STAGE 6: BIOLOGY DEPTH STUDY
DATING WITH DNA: TARONGA'S BREEDING PROGRAMS

Taronga Zoo is committed to the conservation of wildlife in Australia and around the world. Taronga has an active involvement in endangered species breed and release programs, habitat recovery and the development of insurance populations with maximum genetic diversity.

OUTCOMES

KNOWLEDGE AND UNDERSTANDING

- BIO12-12 explains the structure of DNA and analyses the mechanisms of inheritance and how processes of reproduction ensure continuity of species
- BIO12-13 explains natural genetic change and the use of genetic technologies to induce genetic change

WORKING SCIENTIFICALLY SKILLS

- BIO11/12-1 Questioning and predicting
- BIO11/12-7 Communicating
- BIO11/12-5 Analysing data and information
- BIO11/12-6 Problem solving

Throughout this depth study, you will develop a practical understanding of how predictive models of inheritance enable decision making to maintain genetic diversity in zoo-based animal populations. Investigate how science is used to make predictions about future changes to populations and explore the impact of biotechnology on biological diversity. Learn about the work and research of Taronga's scientists in developing new methodologies for the genetic management of endangered species.

AT SCHOOL BEFORE THE ZOO (4 X 2HRS)

Through a series of four case studies, you will discover some of the incredible projects being undertaken by Taronga's scientists, vets and zookeepers to help save endangered species through zoo-based breeding.

AT THE ZOO (5HRS)

Take a self-guided tour of Taronga Zoo and witness the results of our successful breeding programs, whilst exploring the Zoo's current science communication initiatives to gain ideas for your own design project.

ZOO WORKSHOP (OPTIONAL)

Meet Taronga's education staff for a face-to-face workshop – Hereditary and Genetic Change - to take a more in-depth look at the processes of reproduction and genetic management of animals at the Zoo.

BACK AT SCHOOL (2HRS)

Create and utilize your science communication skills to design an interpretive zoo display to convey the latest scientific advancements in breeding programs in a manner suitable for general zoo visitors.

CASE STUDY 1 - NORTHERN CORROBOREE FROG

To learn about the Corroboree Frog Recovery Program visit https://www.corroboreefrog.org.au

AIM OF BREEDING PROGRAMS

To maintain genetically viable and genetically diverse insurance colonies *ex-situ* (in captivity) while also providing individuals for population augmentation, translocation and reintroduction *in-situ* (in the wild).

This species has been the focus of an intensive zoo-based breeding and reintroduction program since 2003, established as a partnership between the Taronga Conservation Society Australia, Tidbinbilla Nature Reserve and the New South Wales Office of Environment and Heritage.

WHY ARE NORTHERN CORROBOREE FROGS CRITICALLY ENDANGERED?

The Northern Corroboree Frog (*Pseudophryne pengilleyi*) is considered one of Australia's most threatened vertebrates, listed as Critically Endangered by state and federal governments.

The primary cause for the decline of the Northern Corroboree Frog is chytridiomycosis, the disease associated with amphibian chytrid fungus (*Batrachochytrium dendrobatidis*).

The fungus attacks the parts of a frog's skin that contain keratin. Since frogs use their skin in respiration, this makes gas exchange difficult. The fungus also damages the nervous system, affecting the frog's behaviour.

The spread and persistence of chytrid fungus in the population is facilitated by a species living alongside the Corroboree Frog, the Common Eastern Froglet (*Crinia signfera*). This species appears to sustain high infection levels, but doesn't develop the disease. As a result, it acts as a reservoir host, sustaining the disease in the ecosystem and allowing transmission to other species.

CAREER SPOTLIGHT

MICHAEL MCFADDEN

Michael is the Supervisor of the Herpetofauna Department at Taronga Zoo, is co-convenor of the Zoo and Aquarium Association's Amphibian Taxon Advisory Group and is working on his PhD in amphibian conservation!

His work focuses on the application of ex-situ technologies for the conservation of Australia's threatened reptiles and amphibians. This includes establishing insurance colonies, developing husbandry and reproduction protocols, providing quantities of offspring for experimental translocations and facilitating conservation research.

Photo credit - Paul Fahy

THE TROUBLE BREEDING FROGS

Despite considerable efforts to mimic natural environmental cues, many frog breeding programs continue to face difficulties reliably and predictably initiating breeding behaviour in captivity. This threatens the genetic viability of insurance colonies and limits the numbers of individuals for release.

