



NATURE'S SAFE

Regenerative biobanking for wild and endangered species conservation

Tullis Matson,
Chair and Trustee of Nature's SAFE



My Background

- 🐾 Stallion AI Services
- 🐾 Over 30 years of experience in cryopreservation
- 🐾 Worldwide quarantine centre
- 🐾 Store frozen semen for over 1,500 stallions
- 🐾 Over 1 million equine samples in storage
- 🐾 Sport horses plus rare breeds



- Working with equine semen, in particular rare breed semen, has driven many developments and improvements to protocols and technologies
- We can now transfer that knowledge, experience and expertise to wild and endangered species conservation





NATURE'S SAFE

SAVING ANIMALS FROM EXTINCTION

Charity No 1192876

Our mission at Nature's SAFE

To **S**ave **A**nimals **F**rom **E**xtingtion by collecting, indefinitely storing and regenerating reproductive cells and cell lines from endangered animal species

What is Biobanking?

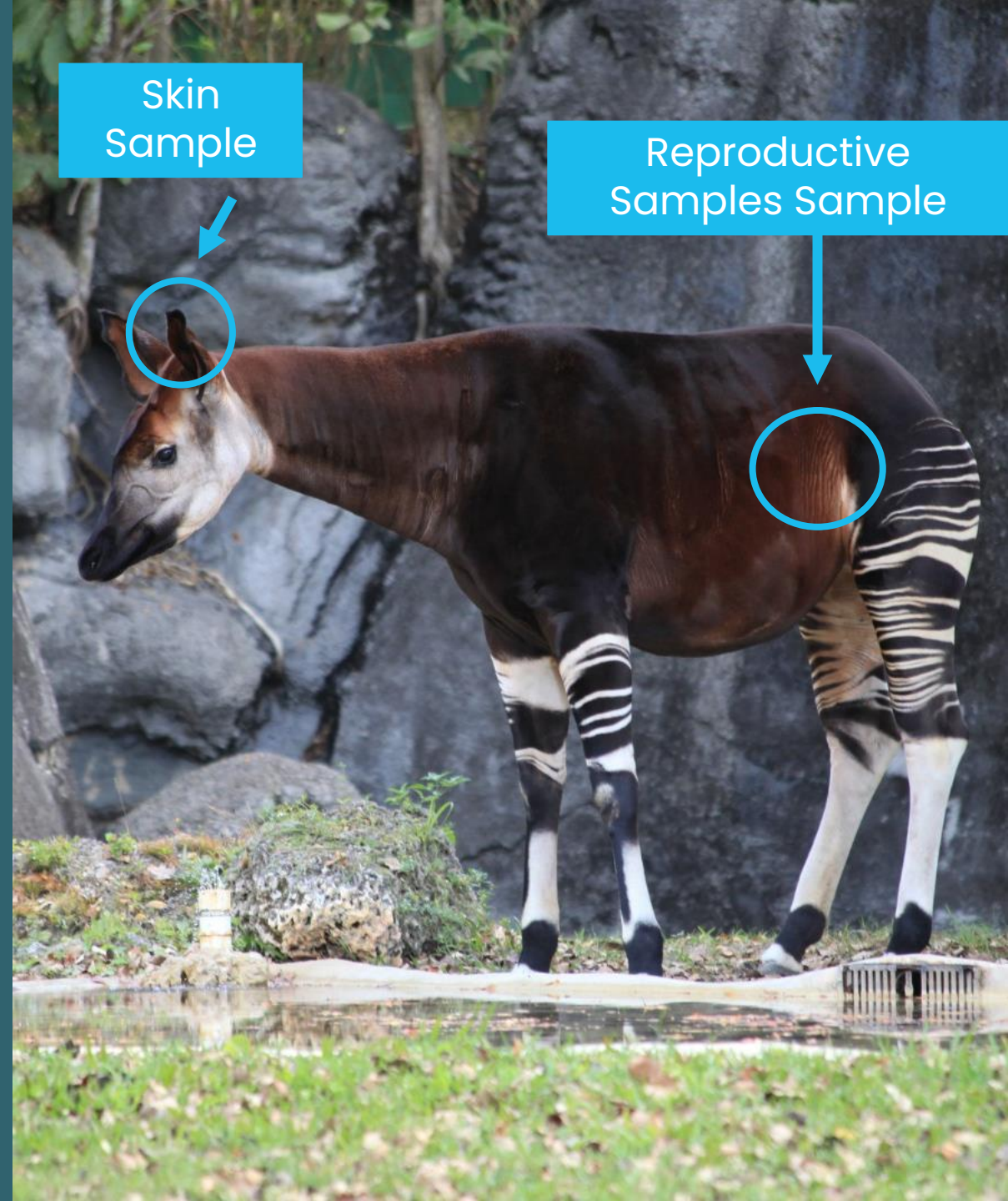
- Collection of biological and genetic material for future use
- Future proofing and future security against the unknown
- Cost effective method of securing species – 90% more cost effective vs. *in situ* conservation measures (*H.D. Blackburn, US Dept Agriculture*)



We also collect several samples per animal

So, we have robust resources for future uses

Reproductive samples plus skin

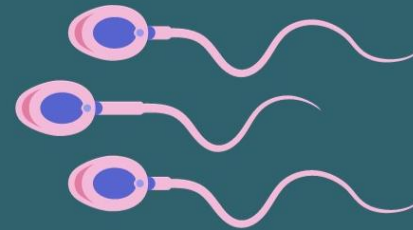


Our Biobanking Model

Multiple sample types

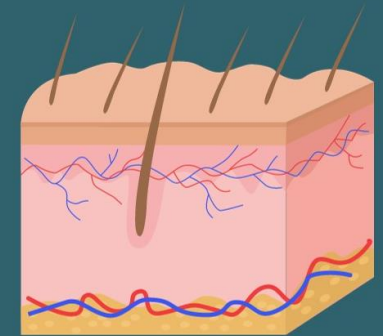


Ovarian & Testicular Tissue



Eggs & Sperm

Regeneration



Skin Samples

- Cryo-conservation
- Preservation of biological resources for conservation purposes
- Retention of a 'living' format
- Ability to regenerate when needed



- 196 Storage



- 80 Storage

Ice Crystal Formation

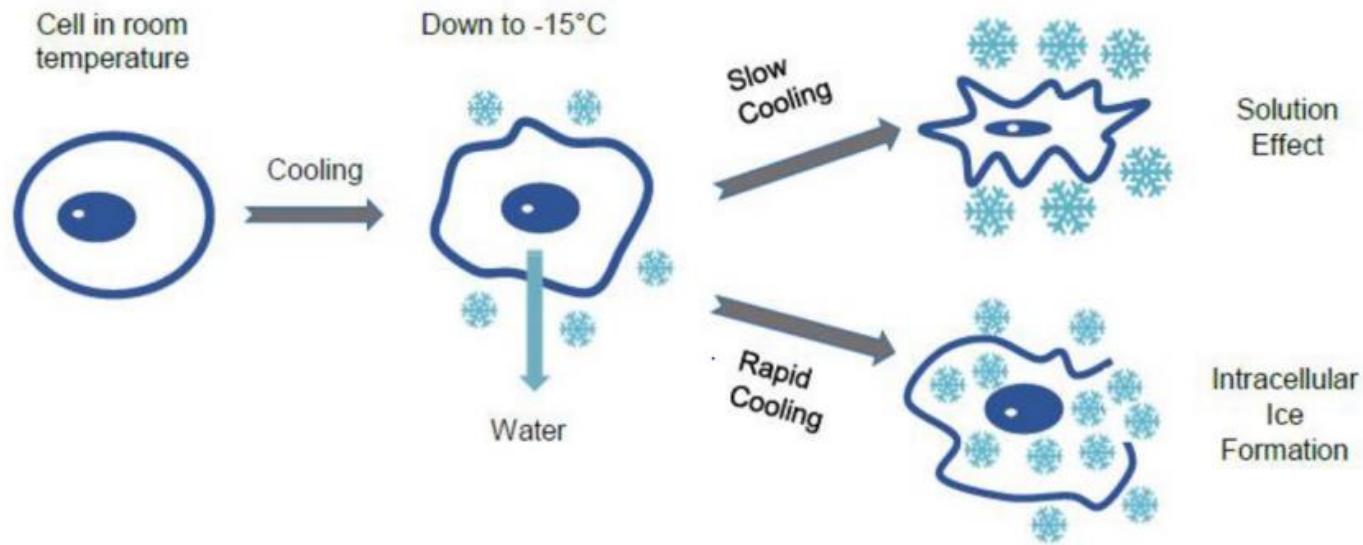
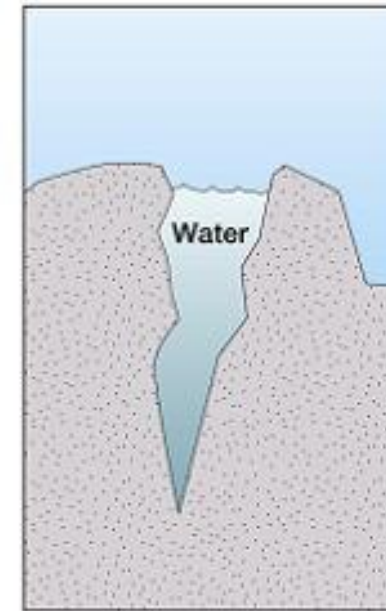
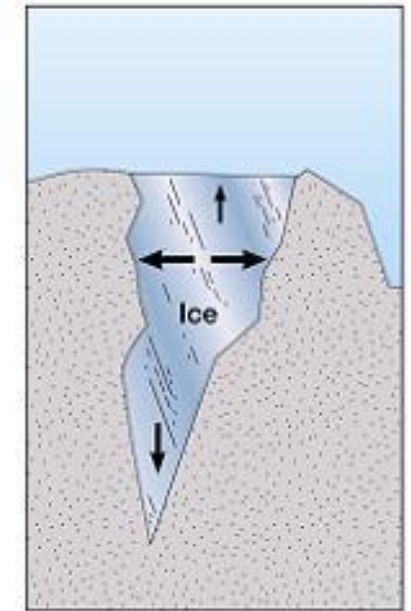


