

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 (Breterton & 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 CACATUIDAE cockatoos

Usually large (30–60 cm in length, 250–900 g) stocky parrots, with large strongly decurved bills, large ceres, and erectile crests; Cockatiel *Nymphicus hollandicus* atypical in size and shape, being medium-small and slender (c. 30 cm in length, 80–100 g). About 19–21 species in six genera (Schodde & Mason 1997); 14 species, from all six genera, occur HANZAB region. Most strongly represented in Aust. but also found across much of s. Asia including the Philippines, Solomon Is and other islands in the sw. Pacific Ocean, Sulawesi, Lesser Sunda Is, and a few small Indonesian islands, and New Guinea; also introduced to Hong Kong, Singapore and NZ.

Four subfamilies recognized (Schodde & Mason 1997, on which following based):

SUBFAMILY MICROGLOSSINAE: Monotypic Palm Cockatoo *Probosciger aterrimus*. Large slate-black cockatoo of C. York Pen. and New Guinea, with massive bill, feathered cere, bare and coloured lores and periophthalmic ring, large erectile crest and uncoloured tail. Sexes alike in plumage and bare parts but differ in size. Scratch head from under wing. Young have grey down, uniquely among Cacatuidae.

SUBFAMILY CALYPTORHYNCHINAE: Black-cockatoos; five species in single genus *Calyptorhynchus*, all endemic to Aust. Large, mainly black cockatoos with long tails, which are banded or barred with red, white or yellow, uncoloured erectile crests, and bare ceres. Moderate sexual dimorphism in plumage and bare parts; some differ slightly in size. Scratch head from under wing.

SUBFAMILY CACATUINAE: White cockatoos. Medium-sized, white, grey or pink cockatoos, usually with up-curved erectile crests, feathered nares, and plain tails. Thirteen to 15 species in three genera: monotypic *Eolophus* and *Callocephalon*, and *Cacatua*. Seven species, from all three genera, in HANZAB region. Slight sexual dimorphism except in *Callocephalon*. Scratch head over wing. Position of *Callocephalon* problematical (see Homberger 1991; Schodde & Mason 1997).

SUBFAMILY NYMPHICINAE: Monotypic Cockatiel. Small, slender, grey cockatoo endemic to Aust., with coloured up-curved crest, and bare cere. Sexually dimorphic in plumage and slightly in size. Scratch head over wing.

Naso-frontal hinge ossified or not. Carotid arteries paired in hypophyseal canal, and sometimes coalesced. Syrinx bronchial, the first rings straight, cartilaginous and separated by membrane. Gall bladder present. Powder downs particularly well developed (Smith 1975). Feathers have no Dyke-texture (cf. Psittacidae) (Smith 1975).

Adult plumage rather plain: mainly white, black or grey. Many are sexually dimorphic in plumage. All species have well-developed erectile crests. Bare parts mostly black, grey, brown or cream; irides mostly brown or reddish brown; bare orbital skin around eyes (periophthalmic ring) often enlarged and coloured. Post-breeding (pre-basic) moult of adults usually complete; some possibly take more than 1 year to finish moult. Moult of primaries centrifugal; can begin from any primary, but usually between p5 and p8. Some appear to have slow continuous moult of remiges and rectrices, which possibly takes longer than 1 year to finish. Nestlings have a single down; usually wispy and sparse. Juveniles usually similar in appearance to adult females. Can take up to 5 years to attain full adult plumage. Age of first breeding not known in many, but up to 4 years.

Occur in most habitats; from arid and semi-arid zones to tropical rainforest. Some species strictly arboreal (e.g. Palm Cockatoo), and others partly terrestrial and partly arboreal (e.g. Sulphur-crested Cockatoo *Cacatua galerita*, Long-billed Corella *C. tenuirostris*). All require hollows, and therefore old trees, in which to nest, and are adversely affected by the removal of hollow-bearing trees (Robinson & Traill 1996). Further, clearance and fragmentation of natural habitats has also adversely affected some species (see introduction to Psittaciformes). However, populations of some species, such as Galahs *Eolophus roseicapillus*, have increased dramatically, and ranges expanded after clearing of native vegetation and conversion to farmland, which has created habitat of similar structure to preferred natural habitats, as well as providing vastly increased availability of food. As a result, some species now agricultural pests in some regions, especially those areas where wheat and other grain grown (Saunders et al. 1985; Saunders & Ingram 1995; Vic. Atlas). In WA, feral Sulphur-crested Cockatoos, populations of which have increased, may compete with endemic species for nest-hollows and food, as well as potentially pose a threat to agriculture. Populations are, therefore, controlled by local authorities (Saunders et al. 1985; Saunders & Ingram 1995). There have been few extralimital introductions of cockatoos (see Long 1981).

Patterns of movements appear to vary widely, but movements of most species in HANZAB region not well known and some very poorly known. Few detailed studies in HANZAB region, and almost none for extralimital forms. Well-established migration only shown in some populations of Short-billed Black-Cockatoo *Calyptorhynchus latirostris*

(Saunders 1980), and this appears to be over short distances. Other species in Calyptorhynchinae considered resident or sedentary (Rowley 1997). Cacatuinae generally sedentary, often with formation of locally moving flocks in non-breeding period or when birds young (Rowley 1983; Smith & Moore 1992). Most movements, from sedentary to migratory, have been attributed within and between species in this family. Many species described as nomadic or dispersive, which appears merely to reflect lack of knowledge of true patterns. Some species appear to move differently in different parts of range or in different habitats.

In some species, leg bands not appropriate method of marking because birds damage or destroy them, and colour-bands on short tarsi difficult to see or impossible to fit; wing-tags (coloured and labelled plastic or metal tags; Rowley & Saunders 1980) have been used to study movements (e.g. Saunders 1980; Rowley 1983; Smith & Moore 1992).

Mostly herbivorous; specializing on seeds and nuts (Campbell & Lack 1985). In HANZAB region, feed mainly on seeds of grasses, herbs and trees; also take a wide range of other plant food, including flowers, fruits, nuts, roots, corms, shoots and leaves; most species eat insects and their larvae, and one species feeds mainly on insect larvae (see below). Ground-feeding forms (e.g. *Cacatua*, *Eolophus*) mainly eat seed of grasses and herbs; some specialize in extracting bulbous roots and corms from soil (e.g. Long-billed Corella). Most arboreal forms (e.g. *Calyptorhynchus*) feed mostly on seeds of *Eucalyptus* and some other native trees; some specialize on seeds of Proteacea (e.g. Short-billed Black-Cockatoo); Glossy Black-Cockatoos *Cacatua lathami* feed exclusively on seeds of *Allocasuarina*; Palm Cockatoo eat more fruits than seeds and nuts; and Yellow-tailed Black-Cockatoos *Calyptorhynchus funereus* almost insectivorous, feeding mainly on wood-boring insects, supplemented by plant food. Usually feed in small groups, less often in pairs or singly; some feed in large flocks (e.g. Little Corella *Cacatua sanguinea*). Bills large and robust and specialized in some species, e.g. in Yellow-tailed Black-Cockatoo, for example, bill narrow with elongated and pointed tip to upper mandible that enables bird to dig into timber for wood-boring insects; Red-tailed Black-Cockatoos *Calyptorhynchus banksii* have broad blunt bill, for crushing seeds and hard woody nuts; Glossy Black-Cockatoos have protruding bulbous bill, with exceptionally broad lower mandible, an adaptation for tearing hard seed-cones of *Allocasuarina*; Cockatiels have narrow bills suited for feeding on small seeds, such as those of grasses; and Palm Cockatoos have massive bill that can crack nuts of *Pandanus* (Saunders 1974, 1979; Forshaw). Ground-feeding forms mainly feed in flocks; they have short tarsi which bring eyes and bill close to ground and enable birds to search and harvest an area quickly and efficiently. Dispersion of seeds determines pattern of flock foraging: where seeds densely accumulated in small area, feeding flocks dense; where food more dispersed, flocks feed in lines, moving in constant direction, usually into wind; when food in short supply, feeding flocks progress in rolling fashion, with birds at rear continually flying to the front (Rowley 1990, 1997).

Social organization and social behaviour not well known for species that occur outside HANZAB region (e.g. see Coates 1985; Coates *et al.* 1997); most of below based on Aust. data. Highly gregarious, especially *Cacatua*, *Eolophus* and Cockatiel; most species usually forage and roost in flocks of up to 100 with congregations of 1000s common, especially in non-breeding season; flocks sometimes immense; in HANZAB region, Palm Cockatoo is main exception, remaining in pairs or small groups except for occasional congregations of up to 30 at sources of food. Within flocks, pairs and family groups remain together and individuals, pairs and small groups often come and go independently. During breeding, flocks smaller, as breeding pairs disperse to nest, though many continue to form smaller groups with other breeders or non-breeders in area. After breeding, pairs with their offspring rejoin flocks. All species monogamous, pairing for life except for occasional divorces. Re-pair after death of mate or divorce, usually by next breeding season. Mates rarely apart, moving, feeding and roosting together. First breed when several years old, except for Cockatiel, which can breed in first year. Sexes generally share all aspects of parental care except only females incubate in black-cockatoos *Calyptorhynchus* and, probably, Palm Cockatoo. Young can remain with parents till next breeding season, or even for several years in larger species, but in *Cacatua* and Cockatiel, normally leave soon after independence. Crèches of young sometimes formed by Galahs and Gang-gang Cockatoos *Callocephalon fimbriatum*. Nesting generally solitary but nests often close together, even in same tree, with only a small area around nest defended. However, Palm Cockatoo and Major Mitchell's Cockatoo *Cacatua leadbeateri* nest farther apart, appearing to maintain territories of many hectares. Nests are often used year after year, and *Cacatua* tend to have a year-round association with nest. Roosting usually communal, except for nesting pairs who roost in nest-tree, in all except Palm Cockatoo, which roosts year-round in pairs or family groups within territory. Roosts often used regularly for years, though nomadic birds often use sites for only days or weeks before moving on.

Most species noisy and conspicuous. Wary and difficult to approach when on ground but more confiding if in trees. Very wary near active nests. Flocks, when disturbed, fly off together calling loudly; often mob predators. Belief that many species have sentries to warn foraging flocks of danger probably spurious (Noske 1980). Daily activity consists of leaving roost around sunrise then feeding before resting in trees over middle of day, feeding again in the afternoon, and returning to the roost around sunset. Crest important in virtually all social interactions, generally raised whenever aroused in aggressive, sexual or alarm contexts. Aggression mostly infrequent, generally only involving mild threat or displacement, rarely escalating to fighting and then usually only over nest-sites. Commonest threat behaviour consists of gaping bill widely; most fighting with bill. Submissive behaviour generally consists of turning away or

retreating. Some species have apparent territorial displays, e.g. Heraldic Display of the Galah (Rowley 1990), but none so complex as that of Drumming Display of Palm Cockatoo, for which bird prepares sticks to drum on trees (Wood 1988; see that text). In all species, display in which wings swept forward and over head given by both sexes when excited (Courtney 1974). No evidence of stable hierarchies in wild. Sexual displays of males can involve bobbing or shaking of head, spreading of wing and tail and calls; female *Cacatua* can respond to males similarly. Courtship feeding by regurgitation; most developed in species in which only female incubates, with male feeding female often as part of courtship and continuing to provision female during nesting; in other species, courtship feeding is much reduced and absent in other species. Allopreening between mates occurs in many species, particularly in breeding season; also occurs in many species between parents and young, between siblings and between unrelated birds. Before roosting, flocks commonly perform noisy display flights. *Cacatua* strip vegetation from trees, especially during midday rest periods. Bathe in rain or wet foliage, rarely in pools, often with much excitement.

Calls usually loud, harsh and often piercing; most calls described as squawks or shrieks, but some melodic and whistle-like (e.g. Forshaw & Cooper 1981; Coates *et al.* 1997; Forshaw). Most remarkable sound is that produced by Palm Cockatoo during Drumming Display, when a tool or foot is used to produce a loud drumming sound from resonant surface on a tree (Wood 1984, 1988; see that text). Calls usually distinctive, including quavering cry of Major Mitchell's Cockatoo and soft, strange, creaky calls of Gang-gang Cockatoo.

Breeding well known in HANZAB region, poorly known extralimitally; breeding for some extralimital species of *Cacatua* known only from captivity (Forshaw & Cooper 1981). Breeding generally seasonal; in HANZAB region, laying usually from July or Aug. in s. Aust., Apr. or May in n. Aust., but most species will lay at other times of year if conditions suitable. Nest predominantly in large hollows of trees; in HANZAB region mostly in eucalypts; Sulphur-crested Cockatoos and Long-billed Corellas also known to nest in holes in cliffs. Most species maintain and enlarge tree-hollows by chewing bits of wood from sides of hollow to form lining at bottom; Galahs line nest with sprays of *Eucalyptus* leaves. Eggs white but may become stained in nest. Mean size of eggs varies from 24.5×19 for Cockatiel to 52.7×36.4 for Red-tailed Black-Cockatoo (noinate *banksii*). Usual clutch-size varies: 1–2 for *Calyptorhynchus* and *Probosciger*; 2–4 for *Cacatua* and *Callocephalon*; 2–5 for *Eolophus*; and 3–6 for *Nymphicus*. Incubation by both sexes in *Cacatua*, *Callocephalon*, *Eolophus* and *Nymphicus*, and by female only in black-cockatoos *Calyptorhynchus* and *Probosciger*. Incubation period 20–30 days in *Cacatua*, *Callocephalon*, *Eolophus* and *Nymphicus*; 28–35 days for *Calyptorhynchus* and *Probosciger*. Young altricial, nidicolous. Young develop down within a few days of hatching; yellow in *Calyptorhynchus*, buff-white to pale yellow in *Cacatua*, reddish in *Callocephalon*, pinkish in *Eolophus* and grey in *Probosciger*. For *Calyptorhynchus* and *Probosciger*, young fed by female only or by female for first few weeks then assisted by male; in other genera, both sexes feed young. Fledging period ranges from 28 days for *Nymphicus*; 6–10 weeks for *Cacatua*, *Eolophus* and *Callocephalon*; 8–9 weeks for *Probosciger*; and 80–90 days for *Calyptorhynchus*. Fledgelings usually remain with parents for some time after leaving nest.

REFERENCES

- Campbell, B., & E. Lack. 1985. *A Dictionary of Birds*. T. & A.D. Poyser, Calton, England.
- Coates, B.J. 1985. *The Birds of Papua New Guinea*. 1. Dove Pubs, Alderley, Qld.
- , *et al.* 1997. *A Guide to the Birds of Wallacea*. Dove Pubs, Alderley, Qld.
- Courtney, J. 1974. *Emu* 74: 97–102.
- 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. *Parrots of the World*. Lansdowne, Melbourne.
- Homburger, D. 1991. *Proc. Int. Orn. Congr.* 20(1): 398–403.
- Keast, A., *et al.* (Eds) 1985. *Birds of Eucalypt Forests and Woodlands*. Surrey Beatty, Sydney.
- Long, J.L. 1981. *Introduced Birds of the World*. Reed, Sydney.
- Noske, S. 1980. Unpubl. MSc thesis, Univ New England, Armidale, NSW.
- Robinson, D., & B.J. Traill. 1996. *RAOU Conserv. Statement* 10 (*Wingspan* 6[2], Suppl.).
- Rowley, I.C.R. 1983. *Aust. Wildl. Res.* 10: 329–42.
- 1990. *The Galah*. Surrey Beatty, Sydney.
- 1997. Pp 246–79 *In*: del Hoyo *et al.* 1997.
- , & D.A. Saunders. 1980. *Corella* 4: 1–7.
- Saunders, D.A. 1974. *Aust. Wildl. Res.* 1: 55–69.
- 1979. *Emu* 79: 215–27.
- 1980. *Aust. Wildl. Res.* 7: 257–69.
- , & J. Ingram. 1995. *Birds of Southwestern Australia*. Surrey Beatty, Sydney.
- , *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.
- Smith, G.A. 1975. *Ibis* 117: 18–68.
- Smith, G.T., & L.A. Moore. 1992. *Emu* 92: 19–27.
- Wood, G.A. 1984. *Corella* 8: 94–5.
- 1988. *Corella* 12: 48–52.

