

## Order ANSERIFORMES

Medium-sized to large aquatic, marine and terrestrial birds. Three families: (1) Anhimidae (screamers), (2) Anseranatidae (Magpie Goose) and (3) Anatidae (true wildfowl); Screamers confined to South America, Magpie Goose confined to Aust. and New Guinea, and rest cosmopolitan. Suggestion that the order is distantly related to Phoenicopteriformes and Ciconiiformes (see Sibley & Ahlquist 1972) now seems unlikely. Claims for some anatomical similarities with gamebirds such as Cracidae, suggesting distant affinity with Galliformes via Anhimidae and Anseranatidae (Simonetta 1963; Johnsgard 1968; Bock 1969), strongly rejected by Olson & Feduccia (1980).

All members of the Anseriformes are web-footed (in some semi-palmate) swimming (some now almost terrestrial) and diving birds that are filter-feeders or are derived from aquatic filter-feeders. They differ from Galliformes in almost every anatomical feature (see Olson & Feduccia 1980). The unique filter-feeding mechanism is diagnostic of the order. Two groups of filter-feeding birds probably evolved from some charadriiform origin; in one, the specialized mechanisms for filtering evolved in the lower mandible (flamingoes); in the other, the upper mandible housed the specialized tongue used to provide the pump-action for filtering. The complex structure of the bill and its operation during filter-feeding in a typical duck has been investigated recently (Zweers 1974; Zweers *et al.* 1977; Kooloos 1986; Kooloos & Zweers 1989; Kooloos *et al.* 1989). Sensory apparatus of the bill associated with this filtering function is likewise complex (Berkhoudt 1980). The typical bill, representing the fundamental apparatus unique to the order, acts as a double-action suction-pump in which fluid is drawn in at the tip and expelled past filter plates at the sides and rear. The tongue and internal shape of the bill provide the elaborate piston effects and the lamellae or fine plates, common to all members of the order, act as the sieves. Lamellae trap the food, which is then brushed free and swallowed by the combined actions of tongue and lamellae. Vestigial lamellae occur in screamers (Olson & Feduccia 1980). Filtering is the original feeding method and departures from it towards adaptations for grazing in geese, serrated edges for catching fish in 'saw-billed' ducks (mergansers and allies) or superficially fowl-like bill of screamers, are all derived features (Olson & Feduccia 1980). Anhimidae, however, being extralimital, are not considered further.

The innovative modern classification of the ducks, geese and swans, and the systematic order proposed by Delacour & Mayr (1945, 1946) and Delacour (1954-64), was modified by Johnsgard (e.g. 1965a, 1968) in the light of further studies, particularly on behaviour and social signals, and new information on little known species. Woolfenden (1961) and Livezey (1986) have prepared phylogenetic analyses of the order based on morphological characters, and the classification by Livezey has been followed by some recent works (e.g. Madge & Burn 1988). Madsen *et al.* (1988) provide important additional information from DNA studies and give a partial classification of the order. We have adopted the classification of Johnsgard in Peters with some modification concerning only those species within our area. Our reasons for these changes are as follows but the arrangement of species fits closely the proposed classification of the order given by Sibley *et al.* (1988) and Madsen *et al.* (1988). The arrangement is consistent with the persuasive argument presented by Olson & Feduccia (1980) concerning the origin and evolution of the order. The fossil *Presbyornis* (Eocene; North America) and the endemic *Stictonetta* (Freckled Duck) and *Malacorhynchus* (Pink-eared Duck) of Aust. have special significance in this respect (see Olson & Feduccia 1980).

Special features of *Stictonetta* are: reticulated anterior face of tarsus; lack of a syringeal bulla; no speculum; unpatterned downy young (see Frith 1964a,b). Structure of the trachea and syrinx described by Ramsey (1878) and in more detail by Campbell (1889) and in Campbell demonstrate the lack of any development of a swollen bulla in drake. Claim by Frith (1964a, 1965, 1967, 1982) that tracheal loop occurs in mature drake is unconfirmed in many hundreds of birds examined (G.F. van Tets). Long neck. Uropygeal wax esters like those of some swans (Edkins & Hansen 1972) but chemotaxonomy difficult to interpret because similarities also shown with *Cereopsis*, *Branta*, *Cairina*, *Tadorna*, *Mergus* and *Melanitta* (Jacob & Glaser 1975). Brush (1976) has shown that the feather-proteins are unique. Verheyen (1953) on skeletal characters (cranial & post-cranial) concluded that it was sufficiently distinct to be separated from other waterfowl. Clearly it shows a large number of 'primitive' characters. Olson & Feduccia (1980) emphasize several features of the cranium that are unique in living ducks: the markedly recurved rostrum and mandible and the expanded lachrymal. Livezey (1986), largely from osteological characters, supports traditional conclusions that it is the last branch of the waterfowl with reticulate tarsi and places it after the geese and swans. Faith (1989) has shown that many of these skeletal characters might be explained on divergence between diving, dabbling and grazing adaptations. Recent DNA studies (Madsen *et al.* 1988) lend some support to an earlier suggestion, based on behaviour and some morphological features, of possible similarity with Oxyurinae (Johnsgard 1965b). Fullagar *et al.* (in press) add support to idea that *Stictonetta* has several behavioural similarities with stiff-tails. The uniqueness of this species has been widely supported, but in the past the absence of information about its behaviour and ecology ensured that it remained doubtful to which other group of



wildfowl it was most closely related. Many of these deficiencies have now been resolved (see text elsewhere) and the argument for a link with stiff-tails has become more compelling. Plumages, social signals and vocalizations are all in some way most readily comparable to *Oxyura* and *Biziura* but specially to *Heteronetta*. A seasonally colourful bill in the male most closely matches the condition found in *Heteronetta* but also in most stiff-tails; sequence of moults follow unusual pattern found in at least some, if not all, stiff-tails but not known in other wildfowl, notably the presence of a post-juvenile moult including wings. Many characteristics of breeding biology (nest-construction and choice of site; small clutch-size; predisposition to dump laying; appearance and quantity of down used in lining nest; unpatterned ducklings) are features shared with most stiff-tails. In particular the unusual copulation involving greatly elongated pseudopenis is most closely comparable with features shown only by stiff-tails.

Major recommended works of reference are: **Comprehensive accounts:** Delacour (1954-64); Todd (1979); Phillips (1922-26) [ducks]; Scott (1972) [swans]; Owen (1980) [geese]. **Regional accounts:** Palmer (1976) [Nearctic]; BWP [w. Palearctic]; Bauer & Glutz von Blotzheim (1968-69) [Europe]; Frith (1982) [Aust.]. **Field guides:** Scott (1988); Madge & Burn (1988). **Special studies:** Hochbaum (1955, 1973) and Sowls (1955) [migration and habits]; Johnsgard (1965a) [complete review of behaviour]; Hochbaum (1944); Driver (1974) and Kear & Berger (1980) [species monographs].

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Family **ANATIDAE** wildfowl

Waterbirds (some more or less terrestrial) with rather short legs and front toes connected by webs; hallux elevated and reduced. Though considerable adaptive diversity in outward appearance, size, colours of plumage, behaviour, and ecology, homogeneous in many characters, as attested by numerous, often fertile, interspecific hybrids reported, chiefly in captivity (see Gray 1958). About 160 species in six sub-families: (1) Dendrocygninae (whistling-ducks); (2) Oxyurinae (stiff-tails and Freckled Duck); (3) Anserinae (swans and geese); (4) Tadorninae (shelducks, sheldgeese and steamer-ducks); (5) Anatinae (dabbling ducks and allies); (6) Merginae (eiders, scoters, mergansers and allies).

