

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

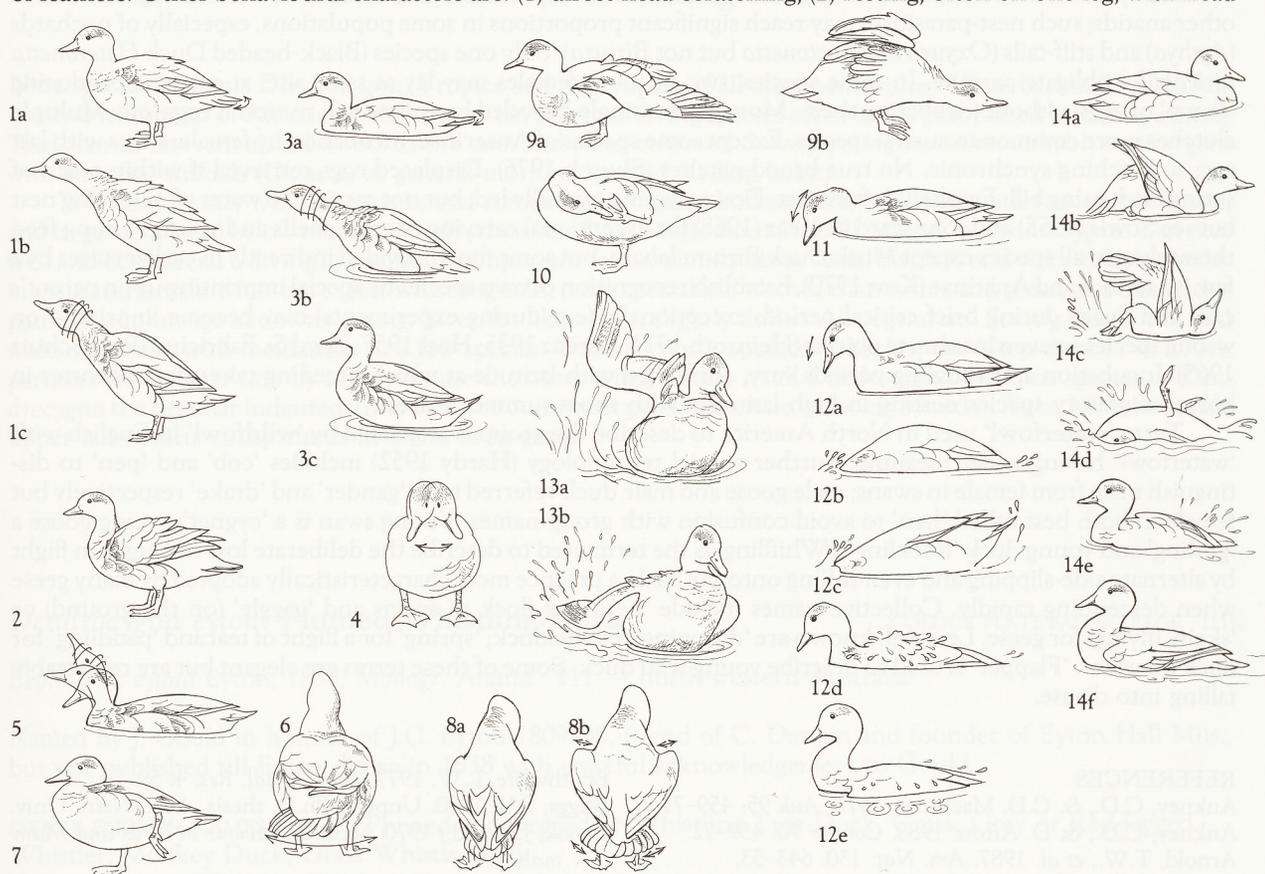
Waterbirds (some more or less terrestrial) with rather short legs and front toes connected by webs; hallux elevated and reduced. Though considerable adaptive diversity in outward appearance, size, colours of plumage, behaviour, and ecology, homogeneous in many characters, as attested by numerous, often fertile, interspecific hybrids reported, chiefly in captivity (see Gray 1958). About 160 species in six sub-families: (1) 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 (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-craning**, **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.

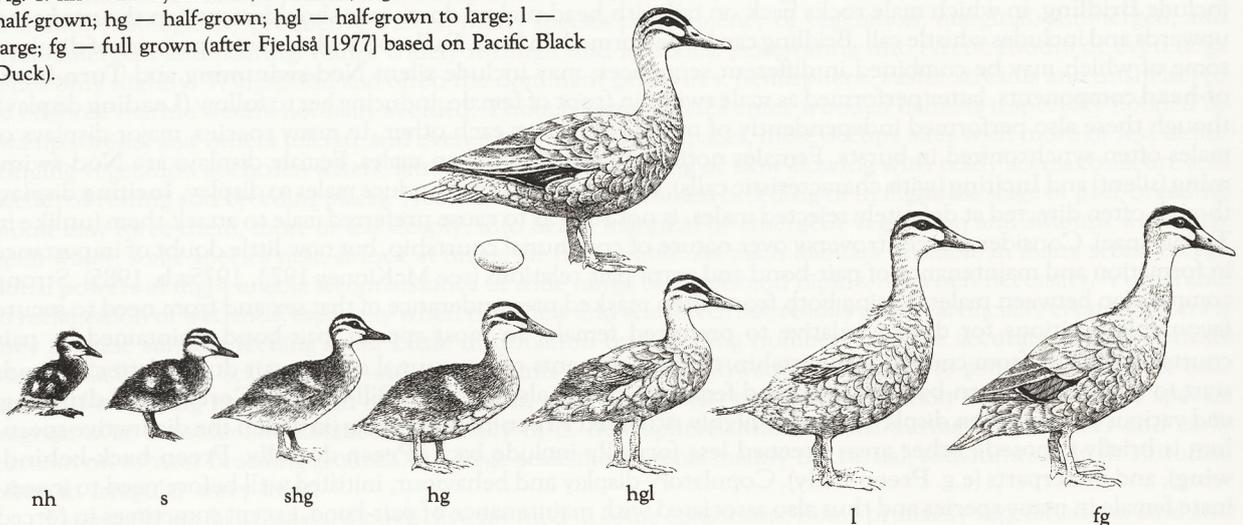
Essentially surface feeders, though dive for food in some conditions. Some primarily vegetarian, on land and

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 platyrhynchos Linnaeus, 1758, *Syst. Nat.*, ed. 10, 1: 125 — Europe; restricted to Sweden by Linnaeus, 1761, *Fauna. svec.* ed. 2: 42.

