

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	seed-snipes; 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.
Jacaniidae	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.
Ibidorhynchidae	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, 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, Jacaniidae) and charadriids and allies (Chionididae, Burhinidae, Haematopodidae, Recurvirostridae, Ibidorhynchidae, 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 Jacaniidae. 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.

REFERENCES

- Christian, P.D., *et al.* 1992. *Aust. J. Zool.* 40: 291–302.
- Fjeldså, J. 1976. *Vidensk. Medd. dansk. Natur. Foren.* 139: 179–243.
- 1977. *Guide to the Young of European Precocial Birds*. Scarv Nature Productions, Tisvildeleje.
- Glenny, F.H. 1955. *Proc. US natn. Mus.* 103 (3346): 525–621.
- Jehl, J.L., Jr. 1968. *Mem. San Diego Soc. nat. Hist.* 3.
- Mayr, E., & D. Amadon. 1951. *Am. Mus. Novit.* 1496.
- Mickevich, M.F., & L.R. Parenti. 1980. *Syst. Zool.* 29: 108–113.
- Olson, S.L., & A. Feduccia. 1981. *Smithson. Contrib. Zool.* 323: 1–24.
- , & D.W. Steadman. 1981. *Smithson. Contrib. Zool.* 337: 1–25.
- Sibley, C.G., & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds of the World*. Yale Univ. Press, New Haven.
- , & B.L. Monroe. 1990. *Distribution and Taxonomy of the Birds of the World*. Yale Univ. Press; New Haven.
- , *et al.* 1988. *Auk* 105: 409–423.
- Strauch, J.G., Jr. 1978. *Trans. zool. Soc. Lond.* 34: 263–345.

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.

REFERENCES

- Christian, P.D., et al. 1990. *Aust. J. Zool.* 40: 291–302.
 Christides, L. 1990. *Animal Cytogenetics—Aves*. Gebrüder Borntraeger, Berlin.
 Jehl, J.R. Jr 1968. *San Diego Mus. nat. Hist. Memoirs* 3.
 Mayr, E., & L.L. Short. 1970. *Publ. Nuttall Orn. Club* 9: 1–127.
 Olson, S.L., & A. Feduccia. 1980. *Smithsonian Contrib. Zool.* 316.
 Pierce, R.J. 1984. *Notornis* 31: 106–30.
 Sibley, C.G., & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds of The World*. Yale Univ. Press, New Haven, Connecticut.
 —, & B.L. Monroe. 1990. *Distribution and Taxonomy of Birds of The World*. Yale University Press, New Haven, Connecticut.
 Strauch, J.G. (Jr.) 1978. *Trans. zool. Soc. Lond.* 34: 263–345.

Himantopus himantopus Black-winged Stilt

COLOUR PLATE FACING PAGE 745

Charadrius himantopus Linnaeus, 1758, *Syst. Nat.*, ed. 10, 1: 152 — Europe.

Himantopus, composed of the Greek for a strap (ἡμάς, -άντος) and a foot (πούς), is taken from Pliny, and, by an awkward metaphor, implies that the legs are as slender and pliant as if cut out of leather, referring to the long legs of the bird (Jobling 1991).

OTHER ENGLISH NAMES Pied Stilt, White-headed, White-necked or Black-throated Stilt, Stilt-bird or Stilt-Plover, Long-legged Plover, Longshanks, Dog-bird.

POLYTYPIC Nominate *himantopus*, s. Eurasia, India, Sri Lanka, se. Asia and Africa; *leucocephalus* Gould, 1837, Philippines and S through Indonesia to Bismarck Is, Aust., and NZ; *mexicanus* P.L. Statius Müller, 1776, North America, S from nw. USA through central America to Galapagos and n. South America; *knudsen* Stejneger, 1887, Hawaiian Is; *melanurus* Vieillot, 1817, central and s. Andes and s. South America.

FIELD IDENTIFICATION Length 33–37 cm; wingspan 61–73 cm; weight 170–195 g. Medium-sized, extremely long-legged pied wader with long, fine bill. Wings, long and narrow, with pointed wing-tips; at rest, tips of primaries extend well past tail; tail, slightly wedge-shaped and short; in flight, legs trail beyond tail. Sexes similar. No seasonal variation. Juveniles and immatures separable. In NZ, hybridize with Black Stilts *Himantopus novaehollandiae*, see account for Black Stilt.

Description Adult male Mostly white, with black hindneck, from nape to base of neck, and black upper back, scapulars, and upperwings; slightly pale-greyish tinge to tip of tail. Underwing, black, with obvious white triangular patch at base of leading-edge. Bill, black. Iris, red. Legs, pink with reddish tinge. **Adult female** Like male but mantle, scapulars and upperwing, generally duller black. **Juvenile** Appearance of head and neck varies: in most, white with dark-grey frontal band, extending over and round eye to ear-coverts; paler grey area behind dark-grey frontal band covering rest of hindcrown; with varying grey stripe down hindneck to mantle; in some, head and neck, all white. When fresh, upperback, scapulars and wings, black-brown, scaled pale-grey to buff, when fresh; mantle and wings appear uniform dark brownish when plumage worn; narrow white trailing-edge. Rump and tail, off-white, with obvious grey to brownish-grey terminal tail-band. Iris, brownish. Bill, greyish black. Legs, flesh-pink. **First immature** Similar to juvenile with worn plumage, except nape, foreneck and hindcrown, darker grey-black, forming partial cap. Iris, brownish-red. Bill, black. Legs, pink. **Second immature** Like adult but sometimes with faint greyish smudging on ear-coverts and white flecking on hindneck; some retain pale-tipped juvenile remiges; some indistinguishable from adults.

Similar species In Aust., could be confused with juvenile and non-breeding **Banded Stilts** (q.v.). Juvenile Black-winged

could be confused with superficially similar **Greenshank** *Tringa nebularia*, which is smaller; with shorter legs; grey-brown head with fine white streaking; paler grey-brown wings and mantle; bluish base to bill; greenish or yellowish legs; and very different call. In NZ, all ages can be confused with juvenile **Black Stilt** and **hybrids between Black x Black-winged Stilt**; see Black Stilt.

In pairs or family groups when breeding, often gathering in small to large flocks outside breeding season. Often associate with other waders, especially Banded Stilts and Red-necked Avocets *Recurvirostra novaehollandiae*. In wetlands, feeding at edge of water and while wading. When approached, bob head and call before flying off; if with young, circle continuously, yapping loudly; chicks wander freely soon after hatching and often seen accompanied by adults. Often seen strutting gracefully through water. Occasionally swim. Flight, swift with strong rapid wing-beats, often giving yapping call; head held straight out, neck hunched up, long legs trailing well beyond tail, with nearly all tarsus visible. Wings, long, pointed, narrow. Recorded flying at night. Feed mainly by picking daintily at surface of water or mud, chasing fast-moving prey, or scything water in manner of Avocet. Call, distinct dog-like yapping.

HABITAT Prefer shallow, open freshwater wetlands, especially those with dense growth of short grass or similar emergent vegetation. Occur on most types of wetlands: swamps, marshy ponds, billabongs, lakes, lagoons, saltmarsh, closed tidal wetlands, sewage farms and saltworks, flooded paddocks, waterholes (Hobbs 1961; Smith 1966; Crawford 1975; Schodde 1976; Badman 1979; Pierce 1980; Fjeldså 1985; Owen & Sell 1985; Jessop 1987; Bamford 1988). In NZ, occur in upper reaches of rivers, in shingly, braided sections up to 700 m asl (Child 1975; Pierce 1984a; Owen & Sell 1985). Prefer fresh water; but also occur on brackish and

saline waters, such as coastal lagoons and flooded saltpans, and occasionally hypersaline waters, such as saltlakes (Smith 1966; Crawford 1975; Badman & May 1983; Wood 1985; Close & McCrie 1986; Storr & Johnstone 1988; Badman 1989; Chafer 1989; Morris *et al.* 1990); in saltworks near Port Phillip Bay, recorded at salinities between 10 and 145 ppt (Jessop 1987); and in sw. WA, in waters ranging from 0.127 to 21.52 g/l (Goodsell 1990). Often round floodwaters, especially shallow turbid sheets of water, including ephemeral lakes and saltpans, paddocks, pasture and rice crops. Occasionally round dams, flooded claypans, waterholes, and bore drains (Boehm 1960; Badman & May 1983; Gibson 1986; Gibson & Cole 1988; Badman 1989). Also on intertidal mudflats or sandflats in sheltered tidal inlets including harbours, estuaries and river deltas, sometimes among saltbush or mangroves especially in NZ (Hodgkins 1949; Schodde 1976; Gibson 1977; Pierce 1983, 1984a, 1992; Owen & Sell 1985; Powlesland & Robertson 1987; Barlow 1989; Morris *et al.* 1990). Only rarely on ocean beaches, rocky shores or exposed reef platforms (Hodgkins 1949; McGill 1954; Gibson 1977; Martindale 1980; Powlesland & Robertson 1987; Morris 1989; Morris *et al.* 1990).

Breed on islets or hummocks surrounded by shallow fresh, brackish or saline water (Morgan 1931; Hobbs 1961; Smith 1966; Hutchinson 1969; Bell 1985). In NZ, on shingle-banks in broad sections of braided river beds (Smith 1966; Hutchinson 1969; Klapste 1975; Pierce 1980, 1983, 1984a; Child 1983; Owen & Sell 1985). In Cass R. valley, Pierce (1986a) recorded 125 nests, of which 56% were in swamps, 19% in rivers, 13% in sidestreams, 12% in ponds. Also in grassy bore drains in arid Aust. (Badman & May 1983). Recorded nesting on shell bank in estuary during drought (Barlow 1989).

Roost in shallow water or on banks or islets in sheltered wetlands; on sandflats in estuaries (Powlesland & Robertson 1987). Once recorded loafing and foraging on mat of floating weeds (Sibson 1970).

Forage in shallow water or saturated mud in fresh or non-tidal saline wetlands, often close to emergent vegetation. Occasionally on wet flats or along margins of deep channels in tidal estuaries (Pierce 1980; Powlesland & Robertson 1987; Barlow

1989). Rarely on beaches, either in shallows or among wrack at high-tide mark (Powlesland & Robertson 1987); shallows of flooded river (Johnson 1990).

