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Dromaius novaehollandiae 47

Order STRUTHIONIFORMES

Flightless cursorial birds; all, except Apterygidae, huge. Also known as Ratitae and referred to loosely as 'ratites' from the Latin *ratia* (raft) after their raftlike sternum, without a keel. Five living families Struthionidae, Rheidae, Casuariidae, Dromaiidae and Apterygidae, placed in four sub-orders; Casuariidae and Dromaiidae being combined in one, Casuarii. Has also been combined with Tinamiformes to form a single order Palaeognathiformes (Cracraft 1974) or split into three separate orders without Apterygidae (Storer 1971). On basis of DNA-DNA hybridization, four families recognized: Struthionidae, Rheidae, Casuariidae, Apterygidae in two sub-orders Struthioni and Casuarii (Sibley *et al.* 1988). Dromaiidae, Casuariidae and Apterygidae confined to A'sian region. Struthionidae introduced to Aust. Usually now considered to have common origin, probably from flying ancestors and likely to have originated in Gondwanaland (Cracraft 1974; Rich 1975).

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Family APTERYGIDAE kiwis

Nocturnal, flightless, cursorial birds, smallest ratites, only 25–55 cm tall. Endemic to NZ. Three species in one genus. Generally regarded as most closely related to moas (extinct), both being descendants of Gondwana fauna and most ancient element of NZ avifauna. Much reduced thoracic musculature and bone-structure; small head and long neck, usually held forward, but well-developed pelvis and legs give a pear-shape to body. Bills long (up to 200 mm), with nostril openings and rictal bristles at base. Wings greatly reduced and mostly naked with claw at tip. No tail. Feathers of one type with single rachis and unlinked barbs giving shaggy appearance to plumage. No seasonal change to plumage. Eyes small. Legs and feet, well developed. Three forward-pointing toes with strong claws. Hind toe small and above foot. Chicks hatch fully feathered and active. Juveniles reach adult size at about 18 months. Habitat is sub-tropical to temperate, evergreen forest and scrub from sea-coast to alpine terrain at 1000 m. Feed principally on invertebrates. Eat some plant material including fleshy fruits. Use bill to probe for food and can detect it by smell (Wenzel 1968). May also be able to hear movement of larger invertebrates. Feet not used for scratching. Nocturnal, except Brown Kiwi on Stewart I. Sedentary and territorial throughout year. Territories maintained by calls and aggressive encounters. Roost singly or in pairs in burrows dug by birds themselves or in natural cavities at or near ground-level. Monogamous with long-lasting pair-bonds probably reinforced by sharing of roosts and by allopreening. Voice has considerable carrying power and probably serves to keep members of pairs in contact as well as to advertise territory. Little pre-copulation behaviour has been observed, but chasing, jumping, hissing and close-contact grunting occur. Long laying-season of 4–8 months. Replacement laying occurs. Nest in burrows or natural cavities. Clutch 1–3. Eggs very large and 18–25% of female's body weight. Generally, only males incubate, but females may take part at times. No brood-patch. Approximate incubation period 63–92 days. Chicks precocious and nidifugous; first leave nest when few days old and feed unaccompanied; probably never fed by parents. Males brood chicks in nest during day for first 2–3 weeks. Young may disperse in first year. Can breed in their second year in captivity. May live in captivity for over 20 years.

REFERENCES

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Apteryx owenii Little Spotted Kiwi

COLOUR PLATE FACING PAGE 73

Apteryx owenii Gould, 1847; *Proc. zool. Soc. Lond.* 1847: 93 — locality unknown, New Zealand.

Named in honour of Sir Richard Owen (1804–92), Hunterian Professor of the College of Surgeons and Superintendent of Natural History Dept. of British Museum; responsible for BM(NH) building in S. Kensington, London; an opponent of Darwin.

OTHER ENGLISH NAMES Little Grey Kiwi, Kiwi.

MONOTYPIC

FIELD IDENTIFICATION Length 35–45 cm; stands 25 cm tall; bill males 68 mm, females 85 mm. Medium-sized, flightless, nocturnal bird with pale-mottled, grey shaggy plumage, pear-shaped body and long neck and bill. Head and eyes

small in relation to size of body. Tail absent; wings vestigial, tipped with a claw but hidden in body plumage. Bill long (about 20% of total length) and slightly decurved with nostrils at tip where upper mandible overlaps lower. Legs and feet well developed; three forward-pointing toes with strong claws; hind toe above foot and reduced. Smallest kiwi; about half the weight of other species; length of bill and leg about two-thirds that of other kiwis. Sexes similar; females larger, with longer and more decurved bills than males. Juveniles and immatures to about 18 months smaller than adults. No seasonal plumage changes other than wear.

