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## Order GRUIFORMES

Diverse assemblage of small to very large wading and terrestrial birds. Morphologically diverse, with few unifying characters within the Order. Anatomical details are summarized by Sibley & Ahlquist (1990). Possibly polyphyletic, though DNA comparisons indicate that the Order is monophyletic, composed of highly divergent groups that are more closely related to one another than to members of any other order (Sibley & Ahlquist 1990). The boundaries of the Order and relationships with other Orders and between families in this Order are uncertain (Sibley 1960; Sibley & Ahlquist 1972, 1990; Cracraft 1973; G.F. van Tets).

Peters, Wetmore (1960) and Storer (1971) recognized 12 families: Eurypygidae (monotypic Sun-bittern of tropical America); Otididae (bustards); Gruidae (cranes); Heliomithidae (finfoots of tropical Old and New World; three monotypic species); Aramididae (monotypic Limpkin of tropical and subtropical America); Psophiidae (trumpeters of tropical America; three species in single genus); Cariamidae (seriemas of central S. America; two monotypic genera); Rhynchotidae (monotypic Kagu of New Caledonia); Rallidae (crakes and rails); Mesitornithidae (mesites of Madagascar; three species in two genera); Pedionomidae (monotypic Plains-wanderer of Aust.); and Turnicidae (button-quails).

The Plains-wanderer is now recognized as being a charadriiform on evidence of morphology (Olson & Steadman 1981) and DNA-DNA hybridization (Sibley *et al.* 1988). Sibley *et al.* (1988) and Sibley & Ahlquist (1990) placed the Turnicidae in a separate Order, the Turniciformes *incertae sedis* (which we follow here; q.v.) and included Aramididae within the Heliomithidae but otherwise retained a similar arrangement of families. The Mesitornithidae, Rhynchotidae and Otididae have also been regarded as separate Orders.

Only Gruidae, Rallidae and Otididae occur in our region; other families are not considered further here.

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## Family RALLIDAE rails, crakes and gallinules

A group of small to medium-sized (12–65 cm long), generally slender, terrestrial birds, usually of wetlands, often very secretive and skulking. Almost cosmopolitan, not occurring in polar regions and waterless deserts. In our region, 17 breeding species in 11 genera, five accidentals (one doubtful) and three extinct. Relation to other Gruiformes not fully resolved; skeletal morphology suggests close alliance to Psophiidae (trumpeters) and Heliornithidae (sungrebes) (Cracraft 1973); Aramididae, Eurypygididae and Cariamididae of S. America, and Rhynochetidae of New Caledonia and the extinct Aptornithidae of NZ also closely related; some or all of these families could be included as sub-families in Rallidae (G.F. van Tets). DNA–DNA hybridization evidence shows Rallidae form a distinct cluster separate from cranes and their allies (Sibley & Ahlquist 1990). Olson (1973b) recognized two sub-families: the monotypic Himantornithinae and the Rallinae, with Himantornithinae intermediate between Rallinae and Psophiidae. The Jacanidae (Charadriiformes; q.v.) may be derived as aquatic specialists from *Gallinula*-like stock and more appropriately placed within the Rallidae (G.F. van Tets).

Arrangements within the Rallidae have varied: Peters recognized 52 genera; Thomson (1964), 45; Olson (1973b), 35; Ripley (1977) 17; BWP, 32–39; Campbell & Lack (1985), 18; and Sibley & Ahlquist (1990) 34 (142 species). Rallidae vary anatomically in relation to diet and habitat. Olson (1973b) suggested they evolved from terrestrial to aquatic but admits evolution may have occurred several times. For practical purposes, broad division often made into (1) rails, crakes and wood-rails, most of which are terrestrial (in HANZAB region: *Rallina*, *Gallirallus*, *Dryolimnas*, *Porzana*, *Eulabeornis*, *Crex*); and (2) coots and gallinules (including swamp-hens, native-hens and water-hens), which tend to be more aquatic (in HANZAB region: *Amauromis*, *Gallinula*, *Porphyrio*, *Fulica*, *Gallicrex*). The affinities of the genera and, in brackets, the number of volant and flightless species recorded in HANZAB region given below. *Rallina* (2, 0): one species occurring Aust. and New Guinea and another vagrant to Aust.; close relatives are *Canirallus* and *Sarothrura* of Africa, *Mentocrex* of Madagascar and *Rallicula* of New Guinea (Olson 1973b). *Gallirallus* (1, 4): widespread in Indo-Pacific region; one or more species of volant *Gallirallus* are thought to be ancestral to several insular species in the sw. Pacific, including *lafresnayanus* of New Caledonia and *sylvestris* of Lord Howe I. (Olson 1973b; Fullagar & Disney 1981; Schodde & de Naurois 1982; Diamond 1991). *Dryolimnas* (1, 0): one species (*pectoralis*) occurring Aust. and Auckland Is; closely related to *Gallirallus* and *Rallus*; *pectoralis* often placed in *Rallus*. *Amauromis* (1, 0): one species occurring Aust., New Guinea, Philippines and Moluccas. *Porzana* (5, 0): worldwide, with four species native to our region and one vagrant; we follow Mees (1982) by including *Poliolimnas* in *Porzana*; Olson (1973b) thought *Porzana* may have evolved from *Amauromis*. *Eulabeornis* (1, 0) endemic to n. Aust. and Aru Is, and according to Olson (1973b), an allopatric close relative of *Habroptila* (1, 1) of Wallacea and New Guinea. *Crex* (1, 0) breeds in Eurasia and migrates S, mainly to Africa; vagrant to Aust. and, doubtfully, to NZ. *Gallicrex* (1, 0): vagrant from se. Asia to Christmas I. (Ind.); may also have derived from *Amauromis*. *Gallinula* (2, 1) worldwide distribution, with three species in our area; also an *Amauromis* derivative; sub-genus *Tribonyx* is endemic to Aust. with a fossil record going back to Pliocene (Olson 1975); differ from *Gallinula* in broad bill, long tail and short toes. *Porphyrio* (2, 2) appears to be a *Gallinula* derivative, with sub-genus *Porphyryla* intermediate in shape and plumage between *Gallinula* and nominate *Porphyrio* of Africa, Asia and Aust.; the sub-genus *Notornis* of Lord Howe I. and NZ consists of obvious derivatives of the nominate, but are terrestrial with an exceptionally deep bill and short toes. *Fulica* (1, 0): worldwide distribution, with one species in our region, and two flightless extinct species in NZ; probably derived from *Gallinula*-like stock (Olson 1973b).

Bodies, short, often laterally compressed for ease of movement in dense vegetation. Neck, short or moderately long; 14–15 cervical vertebrae. Males, often slightly larger than females. Wings, short, broad, rounded; in volant species, flight appears low, weak and generally not sustained though some species capable of long-distance movements, occurring on or colonizing oceanic islands (e.g. Purple Gallinule *Porphyrio martinica*, Watercock *Gallicrex cinerea* in HANZAB region). Some island species are flightless, yet many others migrate or disperse over long distances. In HANZAB region, all species have 11 primaries (p11 minute) and 10–12 secondaries; in Family, 10–20 secondaries, smaller species have ten and some flightless species have fewer primaries (BWP); diastataxic. Short sharp curved claw on alula. Tail, short, square to rounded, soft; often raised or flicked up to signal colours of under tail-coverts; normally 12 (6–16) rectrices. Bill varies: often rather slender, straight and slightly longer than head, and in some species, slightly decurved; or quite short and laterally compressed (crakes, most gallinules, coots); or massive and laterally compressed (some species of *Porphyrio*). Gallinules and coots have smooth, plate-like horny frontal shield (continuous with ramphotheca) on forehead. Nostrils usually in large depression (not in *Porphyrio*), pervious and perforate in some species. Sense of smell said to be well developed (Ripley 1977). Legs, well developed, usually strong, long to quite short, often laterally compressed. Toes, long and slender but may be rather short and heavy; hind toe, large, slightly raised. In most gallinules (not native-hens *Gallinula*, Takahe *Porphyrio mantelli* and White Gallinule *P. alba*) and some crakes, toes greatly elongated and legs modified for walking on floating vegetation; in coots, toes have enlarged lateral lobes to aid swimming, and pelvis and legs modified for diving. All species can swim; dive easily and can sink, using wings under water if necessary. Many species climb easily among thick vegetation; downy young of some (and



possibly adults) use wing-claw to assist climbing. Oil-gland bi-lobed, feathered in most species. Caeca, long. Syrinx, simple; tracheo-bronchial. Feathers, fairly loose and soft, frayed and even hair-like in some; small after-feather usual.

