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Waterfowl of North America: POCHARDS (Fresh Water Diving Ducks) Tribe Aythyini

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POCHARDS (Fresh Water Diving Ducks)
Tribe Aythyini

Until recent classifications by Jean Delacour and others, the pochard group was not taxonomically distinguished from the more marine-adapted sea ducks, here included in the following tribe Mergini. Nevertheless, the pochards are a readily definable group of mostly medium-sized ducks that differ from their close relatives, the surface-feeding ducks, in several respects. Their legs are situated somewhat farther back on the body, so that they are less adept at walking on land; their feet and associated webs are larger, increasing diving effectiveness (reflected by the increased length of the outer toes); and their bills are generally broad, heavy, and adapted for underwater foraging. Depending on the species, the predominant food may be of animal or vegetable origin. Internally, the males have tracheal tubes that are variably enlarged, and in contrast to the typically rounded and entirely bony structure of the tracheal bulla, this feature is angular and partially membranaceous. No iridescent speculum is present on the wings, but in many species the secondaries are conspicuously white or at least paler than the rest of the wing. The birds nest closely adjacent to water and sometimes even above the water surface, on reed mats or similar vegetation.

North America has five well-distributed species of pochards, one of which (the greater scaup) also extends to the Old World. Additionally, North American tufted duck records have become so numerous in recent years that the inclusion of that species has seemed necessary. One other Old World species, the common pochard (*Aythya ferina*), has rarely occurred in Alaska, with several Aleutian Islands records in recent years (Byrd *et al.*, 1974).
CANVASBACK
Aythya valisineria (Wilson) 1814

Other Vernacular Names: Canvas-backed Duck, Can.
Range: Breeds from central Alaska south to northern California and east to
   Nebraska and Minnesota. Winters from southern Canada south along the
   Atlantic and Pacific coasts to central and southern Mexico.
Subspecies: None recognized.
Measurements (after Delacour, 1959):
   Folded wing: Males 225-242, females 220-230 mm.
   Culmen: Males 55-63, females 54-60 mm.
Weights: Nelson and Martin (1953) reported that sixty-two males averaged
   2.8 pounds (1,268 grams), and seventy-nine females averaged 2.6 pounds
   (1,178 grams). Combining the data of Bellrose and Hawkins (1947) and
   that of Jahn and Hunt (1964) for fall-shot birds, eight adult males aver­
   aged 2.99 pounds (1,356 grams), while fourteen immatures averaged 2.83
   pounds (1,283 grams). Five adult females averaged 2.49 pounds (1,129
   grams), and nine immatures averaged 2.47 pounds (1,120 grams). Nelson
and Martin reported a maximum male weight of 3.5 pounds (1,577 grams) and a maximum female weight of 3.4 pounds (1,542 grams). Dzubin (1959) has provided weight data for various age classes, including some spring weights.

**IDENTIFICATION**

*In the Hand:* Canvasbacks are the only North American pochards that have a culmen length in excess of 50 mm. (or two inches); additionally the bill is uniquely sloping from its base to the tip and lacks a pale band near the tip. Supplementary criteria include the presence of vermiculated upper wing coverts, with the white predominating over the dark, rather than the darker tones predominating.

*In the Field:* When on the water, male canvasbacks appear to be nearly white on the mantle and sides, whereas male redheads are distinctly medium gray, and the longer, more sloping head of the canvasback is usually evident. Compared to the redhead, the head is a duller chestnut brown, darker above and in front of the red eyes; in redheads the head is a more coppery red and little if at all darker in front of the yellow eyes. Female canvasbacks are distinctly longer-bodied than female redheads and lighter in brownish tones, with brown breast usually distinctly darker than the more grayish sides, whereas in redheads the difference in color between the breast and the flanks is not very apparent. Both sexes appear longer-necked than redheads; in males this is accentuated by the extension of the reddish brown color beyond the base of the neck. In flight, this difference is also apparent; the black breast of the male canvasback is more restricted and does not reach the leading edge of the wings, whereas in redheads the black breast extends to the front of the wings. In females the brownish breast appears sharply separated from the pale grayish sides, while in female redheads the brown breast color is continuous with the brown of the sides and flanks. Except during courtship, canvasbacks are relatively quiet, but the male's cooing courtship call (uttered only on the water) may be heard frequently during spring.

**AGE AND SEX CRITERIA**

*Sex Determination:* A reddish eye color indicates a male in any adult plumage, as does the presence of rusty brown on the head or black feathers on the breast or tail coverts. However, since females are extensively vermiculated, this trait is not diagnostic for sex. Even in full eclipse the head of the male is relatively dark and lacks the pale areas around the eyes and the pale throat.
typical of females. Dzubin (1959) reported that by thirty days of age males begin to exhibit lighter scapular feathers than do females.

*Age Determination:* Immature birds of both sexes may still carry juvenal tertials, which are usually frayed to a pointed tip and are iron gray with or without white flecking, whereas in adults they are rounded and always have some vermiculations of flecking. The presence of any juvenal tertiwal coverts, middle coverts, or greater coverts, which can be easily recognized by their more uniformly grayish and unflecked or lightly flecked pattern, compared with the vermiculated first-winter or adult feathers, indicates immaturity (Carney, 1964).

**DISTRIBUTION AND HABITAT**

*Breeding Distribution and Habitat:* The canvasback occupies a breeding range and habitat comparable to that of its close European and Asian relative, the common pochard. It tends to have a somewhat more northerly distribution than that of the redhead, although the habitat requirements of these two species are quite similar. In Alaska the canvasback has a relatively wide breeding distribution and is a common summer resident in much of that state (Hanson, 1960). Its northernmost known occurrence is north of the Arctic Circle, but south of tree line (Campbell, 1969).

In Canada the canvasback ranges from the Old Crow area of the Yukon and the Anderson River of the Northwest Territories southeastward to central and southern British Columbia, and especially through the prairie areas of Alberta, Saskatchewan, and Manitoba. There is also a very local breeding area on Walpole Island, southern Ontario (Godfrey, 1966).

The breeding range in the United States south of Canada is disrupted and probably declining because of the extensive marsh destruction and drainage that has occurred in the prime areas of the canvasback’s range. In eastern Washington the canvasback is a rare nesting bird in Adams and Lincoln counties (Yocom, 1951). In Oregon it nests at Malheur National Wildlife Refuge (Erickson, 1948), as well as in the Klamath Lake–Tule Lake area of southern Oregon and adjacent California. It also nests locally in the Ruby Lake area of Nevada, in northern Utah, northern Arizona, southern Idaho, northern Colorado, and Wyoming. The heart of its United States nesting range is probably in the prairie pothole area of eastern Montana and the Dakotas and the sandhills lakes of Nebraska. The southern limit of breeding in the prairie states is apparently Kansas (Johnstone, 1964). To the east, the canvasback nests locally in northern Minnesota (Lee et al., 1964), has rarely
nested in Wisconsin (Jahn and Hunt, 1964), and has evidently bred on the Montezuma marshes of New York (Audubon Field Notes, 19:540). There is a single breeding record for Michigan (Zimmerman and Van Tyne, 1959) and apparently only one for Illinois (Audubon Field Notes, 19:519).

The preferred breeding habitat of canvasbacks consists of shallow prairie marshes surrounded by cattails, bulrushes, and similar emergent vegetation, large enough and with enough open water for easy takeoffs and landings, and with little if any wooded vegetation around the shoreline. Dwyer (1970) noted a much higher breeding canvasback population outside than inside Riding Mountain National Park in Manitoba, apparently because of the reduced numbers of trees around the breeding ponds. Keith (1961) found the highest use of canvasback pairs per unit of shoreline on a shallow lake with a maximum depth of eight feet, having scattered strands of bulrushes, shorelines dominated by rushes (Juncus), sedges (Carex), and spike rush (Eleocharis), and with several cattail-covered islands. Brood use per acre of water was also highest on this lake; apparently female canvasbacks moved from smaller nesting marshes to larger impoundments following hatching. Hochbaum (1944) noted that canvasbacks tend to use larger bays in the Delta, Manitoba, marsh than do other resident diving ducks, which frequent sloughs and potholes to a greater extent.

Wintering Distribution and Habitat: To a rather surprising degree, the interior-nesting canvasback tends to move to coastal areas for the winter months. On the Pacific coast some wintering occurs as far north as southern British Columbia and the Puget Sound area of Washington, and some occurs in western Oregon, but the center of the canvasback wintering habitat is the San Pablo Bay of central California.

Recent winter surveys by the United States Fish and Wildlife Service indicate that about one-fourth of the continental canvasback population winters in the Pacific Flyway, most of it north of the Mexican border. In Mexico, the canvasback is a relatively minor component of the wintering waterfowl, with the largest numbers found on the Pacific coast and in the interior. Leopold (1959) noted that, during 1952 surveys, most of the canvasbacks seen were on Lakes Chapala and Pátzcuaro, with the remainder primarily found near Tampico.

In the Atlantic Flyway, which harbors the majority of the North American canvasback population, wintering birds commonly occur from as far south as central Florida (Chamberlain, 1960) to coastal New England, but concentrate in the Chesapeake Bay area. This area typically supports nearly three-fourths of the Atlantic Flyway canvasback population, or almost half.
Breeding (hatched) and wintering (shaded) distributions of the canvasback in North America.
of the entire continental population (Stewart et al., 1958). The Detroit River–Lake St. Claire area and the coastal area of the Mississippi Valley represent other major wintering locations in eastern United States.

Stewart (1962) reported that the optimum canvasback habitat in the Chesapeake Bay area consists of fresh and brackish estuarine bays containing extensive beds of submerged plants or abundant invertebrates, especially certain thin-shelled clams and small crabs. Beds of wild celery (Vallisneria) in freshwater estuarine bays are heavily utilized by canvasbacks, as are pondweed (Potamogeton), wigeon grass (Ruppia), and eelgrass (Zostera) in the brackish bays. Brackish estuarine bays are the principal wintering habitats, with both saltwater and freshwater estuarine bays being used relatively little.

GENERAL BIOLOGY

Age at Maturity: Canvasbacks probably normally reproduce when a year old, but in captivity are particularly difficult to breed successfully. Ferguson (1966) noted that only one of fourteen aviculturalists reported breeding by yearling canvasbacks, and most reported initial breeding in the second or third year. Hochbaum (1944) also noted that captive canvasbacks that bred at Delta, Manitoba, were all more than a year old, but he believed that wild canvasback females commonly nest when a year old and that males were also physically able to reproduce at that age.

Pair Bond Pattern: Pairs are re-formed each winter and spring during a prolonged courtship period. Weller (1965) found that up to 10 percent of the female canvasbacks he observed between December and March were paired, while 41 percent were paired during March and April counts. Hochbaum (1944) noted that most canvasbacks were not paired on their arrival in southern Canada, but pair formation reaches a peak in late April and early May, and most birds are paired after the middle of May. Smith (1946) also observed intense pair-forming activities in mid-April.

Nest Location: Lee et al. (1964b) noted that canvasbacks nested over water in emergent vegetation that ranged from 14 to 48 inches high and averaged 34 inches, higher than the averages found for both ring-necked duck and redhead. Seventeen nest sites averaged 11.0 yards from open water, and ranged from 0 to 55 yards. Preference was shown among canvasbacks for nesting in smaller bulrush marshes with some open water present. Stoudt (1971) found that 80 percent of the 172 canvasback nests he found were in cattail cover, and similar preferences for cattail have been reported by Smith (1971) and Keith (1971). Hochbaum (1944) noted a strong preference for nesting in hardstem bulrush (Scirpus acutus), with cattails and reed (Phrag-
mites) also being accepted, but softstem bulrush (Scirpus validus) has not been found as a nest cover. Townsend (1966) found a high usage of reed and a low usage of sedge for canvasback, just the opposite of the situation for ring-necked duck and lesser scaup. Further, canvasbacks placed their nests closer to large areas (over 50 by 50 feet) of open water than did those species, and all the canvasback nests found were within 40 feet of such areas of water.

Clutch Size: Hochbaum (1944) reported that thirty-eight nests had an average of 10 canvasback eggs present, but twenty-two of these nests also had redhead eggs. Erickson (1948) found that fifteen nonparasitized nests had 9.9 eggs initially present, compared to an average clutch of 8.6 eggs in nonparasitized renesting attempts. Among seventy-four parasitized nests, there were an average of 7.0 host eggs and 6.1 intruder eggs. Smith (1971) noted an average clutch size of 7.4 eggs for 118 nests, while Stoudt (1971) found that 172 nests averaged 8.2 eggs.

Incubation Period: Hochbaum (1944) noted that, although ranges in incubation of 23 to 29 days had been recorded, most eggs hatch in 24 days under artificial incubation conditions.

Fledging Period: Fledging reportedly occurs 56 to 68 days after hatching (Dzubin, 1959).

Nest and Egg Losses: Sowls (1948) noted a 48 percent hatching success for twenty-four nests, and Lee et al. (1964b) a 25 percent hatching rate for sixteen nests, with predators accounting for half the losses and the striped skunk being the primary egg predator. Smith (1971) and Stoudt (1971) reported hatching rates of 48 and 65 percent, respectively, with skunks, crows, and magpies apparent predators. Crows accounted for many of the nest losses in Sowls's (1948) study. Erickson (1948) found that parasitism affected nesting success, with 91 percent of the eggs hatching in unparasitized nests that he found, compared to 77 percent of the eggs in parasitized ones. Likewise, a lower percentage of nests hatched when parasitically laid eggs were present, and a smaller average number of canvasback young per nest hatched. Weller (1959) reported comparable results in his studies.