Although Northern Corroboree Frogs have been bred successfully in captivity, a significant problem often occurs where a proportion of gravid females (females carrying eggs) fail to spawn, reducing the reproductive potential of zoo-based colonies. In addition, zoo-based populations exhibit strong mating biases, with less than one-third of available males contributing to mating success. Over time, such zoo-based mating biases may lead to a loss of genetic variation.

TARONGA'S REPRODUCTION RESEARCH

Assisted Reproductive Technologies such as the hormonal induction of spawning and gamete release have the potential to contribute to amphibian conservation. They enhance species propagation, synchronised breeding events and permitting greater control over the genetic management. The focus of current research efforts is to evaluate the effectiveness of hormonal induction of ovulation and spawning using Gonadotropin Releasing Hormone analogue (GnRH-a) to help ensure all potential male and female frogs are able to contribute to the breeding program and to reduce the health issues associated with egg-bound females (where eggs become stuck in the oviduct).

RESEARCH IN FOCUS

The following research is summarised on pages 3-6.

Silla, A. J., McFadden, M., & Byrne, P. G. (2018) Hormone-induced spawning of the critically endangered northern corroboree frog Pseudophryne pengilleyi. Reproduction, Fertility and Development.

AIM

The aim of this study was to test protocols to hormonally induce spawning behaviour in the critically endangered Northern Corroboree Frog.

OBJECTIVES

To investigate the effect of Gonadotropin-Releasing Hormone analogue (GnRH-a) with different methods of administration (injection or topical application) and at different dose rates.

METHOD

1. zoo-based bred frogs were housed in a purpose-built, isolated biosecurity facility at Taronga Zoo
2. 73 male–female pairs were allocated to 1 of 7 experimental treatments (n = 9-13 pairs per treatment)
3. One week before hormone administration, males were removed from communal housing and moved into individual tanks to allow each male establish a nest site
4. Individuals within each pair were administered a single hormone dose corresponding to their experimental treatment. Hormones were either administered via subcutaneous injection into the dorsal lymph sac (Figure A) or administered dermally via drop-wise topical application onto the ventral abdominal surface (Figure B)
5. Three weeks after hormone administration, tanks were searched for the presence of eggs and the number of eggs oviposited and fertilisation success were scored

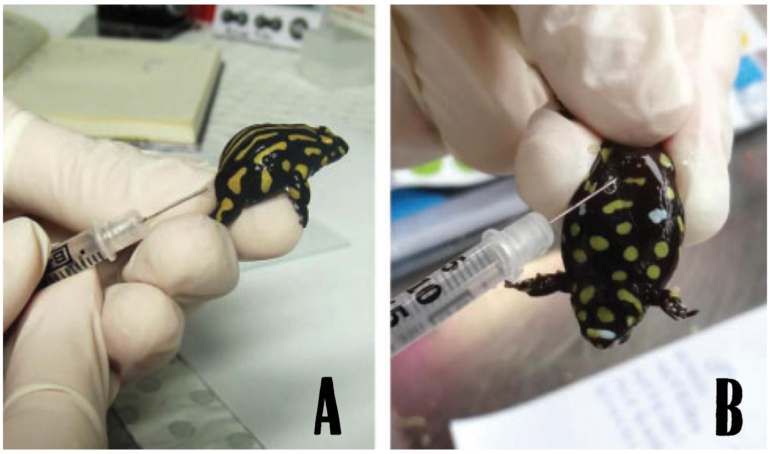

Figure A) Subcutaneous injection into the dorsal lymph sac
Figure B) Topical administration onto ventral abdominal surface

All procedures were conducted following evaluation and approval by the TCSA's Animal Ethics Committee (Protocol numbers 3b/08/14 & 3a/11/16).

