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RE-INTRODUCTION NEWS

Newsletter of the Re-introduction
Specialist Group of IUCN's
Species Survival Commission (SSC)
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RSG

ERWDA
Environmental Research & Wildlife Development Agency

IUCN
The World Conservation Union

Species Survival Commission

RSG MISSION:

To combat the ongoing and massive loss of biodiversity by using re-introduction as a responsible tool for the management and restoration of biodiversity through actively developing and promoting sound inter-disciplinary scientific information, policy, and practice to establish viable wild populations in their natural habitats.

COVER PHOTO

Re-introduced Arabian oryx (*Oryx leucoryx*) in Saudi Arabia.

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letter from the Chairman

Dr. Frédéric J. Launay

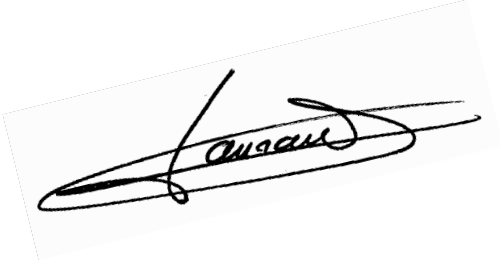
This issue of the RSG is being published after a long spell and is the first issue of the new IUCN Triennium after the IUCN World Congress held in Bangkok during November 2004. We managed to hold several meetings in Bangkok which we hope will lead to some interesting initiatives in this upcoming triennium. The re-invitation of members and the groups organizational structure will be initiated once we have the new membership forms from the SSC and we can then re-organize the group for this current triennium.

During this triennium, we hope to expand our Re-introduction Projects Database to be made more comprehensive so with this in mind I would urge members to contribute information from their respective countries or geographical regions to the RSG Secretariat. Also I would like to urge members to keep their contact details, especially e-mail ID's, up-to date with the RSG Secretariat to allow for easier contact when the need arises. We will be contacting members later on this initiative.

We also received interesting feedback form the RSG membership questionnaire which we distributed last year. The preliminary results of this survey were also presented during the RSG quadrennial presentation at the IUCN World Congress in Bangkok. We are also looking at the results of this questionnaire and hope to use this information to further improve the functioning of the RSG Secretariat. I would like to thank all those who responded to this questionnaire.

We have also had some fairly important meetings in the last triennium and the write-up of the "Developing the Science of Re-introduction Biology" a symposium which was held at the 3rd International Wildlife Management Congress in New Zealand is presented in this newsletter. I also participated in the CBSG-RSG meeting in Taipei, Taiwan where the theme of the meeting was re-introductions and this in conjunction with our South & East Asia Section Chairs has led to many new interesting developments.

I look forward to a productive and interesting triennium and also to more participation by RSG members in activities of the group and in providing information for the Re-introduction Projects Database.



RSG Secretariat News

Re-introduction Projects Database

The RSG Re-introduction Projects Database was initially a compilation of projects with their contact addresses and geographical information (country, IUCN Statutory Region, etc.) which culminated in the *Re-introduction Practitioners Directory 1998*. We now have an upgraded species and projects list which we want to expand and included more detailed information. If you are a re-introduction practitioner willing to provide information on your project(s) please do get in touch with me so I can register your name and contact details in our database. Please e-mail me on Pritpal Soorae, Program Officer, (*Psoorae@erwda.gov.ae*) for further details.

RSG E-mail list moved from SSC listserver to Yahoo Groups

The RSG listserver which had been previously maintained by the SSC at IUCN HQ in Gland, Switzerland has been recently moved to Yahoo Groups. This move was made necessary to allow this expanding e-mail listserver to be in a more efficient and user-friendly interface. A lot of queries were raised before this move as some subscribers do not have good internet connections and there was a misconception that this service could only be accessed by getting on the WWW. I am glad that many of these fears were allayed as subscribers still receive single messages but only from as different address! This now allows many options for subscribers such as simply receiving e-mails to being actively able to browse all postings and allows the posting of documents on the website besides a host of other functions. To join this listserver either send me an e-mail requesting to join the list (*PSoorae@erwda.gov.ae*) or visit: *http://groups.yahoo.com/group/reintro*

Membership for the new triennium

We have not yet received instructions from the SSC Secretariat regarding the membership invitation process for the new triennium. I would recommend those who were members in the previous triennium to please make sure I have your current working e-mail addresses so when the time for membership comes around I can easily mail you the forms electronically. This helps us by saving on postage costs as we have to otherwise physically mail out over 300 envelopes.

Also we are planning to embark on new initiatives in this new triennium and we would like to ensure that we always have working e-mail ID's for members as his saves time and cost trying to reach potential members when there is a need.

Guidelines for Re-introduction in Japanese

The *IUCN Guidelines for Re-introductions* were translated into Japanese by Katsutoshi Watanabe of the Graduate School of Sciences, Kyoto University, Japan. E-mail: (*watanak@terra.zool.kyoto-u.ac.jp*). These guidelines can be accessed at: *http://ecol.zool.kyoto-u.ac.jp/~watanak/conservation/reintroduction.html*

Shark Release Guidelines

These have been formally adopted by the North American and European Taxon Advisory groups run by the AZA (American Association of Zoos and Aquariums), BIAZA (British and Irish Association of Zoos and Aquariums), and EAZA/EUAC (European Association of Zoos and Aquariums/European Union of Aquarium Curators). These need writing up as full IUCN guidelines and this work still needs to be done. **For further details contact Heather Koldewey (formerly Hall), Senior Curator, Aquarium, Zoological Society of London & RSG Fish Section Chair, Regent's Park, London NW1 4RY, UK. E-mail: *heather.koldewey@zsl.org***

The Sahara Conservation Fund (SCF): working for a living desert

In 1998, under the aegis of the Convention on Migratory Species (CMS), representatives of fourteen countries met in Djerba, Tunisia, to discuss the future of their embattled aridland wildlife and to adopt a concerted plan of action. Djerba was a determining moment for Sahelo-Saharan conservation. It also spurred a handful of conservationists into establishing the Sahelo-Saharan Interest Group (SSIG), an informal network committed to implementing the Djerba Action Plan and to the conservation of all Sahelo-Saharan wildlife (RSG Newsletter no. 23: 6-7). To increase the effectiveness of SSIG, the Sahara Conservation Fund (SCF) has now been established. SCF will strive to ensure that the wildlife and natural resources of the Sahelo-Saharan region of Africa are well conserved and managed through action and support derived from stakeholders across all sectors of society. SCF believes that strong partnerships, with people working together to share their commitment, skills, knowledge and resources, can save the unique natural and cultural heritage of deserts. With the big international conservation agencies locked into mega-biodiversity hotspots and wilderness areas, one of the hottest and wildest spots of them all – the Sahara desert – goes unnoticed and unassisted and along with it one of the most precious and uniquely adapted faunal assemblages on earth. SCF intends to change this.

For more information on SCF and its work, please contact its Chair, Dr. Steven Monfort, c/o the Conservation Research Center, 1500 Remount Road, Front Royal, Virginia, 22630, USA. E-mail: **monforts@si.edu**

Developing the Science of Re-introduction Biology a symposium held in conjunction with the 3rd International Wildlife Management Congress

Re-introductions have traditionally been seen as one-off management exercises, and have seldom been designed to meet research objectives. However, since the late 1980s there have been frequent pleas in the literature for more monitoring of re-introductions and a greater research focus. In 1998 the IUCN/SSC Re-introduction Specialist Group (RSG) produced the *IUCN Guidelines for Re-introduction* in an attempt to introduce more rigor into the concepts, design, feasibility and implementation of re-introduction projects.

The level of monitoring of re-introduction projects has now increased substantially, and a good number of papers published testing hypotheses associated with re-introductions. There is therefore now a recognizable field of "re-introduction biology". However, the research so far has been fragmented and *ad hoc*, rather than an organized attempt to address key questions needed to improve re-introduction programs. Consequently, in a strategic review in 2002 the RSG determined that there was a need to facilitate the development of the science and the theory of re-introductions, particularly as the number and taxonomic range of re-introductions increases.

It was with this need in mind that we convened a symposium, entitled Developing the Science of Re-introduction Biology, held as part of the 3rd International Wildlife Management Congress (IWMC), in Christchurch, New Zealand, in December 2003. Unlike many of the previous symposia on re-introductions, which have largely consisted of project updates, the intention with this one was to start laying the platform for scientific progress in re-introduction biology.

The symposium was structured in two parts. The presentations of Part 1 reviewed the use of re-introduction as a conservation tool, summarized research approaches and results to date, and used this summary as a basis for outlining key questions and fruitful directions for re-introduction research. Part 2 consisted of case-study presentations representing a sample of current innovative approaches being taken in re-introduction research.

Wildlife re-introduction programs comprise attempts to re-establish species within their historical range following extirpation or extinction in the wild. Re-introduction projects will entail the deliberate movement, or translocation, of wild or captive individuals, and following initial releases, may require subsequent re-enforcement or supplementation of founder populations. The IUCN Species Survival Commission's Re-introduction Specialist Group (RSG) was established in 1987 in recognition of the increasing use of re-introductions as a conservation tool. In the opening presentation Philip Seddon, Fred Launay and Pritpal Soorae reviewed the scope of re-introduction projects over the last five years and determined that there has been an increase in the taxonomic and geographic scope of projects, with notable increases in numbers of invertebrate projects. Nevertheless, use of re-introduction techniques is most commonly applied to birds and mammals, and least commonly to fish and invertebrates. Also there are more projects situated within developed regions, e.g. USA, Europe, Australasia, and relatively few in less developed regions, e.g. Africa, Meso and South America, South and East Asia.

Richard Maloney and Thomas White then reviewed over 60 recent (<15 yrs.) research results of wildlife re-introductions and translocations within the categories of comparative studies, experiments, or modeling applications, and reviewed correlates of re-introduction and translocation success in relation to these research categories, particularly in terms of knowledge gained. Most re-introduction research (>44%) could be classified as comparative studies, namely; those that anecdotally or statistically evaluated parameters in an opportunistic or a posteriori fashion. Far less common were experimental approaches (21%) specifically designed to rigorously test hypotheses or scientifically evaluate re-introduction techniques. Modeling applications, such as population viability analyses (PVA), and their a priori application in wildlife re-introductions show increasing use (34%) in re-introduction biology. Factors likely responsible for the dominance of comparative studies over experimental and modeling approaches include greater technical ease, inadequate planning, lack of financial resources, small sample sizes associated with most re-introduction efforts, and frequent lack of statistical controls. Nevertheless, rigorous experimental approaches can yield reliable knowledge when correctly applied to re-introductions. Additionally, insights gained by thorough synthesis of all available information such as required in modeling approaches can aid in focusing critical resources and avoiding potential pitfalls. It was strongly recommended that researchers contemplating future re-introductions carefully evaluate a priori the specific goals, overall ecological purpose, and inherent technical and biological limitations of a given re-introduction, and that evaluation processes incorporate both experimental and modeling approaches.

As was made apparent from the first two talks, attitudes toward re-introduction have changed dramatically in the last 15 years. Monitoring levels have increased, some re-introductions have been designed as experiments, and a published literature on re-introduction biology has developed. These are important trends, but the point of any science is not simply to monitor or conduct experiments, but to answer questions using those tools. Thus it is critical to establish the questions we need to answer in re-introduction biology to improve our ability to restore species and ecosystems. Although much has been published, the questions addressed have usually been opportunistic rather than strategic, with a focus on components such as numbers released, and hard vs soft release, probably because such data are easily obtained, not because these were critical to re-introduction success. In the third presentation Doug Armstrong, David Saltz and Philip Seddon proposed that the key questions for most re-introductions are: (1) What ecological factors limit the long-term survival of re-introduced populations?, (2) What restoration or management is required for the population to survive?, and (3) Can we predict optimal sites for future

re-introductions? Other questions are: (4) How do re-introductions impact on ecosystems' function?, (5) Can introductions of non-native species replace functional roles of extinct species?, (6) Can re-introductions ameliorate isolation effects in fragmented habitats?, (7) Under what circumstances will behavioral considerations be important to re-introduction success?, and (8) Under what circumstances will genetic considerations be important to re-introduction success? Answering these questions will require re-introduction biologists to work collaboratively, and to be strategic in deciding where research will have the greatest payoff.

In the fourth talk Francois Sarrazin and Doug Armstrong addressed the question of whether knowledge in re-introduction biology could be substantially improved by adoption of "strong inference", noting that most inference in re-introduction biology takes place by induction, gained from post hoc interpretation of monitoring results or through exploratory comparative analyses. There is scope to improve re-introduction biology by greater application of the hypothetico-deductive method, where models derived from careful observation and theory are subjected to testing. However, re-introduction biology is inevitably constrained, for example by small sample sizes, and lack of replication. It is unrealistic for most re-introductions to be designed as critical experiments, and unrealistic to expect most research projects to produce clear answers. They suggest that the best progress will be made through an integrated approach, where results from comparative analyses, experiments, and modeling results are combined.

Next, Mick Clout and Phillip Casey explored the extent to which biological invasions by alien species can be viewed as models for re-introductions of native species, and thereby assist the science of re-introduction biology. Biological invasions and successful re-introductions both involve the establishment of 'new' species in ecosystems, usually from small founder populations. However, there are likely to be fundamental biological differences between native species that are re-introduced (having previously become locally extinct) versus alien species that are introduced. The use of inherent biological characteristics to predict the success of alien species as invaders is difficult, suggesting that selection of candidate species for successful re-introduction on the basis of such characteristics may not be simple. Other factors such as initial population size and habitat suitability may have more relevance. Of all recent fauna extinctions, 85% have occurred on islands. Island ecosystems are usually less diverse than those on the mainland, and therefore provide restoration models that can be applied elsewhere.

Nonetheless, relatively simple ecosystems still present theoretical and practical challenges. The biggest challenges are posed by small groups of organisms that influence the entire system out of proportion to their diversity or abundance. While seabird extinctions have been relatively few, seabirds are particularly vulnerable to predation and disturbance at their breeding colonies. Attempts to re-introduce burrow-nesting seabirds to islands through the translocation of nestlings have met with mixed success. Failure has been due partly to the lack of science surrounding the techniques used. Seabirds are highly philopatric, so it is critical to the success of any translocation that nestlings be moved before they become accustomed to their natal site. The next two presentations reported on successful techniques in the re-introduction of burrow-nesting petrels (Procellariiformes). In the first of the two case studies Colin Miskelly and David Towns outlined the need to: (1) identify species that formerly had profound influences on ecosystem structure and function, and (2) develop techniques to allow these species to resume their original roles as ecosystem drivers. They used burrow-nesting petrels to illustrate these ideas. Burrow-nesting seabirds once formed enormous populations on most islands and parts of mainland New Zealand, where they heavily modified terrestrial ecosystems through input of marine-sourced nutrients, their burrowing activity, and physical disturbance of ground cover, seedlings and leaf litter. They described techniques developed to measure the ecological impacts of remnant populations of petrels on Korapuki Island (northern New Zealand), and for re-introduction of two species of petrel to Mana Island (Cook Strait, New Zealand). Because success can also be enhanced by avoiding having to feed the translocated nestlings for extended periods, the choice of appropriately aged nestlings is therefore paramount. Nicholas Carlisle and David Priddel presented the second case study, on the endangered Gould's petrel (*Pterodroma leucoptera leucoptera*). Limited to a single breeding locality, the Gould's petrel (~800 breeding pairs) was at risk of stochastic events and the possible introduction of mammalian predators. Plastic nest boxes were fabricated and installed at the species' breeding grounds on Cabbage Tree Island, Australia, and their use and effectiveness evaluated over a decade. In 1995, experimental translocation techniques were developed, trialed and assessed. In March 1999 and 2000, nestlings were translocated to Boondelbah Island, and the first translocated fledglings returned to Boondelbah Island in 2002. The management techniques developed for translocating Gould's petrel are now being applied to endangered petrels in other regions.

The ability to disperse and populate new areas is an essential condition for long-term survival of re-introduced populations. Consequently, understanding the spatial dynamics of re-introduced populations is crucial. Shirli Bar-David, David Saltz and colleagues studied the movement patterns of Persian fallow deer (*Dama mesopotamica*) re-introduced to Israel. Deer were released from the same habituation enclosure, in bi-annual releases starting 1996. The spatial dynamics were characterized by: (1) Short distance movements, mainly of deer from early releases; (2) long distance movements, mainly of deer from latter releases; and (3) spatial shifts in annual home ranges away from the release site, which occurred usually within the first three years post release. The radial expansion of the population during the first 5 years of the project was slower than that of other deer species. While population growth over time was linear (mostly due to repeated releases), the area occupied by deer increased exponentially. This spatial expansion was largely due to long distance movements from the release site to "new" unpopulated areas, which were frequent during the last years. Radiation of re-introduced Persian fallow deer is driven mostly by animals from later releases, suggesting that one possible benefit of multiple releases is increased rates of population expansion.

Advances in captive management for conservation have led to an increase in the use of captive-reared individuals as the release stock for a re-introduction, with captive-reared individuals of at least 76 species released to date. Malcolm Nicoll, Carl Jones and Ken Norris considered the case of the Mauritius kestrel (*Falco punctatus*), a small accipiter-like falcon endemic to the Indian Ocean island of Mauritius. As a result of forest destruction and extensive use of pesticides this formerly widespread falcon was reduced to only four known individuals in the wild by 1974. As part of a successful recovery program, initiated in 1973, the kestrel was re-introduced into the Bambous mountain range in 1987 from which it had been absent for over 30 years. Captive-reared kestrels were re-introduced, using a soft release technique known as hacking, between 1987 and 1990. The population was boosted through the fostering of chicks at established breeding pairs between 1989 and 1994. Kestrels were also released on Ile aux Aigrettes nature reserve (an island 1km off the east coast) between 1989 and 1997. During the re-introduction and continuing up until 1994 the population was managed using techniques such as: brood manipulation, clutch harvesting, nest box provision (continues today), predator control and supplemental feeding..

Re-introductions are often undertaken for the good of the species rather than the individual, with some mammals reportedly suffering diminished health and welfare post-release. Steven Lapidge assessed the impact of re-introduction on a captive-bred mammal, and hence the ethical nature of the popular conservation technique, captive-bred yellow-footed rock-wallabies (*Petrogale xanthopus celeris*) were re-introduced to Lambert Pastoral Station in south-western Queensland, Australia, in 1998. Extensive individual physiological and demographic data collection prior to release, combined with radio-collaring and trap training, ensured individual wallabies could be monitored for their adaptation to the wild for up to 2.5 years post-release. Findings were compared to previous ecological and physiological studies on the species in the wild, and other re-introduced mammals, in particular *P. x. xanthopus* in South Australia. The immigration of wild wallabies into the release site further allowed for simultaneous monitoring of 'natural' physiology and behavior under the same environmental conditions. Assessment of the survival, fecundity, growth, condition, home range establishment, dispersal, haematology, biochemistry, diet, water turnover and field metabolic rates of released captive-bred animals led to the conclusion that re-introduction can be good for the individual as well as the species.

In the final talk of the symposium James Reardon reported on a study that involved translocation of the anole lizard (*Anolis oculatus*) from populations along an ecological cline ranging from coastal forest to rainforest. These populations were translocated to replicated enclosures in coastal forest at Cabrits National Park, Commonwealth of Dominica, from habitats <5kms from translocation site, from an area with no barriers to gene flow, and where anoles have exceptionally high population densities in all habitats. High mortality was observed in all translocated populations except controls, including those from ecologically similar habitats. Fecundity was measured for populations both in translocation enclosures and at the population source, and diminished significantly in all but the control populations. Seasonal replication showed that dry season translocations further increased mortality, reduced fecundity and offspring survival. For translocation survivors, there was a significant shift in phenotype (body characteristics). An experiment tested for phenotypic plasticity (environmentally induced body changes), which proved that the shift in phenotype of survivors was the result of genetic selection reducing founder population diversity. He concluded that the viability of translocated populations can be critically reduced by microhabitat adaptation regardless of translocation distance. Therefore optimizing translocation success should include (i) closely matching the habitat of source populations and the translocation site, (ii) awareness of seasonal survival and reproductive patterns in source and translocation habitats, and (iii) consideration of potential effects of captive environments in adaptive species held for a generation or more.

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RSG attendance in international Meetings:

CBSG Annual Meeting, Taipei, Taiwan 2004

Although the IUCN Specialist Groups Conservation Breeding Specialist Group (CBSG) and RSG are, or should be, closely linked in some areas and have similar problems and issues of mutual interest, the two groups had not met together until recently. In Taipei, Taiwan the Conservation Breeding Specialist Group selected Re-introduction as its theme and invited Fred Launay, Chair, RSG and others deeply involved in re-introduction to given opening presentations, including the Chair of RSG South and East Asia, Sanjay Molur. Asian members of RSG were also invited in the hope that they could take advantage of the meeting based in their region. After the presentations several Working Groups formed with re-introduction as a major theme or as a sub-theme.

Fred Launay's presentation was an overview of re-introduction with special emphasis on captive breeding. Sanjay Molur presented an overview of so-called re-introductions from South Asia of so-called re-introduction projects, very few indeed of which involved zoos, but most of which suffered from lack of adequate planning and of awareness of potential problems and as Sanjay commented, "just releases, not re-introductions." Other speakers discussed current or planned re-introduction projects. Afterwards the meeting broke up into different working groups based on re-introduction as such, on conservation breeding and on the specific projects discussed by the speakers. The general consensus of participants was that the RSG Re-introduction Guidelines are useful and would improve the quality of re-introduction projects if followed.

The Re-introduction Working Group 1 discussed the RSG Guidelines and the problem of practitioners of re-introduction projects not following these Guidelines. There are many reasons for this including lack of knowledge of the guidelines, lack of desire to follow them even if they know, and lack of ability to follow them due to financial and political problems, lack of expertise, and various time and logistics difficulties. Action steps were discussed to provide solutions to some of these problems. Re-introduction Working Group 2 discussed the role of zoos and their increased involvement in re-introduction projects. It was felt that the zoo community should be more involved in re-introduction projects by providing veterinary and husbandry skills, funding, technical expertise and training as well as by providing animals. Action steps were formulated for improving the integration of captive breeding programs with re-introduction programs for conservation.

The Action Steps for each of these groups and a review of the discussion can be referred in ZOOS' PRINT, Volume XX, No. 1., January 2005 (URL: *http://www.zoosprint.org*)

Although there were recommendations for CBSG, RSG and World Association of Zoos and Aquariums (WAZA) to circulate the RSG Guidelines to WAZA members, and for WAZA to formally adopt the RSG *Guidelines for Re-introduction* in its Code of Ethics, it is not, in fact, the members of WAZA who need instruction in the guidelines. WAZA has already adopted the RSG Guidelines in its Code of Ethics in Point 10 of their Code, e.g., "Release-to-the-Wild Programs: The IUCN/SSC/Re-introduction Specialist Group Guidelines for Re-introduction should always be followed. No release-to-the-wild program shall be undertaken without the animals having undergone a thorough veterinary examination to assess their fitness for such release and that their welfare post-release is reasonably safeguarded. Following release, a thorough monitoring program should be established and maintained."

The gap between the organized zoo community's contribution to conservation through re-introduction is not lack of knowledge of the RSG Guidelines but in the mutual failure of communication, cooperation and partnerships between zoos and grass-roots local, state and national NGO's, wildlife agencies, forest departments and governments and the consequent inability of both groups to utilize the strengths and minimize the weaknesses of the other. This came through in some of the recommendations. Many of the recommendations, such as formation of re-introduction advisory groups within regional zoo associations and zoos collaboratively organizing training workshops and symposia themed on re-introduction could make a real difference in range countries where surplus and confiscated animals need to be dealt with more scientifically and the local wildlife agencies need more familiarity with the systematic approach of the RSG Guidelines.

