

## 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).

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## 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 *Psittrichas 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).

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*Cyanoramphus auriceps* **Yellow-crowned Parakeet**

COLOUR PLATE FACING PAGE 449

*Psittacus auriceps* Kuhl, 1820, *Nova Acta Acad. Caesar. Leop. Carol.* 10: 46 — South Island, New Zealand.

The specific name is a compound from Latin *aurum*, gold, and *-ceps*, headed, crowned (*caput*, head).

**POLYTYPIC** Status of forms of 'Yellow-crowned Parakeet' uncertain and controversial, especially status of Orange-fronted Parakeet. Three taxa usually recognized, and which variously considered as separate species, subspecies of the one species, or, in the case of Orange-fronted Parakeet, a colour-morph. These taxa are: *auriceps* Kuhl, 1820 (Yellow-crowned Parakeet), which occurs NI and SI, including many nearshore and offshore islands, Stewart I., and Auckland Is; *forbesi* Rothschild, 1893 (Forbes' Parakeet), which occurs on Little Mangere, Mangere and Pitt Is in Chatham Grp; and *malherbi*, Souancé, 1857 (Orange-fronted Parakeet), which is now confined to a few valleys in North Canterbury, SI (but was formerly more widespread).

Currently, *forbesi* is considered a subspecies of *auriceps*, and *malherbi* a colour-morph of *auriceps* and not given subspecific status (NZCL). However, taxonomic status of *malherbi* and *forbesi* has been subject of recent debate (Taylor 1985, 1998; Triggs & Daugherty 1996) and recent work suggests that both should be recognized as separate species.

Both genetic studies (Triggs & Daugherty 1996) and DNA analyses (Boon *et al.* 1997; J. Kearvell) indicate that *forbesi* should be treated as a separate species. Suggested to be most closely related to Red-crowned Parakeet *Cyanoramphus novaezelandiae* (Triggs & Daugherty 1996).

Earlier cross-breeding experiments suggested that *malherbi* was a colour-morph of *auriceps* (Taylor *et al.* 1986), a position adopted by the OSNZ in NZCL, and still argued by Taylor (1998). However, results of recent DNA analyses and behavioural studies suggest that *malherbi* should be treated as a separate species (Boon *et al.* 1997; J. Kearvell). Genetic differences were sufficient to recognize these birds as more than a colour-morph (Boon *et al.* 1997). Furthermore, the restricted range of *malherbi* is wholly sympatric with *auriceps*; preliminary results provide good evidence of assortative pairing between *malherbi* and *auriceps* (J. Kearvell), which indicate that specific status is probably warranted.

Pending resolution of these issues, we treat each as a subspecies of *auriceps*, but have attempted to present the information for each taxon separately. The Yellow-crowned Parakeet (*auriceps*) is dealt with first, followed by separate accounts for the Orange-fronted Parakeet (*malherbi*) and Forbes' Parakeet (*forbesi*).

*Cyanoramphus auriceps auriceps* **Yellow-crowned Parakeet**

**OTHER ENGLISH NAMES** Kakariki.

**FIELD IDENTIFICATION** Length: male 23–27 cm, female 20–24 cm; wingspan: male 32–36 cm, female 31 cm; weight 50 g. Medium-sized parrot, similar in size and shape to Red-crowned Parakeet *Cyanoramphus novaezelandiae*. Unmistakable: bright reen with crimson frontal band, bright golden-yellow forecrown, and red patch on sides of rump. Sexes alike in plumage but females slightly smaller, with proportionately smaller bill, and these features can sometimes be used to separate sexes in direct comparison. No seasonal variation. Juvenile separable for at least several weeks after fledging. Hybridize with Red-crowned Parakeet (q.v.); any yellow markings behind eye usually indicate hybrids. **Adult** Mostly bright green, slightly paler and yellower on underbody and with: small dark-red patch on sides of rump; diagnostic narrow band of crimson across lower forehead, continuing narrowly across lores to eye; and golden-yellow patch on upper forehead and forecrown (to level with rear edge of eye). Folded wing mostly bright green, as rest of upperparts, sometimes showing narrow dark-blue leading edge; folded primaries, blackish. In flight, upperwing appears mostly bright green, with outer five prima-

ries and their coverts contrastingly dark blue, grading to blackish at tip. Underwing: leading coverts, green-blue; greater coverts and remiges, dark grey-brown, usually with varying pale underwing-bar through middle of remiges; some have prominent long narrow white or cream bar across middle of inner primaries and most secondaries. Undertail, grey with yellow-green wash. Bill, pale blue-grey, with black cutting edge and tip. Cere, grey-black. Iris, red to orange-red. Orbital ring, grey-black to black. Legs and feet, commonly black-brown, but varying to pink-brown or purple-grey. **Juvenile** Very similar to adult and some probably not separable on plumage. Differs by: on fledging, frontal band and yellow patch on forecrown smaller and diffuse, head appearing mostly green; red patches on sides of rump much smaller, or confined to just a tinge of red, or with no red at all; and colour of bare parts distinctive: bill, pale pink with larger dark tip; and iris darker than in adults, dull orange-red to pale reddish-brown. Tail of fledgelings also shorter than that of adult. Bare parts and frontal band and forecrown gradually change to adult coloration soon after fledging (possibly as soon as 2–5 weeks); tail rapidly attains adult length.

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

Gregarious; usually seen in pairs or small groups. Inhabit moist, dense native forests. Where ranges overlap in SI, often in mixed flocks with Orange-fronted Parakeets. Sometimes associate with Red-crowned Parakeets. Will feed in mixed-species flocks and will follow flocks of Whitehead *Mohoua albicilla* in NI and Yellowhead *M. ochrocephala* in SI. Arboreal and terrestrial; in NI and SI, usually seen in small groups high in forest canopy, but on predator-free offshore islands and Auckland Is, also commonly forage on ground. Gait and flight probably much as Red-crowned Parakeet. Calls similar to those of Red-crowned Parakeet but distinguishable, tending to be higher pitched and weaker; flight call usually a rapid continuous *ki-ki-ki-ki-ki-ki*; also utter chattering *chit chit chit* notes and babbling notes when feeding.

**HABITAT** Mostly confined to moist, dense, unmodified native forests, usually dominated by beech *Nothofagus*. Also in mixed hardwood-podocarp forest containing Totara *Podocarpus glaucus*, Rimu *Dacrydium cupressinum*, Kahikatea *Dacrycarpus dacrydioides*, Tawari *Ixerba brexioides* or Silver Pine *Lagarostrobos colensoi* and other broadleaf components, especially as emergents (M'Lean 1911; Child 1975; St Paul 1977; Wilkinson & Guest 1977; Dawson *et al.* 1978; Onley 1980; Read & McClelland 1984; Butler 1986; Elliott & Rasch 1995; Elliott *et al.* 1996a; Oliver; CSN; J. Kearvell). Usually in dense canopy, less often among understorey, and rarely on floor of forest (M'Lean 1911; Moncrieff 1925; St Paul 1977; Read & McClelland 1984). Sometimes in more stunted vegetation at edge of forest, such as subalpine scrub or thickets of Kanuka *Leptospermum ericoides*, Manuka *L. scoparium* and *Dracophyllum* scrub (Turbott 1967; CSN). Rarely in secondary regrowth (Turbott 1967; CSN 21, 22), and do not occur in logged forests (Onley 1983). In areas subject to clearance or forestry operations, usually only in remnant patches of unmodified native forest, which may sometimes be surrounded by plantations of exotic trees (Innes *et al.* 1982; CSN 30). Rarely among exotic vegetation or in gardens in towns, though formerly recorded in agricultural land, especially in crops or orchards (M'Lean 1911; Turbott 1967; MacMillan 1990; Oliver; CSN). **AUCKLAND IS:** In and at edges of dense Southern Rata *Metrosideros umbellata* forest or scrub (R.H. Taylor).

