

Order GALLIFORMES

Morphologically similar, though apparently genetically divergent, group of small to large terrestrial birds (though some species arboreal or partly so). Colloquially often referred to as 'gamebirds', because some of the most familiar pheasants, partridges and grouse are important quarry for shooters, or 'gallinaceous birds', because the Domestic Fowl is a characteristic species. Distributed world-wide (except Antarctica).

Six (or seven) families, containing about 250 species in about 90 genera (or 283 species in 75 genera; Sibley & Ahlquist 1990). Only two families occur naturally in HANZAB region: Megapodiidae (megapodes, scrubfowls and brush-turkeys), with about 19 species in six genera, in A'asia, se. Asia, the Philippines and islands of sw. Pacific; and Phasianidae (pheasants, partridges, Old World and New World quail and allies) with about 160 species in 50 or so genera (189 in 46; Sibley & Ahlquist 1990) distributed in n. and s. America, Africa, Eurasia and Asia; only four species of *Coturnix* indigenous to Aust. and NZ, though many other species have been introduced. The other families are: Tetraonidae (grouse) with 17 species in about six genera, confined to n. hemisphere; Meleagrididae (turkeys) with two species in two genera, confined to North America, with one species introduced to Aust. and NZ; Numididae (guineafowl) with 6-7 species in four genera, confined to Africa, with one species introduced to Aust. and NZ (though no definitely feral populations extant); Cracidae (curassows, chachalacas and guans) with 36-50 species in 8-11 genera, confined to Neotropical region.

The families are said to be closely similar in egg-white protein, osteology, immunology and haemoglobins, though the Megapodiidae differ somewhat from other families. DNA comparisons, however, reveal substantial genetic diversity. On the basis of DNA comparisons, Sibley & Ahlquist (1990) placed both Cracidae and Megapodiidae in a separate Order (Craciformes); they also submerged Tetraonidae and Meleagridae within the Phasianidae, and kept New World quail in a separate family, Odontophoridae. The aberrant Hoatzin *Opisthocomus hoatzin* of South America, in the monotypic family Opisthocomidae, has been placed in the Galliformes on the strength of immunological data (Brush 1979) but study of egg-white proteins (Sibley & Ahlquist 1973) and DNA comparisons (Sibley & Ahlquist 1990) show it most closely allied to the Crotophagidae in the Cuculiformes. Here we do not consider Tetraonidae or Cracidae further. History of taxonomic classification of the Order reviewed by Johnsgard (1988) and Sibley & Ahlquist (1990).

Mostly stocky birds with small heads and short broad wings. Flight, generally fast and low but not sustained and no species are long-distance migrants except the European Quail *Coturnix coturnix*. Eleven primaries (including remicle), curved; 9-20 secondaries; eutaxic, except Megapodiidae; 8-32 rectrices. Bill, heavy at base with curved culmen, usually shorter than head. Nostrils often partly covered by operculum; holorhinal; nares, impervious. Two carotids, except in Megapodiidae. Brightly coloured bare skin, wattles or combs on head in many species. Legs, short, powerful with heavy toes; hind toe present and spurs on tarsus in some. Oil-gland, varies, usually feathered; naked or with short tuft in Megapodiidae; absent in some. Crop, large; gizzard, powerful; caecae, well developed. Syrinx rather simple; tracho-bronchial. Feathers with long aftershaft; down on apteria only.

Clutch-size usually large; 6-15; up to 34 in Malleefowl. Young of most families, downy when hatched; Megapodiidae probably hatch in juvenile plumage (for discussion, see introduction to that Family); precocial, nidifugous. Most species able to fly soon after hatching (3-15 days) but some megapodes can fly almost immediately, though usually only weakly; all can fly strongly before fully grown and before post-natal moult finished. Post-juvenile moult starts within 1 month of hatching and before post-natal moult finishes; complete, or nearly so, outer 2-3 outer primaries and primary coverts retained in most species. Adult post-breeding moult complete, primaries outwards or serially outwards; moult of tail varies between families. Partial pre-breeding moult in many species.

Many species of galliforms have been introduced throughout the world (Long 1981; Westerskov 1990). In Aust. and NZ, most introductions have failed to establish or maintain feral populations; these are treated separately and briefly under the heading 'Failed introductions' at the end. Species with established feral populations are treated in the normal way.

REFERENCES

- Brush, A.H. 1979. *Biochem. Syst. Ecol.* 7: 155-65.
Johnsgard, P.A. 1988. *The Quails, Partridges, and Francolins of the World*. OUP, Oxford.
Long, J.L. 1981. *Introduced Birds of the World*. Reed, Sydney.
Sibley, C.G., & J.E. Ahlquist. 1973. *Auk* 90: 1-13.
—, — 1990. *Phylogeny and Classification of Birds*. Yale Univ. Press, New Haven.
Westerskov, K. 1990. *Proc. Perdix V: Gray Partridge and Ring-necked Pheasant Workshop*: 47-62.

Family PHASIANIDAE pheasants, partridges, quails, and allies

Small to large gamebirds; c. 140 species in c. 45 genera (189 in 46; Sibley & Ahlquist 1990), of which only four species of *Coturnix* indigenous in our region (one extinct); many species have been introduced to our region with five species in five genera, extant. New World (American) quail restricted to Americas; distribution of rest of Family centred in e. Himalayas and se. Asia; rather few species and genera spread W to Africa, N to central Asia and Europe, and S to Aust. and NZ, barely extending beyond the Greater Sunda Is. On the basis of DNA comparisons, Sibley & Ahlquist (1990) submerged the Tetraonidae and Meleagridae within the Phasianidae; they also placed the New World quail in a separate family, Odontophoridae. Morphologically similar to other families in Order, though usually lacking specializations found in other families, such as pectinate claws and feathered tarsi (Tetraonidae), bare heads, bony helmets and fleshy wattles (Numididae), bristles on breast and bare heads and fleshy wattles (Meleagrididae); less adapted to arboreal life than Cracidae. The family is absent only from polar regions, parts of South America and oceanic islands.

New World (American) quail (usually regarded as a sub-family Odontophorinae or put in a separate family Odontophoridae) are small to moderately sized, compact gamebirds; possibly originated in forests of Central America (Johnsgard 1988). About 30 species in nine or ten genera, of which two, *Colinus virginianus* and *Lophortyx californica*, have been introduced to our region, only the latter extant. Similar to partridges and Old World quail, differing in serrated tomium of lower mandible and lacking spurs. Sexes mostly alike in plumages or differing only slightly. Often with crest on head. Bill, short and stout, rather high. Nostrils, bare. Rectrices, 10–14; tail-moult, centrifugal. No species undertake long migrations though *Oreortyx* undertake seasonal altitudinal movements (Johnsgard 1988). Typically monogamous; gregarious when not breeding, in coveys or flocks.

Partridges (including francolins) and Old World quail are small to moderately sized (15–35 cm long), generally brownish birds with short tails. About 106 species in 20 genera distributed in se. Asia, through Himalayas and central Asia to w. Palaearctic and Africa; *Coturnix* extending to Aust. and NZ. Sexes generally similar but usually distinguishable by plumage. Few species have spurs. Rectrices, 8–22; moult of tail, centrifugal. Typically live in open grassy, semi-arid or agricultural land. Fly fast and low but not far, with burst of wing-beats at take-off and then alternate gliding and flapping. Free-striding gait; well adapted for running. Outside breeding season live in coveys or flocks.

