

## 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.                                   |
| 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.    |
| 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, Jacaniidae) 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 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 HAEMATOPODIDAE oystercatchers

Rather large (40–49 cm long) black or pied waders, heavily built, with sturdy legs, and long straight robust bills. About 21 species and subspecies, all in single genus *Haematopus*; almost worldwide on temperate and tropical coastlines. Species limits uncertain (Baker 1975, 1977); rather uniform structure and simple patterns of plumages not reflecting well any generic differentiation of allopatric species and subspecies; as few as three species and as many as twelve have been recognized. The relationships and arrangement of species or subspecies continues to be debated; we treat as five species in our region, two endemic to Aust. and three to NZ and Chatham Is. Probably most closely related to *Recurvirostridae* (q.v.); intermediate anatomically and behaviourally between *Scolopacidae* and *Laridae*.

Solidly built. Sexes similar; females slightly larger than males. Necks stout; 15 cervical vertebrae. Wings, long and pointed; 11 primaries (p11 minute), 18–20 secondaries and moderately large carpal knob. Tails, short and square; 12 rectrices. Bills, long and straight, laterally compressed; adapted for opening shells and chiselling molluscs off rocks, with muscles of jaw and neck strongly developed (Burton 1974). Bills range from blunt and square-tipped to pointed; length and shape of bill-tip varying in individuals according to choice of prey and feeding substrate (Hulscher & Ens 1991). Nostrils, pervious; schizorhinal. Legs, stout and rather long; tarsi, reticulated with small hexagonal scales. Toes, stout, only transversely scutellated on distal half; slightly webbed at base, no hallux. Caeca present. No crop. Large supraorbital glands.

Plumages, black or blackish brown, some species with white underparts, rump and wing-bars. Bills, legs and feet, orange or pink to red; irides, scarlet or yellow; orbital rings, reddish (yellow in *H. leucopodus*). Two moults per cycle. Post-breeding moult, complete, primaries outwards; pre-breeding moult, partial but only in Eurasian Oystercatcher *H. ostralegus* do breeding and non-breeding plumages differ markedly. Young hatch in soft woolly down; most species, brownish grey, with white belly and vent, all with dark lines and spots above forming simple pebbled pattern, similar to that of *Burhinidae*. Juveniles, duller scalloped versions of adult with darker bare parts; first breed at about 3–5 years. Stand erect or with neck hunched and bill pointing down. Flight, direct and fast with rather shallow wing-beats.

Typically of coastlines, especially in rocky areas, though many also use sandy beaches or mudflats. Eurasian *H. ostralegus* and South American *H. leucopodus* Oystercatchers also have inland breeding distribution and, in NZ, *H. finschi* breeds chiefly on braided rivers or nearby farmland; even these chiefly coastal in non-breeding period. Most species sedentary or with only local movements during non-breeding period; some populations of Eurasian Oystercatchers *H. ostralegus* strongly migratory. Many oystercatchers specialize in feeding mostly on molluscs and crustaceans, including hard-shelled barnacles, chitons, limpets and pelecypods, which few other birds can attack. Considerable strength and skill required to open such prey; feeding techniques vary with type of prey and may take a long time to become proficient. Other invertebrate prey taken, especially when feeding on mudflats or farmland, including polychaete and oligochaete worms, and insects.

Breed solitarily, spaced out in defended territories. In non-breeding season, form small groups to large flocks (more so in black-and-white species), though resident pairs may stay on territories with local movements of subadult and non-breeding birds. Monogamous; pair-bonds in those species studied usually life-long, with divorce rare. Courtship, territorial and distraction displays well-developed. Both sexes incubate and attend the young. Most conspicuous vocalizations of all species are loud piping calls in display and alarm.

Breed seasonally. Nests, simple scrapes crudely lined with any suitable material near at hand. Eggs, rounded oval, buffish to whitish and fairly glossy, with varying but heavy blotches, spots and streaks of black-brown. Clutch-size, 2–4. Incubation period, 25–28 days. Young hatch in down; precocial, nidifugous; can run as soon as down is dry and can swim and dive at need. Young fed by adults and fledge at about 5 weeks.

### REFERENCES

Baker, A.J. 1975. *J. Zool. Lond.* 175: 357–90.  
— 1977. *Bijdr. Dierkde* 47: 156–64.

Burton, P.J.K. 1974. *Feeding and the Feeding Apparatus in Waders*. Br. Mus. (Nat. Hist.), Lond.  
Hulscher, J.B., & B.J. Ens. 1991. *Proc. Int. orn. Congr.* XX: 889–96.



*Haematopus unicolor* Variable Oystercatcher

COLOUR PLATE FACING PAGE 713

*Haematopus unicolor* J.R. Forster, 1844, *Descr. Anim.*, ed. Licht., p. 112 — Dusky Sound, New Zealand.

The specific Latin epithet (one-coloured) is a misnomer caused by the first specimen described being all black.

OTHER ENGLISH NAMES Black Oystercatcher, North Island Pied Oystercatcher, Red-bill, Black Red-bill.

The English name, at variance with the scientific, refers to the variable black and white plumage of the species.

## MONOTYPIC

**FIELD IDENTIFICATION** Length: 47–49 cm; weight: 715 g. Largest oystercatcher in NZ; sturdy, all-black or black-and-white shorebird, with long orange bill and short stout pinkish legs and feet; slightly larger and bulkier than South Island Pied Oystercatcher *Haematopus finschi*, with shorter, more deeply based bill. Polymorphic: plumage varies from entirely black to pied, latter similar to South Island Pied Oystercatcher. Sexes alike; female slightly larger with distinctly longer bill. Juvenile and immature, separable.

**Description** **Adult Black morph** Entirely glossy black, becoming duller, brownish black with wear. Bill, bright orange, paler yellowish at tip in some. Iris, scarlet. Orbital ring, bright orange. Legs and feet, coral-pink. **Pied morph** Head, neck, breast and most of upperparts, glossy black. In flight, upperwing black with white even wing-bar across bases of secondaries, tips of greater secondary coverts and inner three secondaries, meeting trailing-edge of wing; and squarish white patch on upper tail-coverts, with square-cut but smudged demarcation with black of back. Sharpness of demarcation between black and white on breast varies, usually have broad zone of blackish smudging, but may appear quite sharp, though always with some black smudging on sides of breast, which may be covered by carpal. Usually no white shoulder tab, though some have small one, always heavily smudged with black and often covered by carpal. Rest of underbody, white, except for tuft of blackish on rear of tibia. Underwing, glossy grey-black with broad white band through centre of lining. Bare parts as black morph. **Intermediates** Continuous gradation between black and pied morphs, with most more black than pied, usually with some white round vent and on wing, and more black on belly, upper tail-coverts and under wing-coverts correlated with reduction in size of wing-bar. Birds that are most pied have white of underbody heavily mottled and smudged with black; those that are more blackish, by mostly black underbody with messy white barring on belly and, usually, some white on vent. Bare parts, as other morphs. **Juvenile** Morphs distinguishable from hatching. Black areas of plumage noticeably duller, blackish brown, grading to darker blackish on head, neck and breast; feathers of mantle, back, scapulars, tertials, inner wing-coverts and, on dark intermediates and black morphs, lower breast, belly and vent, have narrow creamy fringes, soon lost with wear. Bill, dull orange at base, grading through pinkish brown to greyish tip. Iris, dark brown. Orbital ring, yellowish. Legs and feet, dark grey. **Immatures** Plumage as adult. At first, have very dull bare parts as juvenile; in older immatures, bare parts intermediate between adult and juvenile: bill, orange; iris, orange-red to red; orbital ring, dull orange; legs and feet, light pink to pink.

**Similar species** Black morph unmistakable in NZ. Intermediate morph distinguished from other NZ oystercatchers by much

black smudging on white underparts or mostly black underparts with messy white barring on belly and, usually, some white on vent. Pied morph easily confused with **South Island Pied Oystercatcher** (q.v.) but black and white of Variable always less clear cut; could also be confused with **Chatham Island Oystercatcher** *Haematopus chathamensis* (q.v.), though ranges do not overlap.