Plumage, generally sombre browns, chestnut, black, or greys; iridescent purplish-blue and green in *Porphyrio*. Barring on flanks common. Vent and under tail-coverts may contrast with rest of plumage. Upperparts, spotted, barred, streaked, or plain. Bare parts often brightly coloured and forehead shield conspicuous. Sexes usually similar or nearly so (except in *Sarothrura* and *Gallinex*). Pre-breeding moults restricted or absent, with no seasonal changes in appearance (except in *Gallinex*) but colours of bare parts change in some species, coinciding with moults. Post-breeding moult, complete. Remiges may be moulted irregularly, or simultaneously, with consequent flightless period. Post-juvenile moult partial; can be followed by partial pre-alternate moult or by complete second pre-basic. Young, downy, and unlike other precocial birds, black (sometimes iridescent) or dark brown, which may be an adaptation for hiding in dense vegetation; evidently a derived condition (Olson 1973b). In some species, downy young have brightly coloured bills or skin on head or both, which may function for signalling (Fjelds  1977). Downy young of *Gallinula*, *Porphyrio* and *Fulica* also have white or yellow terminal bristles on down. Post-natal development slower than in some other precocial birds, such as Galliformes and Turniciformes, with initial emphasis on development of legs and feet and not wings; flight-feathers develop last. Juveniles generally similar to but duller than adults.

Numerous flightless forms; incidence of flightlessness perhaps greater than in any other group except ratites and penguins. Flightlessness has evolved many times within the Rallidae, often and repeatedly on islands without predators and probably independently each time; appears to evolve rapidly and so probably of little phylogenetic significance above the level of species (Olson 1973a). Selection reduces flight-muscle and pectoral girdle, possibly through neoteny (Olson 1973a); usually corresponding increase in development of leg muscles. Frequency of flightlessness suggests that rails are predisposed to it; they are certainly pre-adapted for coping with some of the restrictions it imposes: many volant species are behaviourally flightless, e.g. avoiding predators by running away; many are temporarily flightless during wing-moult (a feature shared with several other groups containing flightless forms), when secretive and elusive; and post-natal development of flight is slow. In many species, populations of insular flightless species exterminated by introduced predators (e.g. Chatham Island Rail *Gallirallus modestus*, Dieffenbach's Rail *Gallirallus dieffenbachi*). Subfossils from our region have been reviewed (Olson 1977) and include flightless and often large species of coot, waterhen, rail and wood-rail and the distinctive snipe-rail *Capellirallus*. For discussion of biogeography of *Gallirallus* see Olson (1973b), Fullagar *et al.* (1982), Schodde & de Naurois (1982), and Diamond (1991).

Most inhabit all sorts of terrestrial, estuarine and littoral wetlands, from sea-level to mountain highlands. Some genera found in lowland and montane forests; others in wet grasslands; still others, e.g. Takahe *Porphyrio mantelli*, *Crex*, tussock grasslands, hay-fields and similar places, not necessarily with wet areas. Some species migratory; many dispersive; others apparently sedentary. Patterns of movements in HANZAB region generally not known, perhaps because they appear to take place at night and perhaps because the birds are so secretive and silent when not breeding that absences may be more supposed than real. Gallinules and coots appear to be more sedentary than crakes and rails, though at least the Black-tailed Native-hen *Gallinula ventralis* is notably irruptive, in response to floods and droughts of inland Aust.

Omnivorous, or in some species mostly vegetarian. Species with long thin bills probe for invertebrates in soft ground and litter. Eat all sorts of plants and submerged vegetation, insects, molluscs, crustaceans, eggs and young of other birds, small fish and carrion. Some gallinules graze, e.g. Tasmanian Native-hen *Gallinula mortierii* and coots. Only *Fulica* dives for food; they and *Gallinula* will up-end. Often wash food in water.

Mostly solitary or in small groups, though densities can be very high in some wetlands; *Gallinula* (e.g. Black-tailed Native-hen *Gallinula ventralis*) and *Fulica* form large flocks, especially in winter; after onset of inland droughts, irruptions may involve thousands of birds. Roost solitarily except in species that flock; generally at night on ground in cover; occasionally in bushes and trees. Some species nocturnal or crepuscular. Most species nest solitarily; some strongly territorial, advertising territories with loud persistent calling and chasing of intruders. Dense vegetation and apparently secretive habits make it hard to study social organization and behaviour in most species. Agonistic and sexual behaviour often conspicuous with wing-spreading, tail-flicking, fighting with use of bill and feet and other ritualized features of display. Pair-bond usually monogamous and only for one season but may be sustained. Polygyny known in captivity and suspected in wild, e.g. in *C. crex*; polyandry occurs in Tasmanian Native-hen *Gallinula mortierii* and possibly Weka *Gallirallus australis*. Co-operative breeding in some gallinules, e.g. Dusky Moorhen *Gallinula tenebrosa*. Pair-formation and courtship little known except in some gallinules and coots, in which a variety of chasing, bowing, nibbling, mock-preening and feeding, and courtship feeding takes place; no elaborate ceremonies at time of nest-relief. Copulation and other activities take place out of water or on specially built platforms. Most species very vocal, with screams, trills, whistles, booms, rattles, trumpets, grunts or barks; can be ventriloquial; mostly silent when not breeding but social species have loud rallying cries. Stand at rest (sometimes on one leg) in hunched posture with head sunk on shoulders, or lie down; sleep with head on back and bill among feathers. Bathe in shallow water, alternately ducking head in water and flipping water over back or by beating half-open wings in water; coots may bathe while swimming. Leave water to oil and preen after bathing. Sun themselves after preening. Allopreening common. Scratch head directly. Some species (e.g. *Porphyrio porphyrio*, *P. alba*, *P. mantelli*) recorded manipulating and grasping food in foot or holding down large items with feet.

Breed seasonally and protractedly. Nest fairly deep and cup-shaped; in some rails, domed; in wetlands, often with ramps up to nests. In thick vegetation, often near or on surface of water but some species nest high in trees; use old nests of other birds or nest on ground far from water; materials from any available plants; built by both sexes. Horned Coot *F. cornuta* of S. America builds islands of small stones. Some build nests that float or are attached to aquatic vegetation; nests on water may be built up rapidly if water-level rises. Non-functional nests often found in gallinules and *Gallinula*, which also build nursery nests after young hatch. Eggs, blunt oval; smooth and fairly glossy; dull white to tan ground-colour, blotched and spotted red-brown to black; unspotted in *Rallina*. Clutch-size, 5–10 (1–18) but dump-laying or laying by more than one female in same nest may complicate estimation of size of clutch laid by an individual. Usually one or two broods and replacement layings up to three times. Lay at intervals of 24 or 48 h. Incubation usually by both sexes but in some by female alone or with only small share by male. Incubation period, 14–24 days per egg; start of incubation varies from first to last egg and so hatching synchronic or asynchronic. Egg-shells left in nest or removed. Generally have two large lateral and one small median brood-patches. Young hatch in down, precocial, nidifugous; at first fed bill to bill, becoming self-feeding within few days or not until 8 weeks old. Normally tended by both parents and, in a few species, offspring of previous broods may help to feed young, e.g. *Gallinula*, occasionally *Porphyrio*. Fledging period, 30–60 days (20–70) and then independent except in co-operative breeders. First breeding usually when 1 year old or less.

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*Dryolimnas pectoralis* Lewin's Rail

COLOUR PLATE FACING PAGE 521

*Rallus pectoralis* Lesson, 1831, 9 April, *Traite d'Ornithologie* 526, ex Cuvier Australia.*Dryolimnas* compounded unhappily of the Greek  $\delta\rho\upsilon\varsigma$ , an oak tree, and the modern Latin *limnas*, a rail or crake. The specific *pectoralis* is Latin (of the breast), and no doubt draws attention to the slate-grey breast.

OTHER ENGLISH NAMES Pectoral, Short-toed, Slate-breasted Rail or Water Rail, Water Rail, Lewin's Water Rail.

Named in honour of J.W. Lewin, 1770–1819, naturalist, collector and painter, who was in New South Wales from 1800 to 1819.