Pheasants and their allies (tragopans, monals, peafowl, junglefowl) are generally larger than partridges and have long tails. About 50 species in 16 genera. Males are often brilliantly and spectacularly plumaged, differing strongly from the drab females. Males distinguished by spur. Rectrices, 14–32; moult of tail, centripetal. Usually live in wooded habit, roosting in trees. Walk with high-stepping stately gait and run easily with tails held high. Flight, strong but usually only for a few hundred metres; take off with loud wing-beats and in longer flights whirring of wings maintained; often with the ability to rise sharply upwards out of thick woods and scrub. Sedentary, living in loose groups rather than forming coveys; sexes separate outside the breeding season in some species. Many species are not monogamous (Johnsgard 1988).

Habitats vary from arid or semi-desert regions through tropical forests and temperate woodlands to high mountain tops. Particular species and genera are confined to, or prefer, tropical rainforest, woodlands, scrublands, edges of woodlands and forests, open plains, pasturelands and near-deserts. In general, sedentary; only *C. coturnix* of Europe and Africa subject to long migrations. Pheasants typically perch and roost in trees but forage on ground in open areas, where partridges both feed and roost; some pheasants feed in bushes or in the lower parts of trees. Most phasianids are omnivorous, eating roots, tubers, bulbs and other parts of plants such as seeds and fruit, as well as worms, snails, grubs and insects. Bill, feet and claws well adapted for digging and scratching.

Often gregarious but species of woodlands and forest less so than those of open country. In most species with little sexual differences in plumage, pair-bond monogamous, perhaps long-lasting. In strongly dimorphic species, harem polygamy or promiscuity prevalent. In monogamous species, males establish territories and defend them with help from mate. In polygynous species, males hold territories and display within them, in some species at traditional cleared sites or courting grounds. In all species, advertisement by male has a strong vocal accompaniment, sometimes with whirring of wings. Lateral circling display is widely, if not always, used in courtship but among polygamous species may often be replaced by frontal displays in which erection, spreading and shivering of wings, tail or tail-coverts is used. Courtship feeding by several methods is widespread. Voice, especially in large species, is loud, far-carrying and consists of simple crowing, howling, hooting, cackling or whistling. Some pheasants liable to call and whirr wings on hearing a loud noise. True bathing in water does not take place; instead, dusting in one way or another widespread. Birds pant to cool themselves. At rest, squat with head drawn into shoulders and tail drooped in species with long tails. Yawn; scratch head directly.

Breed seasonally. Nest on ground, in open, in shelter, or rocks and vegetation, or in dense cover. Usually female makes simple scrape, often lined with grass, leaves and debris collected from nearby by throwing material sideways. Eggs, oval; smooth, glossy; off-white to brown, immaculate or lightly spotted. Clutch-size, large (7–16) except in a few forest species that lay only 2–8 eggs. Usually single brooded but female may lay at two sites, one clutch for male and another for herself, in *Alectoris rufa*. Replacements laid after loss of eggs. Laying interval, 1–2 days. Incubation by female alone, except for

A. rufa as above, so far as is known. Incubation period, 17–28 days, beginning with last egg of clutch. Hatching synchronic; young, precocial, nidifugous, hatched in down; self-feeding or occasionally fed when first hatched, bill to bill, or shown food by female. Tended by female or by both parents. Injury-feigning and distraction displays may or may not be given. Young can generally fly when 7–12 days old but are not fully grown till 20–60 days old.

REFERENCES

- Johnsgard, P.A. 1988. *The Quails, Partridges and Francolins of the World*. OUP, Oxford.
- Sibley, C.G., & J.E. Ahlquist. 1973. *Phylogeny and Classification of Birds*. Yale Univ. Press, New Haven.

Lophortyx californicus California Quail

COLOUR PLATE FACING PAGE 369

Tetrao californicus Shaw, 1798, Shaw & Nodder's *Nat. Misc.* 9: Pl. 345 and text — California = Monterey.

The generic name combines the Greek λοφος (crest) and ὄρνις (quail).

OTHER ENGLISH NAMES Plumed Quail.

POLYTYPIC Seven subspecies native to w. North America.

FIELD IDENTIFICATION Length 25 cm; wingspan 32–35 cm; weight 145–210 g. Large plump stocky quail; larger than Brown Quail *Coturnix ypsilophora*; smaller than Chukar *Alectoris chukar*. Short rounded wings and short tail. Striking forward-drooping club-shaped plume on forecrown. Sexes distinguishable: male much more boldly marked and with larger plume. No seasonal differences. Juvenile separable.

Description **Adult male** Forehead and lores, buff to whitish, finely streaked black; forward-drooping black club-shaped plume rises from centre of forecrown; narrow band of white and, above this, a band of black, on forecrown, extending over eye to behind ear-coverts; crown and nape, dark chocolate-brown; narrow supercilium and band through eye, ear-coverts, chin and throat, dark-brown to black; U-shaped white band starts behind eye, curves downwards and forwards to middle of throat, bordering black chin and throat. Hindneck and collar, blue-grey, feathers finely edged black and speckled white, meeting narrowly in centre of throat. Mantle, grey; back and scapulars, slate-brown; rump, upper tail-coverts and uppertail, slate-grey. Upperwing, slate-grey with buff fringes to remiges, showing as pale streaks when wings folded. Breast, dark blue-grey; foremost feathers finely edged black when fresh; lower breast, buff to white, with black edges to feathers giving strongly scaled appearance from breast to vent; patch on centre of abdomen, chestnut, strongly scaled black; sides of breast, rich brownish-grey heavily streaked white; lower belly, under tail-coverts and flanks, olive-brown heavily streaked buff to white; feathers of flanks can be raised to cover folded wing; vent, white; undertail, pale grey. Underwing, greyish brown. Bill, black. Iris, dark brown. Legs and feet, blackish. **Adult female** Somewhat similar to male but generally duller, greyer, without bold facial pattern, and with much shorter plume. Forehead and lores, buff to pale grey-brown, finely streaked black; plume, dark brown, shorter than that of male; indistinct narrow band of white, finely streaked black, on forecrown, extending over eye to behind ear-coverts; crown and nape, brown, finely streaked with white; ear-coverts, pale brown; chin, throat and lower face, white, streaked and fringed brown. Hindneck and collar, as in male but collar narrower. Rest of upperparts, as in male. Centre of breast, grey; sides of breast, grey, boldly streaked

white; lower breast and belly, white, strongly scaled black and with light-brown wash on belly; flanks, olive-brown with rich brown tinge and boldly streaked white; vent, thighs, under tail-coverts, undertail and underwing, as male. Bare parts, as male. **Juvenile** Similar to adult female but plume shorter and paler brown. Top of head and neck, light brown, streaked darker; upperparts, grey-brown streaked white and mottled black and brown; scapulars, brown, blotched darker and boldly streaked white; tail, dark grey, mottled buff at edges and tip; remiges, dark brownish-grey, mottled light brown and tipped whitish on all but outer two primaries; greater primary coverts, dark brownish-grey, mottled paler and spotted white at tip; rest of coverts, as scapulars. Breast, brownish grey, with dull-white wedge-shaped markings; belly and thighs, dull white barred light grey-brown. Underwing, dark brownish-grey. Bare parts, as adult.

Similar species Dark plume on forecrown and bold scaling on abdomen and anterior flanks, unique in our region.

