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Endangered Species
Rescue:
How far should we go?

Lyncean Group
June 21, 2017
It is hypothesized that 99.99% of all species that ever existed are gone.

Smilodon

Deodicurus armadillo
The rate of extinction up to 1,000 fold in the last few centuries

Pinta Island tortoise

Carolina parakeet
No previous pulse of mass extinction was driven by a single species consciously driving a number of other species extinct.

Quagga

Ivory-billed woodpecker
Why rescue?

To preserve biodiversity!
Biodiversity

Ecosystem biodiversity

Species biodiversity

Genetic biodiversity
Rescue vs De-extinction

Rescue
saving a species from extinction

De-extinction
resurrecting an extinct species
Species selection
Species selection

Are the species desirable — do they hold an important ecological function or are they beloved by humans?

Are the species practical choices — do we have access to tissue that could give us good quality DNA samples or germ cells to reproduce the species?
Causes of extinction

Can the past cause(s) of decline and extinction be identified and addressed?

Can potential current and future cause(s) of decline and extinction be identified and addressed?
Causes of extinction

What are the main causes of extinction in the world today?
Habitat destruction

Causes

Humans

Chemical run off

Oil spills

Natural disasters
Hunting

Legal

Illegal

Poaching

‘Sport’
Global warming

Human activity
Socio-economic considerations

Are the socioeconomic circumstances, community attitudes, and anticipated benefits and costs of the translocation likely to be acceptable for human communities in and around the release area?
Is there an acceptable risk of direct harmful impacts on humans and livelihoods, and indirect impacts on ecosystem services?
Habitat selection

Are the biotic and abiotic needs of the candidate species sufficiently well understood to determine critical dependencies and to provide a basis for release area selection?

Is the proposed translocation compatible with existing policy and legislation?
Exit strategy

Will it be possible to remove or destroy translocated individuals and/or their offspring from the release site or any wider area in the event of unacceptable ecological or socioeconomic impacts?
Zoo contributions

Create and maintain a viable captive population for stocking/replenishing the wild population.

Research: Health, behavior, reproduction, nutrition, reintroduction, monitoring

Financial support
What are the motives of the de-extinction promoters?

- Scientific knowledge
- Profit, fame
- Cuz it’s way cool
- Species needed in the habitat
- Guilt
DeExtinction candidate selection

Preliminary ten-question evaluation

Formalize conservation goal

Detailed evaluation of risks and feasibility

Decision to proceed

Design objectives actions

Implementation

Monitoring

Outcome assessment

Exit strategy

Public attitudes

Perceived conservation benefit

Technical feasibility

Reject

Accept

Re-evaluate

Modified conservation translocation cycle

TRENDS in Ecology & Evolution
extinct in 2000
cloned in 2009
439 cloned embryos
57 transferred
7 pregnancies
1 birth (0.23%)
kid died at 7 minutes
lung malformations

Pyrenean ibex
40,000 year old mammoth discovered in Siberia in 2013. Long fragments of DNA recovered have not found an intact nucleus for cloning. May use fragments to hybridize with elephant DNA.
**In vitro fertilization from frozen sperm**

1. Isolate a viable sperm cell from a frozen mammoth.
2. Fertilize the egg of an elephant with the mammoth sperm.
3. Implant the fertilized egg in a female elephant.
4. The elephant will give birth to a hybrid—genetically half mammoth, half elephant.
5. Backcross hybrids over generations to create an increasingly pure mammoth lineage.

**Cloning from a frozen cell**

1. Isolate the nucleus of a viable mammoth cell from a frozen carcass.
2. Remove the nucleus from the egg of an elephant and replace it with the mammoth nucleus.
3. Chemically or electrically stimulate the cell to begin dividing.
4. Place the egg in the uterus of an elephant.
5. If the pregnancy is successful, the elephant gives birth to a baby mammoth.

**Cloning from sequenced mammoth genome**

2a. Use genetic engineering to build long strands of mammoth DNA.
3a. Organize the strands into chromosomes, each millions of DNA letters long.

Follow the cloning steps above.
WILL A MAMMOTH WALK AGAIN?

The decoding of 70 percent of the mammoth genome in 2008 sparked new hope that the species might be brought back to life. Huge hurdles remain, but new technologies, and the close genetic match between mammoths and living elephants, suggest ways the experiment may one day be accomplished.
Good idea?
“We are losing species at such an incredible rate that we need to act now … to make sure we don’t lose the treasure we already have on this planet.”

“We shouldn’t be obsessed with things that have gone extinct in the past and ignore those that are still here.”

Axel Moehrenschlager
Essential elements of success

Commitment from UAE government (esp. Sheikh Zayed)
Long-term financial resource investment
Successful captive breeding
World wide collaboration
Available habitat
ʻAlalā
“cry like a child”

Hawaiian crow
endemic to the Big Island of Hawaii

favored upland forests 3,000 - 6,000 feet
The Keauhou Bird Conservation Center completed in 1996
Nola

Northern white rhinoceros
Last male Northern white rhinoceros
Najin

One of 2 living female Northern white rhinoceros
One of 2 living female Northern white rhinoceros
Suni

Male Northern white rhinoceros dod 2014
Rewinding the process of mammalian extinction

Joseph Saragusty, Sebastian Diecke, Micha Drukker, Barbara Durrant, Inbar Friedrich Ben-Nun, Cesare Galli, Frank Goritz, Katsuhiko Hayashi, Robert Hermes, Susanne Holtze, Stacey Johnson, Giovanna Lazzari, Pasqualino Loi, Jeanne F. Loring, Keisuke Okita, Marilyn B. Renfree, Steven Seet, Thomas Voracek, Jan Stejskal, Oliver A. Ryder, Thomas B. Hildebrandt
Meeting goals

- Identify, develop, refine, and customize the measures needed to produce a NWR offspring
- Increase the population as fast as possible to remove the immediate extinction risk
- Generate multiple healthy, resilient, demographically and ecologically functional, genetically robust self-sustaining populations
Species?  Subspecies?  Races?

Northern white rhino

Southern white rhino
Prerequisites for rescue and reintroduction

- Cause of (near) extinction known?
- Current and future causes of decline known?
- Species’ needs well known?
- Sufficient habitat in the wild?
- Legal to reintroduce?
- Is a reintroduction acceptable to local human population?
- Is the socio-economic or health risk to humans acceptably low?
- Is there a feasible exit strategy?
Questions related to advanced cellular technologies

Is there a suitable recipient for embryos of the revived species?

Will the recipients model behavior appropriate to the revived species?

Is it possible to produce a sustainable population with sufficient genetic diversity?

Are the epigenetic effects of cellular technologies known (or knowable)?
Greater one-horned rhino
Vulnerable

Black rhino
Critically endangered

Sumatran rhino
Critically endangered

Javan rhino
Critically endangered