In pairs during breeding season. In winter, occasionally gather in flocks of up to 150 birds; often join larger flocks of South Island Pied Oystercatcher but rarely associate closely with other waders. Mainly coastal, never more than 30 km from sea. Breed and feed on sandy and rocky coasts, especially near mouths of rivers; also feed in estuarine areas, but usually avoid larger harbours. Feed by probing and prising open mussels and other invertebrates. Gait similar to that of South Island Pied Oystercatcher but heavier; flight also similar: low, level and direct, with rapid shallow wing-beats, accompanied by loud contact calls. Vocal, both in flight and during courtship and territorial defence. Calls similar to those of South Island Pied Oystercatcher, but slightly deeper and less piercing.

**HABITAT** Based on contribution from H.A. Robertson. Coasts of mainland NZ and offshore islands, but not outlying islands. Littoral, favouring sandy coasts, especially near estuaries or sand-spits; on shell banks, rocky shores or islets; rarely on boulder-strewn shores or gravel beaches. Occasionally feed and breed on shores of inland brackish or freshwater lakes, but never >30 km from sea. Not known to breed or feed regularly at hypersaline lakes. Post-breeding flocks generally avoid large muddy harbours favoured by South Island Pied Oystercatchers. On sandy beaches and estuaries, forage in shallow water, on wet sand or among tide-wrack at high-water mark. On rocky shores, rarely forage in water, but occasionally round shallow rock pools on wave-cut platforms, or, more often, on rocks close to water-level. Occasionally forage inland on lush pastures after rain. At high tide, roost on beach; occasionally congregate on short pasture, ploughed paddocks, golf courses or playing fields near coast (Baker 1973a, 1974c; Sibson 1975; Owen & Sell 1985; Robertson 1992; Oliver; NZCL; H.A. Robertson). Some birds feed on commercial floating mussel beds (H.A. Robertson).

Usually nest just above high-water mark on sandy beaches, spits or islands (Owen & Sell 1985; Powlesland & Robertson 1987; Oliver; H.A. Robertson); well above high-water mark on rocky shores (Falla *et al.* 1981; Moon & Lockley 1982); occasionally on shingle (Oliver). On wide sand-spits on undeveloped coasts, nests may be >100 m from shore, sometimes in dunes (Moon & Lockley 1982; H.A. Robertson). Once recorded breeding among mangroves near shelly spit (Walter 1984). Also said to



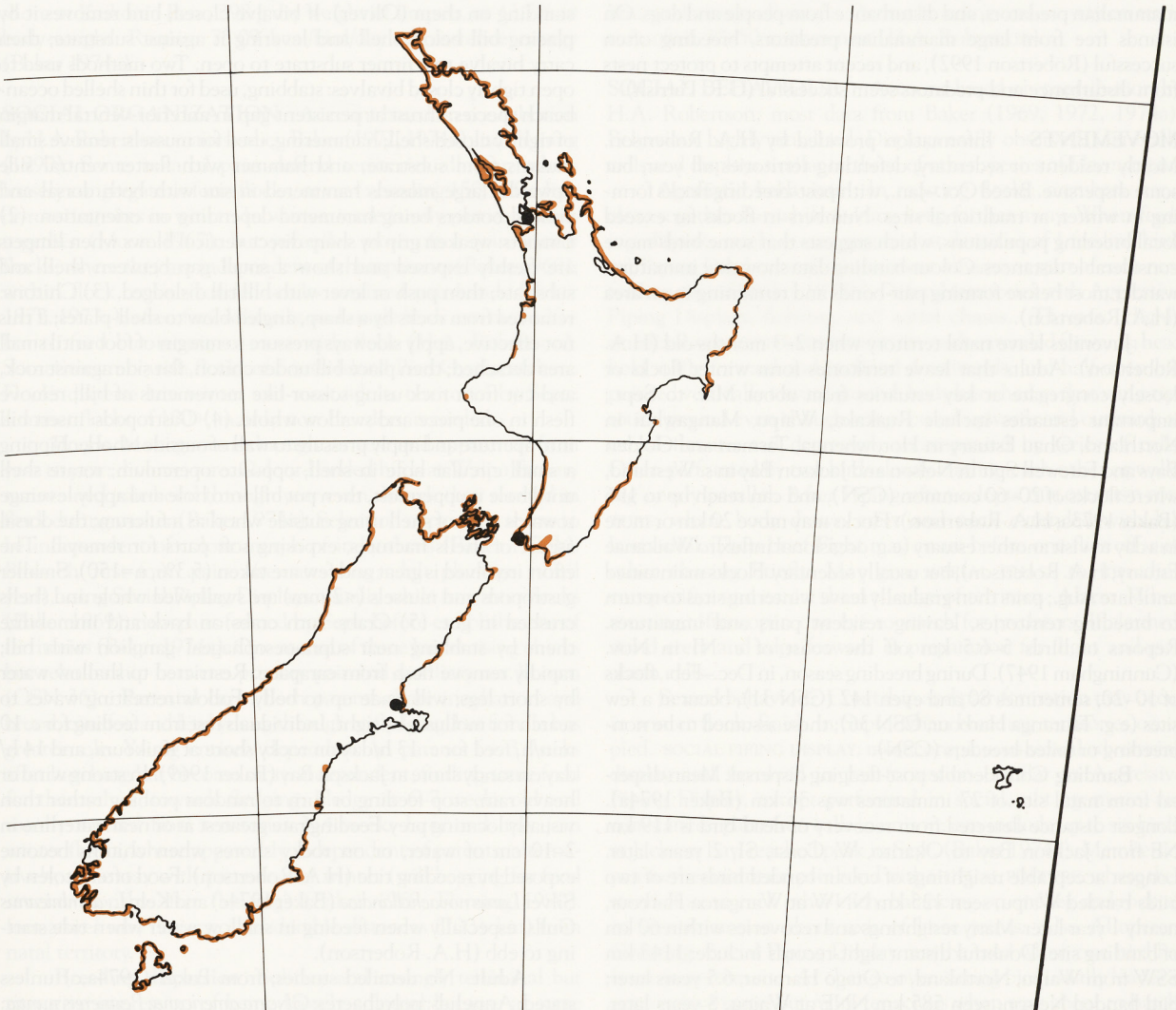
be sometimes situated on cliff-ledges, tops of rocks or under shrubs (NZRD).

Large parts of favoured habitat along sandy coastlines, especially near small estuaries, have been lost because beaches developed for housing.

**DISTRIBUTION AND POPULATION** Endemic to NZ; scattered round coasts of mainland and offshore islands, but not outlying islands. Information supplied by H.A. Robertson, based on OSNZ winter and summer wader counts (P.M. Sagar) and NZ Atlas, unless otherwise stated.

**NI** Most abundant along ne. coast from North Cape to East Cape, and round Wellington. **NORTHLAND:** total c. 1000 birds; e. coast and inshore islands; occasionally on offshore islands (e.g. Poor Knights, Hen & Chicken Is); 100+ birds all year at Waipū Estuary, in summer at Whangarei Harbour, and in winter at Parengarenga Harbour, Great Exhibition Bay and Ruakaka Estuary; few w. coast, though 30–40 breeding Ninety Mile Beach with 100+ birds in winter (Edgar 1971; H.A. Robertson). **AUCKLAND,** s. **AUCKLAND:** common e. coast, with 100+ at Mangahai in winter; inshore islands of Hauraki Gulf and Great Barrier I.; rarely Little Barrier I. **BAY OF PLENTY:** total c. 800 in Coromandel–Bay of