TARONGA ZOO
For the Wild

RESULTS - ANALYSING THE DATA

1) Calculate the total number of fertile eggs per treatment group and use this to calculate the average number of fertile eggs per pair for each treatment (use blank columns)
2) Create a graph of the average number of fertile eggs per pair to visually compare between treatment group (can be done by hand or computer software)
3) (Optional) Add data for the % pairs ovipositing, total number of eggs and % fertilisation to your graphs, or create new graphs
4) (Optional) Discuss the meaning and use of standard error of the mean in statistics and add error bars to your graphs

		Pairs ovipositing / Total no. pairs in group, (%)	Number of eggs per pair (Mean ± s.e.m)	% Fertilisation (Mean ± s.e.m)	Number of fertile eggs per pair (Mean)
Injected GnRH-a (µg g^{-1})	0	2/9 (22)	7.33 ± 4.95	96.87 ± 0.57	
	0.5	9/9 (100)	31.22 ± 3.02	61.42 ± 15.50	
	1	8/9 (89)	27.44 ± 4.82	15.51 ± 10.51	
	2	9/9 (100)	28.33 ± 43.15	21.80 ± 10.81	

		Pairs ovipositing / Total no. pairs in group, (%)	Number of eggs per pair (Mean ± s.e.m)	% Fertilisation (Mean ± s.e.m)	Number of fertile eggs per pair (Mean)
Topical GnRH-a (µg g^{-1})	0	3/11 (27)	10.64 ± 5.74	33.41 ± 24.21	
	25	10/13 (77)	33.77 ± 6.02	47.80 ± 12.81	
	50	8/13 (62)	26.39 ± 6.44	31.27 ± 9.51	

TARONGA ZOO
For the Wild

What does the data mean?

Complete the following sentence for each treatment group.

1) When a dose rate of __________ μg g^{-1} of GnRH was applied using the _____________ method to a group of _________ pairs of frogs, __________ of those pairs laid eggs (which is ___________ %). The average number of eggs laid per pair was __________ and on average ___________ % of these eggs were fertile, resulting in an average of ____________ fertile eggs per pair for this treatment group.

2) When a dose rate of __________ μg g^{-1} of GnRH was applied using the _____________ method to a group of _________ pairs of frogs, __________ of those pairs laid eggs (which is ___________ %). The average number of eggs laid per pair was __________ and on average ___________ % of these eggs were fertile, resulting in an average of ____________ fertile eggs per pair for this treatment group.

3) When a dose rate of __________ μg g^{-1} of GnRH was applied using the _____________ method to a group of _________ pairs of frogs, __________ of those pairs laid eggs (which is ___________ %). The average number of eggs laid per pair was __________ and on average ___________ % of these eggs were fertile, resulting in an average of ____________ fertile eggs per pair for this treatment group.

4) When a dose rate of __________ μg g^{-1} of GnRH was applied using the _____________ method to a group of _________ pairs of frogs, __________ of those pairs laid eggs (which is ___________ %). The average number of eggs laid per pair was __________ and on average ___________ % of these eggs were fertile, resulting in an average of ____________ fertile eggs per pair for this treatment group.

5) When a dose rate of __________ μg g^{-1} of GnRH was applied using the _____________ method to a group of _________ pairs of frogs, __________ of those pairs laid eggs (which is ___________ %). The average number of eggs laid per pair was __________ and on average ___________ % of these eggs were fertile, resulting in an average of ____________ fertile eggs per pair for this treatment group.

6) When a dose rate of __________ μg g^{-1} of GnRH was applied using the _____________ method to a group of _________ pairs of frogs, __________ of those pairs laid eggs (which is ___________ %). The average number of eggs laid per pair was __________ and on average ___________ % of these eggs were fertile, resulting in an average of ____________ fertile eggs per pair for this treatment group.

7) When a dose rate of __________ μg g^{-1} of GnRH was applied using the _____________ method to a group of _________ pairs of frogs, __________ of those pairs laid eggs (which is ___________ %). The average number of eggs laid per pair was __________ and on average ___________ % of these eggs were fertile, resulting in an average of ____________ fertile eggs per pair for this treatment group.

EVALUATION OF DATA

1. Decide which of the injected dose rates and which of the topically applied dose rates was most effective
2. Brainstorm a pros/cons list to compare administration of the hormone by injection vs. topical application
3. Write a conclusion for this research

RESULTS

- When using the injection method of administration, a dose rate of __________ $\mu g\ g^{-1}$ was most effective
- When using the topical application method of administration, a dose rate of __________ $\mu g\ g^{-1}$ was most effective

	PROs	CONs
Injection		
Topical		

CONCLUSION

____

____

____

____

____

AT SCHOOL

CASE STUDY 2 - TASMANIAN DEVIL

Tasmanian Devils (*Sarcophilus harrisii*) are the largest living carnivorous marsupial (Dasyurid) in Australia. They have sharp powerful claws and a backward facing pouch. More than 5000 years ago, Tasmanian Devils were common on mainland Australia. Today they are only found in Tasmania, however, found in virtually every habitat type occurring in Tasmania. As Tasmanian Devils are shy and nocturnal they are rarely seen in the wild. Tasmanian Devils often scavenge dead animals found on roadsides. Sadly, many are hit by cars while feeding. They can devour an entire prey and are capable of consuming one quarter of their own body weight in one feeding session!