Contributed by Sally Walker & Sanjay Molur, Representing CBSG in South Asia & RSG in South & East Asia, Zoo Outreach Organization, India. E-mail: **sallyrwalker@aol.com** ***&*** **sanjaymolur@rediffmail.com**

Second Regional CBSG/RSG Meeting held in Lahore, Pakistan: 2004

This meeting was a follow up to the First South Asian Regional CBSG/RSG meeting held in Colombo, Sri Lanka in 2003. The meeting held from 29th-30th November started with an introduction to the activities of RSG South & East Asia by Sanjay Molur and Sally Walker which listed the need to, 1) identify re-introduction projects in the region, 2) establish networks, 3) compile all releases to date, 4) publishing newsletters, 5) conduct appropriate training and 6) conduct appropriate and correct re-introductions.

There was a presentation on "Planning Re-introductions" by Pritpal S. Soorae, RSG Program Officer and by Bob Lacy, Chairman, CBSG on the work of that particular specialist group. These presentations provided material for the working groups. The main theme discussed by the working groups that related directly to re-introductions is the proposed re-introduction of blackbuck into the Cholistan Desert, Pakistan and the drafting of a letter that can be used to pressurize senior government officials in the region to conduct sensible and viable re-introduction programs and to avoid inappropriate releases. This meeting was sponsored by the Chester Zoological and Botanical Gardens, UK.

EU LIFE International Meeting in Italy, March 2005

A meeting was held for the conservation measures for the Apennine chamois (*Rupicapra pyrenaica ornata*) for the EU LIFE nature projects for the re-introduction of threatened species in Caramanico Terme, Abruzzo, Italy from 21st—22nd March 2005. A general presentation on "Planning Re-introduction Programs" was given by Pritpal S. Soorae, RSG Program Officer. A presentation on re-introductions in Italy with a view to developing national re-introduction guidelines was presented by Piero Genovesi, RSG member based in Italy and responsible for brown bear re-introductions (*see article in this issue pg. 11*).

Contributed by Pritpal S. Soorae, RSG Program Officer, ERWDA, P.O. Box 45553, Abu Dhabi, UAE.
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Are conservation plans fatally flawed? A rejoinder

A January 2004 piece in the New Scientist by James Randerson (*Conservation Plans are Fatally Flawed*, 24th January 2004) suggests that habitat and species conservation plans take little account of science in developing their plans and that conservation scientists "make little effort to disseminate or explain their work to conservationists in the field, and rarely ask the questions managers want answered".

This short piece also berates the IUCN Re-introduction Specialist Group's Guidelines for Re-introduction for not mentioning how to avoid inbreeding nor any problems associated with low genetic diversity. It thus implies that the IUCN/SSC Re-introduction Specialist Group (RSG)

also does not support the use of science in management and re-introduction programs for conservation. The main focus of the article is on the breeding and re-introduction program for the Galapagos Española tortoise, an unqualified success for all but Mr. Randerson. This is a species which had dropped to 2 males and 12 females in 1965 and now numbers between 800 and 1000, a re-introduction program having begun in 1975.

Mr. Randerson complains that genetic considerations were ignored in the breeding program, that the genetic diversity of the population is incredibly low and therefore that the tortoise could yet be wiped out. He suggests that there is currently a cooperative relationship between managers and scientists in an attempt to diversify the population's genetic structure, but that such interactions are atypical in the management of endangered species or habitats. Sadly, I found this article to be fatally flawed in its confused presentation, its mix of opinion and facts, and eventually its conclusions. Mr. Randerson clearly has a point he wishes to make and does not want reality to interfere with his judgment. First, the article jumps back and forth between habitat management plans, species survival programs and the one example of Galapagos tortoises breeding and re-introduction. It does not follow any logical development and juxtaposes information and "best available science" from today with that of 40 years ago.

According to the article, the tortoise breeding program started in the 1960s. Katherine Ralls and Jonathan Ballou's seminal article on the negative effects of inbreeding on juvenile survival in mammals was not published in Science until the mid-1970s. Until then genetic information was not considered relevant. It took another decade before genetic management could be easily incorporated into captive breeding programs because the software techniques for integrating genetic information into species management plans were not developed until nearly 15 years later. Interestingly, most species population managers today would have said that with a tortoise founder population that was so small, numbers were more important than genetic diversity at the start of the breeding program. And the recommendation then, as now, would have been to breed as many tortoises as fast as you could. It is no help to have great genetic diversity if your population goes extinct. In fact, it looks as though the tortoise species managers did rather well with tortoise genetic diversity. They started with 14 individuals and now have the equivalent of 11 founders. I know of numerous examples of species with very controlled and successful breeding programs with fewer than 11 founders. With 800-1000 individuals, I would think that tortoise managers can now focus more on equalizing genetic contributions.

And what of the *IUCN Guidelines for Re-introduction*? They actually do refer to the importance of conducting genetic studies multiple times, both when considering a wild source population for translocation or a re-introduction involving captive animals. The Guidelines state, "If captive or artificially propagated stock is to be used, it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology." And indeed, the Guidelines refer over and over again to the need to do multi-disciplinary scientific studies in the context of a re-introduction. The main conclusion of the article is likely true, i.e. that scientists and managers don't communicate enough and that science is not incorporated into management plans sufficiently. But this lack of communication is a two-way street. Managers don't necessarily want scientists giving them advice or telling them what to do and scientists may find that land and species managers are unwilling to listen. And there may be many other reasons why science is not incorporated into management plans, be they political (e.g. the current hostility between the US government and conservation science) or financial.

I do not think that Mr. Randerson does the conservation community or the wider public a service by writing a piece that paints the incorporation of science into management plans as an all or nothing phenomenon. There is certainly room for improvement, but that's also true of Mr. Randerson's writing.

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MAMMALS

Re-introductions of large mammals in Gorongosa National Park, Mozambique

When Ken Tinley conducted aerial surveys over the rift valley of Gorongosa ecosystem in central Mozambique during the early 1970s, he counted thousands of large mammals, including some 14,000 buffalo, 5,500 wildebeest, 3,500 waterbuck, 3,000 hippo, 3,000 zebra and 2,200 elephant. But during the Mozambican civil war of the 1980s, thousands of animals were slaughtered throughout the country. When Dave Cumming and his colleagues conducted a sample air survey over Gorongosa during 1994, they saw no buffalo, wildebeest or hippo, and discovered that few waterbuck (estimated number 129), zebra (65), or elephant (108) remained.

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During 2004, the Gregory C. Carr Foundation (*http://www.carrfoundation. org*) signed a Memorandum of Understanding with the Mozambican Ministry of Tourism and pledged support of US$ 500,000 for Gorongosa National Park. The money will be used for the rehabilitation of the park: to improve its management, biodiversity and community programs, and to conduct ecological monitoring and scientific research. During October 2004, the Carr Foundation funded an aerial survey (a 10% sample survey) of the park's large mammal populations. This revealed that the numbers of waterbuck and smaller herbivores had increased during the past decade. But no wildebeest or zebra were seen and only a solitary buffalo and 21-23 elephants were recorded, all outside the sample strips. Sixty hippos were seen during a dedicated hippo survey.

As part of the rehabilitation program, the Carr Foundation is now funding the preparation of re-introduction / supplementation strategies for large mammals in Gorongosa NP. A small team will start preparing the first strategy, for buffalo, during January 2005. The strategy should be complete in time for implementation to commence during the 2005 dry season. It is hoped that the first animals – of what will probably be a large, multispecies program of re-introductions and supplementations – will arrive in the park before the end of 2005.

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16th IBA meeting in Italy, 2005

I would like to extend an invitation to members and subscribers of the RSG to attend the 16th International Conference on Bear Research and Management (IBA), that will take place in Riva del Garda (Italy) from September 27th to October 1st 2005. The IBA is a non-profit volunteer organization open to professional biologists, wildlife managers and others dedicated to the conservation of all species of bears. The organization consists of almost 800 members from 47 countries. It sponsors international conferences on all aspects of bear biology, ecology, and management, held alternatively in Europe and North America. The IBA is strictly linked to the IUCN/ SSC Bear Specialist Group, that is in fact chaired by the President of the IBA.

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What makes the 16th IBA Conference particularly interesting for experts of re-introductions, is that Trentino is the area where a translocation of bears is being carried on since 1999 (several updates on the project have been published in the RSG newsletter in the last years). For this reason, the conference – among other aspects of bear biology and conservation – will focus on the diverse aspects of bear translocations. Furthermore, we plan to have a one day excursion in the re-introduction area.

For further information visit the following website: *www.provincia.tn.it/foreste/16IBAconference* or contact us at the following addresses:
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How public opinion changes after a translocation: the case of the brown bear in the Italian Central Alps

Public support is a key element for the success of large carnivores translocations. For this reason, within the feasibility study for the translocation of brown bears (*Ursus arctos*) in the Italian Central Alps, a survey on the opinion of the local residents was carried out through telephone interviews to over 1,500 families living in the area. The poll assessed general attitudes towards wildlife, specific attitude toward the brown bear, fear of the bear, opinion on the translocation program, etc. The decision of starting the translocation was also taken because of the general positive attitude recorded through the survey (73% inhabitants in favour, raising to 80% when ensured that measures to reduce risks of bears' attack to humans had been undertaken).

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In November 2003, after the completion of the release program (4 years, 10 animals released), we repeated the opinion poll in order to test how the attitude of residents had changed in the 6 years time-lag. 2,000 families (ca. 50% in the translocation areas and 50% in other areas)

were interviewed by the same operator who conducted the previous study. 79.5% of inhabitants are aware of the translocation and 97.4% know that bears live in the area. Concern has increased from 1997 to 2003 (significantly more people would not go hiking in an area where bears are present), but is still very low (90.9% of people living in the bear area never felt concerned because of bears). 78.3% approved the use of public money for the translocation. Proportion of residents supporting the translocation decreased to 73.2%, that we still consider a very solid support to the program.

Comparing the results of the two surveys, it appears that the communication campaigns carried out during the translocation have significantly increased the information available to residents on bears and their biology. The translocation have also promoted a more realistic attitude toward bears: bears are potentially dangerous to man and should not be considered as harmless. Despite the damage caused by bears in these years to beehives, livestock and orchards, the general support toward the re-introduction is still very high. This is probably due to the ability of the responsible authorities (Natural Park Adamello Brenta, Province of Trento) to rapidly and effectively respond to these problems, by funding prevention measures, rapidly compensating damage, and maintaining an emergency team trained to intervene in dangerous situations.

We believe that opinion surveys should become a routinary tool in large carnivores translocation projects for monitoring dynamics of support by the public, and efficacy of information and education efforts.

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Reinforcement of Andean Bear populations in the Alto Choco Reserve and neighboring areas, northern Ecuador

The Andean Bear (*Tremarctos ornatus*) is the only bear in South America and is listed under CITES Appendix I and Endangered in the Red Book of the Mammals of Ecuador (Cuesta & Suarez, 2001). The main threats faced by this bear are habitat loss, fragmentation caused by human intervention and hunting due to human–bear conflicts. To minimize the damage caused by this isolation, and to reinforce Andean bear populations in northeastern Ecuador, three juvenile bears were rehabilitated and released in the Maquipucuna Biological Reserve (MBR) in 1995 (under the auspices of the World Society for the Protection of Animals -WSPA). The experiences gained during this study resulted in the decision to rehabilitate and release four Andean bears of different ages in the cloud forest of the Alto Choco Reserve (ACR) and neighboring areas. The objective of this study is to determine whether Andean bears are able to survive in the wild and if success is age dependent. This project also aims to increase knowledge on the species ecology and to improve the current re-introduction processes used for this species.

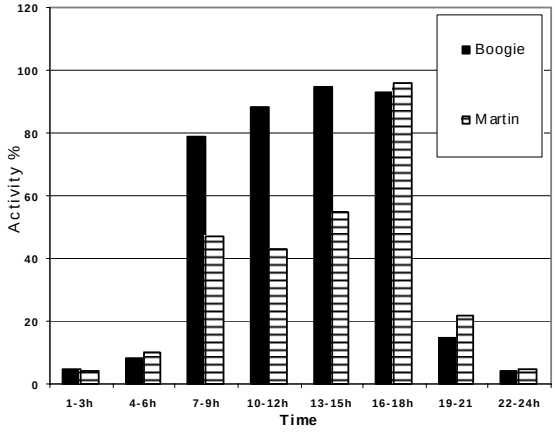

Figure 1. Percentages of activity of two Andean bear in the Alto Choco reserve in neighboring areas

Methodology

This study was carried out in the ACR, located in the Intag region of Imbabura Province, on the western slopes of the volcano Cotocachi, in the Choco bioregion. The study area covers altitudes ranging from 2000 to 4000 m above sea-level (a.s.l.) and contains three vegetation types: cloud forest, upper montane forest and *paramo* (high grasslands). Daily temperatures range between 9°-23° Celsius. The ACR and its neighboring areas (approximately 80 km^2) form part of the buffer zone of the Cotocachi–Cayapas Biological Reserve (approx. 2,044 km^2).

Four bears were selected for the study and three males (born in the wild) and one female (of unknown origin). The bears were named 'Boggie' (adult male), 'Martin' (sub adult male), 'Juguetón' (yearling male) and Yana (sub adult female). The rehabilitation process began at the end of 1999 and the bears were released after six months of rehabilitation and tagged with radio collars. The rehabilitation process was a modified and improved version of Castellanos (1998) conducted in the MBR. In order to aid in the rehabilitation of the bears we studied the diet and behavior of wild bears in the region. For this, we collected and identified feces, tracks and the direct observation of wild bears. In this study, bears were not observed directly as a close human presence may make them liable to not lose their fear of humans.

Results

The male bears were observed masturbating in different ways during the rehabilitation process, namely rapid and insistent licking of various parts of the body. In particular, 'Boggie' licked the inside of his elbow, 'Juguetón' his penis and, 'Martin' the palm of his right hand. 'Juguetón' was found dead one month after release (reason unknown). Similarly, 'Boggie' died three months after release. His death was presumably due to tick fever, caused by the hemoparasite Babesia species. This diagnosis was based on organic anomalies found in the dead body. However, a histopathological examination indicated that the cause of death was pneumonia.

In the months following the bears release, 'Martin' and 'Juguetón' were observed searching around the campsite

near the release area. The bears were subsequently frightened off using dogs and this succeeded in discouraging 'Juguetón' from remaining in the area, but not 'Martin'; who was caught stealing food from the campsite days later. We used pepper spray to frighten him off, but we were unable to deter him. As a result, 'Martin' was trapped and transported to the high Andean forest (between 3200m and 3500 m a.s.l.). Days later, 'Martin' entered a farm to look for food and was recaptured and in an attempt to keep him away from human settlements, we tried a 'soft release' keeping him in the forest but supplying him food for 8 months.

Finally, he entered a nearby village and was injured by the farmers and was eventually taken to a small island (60 ha) situated in the Cuicocha Lagoon, Imbabura Province where he was fed daily. This bear remained here for 17 months, but escaped twice from the island during this period, each time swimming approximately 300 m. After his final escape, we were unable to locate him and it was assumed that he was killed by hunters in the local area. We suspected that 'Yana' was pregnant and decided to try a 'soft release', but she did not return to her food, contrary to what we had expected. She remained in the ABR for 3 months until she was injured by loggers with a machete and was recaptured and released in the SierrAzul Reserve, Napo Province (northeastern region of Ecuador) where she remains to date.

The graph in Figure 1 is based on 835 records of activity and inactivity and the percentages of activity show that the 2 released bears were more active during the day, with activity visibly decreasing at night. The period of least activity was evident between 22:00 and 06:00 hrs. It was not possible to calculate the size of the home range of the released bears due to a lack of data.

Discussion

The oral masturbation reported for the Andean bears was also recorded in our specimens using different zones on the body for stimulation (Zequera, 1989 & Castellanos, 1998). This type of behavior is thought to be frequent in male captive bears. Tick fever could be indicating that introduced parasites are also contributing to the species extinction and more research needs to be done on this issue. Andean bear re-introductions by Castellanos (1998) in the RBM showed a large amount of activity during the day and only limited nocturnal activity. In this study, the bears were more active during the day and almost inactive at night. This small difference in nocturnal activity may be due to the fact that the nights in the ACR are colder than the RBM. It is also likely that the bears need to remain relatively inactive and curled up during the night to maintain body heat and save energy. The low percentages of daytime activity shown by 'Martin' during the `soft release´ were due to the fact that he spent a lot of time around his feeding area resting and waiting to be fed. The 'soft release' method must be carefully planned and managed, as Andean bears are very intelligent animals that quickly get used to 'easy food' and breaking this dependence proved to be difficult, but the method is still considered a good strategy for bear management in private forests.

Conclusion

The present studies and other similar studies had much success in the rehabilitation of bears, but in some cases could not manage to break the imprinting and subsequent dependence on humans. The origin of this problem is due mainly to the fact that the released areas were near human settlements. To avoid these circumstances, future reinforcement efforts will concentrate on releasing animals in extensively protected natural areas, where human bear conflicts will not occur as happened with Andean bears relocated into Sangay National Park by Castellanos (1998). In this way, we can decide whether or not we should continue with the efforts to reinforce bear populations in Ecuador.

Acknowledgments

This project would not be possible without the help of my field assistants Gustavo Tapia and Alberto Tabango, Fundación Zoobreviven and the Ministry of Environment, Ecuador. This project also received financial support World Society for the Protection of Animals (WSPA).

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Proposed re-introduction of the Asiatic Lion in the Kuno Palpur Sanctuary, Madhya Pradesh, India

A very ambitious project was initiated towards the end of the 20th century to bring the roar of the Asiatic Lion (*Panthera leo persica*) back to the forest of Kuno Wildlife Sanctuary (KWS), Madhya Pradesh (M.P.), in the new millennium. At present, Gir National Park and Sanctuary in Gujarat is the Asiatic lion's last home in the world. More than 300 of these big cats represents an extremely restricted population distribution: this leaves them vulnerable to a variety of extinction threats like epidemic diseases and other natural calamities. A large lion population in the Serengeti National Park, Tanzania distributed over a large area recently suffered a devastating outbreak of canine distemper disease in which 75% of the lions have been infected and at least 25% of the population has been wiped out. If an epidemic of such proportion was to occur in Gir, it would be extremely difficult to save the Asiatic lions from extinction,

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in particular given the small size of the park, and also the relatively very small population.

Kuno Wildlife Sanctuary falls in Vijaypur Tehsil of Sheopur district of M.P. It falls in the northern part of the Vindhyan Hill Range. The Sanctuary is located between the longitude 77º07`-77º26` and North latitude 25º20`-25º53` and this area supports a variety of wildlife species. The Kuno Wildlife Sanctuary recently got prominence as it was designated as the most suitable site, of the three sites surveyed, for the Asiatic lion re-introduction project. A team of wildlife biologists from the Wildlife Institute of India carried out the habitat feasibility study and concluded that the Kuno Wildlife Sanctuary offers tremendous potential for establishing a viable population of Asiatic lions outside of the Gir National park of Gujarat state which is the only surviving wild population.

Considering the rich floral and faunal diversity of the area, the Government of M.P. by its notification No.15/8/79/10/2 dated 16/01/81 declared the 344.68 km^2 area, bifurcated by the Kuno River, as a wildlife sanctuary. The Kuno River is actually the lifeline of the sanctuary as the water is retained at numerous pools along the riverbed within the sanctuary. There are in all 24 villages situated within the sanctuary inhabited mostly by Saharia tribes. With a view to prevent the extinction of the Asiatic lions, the KWS in the northwest Madhya Pradesh was selected as the site to establish a second free-ranging population of the Asiatic lion.

The KWS has already been elevated to the Kuno Wildlife Division with an additional area of about 900 km^2 as a buffer zone. This sprawling area across diverse habitat types comes under the tropical dry deciduous forest with major tree species such as Salai (*Boswellia serreta*), Kardhai and Dhawra (*Anogeissus pendula* & *A. latifolia*), Khair (*Acacia catechu*) across an extensive savanna woodland. KWS is home to leopard, wolf and wild dog or dhole and occasionally tigers. The major ungulates include chital, samber, nilgai, wild pig, chinkara, blackbuck and four-horned antelopes. Primates such as common langurs and a large number of bird species can be seen in the sanctuary. After KWS was selected as the site for re-introduction of the Asiatic lion, one of the first tasks at hand was the sensitive job of relocation and proper rehabilitation of 24 villages from within the sanctuary and to create a human-free environment for the lions. Today the sanctuary is totally devoid of human-pressure with the continuing rehabilitation process.

Despite the fact that the implementation of the Asiatic lions re-introduction project has been delayed by more than two years due to unavoidable circumstances, considerable success has been made in the relocation of villages from the Kuno Wildlife Sanctuary. Out of seven villages scheduled in Phase-1, six of them (Chapret, Durredi, Ladar, Palpur, Meghpura & Jakhoda) have completely been relocated to new relocation site whereas 75% families of the seventh village Paira have also been relocated to a new site. Apart from these villages Six villages namely Khalai, Barred, Chak Parond, Khajuri Khurd, Khajurikala and Taparpura proposed in Phase-2 have also been relocated completely.

Monitoring of ecological changes has been initiated and important tasks such as the creation of water holes and weed eradication have been initiated. Population estimation of wild ungulates suggests an encouraging trend in chital and sambar populations and the preliminary data collected will be compared with the ongoing data collection of the ungulate population. It would help to understand the trend of the ungulates population and its response to the overall decrease in the biotic pressure. Similarly, vegetation sampling of the entire sanctuary has been initiated to understand the extent of habitat recovery after village relocation.

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Important components for wolf re-introductions into American and European National Parks

Over the 19th and 20th centuries wolves were extirpated from national parks and forests throughout America and Europe. Their deaths were contributed to by decreased prey numbers through hunting by early settlers; habitat degradation and direct hunting. During these times negative attitudes were projected upon the wolves by farmers, hunters and the general public.

Over the years many wolf populations have naturally restored their numbers despite the persecution through hunting, trapping and predator control programs. Due to these pressures and the increase in human populations, there have been growing concerns for the survival of wolf species, since the middle to late part of the 20th century. With these growing concerns wolf re-introduction programs have been developed to aid in the restoration of wolf populations in American and European national parks. The implementation of re-introduction programs involves key components to ensure the success of the program as well as the survival of a wolf population.

Re-introduction Guidelines and Criteria

The *IUCN Guidelines for Re-introduction* were developed as an aid for conservation groups in their re-introduction projects. The guidelines were not made mandatory but were available as a guide for re-introduction procedures. The guidelines included the aim and objectives of any re-introduction program; the need for public relations

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activities and education; as well as the importance of a multidisciplinary approach. Like the IUCN Guidelines, a set of five criteria for large mammal restoration have been suggested. The criteria covers areas which consider availability of suitable stock, availability of human resources, and improvement of conditions in the areas where the animals have been extirpated from.
The criteria also allow organizations involved with programs to decide if their efforts are viable or not.

Habitat Evaluation and Suitability

Habitat models
The Habitat Suitability Index (HSI) is used to assess the quality of a potential habitat for re-introduction of wolf populations. Unfortunately it is primarily site-level planning and does not consider regional evaluation, which is also important in habitat evaluation. Habitat models such as the HSI are used to assess a range of variables within the habitat, which may affect re-introduced wolves. These include: physical characteristics of the area, prey availability, vegetation, climatic variables, etc.

Habitat size and wildlife corridors
Due to the large sizes of wolf territories (ranging in size from 100-200km^2), the size of a habitat is an important factor in determining the suitability of an area for a re-introduction. If habitats are not large enough to accommodate the packs movement, problems may arise between the wolves, livestock and humans. Wildlife corridors may be used to link two patches of habitat together when a larger habitat is not available for a re-introduction. Corridors allow for the movement and ranging of wolves between the two areas, without the risk of being influenced by human activity.

Prey availability
The availability of prey is a major determining factor in habitat suitability and allows estimations to made of possible number of wolves able to be released into the habitat. Without adequate numbers of prey such as moose, wolf populations cannot be sustained. Prey numbers can be estimated though area observation, as well as plant predation assessments. When adequate prey is available, there is less predation on livestock.