Juvenile Mortality: Although frequent brood disruption and mergers of unrelated broods make brood size counts of older ducklings unreliable as estimates of duckling mortality, Smith (1971) and Stoudt (1971) estimated rearing success rates of about 80 percent. Geis (1959) judged that an average of 77.4 percent of canvasback pairs are successful in raising broods, and that an average of 5.8 ducklings per brood fledged.

From banding of flightless young canvabs, a first-year mortality rate of 77 percent has been estimated (Geis, 1959). This high juvenile mortality
rate and the specialized nesting requirements of canvasbacks are major reasons for the recent serious population declines of the species.

**Adult Mortality:** Geis (1959) estimated that an annual mortality rate of 35 to 50 percent is typical of canvasbacks after their first year of life. Boyd (1962) calculated a 41 percent mortality rate based on these figures. Females have considerably higher mortality rates than do males, which at least in part accounts for the seriously unbalanced sex ratios that have generally been reported for canvasbacks (Olson, 1965).

**GENERAL ECOLOGY**

**Food and Foraging:** The attraction of canvasbacks to wild celery beds in the northeastern states is very well known, and in that area they utilize both the seeds and vegetative parts of this plant extensively. Pondweeds play a secondary role there, but in the western states and the southeast their vegetative parts and seeds largely replace wild celery as the primary food. The vegetative parts of arrowhead (*Sagittaria*) and banana water lily (*Nymphaea flava*) are also of importance in the southeastern states (Martin et al., 1951). Stewart's (1962) study of canvasbacks shot in the Chesapeake Bay area indicated that various mollusks and crustaceans, especially macoma bivalves (*Macoma*) and mud crabs (*Xanthidae*), are important foods for wintering birds in brackish estuaries and the Patuxent River. In Minnesota, canvasbacks have traditionally been attracted to Lake Christina, which is large and shallow and has abundant growths of sago pondweed, wigeon grass, and naiad (*Najas*), of which the sago pondweed is selectively consumed by canvasbacks (Smith, 1946). Cottam (1939) also determined that pondweeds are the most important food for both canvasbacks and redheads.

A group of immature canvasbacks were found to consume from 2 to 3 percent of their body weight per day in natural foods, or an average of 0.78 pounds of wet-weight materials per day (Longcore and Cornwell, 1964).

**Sociality, Densities, Territoriality:** Few figures on canvasback breeding densities are available. Lee et al. (1964b) noted that in a 2.5-square mile study area in Mahnomen County, Minnesota, 2.5 to 7.0 pairs were present per square mile over a four-year period. Keith (1961) found an average of 2 pairs occupying 183 acres of impoundments during five years of study in Alberta, or about 7 pairs per square mile of wetlands. Dzubin (1955) noted that canvasbacks made up 10 percent of the breeding ducks in an area of southern Manitoba having 97.8 pairs per square mile, or about 10 per square mile. Stoudt (1969) noted that the peak densities of canvasbacks on five
prairie study areas in Saskatchewan, Manitoba, and South Dakota ranged from less than 1 to 11 pairs per square mile.

Hochbaum (1944) believed that territorial boundaries in canvasbacks and other pochards are less rigid than in surface-feeding ducks, and he never observed direct attacks associated with apparent territoriality. He did, however, believe that spacing of breeding pairs does exist in this species. However, Dzubin (1955) noted that canvasbacks were highly mobile during the pre-laying and incubation phases of reproduction and that certain areas had overlapping usage by different pairs, so that the concept of a home range, rather than a classic territory, seemed more appropriate.

*Interspecific Relationships:* Perhaps because of the similarities in nest site preferences, the canvasback is conspicuously affected by the parasitic nesting tendencies of redheads (Weller, 1959). Canvasbacks also socially parasitize other females of their own species (Erickson, 1948) and have been known to lay their eggs in the nests of both redheads and ruddy ducks.

Skunks, crows, raccoons, and no doubt a large number of other predators and scavengers have been found to be responsible for losses of eggs and ducklings, but the present unfavorable status of canvasback populations is more directly related to human activities: the destruction of breeding habitat, the pollution or other degradation of critical wintering areas, and the possible overshooting of females. Female losses are serious since females are much more vulnerable than males to shooting and since they represent a limiting factor in potential production, because of the distorted sex ratio among adults.

*General Activity Patterns and Movements:* Hochbaum (1944) has provided an excellent account of the daily and seasonal activities of canvasbacks on their nesting grounds.

Dzubin (1955) reported that a male canvasback occupied a home range with a maximum length of 3,900 yards during the breeding season, and that the female was somewhat less mobile, so that an overall home range of about 1,300 acres was estimated. Male canvasbacks apparently did not defend any of their home range, but did show aggression when other males approached their mates.

To a greater extent than is apparent with most ducks, canvasbacks appear to migrate in “waves,” with the dates of arrival both in spring and fall being fairly predictable (Smith, 1946; Jahn and Hunt, 1964). In spring, paired birds reach the breeding grounds first, followed later by unpaired flocks. There apparently is a differential migration of ages and sexes during the fall flights, but differential sex and age vulnerability to hunting confuses the picture in interpreting fall movements.
SOCIAL AND SEXUAL BEHAVIOR

Flocking Behavior: Hochbaum (1944) noted that during spring, arriving migrant canvasbacks are in small flocks that usually number four to a dozen birds, and rarely exceed twenty. On the other hand, fall groups are typically quite large and gain in size as they move southward. Concentrations are facilitated by the restricted number of favored feeding areas. Smith (1946) reported that on the 4,000-acre Lake Christina in Minnesota maximum concentrations of about thirty thousand birds were counted during the spring migration period. He noted that it was not unusual to see a flock of several thousand birds in close association about a hundred yards off shore engaged in courtship activities.

Pair-forming Behavior: The pair-forming behavior of canvasbacks has been well described by Hochbaum (1944). His account, as well as observations by Smith (1946) and Weller (1965), indicate that pair-forming activities begin in late winter and reach their peak in mid-April, during late stages of spring migration and arrival on the breeding areas.

Pair-forming displays of the canvasback, as described by Hochbaum, have provided the basic terminology for the displays of all pochard species. A courtship call, uttered with or without a head-throw; neck-stretching; a “sneak” posture; and a threatlike posture are the major male calls and postures of canvasbacks. Females perform inciting displays with strong neck-stretching, and inciting occurs in the same situations as with surface-feeding ducks. Wing-preening displays have not been observed in canvasbacks, but preening of the dorsal region is a major precopulatory display of all pochard species (Johnsgard, 1965). Aerial chases, as described by Hochbaum, do occur frequently in canvasbacks, but whether the tail-pulling he described is a typical aspect of pair formation or rather is related to attempted rape behavior is still somewhat uncertain.

 Copulatory Behavior: In canvasbacks, copulation is normally initiated by the male performing alternate bill-dipping and dorsal-preening movements. These are not highly stereotyped displays and are often overlooked by the casual observer. The female may perform the same displays, but commonly assumes a prone posture on the water without prior response. Treading lasts several seconds, and as the male releases the female’s nape, he typically utters a single courtship call, then swims away in a rather rigid posture with the bill pointed nearly vertically downward. The female usually begins to bathe immediately (Johnsgard, 1965).

Nesting and Brooding Behavior: Female canvasbacks typically spend a
considerable period searching for suitable nest sites and may abandon one or two nests before settling on a final location. The first eggs may be laid before the nest is completed and may be "dropped" in various places, sometimes in other nests. Eggs are laid in the morning, usually shortly after sunrise, at the rate of one per day. Down is often initially placed in the nest after the third or fourth egg, and is usually quite abundant by the time the clutch is completed. The female may be on the nest nearly continuously while the last two eggs are being deposited, and apparently begins incubation with the laying of the last egg. During incubation the female may take short rest periods off the nest during morning and evening hours, but these are reduced as incubation proceeds. The period between initial pipping and hatching varies from 18 to 48 hours (Hochbaum, 1944).

Following hatching, the female takes her brood from the nest site to the open water of larger ponds and shallow lakes, feeding heavily in morning and evening, but sometimes also at midday. The hen typically does not defend her young as intensively as do female surface-feeding ducks, but usually abandons them before they have fledged and begins to undergo her postnuptial molt (Hochbaum, 1944).

Postbreeding Behavior: Although the male accompanies the hen while she is searching for nest sites, he spends much of his time at a regular loafing site once the nest site is chosen. As soon as the clutch is completed, he typically deserts his mate (Hochbaum, 1944), although he may also remain associated with her until about mid-incubation (Dzubin, 1955). Thereafter he starts to associate with other males in similar reproductive condition and begins his postnuptial molt.
REDHEAD
Aythya americana (Eyton) 1838

Other Vernacular Names: Red-headed Duck, Red-headed Pochard.
Range: Breeds from central Canada southward to southern California, New Mexico, Nebraska, and Minnesota, with local or occasional breeding farther east. Winters from the southern part of its breeding range from Washington eastward to the middle Atlantic states and south to the Gulf coast of Mexico and Guatemala.
Subspecies: None recognized.
Measurements (after Delacour, 1959):
- Folded Wing: Males 230-242, females 210-230 mm.
- Culmen: Males 45-50, females 44-47 mm.
Weights: Nelson and Martin (1953) reported that eighty-two males averaged 2.5 pounds (1,133 grams), and forty females averaged 2.2 pounds (997 grams). Combining the data of Bellrose and Hawkins (1947) with that of Jahn and Hunt (1964) for fall-shot birds, four adult males averaged 2.39 pounds (1,084 grams), while fourteen immatures averaged 2.22 pounds.
(1,006 grams); six adult females averaged 2.28 pounds (1,034 grams), while five immatures averaged 2.17 pounds (984 grams). Maximum weights reported by Nelson and Martin are 3 pounds (1,361 grams) for males and 2.9 pounds (1,314 grams) for females.

IDENTIFICATION

In the Hand: Easily recognized as a pochard by its lobed hind toe and generally broad, flattened bill; redheads are typical of this genus of diving ducks. Males in nuptial plumage may be identified by their uniformly coppery red head and yellow eyes and by their flattened bluish bills with a pale subterminal band and a blackish tip. The black breast and the uniformly gray speculum, of nearly the same color as the upper wing coverts, are similar to those of the canvasback, but the black breast extends from the wings to the foreneck, and the upper wing coverts are slightly darker rather than lighter than the secondaries. Females may be separated from female canvasbacks by their shorter bills and more rounded head profile (see canvasback account) and from female ring-necked ducks by their longer wings, black margined inner secondaries, less definite eyerings and eye-stripes, and the usual white flecking on their scapulars (see ring-necked duck account).

In the Field: On the water, redheads appear to be shorter-bodied and shorter-necked than canvasbacks, and have a shorter and more rounded head profile. Males have a brighter, more coppery head color, and the backs and sides of the body are medium gray rather than whitish, while female redheads are more uniformly brownish on the head, breast, sides, and back, lacking the two-toned effect of female canvasbacks. During late winter and spring, the male courtship call of redheads is frequent and audible for long distances; it is a unique catlike meow sound that few would attribute to a duck. Like most pochards, females rarely utter loud calls that are useful for field identification. In flight, male redheads appear mostly grayish to white from underneath, except for the black breast (which extends back to the leading edge of the wings) and brownish head. Their shorter necks and greater amounts of black on the breast are the best means of distinction from male canvasbacks. Females likewise exhibit white on the abdomen and the underwing surface, and the brown color of the head and breast extends back in an unbroken manner under the wings along the sides. Redheads fly with strong rapid wing-beats, in a swift flight with relatively little dodging or flaring such as occurs in dabbling ducks, and they are more agile in flight than canvasbacks.
AGE AND SEX CRITERIA

Sex Determination: A pale, yellowish eye indicates a male in any adult plumage, as do vermiculations anywhere except on the scapulars, where females sometimes also exhibit slight vermiculations. However, only males are vermiculated near the tips of the tertials (Carney, 1964).

Age Determination: The greater secondary and tertial coverts of adults are broad and rounded; those of males are heavily flecked with white, and those of females are unflecked or faintly flecked near their edges. Juvenile greater coverts are narrower, squared, often somewhat frayed, and may have pale edges, the males' being faintly flecked and the females' unflecked. Juvenile tertials, until molted, indicate immaturity by their frayed, pointed tips and brownish gray coloration (Carney, 1964). The blunt-tipped juvenile tail feathers are dropped between three and one-half and seven months of age, in no apparent sequence, according to Weller (1957). Weller also reports that young males can be recognized by the reduced area of black in the breast region as compared with older birds, and young females usually exhibit speckled buffy brown on their under tail coverts, whereas older females show brownish olive patches.

DISTRIBUTION AND HABITAT

Breeding Distribution and Habitat: Weller's (1964) review of the breeding distribution of the redhead is both recent and authoritative and has provided the basis for the present summary.

In Alaska redheads are now known to breed in the area of Tetlin and Minto, along the Tanana River, and in the Fort Yukon area of the Yukon and Porcupine rivers.

