. The sanctuary is strategically positioned adjacent to local Shire Reserves that are managed as part of the Darling Range Regional Park, connecting a mosaic of State Forest and National Parks and providing ecological ‘corridors’ through which wildlife can disperse. Foxes (Vulpes vulpes), feral cats (Felis catus) and rabbits (Oryctolagus cuniculus) are excluded from the sanctuary, which is surrounded by a six-foot high electrified predator-proof fence.

Four quokkas (Setonix brachyurus; vulnerable), six numbats (Myrmecobius fasciatus; vulnerable), 42 western ringtail possums (Pseudocheirus occidentalis; vulnerable), two western brush wallabies (Macropus irma), eight common brushtail possums (Trichosurus vulpecula), 13 tammar wallabies (Macropus eugeni), 38 quenda (southern brown bandicoots Isoodon obesulus fusciventer), and 40 woylies (brush-tailed bettongs Bettongia penicillata) were re-introduced to Karikamia Wildlife Sanctuary between 1994 and 2004. Source animals were from Dryandra Woodland (woylie, numbat), the Perth metropolitan region (quenda), Tutanning Nature Reserve (tammar wallaby), Busseelon (ringtail possum) and Collie (quokka) in Western Australia, with some sick or injured animals via wildlife carers. Populations are monitored by regular trapping and spotlighting.

All species have persisted, and by the end of 2006 over 540 woylies, 68 brushtail possums and 50 quenda had been transferred from Karikamia to stock other AWC sanctuaries and Western Australian Department of Environment and Conservation (DEC, formerly Department of Conservation and Land Management) reintroduction sites (predominantly National Parks and Nature Reserves) in Western Australia.

Paruna Wildlife Sanctuary - is located in the Avon Valley on the northern outskirts of the Perth metropolitan region to the north of Karikamia, and was established by AWC in 1998. Paruna was the result of the purchase of a number of agricultural properties along a 14 km stretch of the Avon River, creating a 2,000 ha wildlife corridor between two regionally significant National Parks: Walyunga National Park to the southwest and the Avon Valley National Park to the northeast. Broadscale control of introduced predators is conducted by AWC and DEC within the
Mammals

region on a regular basis by baiting with 1080 (sodium monofluoroacetate). AWC erected a predator-proof fence that runs along one flank of the property, separating the high quality jarrah (Eucalyptus marginata), marri (E. calophylla), wandoow and powderbank (E. accedens) bushland within Paruna Wildlife Sanctuary from adjacent farmland. The fence inhibits invasion by foxes and cats and separated neighboring pets from the fox control program, but importantly, does not impede the movement of wildlife between the two National Parks.

A total of 327 woylies, 131 quenda, 88 brushtail possums, 58 black-flanked rock-wallabies (Petrogale lateralis) and 47 tammar wallabies were translocated to Paruna Wildlife Sanctuary between 2000 and 2006. Source animals were predominantly from Karakamia Wildlife Sanctuary, as well as from Tutanning Nature Reserve (tammar wallabies), the Perth metropolitan region with some via wildlife carers andpager (quenda), and Mt Caroline, The Granites, and Querekin Rock in the Western Australian wheatbelt (rock wallabies). All species have established populations and are sighted or captured during regular monitoring by spotlighting and trapping. Translocations of additional species to Paruna are planned. In addition, the effective control of feral animals led to the appearance of chuditch (Dasyurus geoffroyi; vulnerable) in 2002, a species that has been reintroduced elsewhere in Western Australia.

Faure Island Wildlife Sanctuary - located within the Shark Bay World Heritage Area, was purchased by AWC in 2000, with the aims of establishing viable populations of threatened mammals and initiating ecological research to increase the effectiveness of threatened species management in arid Australia. The island is 6,000 ha in size and is dominated by Acacia shrublands. Faure Island was established as a pastoral lease in 1873 and supported extensive grazing by Angora goats and then Merino sheep for almost 100 years. Horses (Equus caballus) and goats (Capra hircus) were removed by 2004, and less than 100 sheep (Ovis aries) are confined in a paddock. Feral cats were thought to have been introduced to the island by pearlers or pastoralists in the late 1800s and were eradicated from the island in 2001 by a program of 1080 baiting. Neither rabbits nor foxes have ever been recorded on the island. No native mammals were extant on the island at the time of purchase by AWC, though at least four species were known to have occurred there in the past. Five mammal species were chosen based upon conservation status, habitat suitability and need for additional conservation effort.

Seventeen burrowing bettongs (Bettongia lesueur; vulnerable) (see photo 1) were introduced and 114 Shark Bay mice (Pseudomys fieldi; vulnerable) re-introduced to Faure Island in 2002. A total of 26 banded hare-wallabies (Lagostrophus fasciatus; vulnerable) were introduced in three releases in 2004, 2005 and 2006 and 20 western barred bandicoots (Perameles bougainville; endangered) (see photo 2) were re-introduced in 2005. All four species have established well. For example, over 260 individual burrowing bettongs were captured during the last annual monitoring in July 2006, illustrating the suitability of the habitat and rapid population growth in the absence of introduced predators. Source animals were all originally from remnant populations on Bernier or Dorre Islands in Shark Bay, however have come via captive breeding populations at Perth Zoo, DEC’s Peron Captive Breeding Facility in Shark Bay, and the Heirisson Prong re-introduction project managed by the Useless Loop community in Shark Bay. The fifth species, the greater stick-nest rat (Leporillus conditor; endangered), was introduced in late 2006. Twenty two rats were sourced from previously introduced populations on Salutation Island in Western Australia and St Peters Island in South Australia.

Scotia Wildlife Sanctuary - is situated in western New South Wales, 150 km south of Broken Hill near the border of South Australia. The 65,000 ha sanctuary is bordered by Danggali Conservation Park, Tarawi Nature Reserve, and Nanya Station which is owned by Ballarat University and is managed as a conservation reserve. Much of the area is dominated by Eucalyptus shrubland (mallee) and Casuarina pauper (belah) woodlands. The Scotia Endangered Mammal Recovery Project seeks to prevent further mammal extinctions, and contribute to the restoration of western New South Wales mammal fauna by: creating the largest feral-free area on mainland Australia, re-establishing wild populations of seven threatened mammal species, and implementing a biodiversity research program to generate knowledge to assist with the restoration of threatened species and ecosystems across Australia.
A 4,000 ha area of Scotia is fenced to exclude introduced predators, and a further 4,000 ha fenced area was completed in 2006. Foxes, cats and rabbits will be removed from this area during 2007. In four releases between December 2004 and September 2005 a total of 190 woylies, 120 burrowing bettongs, 120 bridled nailtail wallabies (*Onychogalea fraenata*; endangered) (see photo 3) and 40 greater bilbies (*Macrotis lagotis*; vulnerable) were re-introduced to Scotia Wildlife Sanctuary from *in situ* captive breeding compounds. All the translocations appear to have been successful in the short term. Greater stick-nest rats were released earlier in 2006, with 100 animals sourced from an introduced population on Reevesby Island in South Australia and captive populations held at AWC’s Scotia and Yookamurra Wildlife Sanctuaries. The previous land owners re-introduced 19 numbats to Scotia in 1999 and there are now over 100. AWC recently provided animals from this population for a trial release to the Arid Recovery Reserve in South Australia. Bilbies have recently been transferred between Scotia and Queensland in a joint effort by AWC and Queensland Parks and Wildlife Service (QPWS) to enhance the genetic diversity of the Scotia population and provide animals for QPWS to participate in a captive breeding program.

