



# Waterfowl Biology and Management

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South Carolina provides migratory and wintering habitat for about 18-20 different North American waterfowl species which can be commonly found in the state at some period during the year (Table 1). Breeding habitat is also provided for resident wood duck and geese. Some species are not common and are observed during select years, depending on available wetlands and weather conditions.

Most waterfowl species are migratory and spend only a portion of the year in South Carolina. Duck concentrations are generally highest during late November and December when fall migration peaks. The greatest number of species is found throughout South Carolina during late February through early March (spring migration).

Categorized by region, duck migration routes (flyways) are well known. There are 4 major flyways on the continent. The Atlantic Flyway is associated with the Atlantic Coast (South Carolina is in the Atlantic Flyway). The Mississippi Flyway comprises the Mississippi River region and associated rivers. The Central Flyway consists primarily of the Plains states, Texas and New Mexico. The Pacific Flyway includes the region from the Rocky Mountains west to the Pacific Coast.

Few waterfowl species breed within the boundary of South Carolina. Wood ducks are the only species that raise a large number of young each year in the state. The prairie pothole and parkland regions of the north central United States and Canada are the primary breeding grounds for North American waterfowl. The most important breeding area for ducks is the prairie pothole region. In an average year, about 50 percent of this country's ducks are produced on less than 10 percent of the available breeding area. Other areas which provide substantial amounts of breeding habitat include eastern Canada, the northern latitudes of the midwestern U.S., central Alaska, and northern California.

## Natural History of Waterfowl

Ducks, geese, and swans are all members of the same family (*Anatidae*) which is characterized by large bills, webbed feet, rounded bodies, and long necks. Other duck traits include brightly-colored males and drab females, 2 body molts (loss and replacement of feathers) a year, elaborate courtship displays, and brief annual pair bonds, although only the female incubates eggs and cares for the young.

North American ducks are separated into 5 groups. These groups are commonly lumped together into one of three general categories (diving, dabbling, or perching ducks).

The diving duck group (divers) are actually 3 groups placed together because they have similar feeding habits. This group prefers open, deep-water habitats with plenty of submergent plants (plants rooted in the bottom and growing under the water) and/or aquatic invertebrates. A distinguishing characteristic of divers is that they run along the water to gain flight.

Ten species of diving ducks migrate through the state, with ring-necked ducks and lesser scaup the most abundant. Lesser numbers of redheads,

**Table 1. A list of waterfowl that migrate or reside in South Carolina**

Dabbling Ducks	Time of Year in South Carolina
Mallard	December - January
Wood Duck	Resident
Black Duck	December - January
Gadwall	October - December
Green-Winged Teal	October - December
Blue-Winged Teal	September
Northern Pintail	October - December
American Widgeon	October - December
Northern Shoveler	October - December
Diving Ducks	Time of Year in South Carolina
Lesser Scaup	November - January
Greater Scaup	November - January
Ring-Necked Duck	November - January
Canvasback	November - January
Redhead	November - January
Goldeneye	November - February
Bufflehead	November - February
Hooded Merganser	November - February
Ruddy Duck	December - March

canvasbacks, and greater scaup are occasionally observed in isolated flocks or in association with the more abundant lesser scaup. The remaining diving ducks found migrating through South Carolina include the common goldeneye, buffleheads, hooded merganser, common merganser, and ruddy duck.

A shortage of suitable habitat and little traditional use of those habitats are the primary reasons diving ducks are not common in most of South Carolina, except for coastal areas. Historically, except for the major rivers, there were not very many large bodies of open water in this area. Therefore, diving ducks used the major rivers for migration corridors. A few pools in these river systems with abundant aquatic foods were used as staging (resting) areas during migration. The birds would continue to use these pools until they were forced to leave because of bad weather. The recent creation of man-made reservoirs in South Carolina for navigation, flood control, and hydroelectric power has not changed the traditional migration patterns of diving ducks because most of these reservoirs are unable to support large concentrations of birds.

The other 2 groups of ducks are the dabbling (puddle) and perching (tree) ducks. Both of these duck groups have similar habits. Dabbling and perching ducks have brightly colored wing patches, are usually seen feeding by a “tipping up” motion, and spring into flight. The 2 most common dabbling ducks seen in South Carolina are mallards and black ducks. Most of the dabbling ducks are found in small flocks on isolated wetlands; however, each year large numbers of some species are observed on wetlands and reservoirs throughout the state. Northern shovelers and blue-winged teal are early-migrating dabbling ducks frequently seen in late September and October. Other dabbling ducks found throughout South Carolina include the gadwall, green-winged teal, northern pintail, and American widgeon.