POLYTYPIC Nominate *pectoralis*, s. Qld, NSW, Vic., SA; *clelandi* (Mathews, 1911), sw. Aust.; *brachipus* (Swainson, 1838), Tas.; *muelleri* (Rothschild, 1893), Auckland Is. Extraliminally, six subspecies described from New Guinea, Philippines and Flores.**FIELD IDENTIFICATION** Length 20–27 cm; wingspan 31–35 cm; weight: male 80–100 g, female 75–90 g. Medium-sized rail with rather stout body, short tail, rather small head and rather long, slender, slightly decurved bill; slightly larger than Australian Crake *Porzana fluminea*; much smaller and slimmer than Buff-banded Rail *Gallirallus philippensis*. Sexes similar but female duller rufous on head and neck. No seasonal variation. Juvenile separable.**Description Adult male** Crown and nape, rufous, heavily streaked blackish. Forehead, broad supercilium, hindneck and sides of neck, rufous with some fine blackish streaking. Sides of head, foreneck and throat, grey with varying olive tinge, grading to light grey or whitish on chin. Rest of upperbody and leading-edge of innerwing, olive-brown, heavily streaked black; scapulars and central inner wing-coverts, black with narrow white barring. Upperside of remiges and primary coverts, dark brown; secondaries edged olive-brown and finely spotted white. Breast, grey with olive tinge, like foreneck. Flanks, belly, vent and under tail-coverts, black with white to buff barring; feathers of flanks and scapulars often cover part of wing and, from side, much of body looks barred. Underwing, brownish grey, with narrow white leading-edge to innerwing; coverts tipped white. Bill, pink or pinkish-red basally, grading to dusky on culmen and tip. Iris, usually brown; reddish-brown or red. Legs and feet, light to dark grey with varying pinkish tinge. **Adult female** As male except rufous of head and neck duller brownish rufous, with tendency for rufous supercilium and stripe down sides of neck to be narrower; also, for black streaking on forehead, crown, nape and hindneck to be heavier. **Juvenile** Pattern similar to adult but much darker, blackish and duller, without rufous on head or neck and with less distinct barring on underparts. Forehead, crown, nape and hindneck, blackish, faintly streaked brown. Supercilium, sides of head and neck, lower throat and foreneck, dark greyish-olive grading to conspicuous white chin and upper throat. Rest of upperparts as adult but predominantly black, with narrower and duller olive-brown edges to feathers. Underbody from breast to under tail-coverts, blackish, with whitish patch on central belly and finer, sparser white barring than on adult. Bill much shorter at first, darker, grey-black. Iris, dark brown. Legs and feet, grey to black, darker than adult but attain adult coloration before juvenile plumage lost.**Similar species** Adults generally unmistakable, with rufous supercilium, sides of neck and hindneck and long slender pinkishbill. Adults and juveniles may be confused with Buff-banded Rail or Australian Crake. **Buff-banded Rail** larger and bulkier, with longer tail and shorter, stouter bill; all ages readily distinguished by: prominent white supercilium; buff breast-band; more extensive black-and-white barring on underparts, extending to breast; white spotting on upperparts; and bold buff-and-white barring through remiges. **Australian Crake** slightly smaller, more compact, with shorter neck, longer tail, short stout greenish bill, greenish legs and feet; all ages further distinguished by extensive white spotting and streaking on upperparts and, especially, by white lateral under tail-coverts. Blackish juvenile could be confused with **Spotless Crake** *Porzana tabuensis*, which is much smaller and more compact, with longer tail and much shorter finer bill; upperparts, uniform brownish and underbody uniform dark grey, with white barring confined to vent and undertail; iris and conspicuous orbital ring, red; legs and feet generally paler brownish or brownish-flesh in juveniles and pinkish-red in adults.Singly, in pairs or family groups in dense cover of rushes, reeds and rank grass bordering freshwater and brackish wetlands; or in drier habitats among ferns and grasses, tussock herbfields and scrubby forest on some islands. Secretive and skulking but not shy, seldom leaving dense cover except to feed along narrow muddy margins of wetlands. Feed busily, with neck outstretched, picking at surface of mud or earth or drilling vigorously with long bill; feeding bouts interrupted by sudden dashes back into cover, especially after securing food. Walk slowly and deliberately, with stumpy tail erect and flicked; clamber adeptly over low obstacles; run swiftly, with head lowered; swim and dive readily for short distance. Seldom seen to fly, preferring to slip into cover when disturbed and flushing only as a last resort; flight awkward and fluttering on short rounded wings, with legs dangling; rarely flutter far before dropping back into cover. Voice: loud sticking most common call, likened to sound of two coins being tapped together; also, loud, descending *crek*, usually given in bursts of about ten calls; and variety of pig-like grunting, followed by harsh scolding notes.**HABITAT** Densely vegetated, fresh, brackish or saline wetlands, usually with areas of standing water; favour permanent wetlands, but often on ephemeral ones (Gilbert 1936; Leicester 1960; Morris 1975; Czechura 1983). Swamps, marshes, lakes, small pools, inundated depressions, swampy or tidal creeks and streams, saltmarshes, coastal lagoons, estuaries and farm dams all used

when they have dense fringing or emergent, long or tussocky grass, reeds, rushes, sedges or bracken; occasionally in thickets of other wetland shrubs, such as *Melaleuca* (Hood 1935; Gilbert 1936; Wheeler 1950; Skemp 1955; Watson 1955; Morris 1975; Parker 1985; Jaensch 1987; Vic. Atlas; Vic. Bird Rep. 1984). May also use wetlands in rainforest, riverine forest, woodland, wet heathland or open country (McKean 1983; NSW Bird Reps 1984, 1987; Tas. Bird Rep. 1990). Occasionally recorded away from wetlands in suburbs, parks and gardens (Leicester 1960; Czechura 1983; Vic. Bird Rep. 1982; Tas. Bird Reps 10, 18); short pasture, hayfields and lucerne crops (Leicester 1960; Czechura 1983; NSW Bird Rep. 1984); near roads (Johnstone 1989; NSW Bird Reps 1976, 1978). Occasionally among dense or tangled clumps of weeds such as blackberries and lantana (Leicester 1960; Clancy 1979). On Maatsuyker I. and Furneaux Grp, occur in dry grassy areas, among ferns and cutting-grass *Gahnia*, under shrubs (Milledge 1972). On Adams I., Auckland Is, found in areas with damp or wet ground and a dense canopy or subcanopy c. 1 m above ground: herbfield of megaherbs, sedges or woody shrubs; grasslands with sedges, ferns, low-growing woody shrubs and tussock; and scrubby forest with 2.5 m canopy (Elliott *et al.* 1991).

Forage in soft mud or shallow water (<5 cm) at edges of wetlands, in small pools and channels, usually remaining close to, or in, dense vegetation, such as samphire, but occasionally in open (Gilbert 1936; Watson 1955; Leicester 1960; Jaensch 1987; Johnstone 1989; Vic. Atlas). Occasionally feed in gardens, on lawns, short pastures and peaty areas (Leicester 1960; Czechura 1983; Jaensch 1987). Once observed foraging in rubbish tip (Falla 1967). Sometimes loaf in open areas like sandy margin of creek (Watson 1955; Clancy 1979) or near cover (Johnstone 1989).

Breed in swamps and marshes with low dense concealing vegetation, such as sedges, rushes, samphire or tussocks of cutting-grass (Hood 1935; Gilbert 1936; Brown 1950; Wheeler 1950; Skemp 1955; Vic. Atlas).

Local extinctions probably caused by drainage of wetlands and burning for grazing (Garnett 1992); on Auckland Is, by modification of vegetation by pigs, and predation by pigs and cats (Elliott *et al.* 1991). Cover trampled by stock (Leicester 1960). May inhabit sewage farms, saltworks, industrial and urban areas, and agricultural country.

#### DISTRIBUTION AND POPULATION Flores, New Guinea, e. and s. Aust. and Auckland Is.

**Aust.** Qld Absent from C. York Pen.; recorded from Julatten, inland to Atherton Tablelands, and S to Prosperine-Mackay district (Wheeler 1967; Storr 1973; Qld Bird Reps 1983, 1985, 1989; Aust. Atlas). Possible gap in distribution between 22 and 26°S (Aust. Atlas). Probably resident in SE, S from Fraser I., inland to Toowoomba (Sutton 1990; Qld Bird Reps 1984, 1987; Aust. Atlas). **NSW** Coastal regions from Murwillumbah to s. coast; also central and s. Tablelands, sw. Slopes and Riverina. Mainly in Hunter, Central Coast and Illawarra districts (Clancy 1979; Morris *et al.* 1981; NSW Bird Reps 1983, 1984). Isolated records at Bermagui, 7–11 Nov. 1990 (Whiter 1991), Weetawa and Gool Gool HS on central-w. and n.w. plains (NSW Bird Reps 1977, 1984). **Vic.** Mainly in S, round Gippsland Ls, La Trobe Valley, s. Gippsland, central s. Vic. from Westernport Bay to w. Port Phillip Bay, Otway Ras and Portland district. Also isolated records from Grampians; near Kaniva; near Swan Hill; Echuca-Barmah region. Scattered records in NE (Wheeler 1966; Vic. Bird Reps 1981–85; Vic. Atlas). **Tas.** Mainly in N, E and S, including some offshore islands; few records in central Tas. (Thomas 1979; Aust. Atlas). Less common in W and SW (White 1985; Thomas

1979). Widespread on Furneaux Grp (Tas. Bird Rep. 9) and King I., though uncommon on latter (Green 1989; Green & McGarvie 1971). **SA** From SE, N to mid-Murray, Adelaide Plains, s. Mt Lofty Ras and Kangaroo I. (Terrill & Rix 1950; Baxter 1981; Parker 1985; Aust. Atlas). Also Eyre Pen. at Sleaford Mere, SW of Port Lincoln, 30 Mar. 1920 (Parker 1985); record from Arno Bay (Storr 1952) withdrawn (Parker 1985). **WA** Not recorded during Aust. Atlas or SW Waterbirds projects (Jaensch *et al.* 1988; Aust. Atlas); possibly extinct. Known from four specimens: two from Margaret R., 1907; one from King George's Sound, date unknown; one from near Bridgetown, Dec. 1931 (Whittell 1933). Species said to be quite common in early 1930s, but only one specimen procured; last recorded near Bridgetown, Sept. 1932 (Whittell 1933). **NT** Three records: specimen from Casuarina, Darwin, date unknown (McKean 1983); heard on two occasions at Holmes Jungle, Sept. 1984, Apr. 1986 (Thompson & Goodfellow in prep.).