**Discussion**

Source populations have predominantly been from previously re-introduced and established populations or established captive breeding programs, with few animals translocated direct from extant wild populations. Wild source populations have generally been used for species that are not listed in the Red List of Threatened Species (IUCN, 2006), however wild populations of animals listed as threatened are typically not used where suitable re-introduced populations exist.

The addition of genetic diversity by sourcing animals direct from wild populations in the future to contribute to AWC’s translocated populations is thought to be beneficial for long-term population persistence. Impediments to doing so include inaccessibility and expense (particularly in accessing island populations), low remnant population sizes, and disease (e.g. western barred bandicoots suffer from a papilloma virus on Bernier Island in Shark Bay). AWC will continue to conduct translocations of threatened mammals in order to reconstruct past mammal communities. In doing so AWC hope to conserve Australia’s remaining mammal fauna and save them from the plight of extinction.

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**Governmental role in non-human primate re-introduction programs with special reference to Cross River State, Nigeria, West Africa**

As wildlife re-introductions increase in number and complexity worldwide, the responsibility of ensuring their intended outcomes must also fall with the official agencies in the host country, not only the organizations conducting them. In Cross River State, southeastern Nigeria, the state Forestry Commission (FC) is actively involved in two planned re-introduction projects involving medium- to large-bodied primate species. These are important projects not only for the state and country, but also for regional biodiversity conservation. Due to the added complications of releasing primates vs. other wildlife genera – i.e., primates’ close relationship with humans, particularly with regard to disease transmission and human safety – re-introduction or supplementation efforts need to be carefully planned and monitored.

**Background**

Cross River State (CRS) is one of the 36 states of the Federal Republic of Nigeria. It has a population of approximately 2.9 million people, according to the latest 2006 census results. It is situated between latitudes 4°31’ and 7° North of the equator and longitudes 7°45’ and 9°31’, East of the Greenwich meridian. Specifically located at the southeastern tip of Nigeria, CRS borders the southwestern province of the Republic of Cameroon. With a land mass of about 22,000km², the state is blessed with virtually all the ecosystems of Nigeria. Vegetation types range from...
mangrove swamps in the south, to tropical high forest in the central district, to savannah in the north, and there is even montane forest in the famous Obudu mountain range. The state also has the largest vestiges of relatively undisturbed tropical high forest remaining in Nigeria (about 35%). The forest is part of the guinea-equatorial forest, which stretches through southern Cameroon and into the Congo Basin.

The state has been recognized by the IUCN as one of Africa’s biodiversity “Hot Spots.” Management of the state’s forest resources is the exclusive responsibility of state government, except for areas designated as national parks, which have federal jurisdiction. The CRS Forestry Commission is the government agency with the statutory responsibility of protecting, developing, and conserving the state’s forest resources. CRS forests are categorized into four types: 1) forest reserves, 2) community forests, 3) plantations, and 4) sanctuaries. Nigeria is a signatory to the international convention/treaty for the conservation and preservation of endangered wildlife species (CITES), and by extension the CRS government is equally bound to it. The CRS government has demonstrated much concern regarding the conservation of natural resources, especially with respect to habitat protection, and has been actively developing tourism and eco-tourism within the state. In conjunction with several NGOs, both national and international, numerous collaborative efforts have been made with the aim of conserving endangered plants and animal species.

With regard to primates, Cross River State is a home to diverse number of primates, including several critically endangered and endemic species, such as the Cross River Gorilla (Gorilla gorilla diehli), Nigerian chimpanzee (Pan troglodytes vellerosus), Drill monkey (Mandrillus leucophaeus), Red-eared monkey (Cercopithecus erythrotis camerounensis), and Preuss’s monkey (C. preussi). The state government is therefore particularly sensitive and responsive to proposed programs pertaining to primate re-introduction.

**Primate re-introduction – the journey so far in CRS**

CERCOPAN and Pandrillus, two successful conservation non-governmental organizations, have been established in CRS for several years. CERCOPAN (www.cercopan.org) provides sanctuary and rehabilitation to five Cercopithecus guenon species and one Cercocercus primate (the red-capped mangabey, Cercocercus torquatus). CERCOPAN’s rescued population of endangered Sclater’s monkeys (Cercopithecus scelater), Nigeria’s sole endemic primate species, represents the only captive group of C. scelater in the world. Pandrillus has recorded more than 150 M. leucophaeus births to rehabilitated wild-born parents and their offspring, making the project the world’s most successful captive-breeding program for an endangered primate. In the past few years, both organizations have initiated plans to re-introduce monkeys to the wild. The CRS Forestry Commission then became involved in a more active manner. In 2006, each organization made official requests to the FC for formal endorsement of their re-introduction programs. The steps government should follow to ensure that a re-introduction project meets its aims are many and will differ depending on the species, region of interest, and other factors. However, there are a few rules that all government agencies should adhere to, to ensure that re-introduction programs achieve their intended goals while not harming or otherwise damaging wild plants and animals, as well as people.

In the case of Cross River State, in June 2006 the CRS Forestry Commission presented a formal memo to the State Executive Council on the planned re-introductions by CERCOPAN and Pandrillus. The Forestry Commission was thereafter granted EXCO approval to monitor and provide its “seal of approval” of the releases only when the following were satisfied:

- The IUCN/SSC primate re-introduction guidelines are satisfactorily followed.
- Key socio-economic, biological, and environmental issues raised by the CRS Forestry Commission are properly addressed.
- The CRS Ministry of Health and Veterinary Services are satisfied with the health implications of the program (biomedical and veterinary evaluation).