Dabbling ducks use habitats similar to those used by mallards and black ducks. Often mixed flocks of dabblers, including mallards and black ducks, are observed resting together. The species can live in the same habitats because they have different feeding patterns. Mallards, black ducks, and pintails frequently feed on agricultural grains and native foods. Other species such as gadwall, widgeon, shovelers, and blue-winged teal prefer seeds, vegetative parts, and invertebrates associated with wetland flora. Therefore, there is little competition between dabbling duck species.

## Three Common Waterfowl Species in South Carolina

### Wood Ducks

The wood duck (*Apix sponsa*) or “woodie” is a symbol of forested wetlands to hunters, bird watchers, photographers, and artists. This bird is one of the most beautiful water birds in the world. It can be found in 42 states and five Canadian provinces. The wood duck is commonly found visiting sloughs, ponds, and streams. This was not the case at the turn of the century, and the recovery of wood duck populations is a classic conservation story.



Male wood duck

In the early part of the 1900s, its numbers were so low that many people feared the wood duck would become extinct. Unregulated sport and commercial hunting during the spring were primary factors in declining populations. In addition, the birds were losing habitat throughout their range. The passage of the Migratory Bird Treaty Act of 1918 provided the necessary protection to save the birds from possible extinction.

Restricted hunting from 1918 through 1941 throughout this country, and the concerted research and management efforts of waterfowl biologists and managers, helped to reestablish woodies across all of their historic range. Habitat preservation, management, research developing nesting box designs, and regulated hunting have been part of the conservation success story. As a result of these efforts, wood ducks today are the second most common duck that waterfowl hunters harvest in the Atlantic and Mississippi flyways.

Wood ducks may be the most attractive and brightly colored ducks in North America. Male woodies have a large purple and green crested head. The eyes and base of the bill are bright red. The birds also have a pair of white parallel lines running from the bill and back of the eye to the rear of the crest. Male wood ducks have a burgundy-colored chest with white fleckings and a white breast and belly. The purplish-black



Female wood duck

back sharply contrasts with the breast and belly. Not only is the male wood duck the most attractive of our waterfowl, the female is also more colorful than other female ducks. Female woodies are gray-brown with a distinct white, tear-dropped-shaped eye ring. Young females may not show this coloration around the eye. They have a sooty-gray crested head. Both sexes have short wings (8 to 9 inches in length) with iridescent purple wing patches. Adult wood ducks weigh about 1½ pounds and measure about 20 inches long.

### **Cover, Food, Water, and Space Needs of Wood Ducks**

There are 3 distinct wood duck populations (Atlantic, Interior, and Pacific) in North America. South Carolina birds belong in the Atlantic population. Fall migration usually occurs in October and November, whereas spring migration peaks in February.

Typical wood duck habitat, found in bottomland hardwood swamps, wooded sloughs and marshes, or forested riparian areas, usually has an abundance of flooded timber. Ideal woodie habitat in South Carolina includes bottomland hardwood forests with shrubs and herbaceous plants associated with water bodies that have long shorelines. Bottomland forests (either flooded or in close proximity to water) are used by wood ducks all year but are very important nesting cover.

Water should be available to the birds 3 to 4 weeks before nesting. Mature and overmature trees in these forests are an important habitat component because wood ducks nest in natural tree cavities. Bald cypress, sycamore, ash, and sour gum provide cavities in lowland areas. In drier areas, oaks and basswood are important cavity-producing trees. Another part of good wood duck breeding habitat is an abundance of loafing sites. Examples of loafing sites include logs, stumps, muskrat mounds, beaver lodges, or islands in open water and shorelines.

Wood ducks also require security cover. This type of cover is used for brood habitat and escape cover for young molting ducks. Bushy or shrub habitats, where strong durable shrub stems rise about 2 feet above the water and spread into a thick overhanging canopy, are used during the late spring, summer, and early fall. Optimal brood-rearing habitat should be at least 5 acres. Ideal brood habitat consists of 30 to 40 percent shrubs, 35 to 70 percent wetland plants growing in water, 5 to 10 percent trees, and 25 percent open water.

