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 **CHARADRIIDAE** plovers and lapwings

Small to medium-sized, mostly terrestrial, waders of open habitats. About 65 species, placed in varying number of genera. Evidently monophyletic by behaviour and structural characters. Distributed worldwide and separable into two distinct sub-families: Charadriinae (plovers) and Vanellinae (lapwings), both of which are represented in HANZAB region and are discussed in more detail below. Most closely related to Recurvirostridae, Haematopodidae and possibly Burhinidae (Sibley & Ahlquist 1990; Christian *et al.* 1992).

Bodies, compact. Size differences between sexes negligible; sometimes males and sometimes females slightly larger. Necks, short and thick; 15 cervical vertebrae. Wings, long and usually pointed but rounded in some lapwings; 11 primaries, p11 minute; 14–19 secondaries. Tails, short to medium-long, square or rounded; 12 feathers. Bill, short, somewhat swollen at tip and narrower centrally; no sensitive nerve-endings at tip and prey located by sight rather than touch. Nostrils, holorhinal, impervious, slit-like. Head, rounded; forehead steep and broad. Legs, fairly short or medium in length; bare part of tibia short; tarsi, reticulated, rarely with some transverse scutes. Usually three, rather short toes, slightly webbed at base in some plovers; no hind toe in most plovers and in some lapwings; hallux, short and vestigial if retained. No crop. Caeca present. Eyes large. Supraorbital salt-glands, often large; size related to salinity of habitat and influences structure of skull and appearance of head. Plane of *foramen magnum* of occiput nearly horizontal.

Plumages generally boldly patterned in brown, olive-grey, black and white; markings often have cryptic disruptive effect. Bill, bicoloured in some species, especially plovers. Stance erect with head held high. Fast runners for good distances but often proceed in short bursts with halts, especially when feeding. Post-breeding moult complete; primaries outwards; pre-breeding moult varies considerably. Young, precocial, nidifugous and always feed themselves; down of pebbly-pattern type (Fjeldså 1977).

See accounts of sub-families (below) for additional details.

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Sub-family **VANELLINAE** lapwings

Mostly medium-sized terrestrial waders, generally larger than Charadriinae. Widespread in Old World and South America; centre of diversity in Africa. Three breeding species in HANZAB region; one accidental. Classifications have used carpal spurs, facial wattles, orbital skin, presence or absence of hind toe, and tarsal scutellation to divide the group into many genera. Peters recognized 24 species in 19 genera, 14 being monotypic; at the other extreme, Bock (1958) placed all in single genus *Vanellus*. Neither arrangement is satisfactory but until further studies are done, *miles* and *tricolor* should be treated as *Vanellus*. Red-kneed Dotterel *Erythrogonys cinctus* differs considerably from plovers (Charadriinae) and is placed in Vanellinae on basis of allozymes, patterning of wings, and retention of hind toe (Christian *et al.* 1992).

Plumage varies greatly but in many species tends to be dull brown above and with black, white or grey markings on head and breast; all have black primaries, often with broad diagonal white stripe across wing; all except *Chettusia leucurus* have black band on white tail. In flight, patterns of plumage striking. Most species characterized by horny lump or spur at carpal joint; also by red, yellow, greenish, pink or white facial wattles or orbital skin; a few species crested. Wings, broad and rather rounded at tip; flight more buoyant than that of plovers. Gait on land much the same as in Charadriinae. Adult post-breeding moult, complete; primaries outward. Pre-breeding moult restricted or absent. Young hatch in down of pebbled pattern. Juveniles duller than adult. Adult plumage attained in first year. Those few species studied first breed at 1–2 years old.

Breed in open habitats such as marshes, grassy steppes, agricultural lands and the like; after breeding most move away and congregate on estuaries and more coastal areas. May be migratory or partially so but many seem to have only local movements. Food usually and mostly invertebrates, caught by run-stop-grab method; when feeding, birds tend to be scattered rather than in flocks, unlike scolopacids.

Often breed in solitary pairs or at best in loose groups; outside breeding season, gregarious or with a tendency to form flocks. Territorial when breeding; may also hold winter territories. Pair-bond, monogamous. Aggressive displays in defence of territories. Courtship displays on ground or in air, with special song-flights. Voice rather hoarse and grating, far-carrying and conspicuous; song associated with swooping flights, though rasping, has melodious quality. Strongly aggressive towards predators and intruders when breeding; adjacent pairs apparently co-operate in such defence.

Breed seasonally. Nests on open ground; simple scrapes, sparsely lined with material available near nest. Eggs, oval to pyriform; smooth, not glossy; buff, yellowish or green ground-colour, heavily marked and blotched dark. Clutch-size, usually 3–4; replacements after loss. Incubation by both sexes. In hot weather adults may dampen eggs with water brought in belly-feathers. Incubation period, 24–26 days. Young hatched in down, precocial, nidifugous, self-feeding as soon as leaving the nest. Fledging period, 35–50 days.

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Erythrogonys cinctus Red-kneed Dotterel

COLOUR PLATE FACING PAGE 872

Erythrogonys cinctus Gould, 1838, *Syn. Birds Aust.* 4: Pl. 73 and text — New South Wales.

Erythrogonys combines the Greek ἐρυθρός (red) and γόνυ (knee); *cinctus* is Latin for 'girdled' or 'wreathed', referring to the broad black breast-band.

OTHER ENGLISH NAME Sandpiper (in error).

MONOTYPIC

FIELD IDENTIFICATION Length 17–19.5 cm; wingspan 33–38 cm; weight 40–55 g. Medium-sized plump-bodied plover; larger than Black-fronted *Elseyornis melanops* or Red-capped *C. ruficapillus* Plovers. Large head, with high forehead and rather flat cap; short tail; legs appear to be placed well back on the body in normal stance and all of toes trail behind tail in flight; bill moderately long and fine, slightly downcurved. Sexes similar. No seasonal variation. Juveniles and immatures separable.

