

## Order PSITTACIFORMES

Distinctive, familiar, and often strikingly coloured birds, with characteristic shape and structure. Often highly conspicuous. Small to large, ranging in size from tiny pygmy-parrots *Micrositta* of New Guinea, the Moluccas and the Solomon Is (c. 9 cm in length and weighing 10–18 g) to large macaws of South America (up to c. 1 m in total length including tail, and weighing up to 1.7 kg), large cockatoos (e.g. Red-tailed Black-Cockatoo *Calyptorhynchus banksii*; up to 60 cm in total length including tail, and weighing up to 870 g), and flightless Kakapo *Strigops habroptilus* of NZ (up to 64 cm in total length, including tail, and weighing up to 2 kg). Third largest non-passerine order. Roughly 329–356 species in 76–93 genera, distributed on all continents except Antarctica; most are tropical; distributed widely in s. hemisphere, including some subantarctic islands of HANZAB region; in n. hemisphere occur as far N as Safed Koh Mts in e. Afghanistan (Slaty-headed Parakeet *Psittacula himalayana*). Greatest morphological and ecological diversity in A'asia and probably originated in A'asian sector of Gondwana, radiating from subtropical rainforests (Homerger 1991; see also Forshaw & Cooper 1989). In HANZAB region, 60 species in 27 genera. Appear to lack close living relatives, and nearest allies difficult to determine. Suggested that nearest allies are Columbiformes (pigeons) (Burton 1974; Forshaw & Cooper 1989), but this rejected by others (Sibley & Ahlquist 1990). Recent DNA–DNA hybridization studies suggest they should be placed between cuckoos and swifts (see Collar 1997; Rowley 1997). Other groups suggested as close allies include hawks, owls and piciforms (see Sibley & Ahlquist 1990). Recent works (e.g. Forshaw & Cooper 1989; Collar 1997; Rowley 1997) recognize three main groups: (1) cockatoos; (2) lorries and lorikeets; and (3) parrots. However, taxonomic level of each varies: some (e.g. Forshaw & Cooper 1989) classify each at same level, but others (e.g. Collar 1997) group parrots with lorries and lorikeets. On basis of biochemical (Christidis *et al.* 1991a) and chromosomal (Christidis *et al.* 1991b) studies, cockatoos were found to form a monophyletic lineage separate from all other Australo-Papuan parrots and lorries. As such, Christides & Boles (1994) recognized two distinct families within Aust.: Cacatuidae (cockatoos) and Psittacidae, including the Loriinae (thus, parrots and lorikeets); an arrangement also supported by morphological and behavioural studies (Brereton & Immelmann 1962; Smith 1975; Homerger 1991). This arrangement followed here; both families represented in HANZAB region. Relationships between extralimital groups have not been examined closely and are in need of review. In recent works, extralimital subfamilies or tribes have been grouped with Aust. Psittacidae (Forshaw 1989; Collar 1997); that treatment has been followed here. The most widespread alternative taxonomy places all cockatoos and parrots in a single family, Psittacidae (e.g. Sibley *et al.* 1988; Forshaw & Cooper 1989; Sibley & Ahlquist 1990; Sibley & Monroe 1990; Peters). Many alternative taxonomies have been proposed; for reviews see Smith (1975), Sibley & Ahlquist (1990), and Schodde & Mason (1997); for discussion of Aust. taxa, also see alternative treatment of Wells & Wellington (1992).

Structure rather homogeneous. Bill distinctive: upper mandible downcurved, usually extending well beyond tip of lower mandible; lower mandible upcurved, and usually broad with rather square tip that fits neatly into inside of upper mandible. Usually have prominent cere. Rostrum movable, with hinge-like articulation at skull. Palate, desmognathous. Nares, holorhinal, impervious, always in cere. Basipterygoid process absent. Head usually large in proportion to body, and neck rather short; 13–15, usually 14, cervical vertebrae. Pelvic muscle formula, *AXY*. Sternum fenestrated or indented. Tongue, thick and muscular, tactile, grooved; moved by hyoid apparatus with large median foramen in entoglossum; tongue brush-tipped in some species (notably lorikeets in HANZAB region; see below). Feet, zygodactylous, with Type 1 flexor tendons (cf. Piciformes and Cuculiformes, which zygodactylous but with Type 6 flexor tendons). Crop present; no caeca. Oil-gland tufted or absent. Furcula weak or absent in some. Syrinx with three pairs of intrinsic muscles. Wings vary in shape from broad with rounded tip to narrow with pointed tip. Ten primaries; 10–14 secondaries; diastataxic. Tail short to very long; *Prioniturus* have ornate, projecting racket-shaped central rectrices. Usually 12 rectrices. Aftershafts, short and downy. Legs, short and strong; tarsus short, with small granulate scales or papillae; middle toe longer than tarsus. Orbital ring usually complete. Whole body covered in down. Powder downs present; especially in uropygial region. Young ptilopaedic.

Adult plumage often brightly coloured (especially in Psittacidae), though also white, grey and black (especially in Cacatuidae); coarse in texture; and arranged in diffuse tracts. Bare parts mostly dull colours, but some species have brightly coloured bills, irides, lores and facial skin. Sexes alike (e.g. Rainbow Lorikeet *Trichoglossus haematodus*) or highly dimorphic (e.g. Eclectus Parrot *Eclectus roratus*).

Adults undergo a post-breeding (pre-basic) moult each cycle; usually complete, but some species can arrest moult before it is finished. Adult pre-breeding moults not reported (Forshaw & Cooper 1989). Usually moult once a year, but some possibly take longer than a year to finish; in HANZAB region, timing varies (see Family introductions). Moult of primaries of adults usually centrifugal, from mid-primaries, but starting position varies. Moult of secondaries of adults often starts from s10 at about time moult of primaries starts, and replaced outward to finish with s1, but

sequence also often irregular (see Forshaw & Cooper 1989). Moults of tail usually starts after moult of primaries well advanced, but usually finishes before last primary shed; sequence irregular (see Forshaw & Cooper 1989). Young altricial; blind at hatching, covered by sparse pale down. Juvenile plumage often similar to, or slightly duller than, adult plumage, but remiges and rectrices usually more pointed than adults. Rate of maturation and attainment of adult plumage and bare parts varies greatly; slow in some species. Sequence of plumages to adult and timing of moults varies greatly. Post-juvenile (first pre-basic) moult typically partial, but some possibly complete (e.g. Nestorinae). Some species have one or more immature plumages.

Worldwide, occur in wide variety of habitats, from dense rainforest to open, treeless grassed plains, though predominantly, and with greatest diversity, in tropical rainforests (Forshaw & Cooper 1981). In HANZAB region, widespread throughout alpine, tropical, temperate, semi-arid and arid zones; occur in most habitats, from coasts to high altitudes, including above treeline in alpine zones.

No species of Cacatuidae can be regarded as completely migratory (Rowley 1997), though some populations of some species undertake regular movements and considered partly migratory. Other Cacatuidae are resident, sedentary, or dispersive. Worldwide, Psittacidae considered resident, dispersive, nomadic or irruptive (Collar 1997); only two species considered migratory; at least one other species is partly migratory (Collar 1997; see Psittacidae below). Few species of Psittacidae are considered sedentary, usually island forms, and some of these occur in HANZAB region.

Herbivorous. Most feed on seeds and fruits, supplemented by a wide range of other food, such as flowers, nectar, pollen and leaves. Many species include small quantities of invertebrates, mostly insects and insect larvae, in their diet; almost all eat some seed, which always husked before swallowing (Forshaw & Cooper 1981; Campbell & Lack 1985). Specialization evident in some groups (see Family accounts below). Feed arboreally and terrestrially; in HANZAB region, c. 35% of species feed mainly arboreally, c. 35% feed mainly on ground, and the rest feed both arboreally and terrestrially. Of those considered primarily arboreal or terrestrial, about a third of species within those categories occasionally feed on other substrates. When feeding in trees or shrubs, agile and acrobatic, and clamber actively through outer branches and foliage, stretching to reach food, and often hanging upside down; use both bill and feet; while climbing among foliage of trees, often use bill to grasp branches and then clamber up or across from previous position. On ground, equally active, picking up fallen seeds or fruits from ground, or taking them directly from flowering or seeding heads; when food beyond reach, will stretch up to reach, or stand on stalks of plants, felling them to ground; many also use bill to dig up underground roots, corms or bulbs, or scratch soil with feet (Forshaw & Cooper 1981; also see species accounts). Many use bill to tear away or crush hard seed capsules, such as those of *Eucalyptus* and casuarina, and extract seeds from them; bill also used by some to tear open trunks of trees and branches for wood-boring insect larvae. Many use feet to manipulate food and to bring food to bill (Smith 1971; Forshaw & Cooper 1981); some show preference for use of particular foot, usually left (Forshaw & Cooper 1981; Joseph 1989; Magrath 1994). In HANZAB region, Glossy Black-Cockatoos *Calyptorhynchus lathami* exclusively or predominantly left footed (Joseph 1989; Magrath 1994; Pepper 1996), Yellow-tailed *Calyptorhynchus funereus* and Red-tailed Black-Cockatoos, Gang-gang *Callocephalon fimbriatum* and Palm *Probosciger aterrimus* Cockatoos predominantly left footed; while Eastern *Platycercus eximius* and Pale-headed *P. adscitus* Rosellas predominantly right footed (Cannon 1977; Prendergast 1985; Joseph 1989). Drink water at least once during day; most come to drink early in morning, some in morning and late afternoon, and some throughout day depending on heat of day; most drink by scooping water in lower mandible, then tilting head back (Campbell & Lack 1985); also drink water by lapping, ladling or suck-pumping (Schodde & Mason 1997).