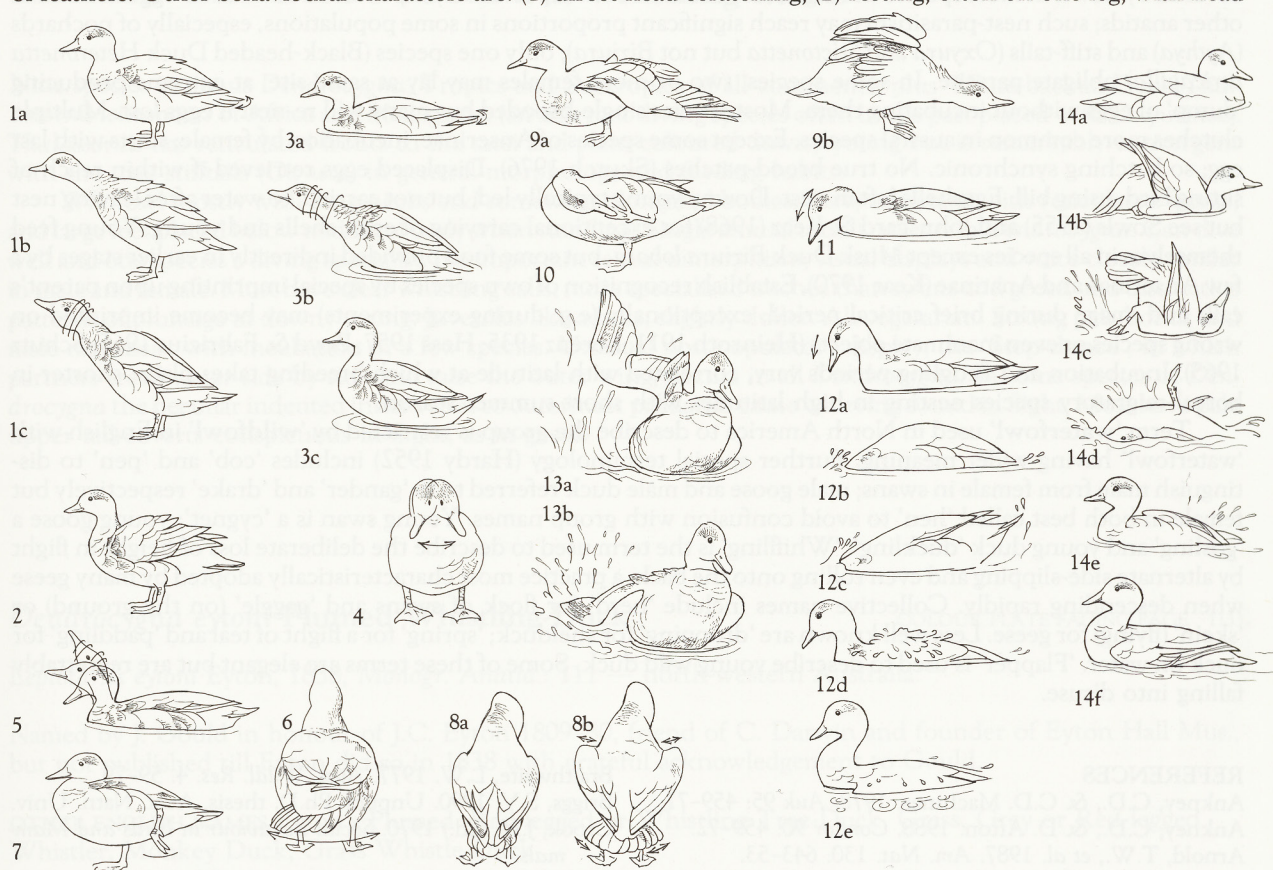
Body, broad and rather elongated in many, though more rotund in some, especially diving species. Plumage, thick and waterproof; contour-feathers distributed over distinct feather-tracts with underlying coat of down. Neck, medium to long. Wings generally rather small; mostly pointed, fairly broad in many, but narrower in some highly migratory species. Small claws on first and second digits occur in most. Spurs—horny sheathed bones—occur in several species as projections near carpal joint; attached either to radial carpal or the metacarpal. Wing-spurs are found in the Tadorninae and *Sarkidiornis*, *Plectopterus* and *Merganetta* in the Anatinae. Eleven primaries; p9 nearly always longest, p11 minute. Wide range in number of secondaries, from 12 to 24, innermost (tertials) often long and brightly coloured; diastatic. Many species, particularly in Tadorninae, Anatinae and Merginae have a specialized, contrastingly coloured patch (speculum) on upper surface of inner wing, important for sexual and social signalling. Most fly fast and have large, high-keeled sternum. Tail, short and square or slightly rounded in most; long in some diving species (serving as rudder), pointed or with elongated central feathers in some others. Tail-feathers, 14–24 but varying even in single species. Bills show much adaptive variation but typically of medium length, broad, often flattened centrally and distally but high at base, and rounded at tip with horny nail at tip, producing slight terminal hook; covered with soft skin. Edges of mandibles with rows of lamellae, showing different development in various ecological types and taxonomic groups; most highly specialized in surface plankton-feeders, least so in species (such as scoters *Melanitta*) that swallow molluscs whole. Tongue, thick and fleshy; epithelium covered with papillae and horny spines. Lower part of tibia and tarsus bare; front toes connected by webs (reduced in a few species), hind toe elevated. Gait, striding or waddling. Oil gland, feathered. Aftershaft, reduced or absent. Special intromittent copulatory organ present in males; vascularized sac everted from wall of cloaca, protruded by muscular action; facilitates sexing by examination (Hochbaum 1942), even of small young. Salt-secreting nasal glands subject to adaptive variation in size, even in same species; enlarged in forms inhabiting saltwater or brackish habitats, modifying profile of head considerably. In many species, males have remarkably lengthened, bent, or locally widened trachea forming resonating tubes; also syngo-bronchial sound-boxes (bullae), either fully ossified or with membranous fenestrae. These vocal structures highly characteristic of species or larger taxonomic units (see Eyton 1838 and, especially, Johnsgard 1961, 1971). Considerable diversity in types of plumage: male and female similar, nearly similar, or show extreme sexual dimorphism. In all species, except some sheldgeese, flight-feathers moulted simultaneously, producing period of flightlessness lasting 3–4 weeks. Two body-moult per cycle. Young precocial and nidifugous, covered with thick down; pattern often cryptic and characteristic of taxonomic groups within sub-families. Able to swim soon after hatching.

Cosmopolitan, but absent from continental Antarctica and some islands. Usually on or close to water. Highly vulnerable to human pressures on habitats. Labrador duck *Camptorhynchus labradorius* extinct during last century, and three more (Crested Shelduck *Tadorna cristata*, Pink-headed Duck *Rhodonessa caryophyllacea*, Auckland Merganser *Mergus australis*) probably so this century. A few species domesticated: Swan Goose *Anser cygnoides*, Greylag Goose *A. anser*, Muscovy Duck *Cairina moschata*, and Mallard *Anas platyrhynchos* (Goodwin 1965); some populations of a few more (Mute Swan *Cygnus olor*, Canada Goose *Branta canadensis*, Egyptian Goose *Alopochen aegyptiacus*) kept in semi-domesticated or feral conditions.

N. forms often highly migratory and tied to Arctic or high latitudes for breeding, exploiting brief but productive period each year to raise young; for many of these species autumn movements preceded by marked moult-migrations by males to special areas for period of flightlessness. More sedentary in warmer latitudes, specially in equatorial regions. The term 'boreal' for these n. wildfowl is useful to draw attention to the marked differences between the breeding ecology of n. high-latitude wildfowl compared with many s. hemisphere species for which the term 'austral' has been used (Fullagar *et al.* 1988). In general, most austral species are more sedentary and certainly lack spectacular migrations. Regular movements in most s. hemisphere species are at best only local. Occasional much wider dispersal is often initiated by factors such as flooding rains and drought (specially in Aust.). Many austral ducks exploit seasonally persistent or occasional, extremely propitious conditions by responding with an extended breeding season. In reality, most are seasonal breeders but productivity of some will vary greatly according to rainfall and flooding; most notable with many species in Aust. For further details see Fullagar *et al.* (1988).



Wide range in diet, from totally vegetable to totally animal, and in feeding habits, from terrestrial grazing to bottom diving; correlated with conspicuous adaptations in structure of bill, musculature of head, length of neck, and in general proportions of body. Terminology of feeding methods in species accounts mainly after Szijj (1965) and Bauer & Glutz (1968, 1969); see also Olney (1963). Typical filtering action of most members of the order, described earlier, best termed 'suzzling'. Most species gregarious, feeding, loafing, roosting, and travelling in cohesive flocks, integrated by calls and special pre-flight signals. Generally solitary breeders nesting in concealed sites, though some species colonial, either habitually or, more often, as alternative to dispersed nesting, usually in protected areas such as islands. Degree of territorialism when breeding and relation between territory and nest-site vary between species and larger taxa; some strictly territorial; others occupy wholly or largely undefended home-ranges. Monogamous pair-bond in most species but much variation between taxonomic groups in duration of bond and degree of male promiscuity (if any). Social systems and displays correlated with formation and maintenance of pairs; complex (see classic work of Lorenz 1951-53) and largely dissimilar in six sub-families (see below). Copulation on water in all species (except some Anserinae and Tadorninae), typically with male grasping female's nape in bill. Vocalizations varied but generally simple (mainly honks, grunts, quacks, coos, and whistles); often different between sexes when linked with anatomical differences in vocal apparatuses (syringeal bullae). Non-vocal sound-signals produced in some species. Calls of downy young are: (1) Contact or Greeting Call (also termed Pleasure and Contentment Call) and (2) Distress Call (see Kear 1968). Comfort-behaviour well known. Bathing frequent and elaborate. Typically performed while swimming in water too deep for standing; involves head-dipping, wing-thrashing, somersaulting, and diving. Followed by oiling (with use of bill and head) and preening. Full description of comfort movements, the behaviour patterns of shaking, stretching, preening, bathing and related activities given by McKinney (1965). The diagrams (Figs 1 to 14) based on those from McKinney illustrate most of these actions, all of which are common to all wildfowl. Some essentially aquatic species (genera *Thalassornis*, *Oxyura* and *Biziura*) have other, slightly specialized, preening and shaking actions peculiar to them because they are performed on water. No elaborate thermoregulatory responses except erection of feathers. Other behavioural characters are: (1) direct head-scratching; (2) resting, often on one leg, with head



Figs 1-14. Comfort movements of Anatidae (based on Grey Teal): (1a-c) Body-shake; (2) Wing-shake; (3a-c) Swimming-shake; (4) Head-shake; (5) Head-flick; (6) Tail-wag; (7) Foot-shake; (8a,b) Wing-shuffle and tail-fan; (9a) Wing-and-leg Stretch; (9b) Both-wing Stretch; (10) Foot-pecking; (11) Bill-cleaning; (12a-e) Head-dipping; (13a,b) Wing-thrashing (14a-f) Somersaulting.



turned back and bill inserted in scapulars on same side as lifted leg (Heinroth & Heinroth 1954), latter being characteristically stowed away in waterproof flank 'pocket'.