The depth of the open water is also important. Shallow water is critical in wood duck habitat because the birds normally do not feed in water that is more than 18 inches deep. Plants growing in the shallow water (emergents) are an important food source for growing ducks because they harbor vast numbers of insects and other small animal life, which are an important source of protein. Important emergent plants in the open and shrubby water habitats include cattails, water lily, smartweeds, water primrose, pickerel weed, rushes, reed canary grass, duckweeds, and sedges.

Flooded lowland forests with abundant mast trees are especially important winter feeding habitat. Pin oak, Nuttall oak, and white

oak provide high energy food for the ducks. Seeds from bald cypress, buttonbush, and various emergent plants are also important food items.

Other habitats, such as flooded dead timber, open marsh, lakes, and reservoirs, are used only after preferred habitats are unavailable. Large open areas (lakes or reservoirs) provide little food or cover for wood ducks.

### **Reproduction of Wood Ducks**

The wood duck is by far the most common waterfowl species nesting in South Carolina. It is a tree duck and prefers to nest in hollow tree cavities. If hollow tree cavities are not available, the birds will nest in artificial cavities (nest boxes). Either cavity should be close to water.

Wood ducks begin to pair with one another starting in mid-October. By February most of the birds have paired off and begin the business of searching for a nest site. Yearling hens will pair and nest their first year. The birds will remain together through most of incubation unless it is a late nesting or renesting attempt, in which case the male will abandon the hen for molting.

Both the male and female search for and select a nesting cavity in March and April. Most nesting sites are close to water, but some may be up to one mile away. Wood duck hens have a remarkable tendency to return to the same breeding area year after year. Once a nest site has been selected, the female begins nesting activities. She makes a nest with materials in the cavity, adding down from her breast about the time the seventh egg is laid.

Hen wood ducks lay one egg a day for 10 to 15 days. Therefore, an average nest size is 10 to 15 eggs; however, predation and dump nesting (when several hens lay eggs in the same nest cavity) make it difficult to accurately determine average nest sizes in the wild. In searching for a nest site, females sometimes lay eggs in several different nests. Dump nests containing 40 or more eggs have been reported.

The hen then sits on and incubates the eggs for 28 to 37 days after the last egg has been laid. The hen stays in the nest with the ducklings for about 24 hours allowing the young birds to dry thoroughly. When the ducklings are dry, the hen calls her brood from the nest and heads for water. The young birds climb out of the nest and jump to the water or the ground, sometimes from staggering heights. The female cares for the young by herself and takes the young birds to brood-rearing habitat.

The first few days and weeks after hatching are a difficult time for the young birds. Travel over land is hazardous if the nest is located away from water, and many young birds die en route. Only about 50 percent of the ducklings will live to reach flying age.

The young ducks mature quickly. Ducklings remain covered with down for 2 to 3 weeks. By 6 weeks of age, the ducks are fully feathered, and can fly between 8 to 10 weeks of age. At this time the adult females and their young separate. The females molt their old feathers at this time and grow new ones. The birds are flightless for about 3 weeks while flight feathers are being replaced. By this time the males have already molted. Most woodies are able to fly by late July to mid-August. By

mid-October the drakes will once again be wearing their bright colorful plumage, and the annual cycle begins again.

### Wood Duck Nesting Boxes

Certain practices have reduced suitable nesting sites for wood ducks. Removal of trees with nest cavities, drainage and destruction of wetlands, clearing timber stands for agriculture, and timber harvesting without leaving den trees have resulted in reduced nesting sites. Wood ducks will use artificial nest structures, which are probably the most recognized tool used for wood duck management. The first nest boxes were built and installed by the U.S. Biological Survey (now the U.S. Fish and Wildlife Service) on Chautauqua National Wildlife Refuge in central Illinois during 1937. Since then, thousands of nesting boxes have been erected by federal and state agencies, as well as private landowners, throughout the wood duck's range.

Through years of research examining wood duck preference for nesting boxes and the following nesting success, biologists have concluded that the best boxes are built from seasoned hardwoods such as cypress or hemlock. A wire screen should be attached to the inside of the box up to the entrance hole to allow traction for the day-old ducklings. All boxes must have 3 to 4 inches of wood chips added because the female does not bring nesting material to the cavity. The boxes should be checked each year, and this material should be changed if needed. The nest boxes should be placed in small groups of 2 to 4 per acre, over water if possible. If the box cannot be placed over water, it should be close to a permanent water source.