To learn about the Tasmanian Devil Recovery Program visit https://dpipwe.tas.gov.au/wildlife-management/save-the-tasmanian-devil-program

Photo credit - Lorinda Taylor

CAREER SPOTLIGHT - LARRY VOGELNEST

Dr. Larry Vogelnest is the Senior Veterinarian at Taronga Zoo and manages the Taronga Wildlife Hospital. He is responsible for the health of the Zoo's animal population and sick, injured and orphaned native Australian wildlife admitted to the Taronga Wildlife Hospital.

Dr Vogelnest specialises in the health and reproductive management of small populations including *ex situ* breeding programs for endangered species. He has participated in and advised on both *in situ* and *zoo based* components of numerous conservation projects, both in Australia and overseas.

REPRODUCTION

Tasmanian Devils are sexually mature at the age of two years and their mating period is between late February and April. Tasmanian Devils are marsupial mammals, meaning they have a pouch. They are polyoestrous (having more than one oestrus period per year) and during the mating season a female may mate with many males.

Males often guard females for around 9 days after copulation in order to increase their chances of fathering a majority of that females offspring. During guarding, the male may be forced to fight with other males attempting to mate with the female. The female is able to raise up to 4 young and it is possible that each young could be fathered by different males!

TASMANIAN DEVIL JOEYS

Tasmanian Devils can give birth to up to 50 tiny, undeveloped young, approximately the size of a grain of rice. At birth the devils only have a mouth, nose, front limbs and claws, allowing them to make their way to the pouch.

The mother only has 4 teats in her backwards facing pouch, so only the first 4 joeys to find a teat will survive. Once attached to a teat, it expands in the young's mouth in order to prevent it from falling out of the pouch.

Joeys live in the pouch for almost four months. Once they emerge, joey devils remain in a den for a further few months, before leaving to learn the skills required for survival.

WHAT ARE THE ADVANTAGES OF MARSUPIAL REPRODUCTION?

TASMANIAN DEVIL FACIAL TUMOUR DISEASE

The Tasmanian Devil has suffered a dramatic population decline in recent years due to an infectious cancer called Devil Facial Tumour Disease (DFTD).
The disease is transmitted through biting, fighting and mating and is one of the only cancers known to spread as a contagious disease. The tumour cells are not rejected by the devil's immune system as it doesn't recognise these cells as being foreign.

Once the Devil is infected, signs of the disease appear around the mouth within a few months, usually in the form of small lesions or pimple-like lumps. These small blemishes quickly develop into large tumours, primarily on the face and neck. The devils soon find it difficult to eat and drink, and usually die from starvation, dehydration and the breakdown of bodily functions within three months.

It was first detected in 1996 and since then, 90% of the wild population has depleted and the disease is rapidly spreading. Sadly, they are now listed as endangered on the IUCN Red List of threatened species.

The only way to ensure the Tasmanian Devil does not become extinct is through our zoo-based breeding program to create an insurance population.

MANAGING INSURANCE POPULATIONS

In 2006 a disease-free insurance population was established to ensure that the Tasmanian Devil is protected from extinction. The insurance program is dependent upon preserving as much wild genetic diversity as possible to maximize the success of reintroductions to the wild. The easiest way to manage genetics is to control exactly which female and male mate by housing them in forced monogamy. However, Tasmanian Devils are naturally polygamous and prefer to choose multiple males.

This insurance program has the aim of preserving 95% of founding genetic diversity for a period of 50 years

Research monogamous and group housing to complete the table below.

	PROs	CONs
Monogamous Housing		
Group Housing		

RESEARCH IN FOCUS

The following research will give you an understanding of SNP (single nucleotide polymorphism) markers.

Wright, B., Morris, K., Grueber, C. E., Willet, C. E., Gooley, R., Hogg, C. J., & Belov, K. (2015). Development of a SNP-based assay for measuring genetic diversity in the Tasmanian devil insurance population. BMC genomics, 16(1), 791.

