Order CHARADRIIFORMES

A large, diverse assemblage of small to medium-large (12–75 cm long) limicoline, pratincoline, aquatic or terrestrial birds. Cosmopolitan from Arctic to Antarctic regions; in all sorts of maritime, freshwater and open terrestrial habitats (including deserts) with a few (woodcocks and snipes) even using dense forests. Once known as Limicolae or Laro-limicolae (e.g. Mayr & Amadon 1951); colloquially, the assemblage (excluding alcids, skuas, gulls, terns and skimmers) is often referred to as waders (especially in Britain) or shorebirds (especially in North America).

About 350 species in 19 families, though taxonomic treatments vary. Following families recognized (mostly based on recent reviews of Order [Sibley *et al.* 1988; Sibley & Ahlquist 1990; Sibley & Monroe 1990]):

Thinocoridae	seedsnipes; four species, S. America.
Pedionomidae	Plains-wanderer; monotypic, Aust.
Scolopacidae	sandpipers, snipes and allies; c. 85 species, cosmopolitan.
Rostratulidae	painted snipes; two species, s. America and Old World.
Jacanidae	jacanas; seven species, pantropical.
Chionididae	sheathbills; two species, Antarctica and subantarctic islands.
Burhinidae	thick-knees, stone-curlews; nine species, widespread in Old World and two in Neotropics.
Haematopodidae	oystercatchers; c. 11 species, worldwide in tropics and temperate regions.
Recurvirostridae	avocets and stilts; about seven species, worldwide in tropical and temperate regions.
Ibidiorhynchidae	Ibisbill; monotypic, central Asia.
Charadriidae	plovers and lapwings; c. 60 species, cosmopolitan.
Pluvianellidae	Magellanic Plover; monotypic, S. America.
Dromadidae	Crab Plover; monotypic, Arabian region.
Glareolidae	pratincoles, coursers, and Egyptian Plover; c. 15 species, widespread in Old World.
Stercorariidae	skuas and jaegers; about seven species, mostly in Arctic and Antarctic regions.
Rhynchopidae	skimmers; three species, pantropical.
Laridae	gulls; c. 47 species, cosmopolitan.
Sternidae	terns; c. 42 species, cosmopolitan.
Alcidae	auks; c. 20 species, Arctic and temperate regions of n. hemisphere.

Apparently monophyletic. Pteroclididae (sandgrouse) probably sister-group of Charadriiformes (e.g. Fjeldså 1976, 1977; Sibley & Ahlquist 1990; BWP), though whether best placed within Charadriiformes or in separate order is debated. Flamingoes (Phoenicopteridae) and divers (Gaviidae) have also been treated as Charadriiformes (Olson & Feduccia 1981; Fjeldså 1976, 1977) but DNA–DNA hybridization studies (Sibley & Ahlquist 1990) inconsistent with these theories. Affinities to other orders still controversial; DNA–DNA hybridization has suggested closest links are to large waterbirds, such as storks, herons and allies, Pelicaniformes, Procellariformes, penguins, grebes, divers (Gaviidae) and also Falconiformes. All these were combined in huge order Ciconiiformes by Sibley & Ahlquist (1990).

Taxonomy and relationships reviewed in Sibley & Ahlquist (1990), Christian *et al.* (1992) and BWP (and references therein). Recent reviews have included: patterning of downy young (Jehl 1968; Fjeldså 1976, 1977), osteology (Strauch 1978; Mickevitch & Parenti 1980; Olson & Steadman 1981), DNA–DNA hybridization (Sibley *et al.* 1988, Sibley & Ahlquist 1990) and electrophoresis of tissue proteins (Christian *et al.* 1992). The studies of allozymes, DNA–DNA hybridization and the most recent osteological study of the entire order (Strauch 1978) have agreed in finding two or three well-knit, monophyletic assemblages within the Charadriiformes: scolopacids and allies (Thinocoridae, Pedionomidae, Scolopacidae, Rostratulidae, Jacanidae) and charadrids and allies (Chionididae, Burhinidae, Haematopodidae, Recurvirostridae, Ibidorhyncidae, Charadriidae, Pluvianellidae, Dromadidae, Glareolidae, Stercorcariidae, Rhynchopidae, Laridae, Sternidae, Alcidae); Strauch (1978) treated Alcidae as separate lineage, but skeletons may be so highly modified for foot-propelled diving that they do not reflect relations well (Sibley & Ahlquist 1990); gulls and allies have also been regarded as a separate lineage (Christian *et al.* 1992) or as allied to charadrids (e.g. Sibley & Ahlquist 1990). Further relationships within the Order discussed in introductions to families.

Because the Order comprises so many species and adaptations are so diverse, few characters shared by all species; those that are shared are mostly anatomical features of the skull, e.g. most or all have schizorhinal nostrils, schizognathous palates, well-developed vomer, lachrymals fused with ectethemoid and pre-frontal bones, well-developed supra-orbital grooves; see Olson & Steadman (1981) for more information on osteological characters. Wings usually have 11 primaries, with p10 longest and p11 minute; 15–24 secondaries; diastataxic except in *Scolopax minor*, as far as is known. Usually 12 tail-feathers. Necks usually rather long with 15–16 cervical vertebrae. Oil-gland bilobed and tufted. Syrinx, tracheo-bronchial; two carotids (type A-1 of Glenny 1955); caeca present. Legs usually rather long; hind toe small or lacking in most but all toes greatly elongated in Jacanidae. Feathers with small thin afterfeathers. Normally two moults annually: complete post-

breeding and partial pre-breeding; some jacanas and alcids have flightless periods when moulting remiges. Young, downy, usually with intricate cryptic patterns on upperparts of three chief types: pebbly, spotted and striped, matching characters of habitat (Fjeldså 1976, 1977): precocial, nidifugous usually, self-feeding or not depending greatly on parents.

Thirteen families recorded in HANZAB region, with 54 species breeding, 41 occurring as regular non-breeding migrants and *c.* 38 as accidentals or probable accidentals. Scolopacidae, Stercorcariidae, Laridae and Sternidae will be dealt with in Volume 3 of HANZAB.

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Family ROSTRATULIDAE painted snipe

Distinctive family containing two species, each in a separate genus: *Rostratula benghalensis* in Old World Tropics and warm temperate zones; and *Nycticryphes semicollaris* in South America; differ in shape of bill and tail (more decurved and wedge-shaped respectively in *Nycticryphes*). Both are medium-sized, long-billed, swamp-dwelling birds, superficially like true snipe *Gallinago* of the Scolopacidae.

Neck, rather short; 15 cervical vertebrae. Bill, long, slender, somewhat decurved for distal third. Nostrils in deep nasal groove extending halfway along upper mandible; schizorhinal. Eyes, large, set well forward for binocular vision. Wings, short, broad, spotted yellow; ten primaries as in Jacanidae and Pedionomidae; about 15 secondaries; no metacarpal spur or knob. Tail, short; tip, square or wedge-shaped; 14 feathers. Legs, fairly long; tarsus, transversly scutellate in front and behind; toes, unwebbed in *Rostratula*, slightly webbed at base in *Nycticryphes*; slender hallux. Female larger than male and role of sexes in behaviour and breeding routine reversed. Downy young characteristically striped, like Jacanidae alone among Charadriiformes. Adults said not to possess true down (Lowe 1931). Caeca present. Uniquely among charadriiforms, oesophageal crop of female does not function in digestion but is enlarged as a resonance chamber. Closest affinities are probably with Jacanidae (e.g. Beddard 1901; Jehl 1968) or Turnicidae (Neithammer 1961, 1966) but DNA–DNA hybridization suggests even these are not close relatives (Sibley & Ahlquist 1990); the family has skeletal characters resembling those of the Rallidae.