Plenty; common Coromandel Pen.; 40+ recorded Matakana I., Tauranga, Maketu, Little Waihi and Ohope and Ohiwa Harbours; a few pairs on most estuaries from Opotiki to East Cape. **GISBORNE, HAWKE'S BAY:** widely distributed from East Cape to Muriwai Lagoon; common e. coast Mahia Pen. and Portland I.; uncommon Hawke's Bay, with a few birds between Mahia and Wairoa and at Mohaka R. and Ahuriri Estuary 4–5 pairs breed Porangahau Estuary (G. Foreman; C. McRae; H.A. Robertson; OSNZ). **WAIRARAPA:** 1–2 pairs at mouths of most main rivers; several pairs nest L. Wairarapa (B.D. Heather; H.A. Robertson). **WELLINGTON:** c. 20 pairs breed Wellington Harbour, including Somes I. and Taputeranga Is with increase in numbers in winter; also 1–2 pairs Mana and Kapiti Is and Waikane Estuary (Fleming 1990; T. Hook; H.A. Robertson). **MANAWATU:** Ohau Estuary: 12–15 pairs breed, up to 81 in winter (CSN 38); small numbers Hokiō, Manawatu and Rangitikei estuaries. **WANGANUI–TARANAKI:** <20 birds on estuaries between Turakina and Kawhia. **WAIKATO:** small numbers Kawhia and Aotea Harbours, mouth of Waikato R., and other estuaries or along w. coast to Manukau Harbour. **SI** Most common round Tasman and Golden Bays, and Fiordland; rare on e. coast between Cloudy Bay and Dunedin. **MARLBOROUGH, CANTERBURY:** probably 100+ scattered round Marlborough





Sounds; rare e. coast to Christchurch, though 10–20 Kaikoura Pen., and a few scattered along rest of coast. OTAGO: c. 50 s. Otago and Catlins in winter; uncommon elsewhere, congregating Blueskin Bay, Aramoana and Hoopers and Papanui Inlets. SOUTHLAND: scattered along s. mainland coast; 150 birds on Stewart I. and associated islands (A. Roberts), including Codfish, Centre, Ruapuke and Solander Is; 400–500 birds on coasts and islands of Fiordland (I. Flux; J. Maxwell). WEST COAST: scattered along coast from Jackson Bay (c. 50 birds) to C. Farewell, including Open Bay Is, Okuru and Haast Estuaries and Okarito Lagoon (Baker 1969, 1972). NELSON: scattered round the coast, with c. 20 pairs breeding Farewell Spit, 10–20 birds at Golden Bay, and 50–100 at Tasman Bay, with greater numbers (40–140) at these sites in winter.

#### Breeding

Throughout range. Status, rare (Bell 1986). Total population c. 3900 birds (H.A. Robertson); c. 2600 on NI; c. 1150 on SI (I. Flux; J. Maxwell). Densities in Wellington Harbour vary seasonally from 60 birds/100 km to 140 birds/100 km. Populations have apparently increased in several regions: in Northland; round Coromandel–Bay of Plenty; Wellington Harbour (78% increase between 1975–77 and 1986–88) (Robertson 1992); Canterbury (A. Crossland). Legally shot until 1922, when protected; some still shot. Low breeding success from predation of eggs and chicks by introduced mammalian predators, and disturbance from people and dogs. On islands free from large mammalian predators, breeding often successful (Robertson 1992), and recent attempts to protect nests from disturbance and predators seem successful (G.R. Parrish).

**MOVEMENTS** Information provided by H.A. Robertson. Mostly resident or sedentary, defending territories all year, but some dispersive. Breed Oct.–Jan., with post-breeding flocks forming in winter, at traditional sites. Numbers in flocks far exceed local breeding populations, which suggests that some birds move considerable distances. Colour-banding data show that immatures wander most before forming pair-bonds and remaining in an area (H.A. Robertson).

Juveniles leave natal territory when 2–3 months old (H.A. Robertson). Adults that leave territories form winter flocks or loosely congregate at key estuaries from about Mar. to Sept.; important estuaries include Ruakaka, Waipu, Mangawhai in Northland, Ohau Estuary in Horowhenua, Tasman and Golden Bays and Farewell Spit in Nelson and Jackson Bay in s. Westland, where flocks of 20–60 common (CSN), and can reach up to 196 (Baker 1973a; H.A. Robertson). Flocks may move 20 km or more in a day to visit another estuary (e.g. occasional influx to Waikanae Estuary; H.A. Robertson), but usually sedentary. Flocks maintained until late Aug.; pairs then gradually leave wintering sites to return to breeding territories, leaving resident pairs and immatures. Reports of birds 5–6.5 km off the coast of e. NI in Nov. (Cunningham 1947). During breeding season, in Dec.–Feb., flocks of 10–20, sometimes 80 and even 142 (CSN 31), occur at a few sites (e.g. Tauranga Harbour, CSN 36); these assumed to be non-breeding or failed breeders (CSN).

**Banding** Considerable post-fledging dispersal. Mean dispersal from natal site of 27 immatures was 36 km (Baker 1974a). Longest distance detected from recovery of dead bird is 119 km NE from Jackson Bay to Okarito, W. Coast, SI, 2 years later. Longest acceptable resightings of colour-banded birds are of two birds banded Waipu, seen 125 km NNW at Wangaroa Harbour, nearly 1 year later. Many resightings and recoveries within 60 km of banding site. Doubtful distant sight-records include: 1143 km SSW from Waipu, Northland, to Otago Harbour, 6.5 years later; bird banded Nelson, seen 585 km NNE at Waipu, 8 years later,

then 1325 km SSW at Stewart I., 2 more years later (H.A. Robertson); record of pullus banded Waipu, 570 km away at Eastbourne, near Wellington, 15 months later (NZRD). Oldest birds recovered dead are 19 years 10 months (banded as adult female at Catlins, Otago) and 17 years 3 months (banded as a juvenile at Waipu) (H.A. Robertson).

**FOOD** Molluscs, crustaceans and worms. **Behaviour** Diurnal and nocturnal, influenced by tidal cycle: no feeding for c. 2 h either side of high tide, then suddenly start to feed as tide ebbs; feeding rate greatest during mid-ebb, with marked decline at about low tide; cessation of feeding before high tide varies individually (Baker 1974c). Forage on open beaches, rocky shorelines, wet pasture and estuarine mudflats especially during winter. Appear to locate prey visually but when substrate obscured, e.g. by water or darkness, locate prey by random probing. Following methods of foraging and feeding observed (mainly from Baker 1974c): (1) Bivalves: locate bivalves by looking for syphon and then probing; probing rate, 15.6 probes/10 min (0.88; 22) with success rate, 45.7% (2.45; 22). If bivalve open, thrust bill into gape using minimum dimension of bill (width <1 mm), then turn bill and body through 90°, usually to left (86.1%, n=36), so that 9–12 mm depth of bill forces valves wider apart or snaps adductor muscles; hold shells down with pressure exerted by bill, or by standing on them (Oliver). If bivalve closed, bird removes it by placing bill below shell and levering it against substrate; then carry bivalve to a firmer substrate to open. Two methods used to open tightly closed bivalves: stabbing, used for thin shelled ocean-beach species: thrust at persistent gap in anterior-ventral margin of tightly closed shell; hammering, used for mussels: remove small mussels from substrate, and hammer with flatter ventral side upwards; large mussels hammered *in situ* with both dorsal and ventral borders being hammered depending on orientation. (2) Limpets: weaken grip by sharp direct vertical blows when limpets are freshly exposed and show a small gap between shell and substrate; then push or lever with bill till dislodged. (3) Chitons: removed from rocks by a sharp, angled blow to shell-plates; if this not effective, apply sideways pressure to margin of foot until small area detached; then place bill under chiton, flat side against rock, and cut from rock using scissor-like movements of bill; remove flesh in one piece and swallow whole. (4) Gastropods: insert bill into aperture and apply pressure to wall of outside whorl, chipping a small circular hole in shell, opposite operculum; rotate shell until hole is uppermost, then put bill into hole and apply leverage towards apex of shell using outside whorl as a fulcrum; the dorsal aspect of shells fractures, exposing soft parts for removal. The effort involved is great and few are taken (5.3%, n=150). Smaller gastropods and mussels (<2 mm) are swallowed whole and shells crushed in gut. (5) Crabs: turn crabs on back and immobilize them by stabbing near supra-oesophageal ganglion with bill; rapidly remove flesh from carapace. Restricted to shallow water by short legs; will wade up to belly. Follow retreating waves to search for molluscs by sight. Individuals rest from feeding for c. 10 min/h, feed for c. 13 h/day on rocky shore at Kaikoura, and 14 h/day on sandy shore at Jackson Bay (Baker 1969). In strong wind or heavy rain, stop feeding or turn to random probing rather than visually locating prey. Feeding rate greatest at or near waterline in 2–10 cm of water, or on rocky shores when chitons become exposed by receding tide (H.A. Robertson). Food often stolen by Silver *Larus novaehollandiae* (Baker 1974c) and Kelp *L. dominicanus* Gulls, especially when feeding in shallow water when tide starting to ebb (H.A. Robertson).

