

## 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. Palaearctic]; 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) Dendrocygnae (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).

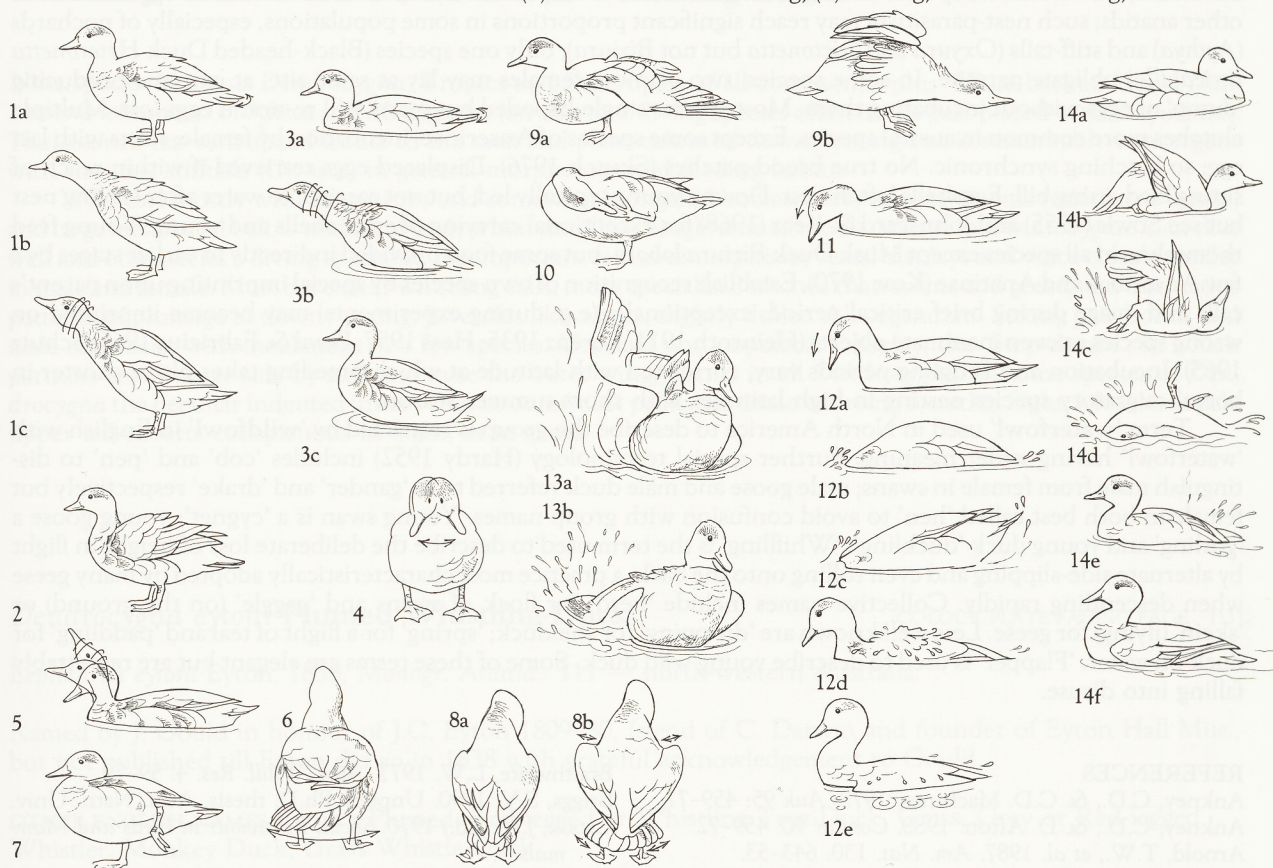
Body, broad and rather elongated in many, though more rotund in some, especially diving species. Plumage, thick and waterproof; contour-feathers distributed over distinct feather-tracts with underlying coat of down. Neck, medium to long. Wings generally rather small; mostly pointed, fairly broad in many, 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 (tertiaries) 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 ANATINAE ducks

Small to fairly large wildfowl. Tarsi scutellate in front. Marked sexual dimorphism in plumage and structure of syrinx in most species; correlated with sexual differences in visual displays and voice. About 70 species, composing four main groups: (1) so called 'perching ducks' and allies; (2) Torrent Duck (polytypic species in genus *Merganetta*, South America); (3) typical dabbling ducks (very large genus *Anas* and monotypic *Marmaronetta*) and (4) pochards (*Netta*, *Aythya* and extinct *Rhodonessa*).

Trachea of male usually with bony, asymmetrical bulla on left side of syrinx. Double annual moult in both sexes, resulting in two recognizable plumages. These usually closely similar and cryptic in females, though non-breeding plumage usually duller. Breeding plumage of male of many species in temperate regions elaborate and colourful ('bright'), contrasting with sombre and cryptic non-breeding plumage (eclipse) usually worn for short period in boreal species, during and following flightless period and post-breeding moult and resembling plumages of females and juveniles. Loss of bright plumage in some austral species much more complex. Wing typically brightly coloured in both sexes, often with metallic speculum on greater coverts and secondaries, which contrasts with colourful median and lesser wing-coverts or tertials; this pattern maintained all year, wing being moulted only once. As a rule, juvenile plumage resembles female plumage, but juveniles separable by tail-feathers (notched tip with bare shaft protruding) and by narrower, shorter, and more pointed body-feathers and wing coverts. Juvenile body-plumage moulted within a few months of hatching (3–4 months). In some species breeding in first year, this plumage involves growth of only a few new feathers and is quickly replaced by breeding plumage; in others that defer breeding until second year, immature plumage more complete and retained longer, being only gradually replaced by breeding plumage during whole first year of life. In all, juvenile wing retained until first complete moult in summer of second calendar year, although tertials often and some wing-coverts sometimes replaced earlier.

**TERMINOLOGY OF PLUMAGES.** Bright (breeding) male plumage of most duck species (often termed 'nuptial' in ornithological literature and more accurately 'alternate'; see Humphrey & Parkes 1959; Humphrey & Clark 1964) usually worn for much of year when birds not actually breeding, including autumn and winter when pair-bonds initiated and maintained until nesting in spring (see below). Thus, males often attain non-breeding plumage (basic) soon after start of nesting when their reproductive activities (but not those of females) are over. In females, though timing of both moults tends to correspond roughly with those of males, also subject to adaptive variation. In many species, post-breeding moult of females more protracted, with greater individual variation in timing, particularly in successfully breeding females; moult usually inhibited during nesting, starting 1–2 months later than in males. Females of some species (e.g. some dabbling ducks) start moult shortly before nesting and therefore incubate and rear young in basic plumage. Although such females in fact nest in 'non-breeding' plumage, terminology sometimes maintained for reasons of homology.

### Perching ducks and aberrant species

Small to fairly large wildfowl, usually living in well-wooded areas, most freely perch in trees, and often nest in holes high above ground. Some semi-terrestrial. Highly diversified group of 19 species in 15 mainly monotypic genera, often showing striking convergences with other Anatidae and some regarded now as more properly assigned to other sub-families, specially Tadorninae. Most are here retained in Anatinae following Johnsgard (1965) and Peters. Two groups: (1) more generalized genera *Plectropterus* (Spur-winged Goose in Ethiopian Africa), *Cairina* (Muscovy Duck of neotropical America; White-winged Wood Duck of se. Asia), *Pteronetta* (Hartlaub's Duck of Africa), and *Sarkidiornis* (Comb Duck of South America, Ethiopian Africa, s. Asia); (2) more specialized genera *Nettapus* (three pygmy-geese of central Africa, India to Aust.), *Callonetta* (Ringed Teal of South America), *Aix* (Carolina Duck *A. sponsa* of North America and Mandarin *A. galericulata* of e. Asia), *Chenonetta* (Maned Duck of Aust.), and *Amazonetta* (Brazilian Teal of South America). Also considered here are two very specialized A'sian genera *Malacorhynchus* (Pink-eared Duck of Aust.) and *Hymenolaimus* (Blue Duck of NZ) and *Merganetta* (Torrent Duck of South America) and *Salvadorina* (Salvadori's Duck of New Guinea). Five species in our region.

Wings, often wide and rounded; bony, spur-like knob on metacarpal joint in some. Tails, fairly broad and elongated; slightly graduated but not pointed. Bill, rather thick and goose-like, not depressed, often heavy; large nail; highly specialized structures in *Malacorhynchus* and *Hymenolaimus*. Hind toe well developed, not lobed, and claws strong and sharp at all ages; legs set far forward, tarsus usually short (especially in *Nettapus*), but longer in some (especially semi-terrestrial *Plectropterus*). Usually do not dive, but *Hymenolaimus* specialized river duck. Male noticeably larger than female in some species. Sexes differ in tracheal structure to varying degrees; except in *Nettapus*, *Malacorhynchus* and *Hymenolaimus*, males with bony enlarged bullae; in *Aix*, rather large and rounded, somewhat resembling a dabbling duck. Plumage bright in many; often iridescent, especially in more



generalized genera. Patterns more complex in other genera, particularly *Aix*. No real speculum in most species but tertials and wing-coverts often bright and metallic. Sexual dimorphism slight in some, considerable in others, especially *Aix*. Eclipse plumage in *Aix*, *Nettapus* and *Chenonetta*. Juveniles, like adult females. Downy young, patterned dark brown and white or yellow, most like those of dabbling ducks; in some species remarkable for long stiff tails and capacity for climbing.