DESCRIPTION **ADULT MALE.** Head and neck, grey. Rest of plumage shaggy; entirely grey, mottled (spotted) with white, forming pale transverse bars; wings, vestigial, hidden; no tail. Bill, long slender and straight or slightly decurved; ivory coloured. Iris, blackish-brown. Legs and feet, off-white to pale pink; claws usually white sometimes darker. **ADULT FEMALE.** As male but larger, heavier; bill longer, more decurved (see Measurements, Weights). **JUVENILE, IMMATURE.** As adult but smaller; adult size attained at about 18 months old.

SIMILAR SPECIES Similar only to other kiwis. **Brown Kiwi** *Apteryx australis* has brown plumage with dark lengthways streaks. Easily confused with **Great Spotted Kiwi** *A. haasti* and distinguishing field characters not resolved; adult Great Spotted considerably larger and, generally, have rufous tinge to back. Possibly Great Spotted (*q.v.*) can appear paler with wear. Little Spotted Kiwis may be indistinguishable from immature Great Spotted Kiwis as these tend to be pale but inseparable on size. An immature female Great Spotted Kiwi (NMNZ 11872), has exposed bill of 86 mm but body clearly smaller than adult Little Spotted, which suggests immature female Great Spotted can be told from Little Spotted on proportionately longer bill. Great Spotted Kiwis are probably bolder and more aggressive but no clearly distinguishable behaviours have been identified. Calls of Great Spotted Kiwi more powerful and drawn-out and can usually be distinguished with experience.

Nocturnal, but chicks also crepuscular; generally solitary or in pairs; inhabit forest or scrub. Long-striding running gait; a springy jump often seen when interacting with another kiwi. Flightless. Usually feed at night, by probing ground or rotten logs with bill or picking from surface. Virtually restricted to Kapiti I. Calls are best indicators of presence of kiwis: call of male, high pitched whistle; of female, lower-pitched trilled whistle.

HABITAT Occur in forest and margins of forest-scrub in temperate region; from sea-level to at least 1000 m; air temperature, sub-zero to 25 °C; average annual rainfall, 1000 mm, spread through year (in parts of original range, up to 6800 mm). Inhabit hilly country; historically probably also mountains and plains.

Occur in evergreen, broadleaf forest with dense undergrowth, in small-leaved, evergreen scrub, and in margins of grassland. On Kapiti I., inhabit older broadleaf forest (*tawa* *Beilschmedia tawa*, *kohekohe* *Dysoxylum spectabile*) and younger seral forest (*kanuka* *Kunzea ericoides*, five finger *Pseudopanax arboreus*) and adjacent patches of rank grassland (J.N. Jolly). Early observers' reports came from dense wet forests with mossy floor and many rotten logs (Oliver) and from lighter forest (Hill & Hill 1987). At one locality in NI, found in high open tussock-country at c. 900 m, and below the

snowline, in mossy places in bush free from undergrowth (Buller 1888; Oliver).

Favour steep banks for roosting and nesting burrows. Early observations of roosting and nesting in hollow trunks, natural holes and cavities among roots of large forest trees, clefts and fissures in rocks. Also, under clump of tussock grass, under overhanging stone on slope of wooded hill (Buller 1888).

Lost from most of original range. Declined in NI before European settlement; now extinct on NI, probably on SI and D'Urville I. (Williams & Given 1981; J.N. Jolly); probably by burning of habitat, conversion to crops and pasture. Introduction of mammalian predators likely major cause of decline in European times.

DISTRIBUTION AND POPULATION Endemic to NZ. Only remaining populations on Kapiti I. and those introduced to Red Mercury and Hen Is (NI) and Long I. (SI).