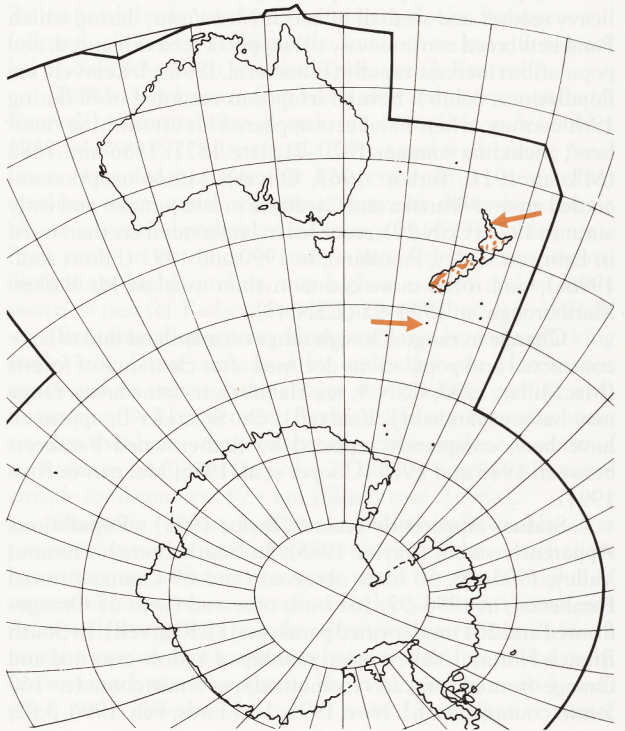
Nest in hollow in trunk or branch of tall tree, or sometimes decaying stump, within forest (M'Lean 1911; St Paul 1977; Forshaw & Cooper 1989; Elliott *et al.* 1996a,b; Oliver; CSN 4). Beech *Nothofagus* (including Red Beech *N. fusca*, Silver Beech *N. menziesii*, and Mountain Beech *N. solandri* var. *cliffortoides*) have regular seeding cycle, with heavy seedset and seedfall every 3–6 years (called 'masting'); in years of heavy seedset, Parakeets breed continuously while seed is available, and numbers increase rapidly; in years other than those of heavy seeding, beech produce far fewer seeds, and breeding of Parakeets restricted to summer–autumn and fewer breed (J. Kearvell; also see Breeding).

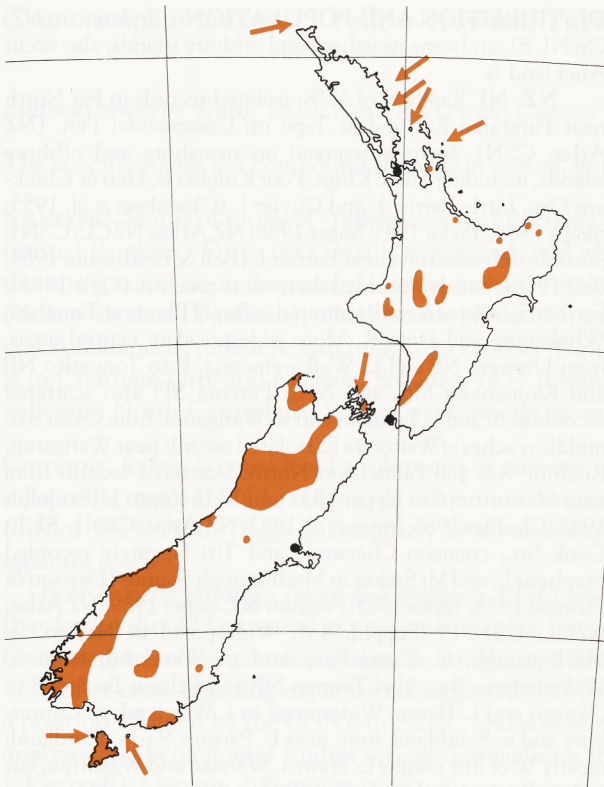
Usually feed in seeding, fruiting or flowering trees or shrubs within forest; mostly in canopy, sometimes in upper levels of understorey (M'Lean 1911; Turbott 1967; Taylor 1975; Norton 1982; Read & McClelland 1984; CSN). Formerly fed in fruit trees in orchards (Oliver). Rarely feed on ground, on floor of forest (Lambert 1970; Taylor 1975, 1985), among grass (Oliver; CSN 5) or in open paddocks with weeds or crops (Turbott 1967).

Recorded roosting in hollows in trees, including nesting hollows (Elliott *et al.* 1996a).

**DISTRIBUTION AND POPULATION** Endemic to NZ. On NI, SI, and some nearshore and offshore islands; also occur Auckland Is.

**NZ NI** Rarely N of 37°S; isolated records in Far North near Parataiko Ra., and at Tapu on Coromandel Pen. (NZ Atlas; CSN). More widespread on nearshore and offshore islands, including Three Kings, Poor Knights Is, Hen & Chickens Grp, Little Barrier I. and Cuvier I. (Chambers *et al.* 1955; Skegg 1964; Taylor 1985; Sagar 1988; NZ Atlas; NZCL; CSN); possible old record on Great Barrier I. (Bell & Brathwaite 1964; Bell 1976), but also recorded there more recently (Ogle 1981). Farther S, isolated records scattered in Bay of Plenty at Tauranga, Whakatane and Motu R. More widespread in central areas, from Urewera NP and L. Waikaremoana, E to Tongariro NP and Kaimanawa Mts, and N to Pureora SF; also scattered records in n. and e. Taranaki and w. Wanganui, from Okau S to middle reaches of Waitotara R. Isolated records near Wanganui, Ruahine Ras and Palmerston North. Scattered records from near Masterton, S to Upper Hutt and W to Kapiti I. (Stidolph 1948; Challies 1966; Innes *et al.* 1982; NZ Atlas; CSN). **SI** In Cook Str., common Chetwode and Titi Is; rarely recorded Stephens I., and Mt Stokes in Marlborough Sounds (Dawson & Dawson 1958; Taylor 1985; Forshaw & Cooper 1989; NZ Atlas; NZCL; CSN 19 [Suppl.], 43). Widespread in Nelson, w. Marlborough, w. Canterbury and n. Westland, from n. Wakamarama Ra., Abel Tasman NP and Pelorus Bridge, S to Okarito and L. Heron. Widespread in s. Westland, w. Canterbury and e. Southland, from near L. Paringa S to s. Fiordland; mostly W of line joining Ls Hawea, Wanaka and Wakatipu, but isolated records in Dingle Burn and at Arrowtown. Also in w. and s. Otago, around Clyde and in Catlins; isolated Otago record at Silver Peak, N of Dunedin (Elliott & Rasch 1995; NZ Atlas; NZCL; CSN). Also on Stewart I. and associated islets (Dawson 1951; Blackburn 1965, 1968; Wilson 1973; Taylor 1985; NZ Atlas; NZCL; CSN).