Usually very vocal. Calls described as squawks, screeches, squeals, shrieks, whistles, cackles, chatters, buzzes or twitters. Many calls harsh, guttural and described as strident, but other calls can be musical rolling screeches and melodic whistles or warbles, often piping in quality. Many calls loud and distinctive; sometimes raucous. In HANZAB region, exceptional calls are those produced by mechanical means by Palm Cockatoos, and remarkable Booming made by male Kakapo during displays (see those texts for details). In HANZAB region, voice not well studied, though several notable exceptions (see below and family introductions). Repertoire of calls of Budgerigar *Melopsittacus undulatus* well known from studies in captivity and in wild; otherwise, repertoires poorly known. Size of repertoire appears to vary greatly between species, though this may be more a reflection of lack of knowledge of many species. Some species have as many as 20 or more described calls. Brereton (1963a,b, 1971a,b) and Pidgeon (1981) compared repertoires of a number of Aust. species. Brereton (1971b) suggested that the information content of vocalizations low in species occurring mainly in habitats with abundant resources, and most complex when resources at intermediate levels, but again simpler with increasing scarcity of resources. Suggested that some calls of Budgerigar functionally equivalent to song of passerine birds (see account for Budgerigar); this may also be true of calls of some other parrots. Within species, variation in calls sometimes complex, with some described as grading from one to another across a wide range of intermediates; these variations generally not well understood. Individual variation often used for individual recognition within pairs, and used to recognize members within family or other groupings (e.g. *Calyptorhynchus*, Galah *Eolophus roseicapillus* and Budgerigar). Some calls sexually distinctive in many species of both families. In HANZAB region, little or no information on seasonal variation for most species. Regional

variations in repertoire and variations in call characteristics little studied in HANZAB region but rarely apparent. However, known from at least three species in HANZAB region (Australian Ringneck *Barnardius zonarius*, Red-crowned Parakeet *Cyanoramphus novaezelandiae* and Kaka *Nestor meridionalis*). Calls of young often show similarity in structure between related species. Courtney (1974, 1986, 1993, 1996, 1997a,b,c) studied development of calls in young of many species of Aust. parrots. Food-begging Calls of many young parrots change with age. Brereton & Pidgeon (1966) speculate on ontogeny of calls in Eastern Rosella and provide illustrative sonagrams. They suggest adult calls develop from simple squawk given by nestlings. In exceptional instance of Galah being reared in wild with brood of Major Mitchell's Cockatoo *Cacatua leadbeateri*, Galah adopted calls of foster parents (Rowley & Chapman 1986). Mimicry almost absent in wild (but see Palm Cockatoo), but common in many species in captivity, especially cockatoos and Budgerigar, but also Rainbow Lorikeet, *Polytelis*, Swift Parrot *Lathamus discolor*, Red-crowned Parakeet and Turquoise Parrot *Neophema pulchella*.

For discussion of Social Organization and Social Behaviour, see family accounts below.

Breeding well known for most species in HANZAB region, poorly known extraliminally. Breeding generally seasonal, though some species can breed at any time if conditions suitable. Nest mainly in hollows in trees; some species nest on ground, under rocks or vegetation, or in tunnels excavated in arboreal or terrestrial termitaria. Eggs white. Clutch-size varies; in HANZAB region, largest clutches laid by Psittacinae and most species of Platycercinae in temperate areas and tropical semi-arid areas. Incubation by female only in Psittacidae and some Cacatuidae, by both sexes in *Cacatua*, *Callocephalon*, *Eolophus* and *Nymphicus*. Young altricial, nidicolous. Naked at hatching; generally develop down within first week. Young usually fed by female at first, then by both sexes. Fledgelings usually remain with parents for some time (Forshaw & Cooper 1981).

Worldwide, at least 90 species of parrots (c. 25% of all species) considered threatened (King 1981; Collar & Andrew 1988; Collar *et al.* 1994). In the HANZAB region, the only extinct taxa are: the Paradise Parrot *Psephotus pulcherrimus* (the only species extinct on mainland Aust.), probably through combined effects of overgrazing and drought; the Norfolk Island Kaka *Nestor productus*, which was killed for food and whose habitat was largely cleared; Lord Howe I. subspecies of Red-crowned Parakeet *Cyanoramphus novaezelandiae subflavescens*, possibly killed off by hunting and trapping; and the Macquarie I. subspecies of the Red-crowned Parakeet *C.n. erythrotis*, which was extirpated by cats (Garnett 1993). However, many more species are threatened: Garnett (1993) lists another 22 taxa in Aust. that are nationally threatened; of these, seven species are endangered, five vulnerable, five rare, and five insufficiently known. In addition, of the eight species of parrots native to NZ, the Kakapo is endangered; Orange-fronted Parakeet *Cyanoramphus malherbi* is rare; Kaka, Forbes' Parakeet *C. forbesi* and Antipodes Island Parakeet vulnerable; and Yellow-crowned Parakeet *C. auriceps* and Kea *Nestor notabilis* near threatened (Taylor 1985; Collar *et al.* 1994). In temperate woodlands and grassy woodlands of s. Aust., one species of woodland-dependent parrot, the Paradise Parrot, is extinct, and six others threatened; another three species of woodland-associated parrots are also threatened (Robinson & Traill 1996).

Overall, major threatening process is extensive clearance and fragmentation of habitat, particularly in S. America (King 1981; Collar & Andrew 1988; Collar *et al.* 1994). In HANZAB region, degradation, clearance and subsequent fragmentation of natural habitats for agriculture and forestry, including collection of firewood, have adversely affected many species (e.g. Glossy Black-Cockatoo, e. population of Regent Parrot *Polytelis anthopeplus*); small and isolated remnants are often too small to support viable populations of birds. Overgrazing and altered fire-regimes also change structure of vegetation, and have reduced populations and range of several species (e.g. Golden-shouldered Parrot *Psephotus chrysopterygius*, Scarlet-chested Parrot *Neophema splendida*, Ground Parrot *Pezoporus wallicus*). In Tas., preferred feeding habitat of Swift Parrot threatened by clearfelling and woodchipping of forests of Tasmanian Blue Gum *Eucalyptus globulus*. Orange-bellied Parrots *Neophema chrysogaster* threatened by destruction of coastal saltmarsh, the main feeding habitat on mainland Aust. In some areas, removal of hollow-bearing trees causes local shortages of nesting hollows, which, in turn, then reduces opportunities to breed. In s. Aust., harvesting of forests for firewood usually removes old dead trees, which often contain hollows; as a result, the reduction in the number of hollows available for nesting has caused declines of populations of many parrots throughout range (Robinson & Traill 1996). There is little replacement of suitable hollow-bearing trees, e.g. in sw. WA, the lowest average age of nest-trees used by parrots was estimated at 275 years and 446 years for cockatoos (Mawson & Long 1994, 1997; *contra* Stoneman *et al.* 1997). Further, introduced hollow-nesting species, such as Common Starlings *Sturnus vulgaris* and Common Mynas *Acridotheres tristis*, and some introduced parrots (such as Sulphur-crested Cockatoos *Cacatua galerita* in WA and Crimson Rosellas *Platycercus elegans* in NZ and on Norfolk I.), as well as Common Brushtailed Possums *Trichosurus vulpecula* and feral honeybees *Apis mellifera*, appear to compete with some species for use of hollows; this problem exacerbated in areas where hollows in short supply as a result of changes to habitats (Smithers & Disney 1969; Dawe 1979; Saunders *et al.* 1985; Garnett 1993).

Conversely, populations of some species (e.g. Elegant Parrot *Neophema elegans*) have increased, and ranges expanded after native vegetation cleared and converted to farmland, which has created habitat of similar structure to preferred natural habitats. Other species (e.g. Rainbow Lorikeet) have experienced increases in populations and

expansion of range since the 1970s, probably resulting from greater availability of food after the establishment and maturation of native trees in parks and gardens in urban areas (Veerman 1991). In some areas, changes to habitats through establishment of agricultural production, particularly grain production, and provision of water for stock, has allowed some species, notably Galahs, Sulphur-crested Cockatoos and Little *Cacatua sanguinea* and Long-billed *C. tenuirostris* Corellas, to undergo dramatic increases in population and expansion of range, to the extent that they are considered pests in some rural areas (Saunders *et al.* 1985; Rowley 1990; Serventy & Whittell). Worldwide, some species are threatened by persecution in agricultural areas, where seen as pests to crops (e.g. Blue-winged Macaw *Ara maracana*, Hispaniolan Parakeet *Aratinga chloroptera*); the Carolina Parakeet *Conuropsis carolina* of N. America was hunted to extinction in late 19th and early 20th centuries because it was considered a pest of agriculture (Halliday 1978; Collar *et al.* 1994). In agricultural areas of sw. Vic., one of the most common causes of death of Long-billed Corellas is shooting by farmers (Emison *et al.* 1994); in WA, an open season declared on feral Sulphur-crested Cockatoos (Saunders *et al.* 1985), and several other species of parrots are also legally shot (Robinson & Brouwer 1989). In NZ, large numbers of Red-crowned Parakeets were formerly shot as pests around crops (Turbott 1967; Taylor 1985; Oliver).

