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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 *ratis* (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 rectal 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 australis* Brown Kiwi

COLOUR PLATE FACING PAGE 72

*Apteryx australis* Shaw and Nodder, 1813, *The Nat. Misc.* 24: Pl. 1057 — Dusky Sound, South Island, New Zealand, *vide* Oliver 1955, *NZ Birds* 2nd Ed: 51.

OTHER ENGLISH NAMES Common Kiwi, Kiwi.

POLYTYPIC NZ endemic. Nominate *australis* SI; *mantelli* Bartlett, 1852, NI; *lawryi*, Rothschild, 1893, Stewart I.

**FIELD IDENTIFICATION** Length 45–55 cm, but males and females differ; bill M 100 mm; F 132 mm. Medium sized, rotund, flightless bird, tail-less; bill, long, slightly decurved. Body cone-shaped, tapering to small head. Powerful muscular legs. Streaky rufous plumage, shaggy and hairlike, obscuring short wings, which end in a claw. Sexes similar but female larger and 10–20% heavier than male and with longer bill. No seasonal variation in plumage but very little information. Juveniles with softer plumage.

**DESCRIPTION** **ADULT.** Head and neck very dark grey, paler on face and round base of bill. Above, dark rufous, streaked with black, but sometimes predominantly black. Below, pale grey or greyish brown. Plumage of *mantelli* stiffer and harsher to the touch than that of other forms. Bill, long;

straight in males, usually slightly downcurved in females; ivory white or pinkish, slaty in *lawryi* (and possibly *mantelli*). Legs, short and set far apart; feet, very large, usually brown in *mantelli* (occasionally pale white), bluish grey in *lawryi*, pinkish white or brown in *australis*. **JUVENILE.** Fully feathered at hatching, with paler face and more downy plumage, which remains softer than that of adult until fully grown at 18–20 months.

**SIMILAR SPECIES** Unlikely to be confused with any other species except other kiwis. In NI, the only species extant. SI and Stewart I. Kiwis larger than NI birds and similar in size to **Great Spotted Kiwi** *A. haastii*; distinguished from Great Spotted Kiwi and **Little Spotted Kiwi** *A. owenii* by less tremulous calls and more rufous plumage with dark streaks

along body; the plumage of spotted kiwis is transversely barred paler. Calls of males sometimes confused with those of Weka *Gallirallus australis*, Purple Swamphen *Porphyrio porphyrio* and Southern Boobook *Ninox novaeseelandiae* by inexperienced observers.

Mainly nocturnal but on Stewart I. often seen actively feeding during day (R.M. Colbourne); eyes small but can see well by both day and night (J.A. McLennan). Inhabit dense vegetation and heard much more often than seen; calls of males ascending, then descending whistles but in Northland whistles often only ascending; calls of females, shorter, harsh, guttural and distinctive. Loud snuffing sounds when feeding. Feed by probing deep into earth or by picking items from surface. Sometimes rest with bill on ground when standing, thus forming tripod with bill and legs. Gait, an easy walk or high-stepping, clumsy run with powerful strides. Wade in streams and, in emergencies, swim.

**HABITAT** Endemic to NZ and neighbouring islands in subtropical to temperate forests and shrublands, with wide tolerance of rainfall, humidity and temperature; but at low density in drier e. regions of NZ. NI: most common in dense forest (mixed podocarp and hardwoods or beech and hardwood) also in scrubland, regenerating bush, pasture and pine plantations (Reid *et al.* 1982); occurrence in pasture may be result of overcrowding. SI: favour wet, undulating, low-lying podocarp and hardwood forests; also in subalpine scrub and tussock grasslands above 900 m (Falla *et al.* 1981).

In Waitangi State Forest, Northland: birds at medium to high density among ridges and gullies with steep slopes, and flat areas with volcanic cones; in pine plantations *Pinus elliotti*, *P. radiata* with remnant native bush, particularly in steep gullies and swamp margins; in logged pine forest, with bracken *Pteridium aquilinum*, inkweed *Phytolacca octandra*, gorse *Ulex europaeus*, manuka *Leptospermum scoparium*, mingimingi *Cyatodes fasciculata*, treeferns *Alsophila tricolor*, *Sphaeropteris medullaris*, tobacco-weed *Solanum mauritanium*, hangehange *Geniostoma ligustrifolium*, and other native shrubs. Territories often coincided with natural or artificial boundaries: differences in vegetation, ridges, valleys, volcanic cones, firebreaks, roads (Colbourne & Kleinpaste 1983). At Tangieria, birds found at high densities in low rolling hills and extensive swamps in valleys, in regenerating forest and scrub bounded by open farmland; some home-ranges encompassed large areas of farmland and small bush remnants. At night, Kiwis spent more time in open bush and near bush edges than in thick or open pasture (M.A. Potter). At Hawke's Bay (McLennan *et al.* 1987) recorded among rolling to very steep hills and narrow valleys with small, deeply entrenched streams, 290–963 m asl, in regenerating scrub of kanuka *Kunzea ericoides*, bracken, manuka, bounded by open farmland and *P. radiata* plantations; also in steep terrain with mature forest of tawa, *Beilschmiedia tawa*, podocarps, beech *Nothofagus spp.*, and young forest of kanuka, kamahi *Weinmannia racemosa*, rewarewa *Knightia excelsa*, tanekaha *Phyllocladus trichomanoides*, bounded by pasture and pine plantations. Boundaries of range sometimes coincided with firebreaks, roads, ridgetops, streams, changes in vegetation. No obvious preference for particular terrain or aspect. Found on very steep hillsides (slope 50–70°) and easier gradients (McLennan *et al.* 1987). On Stewart I., observed in mature forest of rata *Metrosideros umbellata*, rimu *Dacrydium cupressinum*, kamahi, with undergrowth of sparse saw-fern *Blechnum discolor*, mosses, *Coprosma*, suppleack *Ripogonum scandens* and

pungas *Dicksonia squarosa*, seen in clearings and bare areas close to stands of saw-fern on ridge tops, extensive flat areas and gully heads (Larritt 1972) and in tussock grass (Guthrie-Smith 1914) and feeding along strand line on sandy beaches.

Clearance since settlement has caused extinction in many areas, but birds survive in most remaining large areas of forest, scrub country, regrowth areas, farmland near forest (Turbott 1967; Falla *et al.* 1981; Potter 1989), and some pine plantations. Do not use recently logged and burned pine forest, but birds affected can survive if unburned forest nearby, if interval between logging and burning is at least 2 months. Replanting creates new habitat. Therefore current management practices may allow pine forests to hold viable populations (Colbourne & Kleinpaste 1983). However, density higher in pine forest near logged areas because displaced birds enter the pine forest. Much disturbance may lead to breakdown of territorial behaviour and reduced breeding success. Where little or no disturbance, ranges 3–5 times larger than in pine forest and birds never seen fighting or heard calling repeatedly at each other as in pine forest (McLennan *et al.* 1987). Apparent recent decline in numbers in Hawke's Bay in undisturbed habitats: self-supporting population (500–1000 breeding individuals) perhaps needs 7500–15 000 ha of