Description Adult Black cap extends from base of upper mandible, under eye, to lower hindneck; chin and throat, white; black extends from hindneck, down sides of neck and joins broad black breast-band. Black of hindneck merges with dark-brown mantle, upper back, scapulars and folded wings; some dark streaking on anterior scapulars and tertials. Lower back, rump, upper tail-coverts and tail, mostly white with dark-brown stripe through centre, narrower on rump and broadening on tail. In flight, mostly dark-brown innerwing and black outerwing, with broad white trailing-edge to secondaries, narrowing outwards on inner

primaries. Breast-band extends onto flanks, continuing as black then chestnut stripe, narrowing towards lower flanks; prominent narrow strip of white between breast-band and flank-stripe and edge of folded wing. Belly, rest of flanks and vent, white; under tail-coverts, brownish black and buffy white. Underwing: lining, mostly white with blackish leading-edge and grey greater primary coverts; remiges, black with white trailing-edge to secondaries and inner five primaries. Bill, dull pinkish red with base of upper mandible and tip of bill, blackish. Iris, black. Lower tarsus and feet, dark blue-grey; rest of leg, reddish pink. **Juvenile** Similar to adult, differing by: cap, nape and hindneck, light brown; underparts, mostly white, with scattered dark-brown feathers on upper breast and rufous-brown feathers on sides of lower breast and indistinct and mottled appearance through centre; flank-stripe brown and mottled; scapulars and coverts fringed whitish-buff. Bill, duller red than adult. **Immature** Similar to adult but some juvenile feathers retained on crown; breast-band may not be fully developed and has less distinct edges.

Similar species None. **Black-fronted Plover** has black line through eye; narrow black breast-band in adults; upperparts, pale brown, with deep purplish-chestnut scapular-patch and paler central wing-bar; and uniform orange or pinkish legs.

Seen singly, in pairs or family groups; sometimes in small to large but loose flocks, with birds often well spaced. Forage with other wading birds, but rarely close to them except when roosting or disturbed. Mostly on freshwater wetlands, and rarely in brackish or saline wetlands. Dispersive breeding when conditions suitable, sometimes in loose colonies. Usually seen standing motionless in swamps, sometimes bobbing head before rushing forward in one swift movement. Quite aquatic, unusually so; swim readily, occasionally feeding while swimming. Glean and probe on edge of ponds, on wet mud or water; will submerge head. Flight swift with shallow jerky fluttering wing-beats, twisting and turning rapidly; often call in flight. Contact and alarm calls mainly a double sharp wit, usually fairly quiet; also melodious trill in display or threat.

HABITAT Margins of terrestrial wetlands. Prefer temporary or permanent freshwater wetlands, particularly those inundated by rain or floodwaters (Bright & Taysom 1932; McGill 1944; Hobbs 1961; Maclean 1977; Storr 1977; Badman 1979; Morris *et al.* 1981; Fjeldså 1985; Schulz 1986; Storr & Johnstone 1988; Jaensch 1989; Vic. Bird Rep. 1987; NSW Bird Rep. 1985); swamps, lakes, waterholes, dams, reservoirs, claypans, billabongs, creeks, bore drains, inundated dongas and sewage ponds. Wetlands usually with exposed margins and bottom of soft fine mud or clay, or, less often, sand; water usually shallow and turbid (Littlejohns 1931; McGill 1944; Schodde 1976; Maclean 1977; Fjeldså 1985); avoid pebbly shores and stretches of bare mud or dry ground (Littlejohns 1931; Hobbs 1961). Often found in open areas among scattered fringing or emergent vegetation (Maclean 1977; Bamford 1988) such as: short (<12 cm) grass tussocks, reeds and rushes, dense clumps of bushes, e.g. canegrass, bluebush, lignum, saltmarsh, nitrebush (Bright & Taysom 1932; McGill 1944; Boehm 1960; Hobbs 1961; McEvey 1965; Smith 1966; Maclean 1977; Badman & May 1983; Fjeldså 1985; Morris *et al.* 1990). Generally avoid tree-lined wetlands (Hobbs 1961), but some records from rivers lined with *Eucalyptus* woodland (Gibson 1986), tea-tree swamps (Storr 1985a) and timbered settling ponds (McGill 1944). Sometimes among washed-up debris (Smith 1966). Rarely at brackish or saline wetlands; seen on saline swamps, waterholes, saltlakes, flooded saltpans, saltmarsh and coastal dune-lakes (Storr 1977, 1985a,b, 1987; Gibson 1986; Close & McCrie 1986; Schulz 1986; Storr & Johnstone 1988; Morris *et al.* 1990; Vic. Bird Rep. 1985), as lack supra-orbital salt-gland possessed by most shorebirds (Maclean 1977). Recorded on beaches and inshore reefs at Eyre, WA (Storr 1987); once recorded in estuary in NZ (Robertson & Dennison 1977).

Forage along muddy margins on shore (McGill 1944; Maclean 1977) or wading in shallow water (1–1.5 cm); occasionally swim in deeper water; observed in water at least 30 cm deep (Littlejohns 1931; McGill 1944; Boehm 1950; Maclean 1977; Schulz 1986; Johnson 1990). Do not feed on dry land (Maclean 1977).

Nest at freshwater wetlands, on shores or small islets, often where dense or dead shrubs (e.g. canegrass, lignum, bluebush, water-grass) conceal nests (Bright & Taysom 1932; McGill 1944; Hobbs 1961; Maclean 1977).

Often use artificial freshwater wetlands and watering points, including dams, reservoirs (Serventy & Whittell 1976; Maclean 1977; Jaensch 1990; Thompson & Goodfellow in prep.), sewage farms (McGill 1944; Smith 1966; Storr 1977; Vic. Bird Reps 1982–87; Vic. Atlas), overflows and drains from bores and windmills (Badman 1979, 1989; Badman & May 1983; Storr 1985a,b), man-made ponds (van Tets 1969), and reedy swamps round mine heaps (McEvey 1965); occasionally in flooded pastures and buffalo wallows (Storr 1977; Vic Atlas). Recorded on concrete causeway in river (Johnson 1990).

DISTRIBUTION AND POPULATION Throughout mainland Aust.; vagrant to Tas. Also s. New Guinea, between se. Irian Jaya and Port Moresby (Stronoch 1981; Finch 1982; Coates 1985); single record NZ.