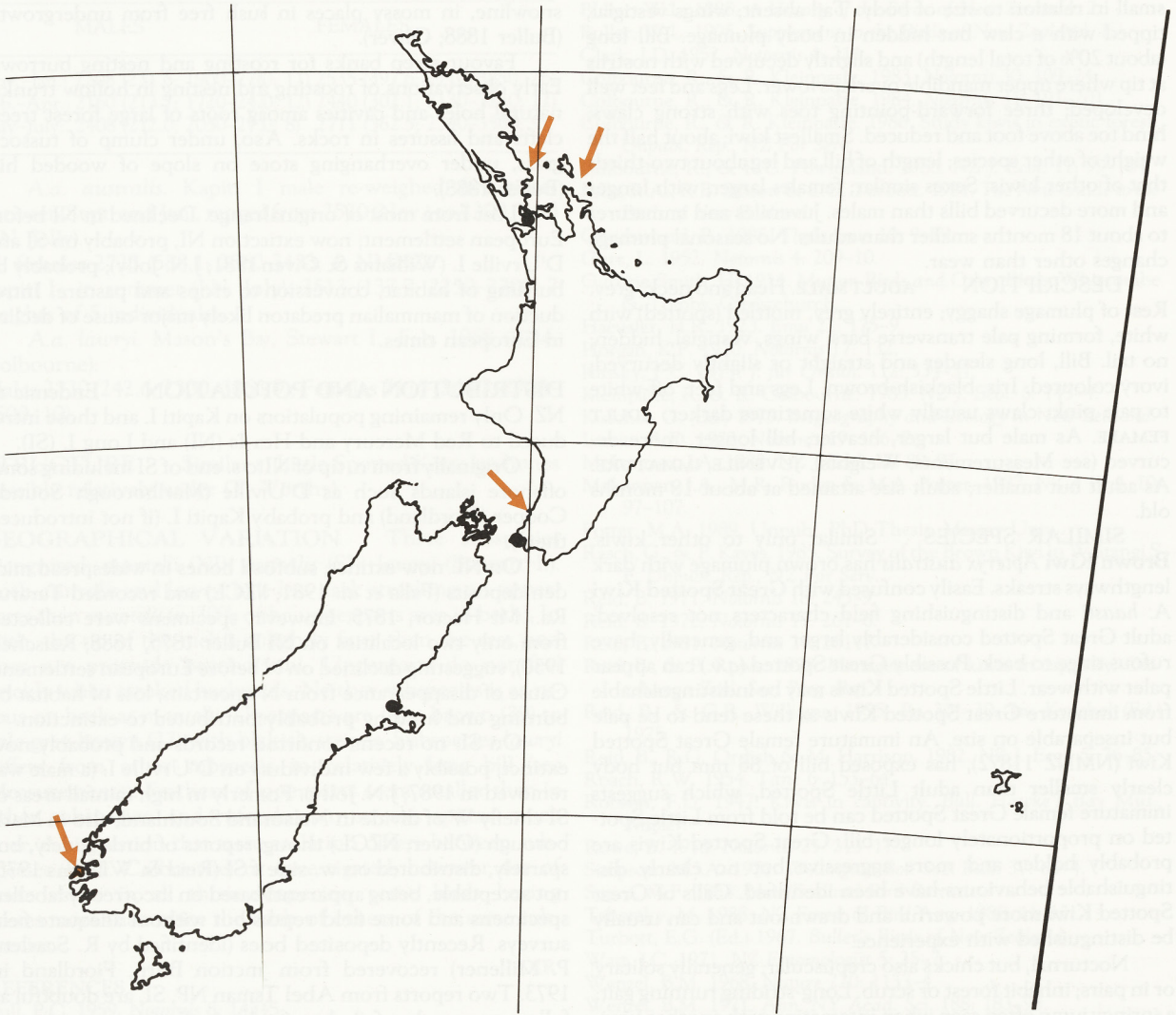
Originally from n. tip of NI to s. end of SI including some offshore islands such as D'Urville (Marlborough Sound), Cooper (Fiordland) and probably Kapiti I. (if not introduced there).

On NI: now extinct; subfossil bones in widespread midden deposits (Falla *et al.* 1981; NZCL) and recorded Tararua Ra.: Mt Hector, 1875. However, specimens were collected from only two localities on NI (Buller 1875, 1888; Reischek 1930), suggesting declined on NI before European settlement. Cause of disappearance from NI uncertain; loss of habitat by burning and hunting probably contributed to extinction.

On SI: no recent confirmed records and probably now extinct; possibly a few individuals on D'Urville I. (a male was removed in 1987; J.N. Jolly). Formerly in high rainfall areas of SI chiefly W of divide in Nelson and Southland, also in Marlborough (Oliver; NZCL) though reports of birds widely, but sparsely, distributed on w. side of SI (Reid & Williams 1975) not acceptable, being apparently based on incorrectly labelled specimens and some field reports but without adequate field surveys. Recently deposited bones (identified by R. Scarlet, P. Millener) recovered from Junction Burn, Fiordland in 1973. Two reports from Abel Tasman NP, SI, are doubtful as follow-up searches failed to find kiwis. Recent unconfirmed reports on D'Urville I. and from Fiordland, Chalky Inlet (1987), Shark Cove, Dusky Sound (1985) and Large Burn (feather recovered, 1969). Specimens from Smyth R., Westland and Whanganui Inlet (Banjo Creek) in 1978 (NMNZ: 23043 and 23036) probably Great Spotted Kiwis and reports of seven calls in Paparoa Ra. believed to be Great Spotted Kiwis (Jolly & Roderick 1983). Loss of habitat apparently contributed to extinction in NI but release of Stoats *Mustela erminea* more likely to be the major factor on SI; locally, pigs, dogs and hunting also contributed.

Origin of Kapiti I. population unclear; may have occurred there naturally before European settlement (Jolly 1985a; J.N. Jolly) or have been introduced to the island (Stidolph 1971; Atkinson & Daniel 1985; NZ Atlas). Report of introduction from Jackson's Bay, S. Westland in 1912 (Stidolph 1971; NZ Atlas) is doubtful (Turner & Thomson 1917; J.N. Jolly).

