

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	pratinoles, 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, Procellariiformes, 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 charadriids and allies (Chionididae, Burhinidae, Haematopodidae, Recurvirostridae, Ibidiorhynchidae, Charadriidae, Pluvianellidae, Dromadidae, Glareolidae, Stercorariidae, 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 charadriids (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, Stercorariidae, Laridae and Sternidae will be dealt with in Volume 3 of HANZAB.

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Family RECURVIROSTRIDAE stilts, avocets

Moderately large (35–48 cm) black-and-white waders with very slender, elongate bills, necks and legs. Seven species in three genera; almost worldwide in temperate and tropical regions. Four species with strongly upcurved bills referred to as avocets, all in genus *Recurvirostra*. Straight-billed species commonly called stilts; in two genera, *Himantopus* and *Cladorhynchus*. Former almost cosmopolitan and polytypic; has been split into as many as eight allospecies (e.g. Mayr & Short 1970; Sibley & Monroe 1990) but we follow Pierce (1984) and BWP in recognizing just two species, *H. himantopus* and *novaezelandiae*. *Cladorhynchus* endemic to Aust. and unusual in many respects; has been said to be intermediate between *Himantopus* and avocets (BWP). Similarities between *Cladorhynchus* and flamingos have also been stressed (Olson & Feduccia 1980) but are probably convergences related to similar diets, habitats and breeding biology; flamingos appear allied to storks, herons and the like (Sibley & Ahlquist 1990). Analyses of DNA–DNA hybridization (Sibley & Ahlquist 1990) and protein electrophoresis (Christian *et al.* 1990) confirm that *Cladorhynchus* is a recurvirostrid, the family being therefore monophyletic; these studies, downy young (Jehl 1968), osteology (Strauch 1978) and karyology (Christides 1990) agree in linking the Recurvirostridae with the Haematopodidae (probably the closest extant relatives), Burhinidae and Charadriidae. Ibisbill *Ibidorhyncha struthersii* of central Asian mountains has sometimes been combined with Recurvirostridae (e.g. Sibley & Monroe 1990) but reasons have not been adequately published and Ibisbills ought to be treated in monotypic family Ibidorhynchidae until more data available.

Bodies rather slim and graceful. Sexes similar but males larger than females; in three species of avocet, bill shorter and more steeply upcurved in females than males (not known if bill shape is dimorphic in *R. andina*). Head rather small in *Himantopus*; neck rather slender and long in all species; 15 cervical vertebrae. Wings, long and pointed with 11 primaries (p11 minute); 16–20 secondaries; no metacarpal spurs. Tails, short and square; 12 rectrices. Bills, long and very fine; straight and pointed in *Himantopus* with bulky adductor muscles (affecting shape of head) that facilitate rapid movement of jaws and firm grip on food taken from surface of water or below it. Bill of *Recurvirostra* specialized for filtering tiny food items from water or mud; strongly upcurved with complex lamellated structure; flattened at base; protractor and depressor muscles well-developed for frequent opening; tongue, broad and fleshy. *Cladorhynchus* has rather straight bill, superficially similar to *Himantopus* but slightly upcurved and with lamellation, basal flattening and enlarged tongue more similar to that of avocets. Scizorhinal. Supraorbital salt-glands present. No crop; caeca present. Tarsus and tibia, elongate and slender (especially in *Himantopus*); scaling, fine and reticulate. Toes, rather short with basal webbing between front three (strongly developed in avocets and *Cladorhynchus*); hallux, small and vestigial in avocets, absent in stilts.

Plumages, white with much black marking on upperparts and upperwings; *Recurvirostra americana* and *R. novaezelandiae* have reddish head and neck; *Cladorhynchus* has chestnut breast-band; and *Himantopus novaezeandiae* entirely black. Ventral plumage dense in all species. Bills and eyes, dark; legs, slaty-blue in avocets, pink to red in stilts. Two moults per cycle, though breeding and non-breeding plumages only markedly different in *Cladorhynchus* and *Recurvirostra americana*; post-breeding moults complete, primaries outwards. Young hatch in soft woolly down, mostly light grey or buff with simple pebble pattern; pure white and unmarked in *Cladorhynchus*, uniquely so among Charadriiformes. Juveniles paler versions of adults, somewhat scalloped above; immatures often separable. Adult plumage attained during first year. First breed at 2–3 years. Flight, swift and direct, with neck only slightly extended and legs projecting beyond tail. Walk briskly with long strides and neck somewhat hunched; often swim, (especially avocets and *Cladorhynchus*).

Frequent shallow wetlands of varying salinity; *Himantopus* more characteristic of freshwater wetlands, avocets of brackish or saline habitats; *Cladorhynchus* strongly prefers saltlakes. Black Stilt *H. novaezelandiae* and Andean Avocet *R. andina* appear mainly sedentary but most species move to some extent (often quite long distances) in response to drought or rainfall; *R. avosetta* and n. populations of *R. americana* and *H. himantopus* have seasonal migrations. Feed when wading or swimming, on small aquatic animals from the surface of water, submerged mud or floating vegetation.

Usually gregarious, forming flocks in non-breeding period that may number hundreds or even thousands of birds; often in single-species flocks or combined with other species of recurvirostrid. Most breed in dispersed colonies numbering scores of pairs; *Cladorhynchus* in tightly packed colonies with many thousand pairs. Monogamous; pair-bond may be formed annually (e.g. *Himantopus himantopus*) or persist till death of one partner (e.g. *Himantopus novaezelandiae*). Both sexes incubate and attend young; both (except in *Cladorhynchus*) defend nest aggressively with loud yelping calls. Other calls are generally simple repeated staccato notes.

Most breed seasonally; *Cladorhynchus* opportunistically in response to filling of inland saltlakes; other species may vary timing somewhat in response to erratic rainfall. Nests set on grass, sand or mud; either bare hollows sometimes lined with dead vegetation (avocets and *Cladorhynchus*) or more substantial (*Himantopus*). Laying interval, 24–48 h. Eggs, oval to pyriform, smooth with slight or no gloss, pale brownish (white in *Cladorhynchus*) blotched or spotted sepia. Clutch-size, usually three or four. Mostly single-brooded but may re-lay after failures and multiple broods probably characteristic of *Cladorhynchus* when water-levels allow. Incubation period 22–24 days. Young, precocial, nidifugous; active soon after hatching. Chicks swim well and feed themselves; usually remain with parents after fledging.

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Recurvirostra novaehollandiae **Red-necked Avocet**

COLOUR PLATE FACING PAGE 776

Recurvirostra Novae-Hollandiae Vieillot, 1816, *Nouv. Dict. Hist. nat.* 3: 103 — New Holland = Victoria *apud* Mathews = probably Van Diemen's Land *apud* Stresemann ex Condon 1975: 122, but based at least in part on description by Dampier (1697–99) at Shark Bay, Western Australia.

The generic name combines the Latin *recurvus*, bent, curved back, with *rostrum*, bill, for the characteristic upturned bill. Specifically of New Holland, being Australia's only avocet.

