Scimitar-horned Oryx Conservation Planning Workshop II

25-27 October 2010, Sidi Fredj, Algeria

WORKSHOP REPORT

Cover photo: © Olivier Born

A contribution of the IUCN/SSC Conservation Breeding Specialist Group and the Sahara Conservation Fund

Lees, C., Miller, P., Beudels-Jamar, R., and Newby, J. 2010. *Scimitar-horned Oryx Conservation Planning Workshop II: Workshop Report.* IUCN/SSC Conservation Breeding Specialist Group: Apple Valley, MN.

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Appendices

Section 1. Executive Summary

The Sahara Conservation Fund (SCF) and international partners seek to initiate stakeholder processes designed to catalyse the repatriation and reintroduction of scimitar-horned oryx across the species' ancestral range in Sahelo-Saharan Africa. Approximately 700 animals are managed in North American, European and Australasian zoos, which can serve as a source population for release programmes throughout the species' ancestral range. In addition, as many as 2000 more are held in semi-captive conditions in the United Arab Emirates. These animals can be valuable additions to the captive source population, but the demographic, genetic and health status of this semi-captive population has been difficult to assess fully.

The IUCN Conservation Breeding Specialist Group (CBSG) facilitated a workshop in Al Ain, United Arab Emirates (UAE), in November 2009 to assemble information on the status of captive scimitar-horned oryx worldwide, and to begin assembling information on potential reintroduction sites throughout the ancestral range. This workshop, generously funded by Al Ain Wildlife Park and Resort (AWPR) and the Sahara Conservation Fund, brought together nearly 30 experts from northern Africa, the Arabian Peninsula, Europe, and North America to discuss the ways in which captive oryx can most effectively serve as founder stock for reintroductions into the species' range. Workshop participants identified a number of important projects focused on genetic and veterinary analyses of the UAE semi-captive population, creation and use of risk assessment tools to evaluate alternative release strategies in proposed sites within the ancestral range, and effective engagement of range country authorities that can support new local reintroduction initiatives.

A second meeting (SHO II) was held in the Algerian port of Sidi Fredj, in October 2010, to continue the strategic planning process. This second workshop was hosted by the Algerian Ministère de l'Aménagement du Territoire et de l'Environnement (MATE) and the World Deserts Foundation. The workshop, with twenty participants from thirteen organisations and ten countries, was co-sponsored by AWPR and SCF thanks to a generous donation from the Mohamed bin Zayed Species Conservation Fund (MbZ). Importantly, it included representation from six of the countries that fall within the species' ancestral range: Algeria, Chad, Morocco, Niger, Senegal and Tunisia.

Building on directions established at **(SHO I)**, the principal focus of this second meeting was the development of a tool for evaluating the conservation value of potential release sites.

DAY 1.

The first day of the workshop was introduced by John Newby of the Sahara Conservation Fund. Participants were invited to introduce themselves and their interest in oryx by providing answers to the following questions:

- What is your name and organisation?
- Why are scimitar-horned oryx important to you?
- What, do you see as the biggest challenge to restoring scimitar-horned oryx in your country?
- What would you like to get from this workshop?

[A summary of the responses is provided elsewhere in this report.]

This was followed by a series of scene-setting presentations:

- Aménagement et Gestion des Aires Protégées en Tunisie – Khelil Mohamed Faouzi
- Communication du Niger – Abdoulaye Hassane
- La Conservation des Oryx au Sénégal - Cheikh Ahmed Tidiane Djigo

- Maroc – El Mastour Abdellah
- Introduction to SHO II goals and tasks – Caroline Lees

[These PowerPoint presentations are available on the briefing site for this workshop: https://sites.google.com/site/cbsgsho/]

Developing the Evaluation Matrix

Following the presentations, work began on the evaluation matrix. The participants decided that criteria for site evaluation should be separated into two components:

- ***Pre-requisites for Success*** *- characteristics which, if entirely absent from a site/project, will predispose it to failure.*
- ***Conservation Impact*** *– characteristics which add value to the site/project in terms of its contribution to pre-defined conservation goals (in this case the long-term (50 year) vision for SHO in the wild).*

Participants were introduced to a draft list of criteria developed during and after SHO I. In plenary and using the definitions provided, participants assigned these criteria to one or, where appropriate, both categories. They brainstormed additions to these lists.

During previous plenary presentations participants had also been introduced to the VISION Statement generated during SHO I:

> *A fifty-year VISION for the international scimitar-horned oryx conservation community:*
> *Viable, secure, free ranging populations of scimitar horned oryx moving through a regional mosaic of interconnected areas, both strictly protected and for multiple use, distributed within ancestral range, in harmony with local people, restoring pride, cultural and natural heritage, economic and ecosystem value.*

The potential conservation impact of a release is expected to be closely aligned with its potential contribution to realising the agreed long-term vision for oryx. Therefore, participants returned to the vision to explore the criteria for evaluating conservation impact. Again in plenary, participants went through a process of deconstructing the VISION into its component themes. Each theme was allocated either to the probability of success list or to the conservation impact list. Additional conservation impact criteria were discussed and added as appropriate. Finally, participants undertook a preliminary prioritisation of pre-requisite criteria by allocating a quota of dots to the criterion or criteria which they considered to be most important to the successful restoration of SHO.

DAY 2.

On day two participants split into two groups: Conservation Impact and Pre-requisites for Success.

Group 1: Conservation Impact

Group 1 discussed the proposed conservation impact criteria, resolving them into major factors and sub-factors and recording any additions. Next, using a map of ancestral range and participant knowledge, the group brainstormed a list of potential release sites – the list was not designed to be exhaustive, only representative. A sample of seven sites was selected for further consideration on the basis of a) including a representative range of situations and b) considering sites sufficiently well-known to members of the group. Taking each sub-factor in turn, the group discussed and recorded the qualities of each site in relation to that sub-factor.

Group 2: Pre-requisites for Success

Group 2 further discussed the pre-requisites for success, grouping them as appropriate into major factors and sub-factors, and brainstorming any additions. Participants were asked to develop a qualitative description of each sub-factor to explain its importance. Once the list was complete, the group took each sub-factor in turn and discussed the current situation on the ground, in each Range State present, in order to begin to establish a plausible range of values or situations for each.

DAY 3

On day 3, the following presentations were given and discussed in plenary:

- Using GIS Technology to Characterise the Potential Habitat for Scimitar-horned Oryx (*Oryx dammah*) Reintroduction - John Newby
- Population Viability Analyses and their Relevance to this Project - Caroline Lees

[These presentations are available at: https://sites.google.com/site/cbsgsho/]

Stakeholder Statement

The long-term vision for SHO restoration is aspirational. It was not designed to encompass or recognise the full spectrum of restoration activities and contributions that could be made towards oryx restoration, nor does it encompass the semi-wild management scenarios likely to be most realistic and possibly permanent, in a number of Range States. Nevertheless, these efforts all play an important role in securing the species for the long-term. To help address this disconnect, participants brainstormed the potential actors in the restoration of SHO and the roles that those actors need to play if the long-term vision is to be progressed. Ideas generated were taken away and crafted into a statement which is intended to travel with the vision, to provide direction, context and recognition for all of the players in SHO restoration.
[This statement is provided in Section 3]

Development of the Evaluation Matrix

Working groups continued to develop the evaluation criteria. Taking each sub-factor in turn and, using the plausible range of situations discussed previously as well as knowledge of the situation in countries not represented, groups identified and defined best and worst-case scenarios for each.

On the afternoon of day 3, working groups gave their final presentations to plenary. It was agreed that work would continue on the evaluation matrix, and a presentation was given on the various ways in which the finished matrix could be used (this is available on the workshop web-site and is discussed in Section 4).

An editorial team was convened to ensure timely production of the workshop report both in French and in English:

Editorial Team

- Caroline Lees, CBSG Australasia
- Phil Miller, CBSG
- Roseline Beudels-Jamar, IRSNB and Chair of the Terrestrial Mammals Working Group of the Scientific Council of the Convention on Migratory Species (CMS).
- John Newby, Sahara Conservation Fund

Unfortunately, at very short-notice and largely due to visa difficulties, a number of key people were unable to attend the meeting, including one of the workshop facilitators. This significantly reduced the amount of work that could be accomplished at the meeting. As a result, the following work was not completed as originally intended:

- Potential release sites were touched on briefly in presentations but were not fully explored.
- The "Scorecard" and prioritisation exercises were progressed but not as far as planned.
- The draft population models were described briefly in presentations but not discussed or progressed.

An additional process for completing these will need to be agreed upon amongst stakeholders.

Further details of both SHO workshops, and the reference library that has accumulated as a result of them, can be founded at: *https://sites.google.com/site/cbsgsho/*

Section 2. Participant Introductions

Participants were invited to introduce themselves by answering the following questions:

- What is your name and organisation?
- Why are scimitar-horned oryx important to you?
- What, do you see as the biggest challenge to restoring scimitar-horned oryx in your country?
- What would you like to get from this workshop?

The following is a summary of the responses:

- This is a flagship species for conservation in the Sahara.
- A common vision is essential for NGOs such as SCF, for use in identifying priorities.
- I fell in love with the desert and have visited many times. My vision is to see SHOs back there.
- There are many oryx in captive collections and it would be great to see some of these returned to range countries.
- At this workshop I would like to learn from and share knowledge with all participants.
- I want to learn more about what is happening in other Range States.
- Tunisia has done a lot already with SHOs and we would like to be able to evaluate what we have done to make sure that we are on the right track.
- I am very involved in Saharan conservation. I want to learn more about what is happening in SHO restoration, to explain what is being done in Morocco to other Range States and to exchange important know-how.
- I think the biggest challenge is the sustainability of SHO reintroduction and the sustainability of nature conservation globally.
- From this workshop I would like to get a science-based consensus on how to proceed.
- The context of restoration is very different in each Range State. International support is essential.
- The oryx was last seen in Niger. Niger has a contract for SHO reintroduction, but nothing has been achieved yet. Niger needs support to reintroduce the species, in Gadabeji in particular. Reintroduction in Gadabeji will help restore this area.
- This is an important species, badly exploited. The Chadian Government is interested in its reintroduction.
- Reintroduction is a new undertaking for Chad and we want to learn about it from this workshop.
- SHO are an element of biodiversity which is important ecologically. There are some in captivity and we must use them. I want to explain to everyone what is happening in Senegal, to listen to every participant and to have a roadmap for SHO reintroduction.
- I want to learn from the experience of countries which have already achieved important milestones and to learn about the outcomes of SHO I.
- I am here to learn about what is being done for this species in neighbouring countries. This is a symbolic species for big Saharan areas.
- This species is an emblem for the big arid zones. I would like to learn from the experience of countries that have achieved management in captivity.
- The topic of the workshop is interesting for me because it will allow me to acquire new knowledge about oryx and to listen to the experiences of other countries.

Section 3. Vision and Stakeholder Statement

At the previous scimitar-horned oryx workshop (SHO I), participants developed the following vision for scimitar-horned oryx restoration:

A fifty-year VISION for the international scimitar-horned oryx conservation community:

> ***Viable, secure, free ranging populations of scimitar horned oryx moving through a regional mosaic of interconnected areas, both strictly protected and for multiple use, distributed within ancestral range, in harmony with local people, restoring pride, cultural and natural heritage, economic and ecosystem value.***

A French translation was provided to participants for review. Comments were captured by a small working group who prepared some improved text. This is available in the French translation of this document.

Participants at SHO II recognised this vision as a valuable aspiration, but recognised the difficulty in linking this vision with the activities and realities of those working on the ground to achieve progress in oryx restoration.

Participants discussed the many actors and roles in scimitar-horned oryx conservation. Notes from this discussion were crafted into a statement which was further discussed and refined by participants, to provide the following **STAKEHOLDER STATEMENT**:

> *Achieving this vision requires the cooperation and support of local people, cross-sectoral collaboration within and among range countries, and strong support from the international conservation community. A functioning global metapopulation – from intensively-managed populations to semi-wild herds maintained in large fenced habitats, to free-ranging reintroduced populations – is essential for the long-term survival of the species. A strong global partnership network must implement actions that will ensure the success of reintroduction programs, including:*
>
> - ***Animals**: maintaining the health, genetic diversity and demographic stability of animals needed for sourcing semi-wild and reintroduced populations;*
> - ***Human Capacity**: developing the technical and scientific capacity among key stakeholder groups for effectively managing and securing global oryx populations;*
> - ***Outreach and Education**: increasing international and local awareness of the important role that oryx play in maintaining healthy ecosystems, and in highlighting the cultural and natural heritage of people whose livelihoods depend on deserts and aridlands;*
> - ***Legislative framework**: enacting international and national laws and conventions designed to protect oryx and the functioning ecosystems they require for survival; and*
> - **Financing and Incentives:** generating adequate financial support and creating incentives for local people to ensure the health and security of reintroduced populations.