Characteristics of plumage, identificatory features, habitat, food, behaviour, voice and breeding habits in account for *R. benghalensis*.

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Rostratula benghalensis Painted Snipe

COLOUR PLATE FACING PAGE 640

Rallus benghalensis Linnaeus, 1758, *Syst. Nat. ed.* 10, 1: 153 — Asia.

Rostratula is the diminutive of the Latin *rostratus* (large-billed) after the long curved bill of the species; *benghalensis* is the geographical identification.

OTHER ENGLISH NAME Australian Painted Snipe, Greater Painted Snipe.

Painted Snipe needs no qualifier because the only other species of *Rostratula* is called the South American Painted Snipe; it is misleading to use **Australian** because the species is widely spread in Africa, Asia, Philippines and Indonesia.

POLYTYPIC Nominate *benghalensis*, Africa, S of Sahara, Egypt, Middle East, Asia to Japan, Philippines and Indonesia; *australis* (Gould, 1838), Aust. and Tas.

FIELD IDENTIFICATION Length: 24–30 cm; wingspan: 50–54 cm; weight: 125–130 g. Skulking but striking and unmistakable snipe-like wader; slightly smaller than Latham's Snipe *Gallinago hardwickii*, with shorter bill (markedly decurved over distal third and with more swollen tip); broader and distinctly more rounded wings; much shorter tail and less attenuated rear-end; and longer legs, with whole foot trailing beyond tip of tail in flight. Sexes different; female slightly larger and more brightly coloured. No seasonal variation. Juvenile separable though very similar to adult male.

Description Adult male Forehead and crown, dark brown, with bold buff median stripe; finely scalloped white when fresh. Rest of head, neck and upper breast, dark ashy-grey, vermiculated whitish, with white chin, whitish streaking and mottling on ear-coverts and throat, and diagnostic bold creamy or white comma-shaped mark round eye. Diagnostic white stripe with blackish borders runs up sides of breast and over shoulders, separating dark head and neck from dark upperparts and sides of lower breast. Rest of upperparts, dark ashy-grey with greenish gloss, vermiculated, blotched and barred blackish; bold golden-buff V along junction of mantle and scapulars, extending to lower back and joining anteriorly with white breast-stripe to form diagnostic pale 'harness'; rump, upper tail-coverts and tail with white spots that become larger and golden buff on upper tail-coverts and tail (spots on latter showing as pale bars in flight); tail, tipped cream. Upperwing: most inner wing-coverts, glossy olive-green with large dark-edged golden-buff spots that form pale wing-panel when settled; rest of wing, light grey, vermiculated blackish, with conspicuous narrow black bar and rows of large buff spots across bases of remiges. Lower breast and rest of underbody, white, sharply demarcated from dark upper breast; sides of lower breast and fore-flanks, dark-brown, mottled white. Underwing, mostly light grey, with blackish vermiculation and white barring, and broad white band through centre. Bill, pale grey, grading to

reddish brown on distal third. Iris, dark brown. Legs and feet, yellowish olive to greyish olive. **Adult female** Slightly larger and more brightly coloured than male: head, neck and upper breast, more uniform, slightly darker brown, contrasting more with paler greyish upperparts; pale comma-shaped mark round eye more pronounced; varying rufous patch on centre of hindneck; white stripes from breast to mantle, more pronounced but without dark upper border. Rest of upperbody, somewhat darker, with strong olive-green gloss, fewer pale markings and narrower pale V on mantle. Pattern of inner wing-coverts on upperwing very different: olive with fine blackish barring and without bold pale spots; settled birds lack pale and spotted wing-panel. Bill, paler, creamy becoming brighter, dull orange on distal third. **Juvenile** Sexes alike though female larger. Similar to adult male, differing by: white stripes less pronounced and without darker borders; inner wing-coverts, mostly light grey (not olive-green), becoming olive towards pale tip, and with subterminal buff spots and dark streaks. Bill, purplish brown with blackish distal third.

Similar species None; when settled, snipe-like shape, bold pale comma-shaped mark round eye and white breast-stripe, diagnostic. True snipe *Gallinago* also differ by: on ground: double pale V on upperparts; clearly different head-pattern, most obvious in pale supercilium and contrasting dark loral stripe; foreneck and breast, paler brownish clearly streaked darker; prominent dark barring on flanks; longer, straight bill, less swollen at tip. In flight, *Gallinago* snipe faster, with more powerful, zigzagging and towering flight, generally over longer distances and with steep dive to cover; often more explosive take-off and calls when flushed, more rasping; uniformly dark remiges above (on Painted, conspicuous black bar and buff spotting across base of remiges); and dense blackish barring over whole of under wing-coverts (cf. on Painted, contrasting bold white stripe through centre of underwing).

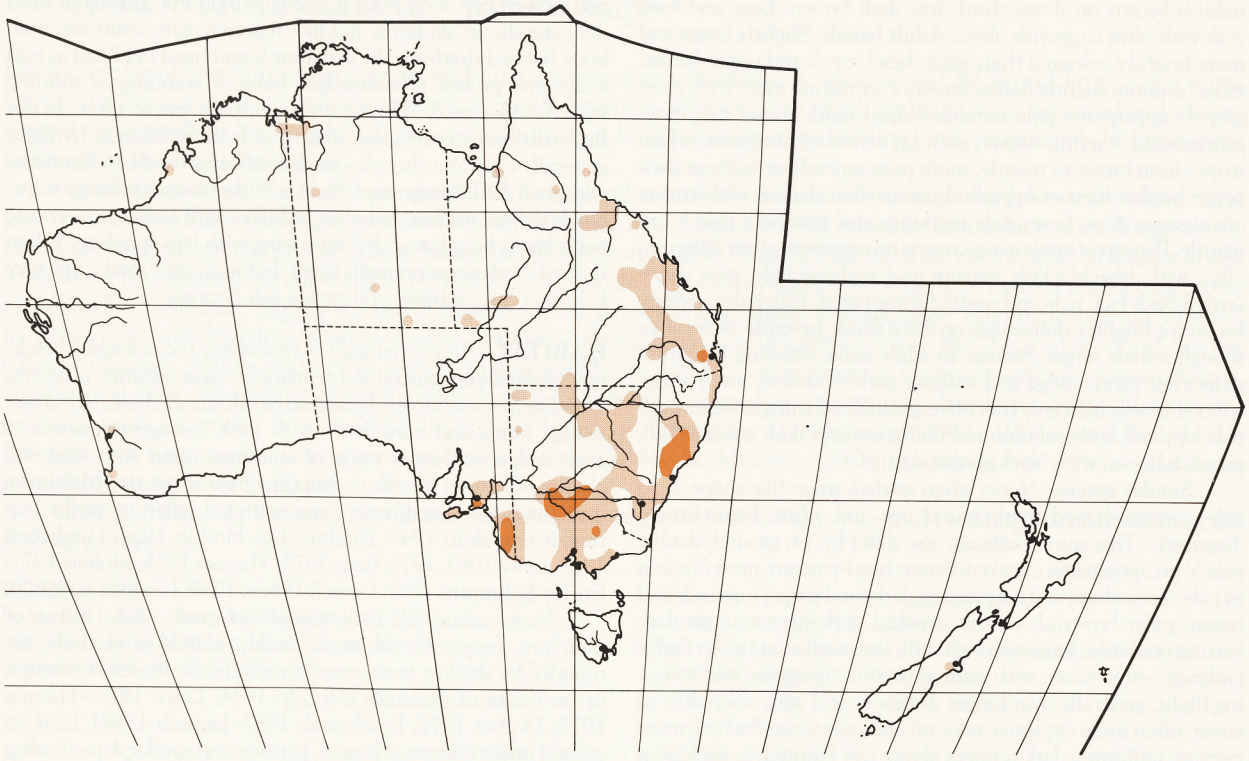
Usually in pairs or small parties, occasionally of one sex only. Mainly in shallow freshwater wetlands or saltmarshes, generally with good cover of grasses, low scrub, lignum, open timber or samphire. Mainly crepuscular, preferring to sit quietly under cover of grass, reeds or other dense cover during day, becoming more active at dawn, dusk and during night; generally remain in dense cover when feeding, though may forage over nearby mudflats and other open areas such as ploughed land or grassland. Feed deliberately, in skulking, rail-like manner; gait, cautious, with body bobbed rhythmically downwards and head held still as bird walks and probes. Characteristic habit of standing or running with head lowered. When disturbed, usually freeze; often do not flush till observer very close, then fly only short distance. In flight, generally keep low, though sometimes fly high and fast, but never with dash of *Gallinago* snipe; flight not like that of *Gallinago* snipe: much slower, weaker and more rail-like, with rather slow erratic wing-beats; broad, rounded outer wing with legs dangling. When flushed, both sexes normally silent, but may utter loud, explosive kek; also various hisses and growls, soft hooting.

