

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].

REFERENCES

- Bauer, K.M., & U.N. Glutz von Blotzheim. 1968-69. *Handbuch der Vögel Mitteleuropas*. 2,3.
- Berkhoudt, H. 1980. *Neth. J. Zool.* 30: 1-34.
- Bock, W.J. 1969. *Ann. NY Acad. Sci.* 167: 147-55.
- Brush, A. 1976. *J. Zool., Lond.* 179: 467-98.
- Campbell, A.J. 1899. *Ibis* (7) 5: 362-4.
- Delacour, J. 1954-64. *Waterfowl of the World*.
- Delacour, J., & E. Mayr. 1945. *Wilson Bull.* 57: 3-55.
- Delacour, J., & E. Mayr. 1946. *Wilson Bull.* 58: 104-10.
- Driver, P.M. 1974. In *Search of the Eider*.
- Edkins, E., & I.A. Hansen. 1972. *Comp. Biochem. Physiol.* 41B: 105-12.
- Faith, D. 1989. *Cladistics* 5: 235-58.
- Frith, H.J. 1964a. *Nature* 202 (4939): 1352-3.
- Frith, H.J. 1964b. *Emu* 64: 42-7.
- Frith, H.J. 1965. *CSIRO Wildl. Res.* 10: 125-39.
- Frith, H.J. 1967. 1982. *Waterfowl in Australia*.
- Fullagar, P.J., et al. In press. *Wildfowl* 41.
- Hecht, M.K., & F.S. Szalay (Eds) 1977. *Contributions to Vertebrate Evolution*. 3.
- Hochbaum, H.A. 1944. *The Canvasback on a Prairie Marsh*.
- Hochbaum, H.A. 1955. *Travels and Traditions of Waterfowl*.
- Hochbaum, H.A. 1973. *To Ride the Wind*.
- Jacob, J., & A. Glaser. 1975. *Biochem. Syst. Ecol.* 1975 (2): 215-20.
- Johnsgard, P.A. 1965a. *Handbook of Waterfowl Behavior*.
- Johnsgard, P.A. 1965b. *Wildfowl Trust Ann. Rep.* 16: 73-83.
- Johnsgard, P.A. 1968. *Waterfowl. Their Biology and Natural History*.
- Kear, J., & A.J. Berger. 1980. *The Hawaiian Goose. An Experiment in Conservation*.
- Kooloos, J.G.M. 1986. *Neth. J. Zool.* 36: 47-87.
- Kooloos, J.G.M., & G.A. Zweers. 1989. *J. Morph.* 199: 327-47.
- Kooloos, J.G.M., et al. 1989. *Zoomorphol.* 108: 269-90.
- Livezey, B.C. 1986. *Auk* 103: 737-54.
- Madge, S., & H. Burn. 1988. *Wildfowl*.
- Madsen, C.S., et al. 1988. *Auk* 105: 452-9.
- Olson, S.L., & A. Feduccia. 1980. *Smithson. Contr. Zool.* 323.
- Owen, M. 1980. *Wild Geese of the World. Their Life History and Ecology*.
- Palmer, R.S. (Ed.) 1976. *Handbook of North American Birds*. 2,3.
- Phillips, J.C. 1922-26. *A Natural History of the Ducks*.
- Ramsey, E.P. 1878. *Proc. Linn. Soc. NSW* 1878: 154.
- Scott, P. 1972. *The Swans*.
- Scott, P. 1988. *A Coloured Key to the Wildfowl of the World*.
- Sibley, C.G., & J.E. Ahlquist. 1972. *Bull. Peabody Mus. nat. Hist* 39.
- Sibley, C.G., et al. 1988. *Auk* 105: 409-23.
- Simonetta, A.M. 1963. *Arch. Zool. Ital.* 48: 53-135.
- SOWLS, L.K. 1955. *Prairie Ducks. A Study of Their Behaviour, Ecology and Management*.
- Todd, F.S. 1979. *Waterfowl. Ducks, Geese and Swans of the World*.
- Verheyen, R. 1953. *Gerfaut* 43 (Suppl.): 373-497.
- Woolfenden, G.E. 1961. *Bull. Fla. St. Mus., biol. Sci.* 6: 1-129.
- Zweers, G.A. 1974. *Neth. J. Zool.* 24: 323-467.
- Zweers, G.A., et al. 1977. In: Hecht & Szalay 1977.