Popular cage-birds. Throughout world, illegal taking of eggs or young from nests, or adults from wild populations for avicultural trade a major threat to continued survival of some species, e.g. Red-and-Blue Lory *Eos histrio*, Spix's Macaw *Cyanopsitta spixii*, Hyacinth Macaw *Anodorhynchus hyacinthinus*, Thick-billed Parrot *Rhynchopsitta pachyrhyncha*, Green-cheeked Amazon *Amazona viridigenalis* (King 1981; Collar & Andrew 1988; Ridgely 1989; Snyder *et al.* 1989; Juniper 1991; Collar *et al.* 1994). However, the effect of illegal collecting is exacerbated by threats posed by loss of habitat as described above (Collar *et al.* 1994; Forshaw). In HANZAB region, several species of cockatoos and parrots with small populations are threatened by illegal collecting for aviculture, for both local and overseas markets, e.g. Eclectus Parrot and subspecies *narethae* of Blue Bonnet *Northiella haematogaster* (Garnett 1993). In Aust., many hollows destroyed by collectors hacking holes in trees to get access to nest-hollows and eggs or young. Hollows that are not destroyed often repeatedly robbed, either in subsequent seasons or after birds re-lay in same season after theft of clutch (Forshaw). In NT, trial programme introduced to legally exploit wild populations of Red-tailed Black-Cockatoos, involving collection of eggs, nestlings and adults (Anon. 1995). Similar schemes have been proposed in other areas of Aust., involving other abundant or pest species, but have not been accepted. Extralimitally, extinction or declines in populations have also been blamed on human persecution, especially if thought to be pest of agricultural production, and including hunting (e.g. Snyder *et al.* 1989).

## REFERENCES

- Anon. 1995. A Trial Management Program for the Red-tailed Black Cockatoo *Calyptorhynchus banksii* in the Northern Territory of Australia. Draft Rep. to North. Terr. Parks & Wildl. Commis., Darwin.
- Brereton, J. Le Gay. 1963a. *Proc. Int. Orn. Congr.* 13: 499–517.
- 1963b. *Living Bird* 2: 21–9.
- 1971a. Pp 69–91 **In:** Esser 1971.
- 1971b. Pp 207–21 **In:** Duffey & Watt 1971.
- , & K. Immelmann. 1962. *Ibis* 104: 169–74.
- , & R. Pidgeon 1966. *Aust. Nat. Hist.* 15: 225–9.
- Burton, P.J.K. 1974. *J. Zool., Lond.* 174: 255–76.
- Campbell, B., & E. Lack. 1985. *A Dictionary of Birds*. T. & A.D. Poyser, Calton, England.
- Cannon, C.E. 1977. Unpubl. PhD thesis, Univ. Qld, Brisbane.
- Christidis, L., & W.E. Boles. 1994. *RAOU Monogr.* 2.
- , *et al.* 1991a. *Condor* 93: 302–17.
- , *et al.* 1991b. *Hereditas* 114: 47–56.
- Collar, N.J. 1997. Pp 280–477 **In:** del Hoyo *et al.* 1997.
- , & P. Andrew 1988. *Tech. Publ. Int. Coun. Bird Preserv.* 8.
- , *et al.* 1994. *Birdlife Cons. Ser.* 4.
- Courtney, J. 1974. *Emu* 74: 97–102.
- 1986. *Aust. Bird Watcher* 11: 261–73.
- 1993. *Aust. Bird Watcher* 15: 60–7.
- 1996. *Aust. Bird Watcher* 16: 236–49.
- 1997a. *Aust. Bird Watcher* 17: 42–59.
- 1997b. *Aust. Bird Watcher* 17: 61–70.
- 1997c. *Aust. Bird Watcher* 17: 169–84.
- Dawe, M.R. 1979. Unpubl. MSc thesis, Univ. of Auckland.
- del Hoyo, J., *et al.* (Eds) 1997. *Handbook of the Birds of the World*. 4. Lynx Edns, Barcelona.
- Duffey, E., & A.S. Watt (Eds) 1971. *The Scientific Management of Animal and Plant Communities for Conservation*. Blackwell, Lond.
- Emison, W.B., *et al.* 1994. *Proc. West. Found. Vert. Zool.* 5: 211–47.
- Esser, A.H. 1971. *Behavior and Space*. Plenum, New York.
- Forshaw, J.M., & W.T. Cooper. 1981, 1989. *Parrots of the World*. First, third edns. Lansdowne, Melbourne.
- Garnett, S. (Ed.) 1993. *RAOU Rep.* 82.
- Halliday, T. 1978. *Vanishing Birds*. Hutchinson, Melbourne.
- Homburger, D. 1991. *Proc. Int. Orn. Congr.* 20(1): 398–403.
- Joseph, L. 1989. *Corella* 13: 143–4.
- Juniper, T. 1991. *Birds Int.* 3(1): 10–17.
- Keast, A., *et al.* (Eds) 1985. *Birds of Eucalypt Forests and Woodlands*. Surrey Beatty, Sydney.
- King, W.B. 1981. *Endangered Birds of the World*. Smithsonian Inst. Press, Washington.
- Magrath, D.I. 1994. *Corella* 18: 21–4.
- Mawson, P.R., & J.R. Long. 1994. *Emu* 94: 149–55.
- , ——— 1997. *Emu* 97: 181–2.
- Pepper, J.W. 1996. Unpubl. PhD thesis, Univ. Michigan, Ann Arbor.
- Pidgeon, R. 1981. *Emu* 81: 158–68.
- Prendergast, H.D.V. 1985. *Canberra Bird Notes* 10: 91–2.
- Ridgely, R.S. 1989. *Birds Int.* 1(1): 8–17.
- Robinson, D., & J. Brouwer. 1989. *RAOU Rep.* 62.
- , & B.J. Traill. 1996. *RAOU Conserv. Statement* 10 (*Wingspan* 6[2], Suppl.).
- Rowley, I.C.R. 1990. *The Galah*. Surrey Beatty, Sydney.
- 1997. Pp 246–79 **In:** del Hoyo *et al.* 1997.
- , & G. Chapman. 1986. *Behav.* 96: 1–16.
- Saunders, D.A., *et al.* 1985. Pp 309–21 **In:** Keast *et al.* 1985.
- Schodde, R., & I.J. Mason. 1997. *Zoological Catalogue of Australia*. 37.2. *Aves*. CSIRO Publ., Melbourne.
- Sibley, C.G., & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds*. Yale Univ. Press, New Haven.
- , & B.L. Monroe Jr. 1990. *Distribution and Taxonomy to Birds of the World*. Yale Univ. Press, New Haven.
- , *et al.* 1988. *Auk* 105: 409–23.
- Smith, G.A. 1971. *Avicult. Mag.* 77: 93–100.
- 1975. *Ibis* 117: 18–68.

- Smithers, C.N., & H.J. de S. Disney. 1969. *Aust. Zool.* 15: 127–40.
- Snyder, N.F., et al. 1989. *Birds Int.* 1(2): 40–52.
- Stoneman, G.L., et al. 1997. *Emu* 97: 94–6.
- Taylor, R.H. 1985. *Tech. Publ. Int. Coun. Bird Preserv.* 3: 195–211.
- Turbott, E.G. 1967. *Buller's Bird of New Zealand*. Whitcombe & Tombs, Christchurch.
- Veerman, P.A. 1991. *Aust. Bird Watcher* 14: 3–9.
- Wells, R.W., & R. Wellington. 1992. *Sydney Basin Nat.* 1: 107–69.

## Family PSITTACIDAE parrots and lories

Usually brilliantly coloured, and vary greatly in size. About 310–335 species in 70–87 genera (Schodde & Mason 1997); 46 species in 21 genera in HANZAB region. Distributed on all continents except Antarctica; most diverse in A'asia, but other centres of diversity in Old World (Africa and Indian subcontinent) and New World (S. America and s. N. America) (Smith 1975; Forshaw & Cooper 1989; Schodde & Mason 1997).

Taxonomy at subfamily level not clear at present time. Different authors have recognized 5–11 different groups within Psittacidae (see Smith 1975; Forshaw & Cooper 1989; Sibley & Ahlquist 1990; Collar 1997). Eleven infrafamilial groups have been recognized here, following Schodde & Mason (1997) for those with representatives in HANZAB region, and Collar (1997) for those wholly extralimital. The following four groups occur extraliminally: Psittrichadini (Pesquet's Parrot *Psittrachus fulgidus*, monotypic); Micropsittini (pygmy parrots, six species); Psittacini (Afrotropical parrots, 12 species); and Arini (Neotropical parrots, 148 species); these not considered further below.

Schodde & Mason (1997) recognized six infrafamilial groups in Aust. and its territories. However, since relationship between species in some of these groups is still not clear, they treated only the three more clearly defined groups as subfamilies (Nestorinae, Loriinae and Platycercinae) and considered the other three groups as unplaced tribes (Psittaculini, Cyclopsittacini and Polytelini). Another subfamily, Strigopinae, is endemic to NZ (NZCL). Collar (1997) differs slightly in which groups he treats as subfamilies and which he treats as tribes; also does not recognize Polytelini, which he includes within Psittaculini. The seven groups occurring in the HANZAB region (based on Schodde & Mason [1997] unless stated and which see for further references):

**SUBFAMILY STRIGOPINAE:** Monotypic Kakapo *Strigops habroptilus*; endemic to NZ. Large, flightless. Furcula cartilaginous; keel vestigial (Holyoak 1973; Smith 1975). Barred remiges and rectrices (Smith 1975). Scratch head over wing (Smith 1975).

**SUBFAMILY NESTORINAE:** Kakas. One genus, *Nestor*, with two species endemic to NZ, and a third isolated and extinct species on Norfolk I. Large and short-tailed, with spines extending from tips of rectrices. Remiges barred (Smith 1975). Parahyoid process joined; styohyoideus muscle reduced; left carotid superficial; tongue thick and muscular with fringe of hair-like papillae on outer edge; pigments fluorescent (Holyoak 1973).