[Vision translation working group: Cheikh Ahmed Tidiane Djigo and Tarik Ladjouze. *Stakeholder statement working group: Steve Montfort (text), Roseline Beudels-Jamar (text and translation)].*

Section 4. Evaluation Matrix: Method

Aims

The goal of the workshop was to develop a tool for assessing the relative conservation value of potential scimitar-horned oryx (SHO) release sites and associated projects[1]. The tool proposed here has the potential to:

1) provide for transparency and consistency in the evaluation of sites/projects;
2) be used either qualitatively and/or quantitatively;
3) assist the ranking of projects in order of "conservation value" (see below);
4) inform grant allocation through quantitative comparisons of "conservation value" per dollar spent;
5) assist project planning by clearly describing the characteristics of a desirable site/project;
6) grow in utility as knowledge and understanding increases;
7) facilitate a clear and detailed historical record of the context in which priorities were set, for future reference.

The method for developing this tool draws together three separate evaluation approaches:

1) conservation-directed cost-benefit assessments (e.g. Spindler *et al*. 2008)
2) population viability analysis using Vortex simulation models (see Miller and Lacy 2005)
3) the conservation scorecard (Sanderson *et al*. 2008)

Approach

The value of a site or project for SHO restoration can be separated into two factors: likelihood of success – the likelihood that the project will achieve its aims; and conservation impact – the size of the conservation achievement if the project or site is a success. It is possible for a single site or project to score highly in one category but not in the other, and *vice versa*. For example, a site in prime habitat, within ancestral range and capable of supporting large numbers of oryx, could have a huge conservation impact. However, if the area cannot be sufficiently protected, infrastructure cannot be built, and funds cannot be raised, the site or project will be predisposed to failure – at least until those problems can be resolved. Conversely, a well-funded project in a protected area with good infrastructure might be likely to succeed, but if it can host only a few oryx, in marginal habitat and on the fringes of ancestral range, its conservation impact will be lower and possibly irreversibly so. Understanding and maintaining this distinction is an important element of the evaluation approach proposed.

The best sites or projects will register highly in both categories (see Figure 1. for illustration) and the combined value of these two elements is referred to here as the "Conservation Value" (CV).

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[1] "Site" refers to a physical location or area and its inherent qualities. "Project" indicates the associated plans and activities directed towards restoration. The evaluation tool should be able to assess both.

Quantifying CV in a systematic way allows projects to be ranked, transparently, in order of priority. Further, where funds are being allocated, it allows consideration of Conservation Value per unit cost, as described below:

Conservation Value of Site X:

$$CV_x = (S_x)(I_x)$$

Or, Conservation Value per unit cost:

$$CV_x = \frac{(S_x)(I_x)}{C_x}$$

Where:

CV = Conservation Value; S = Likelihood of site/project being successful; I = Size of conservation impact in the case of success; C = Cost.

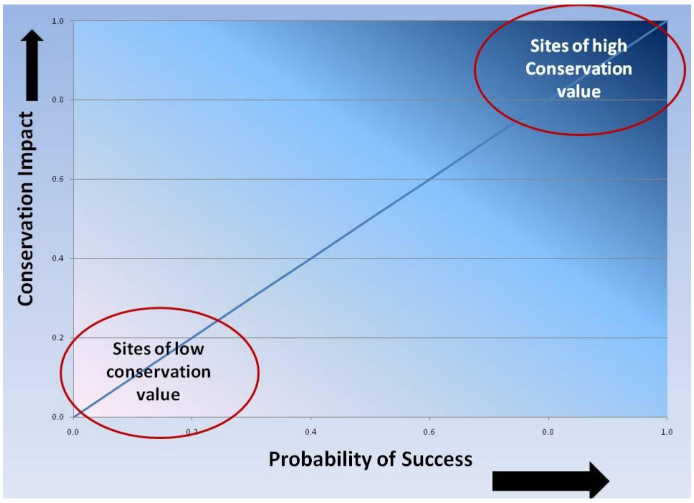


Figure 1. Evaluation concept – highest "conservation value" is achieved where both likelihood of success and conservation impact are high.

The steps involved in assembling these equations are described in the following sections.
Key to this approach is a clear separation of evaluation criteria into those which are pre-requisites for success and those which add value to the conservation impact of the project.

Evaluation Criteria I: Pre-requisites for Success

Pre-requisites are defined in this instance as:

"Characteristics which, if entirely absent from a project, will predispose it to failure".

Pre-requisites include socio-political and socio-economic factors that might make it impossible to secure a site, or to progress a project adequately. Factors of this type were discussed at SHO I and developed subsequently to form a basis for discussion at SHO II:

Draft pre-requisites for SHO restoration (from J. Newby):

- Adequate, suitable habitat.
- Resolution of factors leading to initial extinction.
- Capacity to implement, manage and supervise the operation.
- Infrastructure to implement and manage the operation.
- Adequate funding.
- Favourable legislative framework.
- Monitoring capacity.
- Existence of technical support.
- Local incentives/benefits.
- National recovery strategy in place.

- Favourable security situation.

Importantly these are defined here as pre-requisites – that is, they must all be in place to the required degree, for a project to have a chance of success. To reflect this numerically, a scoring system can be devised which takes account of the relative priority of the agreed criteria. Scores allocated to a site based on its performance against the criteria are multiplied together to provide the total "Likelihood of Success" value (S_x). Therefore, *if a project scores zero on any one of these criteria (indicating absence or an inadequate quantity of that attribute), the site or project's overall score is also zero.*

Evaluation criteria II: conservation impact

These are defined for this purpose as:

"Characteristics which add value to a site or project in terms of its potential contribution to pre-defined conservation goals".

"Conservation Impact" could be measured in a variety of ways. In relation to North American bison recovery, Sanderson et al. 2008 measured it in terms of the contribution made to an agreed long-term vision for the species in the wild. The same approach is taken here.

A 50-year vision for scimitar-horned oryx in the wild was developed by participants at SHO I. Following Sanderson et al. 2008, this vision can be deconstructed into its components parts. For example, the SHO vision encompasses themes such as ancestral range, recovering migratory behaviour and restoring cultural connections; these can form the basis for detailed Conservation Impact criteria.

Unlike the *Pre-requisites*, *Conservation Impact* scores are added together to produce the overall value (I_x). Consequently, only where a site/project scores zero for all *Conservation Impact* criteria does the total site/project score also become zero. Note that achieving any score at all therefore relies on all of the *Pre-requisites* being met and the attainment of a score greater than zero for at least one of the *Conservation Impact* criteria.

Evaluation Criteria III: Population Viability Analysis

The ability of a site to support a viable population of oryx is likely to feature in any list of site or project *Pre-requisites*. Population viability analysis (PVA), typically using simulation modelling tools such as Vortex (see Miller and Lacy 2005), can be an extremely useful tool to assist wildlife population managers in making more informed decisions for effective conservation.

Following the completion of SHO I, population models have been constructed using demographic and genetic data gathered from captive and semi-wild populations (see Modelling Report for details). These models are designed to simulate the behaviour of SHO populations under specific conditions. By modifying the input parameters to reflect the conditions of a particular site or project, the likely suitability of that site for supporting a viable oryx population can be assessed.

It may be useful to consider release projects as having two phases: an establishment phase and a persistence phase. Sites or projects may differ in their suitability for each. For example, a secure, well provisioned site may provide excellent prospects for a population to become established in the

short-term. However, if it can hold only a few animals at capacity then its prospects for sustaining the population in the long-term, without ongoing, intensive management, may be poor. Conversely, a site subject to occasional security breaches and with poor infrastructure for management could struggle during the population establishment phase. On the other hand, if it is ultimately capable of supporting large numbers of animals, then once established, the population could have relatively good prospects for persistence with little or no ongoing management.
Maintaining a distinction between these two components can help clarify the inherent suitability of a site for hosting a release population as well as identifying the areas in which management intervention could improve prospects for success. Creating separate scenarios within the framework of PVA allows managers to explicitly analyze the relative merits of alternative release sites and management strategies that can lead to long-term viability of new populations.

Estimates of the following four components need to be built into a population model to simulate the conditions at a particular site:

1) **Species biology** (assumed to be constant across release projects)
2) **Inherent site qualities**
    a. general level of environmental variability
    b. frequency and severity of catastrophes (e.g. drought, disease)
    c. rate of harvest (due to, e.g. illegal hunting)
    d. carrying capacity of the site
3) **Release strategy (establishment phase) – e.g:**
    a. number of animals to be released and at what interval
    b. sex-ratio and genetic make-up of released animals
    c. soft or hard release (expressed as the resulting impact on expected mortality/reproduction)
4) **Ongoing management (persistence phase) – e.g.**
    a. disease management
    b. supportive feeding/watering
    c. genetic/demographic supplementation
    d. management of herd dynamics (e.g. over-aggression)
    e. culling (e.g. to reduce density and improve herd health)

Once site-specific estimates for these factors have been incorporated into the model, the viability of the resulting simulated population can be summarised in terms of the following metrics:

- probability of extinction
- gene diversity retention
- growth rate

Each project can be scored according to its performance with respect to these characteristics, both during the establishment and persistence phases. More specifically, these characteristics can be scored on a more categorical basis (e.g., High / Medium / Low), with each category corresponding to a given range of quantitative output from the simulation models.

Where projects appear to fail, additional analyses using the models can be used to investigate the impact of changing the release strategy, or the proposed ongoing management regime, to establish what steps could be taken to improve performance.
Details of scimitar-horned oryx models built for SHO II, and the preliminary analyses of these, are provided in the modelling section of this report.

Population Viability scoring would be as for *Pre-requisites*.

Building the Scorecard

Once *Pre-requisites*, *Conservation Impact* and *Population Viability* criteria are established, the "Scorecard" can be built. This is done by exploring the plausible range of characteristics that might be observed during evaluation, categorising them into an appropriate number of categories ranging from inadequate to exceptional, and then weighting the criteria in terms of their relative importance.

Table 1 shows an example of a single criterion from a hypothetical scorecard (modified from Sanderson et al. 2008). Each site or project evaluated should fit into one, and only one, of the categories provided. Standard scores are applied to No contribution, Modest, Good and Exceptional categories, and these scores are weighted by the priority given to the relevant sub-factor.

Table 1. Example of a completed *Scorecard* criterion exploring "Ecological Interactions". Sample scores and weightings are presented for illustration.

Major Factors (criteria)	Sub-factors (sub-criteria)	No contribution (Score 0)	Modest contribution (Score 1)	Good contribution (Score 2)	Exceptional contribution (Score 3)
Ecological interactions	**Natural selection by:** (predation, disease, drought, natural food limitation & mate competition) **[Weighting = *3]**	All selection by humans for production or purpose other than ecological recovery	Some but limited natural selection or management to mimic natural selection (at least 3/5 selection pressures active*)	Most (4/5*) natural selection processes operational. Others managed to mimic nature.	All natural selection processes are present without active human intervention
	Interaction with a suite of native vertebrate species [Weighting = *1]	No native vertebrate species and no plans for restoration of species	Some (10-50%) native vertebrate species present and/or restoration efforts are underway)	Most (50-90%) native vertebrate species present.	All native vertebrate species are represented in the system; no known impairment to intra-specific interactions
	Interaction with ecosystem processes [Weighting = *2]	Herd does not interact in any significant way with ecosystem processes	Herd interacts significantly with ecosystem processes over 10-50% of landscape	Herd interacts significantly with ecosystem processes over 50-90% of landscape	Herd interacts significantly with ecosystem processes over entire landscape

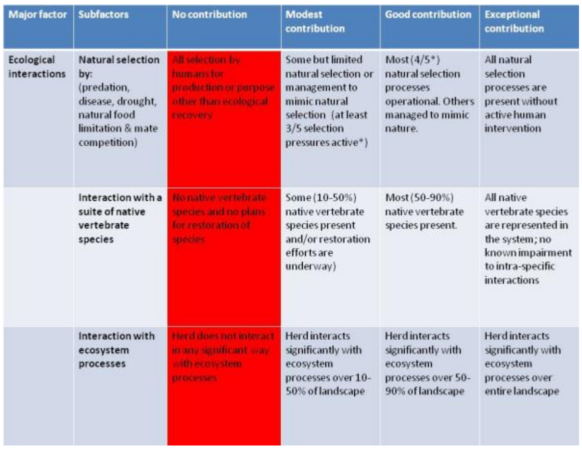
Site or Project Evaluation

The resulting matrix or scorecard can be used in a number of ways, as illustrated below:

Qualitative evaluation

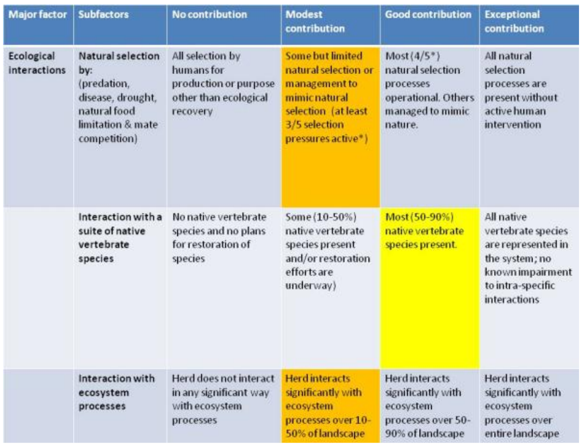
Tables 2a – 2c illustrate qualitative use of the *Scorecard*. This might be useful, for example, for delivering a crude assessment of the strengths and weaknesses of a specific site or project - its likelihood of success, expected conservation impact, and where improvements need to or could be made.