The first boxes were built of wood and required frequent replacement. In an effort to reduce maintenance and replacement costs and predation, nest boxes were built of a variety of materials including plastic, fiberglass, and metal. These boxes should not be used because they result in elevated temperatures inside the box that kill the duck embryos.

Predators are another factor that limit wood duck production. It does little good to put up nest boxes if the result is setting the table with an easy meal for predators. Unfortunately, as woodies adapted to using nest boxes, their predators learned to associate nest boxes with a potential meal. Raccoons, rat snakes, fox squirrels, and starlings commonly destroy wood duck nests.

Research in South Carolina has shown that the raccoon is the major predator of wood duck nests; therefore, predator guards should be installed whenever possible. Consideration can also be given to placing boxes in trees which predators cannot reach from another tree. The protection offered by nest boxes and predator guards should be equal to, if not better than, that of natural cavities.

### Mallards

Mallards (*Anas platyrhynchos*) are the most common duck species found in North America. The U.S. Fish and Wildlife Service estimated that, during the fall migration flight, mallards accounted for approximately 15 percent of the entire duck population. Mallards are the most widely



Male mallard in flight

distributed waterfowl species in the Northern Hemisphere. They can be found from the Arctic to the subtropics in Asia, Europe, and North America. The mallard is the most common migrating waterfowl species found in South Carolina. Many varieties of domestic ducks have a mallard ancestry.

### Mallard Characteristics

In breeding color, drake mallards are the most often recognized of all our waterfowl species. The iridescent green head, white neck ring, brown chest, gray sides, olive-colored bill, and dark rump allow for quick identification. As with most ducks, the hens are not very colorful. Hens are a light brown streaked with darker brown. This pattern is more apparent on the back than the belly. A characteristic dark eye stripe and mottled orange bill distinguish hen mallards from females of other duck species. Both sexes have bright orange legs and violet blue wing patches, which are bordered by white bars on the leading and trailing edges. These wing patches are visible in flight. During the summer months when the birds lose their breeding plumage, the sexes look



Female mallard

similar. However, males can still be distinguished from females by their olive-colored bills.

### **Habitat Needs of Mallards**

In early April, the first mallards arriving on northern breeding areas begin their age-old nesting rituals. The number of birds quickly swells through April as breeding birds return. Mallards that breed in Alaska arrive on the breeding grounds last, usually during the first week of May.

The breeding range of mallards is the most extensive of any duck species on the continent. It encompasses the northern 1/3 of the United States northwestward to Alaska. There are areas of preference where breeding densities are greatest within this large breeding range. For example, it has been estimated that almost 54 percent of the continental mallard population breeds in the region of Alberta, Manitoba, and southern Saskatchewan. Other important areas include the "Prairie Pothole" region of North and South Dakota and western Minnesota. The pothole country is characterized by rapid changes in water abundance, as almost 1/2 of the ponds present in spring have dried up by mid summer. Therefore, rapidly changing pond conditions greatly influence mallard breeding distributions.

Female mallards have a sense of homing when returning to the breeding grounds. Females that raised a successful nest the previous year and a proportion of first-year birds may return (home) to breed in areas where they were raised (natal areas). However, hens also play the major role in finding new breeding areas. Few drakes return to their natal areas because the birds form pair bonds on the wintering grounds and drakes follow their mates back to the hen's breeding site.

Most mallards breed during their first year, although many hens will not nest during drought conditions. Older females are usually more successful nesters because of their experience in establishing home ranges and selecting nest sites.

Mallards begin establishing pair bonds as early as mid autumn and continue through winter. For example, in Louisiana it has been estimated that about 90 percent of the mallard hens are seen with an accompanying drake by January. Forming pair bonds early has some advantages. Birds that have formed early pair bonds exhibit dominance over other birds. In addition, pairs are able to invest more time feeding and less time defending preferred territories. Almost all hens are paired by the time birds return to the breeding grounds.

Pair bonds remain strong until clutches are completed. Pairs begin to break up shortly after the start of incubation. However, females will readily reform pair bonds with the original male or another male if the first nest fails early in incubation or is destroyed by a predator.

Once a pair of mallards takes up residence on a pond or slough, potential nest sites are investigated shortly. Nests are usually located adjacent to water, but may be up to a mile or more away. Nesting cover is variable because of the diverse habitats in which they breed. Grassy areas, brush clumps, sedges, and other natural vegetation may be used on the prairies and parklands. In agricultural regions, hayfields are preferred over other habitats.