**Auckland Is** Resident on Auckland and Adams Is (Taylor 1975, 1985; Triggs & Daugherty 1996; Oliver).

**Breeding** On NI and SI and main islands and associated nearshore and offshore islands, probably throughout most of range; also on Auckland Is.

**Irruptions** Irruptions probably associated with years of heavy seedset and seedfall of beech *Nothofagus*, during which Parakeets breed continuously till supply of seed exhausted, and populations increase rapidly (Elliott *et al.* 1996a; J. Kearvell; see Populations, below). Several irruptions recorded in SI during 19th century, when Parakeets appeared 'in astonishing numbers', including summer 1870–71, late 1877, 1886 and 1888 (M'Lean 1911; Turbott 1967; Oliver). Minor irruption recorded around Wanaka and Cardrona in late summer and early autumn 1973 (CSN 20); recorded in larger numbers than usual in Eglinton Valley, Fiordland, in 1990 and 1993 (Elliott *et al.* 1996a); said to be more common than usual at Mt Stokes, Marlborough, in 1994–95 (CSN 43).

**Change in range** Though range on mainland said to have contracted and populations declined after clearance of forests (MacMillan 1990; CSN 4; see Habitat), in some areas, range may have expanded (J. Kearvell). On Solander I., appear to have been completely replaced by Red-crowned Parakeets between 1948 and 1973 (Cooper *et al.* 1986; McLean & Russ 1994).

**Status** Apparently secure (Taylor 1985). **Populations** Apparently stable (Taylor 1985). In South Branch Hurunui Valley, 1995–96, 50 birds observed (and 65 Orange-fronted Parakeets); in 1996–97, 161 birds observed (with 67 Orange-fronted and 261 unidentified parakeets) (J. Kearvell). In South Branch Hurunui Valley, mean number of Yellow-crowned and Orange-fronted Parakeets (combined) per 5-min count ( $n=160$  5-min counts/month): Nov. 1995, 1.15 birds; Feb. 1996, 3.82;

Nov. 1996, 0.19; Feb. 1997, 0.49; high count in Feb. 1996 result of heavy seeding of beech; the Nov. 1996 count shows a decline with decrease in seed and high mortality; and the Feb. 1997 count shows a slight increase with breeding in a year without heavy seeding (J. Kearvell). In Eglinton Valley, overall mean number per 5-min count ( $n=1334$  counts), 1976–79, was 0.67–2.88 birds (Efford & Morrison 1991); in 1990–93, 1.072 birds (Elliott *et al.* 1996a).

Often killed by Stoats *Mustela erminea* (Elliott *et al.* 1996a). Recolonized Titi I. after disappearance of Brown Rats *Rattus norvegicus* in c. 1975 (Taylor 1985). Formerly captured and kept as pets (M'Lean 1911). Regarded as pests of orchards and crops in 19th century (Turbott 1967; MacMillan 1990). Formerly shot by bushmen and by Maori (M'Lean 1911); also caught by Maori with flax nooses at end of slender rods (Turbott 1967). Unnaturally high rate of hybridization with Red-crowned Parakeets on Auckland Is mainly result of modification of habitats (Taylor 1975; Triggs & Daugherty 1996).

**MOVEMENTS** Poorly known. Considered resident (NZCL); said to stay near nesting area throughout year (Taylor 1985). Claimed, without evidence, to migrate seasonally (Elliott & Rasch 1995); some evidence for altitudinal movements (Dawson *et al.* 1978), but confirmation needed. Some movements regarded as irruptions (Oliver; see Distribution). In Eglinton Valley, all longer movements of radio-tagged birds were through forest, which suggests Parakeets reluctant to cross large open spaces (Elliott *et al.* 1996a). However, seen to fly across river valleys (up to 1 km) and up to 100 m above canopy of forest (J. Kearvell).

Typically recorded throughout year in any location. In Eglinton Valley, Fiordland, caught at all times of year; more common and conspicuous when breeding, which is usually late summer–autumn (though will breed continuously while seed available when heavy seeding of beech *Nothofagus*) (Elliott *et al.* 1996a; J. Kearvell). However, males wander widely and have large home-ranges (see Social Organization: Breeding dispersion). At Central Ohikanui and Inangahua, North Westland, SI, recorded in small numbers at all altitudes in all seasons (Wilson *et al.* 1988). At Minginui, Volcanic Plateau, NI, average number of birds counted per day similar for all months except for a low in May and a high in Nov.; at Tihou and Minginui no seasonal movement apparent (St Paul 1977).

Some seasonality in occurrence possible, though seasonal conspicuousness a confounding factor (G.P. Elliott). Recorded in all seasons except autumn at Lower Ohikanui (Wilson *et al.* 1988). Suggestion of altitudinal movement near Reefton involving movement to higher altitudes for summer and to lower altitudes for winter; but high variation in counts and only a few birds identified to species (Dawson *et al.* 1978).

Some movements possibly irregular. Probably sporadic visitors to Chickens I. from nearby Taranga (Hen) I. (McCallum *et al.* 1984). Not known as permanent resident at Hunua Ra. but a group recorded in 1922 assumed to be visiting area, probably from ranges E of Thames (McKenzie 1979). Irruption away from mountain forests in late summer and early autumn 1973 after unusual dry spell for several weeks (CSN 20); see also Distribution for other irruptions.

**Dispersal of young** Two fledgelings, observed during study in Fiordland, were highly mobile and dispersed rapidly from nesting area (cf. rather slow dispersal of young Red-crowned Parakeets) (Elliott *et al.* 1996a).

**Banding, Radio-tracking** Of 34 banded to 1972, four recovered (Robertson 1973). Of 21 radio-tracked in Eglinton

Valley and followed for up to 62 days, only 14 birds provided useful data; one moved <1 km, eight moved 1–2 km, and five moved >2 km; some moved to various altitudes from c. 380 to 1275 m asl. Males appeared to move more or less at random and have large home-ranges (Elliott *et al.* 1996a).

**FOOD** Seeds, fruit, leaves, buds, flowers, shoots and bark, and invertebrates. **Behaviour** On main islands, feed in pairs or small groups (Taylor 1985); most often seen in pairs (Fleming 1939; Turbott 1967). May accompany feeding flocks of Whiteheads on NI (M'Lean 1911; Forshaw & Cooper 1989; Oliver) and Yellowheads on SI (Lambert 1970; Read & McClelland 1984; Oliver; G.P. Elliott). Tend to forage in mixed-species flocks during colder months, with suggestion that this is important interaction linked to efficiency of foraging on invertebrate prey, at least in NI (Greene 1988). Feed mainly in forest canopy, in outer branches and leaves of shrubs; infrequently on ground (M'Lean 1911; Turbott 1967; Lambert 1970; Taylor 1985; Oliver). In s. Westland, SI, feed mainly in canopy; of 579 feeding observations, 22% in emergent leaves above canopy, 30% in upper canopy, 24% within canopy, 14% in upper understory, and 10% in lower understory; food obtained mainly by gleaning (>90% of obs.) and by ripping bark from branches and trunks to expose galleries of larval beetles (O'Donnell & Dilks 1994). In South Branch Hurunui Valley, Red Beech *N. fusca* important foraging substrate, becoming more important in breeding season (J. Kearvell). In SI, seen searching for scale insects and caterpillars beneath bark on twigs and branches of beech trees; on Chetwode I., obtained invertebrates from loose soil and litter on ground (Taylor 1985). In South Branch Hurunui Valley, readily glean invertebrates from leaves and bark; seen to rip open dead wood, possibly to extract invertebrates (J. Kearvell). Foraging behaviour like that of Red-crowned Parakeet (Turbott 1967), though more arboreal, less gregarious (Forshaw & Cooper 1989), and invertebrates more important in diet (Taylor 1985). Formerly fed in large numbers on fruits, leaves and shoots of trees in orchards; also grain of some crops (Turbott 1967).