In order for government to ensure such concerns are satisfied, my experience in CRS suggests that a few key steps be taken by government officials when cooperating with and endorsing re-introduction projects in their country and state:

1) Know the species and proposed release environment. It is important that government officials understand the general biology of the species to be re-introduced and the social and ecological aspects of the release site.
In the case of Pandrillus, which houses some 220 Drill monkeys, the re-introduction will occur in the Afi Mountain Wildlife Sanctuary (approximately 90km²), which is located in the Buanchor community of Boki Local Government Area. Drills are present in the area, so the project would be a re-inforcement of the current Afi population. Drills are an endangered species, so supplementation might be a good answer to a declining population at Afi Mountain. It is the responsibility of government to ensure, however, that the necessary population surveys are conducted to quantitatively confirm assumptions such as: 1) the current population of Drills is declining in the Afi Mountain sanctuary, and 2) the current population is likely non-viable. Because the Drill is endangered and cryptic, it is very difficult to study in the wild, and limited information exists on wild populations. As such, answers to these questions can be difficult, but nonetheless, proper surveys are still required. Additionally, comparisons can be made with surveys of Drills in other sites and also with studies of the closely related Mandrill (Mandrillus sphinx), which has been much better studied in the wild.

CERCOPAN is home to about 125 monkeys and intends to release initially Cercopithecus mona, a “lesser risk” primate that nonetheless occurs in a human-dense region of West Africa (see photo 1). CERCOPAN’s release site is located in the Iko Esai community forest in the Biase Local Government Area. CERCOPAN’s population surveys, which have recently been completed, show that C. mona has been nearly extirpated from the Iko Esai community forest. Thus, CERCOPAN aims to increase the population size and genetic diversity of the wild C. mona population, ultimately to maintain a viable population in the long term. Monas (to be followed by a release of red-capped mangabeys) would restore the historic primate community of the area (see photo 2).

2) Ensure that individuals designated for release are good candidates in terms of health, behavior, social grouping, etc.

Government officials must ensure that candidates for re-introduction are healthy; have been properly screened for viruses and any potentially dangerous disease or disease not native to the species; do not exhibit non-natural behaviors or behaviors that would otherwise limit their ability to survive in the wild; and that individuals are released in natural social groupings (for example, primates that form social groups with usually a single dominant male should not be released in all-male groups or groups containing only juvenile and no adult males). In Cross River State, we are closely working with the State Ministry of Health and Veterinary Services to review the health and veterinary protocols of each project and make recommendations or request action where necessary.

3) Evaluate the potential impact on surrounding human communities and relationship between the re-introduction organization and communities near the release site.

In the case of Pandrillus, the proposed release site is within an officially protected area (Afi Mountain Wildlife Sanctuary). CERCOPAN has signed a 99-year land lease with the Iko Esai community to protect a particular forest area. The Afi Mountain sanctuary is surrounded by 16 communities, whereas CERCOPAN’s site is bordered predominantly by one community (its host community). Consequently, government needs to understand the relationship of each project with its surrounding communities and the status of community relations and support for the project, including each organization’s approach to education of communities regarding the impending re-introduction. Government must also be aware of the status of threats, such as logging or hunting, and how the threats that were responsible for original decline of the species are now eliminated or being minimized sufficiently to warrant a safe and successful re-introduction. It is the government’s responsibility to assist the re-introduction organization whenever possible in such situations, such as helping to enforce any anti-hunting laws.

Generally, it is important that the ultimate goals and objectives of any re-introduction program be clearly explained to and agreed upon with government and local communities before the program is initiated (for example, does the program aim to increase the size and genetic diversity of a wild population, re-stock a depleted area, or simply contribute to “animal welfare”? In the latter case, for example, re-introduction is strongly opposed). Finally, in the case of larger-bodied, potentially dangerous animals, government must take into account the safety and potential reaction of humans to release programs. This is particularly so if eco-tourism is being promoted, as is the case in CRS, and more visitors are expected to the re-introduction sites.

4) Consult with affiliated organizations and experts and review relevant documents.

In determining conditions for the two proposed primate re-introductions, the CRS Forestry Commission has relied mostly on the IUCN/SSC Re-introduction Specialist Group’s Guidelines for Nonhuman Primate Re-introductions (www.iucnsscrsg.org/downloads.html), as well as site-specific/local context information. All government officials should utilize and consult the general IUCN/SSC Re-introduction Guidelines (or taxon-specific ones if they are available) and be sure the guidelines are adhered to by any group proposing to re-introduce plants or animals into the wild.

It may also be important to discuss proposals for re-introduction with concerned, relevant organizations. For example, the proposals of Pandrillus and CERCOPAN were circulated by the Forestry Commission to nature conservation non-governmental organizations operating in...
the state (such as the Wildlife Conservation Society, Nigerian Conservation Foundation, and Fauna and Flora International). Relevant comments and concerns made by the respective NGOs were integrated into the overall governmental evaluation process. The Forestry Commission articulated these external comments and later requested each organization to address key issues before proceeding with the re-introduction. Because of the issues regarding the transmission of disease between wild and released individuals of conspecifics, re-introduction organizations must consult at least one wildlife veterinarian. If the species to be released could potentially pass disease to humans or acquire a disease from humans, government should also involve relevant official expertise, such as a Ministry of Health. It might also be important to utilize the skills of a social scientist and/or economist to evaluate any possible post-release problems of the re-introduced animals.

5) Visit the proposed re-introduction sites. Government officials cannot properly evaluate any re-introduction project without making one or more visits to the proposed release site and surrounding communities. The relevant government agency must carry out thorough field visits to the proposed release sites to confirm project status and hold community consultations.

Additional Comments

Because the CERCOPAN and Pandrillus re-introductions are the first of their kind in Nigeria, their implementation must be meticulous, and they must be monitored post-release in the long term. A determination of which organization is and/or individuals are responsible for post-release management is required, particularly if the re-introduction organization involves expatriate staff or is not registered in the host country (CERCOPAN and Pandrillus are both registered charities in Nigeria and abroad, and both have expatriate directors). Ultimately, long-term monitoring will allow organizations and government to help ascertain the success of the project: Did the population increase? Did the individuals establish themselves and reproduce? Was genetic diversity affected? How can we improve future releases? Etc.

Even though the IUCN/SSC Re-introduction Guidelines should be implemented in the context of IUCN’s general policies pertaining to biodiversity conservation and sustainable natural-resource management, government must ensure that local and specific issues be accorded due attention to reflect existing realities of proposed release sites. This will help address specific challenges that will in turn aid in the overall success and acceptability of the project.

Conclusion

Because of the socio-economic and ecological concerns associated with re-introduction, government and communities must be sufficiently involved if the program is to succeed and be sustainable. For re-introductions of large or potentially dangerous animals, or where a re-introduction presents a relatively high risk of negative ecological impact, there is a greater need for both government and community participation, particularly with regard to smaller tracts of protected areas and areas where human density is relatively high.

The CRS Forestry Commission is optimistic that this year CERCOPAN and Pandrillus will be ready to re-introduce primates back into the forests of southeastern Nigeria.

Contributed by Dr. Chris Odu Agbor, Permanent Secretary / CEO, CRS Forestry Commission, Calabar, Nigeria.