Cosmopolitan but most species tropical or subtropical. Most species surface-feeders, some very specialized, though others (notably *Plectropterus* and *Chenonetta*) terrestrial grazers. Often in flocks. **Pre-flight** signals diverse; include **Neck-cranning**, **Chin-lifting**, and **Head-thrusting** movements, also lateral **Head-shaking**. Social patterns and behaviour of *Chenonetta* most like those of typical dabbling ducks. **Inciting** display of female also much as in *Anas*. In more generalized genera, however, pair-bonds weak or absent (Johnsgard 1965). Pre-copulatory behaviour varies; includes **Head-pumping** (as in *Anas*), **Head-dipping**, and **Bill-dipping**. Post-copulatory behaviour also varies, but little studied. Voice characteristics vary; sexually differentiated to greater or lesser extent. Male calls mostly whistles; female calls honking, quacking, or squeaking (characteristic **Decrescendo** calls of *Anas* lacking). Some species more or less silent. Torrent Ducks are specialized river-ducks inhabiting rapids and fast-flowing rivers of the Andes of South America; very noisy. *Salvadorina* is similarly specialized but is not necessarily closely allied to the Torrent Ducks. Little is known of its social behaviour and ecology.

**Dabbling ducks** (known also as surface-feeding, puddle, or river ducks)

Fairly small to medium-sized wildfowl. About 40 species in two genera, *Anas* and *Marmaronetta* (Marbled Teal of Mediterranean and w. Asia; has also been placed with pochards but not considered further here). More than 40 species in *Anas*, including following main species-groups, mostly in Holarctic, some or all formerly treated as separate genera: (1) wigeons, three species including *A. sibilatrix* vagrant to S. Georgia; (2) gadwalls, all Holarctic; (3) true teals, including several s. hemisphere species (about ten) typified by Grey Teal *A. gracilis* of Aust.; (4) pintails, including *A. eatoni* and *A. georgica* in our region; (5) mallards, including *A. superciliosa* of Aust. and NZ; and (6) blue-winged ducks, including Australasian Shoveler *A. rhynchotis*. Term 'teal' used loosely in ornithological literature to indicate small ducks generally, not only in different species-groups of *Anas*. Bodies fairly slender. No marked difference in size between sexes (males somewhat larger). Wings, long and pointed; in flight, wing-beats less rapid than in pochards and other diving ducks. Tails, usually fairly short, pointed; central feathers elongated in some species. Bills, fairly long in most species; flattened, with distinct lamellae. Legs, quite short and inserted centrally giving horizontal stance; hind toe much reduced, not lobed. Take-off from water and land with facility. Walk easily but with waddling gait; able to perch well, though only a few species regularly perch in trees. Dive rather poorly, submerging briefly with use of wings. Sexes differ in tracheal anatomy, males having enlarged rounded bony bullae on left side of syrinx. Plumage of both sexes usually with bright speculum. In many species, sexes alike also in other plumage characters; most of these rather sombre or wholly cryptic but some quite bright; in both types, non-breeding plumage differs little from breeding. In many species of *Anas*, particularly migrants within temperate parts of n. hemisphere, males only with bright plumage worn for much of year; alternates with eclipse plumage during flightless period at post-breeding moult. Females of these species highly cryptic at all times. Colour of bill or foot, or both, sometimes bright. Juveniles resemble adults in non-breeding plumage. Downy young, typically brown and buff or yellow, often with dark and light streaks on sides of head and light spot on each wing and on each side of back or rump.

Cosmopolitan and predominantly continental in distribution, though some island forms. Adapted for living in shallow, biologically productive waters. Many species prefer plenty of vegetation, marginal, submerged, and often emergent and floating. Range widely through mid-latitudes, penetrating into Arctic tundra or even taiga zones only slightly. Widespread and often the dominant genus in s. hemisphere. Faster streams and unsheltered or offshore marine waters normally avoided. Though some species enter wooded habitats (especially flooded or swamp forests) and others tolerate and even prefer wide-open spaces, most occupy sites with more or less dense fringing vegetation at chosen waters, latter being either standing or slow-flowing with ready access to secure and sheltered resting and breeding places. Need for concealment when breeding or in flightless stage of post-breeding moult may force them, more or less deeply, into dense marginal or emergent vegetation and swamps with little open water; some species nest, at least at times, far from water. As main habitats unstable in many areas, exceptional powers of flight enable reconnaissance of wide range of waters and rapid shift when necessary. Vulnerable to reclamation of wetlands, especially when these few and scattered, but readily accept artificially created waters if they provide suitable feeding areas. Little information on breeding numbers because accurate counts of nests impossible but large-scale ground and aerial counts now sufficiently comprehensive to provide reasonable estimates of wintering numbers and main locations, and, sometimes, tentative indication of trends. Some species migrate over considerable distances, especially in n. hemisphere. Males moult during late summer and early autumn on or near breeding grounds. All large-scale movements mainly nocturnal, sometimes at high altitudes, often in irregular wavy lines.

Essentially surface feeders, though dive for food in some conditions. Some primarily vegetarian, on land and



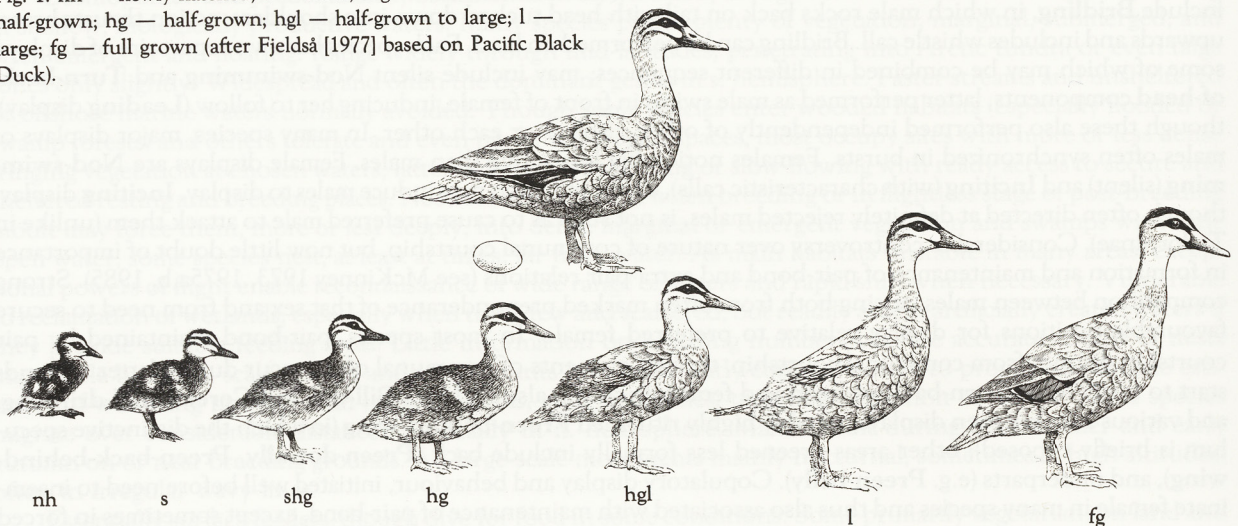
in shallow water. Many omnivorous, taking chiefly seeds and invertebrates mainly from shallow water by dabbling at surface at the same time pumping water and mud through bill, using lamellae to sieve out food (**Suzzling**). Also filter-feed by dipping head and neck below water, and up-ending; some highly specialized filter-feeders (shovelers), others also forage on land. Feed singly, but most often in pairs and flocks; otherwise usually gregarious when not nesting. Main pre-flight signals: lateral **Head-shaking** and repeated vertical **Head-thrusting**. Before and during initial stages of nesting, each pair typically occupies home-range which overlaps with those of other pairs. Within home-range, one or more small areas frequented for feeding, loafing, and preening; variously named 'core area', 'activity centre', 'waiting area' (where male stays while female at nest and where pair meet at times during laying and at times during incubation); defended as territories, to greater or lesser extent, in some species (mainly by male). Monogamous pair-bonds, long-term in monomorphic resident or nomadic, often tropical, species (see Siegfried 1974; Fullagar *et al.* 1988) but more usually of seasonal duration, especially in boreal migratory species. In latter, pair-formation typically starts in flock during autumn and winter after assumption of breeding ('nuptial') plumage, though initial pairings often temporary; final pair-bond ended at some stage during incubation when males again flock. In addition to maintaining firm bond with eventual mate, males of many species also show promiscuous tendencies, displaying to other females and also copulating with them, mainly by forced copulation. Extent of such promiscuity subject to ecological factors that affect intensity of defence of own mate and territory (McKinney *et al.* 1983; Birkhead 1988). Same factors also influence types and frequency of pursuit-flights of a female, which are of three main types: (1) courtship-flights: chase by several males originating from displaying party on water and initiated by female; (2) three-bird flights: chase of intruding pair by single male based on own activity centre; (3) forced copulation intent-flights: chase by several males often ending in attempts at forced copulation. Second and third types connected by intermediates; much controversy over details and interpretation, especially role of such pursuits in dispersing pairs. Courtship, typically on water but sometimes on land or even in flight (during pursuits), of two main types: (1) communal courtship (also termed 'social display') and (2) pair-courtship ('directed courtship' of von der Wall 1965). In communal courtship, often starting in autumn or winter, group of several males typically display to one or more females, both unpaired and (increasingly as season advances) paired birds of both sexes taking part. Courting party develops progressively in many species, as more and more males join in; in some, notably *A. superciliosa* in our region, group typically assembles before display starts. Male displays often elaborate, consisting of secondary and major forms, males tending first to assume special **Courtship-intent** posture, indicative of impending display. Marked tendency for each male to align body parallel to courted female before displaying; components of some displays also show marked directional bias towards female (McKinney 1975a,b). Secondary displays, mainly derived from comfort-behaviour and closely similar to latter in form, usually silent; often precede one or other of major displays. These are: **Upward-shake** and **Wing-flap** (both involving brief rise as bird treads water), lateral **Head-shake** (with bill inclined down), and **Head-flick** or **Head-roll** (with vertical component most marked). Major displays often more elaborate; usually with vocal components produced by contortion of tracheal tubes, which determines posture of neck. These are: **Grunt-whistle** (or **Water-flick**) and **Head-up Tail-up**; in both of which tail elevated and speculum momentarily exposed, specially in latter. **Grunt-whistle** has loud vocal component and deliberate action of spraying stream of water towards female using rapid flick of bill across the surface. **Burp** display, which is mainly a vocal signal, and **Down-up**, which also exposes speculum prominently and includes raising the tail and making contact with the water without directing it away. **Down-up** not usually addressed to female. Other displays include **Bridling**, in which male rocks back on tail with head tucked down into shoulders; action thrusts breast upwards and includes whistle call. Bridling can be performed on land. Each species has own repertoire of displays, some of which may be combined in different sequences; may include silent **Nod-swimming** and **Turn-back-of-head** components, latter performed as male swims in front of female, inducing her to follow (**Leading** display), though these also performed independently of other displays or each other. In many species, major displays of males often synchronized in bursts. Females noticeably less active than males. Female displays are **Nod-swimming** (silent) and **Inciting** (with characteristic calls), either of which may induce males to display. **Inciting** display, though often directed at definitely rejected males, is not such as to cause preferred male to attack them (unlike in Tadorninae). Considerable controversy over nature of communal courtship, but now little doubt of importance in formation and maintenance of pair-bond and extra-pair relations (see McKinney 1973, 1975a,b, 1985). Strong competition between males, arising both from often marked preponderance of that sex and from need to secure favourable positions for display relative to preferred female. In most species, pair-bond maintained by pair courtship distinct from communal courtship, though elements of communal often occur during latter as bonds start to form. Male **Turn-back-of-head** and female **Inciting**; also includes **Bill-dip**, full **Ceremonial-drinking**, and various **Mock-preen** displays, notably highly ritualized **Preen-behind-wing** (in which the distinctive speculum is briefly exposed); other areas preened less formally include back (**Preen-dorsally**, **Preen-back-behind-wing**), and underparts (e.g. **Preen-belly**). Copulatory display and behaviour, initiated well before need to inseminate female in many species and thus also associated with maintenance of pair-bond, except sometimes in forced