**Adult** No detailed studies; from Baker (1974a,c) unless stated: Annelids: polychaetes: *Glycera americana*; *Perinereis nuntia*;



oligochaetes: *Allolobophora caliginosa*. Molluscs: small univalves (Heather 1980); polyplacophorans: *Chiton pelliserpentis*; *Chiton glaucus*; gastropods: *Haliotis iris*; *Cellana denticulata*, *C. ornata*, *C. radians*, *C. flava*; Common Topshell *Dialoma aethiops*; Common Mud Whelk *Cominella glandiformis*; *C. lucida*; Small Horn Shell *Zeacumantus subcarinatus*; bivalves: Mytilidae: green mussel (Jones 1979); Blue-lipped Mussel *Mytilus edulis aoteanus*; *Aulocomya maoriana*; *Modiolus neozelandicus*; *Perna canaliculus*; *Xenostrobus pulex*; cockle *Chione stutchburyi*; Pipi *Paphia australe* (Baker 1974a,c; CSN 24); Tuatua *P. subtriangulatum* (Baker 1974a,c; Jones 1979; CSN 24); Large Wedge Shell *Tellina liliana*; Ribbed Venus Shell *Protothaca crassicosta*; *Dosinia anus*; *D. subrosea*. Crustaceans: isopods: *Dynamanella huttoni*; amphipods: sandhopper *Talorchestia* (Baker 1974a; Powlesland & Robertson 1987); crab: *Helice crassa*; *Hemigrapsis edwardsii*. Size-range of molluscs from c. <2 cm to 10 cm with no selection on size (Baker 1969).

**Young** Not studied. Fed by parents. Apparently similar to adults as no switch in diet of adults feeding young has been noticed (H.A. Robertson).

**Intake** Handling time of food varies greatly, e.g. from few seconds to 3–4 min for some chitons. Feeding rate on cockles, 15.6 probes for 7.2 cockles/10 min (46% success) (Baker 1974c). Daily intake on sandy ocean beach at Jackson Bay, W. Coast, 245 g dry weight of Tuatua *Paphia*, or 35.8% of body-weight; on rocky shore at Kaikoura Pen., 298 g dry weight of limpets, or 43.7% of body-weight. Require 75.09 kcal/bird/day of existence energy (Baker 1974a).

**SOCIAL ORGANIZATION** Account based on contribution by H.A. Robertson; main studies: Baker (1972, 1974a) and Fleming (1990). Some isolated pairs defend territories all year, others loosely congregate or form flocks, never exceeding 150, at feeding or roosting sites in winter. In winter, some family parties remain together (Moon 1967), but juveniles more often join winter flocks, where they are independent of their parents (Baker 1969); within flock, colour-banded adults retained pair-bonds (Baker 1972, 1973a); often feed solitarily, and single birds can move 20+ km to feed but return to roost with flock (H.A. Robertson). Sometimes mix with flocks of South Island Pied Oystercatchers. Flocks disperse late winter and most adults territorial by Sept.; summer flocks of 100+, mainly non-breeders, recorded.

**Bonds** Monogamous throughout year and apparently from year to year; divorce, rare. Colour-banded birds at Waipu Estuary maintained pair-bond through year even though they roosted in flock during winter (Baker 1974a). Selection of partners seems to be independent of colour morph of individuals (Baker 1973b). Probably first form pairs after attaining adult plumage (third year), using Social Piping Displays, usually while in winter flocks (Baker 1969); new pairs formed by Sept. before establishment of territories (Baker 1974a). One record of three birds raising chicks but relationship between primary pair and auxiliary not known (CSN 36). **Parental care** Both parents share incubation and brood, care for, and feed young through to fledging, but female has greater role. Young entirely dependent on parents for 3 weeks after hatching but become more independent, finding some food for themselves, towards fledging. Fledge at 6–7 weeks old and usually evicted from territories 3–4 weeks later and may join winter flocks, where apparently independent of parents; alternatively, some stay with parents over winter (still begging for food several months after fledging) (Baker 1969; Fleming 1990). Immatures may disperse considerable distances (100+ km) from natal territory.

**Breeding dispersion** Solitary and strongly territorial but may give impression of being loosely colonial because at

estuaries there are few breeding sites, e.g. 11 pairs in 1.5 km of coast at Ohau Estuary in 1991 (H.A. Robertson). **Territories** Many held all year, but often abandoned in winter and reclaimed in spring; often stable from year to year (Moon 1967; Baker 1969). At Ohau Estuary, 11 territories average c. 2 ha at high tide and 5 ha at low tide (H.A. Robertson); at Jackson Bay and Farewell Spit, 12 territories average 18 ha (Baker 1969). Generally all-purpose, with birds normally feeding on shore next to breeding site, but sometimes several pairs will feed together more than 1 km away from breeding territories. Nest-site usually determined by topographic features rather than distance to edge of territory (H.A. Robertson).

**Roosting** Related to tidal cycles; usually at high tide. Sites often traditional on rocky or estuarine shores (e.g. promontories, rock stacks, shell banks, or sandbanks) because suitable places are few; varies on sandy shores. Site used determined by tide and weather conditions, and presence of other roosting birds. Sometimes at high tide or after wet weather, small flocks congregate inland to feed or roost (Robertson 1992). Outside breeding season, often join conspecifics or roosting flocks of South Island Pied Oystercatchers, rarely with other waders. Arrive and leave high-tide roosts c. 2 h either side of high tide. When feeding on rocky shores, individuals rest for c. 10 min/h (Baker 1969). Normally form small roosting flocks at low water on estuaries, near tide-line, or drainage channels. During breeding season, stay on territory, often 30–50 m from nest (H.A. Robertson).

**SOCIAL BEHAVIOUR** Account based on contribution by H.A. Robertson; most data from Baker (1969, 1972, 1974a). Behaviour highly ritualized. Displays easily observed. Generally calls and displays similar to those of other species of *Haematopus*.

**Agonistic behaviour** In roosting flocks, members stand close together but while feeding keep farther away. When feeding, disputes rarely occur; apparent keep at densities of 1 feeding bird/m<sup>2</sup>; Piping Displays and fighting most obvious at start of each new feeding period (Baker 1974b). Defend territories with Aggressive Piping Displays, fighting, and aerial chases. **Threats** Highly ritualized **AGGRESSIVE PIPING DISPLAY**: neck extended forwards; head held stiffly forward and inclined downwards, and half-open bill pointed vertically toward ground; body hunched so that wing-tips touch ground even though wings raised upwards and outwards at carpal flexure; tail depressed; accompanied by series of calls. Often performed by two birds slowly circling each other or walking nearly parallel. After Piping often adopts **DIPLOMATIST POSTURE**, where body drawn erect and neck extended with bill horizontal. Then brief **Fight** may ensue before one flies off with other chasing briefly. May give **AERIAL CHASE** to intruding conspecifics and escort them to edge of territory. **Alarm** When roosting, often open one eye to watch for predators. If alarmed, stand erect and edge forward in preparation for flight and give alarm calls.

**Sexual behaviour** Courtship and pair-formation may occur in winter flock; finish in Sept., when breeding territories occupied. **SOCIAL PIPING DISPLAY**: most conspicuous sexual advertising display and involved in pair-formation; similar to Aggressive Piping Display, except performed in social, not agonistic, circumstances; pair often calls in unison; can include up to six birds; at Jackson Bay, reached peak in Sept. (Baker 1974a). Members of pair further maintain pair-bond with **MUTUAL POSTURE**, where they stand close to each other each, balancing on one leg and rocking in seesaw motion about axis of knee joints. Also **Allopreen**. **Greeting** Social Piping Display may be used when one bird has been away from site. At change-over, sitting bird usually leaves at approach of mate, but more tenacious when eggs about to hatch,



and mate may have to prise sitting bird off nest, or lure it away by feigning injury (Baker 1969). Relieving bird usually turns eggs with bill, lowers feathers surrounding brood-patch, shuffles body, and kicks out loose sand from scrape (Moon 1967; Baker 1969).