Figure 1. Physical changes in the cells under different cooling rates: slow and rapid.

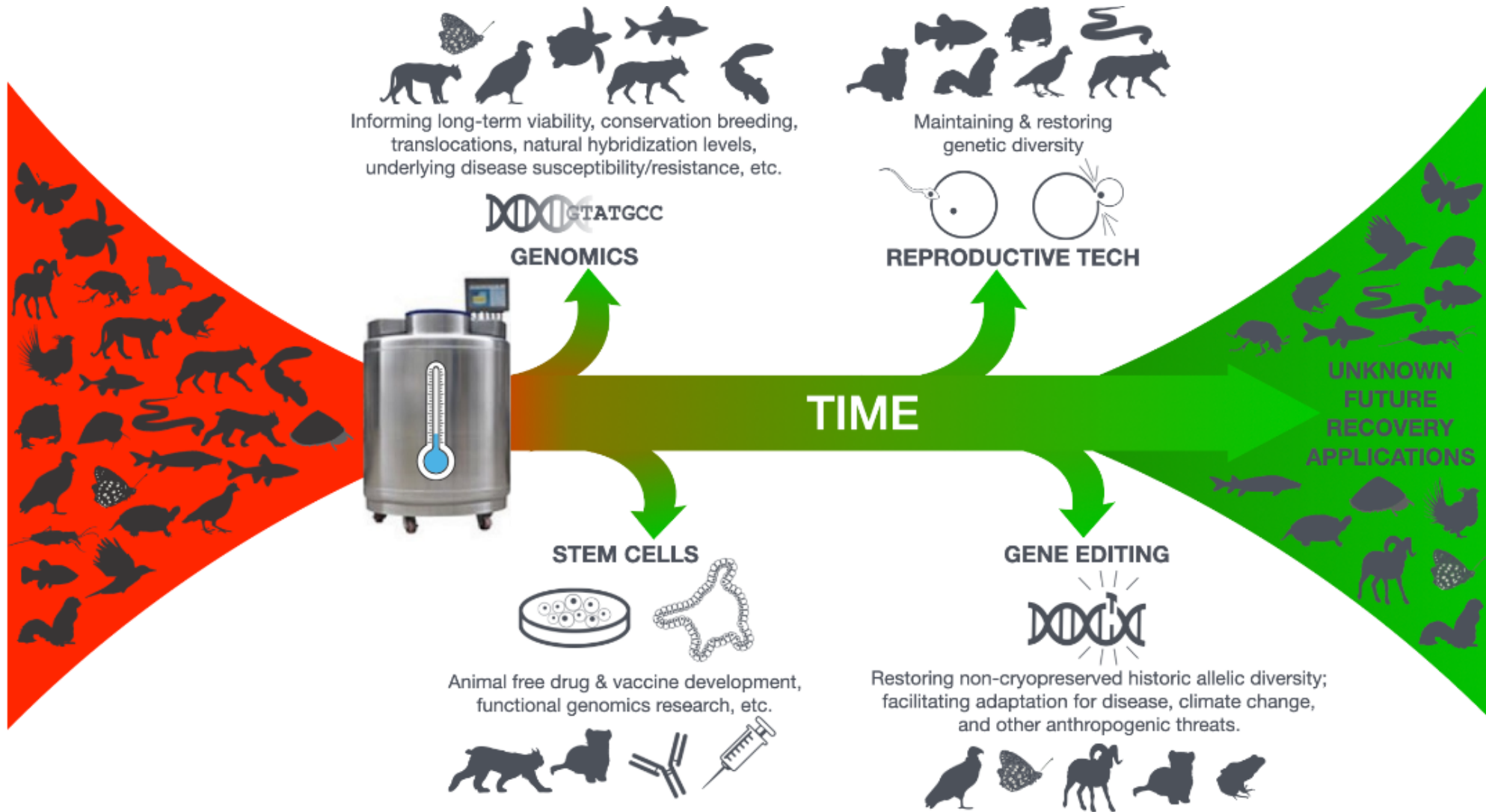


(a)

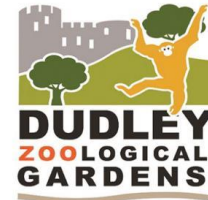


(b)