**Auckland Is** Two specimens collected in about 1864, certainly before 1893 (Falla 1967; Oliver); assumed to be extinct (though unconfirmed reports from Adams I. in 1942 and Ewing I. in 1962) until live bird collected Adams I. in 1966 (Falla 1967). Rediscovered in good numbers on Adams I. in 1989 (Elliott *et al.* 1991), and on Disappointment I. in 1993 (G.P. Elliott). Probably exterminated on Auckland I. since 1860s (Falla 1967).

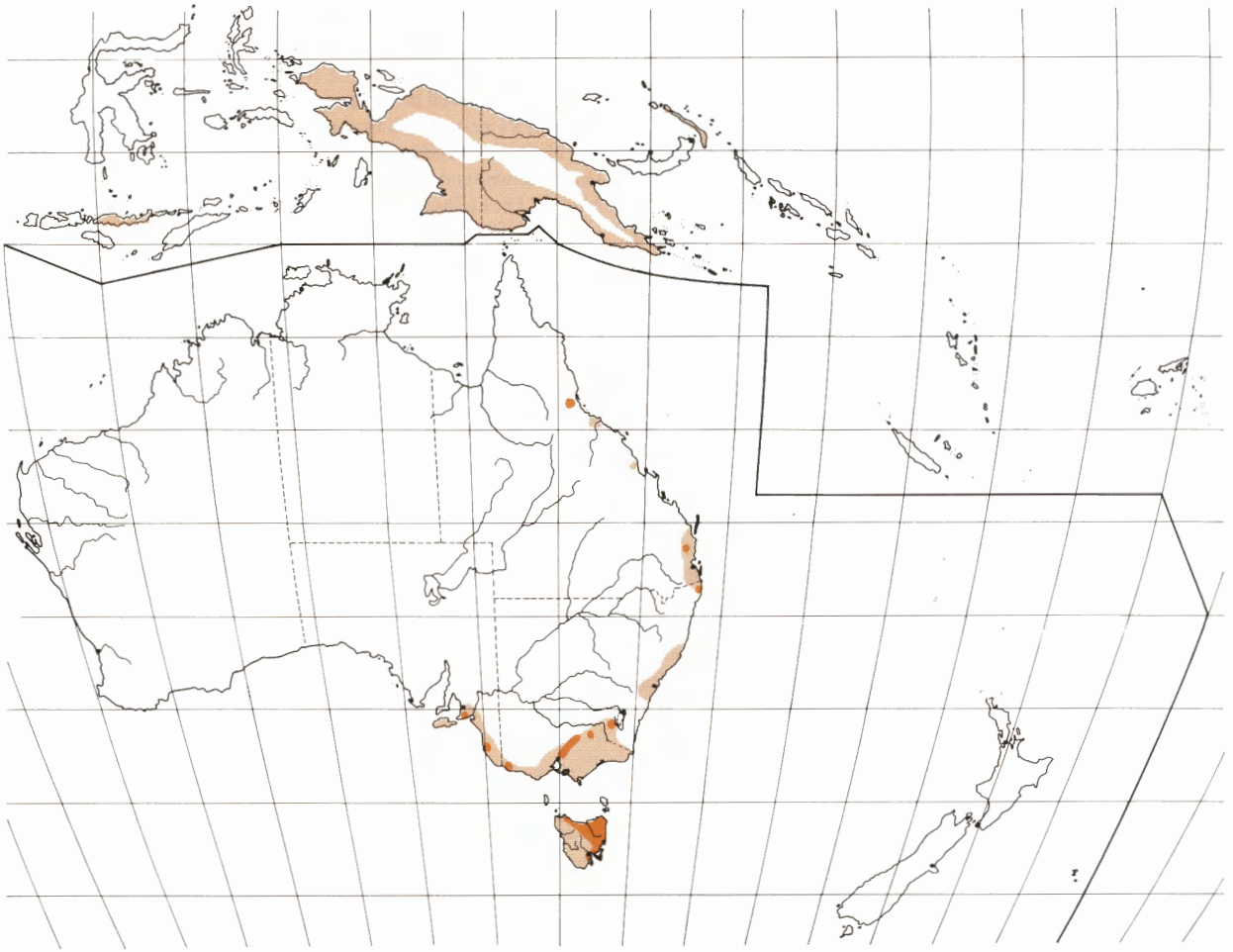
**Breeding** Records scattered throughout range; most in Vic. and Tas. (Aust. Atlas; Aust. NRS); Adams I. (Elliott *et al.* 1991).

Apparently uncommon in mainland Aust., though, because secretive, often difficult to observe. Common in Tas. (Green 1989). Probably extinct in sw. WA, possibly because habitat lost by grazing and frequent burning (Garnett 1992; Aust. Atlas). No measures of abundance. Adults and young killed by feral and domestic cats (Rose 1975; Anon. 1977; Czechura 1983; R. Johnstone; D. Quinn); feral cats or pigs or both probably caused extinction on Auckland I. (Falla 1967; Elliott *et al.* 1991). Foxes may also be predators (NSW Bird Rep. 1984). Occasionally killed on roads (Green & McGarvie 1971; NSW Bird Reps 1976, 1978); killed during grass-mowing (SA Bird Rep. 1966–67) and caught in traps for rabbits and other mammals (Skemp 1955; Leicester 1960; Cooper 1974; SA Bird Rep. 1966–67). Found dead under power lines (Tas. Bird Rep. 1977); caught in wire fence (Leicester 1960); one struck window after dark (NSW Bird Rep. 1984).

**MOVEMENTS** Virtually unknown; sightings rare and observations difficult (Twaits 1982; Elliott *et al.* 1991). May be partly migratory. Some apparently resident or sedentary because present at some sites all year (Gilbert 1936; Green 1969; Vic. Bird Rep. 1982). In s. Aust., lack of records and lower reporting rates in winter may indicate absence of birds but equally may reflect greater difficulty of observing this species in winter (Aust. Atlas). Suggested may move to coastal and subcoastal NSW to breed (Morris 1975; Clancy 1979); summer visitor in SA with no records June–Aug. (Parker 1985); recorded intermittently in Vic. (Watson 1955 *contra* Vic. Bird Reps 1981, 1982). Numbers at some sites in Tas. change between years (Fletcher 1916; Milledge 1972; Brothers 1979; Tas. Bird Rep. 1978), which suggests birds may move when conditions alter, e.g. likely to be confined to a few refuges during droughts (Garnett 1992).

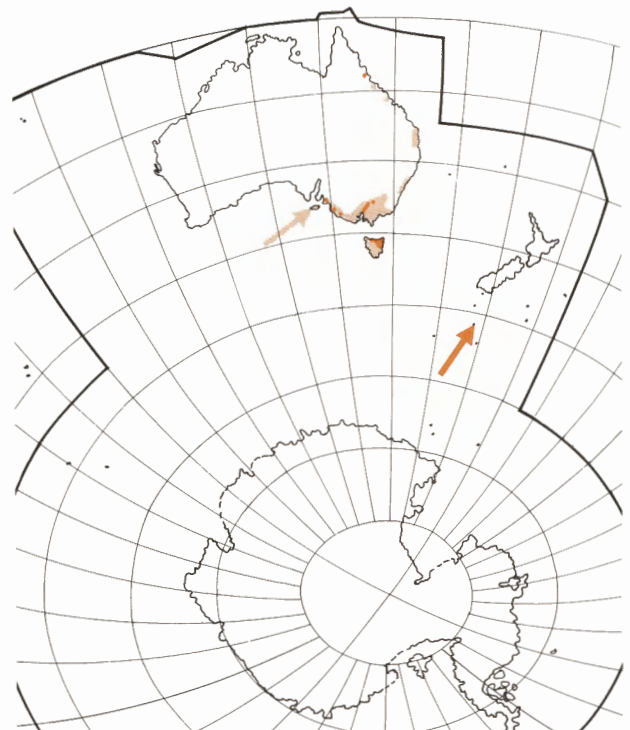
Local movements (perhaps longer movements) apparently nocturnal (Gilbert 1936); one bird struck window at night (NSW Bird Rep. 1984). Probably fly to and from Maatsuyker I. from mainland Tas., c. 12 km (Milledge 1972). Auckland Is birds can fly but do so only infrequently (Falla 1967; Elliott *et al.* 1991).





**FOOD** Molluscs, earthworms, arthropods, especially insects and crustaceans, occasionally frogs and eggs of birds. **Behaviour** Crepuscular; sometimes diurnal (Johnstone 1989). Feed solitarily, on dry ground, soft soil, mud, mangroves, reed beds and shallow water. Peck, probe, and drill holes in mud, soil and even cracks in dry stone edging (Leicester 1960). Probe in soft mud, dry peat (Jaensch 1987), and often in shallow water (<5 cm deep) sometimes submerging head (Johnstone 1989). Probe rate, 1/s (Jaensch 1987). Rapidly carry large items to cover to manipulate; probe for smaller items; others pecked at and swallowed on spot (Johnstone 1989). Leave cover briefly; exceptionally up to 20 min (Jaensch 1987).