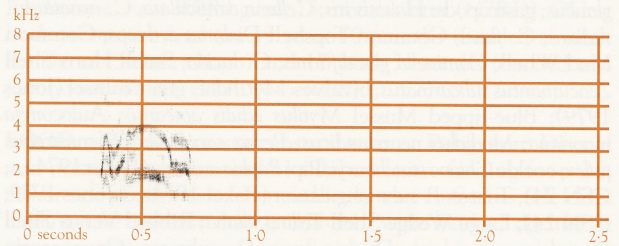
**Copulation** Usually preceded by specific PRE-COPULATORY POSTURE: male approaches stealthily, hunched, with head drawn between shoulders and held to one side of body, body lowered, and tail fanned and depressed. Responsive female assumes passive posture, raising body higher above ground than usual, and raising tail-feathers. Male mounts from behind and balances by flapping wings. Occasionally male does not adopt pre-copulatory posture, either walking up to female or flying onto back of female from close by. Copulation mainly occurs in lead-up to, and not after, laying; sometimes recorded in winter, when probably serves to strengthen pair-bond.

**Relations within family group** When feeding small young, adult stands motionless with bill pointing down and food in tip of bill just above ground and chick pecks food from bill; later, chick begs with neck withdrawn and head at or below level of back, body-feathers puffed out, and giving soft mewling call; often chick rubs bill against chest of adult as they run back and forth in front of adult. Older siblings appear independent of one another, often leaving natal territory at different times (Fleming 1990). **Anti-predator responses of young** Respond to alarm calls of parents by seeking cover, crouching flat, or moving into river or lagoon, where they dive and swim well. **Parental anti-predator strategies** For ground predators, including people, non-incubating bird gives Alarm Call to mate and walks away from nest conspicuously, and false-broods or false-feeds while mate slips quietly off nest. Show increasing response as incubation proceeds, and at maximum at hatching and when chicks very small. When most agitated, birds walk just ahead of predator, calling, and feigning broken wing. Adult displacement activities include picking up and throwing small sticks or shells, and false-sleeping.

**VOICE** Well known; account based on Baker (1969, 1974a); sonagrams of pairs of black, pied and intermediate morphs in Baker (1974a). Flight calls and piping most noticeable. Particularly noisy during breeding season when defending territory or nest; Social Piping peaks in Sept. Calls loud and harsh, given at any time of day. Both male and female call in Piping Display, often in unison; no difference in calls between sexes reported. No difference in piping calls apparent between black, pied and intermediate morphs; similar in structure to but of lower pitch than calls of Chatham Island and South Island Pied Oystercatchers.

**Adult SOCIAL PIPING:** starts with sharp *pic* notes, gathering in volume and pitch, slowing into prolonged chorus of high-pitched calls *kervee-kervee-kervee...*, and ending in short lower trilling phrase. Male and female may call simultaneously, often in unison. May stimulate other birds to join in. Sonagrams in Baker (1974a) show that pipings of pied, black and intermediate morphs have fundamental frequency of just over 2 kHz and first harmonic of c. 4.5 kHz, with no additional harmonics; however, calls of Chatham Island and South Island Pied Oystercatchers, while similar in structure and frequency, have additional harmonics in some parts of call, up to 15 kHz, supporting claim that they sound more highly pitched (Baker 1974a). **AGGRESSIVE PIPING:** calls identical to those of Social Piping but associated with aggressive Piping Display during disputes over food, feeding sites and territorial boundaries. **ALARM CALL:** sharp *hu-eep* (sonagram A) or sharp *click* to warn chicks of danger; shrill noise, not piping, by mate of bird diving at and hitting intruder (Jones 1979) probably this call. **FLIGHT CALL:** loud *kleep* in flight, apparently to maintain contact between birds in air (especially at night) or to elicit same calls

from birds on ground. Often heard at night as birds move along coast (H.A. Robertson).

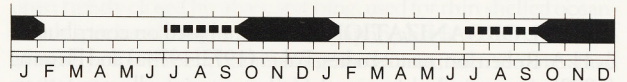


A. L. McPherson; Kaikoura Pen., SI, NZ, Dec. 1982; P36

**Young** Quiet mewling from chicks begging for food.

**BREEDING** No detailed studies. Information mainly from Moon (1967), Baker (1969) and analysis of NZ NRS (H.A. Robertson). Breed in simple pairs, solitarily, but often near other pairs. Often associated with New Zealand Dotterel *Charadrius obscurus* in n. NZ, occasionally with Kelp Gull, Silver Gull, White-fronted Tern *Sterna striata* or Caspian Tern *Hydroprogne caspia*.

**Season** Laying, mid-Sept. to early Feb., peak in Nov.; slightly later on NI; experienced breeders probably start earlier; most clutches after mid-Dec. are replacements (Baker 1969; NZ NRS).



**Site** On beaches, favouring sand spits at mouth of small streams, lake shores, rocky islands, platforms, just above spring high-tide line and with good all-round visibility; 78% on sandy beach, 15% on shingle beach, 6% on rock platform, and 1% on shore of lakes (Baker 1969); occasionally on gravel river beds up to 30 km inland (H.A. Robertson). Often close to clump of marram, a piece of driftwood, kelp *Durvillea antarctica* or other debris, such as plastic containers, which provide shelter and serve as a distinctive marker (Moon 1967; Baker 1969; H.A. Robertson). One nest found on roof of duck-shooters hide in estuary (G.A. Taylor). Nest often made conspicuous on calm days by trail of footprints to and from nest (Moon 1967). Nest-site changes within and between seasons (Moon 1967; Fleming 1990).

**Nest, Materials** Cup-shaped depression in ground, usually unlined, occasionally lined with dry seaweed, driftwood, shells, sticks or leaves (Moon 1967; Baker 1969; Oliver). Scrape made by bird pressing breast against ground, raising rear-end, and then pushing legs back to bulldoze out a scrape with breast; angle of body is changed and pattern repeated (Baker 1969). After laying, both sexes maintain scrape by kicking out wind-blown sand (Moon 1967). Often several trial scrapes made before one selected for final nest (Moon 1967). **MEASUREMENTS** (cm): diameter, 15; depth, 7 (n=16; Baker 1969).

**Eggs** Ovate, slightly pyriform; smooth to finely pitted; ground-colour varies from stone to olive-grey or pale olive, with irregular blotches and streaks of rufous-brown to sepia-black, distributed over shell, but slightly more concentrated at larger end. **MEASUREMENTS:** (mm) 58.6 (1.9; 36) x 40.9 (2.7; 36) (Baker 1969); 58.8 (2.23; 35) x 40.9 (0.98; 35) (Baker 1974a). **WEIGHT:** (g) fresh eggs: 48.2 (1.7; 23) (Baker 1969); 49.4 (1.84; 14) (Baker 1974a).

**Clutch-size** Usually 2–3, range 1–5 (Fleming 1990; NZ NRS); mean 2.4 (0.6; 1–4; 208): C/1 x 11, C/2 x 102, C/3 x 94,



C/4 x 1 (NZ NRS). Slight increase with latitude: Northland, 2.3 (0.6; 1–4; 124); other NI, 2.5 (0.6; 1–3; 48); SI, 2.6 (0.5; 2–3; 36) (NZ NRS). Marked decrease through season: Sept.–Oct., 2.6 (0.6; 1–3; 28); Nov. 2.5 (0.6; 1–4; 103); Dec. 2.2 (0.6; 1–3; 57); Jan.–Feb. 2.0 (0.6; 1–3; 20) (NZ NRS).

**Laying** Eggs laid at intervals of 48 h (36–52) (Baker 1969). Apparently eggs usually laid in afternoon (Moon 1967; Baker 1969). Will re-lay after failure of eggs or small young; interval between failure and re-laying not known, but pairs known to have laid two clutches within 25 days.

