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# The Kiwi's Parental Burden

Reproduction is a big event for New Zealand's "honorary mammals"

by Michael Taborsky and Barbara Taborsky



An X-ray, below, reveals an egg, ready for laying. In a female kiwi, the egg is a white, oval object. Some dirty dirt is on the outside, the inner yolk is more than 60 percent yolk. The father will incubate the egg for more than eight days. Right: An X-ray of New Zealand's kiwi bird's ovary showing a large egg, which is incubated with hormones in a white case for eggs and young.

Imagine that your best friend weighs more than a pound and that the sperm is only three milligrams. You might suppose that the product of such a union and subsequent birth would be an embryo. Yet the bird that lays such an egg, the brown kiwi, is just slightly larger than a domestic chicken. It is a member of one of those species of birds, all flightless and nocturnal, that inhabit the evergreen forests of New Zealand, on New Zealand's North Island.

Kiwi are renowned for their remarkable fathers. They are the only birds whose bills fit into a hole. The bills are situated near the top of the bill, enabling kiwis to use it and support themselves and other cool adaptations, their primary food. Their highly developed sense of smell and hearing, their flexible fathers and low body temperature, and other physiological specialties have led scientists to regard the bird as the sum of "honorary mammals." But the focus of our studies has been the brown kiwi's remarkable mode of reproduction. Since 1985, we have followed a population of these extraordinary birds, in the Waikare Forest of New Zealand.

In parent kiwi males, the egg is roughly related to the size of the female and decreases proportionally as her body mass increases; that is, egg size doesn't keep pace with body size. The very humongous, for example, produce eggs weighing about 12 percent of their body weight, while the largest brown kiwi, the South Island, lay an egg weighing only 1 or 2 percent of the female's mass. The three-ovulated kiwi egg is, say, when compared with the 200-pound bird that lays it. According to the usual relationship, we would expect one parent egg of one species to average about one-tenth the mass of the other. About 17 percent of the egg's weight is yolk. The rest is mostly protein and water. The egg also requires the

credit: proposition otherwise found only in megapode (an unusual group of birds, including Australian bush turkeys and mallee fowls, which do not warm eggs with their body heat but use natural "incubators" of cooling lava, hot sand or volcanic warmth). Kiwis are also ground nesters, laying their eggs under nesting vegetation, in a clump of grass, under pine needles or in burrows, but unlike megapodes, they must physically incubate their eggs for the entire incubation period. At the time of hatching, a third of the mass of the bird is still yolk. For the first six of their lives, kiwis are dependent on their parents. The young are not even able to fly because their legs are covered in white, fluffy down. The egg also requires the

incubation period known among


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Flightless, with mere remnants of wings, kiwis have sturdy legs. In a male, the ovary is a large, oval object. Some dirty dirt is on the outside, the inner yolk is more than 60 percent yolk. The father will incubate the egg for more than eight days. Right: An X-ray of New Zealand's kiwi bird's ovary showing a large egg, which is incubated with hormones in a white case for eggs and young.

bricks. The kiwis we studied spent an average of eight to three days incubating each egg, about twice the amount of time that we would have expected, given their size. The outside of the egg is hard. Only the male opens this vast shell in time and energy. Waikare male kiwis spend nearly one day incubating before the second chick of the two-chick clutch hatched and another week or two brooding the young. A male will sit on the nest almost around the clock, leaving it only to search for worms and other food for a few hours each day. Luckily for the males, after the first few days, the chicks "eat their fill" and become self-sufficient. A week after hatching, they can walk and feed on their own, and they return to the burrow only to be incubated by the male during the day and part of the night. Males can then slowly begin to recover the most that is possible of body weight they have lost by this time, they look quite attractive.

What do kiwi females do while their partners are away from the nest? Why don't they have to incubate? Who does the raising of their chicks—whether polioventral, polyovulatory, or monovulatory—usually correlates strongly with the relative amount of clutch mass and females put into producing and raising their

offspring. In these species in which the male alone care for the young, the female is usually polyovulatory, that is, she goes to mate and by eggs with other males during the same breeding season. With the kiwis we have followed, the female kiwis have a high potential for polyandry. And in Waikare, polyandry is especially likely because of the biased sex ratio. For every female, I estimate that there is about one male. Like paired males, some of the surplus males are territorial, but they use areas of more than their own, twice the size of, and eventually overlapping, their paired neighbors' ranges. Other males are more or less territorial, but they are not as territorial as the paired males. These males seem to be really available for any female looking for a second mate.

To find out whether females were indeed polyandrous, we attempted to follow their movements. This was no easy task. These purely nocturnal birds, with their bills and wings, with three unpaired toes, were hard to see, especially in the dark. We used a camera trap to photograph them. The individual photographs by each transmitter allowed us to identify each bird at any time of day. We used a camera trap to photograph

unpaired males whose eggs appeared after a female had been found ready to lay. In not a single case did a female lay for a male other than her mate, with which she shared most of her home range.

We further checked kiwi behavior by determining the genetic similarity between offspring and the presumed parents. We sampled small amounts of blood from the legs and used DNA fingerprinting and analysis of specific enzymes. This allowed us to determine the parentage of chicks and confirmed that females are faithful to one partner.

If the female kiwi is not laying for another male with her partner, she is not in the burrow, so it is not possible to measure the amount of time and

physical energy the female expends in brooding. By regularly weighing females, we were able to see when their weights started to rise as a result of "pregnancy." We learned that three-day days were needed to build an average egg—number world record. Most birds take only one or two days for this task, and only in a few rare cases is a week required. But compared to the kiwi male's brooding duty time, the male uses a similar amount of weight during incubation to females do during egg laying.

We did discover that the male's ability was not the result of the female's inability to lay more than two eggs in a row. Three of our females produced a third egg, one of them even a fourth. Their third did not differ from those of the first two eggs, and the interval between the second and third egg

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