Human Conflicts

Human and wolf conflicts are effected by factors such as habitat size and distance from human activity. This is represented by urban area, arable lands, inhabitant density, available prey, and predation on livestock.
Areas of low human activity are considered as possible re-introduction sites above areas of higher human activity, due to the major concern of human wolf conflicts when re-introducing a wolf population into an area.

Wolf Management and Welfare

During the re-introduction process, the welfare and proper management of a wolf population needs to be a dominant priority. Wolf management should consider the needs of the wolves; minimise stress, maximise their survival, and maintain the wolves natural instincts. survival, and maintain the wolves natural instincts. It is suggested that stock used for the process may be closely related to those wolves that previously inhabited the area. However if such stock in unavailable, the most suitable group of wolves should be chosen.

Temporary Confinement

Temporary confinement refers to quarantine facilities set up to quarantine the re-introduction wolf population. Quarantine prevents the spread of disease to the new habitat, as well as ensuring the release of a healthy wolf population. During quarantine each individual wolf is tested for disease and also vaccinated.

Transport

During transportation of wolves to their new area, stress needs to be minimised. This can be done by placing the wolf travelling crates within the wolves present territory or within their temporary confinement. This allows the wolves to explore the crates on their own initiative and without fear. During transportation, it is possible to sedate the wolves, giving them regular physical check-ups on their temperature, pulse and respiration rate. Through-out the process noise and human contact should be minimised, avoiding excess stress, as well as de-sensitisation of the wolves to humans.

Release Methods

There are two possible release methods for re-introducing a wolf population. One is the soft release method. This involves acclimating the wolves to their new habitat through delayed release from a temporary enclosure placed in the new habitat. Acclimation lasts around 70 days and can also be used to double the quarantine confinement period. The second release method is hard release, which is the most common form of release and involves the immediate and direct release of the wolves from their transportation crates. Both the soft and hard release methods allow the wolves to display natural behaviors, and to adjust to their new surroundings at differing rates.

Monitoring of Wolves Post-release

After the release of a wolf population, post-release

monitoring becomes an integral part of the re-introduction program. It provides biological support and controlled human interaction for the wolves. It involves both individual and population level monitoring. Radio telemetry (including both ground and aerial) is the most popular form of monitoring. Radio telemetry requires the released wolves to be fitted with radio collars, enabling records to be taken of the wolves diurnal and nocturnal patterns, their location and home range; breeding, reproduction and feeding patterns. Monitoring the released wolves can also be achieved by measuring ungulate numbers and comparing this data to previously collected data on ungulates.

Importance of Public Education and Support

When implementing a re-introduction program, both public (including farmers) and governmental support is crucial to the success of the program. Due to the varying perceptions and attitudes towards wolves, it is important to gain the public's support and approval of re-introduction programs. This can be done through providing the public with current information on the program, the wolves, and the important ecological roles of the wolves being released. It is also important to get the support of farmers, as they may be directly affected by the wolves with regards to their livestock. When personnel involved in re-introduction programs show an interest in the publics and the farmers views, values and concerns, greater support will be offered by these groups.

Commitment, support and funding by governments and other important bodies offers protection for wolves both inside and outside the re-introduction area, for example developing and enforcing laws against illegal killing of wolves. They therefore have a large part in the success of re-introduction programs.

Conclusion

Wolf re-introduction projects are important for not only the increasing of wolf numbers but also the maintenance and recovery of ecosystems. This is due to the important ecological roles wolves play in their environment. There is no set design for a re-introduction program, however, each program should have an adaptive management strategy, suited to the specific group of wolves being handled. Each of the discussed components needs to be considered because of the complexity of such programs and the role they play in the survival of wolf populations. Although wolves continue to face the social challenges that they have been presented with over the centuries, many believe that the wolves have a great chance of survival, due to the increasing support offered them by governments, wildlife organizations, and the public; as well as the wolves natural methods of survival.

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Malaysia gaur *in situ* conservation: re-introduction program

The gaur (*Bos gaurus*) re-introduction program is being implemented in Peninsular Malaysia by the Department of Wildlife and National Parks Peninsular Malaysia (DWNP) following the *IUCN/SSC Guidelines for Re-introductions* developed by the Re-introduction Specialist Group of The World Conservation Union's (IUCN) Species Survival Commission (SSC). The restocking program is to restock and re-establish a viable, free-ranging population of gaur into its natural habitat using captive-bred stock. The Krau Wildlife Reserve (KWR) was selected as the first release site because besides being the gaur's historical range, it is a protected wildlife reserve furnished with a well-designed management plan.

Krau Game Reserve was established under the Wild Animals and Birds Protection Enactment (1921) in 1923. In 1968, a Steven's Report (1968) recommended that the Krau Game Reserve be renamed the Krau Wildlife Reserve. The management of the Krau Wildlife Reserve was then transferred from Pahang State Game Department to the Federal Game Department (Department of Wildlife and National Parks) in 1976 with the total area of 60,338 hectares (DWNP and DANCED, 2001).

The feasibility studies and preparation, which included field surveys, for the gaur re-introduction program began in early 2004. Secondary signs such as of bedding and feeding as well as footprints suggested the presence of a herd of gaurs, comprising 1 adult male, 3 adult females and 1 calf in the KWR. Under the restocking program, the DWNP plans to release 3 gaurs (1 male & 2 females) from the captive-bred stock in the Jenderak Selatan Wildlife Conservation Centre, Pahang. The inbreeding co-efficiencies of the potential offspring of these 3 gaurs were calculated based on the gaur studbook records. The values generated were relatively low. The Gaur Conservation Awareness Increment Program for local communities was conducted amongst the Indigenous communities and the Malay Community. The construction of a 200 m x 200 m paddock in Jenderak Selatan Wildlife Conservation Center for monitoring and soft training of the 3 selected gaurs prior to the release was completed in

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early 2004 and is ready to be utilized for the restocking program. The release program commences in early 2005.

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Release of Chinkara gazelle in the Cholistan Desert, Pakistan

The Cholistan desert area in the south east part of Punjab, Pakistan is an intriguing habitat for several wildlife species including chinkara gazelle (*Gazella bennettii*). The only established water-course of this desert was the Hakra River which vanished from the region in time immemorial. Its unique centripetal drainage system, once maintained by the chinkara, provided water to the local communities for drinking, bathing and washing. This system occurred only in two deserts of the world, the Cholistan desert and the Kalahari Desert. For long, these graceful slender-bodies animals assembled around the depressions filled with rainwater and loosened the soil with their sharp hooves. The soil dried into loose sand when there was no water and was easily blown away by the strong winds of the early spring, recreating, and maintaining centripetal drainage system stayed in place to serve as water reservoirs only as long as there were chinkara in large numbers.

The chinkara population had decline severely perhaps to the point of extinction, in the desert regions along the eastern border of Pakistan due to excessive hunting, poaching and over-grazing of livestock. On 18th April 2004, Houbara Foundation International Pakistan in coordination with the Government of Punjab, WWF-Pakistan and the Department of Private Affairs of His Highness the Late Sheikh Zayed bin Sultan Al Nahyan of UAE released a large number of captive-bred chinkara into the wild. The chinkara were released under the restocking program to re-establish a viable, free-ranging population with the renewed hopes that chinkara population will proliferate and the unique centripetal drainage system will come back to life. The chinkara were donated to Government of Pakistan by His Highness the Late Sheikh Zayed bin Sultan Al Nahyan.

The animals were raised under semi-wild conditions in a large enclosure near the eastern edge of Rahim Yar Khan. Before release the chinkara were housed in a pre-release pen established near the release area of Cholistan Desert to enable the animals to adapt to the new surrounding. Twenty water points were made near the release site. All the water points were established along a water pipe line which carries drinking water with the help of sixteen pumping stations installed in the area

Prior to release arrangements were made between Houbara Foundation Pakistan, Punjab Wildlife Department, Pakistan Army and Pakistan Rangers to ensure maximum protection of the released animals. Liaison and coordination was carried out with the Punjab Wildlife Department and District Administration to implement the wildlife law and prohibiting issuing of hunting licenses. Sixteen protection teams were formed for post-release monitoring and patrolling of the vast desert area to prevent illegal hunting and poaching.

The release of chinkara has been a big step forward for conservation in Pakistan. However, success of re-establishment of a viable free-ranging population will not be possible without a safe habitat.

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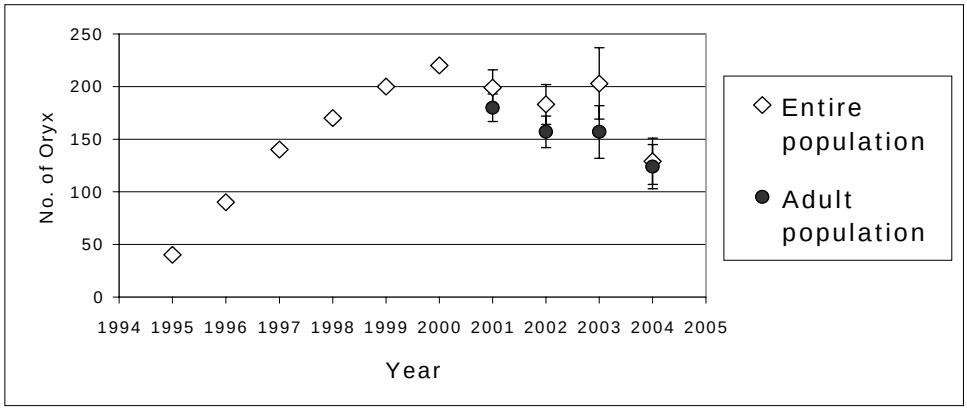
Re-introduction of Arabian oryx in the Kingdom of Saudi Arabia: up-date on population size in two protected areas

The Arabian oryx (*Oryx leucoryx*) formerly occurred throughout Arabian Peninsula deserts but was extirpated from the wild by hunting in early 1970's. In 1986 an intensive captive-breeding program was started at the National Wildlife Research Center (NWRC) of Taif, Saudi Arabia, with the aim of re-introducing Arabian oryx back into the wild (see also *www.arabian-oryx.com*). So far, the captive bred herd has provided nearly 200 oryx to two re-introduction sites, namely Mahazat as-Sayd and 'Uruq Bani Ma'arid.

Mahazat as-Sayd Protected Area

This area was the first site considered for the re-introduction of oryx in Saudi Arabia. The area consisted of a 2,244 km^2 tract of flat, arid steppe desert in west-central Saudi Arabia (28º15'N, 41º40'E). After being designated

Figure 1. Arabian oryx population size estimates in the 'Uruq Bani Ma'arid Protected Area



as a protected nature reserve in 1988, Mahazat as-Sayd was surrounded by a fence in 1989 to exclude domestic livestock.

Re-introduction: Between 1990 and 1993, 72 Arabian oryx from the NWRC and foreign collections (e.g. San Diego Wild Animal Park, USA) were moved to the reserve, held within a 200-ha enclosure, and then released into the protected area. Since that time, we did not reinforce the population through new re-introductions, and animals were never supplemented with food or water.

Population size: The re-introduced population has been monitored yearly since 1990. However, the low numbers of ungulate sightings during the transect count surveys, carried out between 1995 and 2003 (Seddon *et al.*, 2003), impaired the level of precision of the population size estimates. Indeed, the coefficient of variation of estimates was most often above 30% (Mésochina *et al.*, 2003a). For the second consecutive year, we carried out a total count survey during summer. The aim of this survey was to record as many oryx as possible. To achieve this goal, we spent more than 50 hours in the field between the 1st and 3rd September 2004, using a combination of haphazard transects, scanning from vantage points, checking of *Maerua* trees and favored sites where oryx tend to rest during daytime in summer. Results of summer 2003 and 2004 surveys confirmed that the total count method is the most precise census technique so far tested on the oryx population of Mahazat as-Sayd, with coefficient of variation of the population size estimate under 10%.

Between 1990 and 1997, the population increased steadily up to about 400 individuals. Then in 1998 and 1999, because of severe drought conditions, the population leveled off around 350-400 individuals. Between 2001 and 2004 good rainfalls, and resulting good forage conditions allowed the population to recover and increase to an estimated 800 individuals (95% confidence interval: 655–950) in September 2004. The Mahazat as-Sayd protected area therefore currently holds the highest wild population of Arabian oryx in the world. Using data-driven assumptions we developed a computer model that evaluated the probability of extinction of the oryx population under different management strategies (Treydte *et al.*, 2001). According to the assumptions of the model we have estimated the carrying capacity (Kmax) of the Protected Area at 816 oryx under good forage conditions. Our present estimate of population size is close to Kmax, predicting that from now the population is likely to face a significant decline whenever food resources will decrease (e.g. drought period). Among others management strategies, removing annually 15% of the current population would significantly reduce the probability of extinction of the population. Whatever the management option applied, human intervention seems ineluctable to maintain the long-term viability of the Arabian oryx population re-introduced in Mahazat as-Sayd. Rehabilitation of the Arabian oryx in Mahazat as-Sayd Protected Area has been completed in a decade, however nowadays the new challenge concerns its long-term survival.

'Uruq Bani Ma'arid Protected Area

Although situated in one of the driest regions of the world, on the western fringe of the Rub' al-Khali desert, the 'Uruq bani Ma'arid protected area (12,500 km^2) was once home to the Arabian oryx before its extinction in the 1970's. Some nine years after the first oryx re-introduction into the reserve, and despite regular subsequent releases, reinforcement of the population was still considered necessary in 2004.

Re-introduction: The translocation was scheduled in May 2004, as important rainfall occurred in the core area of the reserve in April 2004, inducing excellent vegetation growth. On 25th May, we brought seven oryx (2 males: 5 females) aged 14 to 46 months to the reserve, following a procedure based on boma-training or long-acting tranquilizers. This method proved to be reliable and efficient in the past, and all animals arrived safely at their destination. The oryx were released into the wild after spending an acclimatization period of 45 days in a pre-release enclosure, where they were provided with water and Rhodes grass hay. During ca 10 days, the animals explored an area of approximately 80 km^2 and were seen alone, in groups of 2–4, or, less frequently, in mixed groups with settled individuals. One month after release, the newly released cohort's dominant male was found dead, the carcass bearing puncture marks typical of horning during fights. In addition, the youngest female rapidly lost condition around mid-August, showing signs of haemoragic diarrhea, and died shortly after. The remaining released oryx seem to have adapted to their new habitat relatively well. By the end of August, they had individually explored territories of ca 100 – 200 km^2, and were seen either alone, or integrated in groups of settled oryx. Although the presence of experienced individuals on or close to the release site is thought to be beneficial to naïve oryx in terms of transfer of learned foraging behavior (Tear *et al.*, 1997), the newly released individuals were observed obviously in poorer body condition compared to settled animals, stressing the need of above average grazing availability in order to achieve successful acclimatization.

Population size: Since 2001, the oryx population size at 'Uruq Bani Ma'arid has been estimated once a year in summer by the means of a total count, and using Chapman's modified Lincoln-Peterson Index and Seber's formula for the calculation of variance and 95% confidence interval (*see* Bedin & Ostrowski, 2003 *for site-specific details, and* Seddon *et al.*, 2003 for *methodological details*). Results have been in agreement with crude estimates based on routine monitoring, and consistency in the methodology now allows to compare estimates across years. This year's total count was carried out on 11th-15th August. Few calves and sub-adults were observed, and the entire population was estimated at 107-151 individuals (1 male: 1.2 female), nearly identical to the estimate of the adult population only (103-145 oryx) (see Figure 1). Since the first release in 1995, a total of 156 oryx have been re-introduced in the reserve, and we estimate that 56 of them are still alive and present in the protected area. After an initial phase of increase due both to continued releases and natural recruitment, the oryx population of 'Uruq Bani Ma'arid has not significantly increased or decreased between 2001 and 2003 (*see also* Bedin & Ostrowski, 2003).

However, according to this years estimate, the entire population has sensibly diminished. As regards adults only, the population has also decreased compared to 2001, but not significantly compared to 2003. Potential reasons to this decline are several, including deaths related to environmental stress and conspecific fights, an undetected emigration trend, a bias in the method due to the presence of unmarked wild-born animals in areas not surveyed, illegal hunting, or a demographic fluctuation in response to exceeded habitat capacity (*see also* Bedin & Ostrowski, 2003). Of these reasons, poor range condition and poaching appear to be predominant (Mésochina *et al.*, 2003b). Indeed, the low number of sub-adults observed in 2004 despite the birth of about 70 calves in 2003 suggests an important rate of mortality among juveniles, probably due to the absence of rainfall in 2003 and resulting poor grazing. Likewise, all ten oryx released in July 2002 perished during the last four months of 2003. Concurrently, the impact of poaching is considerable on the already fragile population of 'Uruq Bani Ma'arid, presently accounting for 23% of recorded deaths since its onset in 1998. Despite past measures taken to deter hunters (new ranger camps and increased ground patrolling), an estimated 5 – 10 % of the adult oryx population has been killed over the last 12 months. Fortunately, decisions were made by the NCWCD in September 2004 to reinforce both air and ground surveillance of the protected area.

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Twenty years of rhino re-introduction in Dudhwa National Park, Uttar Pradesh, India

The first rhino re-introductions in India took place from the Pabitora Wildlife Sanctuary, Assam and The Royal Chitwan National Park, Nepal into their former range in Dudhwa National Park (DNP) in two phases during 1984 and 1985. The last rhino in the lowland grassland area known as *terai* in Pilibhit district, close to DNP, was killed in 1878. The Indian one-horned rhinoceros (*Rhinoceros unicornis*) roamed over the Indus, Gangetic to Brahamputra flood plains of the Indian sub-continent and in the relics of Mohenjo-Daro era, some rhino seals were found which are preserved in the Indian National Museum, New Delhi. The records say that the invading Emperor Timor hunted and killed many rhinos on the frontier of Kashmir in AD 1398 and there are evidences that rhino existed in parts of the west of sub-continent as far northwest as Peshawar until the 16th century. Babur, the founder of the Mughal Empire in India in his famous memoirs, the Baburnamah, described how he hunted rhino in bush country near the Indus as late as 1519.

Out of the three species of rhino that roamed over the Indo-Gangetic and Brahamaputra floodplains, two species, the Javan rhinoceros (*Rhinoceros sondaicus*) which was once "fairly common" in the Sundarbans became extinct in India about 1900 and the Sumatran rhino (*Didermoceus sumatrensis*) disappeared from the Lushai hills of Assam in about 1935. The only species of Asiatic rhinoceros that exists in Indian subcontinent is the great Indian one-horned rhinoceros (*Rhinoceros unicornis*). The causes of disappearance of *Rhinoceros unicornis* from much off its former distribution range and population decline were primarily:

- Destruction and fragmentation of habitat primarily for agriculture.
- Sport-hunting during the Mughal period and the early days of British rule in India.
- Poaching of horns and other parts.

In Assam Col. Pollock a Military Engineer engaged in laying of roads in Brahmaputra Valley almost shot a Rhino

or a wild buffalo for breakfast every day and Maharaja Nirpendra Narayan of Coochbehar shot 208 rhino between 1871 to 1907. At the beginning of this century, even though there is no precise documentation regarding the population of rhino that existed in India at the turn of the century, it is believed that approximately 100 individuals (50 to 60 in Assam and 40-50 in West Bengal) survived at the beginning of the current century. The current world population is estimated at 2,500 animals mainly in India and Nepal. These are restricted to natural populations in Assam (Kaziranga, Manas, Orang and Pabitora), two in West Bengal (Jaldapara and Gorumara), one re-introduced population in DNP and one migratory population in Katerniaghat in Uttar Pradesh (U.P.). A few rhino also exist in Bhutan adjacent to Manas Tiger Reserve, Assam.

In Nepal, the three rhino populations are in the Royal Chitwan National Park (NP), Royal Bardia NP and Sulkhlaphanta WLS. The Rhino of Royal Chitwan N.P. comprise a natural population while the other two are re-introduced. The Kaziranga National Park in Assam has the biggest population of rhino (about 1,600 individuals) and while in Nepal the Royal Chitwan NP in Nepal has about 600 rhinos. In 1979, the Asian Rhino Specialist Group of IUCN Species Survival Commission emphasized the need for continuous efforts in protection and monitoring of the species and "to establish additional viable population in suitable areas, preferably in the former distributional range of the rhino". Thus, on the basis of this logic the IUCN Rhino Specialist Group and the Rhino sub-committee of the Indian Board of Wildlife (IBWL) recommended the establishment of additional rhino populations in India and they were re-introduced into DNP in 1984.

The 1984 Translocation from Assam

Early in 1984 a group of about ten rhinos living outside Pabitora Wild Life Sanctuary in Assam was selected by the Assam Forest Department for the capture as they were causing crop damage and proving difficult to protect. Between 11th and 21st March 1984, six animals were captured by drug immobilization, crated, revived and transported to stockades a few kilometers from the capture area and released. After release animals were encouraged to wallow and in most cases satisfactory feeding was established within two to three days. A team of veterinarians rendered necessary health care, mostly consisting of treatment of superficial lacerations received during the capture. The first animal captured, a large male, escaped from its stockade during the night. On 30th March, the five remaining animals (a sub-adult, two elderly females, a young adult and one older male) were transported to Dudhwa National Park. One female died due to stressful abortion after 11 days but the remaining four settled well; three were released from the stockades on 20th April 1984 and the large male was released on 9th May, after being fitted with radio collar. Another female died on 31st July 1984 after a bid to tranquilize her to treat a wound. Thus only three rhinos (1 female and 2 males) were left remaining.

The 1985 Translocation from Nepal

To establish a rigorous breeding nucleus of rhinos in Dudhwa, it was decided to introduce more stock from a

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different population and four adult female rhinos, from the Royal Chitwan National Park, were exchanged for 16 domesticated Indian elephants. By selecting only females, the reproductive potential in Dudhwa would be more than doubled and eventual mating of these animals with the totally unrelated Assam males would ensure maximum genetic vigor. All four female rhinos, estimated to be between five and seven years old, were immobilized and driven 720 km to Dudhwa and were released into the wild after a week.

Present Status

Of the total of nine rhinos translocated to Dudhwa Tiger Reserve, seven survived in excellent health and these consisted of the young female and both the males of the 1984 translocation from Assam, and all four young females of the 1985 translocation from Nepal. Thus, these seven rhinos constituted the seed population of rhinos at Dudhwa National Park. In 1988, one adult male from Assam died after a fight with another dominant male. Again in 1991, a female, from Nepal died due to an internal infection and abortion. She also lost her male calf in 1993 killed by the dominating male. The present rhino population comprises a total of 21 rhinos comprising of 16 calves born in this area and five rhinos from the founder population.

All the rhinos are in a 27 km^2 area encircled by an electric fence in the south Sonaripur Range. Daily, four riding elephants are used for monitoring and in the rainy season, boats are used to monitor the fence in the southern part of the Rhino Re-introduction Area (RRA). If there been a few more males capable of participating in breeding, the birth rate in the population might have been much higher and genetically healthier. As the same dominating male sires all the calves, the females of the progeny are mating with their sire - this is a very sad part of the entire program. The population as of now is heavily inbred and this trend should not be allowed to continue. An attempt to tide over this problem was made by bringing one male from Kanpur Zoo in 1992, but the resident male did not allow it to settle down and was also seriously injured and was sent back to Kanpur Zoo after treatment. Now, we are faced with a situation in which even if Dudhwa born males establish themselves, they will be mating with close relatives which is genetically undesirable.

Conclusion

The re-introduction of rhinos in DNP has resulted in the first viable population of rhino in the *terai* areas of U.P. since the last century. Following India's footsteps the Government of Nepal also has re-introduced rhinos into Royal Bardia National Park from the Royal Chitwan

National Park. Both these re-introduction programs have proven highly successful and there is every hope that it will undoubtedly lead to further use of this approach to re-populate selected areas of the rhino's former distribution range. The re-introduction areas need to be extended and provided with more corridor type outlets so that animals can freely roam within different areas. Last but not the least, as long as the myth of the aphrodisiac and medicinal value of the rhino horn persists, the animal will never be safe form poaching, which has become a lucrative business. Strong protection and mass awareness seems to be the only and best alternative to address this issue.