**Incubation** Starts when last egg laid (Baker 1969), but hatching asynchronous; can be spread over 2–3 days (NZ NRS). Both sexes incubate; female takes greatest share during day, usually in stints of c. 2 h, male c. 1 h (Moon 1967; Baker 1969). One record of New Zealand Dotterels successfully sharing incubation after losing their own clutch (NZ NRS). **INCUBATION PERIOD:** 28.4 days (3.9; 25–32; 15) (Baker 1969), sometimes over 33 days (NZ NRS); longest unsuccessful incubation, over 81 days (Fleming 1990). Chicks call from within egg 2–3 days before hatching (Baker 1969); first pipping to hatching, usually c. 36 h.

**Young** Precocial, nidifugous. Down at hatching: back, sandy with dark streaks irrespective of final plumage; belly: brown (black morph); white (pied morph); or mixture of brown and white (intermediates); some black morphs have dark head (Baker 1972, 1973b). Remain in nest for 1–2 days. **Growth** No information. **Parental care, Role of sexes** Both parents brood chicks for first 36–48 h. Parents feed young, bill to bill, from hatching to fledging, and occasionally after fledging. After leaving nest, young freeze or hide under nearby vegetation or driftwood at approach of danger; sometimes seek refuge in river or lagoon, and can swim well; adults feign injury to distract predator. Totally dependent on adults for first 3 weeks, but towards fledging, young are left for increasing lengths of time to find food for themselves. **FLEDGING PERIOD:** 6–7 weeks.

**Fledging to maturity** Young of isolated pairs often remain with parents through first winter, but otherwise join winter flocks 3–4 weeks after fledging, where young appear to be independent of parents (Moon 1967; Baker 1969; Fleming 1990). Probably do not start pairing or breeding until third year, when adult plumage is attained (Baker 1969); birds in subadult plumage not recorded breeding.

**Success** Little information available; at Waikanae Estuary, a pair hatched 22 young and fledged 16 young in 11 of 18 breeding seasons and at least 21 nesting attempts (Fleming 1990). In 1987–90, at protected nest-sites: 147 pairs raised at least 94 young, generally with high fledging success (CSN 36, 38). Success at unprotected sites apparently much lower (NZ NRS). Survival from fledging to maturity not studied. Maximum age recorded from banding 19 years 10 months. Breeding success controlled by storms and high spring tides causing desertion, washing out nests (Fleming 1990; NZ NRS). Human disturbance during incubation leads to failure of eggs, and increases opportunities for predators (especially gulls and dogs); off-road vehicles damage nests, and nests damaged maliciously. Main predators of nests and chicks are Kelp Gulls, Silver Gulls, Swamp Harriers *Circus approximans*, Australian Magpies *Gymnorhina tibicen*, skuas *Catharacta* (round Stewart I. only), dogs, cats, mustelids, and possibly rats. Adults have few predators apart from people, dogs, cats and mustelids.

**PLUMAGES** Prepared by D.J. James. Hatch in natal down. Begin pre-juvenile moult at unknown age. Partial post-juvenile moult introducing immature non-breeding plumage, followed by partial pre-breeding moult introducing immature breeding, latter without changing appearance. Thereafter, complete post-breeding

and partial pre-breeding moults each cycle produce alternating non-breeding and breeding plumages without seasonal variation in appearance. Sexes, similar. First breed in fifth or possibly fourth year (Baker 1974b). Complete range of variation from fully pied birds that resemble other pied species, to fully black; here treated as two morphs and intermediates. Degree of pied condition remains constant or nearly so through life (Baker 1973b).

**Adult** (Definitive basic and alternate). Underdown, and plumulaceous bases to feathers, sooty grey (c84) in zones of black feathering and white in zones of white feathering. In breeding plumage, contrast between fresh head and body and faded wings, sometimes apparent. **Black morph** Entirely black. When fresh have faint greenish gloss but this rapidly lost and plumage becomes sooty black with brown tinge; when worn becomes blackish brown (brown 119). Underside of remiges, dark greyish-brown (grey 121). **Pied morph** Similar to South Island Pied, Chatham Island and Pied *H. longirostris* Oystercatchers. Completely intergrades with black morph through large range of intermediates. Extreme limit of variation at pied end difficult to determine as material examined not necessarily fully representative and published information sparse; thus whether there are consistent differences in plumage from South Island Pied Oystercatcher that hold for all individuals is unknown. Following based on most extensively pied specimens examined. **Head and neck** Entirely black, like black morph; greenish gloss fainter than in South Island Pied and more rapidly lost. **Upperparts** Mantle, scapulars and upper back, black, as head. Lower back, rump and upper tail-coverts, white. Back, typically black merging into white rump through smudgy transition zone of white feathers with blackish tips; transition may occur anywhere on lower back or rump and varies from gradual and smudged to abrupt; usually, transition zone sufficiently behind overlying scapulars in flying bird to be visible, and consequently white appears to end in blunt or square line across back (compared with white point or wedge on upper back in South Island Pied). Longest upper tail-coverts, black to black-brown (119) with white bases, which concealed by white coverts of overlying row. Tuft of bristly feathers and down round pygostyle, brown (c28) but normally concealed by tail-coverts. Band of white across rump and tail-coverts rarely much broader than band of black tail. **Underparts** Upper breast, black; lower breast, white; transition, straight but usually more gradual and untidy than South Island Pied, involving several rows of feathers with black bases and white tips or edges that produce smudgy or blotchy transition zone; line of demarcation usually slightly lower than in South Island Pied, so that lateral breast-tabs (in front of carpal when wing folded) are lacking or, at most, only narrow; white, mottled or smudged with black; in one skin (CM AV. 1723), transition about as high and clean as in typical South Island Pied in centre of breast but slightly lower at side of breast so still showing only narrow tab. Small dusky tuft of filamentous feathers and underdown round base (especially back) of tibia, which is usually evident in field; in the hand, generally more conspicuous than in South Island Pied, though is progressively smaller with increasing pied condition. Some have fine brownish speckling on feathers at side of thigh and on under tail-coverts. Rest of underparts, white. **Tail** Appears black. Rectrices, black with broad square-cut white bases (about one-third of length) that are concealed by tail-coverts. **Upperwing** Black, as head, with large tapering white wing-bar, which in extremely pied morphs is similar to that of South Island Pied: broad, reaching trailing-edge of wing at inner secondaries and narrowing outwards to outer secondary. Primaries, primary coverts, alula, marginal, lesser and median secondary coverts, black. Marginals outside carpal, black with white fringes. Greater secondary coverts,



black with varying, sometimes broad, white tips, usually of equal width along wing. Outer six or so secondaries, black with white bases (mostly and perhaps always concealed by greater coverts). Inner one or two secondaries essentially all white, though mostly with large dark-brown (121) tips to inner webs (South Island Pied always has one or two entirely white inner secondaries). Maximum of three inner secondaries with entirely white inner webs seen in skins (always four or five in South Island Pied). Impression may often be of wing-bar rather even in width through outer secondaries and then stepped to reach trailing-edge at inner few secondaries (nearly evenly tapered in South Island Pied). **Underwing** Generally white with dirty blackish border. Coverts and subminals, mainly white; broad black leading-edge to inner wing, formed by black leading rows of lesser secondary coverts; rest of lesser and median secondary coverts may be clean white or faintly streaked dark brown (c121); greater secondary coverts, white at base with narrow to broad dark-brown (121) tips. Lesser and median primary coverts, blotched or mottled dark brown and white; feathers, dark brown (121) with white spots at tips. Greater primary coverts, uniform dark grey-brown. Remiges, dark grey-brown (dark grey 28 or brown 79) (very faintly paler towards bases where contrast faintly with greater coverts); white visible on tips of inner few secondaries but not at bases of outer ones. Records of Variable Oystercatchers with pattern of upperparts that matched that of South Island Pied Oystercatcher (Baker 1973b) probably incorrect (A.J. Baker); no skins examined matched this condition. **Intermediates** Continuous variation; Baker (1973b) arbitrarily divided variation into about eight stages. From extremes of variation from pied to black there is corresponding reduction of white on back, rump and upper tail-coverts, underparts, upperwing and underwing. Black tends to encroach from anterior to posterior on body: transitions between black back and white rump and between black breast and white belly shift towards tail and become progressively messy; black also encroaches inwards from sides of belly; untidy mottling caused mostly by feathers with white bases and tips to inner edges and black middles and tips to outer edges. Wing-bar becomes narrower and more even in length, secondaries often black leaving only greater secondary coverts to form bar. Under wing-coverts become mottled with black. First stages towards dark condition characterized by black mottling between rump and back and round lower breast, dark smudging on thighs, sparse black mottling on under tail-coverts and reduction in width of wing-bar, especially in outer portion. Darkest stages characterized by white flecking on belly and vent only; vent last region to retain white. Rump and upper tail-coverts become fully black when underparts at about mid-point (i.e. belly, vent and under tail-coverts about 50% mottled with black); wing-bar disappears when underparts still heavily flecked with white, about three-quarters or more black. Progress of underwing poorly known; wing-lining becomes increasingly mottled in progressive stages, having white coverts with black tips, then black coverts with white bases.