In FIORDLAND, SI (qualitative listing of food by month; Elliott *et al.* 1996a): **Plants** FERNS: Blechnaceae: *Blechnum penna-marriana* fronds (Jan.). GYMNOSPERMS: Podocarpaceae: *Phyllocladus alpinus* sds (Feb.); *Podocarpus hallii* sh. (Dec.) MONOCOTYLEDONS: Cyperaceae: *Uncinia* sds (Dec., Feb.); Orchidaceae: *Corybas* petioles (Jan.). DICOTYLEDONS: Coriariaceae: *Coriaria* fru. (Feb.); Cornaceae: *Grisilina littoralis* bark, petioles (Oct.); Escalloniaceae: *Carpodetus serratus* fru. (Dec.); Fagaceae: *Nothofagus solandri cliffortioides* sh. (Dec.); *N. fusca* sh. (Aug.), sds (Oct.); *N. menziesii*, sh. (Aug.), leaf buds, sds (Oct.); Loranthaceae: *Peraxilla tetrapetala* fl. (Dec.), fru. (Feb.); Myrsinaceae: *Myrsine divaricata* fl. (Sept.–Oct.), fru. (Dec.); Rosaceae: *Acaena* sds (Apr., Aug.); *Rubus* fru. (Feb.), sh. (Oct.); Rubiaceae: *Coprosma* fru. (Mar.); *Nertera* fru. (Feb.). **Animals** INSECTS: Unident. (Dec.).

In s. WESTLAND, SI (579 feeding observations; O'Donnell & Dilks 1994): Fed on 17 species of plant; item eaten from each plant not identified, but of 579 observations, 11.4% fruit, 1.7% leaves and buds, 13.5% seeds, and remaining 72.7% not identified, but many of which may be feeding on invertebrates. Of the 66 observations of feeding on fruit, 80.3% were from Rimu *Dacrydium cupressinum*, 18.2% from Hall's Totara *Podocarpus hallii*, and 1.5% from Hupiro *Coprosma foetidissima*; all ten of the observations of feeding on buds and leaves were on Silver Beech *Nothofagus menziesii*. **Plants** MOSSES 0.4% no. observations. GYMNOSPERMS: Podocarpaceae: *Dacrydium cupressinum* 45.9%

no. observations; *Dacrydium cupressinum* 1.7; *Lagarostrobos colensoi* 1.4; *Phyllocladus aspleniifolius* 1.4; *Podocarpus hallii* 7.1; *P. totara* 1.4; *Prumnopitys ferruginea* 1.2. DICOTYLEDONS: Araliaceae: *Pseudopanax crassifolius* 0.7; Chloranthaceae: *Ascarina lucida* 1.0; Cunoniaceae: *Weinmannia racemosa* 9.2; Elaeocarpaceae: *Elaeocarpus hookerianus* 0.4; Fagaceae: *Nothofagus menziesii* 24.0; Myrtaceae: *Meterosideros* 1.2; *M. umbellata* 3.8; Rubiaceae: *Coprosma foetidissima* 0.2; unident. 0.2. Not feeding in plants 1.0.

**Other records** **Plants** Seeds<sup>2,3</sup>, fruits<sup>2,3</sup>, shoots<sup>3</sup>. GYMNOSPERMS: Podocarpaceae: *Dacrydium cupressinum* sds<sup>1,11</sup>; *D. intermedium* sds<sup>7</sup>; *Podocarpus totara* sds<sup>9</sup>. MONOCOTYLEDONS: Agavaceae: *Phormium* fl.<sup>5</sup>; Poaceae: grass sds<sup>7</sup>. DICOTYLEDONS: Araliaceae: *Pseudopanax* sds<sup>5</sup>; Asteraceae: *Senecio* fl.<sup>5</sup>; Coriariaceae: *Coriaria arborea* sds, fru.<sup>3,7</sup>; Escalloniaceae: *Ixerba brexioides*<sup>1,6</sup>; Fagaceae: *Nothofagus* sds<sup>5,7,8,10</sup>; Meliaceae: *Dysoxylum spectabile*<sup>6</sup>; Mimosaceae: *Acacia* sds<sup>14</sup>; Myrtaceae: *Leptospermum* sds<sup>5</sup>; *L. ericoides* sds<sup>13</sup>; Pittosporaceae: *Pittosporum umbellatus* sds<sup>12</sup>; Rubiaceae: *Coprosma* fru.<sup>1,4,6</sup> fl.<sup>5</sup>; *C. robusta* sds, fru.<sup>7</sup>; Violaceae: *Hymenanthera obovata* fl.<sup>5</sup>; Winteraceae: *Pseudowintera axillaris* sds, fru.<sup>7</sup>. **Animals** INSECTS: Hemiptera: Coccidae: *Ultracoelostoma assimile*<sup>5</sup>; Lepidoptera: *Heliosites vibratrix* larv.<sup>5</sup>. (REFERENCES: <sup>1</sup>M'Lean 1911; <sup>2</sup>McCann 1963; <sup>3</sup>Turbott 1967; <sup>4</sup>Norton 1982; <sup>5</sup>Taylor 1985; <sup>6</sup>Forshaw & Cooper 1989; <sup>7</sup>Oliver; CSN: <sup>8</sup>3, <sup>9</sup>5, <sup>10</sup>7, <sup>11</sup>23, <sup>12</sup>30, <sup>13</sup>33, <sup>14</sup>37.)

**Young** Crops of two chicks contained only *Nothofagus* seeds (Elliott *et al.* 1996a).

**SOCIAL ORGANIZATION** Poorly known. Usually seen in pairs or small groups of up to about ten (St Paul 1977; Taylor 1985; Moon 1992; J. Kearvell); rarely in flocks of >100 (G.P. Elliott). On Outer Chetwode I., in early Oct., of 232 Yellow-crowned Parakeets observed, at least 68% were in pairs (Taylor 1985). In South Branch Hurunui Valley, often in mixed flocks with Orange-fronted 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).

**Bonds** Not known. Can breed after only a few months (J. Kearvell). **Parental care** Female incubates (Moon & Lockley 1982; Moon 1992; Elliott *et al.* 1996a) and feeds young nestlings; often fed by male just before she enters nest; when nestlings older, males sometimes arrive at nest when female absent, enter and probably feed young; when even older, nestlings come to entrance of nest, where fed by both parents. Fledgelings highly mobile, stay high in canopy and so rarely seen near nest (cf. Red-crowned Parakeet) (Elliott *et al.* 1996a).

**Breeding dispersion** **Home-ranges** In radio-tracking study, cumulative area used by males did not plateau but continued to increase the longer the tracking period, with distances of >3 km between farthest sightings for some birds; suggests that home-ranges very large. Some males concentrate activities in small area (e.g. of c. 25 ha) but occasionally move outside for distances of 2+ km (Elliott *et al.* 1996a).