Family **ANATIDAE** wildfowl

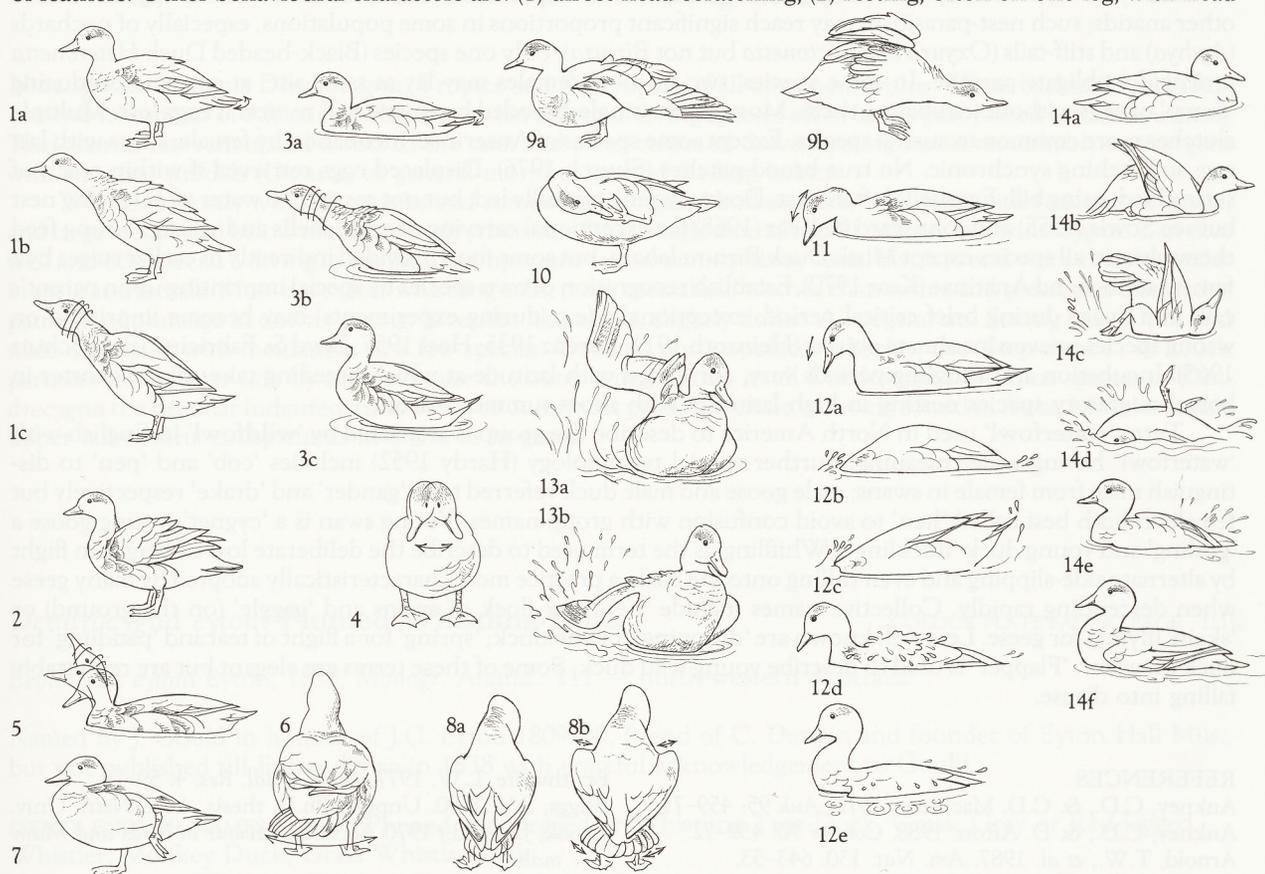
Waterbirds (some more or less terrestrial) with rather short legs and front toes connected by webs; hallux elevated and reduced. Though considerable adaptive diversity in outward appearance, size, colours of plumage, behaviour, and ecology, homogeneous in many characters, as attested by numerous, often 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 (tertials) often long and brightly coloured; diastatic. Many species, particularly in Tadorninae, Anatinae and Merginae have a specialized, contrastingly coloured patch (speculum) on upper surface of inner wing, important for sexual and social signalling. Most fly fast and have large, high-keeled sternum. Tail, short and square or slightly rounded in most; long in some diving species (serving as rudder), pointed or with elongated central feathers in some others. Tail-feathers, 14–24 but varying even in single species. Bills show much adaptive variation but typically of medium length, broad, often flattened centrally and distally but high at base, and rounded at tip with horny nail at tip, producing slight terminal hook; covered with soft skin. Edges of mandibles with rows of lamellae, showing different development in various ecological types and taxonomic groups; most highly specialized in surface plankton-feeders, least so in species (such as scoters *Melanitta*) that swallow molluscs whole. Tongue, thick and fleshy; epithelium covered with papillae and horny spines. Lower part of tibia and tarsus bare; front toes connected by webs (reduced in a few species), hind toe elevated. Gait, striding or waddling. Oil gland, feathered. Aftershaft, reduced or absent. Special intromittent copulatory organ present in males; vascularized sac everted from wall of cloaca, protruded by muscular action; facilitates sexing by examination (Hochbaum 1942), even of small young. Salt-secreting nasal glands subject to adaptive variation in size, even in same species; enlarged in forms inhabiting saltwater or brackish habitats, modifying profile of head considerably. In many species, males have remarkably lengthened, bent, or locally widened trachea forming resonating tubes; also syngo-bronchial sound-boxes (bullae), either fully ossified or with membranous fenestrae. These vocal structures highly characteristic of species or larger taxonomic units (see Eyton 1838 and, especially, Johnsgard 1961, 1971). Considerable diversity in types of plumage: male and female similar, nearly similar, or show extreme sexual dimorphism. In all species, except some sheldgeese, flight-feathers moulted simultaneously, producing period of flightlessness lasting 3–4 weeks. Two body-moult per cycle. Young precocial and nidifugous, covered with thick down; pattern often cryptic and characteristic of taxonomic groups within sub-families. Able to swim soon after hatching.