The specific name means 'flat-billed' (πλατύς + ῥύγχος).

PROBABLY MONOTYPIC One tenuous subspecies (Greenland); not known to have been involved with introductions to our region. Several other closely similar forms best regarded as species (P.J. Fullagar). For details on variations and difficulties with diagnosing species and subspecies within this group see Palmer (1976) and BWP.

FIELD IDENTIFICATION Length: male 55–70 cm, female 50–60 cm; wingspan: male 85–100 cm, female 75–100 cm; weight 1–2 kg. Distinctive, large dabbling duck; males with yellow bill, glossy green head and neck, white collar, chestnut breast and grey-brown body; black rump and undertail; tail, partly white; females, slightly smaller, mottled brown and buff with pale tail. Eclipse plumage in male. Juveniles, like female.

DESCRIPTION ADULT MALE BREEDING. Head and neck, iridescent green; narrow white collar at base of neck; back and mantle, grey-brown, vermiculated, shading to brown above flanks; rump, black; tail, centrally glossy black with central feathers curled, grading outwards to white; breast, chestnut to purple-brown; abdomen and flanks, white to pale silvery-grey with fine dark streaks, speckles or vermiculations; wings, pale ash-grey to brown-grey; speculum, bright blue to violet-purple, edged front and rear with black-and-white bars; cream under wing-coverts contrast with brown flight-feathers. Bill, lemon to green-yellow. Iris, dark brown. Legs and feet, orange. **ADULT MALE ECLIPSE.** Like female but crown, upperparts and breast darker, more uniform without mottling. **ADULT FEMALE.** Head and neck, pale brown to buff, with dusky brown or black streaks on crown, cheeks and through eye; body, pale brown mottled and streaked with buff, dusky brown and dull chestnut; wings, brown; speculum as in male. Bill, dark olive-brown, commonly mottled irregularly, and orange at margins. Iris, brown. Legs and feet, dull orange. **JUVENILE.** Like female but duller and less strongly marked; crown, neck and upperparts, darker; breast distinctive with regular longitudinal streaks. **DOWNY YOUNG.** Face, yellow with black line through eye and ear-coverts; upperparts, black-brown with yellow markings on back and wings; underparts, yellow.

SIMILAR SPECIES Many variants in feral, domestic and hybrid forms. Breeding males unmistakable; females and eclipse males distinguishable from Pacific Black Duck *Anas superciliosa*, which has darker plumage and conspicuous black-and-white striped facial pattern; from female

and eclipse male Australasian Shovelers *Anas rhynchos*, which are smaller with much larger bills, poorly defined eye-stripes, and in flight have narrow wings set far back and blue upper forewings. For hybrid Mallard-Black Ducks, see separate statement. In flight, partly white tail of male and pale tail of female Mallard differ from Pacific Black Duck, specially in female Mallard, which is most similar, and provide conspicuous and valuable field-characters.

Seen in pairs or small flocks on urban lakes, ponds, farm dams, also any fresh water close to human habitation. Often with other species. Feeds by filtering at surface of still shallow water, sometimes stirring mud by paddling feet. Urban birds may become tame and allow hand-feeding; wild birds very wary. Wounded or moulting birds may dive to escape danger. Flight swift with shallow wing-beats that produce loud whistling sounds. Readily comes on land and walks with near horizontal carriage. Female has well-known deep loud *quack* or laughing series of *quacks*, the familiar Decrescendo Call; most common call of male, wheezy *raehb* but other distinctive calls associated with displays.

HABITAT Limited to where seasonal conditions approach those in n. hemisphere range (Braithwaite & Miller 1975). On terrestrial wetlands, grasslands and croplands, and sheltered estuarine and marine habitats. Strongly structured bill equally enables feeding on land and in water; as in n. hemisphere range, prefer still shallow waters with abundant submerged, floating or emergent plants; hardly any area of water too small (BWP).

In NZ, now widespread and abundant on artificial and natural wetlands. As in native range, catholic in choice of habitat; especially in settled and agricultural areas, with rich feeding grounds in pasture, stubble fields, and crops of grain, seeds and tubers, associated with small waterbodies (farm dams, ditches); on urban creeks and ponds often attracted and maintained by hand-feeding. Also use natural creeks, rivers, swamps, shallow margins of large lakes, and intertidal mudflats and channels in estuaries. In hunting season, found at sea,

often off river mouths (Balham 1952; Owen & Sell 1985; T.A. Caithness). Wetlands where fluctuations in water-level promote growth of marginal aquatic vegetation (e.g. *Potamogeton*, *Chara*, *Lemna*) especially productive for feeding (Potts 1977).

Less abundant and widespread in Aust., where small populations depend on artificial wetlands in urban or intensely farmed districts (Braithwaite & Miller 1975). Recorded occasionally on natural wetlands, seldom far from settled areas; shallow or deep freshwater swamps, billabongs and coastal lagoons (Corrick & Norman 1980; Gosper 1981).

On subantarctic islands, regularly use marine habitats, such as beaches, inshore waters and tidal pools on rock platforms (Antipodes Is, Macquarie I.) (Warham & Bell 1979; Norman 1987). Also moist or aquatic habitats in coastal lowlands; creeks and pools in tussock grassland, rush or tussock flats, lakes and seal wallows (Norman 1987).

Breed throughout range in NZ; in Aust., breeding poorly recorded but probably most confined to semi-domestic situations (Aust. Atlas); recently confirmed on Macquarie I. (Norman 1987). Nest in various situations near fresh or salt water and under shelter of vegetation (Balham 1952; Potts 1977; Owen & Sell 1985; Norman 1987).

Males and non-breeding females moult on large lakes and lagoons, where remain on open water far from shore; breeding females on or near breeding wetland, in tall emergent vegetation (NZ; Williams 1981). Fly freely, rising steeply and often circling at heights up to 500 m. Underwater use of habitat limited to top 1 m reached by upending. Walk readily, even through fairly dense vegetation (BWP).

Adaptability of Mallards and their tolerance of humans encourage use of artificial wetlands and food supply. Establishment and spread of introduced populations probably depend on widespread agricultural development, as crops, pastures and small wetlands ideally suited for this species. Breed close to settlement, especially in Aust., and use artificial structures for nesting e.g. haystacks, buildings (T.A. Caithness).