Psittacus galeritus Latham, 1790, *Index. Orn.* 1: 109 — New South Wales.

The specific name is directly from Latin *galeritus*, wearing a hood or skullcap (*galerus*, skullcap).

OTHER ENGLISH NAMES White Cockatoo, Greater Sulphur-crested Cockatoo.

POLYTYPIC Nominate *galerita*, e. and se. Aust.; subspecies *fitzroyi* (Mathews, 1912) n. Aust.; subspecies *triton*, Temminck, 1849, W. Papuan Is, New Guinea and surrounding islands; subspecies *eleonora*, Finsch, 1867, Aru Is.

FIELD IDENTIFICATION Length 48–55 cm; wingspan 103 cm; weight 815–975 g. Large bulky cockatoo with broad rounded wings, rather short tail and long narrow forward-curving crest. Noticeably bigger and bulkier than corellas *Cacatua*, with noticeably broader and more rounded wings. Gregarious, noisy and conspicuous. Sexes differ slightly. No seasonal variation. Juvenile separable. **Adult male** Wholly white with conspicuous yellow crest, faint pale-yellow wash on ear-coverts and pale-yellow wash on underwing and undertail. Bill, legs and feet, grey-black to dark blue-grey. Orbital ring, very pale blue. Periophthalmic ring varies: white to pink-white (nominate subspecies) or pale blue (subspecies *fitzroyi*). Iris, brown-black. **Adult female** Iris typically red-brown but in many older females can be brown-black as in male. **Juvenile** Very similar to adult, differing only by: faint grey tinge to crown, back and wings in some; and pale-brown iris.

Similar species Normally unmistakable. In Aust., flying birds seen at distance could be confused with **Long-billed C. tenuirostris**, **Western C. pastinator** or **Little C. sanguinea Corellas**; Sulphur-crested is noticeably bigger and bulkier, with much broader, more rounded outerwings; also by extremely loud, harsh screeching flight call (usual flight call of corellas is a very different series of two or three tremulous notes) and shallower wing-beats (though overall flight pattern similar to that of corellas). In better views of flying birds, also note blackish bill, all-white head, neck and breast, and yellow crest (corellas have whitish bill; head appears more rounded in profile, without

obvious crest; and bluish periophthalmic ring stands out as distinctive large dark patch round eye; **Long-billed** and **Western Corellas** further differ by orange-pink markings round eye and on foreneck or breast). In quick flight view, could also be confused with white-morph **Grey Goshawk** *Accipiter novaehollandiae* (q.v. HANZAB 2), which sometimes associates with flocks of cockatoos when foraging.

Gregarious; seen in pairs, small parties and flocks of hundreds, especially when foraging, travelling or roosting. Occupy wide range of habitats, from eucalypt forests and woodlands to rainforest and mallee, favouring timbered watercourses. Active, noisy and conspicuous; normally wary and difficult to approach but often tame in urban areas or at picnic grounds. Forage mainly on ground, often with some birds maintaining lookout in nearby trees. During middle of day groups loaf in isolated trees in farmland or emergent trees in forest, often stripping leaves or branches. Form large communal roosts; very noisy at dusk and dawn. Often associate with corellas when feeding in open country. Walk with awkward waddling gait as other cockatoos. Normal short-distance flight a series of rapid, rather stiff shallow wing-beats interspersed with brief glides; wingbeats more regular when travelling long distances. Traveling flocks fly at considerable heights; glide down to trees in wide sweeping circles. Crest raised after alighting; held fully erect when alarmed, accompanied by loud screeching calls. Voice distinctive: normal contact call, given often in flight, is a loud harsh raucous screech, ending with slight upward inflec-

tion; also give series of abrupt guttural screeches when alarmed; and occasional sharp squawk, or shrill disyllabic whistle when feeding or preening.

HABITAT In Aust., usually in and round timbered areas near watercourses. Occur in wide range of forests and woodlands, including tropical or temperate rainforests, wet or dry sclerophyll forests, monsoonal broadleaf or vine forests, mallee, and *Eucalyptus*, *Callitris* and casuarina woodlands (Jones 1952; McEvey 1965; Ridpath & Moreau 1966; Bravery 1970; Gell 1977; Smith *et al.* 1978; Leach 1988; Woinarski *et al.* 1989; Verbeek *et al.* 1993; Forshaw); also plantations of *Araucaria* and *Pinus* (Marshall 1934; Stevens 1975; Roberts & Ingram 1976; Friend 1982). In partly cleared areas, prefer edges of remnant vegetation; often in grassland and farmland with remnants of original woodland, especially along creeklines; rare or absent on treeless farms (Emison & Porter 1978; Leach 1988; Aust. Atlas). On farmland, occur on pastures, crops or orchards; on drier plains, usually near riparian vegetation (Shilling 1948; Hobbs 1961; Costello 1981; Sharrock 1981; Vic. Atlas). Also occur in short-grassed areas, including golf courses, suburban parks and airstrips; occasionally on wet or dry heathland (Ridpath & Moreau 1966; Gell 1977; Rose 1980; Ratkowsky 1983; McFarland 1988; Green 1989) and, in Tas., buttongrass sedgeland (Brown & Holdsworth 1992; Tas. Bird Reps). May occur on beaches and tidal flats (Longmore 1978; Morris 1986; Schulz & Kristensen 1994; Tas. Bird Rep. 3), and recorded in mangroves (Schodde 1976; Longmore 1978; Smith *et al.* 1978). Occur in *Melaleuca* swamps in NT (Deignan 1964). In NZ, recorded in remnants of native podocarp forests, in pine plantations and coastal vegetation; also in cleared areas such as farmland, including pasture, crops and orchards; also golf courses and urban areas (Martin & Bartlett 1963; CSN).

Breed in hollows in tall mature trees, either dead or alive, in forests, woodlands or remnants of either; often near watercourses; will breed in urban areas (Lansell 1933; McEvey 1965; Morris 1975; Brown & Holdsworth 1992; Forshaw; Aust. Atlas; ACT Atlas). Prefer *Eucalyptus*, but also recorded in *Melaleuca* in paperbark swamp (Deignan 1964). In Torres Str., breed on most wooded islands (Draffan *et al.* 1983). Along Murray R., SA, recorded breeding in holes in sheer cliffs (Chisholm 1914; White 1914; Gould). In NZ, recorded breeding in tall dead Kahikatea *Dacrydium dacrydioides* (Martin & Bartlett 1963).

Forage on ground or in trees (MacDonald & Colston 1966; Vic. Atlas); said to be more arboreal in n. Aust. (Forshaw). Feed on ground in cleared country, particularly farmland, either under pasture or ploughed or cultivated; also in cattle feedlots (Hobbs 1961; Robinson 1964; Morris 1975; Loyn 1980; Brown & Holdsworth 1992; Cobcroft 1992; Green 1995). Once seen feeding at muddy margins of drying wetland (O'Donoghue 1915). Also in grassed areas, such as lawns or golf courses (Morris 1989; Forshaw; ACT Atlas), natural grasslands and buttongrass sedgelands (Boehm 1960; Cooper 1974; Brown & Holdsworth 1992; Tas. Bird Rep. 14); once on recently burnt grassland (Waugh 1981); occasionally on roadsides (Favaloro 1984). Recorded foraging on sandy beaches among beachcast kelp and sand-colonizing Sea-Rocket *Cakile maritima* (Schulz & Kristensen 1994; Forshaw; Tas. Bird Rep. 3), and once seen feeding on exposed intertidal platform (G.D. Price & K.M. Hamilton). Occasionally forage on ground beneath trees (Parker 1971; ACT Atlas; CSN 33). Also forage in flowering, fruiting or seeding trees, or among foliage, in forests, woodlands, pine plantations, farmland, orchards or gardens (Roberts 1957; Hobbs & Kaveney 1962; Officer 1967; Parker 1971; Roberts & Ingram

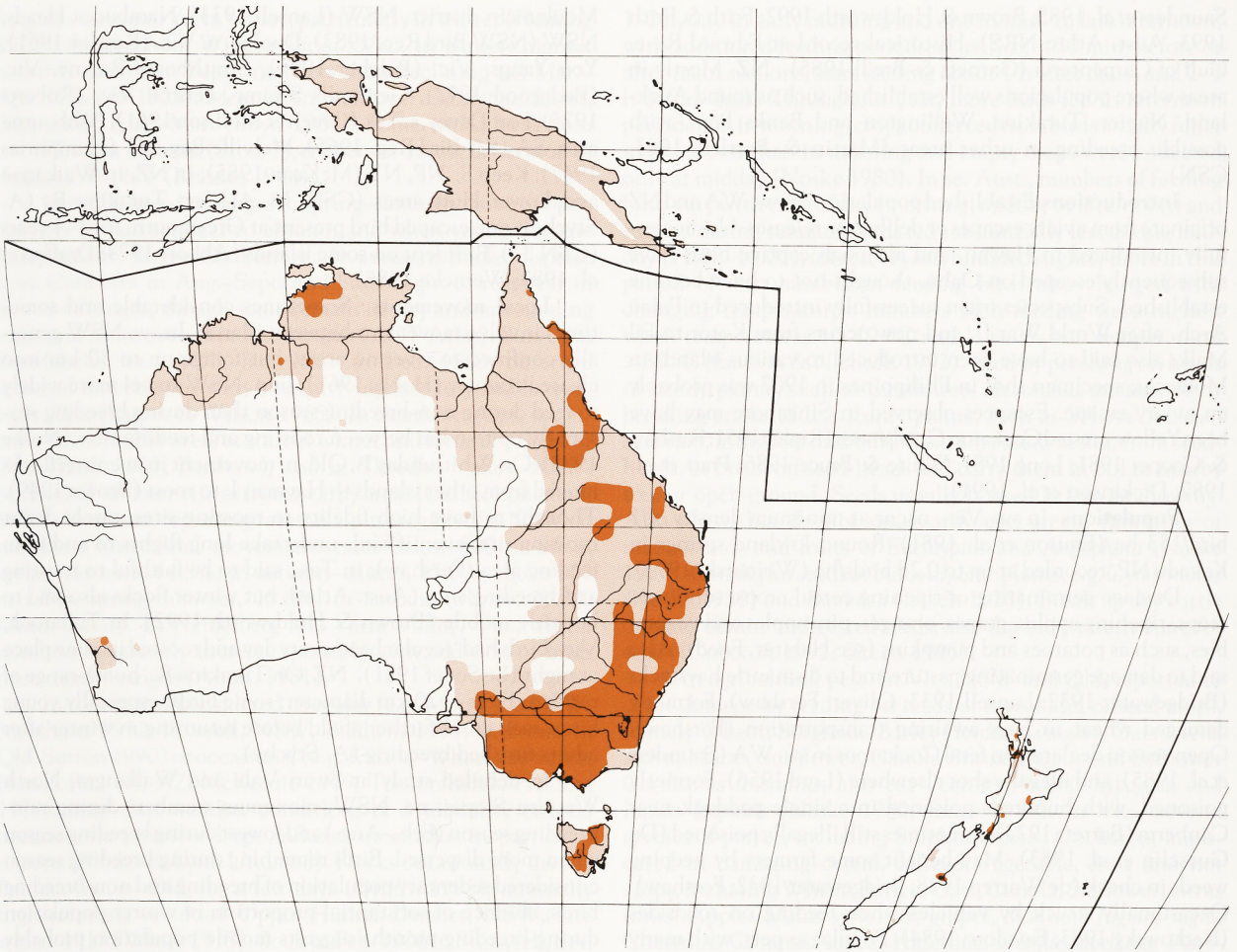
1976; Fielding 1979; Loyn 1985; Hobbs 1988; Browne 1990; Wood 1992). In NZ, forage in native forest, pine plantations, farmlands and orchards (Martin & Bartlett 1963; CSN).

Roost or loaf in tall trees, occasionally in dense copses, and often near water (Hobbs 1961; Cooper 1975; Lindenmayer 1996; Aust. Atlas; ACT Atlas), but proximity to feeding sites varies (Forshaw; Crome & Shields). Often in *Eucalyptus* but also in other species, including *Allocasuarina*, *Melaleuca*, *Leptospermum* or exotic deciduous trees such as poplars (Hobbs 1961; Cooper 1975; Conole 1981; CSN); in study in Buccleuch SF, NSW, of 173 observations of roosting Cockatoos 96% were in large Ribbon Gums *E. viminalis*, only 4% (7 birds) in Narrow-leaved Peppermint *E. radiata* and none in other species (Lindenmayer *et al.* 1996). Also recorded in tall emergent tree in tropical vine forest (Frith & Frith 1993). On Turakina R., NZ, all roosts in stands of tall native forest; elsewhere in NZ, recorded roosting in plantations of introduced trees (A. Styche).

Often a pest in crops and orchards. When loafing, habitually chew branches and trunk of roosting tree, but in areas of human habitation may habitually chew ornamental plants, outdoor furniture and cedar houses (Crome & Shields). Has benefited from clearing for farmland and subsequent provision of water and crops. Occasionally attacked by dogs (Dowling *et al.* 1994).

DISTRIBUTION AND POPULATION Widespread in n., e. and se. Aust. Also throughout much of New Guinea and its associated islands, including W. Papuan Is, islands in Geelvink Bay, Kai Is, Aru Is, D'Entrecasteaux and Louisiade Archs, Trobriand Is and Woodlark I. (Forshaw & Cooper 1981; Coates 1985). Introduced to NZ.

Aust. Qld Gulf Country, S to S of Mt Isa but most N of there. Extend N through C. York Pen. to islands of Torres Str., and S through e. and central regions, occasionally as far W as Cunnumulla. Rarely recorded in SW: round Thargomindah, Windorah and Bedourie (MacGillivray 1924; Storr 19; Aust. Atlas). **NSW** Widespread W to North Western Plain and Western Slopes, extending W to Riverina in S, along Lachlan, Murrumbidgee and Murray Rs. Scattered records in w. regions, especially along Murray and Darling Rs (Schmidt 1978; Morris *et al.* 1981; Cooper & McAllan 1995; Aust. Atlas). **Vic.** Widespread, though sparser in Mallee and some parts of Western Districts, High Country and far East Gippsland (Vic. Atlas). **Tas.** Widespread in all areas, except E of line from Bridport to Darwin. On King I., said to have died out since severe bushfires in 1920; now rare or accidental there, and some birds recorded there may have been aviary escapes. Single record Flinders I. probable aviary escape (Green & McGarvie 1971; Thomas 1981; Green 1989; Brown & Holdsworth 1992). Between Jan. 1970 and Oct. 1971, 28 were unsuccessfully released on Maria I. (Rounsevell *et al.* 1977). **SA** Mostly restricted to areas S of 33°S and E of Spencer Gulf. Extend from SE and Murray-Mallee Districts, W through Adelaide Plains to n. Kangaroo I., and N to Port Augusta (Condon 1969; Baxter 1989; Stove 1994; Aust. Atlas; SA Bird Rep. 1977-81). **WA** Populations in SW originated from deliberate releases or aviary escapes (of nominate *galerita*). First recorded in 1935 at Mandurah. Populations established round Pinjarra since 1955 and Guildford-Midland area since 1964. Total population in SW in 1982 was 300-500 birds. Two populations round Perth, one to N and one 60 km S; control programs in early 1980s reduced numbers to very low levels, but eradication not achieved; population S of Perth now >100 (Long 1981; Saunders *et al.* 1985; Mawson & Johnstone 1997; Storr 28). Widespread in



Kimberley Div., S to 18°S, including some offshore islands (Smith *et al.* 1978; Storr 11; Aust. Atlas). **NT** Widespread in Top End, extending S to 17°S, from Victoria R. to Barkly Tablelands, with single Aust. Atlas record farther S at Warrego, and once recorded in n. Tanami Desert. Also on some adjacent islands (Gibson 1986; Storr 7; Aust. Atlas; H.A.F. Thompson & D.K. Goodfellow).