Informed Biobanking



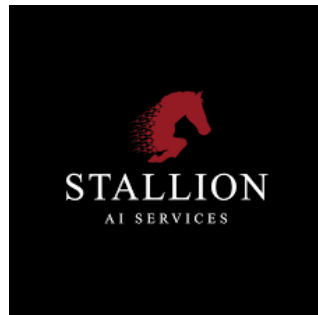
ZOO PARTNERS



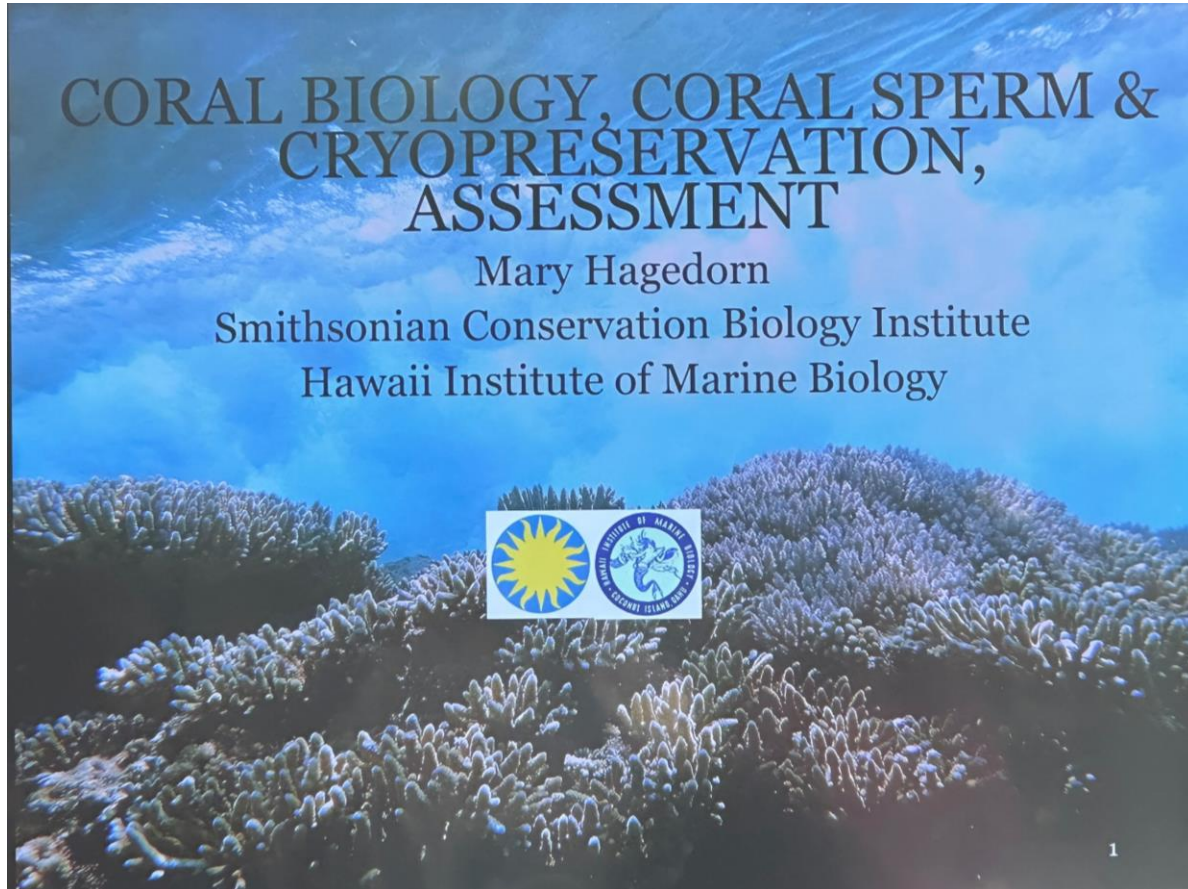
OUR CORPORATE PARTNERS



noblefutures
placing people first



London ZSL and Natural History Museum Event



Lucy Morgan & Tullis Matson attend the Mary Hagedorn cryo workshop on fish and coral cryopreservation

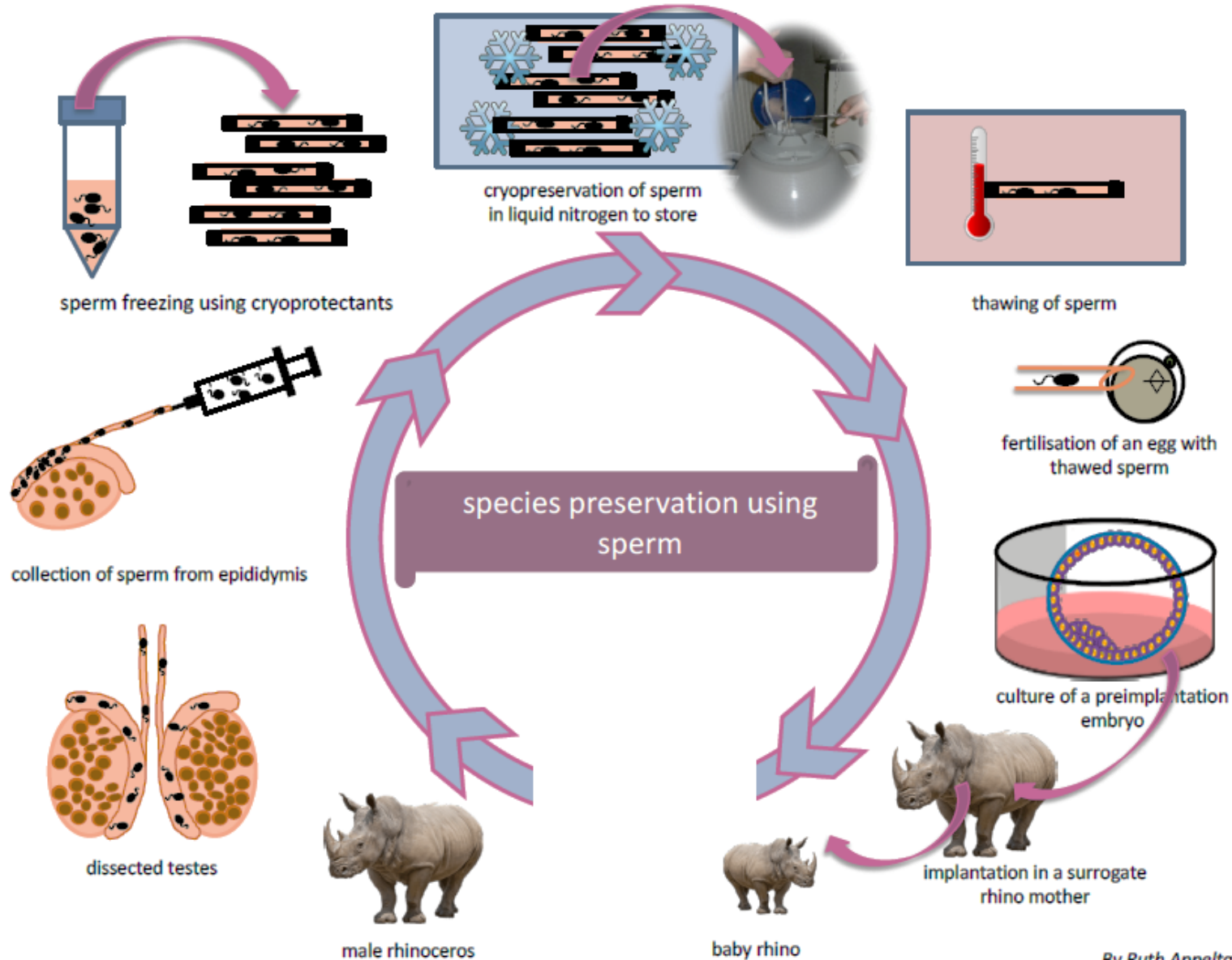


- **OVER 50% of world coral reef cover has been lost since 1950**
- **One of the most threatened animal species**

