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A Conglomeration of Stilts: An Artistic Investigation of Hybridity

BIOLOGICAL HYBRIDITY

Hybridity of native species, especially critically endangered ones, is of great concern to the natural history and wildlife management communities of New Zealand. Human impact on the environment has resulted in an increase in the interbreeding between species worldwide, which has given rise to an increase in hybridisation. This genetic mixing has the potential to threaten many species with extinction.

Hybridisation is greatly influenced by human impact on the environment, through effects such as habitat loss and fragmentation and species introductions. Such impacts make it difficult to conserve the genetic diversity of populations.

Hybridisation has contributed to the extinction of many species through direct and indirect means. However, recent studies have found that natural hybridisation has played an important role in the evolution of many plant and animal taxa. Determining whether hybridisation is natural or anthropogenic is crucial for conservation, but is often difficult to achieve.[1]

Controversy has surrounded the setting of appropriate conservation policies to deal with hybridisation and introgression (genetic admixture resulting from backcrossing with one of the parent species). Any policy that deals with hybrids must be flexible and must recognize that nearly every situation involving hybridisation is different enough that general rules are not likely to be effective.

The increased use of molecular techniques to determine the extent of interbreeding between species focuses attention on the extent of this underappreciated problem, that is not always apparent from morphological observations alone. Some degree of gene flow is a normal, evolutionary process; however, hybridisation with or without introgression may, nevertheless, threaten a rare species' existence.[2]

KAKĪ AND POAKA GENETIC RESEARCH

Figure 1. Kakī. Photo by Liz Brown, DOC Kakī Recovery Group.

Natalie Forsdick is investigating the hybridisation between kakī and poaka, two New Zealand stilt species. Poaka have self-introduced from Australia, and their range has expanded across the country as the kakī population has declined.

When kakī numbers have been historically low, interbreeding between the two species has occurred, resulting in fertile hybrids that display a range of plumage nodes (hybrid black stilt colour patterns are described as "nodes", ranging from "A", closest to a pied stilt, to "J", closest to a black stilt) intermediate to those of the pure black kakī and the mixed white and black poaka, first described by R.J. Pierce in 1984. Plumage characteristics have been shown to be representative of the underlying genetic makeup of the three groups, with hybrids of intermediate plumage having a mixture of the genetic traits of both kakī and poaka.

A previous genetic study led by Tammy Steeves in 2010 used a very small number of genetic markers to confirm the genetic integrity of kakī.[3] However, the methods used, while the best available at the time, may not be representative of effects across the whole genome. Genetic sequencing techniques have rapidly advanced in recent years, and allow us to re-examine these results on a wider scale across the genomes of these birds.

For Natalie's research project, in collaboration with researchers at the University of Otago, the University of Canterbury, and the Kakī Recovery Team at the Department of Conservation, she is sequencing and assembling the genomes of kakī and poaka to investigate what effect this hybridisation has had on the genome of the threatened kakī population, and whether any genetic information from poaka has been incorporated into the kakī genome.

Natalie will also assess regions of the genome associated with plumage colouration, to find out more about the genetics underlying the varying plumage nodes. As hybridisation may have negative effects on species survival and recovery, this information will be useful for kakī conservation management, and inform other conservation programmes involving hybridisation.

ARTISTIC HYBRIDITY

As a contemporary jeweller with a background of working in natural history, I was drawn to Natalie's work. My art practice focuses on the investigation of biodiversity loss and absence. Disappearing and extinct New Zealand species are the motivation and focal point of my work. I jumped at the chance to learn more about one of our critically endangered species and the work behind the scenes to save it.

Figure 2. *MW2017-01-01 Pure Poaka*, brooch, copper, 925 silver, aluminium, heat shrink tube, polymer clay, resin, steel pin, 150 x 50 x 10 mm and *MW2017-01-09 Pure Kaki*, brooch, fine silver, 925 silver, aluminium, heat shrink tube, polymer clay, resin, steel pin, 150 x 50 x 10 mm.

I have always been interested in the concept of hybridisation, in its many different forms, and this project presented the opportunity to learn and investigate the different meanings and implications of this. It also presented the chance to raise awareness for kakī and the complications it is facing to survive.