NZ Introduced; mostly from aviary escapes, but some birds possibly occurred naturally; single, exhausted bird seen Kaipara Heads, May 1959, after several days of strong w. winds thought to be genuine vagrant (Waller 1959). First escapes recorded 1907: four newly imported birds escaped at Turakina, near Wanganui; birds moved inland along Turakina R.; by 1911, 11 birds recorded; by early 1960s, c. 400 recorded Turakina R. and round Mangahoe, and range also extended to Rangitikei R. (Martin & Bartlett 1963). Numerous similar escapes since 1920s, and subsequently established in several areas (Stidolph 1933; Anon. 1946; Long 1981; Oliver). **NI** Infrequently recorded in Northland, between Houhara and Awanui, round Whangarei and Kaipara Harbour. Widespread from Muriwai Beach, S through Auckland to Matira, and E to Clevedon, Kawa Kawa Bay and w. shores of Firth of Thames. Also round Raglan N to Glen Masey and E to Karapiro, with stragglers extending S from Koramautua to Piopio. Farther E, several records from sw. Bay of Plenty, from Papomoa, E to Rangiuuru, and S to Te Puke, with stragglers reported farther S, on Volcanic Plateau, round L. Rotoiti and Aratata, near L. Taupo;

also in Taranaki at New Plymouth. Established populations sw. Hawke Bay, from Napier to Moraetotara R., and in Wanganui, extending N to Mangamahu, E to Hunterville, and S to Marton and Rangitikei R. Few Manawatu records, but widespread in Wellington, S from Waikanae, and W from Rimutaka Ra.; also recorded in Wairarapa region (Martin & Bartlett 1963; Edgar 1971; McKenzie 1979; Falla *et al.* 1981; CSN; A. Styche). **SI** Historical record from Nelson; few scattered records in Westland from Rahu S to Te Kinga and Inchbonnie. Population established on Banks Pen., with single record from nearby Greendale. Stragglers to Otago and Southland at Pounaweia and Gorge Road, the latter thought not to be an aviary escape (Long 1981; CSN).

Change in range In NSW, numbers round Central Coast and Illawarra Regions have increased rapidly since early 1970s (Gibson 1977; Morris 1986); also increasing in Blue Mts (NSW Bird Rep. 1982). Range has expanded E into Gippsland since 1967 (Bedggood 1980). In contrast, numbers round Nanango, se. Qld, have declined markedly since 1940s (Templeton 1992). In Tas., large flocks recorded in 1880s, but by 1924 seldom seen (Anderson 1924), though populations apparently recovered, as now widespread and abundant (Brown & Holdsworth 1992).

Breeding Aust. Widespread throughout much of range, from C. York Pen., S to sw. Tas., and W into s. SA. Feral populations recorded breeding in sw. WA. No published records from Kimberley Div., though recorded in adjacent areas of NT (e.g. Keep R.), and also farther N in Top End (McKean 1985;

Saunders *et al.* 1985; Brown & Holdsworth 1992; Frith & Frith 1993; Aust. Atlas; NRS). Historical record at Edward R., e. Gulf of Carpentaria (Garnett & Bredl 1985). **NZ** Mostly in areas where populations well established, such as round Auckland, Napier, Turakina, Wellington and Banks Pen., with possible breeding in other areas (Martin & Bartlett 1963; CSN).

Introductions Established populations in sw. WA and NZ originate from aviary escapes or deliberate releases. Unsuccessfully introduced to Hawaii, and although captive birds have subsequently escaped on Oahu, thought not to have become established. Subspecies *triton* successfully introduced to Palau Arch. after World War II, and now occurs from Koror to Eil Malk; also said to have been introduced to various islands in Moluccas; specimen shot in Philippines in 1907 was probably an aviary escape. Escapes observed in Singapore may have been Yellow-crested Cockatoo *C. sulphurea* (Ripley 1951; Forshaw & Cooper 1981; Long 1981; White & Bruce 1986; Pratt *et al.* 1987; Dickinson *et al.* 1991).

Populations In sw. Vic., occur at minimum density of 1 bird/153 ha (Emison *et al.* 1981). Round lowland springs in Kakadu NP, recorded at up to 0.28 birds/ha (Woinarski 1993).

Damage germinating or ripening cereal crops, sunflower crops, ripening apples, grapes, oranges, pineapples and vegetables, such as potatoes and pumpkins (see Habitat, Food). Also said to damage germinating pasture and to dismantle haystacks (Bridgewater 1932; Lansell 1933; Oliver; Forshaw). Formerly damaged wheat in bags awaiting transportation (Forshaw). Open season declared on feral Cockatoos in sw. WA (Saunders *et al.* 1985), and illegally shot elsewhere (Lord 1956). Formerly poisoned, with hundreds poisoned in a single paddock near Canberra (Barrett 1922); sometimes still illegally poisoned (Du Guesclin *et al.* 1983). May benefit some farmers by keeping weeds in check (de Warren 1928; Bridgewater 1932; Forshaw). Occasionally struck by vehicles when feeding on roadsides (Ratkowsky 1983; Favaloro 1984). Popular as pets, with many trapped (Chisholm 1946; CSN 41) but more taken as nestlings (Jackson 1925; Boehm 1952; CSN 38), which has led to declines of some populations (Boehm 1952). In sw. WA, trapping for aviculture has been encouraged to keep feral populations in check. However, between 1977 and 1980, only 21 free-flying birds trapped, with trappers preferring to take nestlings; during same period, 109 were imported into WA (Saunders *et al.* 1985). Formerly eaten by early settlers: 'well worth the expenditure of ammunition, as it makes one of the richest soups to be obtained in the bush' (Chisholm 1944b).

MOVEMENTS Vary. Considered resident (Boekel 1980; Bravery 1970; Hardy & Farrell 1990; Longmore 1978), nomadic (Baldwin 1975; Horton 1975) and mostly or partly sedentary (Noske 1980; Storr 7; Forshaw; Crome & Shields). No large-scale seasonal movements (Aust. Atlas), and movements mostly local (Forshaw). Some evidence for altitudinal movement (Forshaw). Seasonality in other areas attributed to local movements, which possibly determined by availability of food (Forshaw). Some movements apparently irregular. Move freely between offshore islands along parts of Aust. coast (Forshaw), e.g. visitor to King I., Bass Str. (Aust. Atlas), and French I., Westernport Bay, Vic. (Vic. Bird Rep. 1985). May have flown across Tasman Sea (Falla *et al.* 1981; Waller 1959).

In many areas of Aust. and NZ occur throughout year: in Aust.: Mt Spec, n. Qld (Griffin 1974), Richmond R. district, n. Qld (Berney 1906), Coomooboolaroo, Qld (Barnard & Barnard 1925), Swan Vale and Wallangra, ne. NSW (Noske 1980),

Moulamein district, NSW (Lansell 1933), Nambucca Heads, NSW (NSW Bird Rep. 1983), Dookie, n. Vic. (Rowley 1961), You Yangs, Vic. (Belcher 1914), Strathbogie Ra, ne. Vic. (Bedggood 1972), Gemmills Swamp, central Vic. (Roberts 1975), Port Davey, s. Tas. (Green & Mollison 1961), Ashbourne area, SA (SA Bird Rep. 1965), Melville Bay, NT (Humphries 1947), Keep R. NP, NT (McKean 1985); in NZ, in Waikanae and Lower Hutt areas (CSN 38, 41), on Turakina R. (A. Styche), one escaped bird present at Greymouth, for 3–4 years (CSN 33). Resident on some islands (Abbott 1974; Draffan *et al.* 1983; Weineke 1988).

Local movements Sometimes considerable and sometimes involve movement between islands. In sw. NSW generally confined to riverine areas, but forage up to 30 km into cleared country (Hobbs 1961). In n. NSW travel more widely to feed during non-breeding season than during breeding season; fly up to 6 km between roosting and feeding sites (Noske 1980). On Whitsunday Is, Qld, n. movement in evening; flocks moved from other islands to Hayman I. to roost (Brown 1949). Thought to have high fidelity to roosting sites: rarely desert roosting site, even if birds undertake long flights to and from feeding area (Forshaw); in Tas., said to be faithful to roosting and breeding sites (Aust. Atlas), but winter flocks also said to be fairly mobile (Brown & Holdsworth 1992). In Tallarook, Vic., birds had 'regular beat' every day and roosted in same place at night (Le Souëf 1921). **NZ** On Turakina R., home-range of resident birds c. 20 km diameter; some birds, especially young birds, may move farther afield before returning in winter after adults finished breeding (A. Styche).

In detailed study at Swan Vale and Wallangra, North Western Slopes, ne. NSW, maximum numbers during non-breeding season (Feb.–Aug.) and lowest during breeding season when more dispersed. Birds remaining during breeding season considered sedentary population of breeding and non-breeding birds; absence of substantial proportion of winter population during breeding months suggests mobile population probably consisting of young birds and possibly non-breeding adults; movements of these flocks in breeding season unknown (Noske 1980). During winter on Turakina R., NZ, small flocks of neighbouring valleys reported to disappear, possibly joining flock on Turakina R.; these small flocks seen again from spring through to autumn. Birds used 14 roosting sites during spring and summer, but only three during winter. In 14 km stretch of Turakina R. in 1993, in July, c. 306 birds resident, with c. 300 roosting in 4.3 ha; in Dec., c. 40 birds resident, occasionally joined by nomadic flocks (A. Styche). In Atherton Shire, Qld, very common June–Aug. in most years (Bravery 1970); flocks disperse during summer (Bourke & Austin 1947). At Burketown, one flock remained near river till first rain, then left for Squires I. where usually bred (Church 1925). Flock arrived at an orchard on central coast NSW each May (Hobbs & Kaveney 1962). In lower Hastings R. Valley (Wauchope–Port Macquarie), NSW, present only during winter, arriving mid-May to early June and leaving Aug. (J.M. Forshaw). At Sandy Ck, Riverina, NSW, only seen in open country June and July (Gubanyi 1910). In Vic. breeding dispersal and non-breeding flocking occurs at least locally; during non-breeding period large flocks gather in more open habitats (Vic. Atlas). Along road between Melbourne and Seymour, maximum numbers May–June (after breeding); numbers decrease in Aug. and few or none in Sept. and Oct. during breeding season (Favaloro 1984). Said to be regular winter influx to suburban Melbourne (Vic. Bird Rep. 1986–87). Numbers in Maribyrnong Valley apparently increase seasonally (Anon. 1987). Regarded as

frequent visitor to Yarra Valley, particularly in winter (Fleming 1976). Absent from Wilsons Prom., Vic., in winter; highest monthly counts in Sept., numbers then declining till Mar.–Apr. (Cooper 1975). Most often seen over *Eucalyptus* forest, Gippsland, Aug.–Mar. (Loyn 1980). Some withdrawal from nw. NT in wet season (Storr 7); numerous during dry season at Adelaide R., NT (Rhodes 1944).

In ACT, breed in ranges in spring–summer; move to open habitats in late summer to autumn and when young become independent; arrive Canberra early autumn; flocks disperse from Canberra in Aug.–Sept. and birds begin to reappear in forests in ranges, though some remain in city and surrounding areas and some even breed in suburbs (ACT Atlas). Survey in Brindabella Ra., ACT, Jan. 1961 to Dec. 1963, observed seasonal movements, with birds arriving late July and leaving early Apr. (Lamm & Wilson 1965). In Southern Alps, apparently leave higher areas at start of winter and return by Sept. or Oct. (Frith 1969; Forshaw); and in Thredbo Valley, NSW, occasional summer visitor from nearby areas (Gall & Longmore 1978). However, reporting rates in alpine region of s. NSW do not show altitudinal movement: rates below 500 m asl in spring–summer, 14.8%, in autumn–winter, 15.0%; above 500 m asl in spring–summer, 15.8%, in autumn–winter, 13.3% (Aust. Atlas). In Heidelberg and Yarra Valley, Vic., winter numbers apparently increase, possibly with addition of birds from nearby ranges (Anon. 1981).

In some areas considered irregular (e.g. Moruya, s. NSW, Marchant 1992; Inverell, NSW, Baldwin 1975; n. Fraser I., Qld, Sutton 1990) or occasional (e.g. Kaiua–Wharekawa area, Hunua Ra., NI, NZ, McKenzie 1979; Tas. orchards, Fielding 1979). Said that weather conditions or availability of food occasionally promote large influxes or exodus in particular regions (Sindel & Lynn Undated). Flocks occasionally invade Paluma Ra., n. Qld, for a few days (Griffin 1995); unusually high numbers recorded Upper Hunter District, NSW, late winter 1913 (White 1913); flock in Feb. 1906 in Stonyfell, SA, where had not been seen for years (Crompton 1915).

Banding Of 258 banded in Aust., 1953–96, 14 recoveries (5.4%): 12 (85.7%) <10 km from banding site; 2 (14.3%), 10–49 km. Longest lived, >96 months (ABBBS 1969). Birds have been wing-tagged (see Rowley & Saunders 1980).

FOOD Seeds of grasses and herbaceous plants, including cereals and oilseeds; also fruits, flowers, bulbous roots and insect larvae. **Behaviour** Fairly well known from detailed study at Swan Vale and Wallangra, ne. NSW (Noske 1980), and se. Aust. (Emison & Nicholls 1992). Mainly feed on ground but also in trees. Usually forage in small parties to flocks of hundreds. In se. Aust., feed with Long-billed Corellas and Galahs *Eolophus roseicapillus* (all birds responding to one alarm call) (Emison & Nicholls 1992); at Swan Vale and Wallangra also feed in mixed flocks with Galahs; of 500 feeding flocks of both species, 39% were mixed flocks. At Swan Vale and Wallangra, feed singly or in flocks from 2 to c. 500 birds; feeding flocks significantly larger during afternoon period in all seasons at Swan Vale, and in winter and spring at Wallangra (Noske 1980). In se. Aust., size of feeding flocks varied seasonally; mean size greatest in autumn (c. 52 birds), lowest in spring (c. 12); also mean sizes of flocks largest when birds feeding (c. 50), compared with flying (c. 7) or roosting (c. 19) (Emison & Nicholls 1992). In NZ, mean size of feeding flocks highest when feeding on crops or stubble of Maize *Zea mays*, and in pasture; lowest in low native scrub (A. Styche).