**Roosting** Roost in nests or similar hollows. No clear pattern of use of roosts; some roost every night in same hollow but others use different one every night for several nights in succession; can use same roost over long period, though not necessarily every night, e.g. two sites used intermittently for 23 months, one of which apparently for 6 months continuously. Leave roost 5 min after sunrise (from 21 min before to 41 min after; n=22 observations); go to roost 32 min before sunset

(from 78 min before sunset to sunset; n=8 observations); in winter, appear to leave roost earlier and go to roost later (Elliott *et al.* 1996a).

**SOCIAL BEHAVIOUR** Poorly known in wild; captive breeding behaviour quite well known but little published (e.g. Dyer 1979; Batty 1989). Cognitive development studied in captivity (Funk 1996a,b). In breeding season, noisy and conspicuous; quiet and inconspicuous at other times (Elliott *et al.* 1996a); usually stay high in canopy of forest (Moon 1992).

**Comfort behaviour** In captivity and wild, observed to preen feathers, particularly of wing and tail, with mixture of chewed aromatic leaves and preen oil, and claimed this has some effect against parasites; this material often ingested and suggested to be anthelmintic (Greene 1989). Other comfort behaviour very similar to that of Red-crowned Parakeet (q.v.; Dawe 1979).

**Aerial displays** Pair once seen in apparent display involving aerobatics and calling (Greene 1990).

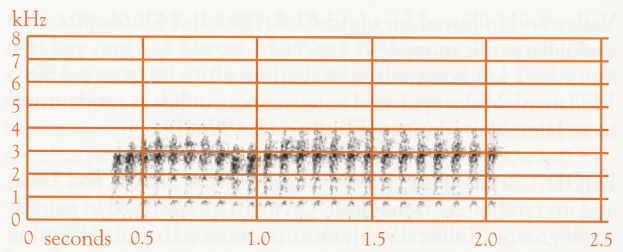
**Agonistic behaviour** Probably like that of Red-crowned Parakeet (q.v.; Dawe 1979; Pickard 1990). On Outer Chetwode L., in Oct. 1974, many males seen aggressively chasing other pairs (Taylor 1985). In captive group, feet used to displace siblings with Waving Foot and Standing Claw displays as described for Red-crowned Parakeet (as described by Dawe 1979; q.v.); in captivity, a partly disabled male was occasionally attacked by another male, who would fly on top of disabled male and try to bite and claw it (M.S. Funk).

**Sexual behaviour** **Courtship** In captivity, very similar to Switch-siding of Red-crowned Parakeet (as described by Dawe 1979; q.v.) (M.S. Funk). **Courtship feeding** Male feeds female during incubation and until female stops brooding constantly; female rarely leaves nest unless male nearby. Male comes to feed female often throughout day; usually calls female off nest with soft twittering and feeds her nearby; pair sometimes fly away together. While male feeds female, she crouches with head slightly back and bill open; male jerks his head up and down several times, apparently to bring food from crop, then places bill crosswise over that of female and transfers food; in each feeding session, 2–24 mouthfuls passed, each usually accompanied by short squeak from female (St Paul 1977; Moon & Lockley 1982; Moon 1992; Elliott *et al.* 1996a). In captivity, female newly introduced to cage observed to feed male (M.S. Funk). In captivity, male gives quick throaty call after courtship feeding (M.S. Funk).

**Relations within family group** Usually investigate potential nest-holes in pairs; sometimes only put head in holes, other times enter and remain inside for up to 5 min; this behaviour always accompanied by soft contact calls (Elliott *et al.* 1996a).

**VOICE** Reasonably well known from detailed study of captive birds, with sonagrams, by Pickard (1990); this account incomplete and Pickard not summarized here (P.J. Fullagar). Repertoire probably similar to that of Red-crowned Parakeet but calls said to be weaker and higher pitched (Falla *et al.* 1981; Forshaw & Cooper 1989). Noisy during breeding season but quiet and inconspicuous at other times (Elliott *et al.* 1996a); calls noisy but notes soft and musical (M'Lean 1911). No other information on seasonal differences or on individual or regional variation. Period of calling not studied. Mimicry not reported in wild. **NON-VOCAL SOUNDS:** When birds alarmed at nesting site, said to make a peculiar clapping noise with wings while in flight (M'Lean 1911).

**Adult FLIGHT CALL** (sonagram A): Chattering *ki-ki-ki-ki* (Falla *et al.* 1981; Forshaw & Cooper 1989). Given in flight.



A L.B. McPerson; Codfish I., Nov. 1989; P106

Equivalent to Vocal Chatter Display Call of Red-crowned Parakeet (q.v.), but said to be noticeably higher-pitched and weaker (Falla *et al.* 1981). **VOCAL TWO-NOTE CHATTER CALL:** No descriptions available; like Vocal Two-note Chatter of Antipodes Is population of Red-crowned Parakeet (q.v.). **Other calls** Loud sharp chattering when scolding (M'Lean 1911). On Little Barrier I., utter loud *err-e-e*; appear to be given only by male and may have territorial function (Greene 1988). M'Lean (1911) states most common call *whui-whuick* or soft *whuick*. Investigation of potential nesting holes accompanied by soft, but undescribed, contact calls; during incubation and brooding period, male calls female from nest to be fed with soft twittering; during courtship feeding, female gives short squeak as food passed, this call only being given in this context (St Paul 1977; Moon & Lockley 1982; Moon 1992; Elliott *et al.* 1996a). In captivity, male gives quick throaty exclamatory *awk!* after feeding female; only given in feeding context; females reported to utter soft notes while preening (M.S. Funk).

**Young** From observations of captive birds (Funk 1994; M.S. Funk). **FOOD-BEGGING CALL:** At first, calls soft. In second week, beg with strong, repeated wavy whistle. At 7 weeks old, gave Food-begging Call when parents seen. **ALARM CALL:** If disturbed (fear or annoyance), utter undescribed cry. At fledging (c. 6 weeks old), juveniles utter Food-begging and Alarm Calls and an undescribed call. One week after fledging, heard to give soft notes while preening. At 10 weeks old, some calls like those of parents, but some calls still imperfect at 4 months.

**BREEDING** Detailed study in Fiordland, SI, 1990–93 (Elliott *et al.* 1996a,b). Peak of nesting activity may be correlated with peak of seeding of beech *Nothofagus*; can raise more than one brood in a season if conditions suitable, and breed continuously in years of heavy seeding of beech while seed remains abundant (Elliott *et al.* 1996a; G.P. Elliott). Possibly hybridize with Red-crowned Parakeet in wild, including on Auckland Is, but little evidence and further study needed (Taylor 1975; Greene 1988).

**Season** Usually begin breeding in summer but may breed all year round in years of heavy seeding of beech; in non-beech-seeding years, breeding activity peaks in late summer, with little or no breeding in winter (Elliott *et al.* 1996a). Young, July–Apr. (Oliver); eggs, nestlings and fledgelings, Oct. (Taylor 1998).