In Canada redheads breed in the intermontane region of British Columbia and are particularly prevalent in the Prairie Provinces of Alberta, Saskatchewan, and Manitoba, extending locally northward as far as Great Slave Lake, Northwest Territories. There are several small breeding localities in the southern part of Ontario, including Lake St. Clair, Charter Island, Luther Marsh, and Toronto Island (Godfrey, 1966; Audubon Field Notes, 19:538; 20:565). In Quebec redheads have bred at Lake St. Francis and perhaps also on the St. Lawrence River near Trois Rivieres (Audubon Field Notes, 22:590); the latter may be the result of releasing captive birds (Weller, 1964). Breeding has also been recorded in New Brunswick, which evidently is the eastern limit of the breeding range of this species.
Breeding (hatched) and wintering (shaded) distributions of the redhead in North America.
In the United States south of Canada, the breeding range of the redhead is discontinuous and declining, but is centered in the prairie potholes area of the Dakotas. Small, local breeding populations probably occur in all of the western states eastward as far as Kansas, Nebraska, Iowa, and Minnesota (Weller, 1964). The southernmost breeding record may be for a lagoon south of Carlsbad, New Mexico (Audubon Field Notes, 13:455). In Minnesota the species reaches the eastern limit of its major breeding range and is about the fifth most common breeding duck (Lee et al., 1964a). In Iowa it is still common in a few northwestern counties (Weller, 1964), but in Wisconsin it is now a regular breeder only in one county (Jahn et al., 1964). It has bred at Lake St. Clair, Michigan, as well as at several other localities (Zimmerman and Van Tyne, 1959). Additionally, there are breeding records for Ohio and Pennsylvania, and in New York nestings have occurred recently in the central part of the state as an apparent result of releasing hand-reared birds (Weller, 1964). There are also a few records of redheads breeding at Jamaica Bay, Long Island (Audubon Field Notes, 15:453; 19:528).

Weller (1964) described the redhead’s breeding habitat as nonforested country with water areas sufficiently deep to provide permanent, fairly dense emergent vegetation for nesting cover. Weller believes that this species evolved in the alkaline water areas of the American Southwest and attains highest breeding densities in alkaline water areas.

In Minnesota redheads usually nest in wet emergent vegetation from 20 to 40 inches tall, typically among cattails or similarly high vegetation around deep potholes that have some open water present (Lee et al., 1964a). Lokemoen (1966) found that redheads preferred to nest in potholes at least one acre in size, and that potholes most suitable for brood rearing were of this size or larger and were also deeper than those used for nesting. Low (1945) reported that the highest nesting densities in Iowa occurred where about 10 to 25 percent of the habitat consisted of open water; the areas of open water used for landing and taking off were at least a square rod in size, and usually 3 to 4 rods square. Water depth in nesting areas appeared to be more important than the presence of specific plant species, with a water depth of about 9 inches at the nest site seemingly favored. Water areas used for brood rearing were larger, deeper, and more open than those used for nesting.

Wintering Distribution and Habitat: Weller has provided an excellent summary of the distribution and relative abundance of redheads in their major North American wintering areas. He reported that 78 percent of the wintering birds, based on 1951 to 1956 winter inventory surveys, were concentrated along the Laguna Madre of coastal Texas and adjacent Tamaulipas. Another 11.9 percent occurred from the Chesapeake Bay area south to Pamlico
Sound, and coastal Florida supported about 5 percent. The remaining 5 percent occurred on the western coast of Mexico, in California, along the southern Great Lakes, and in other minor wintering areas. Weller characterized typical wintering areas as large bodies of water along the coast that are well protected from heavy wave action. They are often fairly shallow, and they may be brackish or highly saline, as in the case of the Laguna Madre. Stewart (1962) indicated that in the Chesapeake Bay area redheads are most numerous during winter in brackish estuarine bays containing extensive beds of clasping-leaf and sago pondweeds (Potamogeton perfoliatus and \( P. \) pectinatus), wigeon grass (\( Ruppia \)), and eelgrass (\( Zostera \)). During spring and fall migration they evidently prefer fresh and slightly brackish estuarine bays and concentrate in areas having an abundance of submerged plants such as wild celery (\( Vallisneria \)) and naiad (\( Najas \)). They also use more brackish areas like those typical of wintering birds, but concentrate on freshwater areas. Stewart suggested that seasonal shifts of habitat might be related to weather severity and resulting ice conditions in different areas during winter.

**GENERAL BIOLOGY**

*Age at Maturity:* Ferguson (1966) noted that only six of nineteen aviculturalists reported breeding by captive redheads in their first year of life, but in part this apparent delayed maturity may reflect the difficulties of breeding this species under captive conditions. Since Weller (1965) noted that all the wild females he observed had established pair bonds by the time of their arrival at breeding areas, it seems probable that many of them at least attempt to nest during their first year. Quite possibly the yearling birds are responsible for much of the parasitic egg-laying found in this species, as a result of incompletely matured nest-building and brooding tendencies.

*Pair Bond Pattern:* Pair bonds are established yearly, after a rather prolonged period of social courtship (Weller, 1965; 1967). Pair formation begins as early as late December or January and normally persists until about the beginning of incubation (Oring, 1964), although Hochbaum (1944) recorded a single case of the pair bond apparently persisting until after hatching.

*Nest Location:* Nests are typically found over standing water in emergent vegetation or on a mass of plant material surrounded by water. In Minnesota wet cattail stands are the most common nest sites of redheads, although other emergent species are also used (Lee *et al.*, 1964a, 1964b). The average height of vegetation above the water surface in a sample of Minnesota nests was 29 inches, with a range of 20 to 40 inches. This average was slightly less than
that of canvasback nests and more than that of ring-necked ducks. Nine redhead nests averaged 9.7 yards from open water, with almost half within 5 yards of open water and none beyond 50 yards. Canvasback and ring-necked duck nests were very similar to those of redheads in this regard. Miller and Collins (1954) also reported that hardstem bulrush from 2 to 10 feet high was preferred nesting cover.

Lokemoen (1966) analyzed nesting preferences of redheads in Montana and found that hardstem bulrush (*Scirpus acutus*) was the most highly preferred cover but that, because of its greater abundance, cattail was most commonly used by redheads. Baltic rush (*Juncus balticus*) and spike rush (*Eleocharis*) were third and fourth place in the preference scale. Large stands and wide bands of emergent vegetation were preferred over smaller or more disrupted stands for nesting, and water depth at the nest site averaged 10 inches. Potholes larger than one acre in size were preferred over smaller ones for nesting sites, and none under one-fourth acre in size were utilized. Williams and Marshall (1938) also found hardstem bulrush to be the most highly preferred nesting cover, with alkali bulrush (*S. paludosus*) scarcely utilized and both cattail and phragmites having only limited usage.

*Clutch size:* Weller (1959) reported that a total of 1,380 redhead nests reported in eight different studies had an overall average clutch size of 10.8 eggs, with averages of individual studies ranging from 8.9 to 13.8 eggs. However, Weller found that of 17 nests that were laid by only a single hen, none exceeded 9 eggs and the average clutch size was only slightly over 7 eggs. Weller considered that renesting was absent or unlikely to be important in redheads because of the lateness of the peak of initial nesting attempts. Lokemoen (1966) estimated an average clutch of 7.9 eggs for nonparasitized nests, and reported finding 23 probable renesting attempts.

*Incubation Period:* Reported as 24 days by Hochbaum (1944). Weller (1957) reported that the incubation period ranges from 24 to 28 days, and Low (1945) stated that five nests he studied had an average incubation period of 24 days, while one other nest required 28 days.

*Fledging Period:* Weller (1957) reported that hand-reared birds fledged at ages of 56 to 73 days.

*Nest and Egg Losses:* Weller (1964) reported an average nesting success of 53 percent for 503 nests found during six different studies. He also (1959) calculated an average hatching success of 32 percent for 10,802 eggs observed in six studies. He believed that only 50 to 60 percent of the female population build nests and he found that eggs laid by nonnesting (parasitic) females had a low hatching success. More recently, Lokemoen (1966) reported 15.2 percent nesting success and 9.9 percent hatching success for the eggs in 138 nests.
with desertion and communal nesting attempts accounting for more than half of the failures. Mammals (mostly skunks) and birds (magpies and crows) also accounted for some nest losses.

In total, Weller (1964) believed that the 60 percent or so of the female redhead population attempting to nest hatch an average of 3.4 young per nest and that about one egg laid by each parasitic female hatches, assuming a 10 to 15 percent hatching success of such eggs.

**Juvenile Mortality:** Prefledging mortality of ducklings is still not well known, but Low (1945) estimated that there may be a 30 percent loss of young during the first six weeks of life. Weller (1964) provided brood size data for well-grown broods that suggest an even higher survival rate, but brood mergers very probably reduce the reliability of such data.

First-year mortality of redheads is extremely high and may average about 75 percent for the year following banding (Hickey, 1952). Rienecker (1968) calculated an even higher mortality rate (78.7 percent) for first-year birds, as Brakhage (1953) did for wild-trapped (80 percent) and hand-reared (94 percent) birds. Females of both the immature and mature age classes are considerably more vulnerable than males to gunning mortality (Benson and DeGraff, 1968) and additionally are more greatly exposed to dangers of predation during nesting.

**Adult Mortality:** Adult annual mortality rates of redheads have been estimated by Hickey (1952) at about 55 percent and by Rienecker (1968) at 41 percent. Longwell and Stotts (1959) estimated a 44 percent mortality for Chesapeake Bay redheads. Lee *et al.* (1964b) estimated a 62 percent adult mortality, as compared with an estimated 80 percent rate for first-year birds. These figures, although not in extremely close agreement, all suggest a dangerously high rate for adults as well. In contrast to Rienecker’s conclusion, Geis and Crissey (1969) reported that highly restrictive hunting regulations resulted in significant reductions in the mortality rates of redheads and canvasbacks.

**GENERAL ECOSYSTEM**

**Food and Foraging:** The summaries by Martin *et al.* (1951) and Cottam (1939) of redhead foods indicate that the vegetative parts and seeds of pondweeds (*Potamogeton*), wild rice (*Zizania*), wild celery (*Vallisneria*), and wigeon grass (*Ruppia*), the seeds of bulrushes (*Scirpus*), and the vegetative parts of muskgrass (*Chara*) are major foods in various parts of the country. In the important wintering area Laguna Madre, McMahan (1970) reported that over 90 percent of the volume of food materials in 104 redhead
samples consisted of wigeon grass and shoalgrass (*Diplantera*), with the latter occurring in 83 percent of the samples and alone constituting 84.2 percent of the food volume. Small gastropod and pelecypod mollusks made up the relatively insignificant proportion of animal materials that were found. Lynch (1968) noted the importance of shoalgrass to wintering redheads throughout the Gulf coast. Stewart (1962) reported on the foods of redheads from the Chesapeake Bay area, based on a sample of 99 birds. There, the leaves, stems, rootstalks, and seeds of submerged plants were also the principal foods, but the food species differed considerably. In freshwater estuaries various pondweeds and naiad (*Najas*) were major foods, in brackish estuaries eelgrass (*Zostera*) and clasping-leaf pondweed (*P. perfoliatus*) were most important, and in samples from saltwater estuaries these two species plus wigeon grass had been taken, as well as bait corn and sorghum.

The findings of Bartonek and Hickey (1969) on summer-collected redheads on their breeding grounds in Manitoba indicate a higher usage of animal materials by both adult and young birds than had been generally appreciated. Aquatic invertebrates form the bulk of spring and summer foods, especially cladocerans, gastropod mollusks, and the larvae of Trichoptera (caddis flies) and Tendipedidae (midges).

**Sociality, Densities, Territoriality:** To a degree that seems stronger than in the canvasback, the redhead appears to exhibit a sociality on the breeding grounds that may in part be related to its semiparasitic nesting tendencies. These tendencies may partly result from the redhead’s specialized requirements for nesting sites, which cause a concentration of nests in the limited suitable habitat. Williams and Marshall (1938) reported an average nesting density of 0.11 redhead nests per acre in 3,000 acres of total nesting cover, but up to 11 nests per acre in a 2-acre area of alkali and hardstem bulrushes. Vermeer (1970) noted redheads to be among the species of ducks he found nesting in higher densities among tern colonies than in areas where larids were absent, and he reported an average redhead nesting density of 0.11 nests per acre.

Densities over larger areas of breeding habitat are of course much lower. Stoudt (1969) reported that in five prairie study areas of Canada and South Dakota the peak density of redheads varied from 1 to 6 pairs per square mile. Lokemoen (1966) reported an unusually high density of 25 pairs per square mile on a 2,600-acre study area of western Montana. However, a high incidence of attempted communal nesting and nest desertion were associated with this breeding density.

There is no evidence that redheads defend a territory or even part of their home range. Lokemoen (1966) noted that males did not defend any
part of their home range. Hochbaum (1944) mentioned that redheads appeared to him to be the most tolerant of the diving ducks in the Delta, Manitoba, area relative to close association of pairs, with as many as three pairs occupying a half-acre slough simultaneously.

**Interspecific Relationships:** The significant role that social parasitism of redheads plays in the breeding biology of other marsh-nesting species has been documented by Weller (1959), who noted that eight other species of ducks, as well as bitterns and coots, have been reported parasitized, and both Weller's and Erickson's (1948) studies indicated that social parasitism by redheads reduced the hatching success of canvasback eggs. Erickson also found a reduced nesting success for canvasback nests when comparing parasitized versus nonparasitized nests.

Weller (1959) also noted that a number of other species of duck, including the ruddy duck, mallard, lesser scaup, canvasback, fulvous whistling duck, pintail, cinnamon teal, shoveler, and gadwall, have occasionally been found to drop their eggs in redhead nests.

Redheads have the usual array of egg and duckling predators, although the fact that they normally nest well away from shoreline probably reduces their losses to those by strictly terrestrial scavengers and predators. Keith (1961) did report that half the redhead nests he found in southeastern Alberta were on land, and many of these were very poorly concealed. He noted that skunks destroyed a number of redhead nests, and Lokemoen (1966) also found that skunks were the major mammalian predators of redhead nests in Montana. Low (1945) reported that minks and crows were responsible for nest losses in Iowa, and both crows and magpies were noted by Lokemoen (1966) as avian egg predators.