Post Castration Epididymal Semen



Post Castration Epididymal Semen



By Ruth Appeltant 2020

Rhino for illustration purposes only, techniques applicable to multiple species

Epididymal Semen Harvesting

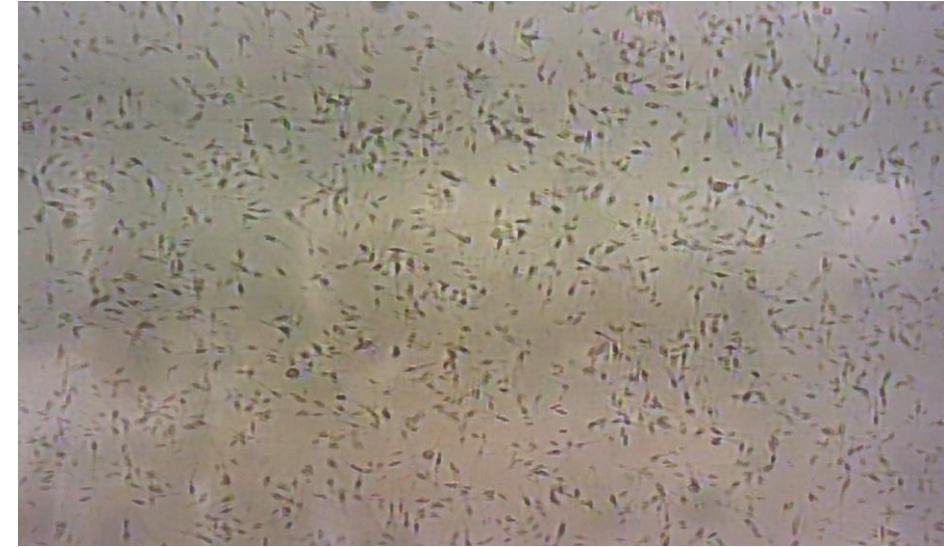
Persian Onagar



29 passed doses



47% post thaw
progressive motility



59% viability

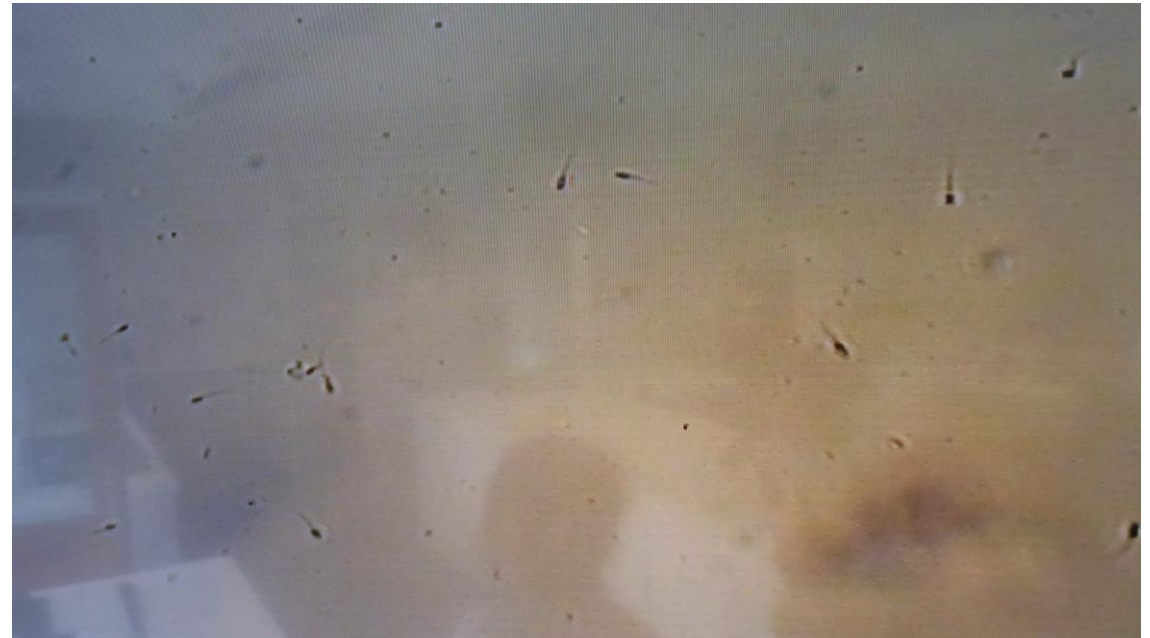
Post Castration Epididymal Semen



👉 Cheetah



👉 6 semen straws

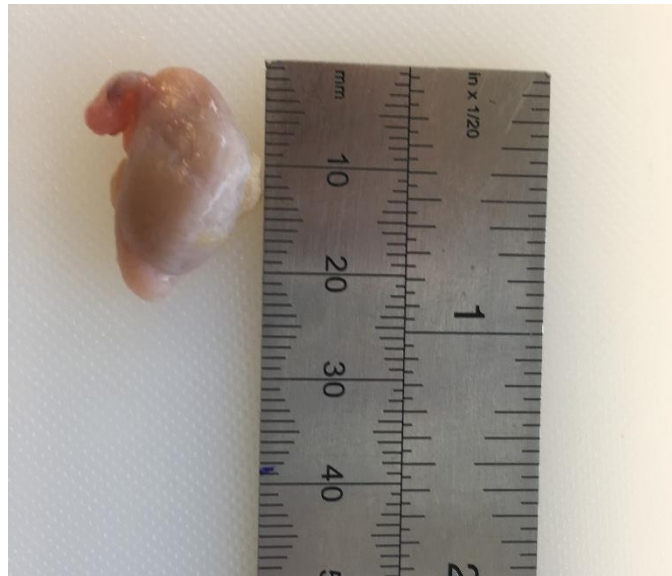


👉 Preserved 18th June 2019

Case Study – Epididymal Semen Harvesting



- Philippine Mouse Deer
- 2 to 5yrs old



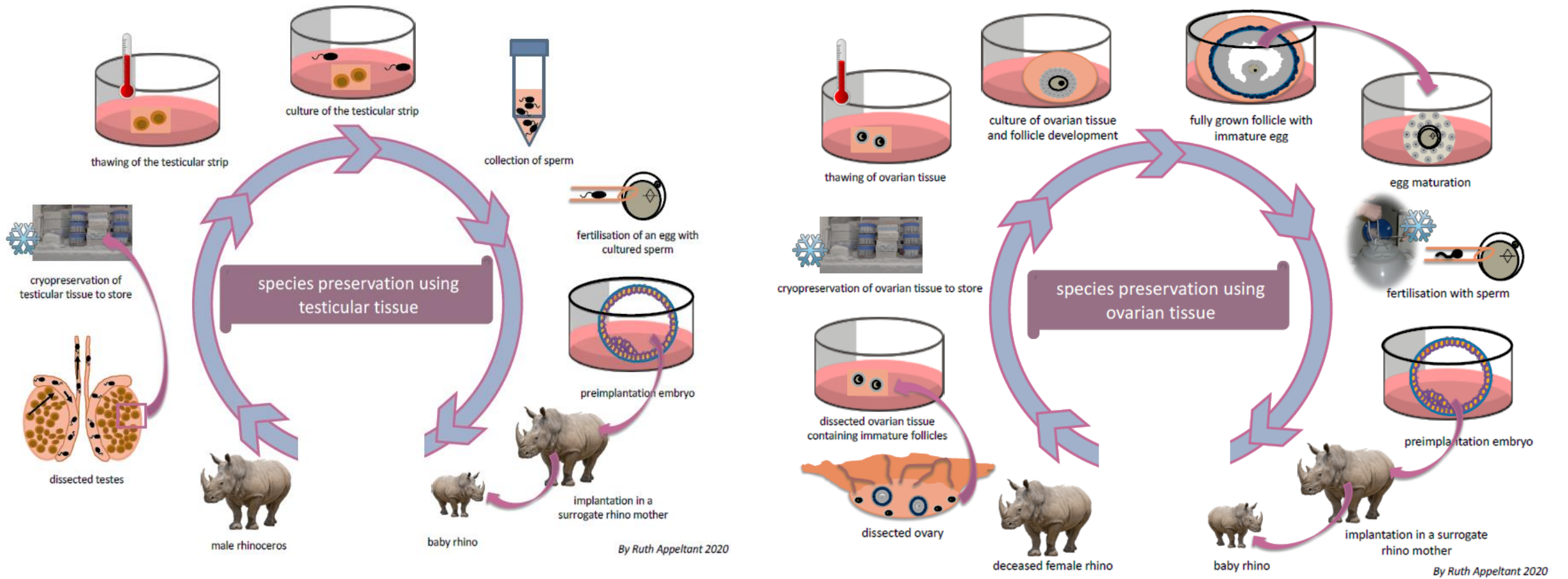
Epididymal Semen Harvesting

- 🔍 Scanning Electron Microscopy
- 🎓 Nottingham Trent University
- 🖥️ 3D visualisation
- 🧠 Increased understanding of sperm & cell membrane structure



Mountain chicken frog sperm cell

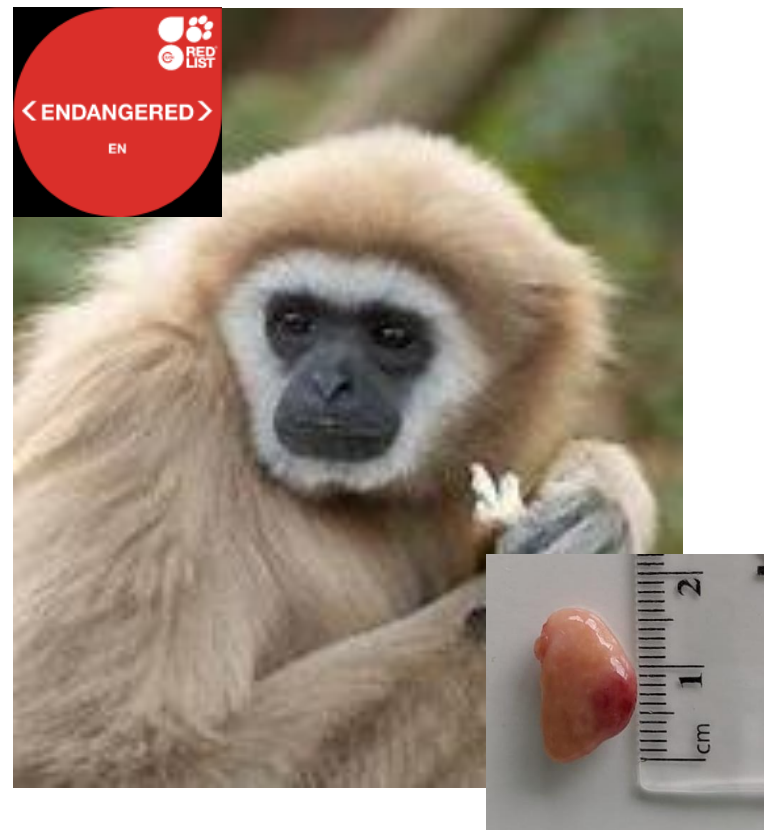
Preservation via Testicular & Ovarian Tissue