OTHER ENGLISH NAMES Yelper, Cobbler, Trumpeter, Avocet.

Avosetta is the local Venetian name for the Pied Avocet *R. avosetta*.

MONOTYPIC

FIELD IDENTIFICATION Length 40–48 cm; wingspan 70–80 cm; weight 310 g. Large wader with striking pied plumage, diagnostic chestnut head and neck, long bluish legs, and long slender upcurved bill. Slightly larger than Banded Stilt

Cladorhynchus leucocephalus, with longer bill and wings. Long narrow wings project clearly beyond tip of tail at rest, and feet and part of tarsi project well beyond tail in flight. Sexes alike (see Sexing). No seasonal variation. Juvenile separable.

Description Adult Head and most of neck, deep chestnut ending in blunt V on foreneck; slightly paler round base of bill, forming narrow white ring when worn; white eye-ring. Rest of upperbody, white, except for pair of parallel blackish stripes on saddle. Tail, white, faintly washed pale grey. Upperwing, white, with black wing-tip and broad black band across central inner wing-coverts, tapering inwards on to tertials. Underbody and underwing, white, with black wing-tip and dark head and neck. Bill, black. Iris, reddish brown. Legs and feet, pale blue-grey.

Juvenile Similar to adult except: head and neck, paler and browner; broad pale ring round base of bill; demarcation between chestnut and white underbody, straight; and black areas of upperparts, paler and browner, scaled buffish-white when fresh.

Immatures Like worn-plumaged adults; differ by: face, duller chestnut; pale ring round base of bill broader and whiter than in adults; and, if seen, remnant buff tips to inner median secondary coverts.

Similar species None; chestnut head and neck, otherwise pied plumage, strongly upcurved bill, and distinctive feeding actions make confusion unlikely. Birds in distance could be confused with **Banded Stilt** (q.v.).

Gregarious at all seasons. Typically encountered in flocks on freshwater, brackish or saline wetlands including salt-fields and claypans. Associate freely with stilts, often feeding in loose flocks with Banded Stilts in saline habitats; will feed while swimming. Roost in single species groups among other waders; regularly roost on water. Voice, loud barking and wheezing whistles.

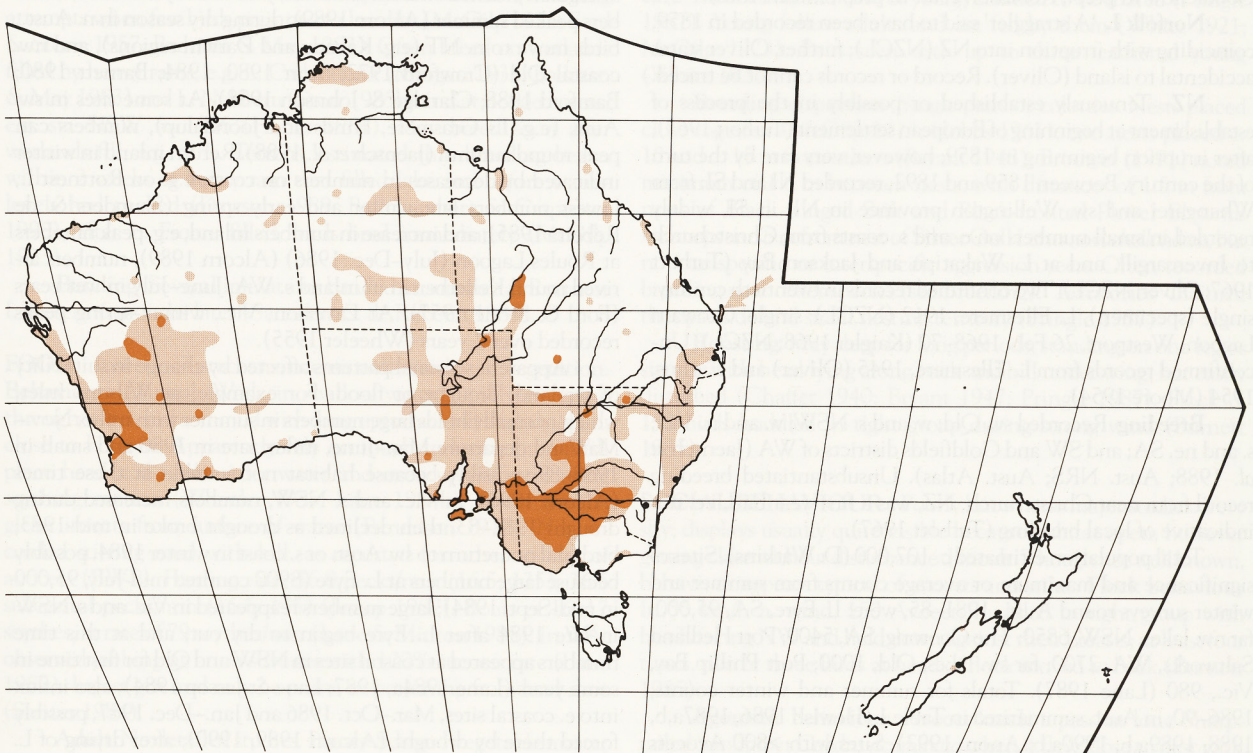
HABITAT Variety of wetland habitats but generally shallow ephemeral inland wetlands. Prefer saline waters, and large num-

bers congregate on flooded saltlakes, especially when salinity has been increased by evaporation; occur on fresh to hypersaline wetlands; at Laverton, Vic., salinity in salt-ponds where Avocets foraged varied from 10 to 146 ppt (Bryant 1947; Hobbs 1961; Smith 1966; Morris 1975; Badman & May 1983; Sonter 1984; Close & McCrie 1986; Gibson 1986; Badman 1989; Dawson 1989; Bellchambers & Carpenter 1990). Also use other wetlands, inland and coastal, often ephemeral, including waterholes, flooded claypans, mud springs, bore drains, dams, lagoons, shallow swamps, and margins of rivers and estuaries (McGilp 1923; Chaffer 1940; Bryant 1947; Hobbs 1961; Smith 1966; Badman & May 1983; Gibson 1986; Badman 1989). From near-coastal habitats, birds may move to nearby intertidal mudflats or shallow tidal water in sheltered or estuarine areas, but generally avoid sea-coast (Morris 1975; Serventy & Whittell 1976). Often occur in artificial wetlands, particularly salt-fields and sewage farms, which provide suitable habitat all year (McGilp 1923; Hobbs 1961; Badman & May 1983).

Mainly breed at inland saltlakes, on low islands or banks beside shallow water; lake may be newly flooded, or with receding floodwaters. Nests may be on bare ground or among low vegetation, including grass or saltbush (Morgan 1931; Bryant 1947; Hobbs 1961; Serventy & Whittell 1976; Dawson 1989).

Typically feed in shallow water, on soft mud, wading up to belly (Bryant 1947; Wheeler 1955; Sonter 1984; Jessop 1987; Bellchambers & Carpenter 1990). In w. plains of Vic., avoid saltlakes in rocky volcanic depressions or in grassy paddocks without mudflats (Bryant 1947). Roost on low bare islands or banks near water, in shallow water, or sometimes among low vegetation (Chaffer 1940; Bryant 1947; Jessop 1987).