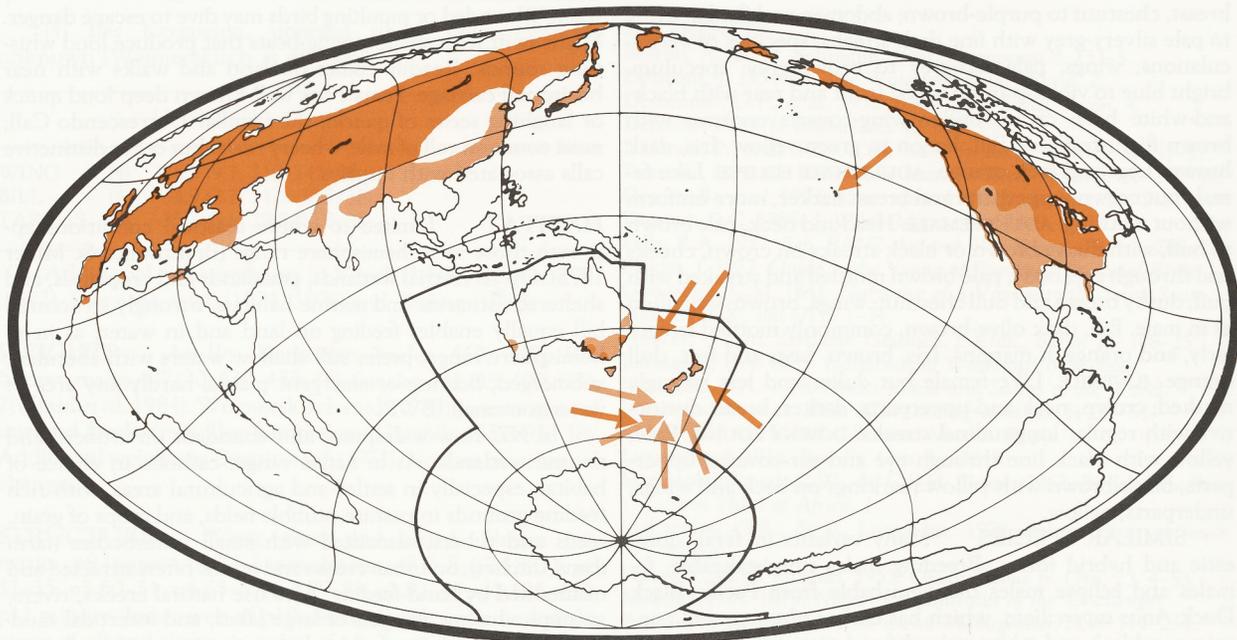
DISTRIBUTION AND POPULATION Natural range, Holarctic, Hawaii; wintering in southern areas to Subtropics in Americas and se. Asia. Introduced Aust., NZ and Iles Kerguelen; no evidence that birds on Macquarie I. were introduced (Gwynn 1953; Norman 1987).

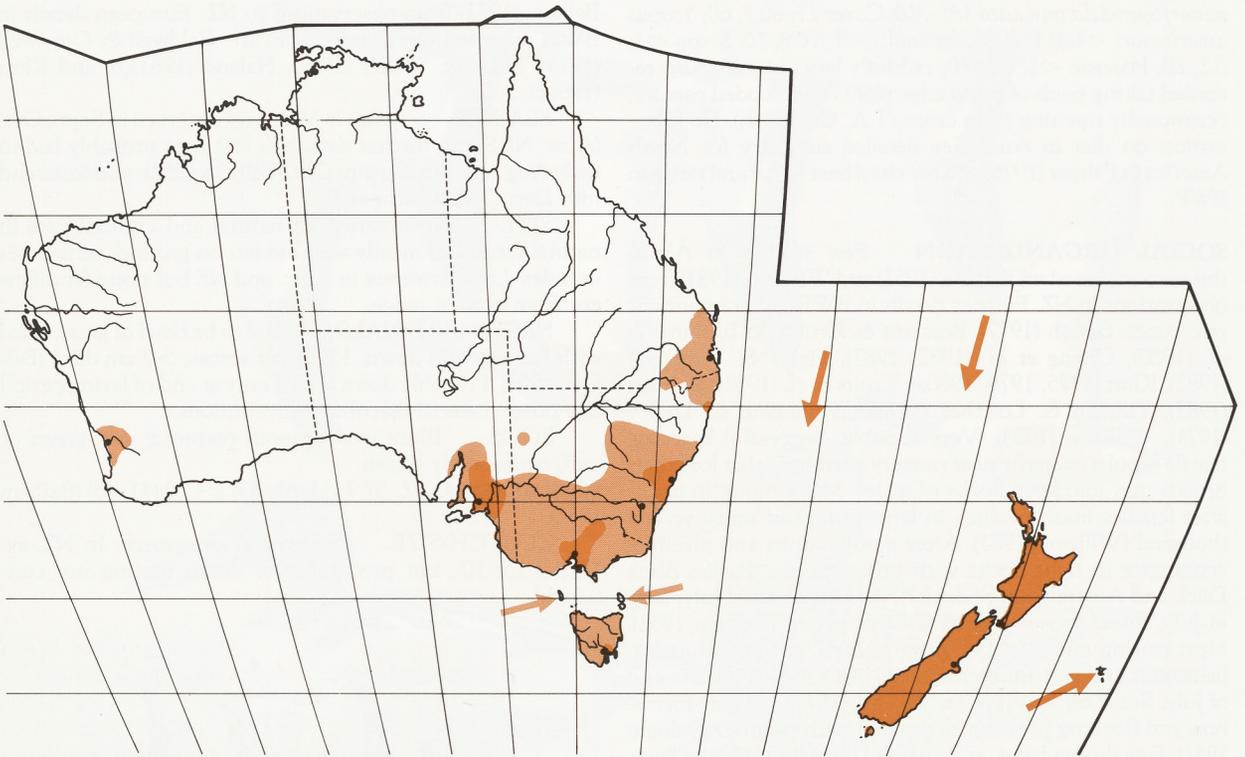
AUST. Widely introduced SE and SW, at least as early as 1862, with main range expansion occurring since 1950s. **Qld.** Scattered records in SE, 1977–81, N to Maryborough but none of breeding birds (Aust. Atlas). **NSW.** First introduced round Sydney before 1900, now widespread e. NSW, rarer W, and increasing (Tarr 1950; Morris *et al.* 1981; McAllan & Bruce 1989; NSW Bird Rep. 1983, 1984). **Vic.** First introductions 1864, 1971–72, mostly unsuccessfully, with few records before 1970s, but now scattered widely and increasing, mostly in S (Ryan 1906; Tarr 1950; Wheeler 1967; Balmford 1978; Long 1981; Vic. Atlas). **SA.** Widely introduced and increasing SE, augmented by vagrants from elsewhere (Parker *et al.* 1985). **Tas.** Introduced locally, now feral, generally uncommon but increasing, also King and Flinders Is (Green 1977; Sharland 1981; Aust. Atlas). **WA.** Locally introduced before 1912 and feral in Perth and environs (Long 1981; Storr & Johnstone 1985, 1988).