Introduced to Resolution and Long Is, Fiordland, from neighbouring mainland in 1890s and 1900s (Hill & Hill 1987) but probably died out. Recent introductions: to Long I. in 1981 and 1987 (two birds from D'Urville I. and two birds from Kapiti I.), to Red Mercury I. in 1983 (six pairs from Kapiti I.) and to Hen I. in 1988 and 1989 (18 pairs from Kapiti I.). Birds



established and breeding on Red Mercury and Long Is.

Population on Kapiti I. estimated currently 1000+ birds (NZ Atlas; Jolly 1985a); Red Mercury I., c. 17 birds; Long I., 5+ birds. Density on Kapiti I., about 1 pair/4 ha but may be less in drier scrub.

Status, endangered (Williams & Given 1981). Persists on Kapiti I., despite presence of rats and possums and predation of eggs by introduced Weka *Gallirallus australis* (Jolly 1989); fire or introduction of predators to island could threaten species (Williams & Given 1981; J.N. Jolly). Establishment of populations on other islands from stock at Kapiti I. being undertaken (J.N. Jolly).

MOVEMENTS Sedentary, adults probably occupying the same 2-3 ha territory throughout their lives. Juveniles disperse from territory but there is no information on distances travelled.

FOOD Omnivorous but mostly soil- and litter-dwelling invertebrates: earthworm, millipedes, adult and larval beetles, larval moths and flies, large crickets, spiders, some fruit and probably fern sprangia. Food taken from surface and by probing in ground and into rotten logs. Individual items

picked up with pincer-like action and tossed back into gullet within reach of tongue, which is shorter than bill. Probably detects food by sense of smell; nostrils at tip of bill, but may also be able to hear movements of large invertebrates with large lateral ears. Do not use feet to scratch litter or soil. Generally feed at night although chicks also crepuscular (J.N. Jolly).

At Kapiti I. (86 faeces; J.N. Jolly & R.G. Ordish) earthworms (Terricolae) 77% freq.; spiders 54; millipedes 26; insects: orthopterans 24, bugs larv. 24, beetles (Carabidae ads. 25, Scarabaeidae 60), lepidopterans mostly larv. 51, flies (Tipulidae larv.) 60; fruit 29. Size range (excl. annelids) 5-40 mm. Also on Kapiti I. (61 faeces; Colbourne & Powlesland 1988) earthworms 75% freq., spiders 66.

Chicks feed themselves but can probe only 50 mm into soil. Four faecal samples contained only small invertebrates (earthworms, millipedes, orthopterans, lepidopteran larvae, tipulid larvae; J.N. Jolly & R. Ordish).

SOCIAL ORGANIZATION Little known; information from Jolly (1989) and J.N. Jolly. In pairs, occasionally singly; transient birds sometimes present.

BONDS Sustained monogamous; probably lasting

for life (10+ years). No divorces in ten pairs studied between 1982 and 1986. Sex ratio 1:1. Pairing probably begins at 2 years of age; timing of formation of bonds, unknown. Male incubates and tends young until 3–4 weeks after hatching; female remains near nest only for first few days after laying and in week before hatching.

BREEDING DISPERSION Solitary. Dig burrows and also use natural cavities e.g. hollow tree stumps, logs and thickets of undergrowth. Territories of 2–3 ha held throughout year. No measures of nest density.

ROOSTING In burrows or cavities within territory, sometimes in dense vegetation. Same roosts used throughout year, but female tends to use those near nest about time of hatching. Most roosts used frequently and for many years. Shared by mates; burrows shared in 297 of 740 observations (Jolly 1989). Birds arrive at roosts at dawn and leave at dusk.

SOCIAL BEHAVIOUR No published studies; some information in Jolly (1989); information supplied by J.N. Jolly. Displays difficult to observe in field because species is nocturnal forest-dweller. No systematic observations of behaviour of birds in captivity.

AGONISTIC BEHAVIOUR Intruders in territory, either adults or immatures of either sex, not tolerated. Territory defended mostly through calls, though less boisterous than other kiwis; call all year, probably more often in spring (early in breeding season) and autumn, and mostly early in night. Neighbouring males may approach each other at territorial boundaries and call, sometimes with support of mate. Hostile approach to intruder, accompanied by snorts, can precede high-speed chases. If neither bird retreats, **FIGHTING** may occur; characterized by jumping, kicking and snorting interspersed with calls; losing bird flees. No information on appeasement and submissive displays.