Preservation via Ovarian Tissue



⦿ Pied Tamarin

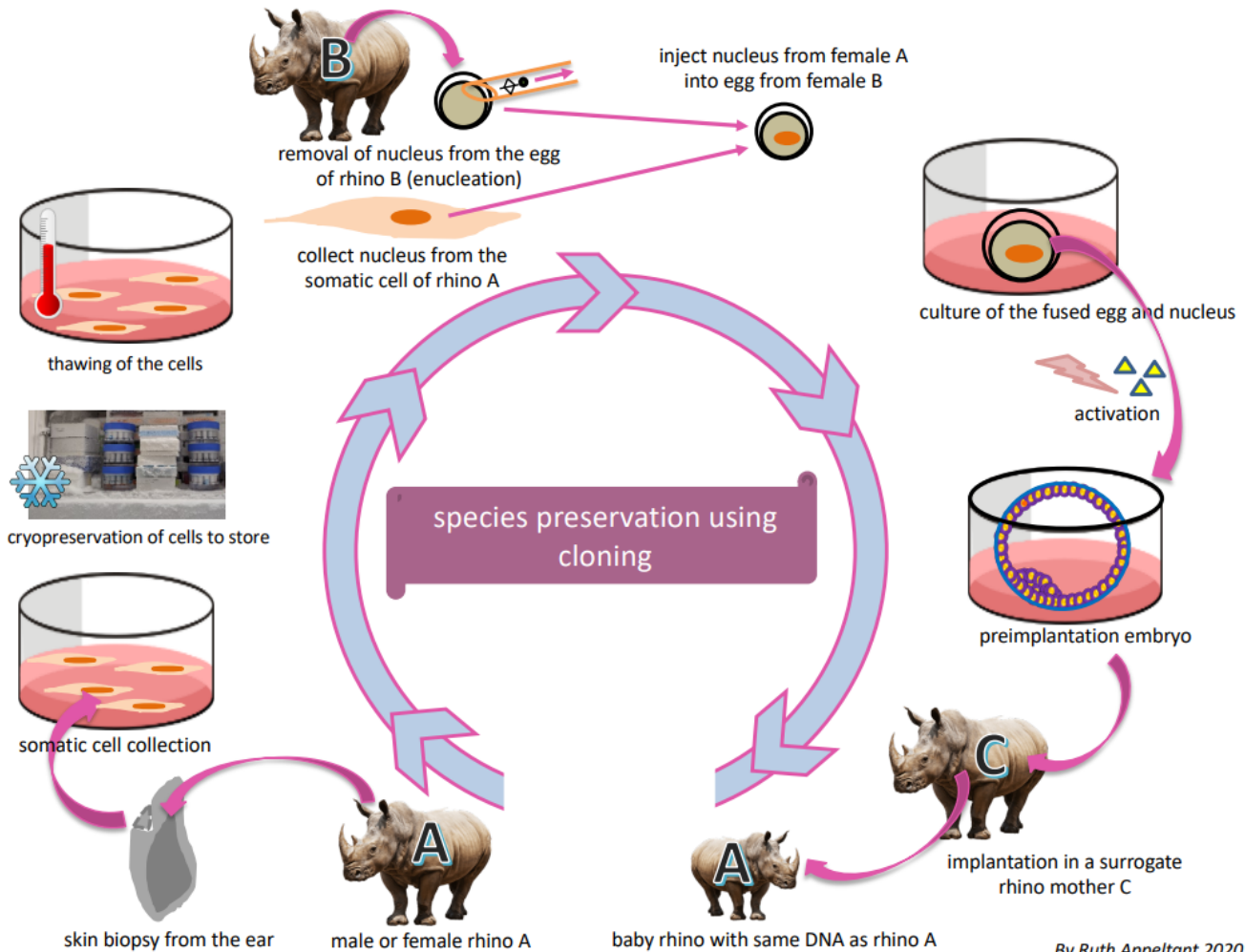


⦿ Lar gibbon

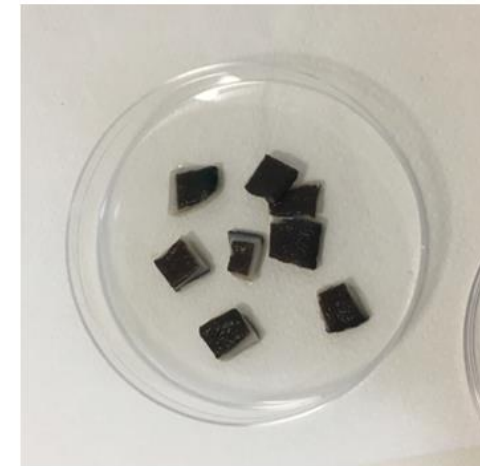


⦿ Cheetah

Preservation Via Skin Samples



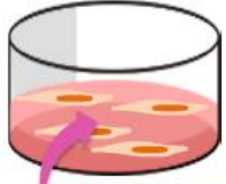
By Ruth Appeltant 2020



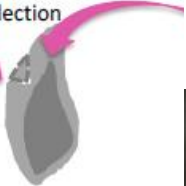
Preservation Via Skin Samples



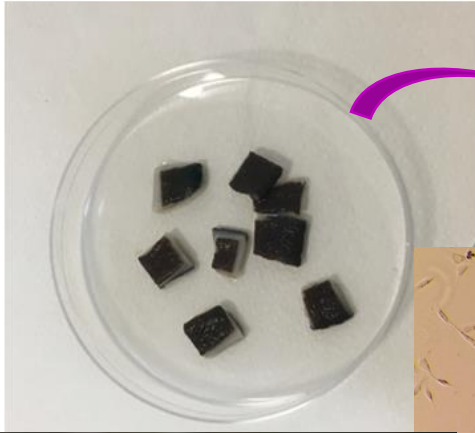
cryopreservation of cells to store



cell collection



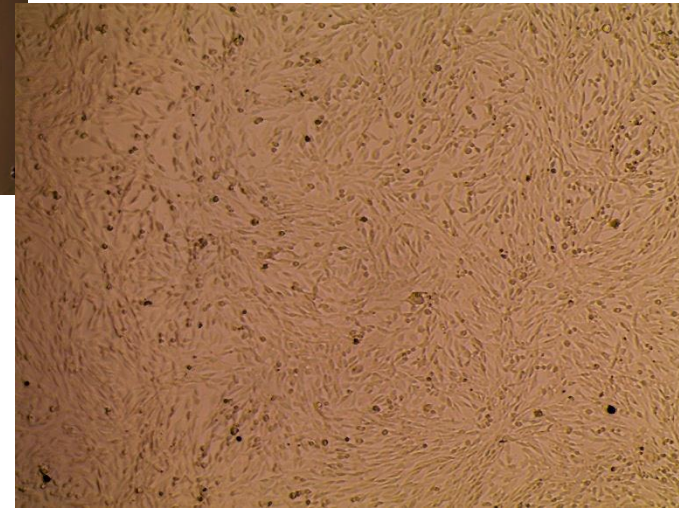
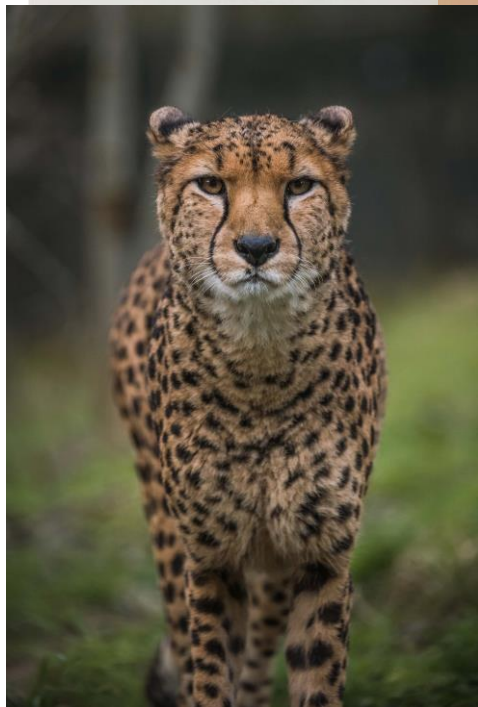
skin biopsy from the ear



These are fibroblast cell lines grown in October from an ear sample cryopreserved in 2019



One vial of skin sample can produce up to six vials of fibroblast cells



Rare Breed Preservation

- ✓ 'We've gone back at least 40 years to create genetic diversity; its as if all the inbreeding of that time can be reset' (Ryan Phelan, Co-founder)