In the example given, the category that best fits the candidate site or project is shaded and colour coded to provide an instant visual impression of site quality or potential.



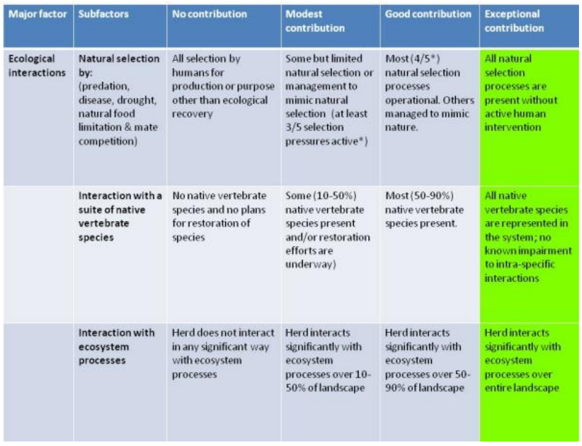
Major factor	Subfactors	No contribution	Modest contribution	Good contribution	Exceptional contribution
Ecological interactions	Natural selection by: (predation, disease, drought, natural food limitation & mate competition)	All selection by humans for production or purpose other than ecological recovery	Some but limited natural selection or management to mimic natural selection (at least 3/5 selection pressures active*)	Most (4/5*) natural selection processes operational. Others managed to mimic nature.	All natural selection processes are present without active human intervention
	Interaction with a suite of native vertebrate species	No native vertebrate species and no plans for restoration of species	Some (10-50%) native vertebrate species present and/or restoration efforts are underway)	Most (50-90%) native vertebrate species present.	All native vertebrate species are represented in the system; no known impairment to intra-specific interactions
	Interaction with ecosystem processes	Herd does not interact in any significant way with ecosystem processes	Herd interacts significantly with ecosystem processes over 10-50% of landscape	Herd interacts significantly with ecosystem processes over 50-90% of landscape	Herd interacts significantly with ecosystem processes over entire landscape

Table 2a. Scorecard representation of an unacceptably poor project with respect to this criterion.



Major factor	Subfactors	No contribution	Modest contribution	Good contribution	Exceptional contribution
Ecological interactions	Natural selection by: (predation, disease, drought, natural food limitation & mate competition)	All selection by humans for production or purpose other than ecological recovery	Some but limited natural selection or management to mimic natural selection (at least 3/5 selection pressures active*)	Most (4/5*) natural selection processes operational. Others managed to mimic nature.	All natural selection processes are present without active human intervention
	Interaction with a suite of native vertebrate species	No native vertebrate species and no plans for restoration of species	Some (10-50%) native vertebrate species present and/or restoration efforts are underway)	Most (50-90%) native vertebrate species present.	All native vertebrate species are represented in the system; no known impairment to intra-specific interactions
	Interaction with ecosystem processes	Herd does not interact in any significant way with ecosystem processes	Herd interacts significantly with ecosystem processes over 10-50% of landscape	Herd interacts significantly with ecosystem processes over 50-90% of landscape	Herd interacts significantly with ecosystem processes over entire landscape

Table 2b. Scorecard representation of a project rating “modest” to “good” with respect to this criterion.



Major factor	Subfactors	No contribution	Modest contribution	Good contribution	Exceptional contribution
Ecological interactions	Natural selection by: (predation, disease, drought, natural food limitation & mate competition)	All selection by humans for production or purpose other than ecological recovery	Some but limited natural selection or management to mimic natural selection (at least 3/5 selection pressures active*)	Most (4/5*) natural selection processes operational. Others managed to mimic nature.	All natural selection processes are present without active human intervention
	Interaction with a suite of native vertebrate species	No native vertebrate species and no plans for restoration of species	Some (10-50%) native vertebrate species present and/or restoration efforts are underway)	Most (50-90%) native vertebrate species present.	All native vertebrate species are represented in the system; no known impairment to intra-specific interactions
	Interaction with ecosystem processes	Herd does not interact in any significant way with ecosystem processes	Herd interacts significantly with ecosystem processes over 10-50% of landscape	Herd interacts significantly with ecosystem processes over 50-90% of landscape	Herd interacts significantly with ecosystem processes over entire landscape

Table 2c. Scorecard representation of an ideal project with respect to this criterion.

Quantitative Evaluation

Table 3 illustrates how the *Scorecard* might be used quantitatively, to rank and prioritise projects for resource allocation. This could be done in-country, within habitat types, or across the entire potential range of SHOs, depending on what is needed. In the example the evaluation is being carried out across several countries and for multiple sites within each.

Table 3. An illustration of quantitative use of the Scorecard. CI = Conservation Impact sub-criteria; PS – Pre-requisite and Population Viability sub-criteria; C = Cost; I and S are the weighted scores for each sub-criterion assessed.

		Criteria						
Country	**Sites**	CI(1)	CI(2)	CI(Tot)	PS(1)	PS(2)	PS(Tot)	C
1	A	I_{A1}	I_{A2}	I_A	S_{A1}	S_{A2}	S_A	C_A
	B	I_{B1}	I_{B2}					C_B
2	C							
	D							
	E							
	F							
3	G							
4	H							
	I							
	J							
	K							
5	L							
	M	I_{M1}						
	N	I_{N1}						C_N

Once this matrix is completed, the Conservation Value of each site can be calculated using the formulae described previously: Conservation Value (CV) of Site X:

$$CV_x = (S_x)(I_x)$$

Or, Conservation Value per unit cost:

$$CV_x = \frac{(S_x)(I_x)}{C_x}$$

Where:

CV = Conservation Value; S = Likelihood of site/project being successful; I = Size of conservation impact in the case of success; C = Cost.

Building the Evaluation Tool

The following steps are involved in building the tool:

Steps:
1. Agreeing the criteria that are pre-requisites for success
2. Agreeing the criteria that confer conservation impact
3. Agreeing the criteria that indicate population viability

4. Establishing a plausible range for these characteristics in the context of potential SHO sites/projects – i.e. best and worst-case scenarios
5. Agreeing where the thresholds lie between (for example) inadequate, modest, good and exceptional.
6. Populating the "Scorecard" with qualitative descriptions of these "states" for each criterion.
7. Assigning a score to each category, and agreeing the relative priorities and, on that basis, the numerical weightings of the sub-criteria considered.
8. Building the evaluation matrix.

Progress made towards the development of this evaluation tool at SHO II is detailed in Section 6.

References

Miller, P.S. and R.C. Lacy. 2005. *Vortex: A Stochastic Simulation of the Extinction Process. Version 9.50 User's Manual*. Apple Valley, MN: Conservation Breeding Specialist Group (SSC/IUCN).

Sanderson, E.W., Redford, K.H., Weber, B., Aune, K., Baldes, D., Berger, J., Carter, D., Curtin, C., Derr, J., Dobrott, S., Fearn, E., Fleener, C., Forrest, S., Gerlach, C., Gates, C., Gross, J.E., Gogan, P., Grasse, S., Hilty, J.A., Jensen, M., Kunkel, K., Lammers, D., List, R., Minkowski, K., Olson, T., Pague, C., Robertson, P.B., and B. Stephenson, 2008. *The Ecological Future of the North American Bison: Conceiving Long-Term, Large-Scale Conservation of Wildlife*. Conservation Biology **22** (2): 252-266

Spindler, R., Banks, C., Foster, W., Possingham, H., West, C., Gipps, J., Dickie, L., Dick, G and O. Byers, 2009. *Measuring and Multiplying our Conservation Effort.* Proceedings of the Australasian Regional Association of Zoological Parks and Aquaria Conference. ARAZPA, Sydney.

Section 5. Population Viability Modelling: A Preliminary Report

Introduction

The Algiers workshop was designed to be the second in a series of three workshops aimed at building a strategy for restoring scimitar-horned oryx (SHO) – currently extinct in the wild – to its ancestral range.

At Workshop I, hosted by Al Ain Wildlife Park and Resort (AWPR) in November 2009, participants explored the question:

> ***"What would it take to establish and maintain a meta-population of scimitar-horned oryx in captivity, semi-captivity and in the wild, as a basis for restoring the species to its ancestral range?"***

This central theme gave rise to many other questions related to the biology and dynamics of small populations. To help address them, CBSG, in consultation with experts in the biology of scimitar-horned oryx, has constructed baseline population simulation models for captive, semi-wild and wild SHO populations. These models can be used to test hypotheses of population dynamics, to clarify priorities for further collection of data on species biology and ecology, and to explore the impact of different types of management interventions on reintroduced oryx populations.

It was intended that the Algeria workshop would provide a forum for refining the wild SHO model for its later use in assessing the suitability of specific release sites. Unfortunately, a number of key people were unable to attend the meeting and so this area of work did not progress as far as originally anticipated. However, progress to date with the models, and the methodology proposed for using population viability analysis (PVA) in this way, are recorded below. Much of this information was presented in plenary during the Algiers workshop.

About *Vortex* Simulation Models

Computer modelling is a valuable and versatile tool for quantitatively assessing risk of decline and extinction of wildlife populations, both free ranging and managed. Complex and interacting factors that influence population persistence and health can be explored, including natural and anthropogenic processes and their impacts. Models can also be used to evaluate the effects of alternative management strategies, to identify the most effective conservation actions for a population or species and to identify research needs. Such an evaluation of population persistence under current and varying conditions is commonly referred to as population viability analysis (PVA).

One of the more common methods for conducting a PVA is through the use of computer simulation models. *Vortex* is a Monte Carlo simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wild or captive small populations. *Vortex* models population dynamics as discrete, sequential events that occur according to defined probabilities. The programme begins by either creating individuals to form the starting population or importing individuals from a studbook database and then stepping through life cycle events (e.g., births, deaths, dispersal, catastrophic events), typically on an annual basis. Events such as breeding success, litter size, sex at birth, and survival are determined based upon designated probabilities that incorporate both demographic stochasticity and annual environmental variation. Consequently, each run (iteration) of the model gives a different result. By running the model hundreds of times, it is possible to examine the probable outcome and range of possibilities. For a more detailed explanation of *Vortex* and its use in population viability analysis, see Lacy (1993, 2000) and Miller and Lacy (2005).

Draft Baseline Model Parameters

The simulation software program *Vortex* (v9.99b) was used to build baseline models for scimitar-horned oryx held under three different management scenarios – captivity, semi-wild (i.e. large but fenced enclosures in range countries) and wild.

Scimitar-horned oryx are currently extinct in the wild. They exist in relatively small numbers under semi-wild conditions in range countries but in relatively large numbers in captivity. As a result, most of the available life-history data for the species has been collected under captive conditions. A captive baseline model was developed in the first instance and subsequently modified for semi-wild and wild situations.

Captive Population Model

The captive baseline model was developed to emulate a healthy, generic captive population in the absence of reproductive controls, for use in testing potential population and meta-population management scenarios.