HABITAT Terrestrial shallow freshwater (occasionally brackish) wetlands; ephemeral and permanent: lakes, swamps, claypans, inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia*, canegrass or tea-tree *Melaleuca*; sometimes tree-lined, with some scattered fallen or washed-up timber (Favaloro 1943; Hindwood & Hoskin 1954; Hindwood 1960; Lowe 1963, 1970; Beste 1970; Thomas 1975; Moffatt 1977; Fairley & Bonnin 1982; Jaensch 1986a, 1989; Leach *et al.* 1987).

Nest among tall rank tussocks of grass, reeds, rushes or samphire, frequently on small, muddy islands or mounds surrounded by shallow fresh water; sometimes on shores of swamps; or on banks of channels (McGilp 1934; Lowe 1970; Thomas 1975; Moffatt 1977; Leach *et al.* 1987; Jaensch 1989). Loaf on ground under clumps of lignum, tea-tree and similar dense bushes (Lowe 1963; Leach *et al.* 1987). Sometimes forage under clumps of tea-trees (Leach *et al.* 1987).

Usually on ground or in shallow water. Fly low (<3 m) over land or water when flushed (Lowe 1963; Beste 1970), but may fly higher when travelling long distances (Beste 1970). Once, disturbed bird crouched in shallow water with one-third of body underwater (Fairley & Bonnin 1982).

Use modified habitats, such as low-lying woodlands converted to grazing pasture, sewage farms, dams, bores and irrigation schemes (Favaloro 1943; Hindwood & Hoskin 1954; Carruthers



1966; Beste 1970; Lowe 1970; Corben 1972; Thomas 1975; Moffatt 1977). Cattle destroy suitable tussocky habitat by trampling and grazing on tussocks (McGilp 1934; Storr 1980).

DISTRIBUTION AND POPULATION Africa, S of Sahara Desert, S to s. Africa; also in Egypt, straggling to Israel; Indian subcontinent, E through s. and se. Asia to s. China and Japan; also S through Malay Pen. to Sumatra and Java; Aust.; straggler to NZ (Urban *et al.* 1986; BWP).

Aust. Generally uncommon. **E. mainland** Scattered E of line between Eyre Pen. and Karumba, Qld; absent C. York Pen.; mostly in e. Qld, and Murray–Darling Basin of NSW and Vic.; scattered records elsewhere including w. Qld, e. NSW, s. Vic. and s. SA, S of 34°S (Qld Bird Rep. 1985; Aust. Atlas). **Tas** Single record: single (specimen), Sandford, 23 July 1910 (Hall 1910). **WA** Rare; scattered records before 1960s, including pair, specimens, near Perth, 1841 (Serventy & Whittell 1976); two females, Munkayarra Pool; near Derby, 19 July 1886 (Storr 1980); round Derby, Jan. 1896 (Aust. Atlas); Brockman Ck, 14 Aug, 1896 (North); pair, specimens, Herdsman's L., 1897 (Storr & Johnstone 1988); single female, specimen, Pinjarra, May 1905 (Storr & Johnstone 1988); single, specimen, Strelley R., Sept. 1907 (Aust. Atlas); single male, specimen, 19 Mar. 1909 (Storr 1980); near Armadale, Moora, near Bunketch, and near Derby, dates unknown (Serventy & Whittell 1976). Since 1960s: single, specimen, Carnarvon, Nov. 1963 (Storr 1985); single, specimen, Puraburdoo, 1974 (Storr 1984); singles, round Kununurra, 26 July 1979 and Dec. 1979 (Aust. Atlas); single, Vasse Estuary, 4 Feb. 1986 (Jaensch 1986a); two, Parry Ck Floodplain, 4 May 1986 (Jaensch 1989); Parry Ck Floodplain, unknown date (Jaensch 1989); single, L. Eda, E of Broome, 10 Nov. 1986 (Jaensch 1986b); three, Bambun L., Gingin, 29 Nov. 1986 (Jaensch & Vervest 1987); wing-feathers found, Parry Ck Floodplain, 8 May 1988 (Jaensch 1989); feathers found, Thundelarra Stn, Yalgoo, 21 Nov. 1992, fourth record S of the Tropic in WA in last 50 years (Jaensch 1993). **NT** Few records, mainly n. interior (Storr 1977); single, specimen, Brunette Ck, 2 Apr. 1906 (Mathews 1909); a few, Elliott, early Nov. 1941 (Jarman 1945); single, Andado Stn, Simpson Desert, 1968 (Tucker 1970); single, Racecourse Billabong, Victoria R. Downs, May 1976 (Boekel 1980); pair, Alice Springs Sewage Farm, 17 Dec. 1978 to 5 Jan. 1979 (Roberts 1980); nine, Winnecke Ck, Tanami Desert, Oct. 1982 (Gibson 1986).

NZ One confirmed record: single, L. Ellesmere, 6 Aug. 1986 (possibly also 12 Aug. 1986) (Harrison & Mulligan 1987).

Breeding Mainly Murray–Darling region; also recorded se. Qld, e. NSW, se. SA and Mt Lofty Ras. Breeding records from Ayr, Qld, in 1950s most n. record (Lowe 1963, 1970; Thomas 1975; Moffatt 1977; Fairley & Bonnin 1982; Leach *et al.* 1987; Aust. NRS; Aust. Atlas).

Appear always to have been sparsely distributed; seemingly as uncommon in Gilbert's time (1840s) as now (Chisholm 1944). Recorded several times round Mt Isa since formation of new habitat by construction of dams (Horton 1975).

Often recorded erratically, absent some years, common in others. Influx into nw. Vic. after floods of 1956, when breeding recorded (Lowe 1963). Drought thought to have forced Snipe to Samsonvale, se. Qld, in 1957 (Bell 1958). Several WA records coincide with first record round Laverton, Vic. for 54 years (Bryant 1905; Wheeler 1955). Recorded several times and mist-netted in ACT in 1963 when L. Burley Griffin was filling (S. Marchant).

Aust. population estimated at *c.* 1500 (D. Watkins). Density: 24 nests/ha recorded in nw. Vic., 1956 (Lowe 1963). Sometimes been shot by hunters who mistook them for *Gallinago* snipe (Bright 1935). Binns (1953) recorded many shot round Terang in some seasons.