copulations. On water, pre-copulatory displays consist typically of mutual **Head-pumping**; post-copulatory displays of males vary more but include **Burp** display, **Bridling**, and **Nod-swimming**. Marked sexual differences in voice. Calls of males vary; often weak nasal, rasping, wheezing, clucking, or rattling sounds but also include penetrating whistles (sometimes followed by grunts) in many species; uttered chiefly during display, when disturbed, aggressive, or separated from mate or companions in flock. Calls of females typically louder and coarser, often quacking; most characteristic vocalizations: **Decrescendo** call (pattern of which tends to be constant individually, facilitating identification) and **Inciting** call. In some species, pair call simultaneously while posturing during and after antagonistic encounters (**Pair-palaver**); when mates separated, often call: **Decrescendo** calls from females; **Burp** calls from males. Non-vocal sound-signals produced in some species. Behaviour includes mass dashing-and-diving during bathing. Most complex repertoire of displays found in almost all teals, pintails and mallards but some of these do not have certain displays; e.g. most pintails and some teals do not have the Down-up; most mallards do not have the **Bridle**, except post-copulatory **bridling**. Gadwalls resemble mallards but never bridle and some also do not **Grunt-whistle**, **Head-up Tail-up**, and **Down-up**. All wigeons, the silver teals (*A. versicolor*; *A. punctata*) and the blue-winged ducks (typified by the shovelers) do not have any of these displays but all the last group have the added display of **Lateral Dabbling**, often use the **Jump-Flight** (less common in most other *Anas*); courtship pursuit-flights are particularly significant for shovelers. For details see McKinney (1978).

Breeding strictly seasonal in most species; short breeding periods in those forms nesting in Arctic, but more prolonged in others. Sites often on ground, concealed in thick cover, sometimes well away from water; less often in open but in our region commonly either above ground in cavities in trees (will use artificial nest-boxes) and old nests of other species or in vegetation, surrounded by water in most, and again often using old nest-sites of other species. Nests usually well dispersed but sometimes grouped even quite densely, at protected places. Shallow depressions with rim of vegetation, lined copiously with down plucked by female. Building by female only. Eggs oval, yellowish or pinkish-white, grey-green, buff, rarely bluish; smooth. Clutches usually 6–12, averaging smaller in forms on remote islands (see Lack 1968); multiple layings sometimes occur. Replacements laid after loss of eggs and several species normally double-brooded. Eggs laid at 24-h intervals. Incubation by female only, leaving nest two or more times per day when usually joins male (if still present). Incubation periods usually 21–28 days (Johnsgard 1968; Todd 1979). Young cared for only by female in some species in our region, and is typical pattern in boreal ducks but male parental activity common for many austral or tropical species with long-term pair-bonds; in them, male and female accompany young though only female broods them (see Kear 1970; Siegfried 1974; Fullagar *et al.* 1988). Young and parents, particularly the female, communicate and recognize each other by characteristic calls. Young aggressively defended by both sexes in species with dual parental care, but main anti-predator reaction otherwise distraction display of female in form of 'injury-feigning', parent flapping awkwardly over water or land with wings open, exposing speculum, and giving **Distraction** calls. In some species male also defensive but never as demonstrative as female. Young become independent just before or at fledging. Mature at 1 year old. Growth of ducklings can be described by reference to appearance that is usefully categorized in the sequence: newly-hatched (nh); small (s); small to half-grown (shg); half-grown (hg); half-grown to large (hgl); large (l) and full grown (fg) (Fig. 1 after Fjelds  [1977] based on Pacific Black Duck).

Fig. 1. nh — newly-hatched; s — small; shg — small to half-grown; hg — half-grown; hgl — half-grown to large; l — large; fg — full grown (after Fjelds  [1977] based on Pacific Black Duck).





## Pochards

Medium-sized, mainly freshwater diving ducks. Designation 'diving duck' used not as taxonomic term but as ecological characterization for these and other ducks that plunge from the surface and swim underwater. Sixteen species in three genera: *Netta* (three species) and *Aythya* (12 species); monotypic *Rhodonessa* (Pink-headed Duck of India and Nepal) recently extinct. *Netta* intermediate in some characters between *Anas* and *Aythya*. Latter composed of three species-groups: (1) typical pochards, none in our region; (2) white-eyed pochards, including Hardhead *A. australis*; (3) scaups, including New Zealand Scaup *A. novaeseelandiae*.

In *Aythya*, body, short and heavy; head, big; wings, broader and less pointed than in typical Anatinae, necessitating faster wing-beats, often producing whistling sound; tail, short; bill, rather heavy (less so in white-eyed pochards), about as long as head, flattened and, in some, wider at tip; legs, short, with large toes and broadly lobed hind toe, and set well apart far back on body. *Netta* similar but body longer and narrower, bill narrower, legs longer and more slender. All take-off from water with some difficulty. *Aythya* clumsy on land; *Netta* much less awkward, with even more upright stance. Though *Netta* somewhat less well adapted for diving than *Aythya* (Delacour & Mayr 1945), all dive with considerable facility, typically without using wings. Sexes differ in tracheal anatomy; as well as showing 1-2 enlargements of tracheal tubes, males have large, rather angular bullae, with several fenestrae, not rounded and evenly ossified as in *Anas* males. Males, mainly patterned simply: black, brown, or chestnut and white; unstreaked females, varying shades of brown. Broad pale (often white) panel on rear half of upper wing; no metallic speculum. In most species, male eclipse. Females often nest in plumage homologous to non-breeding plumage. Bill, usually slate or bluish but red in two *Netta*; eyes, red (most pochards of both genera), white (males of white-eyed pochards), brown or yellow (females of scaup), or yellow (male scaup). Juveniles resemble females. Downy young mostly like other Anatinae but head-stripes faint or absent; young of scaups, dark.

Cosmopolitan, but most species Holarctic. Concentrated both as breeders and in winter on standing fresh water of moderate depth, usually 1-15 m; one Holarctic species (Greater Scaup *A. marila*) marine in winter, partial exception. Tolerate fairly restricted open waters with dense marginal vegetation, even in forest setting. In most areas, suitable sites are not plentiful and vulnerable to desiccation, drainage, and other adverse factors, leading to some instability in distribution and population. Some colonize modern artefacts such as reservoirs, gravel pits, and ornamental waters. All Holarctic species migratory to greater or lesser extent. Species in s. hemisphere have no migration but in Aust. *A. australis* has irregular and sometimes long dispersal movements with large congregations following rainfall and drought.