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Mass capture and translocation of Bohor Reedbuck from an agricultural holding to several conservation areas in Kenya

Bohor reedbucks (*Redunca redunca*) are medium sized antelopes that are found in floodplain and drainage-line grasslands of northern and southern savannah in the Ethiopian biogeographic region of Africa (Estes, 1991). Their habitats are grasslands and wide plains that have tall grass in which they can hide and are rarely found on steep slopes or tall grasslands because of poor vegetation (Newell, 1999). In Kenya Bohor reedbucks are found in small numbers in isolated pockets outside protected areas. The highest concentration of these animals, approximately 1,200 in number occurs in a large-scale agricultural farm in northwestern part of the country. To conserve this population and reduce wheat destruction, translocation to extensive wildlife conservation areas is essential.

There is paucity of literature on Bohor reedbuck capture and translocation. However, literature on capture and translocation of common reedbuck (*Redunca arundinum*) and mountain reedbuck (*Redunca fulvorufula*) is available (Dauth *et al.*, 1987 & Mckenzie, 1993). Common reeducks have been captured and translocated in South Africa and Zimbabwe with exceedingly high mortality, with a reported mortality of 100% in one instance (Mckenzie, 1993). However use of long acting tranquilizers reduced the mortality to about 39% (Flamand & Rogers, 1992). On the other hand, mountain reedbuck have been successfully captured and translocated regularly in South Africa (Dauth *et al.*, 1987 & Mckenzie, 1993). The capture and translocation was undertaken with the two main objectives in mind, 1) reducing the stocking rate in the agricultural holding thereby lessening crop destruction, 2) to restock and establish nuclear breeding herds in recipient areas.

Capture Methods

The capture site was a large-scale agricultural holding about 20 km east of Eldoret town in North-western Kenya. Wheat farming is the major agricultural activity in the farm, although maize and dairy farming is practiced on a smaller scale. The farm is fenced using an electric wire and medium sized private farm and small holder community farms surround it on all sides. In the farm are other wildlife species namely oribi (*Ourebia ourebi*), Rothschild's giraffe (*Giraffe camelopardalis*) and bush duiker (*Sylvicapra grimmia*). The Bohor reedbuck numbers approximately 1,200 according to a recent census while the other animals occur in smaller numbers. The Bohor reedbucks cause massive destruction of wheat crop amounting to several hundred thousand US dollars.

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The release sites were 4 different conservation areas in Kenya:

- The Lake Nakuru National Park is a fully fenced protected area that is a world renown bird sanctuary and is also home to a variety of wild mammalian species most notably the white and black rhino. It neighbors Nakuru, a cosmopolitan town in the heart of Rift Valley. It is about 150 km from the capture site.
- Nairobi National Park is a fenced protected area on all sides other than the southern boundary. It is found within the city of Nairobi. It is about 300 km from the capture site.
- Lewa Wildlife Conservancy is a private ranch located in Laikipia District that is fully fenced on all sides with only a window for elephant migration on the northern boundary. It is about 450 km from the capture site.
- Meru National Park is a protected area in eastern Kenya where wildlife had almost been wiped out due to poaching in the last 2 decades. It is undergoing rehabilitation after security was beefed up. It is about 600 km from the capture site. Bohor reedbuck were found in all these areas in the past but they have been decimated or their numbers have gone too low due to poaching and human encroachment on their ranges.

Bohor reedbucks were captured using nets. The nets were set in thickets near an area of high concentration for camouflage. The animals were pushed towards the net using vehicles. Once entangled they were physically restrained and a tranquilizer, haloperidol (Kyron Laboratories (Pty) Ltd, Benrose 2011, South Africa) administered immediately intravenously. The dosage was 8 mg, 6 mg, 4 mg and 2 mg for adult male, adult female, subadults and juveniles respectively. Once tranquilized the animals were placed into the transportation crate. The crate was modified to allow a short distance between the floor and the roof. This was achieved by putting a hesian cloth midway between the floor and the roof. This modification was to prevent the animals jumping a high height hence avoiding fractures and injuries to other animals. Papyrus reeds and grass was also placed in the crate in order to make it as dark as possible and also to provide dark corners where the animals could hide thereby mimicking the natural environment. Females, sub-adults and juveniles were transported together in mass

crate while males were transported in individual crate. The animals were then transported by road to the recipient areas with stops on the way to check on their condition. The animals were free released immediately they reached their destination.

Results

In total 318 Bohor reedbucks were captured and translocated to the recipient areas. Out of this 170 (53.4%) were released in Meru National Park, 78 (24.6%) in Nairobi National Park, 49 (15.4%) in Lewa Wildlife Conservancy and 21 (6.6%) in Nakuru National Park. Twenty animals died during capture and transportation giving an overall mortality rate of 6.29%. Out of the 20 animals that died 11 (55%) died during capture, 4 due to internal hemorrhages and 7 after euthanasia due compound limb fractures. Nine (45%) succumbed to hemorrhages from traumatic wounds caused by males that were transported together.

Discussion

This being the first mass capture and translocation exercise of Bohor reedbucks in Kenya, it proved to be a success story. Although published reports from South Africa on common reedbuck show that these animals are highly prone to capture stress (Mckenzie, 1993), our experience on Bohor reedbuck proved otherwise. The overall mortality rate of 6.9% realized in this exercise differs substantially from that of 39% reported by Flamand and Rogers (1992) and 100% reported by Mckenzie (1993) in common reedbuck.

The success of this translocation exercise can be attributed to four factors, 1) the animals were handled with great care after being entangled in the net. During the course of the exercise we realized that the animals could get fractures easily if not carefully handled, 2) the animals were tranquilized immediately after capture and this calmed them down, 3) the animals were transported in modified crates with dark background and hiding spaces. Further, the height of the crate was minimized to discourage jumping. 4) the adult males were crated separately and not mixed with others in the mass crates. In one instance, we mixed males that had their horns inserted rubber tubes, with other animals and this became tragic where 9 out of 30 animals' succumbed to hemorrhages as a result of traumatic wounds.

The exercise did have a number of challenges. Firstly, the terrain of the capture area was rough and most paddocks were ploughed making vehicle maneuverability difficult when pushing the animals into the nets. Secondly, the capture site is generally an open ground with small scattered forested areas thus making it difficult to camouflage the capture nets. Thirdly, Bohor reedbucks unlike other antelopes such as impala and gazelles do not move as a herd. This made it difficult to drive a large number into the net, as there was tendency for the animals to scatter in all directions while being herded.

The capture team learned several lessons from this capture activity: i) these animals can be translocated in large numbers at low mortality if the above mentioned factors are adhered to; ii) they are very strong animals with powerful hind limbs that can cause serious injuries to handlers if not carefully handled; iii) they are highly prone to injuries especially limb fractures and must be handled with great care; and iv) adult males should always be crated individually and never mixed with other animals.

Conclusion

The success of this translocation exercise has shown that, the farm where the animals were captured can act as donor site to other conservation areas in Kenya. The translocated animals will form breeding herds in the new areas with subsequent conservation of the species. The stocking rate and resultant crop destruction in this farm will also be reduced.

Acknowledgement

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Re-introduction of captive-raised gibbons in Central Kalimantan, Indonesia

Gibbons (*Hylobates agilis albibarbis* & *Hylobates muelleri*) are the smallest of the apes and are widely distributed from Assam and Bangladesh in the north-west, Southern China, Vietnam, across the Malay Peninsula, Thailand, Sumatra (including the Mentawai Islands), Java and Borneo. The long arms and legs of the gibbons make them excellent climbers and they can swing through the

upper canopy at great speed. Gibbons can be described by five characteristics: (socially) monogamous, territorial, duetting, suspensory and frugivorous. Gibbons are threatened throughout their range, all species are listed on CITES Appendix I and have various listings on the IUCN Red List.

Gibbons have been in decline over the past 30-40 years, primarily due to habitat destruction and fragmentation through timber felling, charcoal burning, encroachment cultivation, general bush burning for hunting, rubber plantations and tea and pine plantations. Other factors contributing to their demise include the illegal wildlife trade (which involves capturing infant gibbons by shooting the mother), the use of their body parts in the manufacture of traditional medicines, and poaching for sale as pets or to bar owners for the purpose of being tourist attractions. The forest fires of 1997-1998 also devastated a large part of the gibbons' natural home range in Sumatra and Borneo: it is estimated that four million hectares of land comprising various different vegetation types, were destroyed by these fires.

Conservation of the gibbons requires two approaches, 1) management and protection of wild populations, and, 2) rehabilitation and management of the wild-born, captive-raised population. Due to gibbons' decline, several gibbon conservation projects have been established in South-east Asia, all with the aim of rescuing and rehabilitating gibbons. Gibbons are brought to centres when their owners become aware that the gibbon can become too aggressive, or when the owners become aware of the disease risks or when the gibbon is confiscated by local police/forestry officials. These centres also provide a sanctuary for abandoned gibbons that may never be rehabilitated, but can no longer be kept with humans.

Avoiding the Problems of the Past

For rehabilitation to succeed, equal care and planning should go into both the pre-release and post-release phases. Past experience has identified several factors that affect the success of the release of previously held captive animals: negative impact on the native flora and fauna, mortality due to animals being unused to natural predators in the release site, poaching, traffic, shooting by humans, inter- and intra-specific competition, lack of familiarity with food and water resources at the release site and poor habitat quality at the release site.

Re-introduction success for the gibbons has yet to be fully achieved. There are several gibbon sanctuaries in Thailand. The Highland Farm in the mountains near Chiang Mai offered a sanctuary for captive-raised gibbons though many of their gibbons have suffered appalling injuries and are unsuitable candidates for release. Due to an incident in 2002, several people (including the owner) were killed at the Highland Farm in north-west Thailand, near the border with Burma, and its present status, including that of the gibbons, remains unknown. The other project is the Phuket Gibbon Rehabilitation Project run by the Wild Animal Rescue Foundation of Thailand, which does re-introduce rehabilitant gibbons. Though this project has been in operation the longest period of time (since 1992) it has published very little regarding the success or otherwise of its operations.

The GRP has recently been criticised as an example of a sanctuary that has created more welfare problems by exceeding its carrying capacity (Schoene & Brend, 2002). Rehabilitant gibbons were exposed to humans, though contact was not permitted, the gibbons saw human visitors daily. Released gibbons from the GRP were not always released in pairs, thus the gibbons formed amalgamated groups on the release island. Also, this island was not capable of supporting all the gibbons, thus long-term provisioning was required. The gibbons are not living free from human assistance and are not in contiguous forest, thus these gibbons are not contributing to the wild population. The only report for rescued gibbons from this rehabilitation project states that all the releases have failed, probably due to the poor-quality relationships between the released adults (DeVeer & van den Bos, 2000). Many of the gibbons released from projects have been released based on subjective impression and not objective scientific data. Until this issue is addressed, many released gibbons will continue to perish, having contributed nothing to the overall survival potential of the species.

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There is only one fully operational project set up for the rehabilitation of gibbons which employs the medical testing techniques of Rijksen (1974): the Kalaweit Gibbon Rehabilitation Program (KP) in Central Kalimantan, Indonesian Borneo. It was founded in 1999 and does not encourage any tourists. KP is very active in working with the local community, raising the awareness of the plight of gibbons in Indonesia.

Release Site

From September 2002 to December 2003, a preliminary survey of known fruiting trees on the release island that were eaten by macaques and/or gibbons was carried out by the local people of Mintin Village, based on their knowledge of fruiting trees on the island. This initial survey gave local names only. With the assistance of a botanist from Palangka Raya University, SMC collected samples of all fruiting trees for which the Indonesian or scientific names could not be identified through local names alone. Scientific identification was made by Erna Shinta, resident botanist at CIMTROP (Centre for International Co-operation in Management of Tropical Peatlands) at Palangka Raya University. Trails were not cut on the release island, nor were transects, but every fruit-producing tree was counted in the initial survey. Fruit-producing trees were marked during the initial habitat

survey and trees >10cm dbh were resurveyed bi-monthly by Kalaweit staff and SMC from January to August 2003.

The island is 100 ha and subsequent surveys noted the number of marked trees that were producing fruit for each species, this number was then extrapolated using the list of total tree numbers to obtain abundance. It is hoped that the island will allow the released gibbons to adapt to the wild and to the presence of other released gibbons. Since this is the first scientifically monitored release, lessons can be learned which can then be applied when future pairs are released into contiguous forest.

Veterinary protocol

Pre-release screening involved testing for herpes simplex, tuberculosis and Hepatitis A and B. Every month pre-release faeces were tested for intestinal parasites and skin was monitored regularly for ecto-parasites. Furthermore, each month post-release stool samples were collected opportunistically and tested for internal parasites.

Capture and Release Process

Gibbons were fully anaesthetized for capture but were revived for the actual journey. Gibbons were transported in separate transport cages to minimize the possibility of injury. Water was provided in the cages. The release took place in the middle of the wet season to ensure there would be an abundance of food (habitat analysis confirmed this). On release gibbons immediately took to the trees and moved away from the release site. Released gibbons were relocated daily and their overall health and behavior were noted. The released gibbons were located every day after release from January to August 2003, but were only observed for about five minutes and not followed. There was no wild population of gibbons on the release island.

Results

- The gibbons were nutritionally independent immediately post-release (Cheyne, 2004).
- All four released gibbons are alive and have remained in their pairs.
- The gibbons have met wild proboscis monkeys and macaques on many occasions. Interactions range from peaceful intermingling to aggressive encounters and chases though there have been no serious injuries (pers. obs.).
- Although the first release pair took about 6 months to resume singing, the second pair (released 16th December 2004) resumed singing within days of the release.

Lessons Learnt

1. The gibbons need at least 24 hrs to recover from the stress of transport and should be released together from a single cage.
2. Gibbons are most vulnerable immediately after release and are likely to flee the release area. Thus either radio collars should be fitted or the gibbons released in an area where they can be easily located.
3. Clearly defined procedures and well-trained staff are essential. Staff who are involved in the pre-release, rehabilitation phase should be different from those who carry out post-release monitoring.
4. Only one pair should be released at a time and there must be adequate staff to conduct post-release monitoring.
5. Only mature (sub-adult or adult) gibbons should be considered for release and single gibbons should not be release: pairs only.
6. More intensive monitoring is recommended in the initial months post-release, this can be reduced as the gibbons are seen to adapt to the forest.

Discussion

At the time of writing (January 2005), none of the re-introduced gibbons has reproduced. All are alive and there have been no losses to disease, predation or hunting. If survival of the gibbons after release is used as a criterion for success then the rehabilitation has indeed worked, but it must be remembered that the pair bond broke down between the first pair of released gibbons, which may or may not have been a direct result of the release procedure. The pair has now re-established itself and are duetting. If successful rehabilitation and re-introduction is to be measured by (1) survival post-release i.e. finding suitable food, (2) maintenance of the pair-bond i.e. duetting and copulating and (3) reproduction and survival of the offspring, then the gibbons have only succeeded in 2 of 3 criteria. Long-term studies are needed to assess whether the gibbons will succeed in all criteria. Reproduction will take time and will clearly not happen until the pair bond is re-established. Although we cannot say that the re-introduction of the pair was a complete success at this stage, the gibbons are surviving well on the Island, free from human assistance. The first stage of the release has been a success. It is now vital that we learn from the mistakes that were made and constantly strive to improve the rehabilitation and re-introduction process. Rehabilitation of gibbons can work, as long as guidelines and scientific protocols are followed and as long as the process is not rushed, resulting in unprepared gibbons being released: that is guaranteed to lead to failure.

Conclusion

There are many hundreds and probably thousands of wild-born gibbons living in captivity as pets or tourist attractions. These wild-born, captive-raised animals may be one of our best hopes for conserving the species. Rehabilitation may be our only chance to repopulate areas that have been devastated by hunting, but only if the process is carried out properly. The rehabilitation and re-introduction process is far from perfect but we must learn from both failure and success and constantly evaluate the process and implement appropriate changes: we cannot afford to make any more mistakes.

Acknowledgements

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Will re-introduction and rehabilitation help the long-term conservation of orangutans in Indonesia?

The orangutans (*Pongo pygmaeus* and *Pongo abelii*), living on the islands of Borneo and Sumatra are amongst the first victims of the large-scale deforestation and exploitation of the south-east tropical rainforest and their future is today joepardized. The increasing orangutan pet trade is furter accelerating this decline. The situation is so critical that if nothing is done, orangutans will become extinct in the next ten years (van Schaik *et al.*, 2001). Several initiatives and measures have been taken to stop the pet trade on one hand and to protect the last remaining wild population and their habitat on the other hand. We choose to focus on the first type of measures, resulting in confiscation of illegally kept orangutans, which had been more or less affected by their capture and detention followed by various ways to rehabilitate the ex-captive individuals. Rehabilitation and re-introduction of confiscated orangutans back to their original habitat was initiated in the 1960s in the double perspective of fighting against the orangutan pet trade and reinforce the already established wild populations (Rijksen & Meijaard, 1999). This method implies for the primates a complete cognitive restructuration as well as a re-shaping of their behaviours in accordance with their awaiting new way of life. They have to lose the dependence towards humans that has been imprinted on them during their captivity, avoid contact with humans and acquire the behavioural repertoire of the species.

The Bornean Orangutan Survival Fund (BOS) has been set up in 1991, following the “Taiwan 10” case, where 10 illegally kept orangutans were confiscated and which brought a background discussion on the rehabilitation method. A new method, named simply re-introduction was set up, where orangutans were released in sites where no wild population existed, during the rehabilitation phase, contact with humans, was restricted and almost no visitors were allowed and finally food supplies were stopped after release in the forest, once orangutans were considered re-adapted to their new environment. The orangutan community that has been re-introduced in the Meratus forest on the Borneo island by BOS since 1997 presented an ideal opportunity to study the success and failures of the readaptation of individual whose maternal bond has been broken at various ages, interrupting their learning phase and to try to understand which abilities were deficient or absent in those individuals. This study enabled us also to evaluate the relevance of re-introduction in the orangutan conservation efforts.

Approach

In an attempt to discuss the essential abilities an orangutan needs to possess to be able to get re-adapted to the forest and the different ways he learns them and to identify the success and failures of the re-introduction program, we followed a group of re-introduced orangutan in the Meratus forest, a 28.261 ha protected forest part of the Bornean Orangutan Survival Fund located in east Kalimantan, Indonesia. This site, free of any wild orangutan population, has been used to re-introduce rehabilitant orangutans and translocate wild individuals since 1997. Up to now, more than a hundred individuals have been released there. Of the 25 identified individuals we found, 20 were followed on a regular basis nest to nest during a 14 month study. All observations were reported on check sheets, using focal animal sampling.

Discussion

According to their behaviours and skills, we could separate our study subject in three groups: Expert orangutans already having acquired a good experience of the forest and showing the necessary abilities to gain access to all types of feeding items as well as good nest building skills; the ‘students’, already able to survive in the forest but missing certain skills which would enable them to gain access to difficult foods for example. These are frequently travelling with experts for a few days. Lastly, the naïve ones, usually newly re-introduced, still dependant on food supply and lacking most of the essential behaviors.

- Experts and students showed a varied diet, comparable to that of wild orangutans with the exception of bark, less eaten when fruit was scarce, but replaced by the heart and shoots of various species of palm tree abundant in the study area. Naïve individuals on the contrary showed a very limited

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diversity in their diet, the mean number of food items eaten per day being four, out of which figured at least one species of Zingiberacée, an herbaceous plant, of quite poor nutritious value
- While orangutans are almost exclusively arboreal, six of the orangutans spent more than 80% of their locomotion time walking quadrupedaly on the ground, these six orangutans were never seen using specific arboreal locomotion types such as brachiation for example.
- The same six orangutans never built nor used a old nest to sleep at night, and spend the night laying on the bare ground.
- Some orangutans were constantly roaming around the human camp, and following them in an evident attempt to initiate contact.
- The youngest orangutans were seeking contact with other and some 'friendship' bonds were tied. Usually one young-naïve individual was bonding with a more expert orangutan, following him around for weeks sometimes, carefully observing every movement. And we could observed some food sharing by the expert to the naïve, specially food difficult to obtain such as palm tree shoots.

From our data, we could see that the crucial point therefore for a complete readaptation of ex-captive orangutans in a natural environment is their ability to evolve in a 3-dimensional arboreal environment. This will enable them to locate suitable food sources as well as being protected at night from soil parasites and potential predators. It appeared to us that as soon as possible after confiscation the young orangutans should be placed in an arboreal environment which could mimicry the forest in which they would be released. This was initiated in a so called half-way house, a small forested enclosure mimicking the natural habitat, while I was in the field and the first release with these orangutans showed very good results and improvements in term of adaptation in a free-ranging natural habitat.

The second major problem was human imprinting. It was specially worrying in the case of orangutans who were not afraid of humans. two individuals in particular, two males at the brink of adulthood, quite independent, re-introduced in 1997 and 1998, were getting in contact quite frequently with illegal loggers in the forest, and came back to the camp on two occasions with bullet wounds and on another occasion with a bad burning probably caused by hot oil. For these individuals imprinting apparently is too strong and not reversible and for their sake, as well as for the respect of local population living at the edge of the forest (they would regularly raid their small garden and crops) maybe we should consider not re-introducing them. Lastly, a substitution maternal bond is also viewed as essential first for its affective dimension and secondly for the learning / apprenticeships opportunities it brings to the young individual, compensating in part the loss of the maternal bond.

Unfortunately in the centre, very few adult females are present, as ideal candidates for substitutional mothers and those who could fulfil this task are contaminated by various diseases such as herpes or hepatitis. Man is therefore the first to take the role of the substitutional mother mostly for the affective dimension but as soon as possible orangutans have to socialize together as it is already done by the BOS project in order to erase as much as possible the imprinting. And we should accentuate the expert-naïve bond opportunities as much as possible between orangutans, to enhance the learning of essential abilities prior and after re-introduction.

A re-introduction is viewed as a success when it is followed by the establishment of a viable and autonomous population (Kleiman *et al.*, 1994). Between 1997 and 1999, when I began my study, 191 orangutans were re-introduced in the Meratus forest. We only found 11 out of the 191 and from the orangutans which were re-introduced during the study and which I followed, we found none of them when we came back in 2000, to check how those individuals were doing. The first explanation is of course the dispersion of the individual in the forest, as each of them needs a quite large territory. But census of the complete site has never been done in order to evaluate the percentage of re-introduction success and no data exist on the survival rate of the re-introduced individuals. From observation we made, of orangutan found dead, or severely sick, we know that some of them have not survived. The great disparity between the behavioural profiles of our study subjects made us think that part of the re-introduced orangutans did not survive.

Survival of an ex-captive re-introduced is linked to three factors:
1. age at which he was captured and separated therefore from his mother
2. the eventual trauma linked to its captivity before confiscation
3. type of rehabilitation procedures

The ideal candidate for a successful re-introduction would therefore be a wild born orangutan, captured when already at least three years old and with a very brief captivity period. Unfortunately very few individual respond to this profile and what should be done with all the others? The various problems: behavioural incompetencies, human imprinting and diseases such as herpes and hepatitis (caught while in contact with humans) plus the fact that less and less suitable forested areas likely to host a re-introduced orangutan population lead us to the following conclusion:
- Only those orangutans with limited psychological and behavioural traumatisms should be re-introduced as they have shown that they could regain a wild and autonomous existence.
- Create sanctuaries with an educational and sensitizational goal as well as a genetic pool with all the individual which could never be re-introduced, such an initiative being under construction by BOS in East Kalimantan.