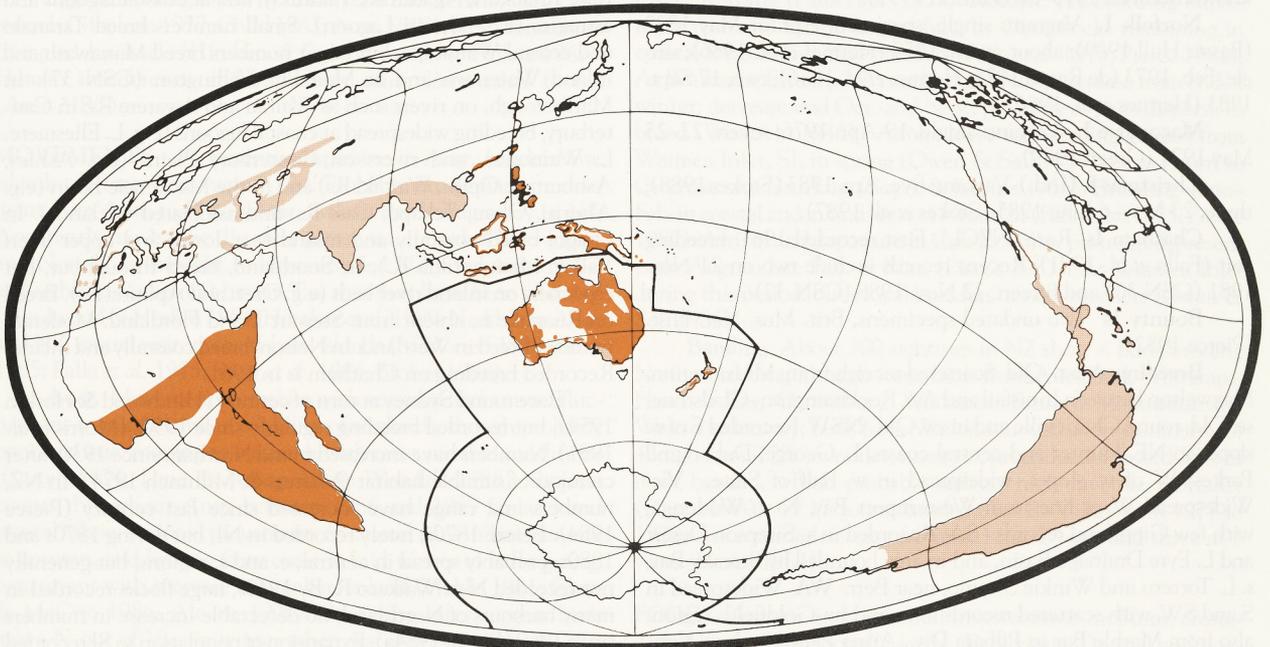
Has benefited from clearing of wooded lands and their conversion to pasture and irrigation. Round Northam, WA, clearing and irrigation have led to increased salinity in previously freshwater wetlands, and increased numbers have been recorded since 1960 when first indications of salting occurred (Masters & Milhinch 1974). Expansion of range in NZ may have been encouraged, but not necessarily caused, by clearing of forests, which has provided seasonal and permanent wetlands suitable for nesting (Pierce 1984a). In central Otago, numbers have declined, partly because suitable breeding sites on shingle river beds have been choked by weeds, including willows, gorse, broom, briars and lupins, even though additional potential feeding habitat created by increasing areas of irrigated pastures (Child 1983).

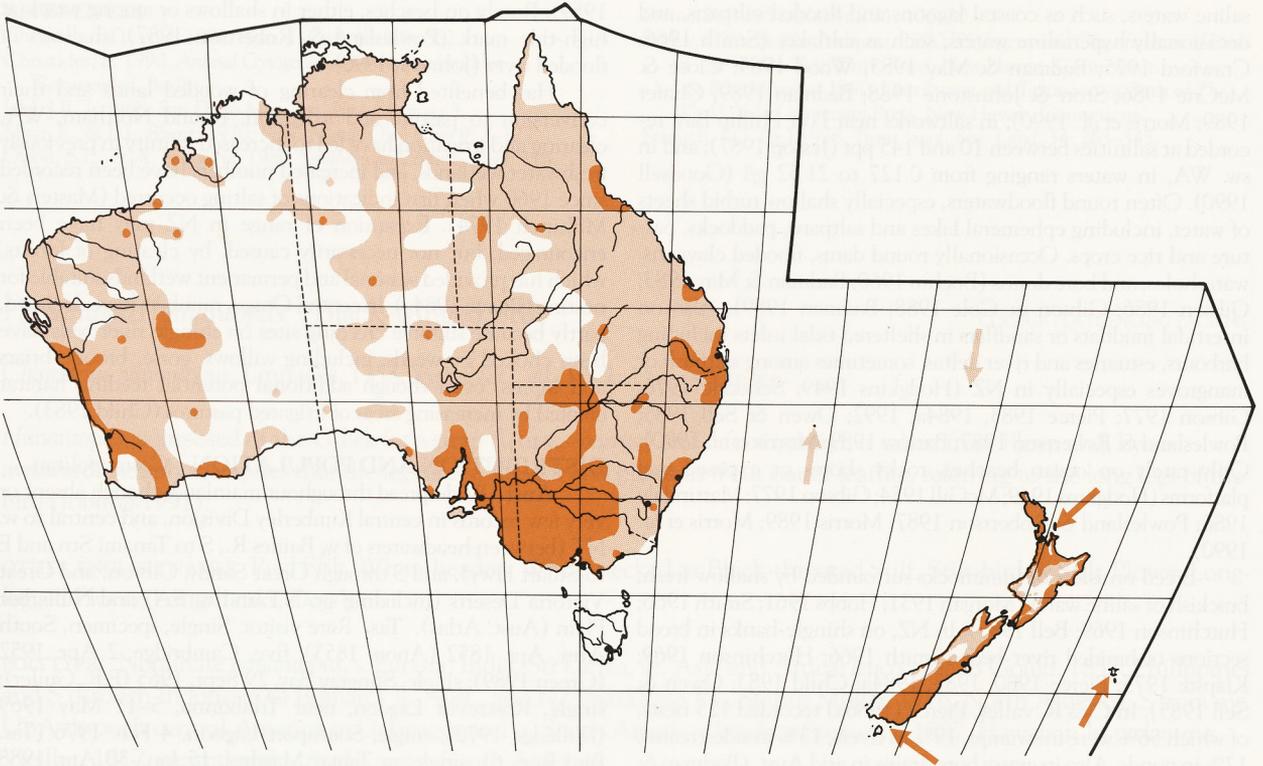
DISTRIBUTION AND POPULATION

Cosmopolitan.

Aust. Widespread throughout mainland, though absent or very few records in central Kimberley Division, and central to w. NT (between headwaters of w. Baines R., S to Tanami Stn and E to Stuart Hwy), and S through Great Sandy, Gibson, and Great Victoria Deserts (including sw. NT and w. SA) and Nullarbor Plain (Aust. Atlas). **Tas.** Rare visitor. Single, specimen, South Arm, Apr. 1852 (Anon. 1853); five, Cambridge, 2 Apr. 1952 (Green 1989); single, Stingray Bay, 29 Sept. 1965 (E.R. Guiler); single, Rostrevor Lagoon, near Triabunna, 5–11 May 1969 (Milledge 1970); single, Southport Lagoon, 4 Feb. 1976 (Tas. Bird Rep. 6); single, w. Tamar Marshes, 15 Jan.–30 Apr. 1988 (Tas. Bird Rep. 18). Record, possibly hybrid Black-winged x Black Stilt, Orielson, 14–29 Dec. 1988 (Fletcher *et al.* 1989; Tas. Bird Rep. 18); however, aberrant plumaged Black-winged Stilt cannot be excluded.

NZ Widespread. May have colonized NZ in early nineteenth century. **NI** Most widespread in coastal and inland regions N of 38°S, but only scattered records in e. Bay of Plenty; sparser, but still widespread in inland Waikato and Volcanic Plateau, S to s. L. Taupo; scattered records in East Coast (inland to L. Waikaremoana). Hawke's Bay (especially between Napier dis-





tract, S to estuary of Porangahau R.) and coastal Wanganui, Manawatu, Wellington and Wairarapa. Sparsely distributed elsewhere. **SI** Widespread; mainly se. of Southern Alps in central and s. Canterbury, Otago and Southland; also W of Southern Alps in West Coast. Scattered inland records N of 43°S, but widespread in coastal regions of Marlborough and Nelson. Absent or vagrant in Fiordland and Stewart I.

Lord Howe I. Vagrant: single, specimen, before Sept. 1888 (Hindwood 1940b); single, specimen, 1891 (North 1892); unknown number, 1975–90 (Hutton 1991).

Norfolk I. Vagrant: single, specimen, Apr. or May 1892 (Basset Hull 1909); about seven, 1957 (Hermes *et al.* 1986); single, Feb. 1973 (de Ravin 1975; Hermes *et al.* 1986); two, 17 Sept. 1983 (Hermes *et al.* 1986).

Macquarie I. Vagrant: single, 19 Apr. 1976; seven, 22–25 May 1977 (Green 1989).

Christmas I. (Ind.) Vagrant: five, Apr. 1983 (Stokes 1988); three, 23 May–6 June 1985 (Stokes *et al.* 1987).

Chatham Is Rare (NZCL). First recorded 1961: breeding pair (Falla *et al.* 1981). Recent records include two on 21 Nov. 1981 (CSN 30) and fifteen, 22 Nov. 1988 (CSN 37).

Bounty Is Two undated specimens, Brit. Mus. Nat. Hist. (Pierce 1982).

Breeding Aust. **Qld** Scattered records from: Mt Isa region, Maxwellton between Innisfail and Ayr, Rockhampton–Gladstone, se. Qld, round Charleville and in sw. Qld. **NSW** Recorded E of w. slopes in NE, Hunter and central coasts, L. George, Dubbo and Parkes; W of w. slopes, widespread in w. half of State. **Vic.** Widespread W of line from Westernport Bay, N to Wodonga, with few Gippsland records. **SA** Recorded in s. Simpson Desert and L. Eyre Drainage Basin, and in area bounded by Streaky Bay, s. L. Torrens and Winkie Swamp, near Berr. **WA** Widespread in S and SW, with scattered records in n. and sw. Goldfields region; also from Marble Bar in Pilbara Div., Anna Plains and sw. Kim-

berley Division. **NT** Recorded at Rabbit Flat and Alice Springs (Aust. NRS; Aust. Atlas). **NZ** Widespread and common in Northland, Auckland and Waikato. Breeding concentrations of up to 100 birds occur in many parts of Northland (e.g. Awanui, Kawakawa, Dargaville, Naumai), Auckland (e.g. Helensville, Drury), and n. Waikato (e.g. Whangamarino). Small numbers on Great Barrier I. In Bay of Plenty, breed on coast and inland at Rotorua Ls (e.g. L. Rerewhakaaitu); smaller numbers on East Coast (e.g. Waiau R.). In Hawke's Bay, common on gravel rivers (e.g. Tutaekuri, Ngaruroro, Tukituki), and at coastal lagoons and estuaries (e.g. Ahuriri Lagoon). Small numbers breed Taranaki and coastal Wairarapa, but larger numbers breed Manawatu and inland Wairarapa and at Moa Pt, Wellington (CSN 37). In Marlborough, on rivers such as Wairau and Awatere Rs; in Canterbury, breeding widespread at coastal lagoons (e.g. L. Ellesmere, L. Wainono), and rivers on Canterbury Plains (e.g. Ashley, Ashburton, Opihi, Waitaki Rs) and in the Mackenzie Basin (e.g. Ahuriri, Ohau, Tekapo, Cass Rs, and associated wetlands). In Otago, breed coastally and inland (e.g. lower and upper Taieri Valley, Manuherikia R.). In Southland, breed throughout, but especially on inland river beds (e.g. Oreti and Apirana Rs). Breed on Ruapuke I.; absent from Stewart I. and Fiordland. Moderate numbers breed in Westland. In Nelson, breed coastally and inland. Recorded breeding on Chatham Is in 1961.

Rare round Sydney at turn of century (Hindwood & Hoskin 1954), but recorded breeding regularly since 1950s (Morris *et al.* 1981). Numbers have increased round Northam since 1930s after creation of suitable habitat (Masters & Milhinch 1974). In NZ, numbers and range have increased since last century (Pierce 1984). Before 1870s, rarely recorded in NI, but during 1870s and 1880s, probably spread in central, e. and s. regions, but generally not recorded N of Waikato R. By 1940s, large flocks recorded in many harbours of Northland; no detectable increase in numbers since 1960 (Pierce 1984a). Expansion of population in SI recorded

since 1870s, when the species was already widespread (Pierce 1984a). In central Otago, especially round Alexandra, a decline in numbers has been detected: areas that held 10–20 breeding pairs are now deserted, possibly because nesting habitat infested by introduced weeds.