In pairs, family groups or large coveys; size of groups varies: in autumn–winter, family groups join other broods to form large coveys; disperse into pairs at approach of breeding season. Found in open country, grasslands and scrublands; roost and shelter in dense cover; forage in open grassland close to dense cover; in NZ, often roost in Monterey Pine *Pinus radiata*; sometimes in groups. Normal gait, slow sedate walk, head and plume erect; can run quickly, with plume laid back and neck stretched forward. Rapid whirring flight on short stiff wings; when flushed, burst upward with rapid whirring flight, then drop into cover or, less often, take shelter in canopy of trees; occasionally crouch and freeze when disturbed. Give loud somewhat melodious crowing, and series of short metallic calls when alarmed; lost chicks utter loud distress whistle to which adults respond with crowing.

HABITAT Open country, grasslands and scrublands in temperate NZ and Aust.

NZ Tend to be absent from areas where mean annual temperatures lower than 10 °C and mean annual rainfall greater than 750 mm; rare at higher altitudes (Williams 1952), though recorded from some districts with mean annual rainfall of 2500 mm (Williams 1952; Falla *et al.* 1978). Recorded to 1800 m asl in

NZ, but most common below 900 m asl (Williams 1952). Found in many habitats; favour mixture of dense cover and open space (Adams 1970); least favoured, if used at all, dense forest and intensively farmed pastureland (Williams 1952). Two associations of native vegetation much used: (1) tussock grasslands of *Poa*, *Festuca*, *Danthonia* and *Agropyron*, interspersed with native shrubs, such as Wild Irishman *Discaria toumatou* and *Coprosma*, and exotic shrubs, such as gorse *Ulex europaeus*, broom *Cytisus scoparius*, tree-lupin *Lupinus arboreus*, briar *Rosa eglantheria*, gooseberry *Ribes grossularia*, and creepers such as *Rubus* and *Muehlenbeckia*; (2) in NI and SI, manuka scrub of Manuka *Leptospermum scoparium* and Kanuka *L. ericoides*, often with understorey of bracken *Pteridium esculentum* (Williams 1952). Manuka scrubs used are: low (1–2 m high) scattered scrub with less than 50% cover, interspersed with tussock-grass (Fordham 1961; Caughley 1962; Challies 1962); low scrub with more than 50% cover, and tall (>3 m) Manuka, Kanuka scrub with more than 50% cover (Williams 1952; Caughley 1962). Also recorded from association of Tutu *Coriaria arborea* and bracken (Oliver), stand of Kahikatea *Dacrycarpus dacrydioides*, swampy flats (Ogle & Cheyne 1981), and edges of mudflats (Hodgkins 1949). In addition to these native habitats, many new habitats have been created by clearing of forests, modification or clearing of native grasslands, and settlement and invasion by some exotic plants; especially by creating more edge habitats where open country adjoins dense cover (Williams 1952; Adams 1970). In SI, most native tussock grasslands replaced by grasslands of introduced grasses and herbs; these modified grasslands much used, particularly where introduced shrubs or trees such as gorse, broom, lupin and pines *Pinus* provide dense thickets of taller cover (Williams 1952; Adams 1970). Pine plantations, mostly *P. radiata*, popular as roosting cover (Williams 1952) and habitat, particularly where plantations interspersed with clearings or firebreaks (Hodgkins 1949; Williams 1952). Also recorded from partly cleared farmland, and wide river beds colonized by such weeds as gorse or lupins (Williams 1952; Adams 1970).

Nest on ground, often under grass tussocks or shrubs, also in lucerne or clover crops, in litter, or under rocks (Williams 1952); one nest in scoria bank, screened by ferns (CSN 20). Cover apparently main limiting factor of distribution; where partly cleared farmland converted entirely to pasture and cover removed, or left to revert to secondary-growth forest with cover becoming too

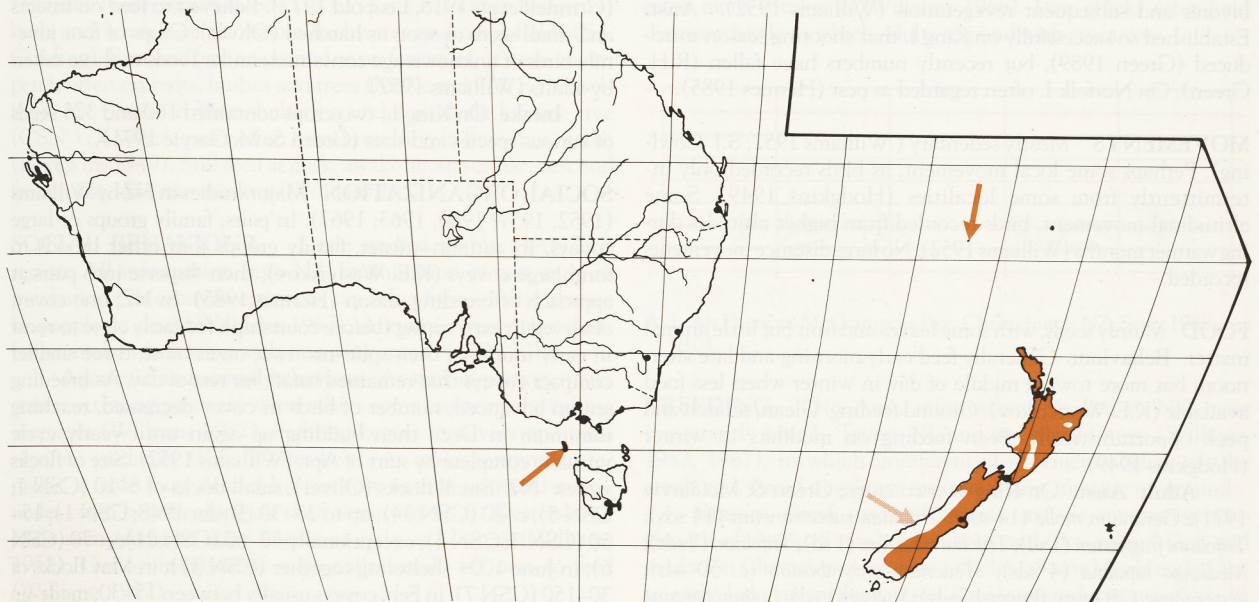
dense and extensive, numbers decrease (Williams 1952; Adams 1970). Continued grazing by sheep, soil erosion and burning off have also reduced suitability of some former habitat by removing food plants and cover (Williams 1952).

Aust. On King I., mostly partly cleared farmland with remnant patches of native vegetation or hedgerows; perch on fence posts (Green & McGarvie 1971; S.J. Cowling); forage in croplands and partly cleared pastures (S.J. Cowling), breed in nearby patches of tea-tree *Leptospermum* or scrubland (Green & McGarvie 1971).

Norfolk I. Most common in pastures of introduced grasses and herbs adjoining plantations or patches of forest or regrowth scrub, open wet flats with cover nearby, and more open areas in regenerating forest, including clearings in areas of native vegetation (Smithers & Disney 1969; McKean 1976; Schodde *et al.* 1983; D. Robinson). Birds roost and shelter in dense cover, forage in open grassland close to dense cover (D. Robinson); quite often perch on posts, trees or bushes (McKean 1976).

DISTRIBUTION AND POPULATION Native to w. USA and nw. Mexico, from Oregon, S to Baja California. Introduced to parts of USA, Canada, Argentina, France, s. Africa, various Pacific islands, Aust. and NZ (Long 1981).