**Adult** No detailed studies (stomachs unless stated). Plants: lvs (Lea & Gray), aquatic plant lvs. Animals: Molluscs (Gould; North): gastropods (obs., Ramsey 1890; Johnstone 1989): freshwater snail (Barker & Vestjens). Annelids: polychaetes (obs., Johnstone 1989); oligochaetes: Lumbricidae (Milledge 1972). Crustaceans (Jaensch 1987): isopods (Leicester 1960); chilopods (Barker & Vestjens). Arachnids: spiders (Barker & Vestjens). Insects (obs., Leicester 1960): aquatic insects (Gould): Orthoptera: Gryllidae; Acrididae (Barker & Vestjens); Coleoptera (Sclater 1881; Leicester 1960): water-beetle (North); Coccinellidae: *Rhizobius debilis* (Lea & Gray); Tenebrionidae; Curculionidae (Barker & Vestjens); Diptera: Statiomyidae: larv.; Trichoptera: larv. (Barker & Vestjens); Lepidoptera: larv.; Hymenoptera: Formicidae: ads (Lea & Gray). Fish: small fish (Gould). Amphibians: frogs: ads, tadpoles (Gould; Lea & Gray). Birds: egg-shell.



Calcareous particles (Sclater 1881); mud (North); sand (Leicester 1960).

**SOCIAL ORGANIZATION** Little known. Usually seen singly, in pairs, or in family groups with one or both parents and up to seven chicks (Thompson 1983; Aust. NRS). Organization probably similar to other small secretive rails; appears more solitary than Buff-banded Rail (Gilbert 1936).

**Bonds** Probably monogamous. **Parental care** Role of parents in building nest, incubation and care of young, not known; claimed that only female incubates (Aust. RD) or that sexes share nest-building, incubation, and care of young (NPIAW 1985). Chicks leave nest within hours of hatching (Skemp 1955; Leicester 1960); adults accompany and defend chicks; last brood may remain with parents during autumn (Fletcher 1913).

**Breeding dispersion** Nesting solitary; said to be territorial (NPIAW 1985). On Auckland I., c. 1000 ha suitable habitat and probably several hundred birds (Elliott *et al.* 1991).

**Roosting** No details. Following records relevant to daily cycle: birds captured were all trapped during day, though may be active at night; call between dawn and half an hour after dark (Elliott *et al.* 1991); activity may peak in early morning and evening (Fletcher 1913; Milledge 1972; Thompson 1983) and on overcast days (Gilbert 1936; Fletcher 1916); one bird seen at night (Thompson 1983). Juvenile recorded sunning itself in early afternoon in open (Clancy 1979); another bird recorded climbing vegetation to sun itself on dull cool day (Johnstone 1989).

**SOCIAL BEHAVIOUR** Poorly known. Behavioural studies particularly difficult because birds secretive and wary, inhabiting dense vegetation; more often heard than seen (Leicester 1960); so difficult to observe that Elliott *et al.* (1991) could only make deductions from trapped birds, calling birds and birds with radio-transmitters attached. Young more approachable than adults (Thompson 1983). If possible, remain in cover to feed (Watson 1955); adult will venture warily into open, where sometimes seen at close quarters (Cashion 1958). Call most in afternoons during breeding season; call sometimes answered by nearby birds (Leicester 1960); respond to tape recordings of calls, sometimes with answering call (Elliott *et al.* 1991). Bathe near, and preen in, cover (Johnstone 1989); sometimes preen and bathe with Spotless Crake (Watson 1955).

**Agonistic behaviour** Virtually unrecorded, though one bird drove Spotless Crake and rabbit from clump of vegetation (Leicester 1960). When sunning, one bird vigilant, constantly moving head (Johnstone 1989). When alarmed, said to flick tail (Aust. RD) though one bird did so seldom (Johnstone 1989); also bob head up and down (Baxter 1981). When disturbed, generally run rapidly to cover (Gilbert 1936; Skemp 1955), but may fly low, legs dangling, for short distances up to c. 20 m, then take cover (Cashion 1958; Leicester 1960); recorded not to flush even when approached to as close as 1 m (Wheeler 1966). Call when startled or captured (Falla 1967; Cayley 1968).

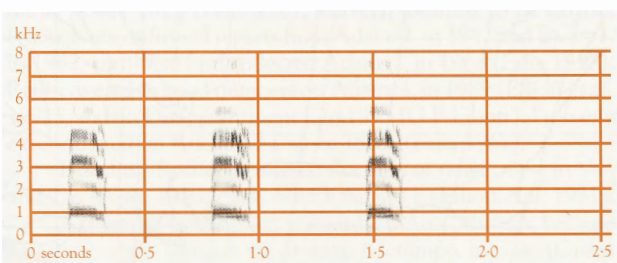
**Sexual behaviour** Not known. Incubating bird and mate recorded calling to each other (Fletcher 1913).

**Relations within family group** **Parental anti-predator strategies** Cautious when approaching nest (Skemp 1955). When disturbed at nest, readily slip off and hide, sometimes at base of nest and once against intruder's boot (Fletcher 1913); may dive (Campbell). In late incubation, less willing to leave nest; will usually do so if overhead cover parted (Skemp 1955) but may allow back to be touched (Fletcher 1913). Parent and chicks slip off nest when in danger (Skemp 1955); apparently parent calls to chicks, which leave nest even if all eggs have not hatched (Leicester

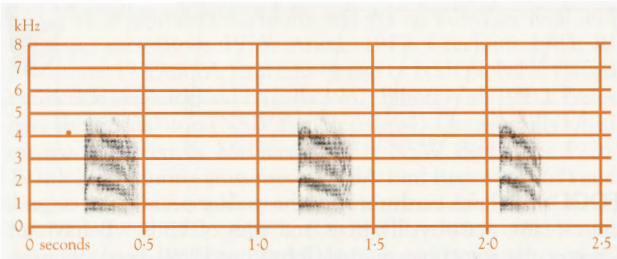
1960; North). Last brood may remain with parents during autumn (Fletcher 1913).

**VOICE** Not well known; no detailed studies. *Crek* and whistle-like call loudest; may carry several hundred metres (Elliott *et al.* 1991). Calls infrequent (R. Jaensch). On Auckland Is, call between dawn and 30 min after dark (Elliott *et al.* 1991); on Maatsuyker I., Tas., most calls heard in early morning and at dusk (Milledge 1972); at Kindred, Tas., calls most frequent in afternoon (Leicester 1960). Sexual and individual differences not known. At least some calls at Auckland I. similar to those from Aust. (Elliott *et al.* 1991).

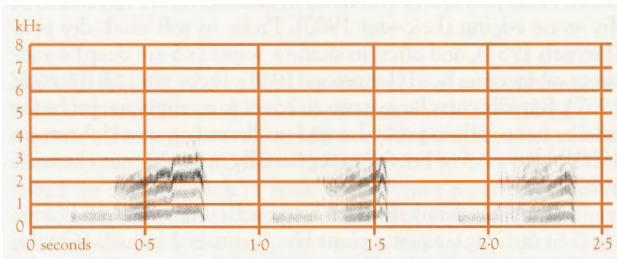
**Adult** (1) *Crek* (sonagrams A, B): loud; ascending then descending; repeated at rate of c. 1/s and usually given in bursts of about ten calls, though sometimes up to 20 (Elliott *et al.* 1991). Sometimes preceded by low rasping grunts (sonagram C), rising in crescendo and wheezy at finish (Milledge 1972). May last up to 30 s, notes becoming louder and faster, then slower and softer



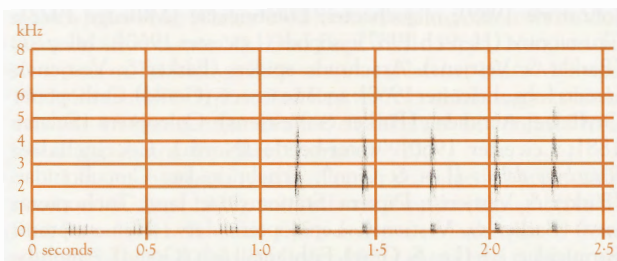
A P.J. Fullagar; Gungahlin, ACT, Nov. 1986; X129



B R.P. Buckingham; Adams I., NZ, Nov. 1989; X151



C D. Stewart; Mullumbimby, NSW, Jan. 1985; P35



D R.P. Buckingham; Adams I., NZ, Nov. 1989; X151

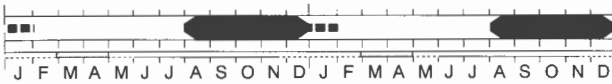


(Leicester 1960). May be given when startled (Gilbert 1936). (2) WHISTLE-LIKE CALL: loud and sharp, repeated at c. 4/s, given in bursts of up to 50 (Elliott *et al.* 1991), sometimes preceded by low drumming (sonogram D). (3) SHARP SINGLE NOTE: repeated; given shortly after capture, probably a distress call (Falla 1967). (4) Tick: loud and repeated, in response to intruder (Fletcher 1913). (5) Grunt (Elliott *et al.* 1991; R. Jaensch). (6) Purrr: given by female on or near nest in response to call of male (Fletcher 1913).