At Swan Vale and Wallangra, feed in two long sessions of

1–2 h, one in early morning and one in mid- to late afternoon, with additional feeding periods, usually of <30 min, before or after main sessions; start feeding about 1 h after dawn and 2–3 h before dusk. Throughout year, more birds fed in afternoon period than in morning; crops collected from birds usually fuller in afternoon than in morning and empty crops were collected only at midday (Noske 1980). In se. Aust., numbers of feeding birds vary with time of day (morning, midday or afternoon) and season: during summer, birds fed substantially less during midday (11:00–16:00); for rest of year, birds fed slightly more in this period of day; number of feeding birds also changed with changing temperatures: numbers seen feeding were highest when temperatures 10–19 °C and lowest when temperatures >30 °C (Emison & Nicholls 1992). Feed by perching on heads of sturdy plants, such as Sunflowers *Helianthus annuus*, or by breaking stalks of less sturdy plants, such as Wheat *Triticum aestivum*, using feet and bills. Consume seeds *in situ*, from seed-heads, or break off seed-heads and carry them in bill to nearby tree or open ground. Seeds usually husked before swallowing. Also chew, but do not necessarily eat, green, flowering or mature buds and fruits of *Eucalyptus* and *Angophora* (Noske 1980). Can dig for seeds or bulbs of some plants, e.g. *Cymbonotus* (Noske 1980) and *Romulea* (Leach 1928). Break up dry cattle dung to obtain undigested seeds; also dip bill in fresh dung for seeds (Cobcroft 1992; Green 1995).

An agricultural pest. In Vic., NSW and Qld, reported to cause damage by feeding on seeds of cereal and oilseed crops, namely Wheat, Sorghum, Barley *Hordeum vulgare*, Oats *Avena sativa*, Maize, Sunflower, Canola *Brassica napus* and Safflower *Carthamus tinctorius*; also eat Peanuts *Arachis hypogaea* and lupins *Lupinus* (Noske 1980; Jones 1983). In Vic., several species of parrot, including Sulphur-crested Cockatoo, implicated in damaging cereal, oilseed, vegetable, fruit and nut crops, including Wheat, Barley, Oats, Canola, Safflower, citrus fruits, Apples *Malus sylvestris*, grapes, Walnuts *Juglans nigra*, Chestnuts *Castanea sativa*, Hazelnuts *Corylus avellana*, Pistachios *Pistacia vera* and Almonds *Prunus amygdalus*; also damage tree-plantings (ENRC 1995). However, ENRC (1995) does not clearly identify damage caused by individual species of parrot, though Sulphur-crested Cockatoos recorded causing damage in orchards and vineyards; in crops of Potatoes *Solanum tuberosum*; and to tree-plantings. Also attack haystacks and, formerly, tore open bags of grain stacked in paddocks or at rail sidings awaiting transport (Forshaw). In NZ, observed to dig into rotten timber for insects (A. Styche). To drink, walk to edge of still or flowing water, or fly onto partly submerged logs and rocks, and immerse bill 1–10 times; after each immersion, raise head to swallow (Noske 1980).

Detailed studies AT SWAN VALE and WALLANGRA, NE. NSW (46 crops; Noske 1980): **Plants** Crop seeds 93% freq. (Wheat, Oats, Barley, Sorghum and Sunflower); seeds of native and introduced plants 34% (see Other records for details); bark, green leaves and stems 12%. For monthly change of food eaten and other details, see Noske (1980). In se. SA (obs. of 5953 birds; Emison & Beardsell 1985): 62% of birds observed feeding on pasture, probably on onion grass *Romulea*; 12% on germinating cereals (Oats, Wheat and Barley); 1% on cereal stubble; 3% on mature sunflower; 7% on sunflower stubble; 6.5% on ploughed paddocks; 8.5% on feed-trails.

Other records **Algae** Phaeophyceae: *Durvillea*^{14,59}; *Macrocystis angustifolia*⁴³. **Fungi**⁵⁰. **Plants** (Seeds unless stated.) Seeds, bulbous roots^{12,50,52,53,54}, fruits¹². **GYMNOSPERMS:** Araucariaceae: *Araucaria cunninghamii*³⁶; Cupressaceae: *Callitris endlicheri*²⁹; *C. rhomboidea*⁴¹; *Cedrus atlantica*⁴⁷; *Cupressus glabra*⁴⁷;

*C. sempervirens*⁴¹; *Platycladus orientalis*⁴⁷; Podocarpaceae: *Dacrycarpus dacrydiodes* fru.⁶⁵; *Dacrydium cupressinum* fru.⁶⁵; *Podocarpus totara* fru.⁶⁵; *Prumnopitys taxifolia* fru.⁶⁵; Pinaceae: *Pinus*^{32,55,65}; *P. halepensis*³³; *P. pinaster*⁴⁰; *P. radiata*²⁶. MONOCOTYLEDONS: Agavaceae: *Cordyline australis*⁶⁵; Arecaceae: *Archontophoenix alexandrae*⁵²; Bromeliaceae: *Ananas sativus*^{15,19}; Cyperaceae: *Eleocharis sphacelata*⁹; Haemodoraceae: *Haemodorum distichophyllum*⁶⁰; Iridaceae: *Diplarrhena moraea* rhizomes⁵⁸; *Iris* bulbs¹⁹; *Rumex* corms^{61,11}; *R. rosea* corms^{7,55}; Liliaceae: *Asteliasolandra*⁶⁵; *Blandfordia* bulbs^{19,35}; *Hypoxis hygrometrica* tubers²¹; Juncaceae: *Juncus*⁶⁵; Pandanaceae: *Pandanus* fru.⁶³; *P. delestangii* fru.²³; *P. spiralis* fru.⁴²; Poaceae: *Avena sativa*^{29,30,32,44}; *Hordeum*⁴⁸; *H. vulgare*^{29,30,31,37,44}; *Panicum miliaceum*³⁰; *Sorghum bicolor*^{290,30,53}; *Triticum aestivum*^{3,7,17,24,29,30,31,44,45,48,51,52,55}; *Sorghum*³⁹; *Zea mays*^{10,12,25,30,38,37,50,52,55,65}; unident. sds.³²; Xanthorrhoeaceae: *Xanthorrhoea semiplana* fl.⁵⁵. DICOTYLEDONS: Araliaceae: *Polyscias murrayi*²⁷; Asteraceae: flowering heads¹⁶; *Archtotheca calendula* roots⁴¹; *Carthamus tinctorius*^{30,44}; *Cirsium vulgare* fl., sds^{29,41}; *Cymbonotus*²⁹; *Cynara cardunculus*²⁵; *Helianthus annuus*^{29,30,31,44,48}; *Heliopsis scabra* fl.²⁴; *Hypochoeris*²⁹; *H. glabra* roots⁴⁸; *H. radicata* buds⁴⁸, roots⁴¹; *Onopordum acanthium*⁵⁵; *Silybum marianum*^{29,55}; *Taraxacum officinale*²⁹; *Xanthium spinosum*^{1,51}; *X. strumarium*^{5,55}; Boraginaceae: *Echium plantagineum* roots⁴¹; Brassicaceae: *Brassica napus*^{30,44}; *Cakile maritima*⁴³; Casuarinaceae: *Allocauarina*^{18,55}; *A. torulosa*²⁴; *Casuarina cunninghamiana*²⁹; Chenopodiaceae: *Atriplex vesicaria*²⁴; Cornaceae: *Griselinia lucida*⁶⁵; Cucurbitaceae: *Citrullus lanatus*^{24,41}; *C. vulgaris*³²; *Cucurbita*²⁹; Davidsoniaceae: *Davidsonia pruriens* fru.⁶³; Elaeocarpaceae: *Sloanea woollsii* fru.⁶³; Fabaceae: *Arachis hypogaea*³⁰; *Castanospermum australe*¹³; *Erythrina nectar*⁴⁰; *E. indica* fl.⁴⁸; *Jacksonia scoparia*²⁹; *Lupinus*³⁰; *Medicago polymorpha*²⁹; *Trifolium*^{29,65}; *Quercus palustris*⁴⁶; Geraniaceae: *Erodium*⁸; Juglandaceae: *Carya*⁴⁸; *Juglans*⁶⁵; *J. regia* fru.⁴⁷; Lauraceae: *Beilschmiedia tawa* fru.⁶³; Meliaceae: *Melia azedarach*⁴¹; Mimosaceae: *Acacia*^{4,27,29,65}; *A. baileyana* sds⁴¹, fl.⁴⁷; *A. dealbata*⁶⁴; *A. decurrens*⁶²; *A. mollifolia*⁶⁴; *A. pravissima*⁴⁷; Moraceae: *Ficus* fru.²⁹; *F. macrophylla* fru.⁶³; *Maclura pomifera*²⁹; Myrtaceae: *Angophora costata*²⁹; *A. floribunda*²⁹; *Eucalyptus* fl., sds^{50,52,65}; *E. agglomerata*⁶⁴; *E. albens*²⁹; *E. calophylla*³²; *E. globulus* fl., sds⁴¹; *E. gummifera* fl.⁶⁴; *E. melliodora*²⁹; *E. tereticornis* fl.²²; *Kunzea ericoides*⁶⁵; Oleaceae: *Olea europaea* flesh and stones³⁴; Onagraceae: *Oenothera stricta* roots⁴¹; Passifloraceae: *Passiflora* fru.⁶³; Plantaginaceae: *Plantago*²⁹; *P. lanceolata* roots⁴¹; *Platanus orientalis*³⁵; Proteaceae: *Banksia marginata*³⁵; *Carnarvonnia araliifolia*²⁷; *Knightsia excelsa*⁶⁵; *Macadamia tetraphylla* fru.⁶³; Rhamnaceae: *Alphitona excelsa*²⁹; *A. petriei* fru.⁶³; Rosaceae: *Crataegus*⁶¹; *C. monogyna*⁵⁵; *Malus sylvestris* young fru.^{44,47,65}; *Prunus* fru.²⁹; *Pyracantha angustifolia*⁴¹; Rutaceae: *Acronychia acidula* fru.⁶³; *Citrus*^{4,20,44}; *Eremocitrus glauca* fru.⁴⁷; *Euodia bonwickii*²⁷; *Flindersia australis* fru.⁶³; *Melicope vitiflora* fru.⁶³; Salicaceae: *Salix*⁶⁵; Sapindaceae: *Alectryon excelsus* fru.⁶⁵; Solanaceae: *Solanum tuberosum*^{19,44}; Sterculiaceae: *Brachychiton populneus*²⁹; Ulmaceae: *Aphananthe philippinensis* fru.⁶³; *Celtis australis* fru.⁴⁷; *Ulmus*⁶⁵; Violaceae: *Melicytus ramiflorus*⁶⁵. **Animals** INSECTS: Coleoptera: Cerambycidae larv.^{2,55}; Diptera larv.^{23,57}; Hymenoptera: Formicidae eggs^{3,49,55}; Orthoptera: Acrididae: unident. eggs⁵⁵, larv.^{28,32}; *Chortoites terminifera* eggs⁴⁹. **Other matter** Grit.^{8,53,54}

1956; ¹⁸Roberts 1957; ¹⁹Green & Mollison 1961; ²⁰Hobbs & Kaveney 1962; ²¹Simpson 1963; ²²Bravery 1970; ²³Parker 1971; ²⁴Simpson 1973; ²⁵Fleming 1974; ²⁶Roberts & Ingram 1976; ²⁷Crome 1978; ²⁸Brown 1980; ²⁹Noske 1980; ³⁰Jones 1983; ³¹Emison & Beardsell 1985; ³²Saunders *et al.* 1985; ³³Hobbs 1988; ³⁴Paton *et al.* 1988; ³⁵Browne 1990; ³⁶Holmes 1990; ³⁷Cobcroft 1992; ³⁸Dawson *et al.* 1991; ³⁹Templeton 1992; ⁴⁰Wood 1992; ⁴¹Lepschi 1993; ⁴²Nicolaas *et al.* 1993; ⁴³Schulz & Kristensen 1994; ⁴⁴ENRC 1995; ⁴⁵Green 1995; ⁴⁶McDonald 1996; ⁴⁷Lepschi 1997; ⁴⁸Rose 1997; ⁴⁹Zitta 1997; ⁵⁰Gould; ⁵¹Campbell ⁵²North; ⁵³Cleland; ⁵⁴Lea & Gray; ⁵⁵Forshaw; ⁵⁶FAB; Tas. Bird Reps: ⁵⁷3, ⁵⁸9, ⁵⁹12, ⁶⁰13, ⁶¹22; ⁶²Vic. Bird Rep. 1987; ⁶³G. Holmes; ⁶⁴T. Saunders; ⁶⁵A. Styche.

Intake At Swan Vale and Wallangra, average 11.99 g dry weight (n=26 crops) of seeds in crops in afternoon and 5.38 g (n=29) in morning; for individual crop seeds, dry weight of crop full of Sorghum seeds, 22.4 g (8.1; 13–35; 8); Sunflower seeds, 10.5 (1.4; 9.8–12.6; 6). Daily energy requirements estimated at 156 kcal/day, which could be fulfilled by eating 26 g dry weight of Sunflower seeds, 43 g Sorghum, 45 g Wheat, 51 g Barley or 55 g Oats (Noske 1980).

SOCIAL ORGANIZATION Reasonably well known. Detailed study in ne. NSW at Swan Vale and Wallangra (Noske 1980) on which account based unless stated. Gregarious, especially in non-breeding season (F.R. 1907; Bravery 1970; Gill 1970; Bedgood 1958, 1973; Griffin 1974; Johnson & Hooper 1973; Forshaw & Muller 1978; Longmore 1978; Costello 1981; Jones 1981; SA Bird Rep. 1967–68; ACT Bird Reps 1983–84, 1984–85; ACT Atlas); individuals and small groups congregate at feeding and roosting areas in flocks up to thousands, though subspecies *fitzroyi* apparently rarely forms large flocks and is mostly found in pairs and small groups (MacGillivray 1914; Lendon 1966, 1973; Rix 1970; Boekel 1976, 1980; Garnett & Bredl 1985; Sindel & Lynn Undated; Forshaw). Flocks are congregations of smaller groups and individuals that often move independently (Emison & Nicholls 1992). Populations sedentary and nomadic, sedentary population consisting of breeding and non-breeding birds, and nomadic populations thought to be made up of juveniles, immatures and other non-breeding birds (Noske 1980; Forshaw). At Swan Vale, population ranges over total area of c. 45 km², but for most of year only within c. 20 km²; range centred on permanent roost. At Wallangra two groups used minimum area of 30 km² and 25 km². Most follow main flight-paths between roosting, feeding and loafing sites; fly up to 6 km to feeding sites, but in breeding season most non-breeders feed close to permanent roost, while pairs generally feed near nest. Pairs leave flocks to breed (F.R. 1907; Thompson 1935; Noske 1980; Favalaro 1984). At Swan Vale and Wallangra, at least 30% of resident population do not breed and remain in flocks. Flocks form, or increase in size, when pairs rejoin flocks, with their offspring, after breeding (Noske 1980; Favalaro 1984; Forshaw). At Swan Vale and Wallangra, flocks of 1–5 most common throughout year, with pairs more common than lone individuals; in spring and summer, mean size of flock smaller than in autumn and winter when largest flocks form, up to c. 120 at Swan Vale and c. 500 at Wallangra, as breeding pairs rejoin non-breeding residents and influxes of nomads arrive and, usually, join resident population. In se. Aust., mean size of flocks: spring c. 12 birds, summer c. 18, autumn c. 52, winter c. 34; flocks largest when feeding: mean size of flocks (all seasons) c. 50 birds when feeding, c. 19 when roosting during day, and about six when flying; smaller flocks in spring–summer coincide with breeding

REFERENCES: ¹Campbell Ford 1903; ²Hill 1907; ³Gubanyi 1910; ⁴Campbell & Barnard 1917; ⁵De Warren 1928; ⁶Leach 1928; ⁷Bridgewater 1932; ⁸McKeown 1934; ⁹Thompson 1935; ¹⁰Hyem 1936; ¹¹Symon 1940; ¹²Chisholm 1944a; ¹³Bourke & Austin 1947; ¹⁴Hinsby 1947; ¹⁵Hopkins 1948; ¹⁶Hindwood & McGill 1951; ¹⁷Lord

and use of more widely dispersed food sources; in autumn–winter, congregate at concentrated food sources (Emison & Nicholls 1992). In NZ, mean sizes of flocks largest in autumn and winter (with peak about July) and smallest in Dec. (A. Styche).