Inspired by Natalie's research I created a series of nine brooches, *A Conglomeration of Stilts*. These brooches represent each of the individuals outlined in the original hybrid description by Pierce: a kakī, a poaka, and seven intermediate hybrid birds.

Each brooch depicts the black-and-white plumage of the birds on the front; the back, which represents the hidden, genetic rofile of each, is made from a different metal alloy, pure silver for the kakī, pure copper for the poaka, and varying proportions of silver/copper alloy for the hybrid birds.
I began by designing a simple, anthropomorphic bird figure. Influenced by modernism, I wanted to create a form that captured the personality of the birds and could be recognised as a stilt. By being anthropomorphic, each talks of the influence that humans have had on their continued existence. Long legs and beaks were imperative, and I required a body that would allow me to add plumage colours on the front and a metal alloy on the back.

The silver/copper alloys were calculated to exact proportions, the individual metals weighed and combined before being melted together and poured into ingots.

Brooch number	Bird descriptor	Silver/copper alloy
MW2017-01-01	Poaka	0 (copper)
MW2017-01-02	Hybrid D1	125
MW2017-01-03	Hybrid D2	250
MW2017-01-04	Hybrid E	375
MW2017-01-05	Hybrid F	500
MW2017-01-06	Hybrid G	625
MW2017-01-07	Hybrid H	750
MW2017-01-08	Hybrid I	875
MW2017-01-09	Kakī	1000 (Silver)

Table 1. Metal alloys.

Interestingly, as I created the metal alloys, intriguing metaphors presented themselves. The alloys had different properties to their parent metals (in terms of hardness, ductility, melting point, malleability, lustre, degree of oxidisation, etc), just as the hybrid birds differ from their precursors. The colour of the alloys changed from silver to gold to red, with unexpected results, dependent on the (genetic) dominance of one metal over the other, matching the plumage morphology seen in the individual hybrid birds. The metals also mixed differently when alloyed, some more resistant to combining than others.

This heterogeneity displayed by the metals reflects the diversity of physical and behavioural traits displayed by the intermediate hybrid stilts. It also delivers thought-provoking allegories and raises many complex and loaded moral and scientific questions around interspecies breeding.

Figure 3. Melting copper and fine silver together to make alloys.

Figure 4. Installation view of work at Art and Genetics exhibition, 2017.

For their display in the Art and Genetics exhibition they were hung like marionettes, their movements, positioning and destiny controlled by someone else.

My intention for these bird brooches is for them to initiate conversations and questions around the concept of species hybridisation and intervention.

CONCLUSION

As a result of this project I have learnt so much. I have become aware of the grey areas that surround moral questions around intervention and interference. I have come to understand the debates over financial implications for managing a critically endangered species, and when to call time. If a species is threatened as a result of human impact, do we then owe it to them to do everything we can to ensure their existence, or are we messing with the greater picture of survival of the fittest? As we enter the Anthropocene, these are all questions we need to consider.

Michelle Wilkinson graduated with a BSc (tech) from Waikato University in 1994, and a PGDip Sci (Environmental Science) in 2000. She worked in marine and environmental science for many years before retraining in contemporary jewellery, and is currently enrolled in a MFA at the Dunedin School of Art.

Natalie Forsdick graduated with an MSc from the University of Canterbury in 2016, and is now a PhD student at the University of Otago, working to assemble a kakī genome. Passionate about conservation, her research focuses on the use of genetic and genomic techniques as part of the conservation 'toolbox' to assist species recovery. You can follow her on Twitter @NatForsdick, or contact her at natalie.forsdick@postgrad.otago.ac.nz.

1. Judith Rhymer and Daniel Simberloff, "Extinction by Hybridization and Introgression," *Annual Review of Ecology and Systematics,* Vol. 27 (1996): 83-109.
2. Fred Allendorf, et al., "The Problems With Hybrids: Setting Conservation Guidelines", *Trends in Ecology & Evolution* Vol.16 (2001): 613-622.
3. Tammy Steeves, et al., "Genetic Analyses Reveal Hybridization but No Hybrid Swarm in One of the World's Rarest Birds," *Molecular Ecology,* Vol.19 (2010): 5090-5100.