Aust. Widespread throughout mainland. Few records between Arnhem Land, Gulf Country and C. York Pen.; generally low numbers E of Great Dividing Ra.; very few records from w. SA and e. WA in band extending from w. Eyre Pen. through Nullarbor Plain to Eucla Division, and N through Western Deserts to Kimberley Division, including Eighty Mile Beach (Start & Fuller 1983; Close & Jaensch 1984; Storr 1985b, 1986, 1987; Black & Badman 1986, Lane 1987; Klau 1988; Aust. Atlas). Scarce between Albany and Bunbury. Widespread elsewhere. **Tas.** Single, Ralph's Bay, near Hobart, 14 Jan. 1967 (Thomas 1969); single, King I., Feb. 1977 (Green 1989); 2–4, Shoal Bay, Maria I., 2–4 May 1977 (Green 1989); single, Tunbridge region, 19 Apr.–8 May 1978 (Aust. Atlas).

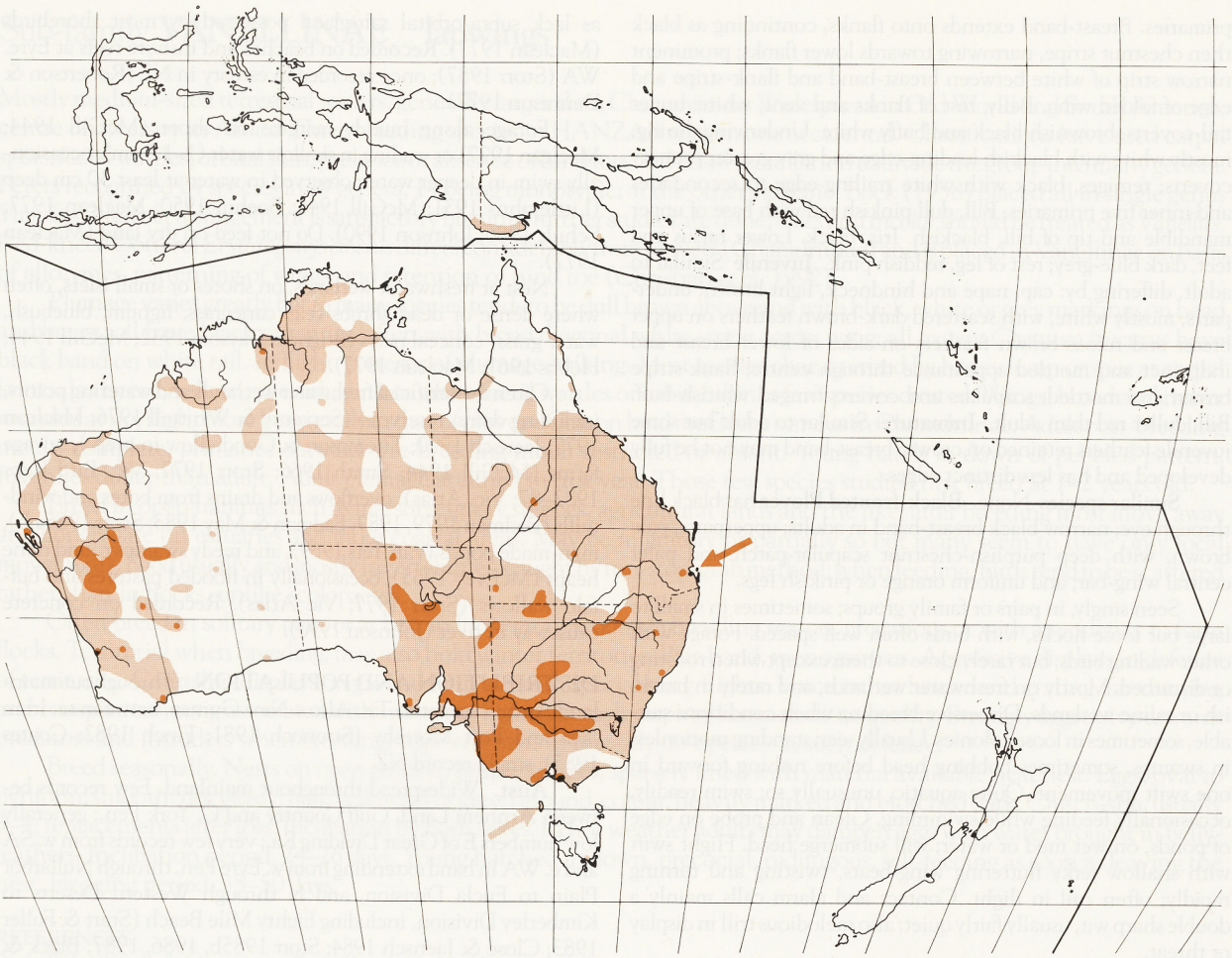
NZ Single, Manawatu Estuary, 14 Mar. 1976 (Robertson & Dennison 1977).

Breeding In e. Aust., widespread S of *c.* 25°S, in Murray–Darling and L. Eyre drainage basins; scattered records from s. Vic., W through s. SA to s. Eyre Pen. In WA, most records from Gascoyne Region; few in SW; isolated record from Ord R. (Aust. NRS; Aust. Atlas).

Once considered rare in s. Vic. before 1950s (Bryant 1933; Miller 1941; Wheeler 1955); now seasonal resident (Wheeler 1955). Colonized Sydney region since 1943 (McGill 1944; Hindwood & Hoskin 1954; Hoskin *et al.* 1991).

True influxes difficult to determine, as birds regularly move into se., s. and sw. Aust. during summer (Lane 1987; Storr & Johnstone 1988; Alcorn 1990). S. and coastal Aust. used as drought refuge (Lane 1987; Woodall 1988); numbers increase inland during good seasons (Stone 1912; McGilp 1923; Boehm 1960; Lowe 1963; Whitmore *et al.* 1983; Close & McCrie 1986; Lane 1987).