Conclusion

Re-introduction could be a very useful tool in the conservation of species but in the case of orangutans, such projects are very costly with usually disappointing results and moreover we must not forget that re-introduction cannot be an isolated measure, conservation of remaining habitat and wild population should be the priority. Finally re-introduction has to be followed by a precise ethological screening of the individual released as well as regular census (IUCN/SSC RSG 2002) in order to estimate the success rate of the process and to point out

the eventual failures in order to make changes in the procedures to enhance the survival rate of the re-introduced individuals (Hannah & MacGrew, 1991).

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BIRDS

Released captive-bred Philippine eagle electrocuted, Philippines

A captive-bred Philippine eagle (*Pithecophaga jefferyi*) that was released into the wild on 22nd April 2004 survived for nine months in the Mount Apo forests before being fatally electrocuted. It is believed that this eagle may have perched on an electric post and in the process was fatally electrocuted. This project was a first for Asia and this eagle had improved its hunting skills by gradually moving from small lizards and rodents to much larger prey such as monkeys. This project has generated a lot of useful data and will have to improve release strategies in the future. ***For further information contact Dennis J.I. Salvador, Executive Director, Philippine Eagle Foundation, VAL Learning Village, Ruby St., Davao City, Philippines.***
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Re-introduction of the California condor to Baja California, Mexico

Only a few hundred years ago, the California condor (*Gymnogyps californianus*) ranged from British Columbia, Canada to Baja California, Mexico. As European pioneers settled within its range, the species declined dramatically to near extinction in the mid-1980s. Working with our Mexican partners, the Zoological Society of San Diego, USA has embarked on a long-term program to restore the California condor to the Sierra San Pedro Martir mountains of northern Baja California, where this keystone species survived until as recently as 1945. Given their flight capabilities, we anticipate that re-introduced condors will ultimately range from the Pacific coast to the Gulf of California, as well as northward across the U.S. border, providing an important link to existing re-introduced populations in California.

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Our work involves behavioral research to produce the most successful and socially-adept release candidates, long-term monitoring using radiotelemetry and satellite GPS technology, studies of environmental carrying capacity, and educational outreach in local communities. By restoring an extirpated and ecologically important species to a key portion of its former range, this bi-national program will make a significant contribution to conservation of Mexico's native biodiversity and natural heritage. The high profile status of condors contributes to their ability to serve as an effective conservation umbrella for the region's remaining old growth forests and other threatened wildlife, including puma and bighorn sheep. Finally, by training Mexican biologists in behavioral and wildlife science techniques and providing employment opportunities for Mexican students and graduates, our work is contributing to conservation science capacity building in the region.

Prior to the release of the first five two-year old birds in May, 2003, we conducted an extensive site evaluation, initiated educational outreach efforts in local communities, and facilitated a Memorandum of Understanding between the U.S. and Mexican governments pledging cooperation and support for the re-establishment of condors in Baja. With seven condors currently released and adapting to the wild we plan to re-introduce four to eight condors annually over the next five to ten years, until the anticipated carrying capacity of 20 pairs is reached.

Our work includes long-term monitoring of released birds using radio-telemetry and satellite GPS technology, in-depth behavioral research to help us produce the most

successful and socially-adept release candidates, and educational outreach in local Ejidos and Pueblos including the development of ecotourism for long-term economic sustainability in the region. Training Mexican biologists and students is an integral and ongoing component of our work, and our field crew is comprised of Mexican nationals.

All of our work is being carried out in close collaboration with our program partners, Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (CICESE), Mexico's Instituto Nacional de Ecologia (INE), the U.S. Fish & Wildlife Service, and the Los Angeles Zoo. We are grateful to the American Zoo and Aquarium Assocation's Conservation Endowment Fund and the Disney Wildlife Conservation Fund for their support of this program.

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Re-enforcement of the white-bellied fish eagle in Karimunjawa National Park, Middle Java Province, Indonesia

The Kutilang Indonesia Foundation in cooperation with the Indonesian Forestry Department has developed a rescue program for confiscated animals by managing the Jogja Wildlife Rescue Centre (JWRC) for the last two years. Now JWRC is taking care of 1,025 individuals consisting of 79 species (as of September, 2004) and among these are 70 individual raptors including ten individuals of white-bellied fish eagle (*Haliaeetus leucogaster*).

According to the *IUCN Guidelines for Confiscated Animals*, euthanasia and captivity of confiscated animal are some alternatives of post-rescue program. However, it will give negative images for several parties in Indonesia. Returning the confiscated animal in to the wild, especially those confiscated from illegal trade or owners, is considered the best alternative. Behavioral and medical analysis conducted by JWRC, identified four individuals of white-bellied fish eagles for return to the wild. Karimunjawa Marine National Park in Central Jawa was picked as a re-enforcement site since illegal capture of the species is a big problem in this area. The release site was analyzed by conducting some surveys to determine white-bellied fish eagle distribution at the park.

Based on the survey result, four individuals were destined to be released in three different locations. Two individuals were released at Tanjung Gelam, while the others are at Kemloko and Jati Kerep. Intensive post-release monitoring activities were conducted for 30 days after release, with two weekly monitorings as a follow up. The result of this monitoring activities shows that the re-enforcement was not as successful as expected. One of the four individuals was found injured by fisherman and sent back to JWRC on 30th September 2004. The other one was found dead near the release site on 15th October 2004. The status of the remaining individuals is not presently available until further planned surveys are completed.

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Hawai`i endangered bird conservation program

The Hawaiian Endangered Bird Conservation Program (HEBCP), formed in 1993, is a unique conservation partnership, composed of the Zoological Society of San Diego (ZSSD), government agencies (U.S. Department of the Interior and the State of Hawai`i), and Hawai`i's private landowners, working together to recover 22 species of endangered Hawaiian forest birds. This program clearly demonstrates the significant role captive propagation can play in world-wide conservation efforts by: 1) establishing and maintaining captive populations as species "bank accounts" against extinction, 2) providing animals for re-introduction/restoration of wild populations, 3) increasing and enhancing conservation education opportunities, and 4) developing captive propagation techniques (artificial incubation, hand-rearing and reintroduction). The HEBCP is a comprehensive model for a collaborative, multi-disciplinary approach to endangered species recovery.

Hands-on technology is being used to increase reproductive output in rare bird populations during this period of environmental crisis. Wild eggs are collected and artificially incubated and chicks are hand-reared for release to wild, or the chicks are integrated into the management of captive populations to produce additional birds for future release (Kuehler *et al.*, 1995, 1996, 2000, 2001). From 1993 to the end of 2004, a total of 1,780 eggs have been managed by the Hawai`i Endangered Bird Conservation Program at the state-of-the-art Keauhou and Maui Bird Conservation Centers. Of this total, 830 eggs have been estimated to be viable, from which 667 chicks have hatched and 582 survived to fledge. This is a record of 80% hatchability and 87% survivability of chicks to 30 days of age, or approximately to the age of fledging.

No other passerine conservation program in the world has established a propagation/release record that can compare with the accomplishments of the Hawai`i Endangered Bird Conservation Program. This collaborative effort has resulted in the first successful recovery program in which captive-hatched birds, offspring of parents which were captive-hatched from wild-collected eggs, were re-introduced and subsequently survived and successfully fledged chicks in the wild (*Puaiohi, Myadestes palmeri*) (Kuehler, *et al.*, 2000). Since 1999, at the time of the first Puaiohi release of 14 birds in the Alaka`i Swamp on Kauai, there have been six consecutive years of releases in cohorts of 5, 15, 8, 18 and 17 for a total release to date of 77 birds. Although the dense rainforest habitat is an extremely difficult environment in which to track released birds, over 50% of the birds have been confirmed to survive the release process. Several successful breedings by captive-reared/ released birds have been confirmed in the wild. Such

restoration techniques provide a means to preserve options while the habitat is secured and managed and wild populations are stabilized.

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A second species of native Hawaiian passerine took a significant step towards recovery with the release of captive-propagated Palila (*Loxioides bailleui*) at Puu Mali on the north side of Mauna Kea Volcano on the Big Island of Hawai`i. This is an area that has been the focus of an intensive recovery effort for the mamane forests by the State of Hawai`i. The mamane tree is the key food and nesting resource for the Palila. In 2003 and 2004, fifteen captive palila were released from two release towers and monitored. Ten of the release birds have survived the initial release process, have established feeding ranges and are now independently eating mamane. In early 2004, one of the release pairs of Palila built a nest and laid an egg. Although the egg was infertile, this is a significant step for the recovery of this highland honeycreeper and the program to establish a new (second) Palila population in Hawai`i.

Other Hawaiian endemic species which are being successfully propagated and managed in captivity at the two breeding centers, and which may soon become part of the release efforts are the Maui Parrotbill (*Pseudonestor xanthophrys*), the Hawai`i `Akepa (*Loxops coccineus*) and Creeper (*Oreomystis mana*), the Nene (*Branta sandvisensis*) and the `Alala (*Corvus hawaiiensis*). This latter species, now likely extinct in the wild, numbers but 50 birds, all in the captive program. In 2004, the population rose from 40 to 50 birds with the addition of ten chicks hatched and raised this past season.

The Hawai`i Endangered Bird Conservation Program is playing the pivotal role of “endangered species bank account” for the re-establishment of endemic Hawaiian species of birds into managed habitat. Without this propagation effort, many of these endangered species might very well go extinct while their habitat is being identified, reserves are being designed, and management measures being implemented. The propagation effort, based on many years of technological advances in zoos and private aviculture has literally saved these species from extinction and will continue to play a role in their ultimate recovery. The first 11 years of the propagation and release effort presents a more optimistic future for the beleaguered avifauna of the Hawaiian Islands. As the captive flocks of the endangered species grow, and the techniques for rearing and release are refined, it is hoped that many of the endangered Hawaiian birds will benefit from restoration efforts.

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Captive field propagation and experimental release of the Eastern loggerhead shrike in Ontario, Canada

The Eastern loggerhead shrike (*Lanius ludovicianus migrans*) is a raptor-like migratory passerine found in south-central Canada and the eastern United States. The decline of the Eastern loggerhead shrike has been precipitous throughout most of its range with breeding populations nearly extirpated from Canada and the northeastern U.S.A. (Pruitt, 2000). In Canada, the subspecies has been listed as Endangered by COSEWIC (The Committee on the Status of Endangered Wildlife in Canada) since 1991. Only 30 breeding pairs were found in Canada in 2003, a significant decrease from an estimated 100 pairs in 1993. Due to concern over this rapid decline, a captive-breeding population was established in Ontario in 1997 with 43 nestlings from wild nests as original founders. By 2001, the captive population had increased to approximately 100 birds. With this success, and with so few pairs remaining in Canada, an experimental release program was initiated in 2001 to develop techniques in the event that a full-scale re-introduction was required. Propagation of captive birds in field enclosures was considered a viable means of increasing productivity while at the same time producing healthy fledglings, raised in as natural an environment as possible, for release.

In 2001, the first year of the program concentrated on the construction of field enclosures and development of field propagation and release techniques. Three pairs of Eastern loggerhead shrikes produced ten fledglings, all of which were released in Ontario in 2001 (Chabot, 2002). Fourteen fledglings were released in 2002, while the project focused on field enclosure design to minimize stress and promote breeding success, and facilitate soft-release techniques (Woolaver & Nichols, 2002). None of the fledglings produced in 2003 were released, as they were all considered genetically important individuals for the captive-breeding program. In 2004, 32 fledglings were released from field enclosures in Ontario. This article summarizes the techniques developed in 2002 (Woolaver & Nichols, 2002) and discusses the potential of field propagation and release for other re-introduction programs.

Field Site and Enclosures

The field site was situated on a 40 ha farm in southern Ontario and consisted of cattle grazed fields separated by patches of mixed-wood forest, a habitat type similar to that being used by the remaining breeding shrikes in Ontario. The site was within the historical range of the shrike in an area where breeding pairs had only recently been extirpated, and was selected in accordance with the 1995 *IUCN Guidelines for Re-introductions*. Six enclosures were set up at the site in early May of 2002. Each enclosure consisted of either two or three rectangular cage units constructed of welded wire mesh (2.5 cm x 1.2 cm), cedar boards and marine plywood connected by welded wire mesh flight corridors measuring 0.3 m x 0.3 m by 1.0 m. The cage units in five of the enclosures measured 2.5 m wide x 3.5 m long x 2.5 m high. The sixth enclosure consisted of two connected larger units (2.5 m wide by 5.0 m long by 3.0 m high). Enclosures were transported to the site as individual pre-constructed panels and bolted together at the field site. Poultry wire mesh was attached to the bottom and along the ground outside of each enclosure to discourage mammalian predators from digging in to the enclosure. Enclosures included live Hawthorn (*Crataegus*) bushes to provide nesting cover and thorns for the shrikes to impale their prey, as they would in the wild. Enclosures were placed at least 50 m from the forest edge providing clear views of open fields. The shrikes were given live invertebrates (crickets and mealworms) in circular feeding corrals of 1 m in diameter and dead vertebrates (thawed chicks and mice) in small dishes.

Nearly all of the shrikes' daily activity involved natural behavior such as scanning fields for predators or catching prey within the enclosure. Wire mesh in the enclosure design allowed entry of wild prey in to the enclosure. Hourly observations were made of the shrikes catching invertebrates in the air and on the ground, and vertebrate prey captured by the shrikes included jumping mice (*Zapus*), snakes (*Thamnophis* & *Diadophis*), and frogs (*Rana*). The three-unit enclosures provided the least amount of stress for the shrikes from human activity during management.

Management of Breeding Pairs

Females and males were initially placed in different units of the same enclosure and separated by sliding doors of wire mesh in the flight corridors. Once a pair was seen mutual feeding (generally the male passing a food item to the female through the mesh) the sliding doors were removed. All six pairs constructed nests and five pairs laid eggs. The pair that did not produce eggs included a human-imprinted female. Nests were inspected twice to determine lay dates and clutch sizes. Shrikes were never flushed from the nest and inspections were made only after a female had left the nest on her own. Mean clutch size was 5.14 (SD = 0.69, n = 7 nests). Nestlings were examined once a week to ensure they were in good health. Nineteen of 20 nestlings fledged. The pair in the enclosure with the two larger units produced two broods. A second clutch of two was laid 9-10 days after the first brood had fledged in to the adjacent unit where they were fed by the male. The two young from the second clutch fledged successfully but were not released.

Once young had fledged they were observed daily to monitor development and ensure they were being fed properly by the parents. Parents were vocal and produced alarm calls when predators were in the area. Fledglings were observed learning anti-predator behavior and hunting skills from their parents. Parents and fledglings were separated in different units when fledglings were 38-49 days old to approximate wild behavior and to encourage the fledglings to feed on their own.

Pre-Release

Twelve days prior to release the adults were returned to the over-wintering facilities. At the same time, fledglings from different broods were placed together so they could be released as larger groups to facilitate bonding and to mimic wild behavior. In the wild, young from different nests group and travel together after fledging (C. Grooms, pers. comm.). Eight fledglings, 56-59 days old, were placed in the same enclosure to form the first release group. A second release group consisted of four 48-49 day old fledglings and two older birds of 60-62 days. Both groups interacted well and no aggression was observed among or within broods. The birds hunted together and the younger shrikes were observed learning skills from older ones. Each of ten days prior to the release, mealworms were placed on a shelf just inside the release doors at the intended time of the release (18:00 hrs). This was to habituate the shrikes to staff approaching the enclosure at this time of day, and to encourage shrikes to feed near release doors in the early evening.

Release

Release techniques were modified from successful re-introductions of Mauritius pink pigeons (*Columba mayeri*) and echo parakeets (*Psittacula echo*) (Jones *et al.*, 1992 & Woolaver *et al.*, 2000). A soft-release with supplemental feeding provided support for the shrikes while they adapted to living in the wild. Supplemental feeding is a critical component of the San Clemente loggerhead shrike (*L. l. mearnsi*) re-introduction and is particularly important during the first week post-release (D. Brubaker, pers. comm.)

Releases were carried out in the evening with release doors opened at 18:00 hrs, 2.5 hours before sunset. This allowed enough daylight for the shrikes to leave the enclosure and orient before roosting nearby. Approaching

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dusk discouraged the shrikes from taking long exploratory flights away from the release area. Mealworms were placed outside each release door when they were opened. Four feeding corrals, each with 50+ crickets and 100+ mealworms, were located in the field 5-15 m from the enclosure. All shrikes in both groups left the enclosure on their own and flew directly to nearby trees. Several birds returned to the doors and fed on mealworms. The shrikes were observed interacting and flying together within hours of the release and made short flights of less than 50 m before returning to the immediate area of the enclosure. All birds roosted just before dark within 10 m of the enclosure.

Staff monitored the shrikes from sunrise to sunset for 4-9 days after each release, until the birds had left the release site. Post-release monitoring was primarily carried out to determine how well the shrikes had developed survival skills while in the enclosures. Feeding corrals were kept well supplied with invertebrates to provide food for the shrikes while they adapted to hunting exclusively on wild prey. Although the shrikes initially relied heavily on the corrals, they were all observed hunting on their own within two days of being released. The shrikes strengthened their flight and hunting skills upon release by aggressively chasing any other nearby passerines and by catching insects on the wing. The shrikes also exhibited natural anti-predator behaviour by hiding under cover when predators such as hawks (*Accipiter* and *Buteo*) were in the area.

Conclusions

- Building captive breeding and release enclosures in natural shrike habitat from pre-constructed panels was simple and effective. The three-unit enclosure provided the least amount of stress during management.
- The pair in the enclosure with the larger units raised two broods. Future releases should concentrate on improving enclosure design to encourage double brooding, thereby maximizing production at a release site.
- Young shrikes learned predator avoidance and hunting skills from their parents and developed strong flight skills in situ.
- It was important that the enclosure remain a safe and positive location for the shrikes. Human activity around each enclosure was minimal and shrikes were not forced to leave the enclosure during the release but were allowed to explore on their own terms while learning to avoid predators, fly long distances and hunt outside of the enclosure.
- As a soft release it was critical that the release birds were provided with a recognizable food source while they learned to find wild food. The shrikes relied on the invertebrates in the corrals during the first week post-release until they had adapted to hunting exclusively wild prey.
- Releasing young shrikes as groups worked extremely well. The shrikes explored the release site, chased one another and other passerines that attempted to perch near the enclosure, and fed from the corrals and on wild prey together. This helped improve their flight skills and younger birds were able to learn skills from older ones.
- As technology improves, shrikes fitted with radio-transmitters will allow future releases to monitor shrike survival, dispersion and migration after they have left the release site.

Potential for other Re-introduction Projects

Field propagation and release techniques similar to the ones currently being developed for the Eastern loggerhead shrike may be preferable to ex situ captive breeding for some species, particularly those that are difficult or expensive to breed in large captive facilities. It may also be preferable for species that are poor candidates for translocation. Field propagation and release in this case was straightforward, cost-effective and produced skilled young shrikes that had been raised by their parents for the full breeding episode in their natural environment and were acclimatized to the release site. Parent-raising of young in field enclosures in situ and releasing the fledglings directly to the natal territory should be considered a viable option to ex situ captive breeding and/or translocations.

Acknowledgements

The Eastern Loggerhead Shrike Recovery Team was responsible for the enclosure design. We thank all the partners of the experimental release effort including the Avian Science and Conservation Centre at McGill University, Bill Dobson and Linda Hynes, Bird Studies Canada, Canadian Cattleman's Association, Canadian Wildlife Service, Metropolitan Toronto Zoo, Ontario Ministry of Natural Resources, and Wildlife Preservation Canada.

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The status and recovery of loggerhead shrikes on San Clemente Island, California, USA

The San Clemente loggerhead shrike (*Lanius ludovicianus mearnsi*) is an endemic subspecies living on San Clemente Island, California, USA. San Clemente Island (SCI) is the southern most of the California Channel Islands, located off the Pacific coast of the USA. The San Clemente Loggerhead Shrike is a non-migratory population that is highly endangered. Early ornithologists visiting SCI described the shrike population as "fairly common and widely distributed across the island" in the late 1800's and early 1900's. Unfortunately, little information is known about this population up until the late 1970s. By 1977, the population was listed as "endangered" under the U.S. Endangered Species Act. In 1984, the population was estimated to be approximately 19-28 adults and further dropped to 17 adults in 1988 (Scott & Morrison, 1990). During their study, Scott & Morrison (1990) found 54 nests and concluded that the reproductive output was too low to sustain this small population. From 1990 through 1998, the population remained critically low (<40 individuals).

Causes of Population Declines

Population declines of the San Clemente loggerhead shrike can be traced to human actions, namely habitat loss and the introduction of non-native predators (Scott and Morrison 1990). Between 1864 and 1934, ranchers grazed sheep and goats on the island, also introducing exotic grasses, feral cats (*Felis catus*), and black rats (*Rattus rattus*). Scott & Morrison (1990) documented 44% predation in the 1980s, and considered cats and rats as likely predators. Although the influence of predators on shrike reproduction may be severe, the effects of an uncontrolled goat population likely had greater consequences for shrikes. In 1934, the U. S. Navy was granted control of SCI, and ranching operations ceased. Unfortunately, the goats were not controlled and the population grew to about 20,000 animals by 1976, inflicting serious damage to the island's vegetation. The overall result of the grazers was a loss of shrub habitat, a cessation of woody plant reproduction, and severe loss of species richness. Shrikes require shrubby habitat for nesting and perches to hunt from in open habitats with short, sparse ground cover. The loss of trees and shrubs, coupled with the increase in dense exotic grass cover degraded the amount of quality habitat and nest sites, which likely led to the precipitous decline in the shrike population.

Recovery Efforts

Although the main objective of the U.S. Navy on SCI is combat training, the Navy has an environmental program for the protection and conservation of natural resources on the island. In 1972, the Navy initiated a feral animal removal program to eliminate the direct cause of habitat destruction. Over the next 20 years, about 28,000 goats were removed from the island, with the last individual removed in 1993. Despite the listing of the San Clemente shrike population as endangered in 1977, large-scale recovery efforts did not begin on SCI until 1991. The primary objective of these early efforts was to prevent the extinction of this subspecies through intensive monitoring of the wild population, initiating methods to reduce nest predation and the development of a captive flock and a reduction of nest predation in the wild (Morrison *et al*., 1995). Early predator control efforts were intended to protect shrike nests; however the results were equivocal, likely only dampening predation pressure in a few cases (Morrison *et al*. 1995). To develop the captive flock, biologists from the Zoological Society of San Diego (ZSSD) removed eggs and nestlings from wild shrike nests and reared them in captivity. In 1992, the ZSSD paired six shrikes which bred in captivity. These six breeders and their subsequent offspring formed the original captive flock (Morrison *et al*., 1995). The ZSSD collected and reared additional eggs from the wild population. The ZSSD reared young from the captive flock until they had developed flight ability (Morrison *et al*., 1995), at which time they placed these shrikes in outdoor cages for five days then released them into the wild on SCI. These birds were provided supplemental food for 10-20 days. From 1992-1996, the ZSSD released 40 captive-reared shrikes on SCI, with none surviving greater than eight months. Despite the failure of the release program, the ZSSD breeding program indicated that shrikes could be successfully reared in captivity (Azua & Lieberman 1995).