NZ Introduced widely from 1867 on, of British stock from Aust., including annual releases 1896–1918; mostly NI where slowly increased by 1930s; in SI unsuccessful by 1920s; for several years from 1939, populations supplemented by introductions of American stock, mainly on NI; by 1947–49 composed 52% of shooters' bags; introductions continued into 1950s; then well-recorded population explosion throughout NI, SI, Stewart I. and smaller offshore islands, also Chatham Is, with vagrants reaching Antipodes, The Snares, Auckland and Campbell Is (Oliver; Balham 1952; Horning & Horning 1974; Warham & Bell 1979; Falla *et al.* 1981; Long 1981; T.A. Caithness; NZCL; NZ Atlas).

LORD HOWE I. Resident. One, 27 Feb. 1963 (McKean & Hindwood 1965). Small breeding population now present, probably established by hybrid stock from NZ; first breeding recorded May 1975 (P.J. Fullagar).

NORFOLK I. First recorded Sept. 1971, then annually





from 1975, with small, but increasing, resident numbers (McKean *et al.* 1976; Moore 1981, 1985; Schodde *et al.* 1983; Hermes *et al.* 1986).

MACQUARIE I. First recorded Aug. 1949 (Gwynn 1953); may now be breeding or hybridizing with Pacific Black Ducks (Merilees 1971; Watson 1975; Green 1977).

ILES KERGUELEN Introduced Jan. 1959 but gone by 1964; also subsequent introductions but current status unknown (Prévost & Mougín 1970; Watson 1975).

POPULATION No measures of abundance in Aust. (Aust. Atlas). In NZ, total estimate of 5 million in 1981 and still increasing (NZ Atlas).

MOVEMENTS In Aust. and NZ, poorly known. In Palaearctic, strongly migratory (BWP). In NZ dispersive but apparently less so than Pacific Black Duck (see Banding); numbers at Waimea Inlet, n. SI, peak in Apr. and fall by June, possibly in response to duck-shooting (Owen & Sell 1985) but otherwise no published information. In Aust., reporting rate in Vic. suggests populations mostly sedentary though individuals irregularly recorded away from established populations (Vic. Atlas). Some long distance transmarine movement: birds from Norfolk I. have reached NZ and New Caledonia (see Banding) and assumed that those on Macquarie I. arrived naturally, perhaps from Campbell I. (Norman 1987). No evidence that Palaearctic birds reach Aust. or NZ.

BANDING Returns from NI, NZ summarized Fig. 1 (NZNBS). Other records:

- 29S167E 01 J U 1 706 356 ABBBS
- 29S167E 11 J F 3 706 356 ABBBS
- 29S167E 08 J M 8 983 167 ABBBS
- 29S167E 09 P U 19 1063 008 ABBBS
- 29S167E 08 J U 68 1106 144 NZNBS
- 29S167E J M 33 1152 144 NZNBS

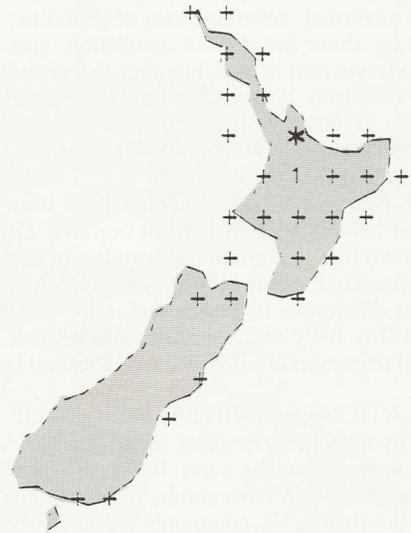


Fig. 1. 37S 175E 1X1 % NZNBS

FOOD Mostly vegetative (seeds and fruits of aquatic plants), but also take much animal matter including insects, especially when young. **BEHAVIOUR** Dabble, up-end and, occasionally in shallow water, dive (Sedgwick 1957), straining fine-grained food from water (Zweers 1974; Zweers *et al.* 1977). Dry food taken up by tongue and palate in conveyor belt action with maximum rate of intake 1.5 g/min of particles 0.55–0.65 cm diameter (Kooloos 1986).

ADULT At **Taiakatahuna, NZ** (five stomachs, 928 seeds; Balham 1952) *Ranunculus repens* <1% vol., 0.8% no., 20% freq., *Polygonum persicaria* <1, 0.1, 20, *Rumex conglomeratus* <1, 2.7, 40, *Trifolium repens* 22, 26.5, 40, *Lemna*

minor/*Spirodela punctata* 19, -, 20, *Carex* 27, 60.7, 60, *Scirpus americanus* <1, 0.1, 20, *S. fluviatilis* <1, 16.8, 20, *S. spp* <1, 0.2, 20, Poaceae <1, 0.2, 20; caddisfly larv. 2, -, 20. Also recorded taking seeds of pond edge plants and flooded pasture, occasionally ripening grain crops (T.A. Caithness). No information on diet in Aust. See detailed summary for North America in Palmer (1976) and for elsewhere in natural range in BWP.