Populations Aust. population *c.* 26,000 (D. Watkins). Sites of significance and average numbers from summer and winter counts round Aust., 1981–85, were: Kimberley region, WA, 750; Lower Darling region, NSW, 240; Port Phillip Bay, Vic., 160;



Horsham area lakes, Vic., 120; far sw. lakes, Qld, 100 (Lane 1987). Recorded on 47 of 197 wetlands surveyed in sw. WA between 1981 and 1985; major congregations included 150 on Nonalling L. NR, Nov. 1984; 80 on Mealup L., Feb. 1986; 40 on Capamaura L. NR, Nov. 1981 (Jaensch *et al.* 1988).

Nests and eggs sometimes trampled by cattle; eggs and young preyed upon by introduced predators; human disturbance has disrupted breeding (Lane 1987; Aust. NRS).

MOVEMENTS Probably in response to availability of fresh water; move to coastal areas when inland areas dry; move to inland areas after wet season or flooding replenishes wetlands. Influxes seem to coincide with those of Black-tailed Native-hen *Gallinula ventralis*.

In Brisbane area, s. Qld, numbers peaked in years of low inland rainfall; virtually absent during periods of high inland rainfall (Woodall 1988). In w. and sw. NSW, arrive to breed in Sept. and depart late Feb. unless heavy rains cause flooding, when may stay longer (Hobbs 1961; North); however, round Sydney, only common during severe inland droughts, when has remained by coast to breed, e.g. 1967–68, 1985 (Hindwood 1969; Morris *et al.* 1990). In Vic., most often recorded spring and summer (Vic. Atlas) and may move toward coast to breed, as coastal wetlands fill more regularly than those inland (Lane 1987); low reporting rates in s. Vic in autumn–winter may be because birds congregate or move inland (Vic. Bird Rep. 1986); in n. Vic., influxes of more than 1000 may occur in summer (Vic. Bird Rep. 1983). In n. SA, large post-breeding flocks and breeding concentrations occur in flooded sites and may occur at any time depending on rains (Badman & May 1983) but concentrate on SA coast mainly in summer (Close & McCrie 1986). In central n. WA in Aug., may regularly gather in concentrations of up to c. 500 (e.g. L. Gregory; Jaensch & Vervest 1990), but in central WA appear and breed only in wet years (Ford & Stone 1957). In coastal NT, appear late in dry season, Aug.–Nov., as inland wetlands dry (Storr 1977; Morton *et al.* 1989).

Numbers in Vic. and e. and s. NSW increased during 1982–83 drought, virtually deserting region when drought broke; by summer 1984, floods receded and large numbers reappeared in Vic. and s. NSW (Lane 1987). During post-breeding dispersal, seen in areas where rare (e.g. Darwin; Lane 1987) or in unusual numbers (e.g. 3000 on Parry Floodplain, Kimberley; Jaensch 1989). Vagrants recorded Tas., NZ and New Guinea (see Distribution).

FOOD Seeds, molluscs, annelids, spiders and insects. **Behaviour** Diurnal. Glean and probe surface and subsurface of wet mud and, less often, sand, or wade up to belly in shallow water (1–1.5 cm); swim, placing head under water to take prey; do not feed on dry ground and avoid pebbly substrates (Littlejohns 1931; McGill 1944; Boehm 1950; Maclean 1977; Schulz 1986; Johnson 1990). Tremble feet in soft substrates to disturb prey (Schulz 1986). One record of bird flying onto floodwaters to take cricket; landed in water, then flew back to land to eat prey (Johnson 1990). In NZ,

vagrant observed feeding at tidal edge of estuary, occasionally entering water (Robertson & Dennison 1977). Lack supra-orbital salt-gland (Maclean 1977).

Adult At **L. Cowal, NSW** (11 stomachs, Vestjens 1977): Molluscs: gastropods: freshwater snails 18% freq. Insects: Ephemeroptera: nymphs 9; Hemiptera: Corixidae waterboatmen 9; Coleoptera 45: water-beetle ads 100, larv. 27; Carabidae 27; Curculionidae 9; Diptera: larv. 9; Hymenoptera: Formicidae: ants 36. Grit 27.

Other records **Plants** Ferns: *Marsilea* spores; *Lotus angustissimus* sds; *Medicago polymorpha* sds; *Trifolium dubium* sds. **Animals** Annelids (Cooper 1947). Molluscs: bivalves (Barker & Vestjens). Crustaceans (Cooper 1947). Arachnids: small spider (Lea & Gray). Insects (Mathews 1909; McKeown 1934; Hall 1974; Gould): aquatic insects (Cooper 1947; North); Odonata: nymphs; Dermaptera: Labiduridae: *Labidura riparia*; Hemiptera (Barker & Vestjens); Orthoptera: Gryllidae: cricket (Johnson 1990); Coleoptera (McKeown 1934): tiny beetles (Maclean 1977); water-beetle (Barnard 1914; Maclean 1977); Dytiscidae: ads, larv. (Barker & Vestjens); Hydrophilidae: *Bidessus* (McKeown 1934); Tenebrionidae: *Scymena*; *Caediomorpha heteromera* (Lea & Gray); Curculionidae (Lea & Gray; Barker & Vestjens); *Aphela helopoides* (Lea & Gray); Diptera: larv. (Barker & Vestjens); Chironomidae: larv. (Maclean 1977; Schulz 1986); Lepidoptera (Barker & Vestjens); Hymenoptera: Formicidae: ants (Barker & Vestjens). Grit (Mathews 1909); fragments and grit (Lea & Gray); sand (McKeown 1934); stones and small feathers (Maclean 1977).

Young, Intake No data.