MOVEMENTS Unknown; occasional records from remote places indicate species can move long distances (Aust. Atlas). Possibly dispersive or migratory in Aust. (Lowe 1963). Extralimitally, sedentary, resident or migratory (Medway & Wells 1976; Johnsgard 1981; BWP). Evidence for dispersal in Aust. includes irregular and infrequent occurrences and breeding in some areas (Hall 1910; Bell 1958; Hindwood & Hoskin 1954; Hindwood 1960; Fairley & Bonnin 1982; Jaensch 1986a), e.g. non-breeding group at Laverton, Vic., May–Sept. 1951 was first record for area since 1897 (Bryant 1905; Wheeler 1955). Dispersive movements attributed to local conditions: move to flooded areas; from drying to permanent wetlands; from areas affected by drought (Bell 1958; Lowe 1963; Roberts 1980; Lane 1987).

Evidence for migration of Aust. birds includes claims of regular seasonal influxes, e.g. spring–summer or summer visitor to Cunnamulla and Minden in Qld, Mossgiel in sw. NSW, and Vic. (Lowe 1963; Leach *et al.* 1987; North; Vic. Atlas). Surveys 1977–81 suggest birds leave s. part of range in winter, as combined reporting rates for e. Qld, NSW and Vic. were 0.5% in summer and 0.04% in winter (Aust Atlas). Claimed that birds arrived at Ayr, Qld, Mar.–Apr. each year (Lowe 1963); at Cunnamulla, Qld, birds arrived early Oct. and left late Feb. after breeding (North). Breeding flock near Kerang remained *c.* 150 days in area from Nov. 1956 (Lowe 1963).

Banding Single recovery; adult male banded at Naracoorte, SA, 11 Apr. 1957, shot *c.* 11 km away, 16 Nov. 1957 (Hitchcock & Carrick 1958).

FOOD Vegetation, seeds, insects, worms and molluscs, crustaceans and other invertebrates. **Behaviour** Crepuscular and perhaps nocturnal. Glean from edge of water and from mudflats. Probe in soft ground and scythe with bill in shallow water (BWP).

Adult No detailed studies. **Plants** Vegetation (Cleland; Barker & Vestjens); sds (Hindwood & Hoskin 1954); *Bromus*; *Hordeum*; *Heliotropium supinum*; *Atriplex* (Barker & Vestjens); Fabaceae: sds (Vestjens 1977; Barker & Vestjens). **Animals** Annelids: oligochaetes (D'Ombrain 1944; North). Molluscs (North): gastropods (Vestjens 1977; Barker & Vestjens): freshwater snails (Vestjens 1977); Corbiculidae: *Corbicula* (Cleland). Myriapods: centipedes (Barker & Vestjens). Insects (Hall 1974; D'Ombrain 1944): aquatic insects (North); Hemiptera: Pentatomidae (Barker & Vestjens); Notonectidae; Corixidae; Coleoptera: water-beetles (Vestjens 1977; Barker & Vestjens); Dytiscidae; Curculionidae (Barker & Vestjens). In captivity, meat (D'Ombrain 1944).

Young, Intake No information.

SOCIAL ORGANIZATION Not well known in Aust.; some anecdotal material, particularly Lowe (1963); more well known extralimitally (see Urban *et. al* 1986; BWP). Generally seen singly (e.g. Muller 1974; Whitmore *et al.* 1983; North; Vic. Bird Reps 1982, 1985, 1986); sometimes in twos (e.g. Hindwood & Hoskin 1954; Campbell; North; Vic. Bird Rep. 1985); least often in flocks. During breeding season, male and up to four offspring may be seen together (e.g. Hindwood 1960; Fairley & Bonnin 1982; Aust. NRS). Flocks often associated with suitable breeding habitat (Lowe 1963; North); claim of being solitary, but gregarious when not breeding (MacDonald 1973), probably incorrect. During one breeding season, Lowe (1963) found loose gatherings of adults ('breeding flocks'), round each group of nests; at one site, seven birds flushed from *c.* 1.2 ha round nests; smaller groups of 3–4 of both sexes seen together under bushes near nests; breeding groups round nests always included some females; one breeding group remained in district for *c.* 150 days. Another record of 15 adults near nests (Aust. NRS). Lowe (1963) also observed flocks forming after breeding, followed by dispersal as water dried out; once 21 birds in tight flock in Jan. with four together *c.* 1 km away, and no indication of juveniles included; also groups of 4–16; sometimes groups seemed to include more males than females. Flocking not always related to nesting; during one winter, one flock in s. Vic. altered in size: May–June, 14–19 individuals; numbers gradually dwindled until only one injured bird remained in Sept. (Wheeler 1955). Do not form flocks in Vic., only loose groups, sometimes with Latham's Snipe *Gallinago hardwickii* (Vic. Atlas). Other records of groups include: flock of 31 at Bool Lagoon, SA, in autumn (Jaensch 1982); up to 30 seen at L. Cowal, NSW, but no indication of grouping given (Vestjens 1977); *c.* 25 birds, in Nov., Urana district, NSW (Mitchell 1986); two females and one male, in July, s. Qld (Bell 1958); when habitat suitable near lower Avoca R., Vic., small groups nearly always present from late 1950s to mid-1970s (Garnett 1992).

Bonds Generally accepted that female is polyandrous, leaving male to incubate while she mates with any other male she can attract (Hindwood 1960; Lowe 1970; Serventy & Whittell 1976); at one swamp, record of one male tending young while female and another male moved round together (Hindwood 1960); one instance of female apparently tending young (Lowe 1970), and another of pair with young family (Campbell). **Parental care** Often two birds present at site when nest being built (Lowe 1963), though often claimed that only male builds nest (Hindwood 1960; Serventy & Whittell 1976). Often both male and female near nest with eggs (e.g. North; Aust. NRS), but probably clutch not complete; only male appears to incubate and rear young (Hindwood 1960; Lowe 1963, 1970; Serventy & Whittell 1976; Leach *et. al* 1987; Aust. NRS), though some suggestion that females may occasionally attend young (Lowe 1970; Campbell). Period of dependence of young unknown; adult male shepherded and apparently defended immatures with broken-wing display in late Dec.; by 10 Jan., immatures appeared three-quarters adult size, and by 22 Jan. appeared indistinguishable from adult male (Fairley & Bonnin 1982).

Breeding dispersion Some nests apparently solitary (e.g. Lowe 1970; Moffatt 1977; Aust. NRS) though other birds and nests may be nearby because polyandrous (e.g. Hindwood 1960; Leach *et. al* 1987); in some situations, loosely colonial though nests widely separated (e.g. Lowe 1963). Indication of breeding density in colonial situations: Camden Swamp, SA, two nests *c.* 20 m apart; Budgree Swamp, Qld, *c.* 12 nests on *c.* 0.5 ha (McGilp 1934); four nests within *c.* 50 m of each other; two nests, one recently deserted, 150 m apart, another nest 45 m further on, and two other nests nearby (Lowe 1963); two nests *c.* 30 m apart (Aust. NRS). Often breed near nesting Red-necked Avocets *Recurvirostra novaehollandiae*, Banded Stilts *Cladorhynchus leucocephalus*, Red-kneed Dotterels *Erythrogonys cinctus*, and Black-tailed Native-hens *Gallinula ventralis* (Lowe 1963). **Territories** Claimed that female starts defence of nesting territory (Pringle 1987). No other information.

Roosting Spend day hidden, often in dense swamps, and active at dawn, dusk and at night (Muller 1975; Pringle 1987), but roosting behaviour not well known within region; during day, observed walking round and standing under lignum bushes (Lowe 1963); birds often rest and occasionally feed in shade of Black Tea-trees *Melaleuca bracteata* (Leach *et al.* 1987).