**General Activity Patterns and Movements:** Home range estimates for redheads on their breeding grounds are still generally not available. Lokemoen (1966) stated that pairs moved an average of 180 yards (variation among eleven pairs was 50 to 670 yards) from their "breeding-pair potholes" to nesting potholes.

Long-distance movements of redheads have been analyzed by Weller (1964). He documented the occurrence of a postseason adult molt migration in a northerly and somewhat easterly direction, as well as similar movements by juvenile birds. He also established the directions and relative magnitudes of spring and fall migratory movements, pointing out that the flyway concept is relatively meaningless in interpreting this species' movements. In contrast to the canvasback, which predominantly moves to the Atlantic coast or the Pacific coast for wintering, the vast majority of redheads undertake the rela-
tively long flight over dry country to the Gulf coast. Weller attributes this difference in part to the hypothesized differences in areas of evolutionary origin of these two species.

SOCIAL AND SEXUAL BEHAVIOR

Flocking Behavior: Like canvasbacks, redheads often gather in fairly large flocks on lakes that provide protection and food, forming large “rafts” that may number in the hundreds or even thousands. During the winter and spring migration periods these large groupings tend to fragment as pair bonds are formed, and the unpaired birds congregate in courting party units. Low (1945) noted that spring migrant flocks usually did not exceed 25 individuals, and Weller (1967) mentioned that sometimes as many as 14 males were seen following a single unmated female. Shortly after arrival at the breeding grounds, the paired birds separate and disperse, and flocking behavior ceases until after the breeding season.

Pair-forming Behavior: The pair-forming behavior of redheads is similar to that of canvasbacks and other pochard species (Johnsgard, 1965; Weller, 1967) and differs in quantitative rather than qualitative characteristics. The commonest male courtship call is a catlike note, uttered during neck-kinking or a head-throw display. A softer call resembling coughing is also uttered, and aggressive neck-stretching by both sexes is frequent. Females perform inciting calls with alternate lateral and chin-lifting movements of the head, and a frequent male response to such inciting is to swim ahead and turn-the-back-of-the-head toward the inciting female. Weller (1967) noted that males on wintering areas were observed to “lead” females, and the latters’ action in following them seemed to indicate a willingness to pair. This same combination of leading and following has been reported in captive birds (Johnsgard, 1965) and seems to represent a significant aspect of pair formation among both dabbling ducks and pochards. Aerial chases, involving tail-pulling, are characteristic of birds on the breeding grounds but are rare during migration, suggesting that they do not play a role in the pair-formation process, which is virtually completed by the time of the birds’ arrival at their nesting grounds. More probably, they are associated with chases of the female by strange drakes, and represent attempted rapes.

Copulatory Behavior: Copulation is normally preceded by alternate bill-dipping and dorsal-preening behavior on the part of the male or, at times, by both male and female. The female then assumes a receptive posture and is immediately mounted by the male. Following treading, the male normally
utters a single note as he releases his grip on the female’s nape, and he swims away in a stereotyped bill-down posture. This same posture may be assumed for a short time by the female before she begins to bathe (Johnsgard, 1965).

**Nesting and Brooding Behavior:** Low (1945) reported on nesting and incubating behavior of redheads. He found that nest-building began two days to a week before egg-laying began. Eggs were deposited in the nest at any time of the day, as Weller (1959) later confirmed, although most eggs are apparently laid before noon. One to two more days are required to lay a clutch than there are eggs present, indicating an egg-laying rate of slightly more than one day per egg. Incubation may begin as late as 24 to 48 hours after the last egg is laid. During incubation the females that Low studied left the nest an average of six times a day. Renesting females not only left their nests more often, but also spent less total time on the nest than those making initial nesting attempts. Pipping requires from 16 to 18 hours, and Weller (1959) noted that during this period the female begins to utter low notes that probably serve to “imprint” the ducklings on their mother. Weller watched one brood that left its nest when the young were no more than 47 hours old. Redhead females are well known to be relatively poor parents, relatively rarely feigning injury when a family is approached and often deserting their brood while they are still fairly young. Low (1945) said that the young were usually abandoned by the time they were 7 or 8 weeks old, before they were able to fly.

**Postbreeding Behavior:** Male redheads usually abandon their females fairly early in the incubation period and soon begin to gather in groups prior to their postnuptial molt. At least in some areas a fairly long molt migration may be undertaken by such birds to more northerly areas to certain large, shallow lakes such as Lake Winnipegosis (Weller, 1964). Young redheads may also move considerably during late summer and autumn following fledging and also often range far to the north of the place where they were reared. There is no strong evidence favoring a major differential migration of the sexes during fall, but the greater vulnerability of females to gunning results in a high proportion of this sex being shot during fall migration. Rienecker (1968) noted, however, that males range farther than females in their migratory movements.
RING-NECKED DUCK
Aythya collaris (Donovan) 1809

Other Vernacular Names: Blackjack, Ring-billed Duck, Ringbill, Ringneck.
Range: Breeds from Mackenzie District through the forested regions of southern Canada, south locally to California, Colorado, Nebraska, Iowa, Pennsylvania, and New York, and from New England to Nova Scotia, Cape Breton Island, and Newfoundland. Winters along the Pacific coast from British Columbia to Baja, California, in most of Mexico and adjoining Central America, in the southeastern states and along the Atlantic coast north to Massachusetts, and in the West Indies.
Subspecies: None recognized.
Measurements (after Delacour, 1959):
- Folded wing: Males 195-206, females 185-195 mm.
- Culmen: Males 45-50, females 43-46 mm.
Weights: Nelson and Martin reported that 285 males averaged 1.6 pounds (725 grams), and 151 females averaged 1.5 pounds (679 grams). Combining the data of Bellrose and Hawkins (1947) with that from fall-shot...
birds reported by Jahn and Hunt (1964), 17 adult males averaged 1.74 pounds (789 grams), while 33 immatures averaged 1.53 pounds (694 grams); 15 adult females averaged 1.51 pounds (685 grams), while 29 immatures averaged 1.49 pounds (676 grams). The maximum weights reported by Nelson are 2.4 pounds (1,087 grams) for males and 2.6 pounds (1,178 grams) for females. Mendall (1958) provides additional weight data from winter, spring, and summer seasons.

IDENTIFICATION

In the Hand: Ring-necked ducks are often misidentified by hunters, the males usually being confused with scaup and the females with scaup or redheads. The pale whitish ring near the tip of the bill will separate both sexes from scaup, as will the absence of predominantly white secondary feathers. The male ring-necked duck may be readily distinguished from redheads or canvasbacks by its darker, rather glossy greenish black upper wing coverts and tertials, which lack any light gray vermiculations. Females, however, are much more difficult to separate, for although ring-necks lack the long, sloping bill of female canvasbacks, redheads also have a whitish band near the tip of the bill. Nevertheless, unlike female redheads, female ring-necked ducks have secondaries that are more distinctly grayish than are the relatively brown coverts, and a white eye-stripe and eyering are more evident. The wings are shorter (folded wing less than 200 mm. vs. at least 210 mm. in female redheads), and the scapulars are never flecked or vermiculated with whitish.

In the Field: When in nuptial plumage, the male ring-necked duck on the water is the only North American diving duck that has a black back and breast pattern, with a vertical white bar extending upward in front of the folded wing. The rare tufted duck also has a black back and breast, but lacks the white bar and has a much longer and thinner crest than does the ring-neck. The ring-neck's white ring near the tip of the bill is often apparent at close range, but the chestnut ring at the base of the neck is rarely visible. Females on the water are probably best identified by their association with males, but usually exhibit a white eyering and posterior eye-stripe, as well as the white ring near the tip of the bill. Females lack the scaup's white facial mark, but they do have distinctly pale areas near the base of the bill. In flight, ring-necked ducks resemble scaup but lack white wing-stripes, and their darker back and upper wing coloration serves to separate them from redheads or canvasbacks, even before the head coloration is apparent. Ring-necks are relatively quiet ducks, and the courting calls of the male include a soft breathing note and a louder whistling sound difficult to characterize, both of which are only uttered on the water.
AGE AND SEX CRITERIA

Sex Determination: Males have yellowish rather than brownish eyes, and a pale area at the base of the bill. Vermiculated flanks or black feathers on the head, breast, or back also indicate a male. Sex determination by wing characters is difficult, but the tertials of males are more shiny greenish black and more pointed than those of females, and the secondary coverts are darker and may be slightly glossy.

Age Determination: Juvenal tertials are pointed, straight, and usually badly frayed, whereas those of adults are more rounded and usually are slightly curved. Likewise the greater and middle coverts of juveniles are relatively narrow, frayed, and rough (Carney, 1964). The tail should also be examined for notched tips.

DISTRIBUTION AND HABITAT

Breeding Distribution and Habitat: The breeding range of this strictly North American species has been documented by Mendall (1958), whose work may be consulted for details of distribution.

The ring-necked duck did not until recently breed in Alaska, but has been reported from the Bering Sea to the Canadian border (Hansen, 1960). In the past few years the species has been increasing in Alaska, and there are now several breeding records (White and Haugh, 1969). In Canada it is for the most part restricted to the area south of latitude 60° N., with its northernmost limits near Fort Simpson and lower Slave River (Godfrey, 1966). Otherwise, it breeds in the Cariboo Parklands of British Columbia, over much of Alberta, Saskatchewan, and Manitoba north of the prairie “pothole” country, in Ontario from Hudson Bay south to the Great Lakes, in southern Quebec, in the Maritime Provinces, and on Newfoundland.

To the south of Canada, the species is primarily found in the Great Lakes and New England regions, but isolated breeding does occur elsewhere. In northeastern Washington there are several breeding records (Yocom, 1951), and in Oregon there is a breeding record for the lower Klamath region (Mendall, 1958; Audubon Field Notes, 8:355). Limited breeding has also been reported for Nevada, Montana, and Colorado (Mendall, 1958). In Nebraska ring-necks breed locally in the sandhills lakes (Rapp et al., 1950); breeding in South Dakota is rare (American Birds, 25:869); and in North Dakota they breed locally in the eastern and northeastern portions of the state (Stewart, 1968). In Minnesota the ring-neck ranks third, behind the blue-winged teal and the mallard, among breeding birds for the state as a whole (Lee et al., 1964a). In Wisconsin it likewise ranks third (also behind the blue-winged teal
Breeding (hatched) and wintering (shaded) distributions of the ring-necked duck in North America.
and the mallard) in abundance of breeding ducks (Jahn and Hunt, 1964), and in Michigan it is a common breeder (Zimmerman and Van Tyne, 1959). It has been recorded breeding in Illinois, Indiana, and Pennsylvania, and in New York it breeds over a 500-square-mile area of the Adirondacks (Foley, 1960). Vermont, New Hampshire, and Maine probably represent its southern limit of regular breeding in New England, but it has bred a few times in Massachusetts (Mendall, 1958), and there is even a recent record of a brood sighted in Florida (Audubon Field Notes, 23:644).

Mendall has characterized the favored breeding habitat as sedge-meadow marshes and bogs, ranging in size from an acre to nearly 2,000 acres. Shallow freshwater marshes, swamps, and bogs are all used by ring-necks, and bogs are especially favored, particularly those with sweet gale (Myrica) or leatherleaf (Chamaedaphne) cover. Further, white water lily (Nymphaea odorata) and water shield (Brasenia schreberi) are frequent associate plants of nesting birds in Maine, as are yellow water lilies (Nuphar) in Washington. Fresh water or acidic areas are apparently preferred over brackish or saline waters; a pH range of 5.5 to 6.8 is typical of breeding habitats.


In recent midwinter surveys, nearly 60 percent of the wintering ring-neck population have been seen in the Mississippi Flyway, almost 40 percent in the Atlantic Flyway, and only insignificant numbers in the western states. In Mexico they are mostly limited to the Gulf coast region, with major concentrations from Tamaulipas to northern Yucatán, and especially in the Laguna de Alvarado, Veracruz (Leopold, 1959). They also winter along the Caribbean lowlands through Honduras at least as far as Panama, although in small numbers.

The Gulf coast of Texas supports some wintering ring-necks, but far fewer than does the corresponding area of Louisiana, which, with Tennessee, probably has the largest numbers of wintering birds in the Mississippi Flyway. In the Atlantic Flyway, the species is widely dispersed during winter on marshes, lakes, ponds, and reservoirs throughout the south, but peak concentrations probably occur in South Carolina, Georgia, Florida, and Alabama (Mendall, 1958; Addy, 1964). Some birds winter as far north as Chesapeake Bay, and very limited numbers occur locally even farther north.

In the Chesapeake Bay area, the preferred habitats of migrant and wintering ring-necks consist of fresh or slightly brackish estuarine bays and interior impoundments, with movement to moderately brackish waters during colder periods (Stewart, 1962). Mendall reported that on wintering areas the birds remain partial to shallow, acid marshes. They do also use coastal la-
goons, where they often associate with scaup, but they generally select less brackish conditions than do scaup.

**GENERAL BIOLOGY**

*Age at Maturity:* Ferguson (1966) noted that only one of eleven aviculturalists reported breeding by captive ring-necked ducks in their first year of life, but nevertheless it is generally assumed that wild birds attain sexual maturity within a year of hatching.

*Pair Bond Pattern:* Pair bonds evidently begin to be formed on wintering grounds, probably starting in January or February (Weller, 1965). The pair bond typically breaks during the last week of incubation, or at the latest very shortly after hatching (Mendall, 1958). The association of apparently paired birds during fall migration may indicate the re-forming of bonds of previously paired birds, but this point has not been established.