Number of iterations:	*500*
Number of years:	*100 (about 14 generations)*
Extinction definition:	*Only one sex remains*
Number of populations:	*Single population*
Initial population size (N_0):	*36 (8.28) (at stable age distribution)**
Carrying capacity (K):	*500*

***Current captive populations in Europe, the US and Middle East are considerably larger than this.

These figures are not used in the baseline because *Vortex* assumes that all animals in the initial population are founders, which in this case would overstate the genetic diversity of the population being modelled. The figure used (36) represents, roughly, the founder base of the EEP and SSP populations, configured with a starting sex-ratio of 1 male to 3-4 females, a typical group composition in zoos.

Reproductive Parameters

Mating system: *Polygynous (mean number of mates per successful sire = 2)*

Age of first offspring: *3 years (females); 3 years (males)*
This parameter represents the average age of first reproduction, not the age of sexual maturity or earliest reproductive age observed. Data are from EEP studbook data (female median=3.7, n=132; male median = 3.6, n=129)

Density-dependent reproduction: *No*
VORTEX can model density dependence with an equation that specifies the proportion of adult females that reproduce as a function of the total population size. In addition to including a more typical reduction in breeding in high-density populations, the user can also model an Allee effect: a

decrease in the proportion of females that bread at low population density due, for example, to difficulty in finding mates that are widely dispersed across the landscape. It is possible that density dependence is operating in captivity but this is not currently known.

Percent adult females breeding: *65%* *EV=9.94%*
From 19 years of EEP studbook data. Based on a subset of EEP females for which opportunity to breed was known (see Table 1).

Percent adult males in the breeding pool: 52.6%
In many species, some adult males may be socially restricted from breeding despite being physiologically capable. This can be modelled in *VORTEX* by specifying a portion of the total pool of adult males that may be considered “available” for breeding each year. This parameter value is calculated from EEP population data.

Maximum number of reproductive events per year: *2 (maximum of 1 offspring per event)*
On average and from EEP studbook data, 11% of females have two offspring per year whilst 89% have only one offspring.

Percent males at birth: *50%*
There is no evidence that sex ratio at birth differs statistically from 50:50.

Mortality Parameters

Mortality rates: *Age specific*
Age-specific mortality rates were calculated from studbook data (1995-2007). Variation across years is discounted by that expected from demographic stochasticity to provide an estimate of variation due to environmental factors (EV) (see Tables 3 and 4).

Females (EV)
0-1yrs - 26.64 (5.10)
1-2yrs - 5.97 (0.00)
2-3 yrs - 4.32 (2.58)
Adult (3-13 yrs) - 7.25 (0.38)
Adult (14-17 yrs) - 15.00 (0.038)
Adult (18-19 yrs) - 50.00 (0.038)

Males (EV)
0-1yrs - 33.21 (2.74)
1-2yrs - 13.67 (2.22)
2 - 3 yrs - 7.93 (3.97)
Adult (3 - 10 yrs) - 11.78 (4.26)
Adult (11 - 17 yrs) = 15.00 (4.26)
Adult (18 - 19 yrs) - 50.00 (4.26)

Inbreeding depression: *Yes*
Vortex offers a default of 3.14 lethal equivalents (LE) which are applied as a depression in juvenile survival of inbred individuals. This value is the median LE calculated from studbook data for 38 captive mammal species (Ralls *et al*. 1988). Wilcken (2002) provides an adjustment to this value based on a study of inbreeding impact on life-time survivorship, also using captive data. This increased value is applied here (LE=3.55) though the model applies it only to juvenile survivorship. To emulate inbreeding impact on reproductive output, an equivalent number of LEs is applied to %

females breeding (% females breeding = 65*[E^(-I*0.01775)]). Fifty percent of the lethal equivalents applied to juvenile survivorship are assigned to lethal alleles and are subject to purging.

Concordance between environmental variation in reproduction and survival: *No*
In a captive environment there is no reason to assume that these factors will be linked.

Maximum age: *19 years*
From studbook data. Individuals are removed from the model after they pass the maximum age. *Vortex* assumes that animals can reproduce throughout their adult life unless functions are used to indicate otherwise. In this instance it is assumed that females can breed equally well throughout life, and have no period of reproductive senescence.

Number of catastrophes: *Not included in the baseline captive model*
We assume that catastrophes can be avoided in captivity.

Harvest: *Not included in the captive baseline model*
Supplementation: *Not included in the captive baseline model*

Breeding management: *Static MK; Breed to maintain the population at K*
An individual's mean kinship (MK) value indicates its average degree of relatedness to other individuals in the population. Individuals with low MK values are less related to the population and, therefore, more likely to carry rare alleles. Pairing low MK individuals with each other is a useful strategy for retaining/improving gene diversity. A static MK list is selected here as the dynamic list (which re-calculates values after each selection) made little difference to overall results and runs more slowly. In addition, we activate an option within *Vortex* whereby the program calculates each year the expected number of matings required to bring the population to (but not beyond) the carrying capacity (K). Note that carrying capacity may still not be reached if there are not enough adult females to achieve the required number of matings.

Semi-wild and Wild Population Models

Semi-wild and wild baseline models differ from the captive model in six separate areas:

Social system: Wild and semi-wild models include a long-term polygynous breeding system to indicate that males remain with the same group of females for long periods of time. Under this option, a set of adult females are therefore randomly selected each year to breed with a given male. Pairs that are produced in a given year are then retained in future years until one of the mates dies. In captive situations, management may impose more frequent rotation of males for management purposes; therefore, a simple polygynous system is applied in that case.

Concordance between environmental variation in reproduction and survival:
We assume that this concordance is in effect in the wild population model. This means that environmental variation in reproduction and survival are directly linked, such that 'good' years for reproduction are also 'good' years for survival and vice versa. The semi-wild model does not include this concordance, on the basis that some of the "bad year" effects may be mitigated by management in semi-wild situations.

Reproductive life-span: In the semi-wild and wild models males begin breeding at four years rather than three as it is assumed that they will need to develop some size and experience before gaining the opportunity to breed. In captivity male-male competition can be managed and males are able to breed at the earlier age of three years or even before.

Density dependence: We assume that density dependence is operating in semi-wild and wild situations. In the absence of any data to inform estimates of the size of the effect, the following density dependent modifier is based on 30% females breeding at carrying capacity and 70% breeding at low density, with an Allee parameter = 1 (indicating a lowered % of animals breeding at very low densities as a result of, for example, failure to locate mates) and a steepness parameter = 8, indicating that reproduction reduces only when the population is quite close to carrying capacity, and then does so fairly steeply.

(70-((70-30)*((N/K)^8)))*(N/(1+N))   A=1; B=8

Inbreeding depression: We assume that the effects of inbreeding are reduced in captivity as a result of the low-stress environment and supportive management. O'Grady *et al*. (2006) concluded that 12 lethal equivalents spread across survival and reproduction is a realistic estimate of inbreeding depression for wild populations. Semi-wild conditions are expected to fall somewhere in between those for captive and wild conditions. Therefore, the number of lethal equivalents is set at a value that represents the midpoint of these two conditions.

> *Semi-wild:* LE = 4.775 applied to survivorship and the equivalent applied as the following multiplier to % females breeding - E ^ (-I*0.02389).
>
> *Wild:* 6.0 LEs applied to survivorship and the equivalent applied as the following multiplier to % females breeding - E ^ (-I*0.03)

Input values for captive, semi-wild and wild baseline models are summarised in Table 4.

Table 4. Baseline input values for the *Vortex* baseline scimitar-horned oryx models – shaded rows indicate parameter differences between models.

Parameter	**DRAFT Captive**	**DRAFT Semi-wild**	**DRAFT Wild**
EV Concordance – reprod + survival	No	**Yes**	**Yes**
Breeding system	Polygynous	**LT Polygynous**	**LT Polygynous**
Reproductive lifespan (females)	Ages 3-19 years	Ages 3-19 years	Ages 3-19 years
Reproductive lifespan (males)	Ages 3-19 years	**Ages 4-19 years**	**Ages 4-19 years**
Density dependent reproduction?	No	**Yes**	**Yes**
Adult females breeding/year (EV)	65% (10) Inb. multiplier: E^(-I*0.01775)	**70%** **Inb. multiplier: E^(-I*0.02389)**	**70%** **Inb. multiplier: E^(-I*0.03)**
Males in breeding pool	52.6%	52.6%	52.6%
Maximum litters per year	2	2	2
Maximum litter size	1	1	1
Litter size distribution	89% = 1; 11% = 2	89% = 1; 11% = 2	89% = 1; 11% = 2
Overall offspring sex-ratio	50:50	50:50	50:50
Inbreeding depression **(50% lethal for juvenile mortality)**	3.55 LEs	**4.775 LEs**	**6.0 LEs**
Female % annual mortality (EV)			
0-1 years	26.64 (5.10)	26.64 (5.10)	26.64 (5.10)
1-2 years	5.97 (0.00)	5.97 (0.00)	5.97 (0.00)
2-3 years	4.32 (2.58)	4.32 (2.58)	4.32 (2.58)

Parameter	DRAFT Captive	DRAFT Semi-wild	DRAFT Wild
Adult (3-13 yrs)	7.25 (0.38)	7.25 (0.38)	7.25 (0.38)
Adult (14-17 yrs)	15.00 (0.038)	15.00 (0.038)	15.00 (0.038)
Adult (18-19 yrs)	50.00 (0.038)	50.00 (0.038)	50.00 (0.038)
Male % annual mortality (EV)			
0-1 years	33.21 (2.74)	33.21 (2.74)	33.21 (2.74)
1-2 years	13.67 (2.22)	13.67 (2.22)	13.67 (2.22)
2-3 years	7.93 (3.97)	7.93 (3.97)	7.93 (3.97)
3-4 years	-	**6.83 (6.12)**	**6.83 (6.12)**
Adult (4 - 10 yrs)	11.78 (4.26)	**13.21 (4.26)**	**13.21 (4.26)**
Adult (11 - 17 yrs)	15.00 (4.26)	15.00 (4.26)	15.00 (4.26)
Adult (18 - 19 yrs)	50.00 (4.26)	50.00 (4.26)	50.00 (4.26)
Maximum age	19	19	19
Catastrophe(s)	None	None	None
Capacity	500	500	500
Breeding management	MK (static)	**None**	**None**

Results

Results reported for each modelling scenario include:

$\underline{r_S}$ (SD) – The mean rate of stochastic population growth or decline (standard deviation) demonstrated by the simulated populations, averaged across years and iterations, for all simulated populations that are not extinct. This population growth rate is calculated each year of the simulation, prior to any truncation of the population size due to the population exceeding the carrying capacity.

$\underline{P(E)_{100}}$ – Probability of population extinction after 100 years, determined by the proportion of 500 iterations within that given scenario that have gone extinct within the given time frame. "Extinction" is defined in the *VORTEX* model as the absence of either sex.

$\underline{N_{100}}$ (SD) – Mean (standard deviation) population size at the end of the simulation, averaged across all simulated populations, including those that are extinct.

$\underline{GD_{100}}$ – The gene diversity or expected heterozygosity of the extant populations, expressed as a percent of the initial gene diversity of the population. Fitness of individuals usually declines proportionately with gene diversity.

Baseline Simulation Models

The captive population model shows a growth rate of just under 3% per year (r_S = 0.028) (Table 5). This relatively low growth potential results from the fact that the model imposes a restriction on the number of breeding events in order to maintain the population at carrying capacity. If this restriction is relaxed, the long-term stochastic population growth rate increases significantly to a robust r_S = 0.084 (results not shown below). We believe that this restriction on breeding rates in captivity is a fairly accurate portrayal of general population management techniques, especially when the captive population is at or very near the carrying capacity of the institutions holding the animals. The captive model retains approximately 95% of the original gene diversity present in the founding population, with no risk of population extinction within the timeframe of the model. Semi-wild and wild population models show slightly higher mean stochastic growth rates, again largely due to the fact that, despite the explicit addition of density dependence, the restriction on breeding at high population densities is not as great as we see in the simulated robust captive population.

Model Type	**r_S (SD)**	**$P(E)_{100}$**	**N_{100} (SD)**	**GD_{100}**
Captive	0.028 (0.065)	0.0	481 (16)	0.9491
Semi-wild	0.033 (0.078)	0.0	476 (24)	0.9244
Wild	0.031 (0.077)	0.0	470 (25)	0.9266

Table 5. Summary statistics for the three baseline scimitar-horned oryx models. See text for additional information on model parameters and conditions.

Figure 2 shows 100-year projections of mean population size for each of the three baseline simulation models.