**SUBFAMILY LORIINAE:** Lorikeets and lories. Small, brightly coloured, and arboreal parrots. Eleven to 13 genera, distributed across e. Indonesia, New Guinea, islands of sw. Pacific and Aust. with greatest diversity in New Guinea, where 8–10 genera occur; three genera in HANZAB region: *Glossopsitta*, *Psitteuteles*, *Trichoglossus* (Schodde & Mason 1997). Most have permanent underwing-stripes (Smith 1975; Forshaw & Cooper 1989; Courtney 1997b); present only in some juveniles of extralimital *Charmosyna* (Courtney 1997b). Parahyoid process joined; styohyoideus muscle reduced or absent; tongue has brush of papillae at tip (Holyoak 1973; Smith 1975; Forshaw & Cooper 1989). Also characterized by pointed wings and tails, dashing flight, and short intestinal tract with inelaborate crop and gizzard.

**SUBFAMILY PLATYCERCINAE:** Broad-tailed parrots. Diverse group of small to medium-sized parrots. About 14 genera containing 35–38 species distributed across Aust., NZ and New Caledonia and on some associated islands; 11 genera and 28 species in HANZAB region: *Barnardius*, *Cyanoramphus*, *Lathamus*, *Melopsittacus*, *Neophema*, *Neopsephotus*, *Northiella*, *Pezoporus*, *Platycercus*, *Psephotus*, *Purpureicephalus*. Underwing-stripe present in juveniles and most adult females, but usually 'deciduous' in adult males (Holyoak 1973; Courtney 1997c); permanent in *Melopsittacus* and *Pezoporus* (Courtney 1997b,c); absent in extralimital *Prosopieia* (Courtney 1997c). Characterized by crescentic auditory maetus; foss at base of zygomatic process; orbit open below (except *Melopsittacus*); parahyoid process more or less converging; tongue has shallow grooves; furcula cartilaginous (except *Lathamus*); stylohyoideus muscle often wide; left carotid often superficial; fluorescent yellow pigment in plumage; scratch head over wing (Holyoak 1973). Except for *Geopsittacus* and *Pezoporus*, all have small patch of feathers on nape with white or pale yellow bases, instead of the usual grey, and which forms a nape-spot (Smith 1975), though spot hidden unless feathers of the region are erected or worn.

**Unplaced tribes: PSITTACULINI:** Palaeotropic parrots. Medium-sized arboreal parrots with heavy bills. Composition uncertain; about 11 genera, distributed from India to A'asia. Two genera in Aust.: *Eclactus* and *Geoffroyus*. Both tongue and dental pad ridged or grooved. No stripe on underwing.

**CYCLOPSITTICINI:** Fig-parrots. Small, green, arboreal fruit-eating parrots. Five species in 1–3 genera, with distribution centred in New Guinea; single species in genus *Cyclopsitta* in HANZAB region. Have stout ridged bills; wedge-shaped tails; marked sexual dimorphism; permanent double stripes on underwing; and completely ossified orbital ring free from well-developed zygomatic processes (Smith 1975; Courtney 1997b).

**POLYTELINI:** Long-tailed parrots. Slender medium-sized parrots. Eight species in three genera, with distribution centred in Aust. Five species from all three genera in HANZAB region: *Alisterus*, *Aprosmictus* and *Polytelis*.

Characterized by long, attenuated pink-tipped tails (Schodde & Mason 1997); inner webs of lateral rectrices have rose-pink edging, a character not possessed by any other parrot (Courtney 1997a). Other characters include: marked sexual dimorphism; no stripe on underwing; tongue ridged or grooved; soft palate; extrinsic syringeal muscles evidently attached to lung membrane.

Generally slim bodied, with short necks and short bills. Plumage coloured by carotenoid pigments and back-scattering of light through hollow cortical cylinders in feather barbs (Dyke-texture or Tyndall-texture). All feathers of body (except nape of some groups) have grey bases. None has erectile crests, though Horned Parakeet *Eunymphicus cornutus* of New Caledonia has elongated feathers on crown forming an immovable crest (Forshaw & Cooper 1989). Maxillae attached to skull by a flexible joint. Carotid arteries paired, fused, or left carotid superficial. Syrinx bronchial, the first rings upcurved, ossified and fused (except in Nestorinae). Zonary proventriculus present. No gall bladder. See introduction to order for characters shared with Cacatuidae.

Adult plumage often bright and colourful; ground-colour commonly green, with blue, red or yellow markings. In most, sexes similar or differ only slightly in plumage; in *Eclectus*, *Psephotus* and some *Neophema*, sexual dimorphism in plumage marked. In those groups that have stripe on underwing, presence often related to age or sex. Adult bare parts vary greatly: dull greys, browns and creams in many, but can be bright red or orange in many others. In most species, males slightly larger than females. Adult post-breeding (pre-basic) moult usually complete. Moult of primaries centrifugal; usually begins from p6, but in some can begin with any primary between p5 and p8. Nestlings usually hatch with sparse covering of down; a few hatch naked or nearly naked. A second, mesoptile, down develops in many species. In most, juvenile plumage duller than that of adults (and often resembles dull version of adult females in species where sexes differ). Post-juvenile (first pre-basic) moult partial in most species. Time to attain adult plumage varies greatly between species; in some, young birds not separable from adults after a few months, in others, adult appearance not attained until c. 4 years old. Similarly, time of first breeding can vary between species, from within first year to 4 years or older.

Occur in most habitats, from arid and semi-arid zones to tropical rainforest. Some species wholly arboreal, e.g. Loriinae, Cyclopsittacini, Eclectus Parrot *Eclectus roratus*; most others at least partly arboreal; a few strictly terrestrial, e.g. Night Parrot *Pezoporus occidentalis*, Ground Parrot *P. wallicus*. Though recorded in most habitats, some are specialists: e.g. fig-parrots *Cyclopsitta* mostly restricted to tropical and subtropical rainforests; Kaka *Nestor meridionalis* mostly inhabits temperate beech, broadleaf or podocarp rainforests; and Ground Parrot mainly confined to heathland in s. and e. Aust. In contrast, rosellas *Platycercus* may occur in a wide variety of treed habitats. Most require hollows, and therefore old trees, in which to nest, and are adversely affected by the removal of hollow-bearing trees (see Introduction to Order).

Patterns of movements vary greatly: from sedentary (e.g. Ground Parrot, Kakapo *Strigops habroptilus*), resident (e.g. Australian Ringneck *Barnardius zonarius*), to highly nomadic or dispersive (e.g. Budgerigar *Melopsittacus undulatus*). Several species migratory: Swift Parrot *Lathamus discolor* and Orange-bellied Parrot *Neophema chrysogaster* breed in Tas. and most or all of population moves to mainland Aust. for non-breeding season; further, Tas. breeding population of Blue-winged Parrot *Neophema chrysostoma* also apparently mostly migratory, moving to mainland Aust. Kakapo of NZ flightless. As with Cacatuidae, movements of many species poorly known, and many types of patterns have been attributed to them (e.g. Superb Parrot *Polytelis swainsonii*), probably in ignorance of actual movements, but possibly because movements vary between years or areas. Movements of lorikeets in Aust. (Loriinae) often considered to be related to flowering of food-trees. Many other species in HANZAB region appear to move in response to rainfall; in Budgerigar, both rainfall and temperature act indirectly on control of movements and breeding by affecting production of food (Wyndham 1980, 1983). Some species might make altitudinal movements (e.g. Eastern Rosella *Platycercus eximius*). Even suggested that movements of Golden-shouldered Parrots *Psephotus chrysopterygius* possibly linked to those of Black-faced Woodswallows *Artamus cinereus* (Garnett & Crowley 1995). Major studies of movements have been carried out on some species in HANZAB region (e.g. Crimson Rosella *Platycercus elegans*), using standard leg-banding, radio-tracking, and, in case of Ground Parrot, even cotton and spool method (Jordan 1987, 1988).

Almost all are herbivorous, feeding mainly on seeds, though many also take insects and their larvae. Most gregarious. Feed on ground, in trees, or both. Drink water by lapping, ladling or suck-pumping. All (except monotypic Psitttrichadini of New Guinea) husk seeds in same way: seed held between tip of lower mandible and notch on horny palate of upper mandible (which also corrugated to improve grip); the tip of the lower mandible driven into husk, between seed and husk, which is thus removed. The seed is then split and eaten; very hard nuts are held in part of bill nearest gape, where pressure between mandibles greatest (Collar 1997). Handling of other items similar. In HANZAB region, groups show variety of adaptations and behaviour; the following based on Forshaw & Cooper (1981), Schodde & Mason (1997), Forshaw, and species accounts, unless stated. **LORIINAE:** Almost exclusively arboreal, feeding mainly on nectar and some pollen and fruit. Specialized for harvesting pollen and nectar, with: narrow and protruding bills, brush-tipped tongues (see Churchill & Christensen 1970; Hooper & Burbidge 1979), non-muscular gizzard, and compound glands arranged linearly along wall of proventriculus (Steinbacher 1934). Gizzards of lorikeets much