Range from chiefly vegetarian (e.g. *Netta*) to omnivorous; in some species (e.g. *A. australis*) animal food predominates. Food obtained in water, mainly by diving from surface to bottom. Usually submerge for shorter periods than Merginae. Difference between sexes in preferred depths of diving, and hence in mean duration of dives, recorded in some n. hemisphere species and probably widespread; may be contributory factors in partial winter segregation of sexes in those areas. Most species (especially in *Netta*) also dabble on surface at times, head-dip, and up-end. Feed mainly in pairs and flocks. Largely gregarious at most times. Repeated **Bill-lifting** main **Pre-flight** signal, but **Head-flicks** also frequent in some *Aythya*. Monogamous pair-bonds of short seasonal duration typical in Holarctic species. Promiscuous tendencies of males much less marked than in other Anatinae; except in *Netta*, attempts at forced copulation rare in Holarctic species, and pursuit-flights largely of courtship type. Communal courtship on water much as in other Anatinae though most major displays different. Often nocturnal as well as diurnal. Secondary displays of males are: **Head-flick** and **Upward-shake**, though latter infrequent in some species. Typical major displays, usually accompanied by calls, are: **Sneak** display, **Kinked-neck**, and **Head-throw**. Sneak takes two main forms: full version with head along water; incomplete version (or **Crouch** display) with head inclined forward. **Kinked-neck** involves sudden horizontal distortion of neck; **Head-throw**, the vertical posturing of head above centre of back with bill pointed upwards. Other displays include **Turn-back-of-head**, **Neck-stretch**, and **Coughing**, though some confusion in literature whether **Neck-stretch** and **Coughing** displays differ or are partly the same. In some species, females perform male-like major displays at times; **Inciting** display of same functional type as in other Anatinae but differs largely in form. In most species, some displays used by male in communal courtship also used in pair-courtship; others distinct, including unique **Courtship-feeding** of *N. rufina*. Displays performed by both male and female, sometimes mutually, include **Ceremonial-drinking** and **Mock-preening**. Copulation also part of pair-courtship. Pre-copulatory displays include **Bill-dipping** and **Preen-dorsally**; in *Netta*, also *Anas*-like **Head-pumping**. Prone-posture of female differs from that of *Anas* in that neck stretched diagonally forward not flat on water. Post-copulatory displays include characteristic **Bill-down** posture by male or both sexes. Calls of males often whirring or cooing and not far-carrying, but some (notably scaups) also whistle. Used chiefly in courtship, of two main types given (1) during **Head-throw** and **Kinked-neck** displays and (2) during **Coughing** display. Females usually not highly vocal; calls mostly growling and harsh, louder than those of males, include **Inciting** calls but **Decrescendo** calls lacking in most species. Non-vocal rattling sound produced in **Preen-behind-wing** display in all or most species.



Holarctic species strictly seasonal breeders; probably similar for species in our region. Nests sited over shallow water or on ground never far from water; usually in thick cover. Well dispersed or grouped, sometimes close together. Shallow depressions with rim of available material, lined with down plucked by female. Building by female only. Eggs oval, green-grey or pale buff; smooth. Clutches usually 5-12; multiple laying common in some species. Single-brooded; replacements laid after loss of eggs. Eggs laid at 24-h intervals. Incubation by female only. Incubation period 24-28 days (Kear 1970; Todd 1979). Young cared for by female only. **Distraction** display, in form of 'injury-feigning', occurs (at least in *Aythya*) but less common than in other Anatinae. No true crèching but broods sometimes amalgamated. Young independent at or before fledging in most species. Mature in first year.

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*Anas chlorotis* G.R. Gray, 1845, in Richardson and J.E. Gray (eds.), *Voyage Erebus Terror*, 1, Birds: 15, pl. 20 — New Zealand.

Specific name compounded of Greek *χλωρός* (green, pale) and *ὠτίς* (eared).

MONOTYPIC

**FIELD IDENTIFICATION** Length 48 cm; weight 600–700 g. Small dark-brown dabbling duck with narrow white eye-ring; wings crossed high on back. Sexes dissimilar; females more uniform brown. Immatures like females but darker and heavily blotched on breast. Eclipse plumage in males.

**DESCRIPTION** **ADULT MALE BREEDING.** Face, head and neck, dark brown; crown and nape with green iridescence; narrow white eye-ring; narrow indistinct paler band on front and sides of neck. Back, dark brown, feathers edged paler; scapulars, dark brown with broad pale edges, some barred black and brown with black on outer web; tail and upper tail-coverts, black-brown with pale edges to feathers. Upperwing, brown; speculum, black with green iridescence anteriorly, edged behind with narrow white bar, in front with indistinct cinnamon bar. Breast, deep chestnut, paler toward abdomen, each feather with central dark spot becoming larger and more conspicuous posteriorly, giving spotty appearance. Abdomen, buff coloured, each feather with central dark spot becoming lighter posteriorly. Flanks, finely barred buff and dark brown. Undertail, dark brown-black with prominent white patch at base of tail. Underwing, mostly brown; coverts, mottled brown and white. Bill, blue-black. Iris, black. Legs and feet, slate-grey. **ADULT MALE ECLIPSE.** Like breeding but lacks green iridescence. Face and head, blotchy brown. Breast, dark mottled brown. Flanks, uniform dark brown with pale edges of feathers. Eye-ring duller or lacking. No white tail-spot. **FEMALE.** Head, face and throat, mottled brown. Narrow white eye-ring. Back, upper tail-coverts and tail, dark brown-black, with pale edges to feathers. Lower neck, dark chestnut. Breast and abdomen, pale with dark-brown blotches. Flanks, dark brown with pale edges to feathers. Wings and bare parts like male. **IMMATURE.** Like female but generally darker with very heavy black blotching on breast. **DOWNY YOUNG.** Crown, dark olive-brown; pale stripe over eye; black stripe through eye. Upperparts, brown-black with small pale spots on sides of rump and back. Underparts, mostly dull white with buff on breast; brown flanks.

**SIMILAR SPECIES** Distinguishable from **Grey Teal** *Anas gracilis*, which has pale throat, boldly scalloped plumage, no white eye-ring; in flight, prominent white triangle on upper wing. Similar **Chestnut Teal** *A. castanea* not yet recorded in NZ. Possibly mistakable for **New Zealand**

**Scaup** *Aythya novaeseelandiae* but Scaup sits much higher on water, has much dumpier body and steep forehead and lacks white eye-ring; male Scaup much darker with bright-yellow eye; most female Scaups have large white patches on lores and base of bill.

Usually seen in flocks at traditional sites in heavily vegetated wetlands, preferably with still or slow-flowing open water. Have adapted to vegetated stock ponds or pastoral flats with reeds and sedges that are boggy throughout year, and near waterways. Occasionally use marine or estuarine environments, resting and feeding in areas of bull-kelp. Highly gregarious, roosting communally when not breeding. Dive well. Flight, strong but infrequent. Feed at dusk and night, catching live prey, picking roots and shoots, stripping seed heads, seiving mud on stream banks. Males aggressive to all waterfowl in nesting territory. Male gives wheezy, high-pitched *mm-yea* and bell-like *pop*. Female gives typical decrescendo call of up to seven rapid quacks, also raucous growl and coarse rasping note that rises in pitch.

**HABITAT** Occupy terrestrial wetlands and estuarine habitats. Early records of abundance in kahikatea *Podocarpus dacrydioides* swamp-forest. Apparently prefer wetlands with areas of still or slow-flowing open water and abundant vegetation for loafing or escape, such as *Typha* swamps, and lakes, billabongs and rivers with dense marginal vegetation (Buller 1888; McKenzie 1971). Much suitable habitat cleared or drained. Recent records from swampy tidal or freshwater rivers and creeks, hill-swamps, gully-heads, mountain and valley lakes, pasture and estuarine mudflats (Bell 1959; McKenzie 1971; Williams 1974; Hayes & Williams 1982; Robertson 1982). In breeding season, birds feed near slow-flowing creeks in marshy pasture with abundant rush and sedge (*Juncus*, *Carex*) (Weller 1975; Williams 1977); in non-breeding season, frequent tidal flats, creeks, beaches and rocky outcrops in or near estuaries, and nearby grassy fields; particularly where barrier beaches wall off pools or retard flow at mouths of creeks to form wide slow-moving lagoons. Coastally, birds feed on shores and flats of silt, sand or gravel, in very shallow water, and on rocky outcrops; in pools, feed in deep, slow-moving or still water (Weller 1974; Heather 1980). On Little Barrier I., a few birds forage in dry farmland, in moist mouths



of stony creeks, in damp, densely vegetated parts of coastal flats, in pastures and at outlets of drains (Blanshard 1964).