SOCIAL ORGANIZATION Few studies in A'asia; this account based on Balham (1952) and Williams (1981) from observations in NZ. Further details in BWP; other important references: Barash (1977), Bossema & Kruit (1982), Burns *et al.* (1980), Cheng *et al.* (1982, 1983), Figley & VanDruff (1982), Klint (1975, 1978, 1980a), Kruits *et al.* (1982), Tidman (1983), Tidman & Lowther (1975), Weidmann & Darley (1971), Williams (1983). Very sociable. Successful breeding female moults solitarily near nursery site; those that lose their broods may join large flocks of males. Males moult in flocks after females finish nesting; in large groups of up to several thousand (Williams 1981). After moult, adults and juveniles congregate in tight flocks with other species (Pacific Black Duck and Australasian Shoveler), peaking in early July; later in July, flocks looser and most birds paired (Balham 1952). Most pairing mid-July, but from as early as Mar. courtship behaviour and pair-formation takes place. Nesting starts end of July. Some birds still paired in Oct. Timing of pair-formation and flocking probably associated with weather (Balham 1952). Female incubates, and guarded by male while she feeds before laying and in early stages of incubation. In July, male becomes territorial, defending area of shoreline; remains on territory for about five days of incubation, guarding female when she leaves nest to feed, but after that abandons her and territory (Williams 1981). After breeding, spend daytime in tight flocks in middle of lake and come ashore to feed about lake margins at night (Williams 1981).

SOCIAL BEHAVIOUR There have been no critical studies on behaviour of Mallard in our area. Display repertoire, known from comprehensive studies in species' natural range, appears to be same as Pacific Black Duck (*q.v.*), with no significant differences in postures or calls. For details refer Palmer (1976), BWP and see Pacific Black Duck. Important additional references are Weidmann (1956) and Leuret (1958, 1961).

RELATIONS WITHIN FAMILY GROUP Female deserted by male in early stages of incubation. At hatching, she leads young to nearby water. Rearns young in drains, temporary pools in fields, farm ponds, lakes, swampy pasture or rivers; in Southland, NZ, commonly in middle of pasture with no access to water at all (Williams 1981). Attends them until they fledge at 55-60 days.

VOICE No studies in A'asia. Extensive studies on populations in natural range, mostly summarized in BWP and Palmer (1976) (*q.v.*); Abraham (1974) made most important detailed study of calls; see Klint (1980b) on incidence of *raehb* calling males; for anatomy and mechanisms of vocalization see Lockner & Murrish (1975) and Lockner & Youngren (1976). Calls identical in form to those described for Pacific Black Duck (*q.v.*) and appear virtually indistinguishable; no easily defined differences found (P.J. Fullagar).

BREEDING Few studies in A'asia. Account based on

Balham (1952) from observations in NZ. European details in BWP; other important references are: Caldwell & Cornwell (1975), Elder & Weller (1954), Haland (1983a,b) and Klint (1980c).

SEASON Aust.: in Vic., eggs observed in Sept., Oct. (Aust. NRS); no further data. NZ: first eggs probably laid in early Aug., continuing into Oct. (Balham 1952); said to extend into Dec. (T.A. Caithness).

SITE Great variety of natural and artificial sites in natural range but mostly well-hidden on ground, sometimes in holes. Little evidence in Aust. and NZ but none far different from natural range.

NEST, MATERIALS Said to be bowl of grass, lined with feathers and down, 13-23 cm across, >7 cm deep (Balham 1952). Probably down added only at end of laying period and other material essentially adventitious.

EGGS Blunt oval; smooth textured; grey-green or buff, occasionally bluish.

MEASUREMENTS. NZ: 57.7 (54-62; 53) x 43.0 (41-45) (Balham 1952).

CLUTCH-SIZE No critical assessment. In NZ, av. 12 (10-15; 10), but probability of dump nesting not considered.

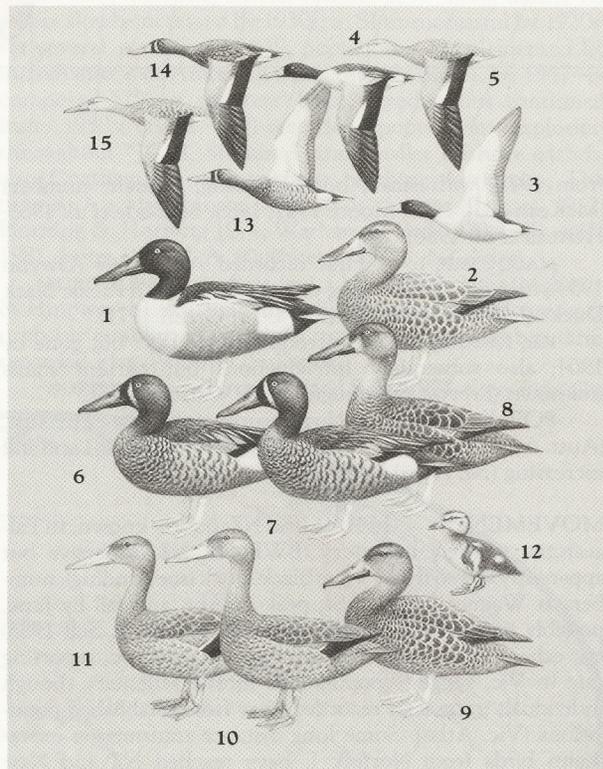


Plate 95

Northern Shoveler *Anas clypeata*

1. Adult male breeding
2. Adult female
3. Adult male breeding (flight), ventral
4. Adult male breeding (flight), dorsal
5. Adult female (flight), dorsal

Australasian Shoveler *Anas rhynchotis*

6. Adult male breeding, subspecies *rhynchotis*
7. Adult male breeding, subspecies *variegata*
8. Adult male non-breeding
9. Adult female
10. Juvenile female
11. Juvenile male
12. Downy young
13. Adult male breeding (flight), ventral
14. Adult male breeding (flight), dorsal
15. Adult female (flight), dorsal

LAYING Daily at 24-h intervals. If clutch destroyed, may re-lay up to three times (Balham 1952).

INCUBATION Only by female, who leaves nest twice each day to feed; eggs covered by down when absent. Eggshells and unhatched eggs probably left in nest. **INCUBATION PERIOD:** 27–28 days in natural range.

YOUNG Black-brown upperparts; face, sides and underparts, yellow; dark eye-stripe; dark spots on back and wings; dark spots or short lines on ear-coverts. Female attends ducklings alone, leading them to water soon after hatching. Frequently feigns injury, which allows ducklings to reach cover, where they remain motionless until mother indicates safety by calling (Balham 1952).

FLEDGING TO MATURITY Fledge at 56–60 days, and breed when 1 year old (BWP).