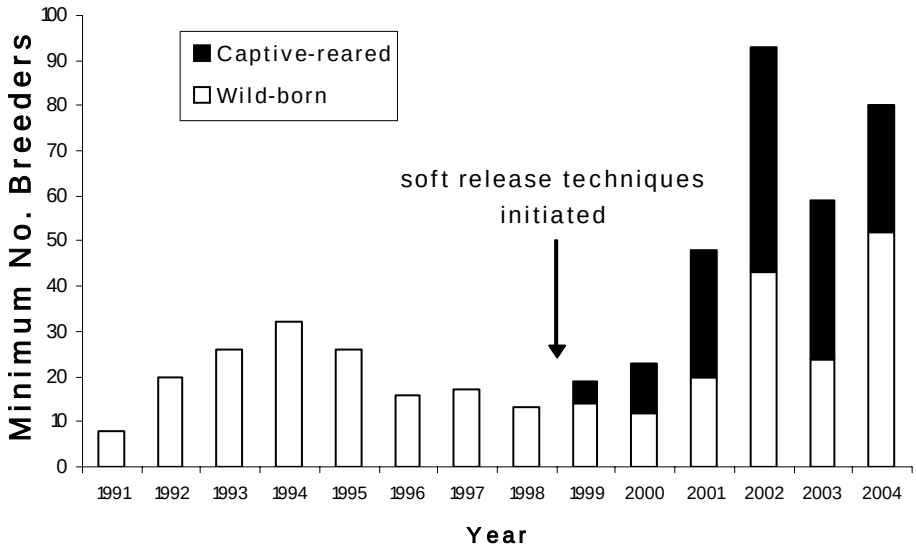
After the failure of the early release attempts, recovery efforts were reduced to captive-flock management, predator control, and monitoring the wild population, while a re-assessment of release techniques took place in 1997 and 1998. By 1998, the wild population had dwindled to ~14 adults. At this time, an aggressive multi-agency program was re-initiated by the U.S. Navy. This new program included 1) the continued monitoring and banding of the wild population to provide details on reproduction and survival by PRBO, 2) captive-breeding to manage the population's genetic diversity and provide individuals for population augmentation by ZSSD, 3) the release of captive-bred individuals with new "soft" techniques by the Institute for Wildlife Studies (IWS), 4) continued predator control focusing on the removal of cats and rats and managing native predators by IWS, 5) shrike ecology research, and in 2000 a sixth component, the restoration of island vegetation through on-island seed collection, propagation and out-planting, was initiated.

The main changes to the recovery efforts were the establishment of a habitat restoration program and the creation of new protocols for releasing and managing captive-reared birds. In 1999, wild birds were included into the ZSSD's stud-book, to make better decisions regarding how to maintain and/or increase the genetic diversity of both the wild and captive populations. ZSSD decides which individuals to pair, breed and/or release into the wild based on these genetic data.

The new release program started in 1998 incorporated "soft" techniques that encourage increased survival and

recruitment into the breeding population. Release sites were based on a number of selection criteria, which included variables such as the presence of potential breeding sites (small shrubs/trees), escape cover, and areas that were a reasonable distance from established shrike territories. Once a site was chosen, IWS biologists constructed release cages at that location, and maintained birds for varying lengths of time to allow acclimation to the island environment. IWS used four different techniques for releasing birds to the wild. IWS released 1) single adults into empty breeding territories or into the territory of an unpaired shrike of the opposite sex, 2) bonded-pairs: pairs established in captivity and released before the onset of nesting, 3) family groups: pairs established in captivity, allowed to breed in release cages with the entire family released together, and 4) juvenile groups: the release of captive-reared birds after they develop adequate flight skills. The goal of adult releases was to establish successful breeding pairs, providing an immediate boost to the wild breeding population. IWS believed that releasing juveniles might offer one of the few methods of rapidly increasing the number of shrikes on SCI if post-release survival is high.

Figure 1. The minimum number of breeding wild-born and captive-reared Loggerhead Shrikes



Another change to the release program was the development of a consistent supplemental feeding program. IWS fed newly released birds twice a day, gradually weaning the birds to being fed once every three days after the breeding season. It was hoped that post-release supplemental feeding would ease the transition from captivity to the wild and increase survival and productivity.

Success of Current Recovery Efforts

One of the most important aspects of the new recovery efforts is the habitat restoration program. This program is designed to collect, propagate and restore native vegetation communities across the island. This process will require many years before the shrikes are able to use the restored sites, but over time, the addition of more breeding habitat will prove beneficial to shrikes by increasing the potential carrying capacity of the island. Additionally, natural revegetation of the island has begun since the removal of feral grazers. As habitat is established across the island, more nesting sites have become available and shrikes have begun to breed in locations previously not known to be suitable. Prior to 2001, no shrikes were recorded breeding outside of SCI's deep canyons (where most of the woody vegetation remains). However, in 2001 a pair of birds that had been released the year before as juveniles, successfully fledged six young from a nest on a flat terrace area where *Baccharis piluaris* shrubs were re-colonizing. This trend continued in 2002 and 2003, with other pairs breeding on these previously unoccupied terrace locations. These recent nesting attempts, suggest that as natural vegetation succession continues shrikes might begin to expand their distribution across the island. Thus, efforts to restore vegetation could have a significant effect on the opportunities for breeders in the future.

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From 1999 through 2004, IWS released 210 captive-reared San Clemente loggerhead shrikes into the wild on SCI using soft techniques. Sixty-six percent of all shrikes released survived the first month post-release. High early survival might be due to the assimilation time and supplemental feeding which allows shrikes to adjust to the wild environment without the added burden to locate food resources. For the 190 shrikes released from 1999-2003, the survival rate for the first year was 35%, a rate that is comparable to the wild population. Shrikes released as juveniles survived at a higher first year rate (40%), than shrikes released as adults (23%). Furthermore, 26 (76%) of the 34 birds that survived greater than two years in the wild were released as juveniles. These results suggest that releasing juveniles born in captivity is a successful technique for rapidly increasing and providing future breeders to the population. Although shrikes released as adults do not survive to one year post-release as well as juveniles, they do provide immediate benefits to the

population through post-release breeding. Of the 61 shrikes released as adults from 1999-2003, 29 (48%) bred in the wild either during their year of release or in subsequent years. Of the 52 juveniles released from 1999-2003 that reached breeding age, 41 (79%) have bred in the wild.

Currently, birds of captive-origin make up approximately 35% of the breeding population (Figure 1). Since 1999, 157 nesting attempts have been made by wild and captive-origin shrikes, and despite ongoing predator control efforts, apparent nest success from 1999-2003 was similar to the estimates of Scott and Morrison (1990). However, the proportion of nests that failed due to predation dropped from 44% to 35% during the same time period.

Future Work

Increased emphasis should be placed on habitat restoration efforts to increase the number of sites being restored. As restored sites develop and natural re-vegetation continues, the number of suitable breeding sites will increase and allow a larger carrying capacity for the breeding population. Concomitantly, increasing the scope of the release program should be considered. Increasing the number of birds released each year, might increase the total number of birds that survive and are eventually recruited into the breeding population, assuming that sufficient breeding habitat is available. The "soft" techniques currently employed appear adequate to get shrike assimilated to the wild environment. Strategies to increase winter survival should be explored as this appears to be when both wild and captive-reared birds are increasingly susceptible to mortality.

There is also a need to ensure non-native predator populations are adequately controlled. Invasive species are capable of fast recovery after population management efforts have ceased (Veitch & Clout, 2002), and several failed re-introduction programs have not adequately controlled predator communities that were responsible for lowered productivity and survival (Beauchamp *et al*., 2000). By increasing the emphasis on habitat restoration, continuing with population augmentation and predator control, we feel that the San Clemente loggerhead shrike can be pulled back from the brink of extinction.

Acknowledgements

A project of this magnitude could not be accomplished without the hard work and cooperation of multiple organizations and agencies. We would like to thank PRBO Conservation Science, the Zoological Society of San Diego, and the Soil Ecology Restoration Group from San Diego State University for the dedication of their field staff and the sharing of information. We thank the United States Navy for funding this recovery effort and the United States Fish and Wildlife Service for guidance on project related decisions.

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The Socorro Dove Project Update, Mexico

On 18th November 2004, the Island Endemics Foundation was privileged to receive the keys to the Socorro dove breeding aviaries during a special ceremony held on Socorro Island, part of the Revillagigedo Archipelago situated 650 km off the west coast of Mexico. Capt. Angel Alfaro Castelán, commander of the Mexican Naval Base on Socorro Island, and Capt. Alejandro Abascal Andrade, Coordinator for Inter-institutional Oceanographic Research, represented the Mexican Navy. This ceremony initiated the Operation Phase of the Recovery Plan for the endangered Socorro Dove, currently extinct in the wild (see Martínez-Gómez *et al.*, Reintroduction News 23: 24-25). Attending the ceremony were representatives of the Mexican Navy, Island Endemics US and Endémicos Insulares Mexico, Frankfurt Zoo, the Mauritian Pink Pigeon Project, the National University of Mexico (UNAM), the National Commission for Protected Areas (CONANP), the National Institute of Ecology (INE), the San Francisco Zoo, African Safari, and Conservation International México.

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The aviaries were built by Navy Engineering Unit Number 4 under the direction of Lt. Juan Manuel Candelario Vázquez, with materials provided by Island Endemics. They are constructed of native volcanic stone and are built to withstand the severe hurricane season that affects the island during summer and fall. The building has a large service area with enough room to allow for medical and laboratory activities, as well as additional holding cages. Each flight has an indoor room as well as an outdoor pen. As Socorro dove pairs can be very aggressive towards each other in captivity, the flights are larger than for other dove species and can be subdivided if necessary.

The trip afforded an opportunity for IE representatives Juan Martínez-Gómez and Helen Horblit to meet in situ with Stefan Stadler, the coordinator of the European Endangered Species Program for the Socorro Dove (EEP) and Studbook holder, and Kirsty Swinnerton, formerly of the Mauritian Wildlife Foundation Pink Pigeon Project. From this meeting, final details of the Recovery Plan for the Socorro Dove were incorporated and potential release sites for the doves were identified. Participants were able to visit many habitats on the island, ranging from severely degraded areas on the south side of the island to relatively pristine forests in the north. They were also fortunate to see most of the surviving, but critically endangered, endemic land birds inhabiting the island. The pressing importance of conserving this threatened habitat, which supports such high endemism, became apparent to all expedition members. Thus, Island Endemics has made a commitment to integrate comprehensive restoration actions to the Recovery Program for the Socorro Dove to save the island habitat required by all endemics on Socorro Island.
The generous support afforded the Socorro Dove Project by the Naval Command in Mexico City cannot be overemphasized, as well as the hospitality by the Naval Base on Socorro, and the crew of the vessel ARM Zapoteco (currently on a relief mission in the Indian Ocean). They made this important reconnaissance and planning expedition possible and are invaluable partners in the effort to return the Socorro dove to its ancestral home.

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Conservation of the yellow-eared parrot in Colombia, South America

The yellow-eared parrot (*Ognorhynchus icterotis*), native to the High Andes of Colombia and Ecuador, is Critically Endangered. No longer found in Ecuador, it was re-discovered by Fundación ProAves in Colombia in 1999 with a population of only 81 birds. Fundación ProAves launched a recovery effort, 'Proyecto Ognorhynchus', funded principally by the Loro Parque Fundación with partner funding from the Zoological Society for the Conservation of Species and Populations (ZGAP), and contributions from the American Bird Conservancy and other supporters. The excellent result to date is that the total population now numbers over 600 birds, and the project ranks as one of the most successful conservation efforts in South America. This success has been achieved by using a multi-pronged approach with many distinct activities under way at the same time, and some astute applied science to what was a little-known species. The species is not known in captivity, and re-introduction is not part of the recovery effort. However, the conservation activities include many elements transferable to re-introduction projects.

The yellow-eared parrot is adapted to wet montane forest in the upper subtropical and lower temperate zones, 1,200 to 3,400 m above mean sea level. It has a close biological relationship to the wax palm (*Ceroxylon* sp.), which has suffered catastrophic decline from forest clearance, despite being Colombia's national tree. The yellow-eared parrots nest in loose colonies in the trunks and feed on the fruits of the palms. Human disturbance and persecution have been additional pressures.

Direct protection of forest habitat, palms and parrots at the two geographically separate sites has resulted in the explosion in breeding output. Habitat restoration and fencing of land have both increased the habitat availability, with more than 15,000 trees planted in the period January to October 2003 alone. Half of the breeding population has produced an average of two young per nest and has had two breeding attempts per year. Artificial nest-boxes have been installed on palm trees without natural cavities and, after a slow start, there is now breeding success from the new box designs.

'Proyecto Ognorhynchus' runs a strong campaign for public awareness of the species and the project, and has almost stopped the destructive use of wax palms for the traditional Palm Sunday processions. The environmental education and local community involvement has resulted in generation of community workshops, local radio campaigns and visits to local schools by project personnel Local people have responded positively, taking pride in what they now understand is a very special parrot unique to their region.

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Conservation introductions of Seychelles fody and warbler to Denis Island, Seychelles

The Seychelles fody (*Foudia sechellarum*) and Seychelles warbler (*Acrocephalus sechellensis*) are two of eight endangered endemic bird species, both currently listed as "Vulnerable" on the basis of their very small ranges (BirdLife International, 2000.) The goals of the five-year Action Plans for both species are "Down listing" from 'Vulnerable' to 'Near Threatened'. The objective of the Seychelles Fody Action Plan is to increase the range to six islands and the population to 2,000 mature individuals by 2006, and the objective of the Seychelles Warbler Action Plan is to increase the range to five islands and over 3,000 individuals by 2006.

In January 2004, 47 Seychelles fodys were moved from Frégate Island to Denis Island to establish a breeding population on Denis. In May and June, 58 Seychelles warblers were moved from Cousin Island to Denis Island to establish a breeding population. The successful establishment of populations of fody and warbler on Denis will greatly improve the conservation status of both species. In fact it should lead to down listing of the Seychelles fody to near threatened, a significant

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conservation management achievement. One further translocation would be required to down list the warbler.

Denis is outside the known natural range of both species; however the distribution of bird species prior to human settlement in the Seychelles is very poorly known and therefore not necessarily accurate. In addition there are currently very few islands free of mammalian predators that could support translocated populations of Seychelles fody and Seychelles warbler. Denis is within the inner island group, approximately 50 km from the other central Granitic populations, and the Seychelles fody can thrive on coralline islands, as indicated by the population on D'Arros.

Denis was identified as a suitable island for both species on a number of criteria: a large area of native forest exists including 30 ha of restored native forest where dense coconut has been removed and replaced with native species; mammalian predators are absent following the eradication of cats in 2000 and rats in 2002; the range of foods and favoured tree species exploited by both birds are present on Denis; and island tenure and management practice is appropriate to endemic bird populations.

The translocations were undertaken just prior to the main breeding seasons, when birds do not have dependent juveniles and when they are at their heaviest weights. The translocated individuals were a mix of independent juveniles and adults with a sex ratio of c.50% male and c.50% female. Birds were caught in mist nets, transferred by airplane (fody) and helicopter (warbler) and released immediately on arrival. It is too soon to be sure of the establishment of self sustaining breeding populations, however early signs are very positive. Both species are breeding successfully and juveniles of both species have been observed. Monitoring of the translocated populations is ongoing and we hope to be able to report two conservation introduction successes in the near future.

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The fody translocation was a joint project between Nature Seychelles, Denis Island and Frégate Island and the warbler translocation a joint project between Nature Seychelles, the Warbler Study Group (Universities of Gröningen, Netherlands, and East Anglia, UK) and Denis Island. The translocations were approved by the Seychelles Government. Funding was received from the Seychelles Environment Trust Fund, a Rufford Small Grant and African Bird Club.

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Re-introduction of saddleback to Boundary Stream Mainland Island, New Zealand – returning a predator vulnerable species to the mainland

The management of the previously endangered saddleback (*Philesturnus rufusater; tieke*) is one of New Zealand's conservation success stories. The saddleback is a medium-sized forest passerine and a member of the New Zealand wattlebird family Callaeidae. Saddleback have two distinct geographical sub-species: *Philesturnus rufasater* in the North Island and *Philesturnus carunculatus carunculatus* in the South Island. Saddleback feed on invertebrates, spending a significant proportion of the time on the ground and often nesting in low cavities. These characteristics make them vulnerable to predation and have largely contributed to their decline. By the turn of the 20th century, saddleback had become extinct on the mainland. Formally widespread across the country, numbers were decimated by rats, mustelids and cats. Only 500 North Island saddleback were left, found only on Hen Island, and 36 South Island saddleback remained on Big South Cape Island. Successful transfers by the Wildlife Service and later the Department of Conservation resulted in changing North Island saddleback's status from endangered to a total population of over 7,000, and the South Island sub-species to 1,200. Until recently, saddleback were restricted to ten off-shore islands, one lake island and a population within the predator-proof fenced Karori Wildlife Sanctuary in Wellington.

Boundary Stream Mainland Island (BSMI) is a 800 ha Scenic Reserve in the Hawke's Bay. It is intensively managed by the Department of Conservation as a "mainland island" where pests and predators are controlled to near zero numbers by trapping and poisoning. North Island robin, North Island brown kiwi and North Island kokako have already been successfully re-established in the reserve. The Department of

Conservation proposed to re-introduce North Island saddleback to BSMI in September 2004. If successful, then the establishment of a saddleback population would be a strong demonstration of the ways in which Mainland Islands can advance biodiversity conservation in New Zealand. The success of previous saddleback transfers between offshore islands, and their change in status from endangered to range restricted, provided an opportunity to change the mind set of restricting conservation of endangered species to offshore islands. Threatened species recovery can now be merged into the restoration of whole ecosystems. Research into determining the vulnerability of a currently island restricted species on the mainland would be a significant advancement to New Zealand mainland conservation.

Methods

In August 2004, a team of ten personnel traveled to Cuvier Island, a Nature Reserve off the coast of the Coromandel Peninsula. Cuvier Island has an abundance of saddleback, with a population at carrying capacity, estimated at 1,200. Saddleback were caught using 38 mm mist nets, ranging in length from 3 - 10 m. Ten mist nets were assembled each day at permanent mist net sites in sets of one to six nets strung together. As the birds were in the pre-breeding stage, the majority did not respond to recorded tape calls. The birds also appeared to spend the majority of their time feeding on the ground, therefore there were few “incidental” captures. The majority of saddleback were captured by two or more people gently herding the saddleback towards the net. This worked best when the saddleback were feeding less than approximately 20 m away.

Captured saddleback were carried to a central processing site for banding and disease screening. After processing, the bird was placed in a holding box and provided with water and mealworms until the box had up to eight birds, then the box was carried to the aviaries and the birds released inside. The two aviaries were each equipped with two perches and three feeding platforms. The saddleback were provided with invertebrates, sliced fresh fruit and cheese twice a day. Leaf litter was provided and changed every second day along with large branches of vegetation to provide stimulation to the captive birds. All saddleback were disease screened upon capture and samples were taken for ectoparasites (mites, lice, etc.), blood parasites and faecal parasites. Faecal samples were tested for salmonella, coccidia, camplybacter and yersinia and blood samples were tested for avian malaria. These samples were taken off the island and tested while the saddleback remained on the island with two care takers for an additional six days until the disease screening results were completed. Seven saddleback tested positive for coccidia. Due to the contagious nature of coccidia, all of the saddleback were treated before being transferred to the holding box.

Eight of the saddleback showed a positive test for salmonella in the initial tests. Due to the difficulty in testing and treating salmonella which could take up to an additional 30 days, and the fact that the aviaries on Cuvier Island would not support the saddleback for longer than ten days, the saddleback were transferred by helicopter to Auckland Zoo, a flight of 45 minutes. The samples were re-tested and the bacteria was found to be citrobacter, a harmless bacteria which commonly mimics salmonella. For the Auckland Zoo to BSMI transfer the saddleback were placed in modified cardboard cat travel boxes. Two dowel perches were placed in each box and a flap door cut in the side. Sliced oranges were placed in each box. The birds were caught from 16:00 to 19:00 hrs and driven immediately to BSMI, with 2-3 birds per box, taking six hours. Upon arrival (02:00 hrs) the birds were placed in a warm, dark room and given weak jam water, orange and cheese. The birds were walked for 20 minutes into the Reserve and released at 10:00 hrs. The delay between arrival at BSMI and release allow the birds to rest and feed before release. The release site was at least 1 km from the forest edge.

Results

Of the 41 captured saddleback, there were 18 adult females, five juvenile females, 11 adult males and six juvenile males. One adult male incurred injuries from the holding box prior to transit from Cuvier Island to Auckland and died despite treatment, and two males died in transit from Auckland to BSMI due to stress related illnesses. One adult female was kept in captivity for a further six days due to weight loss until she had undergone further tests and retained weight. An adult male was released but recaptured 15 minutes later as it became clear that the bird was ill. Tests showed this male had campylobacter, tapeworms and aspergillosis. Due to the difficulty in treating aspergillosis the male was taken to the New Zealand Wildlife Health Centre at Massey University where he was treated. Overall, this male was kept in captivity for a further three months before being returned to BSMI and released.

Ten saddleback had tail-mounted transmitters attached (model BD-2; Holohil Systems Ltd, Canada), and were located once a week. Three weeks after release, four transmittered saddleback were found dead after a week of unseasonably cold weather. Two were necropsied and found to have aspergillosis. Two were too deteriorated to be necropsied, however one had a broken neck caused by a severe blow. The cause was undeterminable, but mammalian predation was ruled out. Aspergillollis is a fungal disease which lies dormant (and therefore generally undetected) in healthy birds but can be fatal if the bird is placed in stressful conditions. A survey was undertaken six weeks after release, and a survival of 57% was estimated. This survival estimate is similar to other island to island transfers, for example, both the Hen Island to Cuvier Island and the Cuvier Island to Little Barrier Island transfers had 44% survivalship (T. Lovegrove, pers. comm.).

Birds that did not form territories had a low incidental resighting probability. Two months after release there were four known pairs. These pairs began to show signs of breeding in mid-December. The population will be supplemented before the next breeding season to increase the likelihood of the re-introduction succeeding. It will increase our learning potential of saddleback ecology and behavior of an island-restricted predator-prone species on the mainland with the presence of low numbers of predators.

Discussion

While the new population cannot yet be deemed secure, a considerable amount has been learnt from this translocation. This translocation reiterated the need for disease risk assessment and screening. However, retaining the saddleback in captivity for an additional ten days may have been a factor in the build-up of aspergillosis and was contributed to the death of the four transmittered birds. Disease screening to this detail is a relatively new practice in New Zealand conservation, and while a standard operating procedure has recently been established (Jakob-Hoff, 2004), case by case assessment is difficult. Continued disease screening with other transfers will add to the knowledge base and help formulate best practice. Rather than disease screening the birds to be transferred upon capture, pre-translocation testing of a sub-sample from the source population may have been a better option of establishing which diseases were present. This may have prevented captivity related diseases being manifested and would have reduced the risk of spreading pathogens to BSMI. Positive bacterial results can result in the birds being kept in captivity for further a 10-30 day period. Diseases such as salmonella are difficult to treat and require daily capture and treatment. As the aviaries were not adequate for long periods of captivity, the potential result of salmonella resulted in a double transfer. This additional stress may have also been a factor in the aspergillosis.

Transferring during spring and the pre-breeding phase may have also contributed to the aspergillosis problem, as birds were not in premium condition and spring is a time where such diseases are prevalent in the environment. Spring was deemed the best time of year for this translocation. The risk of dispersal was considered a major factor in preventing the population from becoming established. By transferring the saddleback immediately prior to breeding, it was hypothesized that the saddleback would concentrate on breeding rather than exploring their new surrounds and potentially leaving the reserve where they are more likely to be preyed on. Spring is also the time of minimum mustelid activity, therefore less chance of predation while the saddleback were adapting to their new habitat. We were also reluctant to transfer in autumn or late winter due to the harsh climate at BSMI at this time of year. While their has been no evidence of dispersal outside of the reserve, and only one saddleback has been found preyed on or scavenged, the released saddleback may have been in poor condition and more prone to disease. The saddleback have not bred as quickly as expected and this may be due to a longer settling in period than predicted. Cuvier Island was considerably warmer than BSMI although spring and summer has been unseasonably cold with many birds appearing to be breed later than usual (pers. obs.). To minimize such disruptions for future transfers, the source and release locations should be as similar as possible in both climate and habitat to allow the translocated species to adapt as quickly as possible.