smaller than those of seed-eating parrots of similar body weight, and intestine substantially shorter (Richardson & Wooller 1990). Gregarious, feeding in noisy flocks that continually move from one stand of flowering trees to another. When feeding, very active, clinging to and climbing all over flowering branches. PSITTACULINI: Arboreal, mainly in canopy of rainforest trees. Feed on fruits, seeds, flowers and nectar; said to prefer rainforest fruits. Usually feed in pairs or small flocks. CYCLOPSITTICINI: Wholly arboreal, but may descend to c. 1 m from ground to feed on low branches and trunks of fig-trees. Frugivorous, eating mainly figs, though tend to extract seeds from fruit and discard pulp rather than eat fruit. Bills broad, stout and ridged. Feed in pairs or small parties. POLYTELINI: Arboreal and terrestrial, granivorous. *Alisterus* and *Aprosmictus* arboreal, feeding mainly on seeds of native trees, such as *Eucalyptus*; *Polytelis* spend more time on ground feeding on seeds of grasses and herbaceous plants. Feed in pairs or small flocks, though *Polytelis* usually feed in flocks. PLATYCERCINAE: Terrestrial and arboreal. Diet: (1) mainly seeds of grasses, herbs and trees, procured from ground or from shrubs and trees (*Barnardius*, *Neopsephotus*, *Northiella*, *Platycercus*, *Polytelis*); (2) mainly seeds of grasses and herbs obtained almost exclusively from ground (*Melopsittacus*, *Neophema*, *Pezoporus*, and *Psephotus* [except Mulga Parrot *P. varius*, which feeds both on ground and in trees]); (3) nectar (*Lathamus*); (4) leaves of grasses and sedges (*Cyanoramphus*). Some highly specialized, e.g. Red-capped Parrots *Purpurecephalus spurius* have narrow projecting bill and feed on seeds extracted from capsules of Marri *Eucalyptus callophylla*. Many also supplement main diet with flowers, nectar, or fruits, and almost all take some invertebrates. One, Antipodes Island Parakeet *Cyanoramphus unicolor*, known to take dead and nesting seabirds. Most feed in small flocks; some feed in large flocks (e.g. Budgerigar); others often feed singly or in pairs (e.g. *Platycercus*). Feeding behaviour varies widely depending on nature of food and where obtained; for details see individual species accounts. NESTORINAE: Mainly herbivorous but omnivorous, taking wide range of plant foods and invertebrates. Arboreal and terrestrial, forage at all levels from ground to canopy of trees. Use wide range of foraging methods, including gleaning, probing, digging, stripping and chiselling bark, excavating wood, and licking nectar from flowers; unlike other parrots, feed on sap by stripping bark and exposing cambium, and then lick sap from damaged surface. Feed singly, in pairs or small flocks, though Kaka more often singly. STRIGOPINAE: Mainly herbivorous, partly granivorous. Forage at all levels, including canopy of tall forest, but most foraging on or near ground. Sense of smell thought to be well developed and of importance in foraging, and at least some birds can locate foods by smell alone. Short, powerful and compressed bill, and short, broad and thick tongue adapted for browsing, crushing, grinding and extracting juices from fibrous plant tissues. Solitary.

In HANZAB region, all species gregarious to some extent with notable exception of Kakapo. In most species, flocks typically of up to c. 30 birds. However, some species in flocks of 100s and, in Budgerigars, 1000s. Most species more gregarious in non-breeding season, though even in breeding season, many species often form flocks when feeding. All monogamous, with exception of Kakapo, in which the sexes come together only at leks. Pair bonds lifelong and mates remain together year round. Co-operative breeding does not occur, with probable exception of Eclectus and Red-cheeked *Geoffroyus geoffroyi* Parrots (Psittaculini) and possibly, but rarely, Regent Parrot *Polytelis anthopeplus* (Polytelini). Only female incubates but both sexes involved with feeding of young, except in Kakapo, in which female raises young alone, and possibly Ground Parrot, in which male appears responsible for feeding of young. In most species, young generally leave natal area by 3–6 months old. Aust. lorikeets, *Polytelis*, *Eclectus*, and some *Neophema* often nest in loose colonies; others strictly solitary nesters. Generally defend only nest-hole. Most gregarious species roost communally, at least when not breeding.

Often conspicuous, vocal and active but may be hard to observe when feeding in tree-tops or on ground. All species courtship feed, except Kakapo; in some, occurs year round e.g. *Trichoglossus*. Many known to, or likely to, allopreen, except rosellas *Platycercus*, Australian Ringneck, *Cyanoramphus*, *Neosephotus*, *Neophema*, Red-winged Parrot *Aprosmictus erythropterus*, Australian King-Parrot *Alisterus scapularis*, possibly Red-cheeked Parrot, and assumed not to in Kakapo. Sexual and aggressive displays generally fairly simple, consisting of actions such as bobbing, eye-blazing, arching of wings, fanning and wagging of tail and calls. However, in *Trichoglossus* and Varied Lorikeet *Psitteuteles versicolor* (Loriinae), displays complex and performed in many social contexts; in *Trichoglossus*, displays often performed either reciprocally or in unison by both members of a pair. Other notable displays are aerial circling performed by Eclectus and Red-cheeked Parrots, and distinctive calling behaviour of Kakapo and Ground Parrot.

Calls usually described as whistles, chatterings or pipings, though some are shrieks. Calls often melodic and some are extraordinarily complex, such as Warble song of Budgerigar, and highly varying yodelling calls of Kaka *Nestor meridionalis*. Booming of Kakapo at lek unique form of vocalization in parrots. Sexually differentiated calls known in many species in most genera. Food-begging Call of all Aust. lorikeets a repeated sharp high-intensity hissing note that begins with a structureless hiss, which gives way abruptly to a brief high-energy blip preceding a structured hiss (see Courtney 1997b). For details of Food-begging and other calls of platycerine parrots see Courtney (1997c, which was not available for summary in species accounts).

Breeding well known in HANZAB region. Extralimitally, breeding of most species of Loriinae, Platycercinae and Cyclopsittacini virtually unknown; some species of Psittaculini moderately well known. Plum-headed Parrot *Psittacula cyanocephala* and some lovebirds *Agapornis* (Psittaculini) breed colonially (Forshaw & Cooper 1981), and Large Fig-Parrot *Psittaculirostris desmarestii* (Cyclopsittacini) thought to breed colonially within hollow trunks of large



trees (Rand 1942; Beehler 1982). Breeding generally seasonal but some species will breed at any time of year if conditions suitable, and some species can raise two or more broods in a season. Most species nest in hollows in trees, though some nest on ground, under rocks, vegetation or in burrows; some species excavate tunnels in termite mounds. Extralimitally, Red-flanked Lorikeet *Charmosyna placentis* (Loriinae), Orange-breasted Fig-Parrot *Cyclopsitta gulelimitertii* (Cyclopsittacini) and some *Agapornis* (Psittaculini) nest in holes excavated in arboreal termitaria (Rand 1942; Bell & Coates 1979; Forshaw & Cooper 1981; Coates 1985). Hollows generally unlined, or lined with wood dust chewed from sides of hollow; extralimitally, *Agapornis* and hanging parrots *Loriculus* (Psittaculini) line hollow with pieces of leaves or bark or both; female carries material in bill or tucked among feathers of rump, flanks or lower back (Abdulali 1964; Ali & Ripley 1969; Forshaw & Cooper 1981). Eggs invariably white but can become stained in nest. Mean size of eggs varies from  $19.5 \times 16.4$  for Little Lorikeet to  $50.5 \times 37.2$  for Kakapo. Extralimitally, smallest egg ( $16.8 \times 13.5$ ) laid by Pygmy Lorikeet *Charmosyna wilhelminae* (Forshaw & Cooper 1981). Loriinae, Nestorinae, Strigopinae, Cyclopsittacini, Ground Parrot and most Psittaculini generally lay small clutches (2–4); a few species of Psittaculini and most Platycercinae generally lay 4–7 eggs, but can lay up to nine. Incubation lasts 18–23 days for most species; up to 25 days for Rainbow Lorikeet *Trichoglossus haematodus*, 26 days for Eclectus Parrot, between 3 and 4 weeks for Kea *Nestor notabilis* and 25–30 days for Kakapo. In all species, female incubates; male usually feeds female at nest or nearby. Young altricial, nidicolous. Most hatch naked and develop whitish to grey down in first few days. Generally, young fed by regurgitation, by female only, or by female for first few days then assisted by male; only male Ground Parrots feed young; male Kakapos play no part in nesting. Young of most species fledge at 5–7 weeks, 7–10 weeks for Rainbow Lorikeet, Kaka and Kakapo, 11–12 weeks for Eclectus Parrot, and 13 weeks for Kea; Ground Parrot has the shortest fledging period, c. 24 days. Fledgelings usually remain with parents for some time (Forshaw & Cooper 1981).

## REFERENCES

- Abdulali, H. 1964. *J. Bombay Nat. Hist. Soc.* 61: 483–571.
- Ali, S., & S.D. Ripley 1969. *Handbook of the Birds of India and Pakistan*. 3. OUP, Bombay.
- Beehler, B. 1982. *PNG Bird Soc. Newsl.* 187–188: 4–6.
- Bell, H.L., & B.J. Coates. 1979. *Emu* 79: 230.
- Churchill, D.M., & P. Christensen. 1970. *Aust. J. Zool.* 18: 427–37.
- Coates, B.J. 1985. *The Birds of Papua New Guinea*. 1. Dove Pubs, Alderley, Qld.
- Collar, N.J. 1997. Pp 280–477 In: del Hoyo et al. 1997.
- Courtney, J. 1997a. *Aust. Bird Watcher* 17: 42–59.
- 1997b. *Aust. Bird Watcher* 17: 61–70.
- 1997c. *Aust. Bird Watcher* 17: 169–84.
- del Hoyo, J., et al. (Eds) 1997. *Handbook of the Birds of the World*. 4. Lynx Edns, Barcelona.
- Forshaw, J.M., & W.T. Cooper. 1981, 1989. *Parrots of the World*. First, Third edns. Lansdowne, Melbourne.
- Garnett, S.T., & G.M. Crowley. 1995. *Recovery Plan for the Golden-shouldered Parrot*. Rep. to Aust. Nature Conserv. Agency, Canberra.
- Holyoak, D.T. 1973. *Emu* 73: 157–76.
- Hopper, S.D., & A.A. Burbidge. 1979. *Emu* 79: 40–2.
- Jordan, R. 1987. *RAOU Rep.* 27: 19–23.
- 1988. *Corella* 12: 18–21.
- Keast, A., et al. (Eds) 1985. *Birds of Eucalypt Forests and Woodlands*. Surrey Beatty, Sydney.
- Rand, A.L. 1942. *Bull. Am. Mus. Nat. Hist.* 79: 289–366.
- Richardson, K.C., & R.D. Wooller. 1990. *Aust. J. Zool.* 28: 581–6.
- Schodde, R., & I.J. Mason. 1997. *Zoological Catalogue of Australia*. 37.2. Aves. CSIRO Publ., Melbourne.
- Sibley, C.G., & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds*. Yale Univ. Press, New Haven.
- Smith, G.A. 1975. *Ibis* 117: 18–68.
- Steinbacher, G. 1934. *Orn. Mber* 42: 80–4.
- Wyndham, E. 1980. *Proc. Int. Orn. Congr.* 17(1): 485–92.
- 1983. *Emu* 82: 276–82.
- , & C.E. Cannon. 1985. Pp 141–50 In: Keast et al. 1985.