SUCCESS No adequate data. **PREDATORS.** Eggs destroyed by ferrets *Putorius* spp, Brown Rats *Rattus norvegicus* and pigs (Balham 1952). Young have been eaten by Silver Gulls *Larus novaehollandiae* (Wheeler & Watson 1963). In some localities in NZ, 35% of populations said to be shot (T.A. Caithness).

PLUMAGES Nominate *platyrhynchos*.

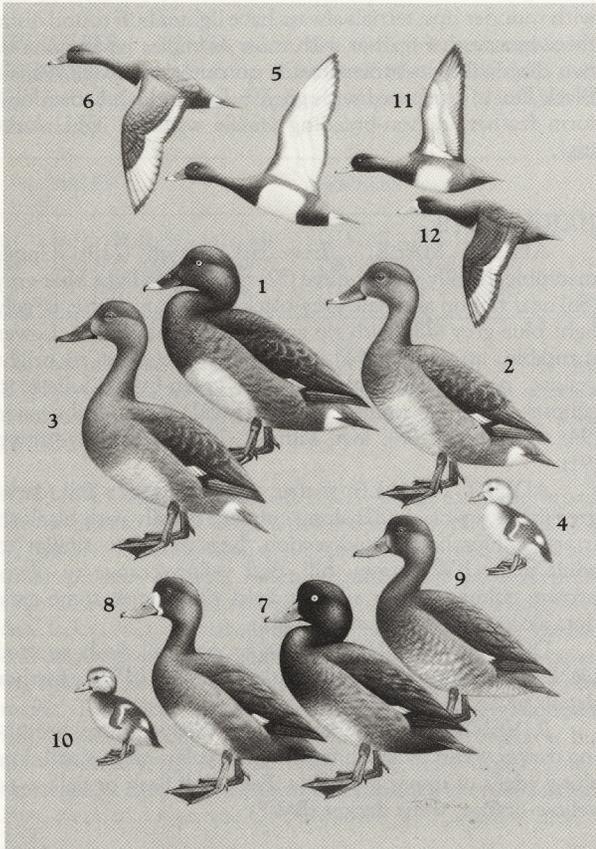


Plate 96

- | | |
|----------------------------------|---|
| Hardhead <i>Aythya australis</i> | New Zealand Scaup <i>Aythya novaeseelandiae</i> |
| 1. Adult male | 7. Adult male |
| 2. Adult female | 8. Adult female |
| 3. Juvenile male | 9. Juvenile |
| 4. Downy young | 10. Downy young |
| 5. Adult male | 11. Adult male |
| 6. Adult female | 12. Adult female |

ADULT MALE BREEDING HEAD AND NECK. Feathers, glossy dark-green (162A); in some lights, glossed purple (172A). At base of foreneck, narrow collar of white feathers forms sharp square-cut demarcation with underparts and upperparts. **UPPERPARTS.** Mantle, dark brown (119A), fringed brown (223B) to brown (223A). Inner scapulars, light grey-brown (119C) vermiculated dark brown (219). Longer outer scapulars, vermiculated on edges of web, dark brown (119A) and brown (223A). Back, black-brown (119) narrowly fringed dark brown (119A). Rump and upper tail-coverts, black (89), glossed black-green (162); in some lights, upper tail-coverts appear glossy purple (172A). **TAIL.** Central four rectrices, black with emerald sheen, recurved and often so bent as to form circle (Palmer 1976). Next pair, black brown (119), broadly fringed white; other rectrices, dark brown (119A) mottled white, gradually becoming whiter towards outermost. **UPPERWING.** All coverts, including alula, brown (119B); inner webs paler; median and lesser coverts narrowly fringed light grey-brown (119C). Primaries, dark brown (119A) edged dull white on outer webs. Secondaries, dark brown (119A) broadly tipped white with subterminal black (89) borders, bordering patch of glossy dark-blue (170), which in some lights, becomes glossy purple (172A); glossy patches on secondaries, form speculum. Greater coverts, brown (119B) for half of length, tipped black (89) with subterminal white band. When wing spread, upper margin of speculum bordered by black (89) tips of greater coverts. Tertials, light grey-brown (119C); outer webs have broad subterminal brown (223A) edges. **UNDERPARTS.** Upper breast, rufous-brown (136), feathers narrowly tipped white when fresh. Moderately sharp demarcation occurs at lower breast with rest of underparts, which are white narrowly vermiculated dark brown (119A); vermiculations become paler, almost brown (c119B) towards vent. Axillaries, white. **UNDERWING.** Coverts, white; innermost greater coverts have vermiculated brown-grey (80) tips.

ADULT FEMALE BREEDING HEAD AND NECK. Crown feathers, black-brown (119), edged dull white; eye-stripe, black-brown (119), extends to ear-coverts. Rest of sides of head and hindneck, dull white with black-brown (119) shaft-streaks; shaft-streaks at side of neck, dark-brown (119A). Chin and throat, dull white to pink-buff (121D); rest of foreneck, dull white to pink-buff (121D) with narrow dark-brown (119A) shaft-streaks. In general, feathers on head and neck have streaked appearance. **UPPERPARTS.** Feathers of mantle, scapulars and upper tail-coverts, black-brown (119), fringed dull white; feathers have V-shaped dull-white to light-brown (223D) subterminal marks, crescents or streaks. Back and rump, black-brown (119), fringed dull white, with irregular light-brown (223D) spots on webs; fewer spots on upper tail-coverts. **TAIL,** dull white with dark-brown (119A) irregular shaft-streaks, bars and spots; outer rectrices, edged white. **UPPERWING,** similar to adult male, but tips of greater tertial coverts, light grey-brown (119C) to white. Speculum, narrower. Tertials, dark brown (119A) edged buff (124) to dull white; outer webs of outermost, edged light brown (223D). **UNDERPARTS.** Fringes on breast, buff (124) to light brown (223D); rest of feather has dark-brown (119A) and paler, subterminal crescents, shaft-streaks, opposing spots at edges of webs or blotches. Flanks, dull white, with broad dark-brown (119A) irregular subterminal U-shaped marks that are wider than dull-white fringe. Abdomen and vent, pale dark brown (119A), fringed pink-buff (121D) to white; under tail-coverts, white; rachis on central feathers, white with subterminal dark-brown (119A) rachis-streak. Outer under tail-coverts

similar, but with subterminal dark-brown (119A) spot on outer web. **UNDERWING**, similar to adult male. For full details of feather patterns and differences from adult female non-breeding, see Heitmeyer (1987).