SOCIAL ORGANIZATION Not well known. Gregarious (McGilp 1923; Maclean 1977; North), but often seen singly or in pairs (e.g. Berney 1903; Morris 1975; Badman 1979; Storr 1980, 1985a,b), or pairs with young (Maclean 1977; Stranger 1991). Flocks loose (Maclean 1977); often small, up to 20 (e.g. Wheeler 1955; Storr 1980, 1985a,b, 1987, 1988) to medium, 40–90 (e.g. Morris 1975; Maclean 1977; Storr 1985a,b, 1988; Badman 1989); occasional records of much larger gatherings, e.g. loose flock of more than 150 in n. SA (Badman & May 1983), flock of 1000 (Aust. NRS), gathering of more than 1000, including many breeding pairs, on floodplain of L. Tutchewop, nw. Vic. (Vic. Bird Rep. 1983), flock of 3000, Ord R., Kimberley (Lane 1987). In dry inland areas, in small numbers of <20 at waterholes; larger numbers at swamps (Boekel 1980; Badman & May 1983; Badman 1989). Flocking observed, spring–summer (e.g. Bright & Taysom 1932; Maclean 1977; Humphreys 1986) and autumn–winter (e.g. Wheeler 1955; Smith 1966; Vic. Bird Reps 1986–88); birds seen gathered before breeding (Alexander 1916); also during breeding when flocks and loose colonies occur (also see Breeding dispersion; Badman & May 1983; North; Aust. NRS). Seen feeding alongside Black-fronted Plovers, Red-capped Plovers, Black-winged Stilts *Himantopus himantopus*, Common Sandpipers *Tringa hypoleucos*, Sharp-tailed Sandpipers *Calidris acuminata*, Red-necked Stints *C. ruficollis*, and Curlew Sandpipers *C. ferruginea* (Alexander 1916; McGill 1944; Smith 1966; Maclean 1977; Johnson 1990).

Bonds No information. **Parental care** Both sexes incubate; probably shared equally; both sexes defend territory and young (Maclean 1977). No information on period of dependence but record of flock of four adults with one juvenile, almost ready to fly (Maclean 1977), and one pair with three immatures (Carter 1904).

Breeding dispersion Breed as territorial pairs; solitarily (e.g. Carter 1904; Boehm 1964; Aust. NRS), or in loose colonies (Bright & Taysom 1932; Maclean 1977) of up to 14 nests (Aust. NRS) or in companies of as many as 40 (Bright & Taysom 1932); sometimes in association with colonies of Black-winged Stilts, Hoary-headed Grebes *Poliocephalus poliocephalus*, Whiskered Terns *Chlidonias hybrida*, Red-capped Plovers, and Red-necked Avocet *Recurvirostra novaehollandiae* (Bright & Taysom 1932; Bright 1935; Aust. NRS). **Territories** Quite small; flocks may feed within a few metres of nests (Maclean 1977).

Roosting Recorded resting under shade of bushes (North); floating and resting with Grey Teal *Anas gracilis* (Wheeler 1955).

SOCIAL BEHAVIOUR Not well known though some observations by Maclean (1977) in inland NSW. Tame (Alexander 1916). Scratch head indirectly; immature seen bathing in belly-deep water (Maclean 1977). Contact and Flight Calls recorded (Maclean 1977). Hall (1902) noted often bowed or ducked heads in slow motion when standing on bank.

Agonistic behaviour **Threat** Much aggression sometimes seen in feeding flocks; birds charge each other with head lowered and tail raised, while giving trilling call (Alexander 1916; Johnson 1990). In one flock, attacked birds ran quickly away but occasionally stood ground with head low and short fight ensued; sometimes individuals appeared very excited, rushing in all directions, flying round swiftly over surface of water, then landing and splashing wings, but function of behaviour unknown (Alexander 1916). Within territory, both sexes threaten conspecifics with UPRIGHT POSTURE: feathers of crown flattened, feathers of nape raised, and feathers of flanks slightly fluffed out (Fig. 1). **Fighting** Adversaries

Figure 1 Upright Posture

attack in turns; attacked bird gets pushed right under water by attacker (Maclean 1977); spar like game-cocks (Alexander 1916); one breeding female seen fighting with adult and immature birds (Maclean 1977). Recorded being aggressive towards Spotted Crakes *Porzana fluminea*, Sharp-tailed Sandpipers (Smith 1966), and Common Sandpipers (Johnson 1990). **Alarm** Lowest intensity, bobbing head; higher intensity, body bobs also. Also have Alarm Call (Maclean 1977). One bird, alarmed and attacked by Australian Hobby *Falco longipennis*, dived repeatedly and swam until reached shelter (MacGillivray 1929); can swim (e.g. Hall 1902; Boehm 1950, 1960).

Sexual behaviour **Courtship, Copulation** About 10 days after Alexander (1916) recorded excited threat and flying displays within flock (described above), flock had apparently separated into pairs, each having own area of mudflat; no fights, but flying display ending in splashing observed; 2 weeks later still in pairs but no nests found. Maclean (1977) saw several sexual encounters in shallow water; one female left nest to meet male 5 m away; male adopted COURTSHIP POSTURE (Fig. 2): with body tilted forward and plumage fluffed dorsally, and uttered trilling call; he then came to nest while female fed; c. 30 min later, male gave trilling call from nest; he stood up as female approached, then adopted Courtship Posture, still uttering trilling call, and chased female to water; she adopted horizontal SOLICITING POSTURE (Fig. 3), with partly spread wings, then male mounted and copulated.

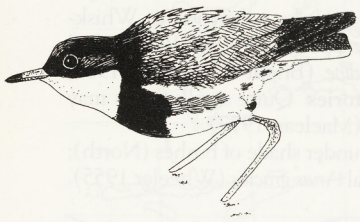


Figure 2 Courtship Posture

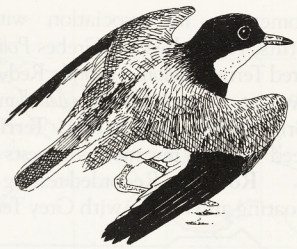


Figure 3 Soliciting Posture

Relations within family group Young swim readily and well (Stranger 1991). **Anti-predator responses of young** At alarm call of parents even very young chicks immediately swim or wade to nearby plant in water; rarely crouch on dry land (Maclean 1977; Stranger 1991). **Parental anti-predator strategies** When on eggs, sitting bird Bobs when alerted; seen leaving nest when Australian Ravens *Corvus coronoides* flew over (Maclean 1977); male recorded driving female back to eggs (Littlejohns 1923). When with young, may give alarm call (Maclean 1977); when one chick waded into shallow water, adult followed and stood over it, providing shelter (Stranger 1991). Well developed Distraction Displays given near eggs or young (Littlejohns 1923; Maclean 1977); include rodent-run, false brooding, flutter-jump (with noisy wing-beats), and injury-feigning, facing away from or toward intruder (Maclean 1977), e.g. broken-wing display (Stranger 1991); all these may be performed in rapid succession and in any sequence. Injury-feigning accompanied by wing-and-tail flash (Fig. 4) when white tail-feathers and trailing-edge of wings are briefly and repeatedly exposed; tail not fanned but tilted forward with body when facing intruder and depressed when facing away; variations of display: one bird stood near bush in water and beat wings in exaggerated manner; another swam while holding wings and tail partly spread on surface of water (Maclean 1977).