**Young** Squeak (Leicester 1960; Elliott *et al.* 1991).

**BREEDING** Poorly known, no major studies. Based on Leicester (1960), Skemp (1955), general references and contribution by G.P. Elliott; six records in Aust. NRS.

**Season** In Aust., usually Aug.–Jan., may raise two broods per season (North); on Auckland Is, probably Oct.–Dec. (Elliott *et al.* 1991). Qld: young, early Dec., late Jan. (Czechura 1983; Aust. Atlas). Vic.: young, late Oct. to early Dec. (Wheeler 1950; Vic. Bird Rep. 1985; Aust. Atlas). NSW: eggs, mid-Aug. (North), late Sept. to early Jan., most hatch Oct.–Nov. (Gilbert 1936). SA: eggs, 26 Oct.–7 Nov. (Attwell 1972). Tas.: eggs, mid-Aug. to mid-Dec.; usually two broods (Fletcher 1917; Skemp 1955; Leicester 1960; Aust. NRS; North); ne. Tas., mainly Oct.–Nov., with older birds starting to lay mid-Aug. (Singline 1981).



**Site** At edge of swamps, drains, in paddocks, usually above water, in slightly elevated area, alongside puddle in dry area; well hidden in clumps or tussocks of rushes *Gahnia*, *Juncus*, in tussocks of *Chionochloa antarctica* and *Carex appressa* on Auckland Is (Elliott *et al.* 1991), often covered by blackberries *Rubus fruticosus*, in area with a few saplings or tangle of grass under fern (Fletcher 1913; Gilbert 1936; Leicester 1960; Aust. NRS; North). On or near ground, may prefer slightly elevated areas where saplings grow (Gilbert 1936). **MEASUREMENTS** (cm): average height of nest, 64 (0–122; 12). May nest near site of previous year; if clutch fails, rebuild a metre or so from failed nest (Fletcher 1913).

**Nest, Materials** Shallow cup or saucer-shaped structure, occasionally a solid platform in denser cover; woven out of rushes or dead grass stems and lined with fine green stems (Gilbert 1936; Leicester 1960; North); with woven dome-shaped hood (Elliott *et al.* 1991; Campbell). Construction may take 4–5 days to over 1 week; replacement nests built more rapidly than first nests (Fletcher 1913; Leicester 1960; North). During incubation, female pulls cover over herself to form canopy (Leicester 1960; Campbell). Cup of nest 10–60 cm above mud or water; entry may be gained by narrow path through surrounding vegetation not aligned in any special direction (Singline 1981). May construct ladder or pathway from water to nest; one nest 107 cm high had ladder sloping up to nest (Fletcher 1917). Other platforms noted near active or recently active nests suggest building of nursery nests (Leicester 1960). **MEASUREMENTS** (cm): diameter, 18 (10–24; 6); depth, 8 (5–11; 4); cavity diameter, 12–13, depth: 4 (2–5; 4). On Auckland Is: outside diameter, 14–23; inside diameter, 7, with depression, 2–7 deep (G.P. Elliott).

**Eggs** Oval to elliptical; close-grained, smooth, more or less glossy; creamy-white, dull-white to warm-brown or reddish-buff ground-colour, irregularly streaked, spotted and blotched with purplish to chestnut brown or black, evenly distributed or zoned on thicker end to form irregular cap. Eggs of two different colours and patterns may be found in one nest (North), which suggests laying by two females. **MEASUREMENTS**: 34.9 (1.22; 33.8–38.6; 15)

x 26.3 (0.60; 25.4–27.2) (Leicester 1960; North); two eggs from Auckland Is: 35.1 x 26.5 and 32.8 x 24.2 (Elliott *et al.* 1991).

**Clutch-size** No quantified data; 3–5 eggs (Gilbert 1936), 4–6 eggs (North); 4–8 eggs (Singline 1981); C/4 x 3, C/5 x 4 (Campbell). A clutch of eight eggs (Aust. NRS) probably laid by two females. On Auckland Is, clutch of two eggs probably complete because incubation had begun (Elliott *et al.* 1991).

**Laying** Consecutive days (Gilbert 1936; Skemp 1955); eggs laid at midday (Fletcher 1913). One pair re-laid (clutch of five eggs) within 20 days of failure of first clutch (Fletcher 1913).

**Incubation** Probably by female only; no change-overs recorded at nest; leave nest for periods of 70–120 min when sun shines on it (Fletcher 1913; Leicester 1960). Probably begins after clutch complete; hatching not synchronic but clutch usually hatches within 24 h (Skemp 1955; Leicester 1960). **INCUBATION PERIOD**: c. 19 days (Gilbert 1936), 19–20 days (Leicester 1960), 20–21 days (Skemp 1955).

**Young** Precocial, nidifugous. Down, black at hatching. Remain in nest for up to 24 h; hatchlings will slip off nest when female gives grunt at approach of danger; defend nest by chasing away threatening intruders (Fletcher 1913; Leicester 1960).

**Fledging to maturity** Last brood may remain with parents during following autumn.

**Success** For four clutches: 18 eggs laid, 13 (72%) hatched (Fletcher 1913; Skemp 1955; Leicester 1960). Eggs taken by Water Rat *Hydromys chrysogaster*; nest deserted when Tasmanian Native-hen *Gallinula mortierii* occupied ground nearby (Fletcher 1918). Predators of adults and young are cats (McKean 1983; Tas. Bird Reps 1977, 1980, 1984), dogs (North), Grey Goshawks *Accipiter novaehollandiae* (Olsen *et al.* 1990) and Kelp Gulls *Larus dominicanus* (Tas. Bird Rep. 1989); potential predators on Auckland Is are New Zealand Falcons *Falco novaeseelandiae* and skuas *Catharacta* (Elliott *et al.* 1991).

**PLUMAGES** Prepared by D.I. Rogers.

**Adult male Head and neck** Crown and nape, black-brown (119), heavily streaked with rufous (c240) edges to feathers, that make up c. 60% of area. Forehead, broad supercilium and sides of neck, bright rufous (c32); feathers of forehead have black-brown (119) shaft-streaks that are concealed in most birds. Hindneck, rufous (c32) when fresh; with wear, black-brown (119) shaft-streaks exposed and give streaky appearance. Interramal region always, and chin sometimes, white; feathers of chin have narrow olive-buff tips that are lost with wear. Throat, ear-coverts and foreneck, grey, strongly tinged buffish olive; feathers have broad buffish-olive tips and grey (84) bases that grade to pale grey on uppermost throat. **Upperparts** Scapulars, black (c89) varyingly tipped olive-brown (olive 123), with white bars c. 1 mm wide at 4 mm intervals. Rest of upperparts, black (c89), heavily streaked by olive-brown (olive 123) edges to feathers, that cover 30–40% of area. In some, feathers have small white spots at edges. Upper tail-coverts in some birds have 2–3 white bars at edge of each web, not extending to shaft. Feathers of rump have concealed dark-brown (c121) bases, narrower than those of juvenile. **Underparts** Upper breast, as foreneck. Central breast, similar but some feathers barred white. Lower breast, flanks, belly, thighs and under tail-coverts, brownish black (c119), barred and tipped white to cream; pale bars from 1 to 3 mm wide; on vent, belly and sometimes lower breast, pale bars have cream (c92) or buff (124) tinge toward tip of feather. Extent of pale barring varies individually and is reduced by wear. **Tail** Feathers, brownish black (c119), edged brownish olive (olive 123). **Upperwing** Most lesser coverts as feathers of back. Median coverts, greater secondary coverts and longest lesser coverts, black-brown (c89), grading to dark

brown (c121) at concealed bases, with olive-brown (olive 123) central tips and white bars that do not meet shafts. Most secondaries, dark brown with olive-brown (olive 123) fringes that are progressively broader toward body. Small white spots on outer edges of olive-fringed secondaries progressively larger toward body, tending to be crescent-shaped toward body and forming incomplete white bars on tertials. Primaries, primary coverts, alula and outer 3–5 secondaries, dark brown; p6–p9 usually have small to minute white spots on outer edge. **Underwing** Remiges, brownish grey (grey 119A). Greater coverts similar but with very narrow white tips; median and lesser coverts similar but with white tips c. 1 mm wide. Leading-edges of median coverts, white, c. 2 mm wide; they form small but well-defined white patch just inside carpal joint.

**Adult female Head and neck** Duller than male. Supercilium and stripe down side of neck, brownish-rufous (240) grading to rufous-brown (340) towards forehead; tend to be narrower than in male. Rufous (c240) streaking on crown and nape narrower than in male, covering c. 40% of area. Black streaking on forehead and hindneck, more common than in males; forehead streaking occurs in c. 87% of females and c. 30% of males; streaking on hindneck occurs in c. 94% of females, c. 60% of males. Rest of plumage as male, *contra* Mathews who claimed female has greyer breast.