The Gibbon Rehabilitation Project in Phuket, Thailand

The white-handed gibbon (Hylobates lar) was hunted to extinction on Phuket Island in the early 1980s. Since 1992, the Gibbon Rehabilitation Project (GRP) has attempted to rehabilitate individuals confiscated from the illegal pet trade with the aim of returning them to a life in the wild. The first releases were made on uninhabited islands just off the coast; however this strategy has been discontinued due to conflicts with local fishermen, all of the surviving gibbons were re-captured as these islands were also too small to support self sustaining gibbon populations. Since 2002 gibbons have been released into the 22 km² Khao Phra Theaw non-hunting area on the main island of Phuket. Gibbons arriving at the GRP are either confiscated by the Thai authorities from wildlife touts or are handed in by private owners.

Quarantine lasts for approximately three months in which time they are thoroughly screened for disease. Behavioral observation also begins at this point as the gibbons are in auditory and visual contact with conspecifics, some for the first time since infancy. Once quarantine is complete animals that are free from infection are transferred to the rehabilitation site. It is here that training for life in the wild begins; young gibbons are put into peer groups to aid in social development while adults are monitored to determine which individuals could be successfully paired. Once pairs have bonded sufficiently they pass through a succession of environments designed to encourage natural behaviors. Pairs are deemed suitable for release only after rearing of at least one infant. This process has taken up to 10 years in some cases. A soft release methodology is employed which includes at least 10 days acclimatization at the release site in an enclosure suspended in the lower canopy. Release sites are selected to be adjacent to the territory of previously released gibbon groups to encourage territorial behaviors. Provisioning takes place at the release site with the amount and frequency of supplemental feedings reduced when the gibbons show less interest in the provisioned food. There are currently two completely self sustaining gibbon groups.

Post-release monitoring is an essential part of re-introductions, accordingly over 15 km of permanent transects have been cleared in the forest and new transects are cut prior to each release. Observations take place between 07:00 - 17:00 hrs daily for the first month after release. After this bi-weekly observations are carried out on all released groups. Behavioral data are collected on a focal animal every 120 seconds. Group scan sampling every 10 minutes is used to supplement data on ranging, adaptation, diet and inter-group interactions. Additional data are collected on favored fruit and browse, sleeping sites and territorial expansion. This has been found to be important when planning subsequent
Whether this re-introduction program can be considered a individual animal welfare as one of its core objectives. Important factor for a re-introduction program with deaths and disappearances to a minimum, a very interactive post-release management has helped to keep extensive pre-release training given to the gibbons. The that the successful releases can be attributed to the island where most of the wildlife touts operate. It is felt awareness raising campaigns in the tourist centers of the communities are made in conjunction with leafleting, and education program. Regular visits to local schools and are adept at finding their own food (see photo 1). This is especially true of those released in infancy or born in the forest. The GRP plans to continue its re-introduction and education work, and it is hoped that not only will there be a self sustaining gibbon population on Phuket once again, but also a halt to the hunting, trade and exploitation of gibbons in Thailand.

A further family group of four gibbons is currently undergoing acclimatization at the release site. Although some of the adult gibbons have at times shown interest in human observers, this behavior has not been seen in infant or juvenile individuals, who show a marked preference for the upper canopy and avoid contact with observers. The KPT forest is estimated to be able to support about 60 gibbon families. This leaves sufficient room for natural population growth as well as future releases. In addition to the re-introduction work the GRP is also coordinating an island wide environmental education program. Regular visits to local schools and communities are made in conjunction with leafleting, and awareness raising campaigns in the tourist centers of the island where most of the wildlife touts operate. It is felt that the successful releases can be attributed to the extensive pre-release training given to the gibbons. The interactive post-release management has helped to keep deaths and disappearances to a minimum, a very important factor for a re-introduction program with individual animal welfare as one of its core objectives.

Whether this re-introduction program can be considered a success is hard to determine. The short term success of a project is most easily measured by the survival and adaptation rate of the re-introduced animals, in this way the GRP can be viewed as having been moderately successful to date. Long-term success is a harder thing to measure. In the case of highly intelligent animals such as primates, rehabilitated adults may never fully revert to wild behavior and so proper evaluation may take decades. A possible indicator of success can be seen in the behavior of the younger gibbons; they spend more time in the upper canopy, show less trust of human observers and are adept at finding their own food (see photo 1). This is especially true of those released in infancy or born in the forest. The GRP plans to continue its re-introduction and education work, and it is hoped that not only will there be a self sustaining gibbon population on Phuket once again, but also a halt to the hunting, trade and exploitation of gibbons in Thailand.

According to these criteria three sites have been identified as potential release sites in the south-western corner of Abu Dhabi Emirate which borders Saudi Arabia in the south and Oman to the west. The release area covers approximately 10,000 km² of sand-dunes (mega & undulating) which also include sabkhas (salt marshes), gravel plains and sand-sheets (see figure 1). Three pre-release sites were selected and pre-release enclosures constructed. As part of the on-site preparations, artificial shade shelters and water drinking troughs have been constructed in order to improve the acclimatization of the animals especially during the early stages of the release (see photo 1). Parallel to that, plantations of animal feed such as grasses, shrubs and trees were planted at the pre-release site to provide animals with food and shelter taking into accounts the harsh climatic conditions of the area.

Arabian Oryx Release Program, Abu Dhabi Emirate, United Arab Emirates

Historically the Arabian Oryx (Oryx leucoryx) inhabited the western region of the United Arab Emirates (UAE). This large beautiful antelope became extinct in the wild by the late 1960s or early 1970s. Since then large scale captive-breeding programs were established and large groups were kept in zoos and private collections. Today due to the successful breeding of this animal the UAE hosts the largest population of the Arabian oryx in the world. The recent figures indicate more than 3,000 animals present within the UAE and more than 66% of these are within the Abu Dhabi Emirate. To continue the efforts of the late President of UAE, H.H. Sheikh Zayed bin Sultan Al Nahyan in protecting the Emirate’s environment and conserving its natural heritage, this release project has been initiated by H.H. Sheikh Khalifa Bin Zayed Al Nahyan, the UAE President. As the governmental authority working towards the protection of the emirate’s natural environment, the Environment Agency—Abu Dhabi (EAD) has been delegated to implement this project.

Preparing the Release Site

As a first step towards the on-site implementation of the project, a set of criteria have been identified to select release sites that would best suit the Arabian oryx requirements in term of:

- Availability of food, water and shelter
- Habitat quality and quantity
- Human use
- Site accessibility

Acknowledgements:

We would like to thank Suwit Punadee, DVM. and all the staff at GRP and WAR Thailand for the amazing work they do for conservation. Also the US Fish and Wildlife service for the support they have given towards environmental education in Phuket.