The female scrapes a shallow depression on the selected site and begins to deposit her eggs. Hens usually lay 1 egg per day for 9 to 10 days until the clutch is complete. After the last egg is laid, hens will incubate the eggs for about 25 days. If the nest is destroyed or eaten by a predator during egg laying or the early stages of incubation, the hen may renest in another location.

It takes about a day for the ducklings to pip out of the egg, and soon after the ducklings are dry, the hen leads them to water. Hens and broods may move to other ponds in search of adequate food and cover. During drought conditions, mallards may move considerable distances in search of water. One study found that the broods traveled up to 5 miles from where they were hatched.

The down-covered ducklings grow rapidly. The birds are covered with down for 18 days, and their first feathers become readily apparent about the 25th day. The young are able to fly at between 40-60 days after hatching, depending on breeding locality.

Mallard drakes, who do not help the hens incubate the eggs, leave the nesting area shortly after incubation begins. At this time the males gather on large bodies of water to molt (replace feathers). Nonbreeding drakes and hens that were unsuccessful in nesting arrive at the molting areas shortly thereafter. Successful nesting hens may or may not use the same molting areas after leaving the brood.

The fall migration of mallards usually occurs later than that of other dabbling duck species. The birds appear reluctant to migrate south as long as adequate food and open water are available to them, and some birds are known to spend the winter in these areas. Traditionally the last big mallard migration flights south from the Canadian prairies may not occur until mid November.

Early migrating mallards usually arrive on southern wintering areas about mid-October. Populations slowly build through November and December. Because of the prolonged migration window for mallards, there are no sharp migration peaks as seen with other ducks.

Winter concentrations in the Mississippi Flyway are the largest in North America. The heart of this wintering area extends from Cape Girardeau, Missouri, south to the Gulf of Mexico through the fertile lower Mississippi River Delta region. Waterfowl counts have recorded up to 37 percent of the entire North American mallard population wintering in this region. These tremendous concentrations have lead some to nickname the Mississippi Flyway "the mallard flyway." Mallards also winter in much of the United States as far south as the Gulf of Mexico and along the west coast as far north as Alaska. Recently mallards have expanded their range eastward to include much of the Atlantic Coast from New England to North Carolina.

Contrary to the pattern of fall migration, during the spring mallards appear to rush back to the breeding grounds. Birds start to leave southern wintering areas in February. By early April few birds remain on the wintering grounds.

Adaptability is the key for a species like the mallard that uses a broad range of habitats. Mallards eat both native and cultivated (agricultural) foods. Each of these food groups are equally important during some period of the annual cycle. These varied diets ensure that the ducks obtain nutrients essential for survival. Native foods are usually nutrient-complete, while cultivated foods may lack some essential requirements. Cultivated foods can supplement but cannot totally replace native foods.

Fall and winter foods consist primarily of high energy seeds from aquatic or emergent wetland plants and cultivated sources. Native foods include seeds from sedges, millet, smartweed, coontail, duck potato, and duckweed, along with mast from nut-producing trees. Cultivated grains include corn, rice, sorghum, wheat, barley, and oats. Mallards also feed on tubers and rhizomes of chufa, flatsedge and bulrush.

In the spring, male and female diets vary because of differing nutrient requirements. Females seek protein-rich foods to obtain nutrients essential for egg production. Their diets consist primarily of aquatic invertebrates such as midges, crustaceans, and mollusks. Males also use these tiny animals, but may eat more seeds and other vegetative matter at this time. Male diets shift to animal matter during the molt because the birds need extra protein to replace feathers.

The summer diet of adults and ducklings is dominated by animal matter, although plant foods are eaten when available. Mosquito, dragonfly, and other insect larvae, along with those listed previously, are readily eaten. By late summer, the diet shifts to include more high energy foods in preparation for fall migration.

## Geese

To many people, geese are truly a symbol of the northern wilderness, representing the mystery of our natural environment. The sight of "V"-shaped flocks and the sound of distant honks each fall may lead a person to ponder over the travels of these annual visitors. How geese move from the vast, featureless arctic tundra breeding grounds to southern wintering areas in the United States and Mexico remains a mystery.