SEXUAL BEHAVIOUR No information on pair-formation. Partners seldom meet at nest but any greeting likely to be similar to that elsewhere in which both birds stretch to full height with bills raised. Pairs together at burrows usually gave grunts and snuffles before, and sometimes shortly after, leaving burrow at dusk. Non-ritualized reciprocal allopreening not observed, but likely to occur; probably accompanies grunting by members of pair in roost shortly before emergence. Mates sometimes ran towards call of partner. **Bill-to-bill Display**: members of pair faced each other, bills horizontal and crossed, and shuffled round each other and utter short rapid soft grunts; observed once by Jolly (1989) and once before and during copulation. No detailed information on copulation, but accompanied by grunting.

RELATIONS WITHIN FAMILY GROUP Female known to visit nest-site up to 2 months before laying, but nothing known of interactions between pair in selection of site and change-over after laying. Only male incubates. Female seen near nest about time of hatching, but only male shares nest with nestling. Period chicks stay in nest not known; chicks leave and return to nest each night to forage for up to 26 days after first leaving nest; chicks usually left before male and returned after him in morning. Both parents escort chicks only loosely when away from nest. Adults never seen to feed young, in captivity or in wild and, because very young nestlings seen feeding themselves, unlikely parents ever feed them. Chicks *peep*; parents emit soft call when chick nearby. Not known how long immatures tolerated within parental territories; at first, juveniles shelter and roost in natal terri-

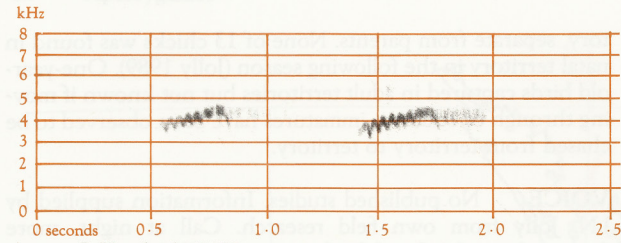
tory, separate from parents. None of 13 chicks was found in natal territory in the following season (Jolly 1989). One-year-old birds captured in adult territories but not known if moving through or resident; immatures have been observed to be chased from territory to territory.

VOICE No published studies. Information supplied by J.N. Jolly from own field research. Call at night, more frequently in the first 2 h after sunset; call throughout year which provides best indication of presence of kiwis. Contact calls very loud and audible from distance of several hundred metres. Range of calls limited: loud, high-pitched whistles and soft grunts, given by males and females, with differences between sexes. Occasionally hiss when agitated. Non-vocal sound: both sexes snap bills. Calls of Little Spotted and Great Spotted Kiwis similar and can be confused, particularly those of males, but calls of Great Spotted Kiwis more powerful, more drawn out and with slower repetitions; calls of Brown Kiwi also repeated whistles but distinct from those of spotted kiwis. Calls of Little Spotted Kiwis have some similarities to calls of Long-tailed Cuckoos *Eudynamis taitensis* and *Wekas Gallirallus australis*. Birds call frequently, at least hourly and more often when responding to neighbouring birds; calls more frequent in spring, at the beginning of breeding, and in autumn. Distinct sexual differences: female's whistles have same general form as those of males but with distinct trill; grunts of males lower pitched than those of females. No alarm or distress calls known. Little variation within types of calls.

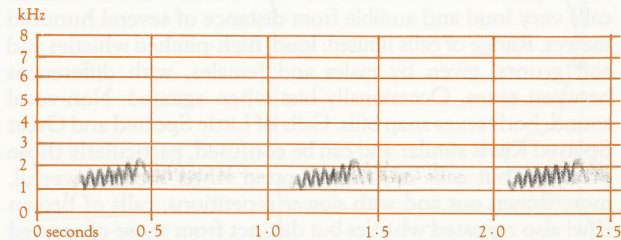
GEOGRAPHICAL VARIATION. Slight variation reported between Kapiti and D'Urville Is, but very small samples. Calls from both islands similar in ascending scale and range of notes, however taped calls of one female from D'Urville I. rise three notes higher than Kapiti I. females; calls of D'Urville I. males slightly lower pitched than those of males on Kapiti I.; one male on D'Urville I. also gave second call: soft, low-pitched and drawn out and not noted on Kapiti I. (J.N. Jolly; R.M. Colbourne). Differences possibly founder effect due to isolation of populations on these islands.

ADULT MALE Whistle. Short, ascending high pitched whistle; composed of single syllables, usually repeated 12–30 times in one call, duration 15–20 s (sonagram A). Functions as Contact Call between members of a pair, to maintain territory and in advertising; appears to be identical in these circumstances. When given at close range, function appears to be as principal Threat; may also function in mate-attraction and given during fights, interspersed with grunts. Frequency (Hz) possibly increases during agonistic encounters. **Grunt.** Soft low-pitched vocalization; lower pitched than equivalent female call. Given most often before pair sharing burrow emerges in evening and used throughout year as greeting between pairs sharing burrow; also during Bill-to-Bill Display and during copulation. **Chirps.** Both males and females sometimes make repeated soft chirps when near chicks (R.M. Colbourne). **Snorts.** Birds snort as part of hostile approach to intruders, which may precede high-speed chases; and during fights. **Hiss** as threat. **NON-VOCAL SOUNDS.** **Bill-snapping** used as threat, with Whistle; also used when birds agitated when being handled.