Aust. Established only on King and Norfolk Is, from NZ stock. **Qld** Possibly released early 1970s at Eton Vale, but not established (Chisholm 1919). **NSW** Released Liverpool Plains, Bathurst, Blue Mtns in 1880 (Long 1981). Attempts to import the species in 1936–37 were obstructed (Cooper 1938). Further introductions in Prospect district, near Sydney, in 1944; unconfirmed breeding records there (Tarr 1950). More than 25 claimed to have been seen at Millers Forest, near Newcastle, 10 Mar. 1981 (NSW Bird Rep. 1981). **Vic.** First liberated 1863, when six birds released. More released at Gembrook, 1872 and 40, 1874. Initially successful, but disappeared later (Ryan 1906). After 1860, eggs placed in nests of native quail on Phillip I. (Long 1981). More than 260 birds unsuccessfully released in 1873–74 (Long 1981). Declining at Gembrook by 1886; also recorded at Sandhurst (Bendigo?) and Lilydale (Long 1981). Possibly further releases in 1930s, as unconfirmed records made in various parts of Vic. in 1938 (Chisholm 1950). Unconfirmed sighting at Wonthaggi, May 1965 (Wheeler 1965). **Tas.** First introduced between 1863



and 1874 (Long 1981). Once plentiful on Huon I. and near Bridgewater, but probably now extinct on Tas. mainland (Tarr 1950; Sharland 1958). Successfully introduced to King I., about 1920 (Green 1989) or 1930 (Frith 1973); coveys of up to 30 reported in early 1970s (McGarvie & Templeton 1974). **SA** Pair liberated Pewsey Vale, 1879–80 (Long 1981). **WA** 'American' (California?) Quail unsuccessfully released on Rottneest I. in 1876 (Storr 1965).

Norfolk I. Introduced from NZ stock in 1895 (Williams 1952); very common and widespread (Wakelin 1968; Smithers & Disney 1969; Schodde *et al.* 1983).

Lord Howe I. Introduced in 1880; numbers increased and fairly large flocks recorded till 1918, when quickly exterminated by introduced rats (Hindwood 1940).

NZ NI Widespread. Mainly from Northland, S to Bay of Plenty and n. and w. Taranaki. Scattered records elsewhere (NZ Atlas). **SI** Mainly N and E of Southern Alps; from Nelson and Marlborough to Otago and n. Southland; few records for West Coast, or W of 169°E (Williams 1952; NZ Atlas). First introduced at Papakura in 1862 or Nelson in 1865. Many further introductions until at least 1945 in most districts. Williams (1952) maps locations and dates of introductions as far as is known from various records of acclimatization societies, but details of many introductions incomplete. Introduced to Chatham Is before 1900, where still occurring in small numbers (NZCL).

In central Otago, in 1950, 8.5 birds/ha in winter and 3 birds/ha in late spring (Williams 1952). In NZ, eggs and birds preyed upon by introduced cats, rats, mustelids and hedgehogs (Moncrieff 1931; Hindwood 1940; Williams 1952; Oliver). Hunted in NZ and King I. (Williams 1952; Green 1989). A third of all birds desert nests following discovery; nests may be destroyed by farm machinery and stock (K.E. Westerskov). Sometimes damage vegetable gardens and commercial crops (Hermes 1985; Oliver). Small numbers struck by vehicles. Occasionally caught in rabbit traps, or poisoned by baits laid for rabbits (Williams 1952; Oliver). **NZ** Generally common in suitable areas. By 1890s, so plentiful that large numbers frozen and exported to England (Williams 1952; Oliver). In 1930s, numbers round Nelson may have decreased, possibly through predation by weasels (stoats) (Moncrieff 1931) though many NZ Atlas records from that region. Numbers decreased on Kapiti I., following eradication of introduced herbivores and subsequent revegetation (Williams 1952). **Aust.** Established so successfully on King I. that shooting season introduced (Green 1989), but recently numbers have fallen (R.H. Green). On Norfolk I. often regarded as pest (Hermes 1985).

MOVEMENTS Mostly sedentary (Williams 1952; S.J. Cowlings). Perhaps some local movement, as birds recorded only intermittently from some localities (Hodgkins 1949). Some altitudinal movement, birds recorded from higher altitudes during warmer months (Williams 1952). No long-distance movements recorded.

FOOD Mainly seeds, with some leaves and fruit but little animal matter. **Behaviour** Generally feed early morning and late afternoon, but more toward middle of day in winter when less food available (K.E. Westerskov). Ground feeding. Glean, scratch and peck opportunistically. Seen feeding on mudflats in winter (Hodgkins 1949).

Adult Aust. On King I. (two crops; Green & McGarvie 1971): *Geranium molle* (14 sds); *Trifolium subterraneum* (14 sds); *Trifolium fragiferum* (1 sd); *Trifolium dubium* (1 sd); *Trifolium* (7 sds); *Medicago lupulina* (4 sds); ?*Teucrium corymbosum* (c. 50 sds); Asteraceae (28 imm. flower-heads); *Vulpia* (1 sd); *Lolium perenne*

(55 sds); *Bromus* (7 sds); *Holcus lanatus* (6 sds); *Danthonia penicillata* (89 sds); *Anagallis arvensis* (20 sds); *Scirpus* (3 seed-heads); *Poranthera microphylla* (184 sds); *Phalaris* (1 sd). Some sand, two grains of grit.

Breeding NZ Taupo (16 stomachs, sds unless stated; Williams 1952): Plants: *Cytisus scoparius* (69% vol.); *Rumex acetosella* (13); *Trifolium* (9% lvs, 7% sds); *Oxalis* (1 lvs); *Vulpia* (1); <1: *Pteridium esculentum*, *Juncus*, *Poa*; *Bromus mollis* (lvs), *Cerastium*, *Danthonia*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Haloragis uniflora*, *Ranunculus repens*, *Acaena oviana*, *Rubus*, *Prunella vulgaris*, *Alchemilla arvensis*, Asteraceae, *Senecio Sonchus asper*, *Crepis capillaris*, *Galium*, *Hydrocotyle novaezealandiae*, *Hypochaeris radicata*, *Lactuca virosa* (lvs), *Myosotis*, *Silene gallica*, *Verbena officinalis*, *Veronica*, *Wahlenbergia*. Animal material (0.2%).

Non-breeding NZ In Marlborough (16 stomachs, sds unless stated; Williams 1952): Plants: *Discaria toumatou* (33% vol); *Trifolium* (14% vol. lvs, 12% vol. sds); *Medicago lupulina* (incl. lvs, 10); *Ulex europaeus* (9); *Vicia* (12); *Cirsium lanceolatum* (1); *Carmichaelia* (1); *Bromus mollis* (1); <1: *Juncus*, *Carex*, Asteraceae, *Danthonia*, *Crepis capillaris*, *Daucus*, *Holcus lanatus*, *Hymenanthera*, *Griselinia*, *Echium vulgare*, *Rosa eglantaria*, *Poa*, *Agrostis muscosa*, *Urtica*, *Anagallis arvensis*, *Sagina procumbens*, *Myosotis*, *Cerastium*, *Oxalis*, *Prunella vulgaris*, *Ranunculus repens*, *Vicia*, *Vulpia*. Animal material (0.2).