## *Cyanoramphus auriceps malherbi* Orange-fronted Parakeet

*Cyanoramphus Malherbi* Souancé, 1857, *Rev. et Mag. Zool.* (2) 9: 98 — South Island, New Zealand.

OTHER ENGLISH NAMES Alpine Parakeet, Kakariki.

**FIELD IDENTIFICATION** Very similar in all respects to Yellow-crowned Parakeet. **Adult** Differences from Yellow-crowned: more uniform and duller, colder green, with no yellow tones on underbody; narrow band across forehead and lores, orange (not crimson); patch on forecrown, pale lemon-yellow (cf. brighter yellow); and patch on sides of rump, orange (not dark red). Patches on rump useful for distinguishing Orange-fronted and Yellow-crowned when birds feeding, walking or preening; often covered by folded wings when bird perched, and rarely seen when birds in flight. **Juvenile** Poorly known. Very similar to adult; differs by: frontal band and forecrown fainter and diffuse for first few weeks after fledging; bill of recently fledged birds, pale pink, as in Yellow-crowned Parakeet; and iris, pale red-brown. Gradually attain adult coloration.

**Similar species** Red-crowned Parakeet (q.v.).

Habits not known to differ from Yellow-crowned Parakeet (q.v.); said to be not so bold (Buller 1870; Taylor 1985).

**HABITAT** Extant populations occur in beech *Nothofagus* forest, mostly below 900 m asl on Alpine Divide of SI, especially forests dominated by Red Beech *N. fusca*; often in areas bordering Mountain Beech *N. solandri* forest. Historically always associated with beech forest and not recorded from areas of West Coast where beech not present (Harrison 1970; Read & McClelland 1984; Taylor 1985; J. Kearvell). Formerly recorded from dense subalpine scrub to near sea-level, but not an alpine species (Harrison 1970).

Nest in hollows in trees. In L. Sumner area (Hope-Kiwi Rs), nesting only observed in forest dominated by Red Beech between 600 and 900 m asl; may prefer to nest in areas bordering Mountain Beech forest (Taylor 1985, 1998). Require mature trees for nest-sites and so most breeding on lower slopes of

valleys and valley floors (J. Kearvell). Breeding linked to seeding of beech, especially Red Beech (as in Yellow-crowned Parakeet; q.v.); birds breed continuously while seed available and numbers can increase (J. Kearvell; see Populations, below).

No information on feeding or roosting habitats, but probably as in Yellow-crowned Parakeet (q.v.).

**DISTRIBUTION AND POPULATION** Endemic to NZ. Now confined to several valleys in n. Canterbury, SI; formerly more widespread.

**SI** Mostly confined to several river valleys round L. Sumner and Arthurs Pass NP in s. NELSON and nw. CANTERBURY. Current known distribution: South Branch of Hurunui R. Valley, and Hawdon R. Valley; also recent and reliable report of several birds from Poulter R. Valley. Unconfirmed reports from Ada R. Valley, Jollie Brook and North Hurunui R. Valley (J. Kearvell). Recent searches have failed to find Orange-fronted in Nelson Ls or Hope R. Valley, where recorded in 1980s (J. Kearvell). Two recent records in SOUTHLAND, S of 44°S: singles, Eglinton Valley, 22 Dec. 1990, 16 Jan. 1991 (CSN 39).

**Change in range** In n. SI, formerly recorded from n. Nelson, S to nw. and w. Canterbury; rarely on e. coast. In S, occurred in Southland, from Stewart I. W to Fiordland. Also occurred NI, but status there uncertain. Probably never particularly common since European settlement (Williams 1962; Turbott 1967; Taylor 1975). **NI:** Few records. Two specimens collected by Reischek on Taranga I., Hen & Chickens Grp, and held at Vienna Museum (Taylor 1985, 1998; Oliver; J. Kearvell *contra* Fleming *et al.* 1953; Harrison 1970); Reischek also reported collecting a specimen on Little Barrier I. (Taylor 1985, 1998; Oliver; *contra* Fleming *et al.* 1953; Harrison 1970) though validity and fate of this specimen uncertain. Another specimen

said to be from NI held at NMNZ (J. Kearvell), but no further details. Unverified report of single bird, Taranga I., Hen & Chickens Grp, 1985 (Taylor 1998). sr: In N, formerly recorded from Takaka and Nelson round Golden and Tasman Bays, S to Arthurs Pass. E. coast records on Banks and Otago Pens probably only associated with irruptions (see Yellow-crowned Parakeet), rather than established populations (J. Kearvell). In Southland, recorded from Stewart I. and near Invercargill, W to Thompson and Caswell Sounds in w. Fiordland. In 19th century, most records clustered round Nelson and in Fiordland, with scattered records at Mt Alexander, Oxford Ra. and near Invercargill (Harrison 1970; J. Kearvell), with possibly irruptive occurrences on e. coast (see above). Recorded at seven locations between 1901 and rediscovery in 1965: single specimen, Stewart I., 1904 (NMNZ: 472); single specimen, Takaka, 1913; five specimens, Owen Junction, 14 Aug. 1928; unknown number, Manapouri, 28–30 Nov. 1947 (CSN 3; not 1949 as reported in Harrison [1970] and Taylor [1985]); single (unconfirmed), Flora R., 13 May 1955; unverified report of three, D'Urville R., Jan. 1957; unverified report, Hope R., 1963 (Harrison 1970; Fleming 1980; Taylor 1985; Oliver; CSN 6, 8). Rediscovered in D'Urville R. Valley, Nelson Ls NP, in 1965 (Harrison 1970; McPherson 1974). In Sept. 1980, small numbers discovered near Hope R. (Taylor 1985). Since early 1980s, recorded in L. Sumner area (Hope, Kiwi and S. Hurunui Rs), and in Hawdon R. Valley in Arthurs Pass NP (Cox 1981; Nixon 1981; Read & McClelland 1984; Taylor 1985; Taylor *et al.* 1986; Heatherbell 1992; Triggs & Daugherty 1996; CSN 37; J. Kearvell), but not recorded in Nelson Ls or Hope R. since 1980s (J. Kearvell). **Auckland Is** No acceptable records (see Harrison 1970); specimens claimed to have been taken there cannot be located (J. Kearvell).

**Status** Rare (Taylor 1985). **Populations** Known population probably <500 birds, possibly 200–500 (J. Kearvell). In South Branch Hurunui R. Valley, 1995–96, 65 birds observed (and 50 Yellow-crowned Parakeets); in 1996–97, 67 birds observed (with 161 Yellow-crowned and 261 unidentified parakeets) (J. Kearvell). For monthly counts of Yellow-crowned and Orange-fronted Parakeets (combined) in South Branch Hurunui R. Valley, see Yellow-crowned Parakeet. Population thought to be still declining and range contracting (J. Kearvell *contra*

Taylor 1985). Decline in population said, without any evidence, to be density-dependent response to overpopulation (Harrison 1970). Modification of habitat and introduced predators more likely to be cause for decline (*contra* Harrison 1970).

**MOVEMENTS** No detailed studies. Considered resident (NZCL; J. Kearvell). Recorded throughout year at any one site (J. Kearvell). Recorded at all altitudes in South Branch Hurunui Valley, which ranges from 700–950 m up to 1200–1300 m asl; in winter, when not breeding (i.e. not a year of heavy seeding of beech), tend to leave valley floor and move to sides of valley, where more difficult to locate (J. Kearvell). In South Branch Hurunui Valley, one pair seen to fly directly along top of canopy from 1300 m down to valley floor (J. Kearvell). Early e. coast records possibly irruptions after continuous breeding associated with heavy seeding of beech *Nothofagus*, as described in Yellow-crowned Parakeet (J. Kearvell).

**FOOD** Seeds, fruit, leaves, flower and leaf buds, flowers and invertebrates (Harrison 1970; Taylor 1985). **Behaviour** Not known to differ from Yellow-crowned Parakeet (q.v.), but proportion of invertebrates in diet possibly greater and proportion of plant material less. In South Branch Hurunui Valley, Red Beech *Nothofagus fusca* important foraging substrate, becoming more important in breeding season. Readily glean invertebrates from leaves and bark; seen to rip open dead wood, possibly to extract invertebrates (J. Kearvell). Take larval insects and other invertebrates from dead wood, beneath bark and from fronds of *Polystichum* (Taylor 1998).

No detailed studies. **Plants** Fruits<sup>1,2,4</sup>, seeds<sup>1,2,3</sup>, leaf buds, flowers, young leaves<sup>3,4</sup>. **GYMNOSPERMS:** Podocarpaceae: *Phyllocladus alpinus* sds<sup>4</sup>. **DICOTYLEDONS:** Fagaceae: *Nothofagus fusca* leaf buds, fl., sds<sup>4,5</sup>; *N. menziesii* fl., leaf buds<sup>4</sup>; *N. solandri* var. *solandri* leaf buds, fl., sds<sup>4</sup>. **Animals** Unident. invertebrates<sup>4</sup>. **INSECTS:** Unident. ads<sup>2</sup>; larv.<sup>1,2,5</sup>; Hemiptera: Coccidae: scale insects<sup>3,4,5</sup>. (REFERENCES: <sup>1</sup> Harrison 1970; <sup>2</sup> Forshaw & Cooper 1989; Taylor; <sup>3</sup> 1985, <sup>4</sup> 1998; <sup>5</sup> J. Kearvell.)