Numbers round Melbourne said to have declined earlier this century after drainage and reclamation of wetlands (Bryant 1947). Now offset by additional habitat in saltworks and sewage farms, where birds often occur.



DISTRIBUTION AND POPULATION Endemic to Aust.

Qld Sparse throughout, N to 14°S on w. C. York Pen. Rare in SE (Barry & Vernon 1976; Roberts 1979; Garnett & Bredl 1985; Qld Bird Reps; Aust. Atlas). **NSW** Widespread in all regions W of Great Dividing Ra. In E, occasionally recorded in Tablelands and in coastal regions, including N, Hunter, Central Coast and Illawarra (cf. Morris *et al.* 1981). Regular, sometimes in large numbers, at Kooragang I. (Alcorn 1989; Chafer 1991; NSW Bird Reps; Aust. Atlas). **Vic.** Vagrant to Gippsland, round Bairnsdale and Jack Smith L.; regular in Westernport Bay and occasionally e. Port Phillip Bay, (Vic. Bird Reps 1982, 1983, 1985, 1986–87; Vic. Atlas); widespread in W, from w. Port Phillip Bay, W to w. plains, and N through Wimmera to Mallee and n. regions (Vic. Bird Reps; Vic. Atlas). During nineteenth century, fairly numerous near Melbourne (North), but apparently much less common round Melbourne and Geelong by 1913–14 (Belcher 1914; North); considered a casual visitor to s. Vic. by 1940s (Bryant 1947), now recognized as regular and widespread (Garnett *et al.* 1986). **Tas.** Vagrant. Recorded at George Bay, 1880; Black R., 1887; Flinders I., 1973 (Aust. Atlas). No further details. **SA** Widespread E of line from s. Eyre Pen., NE to Marla Bore (Aust. Atlas). Also round Streaky Bay (Eckert 1971). **WA** Scattered records on Nullarbor Plain; widespread W and S of line from round C. Arid, N to between Wethallie and Gubbata Siding, and W to L. MacLeod, but sparser in Gascoyne district than Goldfields. Sparse records in Pilbara and s. Kimberley Divisions, though regularly in hundreds at Port Hedland and smaller numbers regularly at Roebuck Bay and Roebuck Plains, near Broome (C.D.T. Minton); occasional records in n. Kimberley and w. Deserts (Brooker *et al.* 1979; Storr 1980, 1985a,b, 1986, 1987; Smith & Johnstone 1985; Aust. Atlas). **NT** Widespread but sparse S of 18°S. In Top End, recorded from round Darwin to w. Arnhem Land; from round Katherine; and mouth of Robinson R. (first NT Gulf record, 21 Apr. 1988) (Carruthers 1966; Parker 1969; Crawford 1972; Wilson 1974; Roberts 1981; Thompson & Goodfellow in prep.; Robinson *et al.* in prep.; Aust. Atlas).

Norfolk I. 'A straggler' said to have been recorded in 1859, coinciding with irruption into NZ (NZCL); further, Oliver states accidental to island (Oliver). Record or records cannot be traced.

NZ Tenuously established or possibly in the process of establishment at beginning of European settlement (Turbott 1967), after irruption beginning in 1859; however, very rare by the turn of the century. Between 1859 and 1892, recorded NI and SI: from Whangarei and sw. Wellington province in NI; in SI, widely recorded in small numbers on e. and s. coasts from Christchurch to Invercargill, and at L. Wakatipu and Jackson Bay (Turbott 1967; Oliver; NZCL). Two confirmed records in twentieth century: single (specimen), L. Ellesmere, 1912 (NZCL); single, Orowaiti Lagoon, Westport, 26 Feb. 1968–70 (Kaigler 1968; NZCL). Unconfirmed records from L. Ellesmere, 1945 (Oliver) and Catlins, 1954 (Moore 1954).

Breeding Recorded sw. Qld; w. and s. NSW; w. and n. Vic.; s. and ne. SA; and SW and Goldfields districts of WA (Jaensch *et al.* 1988; Aust. NRS; Aust. Atlas). Unsubstantiated breeding record from near Christchurch, NZ, was a first-year bird, i.e. not indicative of local breeding (Turbott 1967).

Total population estimated c. 107,000 (D. Watkins). Sites of significance and maximum or average counts from summer and winter surveys round Aust., 1981–85, were: L. Eyre, SA, 95,000; far nw. lakes, NSW, 6850; The Coorong, SA, 5400; Port Hedland Saltworks, WA, 2700; far sw. lakes, Qld, 1000; Port Phillip Bay, Vic., 980 (Lane 1987). Totals for summer and winter counts, 1986–90, in Aust. summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b; Anon. 1992). Sites with >800 Avocets

from regular counts between 1981 and 1990 (AWSG, R. & M. Alcorn): Fletcher's L., NSW; Hattah Ls, Vic.; Price Saltfields, SA; Wilson Inlet, WA; L. Forrestdale, WA. Recorded on 60 of 197 nature reserves surveyed between 1981 and 1985 in sw. WA (Jaensch *et al.* 1988). Some shot during duck-shooting season; may ingest lead-shot (Sonter 1984). At the turn of the century, often sold in Melbourne shops (Campbell).

Table 1.

DATE	NUMBER OF BIRDS	NUMBER OF SITES
summer 1986	2789	23
winter 1986	4107	23
summer 1987	3249	22
winter 1987	4089	23
summer 1988	801	23
winter 1988	264	23
summer 1989	1522	22
winter 1989	0	21
summer 1990	438	21

MOVEMENTS Not well known. Dispersive; in response to rainfall and changing water-levels (Vic. Atlas). No apparent seasonal or regular movements (Aust. Atlas), though at some sites, changes in numbers coincide with seasonal changes, apparently moving inland in winter and to coast in summer; pattern may be interrupted by inland drought or rainfall, or availability of food. Present in some areas all year (McGill 1923; Hobbs 1961; Serventy & Whittell 1976; Sonter 1984).

Increase in numbers at coastal sites indicates some movement from inland to coast in summer or dry season: at Gulf St Vincent, SA, 1976–85, maximum numbers Dec.–Mar. (Close & McCrie 1986); on Swan Coastal Plain and Wilsons Inlet, WA, most numerous in summer (Serventy 1938; Serventy & Whittell 1976; Lane 1987; Storr & Johnstone 1988; Alcorn 1989, 1990); at regularly visited sites on sw. coast, Jan. 1986–June 1988, numbers peaked summer (Alcorn 1989); during dry season in n. Aust., birds move to n. NT (e.g. Kakadu and Darwin regions), and nw. coastal Qld (Crawford 1972; Storr 1980, 1984; Barnett 1980; Bamford 1988; Claridge & Johnson 1988). At some sites in sw. Aust. (e.g. Ls Grasmere, Hinds and Joondalup), numbers can peak round autumn (Jaensch *et al.* 1988). Return inland in winter indicated by decreases in numbers on coast, e.g. on Rottneest I., lowest numbers late winter and early spring (Saunders & de Rebeira 1985); and increase in numbers inland, e.g. peak numbers at Roules Lagoon (July–Dec. 1986) (Alcorn 1989), numbers arrived round Kellerberrin inland s. WA, June–July in wet years (Ford & Stone 1957). At Laverton, Vic., winter–spring peaks recorded over 2 years (Wheeler 1955).