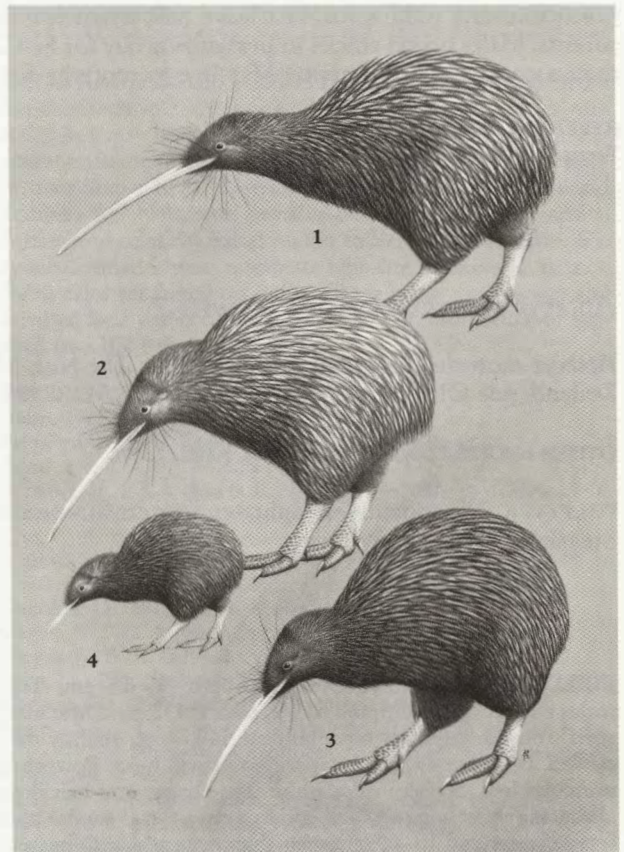


Plate 3

Brown Kiwi *Apteryx australis*

1. Adult, subspecies *lawryi*

2. Adult, subspecies *australis*

3. Adult, subspecies *mantelli*

4. Juvenile, subspecies *mantelli*

native vegetation and no patches of this size remain; some pine forests large enough but do not support Kiwis (McLennan *et al.* 1987). However, at Tangiteroria, range-sizes similar to Hawke's Bay but range overlap great and area requirements less (Potter 1989). In Northland and Taranaki, birds found dead included 12 struck by vehicles, eight poisoned, three caught in traps, two crushed by earth-moving machinery, 14 taken by dogs and 11 dead of unknown causes (Reid *et al.* 1982).

**DISTRIBUTION AND POPULATION** Endemic to NZ; on NI and SI and on Stewart I.

NI Only N of 40°S; occur in most large tracts of forest but range substantially reduced by land clearance since European settlement. Now rare except in Northland and Taranaki. Large, widespread population in Northland in area between Tauroa Pt and Doubtless Bay, and Bream Bay and Ruawai. Isolated occurrences S of Papakura; N of Coromandel Pen.; E of Thames; between Putaruru and Tauranga. Another population in district between Whakatane, N of Moutohora, S of Waikaremoana and N through the Urewera NP. Small population S and W of Tarawera. Second widespread population within area from near Kawhia Harbour, SE to L. Taupo, Tongariro NP, Patea, North Taranaki Bight and N along coast to

Kawhai (NZ Atlas). Also on Little Barrier, Kawau and Ponui Is (NZCL). Re-introduced to Little Barrier I.; introduced to Kapiti I. 1908, 1912 (seven SI birds); between 1910-40 (4 NI birds) (Oliver); about 50-100 birds still present (R.M. Colbourne).

SI Fiordland, population coastal from S of Preservation Inlet to Milford Sound, including Resolution, Cooper, Long, Parrot and Secretary Is, and inland as far E as L. Te Anau. A small population between Haast and Arawhata Rs and another near Okarito, Westland. Unconfirmed reports in other nearby areas may be this species. Formerly occurred in high-rainfall areas of w. Otago, Southland, Westland but absent from Banks Pen. and Canterbury Plains (Falla *et al.* 1981). Records Nelson and Marlborough (NZCL) probably of Great Spotted Kiwis (R.M. Colbourne). Recorded se. SI before 1900 and in Marlborough Sounds in 1931 (Oliver); on Canterbury Plains before European settlement (Reid & Williams 1975). Stewart I., widespread population, particularly abundant S of Paterson Inlet; formerly only on main island (NZCL), but now on one other islet (Ulva).

**BREEDING** Rarely reported; presumably throughout range.

**POPULATION** Particularly abundant in Northland: Waitangi State Forest (exotic pines, 2888 ha): 400-500 pairs (Colbourne & Kleinpaste 1983; Rasch & Kayes 1985); Waipoua State Forest (indigenous forest, 25 000 ha): 5000 pairs (Colbourne & Kleinpaste 1984); Tangiteroria (regenerating indigenous forest, 210 ha): 35-45 pairs (Potter 1989).

Densities much lower in indigenous forest near s. limit of range: c. 1 pair/100 ha in Kaweka Ra. and s. Ureweras (J.A. McLennan); c. 1 pair/10-15 ha in mixed hardwood scrub at Aotuhia, inland Taranaki (J.A. McLennan). General reduction in population with land clearance. Some evidence of decline in indigenous habitats in Hawke's Bay and Kaimanawa Ra. since 1900, possibly by predation from introduced animals and by gin-trapping for Common Brush-tailed Possums *Trichosurus vulpecula*. In Waitangi State Forest, in less than two months estimated that 500 Kiwis were killed by single dog (Taborsky 1988). Many populations in NI now isolated by clearance and too small to survive. Further decline to be expected. Population on Stewart I. may be increasing. Lives to 25-30 years in captivity (Reid & Williams 1975); no information on longevity of wild birds.

**MOVEMENTS** Adults sedentary and territorial throughout the year. Birds banded as juveniles recaptured as territorial adults 2, 3 and 5 km from their origin (Rasch & Kayes 1985; NZ Banding Office).

**FOOD** Mostly soil invertebrates such as earthworms and beetle larvae with a small percentage of fruit, seeds, leaves and surface-dwelling invertebrates. When feeding, moves slowly, tapping its bill on the ground like blind person feeling ahead with stick (Haeusler 1923). Can locate prey by sense of smell alone (Wenzel 1968), although a combination of olfactory, tactile (Wenzel 1971) auditory (Reid & Williams 1975) and visual (J.A. McLennan *contra* Reid *et al.* 1982) senses probably used. When prey detected, bill forced into ground with back-and-forth levering motion of head and neck (Haeusler 1923). Cone-shaped holes, up to 12 cm deep and 10 cm wide, often provide indication of presence. Prey taken near the end of bill and sometimes crushed before eating (Larritt 1972). Worms pulled from ground slowly, with pauses to avoid breakage (Haeusler 1923). Audible sniffing while feeding probably to