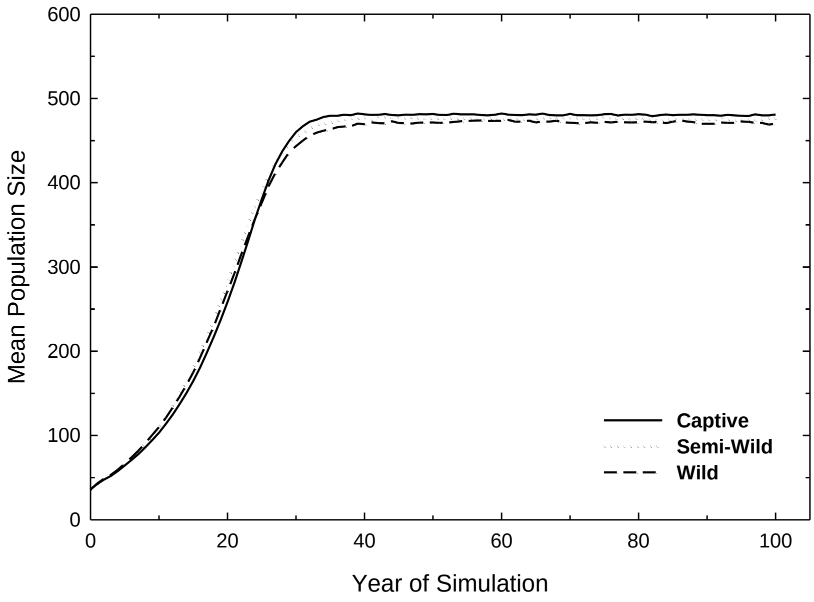


Figure 2. Projections of mean population size for the three baseline models of scimitar-horned oryx population dynamics. See text for additional information on model parameters and structure.

Model Validation

Data on the dynamics of recently-released populations have been collected from sites in Tunisia (Bou-Hedma National Park) and Senegal (Ferlo Nature Reserve). Figure 3 shows a comparison between population growth observed at these sites and growth predicted from the three baseline models discussed in detail in this report. Over the period of observation at these sites, the growth rates predicted from all three scimitar-horned oryx models discussed here are quite similar to those observed in actual oryx populations. Consequently, we believe these existing models form a realistic and solid foundation upon which we can build additional modes for detailed analysis of the potential for alternative sites to maintain viable scimitar-horned oryx populations across the species' ancestral range.

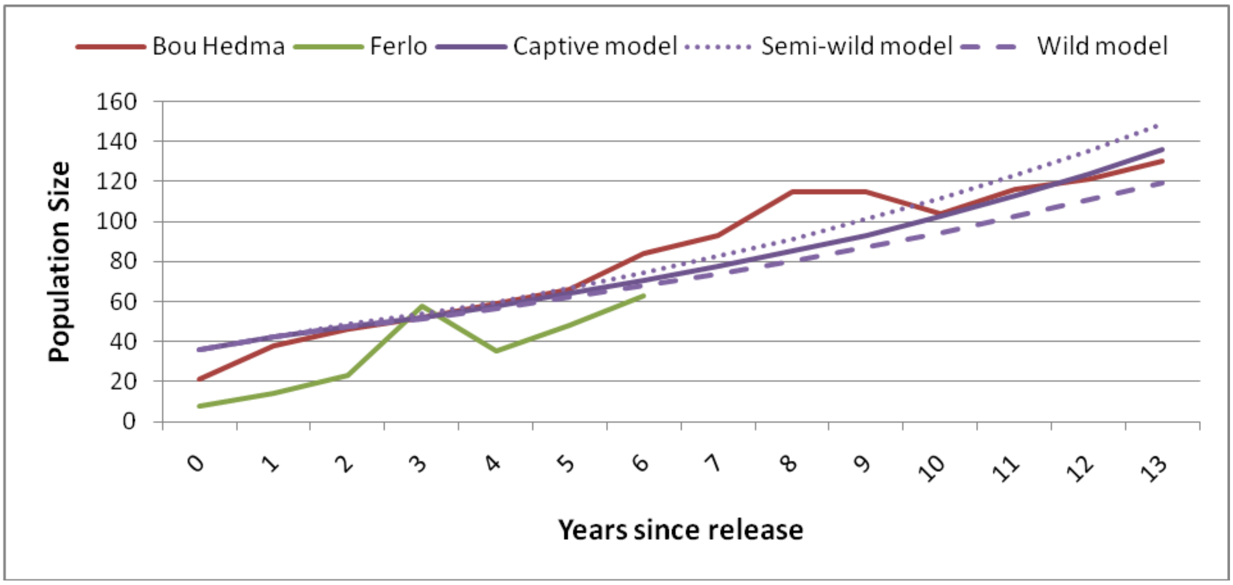


Figure 3. Comparison of population trajectories for simulated scimitar-horned oryx populations in captivity, semi-wild and wild scenarios, against actual population trends for released oryx populations in Tunisia's Bou-Hedma National Park and Senegal's Ferlo Nature Reserve.

Sensitivity Testing

During the development of the baseline input datasets, it quickly became apparent that a number of demographic characteristics of scimitar-horned oryx populations were being estimated with varying levels of uncertainty. This type of measurement uncertainty, which is distinctly different from the annual variability in demographic rates due to extrinsic environmental stochasticity and other factors, impairs our ability to generate precise predictions of population dynamics with any degree of confidence. Nevertheless, an analysis of the sensitivity of our models to this measurement uncertainty can be an invaluable aid in identifying priorities for detailed research and/or management projects targeting specific elements of the species' population biology and ecology.

To conduct this demographic sensitivity analysis, we identify a selected set of parameters from Table XX whose estimate we see as uncertain. We then develop biologically plausible values for these parameters. For this set of parameters listed above we construct multiple simulations, with a given parameter set at its prescribed value, with all other parameters remaining at their baseline value. With the seven parameters identified above, and recognizing that the aggregate set of baseline values constitute our single baseline model, we constructed a total of 19 additional models whose performance (defined in terms of average population growth rate) can be compared to that of our starting baseline model. The entire suite of sensitivity analysis models was based on the captive population model, except that we relaxed the restriction of reducing the number of breeding events that were to take place when the population approaches carrying capacity (see "Baseline Simulation Models" section above). With the restriction relaxed, the baseline model shows a mean stochastic growth rate of $r_S = 0.084$ over the time period of the simulation.

The results of our sensitivity analysis are shown in Table 6 and Figure 4. As is most easily seen in Figure 4, the captive population baseline model shows the greatest level of sensitivity to changes to the percentage of adult females that are expected to breed each year, as changes to this parameter produce the greatest change to the stochastic population growth rate, i.e., the steepest slope. In contrast, changes to oryx longevity or to juvenile male mortality produce small changes in the stochastic growth rate, indicating that the model is rather insensitive to these parameters.

The sensitivity analysis presented here is neither formal nor exhaustive; it is merely a demonstration of the type of analysis that can be performed using the PVA methodologies described in this section. A more formal systematic analysis can be extremely valuable for identifying those parameters which are both poorly known in wild populations and likely to exert a major influence on predicted future population performance, as measured by something like population growth rate, extinction risk, or retention of genetic diversity. The knowledge gained through a formal sensitivity analysis can help species biologists prioritize their future data collection efforts – tackling those parameters identified as contributing the greatest level of sensitivity – and can also help species managers prioritize broad management strategies that focus on sensitive parameters in order to achieve maximum benefit from a given strategy.

Table 6. Results of the sensitivity tests carried out on the captive baseline model. Results highlighted in red show either a greater than zero probability of extinction and/or retention of less than 90% of wild source gene diversity by the end of the 100-year period.

Scenario	r_S (SD)	$P(E)_{100}$	N_{100} (SD)	GD_{100}
Baseline				
SHOC	0.084 (0.050)	0.00	500 (6)	0.9440
Annual % females breeding				
40%	0.006 (0.071)	0.06	122 (117)	0.8329
50%	0.044 (0.052)	0.00	493 (31)	0.9193
60%	0.069 (0.052)	0.00	498 (22)	0.9293
70%	0.092 (0.052)	0.00	500 (7)	0.9346
80%	0.111 (0.053)	0.00	500 (7)	0.9367
Longevity				
15 years	0.066 (0.054)	0.00	499 (8)	0.9156
16 years	0.072 (0.051)	0.00	499 (7)	0.9241
17 years	0.076 (0.050)	0.00	499 (7)	0.9273
18 years	0.079 (0.050)	0.00	499 (6)	0.9302
Juvenile mortality (females)				
15%	0.102 (0.050)	0.00	499 (7)	0.9338
20%	0.093 (0.050)	0.00	499 (7)	0.9332
25%	0.084 (0.050)	0.00	500 (7)	0.9324
30%	0.074 (0.050)	0.00	500 (6)	0.9324
35%	0.065 (0.051)	0.00	498 (8)	0.9318
Juvenile mortality (males)				
25%	0.082 (0.050)	0.00	499 (6)	0.9342
30%	0.081 (0.050)	0.00	499 (7)	0.9329
35%	0.08 (0.050)	0.00	500 (7)	0.9328
40%	0.079 (0.050)	0.00	500 (6)	0.9298
45%	0.079 (0.050)	0.00	499 (7)	0.9276

r_S (SD)	Mean stochastic growth (standard deviation), calculated directly from the observed annual population sizes across the simulations.
$P(E)_{100}$	Probability of population extinction (determined by the proportion of simulated populations that become extinct during the designated 100-year timeframe).
N_{100} (SD)	Mean population size (standard deviation) across all iterations (populations).
GD_{100}	Mean gene diversity (expected heterozygosity) remaining in the extant populations at the end of the simulation.

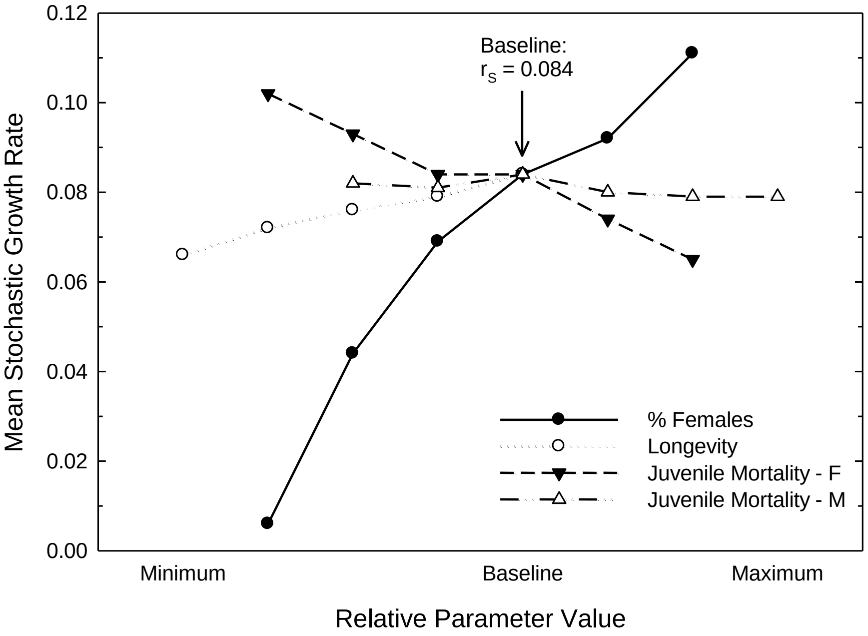


Figure 4. Demographic sensitivity analysis of a generic captive population of scimitar-horned oryx. Those curves with the steepest slope indicate the model parameters with the greatest overall sensitivity. See accompanying text for additional information on model construction.

Future Directions for PVA and Scimitar-Horned Oryx Restoration

As described elsewhere in this report, our goal is to use a variety of tools to assist range country wildlife managers, in collaboration with the international oryx conservation community, in making the best decisions about where and how to restore scimitar-horned oryx to remaining parts of their ancestral range. Predictive modelling using population viability analysis (PVA) techniques is an important component of that decision-making process.

As we move forward in developing a strategic plan for restoring scimitar-horned oryx in Sahelo-Saharan Africa, we need to improve our PVA models to make them as realistic and informative as possible. This is especially true for the semi-wild and wild population models. At the same time, we realize that these models are based on precious little wild population data as the species exists largely in captivity. Consequently, it is important to understand and accept that results from PVA-type analyses must be interpreted in a comparative context, without relying on the absolute results from any one predictive model. This reliance on comparative interpretation of results is necessary because we have rather little confidence in the predictive value of any one model, due to considerable uncertainty about values of individual demographic, genetic, and ecological parameters that collectively define any one modelling scenario. While relying on the results from any one model is difficult at best, a comparative approach to interpreting the results from a suite of scenarios is much more robust. This philosophy is demonstrated in the broad interpretation of the sensitivity analysis results presented in the previous pages. We will continue to use this approach throughout our study of future PVA models that developed in the context of comparative analysis of suitability of alternative sites for oryx restoration.