ADULT FEMALE Whistle. Similar to but clearly distinguishable from Whistle of males; distinctly trilled and of lower frequency than males (sonagram B); used in the same circumstances. **Grunt.** Also similar to that of male, but more highly pitched and more aspirated (less vocal) than males; used in same circumstances. **OTHER CALLS,** as male.



A J. Kendrick; P100



B J. Kendrick; P100

YOUNG Chicks and juveniles generally silent; occasionally *peep* when in nest and away from it; sometimes when handled. Probably functions as contact and alarm or distress call (R.M. Colbourne). Call of immature varies; similar to Whistle of adult but softer with fewer repetitions within any one call, at times breaking into full adult call; probably Bill-snap (Reid & Williams 1975).

BREEDING Not well known. Detailed field study at Kapiti I. by Jolly (1989) and R.M. Colbourne. Information supplied by J.N. Jolly. Breed solitarily in simple pairs, in burrows; usually in forest.

SEASON Claimed to breed throughout year (Kinsky 1971; Reid & Williams 1975) but at Kapiti I. usually Sept.-Oct., extending to Nov.-Dec., by replacement laying and occasionally Jan.-Apr.; active nests found only Sept.-Dec. in Fiordland, Oct. (Henry 1903).

SITE Generally in burrows in steep banks, rotten log or stump, or in existing cavity; in forest or well-vegetated areas; occasionally on surface, deep in thickets. Of 31 nests, 22 in burrows dug by Kiwis, three on ground in dense vegetation, three in logs, two in cavities in bases of tree stumps and one in seepage tunnel (Jolly 1989). Usually well hidden but may be quite conspicuous in more open places in spite of camouflage over entrance. Burrows 20–200 cm long, 9–15 cm in diameter, without enlarged nesting chamber. Occasionally in shallow cavity, where incubating bird clearly visible. New sites used annually and for replacements. No information on selection of site but female may roost nearby for some weeks before laying (Jolly 1989; R.M. Colbourne).

NEST, MATERIALS At Kapiti I., burrows differed in length at two sites: average 87 cm (40–190; 20) and 60 cm (50–200; 9); mostly horizontal or sloping slightly upwards. Burrow sometimes lined with twigs and dead leaves, collected readily nearby; feathers in lining probably adventitious. Twigs and leaves sometimes used to cover entrance. Males collect material but role of female, if any, not known; material picked up in bill and often thrown over shoulder towards entrance of burrow, cavity; process starts about time of laying (Jolly 1989; R.M. Colbourne).

EGGS Elliptical-ovate (obovate); smooth shelled; white, sometimes with green tinge.

MEASUREMENTS: 109.8 (106.3–114.6; 33) x 69.6 (67.2–72.1) (J.N. Jolly).

WEIGHTS: 301 (294–311; 4).

CLUTCH-SIZE Kapiti I.: 19xC/1, 3xC/2 (Jolly 1989). C/1–2 reported by Reid & Williams (1975) and Oliver.

LAYING Probably about 2–3 weeks between eggs (from captive birds; J.N. Jolly). No record of more than one female laying in a nest. At Kapiti I., first nest found on 10 Sept., last clutch started 24 Dec. Single brooded, if successful. Replacement laying average 46 days (31–55; 5) after loss. Only one replacement per year recorded and only a few early failures replaced.

INCUBATION Only by male, usually first attended the day after laying; may not incubate at all on 1 or 2 days in first 10; otherwise incubates continuously for 14 h each day in first 10 and apparently away from nest at night (10 h); later sits for 18–21 h by day and is off for 3–6 h by night. When leaving nest, male may or may not cover entrance. Not fed on nest by mate (Jolly 1989). **INCUBATION PERIOD:** 63–76 days, determined four times for C/1.

YOUNG Precocial, semi-nidicolous; usually stay in nest-site for 2–3 weeks. Fully feathered when hatched, with small adult-type feathers. Little information on growth; in captivity, one weighed 158 g at 8 days old; in wild, another, 216 g at 2–3 weeks old; and another, 200 g at one month old. Minimum weight of 15 chicks of unknown age in wild, 145 g. Weight can decrease as yolk-sac is depleted. Leave nest at c. 15–20% of average adult weight. Before departure, brooded by male in burrow at night only. Not seen to be fed by parents. Believed to be nourished on supply from yolk-sac for first few days, finds own food after departure. Often leave nest-site before dusk unaccompanied by parent and return after male at or after dusk dawn. Often alone in nest-site on last day, leave at dusk and then find shelter during day at base of tree or in thickets. Loosely escorted by parents for some weeks. No information on attainment of maturity but probably at least 2 years old before pairing or breeding (J.N. Jolly).