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Selection and Translocation of Animals

Animals were selected from three different groups within Abu Dhabi Emirate namely: 1) Al Ain Zoo, 2) Sir Bani Yass Island Arabian oryx collection, and, 3) Sheikh Mohammad Bin Butti private Arabian oryx collection. The primary reason for this is to have different blood lines and increase the genetic diversity of the released animals. The veterinary and genetic history of the Sir Bani Yass island group shows it to be a genetically diverse herd. Selection of animals from each of these groups was made according to certain criteria to ensure that the animals will tolerate the translocation and new environmental conditions at the release site. Healthy and fit animals have been selected to form herds in the pre-release enclosures and grouped into various herds. Each release site has three small oryx groups, each group is comprised of one dominant male, two sub-adult males and seven to eight adult and sub adult females (see photo 2).

Blood samples of randomly selected animals were first screened for infectious diseases before the actual translocation. Translocation procedures start with darting the selected animals according to sex, age and body condition. Animals were then vaccinated against common infectious diseases such as Peste des Petits Ruminants (PPR) and Foot & Mouth Disease (FMD). Both ear tags and microchips were used to mark all animals. Blood and hair samples were taken from individuals for further genetic analysis. Animals were crated in individual crates for transportation to the pre-release facilities. The following table summarizes numbers of animals translocated to the three selected sites shown (see table 1).

Future Management Options

Currently, hunting control and wildlife protection are the only management activities that take place in the release area. However, the management vision for the release site is primarily aimed at restoring the natural habitat of the area, while at the same time minimizing human and other interferences by adopting sustainable strategies.

| Table 1. The total number of Arabian oryx translocated to the release pens |
|-----------------------------|-----------------------------|-----------------------------|
|                             | Al Aslab        | Umm Al Zummoul | Hammem         |
| Males                       | 7              | 8              | 8              |
| Females                     | 20             | 11             | 30             |
| Total                       | 27             | 19             | 38             |

The long-term objectives include:
- Establishing the site as a protected area
- Develop and implement regulations for grazing and other practices.
- Develop a conservation oriented zoning plan for the release area.
- Enforce wildlife legislation through well trained rangers.

Monitoring and Evaluation

Monitoring of the animals after the release will be carried out using:
1) satellite tracking, and
2) Radio tracking.

Satellite transmitters will be sending 4 to 6 GPS readings per day which will be directly downloaded and displayed visually on a map of Abu Dhabi Emirate. This data will help the project team understand the animal’s movements, behavior and distribution. Radio collars will help rangers and ecologists on the ground for daily monitoring of the released animals. A total of 11 satellite...
transmitters and 15 radio collars will be fitted to the released animals in the three release sites.

Pre-Release Lessons

- It is highly recommended that translocation takes place in the winter months so that the summer heat (>50°C) does not cause additional stress on the animals and at the same time give them a chance to acclimatize to the new environmental conditions before actual release.
- Animals should be given enough time to form herds and socialize before the actual release takes place.
- Genetic and blood tests are crucially important in the translocation and release phase.
- It is important to get the animals adapted to the release environment through adopting a diet program based on the food quantity and quality that animals might require daily.
- Documentation and proper management of the data are highly important tools to manage the herds and overall release program effectively. Newborns, deaths, ear tag numbers and all other data should be documented in well designed data collection sheets.
- Daily close observations on the behavior and health conditions of the animals are vitally important to improve the management of animals and ultimately increase the chances of survival and success in the wild.

Acknowledgments

This project is grateful to the continuous support and commitment of the Abu Dhabi Executive Council represented by its Secretary General H.E. Mohammad Al Bawardi (EAD Managing Director); Majid Al Mansour, EAD Secretary General and Abdullhasser Al Shamsi, Director, Terrestrial Environment Research Centre (TERC). With special acknowledgments to Mohammad Nawaz, Technical Manager, Forestry Department; Mark Craig, Director, Al Ain Zoo; Azhar Abbas, Curator, Al Ain Zoo; Mohammad Saad, Veterinarian, Al Ain Zoo. Last but not least to all EAD-TERC staff including Maher Kibshawi, Pritpal Soorae, Badria Mohammad Bin Faisal, Mohammad Ahbabi, Mohammad Muhaibri, Rashid Al Mansouri and Ahmad Al Mansouri.

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The NWRC has now translocated 162 oryx (74 males, 88 females) to the 12,000 km² unfenced 'Uruq Bani Ma’arid Protected Area since 1995 and, to date, no transportation-linked mortalities have been recorded. Monitoring of this oryx population continues unabated, despite changes in the NWRC staff and management at the end of 2004. The population in this area is still estimated to number in the region of 120-150 oryx. However, the monitoring success, expressed here as the number of individually identifiable animals positively identified per year, has decreased markedly from 2004 onwards (see table 1). The reasons for this are three-fold: firstly an increasing number of radio-collar failures, coupled with a decreasing number of new collars being deployed; secondly, increasing wariness of the oryx population due to a decreasing amount of time spent on intensive monitoring and, thirdly a decreasing ratio of captive-bred to wild-born animals in the population. The failure of radio-collars severely restricts monitoring in this hyper-arid region as it becomes near-impossible to identify those areas of temporarily suitable habitat - a result of rainfall variability - that are being used by animals at any particular time. Furthermore operating radio-collars also provide access to additional animals, some of them also potentially identifiable, than just the animal wearing the transmitter.

While intensity of monitoring, as measured by the number of days spent by a biologist in the area, have decreased during the last three years, monitoring efficiency (number of marked animals identified per day in the field) has not. In fact, it has increased from 2004 to 2005, and this increased level was maintained through 2006 and is believed to be a result of extensive previous experience of monitoring staff in the area. This suggests that detailed knowledge of the difficult terrain, oryx behavior and patterns of habitat use, affect monitoring efficiency in this area. This could also be true for other species being introduced into other areas and is perhaps something that needs to be borne in mind by projects relying heavily on often-inexperienced volunteers for monitoring.

While poaching has previously been reported in the ‘Uruq Bani Ma’arid Protected Area (Chassot et al., 2005), the low detection rates of poaching during 2005 (1 confirmed case and potentially 2 more cases) and 2006 (no cases) is believed to be due to the new, systematic way in which the protected area rangers are patrolling the protected area and therefore remain vigilant.

With increasing numbers of unmarked, wild-born oryx in the population, post release monitoring should continue its shift from that of the individual to that of the population. However, the lessons here are that radio-collars should remain a vital part of any monitoring program in this vast, unfenced protected area in the hyper-arid Rub al-Khali Desert. Moreover, replacing radio-collars on the same animals is vital as that enables the collection of long-term data on specific animals under varying environmental conditions.

Monitoring of the ‘Uruq Bani Ma’arid population will continue at both the individual and the population level. To facilitate the former, concerted efforts will be made to maintain the sample of radio-collared animals in the area by replacing some of the collars that reach the end of their battery life. Concomitantly work is ongoing to develop a suitable technique for estimating population size in the area, since the landscape provides significant challenges to standard methodology. Environmental conditions permitting, it is envisaged that releases into the ‘Uruq Bani Ma’arid Protected Area will continue for the foreseeable future. This is partly because an (admittedly simplified) population modeling exercise suggested that this would be needed to maintain this population (Strauss, 2001) and partly because we are reluctant to halt further releases until such time as reliable population estimates can be routinely generated.