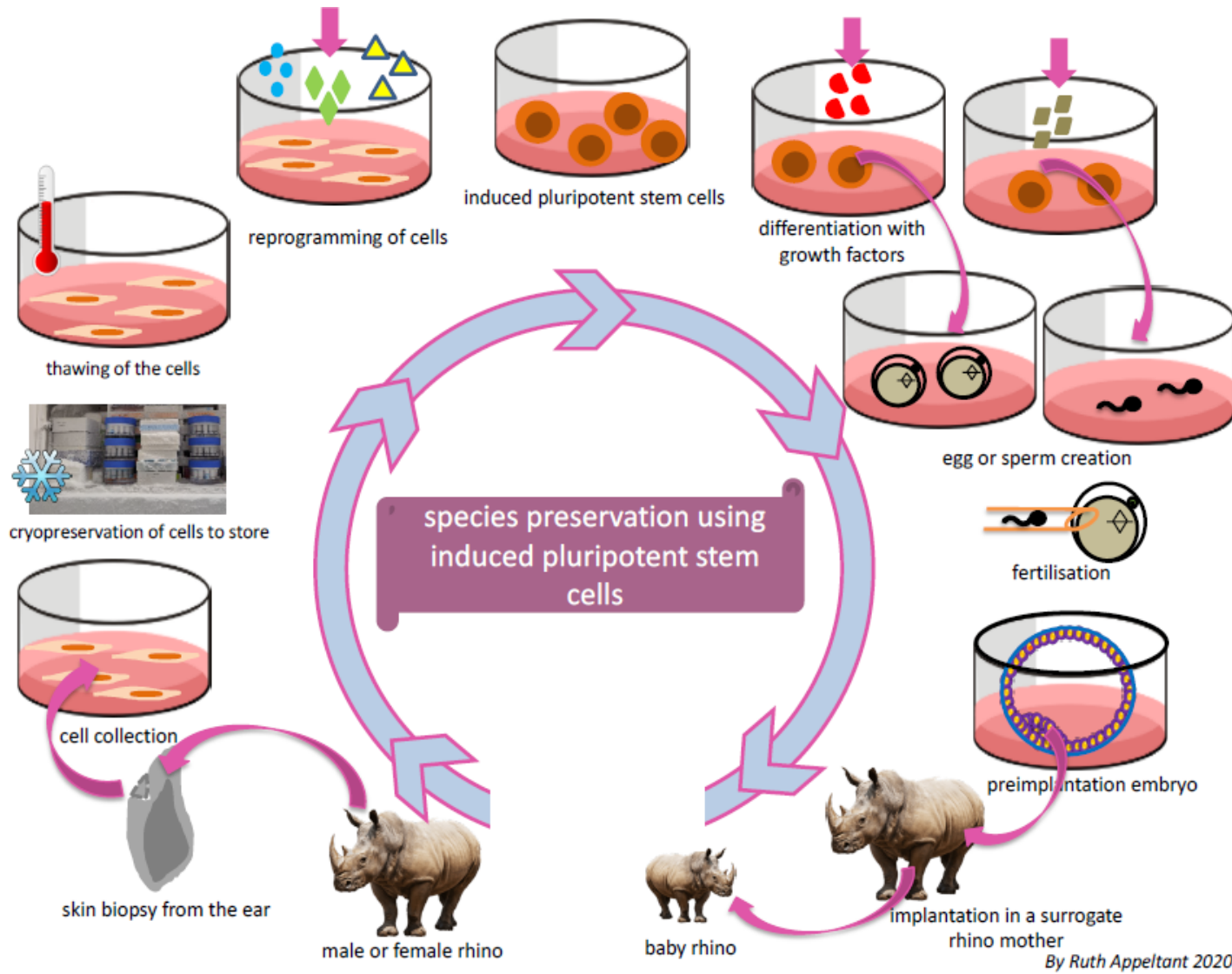


- ⌘ Endangered black-footed ferret
- ⌘ Few founder individuals
- ⌘ Notable disease challenges
- ⌘ Skin samples preserved 30 years ago
- ⌘ Clone born 10th December 2020 to re-introduce genetic diversity to the closed population

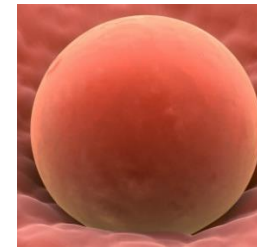


Cloned Black Footed Ferret, Elizabeth Ann,
born 10th Dec 2020

Utilisation of Skin Samples - iPSCs



Skin

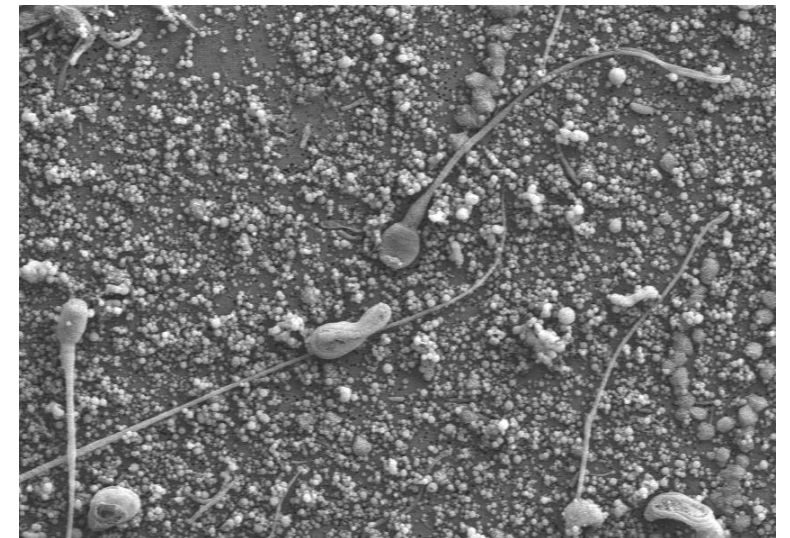


Egg Cells



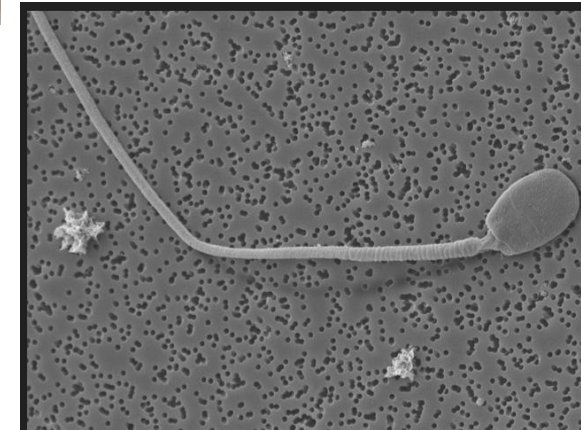
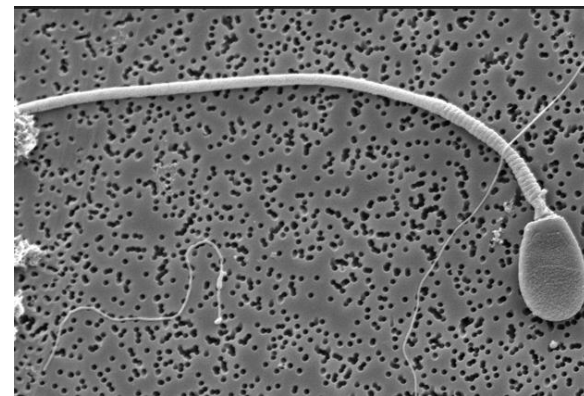
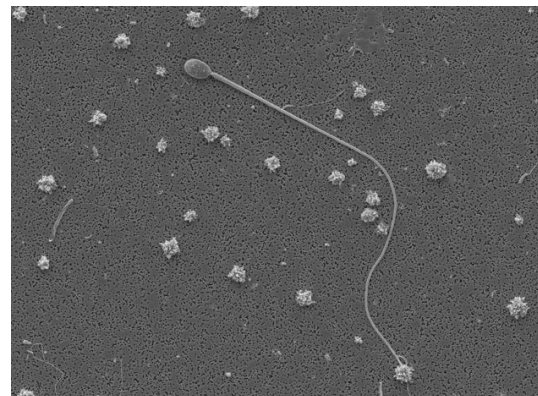
Sperm Cells