In **Central Otago, NZ** (winter, 22 stomachs, sds unless stated; Williams 1952): Plants: *Sambucus nigra* (29% vol.); *Medicago* (23); *Trifolium* (17% vol. mainly lvs); *Cirsium lanceolatum* (5); *Medicago* (5% vol. lvs); *Euphorbia pepus* (4); *Hymenanthera* (4); *Stellaria* (3 lvs); *Poa lindsayi* (2 lvs); *Myosotis* (1); *Sagina procumbens* (1); <1 *Carex*, *Agrostis*, *Aira*, *Bromus mollis* (lvs), *Festuca rubra* (lvs), *Holcus lanatus*, *Lolium*, *Poa pratensis* (lvs), *P. maniototo* (lvs), *Trisetum* (lvs), *Hydrocotyle novaezealandiae*, *Anagallis arvensis*, *Vulpia*, *Pimelea*, *Urtica*, *Cerastium*, *Discaria toumatou*, *Myosurus novaezealandiae*, *Vicia angustifolia*, Compositae (flowers), *Geranium*, *Chenopodium album*, *Rumex acetosella*, *Rosa eglanteria*, *Acaena* (incl. lvs), *Coprosma*, *Cotula* (lvs), *Erodium*, *Oxalis* (incl. lvs), *Ranunculus*. Animal material (0.2).

Other records Violet lvs, cabbage (CSN 32); acorns cut by lawn-mower (CSN 19); broom sds (Phillipps & Lindsay 1948).

Young Nidifugous. Mainly insectivorous for first week (Grinnell *et al.* 1918; Leopold 1977). Believed to feed on insects and small seeds as soon as hatched (Oliver). Crops of four juvenile birds of unknown age contained similar foods to those taken by adults (Williams 1952).

Intake On King I., two crops contained 160 and 325 seeds of various species and sizes (Green & McGarvie 1971).

SOCIAL ORGANIZATION Major studies in NZ by Williams (1952, 1957, 1960, 1963, 1967). In pairs, family groups or large coveys. In autumn–winter, family groups join other broods to form large coveys (K.E. Westerskov), then disperse into pairs at approach of breeding season (Hermes 1985). In NZ, one covey, observed in early spring (before courtship), fed fairly close to roost in early morning, then split into two, or, at most, three smaller compact coveys that remained intact for rest of day. As breeding season advanced, number of birds in covey decreased, reaching minimum in Dec., then building up again until yearly cycle virtually complete by start of Apr. (Williams 1952). Size of flocks varies. **NZ** Small flocks (Oliver), small flocks of 8–10 (CSN 1; CSN 5), c. 20 (CSN 34), up to 25–30 (Ryder 1948; CSN 1); 15–50 (CSN 3; CSN 4), exceptionally 50–60 (CSN 21); c. 70 (CSN 6); in June 100+ sheltering together (CSN 37); in May flocks of 30–150 (CSN 7); in Feb. coveys usually between 15–30, made-up

of 3–5 family groups (Williams 1952); large family groups of 10–12 chicks plus adult (Olsen 1989). **Norfolk I.** Usually in coveys of 3–20 (Schodde *et al.* 1983); usually singly, pairs or family groups (Smithers & Disney 1969). **King I.** Coveys up to 30 birds in autumn and winter (McGarvie & Templeton 1974). Family group, pair with offspring, recorded Dec. 1983 (S.J. Cowling). No records of large flocks (500–600) being seen in non-breeding season, as has been recorded elsewhere (Long 1981). **NZ** In Feb.–Mar., up to 80 observed feeding on acorns (CSN 19). NZ populations appear to exhibit regular annual fluctuations in winter age-ratios: four-year cycle of large and small populations, with corresponding high and low proportions of young (Williams 1960), later found not to be cyclic (Williams 1966). Ratio of juveniles to adults in population varied from 0.17 to 1.15 during 14 years (Williams 1963); age- and sex-ratios related, see below.

Bonds Monogamous. In NZ, sex-ratio varies from place to place and year to year (Williams 1952). Surveys found sex-ratios of 1.3:1 (Gurr 1951; Williams 1952) in favour of males; bias less marked among immatures and more marked among adults (Williams 1952; 1957). Yearling birds breed (Williams 1967). In NZ, pairing begins in late Aug. or early Sept. (Williams 1952), and can be paired by mid-Sept. (CSN 1); pairing also noted Nov. (CSN 4). **Parental care** Incubation by female only, at which time male usually guards territory (K.E. Westerskov); male occasionally recorded sitting, e.g. captive male said to have successfully incubated clutch after female killed (Williams 1952); most records of males sitting on eggs probably examples of casual brooding rather than true incubation (Williams 1952). Male and female accompany and tend brood, male often as guard (S.J. Cowling).

Breeding dispersion Nest in solitary pairs within a territory, but details for NZ not described. Assembly and break-up of non-breeding coveys or range of these coveys also little known (K.E. Westerskov). At one circumscribed site, where birds could easily be observed and counted, 120 birds occupied range of 14 ha during winter at density of about 8.5 birds/ha; by late spring, when nesting was starting, same number of birds occupied 40 ha at density of 3 birds/ha (Williams 1952).

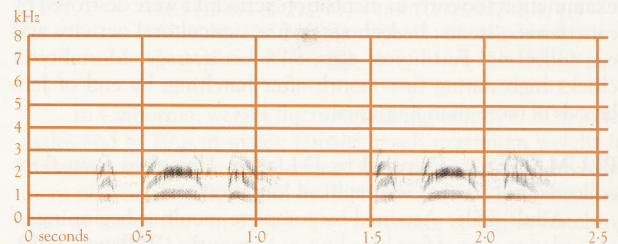
Roosting Roost at night; in groups, at least at some times of year. In NZ, *P. radiata* sometimes favoured roosting cover (Williams 1952); 15+ observed roosting in Totara *Podocarpus totara* and Rimu *Dacrydium cupressinum* (CSN 37). On King I., roost in hedgerow, bush and scrub near accessible freshwater and open fields (S.J. Cowling). Rest and loaf on ground or on fences in, or near, cover; perch often on posts, bushes and trees (McKean 1976; S.J. Cowling); 100+ seen in June sheltering under roadside lucerne tree (CSN 37). Whole party often found perching in branches of tree (Hodgkins 1949). Still feed at dusk; awake about sunrise, descend from roost, and start feeding (Williams 1952).

SOCIAL BEHAVIOUR Little studied within HANZAB region. All information from NZ. Examination of nest early in incubation can cause desertion, as can other forms of disturbance by people or dogs (Williams 1967). Autumn coveys may disturb, males often lying with one wing spread (CSN 20).

Agonistic and sexual behaviour At start of pairing, males start reacting aggressively when others come too near, and calling increases (Williams 1952). Fighting begins in coveys and pairs separate gradually (K.E. Westerskov). As males outnumber females, a male must defend his territory against unmated males; males often heard calling on their territories (K.E. Westerskov). Male seen trying to tread female as early as 22 Aug. (Williams 1952). During incubation, male calls female off nest to feed (Williams 1952).

Relations within family group During laying and incubation, pair secretive. Observations on one pair: male usually led way to nest, watching while female fed; female entered nest leaving male on guard to watch and feed until she rejoined him, then both usually flew off; but when she started to sit longer, he flew to join a remaining small covey; by ninth egg, male perched in tree close to nest for most of day; usually female fed for about 30 min, two or three times daily, generally mid-morning or late afternoon; female escorted back to nest by male (also occurred if female flushed from nest) (Williams 1952). In wet weather, newly hatched young stay in nest with female for up to a day (K.E. Westerskov). Female will not leave nest or young, so reportedly hundreds can perish during bushfires (Phillipps & Lindsay 1948). Female clucks for chicks (K.E. Westerskov). Development of embryos synchronized by means of clicking sounds made by embryo chicks (K.E. Westerskov). **Anti-predator responses of young** When alarmed, parent calls and flies away, while young, if too small to fly, hide under whatever cover available, and lie close to ground until called together by parent (Oliver). **Parental anti-predator strategies** In NZ, obvious predators: feral cats, hedgehogs, stoats and ferrets (Williams 1952). When stoat trailed one family group, parent ushered chicks in front, then moved away from chicks, trying to act as lure; parent tried several times, running towards stoat and fleeing, but not flying, when stoat chased it; no second adult involved; no alarm call given (Olsen 1989). When young 9–10 weeks old, broods often combine to form larger coveys (K.E. Westerskov).