SOCIAL BEHAVIOUR No studies; in wild only anecdotal material; some observations in captivity by D'Ombrain (1944) and Muller (1975); for extralimital material see BWP and Urban *et al.* (1986). Difficult to study because rare, movements unpre-

dictable, very cryptic and secretive; Bright (1935) considered them less shy in non-breeding season. Incubating male seen PANTING with bill opening and closing rapidly, throat quivering, and feathers held compact (Lowe 1963). TAIL-BOBBING: bird stands upright and often dips rear and tail with head and neck held almost still; function not known (Lowe 1963; Fairley & Bonnin 1982), but possibly Alarm; also see Head-bobbing below. **Flock behaviour** When alarmed, each bird of group freezes, maintaining attitude it happens to be holding (e.g. head down or on one leg), and stares at source of danger; group will hold such tableaux for minutes; whole group will also crouch (Lowe 1963); recorded flushing as flock, any separated individuals rejoining flock later; small groups also noted running together ahead of observers (Wheeler 1955); one group, which included immatures, all ran from cover of reeds to shallow water (Fairley & Bonnin 1982). For details of Alarm, see below.

Agonistic behaviour What provokes aggression not well understood but intrusion by human can cause threat displays. Calling by female considered to be territorial as well as to attract males (BWP); see Voice. **Threat** Two fundamental displays, Frontal and Lateral; same in both sexes; occur when approached too closely; performed before and during physical attack on threatening object. FRONTAL DISPLAY (Fig. 1): head forward and low, with both wings fully extended and fanned, and tail raised and spread; exposes bright colours on back and wings and increases apparent size of bird; legs apart; usually remain still, but sometimes sway wings backwards and forward slowly (D'Ombrain 1944; Wheeler 1955; Lowe 1963; Muller 1975). Muller (1975) pointed out that this display is very similar to that of South American Sunbittern *Eurypygia helias*. After initial encounter, bird may charge or slowly retreat and move to LATERAL DISPLAY (Fig. 2): wing nearest to threat folded or extended to ground (Muller 1975). If charges, does so holding posture similar to Frontal Display, gives Threat Call, then jabs with bill; may not retreat but side-step crab-fashion with wings held out and neck tucked in; as nears cover, folds wings back (D'Ombrain 1944). **Alarm** Usually freeze and remain concealed; less often flush, usually by flying (Lowe 1963; Muller 1975); may flush then freeze (Bell 1958). On approach of intruder, sometimes slowly crouch and freeze, then if approach continues, move forward slowly (Harrison & Mulligan 1987), explode into air (Beste 1970) or, in case of injured birds, give Threat Display (Wheeler 1955). When flushed and take flight, often do so in direct line for 100–200 m, at height of *c.* 3 m (Hindwood 1960; Lowe 1963); the longer the flight, the higher they fly; usually land behind cover; may repeatedly flush and fly from cover to cover (Lowe 1963; Beste 1970), though North noted difficult to re-flush if cover nearby. Occasionally call as flying away (Lowe 1963). After being flushed, may perform bobbing, or run in crouched position for *c.* 100 m (Wheeler 1955), or remain upright and watch intruder (Beste 1970). HEAD-BOBBING: observed once when five males associating in close bunch were approached by person: after others had run for cover, one Tail-bobbed and jerked bill downwards for at least 1 min (Lowe 1963). When handled, female utters loud hiss and deep growl; male quiet (Muller 1975). Also see Parental anti-predator strategies.

Sexual behaviour Female probably starts courtship (Hindwood 1960). Threat displays possibly used in sexual behaviour (BWP).

Relations within family group When hatching, chicks call from within shells (Moffatt 1977). **Anti-predator responses of young** When three newly hatched young disturbed, quickly left nest and floated in water; when captured, squeaked, which brought parent; after release, in reply to soft call from parent, young hid in rushes (Lowe 1963). Young chicks passive when handled (Hindwood 1960). Young crouch very close together, at least until able to run easily (Bright 1935); hiding also recorded (e.g. Hindwood 1960; Aust. NRS). Young may also scramble over ground; give displays, during which silent, resembling adult Threat Display: point bills down, raise tails, and spread wings forward (Fig. 3). Immatures, still attended by adult male, seen to freeze in compact group for 15 min; also to run for cover (Fairley & Bonnin 1982). **Parental anti-predator responses** When on eggs, move quickly off nest in partly crouching position, or move off with body held straight and head low; run ahead of intruder and may be difficult to locate; if pressed may squat or stand erect, before taking flight; in flight, defecate regularly (Lowe 1963; Leach *et al.* 1987). One male moved in partly crouching position for *c.* 20 min before flying (Moffatt 1977). Another male near nest with eggs adopted peculiar attitude: stood in water with bill and eye-line parallel to water-line, body vertical, and buff V of back blending with grass (Moffatt 1977). After being flushed, may return to nest within 20 min (Leach *et al.* 1987). Before moving to nest male observed sometimes to move to point near nest and stand motionless; bird then approached nest slowly and cautiously, with body parallel to ground and head low; tail sometimes high and flicked downwards; once appeared to walk on knees; sometimes gave soft call (Lowe 1963). Mount nest with body shuffling and swaying forward and head low. Leach *et al.* (1987) saw bird return to within 3 m of nest in short spurts of about 1 m; paused with head raised above grass between each spurt before continuing; last 3 m traversed slowly and cautiously. When with young, parent, usually male, flies when disturbed (Lowe 1970), but later returns to chicks. Often distraction displays given, but not always (Hindwood 1960); one male made loud hissing call and ran about behind bushes *c.* 10 m from observer handling chicks (Aust. NRS). Adult attending four immatures recorded performing broken-wing display (Fairley & Bonnin 1982). Apparent display: male zigzagged in front of observer, running and creeping in short

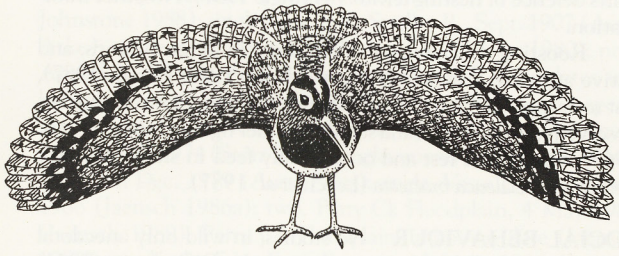


Figure 1 Frontal Display

Figure 2 Lateral Display

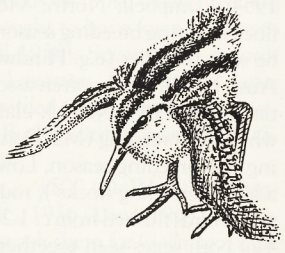


Figure 3 Threat Display of young

spurts; sometimes stopped behind bush, peered furtively round, or crouched in full view, never nearer than 30 m (Lowe 1963).

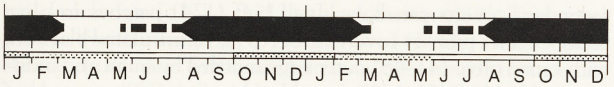
VOICE Little information from HANZAB area. Elsewhere, many calls in Kobayashi (1954, 1955), summary of which in BWP lists nine calls, five for female and four for male. In HANZAB area, observers comment on silence or near silence (Hindwood 1960; Lowe 1963; Beste 1970; Gould; R.P. Jaensch). Niethammer (1966) did not find elongation and convolution of trachea in female as found by Wood-Mason (1878) and Gould; crop of female is secondary sexual characteristic not present in male and can be inflated to serve as a voice amplifier (Niethammer 1966).

Adult ALARM CALLS: loud *kek* or *kak* at intervals of <1 s when flushed (Lowe 1963); sharp repeated *cuck-cuck* (Aust. RD); loud hiss and deep growl from female (Muller 1975); loud hissing from male during apparent distraction display (Aust. NRS); soft buzzing grunt from injured bird when handled (Wheeler 1955). THREAT CALLS: pleasant soft and almost musical *booo* from bird in Frontal Display (see Social Behaviour; D'Ombrain 1944). **Other calls** Soft note in reply to distress calls of young; *click-click* call when approaching nest (Lowe 1963).