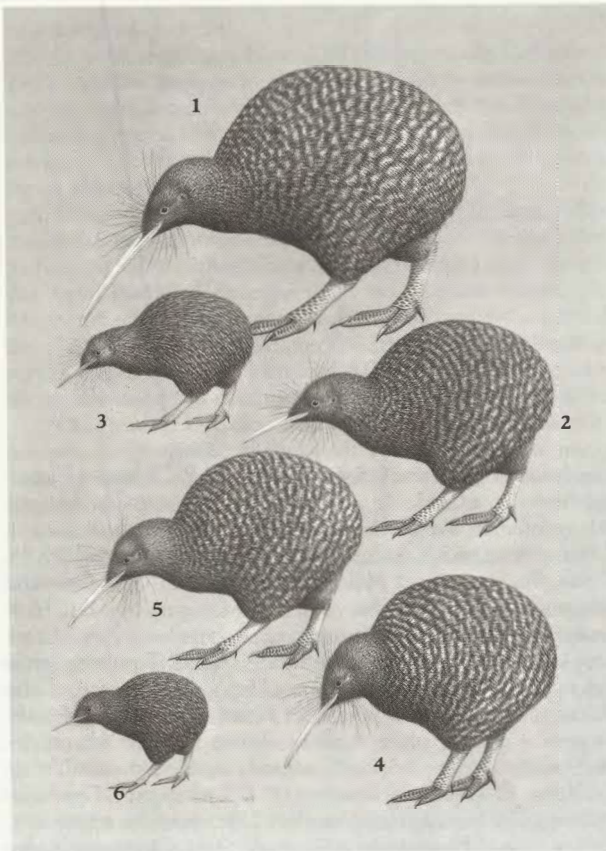
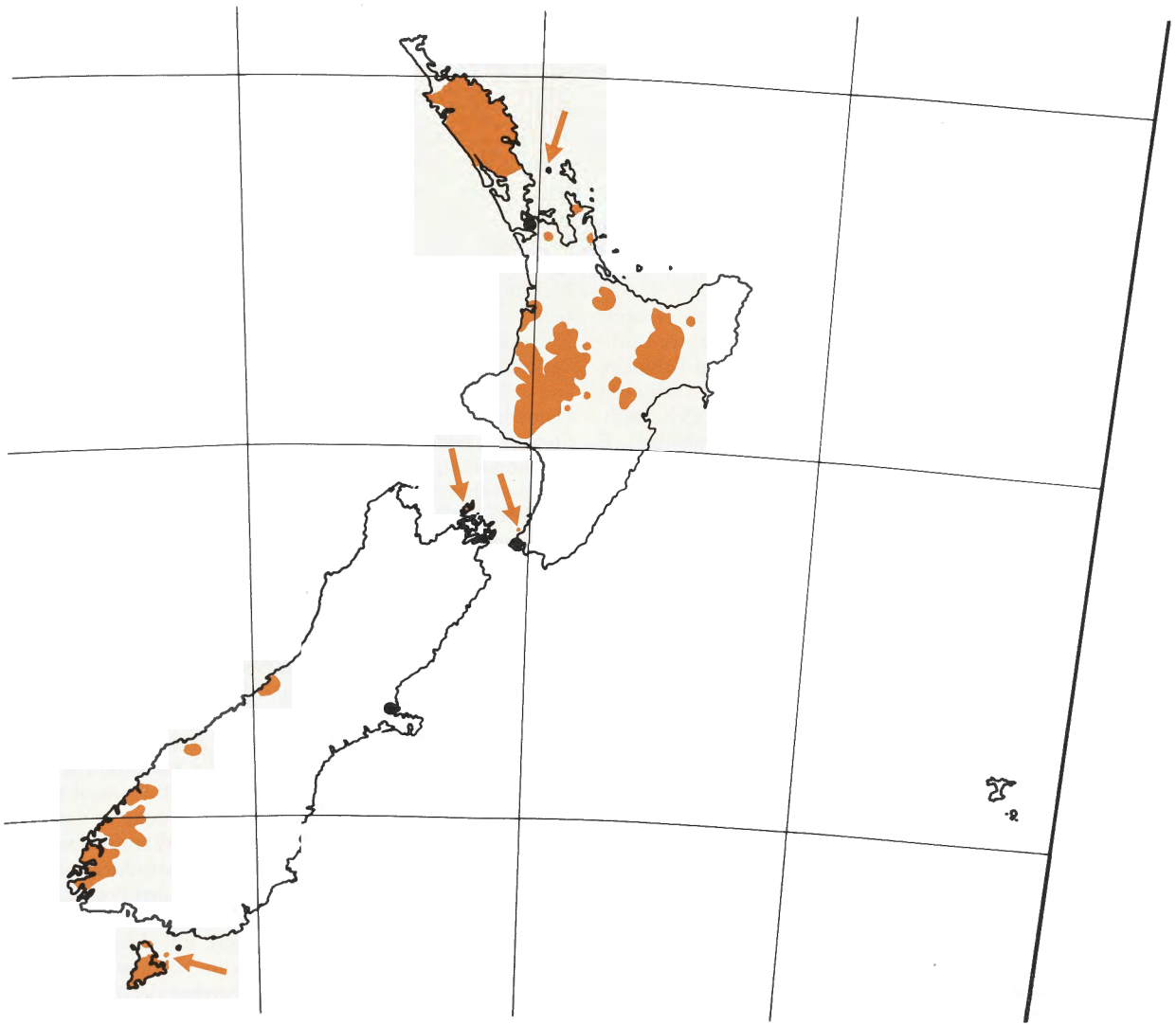


Plate 4

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



clean nares with copious nasal discharge (Wenzel 1971). Nasal valves in proximal end of bill may facilitate feeding in water (Reid *et al.* 1982). In Waitangi State Forest, about 70% of diet extracted from soil; the rest from decaying logs and soil surface (Colbourne & Kleinpaste 1986). Little if any food taken above 10 cm from ground (Reid *et al.* 1982). Feeding behaviour affected by softness of soil. Predominantly nocturnal but subspecies *lawryi* also active during daylight (Reid *et al.* 1982; Colbourne & Powlesland 1988). In Hawke's Bay, birds usually emerge from daytime dens 15–90 min after sunset and remain active until dawn irrespective of weather (J.A. McLennan).

Information on diet of NI and Stewart I. populations summarized Table 1; no information from SI. All those killed accidentally in NI (Reid *et al.* 1982) had eaten mostly invertebrates. Detailed analysis: snails: *Helix aspersa*, *Paryphanta busbyi*, *Schizoglossa novaeseelandica*, *Rhytida dunni*; spiders: Segestriidae, Dipluridae; crustaceans: decapods *Paraneohors planifrons* 0.1% no., 2% fr., isopods 0.2, 4; centipedes: *Cormocephalus*, *Scolopendra*, Geophilomorpha; millipedes: *Proceliostoma*; insects: earwigs 0.1, 2, cockroaches, orthopterans *Hemiandrus*, *Hemideina crassidens*, bugs *Amphisalta*, bee-

gles *Neocicindela* larv. 0.3, 6, Carabidae 1.9, 28 (incl. *Holocaspis mucronata*, *H.* sp., *Mecodema crenaticolle*, *M.* sp., *Mecyclothorax insularis*, *Megadromas*, *Zabronothus*), *Cafius*, *Lissotes stewarti* 0.3, 4; *Costelytra suturalis*, *C.* sp. larv. 18.6, 44, *Onthophagus posticus*, Melolonthinae larv. 13.1, 30, *Odontria magnum*, *O. piciceps*, *O.* sp. 5.3, 52, *Xylostignus brookesi*, *Heteronychus arator* 8.9, 24, unident. Scarabaeidae 1.7, 8, Elateridae larv. 5.2, 42, unident. beetles 0.3, 4, flies Tipulidae larvae and pupae, lepidopterans mainly Hepialidae *Oxycanus*, also Noctuidae, hymenopterans 0.2, 4 Formicidae including *Amblyopone australis*; plant material: leaves 72% fr. (dicots 44, monocots 58), fern fronds 12, moss 7, seeds 72 (dicots: *Urtica*, *Stellaria*, *Elaeocarpus dentatus* 49, *E. hookerianus*, *Cyathodes acerosa*, *Paraserianthes lophantha*, *Leptospermum scoparium*, *Vitis vinifera*, *Pseudopanax*, *Solanum*, *Hebe*, *Coprosma*, *Rubus fruticosus*, *R.* sp., *Leycesteria formosa*, *Cirsium*; monocots: *Rhopalostylis* [?] *sapida*, *Carex*, *Gahnia*, *Uncinia*, *Cordyline australis*; conifers: *Podocarpus dacrydioides*, *P. ferrugineus*, *P. totara*), bark and twigs 44. Seeds of *E. dentatus* were inversely correlated with presence of grit and may serve as gastroliths. Small fragments of bark, twigs and some leaves probably ingested accidentally but three stomachs contained softer leaves