Breeding strictly seasonal in boreal, migratory species and populations; less so or opportunistic at warmer latitudes. For most wildfowl, censuses of breeding numbers extremely difficult. Although breeding habitat and nest-sites show considerable diversity, nests usually placed over water or on or near ground. Well hidden in vegetation or sometimes concealed in other dark places such as burrows and tree holes (or nest-boxes); some species also use old nests of other birds or cliff ledges. Often near water but some species may at times nest far away from it. Nests made only of vegetation, or other materials, within reach of sitting bird, using side-building method (see Harrison 1967). In spite of limited scope of this method materials are often collected from large area by repeated movements of this form. Nest usually lined with down plucked from female's belly (often cryptic and grown specially for this purpose). Value of down for insulation and for concealing nest examined for arctic geese by Thompson & Raveling (1988). Eggs, large, immaculate; surfaces greasy. Clutches often large. Regulation of clutch-size in Anatidae has been the subject of much investigation in n. hemisphere (Rohwer 1984, 1988), but has received little attention in s. Proximate (physiological and psychological [Lack 1974]) factors that may regulate clutch-size include availability of food, condition of birds, weather, age or experience of the breeding birds, ability to incubate, and, of the female, to acquire resources for production of eggs, time of breeding, hormonal levels and interactions between two or more of these (Bengston 1971; Johnsgard 1973; Braithwaite 1977; Ankney & MacInnes 1978; Drent & Daan 1980; Duncan 1987; Ankney & Afton 1988; Kingsford 1989; Briggs 1990). Ultimate (evolutionary [Lack 1974]) factors that may regulate clutch-size are availability of food, condition of birds, length of breeding season, weather, predation and viability of eggs, ability to incubate and rear brood, time of breeding, trade-offs between annual reproductive effort and residual reproductive value, and interactions between two or more of these (Williams 1966; Lack 1967; Ryder 1970; Johnsgard 1973; Braithwaite 1977; Pellis & Pellis 1982; Toft *et al.* 1984; Lessells 1986; Arnold *et al.* 1987; Briggs 1990). Both proximate and ultimate factors can act together to influence clutch-size. Eggs laid at intervals of 24 h in most species but longer in some. Clutch covered by down in most species during recess of adult. Some species may lay some or all of their eggs in nests of other anatids; such nest-parasitism may reach significant proportions in some populations, especially of pochards (*Aythya*) and stiff-tails (*Oxyura* and *Stictonetta* but not *Biziura*); only one species (Black-headed Duck *Heteronetta atricapilla*) obligate parasite. In some species, two or more females may lay at same site, at extreme producing 'dump' of eggs without incubating them. Most species single-brooded but many will re-nest if eggs lost. Multiple clutches more common in austral species. Except some species of Anserinae, incubation by female; starts with last egg; so hatching synchronic. No true brood-patches (Skutch 1976). Displaced eggs retrieved if within reach of sitting bird, using bill. Eggshells left in nest. Downy young typically led, but not carried, to water after leaving nest but see SOWLS (1955) and Johnsgard & Kear (1968) for exceptional carrying of eggs, shells and young. Young feed themselves in all species except Musk Duck *Biziura lobata*, but some food provided indirectly in earlier stages by a few Anserinae and Anatinae (Kear 1970). Establish recognition of own species by special imprinting upon parent's calls and image during brief critical period; exceptionally (e.g. during experiments) may become imprinted on wrong species or even inanimate objects (Heinroth 1911; Lorenz 1935; Hess 1957; Boyd & Fabricius 1965; Schutz 1965). Incubation and fledgling periods vary, correlated with latitude at which breeding takes place; shorter in boreal migratory species nesting in high latitudes with short summer season.

Term 'waterfowl' used in North America to describe the group is restricted by 'wildfowl' in English with 'waterfowl' having wider meaning. Further special terminology (Hardy 1952) includes 'cob' and 'pen' to distinguish male from female in swans; male goose and male duck referred to as 'gander' and 'drake' respectively but female in both best called 'hen' to avoid confusion with group names. Young swan is a 'cygnet'; young goose a 'gosling' and young duck 'duckling'. 'Whiffling' is the term used to describe the deliberate loss of height in flight by alternate side-slipping and even rolling onto the back; a practice most characteristically adopted by many geese when descending rapidly. Collective names include 'herd' for flock of swans and 'gaggle' (on the ground) or 'skein' (flying) for geese. Less well known are 'dropping' for shelduck; 'spring' for a flight of teal and 'padding' for duck on water. 'Flapper' is used to describe young wild duck. Some of these terms are elegant but are regrettably falling into disuse.

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Sub-family **ANSERINAE** swans and geese

Largest wildfowl. Tarsi reticulated in front. Twenty-four species in three genera of swans: *Cygnus*; extralimital *Coscoroba* (South America); and *Olor* (tundra swans, Holarctic); most with all-white plumage. *Cygnus* includes: Mute Swan *C. olor* (introduced) and Black Swan *C. atratus* (Aust., introduced NZ) and Black-necked Swan *C. melanocoryphus* (extralimital South America). *Olor* includes four largely allopatric forms of n. Arctic swans. Two main genera of geese: 'grey' geese *Anser* (nine species); 'black' geese *Branta* (five species). Aberrant *Cereopsis* (Cape Barren Goose, Aust.).

Bills of swans and geese, strong; adapted for grazing, especially in more terrestrial geese in which lamellae take form of varying number of horny 'teeth' especially along edges of upper mandible. No iridescent plumage coloration, pied pattern on wing, or contrastingly coloured tertials. Plumages of geese combine mostly grey, brown, or black with white. Especially in *Anser*, neck feathers of geese arranged in vertical furrows. Vocal apparatus in both sexes a simple tympaniform membrane where bronchi join trachea; in some swans trachea convoluted inside sternum. Lores naked in adult *Cygnus* and *Olor*. Bill and feet, usually bright pink or orange-yellow in *Coscoroba* and *Anser*, dark slate or black in *Branta* and bi-coloured in *Cereopsis*; prominent yellow-green cere covering base of bill in *Cereopsis*; in *Cygnus* and *Olor*, bill usually black with orange, yellow or red; feet, dark. Webs between front toes reduced in terrestrial *Cereopsis* and Hawaiian Goose *B. sandvicensis*. During post-breeding moult, male and female of mated pair normally shed flight-feathers and become flightless at different times. In at least some *Cygnus* and *Olor*, male first to moult, followed by female when male flying again or nearly so (Kear 1970). Downy young simply patterned with varying shades of white, grey, olive-yellow or brown. *Cereopsis* shows most striking pattern of downy young.

Largely Holarctic; four species native in s. hemisphere (two in our region). Most prefer cool or cold regions but generally stop short at ice or deep snow. Large aquatic and terrestrial herbivores; no more than marginally marine (except Brent Goose *B. bernicla* notably) and avoid most deep or fast-flowing waters. Many attached to grasslands and other areas of low, non-woody vegetation in high to mid-latitudes, from tundra to steppe, stopping short at deserts and mountains and most avoiding dense tall vegetation. Vigilant and wary; when breeding, favour sites that are inaccessible (islands and cliff ledges) or eminences commanding wide views over open country. Strong fliers. Most boreal swans and geese highly migratory (in w. Palaearctic, *C. olor* partial exception). Moulting restricted to non-breeders (i.e. mainly immatures); breeding males remain with mates and families, moulting during breeding cycle. In *Olor*, non-breeders tend to unite near breeding areas; in *Anser* and *Branta*, move northwards; most Holarctic species to tundra and forest tundra. Normal migration often at high altitudes, day and night; traditional halting places used on way (Hochbaum 1955).