Young Barely audible calling from chipped eggs (Moffatt 1977). Squeak when handled from recently hatched young (Lowe 1963). Weak *cheep* from chicks thought to be <1 week old (Hindwood 1960).

BREEDING Not well known. Polyandrous throughout range, probably also in Aust. but no direct evidence; one case of female attending young (Lowe 1970).

Season In s. Aust., generally Aug.–Feb.; earlier in n. Aust. In s. Qld: eggs, early Jan. (Aust. NRS); NSW: eggs, Dec.–Feb. (Morris *et al.* 1981; NSW Bird Reps 1972, 1973), breeding, mid-Aug. to late Jan. (Aust. Atlas); Vic.: eggs, mid-Nov. to late Dec. (Lowe 1963; Aust. NRS); SA: eggs, mid-Aug. to late Dec. (McGilp 1934; Attiwell 1972). In n. Qld: successful breeding, May–Oct. (Qld Bird Rep. 1990); eggs, early Mar. (Lowe 1963). Breeding possibly stimulated by flooding of swamps (Leach *et al.* 1987).



Site On ground, in swamps, canegrass swamps, flooded samphire, grazing land, grassland on fringe of flooded area, margin of swamp among casuarinas, grassy bank of rice paddy, in cumbungi *c.* 3 m from bank of sewage pond; on small mound or island, sometimes with built-up nest in vegetation in shallow water; in clump of cumbungi, sedge, grass, saltwater couch *Paspalum*, saltbush *Halosarcia* with grass growing through, in ground cover of waterbuttons and grasses, at base of tussock or under low saltbush, in centre of cow-pat in clump of long grass (Aust. NRS). Distance between nests: *c.* 27 m (Aust. NRS), 41, *c.* 45 and *c.* 136 m (Lowe 1963). Within 1.8 m of nest of Red-kneed Dotterel *Erythrogonys cinctus*, 18 m from nests of Red-necked Avocet *Recurvirostra novaehollandiae* and Black-winged Stilt *Himantopus himantopus* (Lowe 1963).

Nest, Materials Scrape in ground, with scant lining or with shallow bowl-shaped nest of dry grass, barley grass, water-weed, twigs, leaves, samphire twigs and bark, casuarina cladodes (Lowe 1963; North; Aust. NRS). Material collected round nest-site (Aust. NRS). Probably only male builds but both sexes seen together during building (Lowe 1963). Make depression in ground when mud soft; grass flattened to carry eggs; may draw surrounding rushes *Eleocharis acuta* and grass *Polypogon mouspeliensis* together to form canopy overhead (McGilp 1934; Aust. NRS). Nests on dry ground tend to be frail structures whereas nests in water more substantial, built up on ground to above surface: one nest in water *c.* 10 cm deep, a mass of water-weeds and rushes up to 3 cm above water (Bright & Taysom 1932; McGilp 1934), another built 5 cm above water 20 cm deep but not clear if nest on ground (Moffatt 1977). MEASUREMENTS (cm): diameter, 10–15 (n=4) (McGilp 1934; Aust. NRS); height, 2.5–4 (Lowe 1963; Aust. NRS); diameter of egg-cavity, 13; depth, 1 (Moffatt 1977).

Eggs Oval or elongate oval; close-grained smooth and lustrous; creamy white or dull yellowish stone with short thick black streaks, and irregularly shaped spots and blotches, intermingled with a few spots of brown or brownish black and similar underlying markings of dull inky grey. Evenly dispersed almost obscuring ground-colour, sometimes confluent and form in large black patches, others large and predominantly at thicker end (North). Eggs heavily marked all over with large patches of dark olive or sepia, sometimes almost black (Campbell). MEASUREMENTS: 34.9 (1.10; 33–37.3; 20) x 25.3 (0.45; 24.6–26.4) (Campbell; North).

Clutch-size Usually 3–4 eggs per clutch, occasionally six; C/3 x 3, C/4 x 4, C/6 x 1 (Thomas 1975; Moffatt 1977; Aust. NRS). Clutches of six eggs probably result from two females laying in same nest (Aust. NRS).

Incubation By male only (Lowe 1963; Aust. NRS). INCUBATION PERIOD: 15–16 days (Serventy & Whittell 1976); extralimitally, 19 days (n=1; Schmidt 1961). No information on length of stints of incubation; remain away from nest for longer period towards end of incubation (Leach *et al.* 1987). On hot days, rearrange surrounding vegetation to shade nest (Leach *et al.* 1987). Eggs may pip 1–4 days before hatching (Leach *et al.* 1987; Aust. NRS). Egg-shells not removed from nest (Leach *et al.* 1987).

Young Precocial, nidifugous. Down, fawn, with longitudinal stripes of fawn, bright tan and black on upperparts; bill, leaden grey; legs and toes, olive-green; iris, umber-brown (Hindwood 1960). **Parental care, Role of sexes** Both sexes recorded at nest during laying, otherwise male does all incubation and care of young (Thomas 1975; Aust. NRS); one record of female probably attending young: female flushed from area where two young found and no males were seen or flushed (Lowe 1970). If disturbed at nest, male will run for a short distance before flying; young probably led away from nest at or soon after hatching (Leach *et al.* 1987; Aust. NRS). Newly hatched young take to water when disturbed (Lowe 1963); feathered young may freeze and remain motionless for up to at least 15 min (Fairley & Bonnin 1982). Male performed broken-wing display when a sheep approached to within 20 m of feathered young (Fairley & Bonnin 1982).

Success From 20 eggs laid, four hatched (Lowe 1963; Thomas 1975; Aust. NRS). Nest deserted after photographer erected hide nearby (Aust. NRS).

PLUMAGES Prepared by D.I.Rogers. Subspecies *australis*. Hatch in natal down, which is replaced by juvenile plumage; age of fledging, unknown. Post-juvenile moult, partial, not involving remiges or rectrices; can begin when several months old but apparently always occurs before first winter. Resultant immature (first basic) plumage difficult to distinguish from adults. Replaced by adult (second and subsequent basic) plumages when birds *c.* 1 year old, by first winter. Sexes differ considerably in size and, in adults, in plumage; females larger and more brightly coloured.

Adult male First basic and subsequent plumages. **Head and neck** Forehead and crown, dark brown (21), sometimes narrowly scalloped white, with broad buff (21) median stripe. Scalloping