**Downy young** Down, dense, woolly. Variation of pattern from pied to black evident at hatching, though not so clear as in subsequent plumages. **Pied morph** Similar to South Island Pied Oystercatcher. Head, mostly light brownish-grey (c80) to light grey-brown (c119D) with dark-brown (219) bases, giving heavily mottled appearance. Narrow black central crown-stripe, usually reaching to forehead. Two narrow transverse bars on nape (cf. one on South Island Pied). Black zigzag stripe from base of upper mandible back and up to eye; broad near bill but narrow and inconspicuous near eye; possibly continues to behind eye in some. Slight black speckling on upper ear-coverts, behind and above eye, more distinct than in South Island Pied Oystercatcher.

Upperparts, generally light grey-brown (119D) with brown (28) bases to down and heavy blackish speckling. Patterning less distinct than in South Island Pied Oystercatcher. Vertebral and paravertebral stripes, broken series of black blotches with slight buffish tinge on centre of back. Breast, as ground-colour of head. Rest of underparts, clean white. **Black morph** Similar to pied morph except that all underparts dark like upperparts and breast (Baker 1973b). **Intermediates** Degree of intermediacy cannot be determined (Baker 1973b). Birds typically resemble pied morph but with white belly mottled darker, and marked by indistinct longitudinal stripes, which are widely separated on breast and vent but converging, almost joining on belly in shape of hour-glass.

**Juvenile** Similar to adults with full range of variation from black to pied. Black feathering of body and wings, sooty (not glossy), tends to fade very rapidly to dark brown (c121); generally appear browner than adults. Primaries more pointed than on adult. **Black morph** Differs from adult in: feathers of mantle, back, rump, upper tail-coverts, and lesser and median secondary coverts, black-brown (119) with narrow streaky light-brown (223D) fringes; scapulars, dark brown (121) with conspicuous irregular light-brown (223D) speckles at fringes of feathers; broad blotchy light-brown (223D) fringes to subscapulars, tertials and greater secondary coverts; breast, with very faint light-brown (223D) speckling at tips of feathers grading to conspicuous broader speckled fringes on belly, thighs and vent; longest under tail-coverts with light-brown (223D) tips. When fresh, head, uniform sooty black contrasting with browner speckles on body and wing-coverts. When worn, fringes may be evident only on subscapulars, tertials and greater coverts. **Pied morph** Differs from adult in: feathers on mantle, scapulars, lesser and median secondary coverts and breast, black to black-brown (119) with thin, streaky or speckled, light-brown (223D) fringes; subscapulars and tertials with reasonably broad, irregular and blotchy, whitish fringes. White plumage does not differ from adult. See Ageing.

**Immature** (First basic and alternate). Similar to adults of respective morphs, except for retained juvenile remiges and rectrices; tertials and subscapulars (sometimes retained in first basic but usually replaced in first alternate) can show traces of juvenile fringes. Often show contrast between admixed worn dark-brown and fresh black feathers; worn primaries contrast with fresher body. See Bare Parts, Ageing.

**BARE PARTS** Based on photos (Moon & Lockley 1982; Hadden 1990; Moon 1992; NZRD; DOC Slide Library; unpubl.: B. Chudleigh; D. Stonex) and labels on skins (NMNZ). Morphs, similar. **Adult** Bill, bright orange or red-orange (c15) at base, grading to orange-pink or coral-pink (c13) in middle with small pale-yellow (c157) tip; very similar to South Island Pied Oystercatcher, and differing (if at all) only by slightly pinker tinge in middle. Iris, bright red to scarlet (14–12); small dark blood-red patch under pupil makes pupil look larger, but patch not so large as in South Island Pied Oystercatcher. Orbital ring, orange-red, red-orange or bright orange (c15). Legs, pink-red to coral-pink (c10–13); sometimes quite pale pink (c108D). **Downy young** Bill, black with small whitish egg-tooth; by about third week, shows dull reddish to orange tinge at base and dark-grey tip. Iris, dark brown to blackish. Legs, dark grey. **Juvenile** Bill, pinkish orange at base of lower mandible, grading to pinkish-brown (c219D) base of upper and middle of both mandibles and greyish tip. Iris, dark brown with faint red tinge developing. Orbital ring, brown-yellow. Legs, grey-mauve (dark, dirty 77), lightening gradually. **Immature** Bill, orange over most of length with dusky-grey tip.



Baker (1974b) has suggested ageing scheme based on colours of bare parts studied in South Island Pied Oystercatchers (q.v.). Colours change gradually during complete post-breeding moults (Baker 1975).

**MOULTS** Based on examination of c. 30 skins with date (AWMM, CM, NMNZ); spread of dates incomplete. Juveniles moult primaries in spring; 2-year-old birds moult primaries in summer; 3-year-olds and older moult primaries in autumn (Baker 1975). **Adult post-breeding** (Pre-basic). Complete. Primaries, outwards; one or sometimes two active at once. Secondaries, inwards from two or three centres at about s1, s6 and s10. Timing not clear: skins in early primary-moult, Dec. to Feb., mid-moult, Dec. and Jan., and late moult, July. **Adult pre-breeding** (Pre-alternate). Partial moult of head, body, and some or all wing-coverts and tertials. Five skins in active body-moult but not wing-moult, July and Oct. **Pre-juvenile** Most contour-feathers well developed by Weeks 6–7 but moult not complete until about Week 12 (Baker 1973b; unpubl. photos: B. Chudleigh). **Post-juvenile** (First pre-basic). Partial moult of head, body and some wing-coverts; during autumn of first year. **Immature pre-breeding** (First pre-alternate). Partial moult similar to adult pre-breeding. **Immature post-breeding** (Second pre-basic). First complete moult. Similar to adult post-breeding but probably usually a few months earlier. One skin with primary moult-score 24 in Feb.

**MEASUREMENTS** Skins; sexing based on labels (AWMM, CM, NMNZ): (1) adults; (2) juveniles and immatures.

|        | MALES                                      | FEMALES   |    |
|--------|--|---|----|
| WING   | (1) 273 (5.47; 264–284; 15)<br>(2) 264     | 279 (7.93; 264–288; 12)<br>259, 267, 274                    | ns |
| STH P  | (1) 173 (5.18; 164–181; 11)                | 178 (6.62; 168–188; 10)                                     | ns |
| TAIL   | (1) 106 (3.45; 98–11; 16)<br>(2) 97        | 106 (4.67; 98–112; 13)<br>100 (3.06; 100–106; 4)            | ns |
| BILL F | (1) 82.8 (7.90; 69.7–98.8; 15)<br>(2)      | 91.8 (8.61; 78.3–112.3; 12) *<br>78.5 (11.7; 62.3; 88.5; 4) | *  |
| TARSUS | (1) 56.5 (3.01; 50.6–61.3; 15)<br>(2) 55.4 | 56.4 (4.32; 54.7–58.8; 13)<br>54.0 (3.35; 49.4–57.3; 4)     | ns |
| TOE    | (1) 36.3 (1.54; 33.5–38.4; 13)             | 35.6 (1.25; 33.8–38.0; 13)                                  | ns |

Small samples and unreliable sexing may mask sexual dimorphism. Generally, females slightly larger than males, and adults slightly larger than juveniles and immatures.