SUCCESS Of 28 clutches known at Kapiti I. in five years, only three (11%) eggs hatched, two chicks left nest. During three seasons (8–10 pairs): at least 0.92 laying/pair/year; 0.11 hatchings/pair/year; for 0.07 nesting success/pair/year (Jolly 1985a,b, 1989). However, these figures for a small sample during a short term, and effect on population has been questioned in view of unknown climatic and demographic factors over a long term in a population that is one of the densest known for any kiwi, perhaps in overcrowded conditions with no possibility of emigration and the doubtful effect of predation by Weka (Atkinson & Daniel 1985; R.M. Colbourne). Birds have lived for 20+ years in captivity (Reid & Williams 1975). **PREDATION.** On Kapiti I., many clutches destroyed by Wekas; at two sites, 67% and 43% of egg losses (Jolly 1985a,b, 1989) but impact of predation unclear. On NI and SI of mainland, introduced mammals, especially Stoats and cats, and clearing of habitat undoubtedly contributed to extinction. Breeding may be suppressed by bad weather in some seasons (J.N. Jolly). Some birds heavily infested by feather lice but no evidence that they affect population.

PLUMAGES

ADULT Definitive. Age of first breeding unknown. **HEAD AND NECK.** Long disordered grey-black (82) rictal bristles scattered round base of bill. Chin, throat and facial area, uniform light brown-grey (brownish 44) or paler. Ear-

coverts, dark brown (121) when fresh, paler bases (brownish 44) exposed with wear. Forehead appears dark brown wearing to pale brown; feathers, pale brownish-grey (brownish 80) with grey-black (c82) rachis and tip. Crown, dark brown (121); feathers with concealed brown-grey bases. Hindneck, as upperparts. UPPERPARTS, shades of dark-brown (119-119A), with irregular broken bars, ranging from off-white to pale yellowish light-brown (c223D). Barring finer on neck, where feathers shorter. Tips of feathers, brown-black and spiky in texture; rest of feathers partly concealed, soft dark brown (c119A) with one or more transverse cream-white to yellowish light-brown (c223D) bars. No tail; wing feathers indistinguishable from body feathers. UNDERPARTS, as upperparts but pale bars, white with no brownish tinge.

JUVENILE Unknown how long retained but only observed on small chicks. Hatches in this plumage; no downy or naked young stages. Similar to adults, but plumage has a softer, non-spiky texture. Pale bars on body feathers narrow, particularly on underparts, and chevron shaped; coloured as adults. Body appears blackish brown with off-white to yellow drab spotting, least distinct on underparts.

IMMATURE Plumage as adult. Can be recognized on small size until about 18 months (J.N. Jolly).

ABERRANT PLUMAGES Partial and complete albinos of all ages recorded (Oliver; NMNZ; MV).

BARE PARTS

ADULT Iris, blackish-brown. Bill, light pinkish horn; cream (92) and pale pink (pale 7) also observed. Claws usually horn white, but a bird photographed with grey-black (82) claws save for whitish inside hind claw. Tarsus, chiefly pale dull-pink (pale 5) ranging from whitish to dull-pink (5), and always with irregular brown patches on front of tarsus and sides of toes. These formed by scutes, and range from slightly pinkish brown (219B) to black-brown (c19). Softness of tarsus varies, presumably with time elapsed since scales replaced. Softer tarsi tend to have pinker ground colour and smaller, paler scutes. Harder, more brittle tarsi tend to have white ground-colour, and larger, darker scutes.

JUVENILE Iris, grey-black (c82). Bill, cream-white to light pinkish horn. Claws, blackish grey-black (82) with pale grey (86) tips. Size of scutes on front of tarsus and tops of toes varies, but relatively smaller than in adults; dark red-brown (221A), pink-brown (221C) on sides of tarsus. Skin between scutes usually pale pinkish (c7) but ranges from white to pink; usually deepest pink round base of toes. Soles pale pink-brown (221D).

IMMATURE Apparently as adult, but few data available.

MOULTS Little information. Three adults collected in winter in body moult, two collected in summer with no moult (NMNZ). Studies on live birds not attempted. Presumably a shock moult because feathers seldom lost while running through undergrowth (J.N. Jolly).

MEASUREMENTS Few measurements possible on kiwis. Exposed bill (from front edge of cere to tip of bill) more reproducible than total bill (from feathers) since starting point easier to find. Best tarsus measurement from proximal end of tibio-tarsal joint to end of joint between tarsus and flexed mid-toe (this measurement presented below), because thick, fleshy leg covering makes ends of tarsometatarsus hard to locate. Mid-toe also difficult to measure for this reason. Measure-

ments of live birds from Kapiti I. (J.N. Jolly).