Essentially vegetarian, feeding in shallow water and on land, mainly on grasses (including grain in some species) and aquatic and marsh plants. *Cygnus* and *Olor* mainly underwater grazers, neck-dipping and up-ending with frequent foot-paddling (*O. cygnus*); will also graze on land. *Anser*, *Branta* and *Cereopsis* mainly specialized terrestrial grazers while walking, also probing and digging, sometimes in soft mud; will also feed in water by up-ending, etc. Except *C. olor* partly, often highly gregarious at all times when not breeding, typically in flocks composed of pairs and family parties. Pre-flight signals largely **Bill-lifting** (*C. olor*, *C. atratus*), **Head-bobbing** (*Olor*), lateral **Head-shaking** (*Anser*), or **Head-tossing** (some *Branta*); usually reinforced by vociferous calls. When breeding, often loosely colonial (at times with small territories) at protective sites, especially in *Anser* and *Branta*; *Cereopsis* typically on coastal islands. *Cygnus* and *Olor* mostly with well-dispersed nests (in large territories), though *C. atratus* often, and *C. olor* sometimes, colonial. Strong, strictly monogamous long-term pair-bonds, of indefinite duration. Also strong family bonds, between parents and young, and between siblings. No communal courtship. Most important display in formation and maintenance of pair-bond, mutual **Triumph Ceremony** usually with characteristic calls; especially in geese, often initiated by male after attack on rival. Also performed at times by members of same family group. Unlike most Anatinae, little ritualization of comfort-behaviour especially in heterosexual situations though some movements (e.g. **Body-shake**, **Wing-flap**) used in threat by some species. Copulation typically while swimming on water except in *Coscoroba* (in shallows) and *B. sandvicensis*, *Cereopsis* (on land). Pre-copulatory display consists of mutual **Head-dipping**, female eventually assuming **Prone-posture**. In mutual post-copulatory display, pair rise in water to greater or lesser extent in most species; posture and movements varying in *Cygnus* and *Olor*, similar in all *Anser* and *Branta*, ended by bathing and wing-flapping. Elaborate nest-relief ceremony claimed in *C. atratus*; needs confirming. Though varying degrees of reliance on visual displays, vocalizations generally play key role in most species for individual recognition and cohesion of flock. Voice considerably reduced in *C. olor*; used generally at close quarters and not for example for territorial advertisement as in *Olor* and some other *Cygnus*; far-carrying, non-vocal throbbing sound from wings replace flight-calls of others. Voice loud but rather unspecialized in rest; quite powerful, sonorous, and often musical in *Olor* (in which sometimes used in duet), and honking in *Coscoroba*, *Cereopsis*, *Anser*, and



*Branta*. Apparent greater noisiness of last two genera in part related to almost continuous vocal activity of larger, close-knit flocks outside breeding season; but vocabulary of calls also larger than in *Cygnus* and *Olor*, especially in *Anser*. Calls closely similar in both sexes, though sometimes differ in pitch. In addition to usual calls of most Anatidae, downy young also have distinctive **Sleepy-calls**, given when nestling down before sleeping, also at times while feeding (Kear 1970). When threatened at close quarters, all species hiss freely. Comfort-behaviour and other behavioural characters much as in other anatidae, but bathing often spectacular with somersaulting and kick-diving.

Seasonal breeding in most; in Arctic species, highly synchronized laying periods. Nests on ground in open or in vegetation, usually near water but can be distant. Lined with down, though considerably less in *Cygnus* and *Olor* than in *Anser* and *Branta* (and most other Anatidae). Built by both sexes in *Cygnus* and *Olor* though female does larger share. Eggs white, creamy white, or pale green; smooth or with chalky covering. Clutches usually 4-7 (1-14); smaller in high-latitude forms, which do not lay replacements. Sometimes multi-brooded in *C. atratus*. Eggs laid at intervals of 1-2 days. Incubation by both sexes in *C. atratus*; in others, male may cover eggs only during laying or recess of female. Male often mounts guard at various distances from nest, especially in *Anser* and *Branta*. Incubation periods 29-36 days (swans), 24-30 days (geese) (Kear 1970). Downy young tended by both parents, but brooded only by female. In *Cygnus* and *Olor*, adults indirectly provide some food in early stages (plucking underwater vegetation and foot-paddling), young taking it from surface; in all *Cygnus* small young also habitually carried on back. Brood aggressively defended from predators; deferment of wing moult by one of pair in most or all species (see above) ensures that one parent always able to protect young. Fledging periods relatively short in high arctic breeders, long in temperate species. Distraction-display by both sexes, in form of 'injury-feigning' or 'injury-flight' also recorded in some *Anser* and *Branta* and in *Cereopsis*, but apparently lacking in *Cygnus* and *Olor* (see Hebard 1960). Young stay with parents after fledging at least through first autumn, in most through first winter, and into spring migration in some, at least in n. species; may reunite with them at end of one or more subsequent breeding seasons. Mature at 2-3 years.

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## *Cereopsis novaehollandiae* Cape Barren Goose

COLOUR PLATE FACING PAGE 1197

*Cereopsis N. Hollandiae* Latham, 1807, *Index orn. Suppl.*: 67 — New South Wales = islands of Bass Strait, *apud* Mathews, 1927, *Syst. Av. Austr.*

The generic name is compounded of the Greek κηρός (wax) and ὄψις (appearance or look of) and so 'wax like'.

OTHER ENGLISH NAMES Pig or Pigeon Goose, *Cereopsis*.

### MONOTYPIC

**FIELD IDENTIFICATION** Length 75–91 cm, body about two-thirds of total; wingspan 137–162 cm; weight 4–6 kg. Large, long-legged, goose-like bird with small head and large green-yellow cere. Sexes alike; female slightly smaller and distinguishable by voice. Immature like adult but legs and cere, paler. No marked seasonal differences.

**DESCRIPTION** **ADULT.** Crown, white; rest of head and upper neck, pale grey; lower neck and back, ash-grey; short scapulars with broad dark-grey subterminal bar, long scapulars with dark-grey oval spots; wing-coverts marked like scapulars; primaries, grey with terminal half black; secondaries, grey with black tips; tail and upper tail-coverts, black. Underparts, grey. Bill, black, mostly covered by green-yellow cere. Iris, hazel-brown. Legs, pale pink to deep carmine; feet, black, black may extend up legs varying distance. Birds from

Recherche Arch., WA, differ in white crown extending to top of eye; body-plumage, browner; legs, darker. **DOWNY YOUNG.** Top of head, back of neck and upperparts, black with broad white stripe on each side of back; face white with broad black stripe through eye; wing black-brown with pale grey leading-edge. Underparts light grey. Iris and bill, black; cere, green-grey; legs and feet grey-green. **IMMATURE.** Like adult but legs and cere, paler.

**SIMILAR SPECIES** None; unmistakable on ground and in air.

Adults seen in pairs, immatures in large flocks in open grasslands, tussocks or among rock and low scrub on islands and adjacent mainland coasts of s. Aust. On land, walk with rolling gait; fast over short distances; wary, hard to approach; graze on natural and improved grasslands. Will enter water



when pursued, then swim and dive strongly. In flight, head outstretched; wings broad with dark trailing edge; beats regular, strong, interspersed with glides; may form skeins or fly in unstructured flock. Vocal in flight, generally silent on ground unless alarmed; both sexes have low-pitched honking, males also have high-pitched multi-syllabic honk or trumpet.

**HABITAT** Grasslands and terrestrial wetlands on s. offshore islands and adjacent mainland. Mainly terrestrial, grazing on short green herbage including grass, pasture, cereal and other crops, but occasionally entering water to graze on edges of wetlands or seashore. Breed on offshore islands; in Bass Str. and SA young birds move to large islands and mainland in summer (Aust. Atlas).

Breeding islands usually small and low-lying; vegetation dense enough to provide nest cover without restricting movement or visibility; feeding areas of short green grass near nests. Low lying granite islands favoured in Bass Str.; in SA, and probably elsewhere, low limestone islands favoured; usually substantial cover of soil or sand supporting open shrubland or grassland <1 m tall (e.g. *Poa*, *Stipa*, *Atriplex*, *Rhagodia*, *Muehlenbeckia*) and ground-cover of herbs and grasses (e.g. *Hordeum*, *Lolium*, *Rumex*, *Cirsium*, *Erodium*). Birds rarely nest in dense scrub (Guiler 1967). High granite islands avoided; shrubland develops only over pockets of deep soil and is often too tall and dense for nesting, and large areas of bare rock cannot support herbfields for feeding (Guiler 1967; Robinson *et al.* 1982).

Young birds spend summer on large islands and mainland, where congregate on grasslands and pasture; short green grass of highest nitrogen content and greatest digestibility preferred, leading to concentration on irrigated fields, fertilized pasture and wetland edges. Particularly select pastures that are flat, not partitioned by shelter belts or hedges, near safe roost, and away from disturbance. Provided short grass present, birds not deterred by presence of taller plants (eg reeds, tussock, bracken) (Dorward *et al.* 1980; Eberhard & Pearse 1981; Robinson *et al.* 1982). Occasionally feed on intertidal mudflats (Smith 1954).