**Table 1.** Diet of the Brown Kiwi (+ food present, detailed data not available).

	%wt.		%no.			%freq.	
	1 <sup>a</sup>	2 <sup>b</sup>	2 <sup>c</sup>	3 <sup>c</sup>	4	2	3
snails			1.7	1.5		10	
earthworms	14.1	+	+		+	80	94
spiders	2.9	19.2	21.8	2.1	0.8	71	30
crustaceans		0.1	0.5	0.3		3	+
centipedes		2.4	5.6	0.9		28	+
millipedes				1.8			30
insects	73.3	78.3	71.4	93.0	97.7	+	+
orthopterans	2.4	7.9	7.2	2.3	0.8	30	20
bugs	41.7	10.5	5.9	24.0	52.6	20	52
beetles	28.6	21.4	27.6	55.6	37.6	+	+
lepidopterans		36.4	27.5	3.5	7.5	28	16
flies	1.6	2.1	3.2	7.3	1.5	9	24
other				0.3	+		
plant matter	5.2	1-5 <sup>d</sup>	+	+	+		+93

a. %dry wt., b. %dry wt. soft parts excl. annelids, c. excl. annelids, d. % wet wt. faeces

(1) Kleinpaste & Colbourne (1983); (2) 146 faeces, Colbourne & Powlesland (1988); (3) 27 male, 23 female stomachs, Reid *et al.* (1982); (4) one stomach, 133 animal food items, Bull (1959).

in substantial quantity.

In Waitangi State Forest, NI (Kleinpaste & Colbourne 1983) detailed analysis insects: bugs cicada nymphs; beetles ads. 4.5, larv.: Scarabaeidae 20.2, Elateridae 2.9; flies Tipulidae larvae. Increased consumption of beetle larvae noted in dry summers. Diet in indigenous forest more varied than in exotic forest although main foods the same.

Detailed analysis single stomach from NI (Bull 1959): snails: *Schizoglossa novaeseelandica*; spiders: *Porrhothele antipodiana*; insects: orthopterans Stenopelmatidae, bugs Cicadidae larv., beetles *Holocaspis* 0.8% no., *Mecodema* ad. 0.8, *Megadromus* ad. 0.8, Lucanidae larv. 4.5, *Costelytra* ad. 0.8, larv. 23.3, Tenebrionidae/Elateridae ad. 1.5, larv. 5.3, lepidopterans Hepialidae 4.5, Noctuidae 3.0, flies Tipulidae; plants: dicots *Elaeocarpus dentatus* seeds, *Coprosma tenuifolia* lvs.

On Stewart I. (Colbourne & Powlesland 1988) detailed analysis: earthworms: *Plutellus* sens.lat. *stewartensis*; arachnids: spiders *Centauria*, *Mamaea grandiosa*; crustaceans: amphipods; insects: orthopterans *Zealandosandrus*, bugs *Kikihia rosea* nymphs, beetles *Mecodema* ads. 10.5% dry wt., 15.8% no., 72% fr., larv. 0.5, 0.5, 4, Staphylinidae 0.3, 0.7, 3, *Odontria* ads. 1.9, 2.9, 12, larv. 5.3, 3.4, 10, Elateridae larv. 2.9, 4.3, 22, lepidopterans Hepialidae caterpillars, flies Tipulidae larv.; plant material: leaves of dicots *Leptospermum scoparium*, *Coprosma*, conifer *Dacrydium bifforme*, fern *Gleichenia circinata*, liverwort *Bazzania*; seeds of dicots *Pentachondra pumila*, conifer *Dacrydium cupressinum*. Lepidopteran larvae taken one year but not the next.

Other records: earthworms: *Megascolides* sens.lat. *maoricus* (size range 0.7-1.0 g), *Spenceriella* sens.lat. *gigantea* (50-160), *Allolobophora caliginosa* (1.0-1.5; Roach 1954); arachnids: daddy longlegs, spiders Mygalomorphae, Araneomorphae; centipedes: *Cormocephalus rubriceps*, *Paralamyctes validus* (Gurr 1952); insects: orthopterans *Dienacrida* (Buller 1888), *Teleogryllus commodus* (Watt 1971), beetles *Agonum sulcitarise*, *Ctenognathis bidens*, *Holocaspis dentifera*, *Thyrecephalus chloropterus*, *Lissotes planus*, *Costelytra zealandica* /*longicornis*, *Odontria borealis*, *O. sylvatica*, *O. xanthosticta*, *Heteronychus arator*, *Uloma tenebrioides* (Watt 1971), *Cop-*

*tomma*, *Prionoplus* (Buller 1888), Curculionidae (Gurr 1952); plants: leaves of dicots, *Cyathodes fasciculata*, *Leptospermum* (Gurr 1952), *Melianthus major*, monocots, *Scirpus* (Simpson 1971), capsules of dicot *Geniostoma ligustrifolium* (Gurr 1952), berries of dicots *Mida salicifolia*, *Olea* (Buller 1888). Pasture pests such as the beetles *Costelytra zealandica* and *Heteronychus arator* and cricket *Teleogryllus commodus* sometimes taken in large numbers in rough farmland (Watt 1971).

During dry weather may lose at least 16% body weight (Kleinpaste & Colbourne 1983) but subcutaneous fat of  $\leq 30\%$  body weight can sustain fasting of  $\geq 3$  weeks. When actively feeding, time between ingestion and defaecation 70-85 min. Distended gizzard contained 49 g (4.2 g grit), capacity 40-45 cm<sup>3</sup>, dimensions 75x55 mm (Reid *et al.* 1982).

Chicks begin probing and eating invertebrates at 4-6 days old when they first emerge from nest. Before emerging sustained by yolk and not fed by parents. In captivity chicks sometimes active in daylight during first 3 weeks of life but appear to be strictly nocturnal in wild.

**SOCIAL ORGANIZATION** Based mainly on unpublished information from Hawke's Bay (J.A. McLennan) and Northland (M.A. Potter; M. Taborsky). Usually in pairs, unless very small population in isolated areas; occasionally single juveniles or widowed birds (R.M. Colbourne); adults occasionally accompanied by newly fledged chicks (Buller 1888).

**BONDS** Monogamous (J.A. McLennan) or sequentially monogamous (M.A. Potter). Maintained throughout year and probably life-long; will re-mate if partner dies. High annual divorce rates reported in some populations may be density related (Potter 1989). Weak parent-young bond but parents may be very protective initially (R.M. Colbourne). Chicks usually feed alone when first emerge from nest aged 4-6 days, but continue to be brooded by male during day. Females occasionally enter nests when eggs hatch, possibly to assist with brooding. Chicks leave the nest permanently after 15-20 days; loose bond may be maintained with parents for up to a year in *mantelli* and possibly up to 3 years in *lawryi* (R.M. Colbourne).

**BREEDING DISPERSION** Solitary; nests widely separated usually within fixed territories or non-overlapping home-ranges (McLennan *et al.* 1987; R.M. Colbourne); at Tangiteroria, home-ranges can overlap extensively (M.A. Potter). Territory size: Waitangi, 5-10 ha, smaller on ridge tops and in drier pine plantations than in swampy valleys and gullies with native vegetation (Colbourne & Kleinpaste 1983); Tangiteroria, Northland, 20-40 ha (Potter 1989); Hawke's Bay, pairs occupy 19-43 ha and average individual range-size was 39.5 ha (14.1-134.4; convex-polygon method; McLennan *et al.* 1987); at Chew Tobacco Bay, Stewart I., 5-6 ha (E. Spurr). At Hawke's Bay, females tended to have larger ranges than males, but difference not significant and paired birds rarely entered ranges of neighbours (males 0.83% of 480 locations; females 1.5% of 273 locations); unmated females entered ranges of other birds significantly more than did paired females (McLennan *et al.* 1987). At Tangiteroria, Northland, more territorial during breeding season than at other times when ranges overlap extensively. Factors governing variation in breeding density not understood.