*Nest Location:* Mendall (1958) reported that of 518 nest sites found, almost half were on floating islands, nearly 40 percent were on hummocks or clumps in open marsh, 9 percent were on solid islands, and the remaining few were on floating logs, in woodland swale, or in dry meadow. Only a single nest was on a dry site, and only two were in emergent vegetation, but the distance to open, permanent water averaged only 27 yards and ranged up to 400 yards. About 70 percent were within 15 yards of water sufficiently open for birds to land and take off. Perhaps the most important site criterion is the presence of a reasonably dry site with suitable cover and fairly close to water of swimming depth. About 70 percent of the nests were in a mixture of sedge (*Carex*), sweet gale, and leatherleaf vegetation, and another 10 percent were in a mixture of sedges and other plants. More nests were found under sedge than under any other growth of a single plant species, but most nests were placed in mixed cover types. There was no evident relationship to distance from shoreline or woods, but small clumps of nesting cover seemed to support more nests than did larger ones.

*Clutch Size:* Mendall (1958) reported that the average size of 423 completed clutches was 9.0 eggs, with an observed range of 6 to 14. Renest clutches averaged about 2 eggs fewer (6.96), with nearly half of the observed cases having 7 eggs present. Eggs are apparently laid at the rate of one per day. Hunt and Anderson (1965) noted a reduction in average clutch size from 7.9 eggs in eight initial nests, to 7.8 eggs in eight second nests, and 7 eggs in one third nesting attempt. They found that eight of ten marked females attempted to renest following nest loss, and one attempted a second renest.

*Incubation Period:* Observed incubation periods on naturally incubated
eggs have ranged from 25 to 29 days, with most clutches hatching after 26 or
27 days (Mendall, 1959).

_Fledging Period:_ Mendall reported a fledging period of 49 to 56 days for
wild ring-necked ducks, which is a surprisingly short fledging period for any
pochard species.

_Nest and Egg Losses:_ Mendall reported that 70 percent of 485 first nests
under study hatched, while 61 percent of 52 renesting attempts hatched. This
relatively high nest success was associated with a very low nest desertion rate,
and most of the losses were attributed to predation. Major mammalian egg
predators were minks, raccoons, and foxes, while crows, ravens, and marsh
hawks were primary avian predators. Minks, crows, ravens, and raccoons
alone accounted for over 70 percent of the predation losses and probably also
contributed to the 19 percent loss by unknown predators.

_Juvenile Mortality:_ Mendall found that the average brood size at hatch-
ing was 8.4 young, while that of well-grown (class III) broods was 5.2 young.
Evidently the highest brood losses occur in the first 48 hours of life, and there-
after the mortality is fairly low. Some losses were definitely attributed to snapp-
ing turtles, and this species was believed responsible for considerable brood
mortality in some areas. Jahn and Hunt (1964) summarized data from a
variety of studies that indicated an average of about 6 ducklings per brood
surviving to near the flight state. They also judged that about half the females
succeeded in producing broods.

Mortality rates of birds banded as juveniles and recovered in their first
year after banding are apparently high. Lee et al. (1964b) calculated a 75.7
percent mortality rate for such birds, and Jahn and Hunt (1964) estimated a
70 percent annual immature mortality rate.

_Adult Mortality:_ Lee et al. (1964b) calculated a 66 percent annual mor-
tality rate for ring-necked ducks recovered one to five years after banding,
while Jahn and Hunt (1964) estimated a 50 percent annual adult mortality
rate.

**GENERAL ECOLOGY**

_Food and Foraging:_ Martin et al. (1951) and Cottam (1939) reported
that the seeds of water shield, the seeds and vegetative parts of pondweeds,
and the seeds or vegetative parts of various other submerged or emergent
aquatic plants are consumed by ring-necked ducks in considerable quantities.
Additionally, animal materials such as insects, mollusks, and other aquatic
animal life are taken in substantial amounts, averaging about a quarter of the
total diet.
Mendall (1958) made a detailed study of food intake of ring-necked ducks in Maine, and found that the tubers and seeds of two species of bulrush, seeds and vegetative parts of various pondweeds, and seeds of bur reeds (*Spar­ganium*) were major foods of adults, especially in spring and fall. Samples obtained during summer had a higher incidence of pondweeds and grasses, specifically wild rice (*Vallisneria*), followed by the seeds of spike rush (*Eleo­charis*) and water lilies. Although nearly 90 percent of the adult food was of plant origin, samples from downy young contained about half animal matter, mostly aquatic insects. Plant materials included many of the same items taken by adults, even including the tubers of bulrushes. Mendall reported that ring-necked ducks generally feed in shallower waters than do other diving ducks in Maine, and preferred those less than five feet deep for foraging. They also tip-up at times, and generally remain submerged for relatively short periods of about 8 to 25 seconds.

**Sociality, Densities, Territoriality:** Mendall (1958) reported that ring-necked ducks are not averse to nesting in close proximity to one another, sometimes nesting only 5 or 6 feet apart. One quarter-acre island was found to support 6 ring-neck nests and 1 black duck nest. This would suggest the possibility of fairly high nesting densities in favorable habitats. Jahn and Hunt (1964) indicated that a six-year average density of ring-neck pairs per 100 acres of wetlands in Wisconsin was 9 for the northern highland and 6 for the central plain. Perhaps a more realistic measure of ring-neck densities is that provided by Lee et al. (1964b) for a 2.5-square-mile study area in Mahnomen County, Minnesota. In four years, the estimated population of ring-necked ducks ranged from 4.5 to 12 pairs per square mile and averaged 8.8, or almost twice as high as either the redhead or the canvasback populations. Mendall (1958) reported maximum densities of various study areas as ranging from a pair per 23 acres to one per 6 acres, with the latter density apparently close to the maximum possible. He believed that the unusual small home range and low level of intraspecific aggressiveness accounted for this remarkably high potential breeding density.

Mendall (1958) has discussed the possible role of territoriality in ring-necked ducks and noted that defense of the female had often been seen, but defense of specific areas had been noted only a few times, and then only prior to or during nest site selection. He nevertheless accepted the concept of territoriality as applying to this species, assuming that a condition of mutual respect served to avoid friction between pairs. Yet, little or no evidence of territorial boundaries could be found, and Mendall was unable to explain how concepts of classic territoriality might be applied to this species.

**Interspecific Relationships:** The rather specialized habitat preferences of
the ring-necked duck largely place it out of direct contact with other pochards on the breeding grounds, and probably only the black duck regularly breeds in its preferred nesting habitats. On wintering grounds it most often associates with scaup, but tends to occupy less brackish waters.

Predators of eggs include minks, crows, ravens, raccoons, foxes, skunks, and perhaps other species, but the first four probably account for the largest number of losses (Mendall, 1958). Ducklings have reportedly been taken by snapping turtles, minks, and foxes, and no doubt other predators also account for some losses.

General Activity Patterns and Movements: Little specific information on daily activity rhythms and local movements are available. Mendall (1958) noted that ring-necks have a regular daily feeding pattern, except during courtship and the early stages of nesting. He mentioned that their morning foraging flights are seldom as early as those of black ducks and goldeneyes, but the evening feeding period is at about the same time.

Mendall also reported that on a seventy-acre study area (Barn Meadow), the first pairs to arrive in spring initially had rather large home ranges ("territories"), which decreased in size as other pairs moved in. Up to seven pairs were found to occupy the marsh, and additional pairs may have had their nests within it, but established waiting sites and/or "territories" elsewhere. Thus, it would seem that home ranges of this species may vary in size during the breeding season, but in general are probably relatively small and localized.

SOCIAL AND SEXUAL BEHAVIOR

Flocking Behavior: Mendall (1958) stated that fall migrant flocks of ring-necks are generally larger than those in spring, but groups of 10 to 25 birds are frequent. During periods of mass migration large flocks may sometimes occur, but the usual flock size of groups arriving at the wintering grounds is 5 to 25 birds. Apparently there is a substantial segregation of the sexes during fall migration, although the details of this are still obscure.

Spring migrant flocks are usually rather small, with groups of about 6 to 30 being typical. The earliest migrants are usually pairs and courting groups, followed by many unpaired birds having a large excess of males (Mendall, 1958).

Pair-forming Behavior: The pair-forming behavior of ring-necked ducks begins on the wintering grounds and probably reaches a peak during spring migration in March and April (Weller, 1965). By mid-May, when nesting is under way, it is seen very little, although scattered occurrences may take place until mid-June (Mendall, 1958).
The male pair-forming display of ring-necked ducks includes the usual pochard head-throw and "kinked-neck" calls, both of which are associated with a soft whistling note, neck-stretching, a rudimentary head-forward or "sneak" posture, and a few other less conspicuous displays (Johnsgard, 1965; Mendall, 1958). The female's inciting movements and calls are much like those of other pochards and serve the same function. Marquardt (cited in Mendall, 1958) noted the importance of the female's inciting in stimulating and maintaining male display activity, and it is certainly true that inciting behavior seems to play a major role in pair formation. The response of the preferred male to such behavior is usually to swim beside or ahead of the female and turn-the-back-of-the-head toward her. Ripley (1963) described an unusual lateral threat display in males that has not been reported by other observers, but evidently failed to observe some of the more typical ring-neck displays.

_Copulatory Behavior:_ Ring-necked ducks normally precede copulation with mutual bill-dipping and dorsal-preening behavior. The postcopulatory display is reportedly the usual male call and bill-down posture typical of all pochards so far observed (Johnsgard, 1965).

_Nesting and Brooding Behavior:_ Mendall (1958) has provided a large amount of information on nesting behavior, part of which may be summarized here. Females apparently select the nest site, but are accompanied by males. In early-nesting birds as much as a week or ten days may elapse between site selection and the laying of the first egg, while late-nesting birds may begin to lay almost immediately. Sometimes little or no actual nest is evident at the time the first egg or two are deposited, and until about the sixth egg there is still usually little nest shape evident. However, down is then usually added as the clutch is completed, and the vegetation overhead may be woven together to form an overhead arch. Ramps may be built to nests elevated above the ground surface, and runways to the nearest water are established. Eggs are usually laid in the forenoon, during visits lasting fifteen minutes to three hours. Incubation apparently begins on the day that the last egg is laid. During early stages of incubation the female may spend considerable time away from the nest, especially on cool days, and the period of strongest incubation behavior is between 9:00 a.m. and 3:00 p.m. During the last two weeks of incubation the females incubate more closely, and during this period the male usually abandons his mate.

Pipping of the egg occurs 24 to 48 hours prior to hatching, and most eggs hatch within a 6 to 8-hour period. The female then normally broods her young for at least 12 hours, and the family leaves the nest in late afternoon or, more frequently, shortly after sunrise on the day following hatching. In contrast to
most other waterfowl, the female ring-neck may bring her young back to the
nest for brooding purposes for 2 to 4 days after hatching, or even longer. Fur­
ther, few females abandon their broods prior to the time of fledging, even when
they themselves have become flightless. There are apparently few if any brood
mergers in this species and no apparent friction between the parents of broods
feeding in close proximity.

Postbreeding Behavior: Males begin their postnuptial molt even before
they have abandoned their mates and soon begin to gather with other males
that never attained mates or have abandoned theirs. There is probably a north­
ward molt migration of birds that breed in Maine, but the distance and location
of molting areas are still only poorly known. One such area, the St. John
Estuary of New Brunswick, regularly supports several hundred molting birds
in August and early September. The duration of the flightless period is prob­
ably three or four weeks, with the females having their flightless stage about a
month later than the males. As young birds attain the power of flight, they
begin to wander about, forming loose flocks that seem to disperse in a hapha­
hazard fashion. Before long, however, cooling weather in fall brings on initial
gatherings in preparation for the southward migration.
TUFTED DUCK
Aythya fuligula (Linnaeus) 1758

Other Vernacular Names: None in North America.
Range: Breeds in Iceland, the British Isles, and through most of northern Eu­
rope and Asia to Kamchatka and the Commander Islands. Winters in cen­
tral and southern Europe, northern Africa, southern Asia, the Philippines, 
and Japan, with stragglers regularly appearing on both the Pacific and At­
lantic coasts of North America and rarely inland.
Subspecies: None recognized.
Measurements (after Delacour, 1959):
   Folded wing: Males 198-208, females 189-202 mm.
   Culmen: Males 38-42, females 38-41 mm.
Weights: Bauer and Glutz (1969) have summarized weight data on this spe­
cies, and considerable data are also provided by Dementiev and Gladkov 
(1967). January weights of twenty-one males reported by Bauer and Glutz 
averaged 872 grams, while eleven females weighed during the same period 
averaged 759 grams. Maximum weights mentioned were 1,020 grams for 
males and 955 grams for females.

IDENTIFICATION

In the Hand: This rare Eurasian duck has been seen frequently enough in 
North America to warrant a knowledge of its identifying marks. The bill is 
slightly narrower and shorter than that of a scaup (maximum culmen length
42 mm.; maximum width under 24 mm.) and is only slightly wider toward the
top than at the base, while both the nail and adjacent tip are black in color.
Whitish vermiculations are lacking on the back and upper wing coverts of both
sexes. Males have a thin, drooping crest, which is rudimentary in females, but
females lack a white cheek mark large enough to be continuous across the
forehead (some females have a whitish mark at the sides of the mandible).

In the Field: Females may not safely be distinguished from female scaup
in the field, but males may be safely recognized by the presence of a black
back and chest with no white vertical bar between them (eliminating ring-
necked ducks) and a thin, drooping crest on a purplish head (eliminating
scaups). In flight, both sexes are very similar to scaup and cannot be safely
distinguished from them by inexperienced persons. The calls of both sexes are
virtually the same as those of scaup.