Bonds Monogamous; pair-bond probably permanent.

Parental care Both sexes prepare nest, incubate and feed young (Noske 1980; Sindel & Lynn Undated; Forshaw). In captivity, female incubates alone for first 1–2 days after laying then continues to do so at night, while male incubates during most of day (Sindel & Lynn Undated). Both parents often perch together near nest when resting in middle of day; less time spent at nest as nestlings become older; 1–2 weeks before fledging, nestling fed at entrance to nest rather than inside. In captivity, young can be removed from parents 3 months after fledging (Sindel & Lynn Undated), though one brood fed themselves 4 weeks after fledging (Paech 1992).

Breeding dispersion Often nest near other Sulphur-crested Cockatoos (Chisholm 1914; Noske 1980; Anderson 1995). At Wallangra, most nests within clumps; within clumps, mean distance between nests 30 m, with clumps separated by 100–400 m; other nests solitary, 200–500 m from nearest neighbour. At Wallangra and Swan Vale, many potential nest-holes, but c. 30% of population did not breed each year; more than one nest-hole in some trees but only one occupied at once. Not uncommon for up to ten birds to perch in nest-trees in breeding season. At Iron Ra., several pairs nested in two trees (Frith & Frith 1993). On Turakina R., NZ, highest density of nests was five in 53 ha stand of native forest; otherwise single nest per stand of forest. Of 40 birds in 14 km study area in two consecutive breeding seasons, not all bred (A. Styche). **Territories** No conflict over nest-holes observed. Some nests inspected and cleaned through year (though rarely in 2–3 months after young fledge), and assumed by same pair; nests visited more often before and during laying. Nests often used in successive years for up to 25–30+ years, probably by same pair or at least one of pair; one abandoned after c. 30 years and another hole in same tree used; other nests used only once. During breeding, pairs feed mostly close to nest. On Turakina R., NZ, during 3 years of observations, two nests used in all 3 years and one nest in 2 consecutive years; not known whether by same pair (A. Styche).

Roosting Roost communally, with up to several hundred together (Lamm & Calaby 1950; Noske 1980; Frith & Frith 1993, 1995; Sindel & Lynn Undated; North; ACT Bird Reps 1977–78, 1983–84); at Swan Vale and Wallangra, up to 30 in same tree (Noske 1980); at Iron Ra., flock of c. 500 roosted in large emergent tree, with most upper branches bare (Frith & Frith 1993, 1995); in Buccleuch State Forest, s. NSW, usually only one or two in same tree (Lindenmayer *et al.* 1996); on Turakina R., NZ, roost in stands of tall native forest; most roosts used during same months and by similar numbers of birds each year; three roosts used throughout year, eleven used for only part of year; some trees used for roosting and as day rests (A. Styche). Individuals and flocks will congregate at roosts (Emison & Nicholls 1992; Frith & Frith 1993, 1995). Sleep in upper branches, usually under foliage but occasionally on exposed branches (Noske 1980). Some roosts permanent, so long as food and water remain available (Frith 1969; Sindel & Lynn Undated; Forshaw), and known to be used for up to 50+ years (Noske 1980; Frith & Frith 1993, 1995; North; ACT Atlas). At one such roost, birds abandoned any tree that died, moving to live tree nearby (North). Other roosts temporary (Noske 1980; ACT Bird Rep. 1983–84). At Wallangra and Swan Vale,

influxes of non-residents either roost with residents at permanent roost or in separate temporary roosts, where some residents may join them. Wake at sunrise; birds perch and call in flocks of 1–100 in trees; fly off from roost at (Forshaw) or soon after (Frith 1969) sunrise, though also said to begin to leave roost before sunrise (Eastman & Hunt 1966). Leave roost with much calling (Frith 1969; Forshaw). Return to roost toward dusk (Frith & Frith 1995; Forshaw); enter and settle at sunset, up to 45 min after arrival at roosting area; on hot days, go to roost up to 45 min later than usual (Noske 1980). Before roosting, flock of 50–100 often circle area of roost 1–5 times (Noske 1980). Before settling to sleep: fly and climb about trees calling (Noske 1980); continue to jostle and squabble for position for some time, generally falling silent well after dark (Frith 1969; Frith & Frith 1995; Forshaw). On moonlit nights, often call and move about roost through much of night (Noske 1980). Sleep with head tucked over shoulder and hidden in scapulars and feathers of back. When settling after dusk, make soft noises, with tongue and bill (Noske 1980). Rest for much of middle of day in trees, often along watercourses, near feeding areas (Frith 1969; Noske 1980; Forshaw; Crome & Shields). In se. Aust., feed less when temperature high, especially when >30 °C; reflected in low numbers feeding during middle of day in summer, though through rest of year, numbers feeding highest at this time (Emison & Nicholls 1992). While resting, sit on one or both legs for up to 2 h with little movement except for occasional yawning, shaking or preening; while eyes sometimes half-closed, appear to remain awake and alert (Noske 1980). Also said to strip leaves, twigs and bark from trees in which resting (Frith 1969; Forshaw; Crome & Shields). During heavy, continuous rain, remain perched for long periods at roosting or loafing sites till rain eases or stops; intermittent or light rain appears not to affect activity (Noske 1980).

SOCIAL BEHAVIOUR Generally not well known; much information from study at Swan Vale and Wallangra, ne. NSW (Noske 1980), on which account based unless otherwise stated. Noisy and conspicuous; wary and difficult to approach, especially when on ground, but immatures less so than adults (Frith 1969; Noske 1980; Forshaw). In NT, less wary and quieter than in S (Rix 1970; Boekel 1976; Forshaw). Greatest variety and number of calls produced in or near roost in early morning and late afternoon; when feeding and loafing, silent except when disturbed or during activity changes. Immediately after landing, often bend forward and raise crest (Noske 1980; Forshaw); sometimes followed by Head-nodding, in which head lowered then jerked up again, with crest raised, several times; performed when perched or while walking (Noske 1980). Sometimes hang upside down from branch by legs or bill, often with wings outstretched. **WINGS-OVER-HEAD DISPLAY:** While perched or on ground, suddenly sweep wings forward over head till wings pointing forward, with leading edges almost touching and in line with body; follows excited behaviour and performed by adult males or females; sometimes accompanied by loud screeching (Courtney 1974). Much of behaviour very similar to that of Galah, especially maintenance, locomotion, alarm and threat displays (Noske 1980). **Flock behaviour** Flocks move in co-ordinated manner. Individuals sometimes display intention movements, becoming restless and leaving flock but returning seconds later (Noske 1980). When about to land, intersperse flight with brief glides, which is thought to be intention signal (Courtney 1993); seldom, if ever, use brief glide when flying long distances (J. Courtney; A. Styche). On awakening, perch and call in small to large flocks (1–100) near roosting trees

before flying off in flocks of 1–20 to congregate at major feeding area; often several such feeding congregations of 2–200 during morning. Rest during middle of day, at roosting or loafing site, usually in groups of 1–30 (Noske 1980). In afternoon, congregate to feed again, usually in larger concentrations than in morning, 10–600 birds. After afternoon feeding, fly off in flocks of 1–100 to congregate near or at roost; before roosting, fly and perch in flocks of 1–500; near dusk, disperse and settle into roosting trees in groups of 1–30 (Noske 1980). In early morning, one flock landed in two trees c. 50 m apart; both groups then flew from tree to tree, in and out of each other, c. 30 times before being disturbed and flying off (Heumann 1927). **PREENING:** Nibble feathers of body and oil-gland; draw large feathers, such as remiges and rectrices, through bill; raise, shake, then gradually sleek feathers of body, head and crest. **STRETCHING:** Arch and stretch wings, stretch leg and fan or shake tail; occurs throughout day but less frequent during middle of day, when resting (Noske 1980). Will bathe in light rain and wet foliage; generally noisy when doing so (Noske 1980; Veerman 1988; ACT Bird Rep. 1983–84). In rain, hang upside down with wings outspread, or lean forward over branch with wings stretched; often followed by preening (Noske 1980). One, hanging upside down in tree, half full, half flew, into wet leaves below and, still upside down, continued to flap wings before repeating procedure and flying off (Veerman 1988). At temperatures above 38°C will sit patting with bill open, head raised, feathers of body sleeked, cheek-feathers ruffled, and folded wings held slightly out from body. Mainly use left foot when holding food: 98% of observations (n=48) (Noske 1980); 87% of individuals (n=113) (Rogers 1980).

Agonistic behaviour Pairs often perch side by side; other birds keep 1–2 body-lengths apart aggression sometimes used to maintain individual distance. Dominance hierarchy unlikely to exist. **Threat** Bird approaches another while leaning forward, with crest raised and bill gaping; usually results in displacement (without physical contact); rarely, parry or lock bills before separating. Flying chases are often result of one bird repeatedly flying at and displacing other till subordinate moves well away; flying chases more frequent during breeding season. **Alarm** When alert, perch erect with feathers sleeked and crest half or fully raised; when fully alarmed, often give loud harsh Alarm Call and sometimes fly with crest raised (Noske 1980; Forshaw). Claimed to detect approach of people from long distances; nesting pair would always fly away when observer c. 300 m away (Hill 1916). In ne. NSW, no evidence of sentinel behaviour in flocks of Cockatoos, even though many anecdotal reports of such behaviour; entire flock often fed on ground with no birds in trees; at other times, birds perched in trees near feeding flock but no evidence that birds were acting as sentinels (Noske 1980). At Turakina R., NZ also no evidence of sentinel behaviour; alarm calls given as often by birds on ground as by those in trees above feeding flocks (A. Styche). In n. Aust., large flocks rare, and sentinels not observed to be used (Forshaw). However, many anecdotal descriptions of sentinel behaviour, e.g. in open country, a few birds remain perched in tall trees, acting as sentinels, while flock feeds on ground; sentinels constantly relieved; if alarmed, sentinels took off screeching loudly and flock took off (Heumann 1927; Erickson 1956; Eastman & Hunt 1966; Frith 1969; Lendon 1973; O'Gorman 1981; Sindel & Lynn Undated; North; Forshaw; Crome & Shields). Sentinels also said to precede flock to feeding area to ensure no danger (Lendon 1973) and to be posted in numbers relative to size of flock, with flock of 500–700 having up to six (O'Gorman 1981). While flocks feeding, at least one member

has head raised at any time. When flushed, flock takes off together in silence, with loud screeching starting when in air (Noske 1980). In NT, when disturbed, usually fly off in silence, only occasionally giving screeches, unlike s. birds (Rix 1970). Sometimes mob predators, circling above while calling loudly; human intruders once mobbed continuously for >3 h (Crome & Shields); alarm screeches from wounded conspecifics or handled nestlings also usually result in mobbing. Often respond to raptors, especially Wedge-tailed Eagles *Aquila audax*, though rarely to Nankeen Kestrels *Falco cenchroides*; rarely mob raptor, instead fly away toward cover, in silence if in open areas but often giving Alarm Calls if in or near forest or woodland; during flight from raptor, sometimes circle high in tight flock close to it (Noske 1980). Two birds reacted to Brown Goshawk *Accipiter fasciatus* by flying to c. 20 m above it in tight circles with high, stiff-winged wing-beats while uttering low growling note, different from usual alarm call; within a few minutes, 20–30 others had joined in but did not utter growling call (Leonard 1997). One sparrowhawk attacked flock and caught one member, which escaped and took refuge on dead branch and sat calling at sparrowhawk perched nearby; rest of flock then flew in compact formation as sparrowhawk chased them again (Anderson 1928). Occasionally seen to chase Galahs and Kookaburras *Dacelo novaeguineae* from near nest; perching corvids also displaced. Groups of 2–6 seen displaying simultaneously at entrance of tree-hollow, staring at object on ground with crest raised, wings outspread and bill open while screeching loudly; in three such cases directed at Lace Monitor *Varanus varius*; similar behaviour also directed by individuals at ground, at nesting holes or toward other birds perched in nesting or loafing trees, including Galahs, Straw-necked Ibis *Threskiornis spinicollis* and Little Pied Cormorants *Phalacrocorax melanoleucos* (Noske 1980). One, whose mate was on nest c. 15 m away, observed on ground directing similar behaviour at snake; then bit snake, which moved off when released; mate of attacker then emerged from nesting hole and flew to nearby tree and watched; attacker followed snake on foot, occasionally nipping its tail; c. 10 min later, another five Cockatoos appeared, apparently in response to calls of attacker; one flew into tree while others flew to ground and joined pursuit, all following snake for another 10+ min till it went into a hole; for about 5 min, pursuers walked round place snake had disappeared then all flew to nearby tree and perched till snake emerged c. 15 min later, at which original attacker immediately flew back down to snake and again followed, lunging at tail, as snake moved off; several others soon flew to ground and followed snake until c. 150 m from nest-tree and waited for another 10+ min after which, snake having not returned, all flew off simultaneously, breeding bird flying back to near partner still in tree near nest and others leaving area; Cockatoo kept its distance from the snake if it showed signs of trying to bite (Anderson 1995).

Sexual behaviour **Courtship** Preparation of nest often interrupted by courtship displays and mutual preening (Sindel & Lynn Undated). **BILL-CLICKING DISPLAY:** Male rapidly opens and closes bill, making soft tapping noise; thought to be part of courtship; performed at nesting hollow with female before laying; commonly performed in captivity when receiving human attention (Courtney 1974). **COURTSHIP DISPLAY:** Male struts toward female, with crest raised and tail fanned while giving low clucking or chattering call and bobbing head and swinging body with each step (Noske 1980; Hocking 1983; Sindel & Lynn Undated; Forshaw); female either gaped bill aggressively, flew off, or remained still, often lowering stance, and accepting male submissively (Noske 1980). Usually fol-

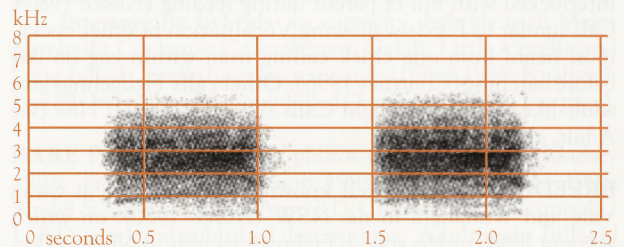
lowed by mutual allopreening (Forshaw) and copulation (Hocking 1983). **Courtship feeding** Not observed by Noske (1980), but in one captive pair male would feed incubating female (Paech 1992). **Allopreening** Occurs only between pairs: one sidles to other, which lowers head and closes eyes; approaching bird nibbles recipient round neck, eyes, bill, crest and sometimes breast, flanks, vent and feet; sometimes then reverse roles and occasionally both allopreen simultaneously. Others approaching allopreening pair always threatened or displaced by one of pair. Occurs through year but most often during breeding season; longest and most intense bouts, up to 45 min, take place in nesting trees. **Copulation** In one attempt, male attempted to stand upright on back of female crouched low on branch with head raised; eventually mounted, turned parallel to body of, and lowered head over neck of, female; both had wings slightly raised and male had tail fanned; male then moved tail beside and beneath that of female; position held for 5 s before male dismounted. In two other copulations, position held for c. 1 and 2 min; in first case, male dismounted and flew off while female remained perched; in second, male bobbed head, with crest raised, before dismounting and approaching intruder perched nearby, then returned immediately after intruder left, and preened female; once, male preened female before copulating.