VOICE No information from HANZAB region. Calls and their functions well known from study of Williams (1969) in USA, mainly with captive birds; summarized in Johnsgard (1973) and Leopold (1977). Most frequently heard calls are: loud somewhat melodious crowing *cu-ca-cow* (sonagram A) given by both sexes throughout year; louder, longer *cow* persistently given by unpaired males seeking mates; series of metallic *pit* calls in alarm. Other calls are: conversational note *ut-ut* (contact call); soft *put-put* notes like distant outboard motor (prolongs freezing behaviour during alarm); high-pitched staccato whistle, like a short vehement sneeze (males establishing dominance). Fourteen different calls, 11 by both sexes, three by males only. Antiphonal calling occurs, male responding with 'sneeze' call to *cu-ca-cow* of separated mate (Stokes & Williams 1968). Lost chicks utter loud distress whistle to which adults respond with *cu-ca-cow*.



A L. McPherson; McCormacks Bay, Christchurch NZ; Sept. 1988; P103

BREEDING No Aust. information. Studied in NZ, most importantly near L. Taupo, NI, and in central Otago (Williams 1952, 1967), to which unreferenced statements below can be attributed. Breed in solitary territorial pairs, nesting on ground.

Season From study of gonads, mature spermatogenesis (length of testes >8 mm) from about mid-Oct. to end Dec. and ovulation (diameter of ovarian follicles >5 mm) from early Oct. to early Jan.; mean duration of female reproduction period, 13

weeks. By backdating from hatching or age of young birds, extremes of laying period from about 1 Oct. to 1 Feb. at L. Taupo.

Site On ground among vegetation or between rocks; anywhere with some shelter, however slight; under overhead cover of some kind. Few (nine) nests described: one in willow tree 70 cm above ground, all others on ground, under steel pipes, rocks, stones or in thick grass and among thistles.

Nest, Materials A mere hollow or scrape in the ground, lined with a few straws or one or two feathers. No information on selection of site or preparation of nest.

Eggs Pointed oval or short ovate; little or no gloss; ground-colour, cream-buff, ivory-yellow or dull white blotched irregularly or minutely dotted in shades of brown. **MEASUREMENTS:** 31 (28–34; 77) x 24 (23–26) (N. American nominate subspecies; Bent 1932).

Clutch-size In Otago, average 13.7 (0.3; 8–22; 103). At L. Taupo, 13 (0.8; 10–20; 16). May decrease in size during season and varies annually from 10.7 to 14.2. No true second broods. Re-lay after loss of eggs.

Laying At approximately 24-h intervals but slightly earlier each day, so that last eggs of clutch laid 2–4 h earlier during day than first.

Incubation Only by female but in captivity male has been reported twice to have sat on eggs or incubated to hatching of eggs. Female spends longer on eggs from about midway through laying of clutch but full incubation starts only with last or penultimate egg. During laying period male usually leads female to within a metre or two of nest then maintains watch near nest. As female gradually lengthens stay on nest, male liable soon to fly off and join any small covey that persists nearby. During full incubation, male stays most of day in nearby tree and calls female off for her feeding periods, which take place 2–3 times a day and last for c. 30 min. **INCUBATION PERIOD:** 22 days.

Young Precocial, nidifugous. Hatch synchronically, in down; leave nest after a few hours but during wet weather stay for a day, sheltered by hen. When 2 weeks old, can flutter; when 3–4 weeks old, fly short distances. Both adults attend, guard and brood chicks. At 4 months old, reach size of adults (K.E. Westerskov). No detailed information on growth and development in NZ. Breed when about 12 months old.

Success Of 102 nests in Otago during 15 years, the fate of 43 not known. Of the 59 others, 37 were successful; 11 were deserted after interference by people or dogs or by reason of examination too early in incubation period; 11 were destroyed by cats, ferrets, stoats, hedgehogs or fire, agricultural activity and egg-collecting. Fertility of eggs, 94% on average. Mortality of chicks high during first month after hatching; by end of Jan. broods of more than 4 unusual.

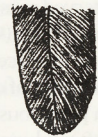
PLUMAGES Prepared by D.J. James. Described from skins collected in NZ; see Geographical Variation.

Adult male Attained by complete moult at beginning of second year. Age of first breeding, c. 12 months (Williams 1959). Feathers of head and body have concealed grey (84) plumulaceous base and aftershaft. **Head and neck** Forehead and lores, cream (92) with inconspicuous black-brown (119) shafts; form broad square frontal patch. Crown and nape, brown (c223B); grading to black-brown (119) towards front of crown; narrow sharp white border, square-cut across front and along sides of crown to sides of nape. Distinctive crest on forecrown, of four elongated (30–35 mm) spatula-shaped black-brown (119) feathers that are symmetrical but folded in half about shaft, so seem club-shaped. Small triangular brown (223B) patch on ear-coverts grades to black anteriorly, continuing as line through eye. Chin and throat,

black, bordered by white band across base of foreneck and up lower side of neck to behind eye. Hindneck and side of neck, mostly black, densely spotted white; feathers, black with indistinct grey (c84) edges to feathers and small white subterminal spot on each web. Towards mantle, feathers of hindneck become larger and grey (c84), with cream (92) subterminal border and grey-black fringe and shaft-streak. **Upperparts** Mantle, grey (85) with grey-black (82) shafts to feathers. Scapulars, olive-brown with grey tinge (29 to grey 30). Back, rump and upper tail-coverts, as scapulars at bases, grading to grey (84) at tips of feathers, especially towards tail. **Underparts** Central breast, grey (84) with very slight bluish tint; when fresh, feathers have very narrow inconspicuous black fringe at tip. Feathers at sides of breast have broad white shaft-streaks that are often raised to cover bend of folded wing. Lower breast, buff (123D–124) (fading to cream [92] with wear) with sharp, even, grey-black (82) fringes (scallops) at tips of feathers; in zone between grey and buff feathers, some grey (84) with white subterminal scallop and grey-black (82) fringe at tip. Belly, rufous to rufous-brown (136) with grey-black (82) scallop at tip and across middle of feathers. Lower belly and flanks, olive-brown (29) with broad white shaft-streaks; feathers of flank can be raised to cover folded wing. Vent, plumulaceous, white. Under tail-coverts and thighs, dirty buff with broad dark-brown (c21) shaft-streaks; tail-coverts, long, covering most of underside of tail. **Uppertail** Dark grey (83). **Undertail** Grey (84), rectrices with white shafts. **Upperwing** Primaries, greater primary coverts and alula, dark brown (119A) (see Fig. 1). Secondaries, dark olive-brown (c129) with buff (124) to cream (92) fringe at tips and faint fine dark-brown (121) vermiculations along outer edge. Greater secondary coverts, olive-brown (30) with fine dark-brown (121) and light-brown (223D) mottling along edges. Lesser and median coverts, olive-brown (c29–30) with faint vermiculations and faint narrow light-brown (223D) fringe at tips. Tertiaries and tertial coverts, olive-brown (29–30) on outer webs; inner webs, brown (c23) with fine blackish vermiculations and broad cream (92) inner edges, that form bold stripe along side of upperparts. **Underwing** Remiges and greater primary coverts, brownish grey (c79). Rest of coverts, brownish grey (c79) with whitish fringes.