Population Aust. Estimated at c. 266,000 (D. Watkins). Totals for summer and winter counts in Aust., 1986–90, summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b; Anon. 1992). Sites of significance and maximum or average counts from summer and winter surveys round Aust., 1981–85, were: Swan R. coastal plain, WA, 1680; Port Hedland Saltworks, WA, 1230; The Coorong, SA, 990; Charters Towers area, Qld, 940; Peel Inlet, WA, 850; Kimberley region, WA, 690 (Lane 1987). In surveys of 197 nature reserves in sw. WA between 1981 and 1985, recorded at 65 sites (Jaensch *et al.* 1988). **NZ** In 1984, total may be c. 30,000 birds (Pierce 1984a). Recent maximum counts, autumn–winter: Parengarenga, 1500; Houhora, 350; Rangaunu, 3000; Whangarei, 600; Kaipara, 3000+; Manukau, 5000; Firth of Thames, 5000; Kawhia–Aotea, 500; Tauranga, 1500; Maketu, 400; Whakaki Lagoon, 1000; Ahuriri Estuary, 900; L. Poukawa, 1500; L. Hatuma, 500; Waiwhakaiti, 300; Manawatu Estuary, 400; L. Wairarapa, 570; L. Grassmere, 350; Avon–Heathcote, 250; L. Ellesmere, 3000; L. Wainono, 1000; Green I. Lagoon, 465; Southland lagoons, 500; Nelson Haven, 400 (CSN; R.J. Pierce).

Table 1

	NUMBER OF BIRDS	NUMBER OF SITES
summer 1986	2404	23
winter 1986	2972	23
summer 1987	1532	22
winter 1987	2295	23
summer 1988	1267	23
winter 1988	374	23
summer 1989	2026	22
winter 1989	183	21
summer 1990	1320	21
winter 1990	651	21

Eggs and young taken by foxes, feral cats, ferrets, stoats and weasels (Maclean 1977; Child 1983; Aust. NRS). Nests sometimes trampled by stock (Hindwood & Hoskin 1954; Pullen 1967). Human interference and vandalism cause some nests to fail (Aust. NRS).

MOVEMENTS Apparently dispersive in Aust.; resident nw. islands of Torres Str.; vagrant Tas. Probably no regular n. movement from Aust. to PNG (Aust. Atlas). Partly migratory in NZ. Apparently move long distance across sea: recorded Lord Howe and Norfolk Is; thought to have invaded NZ from Aust. twice; and sighting of aberrant bird in Tas. that may have been from NZ (Hindwood & Hoskin 1954; Fletcher *et al.* 1989; North). In Aust. and NZ, casual visitors to offshore islands (Moncrieff 1929; Storr 1965; Falla *et al.* 1975; Storr *et al.* 1986; Stokes 1988).

Aust. Movements correlate with seasonal and annual fluctuations in rainfall and availability of wetlands, though probably opportunistic, moving to wetlands with most suitable conditions (Carter 1904; Lane & Jessop 1984; Woodall 1988). Regular counts throughout Aust. between 1986 and 1989 (inland and coastal) show seasonal movements to coastal sites in late summer to autumn, and leaving from coast in mid-winter to early spring, concurrent with increase in numbers inland (Hobbs 1961; Close & McCrie 1986; Alcorn 1990). Reporting rates suggest birds move N out of Vic. in winter when water present inland (Vic.

Atlas). Seasonal patterns interrupted in wet years, when greater diversity of wetlands available (Alcorn 1990). In some areas, no seasonal pattern of movement apparent, e.g. Mt Isa, Richmond R. and Sydney area (Berney 1907; Hindwood & Hoskin 1954; Liddy 1955). Movements to breeding areas may also relate to availability of wetlands, e.g. first breeding record from Swan Coastal Plain followed heavy mid-winter rains (Jenkins 1969); bred in inland SA after heavy rain (Klapste 1975); first bred Camden after flooding (NSW Bird Rep. 1976). Movement to Vic. corresponds with main breeding season (spring) after winter rains have created many suitable wetlands (Lane 1987).

NZ Availability of wetlands and prey probably ultimate factor in seasonal movement (Pierce 1982). After breeding inland, most of population moves to coast, many then moving N (Wodzicki 1946; Pierce 1984a; CSN 1). Also move in response to availability of water regardless of season (Barlow 1989), and timing of movements can be influenced by bad weather, especially snowstorms (Pierce 1982, 1983). After breeding, family groups and unsuccessful pairs disperse to nearby wetlands with abundant food. Birds migrate to coast after breeding inland, movement peaking Dec.–Jan.; by Feb., large flocks in many coastal areas on both islands (Pierce 1982). At Queenstown, birds leave Feb.–Mar. (Soper & Jardine 1956); may follow river valleys to coast (Pierce 1982; CSN1). After breeding at L. Wainono, numbers of adults and juveniles peak in summer and decrease in autumn (Pierce 1980); at Waimea Inlet, numbers peak in late summer (Owen & Sell 1985); highest number of adults and juveniles occur late summer at Waikanae Estuary (Wodzicki 1946). Much n. movement occurs from SI and s. NI, especially Feb.–Apr. (Pierce 1982). Flock observed moving N at Paraparaumu Beach (Wodzicki 1946); from Feb. to Apr. small flocks regularly heard flying N from L. Wainono (Pierce 1980); on 10 Feb. 1941 heard flying NE over Dunedin; heard every evening 21 Jan. to 2 Feb. 1941 over Purakanui (CSN 1). Occur in large numbers in winter in Auckland and Northland harbours, though some winter on SI (Moncrieff 1929; Wodzicki 1946; Falla *et al.* 1975; Veitch 1978; Pierce 1980, 1984a). Influx into Firth of Thames in winter with wintering birds settled by Apr. (Sibson & McKenzie 1944). Most birds winter on coast although some winter on inland wetlands, e.g. L. Rotorua (Falla *et al.* 1975). **Return** Pre-breeding movement to S and inland begins July; by Oct., flocks remaining in coastal areas mainly non-breeders (Falla *et al.* 1975; Pierce 1982). At Waikanae Estuary, NI, numbers gradually increase from end of winter; decrease end Oct. and Nov., probably as pairs disperse to breed (Wodzicki 1946). Adults leave for breeding ground from Waimea Inlet, SI, in spring (Owen & Sell 1985); birds return to Queenstown, late Aug. (Soper & Jardine 1956). **Breeding** June–Feb. in coastal and inland areas of NI and SI (Falla *et al.* 1975; Pierce 1982). Arrival and departure in Cass R. Valley protracted; present early Aug. to late Feb. or Mar. (Pierce 1983). At Waimea Inlet during this period, birds local breeders or non-breeders (Owen & Sell 1985).

Banding About 300 sightings in NZ show s. birds heading N after breeding, though some birds from Auckland, Wairarapa, Hawke's Bay, Canterbury, Waikanae Estuary, Manawatu and Wairoa sedentary; birds from Waikato moved short distances. Of 42 sightings, 17% juveniles; however, juveniles composed 38% of birds banded, which probably reflects high juvenile mortality (Pierce 1990). Of 17 young banded Cass R. Valley from 1977 to 1978, one returned at age of 1 year, 13 at 2 years and three at 3 years (Pierce 1982).

FOOD Aquatic and terrestrial invertebrates: molluscs, crustaceans, insects; occasionally seeds. **Behaviour** Diurnal and noc-

turnal in all habitats, during both breeding and non-breeding season. In estuarine habitats, follow tidal cycles. Forage in water up to belly, on damp pasture, among floating debris and on tidal mudflats. Nine feeding methods described. (1) PECK: most common method used for aquatic or surface prey; thrust head forward with bill slightly open, grasp prey and swallow. Easily swallow insects up to c. 12 mm in length and worms up to 30 mm long. Larger prey need to be cut or crushed. When prey scarce, head held high; when prey abundant, head held closer to surface of water. In rivers or on wind-blown marshes, may stand in one place to wait for prey to drift within range (Pierce 1986b; L.B. Kahl). Individual distance inversely proportional to density of prey (Pierce 1985). (2) PLUNGE: peck with bill and head immersed. (3) SNATCH to capture flying insects. (4) BILL-PURSUIT (uncommon): rapidly open and close bill on surface of water. (5) FILTERING (uncommon): rapidly dabble bill, sweeping from side to side in mud and weed. (6) PROBE: insert bill into substrate. (7) SCYTHE: hold neck, head and bill at low angle, sweeping bill in arc of 100–300 mm, once or many times. (8) LATERAL PROBING (uncommon): place slightly open bill under substrate. (9) RAKING: sweep bill through fine shingle to reveal prey, which is then pecked up (Pierce 1985). Also take invertebrates displaced by flood, by hovering over them with legs trailing in water, seizing them and returning to shore to swallow (Johnson 1990). When taking crabs larger than c. 15 x 25 mm, cut off legs and then cut body in half, before pecking at smaller portions. Swallowing (for all methods) assisted by slow backward thrust of head, returning head to pre-strike position. In NZ, feeding style affected by weather, patterns of floods, abundance of prey and substrate, accompanied by switch to non-visual feeding (Pierce 1985, 1986b). In Aust., tend to continue feeding by sight in shallower water when ambient conditions deteriorate. Importance of tactile and chemosensory detection in non-visual feeding unknown. Negative phototaxis and positive thigmotaxis of invertebrates in NZ rivers places pressure on this species, which compared with Black Stilt has weaker bill and has difficulty maintaining sufficiently high rate of digestion in these habitats. Respond by increasing rate of searching or switching habitats temporarily (e.g. daily during periods of low water temperature) or for rest of season (Pierce 1986b). Often forage in loose groups. Feeding rates highly varying, ranging from less than 2 pecks/min (e.g. scarce large prey) to over 60 pecks/min (abundant small prey) (R.J. Pierce). In Vic., make 46.8 pecks/min (18.9; 66) of which 43.6 (20.1; 66) successful (Jessop 1987). Take earthworms and grass grubs from pasture in winter and spring (Pierce 1980).

Adult In **Manawatu, NZ** (McConkey 1971): Molluscs: unident. 39; gastropods: *Potamopyrgus* 63% freq.; *Physastra* tr.; *Planorbis* tr. Crustaceans: ostracods: tr. Insects: Odonata: Coenagrionidae: *Xanthocnemis* tr.; Hemiptera: Cicadidae: tr.; Notonectidae: *Anisops* tr.; Corixidae: *Sigara* 39; Megaloptera: tr.; Coleoptera: unident. 23; Dytiscidae 5; Scarabaeidae: *Pyronota* 7; Elmidae: larv. 40, ads 29; Elatridae: tr.; Curculionidae: tr.; Diptera: unident.: tr.; Tipulidae 12; Culicidae: tr.; Chironomidae 29; Muscidae: tr.; Trichoptera: sandcase caddisfly larv. 21; free-living caddisfly larv. tr.; Hydroptilidae: *Oxyethira*: tr.; Sericostomatidae: *Olinga* 9. Cordates: unident. tr.