	MALES	FEMALES	
TOT. BILL	72.0 (2.53; 27)	87.1 (4.44; 17)	**
EXP. BILL	68.0 (2.13; 63.5-71.5; 44)	85.1 (4.00; 75.1-93.8; 24)	**
TARSUS	74.1 (3.03; 65.6-78.5; 56)	79.7 (4.30; 69.4-86.7; 46)	**
MID TOE	47.1 (3.97; 38.5-50.0; 13)	49.4 (3.64; 40.7-53.4; 10)	

WEIGHTS Vary; patterns of change throughout year not clear. Males tend to be heaviest in winter and early spring; maximum change recorded on an individual, 330 g. Weight of female increases considerably when gravid. All data here from Kapiti I., throughout year (J.N. Jolly): males 1135 (118.8; 880-1356; 51); females 1351 (163.6; 1000-c. 1400; 41); gravid females 1710 (143.7; 1430-1950; 13).

STRUCTURE Bill, long, slightly decurved. Nostrils in recess at tip of bill. Rictus firm, runs into tomia, which are flattened and jut outside semicircular cross-section of the culmen at base of bill. Cere, horny and concave; a convenient point from which to measure bill. Rictal bristles long and disordered. Small eyes point sideways. Neck, long; usually points sideways at base, but flexed half-way along length, so that bill is clear of ground but points down. Feathers have single shaft and unlinked barbs giving shaggy appearance to plumage. Wings, minute and not visible through thick shaggy plumage; four primaries, similar to body feathers but with longer calamus; wings end in small brittle claw. Legs, long, robust and muscular; tibia, feathered. Tarsus and toes, scutellated and fleshy, especially at tibio-tarsal joint; claws robust. Mid-toe longest; hind-toe 33% of length; inner toe 66%, outer toe c. 78%.

RECOGNITION Immature Brown Kiwi (*A. australis mantelli*) can be aged on ossification as shown by X-rays (Beale 1985). Because kiwis are osteologically similar, to the extent that no identification characters yet recognized (P. Millener; T. Worthy), this is assumed to apply to spotted kiwis, and found to be useful in separation of full grown *A. owenii* from immature *A. haastii* (J.N. Jolly); *A. owenii* and *A. haastii* also have different lice (Pilgrim & Palma 1982).

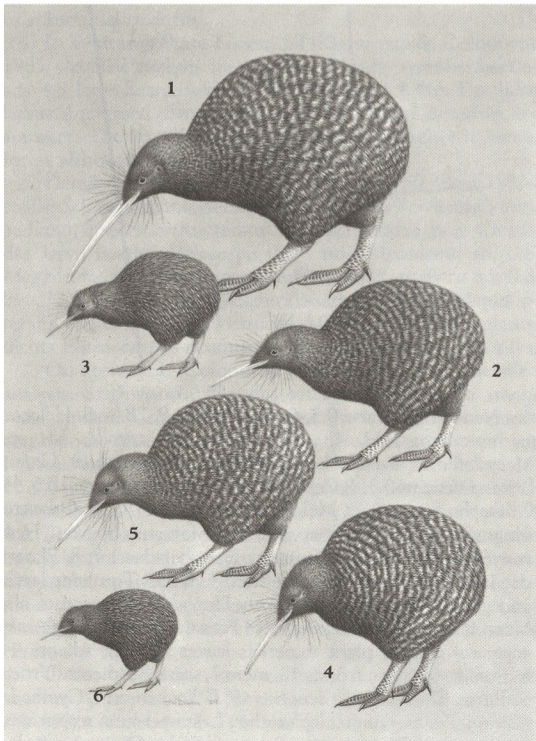
GEOGRAPHICAL VARIATION Not understood. No subspecies currently recognized (NZCL). Birds from w. side of Southern Alps have sometimes been given specific or subspecific name *occidentalis*; said to be larger than birds from Nelson and Marlborough with wider brown bands on upperparts (e.g. Oliver). Taxonomic studies based on skins complicated by variation of size with age, possible confusion with *A. haastii*, shortage of specimens with adequate data and probable extinction on SI. Many skins, especially older ones, are now greasy and look unnaturally dark. Birds from D'Urville I. heavier than those of Kapiti I., perhaps because density of population and diets differ locally (J.N. Jolly). Mallophaga of birds on Kapiti I. differ from those of all other specimens. Only *Rallicola gadowi* and *Apterygon dumosum* recovered from Kapiti I.; the single NI specimen (Buller 1875) and SI specimens only have *Rallicola pilgrimi* (R. Palma).

DIR

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Volume 1 (Part A), Plate 4

Great Spotted Kiwi *Apteryx haastii*

- 1. Adult
- 2. Immature
- 3. Juvenile

Little Spotted Kiwi *Apteryx owenii*

- 4. Adult, light morph
- 5. Adult, dark morph
- 6. Juvenile

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