Throughout our process of analyzing the relative viability of oryx populations that may be restored to candidate sites, we also propose to consider in depth the notion of population establishment versus population persistence, and how these characteristics may interact to determine candidate site suitability. In our preliminary thoughts on this issue, we see the probability of population establishment as being perhaps more closely related to the intrinsic ecological characteristics of the proposed site, and the associated oryx demographic profile conferred by those characteristics. In contrast, the probability of population persistence may be influenced more directly by the intensity of habitat and/or population management imposed by the conservation community. As an example, it may be possible for a site to have high-quality habitat that could allow for relatively strong rates of reproductive success among newly-released oryx, thereby conferring a high probability of population establishment at that site. However, the amount of high-quality habitat may be quite small – so small, in fact, that the long-term prospects for population persistence may be low without significant levels of active population management such as augmentation, intense mitigation of mortality factors, etc. The relative probabilities of establishment and persistence may not be easily estimated without a PVA approach, making this an important tool for evaluating the comparative merits of a number of alternative sites with different characteristics.

Section 6. Building the Evaluation Matrix

The following working groups were convened to progress this:

- ***Working Group 1:*** **Pre-requisites for Success**: Abdoulaye, Djigo, El Mastour, Fellous, Heredia, Faouzi, Monfort, Newby, Laouar.
- ***Working Group 2:*** **Conservation Impact**: Bala, Beudels-Jamar, Ladjouze, Laouar, Mechkour, Medani.

Step 1. Agreeing the criteria that are pre-requisites for success

Criteria agreed in the initial plenary exercise, with their associated prioritisation scores, were as follows: Adequate habitat (10); Sensitisation of the local population (6); National Strategy (5); Extinction factors are controlled (4); Finances are adequate (4); Adequate monitoring/management capacity (4); Adequate human resources (2) ; Appropriate legislative framework (2) ; Technical support (external + internal) (2); Presence of economic benefits/incentives (2); Good security situation (2); Cross-sectoral cooperation (2); Transboundary cooperation (2); Adequate infrastructure (1); Satisfactory disease environment (0); Local knowledge/skills are valued (0).

Additional pre-requisites agreed as a result of deconstructing the vision (not prioritised) were as follows: Viable, Protected species (hunting is illegal); Protected areas (exist or are in progress); Harmony with local populations; Recognised economic benefits (by politicians et local populations).

Group 2 took these criteria, separated them into Major Factors and their component Sub-factors and brainstormed any missing elements, to provide the following Pre-requisites for Success:

1. **National strategy to support reintroduction programs:**
    a. Appropriate legislative framework
    b. Trans-boundary cooperation
    c. Incentives (adding value, financial incentives, cultural enhancement etc.) for local people derived directly from reintroduction programs (i.e., tourism etc.)
    d. Incentives for local people (i.e., infrastructure development etc.) not directly related to the reintroduction program
    e. Inter-ministerial cooperation
    f. Outreach and public awareness programs
    g. Concerted action plans to guide programs
    h. Capture knowledge from local indigenous people
    i. Interface effectively with local populations

2. **Adequate habitat to support reintroduced populations:**
    a. Appropriate for supporting the ecological and life history requirements of the species
    b. Permit species to exist without disturbance factors (roads, human disturbance). This does not necessarily mean this should be “protected area”
    c. Control environmental factors responsible for extinction (human-induced and natural)
    d. Security for people within the reintroduction habitats (i.e., civil conflicts, bandits etc.)
    e. Protection schemes for animals within reintroduction sites (i.e., protected area management strategies)

3. **Adequate capacity to support reintroduction programs:**
    a. Infrastructure
    b. Financing
    c. Human resources
    d. Material resources
    e. Technical support
    f. Monitoring and management
    g. Animal health and disease surveillance programs

4. **Population viability:**
    a. Appropriate sex ratios, genetic diversity and demography to maximize long-term population viability post-reintroduction

Step 2. Agreeing the criteria that confer conservation impact

Criteria agreed in plenary as a result of deconstructing the VISION : Free-ranging; A mosaic of interconnected habitats; Ancestral range; Restoring pride; Cultural heritage; Economic value; Ecosystem value.

Group 1 took these criteria, separated them into Major Factors and their component Subfactors and brainstormed any missing elements, to provide the following criteria for assessing Conservation Impact:

1. A mosaic of suitable habitats
  a. Historical distribution (extent to which sites fall within the known historical distribution)
  b. Inter-connectivity (distance to other potential sites – connectivity lessened by desertification, overgrazing and agricultural pressure)
  c. Availability of seasonal pasture

2. Free-ranging populations
  a. Captivity (as a preliminary stage to release)
  b. Semi-captivity (can be either a preliminary step of a goal in itself)
  c. Free-ranging populations

3. Cultural heritage
  a. Public access
  b. Reinforcement of local culture and knowledge

5. Ecosystem function
  a. Ecological interaction of SHO with its habitat
  b. Interaction of SHO with an array of native species

Step 3. Agreeing the criteria that indicate population viability

This could not be explored in detail as originally intended. Logistical difficulties prevented the attendance of one of the CBSG workshop facilitators and activities were down-sized to take account of this. However, the topic was presented, discussed briefly, and some suggestions made about how to proceed. It was agreed that work would continue along the lines proposed, after the workshop.

Step 4. Prioritising or weighting criteria as appropriate

Only preliminary prioritisation was achieved during the workshop, for the Pre-requisites. Further work is required to provide meaningful priorities and to agree the degree of weighting for those.

Step 5. Establishing plausible ranges

In order to complete the "Scorecard" it is necessary to build an understanding of the spectrum of site qualities or situations that the evaluation process could be required to consider. To help assemble this information, Group 2 was asked to describe, against each sub-factor, the current situation or range of situations, in each of the Range States represented. Similarly, Group 1 was asked to describe, against each sub-factor, the current situation on the ground at each of the sample sites. The results are summarised in the following tables.

Table 7. Plausible Ranges for Pre-requisites

Major Factor	Sub-factor	Range of characteristics in the cases studied.	Best and Worst Scenarios	Notes
Pre-requisites		**A=Algeria, C=Chad, M=Morocco, N=Niger, S=Senegal, T=Tunisia**		
National Strategy (Long term national strategy addressing the elements described).	**Legal Framework**	SHO is a Protected Species by law in all 6 countries represented. Protected Area (PA) laws are either in place in former SHO habitat or are currently being adopted (A).	Best: both levels are in place and functioning well. Worst: no legal protection for the species or for areas of key habitat.	JN - Favourable legislative framework, including functioning protected areas where implicated. The legislative framework should protect both the species itself and key areas of habitat.
	Harmony with local people	None of the countries represented felt they had achieved this fully so far. Progress to date includes: • M+T+S are working with communities local to release sites, promoting the connection between SHOs and the local economy. Schemes include: employing local people as wardens, encouraging local providers of commodities (e.g. fodder for the animals) and organising ecotourism through local cooperatives. • Awareness is being raised in relevant local populations through school visits and/or giving talks in the villages (All).	Best: plans for eco-development are functional before the launching of the project and income is being generated. Worst: local people are unhappy with the project and/or against the existence of the protected area and no approach has been formulated to address this.	BH - Local people may be unhappy with the project and/or against the existence of the protected area, e.g. because it makes suitable grazing areas for cattle inaccessible. JN - Presence of local incentives/benefits (national as well as rural) that support the operation in the short, medium and long term. This is most likely to be achieved where the following factors are in place: Economic incentives benefitting local communities – e.g. tourism; compensation for loss e.g. of grazing, employment; incorporation of indigenous knowledge and know-how in project implementation.

Major Factor	Sub-factor	Range of characteristics in the cases studied.	Best and Worst Scenarios	Notes
		- Local knowledge and know-how is being applied in some countries with respect to animal husbandry and management, enclosure size and prevention of predation (M+T).		These were previously listed as separate subfactors.
	Cross-sectoral cooperation	There is cross-sectoral cooperation in all 6 countries represented.	Best: all of the different sectors implicated are involved and there is coordination between them. Worst: there is no cross-sectoral cooperation.	
	Transboundary cooperation	There is currently no transboundary cooperation between Range States with respect to SHO restoration.	Best: a collaborative regional strategy exists which incorporates bi-lateral and/or multi-lateral agreements as needed. Worst: no transboundary initiatives exist.	This is a migratory species naturally moving between Range States. Transboundary cooperation will need to be secured for the success of some projects?
Suitable Habitat	**Ecological and biological requirements**	Current status in regard to this was reported as follows: - Literature reviews aimed at identifying these requirements have been carried out (A, M, N, S, T) or are underway (C). - An inventory of favourable habitats has been compiled (A) - Feasibility studies have been carried out (S, T).	Best: ecosystem is favourable. Worst: habitat is disadvantageous.	JN - Existence of adequate habitat (qualitative/quantitative), including land fit for restoration, using fundamental oryx ecology as a determining factor, and in reference to carrying capacity for medium to long-term population growth. From JN's talk and CMS (2006), fundamental requirements are considered to relate to: 1) Suitable ecological range (taking into account Sahelo-Saharan precipitation range (100-350mm/year) plus areas where arid range (50-100mm/year) overlaps with Atlantic coastal

Major Factor	Sub-factor	Range of characteristics in the cases studied.	Best and Worst Scenarios	Notes
				desert or Saharan mountain systems) 2) Habitat structure and content – presence of appropriate species for shade and food.
	Level of disturbance	Responses varied from low to medium levels of disturbance, though these were not quantified. Roads were considered an important indicator.	Best: the area is well enough protected from disturbance. Worst: the site is not protected from disturbance.	JN's talk on day 3 proposed a threshold population density of < 5 hab/km^2 as suitable for supporting SHO presence.
	Status of extinction factors (excludes natural factors such as drought)	This would be expected to differ between sites within countries, depending on the level of protection applied. In general, extinction factors were not considered to be under control in A, N, S and C and were considered to be somewhat under control in T. For M it was noted that the question needs to be more clearly defined.	Best: factors leading to initial extinction are either resolved or known and managed. Worst: factors remain and protective measures and/or legislation are not enforced.	JN – Need confidence that factors leading to initial extinction are either resolved, known and managed, or calculated as a risk. From CMS (2006), extinction factors are considered to be: *1.Degradation and decline of habitat due to:* • severe droughts (excluded from this criterion assessment but included in the PVA models). • human occupation hampering re-growth following drought • overgrazing of pastures by livestock • displacement by human development into marginal habitat for oryx (e.g. sub-desert zones) *2.Direct exploitation through:* • traditional hunting by nomads • taking by sedentary hunters with traps • hunting with vehicles and firearms • hunting tourism *3. Other threats:*

Major Factor	Sub-factor	Range of characteristics in the cases studied.	Best and Worst Scenarios	Notes
				- extension of livestock herds - multiplication of deep wells - human invasion of remaining habitats
	Protected area status	Protected areas exist around SHO habitat in all countries and others are being created.	Best: is in place Worst: does not exist	
Capacity for restoration initiatives	**Infrastructure for captive management**	This was considered to be in place in all countries though requiring some renovation in C.	Best: exists and is appropriate for the species. Worst: is non-existent.	JN - Presence of adequate (qualitative/quantitative) infrastructure to implement and manage the operation over the long term, including the potential to create such infrastructure.
	Human resources	Human resources are considered sufficient in M and T but require strengthening in N and S and C. Greater specialisation is needed in A and C.	Best: are sufficient to implement, manage and supervise the operation over the long term Worst: there are no dedicated human resources for the project.	JN - Existence of adequate (qualitative/quantitative) capacity to implement, manage and supervise the operation over the long term, including the potential and likelihood of producing such capacity through training, skills development, etc. BH – need to have people at all levels: on the ground for day-to-day work but also veterinary assistance and people in the Administration (Ministries etc.) supporting the project.
	Health monitoring	This does not exist in C (where there are no current projects) and requires strengthening everywhere else.	Best: is in place. Worst: does not exist.	BH – there is a need for specialised expertise to operate effective vaccination programmes and treatment of injuries or trauma where necessary.
	Monitoring and evaluation	All countries expressed their need for this.	Best: system is established and functioning. Worst: non-existent and not planned.	JN - Presence of adequate (qualitative/quantitative) monitoring capacity and monitoring-management feedback loops, and/or the capacity to build such.