**Conclusion**

The recent developments in the Arabian oryx re-introduction program in the Mahazat As-Sayd Protected Area...
Area again confirm that reintroductions can be very successful over the longer-term when the conditions set by the RSG guidelines are being met and maintained. It also shows that while captive breeding - as an emergency measure - is a vital conservation tool, species recovery programs can, and we feel they should, move beyond the ephemeral need thereof.

The Arabian oryx re-introduction program in Saudi Arabia continues with the knowledge that a combination of old and new challenges face the successful long-term conservation of this species. Old challenges include maintaining the population in the ‘Uruq Bani Ma’arid Protected Area, as well as maintaining and improving the monitoring thereof, while new challenges include the development of an effective conservation management strategy for the oryx population in the Mahazat As-Sayd Protected Area.

Acknowledgements
The NWRC operates under the auspices of the NCWCD and the guidance of its Secretary General, His Highness Prince Bandar bin Saud bin Mohammed Al Saud. Over the years countless numbers of administrators, biologists, veterinarians, mammal keepers and protected area rangers have been involved in the Arabian oryx captive-breeding and re-introduction projects in Saudi Arabia. We thank you all for your valuable contributions.

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habitat loss and introduced mammals associated with European colonization have taken a heavy toll on these charismatic and ecologically important reptiles. So much so, in fact, that all nine Cyclura species are listed on the IUCN Red List of Threatened Species: five as critically endangered, one as endangered, and four as vulnerable. Collectively, rock iguanas are the world’s most endangered group of lizards.

Because Turks and Caicos iguanas (Cyclura carinata) are among the smallest species of rock iguana (<2 kg), they have been especially hard hit by introduced cats and dogs. At the time of European colonization, this species was found throughout the Turks and Caicos Islands, located at the southeastern terminus of the of the Bahama Archipelago, and likely numbered in the millions. Since then, increasing pressures from humans and domestic animals have caused the extinction of iguanas on all large islands and many small cays in the Turks and Caicos. Today, the species occupies less than 5% of its historic range and at least 15 island populations have gone extinct in the last 25 years. The Turks and Caicos iguana now numbers in the thousands, and the remaining animals are concentrated on just a handful of cays, many of which are threatened by active development or expanding populations of invasive mammalian predators. For these reasons, the Turks and Caicos iguana is listed as critically endangered on the IUCN Red List of Threatened Species.

REPTILES

Turks and Caicos iguana translocation program, Bahama Archipelago

Rock iguanas (genus Cyclura) are the largest native land animals and dominant herbivores on most islands where they occur. They also have the dispersal and germination of seeds that pass through their digestive tract, rock iguanas play a critical role in maintaining and perpetuating native plant communities. Unfortunately,
and its recovery is a priority of the IUCN Iguana Specialist Group.

Approach

In response to threats from introduced predators and human development, a multidisciplinary translocation and research program for the Turks and Caicos iguana was initiated in 2000. Potential source and recipient islands for iguana translocations were identified during surveys of iguanas and feral mammals conducted on over 200 islands in the Turks and Caicos between 1995 and 1998. Based on these data, a translocation strategy was developed to move iguanas from large populations under threat and expected to decline to small, uninhabited islands within the Turks and Caicos protected areas system that no longer supported iguana populations but had good iguana habitat and were free of feral mammals. To this end, two source islands and four recipient islands for iguana translocations were selected from the pool of potential candidate islands.

The source populations selected were Big Ambergris and Little Water Cays. Big Ambergris Cay (400 ha) was chosen because 1) it supported the single largest remaining population of Turks and Caicos iguanas (15,000 - 20,000) and 2) it was in the early stages of extensive development. Aside from significant habitat loss associated with development, it was feared to be only a matter of time before mammals were introduced, despite restrictions prohibiting pets. Little Water Cay (100 ha) was chosen because 1) it was a National Park with a high-profile iguana ecotourism industry and 2) cats had recently colonized it via a storm-induced land bridge connecting it to two larger islands. Thus, iguana populations on Big Ambergris and Little Water were robust but threatened. The four recipient islands chosen for translocation were Middle (1 ha), Bay (4 ha), Six Hills (4 ha), and French (12 ha) Cays. Prior to translocating iguanas, traps were set on each of these cays to ensure they were free of feral mammals. Rats were found on Bay Cay as well as three much smaller nearby islands, each less than 1 ha. Rats were eradicated from all four of these cays using poison bait blocks containing 0.05% bromadiolone, set in a 15-20 m grid over each island, and maintained for six months.

The translocation of iguanas to the recipient cays took place in January 2002 (Bay, Middle, and French Cays) and January 2003 (Six Hills Cay). Each cay received 18 - 82 iguanas from one of the two source islands (see figure 1), depending upon island size and estimated iguana carrying capacity. To maximize the reproductive potential and genetic diversity of the new populations, only mature iguanas of an equal sex ratio were translocated. All iguanas were health screened by a veterinarian prior to being translocated. Animals were transported to the recipient cays in PVC tubes, 3 feet long and 4 inches in diameter, aboard a boat and released at a single site along the shore to simulate a colonization event. To monitor translocation success and study the effects of translocation on the iguanas, a schedule was established to compare source and recipient iguana populations at regular intervals, two to three times annually, for three years. This research included investigations on each cay of iguana movement, survival, reproduction, growth, diet, and stress (by assaying corticosterone levels, and hematology and blood chemistry parameters). In addition, a plant list and vegetation map was produced for each cay, a nutritional analysis of over 100 food plants was conducted, and a data-logging weather station was erected on each cay to continuously monitor temperature, humidity, and precipitation. To facilitate the translocations and associated fieldwork, a 44-foot live-aboard vessel and 16-foot skiff were purchased, overhauled, and outfitted to serve as a mobile base for conservation and research activities.

Results

One month after being translocated, iguanas on the recipient cays, relative to those on source cays, exhibited higher movement rates and corticosterone levels, decreased mass, and changes in hematology and blood chemistry profiles consistent with dehydration and stress. However, these effects were short lived. By five months post-translocation, iguanas on the recipient cays were exhibiting corticosterone, hematology, blood chemistry, and growth profiles similar to those observed for the source populations, and females were laying eggs. Since
then, survivorship has not differed between source and recipient cays, successful reproduction has been observed on every recipient cay each year since translocation, and growth rates on these cays have exceeded those recorded for iguanas on source cays. Furthermore, differences in growth rate have occurred despite significantly lower plant diversity on recipient cays, relative to source cays. On average, iguanas hatched on recipient cays have experienced growth rates three times those observed for identically aged juveniles on source cays. More significantly, differences in juvenile growth rates have translated into reproductive maturity being reached in two years on the recipient cays as opposed to six or seven years on source cays.