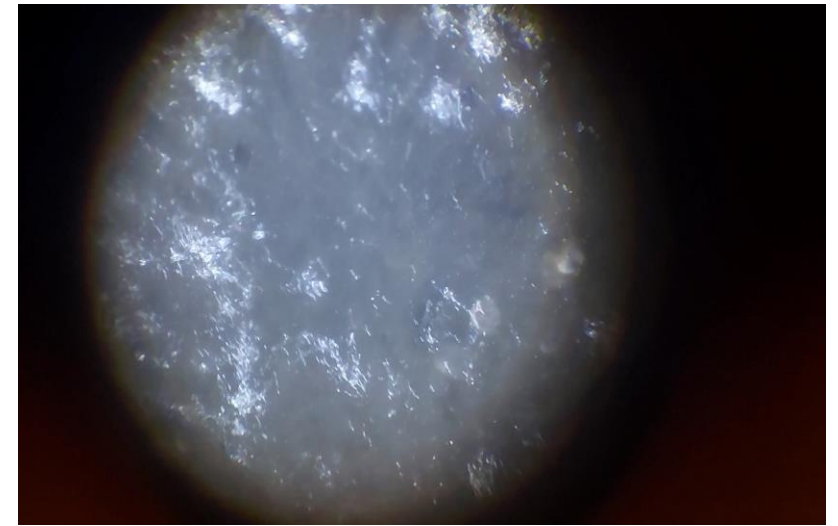
London ZSL Semen Freezing & Fertility Assessment



London ZSL Zoo Health Check as part of the Asiatic lion EEP reproduction review

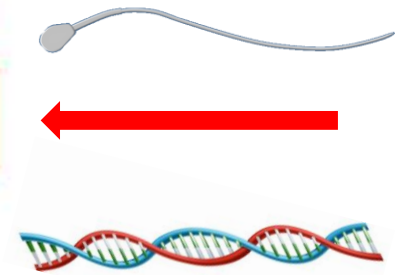
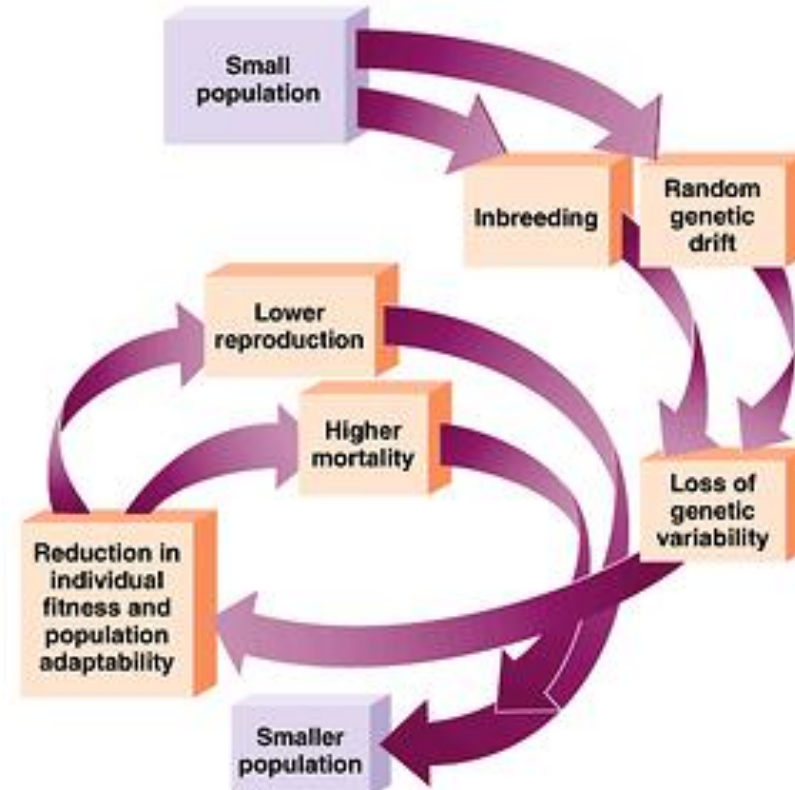
Grandidier's Vontsira Semen Freezing & Fertility Assessment





The Extinction Vortex

- Small populations of low genetic diversity are highly vulnerable to the extinction vortex.
- Highly in-bred species suffer from high levels of abortion, still birth and genetic abnormalities – this is a **major welfare concern**.
- Nature's SAFE can prevent the extinction vortex by preserving genetic diversity thus improving animal welfare.



NATURE'S SAFE IN ACTION



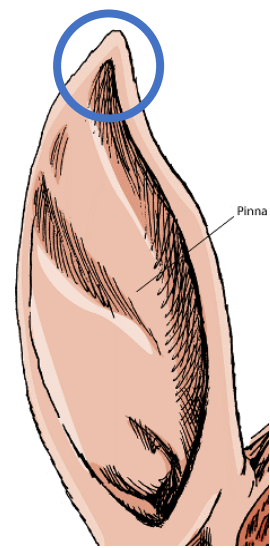
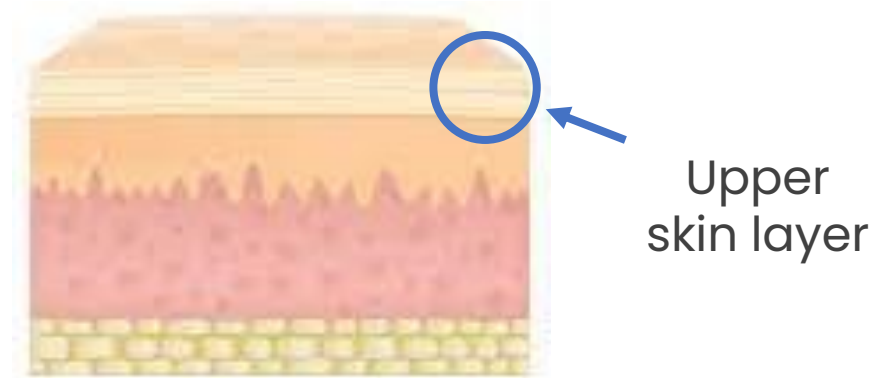
SAMPLES — **702**

INDIVIDUALS — **528**

SPECIES — **248**




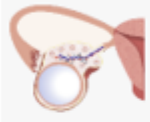















Biobanking – Where to Start?

- Skin samples
 - ear tissue / skin sample (minimal fat content)
 - internal tissue e.g. muscle
- Preserved within 5 days of the animal's passing
- Kept chilled after sample taking until preserved



ALTERNATIVE SAMPLE SITES

Please ensure aseptic techniques are followed.

Species Type	Sample Type				
	Core	Additional			
Mammals 	Ear tip 	Testes 	Ovary 		
Reptiles & Amphibians 	Muscle / skin / toe 	Liver 	Heart 	Eye 	
Birds 	Muscle / skin / toe 	Blood Feathers 	Tongue 	Trachea 	Eye 
Fish 	Muscle / scaled skin 	Gills 	Eye 		

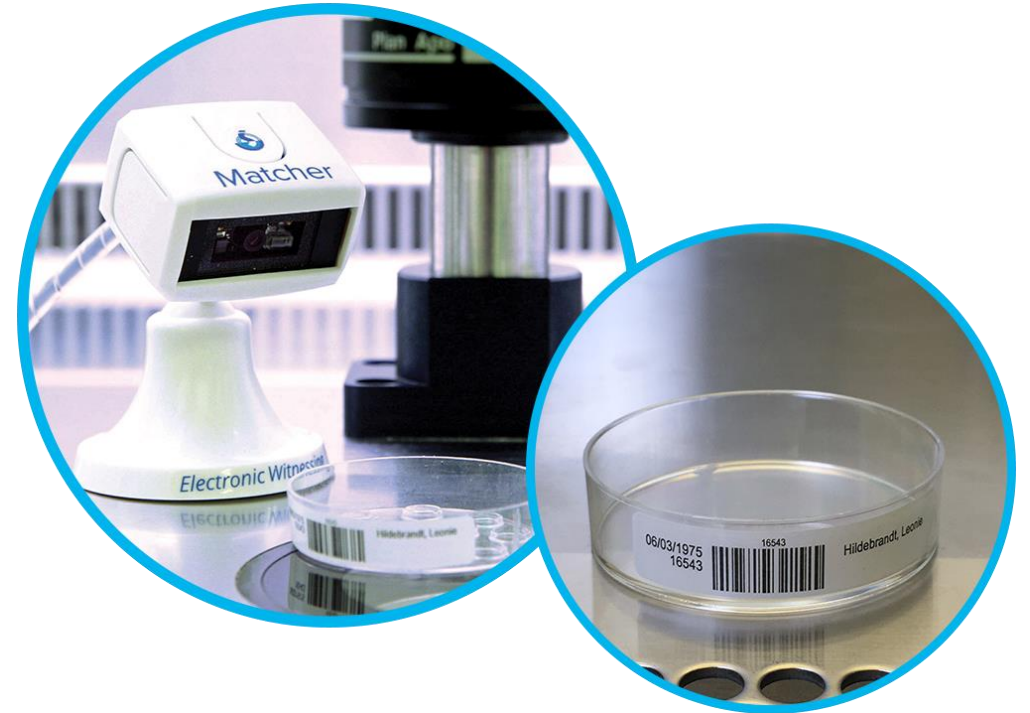
Biobanking – Where to Start?