**Site** In hole in branch or trunk of tree, living or dead; also reported to nest in knothole, hole under broken branch, between trunk and dissevered bark of decaying tree (M'Lean 1911; Oliver). In NI, recorded in Black Beech *Nothofagus solandri* var. *solandri*; also in Hinau *Elaeocarpus dentatus*, Pohutukawa *Metrosideros excelsa*, Tawheowheo *Quintinia serrata* and Kawaka *Libocedrus plumosa* (M'Lean 1911; T. Greene). Of 73 nests in Fiordland, SI, 81% in trunk and 19% in branch; 77% in Red Beech *Nothofagus fusca*; 21% in Silver Beech *N. menziesii*; 3% in dead tree; 7% in dead branch of live tree (Elliott *et al.* 1996b). **MEASUREMENTS:** Height of hollow, 14.4 m (6.1; 4.5–32;

72); height of nest-tree, 27 m (7; 12–42; 70); diameter of nest-tree at breast height, 105 cm (35; 44–190; 72); diameter of trunk or branch at nest, 68 cm (27; 30–140; 73) (Elliott *et al.* 1996b). Of 63 sites in Fiordland: 8 (12.7%) used twice and 1 (1.6%) used three times; five used for re-nesting, three after period of up to 2 years (Elliott *et al.* 1996b). Compete for sites with Yellowhead (Elliott *et al.* 1996b).

**Nest, Materials** Of 68 nests in Fiordland, 89% had entrance through knothole and 11% through slit (Elliott *et al.* 1996b). Eggs laid on rotten wood or dry leaves at bottom of hollow; sometimes on remains of nests of Rifleman *Acanthisitta chloris* or Yellowhead (M'Lean 1911; Elliott *et al.* 1996a,b). One pair said to have repaired a split in side of hollow using moss and leaves (M'Lean 1911). **MEASUREMENTS:** In Fiordland (Elliott *et al.* 1996b): Depth of hollow, 184 mm (316; 67); 40% of nest-chambers level with entrance; deepest hollow >1.5 m. Dimensions of entrance (height × width), 72 × 72 mm (30 × 30–600 × 45; 68 entrances), including one entrance, 25 × 75; dimensions (width × length) of nest-cavity, 257 × 257 mm (130 × 160–550 × 550; 63).

**Eggs** Broadly elliptical; white (Oliver). **MEASUREMENTS:** 22.9 (21.6–24.2; 7) × 18.9 (17.8–20.0) (Forshaw & Cooper 1989).

**Clutch-size** In Fiordland, mean 5.5 (2–9; 10) (Elliott *et al.* 1996a).

**Laying** A clutch of nine eggs laid within 12 days; in captivity, eggs laid at intervals of 2 or 3 days (Elliott *et al.* 1996a). Five sites re-used within 3.5 months of end of earlier attempt (Elliott *et al.* 1996b). Eggs hatch asynchronously (Oliver).

**Incubation** By female only; at one nest observed during one day, female left nest seven times, first time 60 min after sunrise, last time 58 min before sunset; mean duration of stints of incubation, 107 min; mean duration of period away from nest, 4.9 min (Elliott *et al.* 1996a). Male feeds female during incubation (Elliott *et al.* 1996a; see Social Organization, Social Behaviour). **INCUBATION PERIOD:** No precise determinations in wild; in captivity, 18–20 days (Falla *et al.* 1981).

**Young** Altricial, nidicolous. In captivity, naked at hatching, except for a few wisps of grey down, and eyes closed; eyes open slowly, and not fully open till 3 weeks old; at 3.5 weeks, young covered in grey down, with some feathering appearing on wings; at 4.5 weeks, more feathers have emerged and down still present in patches; at 5.5 weeks, fully feathered (M.S. Funk).

**Parental care, Role of sexes** Only female feeds young at first, and male feeds female; when chicks older, male may enter hollow and feed young; large young come to entrance of nest to be fed, by both parents (Elliott *et al.* 1996a; Oliver).

**Fledging to independence** **FLEDGING PERIOD:** No precise determinations in wild; three estimates of 39, 41–46 and 43–44 days; in captivity, a brood of two fledged at 44 and 47 days; a brood of five at 37, 40, 40 and 41 days (Elliott *et al.* 1996a). In captivity, six young fledged at 40 days (2.28; 38–43), leaving nest over period of 18 days (M.S. Funk). Usually able to fly at fledging (Elliott *et al.* 1996a).

**Success** In Fiordland, average daily survival rate of all nests, 99% (no N value); equivalent to 53.5% nests fledging at least one young. In Fiordland, during years when numbers of Stoats high, successful nests were significantly higher above ground than unsuccessful nests. When numbers of Stoats low, 71.5% nests fledged at least one chick; when numbers of Stoats high, only 29.1% fledged at least one chick (Elliott *et al.* 1996a). One young killed when nest-tree felled (M'Lean 1911).

**PLUMAGES** Prepared by A.M. Dunn. Fledge in juvenile plumage. Then undergo complete post-juvenile (first pre-ba-

sic) moult to adult plumage, probably toward end of first year. Thereafter complete post-breeding moults each cycle produce successive adult plumages without change in appearance. Sexes similar. In captivity, can breed when several months old (J. Kearvell).

**Adult** (First and subsequent basic). **HEAD AND NECK:** Lower forehead and lores, to front of eye, crimson (108), forming narrow frontal band. Most of forehead and forecrown to above eye, yellow (c55) to orange-yellow (18). Supercilium, sides of crown, hindcrown, nape, hindneck and sides of neck, dark green (c260). Lower half of lores and ear-coverts, green (c162B). Cheeks, throat and foreneck, bright green (c158). Chin covered in very small brownish-grey (79) feathers. **UPPERPARTS:** Mostly dark green (c260) with concealed brownish-grey (79) bases to feathers. Small patch on sides of rump, red (12). **UNDERPARTS:** Mostly bright green (c58) with concealed grey (84) bases to feathers; tends to be slightly darker green on flanks and sides of belly. **UPPERTAIL:** All rectrices, dark green (c146) with dark-brown (219) shafts; t2–t6 have dark-grey (83) inner edges. **UNDERTAIL:** Dark-grey (c83) with pale yellowish-green (ne) wash. **UPPERWING:** Lesser and median secondary coverts, dark green (c260) with concealed brownish-grey (79) bases. Greater secondary coverts, dark green (c260) with concealed dark-brown (c121) inner webs. Lesser and median primary coverts, blue-green (ne). Alula, mostly dark blue (74) with black-brown (119) inner edge. Outer webs of greater primary coverts grade from dark blue (74) on outermost to dark blue-green (ne) on innermost; all greater primary coverts grade to black-brown (119) on inner web with a greenish tinge near tip. Outermost primary, p10, mostly black-brown (119) with greenish tinge to outer edge. P9–p6, dark blue (74) on basal half of outer web, grading to dark green (c146) toward tip of outer web and with very fine pale-yellow (157) edge; whole tip and inner web, black-brown (119), sometimes with concealed white spot in middle of inner edge (corresponding to pattern of pale underwing-bar; see below). Inner primaries and all secondaries, dark green (c146) on outer web and black-brown (119) to dark brown (121) on inner web and whole tip; often have concealed white or yellowish-white spot in middle of inner edge (corresponding to pattern of pale underwing-bar; see below). **UNDERWING:** Lesser and median coverts, green-blue (c164) with grey (84) bases to feathers. Greater coverts, grey (84). Primaries and secondaries, dark brown (c121), usually with white or yellowish white spot or smudge on inner edge of inner primaries and most secondaries; generally have only a faint white smudge on inner edge of feathers; some have no pale marking; smudge forms varying pale underwing-bar, at greatest extent from c. p6 to c. s7; underwing-bar extremely faint. In study in Eglinton Valley, SI, underwing-bar varied from narrow and faint to broad and strong, but always <1 cm in width; of 86 live birds, underwing-bars recorded on field sheets for 51 (J. Kearvell; C.F.J. O'Donnell).