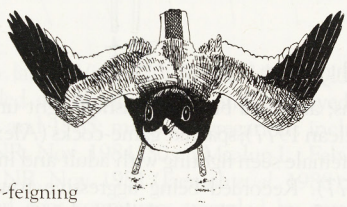
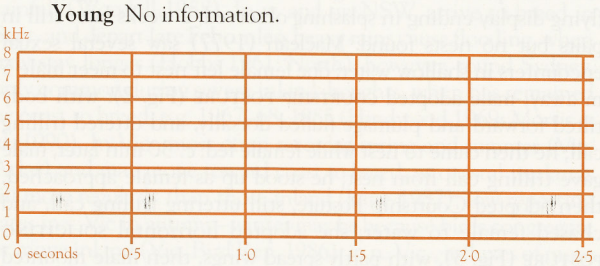


Figure 4 Injury-feigning

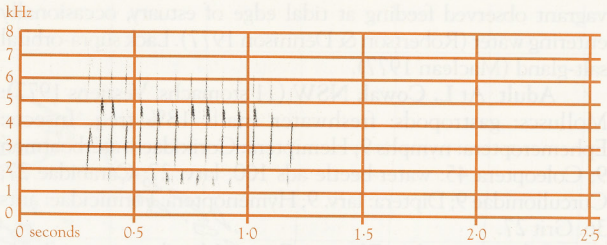
VOICE Not well known. All information from Maclean (1977). Calls rapid disyllabic or staccato notes and melodious trills. Uttered by both sexes.

Adult ALARM CALL: rapid mellow *wit-wit* (sonagram A), always disyllabic. CONTACT CALL: rather like Alarm Call; disyllabic. FLIGHT CALL: rapid staccato notes (sonagram B), usually at take-off. THREAT CALL: trilling *prrr-prip-prip*; melodious (Maclean 1977) or sharp (Johnson 1990); given when charging another bird in threat, and also by male in Courtship Posture (see Social Behaviour).

Young No information.



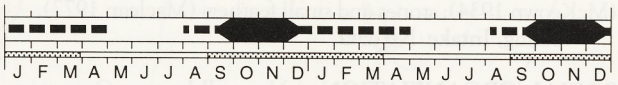
A R. Swaby; Coward Springs, SA, Oct. 1978; P104



B R. Buckingham; Pt Wilson, Vic., June 1982; P36

BREEDING Not well known, no major studies; 87 records in Aust. NRS up to Oct. 1992. Breed in simple pairs, often many pairs in same locality, sometimes in colonies of up to 30 pairs.

Season Usually breed Aug. to Dec. or Jan.; will nest in summer, autumn or early winter after heavy rain (North; Aust. NRS). Qld: eggs in Apr. after heavy rain (North); NSW: laying, Aug.–Dec., peak in Oct. (Maclean 1977); eggs also recorded, Jan. to mid-Mar. (Aust. NRS); Vic.: eggs, early Oct. to early Jan. (Aust. NRS); SA: laying, late Sept. to late Jan. (Attiwill 1972); WA: eggs, Aug.–Dec.; peak laying, Oct.–Nov.; timing of laying highly correlated with peak rainfall +3 months (Halse & Jaensch 1989; Aust. NRS).



Site On sand, damp soil or mud, on mounds, sandbar or islets near margin of swamps, in flooded saltmarsh, swamps, bore streams, lakes, on peninsula between arms of lagoon, in flooded paddock, sewage treatment pan, belah scrub, on edge of rubble road; in or under dead shrubs, small lignum bush, tuft of samphire, tall canegrass, nitrebush, thistle, among water-grass, centre of clump of grass surrounded by water and under wooden boardwalk; will use nests of Hoary-headed Grebe, occupied or disused (Carter 1904; McGilp 1923; Bright & Taysom 1932; Boehm 1964; Mack 1970; Maclean 1976; Aust. NRS). Often within mixed colonies of Black-winged Stilts, Red-necked Avocets and Hoary-headed Grebes; nests found 70 cm from nest of Red-necked Avocet and 90 cm from Black-winged Stilt (Bright & Taysom 1932; Aust. NRS).

Nest, Materials Depression in ground; scantily lined, or having substantial saucer of fine twigs, grass, stems of rushes, casuarina needles, flood debris, sheep dung (McGilp 1923; Bright & Taysom 1932; Boehm 1964). Will level uneven site by building half-nest of mud in semicircle, *c.* 5 cm high; nests in water may be built up (Aust. NRS).

Eggs Short oval, rather pointed at smaller end to pyriform; close-grained, smooth, dull and lustreless or with very little lustre; ground-colour varies from cream to pale creamy-brown (North), rich yellowish-ochre (Maclean 1976) or stone (Campbell), with thickly distributed network of fine wavy lines with intermingled irregularly shaped freckles, spots and blotches of dark sepia or black or both, evenly dispersed or sometimes with blotches confluent and forming large patches (Maclean 1976; Campbell; North). MEASUREMENTS: 31.6 (1.01; 30.0–33.5; 16) x 22.1 (0.26; 21.8–22.6) (Campbell; North); NSW: 30.9 (1.43; 29.0–34.1; 20) x 22.4 (0.49; 21.2–23.5) (Maclean 1976; Aust. NRS).