Apparent seasonal patterns affected by change in suitability of wetland, drought or flood. For example, at Wilsons Inlet, which normally holds large numbers in summer with influx Nov.–Mar. and departure Mar.–June, influx late in 1986 and small in 1988–89, possibly because habitat not suitable at these times (Alcorn 1990); in Vic. and s. NSW, numbers increased during drought 1982–83, then declined as drought broke in mid-1983; birds did not return to sw. Aust. or s. coast in winter 1984, possibly because large numbers at L. Eyre (8900 counted mid-July, 95,000 in mid-Sept. 1984); large numbers reappeared in Vic. and s. NSW in late 1984 after L. Eyre began to dry out, and at this time numbers appeared at coastal sites in NSW and Qld for first time in some years (Lane 1984a, 1987; Lane & Jessop 1984); also influx into e. coastal sites, Mar.–Oct. 1986 and Jan.–Dec. 1987, possibly forced there by drought (Alcorn 1989, 1990); after drying of L.

Eyre, arrived quickly at Werribee (Nov. 1984), with numbers doubling every 10 days (Lane 1985). Movement from drought may also explain intermittent presence in other areas where usually rare, e.g. E of Great Dividing Ra. (Lane 1985; M. & R. Alcorn), at White L., Rockingham district, WA (Sedgwick 1942), and Mt Isa district (Carruthers 1966). Move to suitable wetlands as surrounding wetlands dry (e.g. Badman & May 1983). Sometimes move to drying wetlands, e.g. numbers increased to c. 5000 at Fletcher's L., nw. Vic., when drying and salinity increasing in Nov.–Dec. 1979 (Sonter 1984); present each autumn at Glen Avon Dam, Northam, WA, when water-levels low (Masters & Milhinch 1974). Usually appear at ephemeral sites in latter half of year after winter and spring rains (Alcorn 1990). Common in some low-rainfall areas in wet years, e.g. s. NT (Storr 1980). Possibly move to areas rich in food, e.g. in 1951, absent from Laverton Saltworks, Vic., until numbers of brine shrimps increased (Wheeler 1955); and has occurred regularly, and has bred, on Rottnest I., WA, only since introduction of suitable food (Storr 1965; Saunders & de Rebeira 1985; Goodsell 1990).

Present all year in Vic. but numbers fluctuate locally (Vic. Atlas), e.g. at Altona, intermittently present 1943–45 (Bryant 1947) and birds began leaving Werribee and soon began appearing at nearby swamp May–Sept. 1964 (Smith 1966). While near sw. coast of Aust., apparently move from coastal estuaries (occurring there Oct.–Nov.) to wetlands of Swan coastal plain (Nov.–Dec. to Feb.–Apr.), then return to coastal estuaries (Feb.–Mar.) before dispersing again to inland with onset of winter rains (M. & R. Alcorn). Occasionally found on islands (e.g. Tas.; Pelsaert I., WA; Fraser I., Qld; NZ), indicating capable of long-distance movements (Moore 1954; Thomas 1968; Yocom 1970; Barry & Vernon 1976; Storr *et al.* 1986; Aust. Atlas). At w. Port Phillip Bay, flocks sometimes move to tidal zones at low tide (Vic. Atlas).

Breeding Opportunistic; on coast and inland (apparently not N of 23°S or E of 148°E) when conditions suitable (Bryant 1948; Boehm 1960; Badman & May 1983; Sonter 1984; Aust. Atlas). Sometimes intervals of many years between breeding attempts when few birds present at a locality (McGilp 1923; Ford & Stone 1957; Badman & May 1983). Often breed on wetlands filled by heavy rains, e.g. L. Callabonna (Morgan 1931; Badman & May 1983) and L. Nabby (Storr 1985b) and at flooded areas, e.g. sw. NSW in 1956 (Hobbs 1961). May breed soon after wetlands fill, e.g. at L. Torrens, estimated that breeding began within 2 weeks of heavy rain that filled lake and before water-levels had peaked (Dawson 1989; Bellchambers & Carpenter 1990); after L. Frome filled, birds bred immediately (McGilp 1923).

Banding Several immatures banded in summer at Rottnest I. present 6 months later (Saunders & de Rebeira 1985).

FOOD Insects, crustaceans, occasionally seeds and vegetation. **Behaviour** Diurnal. Wade in shallow water, rapidly sweeping through water and soft mud with long upturned bill slightly open, close to bottom. Apparently rely on touch to locate prey. Will place head and neck under water and even up-end, still using scything motion (Wheeler 1955; Lane 1984b). Swim readily; glean insects from surface of water (Beruldsen 1972). Not recorded stirring mud with bill, as reported for other species of avocets (BWP). Feeding rate: 36.8 pecks/min (16.5; 135); 36.6 successful pecks/min (16.6; 135) (Jessop 1987). Bouts of 16–17 scythes, at rate of 79 scythes/min (Lane & Minton 1985). In WA, observed jabbing at brine shrimps with 100% success rate (Lane 1987). Ingest grit and may be prone to poisoning from lead-shot (Sonter 1984).

Adult No detailed studies. Plants: Sds and vegetable matter

(Hall 1974). Animals: Annelids (Chaffer 1940). Molluscs (Gould). Crustaceans (North): branchiopods: brine shrimps (Wheeler 1955); Anostraca: Branchiopods: *Parartemia* (Lane 1987). Insects (Beruldsen 1972): larv. (Hall 1974); aquatic insects (Gould; North; Mathews); Coleoptera: Dytiscidae (Barker & Vestjens); Scarabaeidae: Melolonthinae (Barker & Vestjens); Diptera: Chironomidae: *Tanytarsus* (Lane & Minton 1985). Fish: Atheriniformes: Atherinidae: *Craterocephalus* (Lane 1987). Quartz grit (Hall 1974); grit and lead-shot (Sonter 1984).

Young, Intake No data.

SOCIAL ORGANIZATION Poorly known, no major studies. Gregarious. Seen in small parties (e.g. North; Storr 1980, 1984, 1985b; Badman 1989; Saunders & de Rebeira 1985) to groups of hundreds (e.g. Smith 1966; Storr 1984, 1987; Vic. Bird Rep. 1985; Lane 1987), with occasional concentrations of up to several thousand or tens of thousands, e.g. 8000+ at Papitta L., NSW (NSW Bird Rep. 1978); also singly or in twos (e.g. Bryant 1947; Smith 1966; Storr 1980, 1984, 1987; Garnett & Bredl 1985). Flocks may be of juveniles and adults; one flock 40% juveniles (Vic. Bird Rep. 1985). Feed in loose groups (Jessop 1987). Commonly associate with Banded and Black-winged *Himantopus himantopus* Stilts, both when feeding and, less often, when nesting (e.g. Carter 1904; Bryant 1948; Wheeler 1955; Smith 1966; Lane 1987; North); behaviour similar to that of stilts (Chaffer 1940; Elliott 1940), which encourages mixed-species flocking; however, partitioning of sites may occur, and probably little competition with stilts because foraging methods differ; Avocets and Banded Stilts often forage together in loose groups, and Banded Stilts occasionally follow foraging Avocets, but Avocets do not join tight foraging flocks of Banded Stilts (Jessop 1987).