AGE AND SEX CRITERIA

Sex Determination: The presence of a definite, elongated crest or of defi-
nite vermiculations on the scapulars, sides, or flanks indicates a male. In
eclipse plumage the sexes may be difficult to distinguish, but some vermicula-
tions are present on the male’s grayish sides and flanks, while in females the
sides and flanks are more uniformly brownish. According to Veselovsky
(1951) juvenile males can be distinguished from females by their darker
brown head and neck color and bluish gray, rather than dark brown, bill. Kear
(1970) found that by the thirty-fifth day of age males have a brighter yellow
eye color than do females.

Age Determination: Although the adult plumage is attained by the end of
December, individuals carrying notched tail feathers have been taken as late
as April (Kear, 1970). Bauer and Glutz (1969) noted that the axillars and
greater and middle upper wing coverts of immature birds are shorter and have
more frayed edges than those of adults.

OCCURRENCE IN NORTH AMERICA

Either the tufted duck has become much more frequent in North America
during recent years or earlier it was confused with the somewhat similar ring-
necked duck. The earliest known North American records are from St. Paul
and Attu islands, Alaska, as reported by Gabrielson and Lincoln (1959).
Tufted ducks have also been seen several times at Adak Island (Audubon
Field Notes, 24:634, 706; American Birds, 25:543, 894). There is also an
unverified report that they have bred on Amchitka Island, and several have been seen there (American Birds, 26:891).

In Canada tufted ducks seem only to have been reported from British Columbia, the first sight record being obtained in 1961 (Godfrey, 1966). In recent years they have been reported from a variety of points in that province (Audubon Field Notes, 24,531; American Birds, 25:616).

Pacific coast records from south of Canada are largely from Washington. In the Seattle area the species has been seen almost every winter in recent years (Audubon Field Notes, 22:369; 469; 23:399; 24:426, 531; American Birds, 25:543). There is at least one winter record from Oregon (Gochfield, 1968) and several from California (Audubon Field Notes, 22:572; 23:101; American Birds, 25:621). There is also one record from the continental interior, of a male in Wyoming (Gochfield, 1968).

Atlantic coast records have recently become so numerous as to make a complete listing impossible. The largest number of state records are from Massachusetts, where the species was first reported in the 1950s (Audubon Field Notes, 9:9; 13:276). In the Falmouth area the tufted duck has been seen yearly since 1963 (ibid, 23:449, 569). New York has also reported tufted ducks in most recent winters (ibid, 20:204; 22:173, 422; 23:183; 24:487; American Birds, 25:555). Likewise, they have appeared during several winters in New Jersey (Audubon Field Notes, 22:158; 23:173) and also have been reported twice from Connecticut (Austin, 1969; American Birds, 25:548).
GREATER SCAUP
_Aythya marila_ (Linnaeus) 1761

Other Vernacular Names: Big Bluebill, Bluebill, Broadbill.

Range: Breeds in Iceland, in northern Europe and Asia to northern Siberia, and in North America from arctic Alaska and arctic Canada east to the eastern shore of Hudson Bay, to northern Labrador, Anticosti Island, and Newfoundland. In North America winters on the Pacific coast from the Aleutian Islands to California, on the Gulf coast almost to Mexico, on the Atlantic coast from Florida to southern Canada, and on the eastern Great Lakes.

North American Subspecies:
_A. m. mariloides_ (Vigors): Pacific Greater Scaup. Breeds in North America as indicated above, as well as in eastern Asia. Includes _nearctica_,

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which is recognized by the A.O.U. (1957) as the North American breeding form.

Measurements (after Delacour, 1959, and including A. m. marila):
Folded wing: Males 215-233, females 210-220 mm.
Culmen: Males 43-47, females 41-46 mm.) Godfrey, 1966, reported males to range from 41.5 to 48 mm., as compared to 39 to 43 mm. for lesser scaup males.)

Weights: Nelson and Martin (1953) reported that sixty males averaged 2.2 pounds (997 grams), while forty-three females averaged 2.0 pounds (907 grams), with maximum weights of 2.9 pounds (1,314 grams) for both sexes. Winter weights of the comparably sized European race were reported by Schiöler (1926) to average 1,256 grams for twelve adult males and 1,131 grams for eight immature males; twelve adult females averaged 1,182 grams and seven immatures averaged 1,024 grams.

IDENTIFICATION

In the Hand: As with the lesser scaup, the presence of a white speculum, a bluish bill which widens toward the tip, yellowish eyes, and vermiculated gray to brownish upperparts will eliminate all other species of ducks. For separation from lesser scaup, see the account of that species.

In the Field: In good light, male greater scaup exhibit a greenish, rather than purplish, gloss on the head and have a relatively low, uncrested head profile. Additionally their back appears more grayish, since it has a more finely vermiculated pattern. In flight, the extension of the white speculum to several of the inner primary feathers may be apparent. Female greater scaup are difficult to distinguish from female lesser scaup unless they are together. They are slightly larger and have more white on the face, especially on the forehead. The calls of the females of both species are similar, the most frequent one a low, growling arrrr that is somewhat weaker in the lesser scaup. The courtship calls of the male greater scaup are a very soft, cooing wa'hoooo and a weak and very fast whistle week-week-week, compared with the lesser's faint whee-ooo and a single-noted whew whistle (Johnsgard, 1963). In both species these calls may only be heard at fairly close range during courtship activity.

AGE AND SEX CRITERIA

Sex Determination: Although both sexes may have vermiculated scapulars, those of males are predominantly white while those of females are predominantly dark. Females always lack flecking on the tertials and usually also
on the greater and middle coverts, whereas males usually exhibit this (Carney, 1964). Most males older than juveniles will have black or blackish feathers on the head, breast, or rump, and may exhibit vermiculations on the flanks. Flank vermiculations are lacking in females.

Age Determination: Juvenal tertials are usually frayed to a pointed tip, whereas those of adults have more rounded tips. Additionally, juvenal tertials are rough, often narrower, and duller than those of adults. The tail should also be examined for squarish and notched-tipped feathers.

DISTRIBUTION AND HABITAT

Breeding Distribution and Habitat: In North America the greater scaup is primarily confined to areas north of 60° N. latitude as a breeding species, considerably farther north than is the case with the lesser scaup. However, in their choice of breeding habitats, the two species appear to be very similar.

In Alaska the principal breeding range extends from the Alaska Peninsula northward along the coast of the Bering Sea to the valley of the Kobuk River (Gabrielson and Lincoln, 1959). It also breeds to some extent along the northern coast of Alaska. It is common on the Aleutian Islands during spring and summer months, and on Amchitka Island it has at least been reported to nest (Kenyon, 1961). Breeding no doubt occurs over much of the interior of Alaska also, since scaup made up over a third of the ducks identified on aerial breeding-ground surveys made by the United States Fish and Wildlife Service between 1960 and 1969. However, at least in eastern Alaska the lesser scaup also breeds, and the relative occurrence of the two species in the state is still rather uncertain. Irving (1960) found the greater scaup to be about ten times more common than the lesser scaup around Anaktuvuk Pass, while at Old Crow near the Alaska-Canada border the reverse situation seemed to apply. Likewise King (1963) reported that in the upper Yukon River area only 52 of more than 12,000 scaup banded while molting were greater scaup, and evidently only a few nest in that area.

In Canada the breeding range extends from the Yukon eastward through the districts of Mackenzie and Keewatin and southward to extreme northwestern British Columbia, northern Manitoba, the Hudson Bay coast of Ontario and Quebec, the Ungava Bay coast, Anacosti Island, and eastern Newfoundland (Godfrey, 1965). It is probably a fairly common breeder on the Avalon Peninsula of Newfoundland (Tuck, 1968).

The breeding habitat of the greater scaup is evidently that of tundra or low forest closely adjacent to tundra. Hildén (1964) reported that this species requires relatively open landscape, cool temperatures, and shallow waters of
Breeding (hatched) and wintering (shaded) distributions of the greater scaup in North America.
high trophic quality with open, preferably grassy, shores. He noted a strong social attraction toward nesting gulls or terns, and he found highest nesting abundance on islets with grassy or herbaceous cover, lower use of islets dominated by boulders or rocks, and little or no use of gravel-covered or wooded islets.

*Wintering Distribution and Habitat:* In Alaska greater scaup winter commonly along the Aleutian Islands, Kodiak Island, and along the coastline of southeastern Alaska (Gabrielson and Lincoln, 1959). In Canada they regularly winter on the coast of British Columbia, on some of the Great Lakes, and along the Atlantic coast from southern Quebec eastward through the Maritime Provinces and Newfoundland (Godfrey, 1965).

South of Canada, greater scaup may be found in winter along the coasts of Washington, Oregon, and California southward to central California. There are occasional wintering birds farther south, but only rarely do they range as far as Mexico (Leopold, 1959).

On the Atlantic coast the greater scaup is most abundant along the coast of New England. Maximum numbers seen during the annual Audubon Christmas counts generally occur along coastal New York. To the south of New York, the relative abundance of greater scaup depends largely on the severity of the winter, with southern movements greatest in years of severest winters, so that in the Chesapeake Bay area either species may be more common during a particular year (Stewart, 1962). As far south as South Carolina and Georgia the greater scaup is quite rare (Sprunt and Chamberlain, 1949; Burleigh, 1958), but apparently is fairly common in Louisiana (Lowery, 1960) and coastal Alabama (Imhof, 1962). However, Burleigh (1944) reported finding only a single definite specimen from the Gulf coast of Mississippi. Considering both the long migratory distance and the cold-weather tendencies of this species, it would seem that the Gulf coast must not be a part of its regular wintering range.

Stewart (1962) stated that in the Chesapeake Bay region the greater scaup are generally largely restricted to brackish and salt estuarine bays and coastal bays during winter, although some migrant birds use fresh and slightly brackish waters for brief periods.

**GENERAL BIOLOGY**

*Age at Maturity:* Ferguson (1966) reported that seven of twelve aviculturalists found initial breeding of greater scaup in their second year of life, and only three reported first-year breeding. Comparable data on wild birds is not
available, but a delayed sexual maturity has been suggested for this species by Munro (1941).

**Pair Bond Pattern:** Greater scaup renew their pair bonds on a yearly basis. In captivity, pair-forming behavior may be seen from late fall through winter and early spring, and probably the same applies to wild birds.

**Nest Location:** Weller et al. (1969) reported that on the West Mirage Islands of Great Slave Lake greater scaup typically place their nests in the grass of the previous year, often in rock cracks or near water. Of 29 nests that they found, the average height above water level was 7 feet, while 28 nests averaged 19 feet away from the nearest water.

In a nesting study on Iceland, Bengtson (1970) reported on the locations of 2,016 greater scaup nests. He found nearly twice as many nests per unit area on islands versus mainland habitats (331 versus 180 nests per square kilometer). Favored nest sites were under the perennial herbaceous angelicas (Angelica and Archangelica) and shrubs, especially those under 0.5 meters high. Other herbaceous cover and sedges were used to a much lesser extent, and only one nest was found in a hole. Bengtson found that scaup exhibited a tendency for nesting in aggregated or clumped patterns and, in general, nested fairly close to water.

**Clutch Size:** Weller et al. (1969) noted that 49 nests averaged 7.8 eggs, but ranged up to 22 in number. Including only the 39 warm (currently incubated) clutches and excluding those numbering in excess of 12 eggs, as assumed multiple efforts, the average clutch was 8.5 eggs. Hildén (1964) reported an average of 9.68 eggs in 360 clutches, with a modal clutch size of 10 eggs and a maximum of 17. He also found nest parasitism to be prevalent, with both intraspecific and interspecific (in tufted duck and shoveler nests) cases being noted. Bengtson (1971) found that 1,409 clutches of greater scaup in Iceland had an overall average of 9.73 eggs, although significant yearly differences in average clutch size (9.01 to 9.83 eggs) were present.

**Incubation Period:** Generally reported as 24 or 25 days, but with some estimates up to 28 days (Bauer and Glutz, 1969; Lack, 1968).

**Fledging Period:** Not yet established, but probably similar to that of the lesser scaup.

**Nest and Egg Losses:** Hildén (1964) reported on egg losses in 137 greater scaup nests in the Gulf of Bothnia. Of these, 87 percent hatched, with crows and ravens accounting for most losses and flooding causing a few. This relatively low loss to species such as crows might be the result of the high social attraction of greater scaup to nesting larids, which tends to reduce crow depredations. The effectiveness of larids in reducing such predations is also greater late in their nesting season, when they are defending young, which may

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be advantageous to the late-nesting scaup. A more recent study by Bengtson (1972) has confirmed the higher hatching success of scaup nests in gull or tern colonies than of nests not associated with larids.

**Juvenile Mortality:** Hilden (1964) found that there was a tendency for scaup broods to intermix temporarily with those of tufted ducks, but he observed no indication of regular mergers of scaup broods. He did note one case of a female with fifteen young, which he thought might represent a merged brood. During three years of study he found that the rate of juvenile mortality ranged from 91 to 98 percent and that much of the mortality was attributable to gull predation and to bad weather. Since the young ducklings moved out into the open water of bays at an unusually early age, they were subjected to higher predation rates than were young tufted ducks and were also more likely to be caught in fishing nets.

**Adult Mortality:** Boyd (1962) estimated an annual adult mortality rate of the Icelandic population of greater scaup as 48 percent.

**GENERAL ECOLOGY**

**Food and Foraging:** The summary of Martin et al. (1951) indicated that during winter and spring a variety of animal materials (mollusks, insects, and crustaceans) seems to predominate in the diet, while thirty-five fall samples were predominantly made up of vegetable materials. The seeds and vegetative parts of pondweeds (*Potamogeton*), wild celery (*Vallisneria*), and wigeon grass (*Ruppi*a) and the vegetative parts of muskgrass (*Chara*) were among the more prevalent plant materials found.