**SOCIAL ORGANIZATION AND BEHAVIOUR** Very poorly known and no published studies. Occur in pairs or small flocks; largest flocks (Orange-fronted only), 15, in South Branch Hurunui Valley, 1996; and 10+ in Hawdon Valley, 1989 (J. Kearvell; C.F.J. O'Donnell); more usually in mixed flocks with Yellow-crowned Parakeets, especially in non-breeding season in South Branch Hurunui Valley (Taylor 1985, 1998; J. Kearvell). In South Branch Hurunui Valley, often in mixed flocks with Yellow-crowned Parakeets and other bush birds, including Brown Creeper *Mohoua novaeseelandiae*, Grey Fantail *Rhipidura fuliginosa*, Silvereye *Zosterops lateralis* and Yellowheads; if present, Yellowheads lead mixed-species foraging flocks. Parakeets will follow flocks led by Yellowheads and seen to leave flocks not led by Yellowheads to join flocks that are (J. Kearvell). Courtship feeding appears similar to that described for Yellow-crowned Parakeet (q.v.); inspection of nesting holes as described for Yellow-crowned (q.v.; J. Kearvell).

**VOICE** Very poorly known. Pickard (1990) found no major differences between calls of Yellow-crowned and Orange-fronted Parakeets, but sample small; Taylor (1998) also noted no differences in calls of the two in wild or captivity. However, others have reported that calls differ slightly (Triggs & Daugherty 1996; Taylor 1998; J. Kearvell); preliminary work suggests calls may be more rapid and lower-pitched (J. Kearvell). Will approach taped calls (Taylor 1998).



**BREEDING** Very poorly known and no detailed studies. Probably like Yellow-crowned Parakeet (q.v.). Following information from Taylor (1985, 1998) from L. Sumner area (hybrid pair a female Orange-fronted and male Yellow-crowned). **Season** Probably as Yellow-crowned Parakeet. Two nests recorded Oct. (includes one hybrid pair). **Site, Nest, Materials** In hollows; one nest in cavity entered through knothole c. 8 cm in diameter, in live Red Beech *Nothofagus fusca*, c. 10 m above ground. Hybrid pair nested in hole high in dead beech. **Eggs** From Mt Peel, Canterbury: broadly elliptical; 21.2 × 18, 21.8 × 18 (Oliver). Possibly slightly smaller than those of Yellow-crowned (q.v.). **Clutch-size** C/3 in one nest. **Success** Nest of hybrid pair deserted when nest waterlogged in a storm. No other information.

**PLUMAGES** Prepared by A.M. Dunn. Sequence of plumages as in Yellow-crowned Parakeet.

**Adult** Plumage much duller than that of Yellow-crowned Parakeet, with less yellow. Differences from *auriceps*: Narrow band across lower forehead and lores, orange (16–17). Rest of forehead and forecrown to above eye, paler yellow (pale 55). Spots on sides of rump, orange (17). Rest of upperparts slightly different shade of green (c160). Underparts appear more lime-green (c159). Wash on undertail slightly bluer green. Green areas of upperwing slightly different shade of green (c160). Of six live birds captured in South Branch Hurunui Valley, 1996, underwing-bar recorded on all (J. Kearvell).

**Juvenile** Similar to adult, but with shorter tail and less distinct frontal band (Harrison 1970; Forshaw & Cooper 1989; NZRD). Differences from juvenile *auriceps* probably similar to differences between adult *malherbi* and adult *auriceps*.

**BARE PARTS** Based on published and unpublished information (Forshaw & Cooper 1989; Oliver; J. Kearvell) and video of captive bird (Unpubl.: J. Kearvell); no photos available. Not known to differ from Yellow-crowned Parakeet (q.v.). Six wild birds from South Branch Hurunui Valley had orange-red irides (J. Kearvell). Label of one skin in Frankfurt Museum states 'eye yellow' (J. Kearvell).

**MOULTS** Only four adult skins with dates available for study. These were collected in Feb., Mar. and May and none was moulting. Timing and sequence of moults probably as in Yellow-crowned Parakeet (q.v.).

**MEASUREMENTS** Throughout former range, including SI and Stewart I., skins: (1) Adults (CM, NMNZ); (2) Adults (Forshaw & Cooper 1989); (3) Age not known, skins (Nixon 1981, 1982). (4) SI, adults, skins and live birds combined (includes most specimens in sample 1) (J. Kearvell).

		MALES	FEMALES
WING	(1)	110.0 (3.27; 106–114; 4)	101, 107, 110
	(2)	105.7 (95–114; 7)	102.4 (97–110; 9)
	(3)	–	103.5 (3.70; 4)
TAIL	(1)	121.2 (5.38; 116–128; 4)	110, 115
	(2)	111.1 (101–119; 7)	111.0 (107–119; 9)
	(3)	–	106.5 (10.21; 4)
BILL	(1)	13.8 (0.73; 12.9–14.4; 4)	11.0, 13.1, 13.2
	(2)	13.3 (11–15; 7)	11.7 (11–13; 9)
	(3)	–	12.2 (1.03; 4)
	(4)	13.8 (0.58; 12.6–14.7; 28)	11.3 (0.51; 10.0–12.3; 29) **
BILL W	(3)	–	7.4 (0.56; 4)
	(4)	8.05 (0.485; 7.4–9.2; 28)	7.13 (0.460; 6.00–8.17; 29) **
TARSUS	(1)	18.8, 18.9, 19.3	17.3, 19.4
	(2)	18.4 (18–19; 7)	18.3 (17–20; 9)
	(3)	–	18.7 (0.64; 3)\
TOE C	(1)	22.9	–
CROWN	(3)	–	17.5 (3.87; 4)

Males have significantly longer and wider bill than females.

One male and one female collected Taranga I., Hen & Chickens Grp, NI, 1880 (Vienna Mus. of Nat. Hist.; Taylor 1998): Wing, 101 mm in male, 98 mm in female; Tail, 102 (worn), 117; Bill, 13.5, 11.3; Bill W, 8.3, 6.8.

Unsexed: (5) Throughout range, adults, skins (Holyoak 1974). (6) L. Sumner area (Hope–Kiwi Rs), North Canterbury, age not known, live (Taylor 1998).

		UNSEXED
WING	(5)	107 (3.67; 99–114; 18)
	(6)	106, 106, 110
TAIL	(6)	96, 117, 122
BILL	(5)	12.4 (1.39; 9.6–15.2; 19)
	(6)	13.3, 14.4, 14.5
BILL W	(6)	8.4, 8.7, 9.1
TARSUS	(6)	19.3, 19.8, 22.8

**WEIGHTS** Few data. Adult males, 37, 39 (from museum labels; NMNZ). Unsexed birds from L. Sumner area (Hope–Kiwi Rs), North Canterbury, age not known, 43, 44, 49 (Taylor 1998). Aviary stock (AIM, NMNZ): adult males 49.0 (4.00; 44–55; 6), adult females 47.9 (5.98; 38–55; 7) (not significantly different).

**STRUCTURE** As Yellow-crowned Parakeet (q.v.).

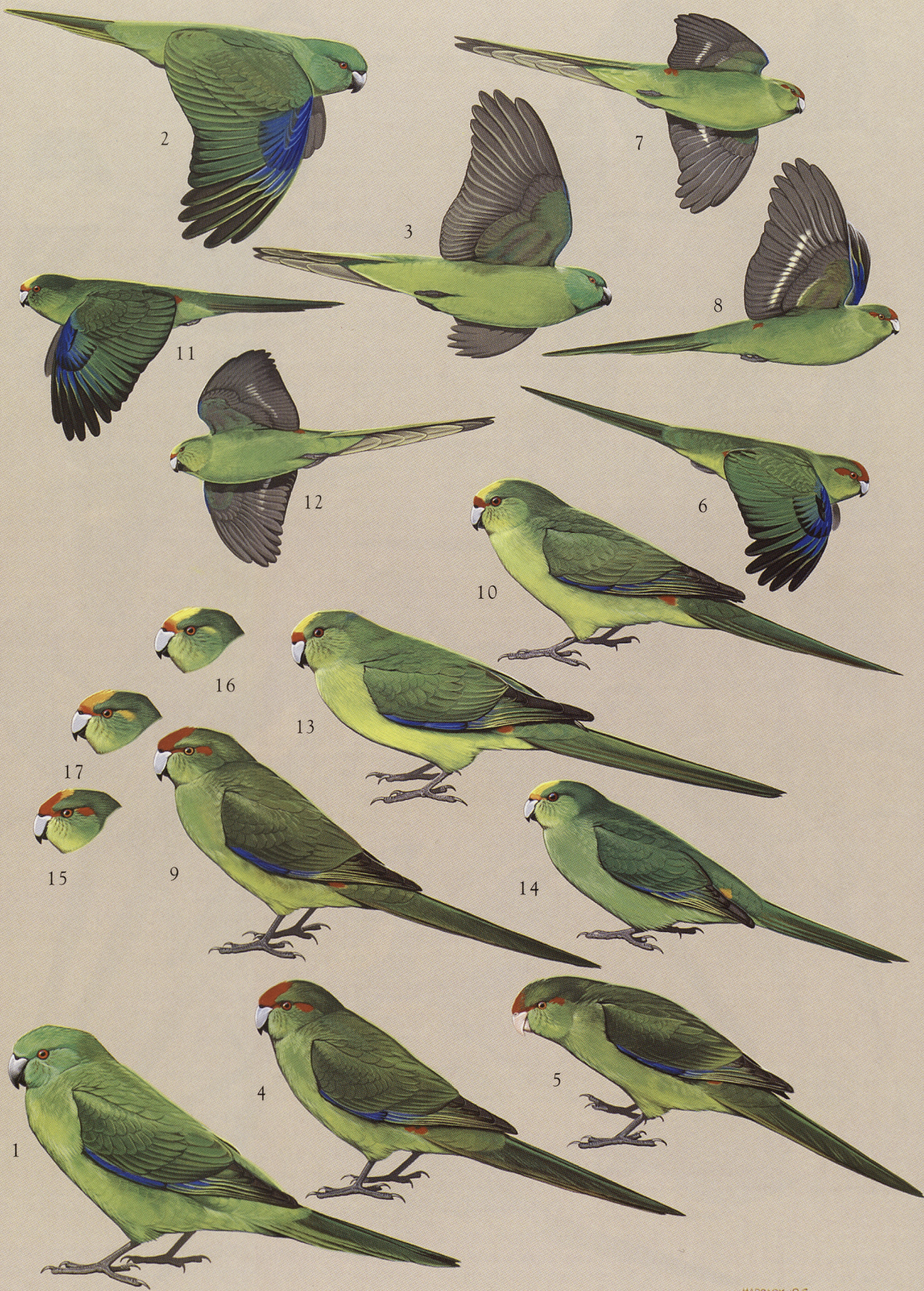
**SEXING** Males have much longer and wider bills than females.