**ROOSTING** In dens, lodges or daytime shelters, scattered throughout range: in Waitangi, mostly at ground level in clumps of Toetoe *Cortaderia fulvida*, under bracken,

dead fronds of treeferns or pine slash; also in hollow logs, piles of volcanic boulders (Colbourne & Kleinpaste 1983). At Tangiteroria, daytime shelters 74% in natural cavities, under tree roots, fallen branches, in thick vegetation or decaying logs, 26% in excavated burrows ( $n=2116$ ; Potter 1989). Use of roosts changed when with mate: when alone, 40% in burrows and natural earth cavities, 60% in surface vegetation and decaying logs ( $n=1360$ ); with mate, 81%, 19% ( $n=466$ ; M.A. Potter). In Hawke's Bay, 62% in natural cavities (as above), 38% in excavated burrows ( $n=431$ ); within pairs, males used burrows more and females used hollows under vegetation (McLennan *et al.* 1987); on Stewart I., in steep sand-bank at edge of forest and under bole and roots of fallen tree, facing N and W (Guthrie-Smith 1914). Generally enter dens in half-light of dawn, leave 15–90 min after sunset. On Stewart I., sometimes active during daylight. Burrows excavated by both sexes; typically have a single, well concealed entrance, about 14 cm wide by 12 cm high and a tunnel 1–1.5 m long, terminating in an enlarged chamber, big enough for two Kiwis. Pattern of use of dens varies greatly between localities. At Hawke's Bay, birds seldom use same roost on consecutive days but sometimes return to sites used previously (McLennan *et al.* 1987). Members of bonded pairs usually roost apart, except in the month before laying. At Tangiteroria, Northland, same roost often used for several consecutive weeks, and simultaneous use by both members of a bonded pair common (Potter 1989); at Hawke's Bay, bonded pairs denned together on 8% of days increasing to 14% May–July (McLennan *et al.* 1987). Unconfirmed reports that on Stewart I. sometimes roosts communally, with up to 6 birds in a burrow; may be family groups sharing burrow (R.M. Colbourne).

**SOCIAL BEHAVIOUR** Little known; Kiwis are nocturnal and displays difficult to observe. Information supplied by J.A. McLennan and R.M. Colbourne.

**AGONISTIC BEHAVIOUR** Main functions of males calling are probably defence of territories and communication with mate. Males call more often than females. Frequency of calling varies with locality and varies between nights and environmental conditions. Calling birds adopt extreme upright posture, neck and legs fully stretched and bill pointed skyward. Vigorous encounters between members of same sex sometimes observed at territorial boundaries (Colbourne & Kleinpaste 1983; Rasch & Kayes 1985). Calling and chasing, occasionally violent fighting in which the combatants kick repeatedly, typical of encounters. In captivity, fights often fatal if males manage to force access into their neighbours' enclosures. Roosting birds and incubating males usually growl and kick at an approaching hand; predators presumably get similar reception.

**SEXUAL BEHAVIOUR** Two birds were observed duetting and displaying on Stewart I.: a male began calling and was answered by a female from about 3 m away; after about 30 s the male stopped calling and began to chase the female (who also stopped calling) in small circles until male grasped the middle of the female's back; the display was then interrupted by the presence of the observer. Female began calling with head and neck extended, bill open and pointed up; the head was then lowered slowly and moved from side to side until the tip of the lower mandible almost touched the ground; the posture of the male was not observed (Horgan 1970). In captivity, no sexual displays or courtship feeding observed. **COPULATION.** Male initiates copulation by tapping females' neck

and back with his bill. She responds by crouching, enabling male to climb onto her back. Duration of copulation 1–2 min., during which male rests on tarsi and maintains balance by grasping feathers on female's back. No post-copulatory displays apart from female occasionally chasing and kicking mate. Captive pairs may copulate four times a night during breeding season.

**RELATIONS WITHIN FAMILY GROUP** Lack of detailed observations; probably weak (see Bonds). No feeding of chicks; post-hatching care limited to brooding. Chicks often not accompanied by adults when they leave nest to feed (J.A. McLennan) however observations of juveniles with parents up to 1 (*mantelli*) or 3 (*lawryi*) years old (R.M. Colbourne); probably fully independent 14–19 days after hatching, but may remain in natal territory for years.

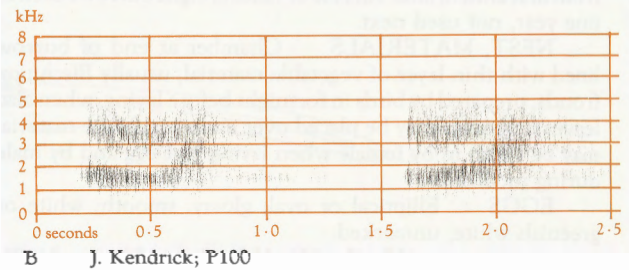
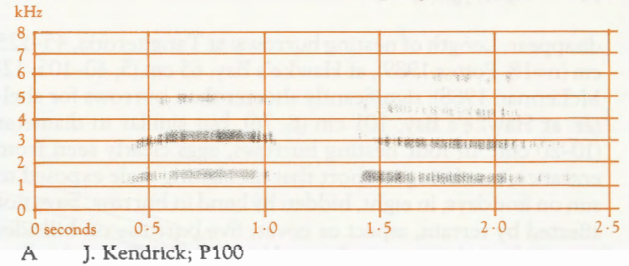
**VOICE** Studied in Waitangi State Forest, Northland (Colbourne & Kleinpaste 1984); and Hawke's Bay (J.A. McLennan; McLennan *et al.* 1987). Call at night, starting soon after sunset; rates of calling vary between nights and areas and seasonally, correlated with breeding (Colbourne & Kleinpaste 1984). Heard more often than seen and produce range of calls throughout year. Main calls are very loud; audibility depends on habitat and conditions; at Waitangi, audible up to 350 m in flat forest with still conditions and faintly audible up to 1 km in clear-felled forest (Colbourne & Kleinpaste 1984); at Hawke's Bay, the Whistle Call of males audible up to 1.5 km in good conditions (J.A. McLennan). Sexual difference in calls; main calls are distinct; at Hawke's Bay and on SI, males have an ascending then descending whistle; in Northland, male calls often ascending whistle only (R.M. Colbourne); females have a harsh, guttural cry *ah-eh*. Non-vocal sounds: males, females and immatures snap bills; indications that they intentionally make noise when approaching territorial intruders, by snapping twigs and with heavy footsteps (McLennan *et al.* 1987). Calls of all kiwis similar; calls of female Brown Kiwis unmistakable; calls of males distinguished from both Great and Little Spotted Kiwis, by those species' warbling whistle. Inexperienced observers could confuse calls of males with calls of Weka, Purple Swamphen and Southern Boobook. No mimicry reported. **RATE OF CALLING.** Males call more frequently than females; at Waitangi State Forest, the ratio of male to female calls was 3:1 ( $n=1032$ ; Colbourne & Kleinpaste 1984); at Hawke's Bay, the ratio was 4:1 ( $n=86$ ; J.A. McLennan). At Waitangi, Northland, rate is greatest in first 1–3 h of darkness (Colbourne & Kleinpaste 1984) or constant throughout night (Rasch & Kayes 1985); at Hawke's Bay, rate of calling greatest in first 2 h of darkness. Rates of calling vary much between nights; generally suppressed during nights of bright moonlight or strong winds; more frequent on dull or wet nights (Buller 1888; Clark 1952). Rate of calling low, almost nil, from first quarter, through full moon, to last quarter (Colbourne & Kleinpaste 1984). Rate peaks in mid winter during the onset of breeding and main mating period (June–Aug.; Colbourne & Kleinpaste 1984; Robson 1947); lowest in late summer following completion of breeding (Jan.–Feb.) including incubation period (J.A. McLennan *contra* Buller 1888, 1905). Maximum number of calls varies from 3 calls/h (Jan. 1982) to 24 calls/h (July 1981); rate varies with density of population; where density is high, rate of calling is higher (Colbourne & Kleinpaste 1984). Birds call throughout night; usually, beginning 45 min after sunset, occasionally as soon as 5 min after; maximum rate in first 1–3 h of darkness; irregular