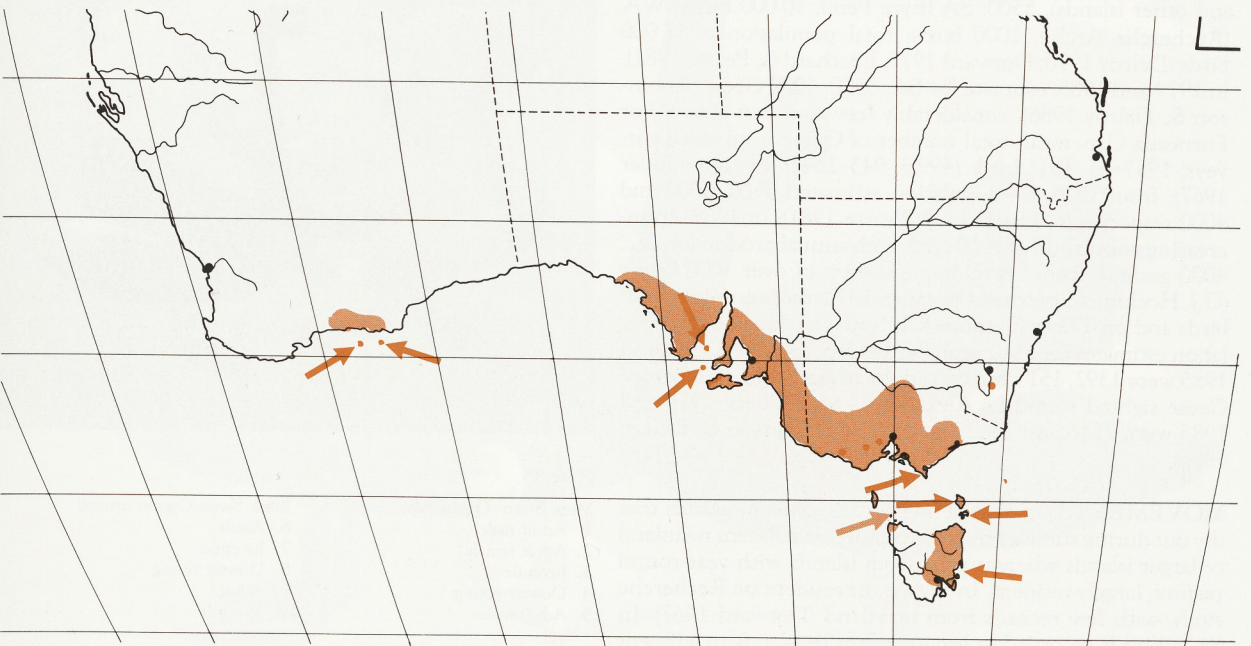
Birds introduced to SI, NZ; population persisted for about 30 years round lakes in open pastoral land and tussock grassland resembling habitat used in Aust.; records in atypical habitat (e.g. lakes in mountain forests) probably vagrants (Williams 1968).

Roost in sheltered parts of feeding areas, and on beaches, mudflats, lake edges, sandbars and islets in wetlands, and offshore islands (Robinson *et al.* 1982). Records from saltmarshes (Corrick 1982) may refer to roosting birds. Fly at low to moderate heights. Rarely swim or dive, except when pursued.

Favourable habitats created by agriculture have ensured recovery of population since uncontrolled persecution ceased. On breeding islands, clearing, grazing and establishment of improved pasture has increased suitable habitat by maintaining open shrubland and short-cropped grass. Management, perhaps limited grazing, may be necessary on breeding islands designated as nature reserves (Eberhard & Pearse 1981); some islands where grazing eliminated have reverted to dense scrubland, e.g. Goose I., Furneaux Group (G.S. Hocking), and recent over-wintering on mainland may indicate decline in breeding habitat (Delroy *et al.* 1989). However, extensive modification for agriculture displaces breeding populations by removing nesting cover and allowing establishment of unpalatable weeds (Eberhard & Pearse 1981; Robinson *et al.* 1982). Irrigated and fertilized pastures and crops favoured feeding areas on over-summering grounds, where birds formerly limited to edges of wetlands; dams and troughs used for drinking (Robinson *et al.* 1982). Continuing debate about amount of damage to pastures and crops where birds congregate to feed and drink (Marriott 1973; Dorward *et al.* 1980; Eberhard & Pearse 1981).

**DISTRIBUTION AND POPULATION** Endemic to s. Aust.; vagrant to NZ (where once introduced). An unconfirmed report of Cape Barren Geese having been seen in Tierra del Fuego (D.F. Dorward, in Williams 1968).

**AUST.** Islands and coastal areas of s. Aust., vagrant farther N. NSW. Vagrant to SW 1955–56, 1966, 1973, also





feral colony at Tidbinbilla, ACT (Hobbs 1961; Morris *et al.* 1981; NSW Bird Rep. 1973; Aust. Atlas) Vic. Islands off Wilson's Prom., including Great Glennie, Anser and Kanowna Is, and since 1950 recorded as visitor to adjacent mainland; visitor to SW, partly from SA, but also introduced birds breeding at or near release site at Tower Hill State Game Reserve (SGR), near Warrnambool; also vagrant to N (Wheeler 1967; Dorward *et al.* 1980; Vic. Atlas). Breeding on mainland following releases (Aust. Atlas), but in places where occur naturally, wild birds may have joined colonies eg in Colac region, Vic., recent nesting on grassy islands in brackish lake (P. du Guesclin). Tas. Islands of Furneaux Grp including Mt Chappell, Badger, Big Green, East Kangaroo and Vansittart Is, visiting n. Tas.; introduced Three Hummock I., 1968; now also other islands of Hunter Grp, source of most vagrants to King I.; also introduced to Maria I., 1968–70; occasional visitor to e. and central Tas. (Green & McGarvie 1971; Green 1977; Eberhard & Pearse 1981; Aust. Atlas; G.J. Hocking). SA. Islands off Eyre Pen., including Sir Joseph Banks Grp, Investigator Grp and Nuyts Arch.; introduced Kangaroo I. 1920s–30s now resident and most birds sedentary; also visitor to coastal and subcoastal areas from Eyre Pen. eastwards to Murray R. area (Robinson *et al.* 1982; Parker *et al.* 1985). WA. Formerly islands off Albany, E to Recherche Arch.; now rare or absent on islands W of Recherche Arch., visitor to adjacent coastal areas; vagrant to Nullarbor Plain; also Busselton, 1942 and Narrikup, 1952, (Serventy & Whittell 1976; Dorward 1977; Lane 1982; Storr 1987; Aust. Atlas).

NZ Small numbers introduced in 1915 on L. Hawea and L. Wanaka, central Otago, SI, where subsequently reported in 1936; also L. Thomson in 1934, but gone by late 1940s; other SI records from L. Maree and L. Hankinson in 1947, Ahuriri River, 1966, and Sutherland Sound, Fiordland, 1967, suggest either remnant population surviving or genuine vagrants from Aust. Latter possibility may apply to 1960s records, although long-distance vagrancy unusual for this goose (Williams 1968; Falla *et al.* 1981; Long 1981).

POPULATION Estimates in major population centres: Vic. (Wilson's Prom.), 500 birds; Tas. (Furneaux Grp and other islands), 5500; SA (Eyre Pen.), 10 000 birds; WA (Recherche Arch.), 1000 birds; total population c. 17 000 birds (Delroy 1976; Dorward 1977; Eberhard & Pearse 1981); in 1979 and 1985, estimate for SA, 3500–4000 Geese (Robinson & Delroy 1986), considerably less than that above. For Furneaux Grp, mean total number of Geese from aerial surveys, 1957–65: 1611 birds (499.3; 943–2642; 9 years) (Guiler 1967); from 1976–78, population estimated 5500, 5000 and 4000 respectively (Eberhard & Pearse 1981); in 1988, an increasing population of 9000 birds with annual production of c. 4000 goslings from breeding population of over 3000 Geese (G.J. Hocking). Elsewhere, population Maria I., estimated 160 birds and on Three Hummock I., 150 (G.J. Hocking). Population estimates for Sir Joseph Banks Grp, SA, 1974, 1979 and 1985 were 1392, 1513 and 663 adults respectively; numbers of Geese sighted round Ls Alexandrina and Albert, 1979 and 1985 were 2246 and 2542 respectively (Robinson & Delroy 1986).

MOVEMENTS Partial migrant. Birds from islands that dry out during summer move to pasture on adjacent mainland or larger islands whereas pairs from islands with year-round pasture, largely resident. In WA, most resident on Recherche Arch. with few records from mainland (Dorward 1967). In SA, all birds recorded as leaving offshore islands to adjacent

mainland areas near L. Alexandrina, L. Albert and Eyre Pen. with small numbers recorded in w. Vic., 670 km ESE (Robinson *et al.* 1982; Delroy *et al.* 1989) although birds nesting Kangaroo I. probably disperse to wetland areas on that island (Delroy *et al.* 1989). In Vic., Geese from islands off Wilson's Prom. visit pastures near Yanakie during summer (Marriott 1970), others, like those introduced to Tower Hill SGR, resident (Vic. Atlas). Some pairs also resident in Furneaux Grp, Tas., but also widespread movement of banded birds late-Nov. from offshore islands to Flinders I., some also flying to ne. Tas., Jan.–Feb. (G.J. Hocking; E.R. Guiler) but apparently none to Vic. (Dorward 1967; G.J. Hocking). Capable of long-distance movement with one, banded SA, recovered Wilson's Prom., Vic. (Dorward 1977).