WHAT ARE SNP'S?

____

____

____

____

____

____

DEVIL PATERNITY TESTING - SCENARIO

TARONGA ZOO For the Wild

- Taronga Zoo received 6 juvenile Tasmanian Devils to contribute greater genetic diversity to the Zoo population.
- These individuals came from a free-range population that allows mate-choice, therefor the animals ancestries are incomplete (sire unknown).
- Fortunately, genetic research has developed a set of single nucleotide polymorphic (SNP) markers that allow for the assessment of familial relationships among devils.
- Use the genetic data provided below to identify the paternity of each Tasmanian Devil.
- For parentage studies, 60–100 SNPs are expected to provide sufficient resolution to construct accurate pedigrees. For this practice activity we will use 10 SNPs.

	Genomic Location									
	20467	20537	28659	31355	31617	31740	34312	34895	37386	74593
Dam 1	T	G	T	C	T	G	C	G	C	A
Joey 1	C	A	T	T	T	G	C	G	C	A
Sire 1	C	A	G	C	C	C	C	A	G	A
Sire 2	C	A	T	T	C	G	T	G	C	G

	Genomic Location									
	20474	20541	20551	31617	31660	31948	32283	32348	40567	74730
Dam 2	G	C	C	C	C	G	A	A	G	A
Joey 2	A	C	T	C	T	A	G	A	A	G
Joey 3	A	C	T	C	T	G	G	A	A	A
Sire 3	A	C	T	T	T	A	G	G	A	G
Sire 4	G	T	T	T	T	A	G	G	G	A

	Genomic Location									
	2046719	2047424	317863	318002	320529	322081	322108	322109	322210	623230
Dam 3	C	G	T	G	C	G	C	T	A	T
Joey 4	T	G	C	G	C	A	C	C	G	A
Joey 5	C	G	T	A	T	G	T	T	A	A
Sire 5	C	G	T	G	C	G	C	T	A	A
Sire 6	T	G	T	A	T	G	T	T	A	T
Sire 7	C	A	C	G	C	A	T	T	G	A
Sire 8	T	G	C	G	C	A	C	C	G	A
Sire 9	C	A	T	A	T	G	T	T	A	A

Joey 1 is fathered by ______________________

Joey 2 is fathered by ______________________

Joey 3 is fathered by ______________________

Joey 4 is fathered by ______________________

Joey 5 is fathered by ______________________

AT SCHOOL

CASE STUDY 3 – CHRISTMAS ISLAND BLUE-TAILED SKINK

Find the Conservation Plan for the Christmas Island Blue-tailed skink at
http://www.environment.gov.au/system/files/consultations/095c1f60-4c26-42c5-90b1-a08b35b69f07/files/e2018-0155-attachment-3-draft-species-conservation-plan.pdf

The Christmas Island Blue-tailed Skink (*Cryptoblepharus egeriae*) was once abundant and widely distributed across Christmas Island, however, population declines were first reported in 1992 and the subsequent decline was rapid and dramatic.

In August 2009 the decision was made to capture as many individuals as possible in order to develop a zoo-based breeding program. Since August 2010 the species has not been observed in the wild and has been declared extinct in the wild by the International Union for the Conservation of Nature (IUCN).

The main threat to this species was predation by the introduced Wolf Snake (*Lycodon capucinus*), which arrived on the island around 1982.

Island species at risk!

Islands often have a high complement of endemic species, but these often have small populations, limited genetic diversity and low reproductive rates, lack immunity to novel diseases or are predator-naive. These characteristics mean that island species have little resilience to introduced predators, consumers, competitors or diseases, or to other environmental modifications. Consequently, island species are over-represented among the world's recent extinctions.

As with many islands, Christmas Island in the Indian Ocean has recently suffered severe biodiversity loss.

CAREER SPOTLIGHT - LISA CAVANAGH

Lisa Cavanagh has a Certificate III in zoo-based Animals and is a Senior Zookeeper in the herpetofauna division of Taronga Zoo. For the last 8 years she has been working with 2 species of lizard from Christmas Island; the Blue-Tailed Skink and the Listers Gecko, developing husbandry guidelines, breeding and getting animals ready for a translocation.

Lisa has traveled to Christmas Island twice to collect and look after the reptiles and is involved in an upcoming trip to Cocos Island to release some of the lizards back to the wild.