Bonds Probably monogamous; no information. Timing of pair-formation and courtship must complement Avocets' ability to breed in response to temporarily favourable conditions, usually after rain (Lane 1987; Halse & Jaensch 1989; North). **Parental care** Incubation and care of young claimed to be shared (Pringle 1987). Young follow adults and are fed by them (White 1921; McGilp 1923). Pairs seen with up to three feathered young (White 1921).

Breeding dispersion Single pairs or colonies. Nests placed close together (McGilp 1923; Hobbs 1961); two nests placed c. 10 and c. 15 m from others (Bryant 1948); Brouwer (1991) noted minimum of 1.6 m between nests, with distances of 1.5 m from nests of Black-winged Stilt and Black-fronted Plover *Elsyornis melanops* and 8 m from nest of Silver Gull *Larus novaehollandiae*, but no intraspecific or interspecific aggression seen. Often recorded breeding near other species (see Breeding). **Territories** Claimed that pairs defend small nesting territory (Pringle 1987).

Roosting May sleep for long periods, standing on one leg or sitting, with head lying along back and bill under wing, but easily disturbed (Chaffer 1940; Bryant 1947; Pringle 1987). Flock of 150 birds huddled in tight group during strong wind (Burnett 1985).

SOCIAL BEHAVIOUR Poorly known, no major studies. Very shy; displays usually quite visible because habitat open, however getting close without disturbance difficult. Though not well known, behaviour appears typical of avocets and stilts. **Flock behaviour** In 55 km/h n. wind, 150 Avocets huddled in tight group with heads facing NW and held down against their breasts; at least four times, two or three birds at head of flock moved to back (Burnett 1985).

Agonistic behaviour Avocet 'made a pass' at lone Sharp-tailed Sandpiper *Calidris acuminata* when it flew close to nest with

eggs (Bryant 1948). **Alarm** Call whenever disturbed, even with no sign of nesting (Wheeler 1955). When approached by people, may swim to escape (Berney 1907). Possible mobbing by non-breeding flock: three birds from flock flew rapidly towards Whistling Kite *Haliastur sphenurus*, one glancing off its tail (Weston 1992).

Sexual behaviour In Aug. in se. Aust., probable pre-nesting behaviour observed, which lasted for several minutes: one bird, and later a second standing nearby, observed picking up small thin sticks and tossing them back along right side; nesting did not take place (Smith 1966). **Copulation** Pre-copulatory displays include bowing and bill-crossing; female indicates readiness to copulate by crouching low with wings spread, often while standing in shallow water (Pringle 1987). One instance of Avocet mounting a stump, flapping its wings and calling, and appearing to make cloacal contact (Weston & Rush 1992).

Relations within family group Bryant (1948) noted casual nature of brooding, even during cold and wet weather. Young leave nest at hatching; give continuous call while follow adults and fed by them (White 1921; McGilp 1923); some young apparently led to cover and kept there for some days after hatching (Bryant 1947). **Anti-predator responses of young** Take to water readily when predators present; flatten out in water or mud and lie motionless (Chaffer 1940); scurry for cover in rock crevice or grass tussock and freeze (Saunders & de Rebeira 1985); shelter under belly of parent standing in water (Brouwer 1991). **Parental anti-predator strategies** On nest, at any sign of danger, bird stands up, then crouches with body low and head forward and down, and slinks away quickly (Bryant 1947). Some parents make no attempt to protect nest other than flying overhead barking continuously (McGilp 1923; Chaffer 1940); not always so, pair may continually swoop: pair attacked camera placed c. 2 m from nest, striking at it with feet 600–700 times in 2 h, swooping several times per minute and calling incessantly (Bryant 1948). Feeding flock of c. 40 Avocets, that probably had young hidden, called noisily, many flapping and shaking wings and walking around in crouched posture (Bryant 1948); flying at intruders, calling, and injury-feigning, including Broken-wing displays, recorded by others (Chaffer 1940; Bryant 1947; Saunders & de Rebeira 1985); one pair, suspected to have young, kept trying to lead intruders away by running with heads lowered and wings outstretched; when harassed by Silver Gulls one member of another pair flew at Gulls, chasing them away from area while other adult led chicks to centre of lake; parents not always successful in defence (Saunders & de Rebeira 1985).

VOICE Little known; anecdotal information only. Barking Call heard often, during both day and night (North); also wheezing whistle (Condon & McGill 1952). Usually silent when feeding or standing and preening; when disturbed, birds with concealed young noisier than birds with eggs (Bryant 1948). Call whenever disturbed, even when not nesting (Wheeler 1955). Barking Call similar to that of Black-winged Stilt, but less puppy-like (Chaffer

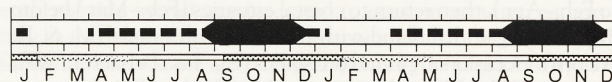
1940); wheezing whistle similar to whistle of Banded Stilt (Condon & McGill 1952).

Adult BARKING CALL: very loud barking; uttered when disturbed and continued in flight (McGilp 1923). **WHISTLE:** wheezing whistle with reedy tremulous quality (sonagram A), similar in sound to squeaky toy trumpet (Jones 1945; Bryant 1947; Condon & McGill 1952; North); uttered loudly when flying at intruders that approach nest or chicks (Saunders & de Rebeira 1985).

Young Calls from eggs can be heard for some days before hatching (Bryant 1948). Feathered young give low but continuous call, similar to calls of Sharp-tailed Sandpiper *Calidris acuminata* (White 1921).

BREEDING Poorly known. No detailed studies; 105 records in Aust. NRS up to Dec. 1992. Breed in simple pairs, individually or in colonies of up to 150 pairs, sometimes with Black-winged Stilts and other species of waterbirds (Carter 1904; Hobbs 1961; Aust. NRS).

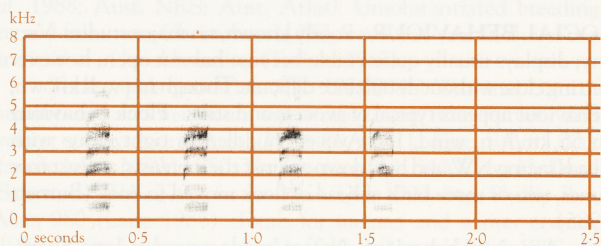
Season Breeding protracted, from mid- or late winter to mid-summer, but also at other times if conditions suitable (North; Aust. NRS). Eggs, Aug.–Jan., peak, Sept.–Nov.; occasional records of eggs and young in Apr., May and July (Bryant 1947; North; Aust. NRS); continuous from May to Jan. during a flood year (Hobbs 1961); July–Dec. in sw. WA, laying correlated with peak rainfall plus 1–2 months (Halse & Jaensch 1989).