FOOD Mostly green herbage including pasture grasses and legumes. BEHAVIOUR. Graze using tip of bill and backward pulling motion of head to shear off herbage. Most of daylight hours spent feeding; 12 h in summer, 6–7 h winter (Marriott & Forbes 1970).

ADULT On Bass Str. islands and adjacent mainland (Marriott 1970) diet varies with availability: on exotic pasture



Plate 85

Mute Swan *Cygnus olor*

1. Adult male
2. Adult female
3. Juvenile
4. Downy young
5. Adult male

Black Swan *Cygnus atratus*

6. Adult
7. Juvenile
8. Downy young
9. Adult
10. Juvenile



on Big Green I., Furneaux Grp, Tas., during breeding season, Apr.–Oct., grass 60–70% of diet (*Bromus*, *Hordeum leporinum*, *Lolium perenne*, *Vulpia bromoides*) with remainder dicots (particularly Geraniaceae *Geranium pilosum*, Plantaginaceae *Plantago coronopus*, Asteraceae *Arctotheca calendula*). The same dicots main component of diet on same island during non-breeding season, Dec.–Mar. while grass not available. On less modified islands off Wilson's Prom., Aizoaceae *Disphyma australe* the major food. During summer on mainland, grasses remain important: on improved pasture near Wilson's Promontory principal components of diet Fabaceae *Trifolium* and Poaceae *Hordeum lanatus* and *L. perenne* with smaller amounts of *P. coronopus* and Asteraceae *Leontodon nudicaulis*. During summer in SA, cereal crops of wheat and barley important (Robinson *et al.* 1982). On unmodified islands of Furneaux Grp during breeding season native Poaceae *Danthonia racemosa*, *Poa poiformis* and *Stipa teretifolia* together with exotic *Avena*, *Hordeum* and *L. perenne* about 65% vol., Juncaceae *Juncus* 20% freq., the remainder being dicot leaves and seeds (Frith 1982). Also recorded: Myoporaceae *Myoporum insulare* seed (Recherche Arch.; Boden 1980); Zygophyllaceae *Nitraria schoberi* (off Eyre Pen.; Finlayson 1938); algae

*Homosira banksii* (Furneaux Grp; Guiler 1967).

**INTAKE** Has simple digestive system with little breakdown of fibre, a rapid rate of food passage (mean retention time 1.3 h) and low digestion efficiency (c. 25% lucerne chaff: organic matter 27.8, crude protein 76.4, soluble carbohydrate 56.6, fibre 0.8, ether extract 26.3) (Marriott 1970). Captive geese fed lucerne chaff had mean dry matter intake of 322 g/day (73.5; 8), equivalent to 2200 g pasture (Marriott 1970; Marriott & Forbes 1970). Free-ranging geese on Maria I. consumed 210–430 g/day (Prescott 1982). Choose sward with high quality food, low in fibre content and high in nitrogen (3 g N/100 g dry matter; Marriott 1970). Well-developed salt-excreting glands allow it to subsist in areas without fresh water.

**SOCIAL ORGANIZATION** Studied in several wild populations including those on Big Green I., Furneaux Grp, Tas., (Marriott 1970; Prescott 1982; G.J. Hocking & E.R. Guiler) and Maria I., Tas. (Prescott 1982); captive populations studied by Weatherley (1971) and Pellis & Pellis (1982). Gregarious, except when nesting; in flocks made up of families, pairs and non-breeding adults. Flocks may consist of up to several hundred geese within which there is an apparent stable dominance hierarchy (Prescott 1982).

**BONDS** Sustained monogamous; pair-bonds lifelong; Weatherley (1971) observed only three changes in 80 pair-years. One to one sex ratio. Age at pair-formation, 12 months (Weatherley 1971) to 24 months (G.J. Hocking & E.R. Guiler). Age at first breeding, 36 months but occasionally at 24 months. Female incubates while male guards nest, but both parents tend young, mainly providing protection from predators (Pellis & Pellis 1982). However, goslings show considerable attraction to one another, often joining other broods rather than parents. Fledgelings observed to form large crèches by amalgamation of many broods (Guiler 1967). Young join itinerant flocks soon after fledging.

**BREEDING DISPERSION** Nesting, solitary. **TERRITORY.** All-purpose in which reproductive activities (courtship, copulation, nesting and rearing of brood) and self-maintenance activities carried out. Prescott (1982) considered territory to function mainly in providing feeding area for parents and young, and to protect pair from harassment and cuckoldry. Mean size of territory on Big Green I. was 3364 m<sup>2</sup> (186; 17); on poorer pasture on Maria I., 5237 m<sup>2</sup> (331; 31) (Prescott 1982).

**ROOSTING** Breeding pairs roost within territory, often in protected sites, eg. on leeward side of shrubs and tussocks; incubating female spends most of night on nest. Non-breeding Geese gregarious and roost on beaches and mudflats in peripheral areas of colony. Marriott (1970) noted Geese departing from feeding grounds to roost 30 min after sunset and returning 30 min after dawn.

**SOCIAL BEHAVIOUR** Based mainly on observations of captive birds (Weatherley 1971; Veselovsky 1970, 1973) and supported by studies of wild population (Prescott 1982). Behaviour similar to that of anserine geese, having well marked Triumph Ceremony and threat displays (Johnsgard 1965).

**AGONISTIC BEHAVIOUR** **INDIVIDUAL DISTANCE.** Individuals in flocks spend most of time feeding; agonistic interactions frequent, apparently associated with individual spacing and position in hierarchy. Territorial pairs aggressive much of time for defence of territory and young.

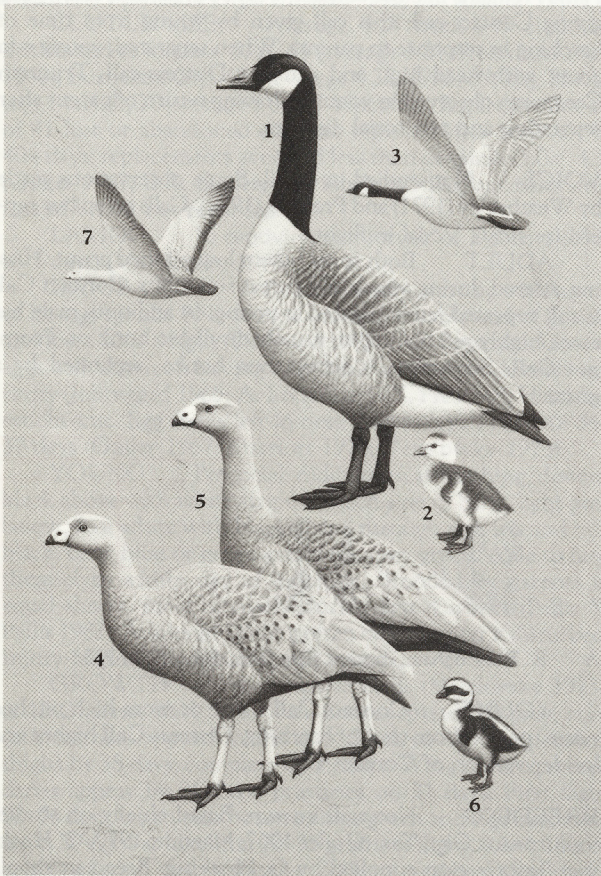


Plate 86

- |                                       |  |
|---------------------------------------|--|
| Canada Goose <i>Branta canadensis</i> | Cape Barren Goose <i>Cereopsis novaehollandiae</i> |
| 1. Adult, subspecies <i>moffitti</i>  | 4. Adult, e. Aust. birds                           |
| 2. Downy young                        | 5. Adult, WA birds                                 |
| 3. Adult                              | 6. Downy young                                     |
|                                       | 7. Adult, e. Aust birds                            |



Varies in frequency through breeding cycle with peaks occurring in early pre-laying, incubation and post-hatching periods (Prescott 1982). Agonistic displays performed mainly by male. Pairs generally vigilant with head held upright often with lateral scanning movements. Encounters at territorial boundaries usually consist of parallel-walking or facing-off, but occasionally may intensify to **THREAT DISPLAY** (Fig. 1), in which neck arched with feathers ruffled, head lowered, folded wings raised, calling throughout. When Threat Display is followed by **Attack** (Fig. 2), attacker walks or runs with neck-feathers ruffled or flies in direction of opponent, often with calls; may result in avoidance by walking or running, often with wings raised, or flying away from attacker. Alternatively, **FIGHTING** involving physical contact, using neck, bill, feet and wings (especially the bony knobs of metacarpals). Followed by