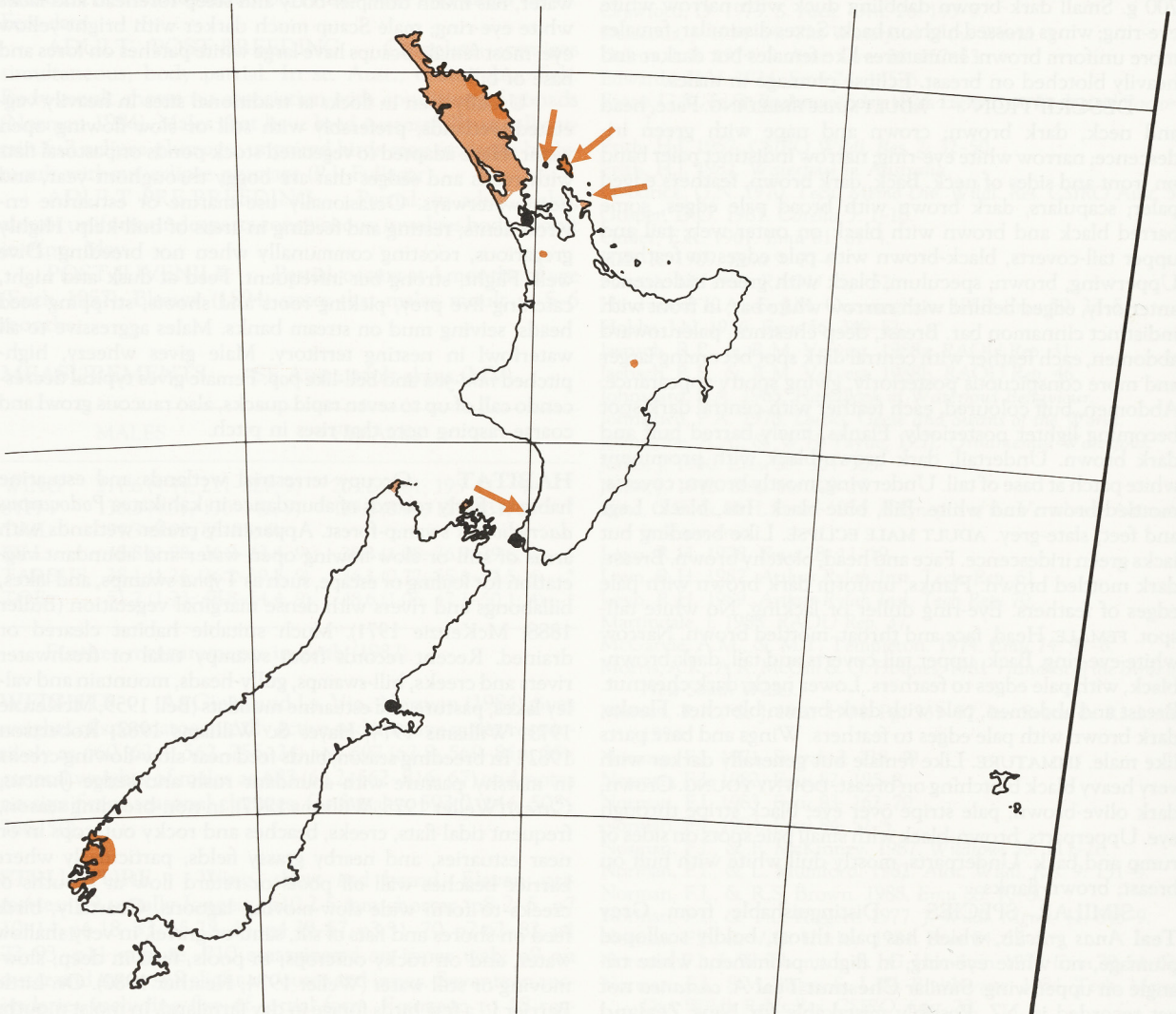
Breed and roost in dense cover near water. Reluctant to fly when disturbed. Swim and dive well in deep pools or sea; diving depth estimated at 0.6 m in pool on Great Barrier I. (Weller 1974) but reported to dive in up to 2 m of water (G.S. Dumbell).

Only remnant populations on mainland, where densely vegetated swamps have been severely reduced by clearing and drainage; although pasture used for feeding and birds can breed on overgrown farm-dams (Hayes & Williams 1982). Estuarine habitats on mainland subject to industrial and urban development, and rivers threatened by hydro-electric schemes. On Great Barrier I., population increased since 1940s, after restrictions on burning allowed regeneration of swamp vegetation (Bell & Brathwaite 1964). On mainland before decline and on offshore islands, birds found in settled areas, feeding in gardens, on lawns and near buildings (Blanshard 1964; McKenzie 1971; Weller 1974). Remarkably tame and highly tolerant of humans, undoubtedly one reason why so heavily exploited last century. Potts (1882) recorded that their response to shooters was simply to keep flying round; '... a flock of teal will keep you going all day — as some

sportsmen say'. Adapts readily to captivity though reported to be extremely pugnacious and requires accommodation separate from others (Hayes & Williams 1982). Successfully held and bred in captivity in NZ and Britain. Major program in NZ, run by Ducks Unlimited, to rear Brown Teal for release back into wild proving to be successful, with average of 100 birds being raised and released annually. By 1989, over 600 birds had been released at two sites in the NI (Hayes & Dumbell 1989). Self-sustaining populations not yet established although captive-reared birds have successfully bred in wild; artificial lagoons being created to enhance habitat (Hayes & Dumbell 1989).

**DISTRIBUTION AND POPULATION** Endemic to NZ; NI, SI and offshore islands. Vagrant to New Caledonia.

**NZ** Formerly throughout NI, SI and Stewart I., with most records from NI, scattered reports from SI, mostly coastal districts, and originally recorded as common member of avifauna of Stewart I. Historic reductions caused by modification of habitat, predation and excessive hunting. Drainage of wetlands led to rapid decline and local extinction from many areas between 1890s and 1930s and probably later but unrecorded from many areas: rapid decline on Stewart I. after





cats increased in 1950s, with none seen since 1972. In spite of protection since 1921, has declined to only a few remnant populations. **SI:** only in part of Fiordland NP: coastal sections of Dusky, Breaksea and Doubtful Sounds; also on mountain tarns in Keplar and Murchison Mts, and declining in all these areas. **NI:** Manawatu, confined to lakes in Himatangi area, survivors of 320 captive-reared birds liberated 1973–83, small numbers persist at Nga Manu near Waikanae; Bay of Plenty region about 50 in headwaters of Rangitaiki R. and its tributary, Whaeo R., where not seen since recent hydro-electric development; Whangamarino Swamp, last vestige of Waikato swamplands; individuals occasionally elsewhere in Waikato and South Auckland areas; Coromandel Pen., since 1965 survey, known only from ne. tip; Northland, stronghold but although 500–700 (minimum) present, possibly declining in spite of adapting to use of overgrown stock-ponds, and, since 1979 survey, mostly restricted to Russell-Whananaki area, but isolated sightings elsewhere. Also islands of Hauraki Gulf, especially Great Barrier I., where population of c. 1400 fairly stable, and Little Barrier and Great Mercury Is. where only a few pairs occur. Introduced 1968 to Kapiti I. but only about five pairs remain and may disappear as habitat deteriorates. Kapiti and Manawatu birds may be source of records from sw. **NI** (Buller 1888; Bell & Braithwaite 1964; McKenzie 1971; Williams 1978; Falla *et al.* 1981; Hayes & Williams 1982; NZ Atlas; M.J. Williams; Hayes & Dumbell 1989).

**POPULATION** Estimate of current total of up to 2100, with c. 1400 on Great Barrier I. and up to 500 in Northland, the only remaining viable strongholds (NZ Atlas; G.S. Dumbell). More recent estimate given of 1500 on Great Barrier I. and minimum population of 700, and possibly as high as 1000, in Northland (Dumbell 1988; (Hayes & Dumbell 1989).

**MOVEMENTS** Movements now generally local but may have been wider when abundant in past. No evidence to support dispersal to mainland from Great Barrier I. during winter as suggested by Weller (1975). Flocking occurs Nov.–Apr. or May (G.S. Dumbell).

**BANDING** 36S175E 10 J F 01 500 178 NZNBS.

**FOOD** Probably mostly invertebrates but no definitive studies. **BEHAVIOUR.** In marine habitats food taken by dabbling with bill and sometimes head underwater while swimming or wading in shallow water (Weller 1974); in freshwater and brackish habitats also dive to depth of  $\geq 0.7$  m (Buller 1882) and upend to feed on bottom; on land sometimes jump to take food from plants up to 0.7 m above ground (Weller 1974) and sieve seeds from streamside vegetation (M.J. Williams). Usually feeds at night, emerging from roosts at dusk (McKenzie 1971; Williams 1977; G.S. Dumbell) and moving onto nearby boggy pasture though timing of feeding on estuarine mud determined by tide (Weller 1975; Heather 1980). May also feed during day but only in summer and always as a flock (Weller 1974; G.S. Dumbell).

**ADULT** Recorded taking insects and worms (Ogle 1981), small black mussels (Heather 1980), insects larvae (Weller 1974), marine molluscs (Dumbell 1986) and small crustaceans (Dumbell 1986); small hard seeds and water-weeds recorded as food (Sanderson 1945; M.J. Williams) but no evidence that aquatic plants used to any great extent (Weller 1974; Dumbell 1986).

