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**Kereru (*Hemiphaga novaeseelandiae*) -  
Impact injuries, morphometrics, moult and plumage.**

**Rachael Anne Cousins**

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## **Abstract**

The New Zealand Woodpigeon or Kereru (*Hemiphaga novaeseelandiae*) is a monomorphic pigeon that is often seen in urban and rural areas, feeding on native or introduced plants throughout the year. The Department of Conservation (DoC) offices around New Zealand, in particular the lower North Island, receive many Kereru each year due to predation and fatalities caused by impacts with windows and vehicles. Little scientific work has been conducted on such a valuable resource to date, so in this study I accessed and used 50 of these Kereru, as well as 76 reports from the Massey Wildlife Clinic (the wildlife surgery and rehabilitation wing of the Institute of Animal, Veterinary and Biomedical Sciences (IVABS)), 20 specimens from Massey's necropsy database and 119 moult records from other workers, to study four aspects of impact injuries and Kereru biology as outlined below.

(1) The type and extent of injuries that were sustained through collision events and how this affected rehabilitation. We used radiographs and necropsies to determine the skeletal and soft tissue injuries in 70 Kereru that died in such collisions, and radiographs of 61 birds that were assessed or treated having survived initial impacts. Vehicle collisions tended to result in damage to the extremities (wing and femur), whereas collisions with windows resulted in trauma to the head, fractures/dislocations of the coracoids and clavicles, and ruptured internal organs. Fractured coracoids frequently damaged flight muscles and ruptured the heart. Extensive bruising of pectoral muscles and haemorrhaging of the lungs was due to the force of impact. Rehabilitation time was not related to the number of skeletal injuries sustained, nor was the time until death for those that did not survive. Flight speed and force calculations suggest that a 570g Kereru would collide with 3-70 times the force that smaller birds (5-180g) would; this may explain the discrepancies between the injuries characterised here and those reported for North American passerines. The differences in injuries sustained from collisions with windows and cars can be used to inform rehabilitators about the possible nature of injuries if the source of impact is known.

(2) Morphometry, gastrointestinal organ masses and crop contents. Of 50 Kereru that died due to impact collisions, little physical variation was found between sexes; males had longer head/bill lengths. Overall, different structural measures were positively related (mass and tarsus, wing and tail, mass and head-bill and head-bill

and tarsus) but variation was generally high between individuals. Fat scores of Kereru were closely related to environmental seasonal variation and 80% of birds were in good body condition. Kereru lack caeca and there were no sexual differences in reference to dry organ mass (liver, intestine, gizzard and crop). Organ masses reflected body mass and size to varying degrees: liver mass was best explained by body mass, gizzard mass by tarsus length as much as body mass, and intestine mass only by body mass. Kereru intestines were proportionately shorter than those of herbivorous grouse, despite grouse having long caeca to help with digestion of plant matter. Kereru seem to rely on long retention times instead, and up to 68g of plant matter were found in the crop, gizzard and intestines. There were no sexual differences in mass of consumed materials found within the gastrointestinal tract, consisting of introduced and native material (foliage/flowers/buds/fruits). Digesta accounted for 0.12 – 13.4% of total Kereru body mass.

(3) Kereru flight feather moult, wing area and wing loading. One hundred and sixty nine Kereru moult records showed that Kereru moult over a nine month period (July – March/April), with a restricted moult of tail feathers during the breeding season. Kereru moult is symmetrical in relation to the number of primary feathers moulted, but not in respect to the position on the wing. Kereru often have multiple moult loci and do not follow a conventional moult sequence. This moult strategy reduces the effect that feather gaps have on wing area and thus wing loading. The moult strategy of Kereru is a solution that works to minimise the change in wing area, but at the cost of having a prolonged moult.

(4) Plumage colouration assessed using reflectance measurements from light spectrometry. This study is the first to assess UV signals in Kereru and UV signals were found in all eight regions investigated, five plumage (Breast, Crown, Mantle, Wing and Rump) and three bare parts (Bill base, Bill tip and Foot). The greatest intensity of maximum UV signal (uvmax) was in the bare parts with a covariance of the bill tip and foot. No sexual differences or condition dependent signals were found, but age-related UV signals were found in the crown and foot. In the visual spectrum, females had a greater intensity of maximum colour signal (rmax) in the wing. Age-related colouration was seen predominately in the bare parts, in particular the foot which has a higher intensity of colour in juveniles. Even with single-angle light spectrometry Kereru are a highly cryptic species.

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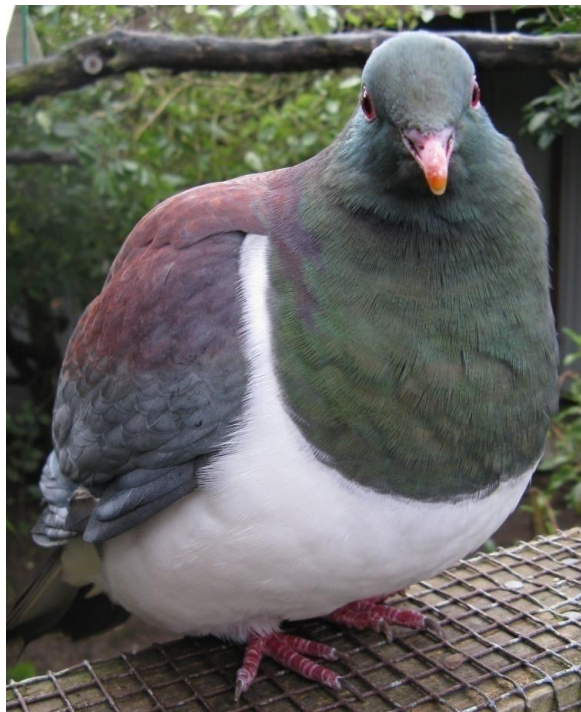
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**Photograph 1 Inquisitive Kereru at Nga Manu Nature Reserve.**

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