Conclusion

Four months after release, it is still too early to determine whether the translocation is a success. There is positive indication that this population, with supplementation, can successfully establish. As saddleback are deemed to be secure in a number of off-shore island population, they are the ideal species to experiment with in both new transfer techniques and with returning an island-restricted, predator-prone species to the mainland. This translocation has provided conservation managers with an exciting opportunity to research saddleback ecology on the mainland. It has raised a number of questions in translocation practices. Despite conservation managers being relatively experienced in transferring saddleback, managers need to continue to investigate alternate techniques and 'test the boundaries' in order to establish the best standard of practice. This translocation is the start in the potential trend to restore saddleback to its former range on the mainland.

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Re-introduction of kaka, kiwi & kokako to Pukaha/Mt Bruce forest, New Zealand

Introduced mammalian predators, including stoats, ship rats and possums, have caused the decline of a large array of New Zealand's indigenous fauna. Small-bodied birds and all lizards and invertebrates are vulnerable to predators throughout their life, while larger species are most vulnerable as chicks or juveniles, or during nesting. Larger species are aggressive and strong enough to defend themselves from attack, but for example, young kiwi (*Apteryx mantelli*) are vulnerable to stoat predation until they reach a critical weight of about 1 kg. To counter the impacts of predators on indigenous species, a range of land care groups, volunteer groups and government and local authorities are undertaking large scale pest control at key sites around New Zealand.

Approach

In May 2001, New Zealand's Department of Conservation, Rangitaane O Wairarapa and the National Wildlife Centre Trust established "Pukaha Restoration", a 942 ha project to restore the forest ecosystem. Pukaha/Mt Bruce forest is adjacent to the National Wildlife Centre, a captive-rearing facility which focuses on breeding threatened species for

release back to the wild. It was envisioned that the captive facility would play a leading role in the establishment of species back to Pukaha/Mt Bruce forest. A restoration plan for Pukaha/Mt Bruce is currently being produced to guide restoration efforts. The plan proposes that species already existing in the forest be protected first. Species needing protection from predators during certain times of their life history with be re-introduced, and more vulnerable species, needing year-round pest control, will be re-introduced in the future if earlier re-introductions are successful and the level of pest control is intensified. Current pest control in Pukaha/Mt Bruce focuses on maintaining possum and rat abundance at very low levels during the breeding season, and stoats at low levels throughout the year. Possum and rat control occurs using a variety of toxins placed in bait stations at 100 m intervals. Non-toxic pre-feed is placed in bait stations with toxin added two weeks later. Control occurs between September and November, the peak nesting time for vulnerable species. Stoats are controlled year-round using specially designed stoat traps with covers placed throughout the forest. Previous research on kokako (*Callaeas cinerea wilsoni*) (Innes *et al.*, 1999) and kiwi (McLennon *et al.*, 1996) were used to guide the level of pest control needed, and it is expected that the current pest control regime will protect common forest birds existing at the site as well as kiwi, kokako and kaka (*Nestor meridionalis septentrionilis*) which had disappeared from the site many decades earlier.

Kaka, kiwi and kokako are species vulnerable to predators early in their life history and during breeding and the pest control being undertaken in Pukaha is considered sufficient to allow establishment of these species in the forest. While kiwi are instantly recognisable as a New Zealand icon, the two other species re-introduced to date are less well known outside New Zealand. The kaka is a large forest parrot, in the same endemic genus as the alpine kea. The kokako is a member of the endemic wattlebird family (also including saddleback and the extinct huia) and is famed for its hauntingly beautiful song. A full planning and risk assessment was undertaken prior to each translocation. Such factors as impact on source population, habitat suitability, release techniques, monitoring and management methods were included in the assessment. Captive-bred kaka were first re-introduced into Pukaha/Mt Bruce in 1999 and the population has continued to grow through production of chicks in the wild and supplementation of additional captive-bred birds. Wild birds are given additional protection from predators if they nest in specially designed, predator-proof nesting boxes.

Three pairs of kokako were taken to captivity during 2001 in order to produce chicks for release to Pukaha/Mt Bruce, but by 2004, when birds failed to breed in captivity, captive and additional wild pairs were transferred and released directly into Pukaha/Mt Bruce. Twelve birds have been released to date, and releases will continue until 10 pair have established in Pukaha/Mt Bruce. Initially there were concerns that kokako would disperse away from the forest and the area of pest control, but all birds have stayed within the core area. The first transferred birds set up a territory and successfully bred within five months of release. Captive bred kiwi were considered the most suitable to establish a kiwi population. The captive kiwi are a mixture of genetically distinct populations of North Island brown kiwi. These birds were unsuitable for supplementing existing populations in the wild, and needed to be released to a site geographically isolated from other kiwi populations. During 2003-2004, ten kiwi were released to Pukaha/Mt Bruce from a range of captive institutes, and it is expected that more birds will be available for release in 2005. To date three eggs have been laid, but all have failed during early incubation.

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Discussion

Kaka were initially released into Pukaha before pest-control was initiated, because it was thought nest boxes would adequately protect nesting birds. During these initial years success was mixed. Birds that bred in natural holes were much more vulnerable to predation despite attempts to protect natural nest sites. Population increase was not as quick as initial results indicated. Kaka are also very mobile and many birds disappeared, some were sighted several hundred kilometers away and so were lost to the population. Outward migration continues but it is difficult to quantify. Further releases of captive-bred kaka boosted the population, and accelerated the rate of growth during the early stages. Additionally the provision of supplementary food encouraged birds to stay at the site, provided additional food, assisted with monitoring of individuals and provided a valuable advocacy tool to the National Wildlife Centre, which also runs an education program. Currently the known kaka population in Pukaha/ Mt Bruce is 40 individuals.

Until recently, kokako translocations have had mixed success, with population establishment being very slow at some sites, including an offshore island free from predators. The causes have been attributed to a number of factors such as dispersal outside the area of pest control, social preference for birds from the same source population (that sing the same dialect), accidental poisoning during pest control, and uneven sex ratios. The technique of transferring the base population of several pairs from one population to a discrete forest may have overcome these problems. One bird died several months after release, its death was attributed to a harrier hawk, but this could not be confirmed. Another bird died soon after release, and is likely to have died as a result of the stress of catching and transfer. These deaths highlight the importance of minimizing the impacts of chance deaths by quickly establishing a breeding population through transfer of sufficient individuals.

The successful establishment of the kiwi population has been hampered by the availability of sufficient birds during the initial release period. During the first year only six birds were released, and the death of one male meant

that of the five remaining, only one was male; this was of particular concern, as male brown kiwi do all the egg incubation. Three further males have recently been released. Good planning has been essential in ensuring that techniques replicated successful practice from other sites, and for building on the information currently available. It is too early to determine the success of re-introductions to Pukaha/Mt Bruce. The formation of pair bonds and breeding attempts is a positive indication that populations will establish. Further monitoring of bird movements and breeding attempts will be critical to establish whether re-introduction techniques are successful. Additional monitoring of common forest bird populations is also proposed for 2005-2006 summer and will further confirm whether species populations respond positively to the predator control regime operating in Pukaha/Mt Bruce.

Conclusions

Where the causes of decline are adequately managed, captive-bred animals can play an important role in the establishment of populations in the wild, especially when there is a large number available to establish a good founder population. Where this is not possible, consideration should be given to supplementing the population with wild-sourced birds (or vice versa).

Acknowledgements

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Captive-breeding and re-introduction Program for the milky stork in Malaysia

The global population of milky storks (*Mycteria cinerea*) is estimated at just over 6,000 (Birdlife International, 2001), with more than half in the coastal wetlands of the east coast of Sumatra, and smaller numbers on Java and Sulawesi. Two other small populations are known: along the west coast of the Malay Peninsula and at Tonle Sap, Cambodia. Combined, these two isolated populations account for a maximum of 150 individuals (Birdlife International, 2001). The milky stork is listed as Vulnerable in the IUCN Red List of Threatened Animals (IUCN, 2004).

The milky stork is one of Malaysia's most endangered species, the entire population confined to the Matang mangroves in Perak State. Historically, it was known to breed on Pulau Ketam, the Klang islands at the estuary of the Selangor river, and a few other sites along the west coast of the Malay peninsula (Wells, 1999). The Matang population has been regularly monitored since early last century, and in the last few years, has experienced an alarming decline. The largest number of individuals counted was 101 in 1984 (Wells, 1999), gradually decreasing, with 42 counted in 1995, and only eight in 2003.

Background & Rationale

In 1987, the National Zoo received a few juvenile *Mycteria* storks, which at that age, could not be positively identified as either Painted Stork (*M. leucocephala)* or milky stork (*M. cinerea)*. These were housed and raised to adults, confirming their identity as milky storks. With the realization that these birds represented a potential breeding stock of this endangered species, the Zoo decided to attempt to breed them in 1991. This began what has today become a flagship effort in the country.

By 1997, the National Zoo had a stock of 60 birds of varying ages. With this stock, a natural next phase would be to attempt to re-introduce milky storks back into the wild. From the very onset, it was clear that any attempt to re-introduce captive-bred storks into the wild would require a significant large investment of time and resources, and would involve the participation of more parties, to achieve success. A programmatic approach was required, and would need to a) be strategically planned, b) involve partnerships with other agencies and c) be able to finance itself for the duration.

In 1998, a partnership was signed between the National Zoo, the Wildlife Department and the Malaysian Nature Society (MNS) to undertake a *Milky Stork Breeding & Re-introduction Program*. The MNS brought to the partnership an established conservation Society, a large pool of expertise derived from its membership and the fact that the MNS was managing the Kuala Selangor Nature Park (KSNP). A suitable site where the storks, if successfully bred, could be released into the wild, was required. The site should preferably be appropriate habitat, an area where milky storks occur, or occurred in the past, and could be managed from a conservation standpoint. KSNP fulfilled all these criteria.

Program Overview

The program consisted two phases. Phase I was to build up a stock of breeding adults in captivity and document the techniques of husbandry and management for the species. Phase I was conducted at the National Zoo, and achieved remarkable success. Phase II was to release free-flying storks into KSNP. This required the birds to be initially maintained in an enclosure within the park, replicating as closely as possible their natural surroundings. An initial stock of 10 birds (F1 population) of mixed ages would be housed here, and left for a period of

two years. Once a F2 population has been established, these would be released into the park. A monitoring program would be set up to document the progress and health of these free-flying birds.

PARTNERSHIPS: The partnerships between the MNS and the National Zoo and the wildlife department were fundamental to the management of the program, and involved regular exchange of views, brainstorming over problems, technical discussions and husbandry training. Other strategic partnerships were established *ab initio* to ensure the all needs of the birds as well as the personnel were addressed.

THE SITE: KSNP (N3° 20'; E101° 15') was established in 1987, on the southern side of the Selangor river estuary, at the town of Kuala Selangor. The 324 ha Park covers both sides of a coastal bund, with pristine mangrove forest on the seaward side and degraded mangroves on the landward side. Flooding of a 10 ha open area (the lake) behind the coastal bund is controlled by sluice gates. Park facilities (information centre, chalets, boardwalks viewing towers and trails) were put into place in 1990, and upgraded in 2004.

LEGAL REQUIREMENTS: The establishment of this program required, under Malaysian law, a permit to keep a totally protected species in captivity. The Wildlife Department gave its endorsement and support to the program, and assisted in obtaining a permit from the Ministry of Science, Technology and Environment.

THE AVIARY: The aviary (20 m X 39 m X 16.5 m) was constructed in the Park, within the bunded area. This location was chosen to avoid clearing of mangrove forest within the Park and to enable the captive storks to have visual contact with open water. A nearby watch-tower allowed visitors to observe the aviary without causing disturbance to the birds. Initially devoid of vegetation, *Acacia auricauliformes* rapidly took root and grew to 10 m in height within the aviary. Metal beams (10 m high), with small square platforms, provided perching and nesting areas for the storks.

PERSONNEL: Two staff of KSNP were trained in the upkeep and management of the aviary and its storks in 1998. This was conducted before the arrival of the birds.

Results

Phase II began in 1998, with the arrival of 10 mixed-aged storks, with a probable ratio of 3 males and 7 females (3:7). The intention was to begin with an equal number of males and females (5:5), but with juveniles mixed with adults, the exact sexual ratio is impossible to determine accurately. By the end of 1999, the birds had all reached adult plumage, and were in good health. However, no courtship behavior was observed. An expert assessment of the program was conducted by the National Zoo in August 2001, and several specific recommendations made to alter the conditions within the aviary with a view to encourage the birds to breed. An important recommendation was to alter the feeding system to reflect more closely the way storks feed naturally. The placing of thawed fish on the ground was thought to be un-natural, and changing this system to allow the birds to catch live fish in a pond was proposed. In 2002, the MNS procured funding and technical cooperation through a partnership with a private company dealing in water-pumping systems, and undertook a re-design of the feeding system within the aviary. A shallow "lake" with a deeper portion at one end was created, and a solar-powered water pumping system was installed to bring brackish water from the nearby canal into the aviary. With constant water flow and flushing, live fish and shrimp could be supplied, allowing the storks to catch live prey.

The first successful nest was built in March 2002, followed by five more between 2002 and 2003. None resulted in fledged young, despite successful hatching of the eggs. Excluding the possibility of nest-robbing by macaques or monitor lizards, it was assumed that either the parent birds were not sufficiently experienced, or that the diet was a factor in hatchling survival. On 30th April 2003, one adult stork was found outside the aviary, escaping through a tear in the netting, assumed to have been caused by macaques. The bird did not venture far from the aviary, returning inside to feed. A decision was made to use this unintentional "escape" as an unofficial start to the release program. The roof-netting of the enclosure was partly removed. The storks began to venture out but remained close-by, perching on the aviary roof at night. They began to use the adjacent lake and mix freely with resident grey herons (*Ardea cinerea)*. Although they fed in the lake, they continued to return once daily to the enclosure to feed. Provision of food in the enclosure was eventually stopped, but the birds continued to return to the enclosure, and continued to make use of its structure for roosting at night.

In May 2003, the free-flying storks began courtship and gathering of nest-materials, eventually building three nests on a low tree within the lake, together with nesting grey herons. A total of 6 eggs were laid between 30th May and early June 2003. Five eggs hatched from these three nests. Three hatchlings died within a couple of days, and two survived for 45 days, until a storm in July toppled the nest, killing the chicks. The two chicks were healthy and developing fast, and would probably have survived if the storm had not killed them. The storks have not attempted to nest again within the lake area since. The storks left the Park at the end of July. Initial attempts to locate them failed. It was believed that they had moved into the mangroves and mudflats along the coast, and may have wandered either north or south along the coastline. On 21st November 2003, 7 birds were seen perched on the aviary, but disappeared the following day. A month later, on 21st December, 3 were observed in the lake, and stayed a day. In March 2004, 4 were spotted at an aquaculture farm south of KSNP. These observations suggest that the storks have remained in the general area, wandering along the coastal mangroves and roosting in suitable areas, including occasionally within the Park. Towards the end of 2004 (Nov and Dec), groups of 3, 4 and 5 birds began to appear in the Park regularly. It has not been determined if these are parts of a single flock, a loose association between individuals, or separate groups that have formed and seen at separate times in the Park.

Problems & Constraints

A total of RM180,983 (US$47,627) has been spent on the program since its inception in 1998. Private sector funding

ceased in 2002, leaving the Society to apply internal funds to sustain the program. To date, a sponsor has yet to be secured, and this is an impediment to the continuance of the program. The maintenance of the aviary has been poor, and since the release of the birds, the aviary is falling into disrepair. This is a big problem if the program is to continue.

Another constraint is the availability and regular access to technical expertise. The knowledge and expertise in captive breeding is still in its infancy in Malaysia. The program does not have a full-time team of staff with this expertise, and of further concern, the mechanisms to record and develop this expertise are not in place. It is critical to the long-term success and continuance of this program that the expertise is developed.

Conclusions

The program has demonstrated that milky storks will breed in captivity, and released birds are able to adapt to a free-flying existence, and will breed. This finding is of great significance in terms of securing the future of this species in Malaysia, and gives much promise for a more concerted effort to re-introduce the species back into the wild. However, it is also evident that no breeding (fledgling) success has been achieved as yet. The reasons for this are unknown. It is concluded that further extension of the program is required if the successes thus far can be translated into real conservation value. The free-flying population within the KSNP area must be increased to a minimum size that will serve as a nucleus for the establishment of a breeding population.

Note:
To obtain a summary of report on the *Milky Stork Captive Breeding and Re-introduction Programme* (2005) Malaysian Nature Society. Contact MNS for a full copy of this report at *mns@stream.com* URL: *www.mns.org.my*

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REPTILES & AMPHIBIANS

The western swamp tortoise, Australia – an update

The western swamp tortoise (*Pseudemydura umbrina)* is a critically endangered Chelid freshwater turtle, restricted to a very small area on the edge of Perth, the capital of the State of Western Australia. Fewer than 50 adults remain in the wild. Most habitat has been destroyed due to clearance and drainage for agriculture, housing and clay mining. The recovery plan has five major recovery actions: Management of Ellen Brook, Twin Swamps and Mogumber Nature Reserves; tortoise population monitoring; captive breeding; translocations; and education, publicity and sponsorship. The Recovery Team has made considerable progress in recent years.

Management of the remaining habitat has concentrated on elimination of foxes through fencing and baiting, pumping groundwater in dry years, habitat monitoring and purchase of additional land. Predation of juveniles by black rats is also an issue. Fire management is vital, as aestivating tortoises can be killed by summer wildfire. Population monitoring has been underway since 1963; now one of the longest ongoing data sets for any Australian animal population. Recovery in the wild is slow, as the population is small, and the species has a low fecundity (one clutch of three to five eggs per year) and a slow growth rate (more than ten years to maturity).

Captive breeding and translocations are the key to increasing numbers of this critically endangered species in the wild. Perth Zoo, with scientific support from Dr Gerald Kuchling from The University of Western Australia, is now routinely producing about 50 hatchlings per year. Translocations, conducted by Dr Kuchling, are of animals of more than 100 g body weight, usually attained at three to four years of age. From 1994 to 2000 more than 190 juvenile tortoises were released to restock Twin Swamps Nature Reserve, where numbers had dropped below 10 due to predation by the European red fox and drought. This population is being monitored, with some animals now attaining breeding age. A new translocation site has been purchased and added to Mogumber Nature Reserve, about 100 km north of Perth. Introductions commenced in 2000; however a major wildfire burnt the whole area in December 2002 killing more than half the tortoises. Most survivors used artificial aestivating tunnels installed by the recovery team. More of these are being installed and efforts are being made to train the tortoises to use them. Finding additional translocation sites is important, as the conservation reserves occupied by tortoises are small and subject to a variety of pressures. The recovery team is currently investigating two sites near Perth.

The aim of the Recovery Team is to move the species from CR to EN and part of the way to VU by having five wild populations, with all populations having stable or increasing numbers of adults, requiring minimal intervention and requiring no restocking from captive breeding, and a total wild adult population of more than 250. Assuming no major setbacks, there should be more than 50 mature individuals in three wild populations within a few years.

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Re-establishment of the Tarahumara Frog into Arizona, USA

The Tarahumara frog (*Rana tarahumarae*) is a medium-sized, drab green-brown frog with small brown to black spots on the body and dark crossbars on the legs. It is known primarily from the mountains of eastern Sonora, Mexico, but also northern Sinaloa and western Chihuahua, and in the United States, from six montane localities in south-central Arizona. Its habitat is characterized by permanent springs and "plunge pools" in bedrock or among boulders, often with deep underwater and streamside retreats. These pools and springs line the bottom of montane canyons vegetated with oaks and pines at the higher elevations and more northern sites, and thornscrub or tropical deciduous forest at the lower and more southern localities. Similar to the plight of leopard frog species (*Rana pipiens* Complex) in the Southwestern United States, *R. tarahumarae* has declined or disappeared from portions of its range, and was extirpated from all localities in Arizona by 1983.

Decline

All the factors that contributed to the decline and extirpation of Tarahumara frogs from Arizona and other localities are not clear, but chytridiomycosis - a fungal skin disease that is killing anurans around the globe - has been associated with at least some of the declines. At some sites, such as Sycamore Canyon in Arizona, die-offs of chytrid-infected frogs in 1974 were followed by rapid extirpation, whereas at several sites in Sonora, Tarahumara frogs have persisted with the disease for 20 years or more (Hale *et al.,* in press). However, other environmental stressors such pollutants from nearby copper smelters (e.g. cadmium, arsenic, and acidic rainfall) could have compromised immune function and made frogs more susceptible to chytridiomycosis (Carey *et al.,* 1999; Rollins-Smith *et al.,* 2002; Parris & Baud, 2004 & Hale *et al.,* in press). In addition, Tarahumara frogs may be particularly affected by disease during winter at colder sites (Hale *et al.,* in press). Other factors that likely contributed to declines include predation by non-native species, flooding, drought, and habitat alteration. If pollutants from copper smelters contributed to declines in the past, they are probably no longer a factor, as the smelters have either closed or are now equipped with pollution control scrubbers.

Re-establishment Planning and Rearing of Stock

Planning for a re-establishment program in Arizona began in the early 1990s among biologists from U.S. and Mexican State and Federal agencies, universities, zoos and museums, and other interested parties. Source animals were obtained from northern Sonora in 2000, and were reared and bred at the Arizona-Sonora Desert Museum in Tucson, Arizona, as well as several wildlife refuges and other facilities. Breeding and rearing facilities ranged from captive operations with relatively high maintenance costs to semi-wild populations at wildlife refuges with little maintenance. Tarahumara frogs were bred at both types of facilities and produced an abundance of animals for re-establishment.

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Releases in Arizona

On 26 June 2004 (47 adult, 138 juvenile & 229 tadpole) Tarahumara frogs were released at four sites in Big Casa Blanca Canyon in the Santa Rita Mountains of south-central Arizona. Big Casa Blanca Canyon was one of the two most important habitat sites for the species in Arizona before its extirpation in 1983. This release was followed by additional releases of nine adults on 14th August, 52 juveniles on 19th August, and 39 juvenile and 99 late stage tadpoles on 10th October. The animals were backpacked into this wilderness site over 3-5 kms of trails. Frogs were carried in plastic containers or wet cloth bags, while tadpoles were transported in 3.7-liter containers equipped with battery-operated aerators. The only mortality during transport was a single tadpole. A sample of frogs from each of the source rearing facilities was tested for chytridiomycosis via PCR tests. All animals tested negative, and we further treated all frogs with the fungicide itraconazole (Nichols and Lamirande 2003) prior to release.

Initial Monitoring

The re-established population was monitored five times during June-October 2004. Before the onset of the rains in July, water levels were low and many juvenile frogs and late-stage tadpoles fell prey to giant water bugs (*Lethocerus* sp.), which were concentrated into remaining pools. However, numerous adult, juvenile, and tadpole frogs were observed on each monitoring trip. We noted no obviously diseased or moribund frogs. Using PCR tests, a sample of nine canyon treefrogs (*Hyla arenicolor*) captured from May-July 2004 in Big Casa Blanca Canyon tested negative for chytridiomycosis. Canyon treefrogs are known to contract this fungal disease.

The population will continue to be monitored, and additional releases are planned for spring or summer 2005. We hope to obtain more animals from Sonora to increase the genetic diversity of the re-established population. We will not consider the re-establishment a success until reproduction and recruitment has occurred and the frogs have persisted for at least several years. If successful in Big Casa Blanca Canyon, re-establishment will be considered at other historical localities in Arizona.

Conclusion and Recommendations

Tarahumara frogs were successfully reared and bred in captive and semi-wild facilities and released in Big Casa

Blanca Canyon, Arizona. We recommend not releasing late-stage tadpoles or frogs smaller than 50 mm snout-urostyle length during the dry season (May-June) before the onset of the summer rains due to high predation rates. Initial monitoring shows the frogs to be persisting, but we cannot yet declare the project a success.

The views expressed within are those of the author and do not necessarily represent the position of the U.S. Fish and Wildlife Service.