Site In swamps, lakes, flooded paddocks, crops, saltworks, flooded gravel pit; on mud islands, islands covered in grass or saltmarsh, mudbanks, sandbars, mounds, ridges, clods of mud, dam banks, on gravel road (Bryant 1947; Hobbs 1961; Aust. NRS). Distance between nests from 1.6 up to 12 m (Brouwer 1991; Aust. NRS). Will nest with Black-winged Stilts, Red-kneed Dotterels *Erythrogonys cinctus*, Red-capped Plovers *Charadrius ruficapillus*, Gull-billed Terns *Gelochelidon nilotica*; Whiskered Terns *Chlidonias hybrida*, Hoary-headed Grebes *Polioccephalus poliocephalus* and Black Swans *Cygnus atratus* (Disher 1962; Aust. NRS; C.D.T. Minton); 1.5 m from nests of Black-winged Stilt and Black-fronted Plover, 5 m from Masked Lapwing *Vanellus miles* and 8 m from Silver Gull (Brouwer 1991; Aust. NRS).

Nest, Materials Depression in ground, scantily lined or with substantial structure made of twigs, samphire, grass, water weed, sheep droppings or gravel (McGilp 1923; Aust. NRS); sometimes built of mud and lined with grass (Aust. RD). At one site, scrapes encircled with gravel and small bits of twigs, giving impression of mounds several centimetres high; mounds larger on sloping ground, with scrape in mound rather than sand; one nest contained 2 kg of gravel (Brouwer 1991; North). **MEASUREMENTS:** scrapes, up to 8–13 cm across; gravel mounds 15–20 cm, sometimes up to 35 cm across (Brouwer 1991; Aust. NRS).

Eggs Oval, sometimes sharply pointed at smaller end; close-grained, dull and lustreless (North); long oval; somewhat coarse-grained, lustreless (Campbell); ground-colour varies from light yellowish-stone to pale creamy-brown (North), or a shade of deep-stone, or stone-colour with an olive tinge (Campbell), evenly distributed with irregular or rounded blackish to dark-brown, umber-brown or sepia freckles, spots and small blotches, with intermingled similar underlying markings of inky grey, occasionally tending to predominate at one end (Campbell; North). **MEASUREMENTS:** 50.1 (0.82; 48.8–52.1; 11) x 36.3 (0.92; 35.6–37.6) (North).



A. R. Swaby; St Kilda, SA, Sept. 1974; P36

Clutch-size Usually four eggs per clutch; average 3.9: C/2 x 1, C/3 x 6, C/4 x 41, C/5 x 1 (Aust. NRS).

Laying Eggs laid at daily intervals; fourth egg of a clutch probably laid 2 days after third (Aust. NRS). No other information.

Incubation May not be able to roll stray eggs back into nest (Bryant 1948). Probably remove egg-shells from nest (Brouwer 1991), though egg-shells also in nest after hatching (Aust. NRS). **INCUBATION PERIOD:** no precise determinations; eggs hatching c. 25 days after first egg laid, and probably at least 23 days from completion of clutch (Aust. NRS). Chicks call from inside egg a few days before hatching; do not all hatch at same time (Aust. NRS).

Young Precocial, nidifugous. Hatch in soft greyish down, mottled dark brown (Chaffer 1940). Leave nest at hatching (McGill 1923). No information on growth, development. **Parental care, Role of sexes** Defend nest by flying above intruder, calling loudly; feign injury to distract intruder from downy young (McGill 1923; Chaffer 1940). Young readily take to water and swim well; when threatened, flatten out in water or mud and remain motionless (Chaffer 1940); will follow adults into water and shelter under their bellies (Brouwer 1991).

Fledging to maturity No information.

Success From 72 eggs, 22 (31%) hatched (Aust. NRS). Nests abandoned when water dries up (Aust. NRS); many eggs broken during hailstorm (Bryant 1947); Silver Gulls take chicks (Saunders & de Rebeira 1985).

PLUMAGES Prepared by D.I. Rogers. Hatch in natal down, replaced by distinctive juvenile plumage; age of fledging, unknown. Partial post-juvenile moult in first summer or autumn does not include primaries or primary coverts; results in first immature plumage which can be difficult to distinguish from adult. Adult plumage attained in second pre-basic moult when 1 year old. No seasonal variation; sexes differ slightly, females having more steeply upcurved bill and less black on primaries.

Adult male Second-basic and subsequent plumages. **Head and neck** Head and upper half of neck, mostly chestnut (dark 240), which extends farther down throat than on hindneck, forming blunt V on central foreneck. Base of neck, white. Bold white eye-ring, formed by very short white feathers on eyelids. When fresh, hindneck feathers narrowly tipped white. All chestnut feathers have white bases, mostly concealed, except at base of bill, where they are partly exposed and cause a pale wash; in very worn plumage, they are more exposed and can form clean white ring round base of bill. Chestnut feathers of face and crown grade through light rufous-brown (c38) to pale grey (86) or white bases; when very worn these areas can be exposed to form light rufous-brown or, rarely, grey tinge over much of face and crown. **Upperparts** Mostly white, with short narrow black (82) band across central back that meets pair of conspicuous black (c82) stripes that run down inner scapulars to meet tertials. Stripes formed by black (c82) inner scapulars, some with white inner edges, and by black (c82) to dark-grey (c83) subscapulars with white edges broadest on tip of outer web. Grey tinge of subscapulars, and veiling effect of white outer scapulars partially overlying black feathers, can make scapular stripes look duller grey in some individuals than in others; hence, use of colour of scapulars as guide to ageing (Rogers 1990) should be used with caution. **Underparts** White. **Tail** Pale grey (c86–c44), grading to white outer feathers. T1, pale grey (c86) when fresh, becoming brownish grey (c44) when worn, with concealed white bases; outer feathers have increasing amounts of white and t6 is white except for varying pale-grey (c86) spot near tip of outer web. **Upperwing**

White, with two large black (c82) markings, which can take on black-brown (119) tinge with wear: (1) broad diagonal wing-bar from tertials to near carpal; formed by black tertials and median and longer lesser secondary coverts, and by black greater secondary coverts, which have white tips occupying distal tenth of inner feathers, distal half of outer feathers; greater secondary coverts can also have narrow white outer edges; (2) large black wing-tip formed by primaries and primary coverts; latter have white bases increasing in size on inner feathers so that inner 2–4 primary coverts wholly white. Outer 5–6 primaries, black with concealed white bases; on inner primaries, extent of white increases considerably, and innermost feathers wholly white except for small dark smudges near tips of outer webs. Innermost primary with any trace of black at tip is usually p1, occasionally p2; innermost primary with large black area (>1 cm in diameter) is usually p3, occasionally p2 or p4. **Underwing** White, except for large black (82) wing-tip, which can look dark grey (83) in bright light. Patterning is similar to that of upperwing except that white greater primary coverts shorter and conceal white bases only of outer three primaries.