Relations within family group While female incubating, mate often perches nearby (Noske 1980). In captivity, male, even in long-term pairs, can occasionally become aggressive to mate; usually associated with changes in surroundings (Silva 1987). Nestlings and fledgelings solicit food from parents by giving continuous Food-begging Call (Noske 1980; Courtney 1993); while being fed, give repetitive, pulsating Food-swallowing Vocalization, jerking head up and down with bill interlocked with that of parent; nestlings up to c. 14 days old beg on hearing noise at entrance to nest. Fledgelings give adult-like Alarm and flight calls. Recent fledgelings remain close to nest, perching quietly, till parents return to feed them; join adults away from nest area from c. 1 week after fledging (Noske 1980). Fledgelings often beg persistently while perched high in tree (Sindel & Lynn Undated; ACT Atlas). In captivity, parents can be aggressive to fledgelings (Sindel & Lynn Undated). Parent observed for almost 30 min supposedly teaching two fledgelings to move from branch to branch (Black 1921). **Anti-predator responses of young** When people inspect nest, young nestlings usually sway body slowly, often with back hunched and body huddled against other nestlings; older, feathered nestlings move to the edge of nest-floor and hold body and head erect against wall. When older nestlings with fully opened eyes are inspected or handled by people, they give threatening Hiss, similar to that given by adults while Bill-gaping; when >35 days old, instead of Hissing, screech loudly; screech similar to that of adult and attracts nearby adults, which circle above nest, calling (Noske 1980). **Parental anti-predator strategies** Wary and quiet near nest; at approach of intruder, move off quietly, only calling when well clear of nest; avoid nest if aware of people nearby (F.R. 1907; Hood 1935; Thompson 1935; Frith 1969; Noske 1980; Sindel & Lynn Undated; Forshaw; ACT Atlas) but will call loudly at nest if unaware of human presence (Noske 1980). If person approaches nests, old male sentinel on top of tallest tree said to give alarm call and instantly every female leaves nesting hollows (F.R. 1907).

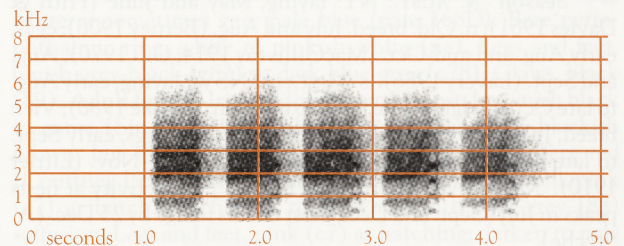
VOICE Unmistakable. Noske (1980) describes ten calls given by adults and three given by young (illustrating most with sonagrams) from study based in n. NSW; Courtney (1996) describes calls of young, also with sonagrams. Very noisy and

some calls extremely loud. Calls given from perch and in flight. Screech said to be loudest of all cockatoo calls (Eastman & Hunt 1966). Variety of calls not fully described. Most vocal at roosts in early morning and late afternoon but silent when feeding or resting during daytime, except when disturbed or during changes in activity (Noske 1980). No details on sexual or seasonal differences, but considerable variation reported in one study, including suggestion of variation between individuals (Noske 1980). Yodel/Whistle Call (see below) was very different at two localities studied by Noske (1980). Mimicry not reported from wild but well known in captivity.

Adult Account based on Noske (1980) unless otherwise stated. Most calls 0.5–2 s long with frequency range of 1–6 kHz. **SQUAWK** (sonagram **A**): Most often described as harsh raucous screech terminating with a slight upward inflection (Forshaw) or raucous, shattering, ear-splitting screech (Pizzey 1980). Most common call. Given when perched or in flight, with crest down or raised; when perched, move head up and down with each call. Pair can call antiphonally or together. Some variation in calls, which is either individual variation or sexual difference. Squawk harsher (Noske 1980) or more guttural (Forshaw) when alarmed. **SCREECH**: Loud harsh screech (sonagram **B**).



A R. Buckingham; Wyperfeld NP, Vic., Nov. 1981; P39



B R. Buckingham; Wyperfeld NP, Vic., Nov. 1981; P39

Can be given as a short single-syllable call, sometimes repeated many times, with crest raised and wings spread; probably signals intense alarm or threat. Can also be uttered as longer call; used as alarm and distress signal and uttered repeatedly if wounded or captured. **CROAK**: A soft, one- or two-syllable call. Given when perched, with crest down and jerking head up and slightly forward; also given in flight. Possibly a locating call or given to indicate change of mood. **BARK**: Harsh, one- or two-syllable call with at least two variants: Bark/Croak and Bark/Whistle. No further details. **RASP**: Long harsh rasping call; no further details. **YODEL/WHISTLE**: Call differed between two localities studied by Noske (1980) but given in same circumstances. At Wallangra, call described as Yodel and at Swan Vale described as Whistle. Given when perched, with wings lifted away from body and nodding head; mate or other bird often responds with same call. Possibly functions as locating call or to proclaim ownership of nest-site; perhaps given only by sedentary pairs. Noske (1980)

lists four other calls without suggesting specific function and with few details. **CRY:** Described as high crying whistle. **CHATTER:** Soft chattering noises given in roost trees. **GRAZE:** Soft sound, like *graze*. **GRATE:** Harsh call sometimes given with Yodel/Whistle Call; given with wings lifted away from body, head bent forward and crest sometimes raised. **Other calls** Low clucking or chattering call given during Courtship Display (see Social Behaviour). **HISS:** A breathy expulsion of air accompanying Bill-gaping and given by juveniles older than 2–3 weeks and by caged adult; probably a low-intensity threat call (Noske 1980).

Young Account based on Courtney (1996) with information from Noske (1980). **FOOD-BEGGING CALL** (= Whirr/Wheeze Call of Noske 1980): Wheezy note; usually c. 4 s long with intervals of 200 ms in which breath-drawing pip noise occurs; repeated at rate of c. 14 calls/min. Energy scattered through frequencies up to 5 kHz (higher in some calls) but almost all energy in two bands at 1.5 and 3 kHz. At times the wheezy note briefly lapses into a clear whistling tone (cf. Cockatiel). Longest Food-begging Call of all cockatoos. **FOOD-SWALLOWING VOCALIZATION:** (= Chuckle Call of Noske 1980): Repeated pulsating noise given while jerking head up and down with bill interlocked with bill of parent during feeding (Noske 1980). Call similar to Food-swallowing Vocalization of other cockatoos; heard from one chick calling from within egg on day before hatching (Courtney 1996). **Other calls** Fledgelings give adult-like Alarm and Flight Calls. Young also utter Hiss (see Adult, above).

BREEDING Fairly well known; detailed study at Swan Vale and Wallangra in ne. NSW (Noske 1980), on which account based unless stated. Eighteen records in NRS to Dec. 1995. Nests may be clustered together in forested areas (Noske 1980).

Season n. AUST.: NT: laying, May and June (Frith & Davies 1961); n. Qld: breed, July and Aug. (Berney 1906); eggs, early Aug. and mid-Oct. (MacGillivray 1914; Gill 1970), Aug. and Sept. (Lavery 1986). s. AUST.: ne. NSW: laying, early Aug. to late Oct.; fledging, late Nov. to mid-Jan. (Noske 1980); Vic.: breed, July–Feb. (Bedgood 1972, 1973); SA: eggs, early Sept. to late Nov. (Attiwill 1972); Tas.: breed, Aug.–Nov. (Littler 1910). NZ: Active at nests from May to Jan.; activity at nests peaks in July–Sept. and Dec.; most chicks fledge by 25 Dec. (A. Styche).

Site Hollow in limb, spout, trunk or stump of tree, usually a eucalypt but also in *Melaleuca* and *Angophora*; often near, sometimes over, water (Berney 1906; Barnard 1914; Noske 1980; Forshaw; NRS); also nest in cliffs along Murray R. (Chisholm 1914). Of 43 nests in ne. NSW: 38 (88%) in living trees and five (12%) in dead trees; 24 (56%) in trunk and 19 (44%) in branch of tree; of those nests in branches, 13 (68%) in live branches and six (32%) in dead branches, including 5 (26%) in dead branch of living tree (Noske 1980). Of 14 nests on Turakina R., NZ, ten (71%) in trunk and four (29%) in branch; of ten in trunk, seven were in dead trees (A. Styche). **MEASUREMENTS:** Height of hollows, 12.7 m (8.04; 1.1–35; 15) (Berney 1906; MacGillivray 1914; Bryant 1934; NRS). In ne. NSW, height of hollows, 10.0 m (2.71; 4.5–16.5; 36); height of nest-trees, 18.6 m (4.99; 11.0–27.5; 33) (Noske 1980). Holes in cliffs, 45.6 m above river (Chisholm 1914). In ne. NSW, some trees contained more than one suitable hollow, but only one hollow per tree ever occupied by Cockatoos. One pair nested in hollow used by Barking Owls *Ninox connivens* in previous season (MacGillivray 1914). One hollow used by Cockatoos

was active in 1977, occupied by Barn Owls *Tyto alba* during the following winter, then by Laughing Kookaburras *Dacelo novaeguineae* during the 1978 breeding season. Recorded nesting in same tree as Brahminy Kite *Haliastur indus*, Grey Goshawk *Accipiter novaehollandiae*, Galah, Eclectus Parrot *Eclectus roratus* and Metallic Starling *Aplonis metallica* (Banfield 1918; MacGillivray 1918; NRS); one pair nested in colony of Great Egrets *Ardea alba* (Bryant 1934). Hollows may be used over many years, probably by same pair, or member of a pair; at Swan Vale, ne. NSW, at least three hollows have been used every year for 25–30 years; one hollow which had been used each year for c. 30 years was abandoned for another hollow in same tree; tree was abandoned in following season (Noske 1980); tree again used 1–2 years later and each year since (J. Courtney).

Nest, Materials In hollow, vertical or inclined (NRS). Eggs laid on decayed matter at bottom of hollow (Berney 1906; NRS); on bed of wood-chips, 2–10 cm deep (Noske 1980). Both sexes prepare hollow by chewing round entrance and inside hollow, sometimes carrying out much excavation (Noske 1980; Sindel & Lynn Undated). Maintain hollow by chewing wood-chips 4–40 cm long from inner walls, producing a honeycomb effect; wood-chips may be added to floor lining, or discarded, forming a pile at base of nest-tree. Wood-chips in hollow are turned by adults before laying. Adults continue to inspect and clean hollows throughout year. **MEASUREMENTS** (cm): In ne. NSW: diameter of entrance, 17 × 27; internal diameter, 32 × 40 (n=6); depth of hollow, 60 (20–100; 9). Elsewhere, depth of hollow, 30–183 cm (North); one hollow, 23 cm (Berney 1906).

Eggs Oval to thick oval or elongate oval, some sharply pointed at smaller end; usually rough-shelled, but some rather smooth, with minute shallow pittings, occasionally with limy nodules; usually lustreless; white, but may become stained by decayed wood (Campbell; North). **MEASUREMENTS:** At Dauringa, central Qld, 48.3 (1.20; 46.5–49.8; 8) × 34.5 (0.75; 33.5–35.3) (North); in NT, a clutch of three, 47.8 × 32.3, 46.2 × 33.0 and 43.2 × 31.0 (Le Souëf 1902); another, 45.5 (45.0–46.0; 3) × 33.0 (32.0–34.0) (Forshaw); in NSW, one clutch, 47.1 × 34.1 and 48.9 × 34.4 (Forshaw).

Clutch-size Two to three eggs per clutch, occasionally one or four (Noske 1980; North). In ne. NSW, C/2 × 8, C/3 × 8. On Turakina R., NZ, of 19 nests, nine had single egg or chick, eight had two eggs or chicks, and two had three eggs (A. Styche).

Laying Chicks hatch 1–2 days apart.

Incubation By both sexes (Sindel & Lynn Undated). Adults incubate for stints of 1–4 h; usually, one bird incubated while other perched in nest-tree or nearby; occasionally both adults entered hollow. **INCUBATION PERIOD:** c. 30 days (Forshaw).

Young Chicks hatch in pale-yellow down, and with eyes closed (Courtney 1965; Noske 1980; Sindel & Lynn Undated). Noske (1980) also noted development of white down feathers on back and rump that are present before fledging. Eyes open at 7–9 days; at 7–17 days, pin-feathers appear; at 10–15 days, pins of crest appear; at 17–23 days, feathers of back and scapulars emerge; at 20–27 days, feathers of crest emerge. **Growth** From growth-curves in Noske (1980): length of culmen (mm): at hatching, 9.6; at 10 days, 14; at 20 days, 20; 30 days, 24; 40 days, 28.5; 50 days, 32.5; 60 days, 37; and 70 days, 41. First-hatched chicks grow faster than younger nestlings. **Parental care, Role of sexes** Adults visit nests more often just before and during laying; frequency of visits gradually decline as nestlings develop. Both adults brood, one at a time; closely for 2–3 weeks and at night till c. 6 weeks old (Noske 1980; Sindel & Lynn Undated). Chicks fed by both parents (Noske 1980; Sindel &

Lynn Undated). Young up to c. 5 weeks old probably fed twice a day, in morning and in late afternoon; after 5 weeks, apparently fed in late afternoon only; fed at entrance to hollow 1–2 weeks before fledging. In most (75%) nests, infertile eggs and broken shells disappeared from nest during fledging stage (Noske 1980). Nestlings defecate inside nest; effected by vigorous lateral shaking of rear half of body while standing upright, with cloacal area rubbing against nest-lining; parents may bury faeces in nest-lining or discard wood-chips with faeces on them.

Fledging to independence FLEDGING PERIOD: For three nests, young fledged at 9.5–10.5 weeks old. Young may leave nest prematurely if disturbed. Recently fledged young remain near nest for c. 1 week then join adults away from nesting area; beg food from and are fed by both parents after fledging, and may continue to be fed by parents for up to 6 weeks (Noske 1980).

Success In ne. NSW, from 40 eggs in 16 clutches, 24 (60%) hatched, 14 (35%) fledged, equalling 0.88 young fledged per pair; 1.3 young per pair would have fledged if seven nestlings from three nests had not been taken by people. In ne. NSW, eggs and young have been taken by Lace Monitors *Varanus varius*; a Brushtailed Possum *Trichosurus vulpecula* occupied a nest hollow, smashing eggs; another nest was taken over by bees *Apis*. A nest failed when rising water in weir inundated hollow (NRS); another failed when nesting tree felled (Noske 1980). Adult taken on nest by Carpet Python *Morelia spilota* (MacGillivray 1914). Birds trapped and nestlings taken for aviculture (Noske 1980; Sindel & Lynn Undated). In ne. NSW, many young shot by farmers in the first few months after fledging (Noske 1980). In NZ, of 19 nests on Turakina R., 1993, all failed or were collected by trappers (A. Styche).

PLUMAGES Prepared by A.M. Dunn. Hatch with thick covering of down. Probably begin pre-juvenile moult to juvenile plumage at c. 3 weeks old. Post-juvenile (first pre-basic) moult to adult plumage probably begins late in first year. Thereafter, undergo complete post-breeding moult each cycle, producing successive adult plumages without change in appearance. Sexes similar in plumage but differ slightly in bare parts. Age at first breeding not known. Two subspecies in Aust.; nominate *galerita* described below.

Adult (Definitive basic). **HEAD AND NECK:** Feathers of most of head and neck, white, with concealed pale-yellow (157) bases. Ear-coverts, white with pale-yellow (c157) wash. Elongated pale-yellow (c157) feathers, with a slight upward curl, arise from crown and upper forehead, forming crest; elongated white feathers of upper forehead cover half of crest when crest relaxed. **UPPERPARTS, UNDERPARTS:** All white. **UPPERTAIL:** Appears white; concealed basal half of inner webs of t2–t6, pale yellow (157). **UNDERTAIL:** White with much pale yellow (157) on basal half of inner webs of t2–t6. Central rectrices (t1), white. **UPPERWING:** All lesser and median coverts and alula, white. Remiges and greater coverts, mostly white with concealed pale-yellow (c157) base to inner web. **UNDERWING:** All lesser and median coverts, white. Greater coverts, mostly pale yellow (pale 157) grading to white near tips. Remiges, white near tip grading to pale yellow (157) at base of feathers; outer primaries about half white and half yellow; secondaries mostly yellow.