Clutch-size Usually four eggs per clutch (North); in NSW: average 3.4: C/2 x 1, C/3 x 1, C/4 x 3 (Maclean 1976); from Aust. NRS: average, 3.7; C/2 x 3, C/3 x 5, C/4 x 25, C/5 x 1.

Laying Probably daily (Aust. NRS). Possible dump-nesting: a nest contained three eggs on 1 Dec., four eggs on 3 and 6 Dec. and five eggs from 9 to 20 Dec., with one egg remaining in nest on 24 Dec. (Aust. NRS). One nest contained egg of Black-winged Stilt (Aust. NRS).

Incubation By both sexes, beginning when clutch complete (Maclean 1976; Aust. NRS). Share incubation equally; in stints of 42–43 min (n=3) (Maclean 1976).

Young Precocial, nidifugous. At hatching: down on upperparts, grey, with golden-brown and black patches; underparts, white (Maclean 1976). **Growth** No information. **Parental care, Role of sexes** Remain near nest for at least 2 days after hatching (Aust. NRS). Young can swim at hatching. At approach of danger, adult gives alarm call, young swim to plant in water rather than crouch (Maclean 1976), hide in shallow water among rushes (Stranger 1991). Adult stood over chick and sheltered it (Stranger 1991).

Fledging to maturity No information. **Success** Loss of eggs high; many probably taken by Australian Ravens (Maclean 1976); eggs trampled by people (Aust. NRS).

PLUMAGES Prepared by A.M.Dunn. Hatch in natal down. Begin pre-juvenile moult at 3–4 weeks. Partial post-juvenile moult to immature plumage begins at *c.* 7 weeks. Adult plumage attained in complete second pre-basic moult; thereafter, complete post-breeding moult each cycle. Sexes similar.

Adult (Second and subsequent basic plumages). **Head and neck** Neat black cap formed by black (89) lores, forehead, feathers below eye, ear-coverts, crown, nape and hindneck; feathers of crown may fade to dark brownish-grey (brownish 83) with wear, contrasting slightly with rest of cap. Chin and throat, white. **Upperparts** Upper mantle, black (89) merging into dark-brown (121) lower mantle, upper back and scapulars. Centre of lower back, rump and upper tail-coverts, black-brown (19) contrasting with white sides to lower back, rump and lateral upper tail-coverts. **Underparts** Black band extends from hindneck to join broad black (89) breast-band across lower breast, enclosing white chin, throat and foreneck; top of black breast-band level with shoulder and sharply demarcated from white foreneck. Lower edge of breast-band less distinct and extending farther towards rear at sides of lower breast (bordering flanks) continuous with narrowing band of rufous-brown (c240) feathers on sides of belly. Sides of flanks, white, visible as prominent narrow white stripe following edge of closed wing and bordering edge of black breast-band and rufous-brown feathers. Centre of lower breast, belly and vent, white; under tail-coverts, rufous-brown (c240) with dark-brown (121) centres and white fringes. **Tail** Central rectrices (t1), dark brown (121); t2, mostly white with dark-brown (121) patch on end of inner web; t3–t6, white. **Upperwing** Inner wing-coverts, dark brown (121) grading to black (849) on outer greater secondary coverts; white fringes on inner greater secondary coverts. Marginal coverts near alula, white. Primary coverts and outer primaries (p7–p10), black (89); p5 and p6, black (89) with broad white tip on inner web only; p1–p4 and secondaries, black (89) with broad white tips forming large bold trailing-edge. Tertials, dark brown (121) with white fringe on outer tertial. **Underwing** Remiges, as upperwing. Most coverts, white, with dark-brown (219) marginal and lesser coverts; outer greater primary coverts, grey (84); inner greater primary coverts, white with grey (89) bases.

Downy young Based on photos (Pringle 1987; unpubl.) and descriptions in Maclean (1977) and Fjeldså (1988). **Head and neck** Forehead and crown, mostly brownish grey (80), with mottled patches of black (89) and rufous (c40); brownish-grey extends well below eye. White band extends from ear-coverts and encircles hindneck; bordered above by narrow black band across nape and below by broad black band. Chin and throat, white. **Upperparts, Wing-pads** Mostly brownish grey (80), mottled with rufous (c40) patches that are bordered black (89), and with black (89) stripes across mantle and along edge of back. **Underparts** White.

Juvenile Differences from adult. **Head and neck** Entire cap, light grey-brown (27). **Upperparts** Lower mantle, upper back and scapulars, dark brown (119A). Lower back and rump, mostly white, with some dark-brown (121) feathers in centre. **Underparts** Mostly white with a few scattered dark-brown (121) feathers on upper breast and one or two rufous-brown (c136) feathers at side of lower breast. **Upperwing** Median secondary coverts, dark brown (121) with pink-buff (121D) tips.

Immature (First basic). Similar to adult but with remnants of juvenile plumage on crown. Breast-band may not be fully developed and has less distinct edges.

BARE PARTS Based on photos (Pringle 1987; unpubl.). **Adult** Base of upper mandible and tip of upper and lower mandibles, black (89); central third of upper mandible and basal two-thirds of lower mandible, dark pink-red (dark 10). Iris, black (89). Tibia, tibio-tarsal joint and upper tarsus, pink (3); lower tarsus and toes, dark blue-grey (78). **Downy young** Bill, black (89) with small white egg-tooth. Iris, black (89). Legs, grey-black (82). **Juvenile** As adult but central third of upper mandible and basal two-thirds of lower mandible, brownish red (94–132B); tibia, tibio-tarsal joint and upper tarsus, brownish red (brown 94). **Immature** As adult.

MOULTS **Adult post-breeding** Second and subsequent pre-basic moult; complete. Primaries moult outward. Adults from Vic. (and possibly throughout range) undergo primary-moult between Sept. and Mar. (Barter 1992). First-year birds possibly moult later than adults; during Mar. in nw. Aust., immatures had median primary moult-score of 25 (n=12) whereas adults had completed moult (Barter 1992). **Pre-juvenile** Young birds have most juvenile plumage by *c.* 4 weeks (Stranger 1991) **Post-juvenile** (First pre-basic). Extent and duration of post-juvenile moult, uncertain. Stranger (1991) observed dark feathers on crown at *c.* 7 weeks. However, immature skins (WAM) in primary-moult with almost complete breast-bands may still have juvenile feathers on crown. All wing-coverts appear to be replaced and breast-band develops quickly. Only feathers on crown remain as recognizable juvenile plumage.