SAVING THE SKINK

The Christmas Island National Park begun a zoo-based breeding program with 64 individuals captured from the wild in 2009. By 2011 the zoo-based population had increased to 192 individuals. To reduce the risk of a catastrophic loss, a separate off-island zoo-based breeding program was developed in 2012 at Taronga Zoo with 83 individuals. There are now over 1,000 individuals in the zoo-based breeding program.

TIMELINE OF EVENTS

Using the information found on this pages 11-12, complete the timeline below

1982	
1992	
2000	
2009	
2010	
2011	
2012	
2019	

THE INBREEDING ISSUE

As a general goal, zoo-based breeding programs aim to retain 90% of the genetic diversity of a species found in the wild, with the aim of eventually releasing the zoo-based population back to the wild.

However, zoo-based populations have a high risk of inbreeding which results in a loss of genetic diversity which can affect the long-term viability of reintroduced populations.

WHAT IS INBREEDING?

HOW CAN WE AVOID INBREEDING?

For populations that are housed in groups (with multiple males and multiple females) it is not usually possible to obtain paternity data for pedigrees. Therefore, strategies have been devised to minimise inbreeding by exchanging individuals among groups on a regular basis. This is often done by moving the males from group to group between each generation.

Read more here - Andrew, P., Cogger, H., Driscoll, D., Flakus, S., Harlow, P., Maple, D., & Tiernan, B. (2018). Somewhat saved: a zoo-based breeding programme for two endemic Christmas Island lizard species, now extinct in the wild. Oryx, 52(1), 171-174.

TARONGA ZOO For the Wild

CASE STUDY 4 - REGENT HONEYEATER

Find the National Recovery Plan for the Regent Honeyeater here: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-regent-honeyeater-anthochaera-phrygia-2016

Photo credit – Dean Ingwerson

Regent Honeyeaters (*Anthochaera phrygia*) are striking and distinctive, medium-sized, black and yellow birds with a wingspan of 30cm. They feed mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar, such as Yellow Box and Swamp Mahogany. Insects make up about 15% of the total diet and are important components of nestling diets.

An open cup-shaped nest is constructed of bark, grass, twigs and wool by the female. Two or three eggs are laid and incubated by the female for 14 days. Nestlings are brooded and fed by both parents at an average rate of 23 times per hour and fledge after 16 days.

Regent Honeyeaters were once seen overhead in flocks of hundreds, from eastern Queensland to South Australia, however their range has contracted dramatically in the last 30 years and there are only three known key breeding regions remaining.

The decline is due to loss of habitat, with up to 85% of their woodland home being cleared for agriculture. This has led to fragmented populations, resulting in the local extinction of the Regent Honeyeater in South Australia and isolation of the remaining small population groups. Sadly, they are now listed as critically endangered on the IUCN Red List of Threatened Species.

CAREER SPOTLIGHT
MONIQUE VAN SLUYS

Dr. Monique Van Sluys is Taronga Zoo's Wildlife Conservation Officer and has a scientific background in the theoretical and applied fields of conservation biology. She has developed a series of research projects and implemented many *in-situ* conservation strategies.

Monique is the species coordinator for the Zoo and Aquarium Association's Australasian Species Management Program for the Regent Honeyeater which means she is responsible for species transfer and breeding recommendations to retain at least 90% genetic diversity and maintain inbreeding coefficients at or below F = 0.125.

TARONGA ZOO'S LEGACY COMMITMENT

In 2016 Taronga Zoo celebrated it's 100th birthday and launched the legacy for the future and for the wild, dedicating the next decade to the conservation of ten critical species, known as our Legacy Species. Five of these Legacy Species are native to Australia, including the Regent Honeyeater and Corroboree Frog, and five are on the brink of extinction in Sumatra – a biodiversity hotspot of critical importance, found right on Australia's doorstep.

FLAGSHIP SPECIES

The Regent Honeyeater has become a 'flagship species' for conservation in the threatened box-ironbark forests of Victoria and NSW on which it depends.

What does it mean to be a 'flagship species'?

STUDBOOKS: RSVP DATING FOR ZOO ANIMALS!