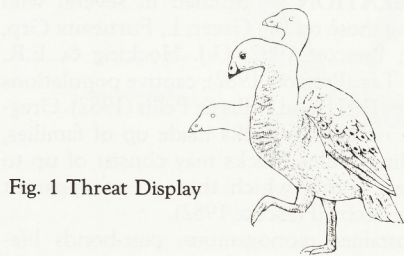
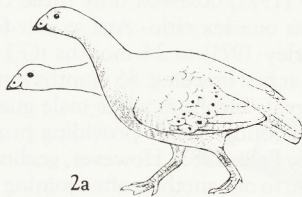
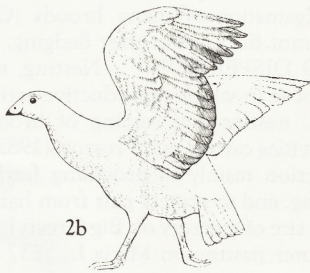


Fig. 1 Threat Display



2a



2b

Fig. 2 Attack

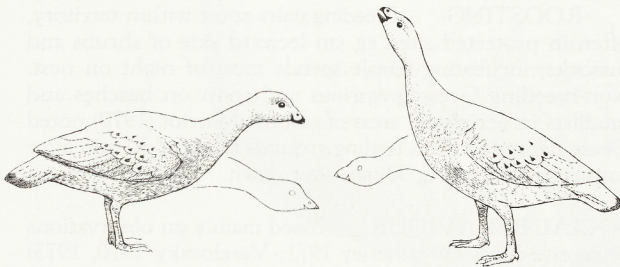


Fig. 3 Triumph Ceremony

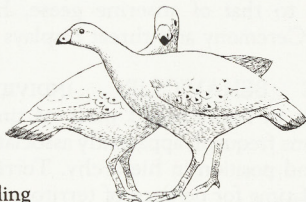


Fig. 4 Nuzzling

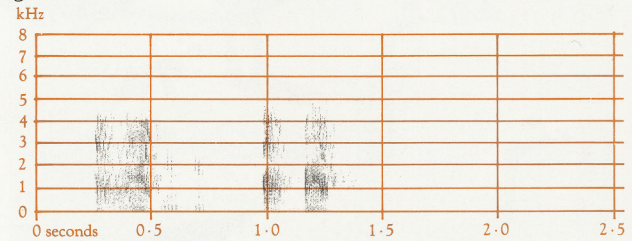
**TRIUMPH CEREMONY** (Fig. 3) in which both birds turn and face each other with necks outstretched and tail feathers spread; heads raised and lowered while Triumph-call uttered.

**SEXUAL BEHAVIOUR PAIR-FORMATION.** Initiated by male or female and begins with **Waltzing** in which one or both members of pair walk round each other slowly, holding lateral posture, and slowly bowing heads. May be followed by **Griffin Display** in which one or both face mate, stand upright, hold neck high with head down, flap their wings and make hissing call. Terminates with Triumph Ceremony. **COPULATION.** On ground, probably not on water as is usual in waterfowl (P.J. Fullagar). Most often observed during early incubation period, but persists into post-hatching period. Initiated by mutual or unilateral nuzzling (Fig. 4) of lower back of partner. Nuzzled individual avoids and turns, and pair rotate. Female may then squat after which male may mount and begin treading. Copulation is of short duration and followed by Triumph Ceremony.

**RELATIONS WITHIN FAMILY GROUP** Female broods young while male defends family group against predators and trespassing Geese. Young stay close together and when disturbed may join other goslings rather than parents. Family remains in close contact, with both parents and young giving Contact-call; this call given by young from time of hatching in response to parents. When separated, young run about with head high and uttering Distress-call. Triumph Ceremony observed in young following return of parent after separation and territorial disputes.

**VOICE** Not studied in detail. Some observations made by Weatherley (1971) and Prescott (1982). Calls often but repertoire small. Vocal in flight.

**ADULT** Both sexes have a low pitched grunt. Hissing uttered during attack and threat situations. **Contact Call** is soft repeated honk directed at young. In addition, male has more highly pitched rapid, usually disyllabic honk or **Trumpet Call**. Sonagram A shows two honks, separated by a grunt.

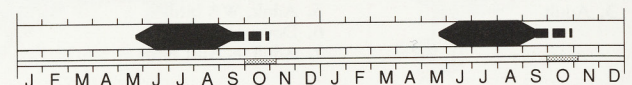


A R. Buckingham; captive, Lara, Vic., June 1982; P35

**YOUNG** **Contact Call** is one or more high pitched notes uttered from time of hatching. **Distress Call** higher and louder version of Contact Call.

**BREEDING** Not well known. Based chiefly on studies in Furneaux Grp, Tas. (Guiler 1967; Marriott 1970; G. Hocking). Information supplied by G. Hocking. Breed in simple pairs, solitarily, territorially.

**SEASON** In winter; determined ultimately by length of daylight (Kear & Murton 1973); influenced by rainfall and availability of food (Guiler 1967; Marriott 1970).





Laying from late May to Aug., occasionally to Oct.-Nov.; young, early July to early Nov., also in late Dec. (Recherche Arch., WA; Lane 1982).

**SITE** On or near ground in tussock grass, also among rocks and low bushes. Typically on rocky prominence on windward (W) side of island. Sites usually used year after year. On Big Green I., Furneaux Grp, 1982-89, 70% of 995 sites within 150 m of windward shore, along boundary between tussock grass and pasture (G.J. Hocking).

**NEST, MATERIALS** Hollow built up with any available plant material (grasses *Poa*, *Stipa*, twigs, nettles), lined with down; averages 35 cm across, 10 cm outside height, 8.8 cm inside depth (n=25; Guiler 1967). Built by male; lined and maintained by female (A. Lonsdale; W.S. Prescott). Disturbance may lead to one nest being abandoned and replaced by another (Guiler 1967). Two captive birds built nests in 17 and 47 days (A. Lonsdale).

**EGGS** Elliptical; coarse grained, smooth with chalky bloom; creamy white, becoming stained and shiny. **MEASUREMENTS:** Furneaux Grp: 82.9 (72.5-91.8; 123) x 55.6 (44.2-59.3) (Guiler 1967). Maria I., Tas.: 80.9 (5.3; 100) x 54.6 (5.5) (feral population; G.J. Hocking)

**WEIGHTS:** Furneaux Grp: 127 (107-142; 50) (Guiler 1967).

**CLUTCH-SIZE** Average 4.24 from 947 clutches, distributed as follows: SA, 264 (average 3.81; Robinson *et al.* 1982); Furneaux Grp, 663 (average 4.38; 1982-89; G.J. Hocking); Maria I., 20 (average 5.0; G.J. Hocking). Replacements: 19 of 41 lost or abandoned clutches replaced after intervals of 40+ days; replacements averaged less than originals (3.0 v. 4.3) (Guiler 1967; E.R. Guiler; G.J. Hocking). Replacement after loss of brood not recorded.

**LAYING** In captivity, at intervals of 1-2 days (14 h to 3 days) (Veselovsky 1973).

**INCUBATION** By female only, starting with laying of 1st egg; spends 70% of time on nest towards end of period and loses 20% weight (Dorward 1977; N.S. Prescott). Covers eggs with down on leaving nest. Male meanwhile defends territory (Johnsgard 1965; A. Lonsdale; N.S. Prescott). Hatching synchronic. Egg shells left in nest. **INCUBATION PERIOD:** 34-37 days (Guiler 1967; Marriott 1970; Veselovsky 1973).

**YOUNG** Precocial, nidifugous; at hatching, downy, black above with white stripe on each side of back, light grey below, face white with black stripe through eye; iris and bill, black; cere, blue or green grey; legs, grey green. Able to feed themselves within day of hatching. Brooded by parents in equal shares, most intensely during first 4 weeks (Pellis & Pellis 1982). Adults and young often take to water if disturbed. Injury-feigning by females with broods.

**GROWTH** From captive birds (Veselovsky 1973); at 15-27 days, black and white down replaced by grey; contour feathers appear on flanks c. 24 days; on back, crown, thighs by 38 days; complete by 59 days. Wing coverts, secondaries appear by 31 days; primaries on 31 days. First flight 70-76 days, when cere becomes lime green and legs becoming pink. Weight at hatching 70-95 g; at first flight, 3.6-4.5 kg or c. 80% of adult weight (Guiler 1967; in captivity, Veselovsky 1973). Growth not complete till 2-3 years old (Guiler 1974; G.J. Hocking). **FLEDGING PERIOD:** hatching to first flight, 70-76 days. Goslings remain with parents for 16+ weeks. (A. Lonsdale).