In **Cass R. Valley, NZ** (37 faecal samples, ten stomachs, 736 items, still freshwater habitats; Pierce 1982): Annelids: Oligochaetes: worms 11.4% no. Molluscs: gastropods (incl. *Lymnaea*) 9.4; Hydrobiidae: *Potamopyrgus antipodarum* 16.9; Bivalves: Pisidiidae: *Sphaerium* 1.6. Arachnids: Acarina: Hydracarina 0.8. Insects: unident. 8.6; Odonata: *Xanthocnemis zealandica* larv. 6.8 (maximum length 17.2); Hemiptera: Corixidae: *Sigara arguata* 8.9 (8.5); Notonectidae: *Anisops assimilis* 3.1 (9.2); Diptera: ads 3.7; Chironomidae: *Chironomus* larv. 28.1 (26); Hy-

menoptera: ads 0.1. In **Cass R. Valley, NZ** (134 faecal samples, ten stomachs, 1363 items, running freshwater; Pierce 1982): Molluscs: gastropods: 10.5% no. Insects: unident. 1.6; Ephemeroptera: Leptophlebiidae: *Deleatidium* ads 39.5 (incl. *D. lillii* [maximum length 9.8 mm], *D. myzobranchia* [12.1]), subimago 4.8 (incl. *D. lillii* [10.3], *D. myzobranchia* [12.7]); Plecoptera: Griptopterygidae: *Aucklandobius* 1.0; Hemiptera: Corixidae: *Sigara* 3.7; *Lancetes* 0.4; Coleoptera: larv. 2.1; Lepidoptera: ads 1.2; Diptera: ads 2.8; Chironomidae larv. 29.3 (16); Trichoptera: Hydropsyche: *Aoteapsyche* larv. 0.1 (21.5); Hyrobiosidae: *Hydrobisis* 0.7; Sericostomatidae: *Pycnocentodes aureola* larv. 0.2 (12); fish 0.1.

Other records **Plants** Diatoms (Cleland); Pteridophyta: Marsileaceae: *Marsilea* sporophytes; Ruppiaceae: *Ruppia* sds; Portulacaceae: sds; Vitaceae: *Vitis* sds (Barker & Vestjens). **Animals** Small animals (McKeown 1934; Johnson 1990; Oliver). Annelids (Oliver): oligochaetes: earthworms (Pierce 1980, 1985). Molluscs (Buller 1888; Mathews 1909; Oliver; North): gastropods: freshwater snails (Bryant 1905; Vestjens 1977; Gould); Hydrobiidae: *Potamopyrgus antipodarum* (Pierce 1986b); Bullinidae: *Isidorella aculispira*, *I. waterhousii* (Vestjens 1977). Crustaceans: freshwater shrimps (Gould); Anostraca: Artemidae: *Artemia* (Lane 1987; Aust. Atlas); Mysidacea: *Tenagomysis* (R.J. Pierce); amphipods (Pierce 1980): Ischyroceridae: *Paracorophium lucasi* (Pierce 1985); crabs (Pierce 1985). Arachnids: Araneae (Johnson 1990). Insects (Bryant 1905; McLennan 1917; Gould; ads, larv. (Oliver); aquatic insects (Buller 1888; Gould; North); Ephemeroptera: mayfly nymphs (Vestjens 1977); Leptophlebiidae: *Deleatidium* larv., subimago, ads (Pierce 1985); *D. lillii*, *D. myzobranchia* (Pierce 1986b); Odonata: Anisoptera: dragonfly larv. (Pierce 1985; Cleland); Orthoptera: Gryllotalpidae; Gryllidae (Johnson 1990); Hemiptera: Cicadellidae (Vestjens 1977); Lygaeidae; Notonectidae (Barker & Vestjens); *Anisops* (Pierce 1986b); Nepidae: *Ranatra australiensis*; Belostomatidae: *Diplonychus* (Barker & Vestjens); Corixidae (Vestjens 1977; Barker & Vestjens): *Sigara arguata* (Pierce 1986b); Neuroptera (Cleland); Coleoptera (Mathews 1909; McKeown 1934; [1 cm] Johnson 1990): water-beetles (Vestjens 1977; Cleland); larv. (Vestjens 1977); Carabidae; Dytiscidae; Hydrophilidae (Barker & Vestjens); Scarabaeidae: *Costelytra zealandica* grass grub larv. (Pierce 1980); Curculionidae (McKeown 1934; Vestjens 1977; Barker & Vestjens); Diptera: midge larv.; shoreflies ads, larv. (Pierce 1980); Culicidae: mosquito larv. (R.J. Pierce); Chironomidae: larv. (Pierce 1985); Ephydriidae: *Ephydrella* brinefly larv. (Pierce 1985); Calliphoridae: *Lucilia* (Barker & Vestjens); Trichoptera: Hydropsychidae: *Aoteapsyche* larv. (Pierce 1986b); Odontoceridae: larv. (Vestjens 1977); Sericostomatidae: *Pycnocentodes aureola* larv. (Pierce 1986b); Hymenoptera: Formicidae (Barker & Vestjens). Fish: small fish (Pierce 1985; CSN 19); Salmoniformes: Galaxiidae: *Galaxias* (Pierce 1986b); Gobiesociformes: Eleotridae: bullies *Gobiomorphus* (Stead 1932). Small quartz pebbles, coarse pebbles, mud and gravel (McKeown 1934); grit (Vestjens 1977); mud (Cleland); sand (McLennan 1917).

Young, Intake No data.

SOCIAL ORGANIZATION Account based on contribution by R.J. Pierce. Fairly well known in NZ from major study by Pierce (1982) in Mackenzie Basin, SI; no major studies in Aust. For extralimital populations, see BWP and Hamilton (1975). Gregarious all year and in all activities; typically in groups of 10–100; occasionally larger numbers, with concentrations after breeding of up to several thousand; rarely singly (Smith 1966; R.J. Pierce). Non-breeding flocks persist throughout breeding season in some coastal areas (R.J. Pierce). After breeding, family parties and

unsuccessful pairs move to ponds, estuaries and lagoons (Pierce 1983). Occasionally associate with Red-necked Avocets (e.g. Lane 1987; North), and Straw-necked *Threskiornis spinicollis* or Australian White Ibis *T. molucca* (Campbell).

Bonds Monogamous. Pair-bond usually lasts one season with new pairs formed at beginning of breeding season; recent examples of retention of pair-bond and of new pair-bonds being formed between years (R.J. Pierce). Close association within pair even when flock in air (Pierce 1990). When aged 1 year, normally do not breed but sometimes form pair-bonds and try to nest; of 17 banded young returning to L. Tekapo, NZ, one returned at 1 year old, 13 at 2 years, and three at 3 years, all trying to breed (Pierce 1982). In NZ, pair-formation occurs July–Oct., peaking Aug. (Pierce 1982). **Parental care** Both sexes incubate, females more so than males (Pierce 1982); both brood during cold weather and at night until chicks 3–4 weeks old (Jones 1938; Pierce 1982; Brouwer 1991); both guard chicks. Families with flying young usually stay near nesting area for a few days at least (Pierce 1986a); families stay together up to 8–10 months but varying.

Breeding dispersion Colonial or semi-colonial, occasionally as single pairs; usually small colonies (average five nests) but sometimes up to 100 pairs (R.J. Pierce). In Cass R. Valley, NZ, of 125 nests, 117 <100 m from nests of other stilts (Black or Black-winged) and eight were solitary (Pierce 1986a). Nests spaced 18 m apart (10–35; 55) (Pierce 1982); in one anecdotal report, 3–4.5 m apart (Campbell). **Territories** Some pairs defend all-purpose territories for breeding season. Territorial birds feed mainly in territories round nests. Off-duty birds fly up to 1.5 km to feeding areas (R.J. Pierce). Sometimes ousted from territories by nesting Black Stilts or Masked Lapwings *Vanellus miles* (Pierce 1982).

Roosting Active day and night (Stidolph 1937); roost or feed at high tide, feed at low tide (Wodzicki 1946). In NZ, outside breeding season, roost in large compact flocks, typically 50–500, or up to 2000 birds; on sand-spits but more often in pasture and edges of wetlands; typically inactive in roosting flocks, but may preen for long periods. During breeding season, off-duty parent often roosts near nest, generally on bank, sometimes in water. When roosting or sleeping, typically stand on one leg, head and neck retracted to fold of wing, and bill tucked under wing; also sit on ground (R.J. Pierce). Chicks forage at night (Pierce 1986a).

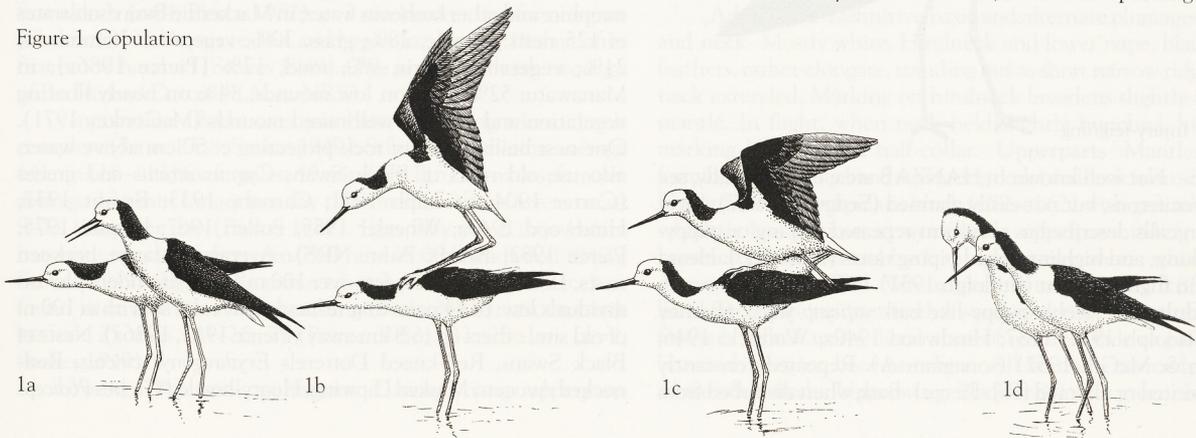
SOCIAL BEHAVIOUR Account based on contribution by R.J. Pierce; studied in NZ by McConkey (1971) and Pierce (1982). Fairly well known extralimally; see BWP, Hamilton (1975), Goriup (1982). Comparison with Black Stilt in Pierce (1982), Reed (1986); pre-copulatory displays as for Black Stilt. Conspicuous; during breeding season, when disturbed can be noisy. **Comfort behaviour** When preening, rub bill over uropygial gland before preening back, wings and breast. Often scratch and

stretch; scratch head indirectly, lifting leg over lowered wing. Bathe in water, especially on hot days; sit in water and dip underwater repeatedly; may be interspersed with springing into air and splashing back in water; rarely, perform aerial belly-flopping over surface of water. When incubating on hot days, pant for many minutes at a time, threshold temperature being 22–28 °C; stand with long axis of body aligned with sun; on cold days, usually side on to, or slightly away from, sun (Pierce 1982; R.J. Pierce).

Agonistic behaviour Uncommon at roosts. Outside breeding season, each bird defends individual distance within feeding flocks (using low-intensity aggression); distances vary with style of feeding and density of prey: at constant densities of prey, distances defended by birds searching by sight nearly three times greater than those defended by birds searching by touch; when feeding by sight, but not by touch, distances correlated negatively with density of prey; when prey scarce, distances of up to 12.5 bird-lengths, but may exceed 20 bird-lengths when foraging area also restricted (Pierce 1982). In confrontations, birds may use low-intensity aggression, e.g. brief chases comprising fast walk, or occasionally UPRIGHT DISPLAY or GIRAFFE POSTURE (Hamilton 1975), when birds extend necks, and walk slowly and parallel to each other. **Fighting** Outside breeding season antagonism usually ends without fighting, but fighting often occurs at breeding grounds. Typically, two birds fly at each other, often to 1–2 m above ground, Parachuting (McConkey 1971) into opponent; less often, will fly low and directly at opponent (R.J. Pierce).