1a Juvenile



1b Adult

Fig. 1 Greater primary covert

Adult female Greyer, less distinctly marked than male. **Head and neck** Forehead and lores, light grey-brown (119C) with inconspicuous black-brown shaft-streaks on feathers. Grades to brown (c119B) on crown, light grey-brown (119C) nape and olive-brown (29) rear and sides of neck, each feather with thin black-brown (119) fringe and shaft-streak. Ear-coverts, throat and foreneck, off-white, each feather with dull-brown (28) fringe and shaft-streak. Crest, black-brown (119), shorter than males (15–20 mm), folded but not so club-shaped. **Upperparts** As male. **Underparts** Central breast, olive-grey (olive 79). Feathers at sides of breast have broad bold white shaft-streaks. Lower breast, white with sharp black-brown (119) fringes producing neat strong scaly pattern; bases of feathers have one or two concealed dark-brown (119A) bars. Belly similar to lower breast but feathers washed light brown (223D). Flanks, olive-brown with rich-brown tinge not present in male; feathers have broad bold white shaft

streaks. Vent, thighs and under tail-coverts, as male. **Tail**, **Upperwing**, **Underwing** As male.

Downy young Top of head buff, with dark-brown cap narrowly bordered by white towards rear. Upperparts, buff or cinnamon-buff with dark-brown to black-brown para-vertebral and dorso-lateral stripes. Underparts, white, buff on breast, and blotched brown on flanks and thighs (Raitt 1961; Fjelds  1977; Leopold 1977; NZRD).

Juvenile Sexes similar until about 7 weeks old, when new black (male) or brown (female) feathers appear on ear-coverts (Williams 1959; Raitt 1961). **Head and neck** Top of head and neck, light brown (26) streaked black-brown (119). Crest feathers, short, broad and not folded, black-brown (119). **Upperparts** Feathers of mantle, light grey (85) at bases grading to dark brown (119A) distally with irregular white shaft-streaks that flare to spots at tips. Scapulars, brown (121C) blotched dark brown (121), with bold cream (92) shaft-streaks that flare at tips. Back and rump, light grey (85), brownish towards tips. **Underparts** Breast, brownish grey (c80) with triangular off-white spot at tip of each feather. Belly and thighs, off-white with inconspicuous light grey-brown (119C) barring. **Tail** Dark grey (c85) speckled buff (124) in centre of rectrices, mottled buff at edges and tip. **Upperwing** Primaries, dark brownish-grey (c79), outer two uniform and inner eight mottled buff (124) along outer edge and speckled buff at tip. Secondaries, dark brownish-grey (c79), uniform at base of inner web, speckled and mottled light brown (223D) elsewhere. Tertiaries, brown (123A) speckled black-brown (119) with broad buff (124) inner edge and short broad black-brown (119) stripe at tip of inner web. Alula and greater primary coverts, dark brownish-grey (c79) mottled light brown (223D) on outer web and with white triangular spot at tip (see Fig. 1); outer two or three, usually uniform or nearly so. Rest of coverts, as scapulars. **Underwing** Remiges and greater coverts, dark brownish-grey (c79).

First immature Sexes alike. Differ from respective adult plumages only in retained outer two juvenile (pointed) primaries and greater primary coverts.

Aberrant plumages Crawford *et al.* (1987) reported a female from USA with plumage intermediate between that of male and female.

BARE PARTS Based on photos (Aust. RD; K.E. Westerskov) and museum labels (AWMM, CM, NMNZ); sexes similar. **Adult**, **First immature** Bill, black. Iris, brown to dark brown. Legs, grey to brownish grey or grey-brown. **Downy young** Bill and feet, buffish pink; iris, dark brown (Fjelds  1977).

MOULTS Described in detail from Californian birds by Raitt (1961). **Adult post-breeding** (Pre-basic). Complete. Primaries, outwards; other tracts completed within time-span of primaries. Secondaries, inward and outward from s3 and inward from s11. Tail, centrifugal. Williams (1959) stated details in NZ to be similar to those reported from California by Genelly (1955) except for timing. In California, females begin moult shortly after broods hatch, males about a month before (Genelly 1955; Raitt 1961). **Post-natal** Already begun at hatching with juvenile p1–p7 just emerging; completed with growth of p10 in Weeks 10 or 11; natal down retained on ear-coverts until Week 7 (Raitt 1961). **Post-juvenile** (First pre-basic). Partial, juvenile greater primary coverts and p9 and p10 retained. Overlaps with post-natal moult, inner juvenile primaries being replaced before outer ones grown. Moult of primaries begins 3–4 weeks after hatching and completed c. 25 weeks (Williams 1959). Other tracts similar to adult post-breeding (Raitt 1961). **Pre-breeding** (Pre-alternate). Dwight

(1900) reported partial moult of head and neck in USA birds; has not been reported since and could not be detected by Raitt (1961) on skins.

MEASUREMENTS NZ, skins (AWMM, CM, NMNZ): (1) adults; (2) first immature.

	MALES	FEMALES	
WING	(1) 116.3 (1.95; 113–118; 10) (2) 113.6 (2.07; 112–117; 8)	112.3 (2.88; 110–117; 6) 114, 114, 115	ns
STH P	(1) 81.0 (2.3; 77–85; 10) (2) 80.4 (31; 76–86; 8)	77.3 (2.22; 75–80; 4) 79, 81, 83	ns
TAIL	(1) 90.4 (4.1; 86–99; 10) (2) 87.7 (3.5; 83–92; 7)	83.0 (3.00; 79–87; 7) 85, 81, 85	ns
BILL F	(1) 12.0 (0.56; 11.0–12.9; 9) (2) 12.6 (0.63; 11.3–13.5; 8)	11.8 (0.42; 11.4–12.6; 7) 11.7, 11.8, 12.0	ns
TARSUS	(1) 31.2 (1.06; 30.0–33.2; 10) (2) 30.9 (1.08; 29.3–32.3; 8)	31.3 (0.72; 30.5–32.4; 6) 31.4, 30.1, 31.2	ns
TOE	(1) 27.1 (0.73; 26.0–28.5; 9) (2) 27.0 (0.91; 26.2–27.9; 8)	26.8 (0.76; 26.0–28.2; 6) 25.5, 26.4, 26.5	ns

SI, NZ, adults and immatures, July; WING = minimum chord; TOE C = mid-toe with claw (Williams 1952): (3) Central Otago; (4) Taupo.

	MALES	FEMALES	
WING	(3) 111 (3.32; 103–117; 28) (4) 110 (2.90; 106–113; 10)	110 (2.64; 103–115; 22) 108 (2.28; 106–112; 10)	ns ns
BILL F	(3) 12.8 (0.82; 11.0–14.5; 28) (4) 13.9 (0.59; 13.0–14.7; 10)	12.7 (0.58; 11.0–13.5; 22) 13.1 (0.59; 12.0–14.2; 10)	ns ns
TARSUS	(3) 35.5 (1.58; 32.5–40.0; 28) (4) 34.2 (1.58; 31.0–36.7; 10)	35.8 (2.04; 32.0–38.0; 22) 33.9 (1.42; 31.1–35.5; 10)	ns ns
TOE C	(3) 35.4 (1.36; 32.0–38.0; 26) (4) 33.3 (2.25; 30.0–36.1; 10)	35.4 (35.5; 33.0–37.5; 21) 33.9 (2.05; 29.3–35.3; 10)	ns ns

WEIGHTS SI, NZ (Williams 1952): (1) Central Otago, adults; (2) Central Otago, first immatures; (3) Taupo, adults and immatures.