In a more recent study, Cronan (1957) analyzed the food contents of 119 greater scaup collected along the Connecticut coast of Long Island Sound between October and May. In this sample animal materials constituted over 90 percent of the total food volume, more than was found in earlier studies. Cronan attributed this to the fact that all the birds were taken in coastal waters. He found that the blue mussel (*Mytilus edulis*) was the most important single food by volume, while the dwarf surf clam (*Mulinia lateralis*) was of secondary importance both in volume and frequency of occurrence. Mollusks, most of which were bivalves, collectively made up nearly 90 percent of the total food contents. The only important plant food found was sea lettuce (*Ulva*), which is rapidly digested and probably was more important than the 3.6 percent of food volume that it constituted would indicate. Cronan concluded that in different areas different mollusks serve as the primary foods, but the particular species utilized are evidently determined by their relative availability.
Cronan observed scaup of both species feeding during all daylight hours, with tidal stages being significant only where mollusk beds were exposed during low tide. Since the birds normally will not feed out of water, such low tides reduce foraging. Most foraging was in depths of less than 5 feet of water, but in one case diving in water 23 feet deep was seen. Temperature, water current, normal weather variations, wind, and cloud cover all had little or no effect on foraging, but human activities did strongly affect usage of local areas by scaup. Cottam (1939) noted that under conditions of human persecution, greater scaup often go to sea and return at night to the foraging areas, especially under moonlight conditions.

Sociality, Densities, Territoriality: Bengtson (1970) reported that greater scaup exhibit a definite pattern of aggregation in their nesting distribution, but did not know whether this was produced by social attraction or by some other environmental cause. On thirteen areas he found an overall nesting density of 273 nests per square kilometer, or about 1 nest per acre. In island areas the nesting density per square kilometer averaged 331 nests, and on the mainland 180 nests.

No specific information on home ranges of the greater scaup is available, but it is apparent that nothing like classic territoriality can be present in this species.

Interspecific Relationships: In North America the lesser scaup is the nearest ecological counterpart of the greater scaup, and in Europe and Asia the tufted duck also occupies a similar ecological niche. Weller et al. (1969) found a considerable amount of nest parasitism between greater and lesser scaup, and Hildén (1964) likewise observed reciprocal nest parasitism between the greater scaup and the tufted duck in Finland. However, because of the rather generalized nest site requirements of these species, there appears to be little if any actual competition for nesting locations.

There is a good deal of similarity in the foods taken by lesser and greater scaup (Cronan, 1957; Stewart, 1962), at least when both are feeding in the same areas. Yet a sufficient degree of ecological segregation, apparently related to water salinity preferences and temperature tolerances, reduces such interactions to a fairly low level.

Although the presence of nesting gulls is highly attractive to scaup in providing nesting associates, at least certain species of gulls can be extremely destructive to ducklings during their first few weeks of life.

General Activity Patterns and Movements: The observations of Cronan (1957) suggest that little obvious periodicity in foraging behavior can be detected in greater scaup, and since the birds are strictly open-water feeders, they do not undertake regular foraging flights to and from feeding grounds.
Millais (1913) reported foraging movements from the open sea to mussel beds at night, as well as at dawn and sunset. Dawson (1909) also noted there was a fall evening flight starting about half an hour before sunset from Drayton Harbor on the Washington coast, where the birds feed in shallow water, back out to sea.

SOCIAL AND SEXUAL BEHAVIOR

Flocking Behavior: The “rafting” behavior of migrant and wintering scaup is well known and is indicated by their vernacular names—“raft duck,” “flock duck,” and “troop duck.” Scaup in such rafts do not all forage at the same time, but rather feeding and nonfeeding birds may be interspersed. When feeding in a current, they often “drift feed,” diving as they drift past a feeding area and eventually flying back to the other end of the raft to begin drifting toward the feeding area again (Cronan, 1957). Sizes of such rafts have not been extensively counted, but Audubon Christmas counts in the Long Island area often show an excess of 10,000 birds within a fifteen-mile diameter.

Pair-forming Behavior: The pair-forming behavior of the greater scaup is extremely similar to that of the lesser scaup, differing only in certain qualitative characteristics (Johnsgard, 1965). The inciting movements and calls of the females of these two species are virtually identical, and it is probable that some mixed courting groups may occur on common wintering grounds. However, wild hybrids between the two species are unknown, although their recognition would prove to be extremely difficult.

Male pair-forming calls and postures include soft whistled “coughing” notes, uttered with an inconspicuous jerk of the wings and tail, and a very weak wa'-hoo note that is produced during a head-throw display or during slight neck-stretching. Turning-the-back-of-the-head toward inciting females is very frequently performed and usually is associated with lowering of the crown feathers. Likewise, both sexes frequently perform a stereotyped preening behind the wing toward the other, especially if the birds are paired or in the process of forming pairs (Johnsgard, 1965).

Copulatory Behavior: Copulation in greater scaup is usually preceded by the male bill-dipping, preening dorsally, and preening behind the wing. The female often responds with these same displays, which closely resemble normal comfort movements, then assumes a prone posture. Following treading, the male typically releases the female’s nape, utters a single call, and swims away from her in a rigid bill-down posture. The female may also assume this posture for a few seconds before she begins to bathe (Johnsgard, 1965).

Nesting and Brooding Behavior: Relatively little has been written on the
nesting behavior of the greater scaup in North America. Hildén’s (1964) study on the Gulf of Bothnia provides a good source of information. He found that the pair bonds of this species last longer than in tufted duck, on the average at least until the middle of the incubation period. The male remains near the nesting place and joins the female whenever she leaves the nest. In one case the male remained with his mate until hatching and was seen with the newly hatched brood.

Following hatching, the young scaup ducklings feed mainly on the surface, catching floating insects or those flying just above the surface. Thus the weather shortly after hatching, its effect on insect abundance, as well as chilling effects on the young are critical to their survival. This is especially true of this species, which quickly leaves the shelter of the bulrushes and moves into the deeper water of the bays. There they are more directly exposed to the elements, as well as to possible predation by gulls and perhaps also predatory fish. Additionally, they must feed to a greater extent by diving because of the relative rarity of insect life. This demands more energy than does obtaining food from the surface or just above it.

Postbreeding Behavior: Hildén (1964) reported seeing flocks of males as early as late June, about the time that the first scaup broods were appearing. Most males were flocked by early July, when up to 50 were seen in a group. Except for a few that remained with apparently renesting females, the males then left the area and evidently molted elsewhere. Major molting areas in North America are still unknown, but Gabrielson and Lincoln (1959) mentioned that nonbreeders are sometimes fairly numerous in southeastern Alaska during summer. Very possibly the coastal regions of the Northwest Territories also support molting scaup, although this is mere speculation.
LESSER SCAUP
Aythya affinis (Eyton) 1838

Other Vernacular Names: Bluebill, Broadbill, Little Bluebill.
Range: Breeds from central Alaska eastward to western Hudson Bay and southward locally to Idaho, Colorado, Nebraska, and the Dakotas. Winters from British Columbia southward along the Pacific coast to Mexico, Central America, and Colombia, and on the Atlantic coast from Colombia north to the mid-Atlantic states, as well as in the West Indies.
Subspecies: None recognized.
Measurements (after Delacour, 1959):
Folded wing: Males 190-201, females 185-198 mm.
Culmen: Males 38-42, females 36-40 mm.
Weights: Nelson and Martin (1953) reported that 130 males averaged 1.9 pounds (861 grams), while 144 females averaged 1.7 pounds (770 grams). Combining the data of Bellrose and Hawkins (1947) and that of Jahn and Hunt (1964) for fall-shot birds, 11 adult males averaged 1.84 pounds (834 grams).
grams), while 36 immatures averaged 1.74 pounds (789 grams); 8 adult females averaged 1.65 pounds (748 grams), while 36 immatures averaged 1.76 pounds (798 grams). Nelson and Martin reported a maximum male weight of 2.5 pounds (1,087 grams), the same maximum weight that Jahn and Hunt reported for females, while the maximum female weight indicated by Nelson and Martin was 2.1 pounds.

IDENTIFICATION

In the Hand: Lesser scaup are best separated from greater scaup in the hand, and even then some specimens may remain doubtful. In the case of females, the presence of a white facial mark and white on the outer webs of the secondaries will exclude all species but the greater scaup. Female lesser scaup usually have no white on the inner webs of any primaries, although some may be quite pale. The length of the culmen in female lesser scaup is 36 to 40 mm., while female greater scaup have culmen lengths of 41 to 46 mm. Female lesser scaup rarely exceed 2 pounds, but female greater scaup average more than 2 pounds. Males can usually be distinguished from greater scaup by a purplish rather than greenish gloss on the head, a more extensive area of grayish vermiculations on the back, no definite white on the vanes of the primaries (although the inner ones may be quite pale), culmen length of 38 to 42 mm. (vs. 43 to 47 mm.), a nail width of less than 7 mm. (vs. 8 or more), maximum bill widths of 20 to 24 mm. (vs. 22 to 26 mm.), and a maximum weight of 2.5 pounds (vs. an average weight of about 2.5 pounds). The bill of the lesser scaup also tends to have a more concave culmen profile and to be relatively narrower at the base than that of the greater scaup.

In the Field: Male lesser scaup, when seen in good light, show a purplish gloss on the head and have a higher head profile, with a rudimentary crest usually evident, rather than a green-glossed head and a low head profile. The back of the male lesser scaup also appears more speckled, since the vermiculations in these areas are coarser. In flight, the restricted amount of white on the wings may be evident. Females cannot be safely separated in the field, but those of the lesser scaup do tend to show less white in front of the eyes than do female greater scaup.

AGE AND SEX CRITERIA

Sex Determination: Although the scapulars of both sexes may be vermiculated, those of females are predominantly dark, whereas those of males are predominantly white. Females have unflecked or only slightly flecked tertials,
whereas males usually exhibit considerable flecking. The greater and middle
coverts are usually unflecked in females and heavily flecked in males (Carney,
1964). The presence of blackish feathers on the breast or rump, or vermicula-
tions on the flanks, or head iridescence indicates a male.

Age Determination: Juvenile tertials are usually frayed to a pointed tip,
rather than being round-tipped, and the greater coverts tend to be narrower
and duller than those of older birds. The tertials of immature birds usually lack
flecking, while those of older males are flecked and of females are unflecked
(Carney, 1964). Squarish tail feathers with notched tips indicate an immature
bird.

DISTRIBUTION AND HABITAT

Breeding Distribution and Habitat: This strictly North American species
of pochard has a fairly wide breeding range in both forest and grassland habi-
tats. In Alaska it breeds commonly in the upper Yukon Valley, and there are
also two old breeding records for Glacier Bay (Gabrielson and Lincoln, 1959).

In Canada it breeds southward from the treeline of the Yukon and the
Northwest Territories across the forested portions of British Columbia, Al-
berta, Saskatchewan, and Manitoba east to Hudson Bay and western Ontario.
Farther east there are only spotty breeding records, mainly for southeastern
Ontario and the eastern shoreline of James Bay (Godfrey, 1966).

South of Canada, localized breeding occurs in eastern Washington (Yo-
com, 1951), northern California (Reinecker and Anderson, 1960; Hunt and
Anderson, 1966), central Arizona (Fleming, 1959), and northern Colorado.
More widespread or common breeding occurs on the northern Great Plains, in
northern and eastern Montana and the Dakotas, with the eastern limits of
regular breeding occurring in northwestern Minnesota (Lee et al., 1964a).
There are also scattered records of breeding for Wisconsin (Jahn and Hunt,
1964), Ohio (Audubon Field Notes, 8:345), Indiana (Mumford, 1954), and
Michigan (Zimmerman and Van Tyne, 1959).

The preferred breeding habitat of lesser scaup consists of prairie marshes
or potholes and partially wooded “parklands” (Lee et al., 1964a). Godfrey
(1966) characterized the breeding habitat as the vicinity of interior lakes and
ponds, low islands, and moist sedge meadows. Munro (1941) stated that nest-
ing usually occurs around lakes of moderate depth with bulrushes on shore and
with brushy coves. Lakes with abundant amphipods and insect larvae support
the best breeding populations.

Wintering Distribution and Habitat: To a greater degree than any other
pochard species in North America, the lesser scaup undertakes a surprisingly
Breeding (hatched) and wintering (shaded) distributions of the lesser scaup in North America.
long southward movement. A few lesser scaup winter in coastal British Columbia and on Lake Erie, but there is a general movement to saltwater areas of the southern United States and Mexico.

Midwinter inventories by the United States Fish and Wildlife Service during the late 1960s indicate that nearly 90 percent of the scaup (both greater and lesser) winter in the Mississippi and Atlantic flyway states. In Mexico, lesser scaup are second only to pintails in estimated numbers of wintering ducks and are abundant along both coasts. There have been particularly large concentrations seen on deep coastal lagoons of Nayarit, Chiapas, Veracruz, and Yucatán, although yearly variations in numbers and distribution are considerable (Leopold, 1959). Lesser scaup are also regular winter residents in Central America as far south as Panama (Wetmore, 1965), and some birds occasionally reach South America.

Along the Atlantic coast, scaup winter from Newfoundland southward, but most of those occurring north of New Jersey consist of greater scaup. To the south the lesser scaup gradually increases proportionally, so that in Florida it makes up nearly the entire wintering population (Addy, 1964). In that state lesser scaup winter mainly along the coast, but also use some of the larger inland lakes (Chamberlain, 1960). In Louisiana the wintering scaup population is normally very high; usually more than a million can be found on Lake Borgne, Lake Pontchartrain, and other lakes near New Orleans (Hawkins, 1964).