There are 6 distinct species (Ross's goose, emperor goose, white-fronted goose, snow goose, brant, and Canada goose) native to North America. The six species are further separated into 19 recognized races based on similar morphological characteristics. Five of the 6 species can be found in more than one continent. The Canada goose is the only species native just to North America. The emperor goose is the only species that does not winter in the contiguous United States.

Commonly seen in South Carolina during the winter is the Canada goose (*Branta canadensis*). Local resident Canada geese populations have been established across South Carolina. To date, man's impact on most goose populations has been relatively minor compared to his effect on duck populations. Much of the breeding range for geese lies in tundra or sub-tundra areas. These areas are not easily farmed or logged. However, the intrusion of man may not be far off. Our dependence on fossil fuels may necessitate oil exploration in these fragile habitats. If we cannot



Canada goose

limit the destructive nature of these activities, North American goose populations may suffer in ways similar to duck populations.

Geese are close relatives to ducks; however, there are several differences in the 2 groups. First, male and female geese look similar to one another. Second, geese mate for life. However, if a mate is lost, the survivor will usually remate before the next breeding season. Third, both parents care for the young compared to ducks, where the hen is the only adult caring for young. Goose families remain intact until the following nesting season.

Goose families are important in flock social order. Dominance is as follows: large families > smaller families > pairs > singles. Older geese are more successful nesters than younger birds, and geese do not breed until they are at least 2 years of age.

The life span of geese is relatively long compared to ducks. Most duck and goose mortality occurs during the bird's first year. Annual survival rates increase substantially for older geese. Reports of wild Canada geese older than 20 years of age are not uncommon.

Geese also use traditional breeding and wintering areas. It is not unusual for a family of geese to use the same breeding, staging, and wintering areas year after year. Yearling birds learn these areas from experience by following their parents. Today most goose management is targeted for specific populations that use those traditional areas.

## Waterfowl Management

Management of North America's waterfowl resource requires the cooperation of several countries, because waterfowl do not recognize the arbitrary boundaries drawn by man. The migratory travels of

waterfowl may carry them across the boundaries of two or more nations each year. Most North American ducks and geese winter in the United States and Mexico, but breed, raise young, and molt on Canadian wetlands.

International cooperation is critical for duck and goose management. The Migratory Bird Treaty Act of 1918 implemented an agreement between Great Britain (for Canada) and the United States for the protection of migratory birds. This treaty established federal jurisdiction for protecting the international migratory bird resource. The act was amended in 1936 and 1974 to include Mexico and Japan, respectively. In 1978, a treaty similar to the Migratory Bird Treaty Act was signed with the Union of Soviet Socialist Republics giving international protection to waterfowl with circumpolar distributions.

Within North America, differences in supply and demand of the waterfowl resource have resulted in managing waterfowl on the flyway management concept. There are 4 flyway councils, and each council's management decisions are based on the historic migratory patterns of the birds. Each council (Atlantic, Mississippi, Central, and Pacific) is composed of the states and Canadian provinces associated with their respective migratory region. This format allows the council to address the interests and concerns of each state or province. Each council has a technical section which is made up of the waterfowl specialists from each state and province. Flyway councils meet in the spring and late summer each year to vote on the management recommendations of the technical section. Annual recommendations for harvest regulations are made at the summer meeting. The U.S. Fish and Wildlife Service gives final approval for regulation recommendations.

Management activities can be categorized under 3 general topics: habitat preservation and/or enhancement, harvest regulations, and disease control. Of the 3, habitat preservation and/or enhancement is the most important. Without sufficient breeding, migratory, and wintering habitats, there would be little need for waterfowl harvest regulations.

## Habitat Preservation and Enhancement

Waterfowl populations are in serious trouble in this country. A number of factors, including habitat destruction, chemical contamination of existing wetland habitat, and a series of droughts in the prairie pothole region, have caused duck populations in North America to drop to 64 million birds during 1990 and 1991. The federal government and the South Carolina Department of Natural Resources (SCDNR) have been doing mid-winter waterfowl surveys since 1955 to count the number of ducks in this country. The number of ducks seen in South Carolina during these surveys have declined.

These recent declines in waterfowl populations have raised many questions concerning the status of waterfowl habitat in North America. The most critical problem facing North American waterfowl populations today is the loss of wetland habitat. Nearly 500,000 acres of wetlands are lost annually to agriculture and urban or industrial development.