Discussion

The Turks and Caicos iguana translocation program has been extremely successful, resulting in the establishment of healthy breeding populations of iguanas on each of the cays targeted for restoration, and reducing the species risk of extinction. Differences in growth rate and age at reproductive maturity between iguanas in recipient and source populations are attributed to significantly lower population densities and thus intraspecific competition on recipient cays relative to source cays. As recipient populations grow and approach carrying capacity, differences in life history parameters between recipient and source populations are expected to decrease and converge. The plasticity observed for Turks and Caicos iguanas in growth rate and age at reproductive maturity suggests a mechanism that could be applied to rapidly increase populations of other endangered Caribbean iguanas. In the future, we plan to continue monitoring the restored populations every two years to document changes in population parameters as carrying capacity is reached. In addition, we have begun working with Island Conservation to implement of a feral mammal eradication program for islands in the Turks and Caicos.

In combination with more translocations, such a program could restore Turks and Caicos iguanas to much of their former range.

Acknowledgements

This program is a collaboration between the center for Conservation and Research for Endangered Species of the Zoological Society of San Diego (ZSSD), the Turks and Caicos National Trust, and the Department of Environment and Coastal Resources of the Turks and Caicos Government. Generous funding for this program has been provided the ZSSD, the Offield Foundation, the Disney Conservation Endowment Fund, the Steve and Carol Weinberg Foundation, and the International Iguana Foundation. The work described here would not have been possible without the assistance provided by more than 80 volunteers who contributed their time and enthusiasm.

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Re-introduction of captive-raised Siamese crocodiles in Thailand

Crocodile management in Thailand has its priority for the re-introduction of pure-bred Siamese crocodiles from a captive breeding institution within the country. The first re-introduction took place in 2004 (see photo 1) following the guidelines for re-introduction which included the following:

- suitable habitat surveys in its histological range,
- selection and preparation of pure-bred and healthy animals,
- public hearing and education,
- park rangers training,
- acclimatization before actual release, and,
- Post-release monitoring.

The Siamese crocodiles were formerly reported virtually extinct from the wild in Thailand because there was no serious survey carried out until 2004, but I reported several remnant populations scattered in protected areas (Regional Proceeding in China, 2001). The report of the Siamese crocodile populations and habitat surveys in 2004 updated the number of wild crocodiles to around one hundred individuals in five surveyed habitats. These population were allowed to survive in the areas that were protected but with a limited carrying capacity. Siamese crocodiles prefer open water such as lakes or reservoirs over a watershed or small creek/canal deep in the forest. Thailand is heavily populated by humans with less than 10% of the land mass designated as protected areas.

![Photo 1: One of the first released Siamese crocodiles](https://example.com/photo1.jpg) © Yosapong Temsiripong

© Yosapong Temsiripong

![Photo 1: One of the first released Siamese crocodiles](https://example.com/photo1.jpg)
The survey found only remnant populations of saltwater crocodiles around the mangrove forest, but no Siamese crocodiles in the freshwater habitat on the island. Khao Ang Lue Nai Wildlife Sanctuary is the largest lowland forest in Thailand in southeast Thailand and the survey found only an adult Siamese crocodile in small pool during the dry season (CSG Newsletter, 20 (4)). This habitat is highly unsuitable for crocodiles so a relocation of this individual is in a plan. Phu Kieow Wildlife Sanctuary is situated in the central Thailand and is the historical range of Siamese crocodiles. The surveys found a remnant population up in the water shed and this recent report is a new record of the highest altitude for this species in Khao Yai National Park at 750 m a.s.l and it is still in question whether they are released crocodiles or a new population?

Even though a series of suitable habitat surveys in five protected areas uncovered the most-likely number of depleted and scattered populations, the only one site chosen as a study area for the pilot project is the Pang Sida National Park because of no human interaction in the area and having sufficient suitable habitat for a crocodile population. Pang Sida National Park in eastern Thailand was awarded a World Heritage by UNESCO in 2005 and the habitat survey showed suitable habitat for a small population of less than 100 crocodiles. The survey found only a track and tail drag of a monitor lizard and interspecific competition may occur if juvenile crocodiles are released. Following the first release of 10 captive-raised juvenile crocodiles in 2005, park rangers often spot two crocodiles present around the release areas within a 1 km range that shows 20% MKA survival index and eight crocodiles were never seen again. This indicated either more effort was needed for monitoring or the area is not suitable. However, there was no report from the villagers downstream whether or not they found crocodiles swept towards the village.

The local folks in the village have been our partner. Public hearing and education was carried out in early 2004 to make certain that escaped crocodiles outside the protected area will not be captured (see photo 2). Since the villagers live next to the park border line, they used to see and capture juvenile crocodiles swept away with the water in the valley but will not be frightened by the crocodiles if seen again. Instead, they promised to capture and hand in the escaped crocodiles to the rangers. The villagers have seen the increase of eco-tourists since the crocodiles were brought back to the areas. The training for wildlife rangers was completed in mid 2004, the rangers were trained to understand natural history of crocodile, the importance of crocodiles in the ecosystem, safe handling of all-sized crocodiles, survey techniques, and field data collection. To avoid serious genetic manipulation, DNA testing with microsatellite techniques was done by the Kasetsart University in 2004. The microsatellite result was confirmed by a former Karyotype technique and the problem of hybridization in captive-breeding was solved (see photo 3). Dr. Parntep Ratanakorn, DVM, performed a health check-up for all captive-raised crocodiles to guarantee disease-free animals for release. Acclimatization of released crocodiles was carried out for three months before their release in February 2005 and October 2006. Released individuals showed excellent survival skills such as finding and capturing prey, seeking shelter, and avoiding natural predators including humans. On 21st October 2006, the second set of 10 captive-raised juvenile crocodiles were released in the same area (Wang Mon pool) and all crocodiles were equipped with a microchip for identification. The monitoring program was conducted by a graduate student at Kasetsart University and involved setting up camera traps along the pool and creek. Because radio-telemetry studies affect the survival rate of crocodiles we decided not to use this technique.

Because the design of this pilot study did not include either radio-telemetry techniques or camera traps, the results of the survival rates may be inadequate, but the public acceptance and continuation of the project for yearly releases will ensure the re-establishment of a crocodile population from a re-introduction program in the long term. Once this project is permitted by the government to release crocodiles in the public lake such
as Bung Borapet in Nakornsawan Province, the Thai Siamese crocodile population will never be depleted again.