Major Factor	Sub-factor	Range of characteristics in the cases studied.	Best and Worst Scenarios	Notes
	Security for fieldworkers	The situation was described as good in A, M, S, C and T, and medium in N. No definitions of these categories were provided.	Best: situation is favourable. Worst: situation is not under control.	JN - Favourable security situation in range state countries to allow for baseline research, project development, implementation, and monitoring to take place. BH notes - In some instances the situation is sufficiently precarious for field teams to require military escort.
	Finance	Finance is sought for projects in N and C. Funding possibilities have been identified for A and in M and T the situation with respect to finance is considered to be medium.	Best: available Worst: not available	JN - Adequate funding to implement and manage the operation over the long term (5-10 years minimum at varying levels).
	Technical support (local and/or external)	All countries expressed their need for this.	Best: sufficient qualified personnel are available and in-country expertise is mobilised. Worst: no technical support is available.	Access to technical support if/when required (*ad hoc* team of experts). Ideally this expertise would be available in-country?
Population Viability	**Likelihood of establishment**			Calculated for individual sites based on PVA modelling.
	Likelihood of persistence			Calculated for individual sites based on PVA modelling.
	Gene diversity retention			Calculated for individual sites based on PVA modelling.
Conservation Impact Criteria		**D=Dghoumes, T=Tassili, S=Souss Massa, F=Ferlo, G=Gadabeji, TS=Termit Sud, O=Ouadi Rhim.**		
Area and herd size	**Area available to SHO**	Not discussed during SHO II		
	Estimated carrying capacity	Not discussed during SHO II		
Habitat Mosaic	**Ancestral range**	All sites are inside ancestral range. No further distinction was made.	Best: SHO re-introduced within its recent range.	**This considers the location of the site with respect to known historical distribution.**

Major Factor	**Sub-factor**	**Range of characteristics in the cases studied.**	**Best and Worst Scenarios**	**Notes**
			Good: reintroduction within Sahelo-Saharan region. Worst: SHO reintroduced to another part of the World (e.g. Australia)	
	Inter-connectivity	This ranged from very poor to poor. More definition of these categories is needed.	Best: several reintroduction nuclei interconnected at regional level. Worst: only one reintroduction site with no potential for dispersal.	**Connectivity between potential release sites is reduced by desertification, overgrazing and agricultural pressure in some areas. This criterion considers the potential for connecting this site to others.**
	Seasonal pasture	• For D, S, F, G, and TS this was recorded as very poor due to either the limited surface area increasing the impact of drought, or intense pressure from livestock and other agriculture. • was recorded as good - large surface area and good extent of suitable habitat. • T was recorded as very good due to the multiplicity of habitats (plateau, oueds, gueltas, piedmonts).	Best: presence of and access to pastures throughout the seasons. Worst: no access to seasonal pastures, and consequent need of supplementary feeding and no possibility of seasonal movements.	SHO habitat typically changes seasonally such that acquiring food year-round requires regular movement between seasonal pastures. Ideal release sites would provide for this.
Free-ranging	**Management of movements**	• The potential for these sites to house intensively managed “captive” animals was considered good for all sites, though some renovation of existing infrastructure would be needed for O. • Like-wise for semi-captive maintenance, though this would require fencing of a core area in G. • Conditions for supporting a free-ranging population were considered	Worst: weak prospect of support for a wild and free-ranging population due to habitat conversion, human development, agriculture, no support from local communities and no activities to help local communities, no infrastructure, insufficient security to allow	Though the long-term vision for SHO is of free-ranging populations, it is recognised that achieving this will require intermediate stages in which movements are controlled to varying degrees. It is also recognised that though some herds may reside permanently under restricted conditions, they can nevertheless play an important role in the survival of the species.

Major Factor	Sub-factor	Range of characteristics in the cases studied.	Best and Worst Scenarios	Notes
		to range from poor (D, S, F, G) through medium (O) to good (TS) and excellent (T). More work is needed on the definitions of these terms.	establishment of captive or semi-captive populations and no prospect of improvement in the medium-term. <u>Medium:</u> modest prospect of establishment of free-ranging population because of habitat conversion. Modest support of local communities. Some infrastructure present. Adequate security and potential for improvement. <u>Good:</u> good infrastructure for reproduction in captivity or semi-captivity, or good prospects for the establishment of free-ranging populations. Good support from local communities and locak authorities. Large expanses of suitable habitat. <u>Excellent:</u> existing very good infrastructure for holding captive and semi-captive populations. Very good prospects for reintroduction of free-ranging populations. Very good support from	

Major Factor	Sub-factor	Range of characteristics in the cases studied.	Best and Worst Scenarios	Notes
			local communities, optimal habitats over very large expanse.	
Cultural Heritage	**Public access**	Conditions range from poor, due to remoteness and difficulty of access (G, TS, O) to medium, where access is restricted (D), to good and excellent, where tourism and therefore access is actively promoted (T).	Best: access open and encouraged. Worst: protected area inaccessible to the public.	It was agreed that cultural heritage would be more likely to be reinforced where people have access to SHOs. This criterion considers the ease of access in this context.
	Reinforcement of local culture and knowledge	Conditions range from poor (O) through medium (TS) to good (S), good and presence of Peuhl culture (F and G) to excellent (T). More work is needed on the definitions of these categories.	Best: local culture stimulated and reinforced. Worst: indigenous knowledge unknown or poorly known and about to be lost.	This was considered of particular relevance to cultures with a known SHO association, such as the Peuhl.
Ecosystem Value	**Interaction with habitat**	Difficult to assess for sites where SHO are absent but recorded as positive at D, S and F.	Best: presence of suitable habitats and potential for extension; productive ecosystem services. Worst: degraded habitats, ecosystem services lost.	This is based on the premise that SHO once played a role in the ecosystem which can usefully be restored. Clarification of its former ecosystem function (if known) and some indicators for measuring restoration of this would be useful if this criterion is to be applied.
	Interaction with native species	Again difficult to assess for sites where SHO are absent, but recorded as very good for D, where a representative array of species is being actively restored and protected, to good at F and S, also due to active protection by area fencing.	Best: optimal restoration of the native species assemblage. Worst: all other native species are extinct.	

A=Algeria, C=Chad, M=Morocco, N=Niger, S=Senegal, T=Tunisia

JN – notes from draft criteria developed by J. Newby and provided as briefing for SHO II

BH – from additional notes provided by B. Heredia from SHO II

Appendix 1: Workshop Participants

Nom et Prénom **Surname & Name**	**Organisme** **Organisation**	**E-mail**
ABDOULAYE Hassane	Direction Faune, Chasse at Aires Protégés/NIGER	hassaneabdoul@yahoo.fr
BALA Aicha	Agence Nationale pour la Conservation de la Nature (A.N.N.)	Aicha.bala@yahoo.fr
Benaziza Sabrina	Fondation SONATRACH-Tassili	louloumery@yahoo.fr
BEUDELS-JAMAR, Roseline	Conservation Biology Unit IRSNB – CMS Scientific Council	Roseline.beudels@naturalsciences.be
BOUCEKKINE Wahida	Direction Générale des Forets, Algeria	Cynegetique2@yahoo.fr
DJIGO Cheikh Ahmed Tidiane	Direction des Parcs Nationaux/Sénégal	ahmedtidiane50@yahoo.fr
EL MASTOUR Abdellah	Haut Commissariat des Eaux et Forets et de la Lutte Contre la Désertification – HCEFLCD, Morocco	elmastourabdellah@yahoo.fr
FELLOUS Amina	Privé/SCF	fellousa2000@yahoo.fr
HADJELOUM Mohammed	Direction Générale des Forets, Algeria	hadjeloum@yahoo.fr
HEREDIA Borja	Convention des Especes Migratrices, Bonn	bheredia@cms.int
KHELIL Mohamed Faouzi	Direction Générale des Forets, Tunisia	Kehlil_Faouzi1@yahoo.fr
LADJOUZE Tarik	Vétérinaire Praticien Consultant Jardin Zoologique du Hamma	tariklad@hotmail.com
LAOUAR Saida	Ministère de l'Aménagement du Territoire et de L'Environnement	saidalaouar@hotmail.com
LEES, Caroline	IUCN/SSC CBSG (Facilitator & Modeller)	caroline@cbsgaustralasia.org
LOULOU	Fondation SONATRACH-Tassili	louloumery@yahoo.fr
MECHKOUR Sihem	Inspectrice Principal en Environnement Membre Active Fondation Déserts du Monde	Sihem_Mechkour@yahoo.fr
MEDANI Sihem	Inspectrice Principal en Environnement Membre Active Fondation Déserts du Monde	Medanisi@yahoo.fr
Ait MESBAH Naima	Ministère de l'Aménagement du Territoire et de l'Environnement, MATE	namesbah@tayahoo.fr
MONFORT Steven	Director, Smithsonian Conservation Biology Institute	monforts@si.edu
NEWBY John	SCF	scf@bluewin.ch
ZEUBOBE BOURTCHIAKBE Sadock	Direction des Parcs Nationaux Reserves de Faune et de la Chasse, Tchad	Zeubobe.sadock@hotmail.fr

Appendix 2: Acronyms and Abbreviations

AWPR	Al Ain Wildlife Park and Resort
CBSG	Conservation Breeding Specialist Group
CMS	Convention on Migratory Species
DPN RFC	Direction des Parcs Nationaux, des Reserves de Faune et de la Chasse
HCEFLCD	Haut Commissariat des Eaux et Forets et de la Lutte Contre la Désertification
MATE	Ministère de l’Améngement du Territoire et de l’Environnement
MEELCD	Ministère de l'Eau, Environnement et Lutte Contre le Désertification
MERH	Ministère de l'Environnement et des Ressources Halieutiques
P.A.	Protected Area
SCF	Sahara Conservation Fund
SHO	Scimitar-horned Oryx

Appendix 3: Working Group Reports

Draft Criteria

The following criteria were drafted by John Newby in preparation for SHO II and were provided as briefing materials:

1. Existence of adequate habitat (qualitative/quantitative), including land fit for restoration, using fundamental oryx ecology as a determining factor, and in reference to carrying capacity for medium to long-term population growth.
2. Confidence that factors leading to initial extinction are either resolved, known and managed, or calculated as a risk.
3. Existence of adequate (qualitative/quantitative) capacity to implement, manage and supervise the operation over the long term, including the potential and likelihood of producing such capacity through training, skills development, etc.
4. Presence of adequate (qualitative/quantitative) infrastructure to implement and manage the operation over the long term, including the potential to create such infrastructure.
5. Adequate funding to implement and manage the operation over the long term (5-10 years minimum at varying levels).
6. Favourable legislative framework, including functioning protected areas where implicated.
7. Presence of adequate (qualitative/quantitative) monitoring capacity and monitoring-management feedback loops, and/or the capacity to build such.
8. Existence of external technical support if/when required (ad hoc team of experts).
9. Presence of local incentives/benefits (national as well as rural) that support the operation in the short, medium and long term.
10. Long term national strategy for the species' (or group of species) conservation and recovery.
11. Favourable security situation in range state countries to allow for baseline research, project development, implementation, and monitoring to take place.

SHO I Vision

The following VISION was developed at SHO I and provided as part of the briefing materials for SHO II.

> **A fifty-year VISION for the international scimitar-horned oryx conservation community:**
>
> ***Viable, secure, free ranging populations of scimitar horned oryx moving through a regional mosaic of interconnected areas, both strictly protected and for multiple use, distributed within ancestral range, in harmony with local people, restoring pride, cultural and natural heritage, economic and ecosystem value.***

Stakeholder Statement

A brainstorming session on the morning of Day 3 identified the following list of actors and roles that should and/or could be mobilised in support of SHO restoration. These ideas were taken and turned into the more general Stakeholder Statement provided in Section 3.

Stakeholders and supporting institutions:

*HCEFLCD (Maroc)

- Ministère des Travaux Publics
- Ministère/Département du Tourisme
- Armée (Transport, logistique)
- Ministère des Finances
- Autorités locales (élus)
- ONGs locales + ONGs Internationales
- Personnes Ressources (Convention inter, experts,…)

*DPN (Sénégal), MEELCD (Niger), MERH (Tchad), DGF (Tunisie), MATE+DGF+Min Culture (Algérie)

- média
- populations locales
- secteur Privé
- instituts de recherche
- communauté des zoos
- vétérinaires
- notables
- bailleurs de fond ?