**SOCIAL ORGANIZATION** Information principally

from wild birds on Great Barrier I. and from captive birds; additional information supplied by M.J. Williams. Outstanding feature is gregariousness. During breeding season, in pairs and strongly territorial. Abandon territories to congregate in large flocks at traditional roosting sites where they remain outside breeding season; flocks of up to 200 or more reported (McKenzie 1971; G.S. Dumbell). At night, paired birds feed together, otherwise feed solitarily. Day time feeding only seen during summer and always as a flock. Birds unpaired while in flocks, until autumn when breeding birds pair then leave roosting site for breeding habitat (G.S. Dumbell); unestablished birds and juveniles remain and continue to occupy roosting site during breeding season (Bell & Braithwaite 1964; Weller 1975); later joined by moulting adults and sometimes adults with young. High frequency of fighting and chasing when in flocks; probably associated with pair-formation and maintenance, but also probably in defence of roosting site. Flocking important habit; no records of small groups or vagrants becoming established or increasing in numbers (McKenzie 1971). In **SI**, restricted to small part of Fiordland NP; sightings here infrequent and usually of single birds or pairs, or family groups. No communal flock-sites known and future of this population appears bleak.

**BONDS** In captivity normally sustained monogamous (Hayes & Williams 1982), assumed to be so in wild. Pair-bond breaks down when pair joins post-breeding flock and reform at roost in autumn departure to breeding habitat (G.M. Dumbell). Fighting in flocks attributed to establishment and maintenance of pair-bond (Hayes & Williams 1982). In captivity, begin to breed at end of first year (Reid & Roderick 1973; M.J. Williams); not confirmed but probably in wild also at this time, though some males may delay breeding until second year, as evidenced by composition of winter flocks (Dumbell 1986). Both adults guard and help rear ducklings, but only female broods; male essentially guardian. Constant parental attention seems not to be provided to ducklings who join flock at roosting site.

**BREEDING DISPERSION** Pairs strongly territorial during breeding season excluding other individuals vigorously. In autumn, pairs leave flock for breeding habitat (G.S. Dumbell). Nest-sites well spaced (Reid & Roderick 1973; Hayes & Williams 1982); generally associated with water and abundant vegetation nearby in which to hide and rest in daytime. Throughout Northland, many territories on farm ponds heavily choked by emergent vegetation and with little open water. On Great Barrier I., territories may not cover open water, many simply in swampy gullies among dense growths of *Juncus* or *Carex*, others high in hills in forest in muddy or damp areas among ferns. Breed and rear brood within territory. Abandon territories after breeding to congregate in flocks at traditional roosting site. Possibly re-use territories following year.

**ROOSTING** In non-breeding season, congregate in flocks at traditional roosting sites (Bell & Braithwaite 1964) near feeding grounds to moult (Dumbell 1986; G.S. Dumbell). Birds in each watershed seem to have one roost. Sites, usually on slow-flowing water and often on upper reaches of tidal influence, provided plenty of protective cover overhead and numerous resting sites on logs, ledges, or in holes in bank. Throughout year, usually hides in vegetation during day, emerging at dusk to feed during night (Oliver; McKenzie 1971; Williams 1977). Often sun themselves in open and hide in bad weather or when moulting (G.S. Dumbell). Also loaf and bathe in freshwater streams (Weller 1975). In coastal



areas, feeding influenced by tidal rhythms rather than nocturnal cycles (M.J. Williams). At high tide, sometimes roost on overhanging trees, usually one to two m above water but seldom higher than three m; may also roost on gravel shoals or rocks; birds feeding on water's edge stop occasionally and loaf (Weller 1974). In Northland, birds widely dispersed on territories containing open water; rear young within territory and join flocks at roost after fledging; only if territory impinges on roosting site can ducklings be expected there. But on Great Barrier I., many pairs seem to bring unfledged young to roosts; adults and young often move from territory high in forests, down water-courses, to join flocks at roosting site; at one roost at least 20 unfledged ducklings counted, youngest only about half grown (M.J. Williams). Why parents occasionally bring ducklings to roost-site is puzzling; according to G.S. Dumbell, unfledged young rarely seen at roost-site. In Fiordland NP, SI, where birds rare, no communal flock-sites known. Roost-sites vital for continued Brown Teal presence in a catchment; in one case destruction of roost site led to decline in numbers within the area (G.S. Dumbell; M.J. Williams).

**SOCIAL BEHAVIOUR** Information principally from wild birds on Great Barrier I. and from captive birds; additional information supplied by M.J. Williams. Male behaviour includes **Krick-whistle**, given in various circumstances such as when disturbed from hiding, during fights, hostile encounters at roosts, while feeding in flocks at nights, when defending mate, and during courtship.

**AGONISTIC BEHAVIOUR** Specific resting places within communal roost more favoured than others, and some aggression at sites seems to be by birds trying to supplant others for favoured positions (Weller 1974). Male especially aggressive toward all other species of waterfowl within territory (Cometti 1975). Female gives raucous growl, heard most often during agonistic encounters at communal roosts. **Broken-wing display** may be used by female with young (G.S. Dumbell).

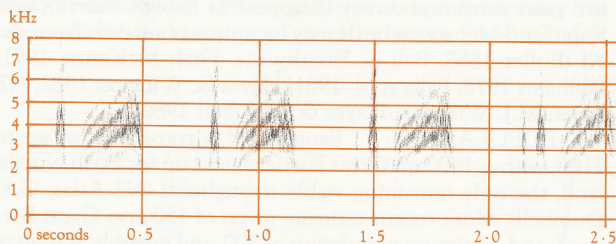
**SEXUAL BEHAVIOUR** Birds pair in flocks in autumn (G.S. Dumbell); females incite and aggressiveness conspicuous but no active displays by males at this time (Weller 1975). Pair maintains contact with soft whistles and chortles (Cometti 1975). Sexual displays similar to related Chestnut and Grey Teals, though rarely used. **COURTSHIP.** Displays performed by male include independent Bridling, Introductory Shake, Grunt Whistle, Nod-swim, Krick-whistle and Burp. **Burp:** male call given often after series of Krick-whistles, often uttered in courtship. **Head-up-tail-up** and **Down-up** displays typical of dabbling ducks very rarely seen. Female displays include Nod-swim and Inciting. During courtship, female has special call associated with Inciting. Cometti (1975) noted that displaying male appeared to hold female's head completely under water; birds swam swiftly in tight circles and skimmed along surface for short distances. According to G.S. Dumbell, was most likely a case of forced copulation. **COPULATION.** Pre-copulatory behaviour involves Mutual Head-pumping; after copulation, male performs typical Bridle before bathing and female bathes. Reported mounting under water (M.J. Williams), most likely forced copulation (G.S. Dumbell).

**RELATIONS WITHIN FAMILY GROUP** Incubation by female only; no information for how long in wild but possibly 29–30 days (G.S. Dumbell); in captivity for 27–30 days. Male remains nearby and guards territory; meets female during nest-relief (G.S. Dumbell). Little information on be-

haviour of male at this stage. Male protects brood and appears to maintain feeding area for female (Cometti 1975); stays in breeding territory as guard and is aggressive to all other waterfowl. Blanshard (1964) recorded male trying to distract attention by flying and calling at intruder, while young dispersed and took cover. In captivity, young able to fly, 50–55 days after hatching; no information in wild. Pairs nesting away from roost gradually move downstream with their broods, to attach themselves to roost. Sometimes ducklings still associated with both parents at roost-site (M.J. Williams), however G.S. Dumbell considers that this rarely occurs.

**VOICE** No detailed studies. Generally unobtrusive nature means that vocalizations usually not obvious. At close range, calls strong and very different in quality compared with calls of Chestnut and Grey Teals.

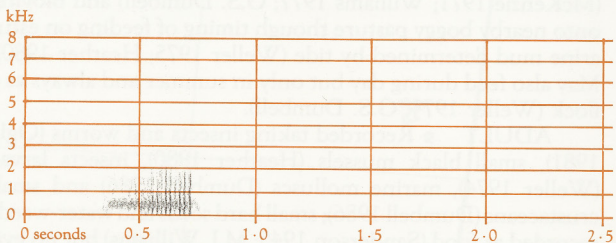
**ADULT MALE** Two distinctive high-pitched calls, Krick-whistle and Burp. **Krick-whistle** possibly equivalent to **Conversation Call** of allied species (P.J. Fullagar); has been described as peculiar and rather musical sniffing sound (M.J. Williams); wheezy tri-syllabic *mmm-yea* (sonagram A),



A P.J. Fullagar; Hamilton, NZ, Sept. 1983; X119

the first syllabic less emphasized and sometimes omitted. Given in various circumstances: when disturbed from hiding, during fights, hostile encounters at roosts, when defending mate, and during social courtship. Post copulatory Bridle Call, a high pitched whistle, and Contact Call (feeding), very quiet repeated whistles (G.S. Dumbell), probably similar to Krick-whistle. So-called **Burp** typical of many species of teal; note is bell-like *pop* and may be given after series of Krick-whistles or independently; often uttered during courtship.