Live birds, sexed by dissection, role in copulation or cloacal inspection; wing flattened but not straightened (Baker 1974b, 1975): (3) black morph; (4) intermediates; (5) pied morph.

|        | MALES  | FEMALES  |                |
|--------|--|--|----------------|
| WING   | (3) 268 (4.8; 12)<br>(4) 271 (8.9; 18)<br>(5) 267 (8.2; 21)    | 274 (4.5; 12)<br>277 (7.4; 17)<br>270 (9.2; 19)    | ns<br>ns<br>ns |
| TAIL   | (3) 103 (1.7; 12)<br>(4) 105 (3.8; 18)<br>(5) 102 (3.7; 21)    | 103 (2.1; 12)<br>106 (3.3; 17)<br>104 (3.9; 19)    | ns<br>ns<br>ns |
| BILL F | (3) 83.9 (2.5; 12)<br>(4) 84.4 (3.9; 18)<br>(5) 83.6 (3.8; 21) | 91.3 (4.8; 12)<br>95.3 (5.2; 17)<br>94.1 (5.7; 19) | **<br>**<br>** |
| BILL D | (3) 18.2 (0.3; 12)<br>(4) 19.0 (0.7; 18)<br>(5) 18.7 (0.7; 21) | 18.8 (0.7; 12)<br>19.6 (0.7; 17)<br>18.9 (1.0; 19) | ns<br>ns<br>ns |
| BILL W | (3) 16.1 (0.3; 12)<br>(4) 15.5 (0.5; 18)                       | 15.6 (0.7; 12)<br>15.5; 0.7; 17)                   | ns<br>ns       |

|        |  |  |                |
|--------|--|--|----------------|
|        | (5) 14.9 (0.6; 21)   | 14.8 (0.8; 19)                                     | ns             |
| TARSUS | (3) 61.2 (1.2; 12)<br>(4) 60.3 (1.7; 18)<br>(5) 58.4 (1.6; 21) | 61.6 (1.8; 12)<br>61.8 (1.9; 17)<br>60.0 (2.3; 19) | ns<br>ns<br>** |
| TOE    | (3) 39.0 (0.9; 12)<br>(4) 38.3 (1.8; 18)<br>(5) 37.7 (1.6; 21) | 39.0 (0.9; 12)<br>39.6 (1.2; 17)<br>38.0 (1.8; 19) | ns<br>ns<br>ns |

Change in bill-length of individual *H. ostralegus* has been related to differences in rate of wear of tip (Hulscher & Ens 1990; see South Island Pied Oystercatcher). On many skins, tips of bills obviously worn.

**WEIGHTS** (1) Ages combined, labels (NMNZ). (2–3) Live, sexed by dissection, cloacal inspection or copulatory behaviour; weighed on spring balance accurate to 5 g (Baker 1975); (2) adults, estimated 3 years and older; (3) juveniles, immatures and second-year adults.

|     | MALES                 | FEMALES               |    |
|-----|-----------------------|-----------------------|----|
| (1) | 682 (57; 595–771; 11) | 662 (87; 430–770; 12) | ns |
| (2) | 717 (n=12)            | 734 (n=12)            |    |
| (3) | 710 (n=18)            | 779 (n=17)            | ** |
| (4) | 717 (n=21)            | 750 (n=19)            | ** |

**STRUCTURE** Very similar to South Island Pied Oystercatcher. P10 longest; p9 1–7 mm shorter, p8 6–14, p7 16–27, p6 30–45, p5 44–62, p4, 62–80, p3 79–99, p2 95–114, p1 111–122, p11 minute. Orbital ring of adults, generally thicker than that of South Island Pied. Bill, long, heavy and straight; slightly laterally compressed at base; shape of tip varies with degree of wear: usually blunt and strongly laterally compressed, sometimes thinner and tubular; deeper and heavier than that of South Island Pied. Feet slightly heavier than those of South Island Pied. Outer toe 86–91% of middle, inner 68–74%.

**AGEING** Juvenile primaries retained through first year (immature plumages), narrower and more pointed than adults. Adults have sooty-grey (c84) underdown and plumulaceous bases in areas of black plumage; in juveniles and immatures these tend to be whitish. Baker (1974b) proposed ageing scheme based on colours of bare parts and tone of upperparts plumage; see South Island Pied Oystercatcher for discussion.

**SEXING** Baker (1974b) calculated discriminant functions based on bill measurements; these sexed 60 birds with 93% accuracy. Considerable geographical variation in length of bill was not thought to confound sexing. See South Island Pied Oystercatcher for further discussion.

**GEOGRAPHICAL VARIATION** Considerable variation but not usually considered to have subspecies (Baker 1973b; NZCL). Black morph common throughout NZ but increases in relative frequency from N to S, comprising 100% of population in extreme S; pied morph common only in Northland and rapidly decreases in abundance southwards; intermediates occur only where black and pied morphs sympatric, mostly Northland. In Northland, ratio of black to intermediates to pied: 37: 38: 25 (Baker 1975). Dimensions of bill and tarsus increase and wing and tail decrease approximately clinally from n. to s. NZ.

All morphs interbreed freely and, at least in Northland, with random assortment (Baker 1973b). Pairs of extreme black or pied birds tend to breed true (Baker 1973b; Oliver) and there is



apparently strong correlation in degree of pied condition between parents and progeny. This led Baker (1973b) to propose hypothetical model of genetic basis with black birds homozygous recessive, fully pied birds homozygous dominant and intermediates heterozygous with modifying genes producing the variation. However not all data (cited in Baker 1973b; Fleming 1990) fit this model and a threshold polygenic model might equally explain the data.

Baker (1969, 1975) hypothesized that pied and black morphs represented separate invasions of *H. longirostris* from Aust.

#### REFERENCES

- Baker, A.J. 1969. Unpubl. MSc thesis, Univ. Canterbury, Christchurch.
- 1972. Unpubl. PhD thesis. Univ. Canterbury, Christchurch.
- 1973a. *Notornis* 20: 128–44.
- 1973b. *Notornis* 20: 330–45.
- 1974a. *Life Sci. Contr. R. Ontario Mus.* 96: 1–34.
- 1974b. *NZ J. Mar. Freshwat. Res.* 8: 211–21.
- 1974c. *Notornis* 21: 219–33.
- 1975. *J. Zool., Lond.* 175: 357–90.
- Bell, B.D. 1986. *NZ Wildl. Serv. Occ. Publ.* 12.
- Cunningham, J.M. 1947. *NZ Bird Notes* 2: 124.
- Edgar, A.T. 1971. *Notornis* 18: 118–30.
- Falla, R.A., et al. 1981. *The New Guide to the Birds of New Zealand*. Collins, Auckland.
- Fleming, P. 1990. *Notornis* 37: 73–6.
- Hadden, D. 1990. *99 New Zealand Birds*. Caxton Press, Christchurch.
- Heather, B.D. 1980. *Notornis* 27: 164–7.
- Hulscher, J.B., & B.J. Ens. 1990. *Int. orn. Congr. Proc.* XX: 889–96.
- Jones, A. 1979. *Notornis* 26: 47–52.
- Moon, G. 1967. *Refocus on New Zealand Birds*. Reed, Auckland.
- 1992. *A Field Guide to New Zealand Birds*. Reed, Auckland.
- , & R. Lockley. 1982. *New Zealand's Birds*. Heinemann, Auckland.
- Owen, K.L., & M.G. Sell. 1985. *Notornis* 32: 271–309.
- Powlesland, R.G., & H.A. Robertson. 1987. *Notornis* 34: 327–38.
- Robertson, H.A. 1992. *Notornis* 39: 263–89.
- Sibson, R.B. 1975. *Notornis* 22: 66–7.
- Walter, D.M. 1984. *Notornis* 31: 278.





Volume 2, Plate 56 [scientific names added cf. original]

Variable Oystercatcher *Haematopus unicolor* (page 748)

1 Adult, pied morph; 2 Adult, intermediate; 3 Adult, black morph; 4 Downy young, pied morph; 5 Downy young, black morph; 6 Juvenile, pied morph; 7 Juvenile, black morph; 8, 9 Adult, pied morph; 10 Adult, black morph

South Island Pied Oystercatcher *Haematopus finschi* (page 727)

11 Adult, 12 Downy young; 13 Juvenile; 14, 15 Adult

Chatham Island Oystercatcher *Haematopus chathamensis* (page 734)

16 Adult; 17 Downy young; 18, 19 Adult