	MALES	FEMALES
(1)	191.5 (15.6; 146–211; 61)	185.0 (13.8; 150–209; 41)
(2)	189.2 (10.7; 174–214; 18)	178.4 (12.8; 158–194; 13)
(3)	176.0 (10.9; 159–188; 10)	162.0 (10.4; 151–180; 10)

In California, weight fluctuates during year by c. 30 g in females and c. 20 g in males; females reach maximum weight in midsummer, males in early spring; fluctuations due to development of ovarian follicles and oviduct in females, seasonal aggression in males (Lewin 1963). Downy young c. 6 g at hatching (Fjelds  1977).

STRUCTURE Wing, short, rounded. Eleven primaries; p6 longest; p10 13–22 mm shorter, p9 6–11, p8 0–4, p7 0–1, p5 1–3, p4 2–9, p3 6–17, p2 15–24, p1 25–34, p11 minute. Fourteen secondaries (Ohmart 1967) including four tertiaries; longest tertial falls between p2 and p4 when wing folded. Tail, wedge-shaped, narrow when folded, long for ground bird; 12 rectrices. Bill, high and wide at base, heavy and conical; culmen, strongly arched; lower mandible, small, overlapped by upper; nostril, slit-like, diagonal, covered dorsally by large oval operculum. Foot scales, scutellate on front of tarsus (in two rows) and top of toes; reticu-

late elsewhere. Outer toe 73–76% of middle, inner 60–70%, hind 23–29%. Claws, quite long, slightly curved, about twice size of claw of Stubble Quail *Coturnix pectoralis*.

AGEING Young can be aged with considerable accuracy on growth of first winter (first basic) primaries; see Williams (1952), Thompson & Kabat (1950) and Raitt (1961) for methodology and ageing charts. Physiological methods of ageing young given by Lewin (1963).

GEOGRAPHICAL VARIATION Seven subspecies native to w. North America (Leopold 1977). One or two introduced to NZ from c. 1862 onwards; details summarized in Williams (1952) and Long (1981). NZ skins seem closest to subspecies *brunnescens* (olive-brown tinge to upperparts) but little comparative material and what there is possibly unreliable. Some greyer skins possibly nominate *californicus* or hybrids between *californicus* and *brunnescens*. Twenty skins from Taupo and Otago sent to Museum of Vertebrate Zoology were identified as *californicus* by F.A. Pitelka (Williams 1952). NZ stock introduced to Norfolk I., where established, and to much of Aust. where surviving only on King I.

REFERENCES

- Adams, J.S. 1970. *Wildl.—A Rev.* 1970: 49–51.
 Bent, A.C. 1932. *Bull. Am. Mus. nat. Hist.* 162.
 Caughley, G. 1962. *Emu* 62: 129–39.
 Challies, C.N. 1962. *Notornis* 10: 118–27.
 Chisholm, A.H. 1919. *Emu* 19: 60–2.
 — 1950. *Emu* 50: 97–100.
 Cooper, R.P. 1938. *Emu* 37: 260–1.
 Crawford, J.A., et al. 1987. *Calif. Fish Game* 73: 244–7.
 Dwight, J. Jr. 1900. *Annals NY Acad. Sci.* 13: 73–360.
 Falla, R.A., et al. 1978. *The New Guide to the Birds of New Zealand*. Collins, Auckland.
 Fjeldså, J. 1977. *Guide to the Young of European Precocial Birds*. Skarv. Nature Pubs, Strandgården, Tisvilditeje.
 Fordham, R.A. 1961. *Notornis* 9: 113–19.
 Frith, H.J. 1973. *Wildlife Conservation*. Angus & Robertson, Sydney.
 Genelly, R.E. 1955. *Condor* 57: 263–85.
 Green, R.H. 1989. *Birds of Tasmania*. Potoroo, Launceston.
 —, & A.M. McGarvie. 1971. *Rec. Queen Vict. Mus.* 40.
 Grinnell, J., et al. 1918. *The Game Birds of California*. Univ. Calif. Press, Berkeley.
 Gurr, L. 1951. *Notornis* 4: 144–5.
 Hermes, N. 1985. *Birds of Norfolk Island*. Wonderland Pubs, Norfolk I.
 Hindwood, K.A. 1940. *Emu* 40: 1–86.
 Hodgkins, M. 1949. *NZ Bird Notes* 3: 116–25.
 Johnsgard, P.A. 1973. *Grouse and Quails of North America*. University of Nebraska Press, Nebraska.
 Leopold, A.S. 1977. *The California Quail*. Univ. Calif. Press, Berkeley.
 Lewin, V. 1963. *Condor* 65: 249–78.
 Long, J.L. 1981. *Introduced Birds of the World*. Reed, Sydney.
 McGarvie, A.M., & M.T. Templeton. 1974. *Emu* 74: 91–6.
 McKean, J. 1976. *Camberra Bird Notes* 3: 18–23.
 Moncrieff, P. 1931. *Emu* 30: 219–24.
 Ogle, C.C., & J. Cheyne. 1981. *Fauna Surv. Unit Rep.* 28.
 Ohmart, R.D. 1967. *Condor* 69: 535–48.
 Olsen, M. 1989. *Notornis* 36: 310.
 Phillipps, W.J., & C.J. Lindsay. 1948. *NZ Bird Notes* 3: 43–50.
 Raitt, R.J. 1961. *Condor* 63: 295–303.
 Ryan, C.S. 1906. *Emu* 5: 110–19.
 Ryder, H.R. 1948. *NZ Bird Notes* 3: 20–2.
 Schodde, R., et al. 1983. *ANPWS Spec. Publ.* 8.
 Sharland, M. 1958. *Tasmanian Birds*. Oldham, Beddome & Meredith, Hobart.
 Smithers, C.N., & H.J. de S. Disney. 1969. *Aust. Zool.* 15: 127–40.
 Stokes, A.N., & H.W. Williams. 1968. *Auk* 85: 83–9.
 Storr, G.M. 1965. *Emu* 64: 172–80.
 Tarr, H.E. 1950. *Emu* 49: 189–98.
 Thompson, D.R., & C. Kabat. 1950. *Wilson Bull.* 62: 20–31.
 Wakelin, H. 1968. *Notornis* 15: 156–76.
 Wheeler, R. 1965. *Bird Obs.* 406: 2–4.
 Williams, G.R. 1952. *J. Wildl. Mgmt* 16: 460–83.
 — 1957. *Bird-Banding* 28: 145–50.
 — 1959. *Bird-Banding* 30: 203–18.
 — 1960. *Proc. NZ Ecol. Soc.* 7: 9–11.
 — 1963. *J. Anim. Ecol.* 32: 441–59.
 — 1966. Unpubl. PhD thesis, Lincoln Coll. Univ., Canterbury.
 — 1967. *Proc. NZ Ecol. Soc.* 14: 88–99.
 Williams, H.W. 1969. *Auk* 86: 631–59.



Volume 2, Plate 30

Chukar *Alectoris chukar* (page 386)

1 Adult; 2 Downy young; 3 Juvenile; 4, 5 Adult

California Quail *Lophortyx californicus* (page 358)

6 Adult male; 7 Adult female; 8 Downy young; 9 Juvenile; 10 Adult male; 11, 12 Adult female

© Peter Marsack