La communauté de l'Oryx algazelle:

-différents spécialistes
-complémentarité, coopération
-renforcement régional---- MoU CMS

→Sous la base de l'expérience acquise au niveau national

→engagement pris vis-à-vis de la CMS

-Tunisie spécialisé dans l'élevage en semi captivité
-Niger veut s'engager s/ processus de restauration à l'état sauvage

GROUP 1 Report – Conservation Impact

Group Members: Roseline, Saida (MATE), Sihem, Tarik.

1. Consolidating and defining criteria

Major Factors :

1. Mosaic of interconnected areas/habitat
2. Free-ranging
3. Ancestral range
4. Restoring Pride
5. Cultural heritage
6. Economic Value
7. Ecosystem Value

Participants discussed ways in which criteria could be grouped.
The group agreed that Cultural Heritage would be a major factor, with Restoring Pride included in the explanation of this. See tables for final list of criteria.

2. Establishing a plausible range of site characteristics

Note that what follows is only valid if all the pre-requisites are ensured:

	Dghoumes (Tunisie)	Tassili (Algérie)	Souss Massa (Maroc)	Ferlo (Sénégal)	Gadabedji (Niger)	Termit sud (Niger)	Ouadi Rime-Ouadi Achim (Tchad)
A Mosaïc of suitable habitats							
Historical Distribution (all sites are within the known historical distribution)	Good	good	good	good	good	good	good
Inter- connectivity (huge distances between different sites, connectivity lessened by desertification overgrazing and agricultural pressure)	Very poor	poor	Very poor	Very poor	poor	poor	Very poor
Availability of seasonal pasture	Very poor because of very limited surface in case of drought	Very good multiplicity of habitats (plateaux, oueds,gueltas,piedmonts)	Very poor because of very limited surface in case of drought	Very poor because of high pastoral pressure	Very poor because of high pastoral pressure and important competition with livestock	Very poor due to pressure from agriculture	Good, large surface and good extent of suitable habitat
B. Free ranging populations							
Captivity (as a preliminary stage to release)	Good	good	good	good	good	good	Medium : Infrastructures to be rehabilitated

Semi captivity (can be either a preliminary step or a goal in itself	Good	good	good	good	Good (if core area is fenced)	Good	Medium
Free ranging populations	Poor	Excellent	poor	poor	poor	good	medium
C . Cultural heritage							
Public access	medium (acces restricted)	Excellent (tourism)	good	Medium (difficulty of access and remote)	Very poor (difficulty of access and remote)	Very poor (difficulty of access and remote)	Very poor (difficulty of access and remote)
Valorisation of local knowledge	Good	excellent	good	good Peuhl culture	good Peuhl culture	medium	poor
D. Economical value							
Public Access	Poor (restricted Access)	Excellent	Medium with perspectives for improvement	Very poor (important distance and complex logistics)	Very poor (complex logistics)	Very poor (important distance and complex logistics)	Very poor (important distance and complex logistics)
Creation of employment (guides, drivers, guards, craftsmen, researchers, management functions…)	Medium Rangers and daily workers	Very good Guides, drivers, craftsmen.	Good, rangers, daily workers and research station	poor	poor	poor	poor
E. Ecosystem value							
Ecological interaction of SHO with its habitat	Positive		positive	positive			
Restoration of an array of native species	Very good (fencing of 8000		Good	Good within the fenced area			

	ha resulted in good restoration of array of native species						

Extreme Scenarios

	Worst	Medium	Good	Excellent
<u>A mosaic of suitable habitats</u>				
Historical distribution (all sites are within the historical range of the species)	SHO reintroduced in another part of the world (australia)		Within the Sahelo-Saharan region	SHO re-introduced within its recent range
Interconnectivity (huge distances between different sites, potential connectivity lessened through desertification, overgrazing by livestock, and agricultural pressure)	Only one reintroduction site with no potential for dispersion			Several reintroduction nucleus nter connected at regional level
Seasonal pastures	No access to seasonal pastures, and consequent need of supplementary feeding and no possibility of seasonal movements			Presence of and access to pastures throughout the seasons
B free-ranging				
Captivity	Weak support for a wild and free-ranging population due to habitat conversion, human development, agriculture, no support from local communities and no activities to help local communities, no	Modest perspective of establishment of free-ranging population because of habitats conversion. Modest support of local communities. Some	Existence of good infrastructure for reproduction in captivity and semi-captivity, or good perspectives for the establishment of free-ranging populations ; good support from local communities and local authorities ; large expanses of	Existing very good infrastructures to hold captive and semi-captive populations ; very good perspectives for reintroduction of free-ranging populations ; very good support from local communities ; optimal habitats

	infrastructure, insufficient security allowing establishment of captive or semi-captive populations, and no prospects for improvement in the medium-term.	infrastructure present. Adequate security to allow establishment of captive and semi-captive populations. Potential for improvement.	suitable habitats;	over very large expanse
Semi captivity				
Free-ranging				
C. Cultural Heritage				
Public access	Protected area inaccessible for the public			Access open and encouraged
Valorisation of Indigenous knowledge	Indigenous knowledge unknown or poorly known about to be lost			Local culture valorised and stimulated
D. Economic value				
Public access	No economical return if no access			Economical return from international and local tourism, research programs, medias, handicraft…
Job creation (guides,drivers, warden, handicraft artists, resarchers, …)	No job created, no local economical benefits, degradation of living conditions of local communities			Job creation, economical benefits from international and local tourism, research programmes, medias, handicraft, transfer of knowledge
E. Ecosystem value				
Ecological interactions between SHO and its habitats	Degraded habitats , ecosystems services lost			Presence of suitable habitats and potential for extension ; productive ecosystems ser vices
Restoration of the cortege of native species	Extinction of all native species			Optimal restoration of the native species cortege.

GROUP 2 Report – Pre-requisites

Morning Breakout Session -- October 26, 2010

The factors essential (i.e. pre-requisites) for the successful reintroduction of scimitar-horned oryx

Facilitator: Djigo
Reporter: Saida
Recorder: Amina
Timekeeper: Borja

Major factors

1. National strategy to support reintroduction programs
2. Adequate habitat to support reintroduced populations
3. Adequate capacity to support reintroduction programs
4. Population viability

Sub-factors

1. **National strategy to support reintroduction programs:**
    a. Appropriate legislative framework
    b. Trans-boundary cooperation
    c. Incentives (adding value, financial incentives, cultural enhancement etc.) for local people derived directly from reintroduction programs (i.e., tourism etc.)
    d. Incentives for local people (i.e., infrastructure development etc.) not directly related to the reintroduction program
    e. Inter-ministerial cooperation
    f. Outreach and public awareness programs
    g. Concerted action plans to guide programs
    h. Capture knowledge from local indigenous people

i. Interface effectively with local populations

2. **Adequate habitat to support reintroduced populations:**
   j. Appropriate for supporting the ecological and life history requirements of the species
   k. Permit species to exist without disturbance factors (roads, human disturbance). This does not necessarily mean this should be “protected area”
   l. Control environmental factors responsible for extinction (human-induced and natural)
   m. Security for people within the reintroduction habitats (i.e., civil conflicts, bandits etc.)
   n. Protection schemes for animals within reintroduction sites (i.e., protected area management strategies)

3. **Adequate capacity to support reintroduction programs:**
   o. Infrastructure
   p. Financing
   q. Human resources
   r. Material resources
   s. Technical support
   t. Monitoring and management
   u. Animal health and disease surveillance programs

4. **Population viability:**
   v. Appropriate sex ratios, genetic diversity and demography to maximize long-term population viability post-reintroduction

2. Establishing a plausible range of situations

Criterion 1. National Strategy to Support Reintroduction Programmes

SUB-FACTOR	**Algeria 0-25%**	**Morocco 50-75%**	**Niger 50-75%**	**Senegal 25-50%**	**Chad 0-25%**	**Tunisia 50-75%**
Legal framework (PA = Protected Areas)	Protected species. PA law being adopted.	Protected species. PA law enacted. PA already present in former oryx range.	Protected species. PA law enacted. PA already present in former oryx range.	Protected species. PA law enacted. PA already present in former oryx range.	Protected species. PA law enacted. PA already present in former oryx range.	Protected species. PA law enacted. PA already present in former oryx range.
Popular incentives	Not yet.	Yes, some.	Not yet.	Not yet	Not yet	Underway
Harmony with local population	Not yet.	??	Not yet.	Not yet.	Not yet.	Underway
Economic exploitation of the oryx or its habitat	Not yet.	Underway.	Not yet.	Underway	Not yet	Underway
Cross-sectoral cooperation	Yes	Yes	Yes	Yes	Yes	Yes
Transboundary cooperation	No	No	No	No	No	No
Sensitization of local populations	Yes	Yes	Yes	Yes	Yes	Yes
Local know how and knowledge used	No	Yes	No	No	No	Yes
Interface effectively with local populations						

Criterion 2. Adequate Habitat to Support Reintroduced Populations

SUB-FACTOR	Algeria	Morocco	Niger	Senegal	Chad	Tunisia
Ecological & biological requirements of the oryx met	Inventory of favourable habitats underway	Identified	Identified	Identified	Studies underway	Identified
Adequate habitat extent (captive and/or wild??)	Sufficient	Sufficient ?	Sufficient	Sufficient	Sufficient	????
Presence of disturbance factors	Low	???	Low	Medium	Medium	Medium (economic development is more important)
Extinction factors controlled (excludes natural factors, drought, etc.)	No	Needs to be defined	No	No	No	Somewhat
Overall security situation (allowing fieldwork, etc.)	Good	Good	Medium	Good	Good	Good
Habitat protected by protected areas	PAs exist and are being created	PAs exist	PAs exist	PAs exist	PAs exist	PAs exist

Criterion 3. Adequate Capacity for Reintroduction/Restoration Activities

SUB-FACTOR	Algeria	Morocco	Niger	Senegal	Chad	Tunisia
Infrastructure for captive breeding activities	No	Yes	No	Yes	Can be renovated	Yes
Human resources	Specialization needed	Exist	Requires strengthening	Requires strengthening	Requires strengthening and specializing	Exist
Health & veterinary monitoring	Requires Strengthening	Requires strengthening	Requires strengthening	Requires strengthening	No	Requires strengthening
Financements	Possibilities exist	Medium	Sought	Medium	Sought	Medium
Local & external technical support	Needs have been expressed	Needs have been expressed	Needs have been expressed	Needs have been expressed	Needs have been expressed	Needs have been expressed
Monitoring & evaluation programme in place	Needs have been expressed	Needs have been expressed	Needs have been expressed	Needs have been expressed	Needs have been expressed	Needs have been expressed

Criterion 4. Population Viability

SUB-FACTOR	Algeria	Morroco	Niger	Senegal	Chad	Tunisia
Population size & structure	Not done	Not done	Not done	Not done	Not done	Not done
Genetic variability	Not done	Not done	Not done	Not done	Not done	Not done

3. Best and Worst Case Scenarios

Major factors	**Sub-factors**	**Worst case**	**Middle**	**Best case**
National Strategy	Legal framework	- No regulation of protection. - No national strategy	- Regulation exists but no strategy.	- Regulation exists. - Strategy exists.
	Harmony with local people	No approach to this is in place.		- Plans for eco-development are functional before the launching of project. - Income is being generated.
	Cross-sectoral cooperation	None		There is involvement by and coordination between all of the different areas implicated.
	Transboundary cooperation	No initiative		Existence of regional strategy in a context of collaboration (agreements bilateraux and multilateral)
Adequate Habitat	Ecological and biological requirements of the species	Disadvantageous habitats.		Favourable ecosystem.
	Level of disturbance	The site is not protected.		Protected area is established and well enough enforced??
	Status of extinction factors (excludes natural factors such as drought)	The legislation is not applied.		Application of the development plan and management of protected area.
	Protected area status	Non existant	In progress	Existant
Capacity for restoration initiatives	Infrastructure for captive management	Is non-existent.	Exists but needs some adaptation	Exists and is appropriate for the species
	Human resources	Non-existent		Exists or can be reinforced

Major factors	**Sub-factors**	**Worst case**	**Middle**	**Best case**
	Health monitoring	Non –existent		Exists
	Monitoring and evaluation	Not available, non-existent and not planned.		System is set up and functioning.
	Security for fieldworkers	Not controlled		Under control
	Finance	Not available		Available
	Technical support (local and/or external)	There are no human resources	There are personnel but they are not trained	Qualified personnel are available, mobilization of national expertise
Population viability	Population size and structure	Simulation models indicate these are not sufficient.		Simulation models indicate these are sufficient.
	Genetic variability	Is below the required threshold.		Is above the required threshold