Wetlands, potholes in the northern prairie region, coastal marshes, bogs, fens, and bottomland hardwood swamps are essential for breeding, migrating, and wintering waterfowl. More than 50 percent of North America's wetland resources have been lost, and some regions (the Central Valley of California) have lost as much as 80 percent.

In addition, associated upland grass nesting sites, critical to mallards and pintails, are being lost at a rate of 2 percent a year. Only 12 percent of Canada's original natural grasslands (one of the primary waterfowl nesting areas) remain. In the last ten years, 33 percent of the remaining grasslands in the north-central states have been converted into cropland.

The problem of suitable habitat is made worse by intensive agriculture, which results in other environmental problems. Soil erosion, water quality degradation, siltation, and chemical contamination results in poorer quality wetland habitat. Poor soil management and wetland drainage can result in salinization, thereby lowering the land's productivity for both agriculture and wildlife.

The long-term destruction of wetland habitats may have severely affected the ability of ducks to survive. Although wetlands are lost by both natural and man-made disturbances, the activities of man are ultimately responsible for much of the habitat destruction. In the Mississippi Flyway, which historically has been the flyway with the greatest number of migrating and wintering waterfowl, seven states have lost more than 70 percent of their wetland habitats. Pollution, siltation, and channelization have affected wetlands by making them unattractive or even deadly to waterfowl that use the areas. At no time have the effects of wetland loss been felt more than when coupled with droughts in the prairies.

Ducks have adapted well to the wet and dry cyclic occurrences characteristic of the prairie breeding grounds. Mobility, long life span, large clutch sizes, and the ability to renest are excellent adaptations for prairie nesting duck species. Greater mobility of waterfowl permits breeding ducks to seek wetlands suitable for nesting. In wet years when wetlands are abundant, the ducks respond and have a banner production year. However, in years of drought when the number of wetlands are reduced, few birds try to reproduce, and predators can find the birds and their nests more easily because they are more concentrated. Most continue to fly farther north to more permanent wetlands.

Reproduction is limited on these alternate wetlands because most are relatively sterile and unable to meet the energy needs of the birds for reproduction. Although alternate wetlands provide little for reproduction, they do increase over-summer survival of the species. This helps ensure that breeding individuals are present in the population when favorable nesting conditions return to the prairies.

Unabated wetland losses during the last 15 years may limit duck population increases usually associated with wet years. Vast amounts of wetland acreage have been permanently lost during droughts. Some regions of prairie Canada have lost as much as 40 percent of the wetlands that were available before droughts. How well duck

populations will be able to recover from the droughts remains to be seen.

What is being done to combat this continuing decline in waterfowl populations? Biologists from the U.S. Fish and Wildlife Service and the Canadian Wildlife Service have taken 7 years to outline a plan of action to preserve North America's magnificent waterfowl populations.

On May 14, 1986, Secretary of the Interior Donald P. Hodel and Canadian Environment Minister Thomas McMillan signed a historic agreement to assure the continued survival of ducks, geese, and swans in North America. That far-reaching document, the North American Waterfowl Management Plan (NAWMP), sets a course of action for both countries to follow. If everyone who cares about waterfowl pitches in, this plan could become a modern conservation success story similar to the restoration of wild turkey, pronghorn antelope, and whooping cranes.

## North American Waterfowl Management Plan

The North American Waterfowl Management Plan (NAWMP) is an international cooperative effort providing a broad framework for waterfowl management and conservation in the U.S. and Canada. The plan's overall goal is to ensure that sufficient habitat exists to support 62 million breeding ducks, 6 million overwintering geese, a wintering population of 152,600 swans, and a fall flight of more than 100 million birds. This goal was based on how much habitat existed in the 1970s. The plan also:

- identifies habitat conservation needs in specific regions of the continent,
- recommends measures for solving problems of international concern,
- outlines the scope of work to be accomplished by cooperating agencies, and
- provides broad guidelines for habitat protection and management.

Since preserving suitable habitat for breeding and wintering waterfowl is critical, the emphasis of the NAWMP is acquisition. However, this program cannot be based solely on fee acquisition. It must be compatible with agricultural and industrial uses. Land acquisition is also beyond the capabilities of public resource agencies alone, so implementation requires cooperation with governments, private organizations, sportsmen, non-hunters, landowners, and concerned citizens.