Stewart (1962) described the lesser scaup’s habitat in Chesapeake Bay as consisting of fresh, slightly brackish, and brackish estuarine bays during migration, while brackish estuarine bays are the chief wintering habitat in most years. During severe weather they may move to salt estuarine bays as well. Unlike other ducks, their distribution was apparently not closely related to the distribution of aquatic food plants, a probable reflection of their greater dependence on foods of animal origin.

**GENERAL BIOLOGY**

*Age at Maturity:* In captivity lesser scaup do not breed until they are two years old, according to eight of eleven aviculturalists responding to a survey by Ferguson (1966). There has been some speculation that a two-year period to maturity may also be typical of wild individuals as well (Munro, 1941), but evidence of breeding by at least some female yearlings was found by McKnight and Buss (1962). It is probable, however, that only a small proportion of yearling birds successfully nest, as suggested earlier for the redhead and as recently reported for lesser scaup by Trauger (1971).
Pair Bond Pattern: Pairs are renewed each winter in lesser scaup, with pair-forming behavior beginning in January or February and in general being more retarded than that of the redhead, canvasback, or ring-necked ducks (Weller, 1965). Pair bonds are broken by the middle of the incubation period (Hochbaum, 1944).

Nest Location: Munro (1941) reported that nests are in dry situations under various kinds of cover, usually close to a lakeshore. Rienecker and Anderson (1960) stated that there is a preference for nesting in dry uplands, with a slight tendency to choose islands with nettle (Urtica) cover. Vermeer (1968; 1970) noted that there is a strong association in the nesting of lesser scaup and terns. Miller and Collins (1954) found lesser scaup to nest principally on islands, with grasses, nettles, and saltbush (Atriplex) accounting for 50, 40, and 10 percent of the cover types, respectively. Nests were never found over water, but all were within 3 to 50 yards of water, usually in cover from 13 to 24 inches high. Townsend (1966) noted that nearly 80 percent of the lesser scaup nests he found were in sedge cover, many of which were on floating sedge mats. Keith (1961) found that 198 lesser scaup nests in Alberta averaged closer to water (39 feet) than those of any of the surface-feeding ducks, and Townsend found that lesser scaup and ring-necked ducks were very similar in their placement of nests relative to water. Over half of the forty nests that Gehrmann (1951) found were within 15 feet of water.

Clutch Size: Keith (1961) reported that the clutch sizes of lesser scaup decreased from 10.6 early in the nesting season to 8.5 for late nests, with an overall average of 10.0 for 131 nests. Likewise, Townsend (1966) found that ninety-four lesser scaup nests averaged 9.0 eggs, with an average reduction of one egg for every 10.3 days of the nesting season. Hunt and Anderson (1966) noted that five initial clutches averaged 10.6 eggs, five second attempts averaged 8.8 eggs, two third attempts averaged 7.5 eggs, and one fourth nesting attempt had 7 eggs present.

Incubation Period: Hochbaum (1944) reported a 22- to 23-day incubation period for lesser scaup eggs hatched in an artificial incubator, with a maximum of 26 days recorded. Vermeer (1968) reported a 24.8-day average period for eighteen clutches incubated by wild females.

Fledging Period: Hochbaum (1944) indicated that captive-reared lesser scaup attained flight in 56 to 73 days. This may be a little longer than typical; Lee et al. (1964a) reported a 7-week fledging period.

Nest and Egg Losses: Nesting success rates seem to vary greatly by locality and year. High nesting success rates (60 percent or more) were reported by Miller and Collins (1954), Rienecker and Anderson (1960), and Townsend (1966). Townsend found that lesser scaup nesting on islands had a higher
hatching success than those nesting on the mainland. Much lower nesting success was reported by Keith (1961), who found an overall 25 percent hatching success (higher on islands) in Alberta, and Rogers (1959), who noted a high incidence of nest losses to ground predators during a year of relative drought in Manitoba. Quite possibly the local availability of suitable nesting islands has a large effect on average hatching success of this species. Vermeer (1968) noted that island-nesting lesser scaup had a high nesting success, whether or not nesting gulls were present.

**Juvenile Mortality:** Townsend (1966) reported that the average hatch per nest of fifty-five scaup nests was 8.7 ducklings. Miller and Collins (1954) estimated an average hatch per clutch of 9.3 ducklings. Because of the prevalence of brood merger in this species (Munro, 1941), counts of older-aged broods are not reliable indications of juvenile mortality. Vermeer (1968) found a 100 percent duckling mortality in Alberta, mainly because of California gull predation.

Postfledging mortality rates for immature lesser scaup do not seem to be available, but they are presumably as high as in related species of pochards.

**Adult Mortality:** Longwell and Stotts (1959) calculated a 41.8 percent annual adult mortality rate for lesser scaup in the first six years following banding, or approximately the same as the rates they calculated for redheads and canvasbacks.

**GENERAL ECOLOGY**

**Food and Foraging:** In contrast to the three preceding pochard species, both species of scaup have high rates of consumption of animal materials. Plant foods are similar to those of other pochards, including the seeds and vegetative parts of wild celery (*Vallisneria*), pondweeds (*Potamogeton*), wigeon grass (*Ruppia*), and various other submerged or emergent plants (Martin *et al.*, 1951). Cottam (1939) found that animal foods, of which mollusks made up over half, constituted only 40 percent by volume of samples from 1,051 lesser scaup taken throughout the year. Insects were of secondary importance, and other animal foods constituted only about 3.5 percent.

The most comprehensive recent study of lesser scaup foods is that of Rogers and Korschgen (1966), who analyzed 164 samples from adults on the breeding grounds, migration routes, and wintering grounds. Animal foods totaled 91.1 percent of breeding-ground food samples, 93.5 percent of fall samples, and 63.7 percent of winter samples. The most important foods were amphipod crustaceans on breeding areas, mollusks on fall concentration areas, and fishes on wintering grounds. Harmon (1962) also noted the importance of
animal foods, specifically mollusks, on Louisiana wintering areas of lesser scaup.

Spring and summer foods of scaup have been studied by several people, and most have commented on the importance of amphipods ("scuds") at this time of year. Munro (1941) noted this in British Columbia, as did Dirschl (1969) in Saskatchewan, Bartonek and Hickey (1969) in Manitoba, and Bartonek and Murdy (1970) in the Northwest Territories. In the last-named study amphipods averaged more than half the total food volume among 35 scaup sampled that had eaten them. Juvenile birds had consumed almost no plant materials, but utilized free-swimming and bottom-dwelling organisms in water averaging 3.5 to 4.0 feet in depth. Adult birds also usually forage in water that is fairly shallow, but at times feed in areas some 15 to 20 feet deep. At such depths they may remain under water about one minute during each dive, but in shallower waters, 8 to 10 feet deep, they usually are submerged for less than half that duration (Cottam, 1939).

**Sociality, Densities, Territoriality:** Perhaps because of their dry-land nesting preferences and their tendencies to nest on islands where these are available, lesser scaup often exhibit fairly high breeding densities and may develop considerable sociality in nesting. Rogers (1959) reported that, on a square-mile study area in Manitoba, the breeding population of lesser scaup was 51 and 65 pairs during two consecutive years. Stoudt (1969) reported lower peak densities of 1 to 17 pairs per square mile for five prairie study areas in southern Canada and South Dakota. Vermeer (1970) reported a nest density of 0.08 nests per acre (51 per square mile) on islands in Lake Newell, Alberta. He also (1968) found that lesser scaup initiated 67 and 66 nests during two years on two islands on Lake Miquelon, Alberta, totalling eleven acres, or about 6 nests per acre. It is thus clear that territoriality cannot play any significant role in producing nest dispersion in this species.

**Interspecific Relationships:** The close relationship of lesser and greater scaup opens the possibility of interspecific competition between these species. Their nesting areas overlap widely, and there is some evidence of interspecific conflict over nesting sites and egg-laying in the nests of the other species (Weller et al., 1969). Various surface-feeding ducks are sometimes also socially parasitized by lesser scaup (Weller, 1959).

The extent to which there may be food competition among the two scaup species is uncertain, but differences in migration routes and major wintering grounds tend to reduce contact between them. Stewart (1962) noted that in the Chesapeake Bay area, where both species winter, greater scaup are mostly restricted to brackish and salt estuarine bays and coastal bays, while lesser scaup range farther toward the upper limits of the adjoining estuaries and only
move out into salt estuarine bays during unusually severe weather. Among birds collected in brackish and salt estuarine bays, both species had consumed the same gastropod mollusks (\textit{Mulina lateralis}, \textit{Brachiodontes recurvus}), in quantity, while samples of both species from salt estuaries included quantities of eelgrass (\textit{Zostera}) and other gastropods (\textit{Bittium}, \textit{Mitrella lunata}). Thus, it appears that potential food competition between the two species is present, and probably the stronger tendencies of lesser scaup to use less salty or brackish waters, interior lakes, and more southerly wintering areas are the prime bases for reducing actual interspecific food competition.

\textit{General Activity Patterns and Movements:} Little specific information on daily activity rhythms is available. Phillips (1925) mentioned that lesser scaup are primarily daytime feeders but do forage to some extent at night. They prefer to forage in shallow waters some 3 to 8 feet deep and probably are less affected in their feeding rhythms by tidal fluctuation than are more marine species such as the greater scaup.

Studies of local movements and home ranges on the breeding grounds have not yet been performed on this species. Hochbaum (1944) commented that the size of a lesser scaup’s “territory” (home range) may be as much as an acre of open bay or only forty yards of a narrow roadside ditch. He noted that paired birds sometimes make leisurely flights beyond the limits of their territory during evening hours, apparently for exercise. Migratory movements based on banding results have been summarized by Aldrich (1949).

\section*{SOCIAL AND SEXUAL BEHAVIOR}

\textit{Flocking Behavior:} The “rafting” behavior of scaup on their foraging areas is well known and often results in the concentration of large numbers of birds in localized areas. A photograph in \textit{Waterfowl Tomorrow} (p. 214) of thousands of lesser scaup in a small arroyo near Aransas Pass, Texas, provides an example of the degree of flocking behavior that occurs on the wintering grounds of this species. In Florida, where the lesser scaup is perhaps the most abundant wintering duck, extremely large flocks usually occur around such areas as St. Petersburg, Fort Meyers, and Cocoa. In Cocoa at least 200,000 were counted during the 1963 Christmas count (\textit{Audubon Field Notes}, 18:171). If these birds were limited to the tidal estuaries that made up 15 percent of the survey area, they were spread out over no more than 25 square miles, or averaged about 8,000 birds per square mile.

\textit{Pair-forming Behavior:} Pair formation evidently begins fairly late on the wintering grounds (Weller, 1965), but during spring migration becomes relatively prevalent. In eastern and central Washington it may be seen from the
time the birds first arrive in March to late April, by which time most females are paired (Johnsgard, 1955; Gehrmann, 1951). Pair-forming displays of lesser scaup are very much like those of greater scaup and the other pochard species. The most elaborate posture is an extremely rapid head-throw, associated with a soft *whee-oo* call. A sharper whistled note is also uttered during a convulsive coughlike movement, and a rudimentary form of the canvasback’s “sneaking” display is sometimes performed. During female inciting, which serves as the focal point of male courtship activity, the male often swims rapidly ahead and turns-the-back-of-the-head toward the female, simultaneously lowering the crown feathers to produce a distinctive low-headed appearance. To a larger extent than the other North American pochards (excepting the greater scaup), a ritualized preening of the wing feathers that exposes the white speculum is prevalent during pair-forming display. Chases of the female, either in the air or under water, are fairly frequent (Gehrmann, 1951), and it is often difficult to determine whether these are courting chases or attempted rape chases.

**Copulatory Behavior:** The precopulatory displays of the male consist of bill-dipping, dorsal-preening, and preening behind the wing, which are sometimes reciprocated by the female. After treading is completed the male releases the female from his grasp, probably calls, and then swims away from his mate in a rigid posture with the bill pointed sharply downward (Johnsgard, 1965).

**Nesting and Brooding Behavior:** The lesser scaup is one of the latest of the prairie-nesting ducks to begin nest-building and egg-laying, although the possible advantage of such late nesting remains obscure. Not only does predation intensity tend to increase late in the season, but also renesting opportunities are reduced (Rogers, 1964).

The length of time required for nest-building apparently has not been reported, but it is probable that eggs are laid on a daily basis. The male normally deserts the female when incubation begins (Oring, 1964), although he sometimes remains as late as the middle of incubation (Hochbaum, 1944).

Following hatching, the brood is led to water and brood rearing occurs in the relatively open water of large marshes. Females normally take good care of their young and usually feign injury when their broods are endangered. Frequently two females will jointly care for their merged broods, and, when threatened, one will remain behind to threaten or feign injury while the other leads the combined brood to safety (Munro, 1941). Feigning injury and other defensive behavior decreases as the season progresses, and late in the season the females may simply attempt avoidance rather than defend their young (Hochbaum, 1944).

**Postbreeding Behavior:** In lesser scaup and related pochard species a rela-
tively long period may elapse between the time the male abandons his mate and when he finally becomes flightless. Oring (1964) reported that this period may be as much as six weeks in the lesser scaup and the redhead. During this time the males gather in groups in favored areas. Hochbaum (1944) noted that male lesser scaup and redheads gather in bands, moving from the Delta, Manitoba, marsh to the adjacent lake every morning and evening from mid-June through July. As July advances they spend more of the daylight hours on the lake and finally remain there permanently, to undergo their wing molt in late July and August.