Adult female Similar to adult male, but generally less black on wing-tip. Innermost primary with trace of black at tip varies from p1 to p4; innermost with large black spot near tip (>1 cm in diameter) usually p4, occasionally p3 or p5.

Downy young **Head and neck** Chin and throat, white. Ground-colour elsewhere, buff (124) grading to pale greyish-brown (c119D) on face, crown and hindneck. Extent of pale greyish-brown increases as down fades with age, but nape, forehead, eye-ring, base of bill and rear ear-coverts remain contrastingly more buff than surrounding parts. On top of head, strands of down have dark-brown (121) bases; these are exposed as large median crown-spot and as varying inconspicuous scalloping elsewhere. Narrow dark-brown (121) eye-stripe runs from centre of lores, through eye, to auricular area. **Upperparts, Wing-pads** Ground-colour grades from buff (124) on wing-pads and sides of upperparts to pale greyish-brown (c119D) in centre; extent of pale greyish-brown increases as down fades with age. Several conspicuous dark markings: dark-brown (121) median spot at junction of mantle and hindneck, often concealed; pair of large dark-brown (121) spots at base of wing-pads; two dark-brown (121–119) spots on central line of back and rump; dark-brown (121) tail-tuft, which meets dark-brown (121) line running round sides of upperparts to base of wing-pads. **Underparts** White.

Juvenile Usually replaced during first summer or autumn. Differences from adults: **Head and neck** Ground-colour of head, slightly duller rufous-brown than in adults, and feathers have slightly looser texture. Pale ring at base of bill about as broad as eye (much larger than in adults) and pale-grey wash on crown and face consistently stronger and larger. Cut-off between rufous-brown throat and white foreneck, straight and about level with cut-off between rufous-brown and white on hindneck; unlike adult, this cut-off does not encroach on foreneck as blunt V. **Upperparts** Feathers noticeably smaller than in adults, especially scapulars. All dark feathers differ considerably from adults; dark brown (c119A) with pale fringes that grade from buff (c54) at tips to white on basal edges. This induces browner, more mottled appearance than in adults. Black band across central back, slightly broader than in adults. **Underparts** White. **Tail** Similar to adult but sometimes with strands of down adhering. On t6, pale greyish-brown area extends over much of outer web, unlike small neat spots occurring on t6 of adults. **Upperwing** Some marginal coverts have dark-brown (121) smudges at tips. Tertials and median and lesser secondary coverts, dark brown (121) grading to black-brown (119) at distal ends, with buff (54–c124) tips of c. 1 mm;

terials also have some buff mottling round fringes. Greater secondary coverts, similar to adult but with dark-brown (121) ground-colour on outer webs. Primaries and primary coverts, similar to adults but outer feathers narrowly tipped buff (124–223B). Size of dark wing-tip varies; innermost primary with trace of black at tip usually p3 but ranges from p1 to p4. This character cannot be used to sex birds with juvenile primaries; it has been used in ageing Pied Avocet *R. avocetta* (Prater *et al.* 1977) but varies too much to be used as a guide to age in *novaehollandiae*. **Underwing** Similar to adult.

Immature First basic; attained about first autumn and replaced by adult plumage when about 1 year old. Some can be aged because a few juvenile median coverts (usually inner feathers) retained. Juvenile primaries and primary coverts nearly always retained; their buff tips are useful guide to age but can be lost with wear. Immatures in worn plumage that have lost all traces of buff tips of juvenile not easily distinguished from adults in worn plumages. Generally stronger pale-grey tinge on face and crown than in adults, and broader, cleaner white ring round base of bill. These characters difficult to quantify and there is slight overlap with adults with extremely worn plumage; nevertheless subjective impressions of dull face and large ring at base of bill usually correct. Not clear if these differences are seen because difference in first-basic plumage inherent, or because body-moult strategies of adults imperfectly known and they always have fresher plumage on head. In some juveniles and immatures, ring round base of bill at forehead is as broad, or broader than eye; apparently never the case in adults.

BARE PARTS From photos (Pringle 1987; Aust. RD.; unpubl.: J.N. Davies).

Adult Bill, grey-black (82). Iris, black-brown (119) to dark reddish-brown (132) or red (-). Variation in colour of iris not well understood and red irides have not been recorded in females; of adults in cannon-net catches in late Nov. 1981, six males had red irides; seven males and seven females had reddish-brown irides; four males and four females had brown irides; colour of iris showed no obvious relation with timing of primary-moult (data from Vict. Wader Stud. Grp). Feet and legs, light blue (168C) or light blue-grey (c88) to pale bluish-grey (c86). **Downy young** Bill, dark grey (c83). Iris, blackish brown (-); dark grey on one label (MV). Feet and legs, pale bluish-grey (c86). **Juveniles, Immatures** Similar to adults but red irides have not been recorded; dark-brown iris has been observed in juveniles, reddish brown and dark brown in immatures.

MOULTS From skins of 51 adults and 15 juveniles or immatures, supplemented by data from Vic. cannon-net catches of 66 adults and two immatures in Nov. and Jan. (Vict. Wader Stud. Grp) and 14 adults and three immatures shot by duck-hunters in Mar. 1982 (B.A. Lane).

Adult post-breeding Complete. Primaries nearly always moult outwards but two individuals caught while in active-moult in Jan. had slightly irregular sequences; one had skipped moult of p4, the other had skipped moult of p8 and p9. Sequence of secondaries, unknown but outer feathers moult first. Tail, irregular; apparently begins moult with centrifugal wave from about t3, but overlap with centripetal wave from t6 and centrifugal wave from t1 causes complicated and often asymmetrical patterns of moult. Sequence of body-moult, unknown; begins at about the same time as primaries or just before; moult of body and tail completed after primaries. Moult usually starts in mid- to late spring and finishes in late summer; extent of overlap with breeding unknown. Earliest records from Sept. and some have not

started by Nov. Some have finished by late Nov.; latest record of active-moult (primary moult-score 48) from early May. Timing perhaps varies from year to year; 30 caught 28 Nov. 1981 had median primary moult-score of 42.5 (range 28–50), yet 36 caught at same site 7 Jan. 1984 had only increased median primary moult-score to 47 (33–50); such a small increase would probably not have occurred in 6 weeks if timing of moult had been similar in both years. **Adult pre-breeding** Not known if a pre-alternate moult of body-feathers occurs. Head of adults seldom looks as worn as in second-summer immatures, suggesting some feathers of adult may be replaced more than once a year. Observation of female from SA in May that appeared to be mated and in early stages of moult (Hall 1974) also suggests pre-alternate body-moult may occur. However, lack of information on body-moult in late winter and early spring leaves this theory unconfirmed. **Post-juvenile** First pre-basic; partial, not including primaries or primary coverts. Some individuals also retain some juvenile median coverts; tail moulted by at least some individuals. Records of active body-moult available from Oct., Dec. and Feb.; all subadult skins collected during first winter had completed post-juvenile body-moult. An immature collected in Jan. of first summer had replaced six innermost primaries; not known if this was part of first pre-basic or separate moult event. **Immature 'post-breeding'** Not known if breeding can occur in first year. Second pre-basic, complete; occurs about same time as adult post-breeding. Records available from Oct. and Nov.