on sides of crown formed by narrow white tips, which are sometimes lost with wear. Hindneck, vermiculated brown-grey (c79) and dark brown (121); sometimes mottled by white tips to feathers and white spots on outer edges; these white markings are largest on nape and can be lost with wear. Large cream (c54) to white eye-ring meets post-orbital stripe of same colour; forms conspicuous pale comma-shaped marking. Chin, white, sometimes faintly mottled by dark-brown (119A–119B) tips. Lores and area below eye-ring, dark brown (119A). Ear-coverts, white mottled by dark-brown (119A) tips. Throat, mottled dark brown and white; feathers, dark brown (119A) grading to light-brown (119C) bases, with varying white spot at tip and varying white spot on each edge; latter markings sometimes meet and form bar. **Upperparts** Mantle, back and scapulars, brownish grey (c79) when fresh, grey-brown (c91) when worn, with black-brown (119) vermiculation, which takes on strong green gloss in some lights. Larger feathers, especially longer scapulars, also have widely spaced black-brown (119) bars with narrow white margins; these can give appearance of dark-brown and white bars superimposed over vermiculated background. At junction of mantle and scapulars, feathers have broad golden-buff (53–153) edges; these form distinctive V on mantle, which extends to lower back. Outermost scapulars, intermediate in pattern between inner scapulars and upper wing-coverts; white bars of scapulars broaden to large cream (54) spots and there are varying olive (c48) patches on outer webs. Concealed subscapulars, golden-buff (153–53) with irregular olive markings. Rump and upper tail-coverts, light grey (85) with narrow wavy black (c89) barring; ground-colour becomes grey-brown (c79) when very worn. Feathers of rump usually have 1–2 white spots on each outer edge; these larger and grade to golden-buff (53) on upper tail-coverts. **Underparts** Fore-flanks and upper breast, dark brown mottled white; these areas separated by broad white diagonal line that meets top of V on mantle. White breast-stripe has even dark-brown (121) borders formed by dark-brown feathers with broad white tips; elsewhere on breast, feathers dark brown (119B, rarely 119A) grading to light-brown (119C) bases, with white tips and subterminal bars. Hindflanks, axillaries, belly, vent and under tail-coverts, white. **Tail** Grey (c84–85), becoming grey-brown (c79) when very worn, with black (c89) vermiculation more widely spaced than on upper tail-coverts. Each feather has 2–3 pairs of golden-buff (53) spots on edges, each spot narrowly bordered black (89). All rectrices narrowly tipped cream (54). **Upperwing** Primaries and secondaries, light grey (c85) with sparse black (89) vermiculations and very narrow white tips; ground-colour, black (89) on basal halves of outer webs, forming narrow black bar across upperwing, which peters out on inner secondaries where bases of feathers concealed by greater secondary coverts. Remiges have series of very large buff (c53) spots at bases, each narrowly bordered black (89), diminishing to small white spots near tips of feathers. Most coverts, olive (43–48) with many large golden-buff (53) to cream (54) spots, narrowly bordered black (89); coverts have grey bases, most extensive on inner webs, which are vermiculated black (89) with occasional white spots. Grey areas sometimes exposed, most often at elbow and on inner lesser coverts. Greater primary coverts similar but ground-colour of tips and entire inner web, grey (c85); some small white spots on inner webs. Tertials, like longest scapulars. **Underwing** Most remiges, light grey (c85) with dark-grey (c83) vermiculation and transverse white spots or bars that are bordered dark grey (c83); p10 differs in being unmarked dark grey (c83) except for light-brown (c92) barring on narrow outer web. Greater and median secondary coverts, white. Greater primary coverts, light grey (85–86) to grey-brown (119B) with white fringes and concentric white horseshoe-shaped markings that are narrowly bordered dark grey (c83). Row of similar feathers lies between secondaries and greater secondary coverts; these short and nearly always concealed by white greater secondary coverts. Marginal coverts, like those of upperwing.

Adult female Second basic and subsequent plumages; attained when about 1 year old. Differences from smaller and less brightly coloured adult male: **Head and neck** Top of head, lores, face and ear-coverts similar to male but ground-colour slightly darker brown (c121), making eye-ring contrast more strongly. Hindneck has varying, sometimes large, rufous patch in centre; feathers of hindneck, rufous (36) with dark-brown (121) tips or subterminal bands that can be lost with wear, sometimes with very narrow white tips. Chin and throat, white sometimes speckled by dark-brown (121) tips; rest of throat and foreneck, rich even dark brown (c219). White edges can form slight streaking on upper throat. **Upperparts** Lower back, rump and upper tail-coverts, as male. Mantle and upper back, dark brown (c119) showing strong olive-green gloss in most lights, strongly vermiculated grey (c85). V on mantle narrower and can be entirely concealed. Scapulars have much-reduced buff spotting; buff markings restricted to tips of scapulars. Black bars of longest scapulars lack white margins. Subscapulars, concealed, elongate, tapering and pure white, occasionally with small dark-brown (121) spot at tip. **Underparts** Pattern similar to adult male but upper breast and fore-flanks, even dark brown (219–c121), which makes white breast-stripes contrast even more. Even colour of throat and upper breast make female lack male's appearance of a dark pectoral band. A few inconspicuous feathers behind fore-flanks, light olive-brown, narrowly barred dark brown (c121). **Tail** As male. **Upperwing** Primaries and secondaries similar to adult male but spots generally whiter. Most coverts differ considerably from males; olive (43–48), grading to usually concealed light-grey (c85) inner edges, regularly and narrowly barred blackish (c82). Blackish bars show olive gloss in some lights. In some individuals, coverts narrowly tipped buff (124). Tertials, similar to these coverts but dark bars broader and more widely spaced; some fine black (c82) vermiculation between barring. Outer greater secondary coverts can have small buff (124) patches in olive areas. Greater primary coverts, grey (c85), vermiculated blackish, with broad olive (43–48) outer edge mottled by small and indistinct golden-buff (53–153) spots. No white spots on inner webs of primary coverts. **Underwing** As male.

Downy young No skins available; following based on photos (Pringle 1987; T. Lowe) and Hindwood (1960). **Head and neck** Ground-colour, very pale-brown (c119D) grading to whitish on top of head; auricular area apparently washed dark brownish-grey but this effect perhaps caused by exposure of underlying dark skin. A black-brown (119) median crown-stripe runs from base of culmen to nape, broader in centre of crown, where it encloses short light-brown (c39) stripe. Long black-brown (119) eye-stripe meets bill on nostrils and runs above auricular area down sides of neck. **Upperparts** Light-brown (c39) median stripe, c. 5–10 mm long, runs along length of upperparts and bordered by slightly narrower black-brown (119) stripes. These surrounded by pair of broad white lateral stripes. Another pair of black-brown (119) stripes, continuous with eye-stripe, runs along sides of upperparts. Wing-pads, very pale brown (119D) with darker down round carpal; precise pattern obscured by emergent juvenile wing-coverts in available photos. **Underparts** Pale grey-brown (c119D); short dark-brown (c121) streak on flanks runs from level with wing-pads to level with vent.

Juvenile Sexes similar but females can usually be distinguished on larger size. Differences from adult male: **Head and neck**

Feathers of hindneck, narrowly tipped white; white streaking on throat generally broader than in male. **Upperparts** Mantle and upper back, faintly barred by narrow white tips and subterminal bars to feathers. Feathers smaller than in adults and those of rump have slightly more downy texture. **Underparts** Patterning similar to adult males but borders of white V on breast no darker than central breast and fore-flanks; hence lack appearance of dark pectoral band and white V contrasts less strongly. Feathers at border of V, brown (119B, occasionally 119A) grading to paler-brown (119C) bases, with white fringes. **Tail** As adult, except rectrices narrower and perhaps slightly shorter. **Upperwing** All primaries have small white tip (at least when fresh); this absent on outer primaries of most adult males. Remiges slightly narrower; difference most obvious in tertials. Primary coverts, similar to adult male. Most distinct ageing character is other coverts; basal 80%, light grey (c85) vermiculated grey-black; distal area, olive (43–48) with narrow cream (c92) to white tips. Olive region of these coverts interrupted by pair of large buff (c53) spots with black-brown (119) margins; spots overlap at shafts of feather, overlapping black-brown margins forming conspicuous streaks. **Underwing** Similar to adults except for smaller, narrower remiges.

Immature male First basic. Indistinguishable from adult male after post-juvenile moult completed.

Immature female Similar to adult female. Rufous patch on hindneck varies considerably but generally smaller; in some, entirely absent. White chin-patch generally larger but overlap occurs. Most reliable ageing character, brown (119A–119B) feathers of foreneck, with white tips and dark brown (121) bases; sometimes have pale brown (119D) subterminal bars. Similar feathers sometimes occur on lower throat and upper breast; produce white-mottled appearance, unlike even dark-brown foreneck of adult females.

BARE PARTS From photos (Leach *et al.* 1987; Pringle 1987; Aust. RD; unpubl.: R. Davies, J.N. Davies) except where stated.