**Downy young** When newly hatched, wholly covered in rather short dense black (89) down that grades to concealed black-brown (119) at base. Gilbert (1936) found down faded to dense blackish-brown (–) in older chicks, but in five skins examined, down had not faded much by time juvenile plumage emerged. None of these birds seem to resemble two captive chicks described by Barnby Smith (1915) as 'black-skinned and semi-naked', 'the ugliest birds I ever saw in my life'. First juvenile feathers to emerge are ear-coverts (which, being grey, are useful identification character from large downy Buff-banded Rail) and stripes on underparts formed by juvenile pteryxae.

**Juvenile Head and neck** Forehead, crown and hindneck black-brown (119) with brown (c123A) streaking which covers c. 20% of area; feathers, black-brown (119) with brown (123A) edges. Chin and uppermost throat, white; feathers of upper throat, vary but narrowly tipped light brown (119C–119B). Ear-coverts and rest of throat, grey (brownish 84) with light brown-olive tinge; feathers, grey (brownish 84) to dark grey (c83) with light brown-olive tips. At sides of throat, feathers also have varying dark-brown (c121) tips that cause strong mottled effect in some. In darkest birds, these tips make sides and most of throat look wholly dark brown (c119). In some birds, strip down sides of neck slightly more brownish and less olive than central throat. **Upperparts** Mostly as adult but edges of feathers, olive-brown (123) with slightly less rufous tinge. Feathers of rump have larger dark-brown bases than adult, and olive-brown (123) edges, narrower and restricted to tips; they wear away readily to expose dark bases of feathers. **Underparts** Upper breast, dark brownish-grey (c83, c84) with faint olive tinge and paler patch in centre, where feathers have grey (84) or light-grey (85) bases that grade to indistinct white or cream (92) subterminal band. Flanks, dark brown, varying tinge olive, with rather sparse white to cream barring. Feathers have olive-brown (123) basal half, and brown (c20) distal half that has pale bars (more irregular and wavy than in adult) ranging from white near centre of feather to cream (92) or occasionally buff (124) near tip. Lower breast, belly and under tail-coverts, similar but olive-brown bases smaller; most distal pale bar on under tail-coverts broad, up to 5 mm wide. **Tail** As adult. **Upperwing** Similar to adult; white bars on tertials, tertial coverts and greater secondary coverts tend to be narrower and

shorter but much overlap. Primaries, especially p10, tend to be narrower than in adult. **Underwing** As adult.

**First immature** (First basic). As adult. Some birds can be aged because they retain a few juvenile feathers on flanks and belly.

**BARE PARTS** Apparently no geographical variation, so data from several sources combined here. For nominate *pectoralis*, photographs (NPIAW 1985; Aust. RD), data from museum labels (AM, ANWC, MV, NMNZ, SAM) and R.P. Jaensch (1987, pers. comm.); for subspecies *brachipus*, Skemp (1955), Leicester (1960) and data from museum labels (AM, QVM, TM); for subspecies *clelandi*, data from museum labels (BM; R.P. Jaensch); for subspecies *muelleri*, Falla (1967), photographs (NZRD; DOC Slide Library; G.P. Elliott; K. Walker), and data from museum labels (NMNZ).

**Adult** Iris, brown (23); a red (brownish 14) eye has been photographed on male *pectoralis* at nest. 'Reddish', 'brick-red', 'vermillion' and 'pinkish-red' eyes also recorded on labels of seven skins, five of which were collected Mar.–May, two of which were collected in Sept.; all happened to be male, but other males have been collected at the same time of year with brown eyes. A 'vivid red' eye has been observed on a female *brachipus* at nest (Skemp 1955); it has been suggested (probably incorrectly) that this bird was misidentified (Leicester 1960). A brown-yellow (–) eye has been recorded in a female *brachipus*. Gilliard & LeCroy (1961) suggested that colour of eye differs between sexes in New Guinea subspecies *captus*. Bill, pink (4, 7) or pinkish red (108B) to red (13) at base, grading to dark brown (21) or dark grey (83) on distal third and culmen; cere, grey (c84). Extent of dark colouring at tip and on culmen varies; perhaps least extensive in *muelleri*. A chestnut tinge to bill, especially at base, reported on many labels but has not been recorded on live birds and is probably post-mortem discoloration. Feet and legs, light grey (c85) to slate-grey (–) with varying pink (7) tinge to centre of scales; pink sometimes extensive enough to make front of tarsus and tops of toes appear predominantly pink. Reddish-brown legs have been recorded on two males (one photograph, one label). Claws, vary; light grey (c85), grey (–) and dark brownish-grey recorded. **Downy young** Bill, blackish (c83, c82); at first, buff (c124) mandibular rami, gonys and tip to lower mandible; buff patch extends slightly on to centre of tomia of upper mandible. At least some have narrow buff (124) orbital ring. Iris, black-brown (119). Legs, dark grey (–). **Juvenile** Bill, grey-black (82). Iris, dark brown (c119). Legs, grey (–) to black (–); legs and feet assume adult coloration before juvenile plumage lost.

**MOULTS** Based on skins of *pectoralis* and *brachipus* from se. Aust. (AM, ANWC, HLW, MV, QVM, SAM, TM, WAM). Almost no data on moult elsewhere; a bird moulting wing, tail and back has been collected in New Guinea in May (Gilliard & LeCroy 1961). **Adult post-breeding** Pre-basic. Complete; primaries, secondaries and tail simultaneous. Wear of feathers of non-moulting birds suggests that most birds moult wing between late Feb. and Apr., but that some may moult as early as Nov., some as late as May. Of 60 adults examined, only one (collected in Mar.) was moulting wing, which suggests birds particularly secretive during flightless period of unknown duration. Body-moult more protracted; begins on crown, upperparts and sides of breast; most occurs in summer and early autumn, but a few adults in body-moult have been collected in all months except June–Aug. **Post-juvenile** Complete in at least some birds, though not clear whether or not wing replaced by all birds in post-juvenile moult. Primaries simultaneous. Nine of 16 full-grown juveniles examined in collections had no moult, suggesting juvenile plumage may be retained for some time



before moult begins, but no juveniles seen with much wear. Earliest areas to begin moult include crown, upper back, breast and flanks. Moult of belly and flanks not always complete and remnant juvenile feathers allow some birds in first basic to be aged. Timing varies, perhaps related to time of fledging; has been recorded from Sept. to Apr.

**MEASUREMENTS** Nominate *pectoralis*: skins (AM, ANWC, HLW, MV, SAM, WAM): (1) adults; (2) juveniles.

	MALES	FEMALES	
WING	(1) 101.7 (3.25; 97–110; 16)	98.9 (1.81; 96–103; 14)	*
8TH P	(1) 73.5 (3.30; 68–79; 16)	69.6 (3.31; 60–73; 14)	**
TAIL	(1) 45.5 (2.59; 42–52; 13)	42.6 (1.59; 39–46; 14)	**
BILL	(1) 33.6 (2.19; 30.4–39.3; 17)	30.6 (1.58; 27.9–33.1; 14)	**
TARSUS	(1) 31.2 (1.54; 28.4–35.0; 17)	29.7 (1.31; 26.2–31.8; 14)	**
TOE C	(1) 35.6 (2.41; 31.3–40.0; 9)	34.6 (0.87; 33.2–35.5; 4)	ns

UNSEXED			
WING	(2) 110.3 (3.86; 93–107; 11)		
8TH P	(2) 70.7 (3.28; 64–77; 11)		
TAIL	(2) 42.8 (3.19; 37–48; 10)		
BILL	(2) 30.4 (2.06; 27.2–33.9; 11)		
TARSUS	(2) 30.2 (1.99; 26.9–34.6; 11)		
TOE C	(2) 33.6 (0.77; 32.8–34.7; 6)		

Subspecies *brachipus*: skins (AM, HLW, QVM, TM): (1) adults; (2) juveniles.

	MALES	FEMALES	
WING	(1) 104.3 (1.48; 102–106; 11)	101.7 (2.39; 97–105; 19)	**
8TH P	(1) 74.3 (1.54; 71–77; 11)	73.1 (2.26; 69–77; 18)	ns
TAIL	(1) 45.4 (2.78; 40–50; 12)	44.8 (2.21; 41–48; 17)	ns
BILL	(1) 35.5 (1.95; 31.7–39.0; 12)	32.5 (1.21; 30.2–35.6; 17)	**
TARSUS	(1) 33.4 (1.10; 30.9–34.6; 12)	31.4 (0.97; 29.8–33.6; 19)	**
TOE C	(1) 38.6 (1.51; 36.1–41.3; 6)	36.0 (1.70; 33.6–39.2; 7)	*

UNSEXED			
WING	(2) 102.0 (3.83; 98–110; 5)		
8TH P	(2) 75.0 (2.37; 72–79; 5)		
TAIL	(2) 46.0 (2.61; 42–50; 5)		
BILL	(2) 31.6 (3.20; 28.6–38.8; 7)		
TARSUS	(2) 32.2 (2.02; 29.2–34.8; 7)		
TOE C	(2) 35.5, 38.2		

Subspecies *clelandi*: only four specimens; one in AM sexed as female with no supporting details (measured by DIR) and three in BM (measured, with unknown methods, by Harrison 1975) including one juvenile, one unsexed adult and one adult male (R.P. Jaensch).