**ADULT FEMALE** Five calls reported: Decrescendo Call, Growl, call accompanying Inciting and two Contact Calls. Typical **Decrescendo Call** up to seven rapid *quacks* in a row. Raucous **Growl**, heard most often during agonistic encounters at communal roosts; possibly equivalent to **Repulsion Call** (P.J. Fullagar). During social courtship, call with Inciting display, coarse rasping note that rises in pitch (sonagram B). **Contact Call (feeding)**, a low grumble given very



B P.J. Fullagar; Hamilton, NZ, Sept. 1983; X119

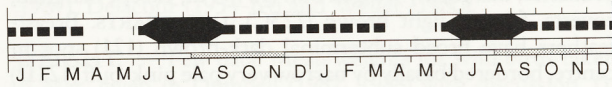
quietly; **Contact Call (brood)**, high pitched chirping given when young threatened (G.S. Dumbell).



**YOUNG** Give typical dabbling duck *cheep* particularly when distressed (G.S. Dumbell).

**BREEDING** Poorly known. Based on MacKenzie (1971) and Hayes & Williams (1982). Information supplied by M.J. Williams. Information mostly from wild birds on Great Barrier I. and from captive birds. Breeds in simple pairs, solitarily.

**SEASON** Broods recorded in all months except Apr. and May but with distinct season, June–Oct., peak in July–Aug.



**SITE** Neatly tucked in centre of clumps of *Carex* and *Cyperus* near creeks but nesting not confined to creeks as newly hatched broods recorded far from them. In Northland, in long grass by roadside (M.J. Williams).

**NEST, MATERIALS** Bowl simply woven out of surrounding grass, lined with down.

**EGGS** Large roundish oval, mat texture (G.S. Dumbell); creamy brown or creamy tan.

**MEASUREMENTS:** 60.3 (2.0; 56.7–66.4; 51) x 42.9 (1.5; 39.8–45.1) (M.J. Williams).

**WEIGHTS:** 60.8 (3.1; 55.9–66.8; 24). Average fresh weight of 20 eggs laid in captivity 61.4 g. Eggs large for size of bird, c. 11% of female weight.

**CLUTCH-SIZE** In wild, 4–8 eggs ( $n=22$  nests; 5–6 commonest) (M.J. Williams); mean 5.5 (3–8), similar in captivity (G.S. Dumbell). In captivity more than one brood may be reared (two broods and start of third in 12 months), but rarely recorded in wild where usually only one per season.

**LAYING** Daily in captivity.

**INCUBATION** By female only. Male guards territory and is joined by female during nest relief (G.S. Dumbell). **INCUBATION PERIOD:** in captivity, 27–30 days; 29–30 recorded in wild (G.S. Dumbell).

**YOUNG** Precocial, nidifugous. See Plumages for description of young. Both adults guard and help rear ducklings, male essentially as guardian. In captivity, young able to fly 50–55 days after hatching (Reid & Roderick 1973). No information in wild.

## PLUMAGES

**ADULT MALE BREEDING** Breed readily in captivity in first year (G.S. Dumbell); in wild, unknown. **HEAD AND NECK.** Crown, black-brown (119), fringed brown (121B); concealed small light grey-brown (119D), ovoid-shaped shaft-streak at base of feathers. Forehead and lores, black-brown (119), fringed light brown (223D), lacking basal shaft-streak. Ear-coverts, sides of neck and hindneck, glossy dark-green (160). At base of hindneck, feathers tuft-like and mixture of grey-black (82) and dark olive-brown (129). Narrow eye-ring of short white feathers; white eye-ring may facilitate visual contact (Weller 1980). Malar region and foreneck, brown (119B); chin, light grey-brown (119C). **UPPERPARTS.** Mantle and back, dark olive-brown (129), fringed light brown (223C); fringes become broader from upper to lower margins of mantle. Outermost mantle-feathers, near carpal joint of closed wing, brown (119B), narrowly barred light rufous-brown (139). Rump and upper tail-coverts, dark olive-brown (129), approaching dark brown (119A) and fringed light

brown (223C). Scapulars vary; some spotted and others uniformly coloured: dark brown (119A) with moderately broad light-brown (223C) fringes; some have outer distal webs narrowly barred black (89) and light brown (223D); others, dark olive-brown (129) with small light-brown (223C) spots on webs; others may have green (160) gloss on webs. **TAIL,** dark brown (119A), narrowly edged light brown (223D) on webs. **UPPERWING.** Primaries, dark brown (119A); p1–p6 have very narrow light-brown (223D) edge on outer web; rachis, dark brown (219A). All marginal, median and lesser coverts, including alula, brown (119B), narrowly fringed light brown (223C); when worn, fringes, light grey-brown (119C). Tertiaries, dark brown (119A); outer web with broad subterminal black (89) patch along distal three-quarters, sometimes with trace of dark-green (160) gloss near rachis; tertiaries, narrowly edged light brown (223D) on outer web. Secondaries, bordered black (89) with glossy dark-green (160) speculum. Feathers, dark brown (119A) on inner web; outer web, broadly edged black (89) with black patch (89) at base, then patch of glossy green (160); feathers tipped white, with tip broader on outer than inner web; towards tertiaries, white tips progressively attain narrow subterminal light-brown (223D) base. Secondary coverts, dark brown (119A), tipped pink-brown (219C) to light brown (123A), extending as narrow edges on webs. Primary coverts, dark brown (119A), narrowly fringed light brown (223D). When worn, fringes on upper wing-coverts mostly lost. **UNDERPARTS.** At base of foreneck, narrow collar of mixed beige (219D) and white feathers sharply demarcated from upper breast; collar indistinct in field, and concealed when bird at rest. Upper breast, rufous-brown (136) merging to light brown (39) at lower breast; each feather has subterminal dark-brown (119A) spot on centre of webs; concealed bases of feathers, light brown-grey (44); towards abdomen, spot progressively larger, paler and more exposed. Abdomen, light brown (pale 223D), subterminal spot, dark brown (pale 119A) and fringed white; when worn, fringes become dull white. Flank-feathers, broad and finely barred dark brown (219) and light rufous-brown (139); concealed bases, dark brown (119A). Thighs, light grey-brown (119C), minutely mottled dull white and narrowly fringed dull white. Feathers round vent, dark brown (119A), fringed light brown (39). Lowermost central vent feathers and whole of under tail-coverts, black-brown (119). Outer lateral vent feathers, white, narrowly barred brown (119B), or almost entirely white; these form white patch on each side of body; some feathers have outer edges pink-brown (219C); similarly longest central under tail-coverts only have traces of pink-brown (219C) on outer edges. Axillaries, white. **TAIL,** brown-grey (80). **UNDERWING.** Greater underwing coverts, glossy brown-grey (79); coverts narrowly tipped white, with tips becoming broader towards inner wing. All median coverts have basal quarter of web, brown-grey (79), with rest white. All lesser and marginal coverts, dark brown (119A), tipped white; tips broadest along radius-ulna bone, and become progressively broader from marginal towards lesser coverts.

**ADULT MALE NON-BREEDING (ECLIPSE)** General appearance similar to adult female (e.g. Dumbell 1986). Further work needed, to provide concise description. Following based on skins at NMNZ approaching eclipse. Differs from adult male breeding in: **HEAD AND NECK.** Dark-green (160) gloss mostly lost. Feathers of throat and foreneck, light grey-brown (119D), tipped dark brown (119A), giving mottled appearance. Eye-ring, duller; said to be lost completely (M.J. Williams). **UPPERPARTS.** Fringes on mantle, light grey-brown



(119C). **UNDERPARTS.** Subterminal dark-brown (119A) spots on breast, larger and paler; breast feathers, fringed pale light-brown (39). Flanks, dark brown (119A) and narrowly fringed light brown (223D); barring absent. Vent and under tail-coverts, dark brown (119A) to black-brown (119), fringed light brown (39). Few outer lateral vent-feathers, white, making white patch on each side of body small and inconspicuous.

**ADULT FEMALE BREEDING** In captivity, capable of breeding at 1 year old (Reid & Roderick 1973). **HEAD AND NECK.** Generally streaked appearance. Forehead and crown, black-brown (119) feathers edged buff (124) or light brown (223D), giving streaked appearance. Narrow eye-ring of short white feathers. Chin, throat and foreneck, light grey-brown (119C), feathers tipped pale dark-brown (119A), giving spotted appearance. Hindneck, dark olive-brown (129). Malar region and foreneck, brown (119B); chin, light grey-brown (119C). **UPPERPARTS.** Most feathers, dark olive-brown (129), approaching black-brown (119) towards tip, and fringed light brown (223D); fringes become broader from upper to lower margins of mantle. Scapulars, dark brown (119A) basally, merging to black-brown (119) distally; slight dark-green (160) gloss on webs in some lights. **TAIL and WING,** similar to adult male breeding. **UNDERPARTS.** Breast-feathers have broad subterminal dark-brown (119A) to black-brown (119) spots in centre, fringed light brown (39); concealed bases, light brown-grey (44). Towards abdomen, feather spot progressively larger, paler and more exposed. Abdomen, very pale light-brown (223D); subterminal spot, light grey-brown (119A) and fringed white; when worn, fringes become dull white; concealed bases, dark brown (119A). Thighs, light grey-brown (119C), narrowly fringed dull white. Upper flank-feathers, dark brown (119A) merging to black-brown (119) towards tip, fringed buff (124). Lower flank-feathers, rounded and long, dark brown (119A), fringed light brown (223D). Vent-feathers and under tail-coverts, dark brown (119A), fringed light brown (223D). Axillaries, white.