- Ovarian & testicular samples
- Preservation of gamete producing strips
- Preservation at -196 degrees Celsius
- Up to 10 vials per animal per sample type for multiple storage locations



Record Keeping & Data Base Management

- Record keeping, data base and sample logging as important as the sample processing
- Clear and reliable sample storage
- Zoo sample ownership
- Multiple locations



Our Vision

- Nature's SAFE aims to roll out our cryopreservation technologies globally to create multiple centres of expertise within new living biobank hubs





Kenya's Nature's SAFE



Aims.

1. Establish Biobank
2. Raise Awareness of Biodiversity Loss
3. Knowledge Transfer
4. Encourage collaboration in conservation

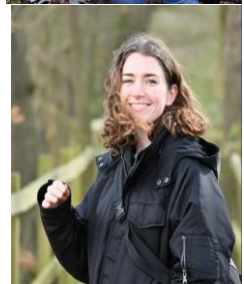
Target = £50,000 - £75,000



Jane Windsor
Dr Robert Browne
Alice Clark
Heather Crowe
James Curry
Camilla Curry
Dr Cecelia Longhorne
Dr Kate Dutton-Register
Prof Philippe Wilson

Dr Imogen Harris
Caroline Dingwall
Prof Bill Holt
Sarah Oliver
Jackie Mackenzie-Dodds
Anna Merkarska
Lucy Morgan
Joss Naylor
Sarah Forsyth

Tullis Matson
Kate Ashmore
Matt Pettit
Val Edwards
Rob Humphreys
Debbie Rolmanis
Tony Noble
Tom Beeston
Terri Hill
Stevie Sheppard





With your help we Can secure a future for animals at risk of extinction

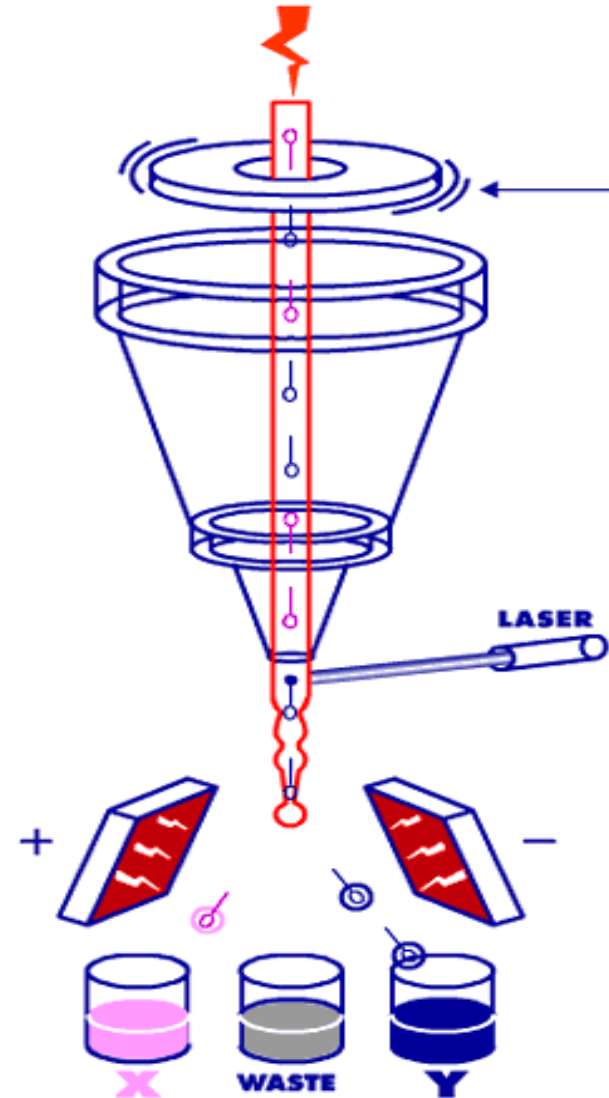


Technologies For The Future



Semen Sexing

- ♀ Based on the difference in DNA content between X & Y bearing sperm
- ♀ X bearing sperm 2.8-4.2% more DNA than Y bearing)
- ♀ 60% sorted; 90% accuracy
- ♀ Insemination fresh dose 40 million PMS



World's First Fresh Semen Sexed Rare Breed Foal



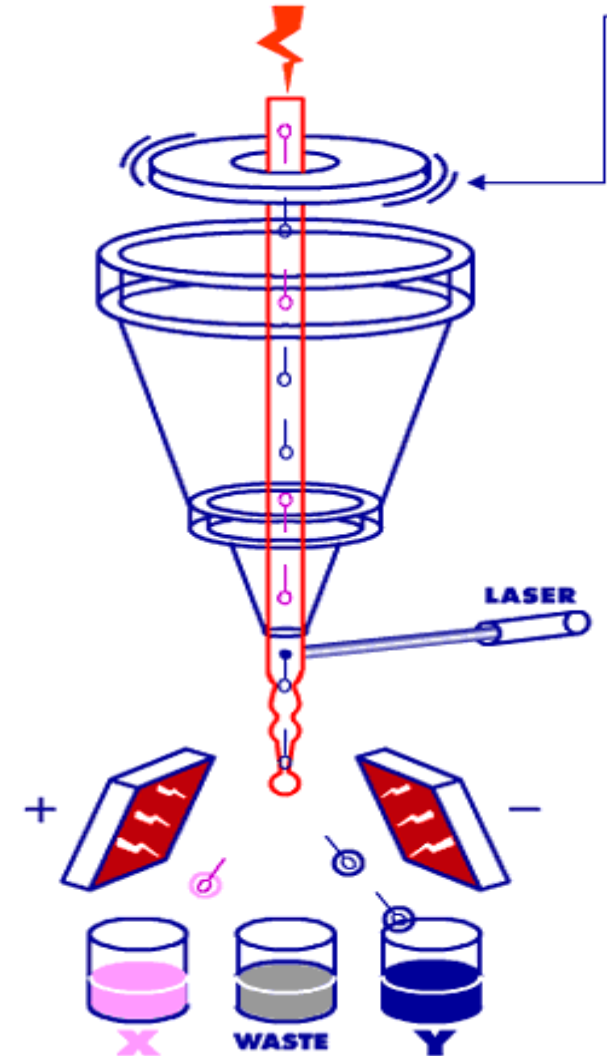
First Frozen Sexed Semen Foal

- ♀ Our first foal from frozen sexed semen
- ♀ For use in combination with ICSI
- ♀ Polo pony filly foal
- ♀ More to follow!



Rhino Semen Sexing

- Work started in the US



- ⌘ Digital DNA
- ⌘ Future possibility
- ⌘ Digital characterisation & storage of animal genetic profiles
- ⌘ 3D printing of DNA for breeding & utilisation
- ⌘ Prof. Philippe B. Wilson, NTU School of Animal Rural & Environmental Sciences



Equine, Zoo and Farm Species



- Working with equine semen, in particular rare breed semen, has driven many developments and improvements to protocols and technologies

- We can now transfer that knowledge, experience and expertise Livestock conservation

UK National Livestock Biobank

*Farm animal biobank
for UK food & breed
security*



<https://www.livestockbiobank.com>

Tel: 01948 668 057

Office@livestockbiobank.com



**UK National
Livestock Biobank**

NordGen

- Nordic Genetic Resource Centre
- Nordic countries' joint gene bank
- Mission to preserve and promote sustainable use of the diversity of domestic animals, forests and plants that are important to Nordic agriculture.





NATURE'S SAFE
SAVING ANIMALS FROM EXTINCTION

Charity No. 1192875

SECURING UK NATIVE WILDLIFE



with support from

Supported by players of

Awarded to



UK Native Wildlife



NATURE'S SAFE
SAVING ANIMALS FROM EXTINCTION





Official Earthshot Nominee 2023



Sir David Attenborough



As the great Sir David Attenborough said, in one of his last programmes called the Mating Game, which he focused on living biobanking, he quoted the fact that:

“By using current technologies, if we wish, we have the ability to save any animal or at least save its tissue until we discover how”.

Thank you for listening

You are helping us
secure a future for
animals at risk of
extinction.