## The ACE Basin Project

The Ashepoo, Combahee, and South Edisto (ACE) Basin in South Carolina represents one of the largest undeveloped estuaries on the east coast of the U.S. The basin consists of approximately 350,000 acres of diverse habitats including pine and hardwood uplands, forested wetlands, barrier islands and beaches. The basin's unique estuarine system, the largest of its type in the state, provides invaluable habitat for a rich

diversity of finfish and shellfish resources. The basin hosts a wealth of wildlife resources including such endangered and threatened species as the bald eagle, woodstork, osprey, loggerhead sea turtle and shortnose sturgeon, and offers a variety of recreational uses.

The ACE Basin Project is a cooperative effort among landowners and private and public conservation agencies to protect important habitats in the watershed of the Ashepoo, Combahee and Edisto rivers, including St. Helena estuary and sound. The project area, identified as one of the highest priority regions for protection under the North American Waterfowl Management Plan, encompasses parts of Beaufort, Charleston, Colleton and Hampton counties. Administered by the ACE Basin Task Force (private landowners, Ducks Unlimited, SCDNR, The Nature Conservancy and the U.S. Fish and Wildlife Service), the plan consists of the following key elements: 1) private land initiative to protect and enhance existing habitats, 2) voluntary conservation easements and deed restrictions, and 3) public land acquisition. The ACE Basin Project has already protected more than 50,000 acres of diverse upland and wetland habitats in South Carolina.

## Waterfowl Harvest Regulations

The purpose of hunting regulations is to control the harvest of waterfowl. This is accomplished by limiting the harvest to the surplus of each species. Surplus means that portion of the population in excess of the breeding component necessary to maintain the population at a certain level or objective. Surpluses are based on quantity and quality of breeding habitat and the annual compensatory mortality. Compensatory mortality varies by species population size and is strongly influenced by habitat conditions.

Determining the surplus is not an easy task. It requires the cooperative efforts of federal, provincial (Canadian), and state waterfowl biologists to collect important information. The size of the breeding population, age and sex ratios, survival rates, and habitat conditions must be known to accurately determine the annual surplus. Age and sex ratios along with survival rates are estimated from the data collected during the previous hunting season. Estimates of breeding populations, reproductive success, and habitat conditions are obtained from surveys conducted during the current nesting year. All the above are factored together to make a fall flight forecast.

The fall flight forecast is an estimate of the total number of ducks available after reproduction and before hunting season. Hunting season length, bag limits, and species restrictions are set from this information. Methods of determining hunting regulations for geese are similar, except estimates of breeding pair numbers are made from mid-winter surveys for some of the deep arctic breeding species.

Harvest regulations differ somewhat for ducks and geese. Season length and bag limits for ducks are fairly uniform across the four flyways. The breeding range for most of the continental duck population occurs within the north central prairies of the U.S. and central prairies and prairie parklands of Canada. Any declines or increases in productivity

of ducks nesting in this region are experienced by all the flyways. Harvesting ducks in excess of the surplus in any of the flyways may negatively impact the entire population.

Unlike ducks, geese nest along the coast, bays, rivers, and lakes across the arctic and subarctic tundra. Populations using specific breeding ranges are closely associated with certain wintering areas. Maintenance of the family bond during the first year allows juveniles the opportunity to imprint on these wintering areas. Except for flyways with shared populations, there is little relation between the reproductive success and harvest of one population versus that of another. Therefore, goose management in some regions can be tailored for specific populations without affecting other goose populations.

## **Disease Control**

Current practical knowledge for waterfowl disease control is limited. The number of waterfowl that die each year from disease is unknown. Many times predators and scavengers remove the bird before it is noticed by man. Other sick birds seek isolation and shelter and die unnoticed. Only when a major die-off occurs are managers able to respond to the individual situation. Most management efforts are concentrated on dispersing birds and disposing of carcasses whenever a large outbreak occurs.

Contaminant poisoning (lead poisoning) is another factor frequently associated with disease. Contaminant poisoning is something managers may have more control over. Lead poisoning in waterfowl has long been recognized as a major cause of death in some areas. The impact of lead poisoning on reproduction is still unknown. Elimination of lead shot for all waterfowl hunting will go a long way in reducing availability of this contaminant in future years, although some hot spots may continue for several years until bottom sediments are deposited over the shot, making it unavailable to the birds. Selenium and other contaminants are nonpoint pollutants that present problems in certain areas. Future efforts may need to focus on reducing nonpoint pollution to eliminate this danger to waterfowl and man.