MEASUREMENTS Aust., skins: (1) adults (HLW, MV, WAM); (2) immatures and juveniles (HLW, MV, WAM).

		MALES	FEMALES	
WING	(1)	111.5 (3.07; 105–117; 13)	112.2 (2.48; 109–115; 11)	ns
	(2)	109.2 (2.67; 106–114; 8)	114.5 (1.73; 113–117; 4)	
8TH P	(1)	75.6 (2.22; 73–79; 10)	76.2 (2.93; 73–80; 6)	ns
	(2)	75.2 (2.90; 70–78; 6)	76.7 (1.71; 75–79; 4)	
TAIL	(1)	44.2 (2.81; 41–49; 15)	43.3 (2.15; 39–47; 11)	ns
	(2)	43.4 (2.61; 39–47; 8)	43.5 (1.73; 42–45; 4)	
BILL	(1)	21.2 (0.78; 20.0–22.7; 15)	20.7 (0.61; 19.6–21.8; 12)	ns
	(2)	20.6 (0.79; 19.9–22.2; 7)	20.0, 22.1, 22.4	
TARSUS	(1)	40.5 (2.22; 36.7–43.7; 14)	40.1 (1.68; 37.0–42.4; 11)	ns
	(2)	39.3 (1.50; 37.2–41.3; 7)	39.7 (2.72; 36.1–42.6; 4)	
TOE C	(1)	24.5 (0.67; 23.5–25.3; 8)	23.6, 24.3, 24.4	ns
	(2)	22.4, 23.2, 24.0	23.8, 24.4	

Unsexed, live birds; wing not straightened in NSW samples (Barter 1992): (3) Vic.; (4) NSW; (5) WA; (6) Vic. and NSW combined (no significant difference between them); (7) Vic., NSW, WA combined (no significant difference between them). First-year birds had significantly shorter tarsi and tails than adults (Barter 1992).

		ADULTS	IMMATURES AND JUVENILES
WING	(3)	113.9 (2.66; 108–121; 127)	113.5 (2.62; 111–119; 15)
	(4)	109.5 (3.18; 100–117; 121)	110.0 (2.88; 103–117; 57)
	(5)	113.4 (2.51; 107–119; 64)	110.2 (1.82; 106–114; 13)
TAIL	(8)	46.6 (1.96; 42–52; 120)	45.2 (2.43; 40–51; 56)
BILL	(3)	–	20.3 (0.90; 18.8–21.3; 9)
	(4)	–	20.3 (0.90; 18.8–21.9; 42)
	(5)	21.3 (1.03; 19.3–23.6; 51)	21.1 (0.80; 19.7–22.6; 5)
	(6)	20.9 (0.90; 18.4–22.9; 126)	–
THL	(3)	–	48.4 (1.00; 46.2–50.3; 13)
	(4)	–	48.3 (1.08; 45.5–50.6; 57)
	(5)	–	48.2 (1.08; 47.3–50.3; 6)
	(7)	48.7 (1.18; 45.7–51.8; 259)	–
TARSUS	(4)	41.4 (1.37; 38.9–44.7; 48)	40.5 (1.44; 36.7–43.2; 42)
	(5)	40.9 (2.19; 36.8–45.3; 33)	39.5 (1.85; 38.7–40.9; 5)

WEIGHTS Throughout range, skins: (1) adults (MV, WAM); (2) immatures and juveniles (WAM).

	MALES	FEMALES
(1)	46.8 (4.76; 41–54; 5)	50
(2)	49, 50, 51	42, 54

Unsexed, live birds (Barter 1992): (3) Vic.; (4) NSW; (5) WA. Vic. birds were significantly heavier than NSW birds which, in turn, were significantly heavier than WA birds (Barter 1992).

	ADULTS	IMMATURES AND JUVENILES
(3)	56.3 (4.89; 43–77; 127)	54.7 (5.34; 47–65; 14)
(4)	51.4 (3.85; 42–60; 114)	47.9 (3.37; 41–57; 55)
(5)	48.1 (4.84; 35–63; 88)	49.1 (4.81; 38–55; 14)

STRUCTURE Wing, long and broad. Eleven primaries; p10 longest; p9 0–1 mm shorter, p8 1–3, p7 7–9, p6 14–16, p5 21–22, p4 26–29, p3 31–35, p2 35–40, p1 40–45, p11 minute. Fourteen secondaries including four tertials; tips of longest tertials fall level with longest primary on folded wing. Tail, short and rounded; 12 rectrices; t1 longest, t6 5 mm shorter. Bill, slender with slightly bulbous tip and about same length as head; nasal groove, three-quarters length of bill; nostril, small and slit-like. Tarsus, laterally compressed; scales, scutellate. Outer toe 77–85% of middle, inner 67–72%, hind 11–22%. Toes, unwebbed.

RECOGNITION Downy young readily distinguished from others in HANZAB region by combination of: (1) grey-brown dorsum with coarse black and rufous mottling; (2) presence of small hallux; (3) no buff on forehead; (4) white collar with black border that is broadest below.

GEOGRAPHICAL VARIATION No subspecies.

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Volume 2, Plate 67

Hooded Plover *Thinornis rubricollis* (page 902)
1 Adult; **2** Downy young; **3** Juvenile in fresh plumage with down remaining on head; **4** Juvenile in worn plumage; **5, 6** Adult

Red-kneed Dotterel *Erythrogonys cinctus* (page 928)
7, 8 Adult; **9** Downy young; **10** Juvenile in fresh plumage; **11** Immature in post-juvenile moult; **12, 13** Adult

Black-fronted Plover *Elseyornis melanops* (page 892)
14, 15 Adult; **16** Downy young; **17** Juvenile; **18, 19** Adult