MEASUREMENTS (1) Throughout Aust., adult, skins (HLW, MV, SAM, WAM). (2) Juvenile and immature combined, skins (HLW, MV, SAM, WAM). (3) Vic., adults, live (Rogers 1990). (4) Vic., immatures, live; may have included some worn-plumaged adults (Rogers 1990). Live birds (3, 4) were separated into two groups, those with steeply upcurved bills and birds with more shallow curves to bills, here treated as female and male respectively (see Sexing) (Rogers 1990).

	MALES	FEMALES	
WING	(1) 233.3 (6.31; 223–242; 17)	232.0 (4.36; 225–239; 12)	ns
	(2) 229.2 (5.19; 224–238; 5)	224.0 (3.00; 219–227; 4)	ns
	(3) 235.4 (6.96; 219–244; 16)	233.9 (6.90; 216–242; 13)	ns
	(4) 231.4 (4.44; 223–236; 7)	231.8 (7.63; 223–243; 5)	ns
STH P	(1) 152.9 (3.77; 147–162; 16)	150.6 (3.93; 144–157; 10)	ns
	(2) 144.1 (2.27; 141–148; 6)	131, 138, 145.	
TAIL	(1) 82.0 (4.26; 76–89; 16)	83.3 (2.75; 79–86; 9)	ns
	(2) 78.7 (2.36; 75–81; 6)	75, 79, 79	
BILL	(1) 92.6 (3.81; 87.6–100.2; 14)	87.8 (3.44; 83.7–93.9; 8)	*
	(3) 93.3 (4.50; 83–102; 25)	89.8 (4.28; 83–98; 18)	*
	(4) 91.4 (3.10; 86–97; 10)	88.6 (3.77; 81–95; 14)	ns
THL	(3) 129.0 (5.80; 117.7–138.9; 33)	126.8 (4.39; 117.5–134.6; 23)	ns
	(4) 126.2 (3.77; 121.3–133.0; 11)	122.6 (4.55; 116.3–130.7; 16)*	
TARSUS	(1) 88.9 (3.30; 80.6–97.3; 18)	86.3 (3.08; 81.3–89.9; 11)	ns
TOE C	(1) 42.9 (1.75; 39.7–45.0; 7)	42.0 (1.39; 40.3–44.3; 6)	ns

(4) Juveniles, fresh skins; (5) immature, skins (HLW, MV, SAM, WAM).

	UNSEXED
BILL	(4) 73.7, 75.5, 78.9
	(5) 86.6 (4.33; 81.7–92.2; 4)
TARSUS	(4) 79.5 (4.77; 72.7–83.8; 4)
	(5) 88.2 (3.99; 82.2–93.4; 5)

Above data indicate that bill and tarsus are not fully grown at fledging. A worn juvenile with bill of 85.3 and tarsus of 85.9 suggests that bill and tarsus approach full size before post-juvenile moult. Wing and p8 are longer in adults than in juveniles and immatures.

WEIGHTS Werribee, Vic., from cannon-net catches in late Nov. and early Jan.; colour of head and scapulars was used to age birds; with new information on wear of plumages, it now appears that some 'immatures' may have been worn adults (i.e. at an earlier stage of pre-basic moult); nevertheless, they appear lighter than adults in which moult was nearing completion (significantly so in females) (Rogers 1990): (1) adults; (2) 'immatures'.

	MALES	FEMALES	
(1)	325.9 (25.07; 270–390; 25)	322.8 (20.79; 270–360; 18)	ns
(2)	308.2 (16.95; 285–380; 10)	300.2 (21.48; 270–345; 13)	ns

STRUCTURE Wing, long and rather broad for a wader; slightly rounded at tip. Eleven primaries; p10 longest, p9 1–6 shorter, p8 8–17, p7 20–28, p6 32–40, p5 47–55, p4 61–70, p3 73–85, p2 85–95, p1 96–108; p11, small and slender, only extending slightly beyond tips of outer greater primary coverts. Eighteen secondaries, about five of which are tertials. Tip of longest tertial lies about level with tip of p7 when wing folded. Tail, rather short and square-tipped; 12 feathers. Bill, long, slender and upcurved; fragile and flexible at tip. Nostrils, slit-like. Tarsus and tibia, long and slender with reticulate scaling; lower half of tibia, unfeathered. Front toes rather short, with straight, sharply pointed and short claws; strongly indented webs between basal two-thirds. Outer toe c. 85% length of middle, inner toe c. 80%. Hindtoe, very short, not reaching ground when birds are standing.

SEXING Rogers (1990) demonstrated clear separation between individuals with steeply upcurved and slightly upcurved bills and suggested this was a sexual difference, as reported in Pied Avocet (BWP) and American Avocet (Hamilton 1975). In live birds the difference is obvious to the naked eye, provided birds of both bill-shapes are present for comparison; see colour plate for illustration. Curvature of bill can be measured from tracings of bills by calculating radius at the point of maximum curvature (see Rogers 1990). Rogers (1990) data for radii of curvature in live adults are presented below (1, 2); he separated data for flat and steep-billed birds, which have been treated here as male and female respectively. Note that to some extent these data exaggerate overlap between steep- and flat-billed birds because error in measurement occurs when tracing outlines of bill and selecting point of maximum curvature. Data from adult skins are also presented below (3); they vary more (probably because post-mortem distortion occurs) but confirm that bill is more steeply upcurved in females. In combination with pattern of primaries, curvature of bill is sufficient to sex most individuals. Fresh juveniles cannot be sexed until bill is fully grown; immatures show sexual dimorphism in bill-shape similar to that of adults.

Table 1 Radius at point of maximum curvature of bill. (1) Adults, live; (2) immatures, live; (3) adult, skins.

	MALES	FEMALES	
LIVE	(1) 76.8 (9.25; 63–99; 18)	59.2 (5.90; 46–70; 19)	**
	(2) 77.9 (4.16; 71–82; 5)	57.4 (6.86; 46–69; 7)	**
SKINS	(3) 73.1 (15.03; 44–104; 21)	52.5 (8.42; 40–71; 13)	**

RECOGNITION For distinguishing downy young, see Black-winged Stilt.

GEOGRAPHICAL VARIATION None.

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Volume 2, Plate 59

Red-necked Avocet *Recurvirostra novaehollandiae* (page 790)

1 Adult male; 2 Adult female; 3 Downy young; 4 Juvenile, in fresh plumage; 5 Adult; 6 Adult

Banded Stilt *Cladorhynchus leucocephalus* (page 780)

7 Adult breeding (alternate); 8 Adult non-breeding (basic); 9 Downy young; 10 Juvenile; 11 Adult breeding (alternate)