Downy young Hatch with covering of thick pale-yellow down (157) (Courtney 1965; Noske 1980; Shephard 1989; Sindel & Lynn Undated), c. 23 mm long (Courtney 1985). Noske (1980) also noted development of white down feathers on back and rump that are present before fledging; not known

whether these are secondary down or part of juvenile plumage. Only one down has been noted in other cockatoos.

Juvenile Much variation between individuals. Some very similar to adults and probably not separable except perhaps on shape of primaries; some have scattered, very faint grey smudges in plumage; and some have bold grey markings in plumage. An individual showing intense juvenile characters described below. **HEAD AND NECK:** Similar to adult but with slightly brighter yellow bases to feathers and many scattered dark-grey (83) feathers or feathers with dark-grey (83) suffusion. Four of five of longest feathers of crest have dark-grey (83) shaft and suffusion near tip. **UPPERPARTS:** Similar to adult but with scattered feathers suffused with dark grey (83). Many feathers have light-yellowish wash or suffusion. **UNDERPARTS:** Similar to upperparts but with more scattered dark-grey (83) feathers. Belly appears to have more yellow wash, most intense near base of feathers. **TAIL:** As adult but one or two feathers have dark-grey (83) suffusion near tip and dark-grey (83) shaft. **UPPERWING:** Many feathers have dark-grey (83) suffusion and dark-grey (83) shaft-streaks. Many primaries and secondaries have strong dark-grey (83) suffusion to tips of feathers. Primaries much more pointed at tips than in adults. **UNDERWING:** As adult but with dark-grey (83) suffusion to some remiges.

Interspecific hybrids In captivity, hybrids with Major Mitchell's Cockatoo *C. leadbeateri*, Galah, Little Corella and Long-billed Corella have been recorded (Gray 1958; Forshaw). Possibly hybridize with Long-billed Corella in wild (J. Courtney).

BARE PARTS Based on photos (Robinson 1970; Lindsey 1992; Trounson & Trounson 1994; Flegg & Madge 1995; Sindel & Lynn Undated; Aust. RD; Crome & Shields; unpubl.: J.N. Davies) and published descriptions. **Adult male** Bill and cere, bluish grey-black (c82) to dark blue-grey (c78); bill often has a flaky appearance. Tongue, grey-black (82). Iris, black (89) or brownish-black (Sindel & Lynn Undated). Orbital ring, white or sometimes very pale blue (pale 168D). Bare periorbital ring, white to pinkish white (ne). Legs and feet, bluish grey-black (c82) to dark blue-grey (c78). Claws, black (89). **Adult female** Iris, reddish brown in most, brownish black in some (Sindel & Lynn Undated); in many, iris blackish brown, but in some dark burgundy, and in a few, fiery red (Courtney 1993). Rest as adult male. **Downy young** Bill, pink (c7) at hatching; changes to off-white with dark-grey (83) suffusion. Legs and feet, pink (c7) at hatching; darken to pale grey (c86). **Juvenile** Iris, pale brown (Shephard 1989). Cere, paler than adult, pinkish or brownish white. Bill darkens just before fledging; probably as adult or only slightly paler at fledging. Legs and feet, slightly paler than adult, grey (c84). In n. NSW, orbital and periorbital rings of nestlings pale blue; gradually change to white (J. Courtney).

MOULTS Based on examination of 67 adult skins, from all months, and 16 juvenile or immature skins from Jan., Feb., May–Aug., and Nov. (AM, ANWC, HLW, MV, QM, SAM, WAM). **Adult post-breeding** (Second and subsequent pre-basic). Probably complete. Holyoak (1973) suggests moult of primaries can begin with any primary, but usually between p5 and p8; from skins, those starting moult of primaries began at p5, p6 or p7. Sequence of moult of primaries not well understood; many birds have unusual patterns of old and new feathers. Probably centrifugal, but primaries often appear to be skipped or replaced out of order. Moult of primaries probably quick; usually two primaries growing at once, sometimes three. Individuals with active moult of primaries recorded in most

months of year, but highest proportion of birds in active moult recorded between Oct. and Feb. Many birds that were not actively moulting primaries appeared to have stopped moult; many had alternating patterns of new and old primaries. Birds with active moult of body recorded Feb., May. and Oct. Birds with active moult of tail recorded over similar period to moult of primaries. **Post-juvenile** (First pre-basic). Very little information. Probably complete. Only two were actively moulting primaries, both in Nov., and had three growing primaries: O³2¹N²3¹N²4¹ and of O²3¹O¹1¹N¹O³1⁰N¹. All other birds had not begun moult of primaries. Four had active moult of body: two in Feb., one July and one Nov. No information on moult of tail.

MEASUREMENTS Nominate *galerita*: (1–3) Adults, skins: (1) E. and s. Aust. (AM, ANWC, HLW, MV, QM, SAM, WAM); (2) S. Qld, NSW and Vic. (Forshaw 1968); (3) N. Qld (Forshaw 1968). (4) Dry Plains, NSW, adults, freshly killed (Forshaw 1968). (5) NE. NSW; ages and methods not specified (Noske 1980; S. Noske).

	MALES	FEMALES	
WING	(1) 344.0 (19.43; 314–384; 33)	333.5 (12.97; 310–357; 29)	*
	(2) 348.79 (18.15; 312–391; 29)	343.46 (19.43; 317–385; 26)	ns
	(3) 317.8 (9.68; 302–336; 15)	320.17 (8.95; 310–335; 6)	ns
	(4) 334.4 (2.50; 324.0–345.0; 10)	327.9 (1.61; 321.0–338.0; 20)	**
TAIL	(1) 179.0 (13.7; 161–218; 34)	174.5 (10.79; 151–199; 29)	ns
	(5) 179.0 (13.7; 161–218; 34)	174.5 (10.79; 151–199; 29)	**
BILL	(1) 42.8 (2.38; 38.0–46.5; 33)	40.6 (2.87; 34.7–47.0; 29)	**
	(2) 42.93 (2.48; 39–48; 29)	42.31 (2.13; 38–47; 26)	ns
	(3) 41.47 (2.16; 38–46; 15)	40.0 (1.27; 38–41; 6)	ns
	(4) 43.1 (2.50; 38.5–45.0; 10)	43.6 (41.0–46.0; 20)	ns
	(5) 44.0 (0.9; 42.8–45.7; 9)	41.4 (1.4; 39.3–44.0; 12)	ns
BILL W	(5) 22.9 (1.0; 20.09–24.1; 13)	21.2 (0.9; 19.9–22.06; 18)	**
TARSUS	(1) 30.5 (1.63; 26.7–33.0; 34)	29.6 (1.58; 24.3–32.4; 30)	*
TOE C	(1) 52.7 (3.80; 46.5–61.4; 23)	49.7 (2.45; 44.0–52.8; 21)	**
CREST	(1) 124.1 (8.94; 109–144; 26)	119.2 (6.47; 108–130; 28)	*

Subspecies *fitzroyi*: (6–7) Adults, skins: (6) N. Aust. (AM, ANWC, HLW, QM, WAM); (7) N. Aust. (Forshaw 1968).

	MALES	FEMALES	
WING	(6) 333.0 (6.96; 323–340; 5)	330.6 (12.64; 310–344; 5)	ns
	(7) 332.4 (13.16; 316–354; 10)	326.6 (17.54; 295–355; 10)	ns
TAIL	(6) 175.5 (7.33; 168–185; 4)	181.3 (13.89; 163–197; 6)	ns
	(7) 175.5 (7.33; 168–185; 4)	181.3 (13.89; 163–197; 6)	ns
BILL	(6) 38.8 (1.67; 36.4–41.0; 5)	38.3 (2.61; 36.2–43.2; 6)	ns
	(7) 40.4 (2.48; 38–45; 10)	38.1 (1.30; 36–40; 10)	**
TARSUS	(6) 30.0 (1.06; 28.9–31.3; 5)	29.6 (2.31; 27.2–32.8; 6)	ns
TOE C	(6) 54.5 (2.34; 52.6–57.7; 4)	50.3 (4.17; 46.6–56.2; 4)	ns
CREST	(6) 131.5 (7.55; 124–138; 4)	127.7 (11.81; 117–143; 4)	ns

Additional measurements of both subspecies in Forshaw. Dimensions of periophthalmic ring: in males, 20 × 14 – 26 × 18 (n=8); females 19 × 14.5 – 23.5 × 16 (n=11) (Noske 1980; S. Noske).

WEIGHTS Nominate *galerita*: S. and e. Aust, museum labels (AM, ANWC, QM, SAM, WAM): (1) Adults; (2) Juveniles or immatures. (3) NE. NSW; ages not specified (Noske 1980; S. Noske).

	MALES	FEMALES	
(1)	815.0 (129.07; 560–1020; 24)	764.5 (124.02; 502–915; 24)	
(2)	577, 900	748.0 (125.22; 640–980; 6)	
(3)	926.3 (47.26; 870–980; 8)	826.5 (41.3; 785–890; 10)	**

Subspecies *fitzroyi*: N. Aust., museum labels (AM, ANWC): (3) Adults; (4) Juveniles.

	MALES	FEMALES
(3)	610, 710	655.0 (83.86; 600–780; 4)
(4)	–	560, 730, 790

STRUCTURE Wing long and broad, with rounded tip. Ten primaries: p8 longest; p10 30–41 mm shorter, p9 3–13, p7 0–9, p6 0–12, p5 8–14, p4 37–45, p3 67–76, p2 82–92, p1 87–103. Outer web of p4–p9 emarginated, with no emargination on inner web. About 15 secondaries, including about five tertials; tips of longest tertials fall between p4 and p5 on folded wing. Tail square; 12 rectrices; t1 longest, t6 3–13 mm shorter. Bill, short and broad. Cutting edges of upper mandible sharp and convex from base to 10–12 mm from tip, then angle sharply downward to tip and slightly concave; tip sharp, flattened inside with small transverse grooves. Lower mandible broad, rather square at tip and scoop-like with raised cutting edge at tip. Cutting edge at tip sharp, concave. Narrow bare cere along base of upper mandible, in which small rounded nostrils situated close to top. Tarsus very short and round; granulate. Tibia fully feathered. Outer toe directed backward. Outer hindtoe 86–96% of outer front, inner front 66–74%, inner hind 46–52%.

AGEING, SEXING All birds with reddish-brown irides are female; all males have blackish-brown irides, but many mature females also have blackish-brown irides (Courtney 1993; Sindel & Lynn Undated). Not known if colour of irides in females related to age or geographical variation, but blackish-brown irides have been reported in known (laying) females >20 years old (Sindel & Lynn Undated). Very difficult to determine sex of immature birds (Sindel & Lynn Undated).

GEOGRAPHICAL VARIATION Four subspecies that differ slightly in size, coloration of plumages and bare parts, and shape of feathers of crest. Two subspecies in HANZAB region: *galerita* from e. Aust. and islands of s. Torres Str., and introduced to sw. WA and NZ; and *fitzroyi* in n. Aust. from Gulf of Carpentaria in w. Qld to nw. WA.

Some variation within nominate *galerita* (described above): a N–S cline in size, with birds in n. Qld smaller than those at s. end of range; also gradual change in shape of bill from N to S. Those in n. Qld have small, very rounded bill, whereas s. populations have larger and more elongated bill.

Subspecies *fitzroyi* differs from *galerita* by: (1) Little or no yellow on ear-coverts or bases of feathers of head and neck; (2) Yellow in undertail and underwing often paler than in *galerita* (but this only evident when comparing large series of skins); (3) Yellow feathers of crest straighter and more exposed when crest relaxed; (4) Orbital ring and periophthalmic ring, often pale blue (c168D) but white in some; (5) Bill slightly broader than in *galerita* and appears more rounded in profile. Male *fitzroyi* had significantly shorter Bill ($P < 0.01$) than *galerita*; difference not significant for females.

REFERENCES

- ABBBS. 1969. *Aust. Bird Bander* 7: 15–17.
 Abbott, I. 1974. *Emu* 74: 124–34.
 Anderson, G.M. 1924. *Emu* 24: 76.
 — 1928. *Emu* 27: 270.
 Anderson, I. 1995. *Canberra Bird Notes* 20: 1–2.