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

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

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



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

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

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

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

REFERENCES

- Ankney, C.D., & C.D. MacInnes. 1978. *Auk* 95: 459-71.
 Ankney, C.D., & D. Afton. 1988. *Condor* 90: 459-72.
 Arnold, T.W., *et al.* 1987. *Am. Nat.* 130: 643-53.
 Bauer, K.M., & U.N. Glutz von Blotzheim. 1968-69. *Handbuch der Vögel Mitteleuropas*. 2,3.
 Bengston, S.A. 1971. *Ibis* 113: 523-6.
 Boyd, H., & E. Fabricius. 1965. *Behaviour* 25: 1-15.
 Braithwaite, L.W. 1977. *Aust. Wildl. Res.* 4: 59-79.
 Briggs, S.V. 1990. Unpubl. Ph.D. thesis, Aust. Natn. Univ.
 Crook, J.H. (Ed.) 1970. *Social Behaviour in Birds and Mammals*.
 Drent, R.H., & S. Daan. 1980. *Ardea* 97: 480-90.
 Duncan, D.C. 1987. *Can. J. Zool.* 65: 234-46.
 Eyton, T.C. 1838. *A Monograph on the Anatidae, or Duck Tribe*.

- Fullagar, P.J., et al. 1988. *Proc. Int. Symp. Wetlands, 1986. Shortlands Centre, Newcastle*: 81-98.
- Goodwin, D. 1965. *Domestic Birds*.
- Gray, A.P. 1958. *Bird Hybrids. A Checklist with Bibliography*. Tech. Comm. No. 13, Cwealth Bur. Animal Breed.Genet, Edinburgh, Cwealth Agric. Bur.
- Hardy, E. 1952. *The Bird Lovers Week-end Book*.
- Harrison, C.J.O. 1967. *Ibis* 109: 539-51.
- Heinroth, O. 1911. *Proc. Int. orn. Congr. V*: 589-702.
- Heinroth, O., & K. Heinroth. 1954. *Aus dem Leben der Vögel*.
- Hess, E.H. 1957. *Ann. NY Acad. Sci.* 67: 724-32.
- Hochbaum, H.A. 1942. *Trans. 7th N. Am. Wildl. Conf.*: 299-307.
- Johnsgard, P.A. 1961. *Wildfowl Trust Ann. Rep.* 12: 58-69.
- Johnsgard, P.A. 1971. *Wildfowl* 22: 46-59.
- Johnsgard, P.A. 1973. *Wildfowl* 24: 144-9.
- Johnsgard, P.A., & J. Kear. 1968. *Living Bird* 7: 89-102.
- Kear, J. 1968. *Beihefte der Vogelwelt* 1: 93-133.
- Kear, J. 1970. Pp. 357-92. *In*: Crook 1970.
- Kingsford, R.T. 1989. *Aust. Wildl. Res.* 61: 405-12.
- Lack, D. 1967. *Wildfowl Trust Ann. Rep.* 18: 125-8.
- Lack, D. 1974. *Evolution Illustrated by Waterfowl*.
- Lessells, C.M. 1986. *J. Anim. Ecol.* 55: 669-89.
- Lorenz, K. 1935. *J. Orn., Lpz.*, 83: 137-213, 289-413.
- Lorenz, K. 1951-53. *Comparative Ecology of the Behaviour of the Anatinae*.
- McKinney, F. 1965. *Behaviour* 25: 120-220.
- Olney, P.J.S. 1963. *Proc. zool. Soc. Lond.* 140: 169-210.
- Pellis, S.M., & V.C. Pellis. 1982. *Aust. Wildl. Res.* 9: 145-50.
- Rohwer, F.C. 1984. *Auk* 101: 603-605.
- Rohwer, F.C. 1988. *Auk* 105: 161-76.
- Ryder, J.P. 1970. *Wilson Bull.* 81: 5-13.
- Schutz, F. 1965. *Z. Tierpsychol.* 22: 50-103.
- Skutch, A. 1976. *Parent Birds and Their Young*.
- Sowls, L.K. 1955. *Prairie Ducks. A Study of their Behaviour, Ecology and Management*.
- Szijas, K.M. 1965. *Vogelwarte* 23: 24-71.
- Thompson, S.C., & D.G. Raveling. 1988. *Wildfowl* 39: 124-32.
- Toft, C.A., et al. 1984. *J. Anim. Ecol.* 53: 75-92.
- Williams, G.C. 1966. *Adaptation and Natural Selection: A Critique of Some Current Evolutionary Thought*.