Sexual behaviour Pairing appears to result from persistent association of female with male, until all aggressive interactions cease (Hamilton 1975). In Black-winged Stilts, occurs both at and *en route* to breeding grounds; time from first encounter to formation of pair-bond often short, sometimes only 3–4 days. When female encounters potential mate, often gives low call and assumes posture resembling receptive posture before copulation; never obtains close attention of male, unless has been closely associating with him for a few days (Pierce 1982). Courtship behaviour possibly more varied: record of four Stilts leaping and flying c. 1 m over others, giving impression of two pairs; also performed short flights round area, returning to same spot and starting jumping again; one bird dived under water while other bird hopped over it; display continued for at least 10 min; may have been territorial behaviour (Wheeler 1955). **Greeting** At change-over, relieving bird seen to fly to within c. 2 m of nest; after brief pause, sitting bird stood up and flew away, and other bird walked to eggs and sat (Jones 1938; Brouwer 1991). **Copulation** Female initiates pre-copulatory display in water when feeding, by giving a few low calls while standing still and assuming distinctive crouched posture with neck extended. Male, if responsive, walks directly toward female, sometimes pecking at and

Figure 1 Copulation



splashing in water and, usually only when standing within 30 cm of side of female, preening in exaggerated manner; exaggerated preening continues at either end of U-shaped course which male walks 5–12 times behind female; during male display, female maintains crouched posture (Fig. 1a) but turns head to side where male preening. After 1.2–3.7 min ($n=33$), male flaps wings and jumps, mounting female, then raises wings, flexes legs, and lowers body until cloacal contact made (Fig. 1b,c). During coition female moves head smoothly from side to side. After 5–12 s, male lowers wings and slides off female's back. Both then cross bills (Fig. 1d) and walk forward slowly to moderately quickly for 0.5 to 3 m. Up to 7 copulations per day, spread throughout day (McConkey 1971; Pierce 1982).

Relations within family group NEST-SHOWING: involves bird standing at prospective nesting site and pointing or pecking into nest with bill held almost vertically and giving Twittering Call (McConkey 1971). Chicks guarded by both adults either simultaneously or, more usually, alternately by male and female. Chicks feed themselves. **Anti-predator responses of young** If predator approaches, young chicks will remain still, older chicks run up to 250 m for cover (R.J. Pierce). **Parental anti-predator strategies** Include walking away from nest, bouncing off ground in a series of hops, Distraction Displays, and aggressive behaviour (Stidolph 1931; R.J. Pierce). During laying, usually react to mammalian intruders by flying in wide circle, sometimes calling; during incubation and fledging periods usually give Distraction Displays: False-brood, feign injury, or run furtively somewhat like chicks; Injury-feigning accompanied by repeated distress-calling (Fig. 2); occasionally Dive-bomb (Pierce 1982; R.J. Pierce). In colony, first bird to detect predator flies into air, gaining height quickly and often uttering alarm calls; this immediately alerts all other birds, and they group together to attack predator or lure it away with Distraction Displays; several birds from colony will feign injury simultaneously; mob aerial predators, flying round them, calling repeatedly, and sometimes Dive-bombing them (Stidolph 1931; McConkey 1971; Pierce 1986a; R.J. Pierce). One pair of nesting birds attacked Cape Barren Goose *Cereopsis novaehollandiae*, diving at it and hitting it with their legs, eventually driving it off (Aust. NRS); another pair with eggs struck White-faced Heron *Ardea novaehollandiae* many times with their bills (Jones 1938). Recently disturbed Stilts may indulge in Parachuting (see Agonistic behaviour; McConkey 1971).

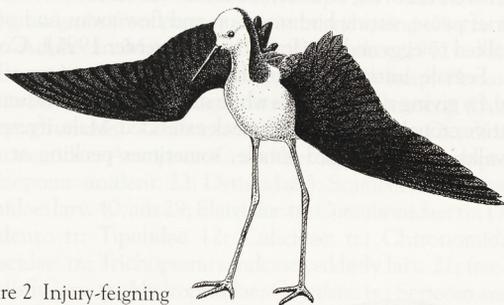
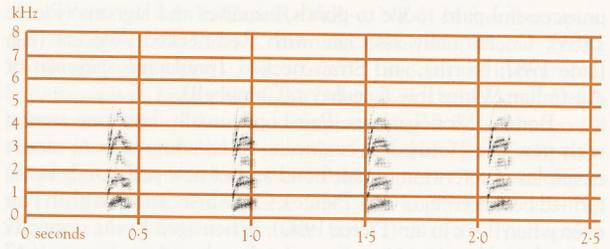


Figure 2 Injury-feigning

VOICE Not well known in HANZAB area; extraliminally, see BWP. Vociferous, but not easily alarmed (Sedgwick 1947). Most common calls described as persistent repeated yelping or puppy-like barking, and higher-pitched piping notes (Aust. RD). Heard to Yelp in flight at night (Stidolph 1931).

Adult YELP: feeble puppy-like bark yap-yap-yap... (Berney 1907; Stidolph 1931, 1937; Hindwood 1940a; Wodzicki 1946; Condon & McGill 1952) (sonagram A). Repeated constantly when excited or alarmed (R.J. Pierce). Bark when disturbed from



A E. Slater; L. Cowal, NSW, Jan. 1985; X138

nest (McGilp & Morgan 1931). **PIPING:** plaintive and mournful, given in flight and after landing (Gould; North). **Other calls** Soft drawn-out calls during courtship (R.J. Pierce). Protracted pleading squeals during Distraction Display (Stidolph 1931; R.J. Pierce). Croaking when robbed of eggs (North).

Young KIP: from juveniles, higher-pitched than Yelp of adults; voices break when birds lose smudgy markings on head and, in spring, juveniles with husky voices not uncommon (Sibson & McKenzie 1944).

BREEDING Quite well known. No major studies in Aust.; studied in NZ by Pierce (1982); 319 records in Aust. NRS to Dec. 1992. Account based on review of literature and contribution by R.J. Pierce. Usually nest in colonies of up to 500 nests, occasionally solitary. Hybridize with Black Stilts.

Season Aust. In S and E, generally Aug.–Dec., but also in late summer, autumn and winter if conditions suitable (Halse & Jaensch 1989; North; Aust. NRS); n. Qld: laying, Feb. and Mar. (Lavery *et al.* 1968); n. WA: early May to mid-Sept. (Carter 1904); sw. WA: Aug.–Dec., rarely May–July; laying correlated with peak rainfall plus 3 months (Halse & Jaensch 1989); s. Qld: eggs, Sept.–Mar. and young in June and July (Aust. NRS); Vic., SA and NSW: eggs, mainly Aug.–Dec. but also Jan.–Mar. (Aust. NRS). **NZ** June–Feb. (R.J. Pierce); in n. NZ: earliest clutches laid early July but peak laying from Aug. to Oct., rarely Jan. (McKenzie *et al.* 1959; Sibson 1960; NZ NRS); s. NZ: earliest clutches, early Aug. with peak in Sept.–Oct. (NZ NRS); late Sept. to late Dec., peak in early Nov. (Pierce 1986a).

Site Aust. In swamps, streams, rivers, flooded saltmarsh, paddocks, in sewage pond, on checkbank of saltworks, rice paddy, stock dam, round natural and artificial waterholes in arid interior, on horizontal limb of dead mangrove, wooden platform over tidal flat and next to mangroves. **NZ** Close to water, in flooded pasture, swamps, edges of ponds, estuaries and river beds; on bare sandy or muddy ground, small islands, sandbars, shingle, grassy banks, sedge or tussock hummocks, mat of *Cotula*, on floating vegetation, crown of grass tussocks, lignum, canegrass, rushes, samphire and other bushes in water; in Mackenzie Basin: substrates of 125 nests: shingle, 28%; grass, 30%; vegetation hummocks, 21%; vegetable debris, 9%; mud, 12% (Pierce 1986a); in Manawatu: 52% nests on low mounds, 34% on nearly floating vegetation and 14% on well-raised mounds (McConkey 1971). One nest built on top of rock projecting c. 50 cm above water; also use old nests of Black Swans *Cygnus atratus* and grebes (Carter 1904; Stidolph 1931; Carnaby 1933; Bryant 1937; Hindwood 1940a; Wheeler 1955; Pullen 1967; Klapste 1975; Pierce 1982; North; Aust. NRS). Average distance between nests, 18 m ($n=55$), very few over 100 m apart; site-fidelity by individuals low: of 14 pairs that re-nested, five did so within 100 m of old site, others up to 8 km away (Pierce 1982, 1986a). Nests of Black Swans, Red-kneed Dotterels *Erythrogonys cinctus*, Red-necked Avocets, Masked Lapwing, Hoary-headed Grebes *Podiceps*

poliocephalus, Red-capped Plovers *Charadrius ruficapillus*, Whiskered Terns *Chlidonias hybrida* and Gull-billed Terns *Gelochelidon nilotica* found with colonies of Stilts (North; Aust. NRS); Black Stilts occasionally nest in or near colonies of Black-winged Stilts; once, Swamp Harrier *Circus approximans* nest found within 50 m of colony of Stilts (Pierce 1982). Both sexes select site (R.J. Pierce).

Nest, Materials On ground, sometimes depression in damp soil, scantily surrounded by material, often as loose platform but sometimes more substantial bowl, cone or mound up to 15 cm high; made of flood debris, driftwood, rootlets, grass, fine twigs, rushes, also algae or other vegetation, whatever is available near nest; one nest made of trampled grass; unlined, or lined with grass and leaves; some nests built up in shallow water and may be consolidated by mud from feet of birds; sometimes add material during incubation; may build up height of mud and other material if nest threatened by flooding; one nest built up to form a substantial structure 10 cm high after heavy rain caused water-levels to rise (Stidolph 1931; Carnaby 1933; Hindwood 1940a; Stokes 1949; Wheeler 1955; McConkey 1971; Pierce 1982; North). Both sexes build; lining gathered in bill and thrown backwards over shoulder towards nest, where male arranges lining within nest (R.J. Pierce). May inspect and line more than one nest before final selection made (R.J. Pierce). **MEASUREMENTS:** one scanty nest 19 cm in diameter and 3.8 high; substantial nests 7.6–16 cm high (North; Aust. NRS).

Eggs Oval; rather close-grained, usually dull and lustrous; ground-colour varies: in Aust., faint yellowish-olive to brown, sometimes tinged green or greenish olive (North); in NZ, fawn-clay, brown or brownish olive to light or lime-green (Pierce 1982); with freckles, irregularly shaped spots and blotches of black or brownish black, intermingled with a few spots and blotches of amber, and underlying markings of dull inky-grey, evenly distributed or predominating and larger at thicker end, sometimes confluent (North). **MEASUREMENTS:** Aust.: 44.7 (1.42; 41.9–46.7; 12) x 30.8 (0.64; 29.7–32.0) (North), 42.3 (1.74; 40.5–46.8; 19) x 30.5 (0.61; 29.5–31.7) (Aust. NRS); NZ: 43.7 (1.32; 37) x 31.7 (0.73) (Pierce 1982).

Clutch-size Three to six eggs (Carnaby 1933). In Aust., average 3.7: C/1 x 4, C/3 x 5, C/4 x 42, C/5 x 1; some single eggs may be deposited on ground, not in nests (Hindwood 1940a); 3.7: C/1 x 2, C/2 x 2, C/3 x 18, C/4 x 86 (Aust. NRS). In NZ: average, 3.8: C/1 x 1, C/2 x 1, C/3 x 15, C/4 x 85 (Pullen 1967; Pierce 1982); for 48 clutches in Manawatu: average, 3.9: C/2 x 1, C/3 x 2, C/4 x 45 (McConkey 1971).