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**Re-introduction of American alligators in Louisiana, USA**

The Louisiana Department of Wildlife and Fisheries (LDWF) has developed wise management programs for one of the state’s most valuable resources - the American alligator (Alligator mississippiensis). Over the years, carefully designed research projects led to successful “sustained use” harvest programs of wild sub-adult and adult alligators, as well as alligator eggs which can be collected by licensed alligator farmers or “ranchers” from suitable wetland habitats statewide. These programs benefit the many Louisiana citizens who elect to participate in them, including private landowners, alligator trappers, alligator farmers and their employees, alligator buyers, dealers and others. In 2005, the value of just the raw alligator hides and meat was approximately US$ 40 million.

The alligator programs are loosely categorized into the wild harvest program and the farming/ranching program. In addition to these, there is a nuisance alligator program to handle human-alligator conflicts and an active research and monitoring program, which is important to ensure that our harvest programs are indeed conservative and not detrimental to the wild population of alligators. One of the most important (as well as time consuming and labor intensive) parts of the alligator program involves the mandatory re-introduction of alligators from farms to the wild. Many landowners choose to participate in the egg ranching program, wherein conservative egg quotas are set by LDWF for selected wetlands, upon detailed review of annual nesting survey results. Alligator farmers/ ranchers are allowed to collect eggs from the wild (which helps avoid natural mortality factors such as flooding, predation and desiccation), but they must later replace the portion of juvenile alligators to the wild that the LDWF estimates would have survived on their own, had the eggs not been collected.

Extensive research now suggests this is about 14 percent of the eggs hatched. Thus, the alligator farmer may keep 86 percent of the hatchlings obtained from collected eggs, grow these to harvestable size and sell the valuable hides and meat. The other 14% must be released back to the wetlands from which the eggs were collected within two years of collection, when the alligators are between three and five feet (91.4 cm – 152.4 cm) in length. The egg “ranching” program was initiated in 1986, with the first re-introductions being made in 1988. Initially, the LDWF required that 17% of the number of eggs hatched be reintroduced to the wild, but studies indicated good survival of the re-introduced juvenile alligators (see photo 1). Thus, starting with the 2000 year egg permits (re-introductions to be made in 2001 or 2002), the return requirement was decreased to 14% of the eggs hatched.

The exact quantity to be re-introduced depends on the average size of the alligators released; with a lesser quantity being required if the alligators are larger, and more being needed if the alligators are smaller, as presumably larger alligators have a better chance of survival.

This program allows landowners to capture an economic benefit from the alligator nests on their marshes, which encourages them to maintain healthy wetlands (perhaps rather than converting the wetlands for other land use practices) and benefits numerous other species such as waterfowl, furbearers, fisheries organisms, etc.

**Approach**

The re-introduction of juvenile alligators to the wild requires a seven-person team of biologists and wildlife technicians employed by the LDWF. Alligator farms are located all over the state in remote distant locations. Each alligator to be re-introduced is measured and then permanently marked by cutting out two of the alligator’s tail scutes, and two web tags with a six-digit identification number are placed between the toes of the rear feet of the alligator. The sex of each alligator is recorded and the alligators are placed in heavy burlap bags and then moved to a livestock trailer or a shady spot prior to release. Complex calculations are done to determine how many alligators of a certain size are required to fulfill the release obligations for each landowner. The alligators are then transported by vehicle and boat to be released in suitable juvenile habitat (small ponds with ample cover and available prey base). Initial indications suggested the experimental program worked successfully, and the program has expanded markedly since inception. Now, a normal re-introduction season from mid-March until late August can involve statewide travel to measure, mark, tag and sack 40,000 to 50,000 alligators, for the trip to the marsh to be released to their wetlands of origin. This compensates for the 350,000 - 400,000 alligator eggs collected from Louisiana’s extensive wetlands (some 2,557,000 acres) in most years.

**Discussion**

Extensive work has been conducted to monitor the fate of the alligators released to the wild, to ensure survival is sufficient for future recruitment and maintain population levels. Thus far, by night-time “tag and release” efforts we have documented growth rates after re-introduction are...
equal to (or better than) comparable sized native wild alligators matched for size and sex. The accelerated growth rates are sometimes maintained for several years after re-introduction. A food habits study showed re-introduced specimens are well able to forage for live prey, despite initially being maintained on dry pelletized feeds provided in captivity. They often consumed larger prey (more mammals and birds) often not taken by native wild alligators until the sub-adult size is reached. Blood samples taken from alligators captured after re-introduction showed comparable plasma corticosterone (stress hormone) levels to those seen in native wild alligators. Thousands of the re-introduced alligators have matured into the adult size classes, and have been taken in annual alligator harvests; including some in the eleven and 12 foot size classes. Increasing quantities of farm re-introductions are being harvested in recent years. We have documented successful reproduction by the re-introduced alligators at younger ages than native wild alligators (see photo 2). Most importantly, annual coastal nesting surveys show continued high levels of alligator nesting (which is an indication of population level trends) despite utilization of both alligator eggs, and sub-adult and adult alligators taken in autumn harvests.

In the autumn harvest of adult alligators in 2006, one exceptionally large alligator was caught on 10th September. The alligator measured 12’ 6” in length (3.81 m) and was noted by the trapper to have been marked by LDWF with a tail notch, and the web tag was still present in the foot. The male alligator had been re-introduced on 28th August 1993 at which time it was 44” in length (1.12 m) about eight miles north of where it was later re-captured. This excellent growth and longevity illustrates how this sustained use program can work successfully.

Some lessons learned have been the importance of selection of appropriate juvenile habitat for release; to enhance survival rates and minimize cannibalism. We also recommend releasing alligators over large areas of wetlands, and releasing reasonable quantities of alligators within one given day. We encourage re-introductions when weather/environmental conditions are optimum (ample water levels and low salinities in small ponds) and recommend avoiding extreme exposure to heat (use of refrigerated trucks and limited brief storage times in shaded locations). We also recommend using year-specific tail notches to mark re-introduced crocodilians, to help provide data as to at least the year of re-introduction (if not which specific animal) should the foot web tag be lost with later growth.

Louisiana’s “release to the wild” program is a clear example of sustained use management of a resource that would otherwise suffer high losses due to natural mortality. This was dramatically illustrated in the summer of 2005, when a record 507,315 eggs were collected by alligator egg ranchers. Hurricanes Katrina and Rita then caused widespread flooding across the entire coast of Louisiana, and undoubtedly massive egg/embryo losses would have been incurred, had the egg ranching program not been in place.

The LDWF alligator program has evolved from the first small, very limited, wild harvest back in 1972 to the highly regulated multi-million dollar industry it is now. Through the dedicated efforts of many LDWF employees and cooperation with landowners and industry personnel, we hope to continue improving our programs for the future benefit of the state’s citizens.

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References


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www.iucnsscrsg.org

Check the following WWW sites:

RSG Australasia/Marsupial web site:
www.massey.ac.nz/~DArmstro/rsg.htm
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