Studbooks are species specific and are the breed registry of the zoo-based population. It keeps records of all animals and their pedigrees/genealogies. Studbooks are the most important tool in scientifically managing *ex-situ* populations of wild animals. The studbook keeper collects the registration number of each animal as well as gender, birthdate, parents, where it was born, transfers, tags and behavioural traits. The studbook keeper also calculates information on the genetic diversity, inbreeding levels and mean kinship of the entire zoo-based population.

This information is then used to manage the zoo-based population by making specific breeding recommendations for each animal in the population. Essentially, studbooks are an online dating database and the studbook keepers are matchmakers and family planners for the wildlife!

What is Mean Kinship?

What is Gene Diversity?

CHOOSE ONE OF THE VARIABLES IN THE TABLE BELOW AND CREATE A GRAPH TO SHOW HOW IT HAS CHANGED OVER TIME.

	2013	2014	2015	2016	2017
Mean Kinship	0.097	0.079	0.063	0.059	0.053
Inbreeding Coefficient	0.03	0.035	0.021	0.020	0.019
Gene Diversity (%)	93.8	92.3	93.6	94.2	94.5
Population Size (#)	90	135	75	141	83
Current Founders (#)	15	19	19	19	19
Captures from the wild (#)	4	0	0	0	0
Births (#)	49	129	70	136	78
Releases (#)	38	0	77	1	101

NATIONAL RECOVERY PLAN

The aim of zoo-based management is to produce Regent Honeyeaters that are reproductively and behaviorally robust and healthy for release to the wild in order to assist persistence of the wild population.

TARONGA ZOO For the Wild

BREED FOR RELEASE

So far, over 260 Taronga-bred birds have been released and monitored in the Chiltern Mt Pilot National Park, Victoria; an impressive number considering the wild population is estimated at only 300-500.

Birds are health screened before being transported in safe boxes and then released into soft-sided dome tents for 72 hours to allow them to acclimatize to their new area and fuel up on local flowering eucalypts.

Key success indicators of the program are the sighting of zoo-bred birds pairing and nesting with wild counterparts which is exactly what is needed to help the wild population recover.

USING MEAN KINSHIP TO DECIDE BREEDING RECOMMENDATIONS:

Selecting breeders by minimizing mean kinship means that individuals likely to harbor rare alleles will be selected to breed over individuals that are likely to have alleles that are more common in the population. By continually selecting individuals with rare alleles, the likelihood of losing the alleles is decreased, leading to the retention of genetic diversity across generations of zoo-based breeding.

Activity:

Determine which individuals you would recommend breeding next season.

Male				Female			
Studbook #	Mean Kinship	Age	Location	Studbook #	Mean Kinship	Age	Location
260	0.0321	6	Taronga Zoo	467	0.0493	2	Currumbin
33	0.0585	19	Melbourne Zoo	452	0.0405	2	Taronga Zoo
264	0.0397	6	Cleland Park	570	0.0509	1	Adelaide Zoo
450	0.0478	2	Featherdale	364	0.0406	4	Moonlit Park
605	0.0509	0	Moonlight Park	391	0.0497	3	Melbourne Zoo
582	0.0478	1	Taronga Zoo	128	0.0703	11	Taronga Zoo
481	0.0545	2	Currumbin	585	0.0517	1	Featherdale
602	0.0648	0	Taronga Zoo	244	0.0550	8	Cleland Park
185	0.0490	9	Melbourne Zoo	463	0.0645	2	Taronga Zoo
344	0.0374	4	Taronga Zoo	468	0.0373	2	Taronga Zoo

Brief: Design an interpretive zoo display to convey the latest scientific advancements in breeding programs in a manner suitable for general zoo visitors.

Outstanding communication should capture the mind and imagination. It stimulates meaningful conversation and debate, granting science greater importance within society.

Giving people data alone may not help them gain that understanding if it cannot be made relevant to their current frame of reference. Translating data into diverse media that appeals to multiple learning styles can help in this effort.

Complex stories do not need to be “dumbed down” for non-scientist audiences. Instead, they need to be interpreted in ways that relate to people’s everyday lives and what matters to them. Social science research suggests that good science communication gets people to think more deeply about ideas and issues.

THE FIELD OF INTERPRETATION

Interpretation is an unusual form of communication in that it melds knowledge with feelings in order to touch the hearts and minds of people. Zoo Interpreters are tasked with translating the technical language of experts into the 'everyday' language of the visitor to forge emotional and intellectual connections between the two.

“Through interpretation, understanding; through understanding, appreciation; through appreciation, protection.”