**SUCCESS** At Furneaux Grp, 1982-89, of 1454 eggs (332 clutches), 89% hatched; over same period, of 4190 eggs, 54% fledged (G.J. Hocking). **PREDATORS.** Forest Ravens *Corvus tasmanicus*, Pacific Gulls *Larus pacificus*, various raptors,

feral cats *Felis catus* and man destroy eggs and goslings. Climate, by influencing growth of pasture, and onset of dry summer conditions critical for survival of young (Marriott 1970; Robinson *et al.* 1982; G.J. Hocking).

## PLUMAGES

**ADULT** Definitive, basic. Attained in first year; age of first breeding, 2-3 years old (Guiler 1967; G.J. Hocking). **HEAD AND NECK**, mostly grey (c84), fading slightly browner (c80) with wear; becomes pale brown (119D) to creamish (c54) with extreme wear. Forehead, crown and nape white, forming cap usually separated from eye by line about as wide as eye; occasionally narrow white line runs from eye to forehead. **UPPERPARTS.** Rump and upper tail-coverts, black (89). Rest has light grey (c85) ground colour, fading to brownish grey (c80) with wear, to pale brown (c119D) with extreme wear. Mantle feathers and shorter scapulars have dark brownish-grey smudge at end. Towards rump this smudge becomes darker, smaller and more sharply defined; longest scapulars and feathers of lower back have small grey-black (c82) spot near end, less than half feather width. On most of back and scapulars, spot dark grey (c83) to grey-black (82), often lightest in centre; extends almost right across feather. **TAIL**, black (89). **UPPERWING.** Coverts and alula, light grey (85), becoming browner (as neck) with wear; rachis, black-brown (c19) grading to brown (23) at base. Median coverts, and lower rows of lesser coverts have small grey-black (82) spot at tip, less than half width of feather. Remiges, light grey (85) at base, with sharp transition to grey-black (c82) ends; distal quarter of secondaries and p1 blackish. Black ends of primaries more extensive outwards; distal five-eighths of outer primaries and outer web of p10 blackish. Rachis of remiges, brown (119B) at base, dark brown (c119A) at ends. Remiges have narrow light-grey (85) tips, lost with wear. **UNDERPARTS.** Vent and under tail-coverts, black (89). Axillaries, light grey (brownish 85). Rest, grey (c84 to light 83), becoming slightly browner (c80) with wear, creamish (c54) with extreme wear. When fresh, feathers grey (c84 to light 83) merging to pale greyish (c80) bases. **UNDERWING.** Remiges as above; coverts, pale grey (c86) with grey-black (c82) shafts. Median coverts have small white central tips; marginal and uppermost lesser coverts have small brownish grey spots at tip, giving speckled appearance.

**DOWNY YOUNG** **HEAD AND NECK.** Crown stripe, nape and hindneck, dark brown (121). Broad dark-brown (21) stripe runs through and below eye from ear-coverts to base of upper mandible. Rest of head and throat, white, grading to grey-white (c86) foreneck. **UPPERPARTS**, black-brown (19) to dark brown (21). Two broad white stripes run from sides of upper tail-coverts to sides of upper back, where they meet underparts just behind base of wing-pad. **UNDERPARTS**, grey-white (c86), with dark brown (c21) flanks, and whitish belly. Wing-pad, dark brown (21) above, save for small white patch on leading edge, outside carpal joint. Underside, dark brown (21) with white tip, and two white stripes of varying width along leading-edge and inside trailing-edge.

**JUVENILE** Similar to adult, although recently fledged birds, paler grey with notched tail feathers (G.J. Hocking).

**BARE PARTS** Based on live birds (Melbourne Zoo, Vic., and Flinders I., Tas.), and photographs (including NZRD, Aust. RD, and Pringle [1985]).

**ADULT** Iris has fine red (12) and pale brown (119D) mottling; except on close examination, appears orange-red.



Cere, yellow-green (58 to yellowish 61) with black (89) circular rim to nostrils. Bill, black (89). Legs, pink (3) to pinkish red (13), with black (89) feet and lower half to front edge of tarsus; in two specimens from SA, black mottling on front of tarsus reached to c. 1 cm of tibiotarsal joint (ANWC); sometimes black scales on side of tarsus.

**DOWNY YOUNG** Iris, black-brown (119). Bill, grey-black (82). Legs and feet, dark grey-brown.

**JUVENILE** Similar to adult; younger birds said to have paler legs and cere (G.J. Hocking).

**MOULTS** From Guiler (1967) except where stated.

**ADULT POST-BREEDING** Pre-basic. Complete, primaries simultaneous. Most birds moult in Oct., but this depends on date of breeding. Non-breeders moult at about same time; these possibly include juveniles.

**POST-JUVENILE** Body feathers moulted at c. 6 months; remiges and rectrices retained until second year (Blaauw 1904). Juvenile collected in Jan. (MV) was in heavy body moult.

**MEASUREMENTS** (1) Adult skins (MV). (2) Adult males; bill includes cere; wing technique unknown (Frith 1982). (3) Adult skins (ANWC). (4) Adult skins (HLW) from sw. Aust.

		MALES	FEMALES
WING	(1)	—	441
	(2)	450-590; 14	—
	(3)	—	442
	(4)	500	460
8TH P	(1)	—	287
	(3)	—	295
	(4)	329	293
TAIL	(1)	—	135, 169
	(3)	—	161
	(4)	169	155
	BILL	(1)	—
BILL	(2)	48-53; 14	—
	(3)	—	41.6
	(4)	45.7	43.8
	TARSUS	(1)	—
TARSUS	(2)	111.2	106.1
	(3)	—	82.9
	TOE	(1)	—
TOE	(3)	—	86.6
	(2)	91.9	87.6

**WEIGHTS** Furneaux Grp; all in kg.

**ADULTS** In 14 males collected in Apr. 1965 open season, 3.7-5.1 kg (Frith 1982). Moulting adults 4.88 (0.834; 2.26-7.25; 372; calculated from Fig. 1 in Guiler 1967). Moulting adults on 17 Oct., 5.60 (n=100; Guiler 1967).

**JUVENILES** Collected Oct.: 3.70 (0.726; 1.81-6.58; 234; calculated from Fig. 1 in Guiler 1967); 3.56 (0.563; 264; G.J. Hocking).

**STRUCTURE** Wing, long, rather broad. Eleven primaries, p9 or p8 longest, p10 3-21, p9 0-1, p8 0-5, p7 1-8, p6 26-34, p5 60-70, p4 92-102, p3 117-132, p2 137-156, p1 154-180; p11 minute. Outer webs of p9-p6 emarginated, of p5 slightly emarginated; inner webs of p10-p9 emarginated, of p8

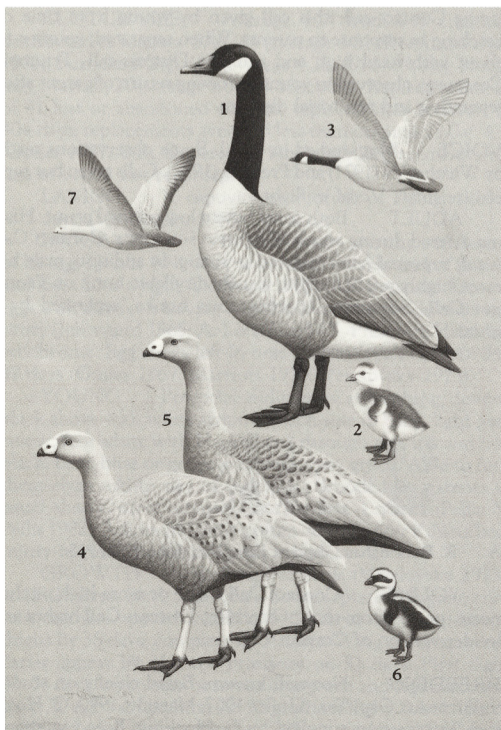
slightly emarginated. Tail, rounded; 14 feathers, t1-t7 c. 25. Long necked. Bill, short. Large fleshy cere runs from forehead to base of broad nail of bill; lower mandible has about ten serrations on tomlia and sides. Tarsus scaling reticulate; tibiotarsal joint bare, tibia feathered. Feet webbed; middle toe longest, outer c. 85%, inner c. 78%, hind c. 31%.

**GEOGRAPHICAL VARIATION** Birds from Recherche Arch., WA, recently described by Storr (1980) as subspecies *grisea*: white cap, broader, extending to top of eye; blackish leading edge of tarsus extends from foot to tibiotarsal joint; also said to be heavier (but no weights published), with browner wings and back (Storr 1980). Upperparts and wing colour in two skins examined (HLW) similar to those of birds elsewhere; confusion perhaps caused by colour changes with wear. DIR

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**Volume 1 (Part B), Plate 86**

Canada Goose *Branta canadensis*

- 1. Adult, subspecies *moffitti*
- 2. Downy young
- 3. Adult

Cape Barren Goose *Cereopsis novaehollandiae*

- 4. Adult, e. Aust. birds
- 5. Adult, WA birds
- 6. Downy young
- 7. Adult, e. Aust birds

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