bouts of calling throughout rest of night till dawn (Colbourne & Kleinpaste 1984). **DUETTING.** Male and female frequently call simultaneously or one of pair calls immediately its mate has completed its call; initial calls were usually given by males. Duetting most often occurs in early evening when mated pairs emerge from different burrows, when birds are close to each other or when one of a pair is out of its territory (Horgan 1970; Colbourne & Kleinpaste 1984). Distinct sexual difference in Whistle Call. No geographical variation reported. Territorial pairs respond aggressively to playback and whistled imitations of calls; generally call in response to intruder's call and then approach intruder (McLennan *et al.* 1987). Response of birds to neighbouring birds varies; at one site in Hawke's Bay, neighbour's calls seldom elicited response from territorial males (McLennan *et al.* 1987), whereas at Waitangi neighbouring birds usually responded shortly after territorial pair called (Colbourne & Kleinpaste 1984).

**ADULT MALE Whistle.** Very loud, prolonged, shrill, ascending then descending Whistling: *ah-eel*; calls usually consist of c. 20 (1-42) repeated whistles (sonagram A) and last c. 30 s. There is individual variation in numbers of repeats per call but not reliable for individual identification. Functions in territorial defence and as a contact call. Audible up to 1.5 km in still conditions (Colbourne & Kleinpaste 1984; J.A. McLennan). Whistles vary, individually recognizable for female (mate often replies when male completes whistle; J.A. McLennan). In territorial encounters, whistles tend to be shorter and repeated more rapidly; pitch of ascending note rises with growing agitation. **Mewing.** Associated with mating and copulation (Reid & Rowe 1978); birds produce a mewing call that develops to a loud purring. Heard from May-Nov., most often in June; audible to 50 m. Given only when pair close together; Purring once heard from copulating bird (Colbourne & Kleinpaste 1984). **OTHER CALLS. Grunt.** Associated with feeding; loud, nasal grunts produced by both sexes; often when pair close together; may function as a contact call (Colbourne & Kleinpaste 1984). **Growl.** A deep, guttural growl used as an aggressive call; given by both sexes, particularly when handled or, if birds in den, at approaching hand or, presumably, approaching predators; bird generally kicks at same time as delivering call; also heard in fights between males. In den, females more vocal than males and more likely to growl than males (Colbourne & Kleinpaste 1984; McLennan *et al.* 1987). **Hiss.** Both sexes produce a hissing sound when handled (Colbourne & Kleinpaste 1984). **NON-VOCAL SOUNDS:** Bill-clack used when alarmed. Both sexes produce a loud clack, by snapping the mandibles shut; predominantly used by males; heard during fights between males (Colbourne & Kleinpaste 1984). Sniffing associated with feeding and smell; when leaving dens in evening, birds would often sniff for c. 1 min round entrance to den (McLennan *et al.* 1987). Made when clearing nostrils of dirt after probing; audible to 15 m (Colbourne & Kleinpaste 1984).

**ADULT FEMALE Whistle.** Coarse, guttural ascending, then descending cry, *ah-eh*, repeated up to 20 times; sonagram B shows two whistles from a sequence. A quiet series of clucks and chortles, reminiscent of domestic hen, sometimes given when approaching a strange male. Mewing, as for male. Other calls as for male. Female can produce a pig-like Squeal when handled; female used Squeals more frequently than Bill Clacks, which male uses in same circumstances.

**YOUNG** Loud Squeaks given when disturbed or alarmed. Bill Clack also given as alarm when held or chased.



At Waitangi, chick with its parents was heard to call, intermediate between male and female calls, with longer intervals between calls (Colbourne & Kleinpaste 1983). In captivity, males develop adult calls at 12-14 months (Robson 1947; Reid & Rowe 1978); females start calling when c. 2 years old (Reid & Rowe 1978).

**BREEDING** Poorly known. Account based on detailed study of three pairs for two years in isolated remnant of forest in Hawke's Bay (McLennan 1988) and study at Tangiteroria (Potter 1989); information supplied by J.A. McLennan. Previously only fragmentary data in wild; some observations in captivity. Breeds solitarily in simple pairs in burrows in forested areas.

**SEASON** At Hawke's Bay, eggs laid: June: 1; July: 2; Aug.: 6; Sept.: 5; Oct.: 2; Nov.: 3; Jan.: 1; Feb.: 1. Other sketchy data suggest laying throughout year, mainly July-Feb. (Reid & Williams 1975); onset of breeding in late winter when calling increased (Colbourne & Kleinpaste 1984). Captive females lay throughout year with small peak in late winter and spring (Reid & Williams 1975; Goudswaard 1985).



**SITE** Well hidden in forest in steep hilly country. At Hawke's Bay: 12 nests in burrows; one under thick layer of fallen *Dicksonia* fronds; one in cavity under tree-stump covered by water-fern *Histiopteris incisa*. At Tangiteroria, 18 nests in burrows, one under Toetoe and one in natural cavity at base of tree (Potter 1989). At Waitangi, burrows in banks, similar positions as daytime shelters; once a simple cavity in pine litter (Colbourne & Kleinpaste 1983). On Stewart I., four burrows (in slightly rising ground under live Kamahi; in steep bank of hard dry sand; shallow holes in hillside) all faced N and W (Guthrie-Smith 1914); also in open bush near top of steep slope and in soft soil among roots of trees (Soper 1963). Burrows are selected for breeding significantly more often than for daytime shelters. Burrows excavated by the birds, months or even years before use, so that moss and ferns can become established at entrance and all trace of excavated soil



disappear. Length of nesting burrows: at Tangiteroria, 45–125 cm ( $n=18$ ; Potter 1989); at Hawke's Bay, 65 cm (5; 40–105; 12; McLennan 1988); significantly shorter than burrows for shelter: at Hawke's Bay, 101 cm (6; 76), but similar in diameter (10–20 cm). In four nesting burrows, eggs clearly seen from entrance, one being so short that incubating male exposed to sun on fine days; in eight, hidden by bend in burrow. Sites not affected by terrain, aspect or cover; five burrows on hillsides with little undergrowth. Second layings in different burrow from first clutch, after success or failure; eight burrows used in one year, not used next.

**NEST, MATERIALS** Chamber at end of burrow lined with thin layer of vegetable material, usually *Blechnum* fronds, prepared by birds in fortnight before laying, when also leaves and twigs may be placed over entrance. More material may be taken in by female when laying first egg and by male during incubation.

**EGGS** Elliptical or oval; glossy, smooth; white or greenish white, unmarked.

**MEASUREMENTS:** 129 (2; 121–139; 7) x 78 (1; 76–81) (McLennan 1988); 125 (104–135; 107) x 78 (66–86) (Reid 1981, eggs from throughout NI).