**ADULT FEMALE NON-BREEDING** Differs from breeding female in: **HEAD AND NECK.** Edges of feathers of crown and forehead, light brown (223C). **UPPERPARTS.** All fringes, brighter, being light brown (123A). **UPPERWING.** Tertiaries have irregular light-brown (223D) streak along centre of outer web. **UNDERPARTS.** Breast-feathers have broad dark-brown (119A) to black-brown (119) shaft-streaks, and feathers, edged light brown (39). Flanks, dark brown (119A) with incomplete subterminal U-shaped dull-white marking.

**DOWNY YOUNG** **HEAD AND NECK.** Crown, hindneck and malar region, dark olive-brown (129). Chin, buff (124). Throat and foreneck, light grey-brown (119D). Supercilium, light brown (26) and extends from forehead. **UPPER-SIDE,** dark olive-brown (129); down, hair-like and tipped buff (124); on lower back, down black-brown (c119). Large dull-white oval-shaped patch on sides of rump and similar but smaller patch on either side of outer back; when wings held closed, posterior margin of wing almost conceals latter patch. **TAIL.** Open pennaceous, and dark olive-brown (129). **UPPERWING,** dark, olive-brown (129); posterior margin of wing, buff (124). **UNDERSIDE.** Upper breast, dull white, tipped buff (124). Flanks, dark olive-brown (129) tipped dull white. Rest of underside dull white. **UNDERWING,** dull white.

**JUVENILE** **HEAD AND NECK.** Crown, nape and hindneck, black-brown (119), narrowly fringed light brown (223D); feathers on hindneck have faint dark-green (160) gloss. Chin, throat and foreneck, light grey-brown (119D) basally, with subterminal inverted U-shaped dull-white band,

tipped pale brown (28); tips give spotted appearance. Lores, malar region and ear-coverts, dark olive-brown (129). **UPPERPARTS.** Mantle, lower back and upper tail-coverts, dark brown (119A), fringed light brown (223D). Upper back-feathers, loose and dark olive-brown (129), fringed light brown (223D). Scapulars, dark brown (119A), approaching black-brown (119), fringed light brown (223D). **TAIL,** dark brown (119A), narrowly edged light brown (223D); rectrices notched. **UPPERWING,** similar to adult breeding male; differs in: secondaries have narrower white tips and gloss on speculum less obvious. Secondary coverts, entirely fringed pink-brown (219C). Inner primaries, marginally fringed buff (124). All, except marginal, coverts, fringed light brown (223C). **UNDERPARTS.** Breast-feathers have broad subterminal dark-brown (121) spot in centre, bordered basally by narrow very pale pink-buff (121D) bar; feathers, broadly fringed pale pink-buff (121D); concealed bases, light grey-brown (119D). Unknown if males have more warmly coloured breast than females. Towards abdomen, spot on feather becomes inconspicuous and paler. Abdomen, light grey-brown (119C), fringed dull white. Thighs, light grey-brown (119C), narrowly fringed dull white. Flank-feathers, dark brown (119A) merging to dark brown (121) towards tip, fringed pale pink-buff (121D). Vent-feathers and under tail-coverts, dark brown (121), fringed light brown (223D). Axillaries, white. **TAIL,** dark brown (119A), narrowly edged light brown (223D); rectrices notched. **UNDERWING,** similar to adult breeding male.

**ABERRANT PLUMAGES** Records of albinistic and partial albinistic birds discussed in Dumbell (1986, 1987).

**BARE PARTS** Based on photos in NZRD and unpublished, of captive birds (R. O'Brien; NZDOC Library), except where stated.

**ADULT** Iris, black-brown (119). Upper mandible, grey (87); base and nostrils, light blue-grey (88); nail, grey-black (82). Phillips (1925) describes bill as having conspicuous yellowish pectinations. No data on lower mandible. Legs, light grey-brown (27). Feet and webs, olive-brown (28).

**DOWNY YOUNG** Iris, dark brown. Bill, black. Legs and feet, pale brown.

**JUVENILE** No data.

**MOULTS** Based on skins (NMNZ).

**ADULT POST-BREEDING** Complete; remiges simultaneous; majority moult in Oct., a few as late as Jan.-Feb.; occurs at traditional roosting sites (Dumbell 1986; G.S. Dumbell). Williams (1976) observed moulting birds late Oct.; male skins show body-moult in Aug. and Sept. In captivity, moult observed in Nov.; rarely delays moult till Mar. (Reid & Roderick 1973). G.S. Dumbell believes males achieve full or partial eclipse plumage depending on reproductive status, as in Chestnut Teal (see Plumages).

**ADULT PRE-BREEDING** Partial; involves body-moult; occurs Jan.-Feb., many breeding males having assumed full nuptial plumage by Mar. (Dumbell 1987; G.S. Dumbell); details of moult require further study.

**POST-JUVENILE** Undescribed, but by analogy with Chestnut Teal, likely to be partial.

**MEASUREMENTS** Adult skins (NMNZ).



	MALES	FEMALES
WING	202.6 (2.24; 201-207; 5)	194.0 (8.00; 186-202; 2)
8TH P	123.8 (4.06; 119-129; 5)	117.6 (6.12; 110-125; 3)
TAIL	87.3 (6.84; 82-97; 3)	94.0 (6.00; 88-100; 2)
BILL	42.8 (0.69; 41.8-43.8; 5)	40.1 (1.01; 39.4-41.6; 3) *
TARSUS	38.3 (2.00; 35.5-40.8; 5)	38.2 (1.35; 36.3-39.4; 3)
TOE	51.1 (2.49; 47.9-55.2; 5)	50.7 (0.62; 49.9-51.4; 3)

Additional measurements in Dumbell (1987), Dumbell (1987), Delacour (1954-64) and Weller (1980).

**WEIGHT** Few data. Mean weights for wild birds taken in Mar. given in Dumbell (1987, 1988) with discussion. (1) Mostly SI, adults, May and Aug; label data from skins (NMNZ). (2) NZ, captive birds (Reid & Roderick 1973).

	MALES	FEMALES
(1)	579.5 (2.50; 577-582; 2)	479
(2)	665 (615-730)	600 (530-700)

No data on seasonal changes.

**STRUCTURE** Wing, short and broad. Eleven primaries: p9 longest, p10 1.4 mm shorter, p8 3-5, p7 11-16, p6 20-27, p5 30-39, p4 42-53, p3 54-66, p2 65-77, p1 75-91, p11 minute. P10 emarginated on inner; p8 slight on outer. Glossy tegmen about half width of web on primaries. Tail, short and pointed; 16 rectrices; t1 longest, t8 31-37 mm shorter. Nail of bill, small and rounded. Bill, flat; slopes upwards towards base at 30° from nostrils. Upper mandible has long tooth-like lamellae; reduced in size on lower mandible. Interramal area, bare. Tarsus, short and rounded in cross-section. Feet, webbed. Outer toe c. 79% of middle, inner c. 62%, hind c. 19%.

**SEXING, AGEING** Discussion of sexing and ageing methods and discriminant function based on THL and tail-

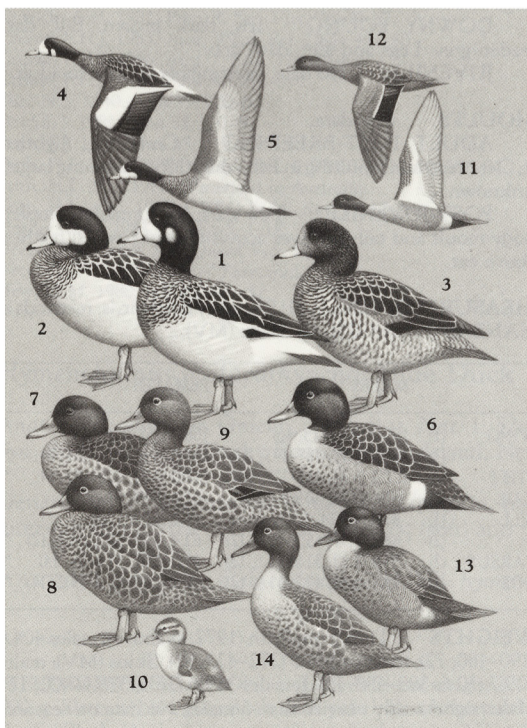
length, which correctly classified 92% of birds measured, in Dumbell (1987).

**GEOGRAPHICAL VARIATION** Mathews (1937) treated as full species and proposed, for SI birds, subspecies *peculiaris* based on measurements (wing from Wakatipu, SI, 185 v. 206-213 Taupo, NI); not listed as synonym in NZCL, but listed in Peters; validity requires study. Treatment of *aucklandica* and *nesiotis* (here considered separate species) needs study. For discussion of taxonomy see Dumbell (1986, 1987). RMO

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**Volume 1 (Part B), Plate 92**

Chiloe Wigeon *Anas sibilatrix*

1. Adult male
2. Adult female
3. Juvenile
4. Adult male, ventral
5. Adult female, dorsal

Brown Teal *Anas chlorotis*

6. Adult male breeding
7. Adult male non-breeding
8. Adult female
9. Juvenile
10. Downy young
11. Adult male, ventral
12. Adult female, dorsal

Auckland Teal *Anas aucklandica*

13. Adult male breeding
14. Adult female

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