Laying Eggs usually laid at intervals of 24 h, occasionally 48 h; in a clutch of four: eggs 2 and 3 laid at 1-day intervals, egg 4 after 2 days (Stokes 1949); laying occurs mostly between 19:00 and 07:00 (Pierce 1982). Replacements laid 3–9 days after loss of first clutch (n=4; Pierce 1982); c. 2 weeks after loss for one pair (Stokes 1953). A pair re-laid and began incubating 18 days after first brood hatched (Stokes 1949). One nest found with two eggs of Red-kneed Dotterel (Aust. NRS).

Incubation Both sexes incubate; beginning when clutch complete (Jones 1938; Stokes 1949). Stints of incubation average 64 min (18–113) for females, 49 min (16–115) for males; females average 134 min longer per day than males; change-overs occur 9–11 times per day (Pierce 1982). Eggs may pip 2 days before hatching; eggs hatch between 09:00 and 13:00 (Hindwood 1940a; Stokes 1949). Egg-shells removed at hatching (R.J. Pierce) or found in or near nest after hatching (Aust. NRS). **INCUBATION PERIOD:** 25 days (23–26; 7) (Pierce 1982), 23, 25 days (n=2; Stokes 1949).

Young Precocial, nidifugous. Downy young: upperparts

olive-brown and light brown towards sides, with spots and blotches of black and brown; underparts, white; iris, brown; bill, blackish brown; legs, pale olive (North). Hatch with eyes open (R.J. Pierce). Attain contour-feathers at 3–4 weeks (Pierce 1982). Young may leave nest within 2 h of hatching or remain in nest for up to 1 day (Hindwood 1940a; Stokes 1949); during fine weather, leave nest 5–16 h (n=17) after hatching (Pierce 1982). **FLEDGING PERIOD:** 28–32 days (Pullen 1967), 29–38 days (n=7; Stokes 1949), average 34 days (30–37; 17) (Pierce 1986a). **Growth** From growth-curves in Pierce (1982): weight at 15, 20, 25 and 30 days, respectively: 36, 65, 103 and 126 g; tarsus at 15, 20, 25 and 30 days: 38, 45, 51 and 57 mm; wing at 20 and 25 days: 48 and 90 mm. **Parental care, Role of sexes** Brooded but not fed by parents on first day; chicks forage individually, within a few metres of nest; first bouts last less than 5 min before chicks return to a parent to be brooded; older chicks forage up to 200 m from nest (Pierce 1982; R.J. Pierce). At night, chicks seldom foraged 40–50 m from nest (Pierce 1986a). Newly hatched chicks in one nest sheltered in water and weed next to nest when approached (Aust. NRS); adults distract intruder by feigning injury, bouncing off ground, yelping, and wing-flapping, often join forces with other Stilts to drive intruders away (Stidolph 1931; Hindwood 1940a).

Fledging to maturity Young leave with adults at end of season (Wheeler 1955); remain as family group for weeks or months after chicks fledge (R.J. Pierce). Usually breed when 2 years old; 1-year-old birds occasionally nest, but unsuccessfully (Pierce 1982).

Success From 185 eggs, 91 (49%) hatched (n=48; Aust. NRS); from 77 eggs, 61 (79%) hatched (Pullen 1967). In NZ: from 1014 eggs, 260 (26%) hatched, 69 (7%) young fledged; 49 (39%) of 125 nests failed, of which 24 (49%) were taken by predators, 16 (33%) flooded and nine (18%) for other reasons, including desertion, damage by stock and unknown causes (Pierce 1986a). Eggs taken by foxes, ferrets, feral cats, rats, Swamp Harriers; destroyed by cattle, boys, eaten by Aborigines; three young lost trying to cross creek (Jones 1938; Stokes 1949, 1953; Maclean 1977; Pierce 1986a; North; Aust. NRS). Adults taken by feral cats (R.J. Pierce).

PLUMAGES Prepared by D.I. Rogers. Aust. *leucocephalus*. Hatch in natal down, replaced by juvenile plumage. Partial first pre-basic moult to first immature plumage (appearing rather similar to worn juveniles) may occur in first autumn or be delayed until second spring. Partial first pre-alternate moult brings in second immature plumage, rather similar to adult; occurs late in first autumn or late in second spring. Some moult remiges in first year. Adult plumage attained with complete second pre-basic moult when c. 1 year old. Adults also have a partial pre-breeding moult that causes no seasonal change in appearance.

Adult male Definitive basic and alternate plumages. **Head and neck** Mostly white. Hindneck and lower nape, black (89); feathers, rather elongate, standing out as short narrow ridge when neck extended. Marking on hindneck broadens slightly towards mantle. In flight, when neck held slightly hunched, hindneck marking like rounded half-collar. **Upperparts** Mantle, white, forming clean white band separating dark hindneck from scapulars. Upper back and scapulars, black (c89–c162) with greenish gloss, which is less obvious in worn birds, upperparts fading slightly browner (119). Central back to upper tail-coverts, white. **Underparts** White. **Tail** White, grading to light-grey (c85) distal band, broadest on inner feathers and sometimes absent on outer feathers. When worn, distal areas of rectrices fade to paler more brownish grey or become white. All feathers narrowly tipped white when fresh. **Upperwing** Black (c89) with greenish (c162)

gloss; fades to black-brown (119). Remiges have black-brown (119) rachis and lack green gloss. **Underwing** Marginal and most lesser and median coverts, black (89) with greenish (c162) gloss. Greater coverts and remiges also blackish (c89), lacking green gloss. Small white triangle at base of forewing formed by white subhumeral and innermost lesser and median coverts.

Adult female Very similar to adult male and not always distinguishable; scapulars and upper back generally more black-brown but colour of worn males and fresh females overlaps.

Downy young Head and neck Top of head, cream (c92) to light brown (c123A), with black (89, 119) median stripe (narrowest and sometimes broken on forehead) and black flecking elsewhere. Narrow line runs from base of bill, through lores and eye, to nape; often broken behind eye. Chin, throat and sides of face, white to off-white. Hindneck, off-white to grey (84).

Upperparts Cream (c92) to light brown (c123A); 'pale grey' reported by Pierce (1984b). Rows of black (89, 119) blotches or flecks form: (1) pair of broad interrupted lines close and parallel to mid-line of mantle that fuse on mid-back or rump; (2) pair of narrower, less even lines, outside and roughly parallel to former markings. Solid broad black line on each side runs along border with flanks. **Underparts** White or off-white, with small dark-grey (-) patch on thighs. **Wing-pads** Above, ground-colour similar to upperparts; broad black (89, 119) stripe along humerus and narrower black stripe (often broken) at base of trailing-edge.

Juvenile Head and neck Forehead, lores, chin and throat, white, perhaps tinged at times by small downy grey (c85) bases to feathers. Crown, dirty grey (c79), grading to paler, greyish (c79-c85) ear-coverts and to paler-grey or off-white (85-86) nape and hindneck. Feathers of nape and hindneck, light grey grading to whitish tips; adhering down (when present) also white at this stage, so hindneck probably looks darkest when worn. Exceptionally, all head and neck white (Pierce 1984b). **Upperparts** Mantle may be white but is more often greyish like hindneck; feathers, pale grey (86) to white with brownish-grey (c79-c91) subterminal bars (broadest towards mantle) and narrow white tips. Upper back and all scapulars, black-brown (119) when fresh, becoming dark brown (c121) with wear. Light brown (-) fringes to tips form conspicuous scalloping when plumage fresh; later fade to whitish and become narrow and inconspicuous. Central back to upper tail-coverts, white. **Underparts** White. **Tail** Similar to adults; some (perhaps all) have narrow pale tips tinged cream (c54) and outer rectrices with narrow dark-brown (119A) subterminal band. **Upperwing** Blackish (c119) at first, all coverts finely scalloped by light-brown (223D) to whitish fringes at tips. Ground-colour fades to dark brown (121) and pale tips lost with wear. Secondaries and inner 5-6 primaries (perhaps more when fresh) have white fringes at tips forming narrow, but conspicuous, white trailing-edge to wing. These white tips become narrower with wear but are retained until juvenile primaries and secondaries moulted. Ground-colour can grade to brown (119B) at distal ends of secondaries and inner primaries, pale area often being separated from white tips of feathers by narrow dark-brown (121) subterminal bar. Remiges, narrower and slightly shorter than in adults. **Underwing** Blackish (like adult but without green gloss), scalloped by white tips to all coverts except greater primary coverts; white tips of secondaries and inner primaries clearly visible from below.

First immature First basic. Rather similar to juvenile.

Head and neck Hindcrown, upper nape and ear-coverts just below and behind eye, darker grey than in juvenile, forming neat rounded cap. As in juveniles, hindneck tinged grey. **Upperparts** Mantle similar to juvenile except dark subterminal bands of feathers generally narrower; often retain juvenile feathers on mantle. Upper back and scapulars, black-brown (119) faintly

glossed green, with narrow dark-brown (c119A) fringes that are lost with wear. First-basic feathers thus darker and more glossy, less scalloped, than juvenile; some individuals retain many juvenile feathers on back and scapulars. **Underparts** White. **Tail** First-basic feathers, as adult. **Upperwing** First-basic feathers, as adult. Some retain much juvenile plumage: primaries, secondaries, most tertials, most greater secondary coverts (except inner) and varying number of other coverts. When many juvenile coverts retained and worn, upperwing looks browner than in adult; all juvenile coverts lose white tips but white tips of primaries and secondaries remain until moulted. **Underwing** First-basic feathers similar to adult; usually most coverts retained from juvenile plumage.

Second immature First alternate. Similar to adult and not always separable in field. Feathers of hindneck have white tips, lost with wear; some (not all) have faint, pale-greyish (c86) wash behind eye. Individuals that have retained remiges throughout first year can be aged readily by white tips on secondaries and inner primaries. Those that have moulted remiges in first year less easily distinguished but differ from adults at similar times of year in having fresh (not worn) primaries. Some retain a few white-tipped juvenile outer secondaries, also of use in ageing.

BARE PARTS From photos (Pringle 1987; Moon 1988; Aust. RD; NZRD; NZ DOC Slide Library; unpubl.: R.J. Pierce) and Pierce (1984b).

Adult Bill, black (89). Iris, crimson-red (11, 12, 13); dark brown (23) recorded in two individuals. Narrow black (89) orbital ring. Tarsus, tibia and toes, red (14, c12) when nesting, perhaps generally reddest in males; dark pink (108C-7) at other times. Claws, black (89). **Downy young** Bill, dark grey (c78, 83), sometimes grading to grey-black (82) distally; have small white egg-tooth at hatching. Iris, black-brown (119). Tibia, tarsus and toes, dark grey (78-83) at hatching, rapidly becoming pale blue-grey (88, c86) with yellowish pink (6) to orange soles and webs. **Juvenile** Bill, black (89), with fleshy-pink (-) base at first. Iris, dark or blackish brown (-). Legs and toes, pale pink (pale 108D); tibia initially tinged yellowish (c53). Claws, grey (-) to grey-black (-). **Immatures** Similar to non-breeding adults but iris, reddish brown (-) in at least some first immatures. Second immatures have adult iris-colour.

MOULTS From Aust. skins of 34 adults and 13 younger birds (AM, ANWC, HLW, MV), except where stated.