	AM	BM
WING	110	109–114
8TH P	77	
TAIL	52	
BILL	39.4	39–45
TARSUS	36.2	35–37
TOE C	41.3	

Subspecies *muelleri*: Adams I.: (1) adult female, skin (NMNZ). (2) Same individual, freshly dead after c. 10 years in captivity (NMNZ). (3) Adults, live; WING= natural chord, bill measured from feathers (Elliott *et al.* 1991). (4) Juvenile, with some down still attached to feathers, live (G.P. Elliott). For measurements of type, see Falla (1967).

UNSEXED	
WING	(1) 80 (2) 79.5 (3) 81 (4.1; 76–84; 5) (4) 71
8TH P	(1) 56
TAIL	(1) 41 (2) 39 (3) 35 (5.6; 29–42; 5)
BILL	(1) 23.8 (2) 23.3 (3) 30.5 (1.93; 27.3–32.3; 5) (4) 26.6
BILL D	(3) 9.1 (0.4; 8.6–9.4; 4) (4) 7.6
BILL W	(4) 5.3
TARSUS	(1) 26.0 (2) 27.2 (3) 28.2 (0.78; 27.3–29.2; 5) (4) 29.9
TOE-C	(2) 31.4 (3) 31.8 (1.65; 29.0–32.7; 5) (4) 35.1

Junge (1953) presents a large series of measurements from L. Wissel area, New Guinea, which also show that males are larger.

**WEIGHTS** Nominate *pectoralis*: adults, throughout year: males 80.8 (9.31; 71–100; 9) (AM, ANWC, MV); females 75.4 (21.0; 63–111; 8) (AM, ANWC, MV). Though samples small they suggest no great seasonal variation; include female of 111 g with developing egg, and male of 82 g and female of 63 g with slight fat. Juveniles, with full-grown wings: 65.1 (14.0; 42–76; 5) (AM, MV).

Subspecies *brachipus*: adults, throughout year: males 97.5 (11.5; 73–112; 9) (QVM, TM) (including birds 'in normal condition' of 102 and 112 g but excluding dehydrated road-kill of 35 g); females 87.3 (7.98; 71–102; 14) (QVM, TM) (including 'fat' birds of 80, 84 and 88 g, 'slightly fat' birds of 83, 84 and 94 g and a bird in 'normal condition' of 71 g, but excluding a bird in 'poor condition' of 45 g). Seasonal variation in weight, if any, slight.

Subspecies *muelleri*: adult female that died in captivity in Nov. with some fat, 62.8 g. Adams I.: adults, Nov.–Dec. 1989: 93 (4.8; 89–100; 4) (Elliott *et al.* 1991); juvenile, Feb 1991, 63 g.

Some weights from New Guinea in Mayr & Gilliard (1954) and Gilliard & LeCroy (1961).

**STRUCTURE** Wing, short and rounded; shape similar in *pectoralis*, *brachipus* and *clelandi*. Ten primaries; p8 longest, p10 12–19 shorter, p9 1–3, p7 0–2, p6 0–4, p5 2–7, p4 5–9, p3 8–14, p2 12–18, p1 14–22. No emarginations. In only available skin of *muelleri*, p8 longest, p10 12–13 shorter, p9 1–2, p7 2–3, p6 1–2, p5 4, p4 6, p3 8–9, p2 11, p1 13–14, p11 minute; p7 anomalously short on both wings. Fourteen secondaries, including six tertials. Tertial and innermost secondary coverts, elongate, almost covering the remiges below. Tail, soft, pointed and short, barely projecting beyond upper tail-coverts; 12 feathers. Bill, laterally compressed

and deeper than broad at base; nostril narrow and slit-like, running half-way to tip of bill. In most subspecies, bill slightly longer than head, slightly decurved and gonys neatly defined; *clelandi* had rather deep bill with rather straight culmen; in *muelleri*, bill slightly shorter than head and appears straight; gonys hardly noticeable from side. Body, laterally compressed. Tarsus, laterally flattened, scutellate in front. Middle toe longest, outer c. 82%, inner c. 78%, hind c. 35%.

**RECOGNITION** Small downy young most likely to be confused with small downy young Bush-hen, which also has blackish bill with buffish tip to lower mandible, and Buff-banded Rail. In **Bush-hen**, pale tip of lower mandible extends on to tip of culmen to just beyond egg-tooth (just reaches upper tomia in Lewin's Rail); mandibular rami, blackish (pale in Lewin's Rail); and no contrasting pale orbital ring; in larger chicks, bill of Bush-hen shorter and stouter than that of Lewin's Rail. **Buff-banded Rail**: small chicks differ most obviously in grey to dark-grey bill, with blackish saddle, which spreads to cover most of bill in larger chicks; in some, at least, separable by pink tinge to tip of bill and nares; may be indistinguishable for short time before juvenile plumage emerges.

**GEOGRAPHICAL VARIATION** Four subspecies in HANZAB area. Nominate *pectoralis* described above. Despite its name, *brachipus*, of Tas. and Furneaux Grp averages larger than *pectoralis* in most measurements, including tarsus and toe (see Measurements); the tarsus-length given by Ripley (1977) of 22.8 must be in error. Major differences in plumage are colour of breast, olive tips of feathers of *brachipus*, being broader and giving breast considerably stronger olive tinge; only overlap in colour of breast between the two is between fresh *pectoralis* and worn *brachipus*, in which grey bases of feathers are unusually exposed. Both subspecies have cream or buff bars on underparts, *contra* Littler (1910) who believed this character to be restricted to *brachipus*; however in *brachipus* cream bars more commonly extend onto lower breast and flanks. Subspecies *clelandi* of sw. Aust. (probably extinct), larger, with longer, deeper bill; breast was clearer grey than in *pectoralis*; the only skin in Aust. is in fresh plumage but olive-buff tips of feathers are only 1.5 mm wide and breast appears uniform grey from distance. Harrison (1975) and Mathews described some other plumage differences from *pectoralis* (darker throat- and neck-stripe) but these characters overlap with larger collections of *pectoralis* now available.

Subspecies *muelleri* of Auckland Is much smaller than other subspecies, with slightly straighter bill (see Measurements, Structure); plumage somewhat softer and denser. Only sexed specimen, an adult female, and photographs of unsexed adults (G.P. Elliott) have head and neck coloured as female *pectoralis* but rufous supercilium and neck-stripe broader; there is variation in extent of rufous but not known if it is sex-related. In two unsexed birds, rufous somewhat redder than in female *pectoralis* but not as dark as in male. Forehead unstreaked, though there are concealed dark central wedges on feathers; hindneck has little or no dark streaking and feathers of interramal region have pale-brown (119D) tips. Lores, dark brown (121) to blackish brown (c119). From distance, upperparts olive-brown with sparse dark streaking occupying only 10% of area; olive-brown outer edges of feathers of upperparts far broader than in Aust. birds. Buffish-olive tips to feathers of throat, foreneck and upper breast broader than in Aust. birds, 7–10 mm wide; even when worn, little can be seen of the grey basal three-quarters of feathers. Rest of underparts similar to Aust. birds but pale barring slightly sparser; white bars spaced at c. 6 mm intervals. Feathers of tail have broader brownish-olive

edges, about equal in width to dark central portion. Primaries lack white spots, p4–p10 have very narrow dull olive-brown outer edges. Outer five secondaries have olive-brown outer edges. Upper wing-coverts have somewhat larger olive-brown spots than in Aust. birds. In two of four adults photographed at Adams I. (G.P. Elliott), white barring on upper wing-coverts sparse, being restricted to a few outer median coverts and to tertial and median coverts at base of wing. Little information on differences of juvenile; two photographs (NZ DOC Slide Library) indicate lores and ear-coverts darker than in Aust. birds, pale streaking of crown occupies c. 30% of area, of upperparts c. 60%.

Six extralimital subspecies, four in New Guinea, one in Flores (Lesser Sundas), and one in Luzon (Philippines). Most differ from A'asian subspecies in having less black streaking on crown, whiter throat, different colouring of markings of neck and edges of feathers on upperparts, and in biometrics; see Ripley (1977) for details.

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Volume 2, Plate 42

Lewin's Rail *Dryolimnas pectoralis* (page 529)

1 Adult male, nominate *pectoralis*; 2 Adult female, nominate *pectoralis*; 3 Adult, subspecies *muelleri*; 4 Adult male, subspecies *brachipus*; 5 Adult male, subspecies *clelandi*; 6 Small downy young, nominate *pectoralis*; 7 Large downy young, nominate *pectoralis*; 8 Juvenile, nominate *pectoralis*; 9, 10 Adult male, nominate *pectoralis*