**WEIGHT:** fresh ( $n=3$ ): 458, 430 and 425 or c. 70 heavier on average than eggs laid in captivity (Reid 1981).

**CLUTCH SIZE** In Hawke's Bay: six clutches established as being two, all having survived for more than four weeks after laying of first egg and all having received second egg later, in contrast to eight nests with only one egg, none of which survived for more than four weeks and might have received a second egg. Females laid 2–5 eggs each breeding season (McLennan 1988). At Tangiteroria, contents of nests recorded as 14x C1, 6x C2 (M.A. Potter). At Waitangi, C2x2 (Colbourne & Kleinpaste 1984). C3 has been reported (Reid & Williams 1975).

**LAYING** At Hawke's Bay, intervals between laying of eggs varied greatly: 2 x 21 days, 2 x 26 days, once each  $28 \pm 11$ ,  $35 \pm 2$ ,  $48 \pm 2$ ,  $66 \pm 10$ . Interval may shorten as season progresses. Replacements after early failure of eggs up to 3–4 in season. One second brood after success known (McLennan 1988). Robson (1947) gave interval between successive eggs ( $n=19$ ) as 33 days (11–60) but his tables are misleading, being for captive birds and not distinguishing 2-egg clutches from replacement laying. At Tangiteroria, interval between eggs 19–55 days; replacements rare; individual females lay 1–2 eggs per season (M.A. Potter).

**INCUBATION** After laying first egg, female usually stayed in burrow for 1–2 days but not after laying second egg; not again found in nest (159 inspections) except in one pair that had two eggs in different holes, when female incubated second egg occasionally for first 19 days until male took over, having abandoned first (addled) egg. In first clutches, male started to incubate immediately female left or up to 14 days later or incubated only intermittently (c. 1 days in 6) for first 20–30 days. In all replacement clutches male started incubation as soon as first egg laid. At Hawke's Bay, incubating males emerged each night (66 inspections) 26 min to 5.5 h after sunset to feed and defecate, except when chicks were hatching; absent for 2–8 h (16 observations); a single absence of at least 20 h before resuming normal routine (J.A. McLennan); at Tangiteroria, absent from nest 3.6 h (1.0–6.25; 13; M.A. Potter). Captive males may stay on nest for up to one week. Two of the three males covered entrance of burrow with vegetation when leaving, carrying material in bill and emplacing it or sometimes throwing it in general direction of entrance from

distance of 50 cm; third male did so only intermittently for first three weeks. On entering burrow, bird sometimes pulled in material to cover entrance. Eggs incubated side by side, half-buried in nest material; usually (17/20 inspections) not covered on departure. Eggs not turned during incubation. Upper part of egg up to 10 °C warmer than lower (Rowe 1978). **PERIOD:** for two eggs: 85 and  $92 \pm 4$  days. In another nest, where only one of two eggs hatched, minimum 77 days and maximum 106 days but not known which egg failed. In two replacement clutches, eggs hatched  $13 \pm 1$ ,  $5 \pm 2$  days apart.

**YOUNG** Precocial, nidifugous. Fully feathered at hatching, weight 300 g (J.A. McLennan). Male may stay in nest while eggs hatch and female may visit nest then and soon after, even roosting in entrance. Males brood small young, which emerge for first time when 4, 6 and 7 days old. Never seen to be fed by parent; forage within few metres of burrow, often returning to it during night. At 10 days old, active and nimble, feed farther from burrow, independently of parents. Two chicks left nest for good at 20 and  $17 \pm 1$  days old. Details of growth not known.

**SUCCESS** At Hawke's Bay for two seasons: 21 eggs laid, six (29%) hatched, three young (19%) reached independence, or 0.5 chicks/pair/year. At Tangiteroria in population of 6–8 pairs for two seasons: 27 eggs laid, six (22%) hatched, five young (19%) reached independence (M.A. Potter). Desertion main cause of failure of eggs, usually after accidental damage by male. Only one definite occurrence of predation, probably by possum.

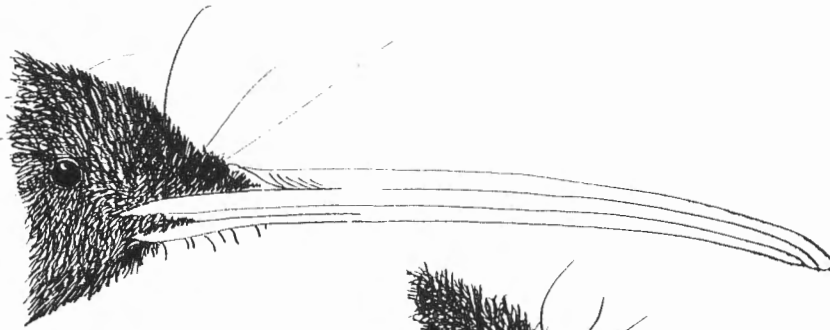
**PLUMAGES** *A.a. mantelli*.

**ADULT** Definitive. Age of first breeding unknown. **HEAD AND NECK** Long disordered black (89) rictal bristles scattered round base of bill. Feathers of face, chin, throat, forehead and crown light grey-brown (c119C) with dark brown-grey tips and concealed whitish bases. When fresh, this area appears dark brown-grey, but gradually becomes paler as tips lost. Feathers of neck similar but dark brown-grey tips broader, and less readily lost with wear. **UPPERPARTS.** Streaked with varying amounts of rufous-brown and blackish brown. Feathers elongate, with a shaggy texture caused by widely spaced barbs and short or absent barbules. Feather bases usually concealed; broad soft and light grey-brown (c119C). Distal third of feather visible and narrower; rufous-brown (36) with grey black (c82) edges formed by elongated dark tips to every second or third rami. Rachis of uniform width; mostly rufous-brown (36) but with grey-black (82) tips that protrude at least 1 mm beyond all rami and make the plumage feel prickly when stroked backwards. In some birds the lighter visible part of feathers is light brown (39), perhaps because they fade with age. Size of this patch varies, so dark streaks can take up between c. 35% and 60% of the upperparts colouration. Underparts light grey-brown (27) sometimes with a little light brown (39) mottling, and with irregular black-brown (119) streaks.

**JUVENILE** Unknown how long retained but only observed on small chicks. Hatches in this plumage; no downy young stage. Similar to adults, but upperparts soft, without prickly texture because tips of rachis fine and flexible.

**IMMATURE** Only differ from adults in smaller size.

**BARE PARTS** Based on NMNZ and NZDOC slide library, except where stated.

Fig. 1a Subspecies *lawryi*, femaleFig. 1b Subspecies *lawryi*, male

**ADULT AND IMMATURE** Subspecies *mantelli*. Iris black brown. Bill pale cream (c54) to pinkish horn, sometimes palest near base of lower mandible. Culmen often has brown (25 or 123) wash, darkest at base. Birds with dark culmen often have brownish-grey (79) cere; in paler-billed birds, cere usually coloured as bill. Colour and size of scutes of tarsus and feet varies. Skin between scutes white; scales often black-brown (119); larger scutes often with paler brown (119C) centre. Grey (84) to grey-black (82) scutes, and dark brownish grey (c79) scutes also common; pale black-brown (119), greyish buff, and buff-white scutes also recorded. Claws dark grey (83) to grey-black (82), often with cream-white central stripe. Cream (54) claws also recorded; sometimes outer two claws on each foot cream (54) and others dark grey.

Subspecies *australis*. Apparently similar. The suggestion that tarsus paler than *mantelli* probably based on examination of small samples that did not show full range of variation.