Freeman Tilden

Freeman Tilden’s 6 Principles of Interpretation:

1. Any interpretation that does not somehow relate what is being described to something within the personality or experience of the visitor will be sterile
2. Information, as such, is not Interpretation. Interpretation is revelation based on information.
3. Interpretation is an art, which combines many arts
4. The chief aim of Interpretation is not instruction, but provocation
5. Interpretation should aim to present a whole rather than a part, and must address itself to the whole man rather than any phase
6. Interpretation addressed to children should not be a dilution of the presentation to adults, but should follow a fundamentally different approach

CAREER SPOTLIGHT - NICOLE WHITFIELD

Nicole Whitfield is the Interpretation Manager and has worked at Taronga for 15 years. She has completed a Bachelor of Science and a Masters in Applied Science and while at the Zoo has gained a Certificate IV in Tourism Guiding and in Training and Assessment. Initially working in the Roar and Snore team Nicole helped develop it from its humble beginnings to a must-do Sydney experience. She now leads the team that is integral in crafting the guest experience and learning journey at both Dubbo and Sydney via a plethora of engaging installations, devices, exhibits, tours, talks and activities. Recent exciting projects her team have developed include the Centenary Theatre, Tiger Trek and Lion Pride Lands.

AT THE ZOO INTERPRETATION

Visit the Zoo and evaluate the interpretive messaging and science communication methods in exhibit designs and presentations

Sumatran Tigers

Determine the key theme or message in the exhibit.

Identify the communication methods used in the exhibit.

What is the aim of the interpretations?

How effective is the messaging? Provide evidence to support your opinion.

Exhibit Information 1

Choose an exhibit that you think demonstrates GOOD interpretation and critically analyse the communication methods used in the displays around the exhibit

Determine the key theme or message in the exhibit.

Identify the communication methods used in the exhibit.

What is the aim of the interpretations?

How effective is the messaging? Provide evidence to support your opinion.

Exhibit Information 2

Choose an exhibit that you think demonstrates POOR interpretation and critically analyse the communication methods used in the displays around the exhibit

Determine the key theme or message in the exhibit.

Identify the communication methods used in the exhibit.

What is the aim of the interpretations?

How effective is the messaging? Provide evidence to support your opinion.

TARONGA ZOO
For the Wild

Keeper Talk

Attend one of the daily Keeper Talks and pay close attention to the communication methods used to convey a message and inspire environmental action.

Determine the key theme or message of the talk.

Identify the communication methods used in the talk.

How effective is the messaging? Provide evidence to support your opinion.

TARONGA'S BREEDING PROGRAMS

Using information from exhibits around the Zoo and the Taronga website www.Taronga.org.au, complete the table below for two species of your choice.

Species	Reproductive Method	Breeding Program Details

TARONGA ZOO For the Wild

BACK AT SCHOOL
DESIGN YOUR SCIENCE COMMUNICATION INITIATIVE

TARONGA ZOO For the Wild

STEP 1 - CHOOSE YOUR SPECIES

- Bongo
- Tasmanian Devil
- Asian Elephant
- Corroboree Frog
- Regent Honeyeater
- Little Penguin
- Other: ______

STEP 2 - CHOOSE YOUR CAMPAIGN

- Wildlife Witness App
- Little Free Oceans
- Raise Your Palm
- They're Calling on You
- Fish For Good
- Beads for Wildlife
- Other:_______

Find Taronga's community conservation campaigns at Taronga.org.au/conservation-and-science/act-for-the-wild

STEP 3 - RESEARCH

- Taronga Zoo https://taronga.org.au
- NSW Government Office of Environment & Heritage https://www.environment.nsw.gov.au
- NSW National Parks and Wildlife Service https://www.nationalparks.nsw.gov.au
- Department of the Environment and Energy https://www.environment.gov.au/biodiversity
- Threatened Species Recovery Hub http://www.nespthreatenedspecies.edu.au
- Zoo and Aquarium Association (Australia) https://www.zooaquarium.org.au
- World Association for Zoos and Aquariums http://www.waza.org

STEP 4 - GET CREATIVE

- You can choose to design either a display for an exhibit, a page for a website or a Keeper Talk style presentation to record or deliver to your class.
- The team at Taronga Zoo would love to see what you come up with.
- Remember to translate data into diverse media that appeals to multiple learning styles.