ADULT MALE NON-BREEDING (ECLIPSE)

Superficially resembles adult female or juvenile. Differs from adult-female breeding by: **HEAD AND NECK**. In some lights, eye-stripe has dark-green (162A) gloss. Chin and throat, dull white. **UPPERPARTS**. Feathers have more uniform appearance; in some lights, rump and upper tail-coverts glossed dark green (162A). **UNDERPARTS**. Breast-feathers, dark brown (119A), fringed light brown (223D). Subterminal dark-brown (119A) spots on under tail-coverts, larger. Flanks sometimes vermiculated dull white. Underparts, less heavily streaked than juvenile. **TAIL**, similar to adult male breeding, but central pair of rectrices, black-brown (119), edged white. **UPPERWING**, similar to adult male breeding, but tertials dark brown (119A). Greater tertial coverts, without light grey-brown (119C) to white tips; white tips in adult female non-breeding.

ADULT FEMALE NON-BREEDING Similar to adult female breeding, but differs by: **UPPERPARTS**. Subterminal markings on feathers of mantle, back and rump, narrower and paler; fewer markings on scapulars and upper tail-coverts. **TAIL**. Irregular dark-brown (119A) shaft-streaks, narrower. **UPPERWING**. Greater tertial coverts, tipped white. Tertials, resemble those of adult male non-breeding (eclipse), dark-brown (119A) edged buff (124) to dull-white; outer webs of outermost, edged light-brown (223D). Tertials without broad subterminal streaks. For more detailed description, and comparison with adult female breeding, see Heitmeyer (1987).

DOWNY YOUNG HEAD AND NECK. Crown, hindneck, eye-stripe extending to nape, and small patch at ear-coverts, dark-brown (119A). Rest of head, yellowish cream (92) to buff (124); paler on chin and throat. **UPPERPARTS**, black-brown (119); down on back, long, hair-like and tipped light brown (26). Small, single oval-shaped dull-white to pale-yellow patch on either side of rump; similar patch on either side of middle of back, where wings folded. **TAIL**. Down, hair-like, dark brown (119A). **UPPERWING**, dark brown (119A); trailing-edge, dull white; merges with dull-white down on middle of back when wings folded. **UNDERPARTS**. Sides of breast and thighs, dark brown (119A). Rest of underparts, yellowish cream (92) to buff (124). **UNDERWING**, yellowish white. For further description, see Fjelds  (1977).

JUVENILE MALE HEAD AND NECK, similar to adult non-breeding male (eclipse), but eye-stripe lacks dark green (162A) gloss. Crown feathers, narrowly tipped light grey-brown (119C). **UPPERPARTS**. Feathers, uniform black-brown (119), narrowly fringed dark brown (119A); in some lights, tips of upper tail-coverts, glossed dark green (162A). **TAIL**, dark brown (119A), fringed buff (124); rectrices notched. **UPPERWING**, similar to adult male, but median and lesser coverts and greater tertial coverts, fringed light brown-grey (44); greater tertial coverts lack white tips; fringes become paler and lost with wear. Tertials, shorter and narrower than adult male non-breeding (eclipse), brown (119B). **UNDERPARTS**. Feathers of breast, dark brown (119A), broadly fringed cream (92) to cinnamon (39); fringes on abdomen, whitish; slightly darker, dark brown (119A) subterminal spots near tips. Flanks, dark brown (119A), fringed buff (124). **UNDERWING**, similar to adult male.

JUVENILE FEMALE Similar to juvenile male, but differs in: **UPPERPARTS**. Feathers, fringed buff (124), appearing paler than juvenile male. **UPPERWING**, similar to adult female;

median and lesser coverts, narrowly fringed buff (124); fringes become paler and lost with wear. Greater tertial coverts tipped white. Tertials resemble juvenile male, but slightly darker.

FIRST BREEDING MALE Similar to adult male breeding, but differs in: **UPPERPARTS**. Sometimes retain juvenile feathers on back and rump. **UPPERWING**. Mostly like juvenile, including tertials. Sometimes dull-white tips to inner webs of outer greater primary coverts. For full details, see Carney & Geis (1960) and Carney (1964).

FIRST BREEDING FEMALE Similar to adult female breeding, but differs in: **UPPERWING**. Like juvenile; separable from adult by pale-buff tips to inner webs of outer greater primary coverts. For full details, see Carney & Geis (1960), Carney (1964) and Krapu *et al.* (1979).

In the following summary (based on Heitmeyer 1987), the recognizable features of breeding (basic) plumage are listed compared with non-breeding (alternate) plumage in the female. Generally darker and more buffy brown and sepia rather than greyer. Differences are recognizable in most feather tracts but in particular: crown, blacker; facial margins, sepia rather than light grey; scapulars, much darker; rectrices distinctly different, being much darker with pattern unique depending on position of rectrix (most easily seen in breeding plumage); flank-feathers, darker but less boldly marked and with rounder tips; tertials always have lighter buff round distal three-quarters of feather with most examples having one or two diagonal light-brown bands on outer vanes (*c.f.* Pacific Black Duck) compared with greyish- to blackish-brown uniform feather in non-breeding female with no light markings.

BARE PARTS

ADULT MALE Iris, dark brown (219). Upper mandible, basally yellow-olive (52) merging to light blue-grey (88) near tip; tip and nail, grey-black (82); near eclipse, largely light blue-grey (88), with tip and nail grey-black (82). Lower mandible, no data. BWP states: bill, olive-green to bright yellow, occasionally pale blue or green-blue (dullest in eclipse). Nostrils, rimmed grey-black (82). Legs, dull orange (94) to salmon (106); feet, salmon (106); webs grey-brown (91).

ADULT FEMALE Iris, red-brown (32). Bill, dark-grey (83); grey-black (82) along culmen; usually with blackish irregular blotches in mid-section. Legs and feet, similar to adult male. BWP states: bill, dull yellow-orange to olive-brown; culmen, upper sides and tip, dark horn; some dark dots along edge of upper mandible.

DOWNY YOUNG Iris, brown. Bill, flesh, spotted black; nail, pink white. Feet, dark olive-grey (BWP); further details given in Fjelds  (1977).

JUVENILE Iris, dark brown. Bill, red-horn, becoming darker when older; in female sides paler, often small dots along edges of upper mandible. Feet, dull flesh or yellow to yellow-orange, webs darker (BWP).