Subspecies *lawryi*. Said to differ from other races in having slate-grey bill and blackish cere (Oliver). However, many birds have cream (54) to light pinkish-horn bills; darkest bills recorded in this study brown (28) at base merging to pinkish-horn at tip, with dark brown (c21) cere.

**JUVENILE** Subspecies *mantelli*. Iris blackish. Bill white to ivory horn, pinkish at base; tarsus and toes grey to blackish brown (Oliver; NMNZ). A chick (probably younger) described by Reid (1972) had pink bill, pinkish-grey tarsus and black claws with horn white distal third.

Subspecies *australis*. Bill light horn; feet light brown (Buller 1888).

Subspecies *lawryi*. Bill ivory, tinged with flesh at base. Feet white, claws pale lead (Guthrie-Smith 1914).

**MOULTS** Little information; like *A. owenii*, subject to shock moult. Specimens of *A. a. mantelli* in moult from Feb. to Sept. (NMNZ).

**MEASUREMENTS** Difficult to measure. (1) Through-out ranges, fresh specimens (NMNZ); culmen from front edge of cere. (2) Stewart I., live birds (R.M. Colbourne); exposed culmen, tarsus from posterior end of tibiotarsal joint to end of joint between tarsus and flexed mid-toe. (3) Waitangi, live birds; as source 2 (Colbourne & Kleinpaste 1986). (4) Kapiti I., live birds; as source 2 (J.N. Jolly). (5) Oliver, methods unknown.

	MALES	FEMALES
<i>A. a. mantelli</i>		
BILL	(1) 98.2 (6.24; 84.8-107.7; 11)	129.9 (10.45; 115-149; 15) **
	(3) 98.4 (4.17; 89.8-105.6; 22)	130.4 (6.05; 117.0-141.2; 38) **
TARSUS	(1) 69.9 (8.48; 53.2-82.3; 11)	73.3 (8.18; 63.6-87.4; 15)
TOE	(1) 68.5 (2.95; 64.0-73.8; 10)	75.0 (4.57; 67.4-84.2; 15) **
<i>A. a. australis</i>		
BILL	(1) 101	129.4 (14.98; 110.5-146.5; 4)
	(4) 93.8, 105.0	129.0 (15.22; 106.8-141.3; 4)
	(5) 110-125	150-170
TARSUS	(1) 73	85.8 (9.25; 79.3-99.5; 4)
	(4) 92.4, 94.5	102.2 (3.51; 98.5-106.1; 4)
	(5) 60-80	70-80
TOE	(1) 73.5	86.1 (5.19; 80-92.6; 4)
	(4) 76.2, 69.2	97.3 (3.68; 92.0-104.5; 4)
	(5) 80-90	85-95
<i>A. a. lawryi</i>		
BILL	(2) 103.2 (4.16; 94.4-108.2; 9)	143.2 (7.37; 134.0-155.3; 10) **
TARSUS	(2) 91.9 (4.31; 86.2-98.3; 9)	97.3 (3.68; 92.0-104.5; 10) **
TOE	(1) 63.9, 78.4	80.4, 86, 83

**WEIGHT** Varies. Condition of birds important; some published weights based on museum specimens anomalously low because samples include birds that bled or starved to death in traps (Reid 1971).

*A. a. mantelli*. Throughout range, excluding emaciated and injured birds (Reid 1971). Males 2080 (1820-2590; 13), females 2490 (2090-3270; 21). Seasonal fluctuations in weight apparent: birds lose weight during breeding season, which they recover by winter. Re-weighed individuals from Hawke's Bay (J.A. McLennan):

MALES	FEMALES
2.0 kg; 1.88 (Feb.) to 2.1 (June, Aug.)	2.62; 2.28 (Dec.) to 2.90 (Aug.)
1.68; 1.44 (Nov.) to 1.88 (June)	2.81; 2.55 (Apr.) to 3.12 (June)
1.62; 1.44 (Nov.) to 2.04 (June)	2.60; 2.35 (Jan.) to 3.00 (June)

Birds from Waitangi State Forest, Northland (Colbourne & Kleinpaste 1986):

MALES	FEMALES
Nov.-Jan.: 2208 (231.6; 1900-2760; 11)	2535 (397.6; 2110-3850; 26)
Feb.-Apr.: 2160 (213.7; 1720-2420; 12)	2440 (302.1; 2130-3220; 12)
May-July: 2408 (212.0; 2050-2730; 8)	2711 (362.5; 2340-3560; 9)

*A.a. australis*. Kapiti I. male re-weighed five times between Sept. and Jan., ranged from 2520 (Nov.) to 2200 (Jan.) (J.N. Jolly).

SI: females 2725 (588.1; 2060-3433; 4; NMNZ).

Kapiti I., in summer (J.N. Jolly): 2513 (137.7; 2250-2700; 7 weights of 5 individuals).

*A.a. lawryi*. Mason's Bay, Stewart I., Feb. 1988 (R.M. Colbourne):

Males 2720 (242.6; 2300-3060; 9); Females 3115 (266.7; 2700-3500; 10).

**STRUCTURE** Similar to Little Spotted Kiwi; leg bones possibly relatively wider (T. Worthy).

**GEOGRAPHICAL VARIATION** Three subspecies recognized: *mantelli* (NI); *australis* (SI); *lawryi* (Stewart I.). Both *australis* and *lawryi* have less dark streaking on upperparts than *mantelli* (c. 30% of the upperparts area in both). In both, the tip of the rachis is slightly finer than the rest, and does not protrude beyond rami. Upperparts do not feel prickly when stroked backwards. Neither subspecies is as rufous on back as *mantelli*. Upperparts are light brown (39) to pale grey-brown (27) with blackish stripes. Subspecies *lawryi* differs from other subspecies in relatively long bill (see Measurements). Feathers of upperparts seem smaller than in other subspecies, and rufous-brown streaks appear much finer. A suggestion that tarsus scalation differs between subspecies (R.M. Colbourne) not investigated; however size of scute varies in all three subspecies, some birds having scutes more than twice the width of others of the same subspecies.

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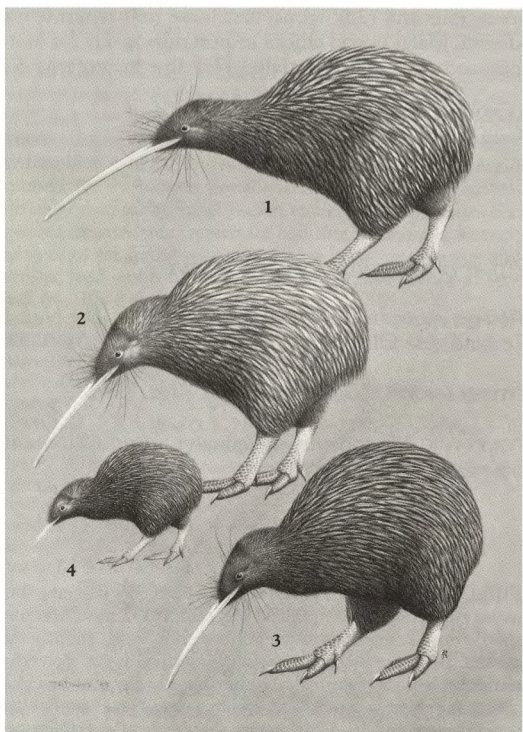
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Brown Kiwi *Apteryx australis*

1. Adult, subspecies *lawryi*
2. Adult, subspecies *australis*
3. Adult, subspecies *mantelli*
4. Juvenile, subspecies *mantelli*

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