Adult post-breeding Second and subsequent pre-basic moults. Complete. Primaries outwards; 1-2 grow concurrently. No information on sequences of secondaries or tail; in NZ, begin moult of feathers of body, followed by scapulars, secondaries, head, neck and primaries; outer primaries last feathers to be replaced; see BWP for summary of sequences in nominate *himantopus*. In NZ, moult mid-Dec. to early Apr. (Pierce 1982). Also moult in summer in tropical and temperate Aust. but timing in Tropics appears to vary more. In Tropics, earliest moult record available ($N^24^{\circ}O^6$) is from 17 Sept.; one had completed moult by 1 Nov. but another still moulting ($N^8^2^{\circ}O^1$) in Apr. In temperate Aust., all eight available records of active primary-moult from Dec. to Mar.; one collected 10 Dec. had yet to begin moult and three collected 14-15 Mar. had completed moult. **Adult pre-breeding** Second and subsequent alternate plumages. Partial, not involving remiges or tail (not known if central feathers can be replaced as in nominate *himantopus*). Head, neck and varying amount of upperparts and underparts moulted. Timing not well-known in Aust.; active moult has been recorded in Oct. but most are in alternate plumage by Sept. In NZ, moult July-Sept., peak-

ing in Aug. **Subadult moults** In Aust., two different pathways occur from juvenile to adult plumage. Some retain remiges throughout first year but replace some or all body-feathers in first pre-basic and first pre-alternate moults. Four such individuals examined, from NSW (two), Vic. and NT. Others also moult all primaries and usually all secondaries during first year; seven such examined from NSW (three), Vic., tropical NT (two) and Cooper's Ck, central Aust. In nominate *himantopus* remiges are retained throughout first year (BWP). Discussion of moults of remiges in first year is given separately below because it is not clear to which moult-event the replacement of primaries should be assigned. **Post-juvenile** First pre-basic. Partial. Usually involves all feathers of head and neck. Extent of moult of upperparts varies; may involve all feathers but some only replace a few scapulars. At least some feathers of underparts moulted. Some tail-moult; all feathers can be moulted but sometimes only t1-t2 or t4-t5 replaced. Varying number of upper wing-coverts moulted; inner greater secondary coverts, medians and especially lessers often replaced. Timing apparently varies; two collected in first pre-basic during first summer (Jan. and Feb.) though others apparently delay moult until first winter (records from July-Sept.). In nominate *himantopus* post-juvenile moult protracted (July-Feb.) and starts, before fully grown, on head and neck. Not known if this is so in birds in HANZAB region; a skin in first pre-basic (confirmed by down adhering to tips of a few old-generation feathers of hindneck) had worn primaries, which suggests onset of post-juvenile moult can be delayed considerably. **First immature pre-breeding** Partial; usually involves all feathers of head, hindneck, mantle and scapulars and some, perhaps all, feathers of rump, underparts and throat. Varying amount of tail-moult occurs, central feathers often retained. Moult some or all tertials and most wing-coverts except alula, all primary coverts, outer greater secondary coverts and a few lesser coverts. Moult has been recorded in Oct. of second spring in four individuals, and in Apr. of first autumn in one individual; presumably timing varies with date of fledging. **Remex moults in first year** Active moult has been recorded in Oct. of second spring (primary-moult scores 26, 47); some individuals have completed primary-moult at this time. Primaries, outwards; sequence of secondaries unknown but some retain outermost 2-7 secondaries. A central Aust. skin (no date) was in late primary-moult N⁷4¹O² but was still in first pre-basic moult of body-feathers. Two others examined (both from NSW in Oct.) combined active, late moult of primaries and secondaries with first pre-alternate body-moult. Five birds examined in first pre-alternate plumage had replaced all juvenile primaries; three of these retained some juvenile outer secondaries. All had done rather extensive pre-alternate moult including all wing-coverts or all but few under wing-coverts.

MEASUREMENTS (1) SE. Aust., adult, skins; TOE-C = middle toe including claw; TOE does not include claw (AM, ANWC, HLW, MV). (2) Tropical Aust. (n. WA and NT), adult, skins (AM, ANWC, HLW, MV). (3) Aust. localities combined, skins; WING, 8TH P and TAIL from juveniles and first immatures with juvenile outer primaries and tail; BILL and TARSUS from first immatures. (4) NZ, ages combined, skins; hybrid plumage nodes A-C (see Black Stilt for plumage descriptions) (Pierce 1984b).

	MALES	FEMALES	
WING	(1) 234.6 (5.16; 227-246; 10)	220.5 (6.44; 213-234; 10)	**
	(2) 227.5 (3.64; 222-232; 4)	219.2 (6.21; 208-225; 5)	ns
	(3) 211.5 (5.32; 207-220; 4)	204.1 (4.67; 197-211; 6)	ns

	(4) 230.3 (12.1; 44)	220.5 (13.3; 39)	**
8TH P	(1) 147.9 (4.38; 139-153; 11)	141.1 (5.72; 133-151; 9)	*
	(2) 140.2 (4.02; 134-145; 4)	139.6 (4.41; 131-143; 5)	ns
	(3) 134.0 (2.74; 131-138; 4)	129.6 (5.89; 124-140; 5)	ns
TAIL	(1) 71.8 (3.35; 64-77; 11)	70.5 (2.87; 65-75; 12)	ns
	(2) 71.2 (2.48; 67-74; 5)	70.2 (0.90; 69-71; 6)	ns
	(3) 66.0 (2.24; 63-69; 4)	67.3 (6.16; 54-73; 6)	ns
	(4) 76.9 (3.4; 40)	75.1 (3.5; 37)	*
BILL	(1) 63.4 (1.89; 60.5-67.1; 8)	59.9 (2.34; 56.5-65.0; 11)	**
	(2) 61.6 (2.74; 56.9-64.8; 5)	61.7 (2.81; 58.7-66.1; 5)	ns
	(3) 54.5, 55.3, 61.1	59.9 (2.98; 56.7-63.9; 4)	
	(4) 62.0 (2.7; 42)	61.3 (2.4; 31)	ns
TARSUS	(1) 117.9 (4.56; 114-125; 10)	105.2 (5.92; 92.6-117; 12)	**
	(2) 117.1 (5.58; 112-125; 5)	108.2 (7.52; 99.5-120; 5)	ns
	(3) 106, 116, 117	108.8 (5.28; 101-114; 5)	
	(4) 100.3 (6.4; 47)	93.0 (3.8; 45)	**
TOE	(1) 37.8 (1.38; 36.0-40.2; 5)	33.9 (1.25; 32.8-36.7; 8)	**
TOE-C	(1) 42.9 (2.75; 37.7-45.4; 6)	39.5, 40.1	

Males larger than females (differences not significant in some of the above, but only when samples small). Juvenile wing, eighth primary and tail are significantly shorter than in adults. Tarsus and probably bill are not fully grown at fledging (e.g. tarsus of fresh juveniles: 91.2, 92.3, 80; bill: 55.3, 51.1, 53.0). First immatures measured had bill and tarsus similar in length to adult. Samples from Tropics small but suggest that wing, eighth primary and tail are shorter than in temperate Aust. Tail significantly longer in NZ; tarsus significantly shorter.

WEIGHTS (1) NT, July, Oct. and Nov. (Dostine & Morton 1989). (2) Aust. localities combined, adults (AM, ANWC, MV). (3) NZ, ages combined (Pierce 1984b).

	MALES	FEMALES	
(1)	164 (21; 139-208; 12)	157 (11; 138-169; 8)	ns
(2)	177.4 (11.3; 164-199; 8)	171.4 (23.4; 143-226; 9)	ns
(3)	193 (10.2; 15)	192 (18.2; 14)	ns

In NZ, seasonal variation in weight negligible except that females heaviest just before breeding (Pierce 1982). Patterns of temporal variation in Aust. not understood; large range of variation in weights (above) may be associated with dispersive movements. No obvious seasonal trends in Aust.; heaviest male and female (199 and 226 g respectively) collected Mar. but lightest male (164) and a female of 170.5 collected at same time. In Aust., juvenile male 137; juvenile females 128, 151.

STRUCTURE Wing, narrow and pointed, rather long. Eleven primaries; p10 longest, p9 7-13 shorter, p8 18-31, p7 30-46, p6 45-62, (p5-p2 not measured), p1 105-118; p11 minute, covered by primary coverts. Twelve secondaries and about four tertials. Tips of longest tertials lie between tips of p5 and p7 on folded wing. Tail, moderately short, square; 12 feathers. Long-necked, with long, straight or very slightly recurved bill c. 1.6 times length of head. Bill, very slender; looks straight; base rounded in cross-section (not flattened as in avocets and Banded Stilt *Cladorhynchus leucocephalus*); bill tapers gradually; extreme tip of upper mandible ends in small fine hook. Tibia and tarsus, very elongate and slender; length of unfeathered part of tibia c. 70% length of tarsus. Tarsus, laterally compressed; scaling reticulate but usually almost fused and barely visible. Tarsus, sometimes slightly convex in skins, outside of curve facing anteriorly; this probably causes slight shrinkage. Toes, rather short (c. 30-35% length of tarsus)

with small webs between bases of outer and middle toes only; outer toe c. 85% length of middle, inner c. 76%; no hind toe.

RECOGNITION. Downy young very similar to those of Black Stilt (q.v.) except that dorsal ground-colour usually paler in Black-winged (Pierce 1984b). Downy young Red-necked Avocets have similar pattern of plumage; older Avocets readily distinguished as bill recurved. Younger Avocets differ in lacking clearly defined median stripe on top of head and in having: vestigial hindtoe, smaller black markings on upperparts, more strongly webbed toes; dorsal ground-colour of Avocets generally paler and greyer.

GEOGRAPHICAL VARIATION Marked; five subspecies, all of which have been recognized as full species at times (e.g. Mayr & Short 1970). Subspecies *leucocephalus* of Aust. and NZ also occurs through Indonesia to Philippines; adults characterized by very slight sexual dimorphism in plumage and mainly white head with ridge of black feathers on nape and hindneck contrasting with white mantle. No detailed study has been done on biometric variation in *leucocephalus*, but birds from tropical Aust. appear to have shorter wing and tail, similar bill and tarsus to birds from se. Aust. (see Measurements). In NZ, pure *leucocephalus* are rare; most have some plumage and structural differences resulting from hybridization with Black Stilt. More black in plumage, often extending from hindneck to dark back, and extending right round upper throat as complete collar; measurements intermediate and NZ *leucocephalus* have longer tails and shorter tibia and tarsus than those in Aust.; they are perhaps heavier (see Weights). Despite much hybridization in recent times, recent authors have preferred to keep Black Stilt as a full species in view of its differences in plumage and morphology, and preference for mating with Black rather than Pied Stilts (e.g. Pierce 1984b; Hayman *et al.* 1986; BWP; NZCL). See Plumages and Measurements of Black Stilt for more information.