**GEOGRAPHICAL VARIATION** See Geographical Variation of Yellow-crowned Parakeet

## REFERENCES

- Archev, G., & C. Lindsay. 1924. *Rec. Canterbury Mus.* 2: 187–201.
- Batty, J. 1989. *New Zealand Parakeets (Kakarikis)*. Nimrod Press, Alton, Hants., England.
- Bell, B.D. 1976. *Notornis* 23: 310–19.
- , & D.H. Brathwaite. 1964. *Notornis* 10: 363–83.
- Blackburn, A. 1965. *Notornis* 12: 191–207.
- 1968. *Notornis* 15: 51–65.
- Boon, W.M., et al. 1997. *Taxonomic Status of the Orange-fronted Parakeet and the Forbes' Parakeet*. Unpubl. Rep. to Birds Aust. (HANZAB).
- Buller, W.L. 1870. *Trans. NZ Inst.* 2: 385–92.
- 1888. *A History of the Birds of New Zealand*. Author, Lond.
- Butler, D.J. 1986. *Notornis* 33: 58–9.
- Challies, C.N. 1966. *Notornis* 13: 18–26.
- Chambers, B.S., et al. 1955. *Notornis* 6: 152–7.
- Child, P. 1975. *Notornis* 22: 143–50.
- Cooper, W.J., et al. 1986. *Notornis* 33: 77–89.
- Cox, A. 1981. *Hope River Orange-fronted Parakeet Capture. 12–27 March 1981*. Unpubl. Rep. to NZ Wildl. Serv., Wellington.
- Dawe, M.R. 1979. Unpubl. MSc thesis, Univ. Auckland.
- Dawson, D.G., et al. 1978. *Notornis* 25: 257–78.
- Dawson, E.W. 1951. *Notornis* 4: 146–9.
- Dawson, G.E., & E.W. Dawson. 1958. *Notornis* 8: 39–49.
- Dyer, I. 1979. *Kakariki*. Isles d'Avon, Kingswood, Bristol, England.
- Efford, M., & K. Morrison. 1991. *Sci. Rep. DSIR Land Res.* 20.
- Elliott, G.P., & G. Rasch. 1995. *Notornis* 42: 94–8.
- , et al. 1996a. *NZ J. Zool.* 23: 249–66.
- , et al. 1996b. *NZ J. Zool.* 23: 267–78.
- Falla, R.A., et al. 1981. *The New Guide to the Birds of New Zealand*. Collins, Auckland.
- Flack, J.A.D. 1976. *Notornis* 23: 253–5.
- Fleming, C.A. 1939. *Emu* 38: 492–509.
- 1980. *Notornis* 27: 388–90.

- , *et al.* 1953. *Checklist of New Zealand Birds*. Reed, Wellington.
- Forbes, H.O. 1893. *Ibis* 5: 521–46.
- Forshaw, J.M., & W.T. Cooper. 1989. *Parrots of the World*. Third edn; Lansdowne, Melbourne.
- Freeman, A.N.D. 1994. *Notornis* 41 (Suppl.): 127–41.
- Funk, M.S. 1994. Unpubl. PhD thesis, *Northwestern Univ., USA*.
- 1996a. *Anim. Learn. & Behav.* 24: 375–83.
- 1996b. *Bird Behav.* 11: 91–104.
- Greene, T.C. 1988. Unpubl. MSc thesis, Univ. Auckland.
- 1989. *Notornis* 36: 322–33.
- 1990. *Breeding Biology of New Zealand Parakeets on Little Barrier Island*. Unpubl. Rep.
- Harrison, M. 1970. *Notornis* 17: 115–25.
- Heatherbell, C. 1992. *Notornis* 39: 131–2.
- Holyoak, D.T. 1973. *Emu* 73: 157–76.
- 1974. *Bull Br. Orn. Club* 94: 4–9.
- Innes, J., *et al.* 1982. *Notornis* 29: 93–9.
- Lambert, R.E. 1970. *Notornis* 17: 62–5.
- MacMillan, B.W.H. 1990. *Notornis* 37: 45–51.
- McCallum, J., *et al.* 1984. *Tane* 30: 105–24.
- McCann, C. 1963. *Notornis* 10: 326–45.
- McKenzie, H.R. 1979. *Notornis* 26: 105–19.
- McLean, I.G., & R.B. Russ. 1994. *Notornis* 41: 213–15.
- M'Lean, J.C. 1911. *Emu* 11: 1–17.
- McPherson, L.B. 1974. *Notornis* 21: 337–48.
- Melville, D. 1984. *Notornis* 31: 91.
- Moncrieff, P. 1925. *Emu* 25: 21–7.
- Moon, G. 1992. *The Reed Field Guide to New Zealand Birds*. Reed, Auckland.
- , & R. Lockley. 1982. *New Zealand's Birds*. Heinemann, Auckland.
- Nilsson, R.J., *et al.* 1994. *Notornis* 41 (Suppl.): 109–25.
- Nixon, A.J. 1981. *Notornis* 28: 292–300.
- 1982. Unpubl. MSc thesis, Victoria Univ., Wellington.
- 1994. *Notornis* 41 (Suppl.): 5–18.
- Norton, S.A. 1982. *Notornis* 29: 91–2.
- O'Donnell, C.F.J., & P.J. Dilks. 1994. *NZ J. Ecol.* 18: 87–107.
- Ogle, C.C. 1981. *Tane* 27: 177–200.
- Onley, D.J. 1980. *Notornis* 27: 335–62.
- 1983. *Notornis* 30: 187–97.
- Pickard, J. 1990. Unpubl. MSc thesis, Victoria Univ., Wellington.
- Read, A., & P. McClelland. 1984. *Notornis* 31: 266–7.
- Robertson, C.J.R. 1973. *Notornis* 20: 59–70.
- Sagar, P.M. 1988. *Notornis* 35: 1–8.
- Skegg, P.D.G. 1964. *Notornis* 11: 159–76.
- St Paul, R. 1977. *Notornis* 24: 20–30.
- Stidolph, R.H.D. 1948. *NZ Bird Notes* 3: 13–16.
- Taylor, R.H. 1975. *Notornis* 22: 110–21.
- 1985. *Tech. Publ. Int. Coun. Bird Preserv.* 3: 195–211.
- 1998. *Notornis*. 45:49–63.
- , *et al.* 1986. *Notornis* 33: 17–22.
- Temple, P. 1996. *The Book of the Kea*. Hodder Moa Beckett Publishers, Auckland.
- Tennyson, A.J.D., & P.R. Millener. 1994. *Notornis* 41 (Suppl.): 165–78.
- Triggs, S.J., & C.H. Daugherty. 1996. *Bird Conserv. Int.* 6: 89–101.
- Turbott, E.G. 1967. *Buller's Birds of New Zealand*. Whitcombe & Tombs, Christchurch.
- Wilkinson, G.B., & R. Guest. 1977. *Notornis* 24: 161–6.
- Williams, G.R. 1962. *Notornis* 10: 15–32.
- Wilson, G.J. 1973. *Notornis* 20: 318–23.
- Wilson, P.R., *et al.* 1988. *Notornis* 35: 217–43.



MARSACK '96

**Volume 4, Plate 24** [caption error corrected from original]

Antipodes Island Parakeet *Cyanoramphus unicolor* (page 469)  
 1 Adult male; 2, 3 Adult

Red-crowned Parakeet *Cyanoramphus novaezelandiae* (page 475)  
 NOMINATE NOVAEZELANDIAE: 4 Adult male; 5 Juvenile female; 6, 7 Adult; 8 Juvenile  
 SUBSPECIES CHATHAMENSIS: 9 Adult male

Yellow-crowned Parakeet *Cyanoramphus auriceps* (page 492)  
 NOMINATE AURICEPS: 10 Adult male; 11, 12 Adult  
 SUBSPECIES FORBESI: 13 Adult male  
 SUBSPECIES MALHERBI: 14 Adult female

Hybrid Red-crowned *C.n. chathamensis* x Yellow-crowned *C.a. forbesi* Parakeet  
 15 Red-crowned type; 16 Yellow-crowned type; 17 Intermediate type