

Who wears the pants in this relationship? Investigating hormonal and behavioural aspects of sex role reversal in Brown Kiwi (*Apteryx mantelli*)

Birds are a group known for their strong sexual dimorphism and males that are particularly eye-catching, from bright feathers to loud calls to enigmatic dances and nest building. These traits which are so interesting for us to observe as both bystanders and scientists serve the purpose of securing a mate through demonstrating physical health, prowess and sets of skills that are vital in the species in question. Most female birds, in contrast, sit in the nest and take care of their offspring, a job that requires them to look and behave in a way as to not be detected. The North Island brown kiwi is one species that is known to take this dynamic and invert it. Females are significantly larger than males in body size and have disproportionately longer bills, while males serve as primary egg incubators. Despite these indicators of inverse sexual dimorphism and parental behaviour in the NI brown kiwi, little research has investigated the inversion of sexual behaviours that would be expected to be found alongside these traits.

We have conducted brown kiwi research on an island in the Hauraki Gulf for 19 years. Annually, our team of researchers, students and trained volunteers fit between 30 to 50 individual kiwi with transmitters in order to record their daily behaviour and movement on the island. Other projects often run concurrently to this main project, as post-graduate students continue to investigate and understand the daily lives of the NI brown kiwi in a wild dense population. Video footage collected on trail cams over two years (2014 and 2015) was available from this population (Strang, 2018) as well as footage collected at nests for this specific project in 2021 and 2022. This allowed us to describe and further analyse the sexual behaviour of brown kiwi.

We analysed 56 videos of brown kiwi interactions collected between 2014 and 2015. From that data, 18 videos contained interactions between an identifiable male and female. Previous anecdotal observations and notes in papers presented that that kiwi engage in a chase-and-tussle style interaction between each other but did not provide context. Our analyses of our videos confirmed that these interactions happen a) between male and female birds and b) happen only within the breeding season (Figure 1) and we propose that these are mating displays.

Behaviour	Description
Bird following another bird (beak on back)	One bird clearly following another bird, bottom of the tip of the beak typically rested on the arch of the back of the bird leading
Grunting	Grunting/squeaking-like noise made by individual bird (specifically adult males during the breeding season)
Grabbing at feathers	One bird clearly grabbing at the feathers of another bird with the beak, typically the back, thigh or flank feathers
Pulsing on feet	Individual bird standing on the front of toes, pulsing in an up and down motion, typically seen during intense interaction with other birds
Pivoting	One bird visible spinning in place, usually 180-degree turn
Tight circle chases	One bird pursuing another bird in a tight circle in a limited small space
Necks crossed	Two birds facing chest to chest, necks are crossed as heads are looped over one shoulder of the other bird, and beaks are rested on backs (or often, grabbing at

	feathers)
Chest shoving	Two birds facing face to face use the chest/sternum area to force each other backwards
Beak movement in front of face	One bird slowly moves beak in front of the face of the other. Usually from low to up high.
Kicking	One bird striking at another with feet (usually at the chest, thigh or back region)
Bird falls	A bird falls on its side on the ground, usually from an interaction with another bird
Shoving bird from side (beak over back)	One bird shoves another from the side on, and keeps momentum by placing its head over the other birds back so the beak is looped over the back arch
Tapping other bird with beak	Brief touching of another bird with a beak

Our results indicate that this behaviour is sexual in nature due to the timing and sex of the individuals involved. Observations of females leading the way in some of these interactions support the over-arching theory that brown kiwi females have what humans would consider masculinised behaviour. Our next stage of research is currently underway as we test hormones of both male and female brown kiwi both inside and outside of the breeding season in order to determine whether or not a potential hormonal mechanism for these differences can be identified.

This project would not be possible without the support of Birds New Zealand, who has been extremely generous in supporting our continued work with the NI brown kiwi. A giant thank you also to all the volunteers who make data collection possible, and to Katherine Strang for sharing her video footage with us.



Figure 1. Still photos cropped from two of our videos. In the left a male and female can be seen engaged in neck crossing, a behaviour that forms part of the brown kiwi mating display. On the right, a group composed of three birds is engaged in a mating display. These birds all had transmitters, but in these stills, only some devices can be seen (orange arrows) due to the birds being in motion. F = female; M = male.