MOULTS Undescribed in A'asia; presumably similar to n. hemisphere; requires study, in particular, timing and duration of moults; for full details of moults elsewhere, see Palmer (1976), BWP, Owen (1979) and Heitmeyer (1987). Also see Endler *et al.* (1988) for more information on moult and sexual dimorphism.

ADULT POST-BREEDING In NZ, at Antipodes Is, occurs Feb. (Warham & Bell 1979).

MEASUREMENTS (1) NZ, adult, live birds; methods unknown (M.J. Williams). (2) NZ, adult, live birds; methods as in Baldwin *et al.* (1931), flattened wing (Balham 1952). (3) Sydney, Aust., adult, live birds (Miller 1971).

	MALES	FEMALES
WING	(1) 277.7 (8.94; 255-303; 101) (2) 282.2 (9.8; 255-310; 147) (3) 268.0 (2.9; 200-320; 30)	262.6 (6.64; 242-278; 99) 264.1 (7.9; 245-290; 120) 268.0 (2.3; 220-300 19)
TAIL	(1) 89.4 (6.34; 74-103.6; 79) (2) 90.3 (3.3; 82-97; 146)	90.2 (5.40; 77.2-104; 87) 87.9 (3.5; 79-96; 121)
BILL	(1) 55.1 (2.33; 49.2-61.4; 111) (2) 55.7 (2.7; 46-62; 146) (3) 60.0 (0.8; 49-77; 30)	51.6 (2.30; 47.3-58.7; 101) 52.2 (2.2; 46-59; 120) 56.0 (0.3; 48-62; 19)
TARSUS	(1) 47.3 (2.21; 41.9-54; 111) (2) 48.9 (2.70; 43-56; 142)	45.2 (1.65; 41.3-49.2; 99) 47.0 (2.2; 41-55; 122)
TOE	(1) 62.6 (3.21; 51.9-70.2; 112) (2) 53.3 (2.4; 49-62; 143)	59.8 (2.46; 54.6-66; 99) 51.4 (2.2; 47-60; 119)

Additional measurements for European birds given in BWP and Owen & Cook (1977); for birds from USA, see Kortright (1942) and Palmer (1976). Full details of growth rates of chicks given in Greenwood (1975).

WEIGHTS (1) NZ, adult, live birds; methods unknown (M.J. Williams). (2) Sydney, Aust.; methods as in Baldwin *et al.* (1931) (Balham 1952). (3) NZ, live birds; methods as in Baldwin *et al.* (1931) (Balham 1952).

	MALES	FEMALES
(1)	1209.5 (98.31; 993-1412; 68)	1113 (102.7; 792-1403; 86)
(2)	1735 (499; 1000-2800; 30)	1580 (481; 1000-2400; 19)
(3)	1279 (145; 992-1928; 171)	1123 (145; 822-1389; 156)

Extralimital weights: in adults, see Palmer (1976) and BWP; in chicks, see Greenwood (1975). Studies on seasonal changes: Folk *et al.* (1966), Street (1975) and Owen & Cook (1977).

STRUCTURE Based on BWP. Wing, long and broad. Eleven primaries: p9 longest, p10 0.6 shorter, p8 5-13, p7 17-27, p6 27-45, p1 105-130 mm shorter. Inner web of p10 and outer p9 emarginated, inner p9 and outer p8 sometimes slightly. Full details of feather structure given in Humphrey & Clark (1961). Tertiaries, broad and long in breeding, shorter and narrower in non-breeding and juvenile. Scapulars, tapering towards pointed tip in breeding, tip round in other plumages. Tail, short and rounded; 18-20 rectrices; t1 longest. Bill, broad, and deep at base; culmen, slightly concave, but convex distally; tip, rounded; nail, small and rounded. Inter-ramal space, bare. Tarsus, short and rounded in cross-section. Feet, webbed. Outer toe c. 92% middle, inner c. 76%, hind c. 29%.

SEXING, AGEING Sexed on cloaca, see details given in Hochbaum (1942). For full details of ageing on basis of plumage characters, particularly of wing, see Carney & Geis (1960), Carney (1964), Hopper & Funk (1970), Krapu *et al.* (1979) and Gatti (1983).

GEOGRAPHICAL VARIATION Introduced into

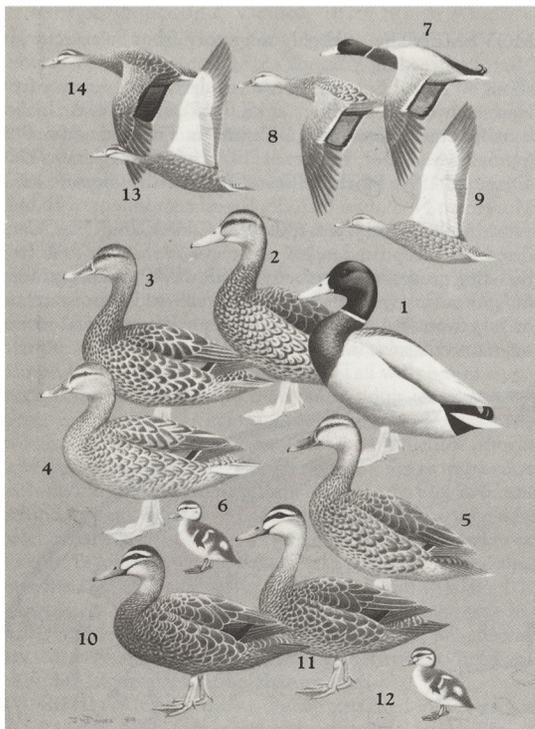
Aust. and NZ (Long 1981). In Aust, of European origin (Braithwaite & Miller 1975). In NZ, of British and North American origin (Williams & Roderick 1973). Hybridizes freely with Pacific Black Duck (see Hybrid ducks text), with which Mallard has close affinities (Peters). For full discussion of nomenclature and subspecific characters, see Delacour (1954-64), Palmer (1976), BWP and Peters.

RMO

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Volume 1 (Part B), Plate 94

Mallard *Anas platyrhynchos*

1. Adult male breeding
2. Adult male non-breeding
3. Adult female breeding
4. Adult female non-breeding
5. Juvenile
6. Downy young
7. Adult male breeding
8. Adult female
9. Adult female

Pacific Black Duck *Anas superciliosa*

10. Adult
11. Juvenile
12. Downy young
13. Adult
14. Adult

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