Sub-family **MERGINAE** eiders, scoters, sawbills, other sea-ducks

Medium-sized to fairly large, mainly marine diving ducks. Twenty species in ten genera, all but two species of n., mostly high, Arctic regions. Monotypic *Polysticta* (Steller's Eider); *Somateria* (typical eiders, three species); monotypic *Histrionicus* (Harlequin); monotypic *Camptorhynchus* (Labrador Duck) recently extinct; *Melanitta* (scoters, three species); monotypic *Clangula* (Long-tailed Duck); *Bucephala* (Bufflehead *B. albeola* and two species of goldeneyes); monotypic *Mergellus* (Smew); monotypic *Lophodytes* (Hooded Merganser of North America) and *Mergus* (typical mergansers, five species). Auckland Merganser *M. australis*, now extinct and Brazilian Merganser *M. octosetaceus* only representatives of Sub-family S of equator. For details see BWP; summary of more important features given here. All dive expertly, with use of wings when submerging and also under water in *Somateria*, *Histrionicus*, *Clangula*, and *Melanitta*; diving habits of *Bucephala* and *Mergus* more like *Aythya*. Sexes differ in tracheal structure; varying in males more than in any other Anatidae. Except in Brazilian Merganser *M. octosetaceus* (and extinct *M. australis*), sexual dimorphism extreme. Eclipse male plumage in most. Sturdy and specialized for living in rugged habitats, especially marine and, in case of *Histrionicus*, on turbulent running water; have outstanding powers of diving. Though strong fliers, less given to long daily or seasonal displacement than many other Anatidae. Concentrated mostly in high and upper mid-latitudes. Favoured coastlines more exposed and often more rocky than those frequented by other Anatinae. Most are gregarious. Chiefly take animal food; in *Mergus*, entirely so. Obtained by diving from surface, mainly to bottom, but *Mergus* unique within Anatidae in pursuing swift-moving prey under water. Seasonal breeders in Holarctic. Communal courtship well developed in most. Mostly ground nesters in cover, but some nest in holes in ground or trees, close to or away from water. Some species regularly loosely colonial. Crèching of young well developed in some *Somateria*.

Mergus australis Auckland Merganser

Mergus australis Hombron & Jacquinot, 1841, *Anns Sci. nat., Zool., Paris*, ser. 2, 16, p. 320 — Auckland Islands.

EXTINCT. Knowledge summarized in Kear & Scarlett (1970). Both male and female similar to small Red-breasted Merganser *M. serrator*; head and neck, rufous; upperparts, dark brown; chest, greyish brown and belly, off-white sometimes mottled grey-brown; erroneously reported as flightless in literature but could fly reasonably well although small-winged (Madge & Burn 1988). Past records from Auckland and Adams Is in Auckland Is Grp; doubtful record from Campbell I. last century; sub-fossil remains found on SI, NZ, and Stewart I. indicating occurrence until quite recently. First recorded 1840; last specimen collected 1902; last record and specimen listed by some as 1905 and 1909 respectively, both these appear unsubstantiated (NZCL; Ogilvie-Grant 1905; Kear & Scarlett 1970). Waite (1909) failed to observe any birds on his visit. Recent expeditions to locate bird, unsuccessful.

Extinction probably due to hunting by pre-Europeans and Europeans and introduction of mammals. Apparently sedentary.

A single gut contained mascerated fish bones, mandibles of a polychaete and a gastropod mollusc (Kear & Scarlett 1970); a fish *Gallaxias brevipinnis* (90x14 mm) was collected from mouth of a bird in the wild (Hutton 1902).

REFERENCES

- Chilton, C. (Ed.) 1909. *The Subantarctic Islands of New Zealand*.
 Hutton, F.W. 1902. *Trans. NZ. Inst.* 34: 198-99.
 Kear, J., & R.J. Scarlett. 1970. *Wildfowl* 21: 78-86.
 Madge, S., & H. Burn. 1988. *Wildfowl*.
 Ogilvie-Grant, W.R. 1905. *Ibis* (Ser. 8) 5: 543-602.
 Waite, E.R. 1909. Pp. 542-600. In: Chilton 1909.