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Re-introduction of endangered frogs to uninhabited, predator-free, islands in the Marlborough Sounds of New Zealand

The frogs in the genus *Leiopelma* are considered to be very similar to the common ancestor of all modern day frogs. There are seven described species of *Leiopelma*, all endemic to New Zealand. Three of these are extinct and the remaining four species are all in decline (Bell *et al.*, 2004). All of the extant species are terrestrial and threatened, with 2 species (*L. hamiltoni* & *L. pakeka*) restricted to predator-free islands. As far as we know, in all *Leiopelma* species the adults lay their eggs on moist soil and the male guards the clutch of developing eggs. There is no real free-swimming tadpole stage and the young climb onto the backs of the male and complete their development there. Although they do not produce loud mating calls they can produce a faint squeak when molested.

Hamilton's frog (*Leiopelma hamiltoni)*, is the largest native frog in New Zealand, with females occasionally reaching a length of 50 mm.. These frogs are also the rarest in New Zealand and one of the rarest frogs in the world with an estimated population size of 300 individuals (Tocher *et al.*, 2005) occurring on one small island (Stephens Island) in

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the Cook Strait. These frogs are extremely endangered and are listed as Nationally Critical. Their continued existence depends upon the conservation measures put in place by the New Zealand Department of Conservation. Maud Island frogs (*Leiopelma pakeka*) live in a stable population of over 19,000 individuals in an old forest remnant on Maud Island in the Marlborough Sounds. This species was synonymous with Hamilton's frog until 1998 and are thought to be very closely related.

Both species were thought to be relatively widespread in New Zealand but were, until recently, confined to two small islands off the north coast of New Zealand's South Island. The decline of the Leiopelmatid frogs occurred with the advent of human colonization in New Zealand and the subsequent introduction of predators and changes to the environment. Current conservation efforts have focused on protection of remaining populations, minimizing the risk of pathogen spread, predator control, and re-introductions. In recent years, the utilisation of re-introductions as a conservation strategy has been highlighted in New Zealand where many of the species are endangered due to introduced mammalian predators and because of the availability of predator-free offshore islands that can be used as sanctuaries.

Two re-introductions have occurred using *L. hamiltoni* and *L. pakeka* (Tocher & Pledger, 2005 and Tocher *et al.,* 2005). The first attempt at re-introducing leiopelmatid frogs to a new island occurred in 1997 when 300 *Leiopelma pakeka* were moved from Maud Island to a nearby island (approximately 30 km apart) in the Marlborough Sounds (Tocher & Pledger, 2005). The receiving island (Motuara) was selected as it was thought to have been very likely to have had populations of *L. pakeka* in pre-human times. The island had also

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undergone a predator eradication programme in the 1990s. The frogs were released in autumn allowing them time to settle in before the onset of winter. They were released into a 10 m x 10 m grid resulting in similar densities to those found on Maud Island. The release site on Motuara was surveyed on a regular basis for five years. Tocher & Pledger (2005) concluded that the re-introduction was a success as the frogs were found to exhibit faster rates of growth, and recruitment and juvenile survival was high.

Following on from the success of this re-introduction it was proposed that a similar island-to-island re-introduction be carried out for the critically endangered Hamilton's frog. After five years of research into the demography of the Stephens Island population, Tocher *et al.* (2005) constructed a model to determine the best case scenario for the removal of a number of Hamilton's frogs to a new island. A suitable site on a predator-free island within the Marlborough Sounds was discovered on Nukuwiata (approximately 25 km distance) and a small cohort of 40 frogs was moved to the new site in May 2004. Tocher *et al.* (2005) suggest that a further 40 frogs be translocated from Stephens Island to Nukuwiata later this year. The frogs at the new site have been monitored every three months since their re-introduction and appear to be healthy and in good condition (H. Cooper, pers.comm). Juveniles have yet to be discovered at this new site.

The re-introduction to a suitable predator-free island seems to be a highly successful conservation strategy for increasing the number of populations of these endangered frogs. Several more re-introductions involving both species are planned for the future and careful monitoring, particularly directly following their release, is an essential part of these future events.

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Gharial re-inforcement in Royal Chitwan National Park, Nepal

Nepal is more often mentioned for its famous snowy summits, rather than its sub-tropical plains called the Terai. Nevertheless, half of the population of the country lives today on this narrow earth band fertilised since millenniums by waters descending from the Himalayas that runs for more than 800 km between the Indo-Nepal border and the mountains. Today some parts of these areas are protected as the National Parks and Wildlife Reserves. Royal Chitwan National Park (RCNP) is one of them, which was identified as the priority area in the Terai for conservation of important faunal elements, particularly one-horned rhinoceros (*Rhinoceros unicornis*), royal Bengal tiger (*Panthera tigris*), Asian elephant (*Elephas maximus*) and gharial (*Gavialis gangeticus*).

Species Biology

The subfamily Gavialinae is represented by a single species, the gharial. The adult male gharial developed a large protuberance of connective tissues on the end of its snout which resembles a clay pot, locally known as ghara in Northern India. Thus, the name of this species is derived from the presence of ghara. The large protuberance on the end of the male's snout is generally considered to be sexual characteristics of very large animals, although it is not obviously present in all males. Its function is apparently a visual sex indicator, a sound resonator, or as a special structure for bubbling and spouting during sexual behaviours (Martin & Bellair, 1977).

Beside the saltwater crocodile, it is considered as one of the largest living crocodilians (adults up to 6-7m) in the world. Of all living crocodilians, this species is the most closely bound to its aquatic environment because its legs are weak and not well-suited to walk on land. It only hauls itself out of the water on exposed sand banks to bask, to build its nest, and to lay its eggs. On the other hand, its broad oar-like tail helps propel this species in the water, making it highly mobile in an aquatic environment.

It is typically a resident of deep, fast flowing rivers, preferring areas where the water current is low (Whitaker & Basu, 1983). The gharial appears to be primarily a fish-eating species, but some large adults have been observed eating wild ducks in the Narayani River. Gharials are predictably synchronised nesters in Nepal. All clutches were deposited between March and April. Female gharial lays 10 – 60 eggs in the Narayani River (Maskey, 1989).

Threats

Reasons for the decline of the gharials are largely attributable to the construction of dams for hydroelectric power and irrigation. These dams create abnormally high water during the monsoon which floods practically all nests near the dams. The use of large seines and gill nets in the major rivers of Nepal not only have reduced the fish population, (gharial's major food) but also caused direct mortality because of entanglement in their nets. The third major cause of population decline is the poaching of gharial eggs by the local communities for its medicinal and food values.

Conservation Program

The gharial is one of the most endangered among all crocodilians. However, unlike other endangered crocodilians, gharial conservation programs are now in place over much of its range. The species was literally brought back from the brink of extinction by restocking programs initiated in India (1975) and in Nepal (1978).

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Gharial eggs were collected from wild nests for captive raising and released them back into the main rivers of India and Nepal. In India, over 3,000 juveniles have been released at 12 sites mainly in the Gangese drainage (Chambal, Ramganga, Girwa and Sharada rivers). The follow-up surveys of released gharials indicates overall increase in the total wild population which has levelled off since 1990 as the number of available sites have become filled. Current wild population is estimated to be more than 1,500 individuals of which about 1,000 are found in the Chambal River with around 64 nests a year at 15 different sites (Rao & Singh, 1994).

In Nepal, gharials are restricted to remnant populations in the Karnali, Babai and Narayani rivers (all tributaries of the Ganges). Since 1981, approximately 380 young individuals originating from the Gharial Conservation Project were released in Narayani and Rapti rivers. In the past, the released gharials were monitored over a short period during the research work carried out by one of the authors (T. M. Maskey). No systematic monitoring was carried out after that. At the beginning of the 1990's the population estimation was only about 100 wild individuals (Maskey & Percival, 1994).

A collaboration between the Department of National Parks and Wildlife Conservation (DNPWC) and the team of La Ferme aux crocodiles of Pierrelatte (France) in collaboration with the association Conservation des Espèces et des Populations Animales (C.E.P.A.), tried to investigate the reasons of the disappearance of the last gharials (*Gavialis gangeticus*). During the monsoon season (between June and September), the flooding of the rivers and the continuous rains render monitoring impossible. During winter, the level and the temperature of water facilitate the observation of the crocodiles on the sand bank because of their basking behaviour. In the month of November 2001, we counted only around fifty individuals, solitary or in small groups disseminated along the river, revealing the poor health of the wild population.

After this first expedition in the Narayani River, we envisaged to monitor the released gharials to collect the systematic data on the movement of released gharials in the Narayani River. Since March 2002, all the re-introduced gharials in Royal Chitwan National Park were individually marked and some were monitored with radio-telemetry. This inventory shows a total population of 50 gharials and 16 re-introduced in 2002 and 2003 and shows a high number of released individuals. In 2003 approximately 40 had been recorded and we noticed that individuals kept on disappearing, particularly immatures from the released batch. Survival rate, first and second year, was respectively 53.9% and 20% showing that young gharials have not established well in the park. After comparing observations in 2003 and 2004, on the Rapti River the low survival rate seems to explain a low versatility of young gharials in a environment very poor in suitable habitat. The loss of habitat is due mostly to anthropogenic activities.

During the short period monitoring released gharials in the Narayani River, we observed most of them moving downstream and finally into India. Since the populations share their habitat between Nepal and India, it is necessary to strengthen the bilateral coordination between India and Nepal for long term survival of gharial in the Narayani and Gandak rivers. A joint survey (especially for Nepalese released gharials, which can cross the frontier), is recommended to study the trends of the gharial population in the transborder area of the Narayani River. This will help to design a long term conservation and management strategy of gharial in the transborder area.

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FISH

Re-introduction of threatened fish in Japan

In Japan there have been few re-introductions of fish as deliberate conservation programs for the recovery of endangered species and populations regardless of a long history of fisheries re-stocking programs. Most people confuse conservation by re-introduction with restocking in fisheries or the introduction of ornamental fish in garden ponds. Common carp (*Cyprinus carpio*), colored ones in many cases, have been frequently introduced into natural waters as a symbol of a beautiful river and nature conservation, although they are known to disturb ecological communities and not to survive there in the long term.

Unplanned introductions of Medaka (*Oryzias latipes*), a vulnerable small freshwater fish, is a recent problem in biodiversity conservation in Japanese freshwater ecosystems. This species was distributed all over the lowland areas and is one of the most common fish, it surprised many people that Medaka was included in the Red List of Japan in 1999. Consequently, the unplanned introductions, with 'conservation intentions', have been widely conducted by amateur naturalists, non-profit organizations, local governments and elementary schools, and hence commercial trade of this species is popular across the region. Coincidentally this is the species whose large scale genetic differentiation across various geographical scales is one of the best known amongst Japanese fishes. In the above circumstances, the Nature Conservation Commission of the Ichthyological Society of Japan is now preparing guidelines for the re-introduction of fishes for the purpose of biodiversity conservation, which is fundamentally based on the IUCN/SSC Guidelines for Re-introduction and other similar ones but optimized for the situation in Japanese fishes. We aim at bringing people's 'conservation intentions' into responsible activities with scientific basis of conservation biology.

A small catfish *Pseudobagrus ichikawai* (Bagridae), which is endemic to a restricted region in the central Honshu Island, is threatened by human activities such as river banking and dam construction. This species is also listed in the Red Data Book of Japan and designated as a natural monument. The populations in the northwest quarter of its distribution area are at critical levels. To initiate a recovery plan the Mie Prefectural Board of Education has recently organized a conservation breeding specialist group for this species which includes specialists of ecology, genetics, river engineering, and captive-breeding.

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The group has started a breeding program of the species since 2003, aiming for a future re-introduction and is new initiative for Japanese fishes. However, the prospects for success are not good as an intensive census conducted in 2003 and 2004 confirmed that only less than 20 catfish survive in a very restricted range, which had contained several hundred individuals 15 years ago!

Using a total of eight wild-caught individuals, captive breeding has been tried by Shima Marinland, an aquarium which has successful experience of breeding this species and by using a breeding plan determined by microsatellite DNA analysis. These attempts have not been successful for two years, possibly due to inbreeding depression and reproduction has also failed in the natural habitat over the last three years. There is also a large number of carnivorous fish which share the same microhabitat as the catfish.

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PLANTS

Plant conservation research at Omaha's Henry Doorly Zoo, Omaha, Nebraska, USA

The Omaha Henry Doorly Zoo established a micropropagation unit in 1994 dedicated to the sustainable conservation of threatened plants. The laboratory conducts research on more than one hundred plant species that face multiple threats in their natural environment, including many species that have not been propagated successfully when using traditional propagation techniques. New micropropagation protocols must be developed on a species by species basis because most of those currently researched in the lab have received little, or no, prior research. Rare plants often have one or more reproductive constraints and many also originate from drastically reduced wild populations where biodiversity requires protection. The project is geared strictly to plant conservation and to provide plant research technology that is not readily available in remote regions or countries. This ex situ propagation and conservation program is carried out in support of a given state's or country's own particular conservation needs.

The species researched in the lab are prioritized and receive efforts based upon their relative status of immediate threat or rarity in the wild. The basic biology, life history and propagation requirements are documented for each species and the information gathered is shared with the applicable regional representatives and government authorities so that re-introductions to the natural habitats have a greater chance of success. Propagules produced in the laboratory are shipped to conservationists in the country of origin, still in vitro, for ease of transport and phytosanitary inspection. Re-introductions to the wild are made as augmentation to existing populations at protected sites through cooperative agreements with governments and local stakeholders.

Recent re-introductions made include a shipment of 400 orchid seedlings that were planted in the eastern Madagascar forest where the seeds were collected in 2000 as a result of agreements between the Malagasy government and the zoo. Several native orchid re-introductions have also been made as population augmentations in the central part of North America for the last five years. In September 2004 a shipment of lab-produced *Diplazium laffanianum* ferns were hand carried by zoo personnel and presented to Bermuda's Minister of the Environment, the Honorable Neletha Butterfield, on behalf of the Bermudian citizens. The in vitro ferns produced at the zoo were returned to their native country, for further research and acclimatization at Bermuda's Botanic Garden, where the nursery carefully maintains the only three adult representatives of the species.

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A long-term seed storage program through cryopreservation was developed to serve as a conservation back-stop for species researched in the laboratory. The Henry Doorly Zoo opened its Conservation and Research Center in 1994, where animal germplasm is stored for some of the world's most endangered animals and many of the rare plant species studied in the micropropagation laboratory are now also stored in the same cryopreservation facility. In order to preserve as much genetic diversity, and genotypic integrity as possible for each species coming from such highly restricted populations, plant germplasm is stored in the form of seeds or spores. Orchid seeds are particularly difficult to cryopreserve successfully, but the zoo's lab has produced many hundreds of normal plantlets from orchid seeds that were cryopreserved and later germinated. The zoo will break ground on a new wing addition to the Conservation and Research Center that will be dedicated to plant conservation. The new lab space and greenhouse will support the zoo's mission of biodiversity conservation, through the transfer of technology and research in species biology.

Direct participation by visiting scientists in the lab's plant biotechnology techniques is part of the lab's overall mission. The plant conservation lab frequently trains scientists, interns, and graduate students, from national and international academic institutions. The training gives them hands-on experience of micropropagation and plant tissue culture so that the techniques are available for implementation in their respective countries. The lab has trained several Madagascar scientists in the last four years, in order to make technology available to more Malagasy people involved with their government's long-term conservation goals. Madagascar has approximately 1,000 native orchid species, most of them endemic, and all which face the threat of habitat loss. Estimates run as high as 90% forest destruction, particularly in the eastern rainforest region. The entire country of Madagascar is often cited as one of the most critically endangered hotspots of biodiversity in the entire world. A burgeoning population, extreme poverty, and the destruction by slash and burn agriculture, as well as natural disasters and the demand for timber that far outstrips the sustainability of their forested regions, all have converged to make Madagascar's situation one of the most urgent conservation needs on earth. Ex situ micropropagation provides an additional tool in the race to prevent extinction for Madagascar's irreplaceable biodiversity.

Plants produced in the lab that have federal, and/or state protection, are re-introduced to protected areas identified by the authorities for that country. Currently, the lab is researching species from Bermuda, China, Madagascar, South Africa, North and South America, and Central America. More than 60% of all the species researched are from the *Orchidaceae* and are native to both temperate and tropical regions. Through in vitro production, ex situ plant conservation can contribute to species conservation even at a distance from the founder population. Although the ideal situation is to produce plants near any future re-introduction site, in the case of some countries, an on-site micropropagation facility is not always available or practical. Although long distance projects are complex and difficult they can assist species conservation in the short term until the time when conservation action plans are undertaken by local residents.

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Re-introduction of the rare fern - oblong woodsia - at four sites in the UK

Over 150 years ago it was fashionable to collect ferns for cultivation or inclusion in private herbaria. As a rare fern in Britain the oblong woodsia (*Woodsia ilvensis*) was greatly prized and suffered from extensive collection. Although this species is now protected, the populations are still continuing to decline. As a UK Biodiversity Action Plan species this fern has been the subject of a long-term research program at the Royal Botanic Garden Edinburgh. Where populations have completely disappeared, four re-introductions have been carried out. The habitat appears to be little changed, with many of the accompanying species still present. It is possible that collecting affected the populations so that there was insufficient spore rain to enable re-establishment. It is hoped that by providing a local source of spores, regeneration will take place.

Growing a Conservation Collection

Spores of the oblong woodsia were collected, under license, from most of the native British plants. There are three sites in Scotland, one in England and two in Wales. Some plants did not produce spores in the year of collection, and although it was intended to collect spores from these plants another year, some still did not sporulate so no further collections were made. If any further losses should occur in the wild populations most of their genetic material will be conserved in this conservation collection. Spores from each population or sub-population were sown together but in one case this meant all the plants from one sub-population were derived from a single individual. Some experimentation was necessary to find appropriate compost that was sufficiently free-draining.

The plants developed in a growth room at 18°C and gradually hardened off before placing outside. The resulting sporophytes are kept in a shade tunnel, standing on coarse sand, where they are regularly watered and given liquid feed as appropriate. The plants are occasionally treated with a pesticide to control attack on the roots as from the larvae of the beetle known as vine weevil. Each pot has a surface layer of gravel to discourage weeds but weeding is still a substantial task. When re-potting, the crowns are separated and they are potted singly. Most of the plants are grown in 7.5 cm pots with several hundred of each provenance grown in a block, usually containing around 300 plants, although 100 is probably an adequate number. There is a possibility that spores could transfer to pots in adjacent blocks but no volunteer plants have been observed in the growing area or in plant pots. Plants that are derived from the nearest provenance have been distributed to gardens that are open to the public, which helps to safeguard the stock.

Selection of Re-introduction Sites

There are several sites, well known from references in literature and herbarium specimens where *Woodsia* ilvensis was known to have previously occurred but is no longer found. In many instances it is possible to know within a small area exactly where the plants were previously found. Species lists that accompanied descriptions of these sites are also useful in confirming the location. The continued presence of these other species, some uncommon in the local area, suggest that the habitat is still suitable and the disappearance of the fern might have been due to collecting. *Hymenophyllum wilsonii* is one such species that was listed and is still found at the two re-introduction sites in the Scottish Borders. A very careful search of the sites was made prior to planting to ensure that no original plants remained using ropes where necessary.

Selection of Plants for Re-introduction

When planting within a few kilometres of surviving populations the re-introduced plants were grown from spores collected from the local plants. The plants used for the re-introduction in the Scottish Borders were thus derived from three, possibly four plants less than 5 km away. Some of the gametophytes grown in culture from these plants did not develop properly, suggesting inbreeding depression. However, the sporophytes from pot-grown cultures were healthy plants and presumably only the more robust plants grew to maturity.

The other two re-introductions sites in the north of England were 70 km from the nearest existing location so that there were no plants nearby to provide a local source. These two sites were planted with a mixture of sporophytes derived from all the British plants in the conservation collection, which gives a good genetic mix and provides for outcrossing. It was found that up to 60 plants is a reasonable number to relocate and measure. If there are more plants it is difficult to have enough time to walk in to the site and spend enough time finding and recording them.

Location of Re-introduced Plants within each Site

Most of the original plants grew out of cracks in a rock face with a south-facing aspect. Cracks are difficult to plant into as most of the plants are in 7.5 cm pots and damage to the root system jeopardizes survival. The plants were pushed into larger cracks, planted on ledges and among scree with both north and south-facing aspects. A few very small plants were inserted into cracks and in the autumn of 2004 a substantial number of gametophytes and sporelings were planted in a new site near a previous re-introduction, but far enough away not to confuse their growth with possible regeneration. It was found better to group the plants into clusters separated by a gap of at least several metres. It is also helpful to centre each planting group around an obvious relocateable feature like a conspicuous rock.

The planting locations were drawn and photographed. It was found useful to leave the flower pot beside each plant after it had been planted until the photographs had been taken. If it was windy the pot had a small stone placed on top or it was filled with stones. This made a clearly visible marker in the photographs. The plants were numbered as they were planted and the labels were pushed down nearly out of sight. It was found that some labels disappeared over time and it was necessary to replace them. The photographs were labeled with self-adhesive dots with the plant number and then laminated for use in monitoring. One copy of the monitoring sheets was given to the landowner, another retained by the Botanic Garden. It is important to have clear records of the planting locations otherwise it will

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Table 1. Survival of three re-introductions four years after planting.				
	Survival %	Fertile %	Mean maximum length frond (cm)	Mean % fronds grazed
South-facing site in S. Scottish	60	65	7.2	16
South-facing site in N England	48	70	6.2	0
North-facing site in N. England	88	70	6.0	52

not be possible to distinguish between re-introduced plants and regeneration.

Some sites were planted in the spring, others in the autumn, and some in two phases in autumn and then spring. At one site a volunteer watered the plants during a dry first summer. It was generally concluded that plants had a better chance of establishment with autumn planting as they received adequate over-winter precipitation. We have recently had little rainfall in the spring making this a less useful time to plant. Volunteers helped to plant at some of the sites. It was found that they did not always dig a deep enough hole, so that some plants were lifted by frost-heave over winter. Other plants placed into scree were put into areas with an air-space below and had to be re-planted. Small, flat stones were placed around the plants to provide additional shelter, conserve moisture and to reduce competition from other plants.

Monitoring Plant Establishment

The sites were visited at least annually for the first four years. Normally the visit was late season, in September or October when it was possible to see if the plants had shed spores. It was found helpful to search the site and mark easily found plants using small upturned flowerpots. Using the marked photographs and the numbered labels on the plants that were more easily found, it was usually possible to locate most of the plants. Being late in the season some had died down without trace and inevitably some small plants were found one year and not the next, but the numbered labels reduced the risk of confusion between plants that are close together.

For each plant, the length of the maximum frond was measured, the total number of fronds counted, including yellowing fronds for the current year, and the sori were examined to determine the state of maturity and if spores had been shed. After annual monitoring at three sites for the first four years it was decided to monitor in alternate years to minimize disturbance to the site, especially as one re-introduction was in an area with other rare species. The fourth site is only in its first year and has not yet been fully monitored.

Results

The survival rate at the three sites was very satisfactory (Table 1). The Scottish site was last monitored in 2003 after a comparatively dry summer and had performed well compared with the previous years. The two English sites were visited in 2004 when the plants might have been stressed by the previous dry summer and then a dry spring. They were smaller and less fertile than they had been the year before, but still showed a good level of fertility.

Discussion

Of the plants that died most were in areas that subsequently proved too dry, although one was growing well until a bird built a nest on top. Plants in scree survived better than those on open rock faces, which is a difficult habitat to plant. Many of our native populations grow on rock faces but these might be the only sites where they are protected from grazing. Grazing could be a problem with goats visiting the first Scottish re-introduction and a rabbit colony near the north-facing site in England. Although most of the plants had survived at the latter site, many were very small, reducing the mean length of fronds. This was compensated for by some very luxuriant plants performing very well.

Conclusion

The results so far are encouraging and it appears to be possible to establish plants in or near their original site. This greatly increases the opportunity for establishment by spores in optimum positions. Sporophytes could take several years to be large enough to be found. Only when this regeneration occurs can the re-introduction be considered successful.

Acknowledgments

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