- Anon. 1946. *Emu* 42: 163–4.
 — 1981. *Birds of Heidelberg and the Yarra Valley*. Warringal Cons. Soc., Melbourne.
 — 1987. *Birds of the Maribyrnong Valley*. Friends of the Maribyrnong Valley, Melbourne.
- Attiwill, A.R. 1972. *S. Aust. Orn.* 26: 59–64.
 Baldwin, M. 1975. *Emu* 75: 113–20.
 Banfield, E.J. 1918. *Emu* 17: 212–14.
 Barnard, C.A., & H.G. Barnard. 1925. *Emu* 24: 252–65.
 Barnard, H.G. 1914. *Emu* 14: 39–57.
 Barrett, C. 1922. *Emu* 21: 257–61.
 Baxter, C.I. 1989. *An Annotated List of the Birds of Kangaroo Island*. S. Aust. NPWS, Kingscote, Kangaroo I., SA.
 Bedggood, G.W. 1958. *Emu* 58: 72–3.
 — 1972. *Aust. Bird Watcher* 4: 116–28.
 — 1973. *Aust. Bird Watcher* 5: 12–22.
 — 1980. *Aust. Bird Watcher* 8: 147–62.
- Belcher, C.F. 1914. *Birds of the District of Geelong, Australia*. Griffiths, Geelong, Vic.
- Berney, F.L. 1906. *Emu* 6: 41–7.
 Black, A. 1921. *Emu* 21: 69.
 Boehm, E.F. 1952. *Emu* 52: 296–300.
 — 1960. *Emu* 60: 67–8.
 Boekel, C. 1976. *Aust. Bird Watcher* 6: 231–44.
 — 1980. *Aust. Bird Watcher* 8: 171–93.
- Bourke, P.A., & A.F. Austin. 1947. *Emu* 47: 87–116.
 Bravery, J.A. 1970. *Emu* 70: 49–63.
 Bridgewater, A.E. 1932. *Emu* 31: 280–5.
 Brown, A.G. 1949. *Emu* 49: 44–9.
 Brown, P.B. 1980. *Tas. Bird Rep.* 9: 4–12.
 — & M.C. Holdsworth. 1992. *Tas. Bird Rep.* 21: 4–12.
- Browne, R. 1990. *Aust. Birds* 24: 20–1.
 Bryant, C.E. 1934. *Emu* 33: 159–73.
 Campbell Ford, T.B. 1903. *Emu* 2: 220–2.
 Campbell, J.A., & H.G. Barnard. 1917. *Emu* 17: 2–38.
 Chisholm, A.H. 1914. *Emu* 13: 118–83.
 — 1944a. *Emu* 43: 281–8.
 — 1944b. *Emu* 44: 131–50.
 — 1946. *Emu* 46: 168–86.
- Church, A.E. 1925. *Emu* 24: 290–5.
 Clarke, G. 1967. *S. Aust. Orn.* 24: 119–34.
 Coates, B.J. 1985. *The Birds of Papua New Guinea*. 1. Dove Pubs, Alderley, Qld.
- Cobcroft, M.D. 1992. *Sunbird* 22: 25–9.
 Condon, H.T. 1969. *A Handlist of the Birds of South Australia*. S. Aust. Orn. Assoc., Adelaide.
- Conole, L. 1981. *Aust. Bird Watcher* 9: 14–23.
 Cooper, R.M., & I.A.W. McAllan. 1995. *The Birds of Western New South Wales: A Preliminary Atlas*. NSW Bird Atlassers, Albury, NSW.
- Cooper, R.P. 1974. *Aust. Bird Watcher* 5: 137–74.
 — 1975. *Aust. Bird Watcher* 6: 17–34.
- Costello, J. 1981. *Aust. Bird Watcher* 9: 55–67.
 Courtney, J. 1965. *Emu* 65: 148.
 — 1974. *Emu* 74: 97–102.
 — 1985. *Aust. Bird Watcher* 11: 94–5.
 — 1993. *Aust. Bird Watcher* 15: 60–7.
 — 1996. *Aust. Bird Watcher* 16: 236–49.
- Crome, F.H.J. 1978. *Aust. J. Ecol.* 3: 195–212.
 Crompton, R. 1915. *S. Aust. Orn.* 2: 36–43.
 Dawson, P., et al. 1991. *Sunbird* 21: 93–110.
 de Warren, J.J. 1928. *Emu* 28: 111–20.
 Deignan, H.G. 1964. *Rec. Am. – Aust. Scient. Exped. Arnhem Land* 4: 345–426.
- Dickinson, E.C., et al. 1991. *BOU Checklist* 12.
 Dowling, B., et al. 1994. *Tech. Rep. Arthur Rylah Inst. Environ. Res.* 134.
 Draffan, R.D.W., et al. 1983. *Emu* 83: 207–34.
 Du Guesclin, P.B., et al. 1983. *Corella* 7: 37–9.
 Eastman, W.R., & A. C. Hunt. 1966. *The Parrots of Australia*. Angus & Robertson, Sydney.
- Edgar, A.T. 1971. *Notornis* 18: 118–30.
 Emison, W.B., & C.M. Beardsell. 1985. *S. Aust. Orn.* 29: 197–205.
 —, & D.G. Nicholls. 1992. *S. Aust. Orn.* 31: 117–21.
 —, & J.W. Porter. 1978. *Emu* 78: 126–36.
 —, et al. 1981. Pp 248–57 *In*: Riney 1981.
- ENRC (Environ. & Nat. Res. Comm.) 1995. *Problems in Victoria Caused by Long-billed Corellas, Sulphur-crested Cockatoos and Galahs*. Parliament Vic. (ENRC); Govt Printer, Melbourne.
- Erickson, R. 1956. *West. Aust. Nat.* 5: 80–1.
 F.R. 1907. *Avicult. Mag.* 5: 211–15.
 Falla, R.A., et al. 1981. *The New Guide to the Birds of New Zealand*. Collins, Auckland.
- Favaloro, N.J. 1984. *Aust. Bird Watcher* 10: 237–8.
 Fielding, P. 1979. *Tasm. Nat.* 57: 2–12.
 Flegg, J., & S. Madge. 1995. *Reader's Digest Photographic Field Guide: Birds of Australia*. Rev. edn. Reader's Digest, Sydney.
- Fleming, A. 1974. *Bird Obs.* 614: 11.
 Fleming, A.M. 1976. *Aust. Bird Watcher* 6: 151–60.
 Forshaw, J.M. 1968. *Emu* 67: 267–82.
 —, & K.A. Muller. 1978. *Aust. Bird Watcher* 7: 171–94.
 —, & W.T. Cooper. 1981. *Parrots of the World*. Lansdowne, Melbourne.
- Friend, G.R. 1982. *Emu* 82: 80–91.
 Frith, C.B., & D.W. Frith. 1993. *Sunbird* 23: 44–58.
 —, — 1995. *Cape York Peninsula*. Reed, Sydney.
- Frith, H.J. 1969. *Birds in the Australian High Country*. Reed, Sydney.
 —, & S.J.J.F. Davies. 1961. *Emu* 61: 97–111.
 Gall, B.C., & N.W. Longmore. 1978. *Emu* 78: 189–96.
 Garnett, S., & R. Bredl. 1985. *Sunbird* 15: 6–23.
 Gell, P. 1977. *Aust. Bird Watcher* 7: 52–5.
 Gibson, D.F. 1986. *Tech. Rep. Cons. Comm. North. Terr.* 30.
 Gibson, J.D. 1977. *Aust. Birds* 11: 41–74.
 Gill, H.B. 1970. *Emu* 70: 105–16.
- Gray, A.P. 1958. *Bird Hybrids*. Tech. Communication 13. Commonwealth Bur. Anim. Breeding Genetics, Edinburgh.
- Green, R.H. 1989. *Birds of Tasmania*. Potoroo, Launceston, Tas.
 — 1995. *The Fauna of Tasmania: Birds*. Potoroo, Launceston, Tas.
 —, & A.M. McGarvie. 1971. *Rec. Queen Vict. Mus.* 40.
 —, & B.C. Mollison. 1961. *Emu* 61: 223–36.
- Griffin, A.C.M. 1974. *Sunbird* 5: 29–39.
 — 1995. *Sunbird* 25: 73–92.
- Gubanyi, C. 1910. *Emu* 10: 118–21.
 Hardy, J.W., & J.R. Farrell. 1990. *Corella* 14: 1–15.
 Heumann, G.A. 1927. *Emu* 26: 296–9.
 Hill, G.F. 1907. *Emu* 7: 18–23.
 Hill, J.A. 1916. *Emu* 16: 56.
- Hindwood, K.A., & A.R. McGill. 1951. *Emu* 50: 217–38.
 Hinsby, K.B. 1947. *Emu* 47: 67–8.
 Hobbs, J.N. 1961. *Emu* 61: 21–55.
 — 1988. *Aust. Birds* 21: 104.
 —, & M. Kaveney. 1962. *Emu* 61: 295–300.
- Hocking, K. 1983. *Bird Keep. Aust.* 26: 121–2.
 Holmes, G. 1990. *RAOU Rep.* 69.
- Holyoak, D.T. 1973. *Emu* 73: 157–76.
 Hood, J.B. 1935. *S. Aust. Orn.* 13: 107–19.
 Hopkins, N. 1948. *Emu* 47: 331–47.
 Horton, W. 1975. *Sunbird* 6: 49–69.
- Humphries, C.P. 1947. *Emu* 47: 130–6.
 Hyem, E.L. 1936. *Emu* 36: 109–27.
 Jackson, S.W. 1925. *Emu* 24: 242.
- Johnson, H.R., & N. Hooper. 1973. *Aust. Bird Watcher* 5: 80–95.
 Jones, D.N. 1983. Unpubl. M. Nat. Res. thesis, Univ. New England, Armidale, NSW.
- Jones, J. 1952. *Emu* 52: 225–54.
 Jones, M.V. 1981. *Aust. Bird Watcher* 9: 1–13.
- Keast, A., et al. (Eds) 1985. *Birds of Eucalypt Forests and Woodlands*. Surrey Beatty, Sydney.
- Lamm, D.W., & J.H. Calaby. 1950. *Emu* 50: 114–22.
 —, & S.J. Wilson. 1965. *Emu* 65: 183–207.
- Lansell, G.L. 1933. *Emu* 33: 122–7.
 Lavery, H.J. 1986. *Emu* 86: 111–13.
 Le Souëf, C.J. 1921. *Emu* 20: 239.
 Le Souëf, D. 1902. *Emu* 2: 85–96.
 Leach, G.J. 1988. *Sunbird* 18: 55–75.
 Leach, H.A.C. 1928. *Emu* 28: 83–99.
- Lendon, A.H. 1966. *Aust. Bird Watcher* 2: 191–206.
 — 1973, 1979. *Neville W. Cayley's Australian Parrots in Field and Aviary*. First, Revised edn. Angus & Robertson, Sydney.
- Leonard, J. 1997. *Canberra Bird Notes* 22: 21.
 Lindenmayer, D.B., et al. 1996. *Emu* 96: 209–12.

- Lindsey, T.R. 1992. *Encyclopedia of Australian Animals: Birds*. Angus & Robertson, Sydney.
- Lepschi, B.J. 1993. *Emu* 93: 195–9.
- 1997. *Emu* 97: 84–7.
- Littler, F.M. 1910. *A Handbook of the Birds of Tasmania and its Dependencies*. Author, Launceston.
- Long, J.L. 1981. *Introduced Birds of the World*. Reed, Sydney.
- Longmore, N.W. 1978. *Sunbird* 9: 25–53.
- Lord, E.A.R. 1956. *Emu* 56: 100–28.
- Loyn, R.H. 1980. *Emu* 80: 145–56.
- 1985. *Emu* 85: 213–30.
- MacDonald, J.D., & P.R. Colston. 1966. *Emu* 65: 255–78.
- MacGillivray, W. 1914. *Emu* 13: 132–86.
- 1918. *Emu* 17: 180–212.
- 1924. *Emu* 24: 13–24.
- Marchant, S. 1992. *Eurobodalla Nat. Hist. Soc. Occ. Publ.* 1.
- Marshall, A.J. 1934. *Emu* 34: 36–44.
- Martin, J.S., & J. Bartlett. 1963. *Notornis* 10: 241.
- Mawson, P., & R. Johnstone. 1997. *Eclectus* 2: 4–9.
- McDonald, D. 1996. *Canberra Bird Notes* 21: 64.
- McEvey, A. 1965. *Emu* 65: 1–56.
- McFarland, D. 1988. *Emu* 88: 249–57.
- McKean, J.L. 1985. *Aust. Bird Watcher* 11: 114–30.
- McKenzie, H.R. 1979. *Notornis* 26: 105–19.
- McKeown, K.C. 1934. *Rec. Aust. Mus.* 19: 113–35.
- Morris, A.K. 1975. *Aust. Birds* 9: 37–76.
- 1986. *Aust. Birds* 20: 65–81.
- 1989. *Aust. Birds* 23: 7–21.
- , et al. 1981. *Handlist of Birds in New South Wales*. NSW Field Orn. Club, Sydney.
- Nicolaas, A.M., et al. 1993. *Emu* 93: 53–8.
- Noske, S. 1980. MSc thesis, Univ. New England, Armidale, NSW.
- O'Donoghue, J.D. 1915. *Victorian Nat.* 32: 26–35.
- O'Gorman, B. 1981. *Aust. Avicult.* 35: 95–6.
- Officer, H.R. 1967. *Emu* 66: 279–87.
- Paech, S. 1992. *Bird Keep. Aust.* 35: 36.
- Parker, S.A. 1971. *West. Aust. Nat.* 12: 23.
- Paton, D.C., et al. 1988. *S. Aust. Orn.* 30: 158–9.
- Pizzey, G. 1980. *A Field Guide to the Birds of Australia*. Collins, Sydney.
- Pratt, H.D., et al. 1987. *A Field Guide to the Birds of Hawaii and the Tropical Pacific*. Princeton Univ. Press, Princeton, New Jersey.
- Ratkowsky, D.A. 1983. *Tasm. Nat.* 75: 2.
- Rhodes, L.J. 1944. *Emu* 44: 87–93.
- Ridpath, M.G., & R.F. Moreau. 1966. *Ibis* 108: 348–93.
- Riney, T. (Ed.) 1981. *Wildlife Management in the '80s*. Monash Univ., Melbourne.
- Ripley, S.D. 1951. *Condor* 53: 299–300.
- Rix, C.E. 1970. *S. Aust. Orn.* 25: 147–91.
- Roberts, G.J., & G.J. Ingram. 1976. *Sunbird* 7: 1–20.
- Roberts, P.E. 1957. *Emu* 57: 303–10.
- Roberts, R.G. 1975. *Aust. Bird Watcher* 6: 61–8.
- Robinson, L.N. 1964. *Aust. Bird Watcher* 2: 113–15.
- 1970. *Australian Parrots in Colour*. Rigby, Adelaide.
- Rogers, L.J. 1980. *Bird Behav.* 2: 1–12.
- Rose, A.B. 1997. *Aust. Bird Watcher* 17: 134–7.
- Rose, R.W. 1980. *Pap. Proc. R. Soc. Tasm.* 114: 209–18.
- Rounsevell, D.E., et al. 1977. *Tech. Rep. Tas. Nat. Parks Wildl. Serv. Wildl. Div.* 77/3.
- Rowley, I. 1961. *Emu* 61: 7–55.
- 1990. *The Galah*. Surrey Beatty, Sydney.
- , & D.A. Saunders. 1980. *Corella* 4: 1–7.
- Saunders, D.A., et al. 1985. Pp 309–21 In: Keast et al. 1985.
- Schmidt, B.L. 1978. *Aust. Birds* 12: 61–86.
- Schodde, R. 1976. *A Survey of the Flora and Fauna of the Lower McArthur River Region, Northern Territory*. CSIRO Div. Wildl. Res. for Mimets Dev't, Canberra.
- Schulz, M., & K. Kristensen. 1994. *Aust. Bird Watcher* 15: 265–72.
- Sharrock, R.E. 1981. *Aust. Bird Watcher* 9: 110–23.
- Shephard, M. 1989. *Aviculture in Australia*. Black Cockatoo Press, Melbourne.
- Shilling, D. 1948. *Emu* 48: 64–72.
- Silva, T. 1987. *Avicult. Mag.* 93: 202–6.
- Simpson, K.N.G. 1963. *Bird Obs.* 385: 3.
- 1973. *Mem. Natn. Mus. Vict.* 34: 253–73.
- Sindel, S., & R. Lynn. Undated [c. 1988]. *Australian Cockatoos*. Singil Press, Austral, NSW.
- Smith, L.A., et al. 1978. *Wildl. Res. Bull. West. Aust.* 7: 29–41.
- Stevens, J.H. 1975. *Aust. Bird Watcher* 6: 77–9.
- Stidolph, R.H.D. 1933. *Emu* 33: 93–5.
- Stove, K. (Ed.) 1994. *S. Aust. Orn* 31: 195–265.
- Sutton, P. 1990. *Sunbird* 20: 41–58.
- Symon, O. 1940. *S. Aust. Orn.* 15: 68–72.
- Templeton, M.T. 1992. *Sunbird* 22: 87–110.
- Thomas, D. 1981. *Tasmanian Bird Atlas*. Univ. Tas., Hobart.
- Thompson, D.F. 1935. *Birds of Cape York Peninsula*. H.J. Green, Melbourne.
- Trounson, D., & M. Trounson. 1994. *Australian Birds*. National Book Dist. & Publ., Sydney.
- Veerman, P. 1988. *Canberra Bird Notes* 13: 26.
- Verbeek, N.A.M., et al. 1993. *Emu* 93: 53–8.
- Waller, M.A. 1959. *Notornis* 8: 165.
- Waugh, J. 1981. *Aust. Birds* 15: 44–6.
- Weineke, J. 1988. *Sunbird* 18: 1–22.
- White, C.M.N., & M.D. Bruce. 1986. *BOU Checklist* 7.
- White, H.L. 1913. *Emu* 13: 101.
- White, S.A. 1914. *Emu* 13: 122–9.
- Woinarski, J.C.Z. 1993. *Emu* 93: 100–20.
- , et al. 1989. *Emu* 89: 223–31.
- Wood, K.A. 1992. *Aust. Birds* 25: 79–81.
- Zitta, J. 1997. *Bird Keep. Aust.* 40: 8–11.



Volume 4, Plate 7

Major Mitchell's Cockatoo *Cacatua leadbeateri* (page 154)

NOMINATE LEADBEATERI: 1 Adult male; 2 Adult female; 3 Juvenile; 4 Adult
 SUBSPECIES MOLLIS: 5 Adult male

Sulphur-crested Cockatoo *Cacatua galerita* (page 163)

NOMINATE GALERITA: 6 Adult male; 7 Adult female; 8 Juvenile; 9 Adult
 SUBSPECIES FITZROYI: 10 Adult male; 11 Adult female