**Downy young** Sparsely covered in light-grey down (R.H. Taylor; M.S. Funk).

**Juvenile** Some possibly inseparable from adults; most differ only slightly from adults: **HEAD AND NECK:** Less colour on forehead and forecrown than in adults, with yellow not extending past level with front of eye; forehead and lower forecrown, as adult; rest of forecrown, dark green (c260). When newly fledged, no frontal band and lower forehead mostly bare or sparsely feathered with dark greyish-green feathers; red frontal band develops quickly, appearing paler at first but soon attaining adult coloration. **UPPERPARTS:** Either no spots on sides of rump or only one or two feathers

red. TAIL: Sometimes have pale-yellow tips to rectrices, but possibly not present in all.

**Aberrant plumages** Oliver described several abnormally coloured birds: in one, normally green plumage replaced with yellow; in another, parts of green plumage replaced with red.

**Hybrids** Hybridize with Red-crowned Parakeets on Auckland Is; see Red-crowned Parakeet for details.

**BARE PARTS** Based on photos (Moon 1992; Temple 1996; NZRD; unpubl.: M.S. Funk; J. Kearvell). **Adult** Bill, pale bluish-grey (c86) with black (89) cutting edge and tip. Cere, grey-black (82). Iris, red (11 or 14) or orange-red (15); irides of 12 from South Branch Hurunui Valley described as orange-red (J. Kearvell); label of skin in Frankfurt Museum gave iris as red; wild male from Eglinton Valley, SI, had red iris; one said to have yellow ring round pupil (G.P. Elliott). Orbital ring, grey-black (82) to black (89). Legs and feet, black-brown (119), pink-brown (c219) or purplish grey (purplish 84). **Downy young** No photos of newly hatched chicks. At hatching: bill, pinkish horn; iris, dark; legs and feet, pinkish grey (R.H. Taylor). At c. 5 weeks old (unpubl. photos: M.S. Funk): bill, pink-buff (c121D) at base with dark-grey (c83) cutting edge and tip; cere, dark grey (c83) with pink (ne) tinge; orbital ring, grey (84); legs and feet, dark grey (c83). **Juvenile** Based on photos of captive birds at 6–7 weeks old (unpubl.: M.S. Funk) and video of one wild, newly fledged juvenile (unpubl.: J. Kearvell). Bill similar to adult but with larger black (89) tip and slight pink (ne) tinge at base; when newly fledged, most of bill duller and greyer than adult. Cere, dark grey (c83) with pink (ne) tinge. Iris very dark or pale reddish-brown (R.H. Taylor). Legs and feet, dark grey (c83) with a pink (ne) tinge.

**MOULTS** Based on examination of 39 adult and five juvenile skins from all months of year (AIM, CM, NMNZ). **Adult post-breeding** (Second and subsequent pre-basic). Complete. Primaries centrifugal; usually starting from p6 (Holyoak 1973), though one skin appeared to have begun at p4 or p5 (NMNZ). Primaries replaced rapidly, often with two or three feathers growing at once. Of five adults with active moult of primaries: three between Dec. and Apr. had just begun moult (PMS=13, 14); one in Mar. had replaced half its primaries (PMS=26); and one from Oct. had almost finished (PMS=43). Moult of body occurred while moult of primaries active, but appeared to be finished before last primaries replaced. No information on moult of tail. Most adults examined (90%) were not moulting primaries. **Post-juvenile** (First pre-basic). No information. None of five juveniles were moulting.

**MEASUREMENTS** (1–2) Throughout range, skins (AIM, CM, NMNZ): (1) Adults; (2) Juveniles. (3) Aviary stock, adults, skins (AIM, NMNZ). (4) Throughout range, age not specified, skins; CROWN = distance from border between red and yellow on forehead to rear edge of yellow on crown (Nixon 1981, 1982). (5) Eglinton Valley, Fiordland, 15 Aug. 1990 to 23 Oct. 1992, age not known, live; most sexed by length of bill (G.P. Elliott). (6) SI (excluding populations in Marlborough Sounds), adults, skins and live birds combined (J. Kearvell).

	MALES	FEMALES	
WING	(1) 111.8 (4.44; 103–121; 32)	106.1 (5.11; 98–114; 13)	**
	(2) 105, 108, 114	102, 105, 105	
	(3) 110, 111, 118	111.1 (6.44; 103–120; 7)	
	(4) 109.1 (3.78; 18)	103.7 (5.09; 13)	**
	(5) 107 (3.5; 100–116; 56)	101 (2.4; 96–104; 12)	**

TAIL	(1)	122.5 (9.67; 102–148; 28)	117.2 (9.04; 103–131; 13)	ns
	(2)	107	106, 117	
	(3)	127, 129	122.4 (7.48; 114–133; 7)	
	(4)	112.9 (8.55; 18)	110.6 (7.29; 12)	ns
	(5)	112 (7.1; 98–128; 56)	103 (3.4; 98–110; 11)	**
BILL	(1)	14.0 (1.12; 10.4–15.7; 31)	12.4 (1.49; 10.3–14.7; 12)	**
	(2)	12.8 (0.88; 11.6–13.7; 4)	10.5, 10.6, 11.7	
	(3)	15.1 (0.85; 13.3–16.7; 12)	12.5 (0.80; 11.5–14.2; 12)	**
	(4)	13.8 (1.12; 19)	12.0 (1.53; 12)	**
	(5)	14.5 (0.59; 13.0–15.9; 84)	11.6 (0.46; 10.8–12.5; 16)	**
	(6)	14.4 (0.73; 12.7–15.9; 114)	11.3 (0.59; 9.7–12.6; 56)	**
BILL W	(4)	8.4 (0.50; 19)	7.6 (0.65; 13)	**
	(5)	8.3 (0.43; 6.8–9.0; 56)	7.3 (0.36; 6.6–8.1; 13)	**
	(6)	8.3 (0.50; 6.8–9.9; 114)	7.3 (0.39; 6.4–8.2; 56)	**
TARSUS	(1)	19.2 (1.81; 10.7–21.6; 31)	18.7 (0.71; 17.6–20.4; 13)	ns
	(2)	19.0 (1.02; 17.7–20.1; 4)	16.6, 18.5, 18.6	
	(3)	18.6, 19.7, 20.2	19.5 (0.92; 18.2–20.4; 5)	
	(4)	19.4 (1.01; 19)	18.3 (0.84; 13)	**
	(5)	20.1 (1.38; 17.4–23.3; 54)	18.6 (1.27; 17.0–21.6; 10)	**
TOE C	(1)	22.5 (1.26; 20.5–25.9; 21)	20.8 (0.81; 20.0–22.7; 9)	**
	(2)	22.7	20.4	
	(3)	21.4	20.0	
CROWN	(4)	20.7 (2.70; 19)	18.4 (2.90; 13)	*

Adult males have significantly longer and wider bill than adult females (in all samples large enough for comparison). Adult males also have longer wing, toe, tail and tarsus than adult females. Captive males (sample 3) had significantly larger bill than wild males ( $P < 0.01$ ), and captive females (sample 3) had significantly longer wing than wild females ( $P < 0.05$ ), supporting claim that captive-raised birds noticeably larger (Nixon 1981). Newly fledged juveniles have shorter tail than adults (Forshaw & Cooper 1989; G.P. Elliott) but difference probably only evident for about 2 weeks till tail fully grown (G.P. Elliott).