Adult male Bill, pale brown-grey (44 to brownish 86) with light-brown (26) distal third; sometimes with small dark-grey (c83) to dark-brown (121) tip; dark olive-green bill on one label. Iris, dark brown (c121A, 121) to black-brown (119). Tarsus and toes, yellowish olive (c52) to greyish olive (42–43). **Adult female** Photos of only one female *australis* available; similar to male but with cream (92) bill grading to dull orange (dark 106) tip. Yellowish bill also reported in adult female (Jaensch 1986a). Dull grey-blue and mauve iris on label. **Downy young** Bill, purplish grey (c77) to brownish grey (c84) with black (82) tip. Iris, brown (121A–121B). Tarsus and toes, light bluish-grey (c88). **Juvenile** Only one photo available; bill, purplish brown with blackish (c82) distal third and grey (c84) area between nostrils and base; iris, dark brown (c19). Labels suggest adult bill-colour attained before post-juvenile moult.

MOULTS Except where stated, based on skins of 40 adults (23 with date) and 14 subadults (eight with date) (ANWC, AM, HLW, MV, QM, SAM, WAM).

Adult post-breeding Complete. Primaries apparently replaced in outwards sequence in *australis* but little information. In nominate *benghalensis*, p1–p6 moult outwards; thereafter primary-moult can follow outwards sequence but p10 often moults before p7–p9; in *benghalensis*, some inner primaries may moult at same time as some outer primaries (Stresemann & Stresemann 1966; BWP). The 11 *australis* available in active moult showed simple outwards primary-moult but in only two had moult proceeded as far as p7; these had moult-formulae of $N^6 4^2 O^2$ and $N^6 4^1 O^3$ respectively. Moult of *australis* occurs in summer; of eight dated records of active primary-moult, seven were from Oct. to Jan.; seven other adults collected in same period had no moult. Also a record of late primary-moult in early May. Usually two primaries grow concurrently, occasionally 3–4; there are also five records of birds (one Oct., one Dec., three undated) that had interrupted primary-moult, retaining 2–7 outermost primaries. Probably no pre-alternate moult of body-feathers; no seasonal change in appearance occurs and only records of active body-moult from birds that were also moulting primaries. For preliminary information on moult of secondaries and tail in *benghalensis*, see Stresemann & Stresemann (1966). **Post-juvenile** Partial, not involving remiges or rectrices. Age at which moult begins unknown but before first winter; some individuals have worn primaries before moult begins. Records of active moult available from Jan. and May. Juvenile remiges and rectrices are replaced in complete second pre-basic moult, which occurs at about same time as adult post-breeding.

MEASUREMENTS Subspecies *australis*, throughout Aust., skins: (1) adult and first basic (ANWC, HLW, MV, SAM, WAM); (2) juvenile (ANWC, MV, QM, SAM, WAM).

		MALES	FEMALES	
WING	(1)	145.2 (2.52; 141–149; 12)	154.5 (3.77; 147–163; 27)	**
	(2)	143.64 (2.87; 139–148)	147, 155, 157	
8TH P	(1)	95.3 (1.71; 93–98; 11)	100.4 (2.75; 95–106; 26)	**
	(2)	93.8 (1.72; 91–96; 5)	97, 100	
TAIL	(1)	50.6 (1.92; 48–54; 11)	52.2 (2.40; 46–58; 28)	*
	(2)	48.4 (2.42; 44–51; 5)	52, 52, 52	
BILL	(1)	43.2 (0.84; 41.9–44.4; 11)	44.8 (2.12; 39.7–47.8; 23)	**
	(2)	39.6 (2.33; 36.3–43.0; 5)	42.0, 45.8, 45.9	
TARSUS	(1)	39.2 (0.98; 37.7–40.60; 10)	41.6 (1.38; 39.08–41.6; 20)	**
	(2)	37.3 (1.79; 35.0–40.4; 5)	39.4, 42.0, 42.0	
TOE-C	(1)	34.6 (1.40; 32.4–36.5; 7)	37.3 (1.75; 35.1–43.7; 19)	**
	(2)	31.3, 32.3, 36.2	37.0, 37.0	

WEIGHTS Adult and immature males 123.2 (15.2; 106–142; 5) (AM, ANWC). Juvenile males 87, 98. Adult and immature females 131.5 (9.89; 119–145; 6) (ANWC; QM; Hall 1974).

STRUCTURE Wing, rather short and rounded. Ten primaries; p9 and p10 longest, about equal; p8 1–6 shorter, p7 5–12, p6 10–17, p5 18–24, p4 23–30, p3 28–34, p2 34–40, p1 39–47. No emarginations. Thirteen to 14 secondaries, including five tertials; 15 secondaries reported in nominate *benghalensis* (Stresemann & Stresemann 1966). Tail, short and square-tipped; 14 feathers. Bill long, *c.* 60% of total head-length, and slender; mostly straight but tip of upper mandible, slightly decurved and protrudes past tip of lower. Tip of bill, slightly swollen, both wider and deeper than most of bill. Nostrils, slit-like; situated in large deep groove on side of upper mandible, which becomes fine and shallow on distal half. Tarsus, fairly long, only slightly shorter than bill, and slightly laterally compressed; scutellate with one row of scales in front, another behind and reticulate on sides with about two rows of scales, each 1–2 mm wide. Most toes, moderately long and slender, hallux very slender; outer toe 82% length of middle, inner 74%, hind 33%.

GEOGRAPHICAL VARIATION None known in Aust.; subspecies *australis* differs in size from nominate *benghalensis* of s. Asia, Middle East and Africa which has shorter wing (Egypt: males 129.4, females 139.7) and tail (43.2, 45.9) but longer bill (48.9, 50.6), tarsus (45.0, 47.9) and toes. See BWP for more

measurements of *benghalensis*. Nominate *benghalensis* also differs in several plumage characters (*contra* Hayman *et al.* 1986); further research may show that *australis* should be treated as a full species. Adult female *benghalensis* differ most obviously from female *australis* in having rufous chin and throat and uppermost breast meeting broad rufous collar round hindneck; sharp demarcation in moustachial area with dark-brown face. Eye-ring of *benghalensis* pure white, never cream as in some *australis*; V on mantle may be broader on average. Ochre spots in tail usually broader and flatter than in *australis*, often forming barring. Adult male *benghalensis* differs from adult male *australis* in wing-coverts, which look more barred, less spotted in former. This effect caused by golden-buff spots on coverts, which average broader and rounder in *australis* and are cleanly bordered blackish; in *benghalensis* only proximal borders of spots cleanly bordered black and distal margins of spots grade to olive. Nominate *benghalensis* also has brighter buff (123A–123B) spots on remiges, and pale markings on undersides of remiges are more extensively tinged buff (c92); ground-colour of rump, upper tail-coverts and tail, darker grey (84) than in *australis*. Scapulars look less grey than in *australis*; golden-buff spots richer and slightly larger with slightly broader black borders; areas of olive on scapulars also larger. Juvenile *benghalensis* differ most obviously from *australis* in pattern of upper wing-coverts; on average, tips of coverts of *benghalensis* are paler cream (54). Nominate *benghalensis* have a broad buff bar near tips of upper wing-coverts, partially bordered blackish below; this blackish bar is slightly chevron-shaped at shaft but chevrons are not deep enough to produce strongly streaked effect seen in juvenile *australis*. Illustrations in BWP and Urban *et al.* (1986) suggest downy young *benghalensis* may have narrower black-brown stripes than downy young *australis*, but more information needed.

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Volume 2, Plate 51

Painted Snipe *Rostratula benghalensis* (page 658)
1 Adult male; **2** Adult female; **3** Downy young; **4** Juvenile; **5** Immature female; **6** Adult male; **7** Adult female

Plains-wanderer *Pedionomus torquatus* (page 649)
8 Adult male; **9** Adult female; **10** Downy young; **11** Juvenile; **12, 13** Adult female