Nominate *himantopus* slightly larger than *leucocephalus* but with wing and bill shorter relative to size of body (BWP); slight clinal variation: size decreases slightly towards S but s. birds have slightly longer bills. Adults differ from *leucocephalus* in varying pattern of crown and hindneck; these usually look white to dusky grey in nominate *himantopus*, appearing paler than *leucocephalus* because white feathers admixed; darkest individuals differ from birds of HANZAB region in that dark of crown extends level with eye. Females and non-breeding males have mantle distinctly browner than scapulars and upperwing. So-called 'Black-necked' Stilts of New World and Hawaii comprise three subspecies, all with black hindneck and lower ear-coverts; none has separate breeding plumage. South American *melanurus* has white upper mantle and centre and rear of crown; wing 220.5 (13.0; 29), tail 76.2 (4.4; 29), bill 62.0 (2.9; 28), tarsus of males 114.5 (6.0; 13; Pierce 1984b). The other two 'Black-necked' Stilts have black centre and rear of crown to level of eye; black of mantle meets that of hindneck; white spot above eye. Subspecies *mexicanus* is rather similar in structure to *leucocephalus*, with smaller body than nominate *himantopus*; in males, wing 225.1 (n=18), bill 65.3 (n=39) and tarsus 113.0 (n=18) (Prater *et al.* 1977); tail, with sexes combined, 67.7 (n=39, Pierce 1984b); *mexicanus* intergrades with *melanurus* in much of South America. Subspecies *knudseni* of Hawaii has more black on head and neck and is much larger than *mexicanus*, e.g. wing (sexes combined) of *knudseni* 235 (n=88), bill 74.1 (n=36), tail 76.1 (n=88) and tarsus (males only) 123.9 (6.1; 59) (Pierce 1984b).

Above summary largely from BWP, Pierce (1984b) and Hayman *et al.* (1986), which should be consulted for further

information. BWP argued that it was best to combine birds in this complex as one species. To treat each allopatric form as full species would be inconsistent with the amount of geographical variation shown.

REFERENCES

- Alcorn, R. 1990. *Stilt* 16: 9–22.
 Anon. 1853. *Pap. Proc. Roy. Soc. Van Dieman's Land* 2: 230.
 — 1992. *Stilt* 20: 33–7.
 Badman, F.J. 1979. *S. Aust. Orn.* 28: 29–55.
 — 1989. *The Birds of Middle and Lower Cooper Creek in South Australia*. Nat. Cons. Soc. SA, Adelaide.
 —, & I.A. May. 1983. *S. Aust. Orn.* 29: 29–39.
 Bamford, M. 1988. *RAOU Rep.* 41.
 Barlow, M. 1989. *OSNZ News* 53: 7.
 Basset Hull, A.F. 1909. *Proc. Lim. Soc. NSW* 34: 636–93.
 Bell, H.L. 1985. *Corella* 9: 108–13.
 Berney, F.L. 1907. *Emu* 6: 106–15.
 Boehm, E.F. 1960. *Emu* 60: 211–18.
 Brouwer, J. 1991. *Stilt* 19: 19–23.
 Bryant, C.E. 1937. *Emu* 37: 160–1.
 Bryant, H.W. 1905. *Emu* 5: 23–6.
 Buller, W.L. 1888. *History of the Birds of New Zealand*. Author, Lond.
 Carnaby, J.C. 1933. *Emu* 33: 103–9.
 Carter, T. 1904. *Emu* 3: 171–7.
 Chafer, C.J. 1989. *Surv. Shorebirds Illawarra & Shoalhaven Regions New South Wales*. Unpubl. Rep. NSW NPWS, Nowra.
 Child, P. 1975. *Notornis* 22: 143–50.
 — 1983. *Notornis* 30: 243–4.
 Close, D.H., & N. McCrie. 1986. *Emu* 86: 145–54.
 Condon, H.T., & A.R. McGill. 1952. *Field Guide to the Waders*. Bird Obs. Club, Melbourne.
 Crawford, D. 1975. *S. Aust. Orn.* 26: 193–5.
 de Ravin, J.A. 1975. *Aust. Bird Watcher* 6: 4–10.
 Dostine, P.L., & S.R. Morton. 1989. *Emu* 89: 250–3.
 Falla, R.A., *et al.* 1975. *A Field Guide to the Birds of NZ*. Collins, Lond.
 —, *et al.* 1981. *The New Guide to the Birds of New Zealand*. Collins, Auckland.
 Fjelds , J. 1985. *Emu* 85: 141–9.
 Fletcher, A.W.J., *et al.* 1989. *Tas. Bird Rep.* 18: 33–4.
 Gibson, D.B., & J.R. Cole. 1988. *Tech. Rep. Cons. Comm. North. Terr.* 40.
 Gibson, D.F. 1986. *Tech. Rep. Cons. Comm. North. Terr.* 30.
 Gibson, J.D. 1977. *Aust. Birds* 11: 41–74.
 Goodsell, J.T. 1990. *Aust. Wildl. Res.* 17: 219–29.
 Goriup, P.D. 1982. *Br. Birds* 75: 12–24.
 Green, R.H. 1989. *Birds of Tasmania*. Potoroo, Launceston.
 Halse, S.A., & R.P. Jaensch. 1989. *Emu* 89: 232–49.
 Hamilton, R.B. 1975. *ACOU Orn. Monogr.* 17.
 Hayman, P., *et al.* 1986. *Shorebirds*. Croom Helm, Lond.
 Hermes, N., *et al.* 1986. *Notornis* 33: 141–9.
 Hewish, M. 1986. *Stilt* 9: 21–9.
 — 1987a. *Stilt* 11: 18–22.
 — 1987b. *Stilt* 11: 23–31.
 — 1988. *Stilt* 12: 41–6.
 — 1989a. *Stilt* 14: 14–20.
 — 1989b. *Stilt* 15: 13–15.
 — 1990a. *Stilt* 16: 23–35.
 — 1990b. *Stilt* 17: 5–16.
 Hindwood, K.A. 1940a. *Emu* 39: 219–32.
 — 1940b. *Emu* 40: 1–86.
 —, & E.S. Hoskin. 1954. *Emu* 54: 217–55.
 Hobbs, J.N. 1961. *Emu* 61: 21–55.
 Hodgkins, M. 1949. *NZ Bird Notes* 3: 116–25.
 Hutchinson, B. 1969. *West. Aust. Nat.* 11: 50–2.
 Hutton, I. 1991. *Birds of Lord Howe Island, Past and Present*. Author, Coffs Harbour.
 Jaensch, R.P., *et al.* 1988. *RAOU Rep.* 30.
 Jenkins, C.F.H. 1969. *West. Aust. Nat.* 11: 50–2.
 Jessop, A.E. 1987. *Stilt* 10: 15–19.

- Johnson, R. 1990. *Silt* 17: 74.
- Jones, J. 1938. *Emu* 38: 276–80.
- Klapste, J. 1975. *Aust. Bird Watcher* 6: 14.
- Lane, B.A. 1987. *Shorebirds in Australia*. Nelson, Melbourne.
- , & A. Jessop. 1984. *Nat. Wader Count Winter 1984*. Unpubl. Rep. to Participants; RAOU, Melbourne.
- Lavery, H.J., et al. 1968. *Emu* 68: 133–47.
- Liddy, J. 1955. *Emu* 55: 297–302.
- Maclean, G.L. 1977. *Emu* 77: 199–207.
- Martindale, J. 1980. *RAOU Rep.* 1.
- Masters, J.R., & A.L. Milhinch. 1974. *Emu* 74: 228–44.
- Mathews, G.M. 1909. *Emu* 9: 1–16.
- Mayr, E., & L.L. Short. 1970. *Publ. Nuttall orn. Club* 9.
- McConkey, B.F. 1971. Unpubl. MSc thesis, Massey University, Palmerston North.
- McGill, A.R. 1954. *Emu* 54: 214–15.
- McGilp, J.N., & A.M. Morgan. 1931. *S. Aust. Orn.* 11: 37–53.
- McKenzie, H.R., et al. 1959. *Notornis* 8: 95–9.
- McKeown, K.C. 1934. *Rec. Aust. Mus.* 19: 113–35.
- McLennan, W. 1917. *Emu* 16: 205–31.
- Milledge, D. 1970. *Tasm. Nat.* 21: 3–4.
- Moncrieff, P. 1929. *Emu* 29: 215–25.
- Moon, G. 1988. *New Zealand Birds in Focus*. Weldon, Auckland.
- Morgan, A.M. 1931. *S. Aust. Orn.* 11: 53–61.
- Morris, A.K. 1989. *Aust. Birds* 23: 7–21.
- , et al. 1981. *Handlist of the Birds of New South Wales*. NSW FOC, Sydney.
- , — 1990. *Aust. Birds* 23: 44–64.
- North, A.J. 1892. *Rec. Aust. Mus.* 2: 36–8.
- Owen, K.L., & M.G. Sell. 1985. *Notornis* 32: 271–309.
- Pierce, R.J. 1980. *Notornis* 27: 21–44.
- 1982. Unpubl. PhD thesis, Otago University, Dunedin.
- 1983. *Notornis* 30: 169–85.
- 1984a. *Notornis* 31: 7–18.
- 1984b. *Notornis* 31: 106–30.
- 1985. *NZ J. Zool.* 12: 467–72.
- 1986a. *Auk* 103: 273–80.
- 1986b. *NZ J. Mar. Freshwat. Res.* 20: 17–28.
- 1990. *OSNZ News* 56: 1.
- 1992. *OSNZ News* 64: 1.
- Powlesland, R.G., & H.A. Robertson. 1987. *Notornis* 34: 327–38.
- Prater, A.J., et al. 1977. *Guide to the Identification and Ageing of Holarctic Waders*. BTO Guide 17.
- Pringle, J.D. 1987. *The Shorebirds of Australia*. Angus & Robertson, Sydney.
- Pullen, R.C. 1967. *Notornis* 14: 76–9.
- Reed, C.E.M. 1986. Unpubl. MSc thesis, Massey Univ.
- Schodde, R. 1976. *Surv. Fauna Lower MacArthur R. Region, North*. Terr. CSIRO Div. Wildl. Res. for Mimets D'ment, Canberra.
- Sedgwick, E.H. 1947. *Emu* 46: 294–308.
- Sibson, R.B. 1960. *Notornis* 9: 106–7.
- 1970. *Notornis* 17: 242.
- , & H.R. McKenzie. 1944. *NZ Bird Notes* 1: 51–7.
- Smith, F.T.H. 1966. *Aust. Bird Watcher* 2: 246–66.
- Soper, M.F., & D.G. Jardine. 1956. *Notornis* 7: 71–3.
- Stead, E.F. 1932. *Life Histories of New Zealand Birds*. Search Publ., Lond.
- Stidolph, R.H.D. 1931. *Emu* 31: 136–9.
- 1937. *Emu* 37: 4–7.
- Stokes, A.F. 1949. *Notornis* 3: 107–8.
- 1953. *Notornis* 5: 120.
- Stokes, T. 1988. *ANPWS Occ. Pap.* 16.
- , et al. 1987. *Aust. Bird Watcher* 12: 1–7.
- Storr, G.M. 1965. *Emu* 64: 105–13.
- , & R.E. Johnstone. 1988. *Rec. West. Aust. Mus. Suppl.* 28.
- , et al. 1986. *Rec. West. Aust. Mus. Suppl.* 24.
- Veitch, C.R. 1978. *Notornis* 25: 1–24.
- Vestjens, W.J.M. 1977. *Tech. Memo. Div. Wildl. Res. CSIRO, Aust.* 12.
- Wheeler, W.R. 1955. *Emu* 55: 279–95.
- Wodzicki, K.A. 1946. *Emu* 46: 3–43.
- Wood, K. 1985. *Aust. Birds* 19: 17–38.
- Woodall, P.F. 1988. *Sumbird* 18: 76–82.



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Black Stilt *Himantopus novaezelandiae* (page 769)
 1 Adult; 2 Downy young; 3 Juvenile; 4 First immature; 5 Adult

Black-winged Stilt *Himantopus himantopus* (subspecies *leucocephalus*) (page 758)
 6 Adult; 7 Downy young; 8 Juvenile; 9 First immature; 10 Adult; 11 Adult