(7) L. Sumner area (Hope–Kiwi Rs), North Canterbury, age not known, live (Taylor 1998).

UNSEXED	
WING	(7) 106.8 (4.24; 100–116; 31)
TAIL	(7) 114.8 (8.86; 94–130; 31)
BILL	(7) 14.6 (0.63; 13.3–15.9; 32)
BILL W	(7) 8.9 (0.43; 8.2–9.9; 32)
TARSUS	(7) 19.5 (1.12; 16.8–22.6; 31)

Additional measurements in Holyoak (1974) and Forshaw & Cooper (1989).

**WEIGHTS** (1) Eglinton Valley, Fiordland, SI, 15 Aug. 1990 – 23 Oct. 1992, age not known, live; mostly sexed using length of bill (G.P. Elliott). (2–3) From museum labels (NMNZ): (2) Adults; (3) Juveniles.

	MALES	FEMALES
(1)	51.2 (4.14; 42.0–58.5; 55)	40.7 (3.77; 34.0–45.0; 11)
(2)	45, 65	–
(3)	37, 46	35, 37

In L. Sumner area (Hope–Kiwi Rs), North Canterbury, age not known, unsexed, 48.2 (3.71; 42–57; 32) (Taylor 1998).

**STRUCTURE** Wing short, broad and wedge-shaped, with rounded tip. Ten primaries: p8 longest; p10 8–10mm shorter, p9 0–1, p7 0–2, p6 9–14, p5 20–24, p4 25–30, p3 28–33, p2 31–36, p1 33–38. About 12 secondaries, including about four tertials;



tips of longest tertials fall between p2 and p3 on folded wing. Tail long and pointed; 12 rectrices; t1 longest, t6 43–69 mm shorter. Bill short and broad. Cutting edge of upper mandible sharp and slightly concave; tip rounded in front but with sharp cutting edge. Lower mandible has slightly raised cutting edge at tip. Narrow, mostly bare, cere at base of upper mandible, in which small rounded nostrils situated close to top. Tarsus medium-length and slender; granulate. Tibia fully feathered. Zygodactyl; outer toe directed backward. Outer front toe longest; inner front 72–78% of outer front, outer hind 85–92%, inner hind 44–54%.

**SEXING** Males have much longer and wider bills than females. The difference in bill is sufficient to separate male and female in field when seen together (G.P. Elliott).

**GEOGRAPHICAL VARIATION** Taxonomic status of *auriceps*, *malherbi*, and *forbesi* discussed fully under the masthead to this species account.

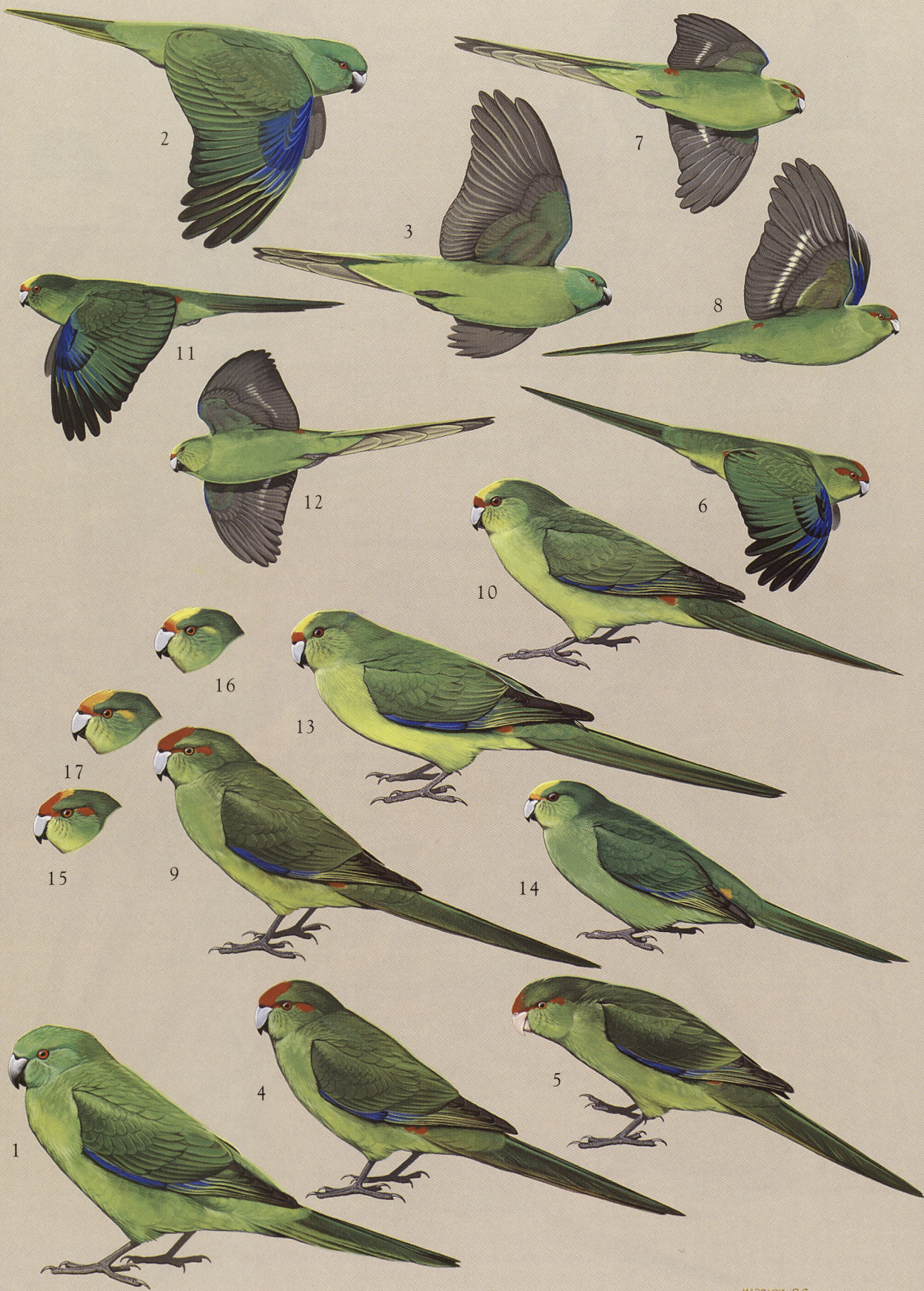
Taxa differ only slightly in plumage (see descriptions above and below) and not known to differ in colour of bare parts (Holyoak 1974; Taylor *et al.* 1986; Taylor 1998; this study). While few data, no significant differences between *auriceps* and *malherbi* in length of wing, tail and bill or width of bill in adult males. This agrees with recent studies (Holyoak 1974; Nixon 1981; see Taylor 1998) *contra* earlier claims that *malherbi* smaller (Buller 1888; Falla *et al.* 1981; Harrison 1970; Oliver). *Forbesi* is largest form, and is significantly larger than *auriceps* and *malherbi* in all measurements.

Status of *auriceps* from Auckland Is not known; no skins available during this study. Said to differ consistently from mainland *auriceps* (J. Kearvell), but differences not described.

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**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